MANUAL OF SURFACE OBSERVATIONS

Circular N, Sixth Edition, Revised

WEATHER BUREAU ADDENDUM

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MANUAL OF SURFACE OBSERVATIONS

Circular N, Sixth Edition, Revised

WEATHER BUREAU ADDENDUM

NOVEMBER 1951

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INTRODUCTION

This addendum supplements the Manual of Surface Observations (WBAN), Circular N, and contains instructions restricted to the Weather Bureau for taking and recording surface observations. In addition, a description of instruments commonly used in the surface observational program is presented, together with general requirements for the exposure, installation, operation, and maintenance of such equipment. Adherence to these instructions is essential in order to obtain meteorological data that are comparable between stations. References in this addendum to column numbers of WBAN-10 pertain to WBAN-10, revised January 1951.

Instructions common to the handling and maintenance of instrumental equipment and to the disposition and routing of observational forms are briefly outlined below.

Stock Inventory.—Reorder supplies sufficiently in advance of need to avert omission of observations. Standard instruments and their accessory items are listed in the catalog of instrumental equipment and accessories, and instructions for the preparation of stores requisitions are included in that catalog and in the Weather Bureau Manual. When returning instruments, observe packing and shipping instructions outlined in the catalog.

Lubrication of Instruments.—Excess lubricant must be removed from surfaces adjacent to bearings, since dirt collecting in the excess lubricant is likely to cause increased bearing wear; also, any lubricant that accumulates on electrical parts may interfere with the insulating or conducting properties of these parts. A more frequent application of a small amount of lubricant is preferable to a more liberal application at infrequent intervals.

Electrical Contacts.—Crocus cloth or fine sandpaper will be used when polishing or cleaning electrical contacts. Never use emery cloth.

Use of Solvents.—Varsol, Stansol, or equivalent, will be used where a petroleum-base solvent is specified. Do not use petroleum-base solvents to clean parts containing rubber, or carbontetrachloride to clean steel.

Instrument Maintenance Record.—A record of instrument maintenance performed (Form 1141) will be kept at all stations. This form will be bound after the last chapter of this addendum and retained until it has been reviewed by a field aide.

Disposition and Routing of Forms.—The Regional Office may modify instructions in the Addendum concerning the routing and disposition of completed charts and forms where such changes are necessary to meet publication dates or other deadlines. The Regional Office will report to the Central Office such changes, identifying the stations concerned.

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CHAPTER A1. CLOUDS AND OBSCURING PHENOMENA

A1100. NEPHOSCOPE

A1110. General.—When a mirror-type nephoscope is available it may be used to determine the direction from which clouds are moving as follows:

(1) Find the image of the cloud in the mirror.

(2) Move the eyepiece about, at the same time shifting the horizontal arm until the cloud image seen through the eyepiece is at the center of the mirror.

(3) Rotate the mirror until the cloud movement is along one of the radial lines. The azimuth bearing corresponding to this line is the cloud direction.

(4) Convert the azimuth bearing to one of eight compass points by use of Table A1-1.

Table A1-1. Azimuth Bearings vs. Compass Points

Azimuth Bearings	Compass Points	Azimuth Bearings	Compass Points
338 - 22	N	158 - 202	S
23 - 67	NE	203 - 247	SW
68 - 112	E	248 - 292	W
113 - 157	SE	293 - 337	NW

A1200. CEILOMETER

A1210. General.—The height of the base of clouds or other layers of aerosols aloft is determined with a ceilometer. The data obtained from the ceilometer may also provide guidance in estimating the vertical visibility into obscuring phenomena at or near the surface.

A1211. The following instructions for installation, operation and maintenance pertain to installations equipped for the remote control of scanning, i.e., to installations which permit the observer to control, from a panel near the recorder, the elevation angle at which the scanning mechanism of the ceilometer detector reverses its motion (see par. A1259.3).

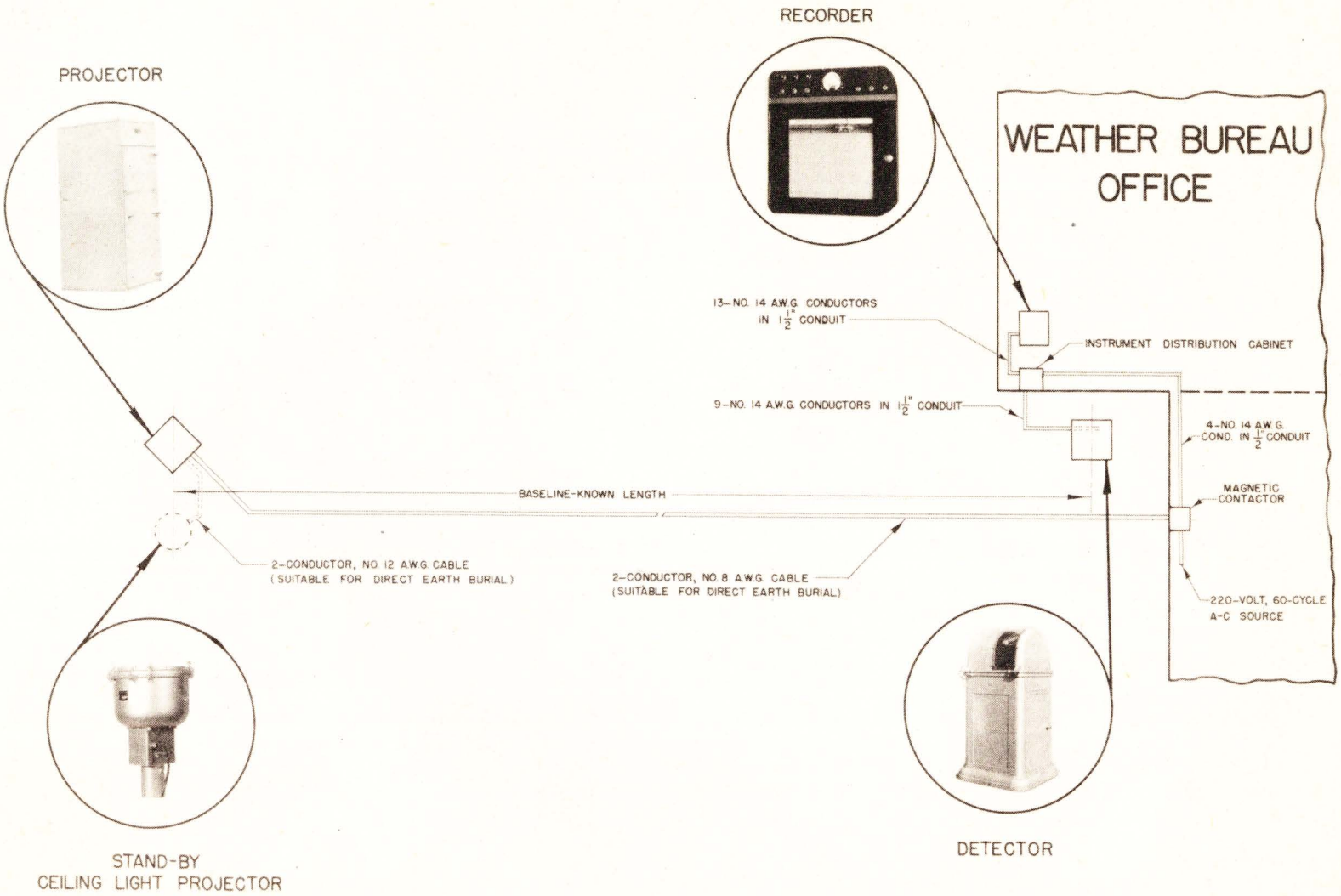

Fig. A1-1. Ceilometer layout.

A1220. Description.—The major components of the ceilometer consist of the projector, detector, and recorder. The general layout of the equipment, including a standby ceiling light projector, is shown in Fig. A1-1. In these instructions the stock numbers of ceilometer parts are used to facilitate identification of the parts and to indicate the components in which they are located. The first numeral in each three-digit number identifies the major component in which the assembly or part is located as follows:

First numeral	Location of part or assembly
1	Detector amplifier
2	Detector discriminator
3	Other portions of the detector
4	Recorder
5	Projector

Letters prefixed to the three-digit numbers identify the general function of the part; however, when the first letter of a two letter prefix is G, the part is for use only in General Electric equipment. Where illustrated parts are similar in function but are not interchangeable, the stock number and predominant difference of each are listed in pars. A1221 and A1223.

A1221. Projector.—(See Fig. A1-2.) The projector consists of a mercury-arc lamp located at the focus of a parabolic reflector. Accessory equipment includes:

(1) A forced-air-cooling system for the lamp.

(2) A power supply for the lamp and cooling system.

(3) Protective devices for mechanical protection and personnel safety.

(4) In some installations (see par. A1250.01), a reflector mounted a short distance above the projector to serve as an indicator of ceilometer operation and alignment.

A1221.1. The following items are illustrated in Fig. A1-2 unless otherwise indicated:

(1) A510 - Sliding base which provides access for servicing the motor, compressor, etc.

(2) A511 - Door of lamp compartment.

(3) B501 - Compressor motor 1-1/2 h.p. (not shown).

(4) B502 - Compressor motor 3/4 h.p.

(5) B504 - Time recorder.

(6) C503 - Power-factor-correction capacitor - installed in parallel to the low-voltage (208-volt) power input side of the lamp-ballast transformer (T501).

(7) E506 - Spring-loaded contact of support for lamp I501 (see Fig. A1-25).

(8) E508 - Stationary contact of support for lamp I501 (see Fig. A1-25).

(9) E512 - Enclosure (less cover) for the lower terminal strip (E537).

(10) E513 - Cover for enclosure E512.

(11) E514 - Upper terminal strip within enclosure E520 (see Fig. A1-29).

(12) E520 - Enclosure for upper terminal strip (E514) and high voltage terminal block E529.

(13) E529 - High-voltage terminal block within enclosure E520 (see Fig. A1-29).

(14) E537 - Lower terminal strip (now shown) within enclosure E512.

(15) I501 - Mercury-arc lamp (see Fig. A1-25).

(16) K502 - Motor starter.

(17) K504 - Magnetic contactor in power supply leads to projector (see Fig. A1-1 and A1-36).

(18) N501 - Name plate.

(19) O513 - Actuating bracket for the safety switch (S501).

(20) O542 - Guide rail for the sliding base (A510).

(21) S501 - Safety switch in the low voltage (208-volt side) of the lamp circuit, operated by the door (A511) to the lamp compartment (see Fig. A1-29).

(22) S502 - Low-pressure cut-out switch in series with the safety switch in the low-voltage side of the lamp circuit.

(23) S503 - High-pressure cut-out switch in the power supply lead from the autotransformer (T503) to the motor starter (K502). (See also Fig. A1-28.)

(24) S504 and
S506 - Manually operated line switches, which also open the circuit automatically in the event of extreme overloads.

(25) T501 - Lamp-ballast transformer in lamp circuit (output voltage 900-1200 volts).

(26) T502 - Autotransformer (output 208 volts).

(27) T503 - Autotransformer (not shown) used in place of T502 where a source of power at the projector is required for a stand-by ceiling light (output 208 and 117 volts).

(28) Z501 - Reciprocating type compressor.

(29) Z501-42 - Filter pad container (same as Z502-6 in Fig. A1-29).

(30) Z501-42 - Filter pads (not shown).

(31) Z502 - Rotary type compressor (see Fig. A1-22).

(32) Z502-5 - Stopcock (see Fig. A1-22).

(33) Z502-6 - Same as Z501-42 (see Fig. A1-22).

(34) Z502-8 - Weights for high-pressure valve of rotary compressor (see Fig. A1-22).

(35) Z502-9 - Grease cups (see Fig. A1-22).

(36) Z502-10 - Filter pads (interchangeable with pads Z501-43).

(37) MS503 - Air tank of cooling system (not shown).

(38) MS511 - Parabolic reflector in lamp compartment.

(39) MS518 - Pressure gage for the cooling system.

(40) MS531 - Jets (2) of cooling system (see Fig. A1-25).

(41) MS534 - High temperature grease for rotary compressors.

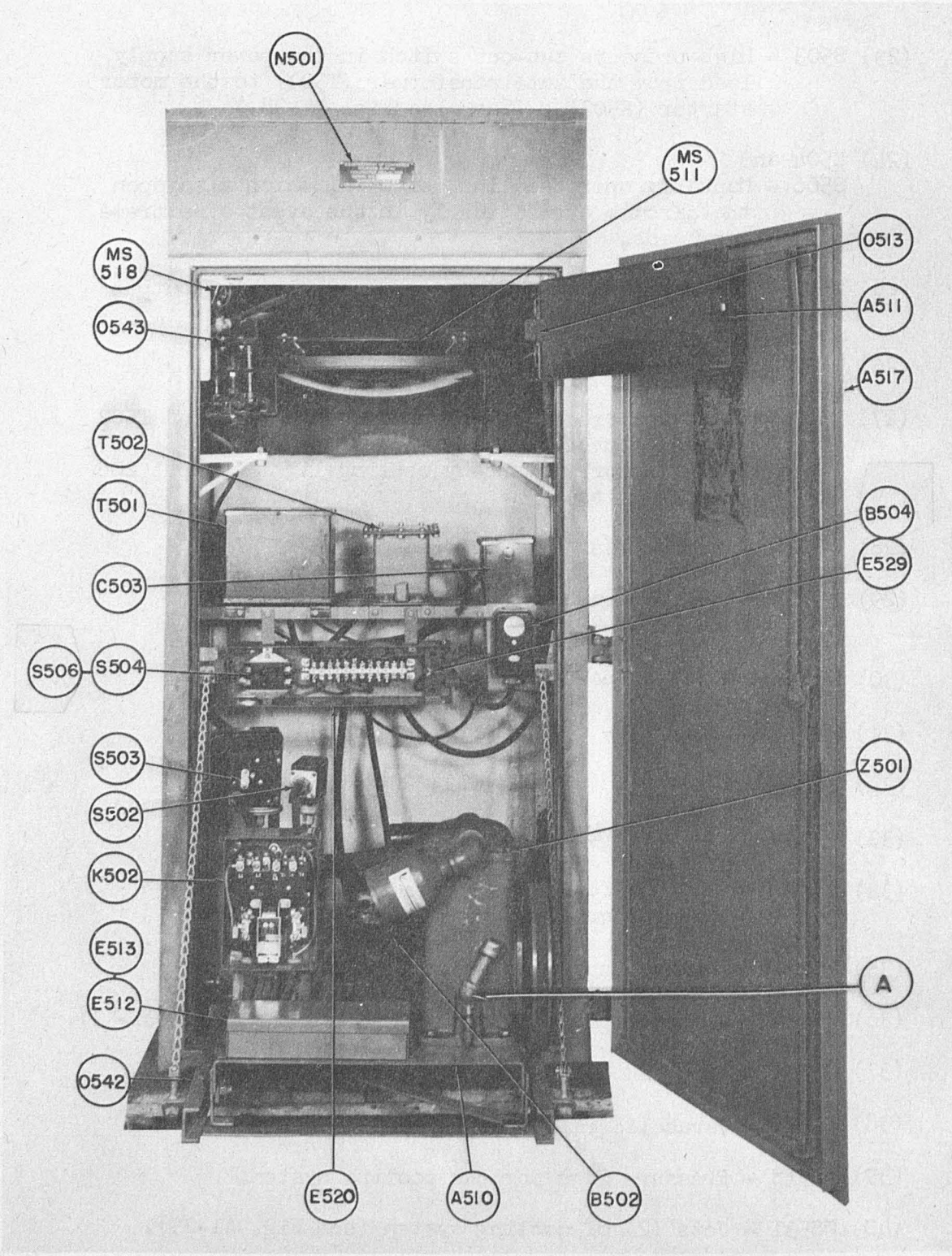

Fig. A1-2. Ceilometer projector.

The air tank (MS503) is located behind the motor starter (K502). A magnetic contactor (not shown) is usually located at the beginning of the branch circuit to the projector (see Fig. A1-1). The contacts of the contactor open automatically in the event of power failure or unduly low voltage at the contactor. They are also opened and closed by means of a 208 volt relay circuit controlled through projector switches S407 and S408 at the recorder.

A1222. Detector.—(See Fig. A1-3 and A1-4.) The detector consists primarily of:

(1) A scanner assembly, including a preamplifier.

(2) An amplifier.

(3) A discriminator.

(4) An external control panel.

A1222.1. Unless otherwise indicated, the following components are illustrated in Fig. A1-3 or A1-4:

(1) C3 - Condenser in the preamplifier circuit (see Fig. A1-32).

(2) E1 - 270-volt battery located in enclosure Z304 as shown in Fig. A1-4.

(3) V1 - 38-type tube located in the preamplifier (see Fig. A1-32).

(4) V2 - 929-type tube (photocell) located in the preamplifier (see Fig. A1-32).

(5) W1 - 4-conductor, shielded cable connecting leads from the terminal strip in the preamplifier (see Fig. A1-32) with the connector J101 of the amplifier chassis.

(6) W2 - 2-conductor shielded cable connecting leads from the terminal strip in the preamplifier with connector J102 on the amplifier chassis.

(7) W3 - 2-conductor, shielded cable from connector J107 of the battery to connector J103 of the amplifier.

(8) A301 - Scanner housing.

(9) A305 - Dome cover to scanner assembly (Crouse-Hinds type as shown in Fig. A1-3).

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(10) B301 - Scanner drive motor.

(11) B302 - Generator of the synchro system.

(12) F302 - 10-ampere, plug-type fuse.

(13) I301 - Lamp for illumination of the scale (N301) and the output meter (M302).

(14) J101, J102, and J103 - Chassis connectors at the amplifier for cables W1, W2, and W3 respectively (see Fig. A1-34).

(15) J104, J105, and J106 - Chassis connectors at the amplifier for cables W101, W102, and W103, respectively (see Fig. A1-34).

(16) J201, J202, and J203 - Chassis connectors at the discriminator for cables W101, W102, and W103, respectively (see Fig. A1-35).

(17) J206 - Jacks for test leads of voltmeter used in making sensitivity tests.

(18) K301 - Relay for reversing the direction of scanner travel.

(19) M302 - Output meter at the detector and in the discriminator output circuit. It is a voltmeter graduated from 0 to 5 volts.

(20) N301 - Elevation-angle scale at the detector.

(21) O332 - Large pulley for 6-minute scanning cycle (90 degrees of travel).

(22) O333 - End of crank shaft which engages the crank used for manual adjustment of the elevation angle of the scanner. In Fig. A1-4, the end of the crank shaft is shown immediately to the right of the output meter (M302).

(23) P101, P102, P103, P104, P105, P106, P107, P201, P202, P203 - Cable connectors for chassis connectors J101-J107, and J201-J203, respectively.

(24) R201 - Phase control (see also Fig. A1-33).

(25) R215 - Grid balance control (see also Fig. A1-33).

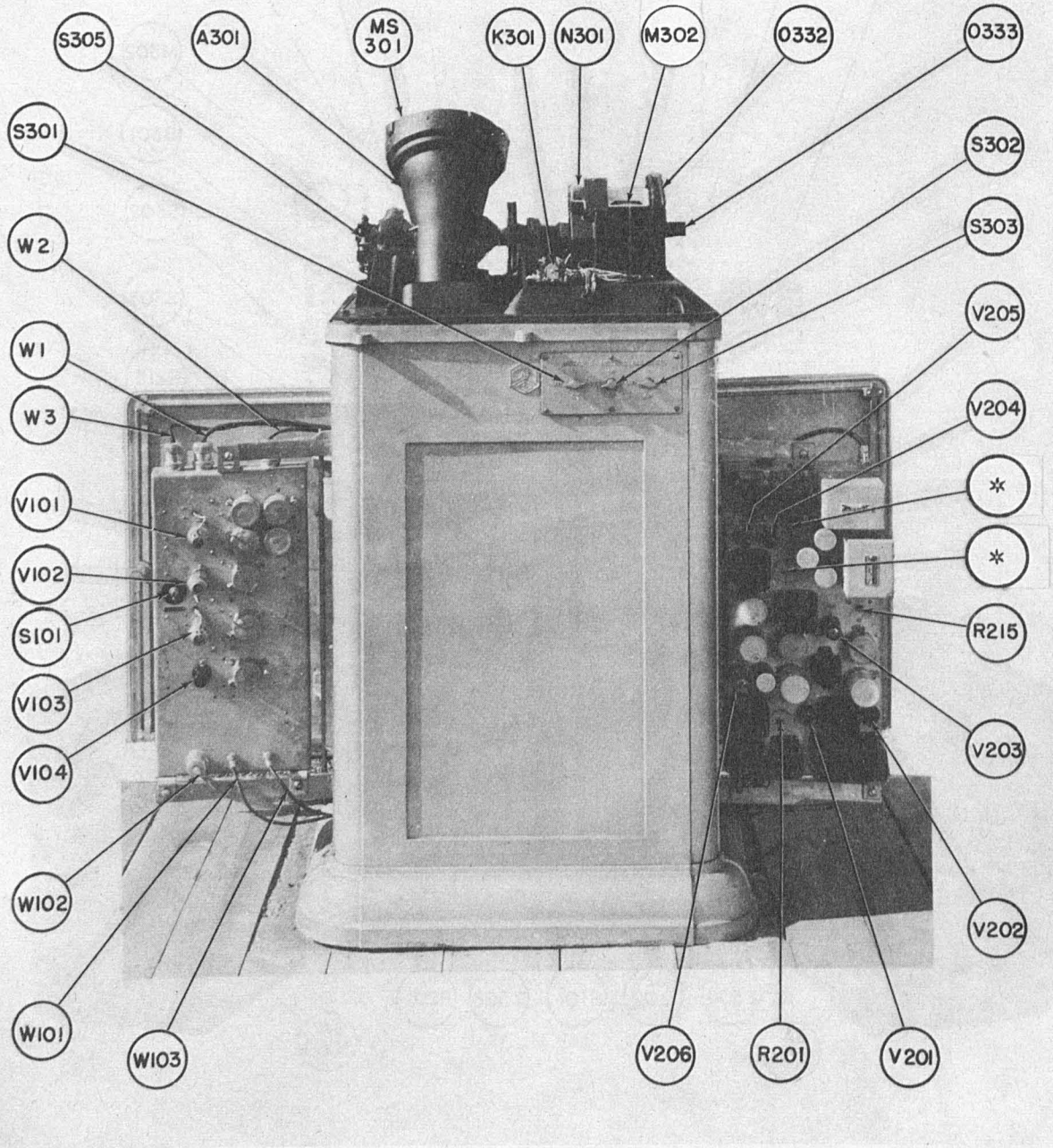

Fig. A1-3. Ceilometer detector (C-H).

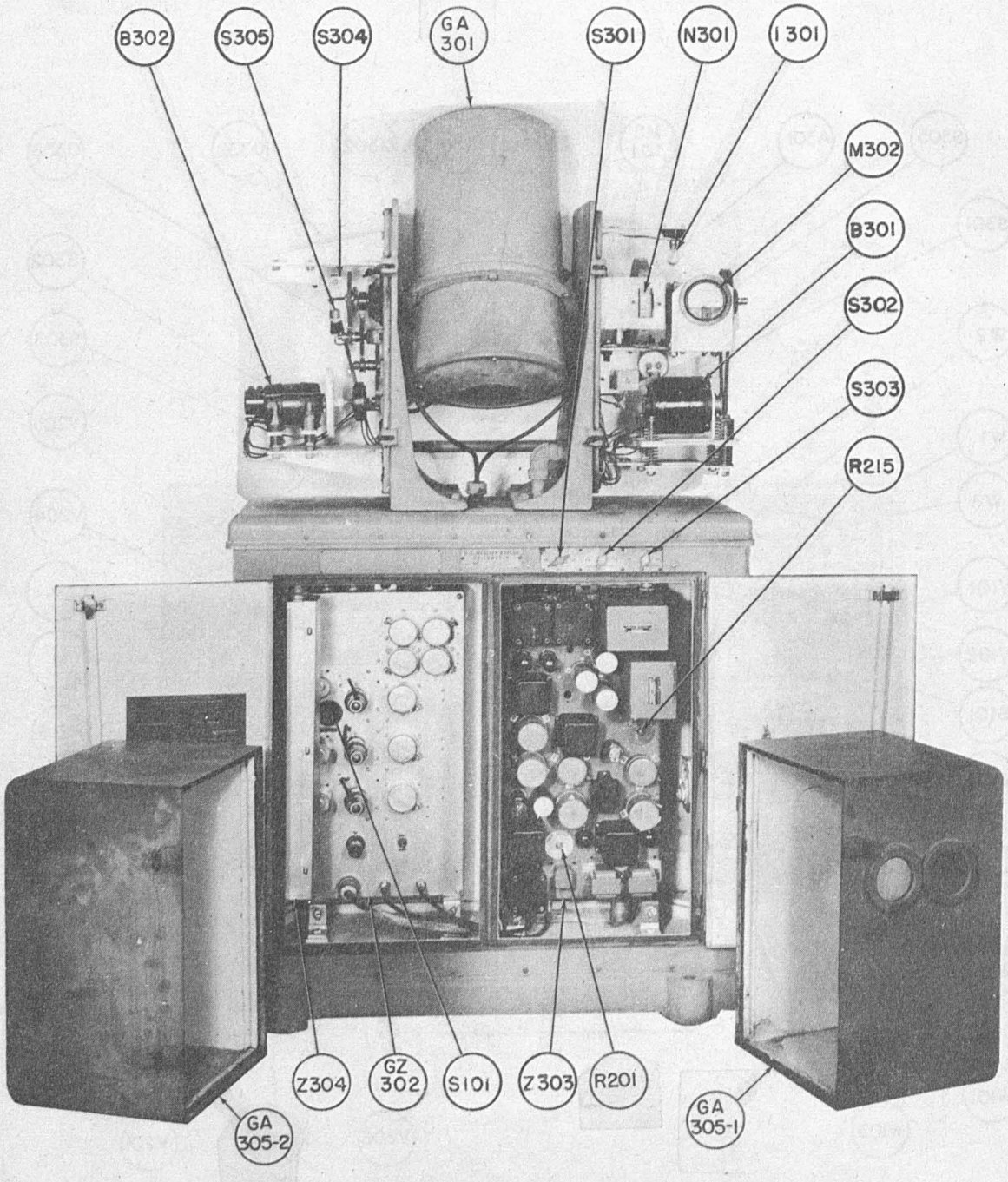

Fig. A1-4. Ceilometer detector (GE).

(26) S101 - Amplifier "Gain" control (see also Fig. A1-34).

(27) S301 - Motor switch.

(28) S302 - Meter switch.

(29) S303 - Amplifier switch.

(30) S304 and
S305 - Scanner-travel limiting switches.

(31) T205 - Discriminator output transformer (see Fig. A1-33).

(32) V101, V102, V103 - Amplifier tubes (6C6 type). (See Fig. A1-34.)

(33) V104 - Amplifier tube (6J5 type), in output stage of amplifier (see Fig. A1-34).

(34) V201 and V202 - 6H6-type tubes in the discriminator (see Fig. A1-33).

(35) V203 - 6SN7-type tube in the output stage of the discriminator (see Fig. A1-33).

(36) V204 and V205 - 5Z4-type tubes in power rectifier circuit in the discriminator (see Fig. A1-33).

(37) V206 - OD3/VR150-type, voltage regulation tube in the discriminator (see Fig. A1-33).

(38) W101 - Single conductor, shielded cable, which conveys the amplifier output at the chassis connector J104 to the discriminator at connector J201.

(39) W102 - 4-conductor, shielded cable which conveys a-c and d-c tube filament current from chassis connector J202 at the discriminator to connector J105 at the amplifier.

(40) W103 - 2-conductor, shielded cable which conveys plate and screen-grid voltage for the 6C6 tubes (V101-V103) from the chassis connector J203 at the discriminator to the connector J106 at the amplifier.

(41) Z301 - Preamplifier complete (see Fig. A1-32).

(42) Z302 - Amplifier chassis - Crouse-Hinds type.

(43) Z303 - Discriminator chassis - Crouse-Hinds type (see Fig. A1-33).

(44) Z304 - Battery container.

(45) GA301 - Scanner housing.

(46) GA305-1 - Cover for scanner-drive-motor compartment.

(47) GA305-2 - Cover for generator compartment of the synchro system.

(48) GV103 - 6B7-type tube used in GE-type amplifiers instead of the 6C6-type tube (V103) shown in Fig. A1-34).

(49) GZ302 - Amplifier chassis (GE type).

(50) GZ303 - Discriminator chassis (GE type - not shown).

(51) MS301 - Lens of the scanner housing A301.

A1223. Recorder.—(See Fig. A1-5.) The recorder consists primarily of:

(1) An electronic converter amplifier.

(2) A recording stylus and stylus motor (stylus assembly); the motor of a synchro system; and a linkage mechanism between the motor of the synchro system and the stylus assembly.

(3) A chart and chart-driven mechanism including a temperature-control mechanism for the chart.

(4) Elevation-angle and height scales.

(5) Switches and other controls in the recorder case.

(6) A 3-inch panel above the recorder for additional controls and a dual-purpose output meter.

A1223.1. Components of the Recorder.

(1) B401 - The motor of the synchro system (see Fig. A1-7).

(2) B402 - Synchronous motor for the chart drive (see Fig. A1-12).

(3) B403 - Stylus motor (see Fig. A1-9).

(4) F401 - Spare fuse (same as F402).

(5) F402 - 8AG or equivalent, 2-ampere fuse (see Fig. A1-8).

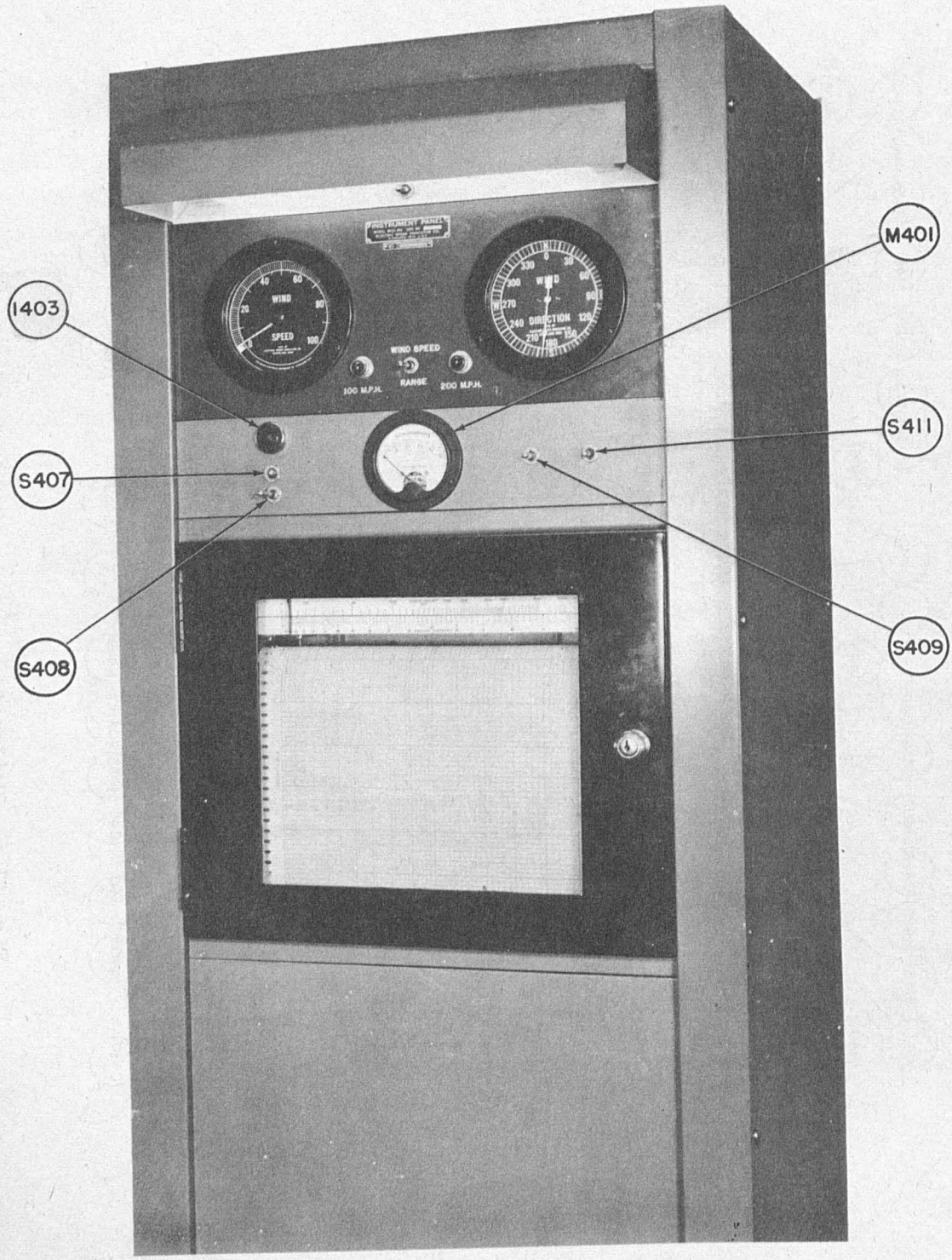

Fig. A1-5. Ceilometer recorder.

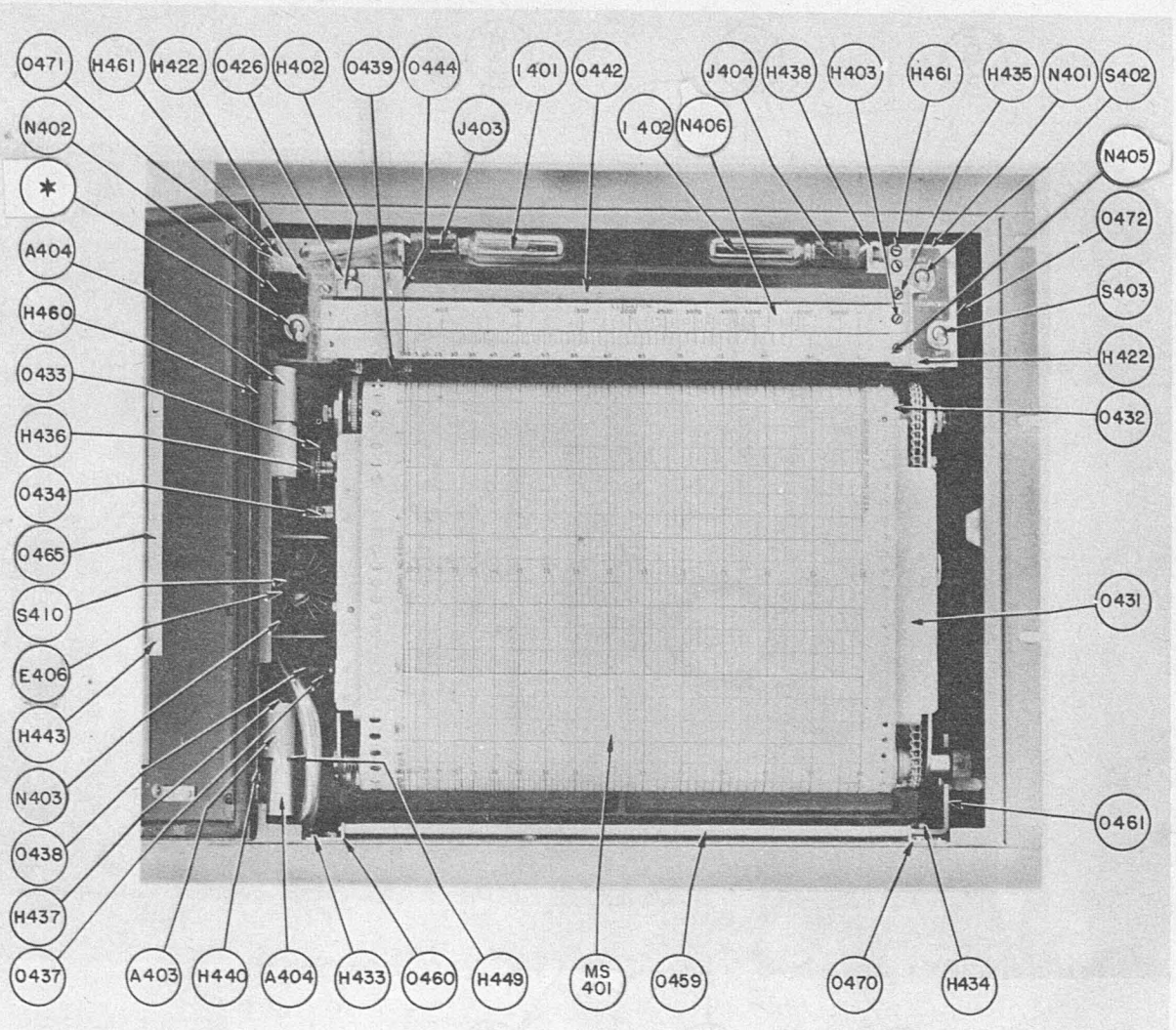

Fig. A1-6. Ceilometer recorder (cabinet door open).

(6) H402 - Retaining screw for cam O426 (see Fig. A1-6).

(7) H444 - Cap nut which covers the bias-adjusting screw, R421 (see Fig. A1-31).

(8) H446 - Locknuts (2) for the chart-drive-roll bearings, O468 (see Fig. A1-12).

(9) I401 and
I402 - Chart lamps - 15T6 or 6S6, 115-volt, small, screw-base type (see Fig. A1-6).

(10) I403 - Lamp for projector pilot light - S6 type, 250 volt (see Fig. A1-5).

(11) K401 - Relay for opening the scanner drive circuit when the synchro motor is not in satisfactory alignment with the generator of the synchro system (see Fig. A1-8).

(12) M401 - Output meter - Voltages are approximately one-tenth the indicated readings (see Fig. A1-5).

(13) N405 - Elevation-angle scale (see Fig. A1-6).

(14) N406 - Height scale (see Fig. A1-6).

(15) O401 - Pinion on shaft of motor B401 of the synchro system (see Fig. A1-8).

(16) O402 - Gear driven by pinion O401 (see Fig. A1-8).

(17) O403 - Double-cam assembly mounted on stud O477 and driven by gear O402 (see Fig. A1-8).

(18) O404 - Magnetized cam follower which follows the profile outlined by cams O403 (see Fig. A1-8).

(19) O405 - Sector-gear assembly driven by the cam follower O404 (see Fig. A1-8).

(20) O410 - Arm for relay actuating switches S405 and S406 (see Fig. A1-8).

(21) O417 - Pin which governs the movement of arm O410 (see Fig. A1-8).

(22) O425 - Hairspring assembly which governs the natural vibration period of the stylus (see Fig. A1-9).

(23) 0426 - Cam for lifting the stylus as the stylus assembly approaches the zero-degree end of the elevation scale (see Fig. A1-6).

(24) 0427 - Stylus which produces a trace by cutting through the wax coating on the chart (see Fig. A1-9).

(25) 0430 - Spacer for the end plates of the chart-roll assembly. The two spacers above the one illustrated in Fig. A1-12 also serve as guides for the chart paper between the feed roll and the chart-drive roller.

(26) 0431 - Writing table for use in adding additional data on the current record (see Fig. A1-6).

(27) 0432 - Chart-drive roller (see Fig. A1-6 or A1-12).

(28) 0435 - Drive center assembly for the rewind roll (see Fig. A1-12).

(29) 0436 - Ladder chain which drives the rewind center of assembly 0435 (see Fig. A1-12).

(30) 0437 - Adjusting nut for adjusting the position of the left center along the centerline of the chart-feed roll (see Fig. A1-6).

(31) 0438 - Locknut for maintaining the adjustment of the left center for the chart-feed roll 0481 (see Fig. A1-6 and A1-12).

(32) 0440 - Core of chart roll provided with a notch to fit the key on the drive center of assembly 0435 (see Fig. A1-13).

(33) 0442 - Stylus assembly guide bar (see Fig. A1-6).

(34) 0444 - Index of the elevation-angle and height scales (see Fig. A1-6 and A1-9).

(35) 0461 - Latch strike plate of hinged frame within recorder cabinet (see Fig. A1-6).

(36) 0462 - Knob on chart-drive roller (0432) for adjusting the position of the chart; e.g., for time adjustment (see Fig. A1-12).

(37) 0468 - Bearings (2) for the chart-drive roller (see Fig. A1-12).

(38) 0481 - Adjustable spring-loaded center for the chart-feed roll (see Fig. A1-12).

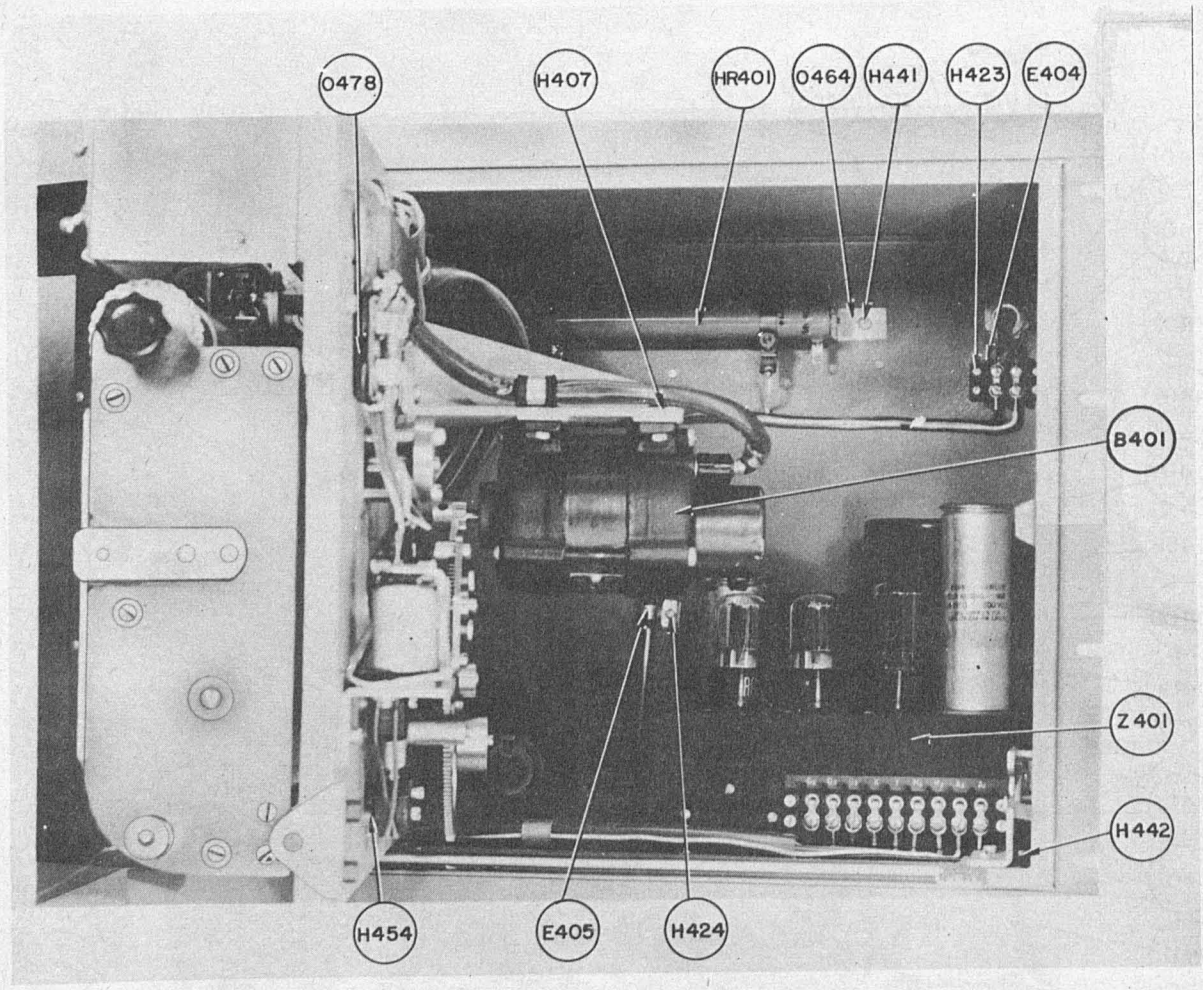

Fig. A1-7. Ceilometer recorder (frame swung outward).

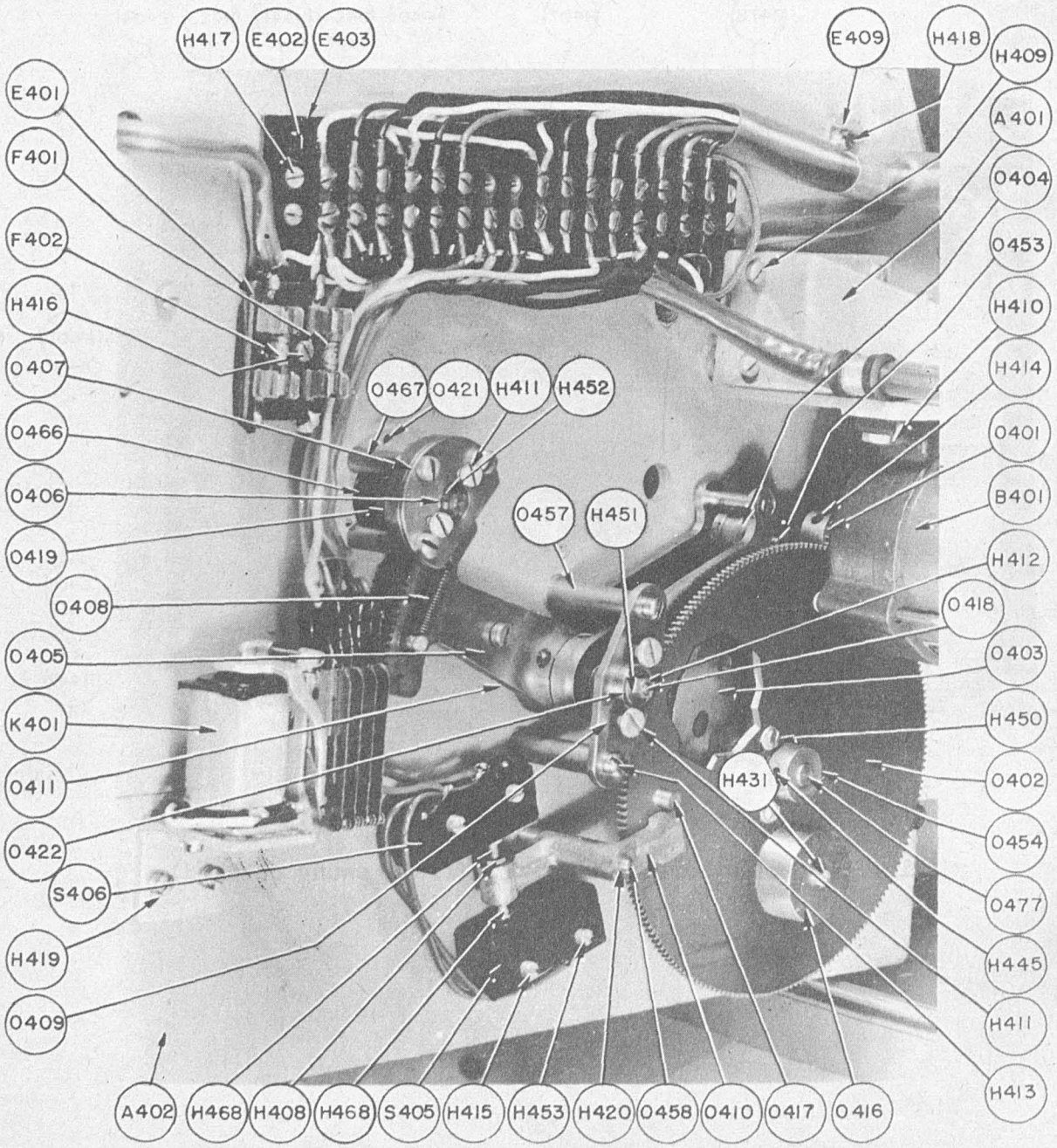

Fig. A1-8. Ceilometer recorder (back of frame).

(39) O482 - Right-hand, spring-loaded center for the chart-feed roll.

(40) O483 - Spring-loaded center for the rewind roll (see Fig. A1-12).

(41) R421 - Bias-adjusting screw (see Fig. A1-31).

(42) S402 - Ceilometer switch (see Fig. A1-6).

(43) S403 - Recorder switch (see Fig. A1-6).

(44) S405 and
S406 - Switches in the circuit of relay K401 (see Fig. A1-8). These switches are normally open unless one is closed by movement of arm O410.

(45) S407 - Projector control switch; a 2-position, S.P.S.T. switch, normally open (see Fig. A1-5). This switch turns on the projector, and is spring-loaded in the "on" position.

(46) S408 - Projector control switch; a 2-position, S.P.S.T. switch, normally closed. (See Fig. A1-5.) This switch turns off the projector, and is spring-loaded in the "off" position.

(47) S409 - Meter-selector switch; a 3-position, D.P.D.T. switch, "off" in the center position (see Fig. A1-5). It is usually wired to place the output meter M401 in the discriminator output circuit when the lever is up, and in the stylus-motor-voltage circuit when the lever is down.

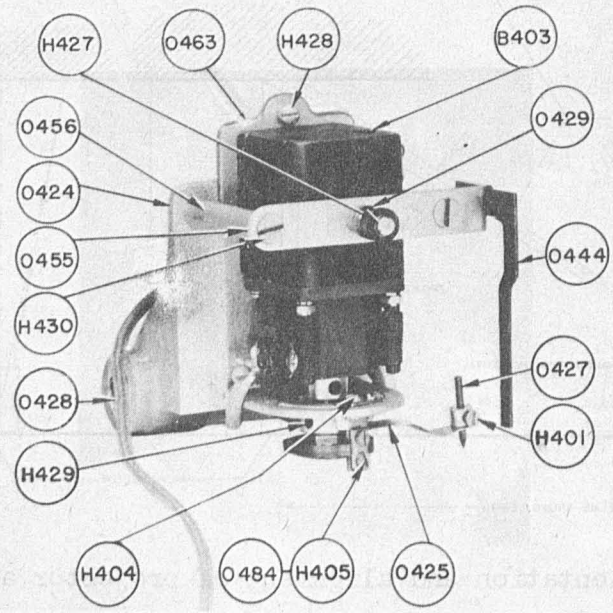

Fig. A1-9. Stylus assembly of recorder.

(48) S410 - Recorder Gain control (see Fig. A1-6).

(49) S411 - Scanner reversing switch; a 3-position S.P.D.T., "off" in the center position and spring-loaded in the two "on" positions (see Fig. A1-5).

(50) V401 and
V402 - 6SN7-type tubes (see Fig. A1-31).

(51) V403 - 5Y3-type rectifier tube (see Fig. A1-31).

(52) Z401 - Converter-amplifier (see Fig. A1-31).

A1230. Principle of Operation.--(See Fig. A1-10.) A pulsating beam of light (120 pulses per second) is projected vertically upward by the projector. The field of a light-sensitive element (phototube) in the scanner is restricted to only a small segment of the projected beam. The

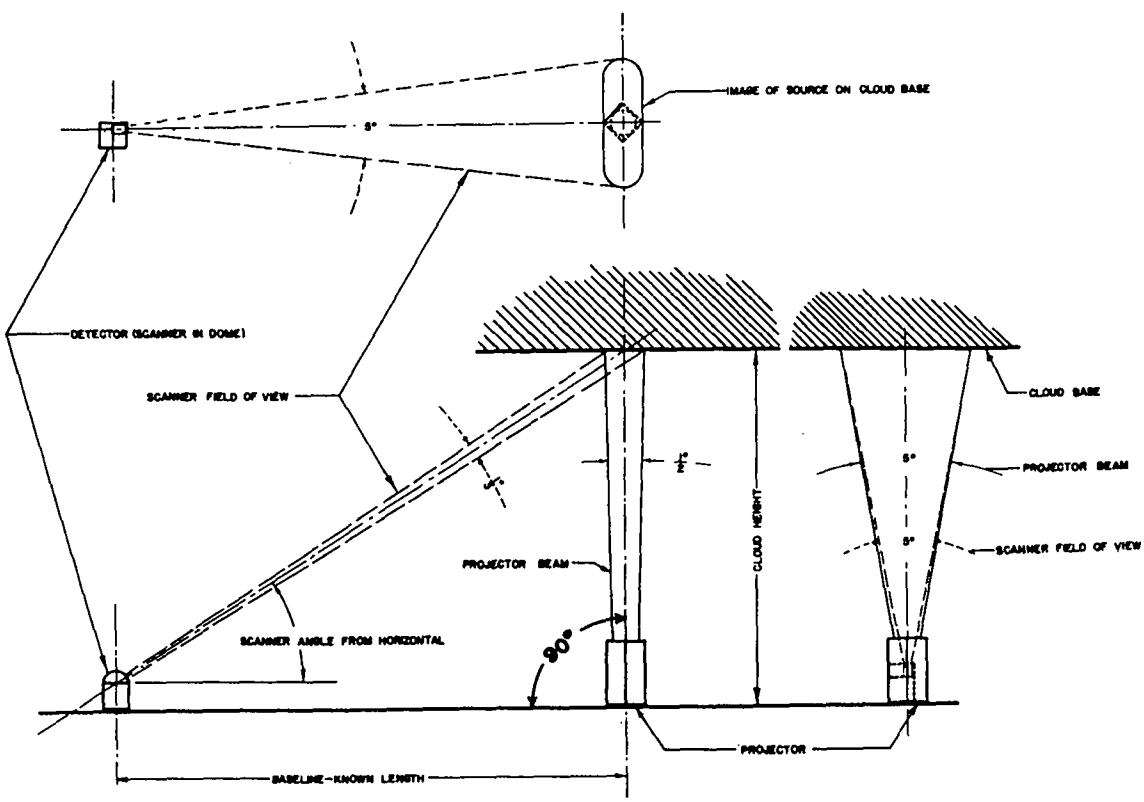

Fig. A1-10. Orientation and alignment of projector and detector.

elevation angle of a line extending outward from the center of the scanner is adjustable in elevation from zero to 90° to permit scanning of the entire beam. The angle is indicated on a scale at the recorder and on another at the detector. The height above a specified reference level (see par. A1259.01) of the point of intersection of the optical line-of-sight with the projected beam is indicated on a scale at the recorder. The intensity of the electrical output of the detector varies with changes in the intensity of light reflected from the projected beam. These changes are indicated on an output meter at the detector, and on another at the recorder. The electrical output of the recorder varies with changes in the output from the detector, and is recorded in terms of the width of a trace (see Fig. A1-11) cut by the recording stylus.

A1240. Installation.—The location of the detector and the projector will be determined by the Central Office on the basis of recommendations submitted by the official in charge and the regional director. These recommendations should be based on technical installation instructions issued by the Instrument Division, and the following primary considerations.

A1240.1. Locate the detector as conveniently to the observing office as practicable, to facilitate operation and adjustment. Avoid locating it near strong electrical energy fields, such as those around VHF antennas, or strong induction fields, or on sites where vibrations approximately 60 or 120 cycles per second occur.

A1240.2. At stations having ILS in use, locate the projector near or in the general direction of the approach end of that runway if practicable. At other stations, install the projector near or in the direction of the runway most frequently used for landings.

A1241. Orient the detector and projector to provide if possible:

(1) An unobstructed line of sight between the two units, and between a convenient observation point and the projector.

(2) A line of sight northward from the detector to the projector that lies more than 22° to the north of an east-west line through the detector, so that little or no direct sunlight reaches the phototube of the scanner.

(3) A base line between the two units from 500 to 1500 feet in length, depending upon whether local requirements call for the greatest accuracy in the measurement of the height of low clouds or the height of intermediate or high clouds. In general, a base line of 700 to 800 feet is desirable.

(4) A location where little if any light from extraneous sources will reach the phototube of the detector.

A1242. At stations where one or more ceiling lights are installed, a ceiling light will be retained as a stand-by light. If the ceilometer projector installation is to be made in the place of, or adjacent to, a ceiling light (see Fig. A1-1), the ceiling light cable may be used if the wires are not smaller than #8AWG and both leads are insulated from ground potential.

A1243. When an auxiliary reflector is desired to provide a base-line signal, the installation will be made by the electronics technician. If the signal provided by the reflector can be detected by the ceilometer, the reflector should be adjusted so that the stylus reaction will be less than the maximum range of stylus oscillation.

A1250. Operation.—Place the ceilometer in operation at least one hour before the forecast time of clouds or obscuring phenomena. Operate it continuously whenever clouds or obscuring phenomena cover 0.1 or more of the sky and, if they dissipate, whenever they are forecast to reoccur within the ensuing six-hour period. Otherwise, place the ceilometer in a stand-by status (see par. A1253). Turn off the projector only (1) when clouds are not expected for twenty-four hours or more, (2) when the projector is being serviced, and (3) when other maintenance is expected to prevent use of the ceilometer for twenty-four hours or more.

A1250.01. Check for satisfactory operation of the ceilometer as frequently as necessary to prevent extended loss of record. At many stations a check of projector operation may be obtained by visual observation of the beam or by the presence of a base-line reaction (a reaction at or near an elevation angle of 0°). At stations where the normal concentration of aerosols is insufficient to provide a visual check or a base-line reaction, a reflector may be mounted in the beam above the projector (see par. A1243) to provide a satisfactory signal. At stations where the projector is at or above the level of the detector, the signal may be recorded as a reference point and as a guide to satisfactory operation of the detector and recorder as well as the projector.

A1250.02. When the recorder record, or the readings of the output meters, cannot be interpreted with certainty during the nighttime, the projector will be used as a ceiling light (see par. 1441).

A1250.03. In case of failure of the ceilometer projector at stations equipped with a stand-by ceiling light, the ceiling light will be used for nighttime observations.

A1250.1. Stand-By Ceiling Light.—At stations where the power for a stand-by ceiling light is taken from a T503-type autotransformer (in the

ceilometer projector), the projector switches S407 and S408 provide for operation of the ceiling light instead of the ceilometer projector after the following adjustments have been made:

(1) Adjust the high-pressure cut-off in the ceilometer projector to the "off" position (see Fig. A1-28 and par. A1281.51). Make the adjustment with the line switches (S504 and S506) off.

(2) Close the branch circuit from the projector to the ceiling light. Either a switch in the branch circuit or a plug-and-socket type connector at the ceilometer is provided for this purpose.

A1251. Controls.—The operational controls, and their location, function, and operational use are tabulated in Table A1-2.

A1252. Activation.—When all of the components of the ceilometer have been activated in accordance with the following subparagraphs, the ceilometer is in a stand-by status (see par. A1253) and can be placed in either manual or automatic operation with a minimum of delay.

A1252.1. Projector.—Before turning on the line switches after working on the projector, turn the motor fan through one complete revolution by hand to make sure the fan clears all wires and other parts of the projector.

A1252.11. Turn on the line switches. The motor should start immediately, provided the circuit through the motor starter is closed. The circuit through the starter is closed by moving switch S407 momentarily to its closed-circuit position. The air pressure should build up rapidly to the normal operating pressure for the type of compressor in use, as recorded on the monthly maintenance reports (see Fig. A1-23). The projector lamp should light within four seconds, provided the lamp compartment door is closed. On projectors where the low pressure switch has been eliminated (see par. A1281.52), the lamp will light as soon as the motor starts.

A1252.2. Recorder and Detector.—Proceed as follows:

(1) Before the Amplifier and Ceilometer switches are turned on, determine that the Recorder, Meter, and Motor switches are off.

(2) Turn on the Amplifier and ceilometer switches.

(3) Balance the discriminator (see par. A1252.21).

(4) Perform a noise and photocell sensitivity check (see par. A1284).

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TABLE A1-2. Ceilometer Controls and Switches (Installations equipped for the remote control of scanning)

Control and Location	Status				Function
		Discriminator Balanced			
			Scanning		
	Deactivated	Stand-by	Automatic	Manual	
1. Ceilometer Switch (S402) - On recorder frame	Off	On	On	On	To supply power to (1) convenience outlet in detector, (2) synchro system, (3) Amplifier and Motor switches, (4) the travel limiting switches for the stylus assembly, and (5) the travel limiting switches for the scanner.
2. Amplifier Switch (S303) - On detector housing	- - -	On	On	On	To supply power to the meter switch and electronic components of detector provided the Ceilometer switch is on.
3. Motor Switch (S301) - On detector housing	- - -	On	On	Off	To supply power to the scanner motor provided the Ceilometer switch is on.
4. Meter Switch (S302) - On detector housing	- - -	Off	Off	Off or On	To operate the scale and meter illumination lamp in the detector whenever illumination is necessary. The Ceilometer and Amplifier switches must also be on.
5. Meter-Selector Switch (S409) - On 3-inch panel above recorder	- - -	Discriminator-Output Position - See par. A1257.5			To place the output meter at the recorder either in the discriminator-output circuit or in the stylus-motor-voltage circuit (see par. A1257.5).
6. Recorder Switch (S403) - On the recorder frame	Off	Off	On	- - -	To supply power to the chart drive, chart lamps, and the converter amplifier in the recorder.
7. Projector Switches (S407 & S408) and Pilot Light - Usually on 3-inch panel above recorder	Pilot Light Off	Pilot Light On (see par. A1252.11)			The switches open and close the magnetic contactor to control the supply of power to the projector for operation of the projector or of a stand-by ceiling light. The lighted pilot light indicates that the power circuit is closed at the contactor.

TABLE A1-2. (cont'd.)

Control and Location	Status				Function
		Discriminator Balanced			
			Scanning		
	Deactivated	Stand-by	Automatic	Manual	
8. Recorder Gain (S410)	- - -	Adjust for optimum performance (see par. A1257)			To govern the magnitude of oscillation of the recording stylus.
9. Amplifier Gain (S101) - On amplifier chassis	- - -	To position eight or less (see par. A1257)			To govern the magnitude of the output-meter reactions.
10. Reversing Switch (S411) - On 3-inch panel above recorder	Neutral	Neutral	See par. A1254.3	Neutral	For reversal of direction of scanner travel (see par. A1254.3).
11. Grid Balance (R215) - On discriminator chassis	- - -	See par. A1252.21			
12. Normal-Diode Switch - On chassis of GE-type amplifier only		Leave in NORMAL position			
13. Phasing Control (R201) - On discriminator chassis		Do not adjust			
14. Line Switches (S504 and S506) - In projector cabinet	Off when working in lamp compartment	On	On	On	To open the projector power-supply circuit for maintenance purposes (these switches also open automatically in the event of an extremely heavy overload - see par. A1281.1).
15. High-Pressure Switch (S503) - In projector cabinet	Normally on - See par. A1281.51	On	On	On	When operated manually, it opens the projector lamp and motor circuits (to deactivate the projector) without interrupting the 104-volt power supply from the autotransformer used to power the stand-by ceiling light.

(5) Determine that the recorder stylus assembly indicates the same elevation angle as is indicated on the elevation-angle scale in the detector (see par. A1257.4).

(6) Turn on the Motor switch.

(7) Determine that the meter-selector switch is in the discriminator-output position (see par. A1257.5).

A1252.21. Discriminator Balancing.—Balance the discriminator under the following conditions:

(1) Whenever the ceilometer is activated after servicing, allow the equipment to warm up, preferably for two hours, but at least for fifteen minutes after the first three steps in par. A1252.2 have been completed. If it is necessary to balance the discriminator before the equipment has been in operation for two hours, it should be balanced again after two hours of operation. If the ceilometer has been deactivated for repairs or for more than twenty-four hours, check the detector and recorder for the characteristic odor of overheating, and for other evidence of malfunctioning during the warm-up period.

(2) When the reactions of the stylus or output meters appear to be abnormal, and the adjustments of the gain controls and switches are correct for the type of operation desired (automatic or manual), determine the nature of the trouble in accordance with sec. A1280.

A1252.211. To balance the discriminator:

(1) Adjust the scanner to 45°, and if it is evident that sufficient signal from the projector is reaching the detector, to cause a noticeable reaction in the meters or recorder, turn off the projector or cover the scanner.

(2) Adjust the amplifier gain to position 1.

(3) Adjust the Grid Balance control slowly until the detector output meter reading is at a minimum. If the deflection of the pointer from its rest position is greater than the width of the pointer, inspect the detector for malfunctioning in accordance with par. A1283(1).

(4) Adjust the amplifier gain to position 8, if the minimum deflection is less than the amount indicated in (3).

A1253. Stand-By Status.—(See Table A1-2.) When operation of the ceilometer is not required (see sec. A1250), it will be maintained in a stand-by status unless it is necessary to deactivate the ceilometer for servicing (see par. A1256).

A1253.1. Change from Automatic Scanning to Stand-By Status.—(See par. A1254.) Turn off the Recorder switch.

A1253.2. Change from Manual Scanning to Stand-By Status.—(See par. A1255.) Proceed as follows:

(1) Turn off the Recorder switch if the recorder is operating.

(2) Turn on the Motor switch.

(3) Turn the Meter switch off and adjust the amplifier Gain control to position 8.

(4) Remove the crank and close the crank opening in the scanner assembly housing.

A1254. Automatic Scanning.—(See Table A1-2) When the scanner is motor driven, the direction of scan is automatically reversed when the scanner reaches 0° and 90°.

A1254.1. Change from Stand-By Status to Automatic Scanning.—Adjust the controls as follows:

(1) Turn on the Recorder switch.

(2) Adjust the amplifier Gain control to position 8 or less and adjust the Recorder Gain control as necessary to obtain optimum performance (see par. A1257).

A1254.2. Change from Manual to Automatic Scanning.—Proceed as follows:

(1) Remove the crank and close the crank opening in the scanner-assembly cover.

(2) Turn off the Meter switch.

(3) Adjust the amplifier Gain control to position 8 or less for optimum performance (see par. A1257).

(4) Turn on the Recorder switch.

(5) Adjust the Recorder Gain for optimum performance (see par. A1257).

A1254.3. Remote Scanning Control.--A spring-loaded switch (S411) on the 3-inch panel at the recorder may be used to reverse the direction of scan manually while the ceilometer is in an automatic scanning or stand-by status. To reverse the direction of scan move the switch momentarily to the position appropriate to the direction of scanner travel desired. The switch lever will return to the neutral (middle) position as soon as it is released.

A1255. Manual Scanning.--(See Table A1-2.) Whenever the scanner is operated manually, do not force the drum below 0° or above 90°. Scanner travel beyond these limits is likely to damage parts of the reversing mechanism. Operate the scanner slowly at and near points of maximum reaction in order that the time lag in the detector will not cause the point to be poorly defined or missed entirely. A speed approximately the same as or less than the automatic scanning speed of fifteen degrees per minute is necessary for satisfactory reactions.

A1255.1. Change from Automatic to Manual Scanning.--Check and adjust the controls in the following order:

(1) Leave the recorder on (Recorder switch on) unless it is not functioning properly.

(2) Turn on the Meter switch, if illumination of the meter and elevation-angle scale is necessary, and check for a satisfactory meter reading (see par. A1257.2(2)).

(3) Insert the scanner crank and adjust the scanner angle slowly until a signal is received. Adjust the gain controls for satisfactory operation (see par. A1257.2(2)).

A1255.2. Change from Stand-By Status to Manual Scanning.--Check and adjust the controls in the following manner:

(1) Turn on the Recorder switch.

(2) Turn off the Motor switch.

(3) Adjust the amplifier Gain control to position 8 or less as may be necessary to obtain satisfactory detector output-meter readings (see par. A1257.1 and A1257.2(1)). Turn on the Meter switch if illumination of the meter and elevation-angle scale is desired.

(4) Insert the scanner crank and adjust the scanner angle slowly until a signal is received. If an amplifier Gain control setting of 8 does not provide a sufficient reaction of the output meter for the identification of

the points of maximum reaction, increase the amplifier gain one step at a time and check the reaction after each increase. Return the amplifier gain to position 8 before leaving the detector.

A1256. Deactivation.—To deactivate the ceilometer:

(1) Return the ceilometer to a stand-by status (see Table A1-2 or par. A1253).

(2) Deactivate the projector by moving switch S408 momentarily to the open-circuit position. Turn off the line switches S504 and S506 for all servicing operations within the projector that do not require power.

(3) Deactivate the detector and recorder by turning off the Recorder, Ceilometer, and Amplifier switches. To deactivate the detector for servicing the electronic portions (preamplifier, amplifier, and discriminator), turn off the Amplifier and Motor switches. The recorder-chart drive and the converter amplifier in the recorder (Z401) may be deactivated independently of the detector by turning off the Recorder switch. The scanner-drive motor may be turned off independently of the rest of the detector by turning off the Motor switch.

A1257. Adjustments.—Adjustments for gain and corrections for time and elevation angle are made as outlined below.

A1257.1. Gain - Clouds and Obscuring Phenomena not Present.—After the ceilometer has been adjusted for automatic scanning, keep the amplifier Gain control set to position 8, except as indicated in par. A1257.2, and the Recorder Gain control at 9 or 10.

A1257.2. Gain - Clouds or Obscuring Phenomena Present.—After these phenomena are detected, adjust the gain settings in the following order:

(1) Maintain the amplifier gain at position 8, unless a lower setting is required to keep the reactions of the output meter from exceeding fifteen on the meter at the recorder (fifteen with the meter-selector switch in the discriminator output position - see par. A1257.5), or 1.5 volts from the output meter at the detector. If a satisfactory setting cannot be obtained, inspect the detector for malfunctioning in accordance with par. A1283.

(2) When the ceilometer is in an automatic scanning status,

adjust the recorder gain so that the maximum oscillation of the stylus will be less than approximately 3/16 inch, unless otherwise specified by the electronics technician.

A1257.3. Recorder Time.—The heavier time lines on the chart identify the beginning of each hour (LST). To adjust the chart for time, turn the knob on the end of the chart-drive roll until the position of the stylus with respect to the adjacent time lines indicates the number of minutes after each hour.

A1257.4. Elevation Angle.—The elevation angle of the scanner is indicated by the lateral position of the stylus and index of the stylus assembly in the recorder, and is indicated on the scale in the detector. In order that agreement will be maintained when the Ceilometer switch is turned on, adjust the position of either the scanner or the stylus assembly until the scale readings at the detector and at the recorder are in agreement. If they are not in agreement when the synchro system is energized, the stylus assembly may move to either the 0° or 90° end of the elevation scale in the recorder and stop. To align the stylus assembly with the scanner, turn off the Ceilometer switch, move the stylus assembly to a convenient value between 45° and 90°, adjust the scanner manually (see par. A1257.41) to the value indicated at the recorder, and turn on the Ceilometer switch.

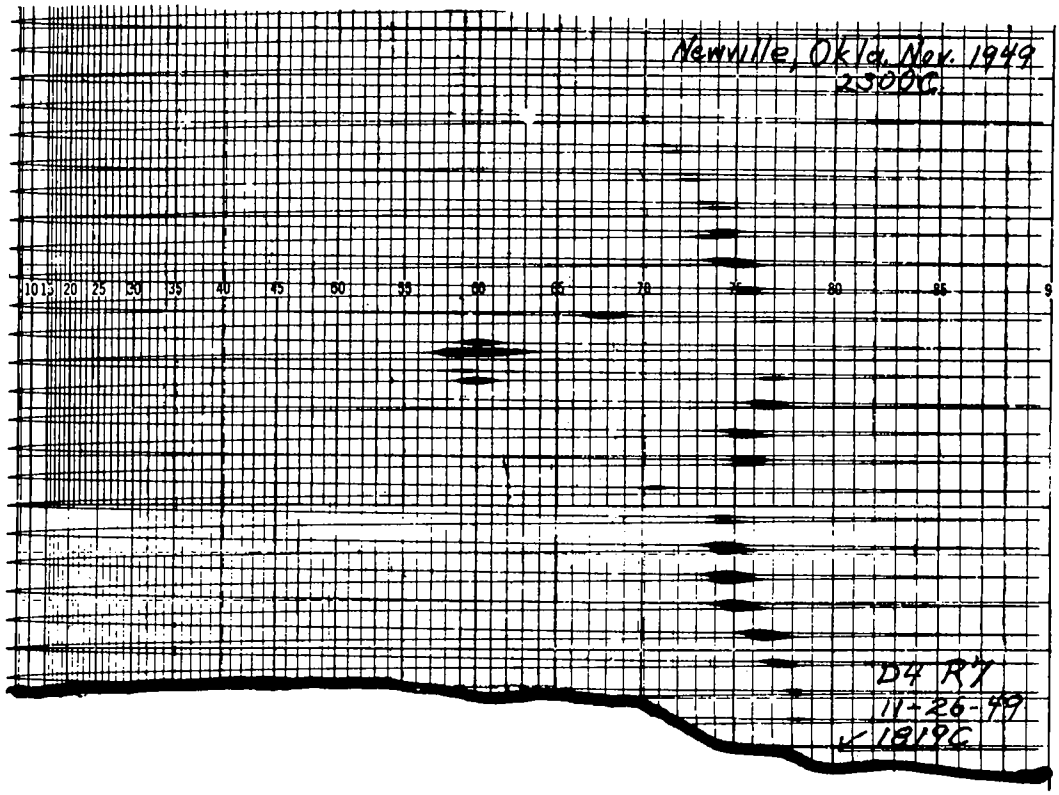
A1257.41. To adjust the elevation angle of the scanner manually:

(1) Turn off the Ceilometer switch.

(2) Remove the cover of the crank opening in the scanner assembly, engage the end of the crank shaft with the crank, and turn the crank until the desired angle is indicated on the elevation-angle scale in the scanner assembly.

A1257.42. If the stylus assembly stops beyond the 90° end of the scale, move the stylus assembly to the left or depress the magnetic cam follower (0404) until the follower touches the steel double cam (0403). If the magnetic connection is broken periodically, check for wax or other foreign material on the contact surfaces of the cam and cam follower.

A1257.5. Meter-Selector Switch.—The meter-selector switch (S409) is used to place the output meter at the recorder in either the discriminator-output circuit or the stylus-motor circuit. The central position of the switch lever is the "off" position. Operate the ceilometer with the meter in the discriminator-output circuit, in which case the meter reading should be approximately zero until a signal is received. When the meter is in the stylus-motor circuit, the meter reading (with no signal input) will be approximately twenty (2.0 volts).



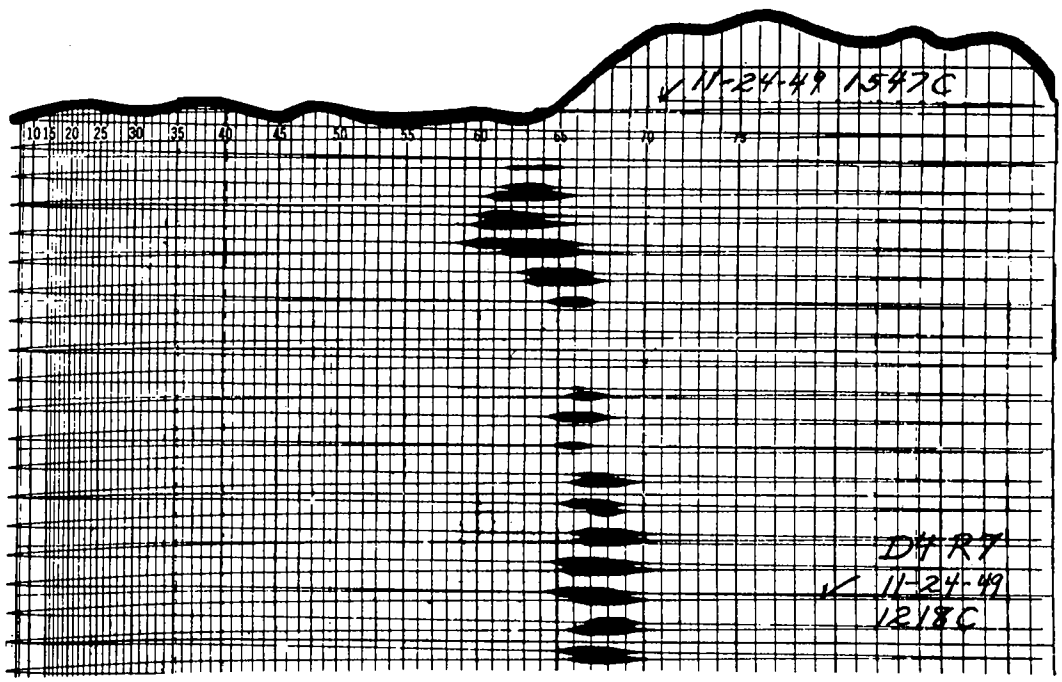


Fig. A1-11. Ceilometer chart.

A1258. Record Forms.—(See Fig. A1-11.) At the time of the 1830 GCT, 6-hourly observation, make a time-check line on the trace and enter, near the right margin of the chart, the date, local standard time to minutes (24-hour clock), and the time zone designator (see Table 17); e.g., 1:12 p.m. Eastern Standard Time would read 1312E. Adjust the chart for differences in time of more than approximately three minutes. When the adjustment is for more than five minutes, enter a time check at the point of adjustment. Enter the correct time to minutes (24-hour clock) and the time-zone designator adjacent to the check mark. Each time the recorder is started or stopped, enter a time check, the date, time, and time-zone designator at the beginning or end of the trace. Enter the station name, date, and the time of the last hour line of the chart roll on each detached portion of a roll. Note whether 90° on the chart coincides with 90° on the elevation-angle scale, and whether the elevation angle as indicated by the stylus agrees with the elevation angle reading on the scale. When disagreement persists from one roll to another, adjust the chart-drive roll in accordance with par. A1282.6. Replace the chart as frequently as necessary to avoid loss of record (see par. A1258.1). Retain completed records at the station for a period of five months. They may be destroyed thereafter.

A1258.1. Chart Renewal.—(See Figs. A1-12 and A1-13.) To replace the chart:

(1) Depress the latch lever (A), below and slightly behind the knob of the reroll assembly in the lower right-hand corner of the case, and swing the frame slightly forward.

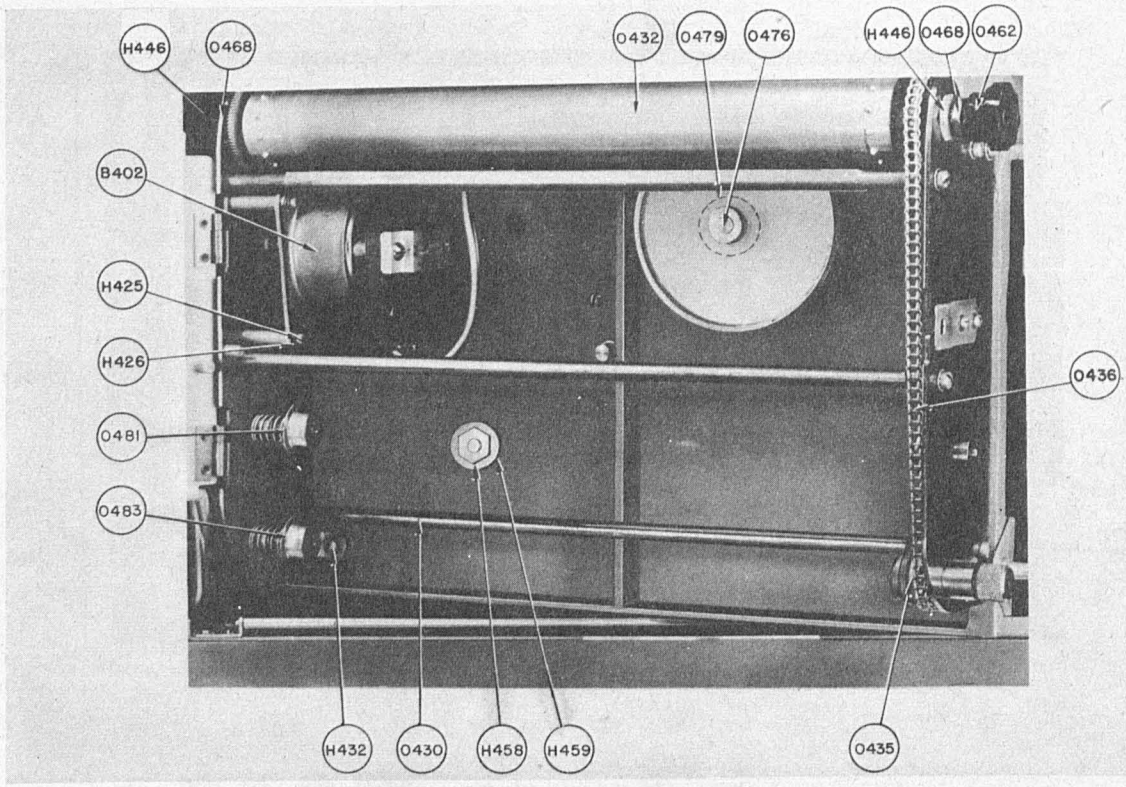
(2) Push the roll of expended chart paper to the left until the right end of the cardboard tube is disengaged from the right (driven) rewind center, and remove the roll.

(3) Release the vertical writing table from its retaining clip on the right end of the frame and swing the table to the left.

(4) Remove the empty cardboard tube from the supply roll centers which are similar to the left rewind center.

(5) Align the chart roll with the free end of the chart feeding upward from the back of the roll and insert the left center in the left end of the cardboard tube. Press the roll to the left until the right end of the roll is free to engage the right center; then slip the tube onto the center.

(6) Thread the free end of the chart upward in front of the two guide rods (above the similar to 0430) and over the



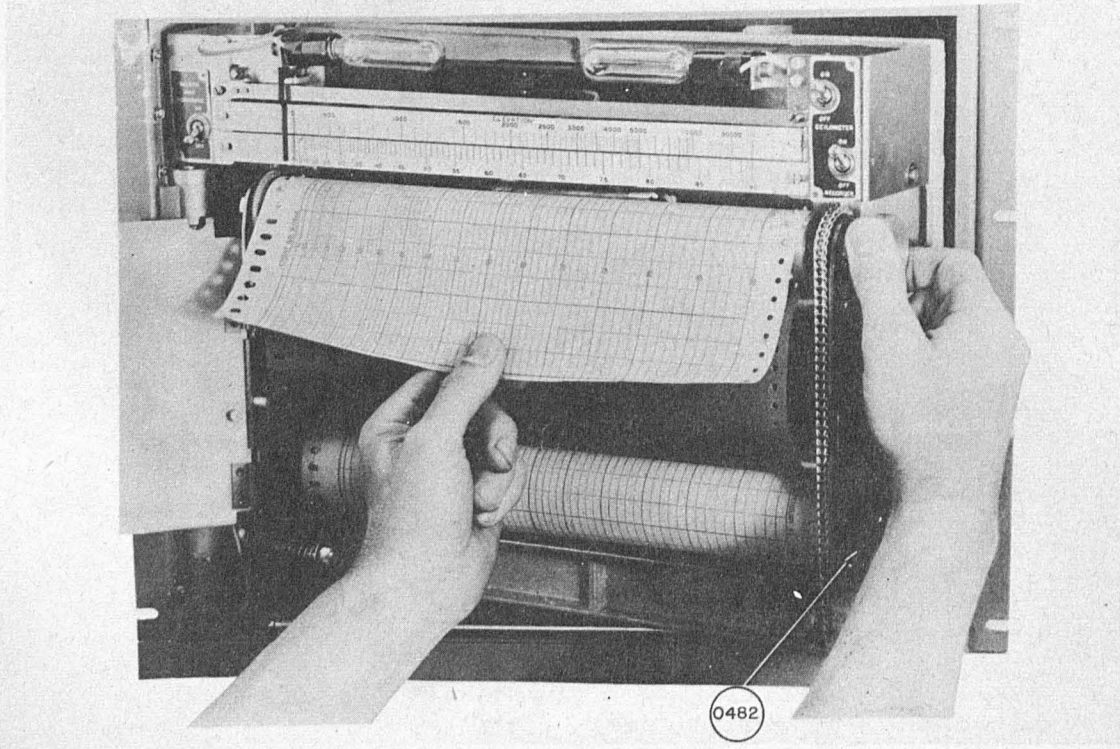
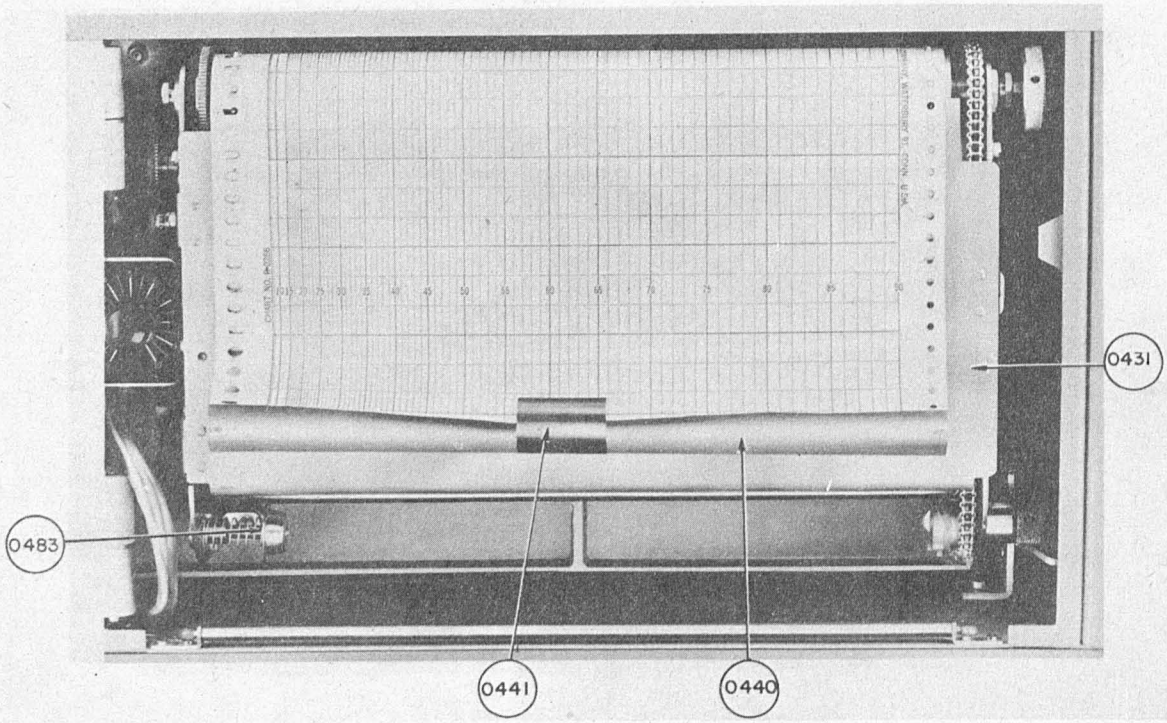


Fig. A1-12. Ceilometer recorder, showing chart removed (top view) and chart being advanced over drive roller (bottom view).



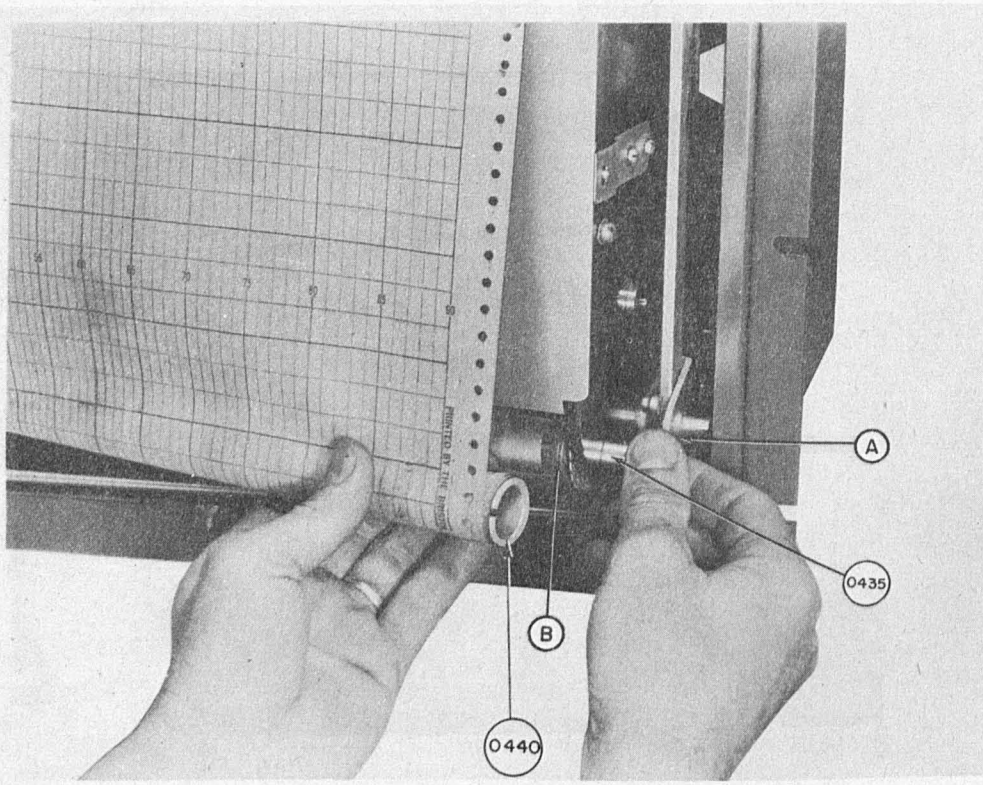


Fig. A1-13. Ceilometer recorder, showing chart ready for attachment to rewind roll (above), and installation of rewind roll on driven center (below).

chart-drive roller so that the teeth on the roller mesh with the holes in the margins of the chart. Alignment of the feed roll with the chart-drive roller is accomplished in accordance with par. A1282.5.

(7) Close the writing table, and attach the free end of the chart to the empty cardboard tube with clips or tape.

(8) Wind several turns of chart onto the tube and insert the tube on the rewind centers. Before the tube is slipped onto the right center, align the notch in the end of the tube with the key on the center.

(9) Turn the rewind knob (A) until the chart paper is taut, with the holes in the paper meshing evenly with the teeth on the chart-drive cylinder.

(10) Swing the frame back into the case until it is secured by the latch.

A1259. Ceilometer Data.—The ceilometer reactions should be interpreted on the basis of visual observations of the sky condition, weather and obstructions to vision, and on the basis of past experience in correlating reaction patterns with both the associated weather and the operating condition of the equipment. (See Fig. A1-16)

A1259.01. The height of points of maximum reaction above a fixed reference level (see Sec. 1400) are normally obtained from the height scale on the recorder. They may also be obtained from tables computed by the method described in par. 1441.1. The height scale is calibrated individually for each installation to indicate heights above the reference level for the installation. The heights indicated are a function of (1) the height of the scanner trunnions above or below the reference level, (2) the length of the baseline, (3) and the scanner angle. Note that zero on the height scale is a reference mark corresponding to zero on the elevation-angle scale, and that it is not an indication of height above the reference level.

A1259.02. Because of a 4-second time-delay in the discriminator, the points of maximum reaction obtained on the up-scan (scanner travel from 0° toward 90°) correspond to heights slightly less than the indicated heights; and the points obtained on the down-scan (travel from 90° toward 0°) correspond to heights slightly greater than the indicated heights. This variation is modified somewhat by lag in the scanner-drive mechanism, but amounts to a difference of approximately one degree or less for successive scans (see Fig. A1-14). Heights, therefore, should be based on the mean value of elevation angles for successive scans, to

the extent that the difference between the angles is the result of time-delay in the discriminator. However, this repetitive pattern of variation should not be confused with actual variations in reactions, such as might occur when the height of the cloud base is fluctuating.

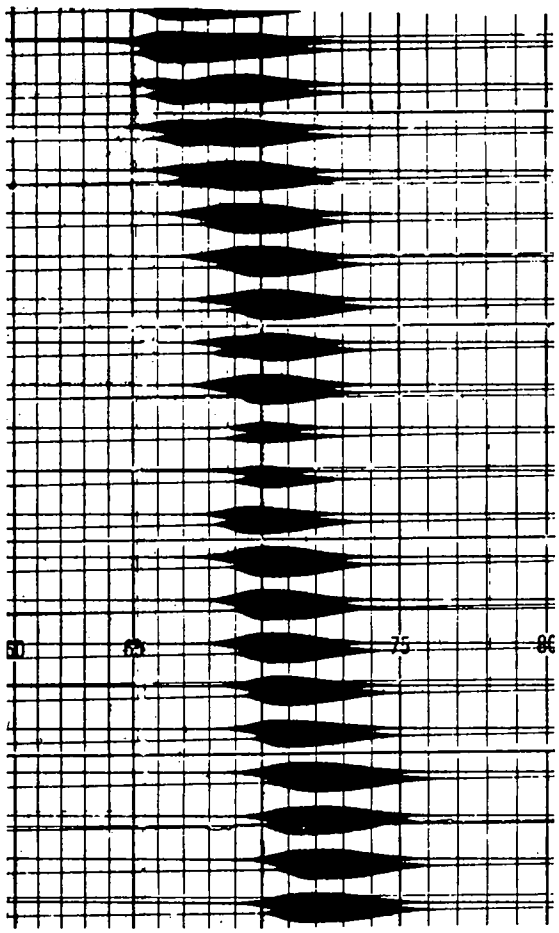


Fig. A1-14. Time-Lag Effect. Note that the elevation angle of the lowest point of maximum reaction obtained on the down scan of each cycle of scanner travel is slightly lower than the corresponding angles obtained on the up scan. This systematic variation is owing to normal time-lag in the discriminator. The elevation angle corresponding to the base of the layer is intermediate between the values obtained from these two portions of the scanning cycle. Allowance should be made for the amount of this effect when the effect is obscured by actual variations in the height of a layer between successive scans.

A1259.1. Determination of Variable Cloud Heights.—The height ascribed to a layer of clouds when the height of their base is fluctuating rapidly will be the average of the heights corresponding to the base of the layer as obtained during several successive sweeps of the scanning drum. (See Fig. A1-17.)

A1259.2. Indications of Vertical Visibility.—(See par. 1411.) Under the conditions described in par. 1434 and 1435, the reaction of the ceilometer is in general characterized by strong reactions at low angles. The amplitude of these reactions slowly falls to zero as the angle increases. The height corresponding to the angle at which the reaction becomes zero will be used only as a guide in evaluating the vertical visibility, which may actually be several times greater than this height (see Fig. A1-18).

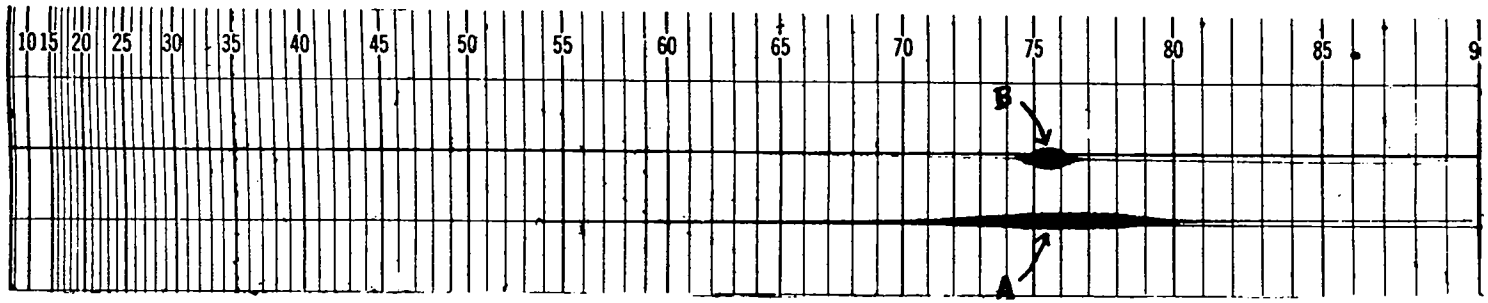


Fig. A1-15. Adjustment of gain controls. The poorly defined point of maximum reaction near A illustrates the effect of excessive detector gain. The more clearly defined point of maximum reaction at B was obtained by lowering the detector gain and increasing the recorder gain. Note that the elevation angle of the point of maximum reaction at B is approximately 75.5° and that this angle corresponds very nearly to the lowest elevation angle within the widest portion of the trace at A. Thus, whenever poorly defined reactions are present and the gain settings have been adjusted properly in accordance with par. A1257, determine the height corresponding to these reactions on the basis of the elevation angle within the widest portion of these reactions.

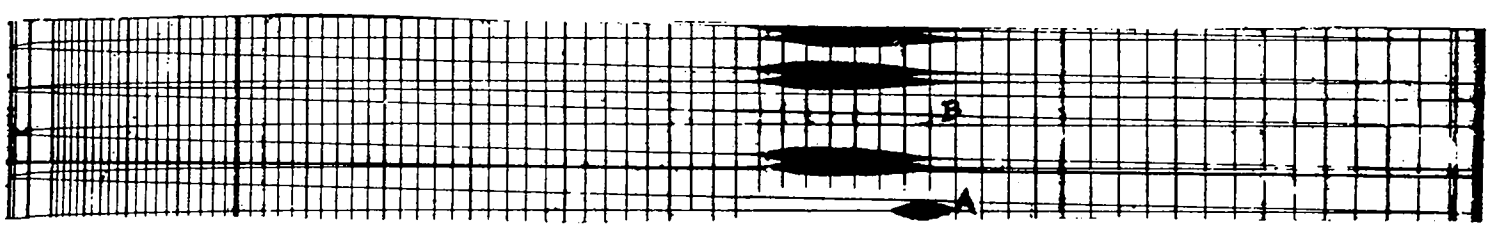


Fig. A1-16. Correlation of recorder record with visual observation. Visual observation indicated that these reactions were obtained from a broken cloud layer. The reaction at A was obtained from the side of one of the elements in the layer. The absence of a reaction on the down scan at A and on both the up and down scans at B occurred when clouds were not present above the projector. On the basis of the remaining reactions, the elevation angle of the layer was selected as 66.5°.

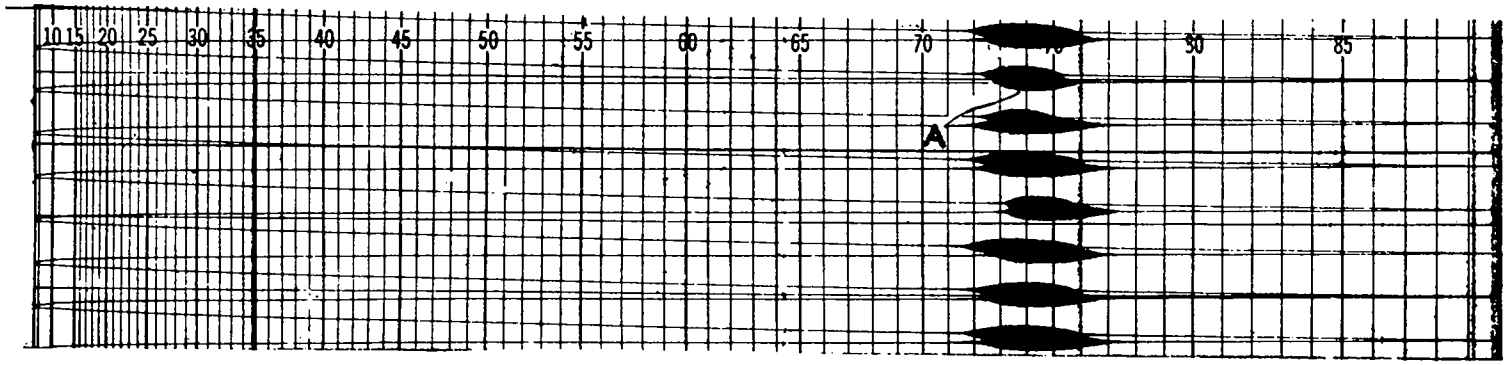


Fig. A1-17. Selection of lowest point of maximum reaction. Point A represents the lowest point of maximum reaction for that transit of the scanner. Note that the elevation angle of this point varies slightly from the elevation angles of similar points for other reactions. These slight variations in the elevation angle of the points of maximum reaction are attributed to the observed roll-like structure of the cloud base, therefore, the height of a layer that is varying in this manner should be based on the average elevation angle obtained from several successive transits of the scanner.

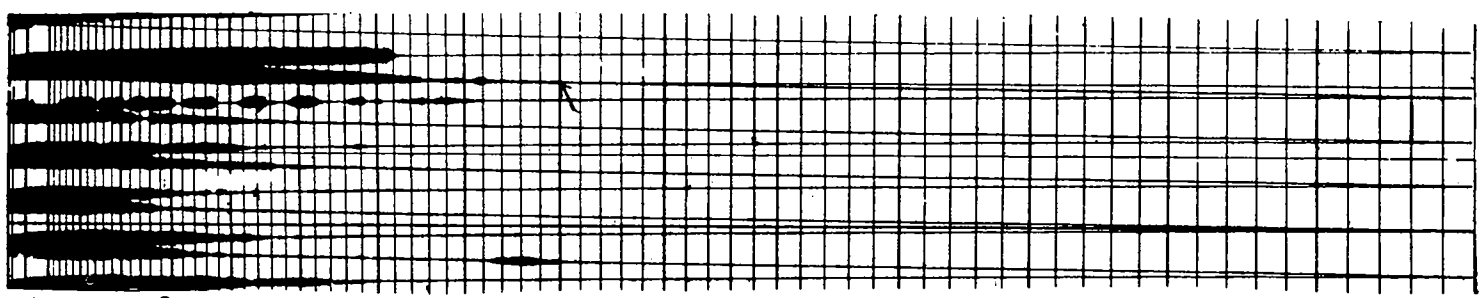


Fig. A1-18. Indication of vertical visibility. Light snowfall obscured the clouds at the time of observation. The elevation angle at which the ceilometer reactions to obscuring phenomena cease (e.g., 55° as indicated by the arrow in this figure), may be used as a guide in evaluating the vertical visibility. However, the height corresponding to this angle represents the minimum value to be ascribed to the ceiling under these conditions. Under similar circumstances, every effort must be made to obtain ceiling observations from aircraft. If these reports from pilots cannot be obtained, the observer will qualify the ceiling indications as necessary on the basis of visual observations and past experience.

A1259.3. Use of Sector Scanning.—A sector limited to the angular range in which a signal is indicated or expected may be scanned manually (see par. A1255) or automatically (see par. A1254.3). With either manual or automatic scanning, a limited sector can be scanned more frequently than a 90° sector. By increasing the frequency of scanning whenever the sky cannot be seen, the observer may gain some idea of the nature and distribution of the clouds. The pattern obtained in this manner during the period of the observation will frequently be useful in determining whether the cloud base is (1) uniform, (2) fluctuating in height or density, or (3) increasing or decreasing steadily in height. In addition, the irregularity of reactions from the side of cloud elements, occasional thin spots in the cloud structure, and from closely adjacent cloud layers, distinguishes them from the more regular reactions pertaining to the base of layers. In the case of manual scanning only, the scanning speed may be varied. Slower scanning may sometimes provide reactions to signals that are missed at the automatic-scanning speed. Reactions that result from malfunctioning of the scanner motor-drive mechanism or the synchro system may disappear when manual scanning is employed.

A1259.31. When a maximum reaction ascribed to a layer appears as a relatively uniform wide band (see Fig. A1-15) rather than as a reaction that increases rapidly to a well-defined point, the height ascribed to the base of the layer will correspond with the lowest elevation angle within the range of the wide portion of the trace. If the range exceeds one degree, it is preferable that the observer scan slowly but more frequently through the approximate point of maximum reaction from both directions. Read the corresponding angle- or height-equivalent as accurately as possible on each scan. An average of the height-equivalents of these readings will be used as the height of the layer of clouds or obscuring phenomena aloft, or as a guide to the vertical visibility into obscuring phenomena at or near the surface (see par. A1259.2).

A1259.4. Refraction Phenomenon.—A phenomenon caused by refraction of light from the ceilometer beam by raindrops is sometimes visible as a spot in the beam. Sometimes it produces a signal of sufficient intensity to cause a reaction of the ceilometer (see Fig. A1-19). The visible spots and the associated ceilometer reactions occur with greatest intensity at an elevation angle of 49°, regardless of the baseline distance from the point of detection to the projector. Similarly, the height of the observation point above or below the projector does not affect the elevation angle of the phenomenon. The phenomenon may produce weak secondary reactions at approximately 36°. However, ceilometer reactions to clouds at 49° and 36° are generally stronger than reactions to refraction phenomena. The latter may be eliminated by low gain settings without seriously impairing reactions to clouds. When a spot is visible at 49° or 36° at the detector, a clinometer or similar device may be used to measure the elevation angle of the spot from another observation point. This observation point should have a baseline that is 10% longer or more than the usual

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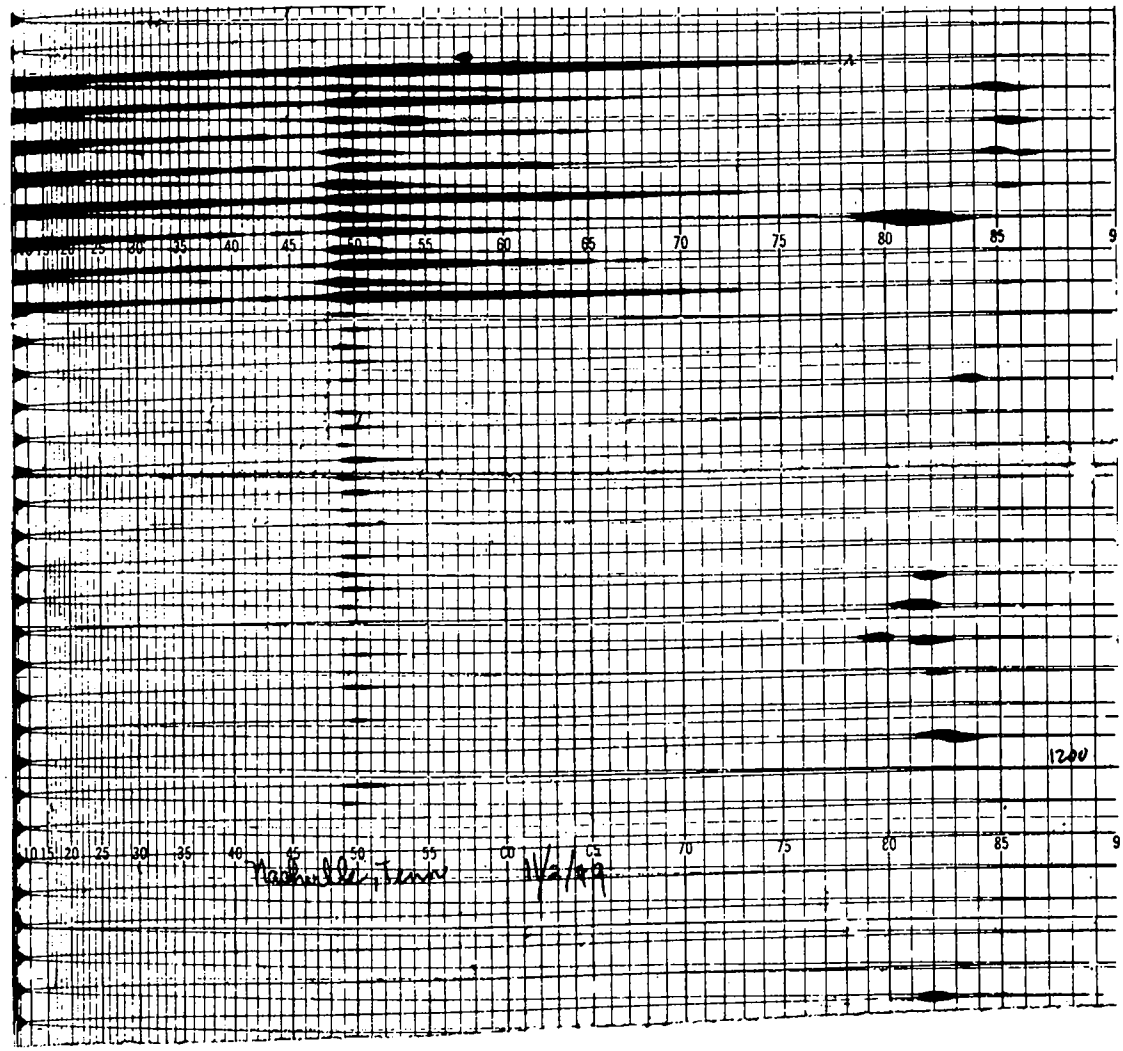

Fig. A1-19. Refraction phenomena (elevation angle 49°).

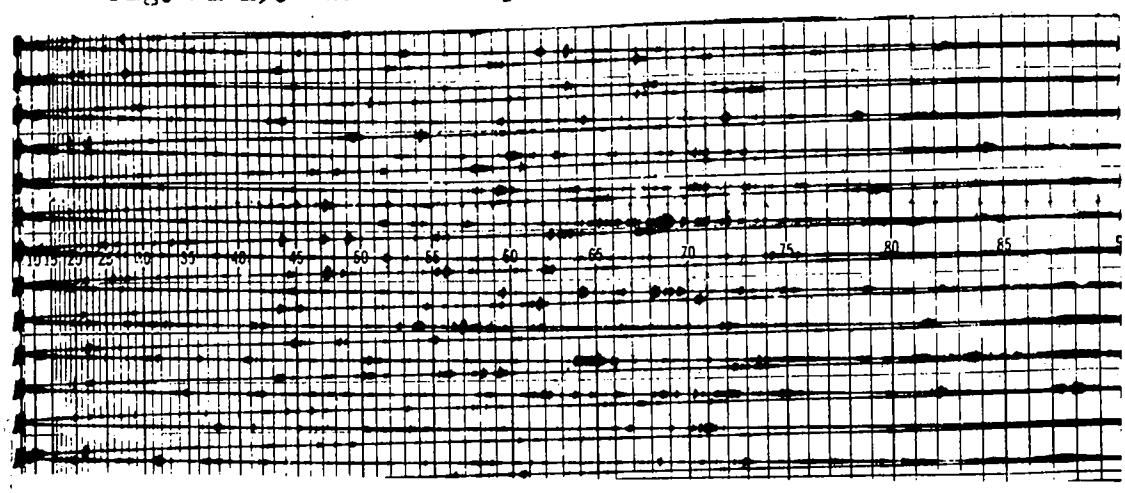

Fig. A1-20. Extraneous reactions.

baseline. If the angle is still the same when measured along the longer baseline, the spot is caused by a refraction phenomenon and not by clouds or obscuring phenomena.

A1259.5. Extraneous Reactions.—Reactions caused by malfunctioning of the equipment (see Fig. A1-20) can usually be identified by the lack of similarity between the reaction pattern and the patterns caused by meteorological phenomena. They are frequently sporadic in nature, and may indicate some abnormality in the exposure of the detector (see sec. A1240), or the operating condition of the detector (see par. A1283(4)). These reactions are usually accentuated by high detector-gain settings (see par. A1257).

A1260. Weekly Maintenance (Preventive).—Weekly maintenance of the ceilometer comprises primarily systematic cleaning. Indicate the action taken on a copy of Form 457-1 (see Fig. A1-21). The work should be done on or about the same day of each week. Correct defects or report them promptly to the Regional Office (see sec. A1280). Except as otherwise indicated on the form, enter a (✓) to indicate either "action completed satisfactorily" or "condition satisfactory", and enter an (x) if the condition is unsatisfactory. Enter pertinent remarks regarding:

(1) Abnormal conditions and other factors which, in the opinion of the observer, may be of value to station personnel and electronics technicians in evaluating the operation of the ceilometer, or in conducting future maintenance.

(2) Corrective action taken during the week.

A1260.1. Retain completed forms at the station until they are reviewed by the electronics technician; after which they may be destroyed.

A1261. Detector:

(1) Deactivate the detector and clean the cover glass (C-H only) and lens of the scanner with any good glass cleaner (Bon Ami or equivalent). Clean the lens on the outside only.

(2) Wipe the inside of the cabinet free of loose dirt.

(3) If evidence of moisture is observed in any component, enter the condition as unsatisfactory, and on the next monthly report (see sec. A1270), enter the location of the evidence and apparent source of the moisture, the date of observation, and other pertinent remarks.

WB Form 457-1
(4-51)

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

Weekly Ceilometer Check List

(To be Kept at Station)

a. Station..... Date.....195.....

b. *Detector*

1. Clean: Lens..... Cover Glass..... (C-H Only)
2. Clean: Cabinet.....
3. Note evidence of moisture: Under lens.....
   Under cover glass..... Behind meter window.....
   In cabinet.....
4. Condition: Scanner Drive Belt.....
5. Operation of Scanner Assembly: Smoothness.....
   Reversal..... Reverses at.....degrees
   and at..... degrees
6. Discriminator Final Balance.....

c. *Projector*

1. Presence of abnormal noise (motor running).....
2. Blow air tank..... Presence of oil or water in tank.....
3. Condition: Belt..... Pulley.....
   Fan Assembly.....
4. Check Compressor oil level ..... for evidence of oil leakage.....
5. Compressor bearings greased.....(Rotary type blower only)
6. Condition: Lamp sockets..... Lamp contact spring.....
7. Condition: Mirror.....
8. Clean: Cover glass..... Mirror.....
9. Clean: Filter pads..... Ventilating screen.....
   Cabinet.....

d. *Recorder*

1. Check alignment of the chart to the angle scale at 90°.....
2. Indicated angle of reversal from scale.....and.....degrees
3. Clean: Cabinet.....

e. *Remarks:*

Fig. A1-21. Weekly ceilometer check list.

(4) Whenever deterioration of the scanner belt is observed, replace it (see Table A1-3 (11a)).

(5) Return the detector to automatic scanning status, watch the operation of the scanner through several scans, and indicate whether the unit operates smoothly, i.e., whether there is any noticeable variation in the speed of scanner travel between reversal points. Report whether the scanner-drive motor has failed to reverse at any time during the week. Enter, to the nearest degree, the angles at which the scanner reverses.

(6) Balance the discriminator and indicate whether final balance is satisfactory.

A1262. Projector:

(1) Check the condition of the compressor and record the operation as unsatisfactory when abnormal knocking noises are heard. Report the condition on the monthly report (see sec. A1270). Whenever loud knocks are heard, notify the regional office immediately.

(2) Blow the pressure tank by opening the air-tank stopcock. Indicate whether oil or water is present in the discharge. Blackening of the lamp, shortened lamp life, or oil in the discharge from the tank may indicate a defective compressor and should be reported on the next monthly report (see sec. A1270).

(3) Turn off the line switches. Check for correct belt tension (see par. A1281.31), and for tightness of (1) the pulley and fan assembly of the compressor, and (2) the pulley on the motor. Replace the belt if it becomes frayed or cracked (see par. A1281.3).

(4) Check the compressor oil level and add oil as required to raise the level to the bottom of the threads of the filler hole (see Fig. A1-2 (A)) of reciprocating-type compressors, or to the level of the stopcock Z502-5 (see Fig. A1-22) of rotary-type compressors. When checking the oil level of rotary-type compressors, open the stopcock, and if oil drains from the stopcock, allow complete drainage before closing it. Report indications of oil leakage from the compressor.

(5) Turn each grease-cup cover of rotary compressors (see Fig. A1-22) until grease is forced from the small holes

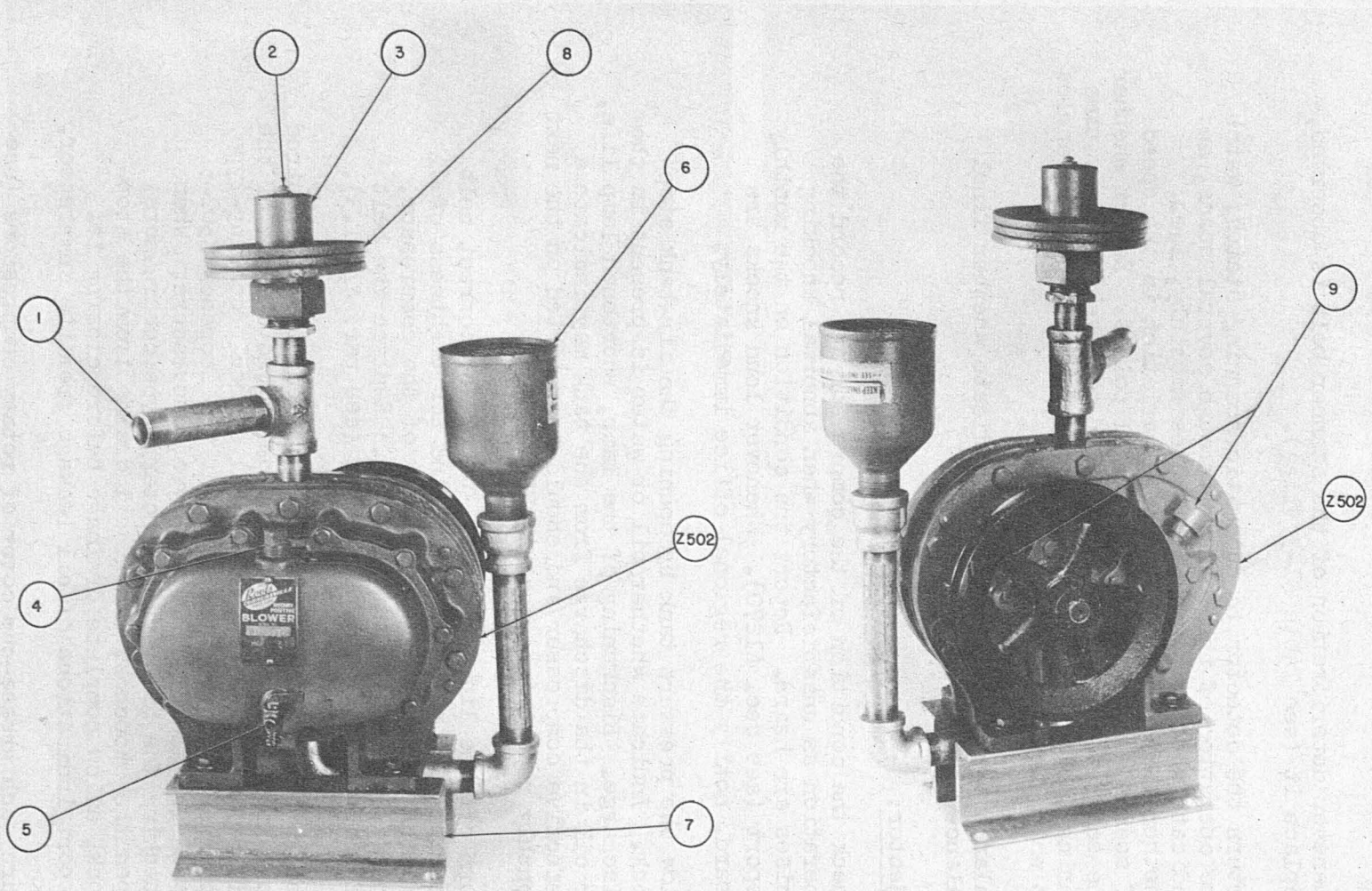

Fig. A1-22. Rotary compressor, Z502.

in the bearing housing and opposite the cups. Refill empty cups with MS534, high-temperature grease only.

(6) Indicate:

(a) Whether the lamp sockets are pitted or burned (see par. A1281.222 and Fig. A1-24).

(b) Any change in the tension of the contact springs E506 (see Fig. A1-25).

(7) Indicate:

(a) Whether the back of the mirror is becoming blistered.

(b) Whether the face of the mirror is becoming scratched.

(8) Clean the cover glass inside and out. Paper towels, a soft cloth, or soft-bristle brush may be used to clean the mirror. Polish the mirror with a soft, clean cloth. Do not use a cloth that has been used previously for cleaning or polishing the mirror.

(9) Clean the upper ventilating screen with a long-handled brush or the equivalent. Take the dust-filter pads (Z501-43) from the container (Z501-42 - see Fig. A1-29), and remove loose dirt from them. Replace the pads when they become clogged with dirt.

A1263. Recorder:

(1) When the right-hand ordinate (90° ordinate) of the chart is not aligned with 90° on the elevation-angle scale, align the chart in accordance with par. A1282.6.

(2) Enter the elevation-angle scale readings corresponding to the points at which the stylus assembly reverses its travel across the chart.

(3) Wipe out the cabinet. Do not blow loose wax out of the cabinet. It should be carefully wiped or brushed out in a manner that will keep the wax from getting into the gear train and other moving parts of the recorder.

A1264. Remarks and Initials.—Enter pertinent remarks, and initial the report.

WB Form 1434A

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

Monthly Ceilometer Maintenance Report

(TRIPLICATE)

a. Station ..... Date ..... 195....

b. *Detector*

1. A. C. Voltage input to the Detector (300 v. a-c scale) .....
2. Noise and sensitivity checks:
   a. Scanner dark gain 11 (60 v. a-c scale) .....
   b. Scanner dark gain 7 (60 v. a-c scale) .....
   c. Scanner at 85° and open, gain 7 (60 v. a-c scale) .....
3. Optimum gain setting .....
4. Discriminator final balance .....
5. Detector outages Date and time
   - 1 off ..... on .....
   - 2 off ..... on .....
   - 3 off ..... on .....
6. Cause and remedy: .....

c. *Projector*

1. Full load voltage ..... time meter reading .....
   Operating pressure .....
2. Low pressure cut-in ..... High pressure cut-out .....
3. Motor condition ..... Oil bearings .....
4. Compressor type ..... Oil level .....
   Rotary type bearings greased .....
5. No load voltage .....
6. Projector outage Date and time
   - 1 off ..... on .....
   - 2 off ..... on .....
   - 3 off ..... on .....
7. Cause and remedy .....

d. *Recorder*

1. Zero signal stylus motor voltage .....
2. Gain settings for low clouds ..... middle clouds .....
3. Occurrence of sporadic recordings .....
4. Recorder outage:
   - 1 off ..... on .....
   - 2 off ..... on .....
   - 3 off ..... on .....
5. Cause and remedy: .....

e. Remarks:

Check made by ....
Initial Official in Charge

Use reverse side for additional remarks

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WB Form 1434A

Fig. A1-23. Monthly ceilometer maintenance report.

A1270. Monthly Maintenance (Preventive).—A monthly maintenance check primarily for maintaining operational efficiency of the equipment should be made on or about the same day each month. A report of the action taken will be made on Form 1434A (see Fig. A1-23). The form is prepared in triplicate (unless additional copies are required by the regional office) as follows:

(1) At the top of the form, enter the name of the station and the date.

(2) Except as otherwise indicated on the form, enter a (✓) on the appropriate lines to indicate "operation satisfactory" or "action completed," or an (x) to indicate "operation unsatisfactory" or "action uncompleted." Where unsatisfactory operation or incomplete action is indicated, explain further in remarks.

(3) At the bottom of the form, enter the initials of the person conducting the check and the signature of the official in charge.

(4) Upon completion of the form, mail the original and first copy to the regional office, Attention, Supervising Electronics Technician, and retain the remaining copy at the station for a period of one year.

A1271. Detector.—Complete the entries for Form 1434A, items b, 1-6 as follows:

(1) A-C Voltage-Input to the Detector.—Measure the a-c voltage-input to the detector with the detector set for automatic scanning operation. Partially remove the OUTPUT plug on the (Sola) voltage-regulation transformer in the base of the discriminator (not enough to disconnect the plug) and measure the voltage across the prongs of the plug.

(2) Sensitivity Checks.—Make a static-noise and photocell-sensitivity check and record the values obtained in accordance with par. A1284 on the appropriate lines (a, b, and c).

(3) Optimum Gain Settings.—Enter the amplifier-gain setting (detector amplifier) that provided the best results during the month (see par. A1257).

(4) Discriminator Final Balance Voltage.—Balance the discriminator (see par. A1252.21) and indicate whether the balance is satisfactory or unsatisfactory.

(5) Detector Outages.—Enter serially, the date and time (LST) the detector was deactivated for servicing and reactivated.

(6) Cause and Remedy.—List serially, in the order given in (5), the cause and remedial action taken in each case of interrupted operation. Explain in sufficient detail to aid the supervising electronics technician in recognizing the trouble when the cause or remedy is unknown.

A1272. Projector.—Complete the entries for items c, 1 to 7 as follows:

(1) (a) Full-Load Voltage.—With the projector on (full-load operation), measure and record the voltage across the terminals of the upper terminal strip (E514) to which leads B and C connect (terminals 1, and either 2, 3 or 4 - see Fig. A1-30).

(b) Time-Meter Reading.—Record the reading of the time meter (B504).

(c) Operating Pressure.—Record the reading of the pressure gage taken with the projector on, but with the lamp compartment door open (lamp off) and record the reading.

(2) (a) Low Pressure Cut-In.—Enter a dash when the projector is not equipped with a low-pressure switch, or when the switch is inoperative. Otherwise, determine the cut-in pressure of the low-pressure switch by reading the pressure gage at the moment the switch closes and record the reading. Closing of the low-pressure switch is indicated at the moment the voltage across terminals 5 and 6 of the upper terminal strip increases to the normal operating pressure of approximately 208 volts. The voltage measurement is facilitated by partially opening the air-tank stopcock to delay operation of the switch.

(b) High Pressure Cut-Out (reciprocating-type compressor only).—To measure the pressure at which the switch opens, tape one or both jets (MS531) sufficiently to

cause the pressure in the cooling system to increase. DO NOT WORK IN THE LAMP COMPARTMENT, UNLESS BOTH OF THE LINE SWITCHES ARE IN THE "OFF" POSITION. Turn on the line switches and, as soon as the high-pressure switch stops the compressor, read the pressure gage and record the reading.

(3) (a) Note whether the operation of the motor appears satisfactory.

(b) Place ten drops of SAE motor oil in each bearing cup. More oil may damage the motor.

(4) (a) Compressor Type.—Enter a "P" if the compressor is a piston type, and an "R" if it is a rotary type.

(b) Oil Level.—Check the oil level, and refill as required (see par. A1262(4)).

(c) Lubrication of Bearings on Rotary Compressors.—Indicate whether the bearings have been greased weekly (see par. A1262(5)).

(5) No-Load Voltage.—With the high-pressure switch off (after checking the high-pressure cut-out pressure), and with the line switches on, enter the voltage measured across the terminals to which leads B and C are attached (see par. A1281.61).

(6) Projector Outage.—Enter the date and time the projector is deactivated for servicing and reactivated.

(7) Cause and Remedy.—List serially in the order given in (4) the cause and remedial action taken in each case where operation was interrupted. Give the reasons for extended periods of interrupted operation.

A1273. Recorder.—Complete the entries for items d, 1 to 5 as follows:

(1) Zero-Signal, Stylus-Motor Voltage.—Turn the Recorder Gain control to zero and the Ceilometer switch off. Measure the stylus-motor voltage on the recorder output meter (see par. A1257.5).

(2) Gain Settings for Low and Middle Clouds.—During the month at times when low clouds, and middle clouds below 10,000 feet are present note the recorder gain settings

that produce a satisfactory trace (see Fig. A1-15). Record, for each category, an average of the observed values.

(3) Occurrence of Sporadic Recordings.—Report the date, time, gain settings and other pertinent remarks concerning any pronounced occurrence of sporadic readings (see par. A1259.5 and Fig. A1-20).

(4) Recorder Outage.—List serially the time (LST) and date each time the ceilometer is deactivated for servicing and is reactivated.

(5) Cause and Remedy.—List in the order given in (4) the cause and remedial action taken in each instance of interrupted operation. Explain extended periods of interrupted operation.

A1274. Remarks.—Enter, on both sides of the form if necessary, all pertinent remarks considered helpful in evaluating the performance and condition of the ceilometer during the month.

A1280. Corrective Maintenance.—Check the reactions of the ceilometer as frequently as necessary to prevent extended loss of record and to provide for maximum use. Table A1-3 is a guide to the causes of abnormal operation and to applicable maintenance procedure. However, because circuit operating conditions vary considerably from one installation to another, and because mechanical features may vary somewhat among installations, the procedure that has been found to work best in most cases for a characteristic defect may not work in every instance of defects in which the characteristics are similar. When normal service cannot be restored in accordance with these instructions, report the circumstances to the regional office as follows:

(1) Any defects that do not affect the output meter readings or recorded data adversely, or appear to endanger the equipment, should be reported to the regional office by mail.

(2) Notify the regional office immediately by telephone, telegraph, TWX or PBA whenever deactivation of the detector or projector is:

(a) Necessary to protect the equipment.

(b) Necessitated by malfunctioning that cannot be corrected locally and that precludes obtaining satisfactory data from either the output meters or the recorder trace.

(c) Specified in the following instructions.

(3) Keep communications brief without omitting details which will enable the technician to determine a) the location of the trouble, and b) whether repairs to, or replacement of, the faulty unit is indicated.

(4) In each case in which erratic operation or malfunctioning occurs, whether or not it is repaired locally or by a technician, enter on the monthly check form (WB Form 1434A) a description of the conditions observed and a report of the action taken.

A1280.01. In an emergency, such as when overheating occurs, the unit concerned should be deactivated immediately as follows:

Projector: Turn off both line switches.

Detector: Turn off the Amplifier switch.

Recorder: Turn off the Recorder switch.

A1280.02. Whenever it is necessary to replace a fuse or reset an overload switch more often than once in twenty-four hours, and especially when overloading occurs almost as soon as the fuse is replaced or the switch is reset, deactivate the ceilometer. Whenever overloading occurs, report the circumstances on the monthly maintenance report (WB Form 1434A). The occasional overloading of a thermal-cut-out type switch is not necessarily an indication of malfunctioning of the ceilometer, but a blown fuse indicates, in most instances, trouble within the fused circuits.

A1280.03. Retain all used and unsatisfactory tubes for disposition by the electronics technician.

A1280.1. Use of Ohmmeters.—Whenever it is necessary to test the continuity of electrical leads or other conductors, turn off electrical power to the circuit, disconnect at least one end of each conductor tested, and connect the test leads of an ohmmeter across the ends of the conductor. If the resistance indicated on the ohmmeter is more than a few ohms, especially if it approaches infinity, a broken or defective conductor is indicated.

TABLE A1-3. Ceilometer Trouble Correction Guide

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
1. Unwanted reactions:	
(a) Interference from reactions occurring at random elevation angles (see par. A1283(4)).	1. Check the amplifier-gain setting. Adjust if necessary (see par. A1257). 2. Defective detector (see par. A1283.3).
(b) Interference from reactions occurring periodically between 0° and 90°, at intervals of 3-1/4 degrees or multiples thereof.	Action of generator in synchro system faulty. If the sensitivity is satisfactory (see par. A1284) and the trouble disappears when the Motor switch is turned off, proceed in accordance with par. A1283.341.
(c) Alternately strong reactions on one scan and weak or no reactions on the following scan.	1. Check the discriminator balance (see par. A1252.21). 2. If the discriminator is balanced and the trouble persists, notify the regional office.
2. Reactions of both the output meters and the stylus are excessive.	Lack of discriminator balance (see par. A1283(1)).
3. Stylus trace abnormally wide.	1. Gain settings too high (see par. A1257). 2. Defective recorder amplifier (see par. A1282.1).
4. Weak discriminator output (weak output meter and stylus reactions).	1. Amplifier gain too low (see par. A1257). 2. Defective preamplifier, amplifier or discriminator in detector (see par. A1283(3)).

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
5. Weak recorder amplifier output (stylus trace too narrow)	1. Recorder gain too low (see par. A1257). 2. Defective recorder amplifier (see par. A1282.2).
6. No signal - No visible baseline signal, and no baseline reaction, cloud-signal reaction, or other indication of signal reaching the detector, although the pilot light is on.	1. Attenuation of signal owing to the intensity of obstructions to vision. 2. Projector inoperative. Check for: (a) Overloading of the motor starter (see par. A1281.4). (b) Defective lamp. (See par. A1281.2.) (c) Defective compressor belt. Replace with appropriate V-type belt (see par. A1281.3). (d) Belt too loose (see par. A1281.31). (e) Defective motor (see pars. A1281.32 and A1281.6). (f) Defective compressor (see par. A1281.3). (g) Jets of cooling system clogged. Unclog the openings with a small wire (paper clip or other wire not larger than a No. 41 drill, i.e., not larger than 0.096 inch in diameter), and report the action on the monthly report (on Form 1434A - see sec. A1270).

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
6. (cont'd.)	(h) Defective low-pressure switch (see par.A1281.52). (i) Defective high-pressure switch (see par.A1281.51). (j) Defective motor starter (K502). (See par.A1281.4.) (k) Defective line switches (see par. A1281.1). (l) Other sources. If the source of trouble is still unknown, conduct voltage tests in accordance with par. A1281.6.
7. No signal; pilot light off.	Close the switch S407 momentarily. If the pilot light and the projector do not come on, the magnetic contactor or the switches S407 or S408 may be defective, or power may not be available at the contactor. If power is available at the building a check as follows may indicate the source of trouble: 1. Check for a blown fuse or open circuit breaker in the power supply circuit of the magnetic contactor (see Fig. A1-1). 2. Approximately 208 volts, either across terminals 13 and 14 of the terminal strip E417 in the base of the instrument rack or the console in which the recorder is mounted, or across terminals C1 and C3 of switches S408 and S407 (see Fig. A1-36), indicate that

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
7. (cont'd.)	2. (cont'd.) power is available at the magnetic contactor and through the coil in the contactor. If a potential is not present at these points, have the condition corrected locally if the services of a competent electrician are available. If 208 volts are available across terminals C1 and C2 of these switches, and are not present when switch S408 is opened, switch S408 is satisfactory. Approximately 208 volts across terminals C2 and C3 with S407 held closed and S408 held open simultaneously, indicate that switch S407 is satisfactory.
	3. If trouble is still present, it is probably in the magnetic contactor, which should be repaired locally if satisfactory repair facilities are available.
8. No discriminator output (no output-meter or stylus reaction).	1. Amplifier gain too low (see par. A1257).
	2. Check adjustment of other switches and controls (see par. A1251 and Table A1-2).
	3. Defective discriminator (see par. A1283(2).
	4. Defective Amplifier switch. See that the switch knob is not sticking in an "on" position when the switch is off.

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
9. No recorder amplifier output (no stylus oscillation).	1. Recorder gain too low (see par. A1257). 2. Defective recorder amplifier (see par. A1282.2).
10. Stylus assembly stopped beyond the 90° end of the elevation-angle scale.	Move the stylus assembly to the left or depress the magnetic cam follower (0404) until the follower touches the double cam (0403). (See par. A1257.42.)
11. Stylus assembly stopped at either the 0° or 90° end of the elevation-angle scale.	Motor of the synchro system not operating. Align the stylus with the scanner (see par. A1257.4), and if normal operation is not resumed, deactivate the recorder and notify the regional office.
12. Stylus assembly stopped between 0° and 90°, and:	
(a) Scanner stationary.	1. Defective scanner-drive belt. Replace with an "O" ring-type, rubber belt. Stretch the belt sufficiently to install it without adjusting the position of the pulleys. The pulleys are adjusted to provide as little belt tension as possible. 2. Defective Motor switch. Check the position of the switch knob, to see whether it is sticking in approximately the "on" position when the switch is turned off. 3. Defective drive motor. Notify the regional office.
(b) Scanner operating	1. Defective synchro system. Determine whether the pinion (0401) of the synchro system motor (B401) can be turned freely by hand. Report the results to the regional office.

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
12. (cont'd.)	2. Defective relay, K401 (see Fig. A1-37 including Detail B). When either switch S405 or S406 is closed by action of the pin 0417, the relay is energized, contacts A, B, and D open, and contact C closes. Opening of contacts A and B stops the motor of the synchro system; and the closing of C keeps the relay energized regardless of whether switches S405 or S406 remain closed. Open the Ceilometer switch and realign the stylus with the scanner (see par. A1257.4). Close the Ceilometer switch, and if the relay is re-energized, it is likely that the relay is defective, in which case deactivate the recorder and notify the regional office. If contacts A and B are closed and the stylus assembly is stationary, the contacts may be dirty. Polish the contacts with crocus cloth, and if the trouble is not corrected, notify the regional office.
(c) Scanner and synchro system operating.	Broken drive cord or loose clamp on drive cord. Report the condition to the regional office.
13. Stylus assembly reverses at other than 0° or 90° on the elevation-angle scale (see 14 below).	Report the condition unless it is a normal operating condition known to the electronics technician.
14. Stylus assembly oscillates through an elevation-angle range of approximately 3-1/2 degrees.	Defective contacts in relay K401. Clean the two sets of contacts, A and B, nearest the movable arm (see Fig. A1-37) with crocus cloth. Contacts A and B are the contacts to which the brown and yellow leads are attached.

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
15. No scanner movement, or output meter or stylus reactions.	Defective detector fuse (F302). Replace with 10-ampere, plug-type fuse.
16. Stylus cuts through the chart paper.	Excessive stylus pressure. Report the condition promptly to the regional office.
17. Stylus cuts through the chart paper at the 0° margin of the chart.	Improper adjustment of the stylus-lifting cam. Adjust the cam (see par. A1282.3) and report the action promptly to the regional office.
18. Chart lamp inoperative.	Defective lamp. Replace with a 15T6 or 6S6, 115-volt, small, screw-base lamp.
19. Chart drive:	
(a) Inoperative.	Failure of the synchronous motor (B402). Report the condition to the regional office.
(b) Timing erratic or slow.	Clutch slipping in the chart-drive roll. Report the condition to the regional office.
20. Chart drive and lamps inoperative.	Defective recorder fuse (F402). Replace with an 8AG or equivalent type, 2-ampere fuse. The F401 fuse clips serve as a spare fuse holder.
21. Misalignment of the chart or scales:	
(a) 90° end of chart not aligned with 90° on the elevation-angle scale.	The chart-drive roll requires adjustment (see par. A1282.6).
(b) Tearing of marginal holes in the chart at the sides of the holes.	Misalignment of the chart-feed roll (see par. A1282.5).

TABLE A1-3. (cont'd.)

Indication of malfunctioning when the ceilometer is adjusted for automatic or manual operation.	Possible source of trouble and procedure.
(c) Tearing of the marginal holes at the back of the holes.	Too much clutch tension in the driven rewind-center assembly (0435). Adjust in accordance with par. A1282.4.
22. Chart paper not taut on the writing table.	Insufficient clutch tension in the driven rewind-center assembly (0435). Adjust in accordance with par. A1282.4.
23. No illumination of the output meter or elevation-angle scale in the detector.	1. Defective lamp (I301). Replace with 6S6, 115-volt, small, screw-base lamp. 2. Defective Meter switch knob. If the knob is sticking, the knob may be in approximately the "on" position when the switch is off.
24. Pilot light off when projector is on.	Defective lamp in pilot light. Replace with an S6-type 250-volt lamp.

A1281. Projector.—Examinations as listed below will frequently indicate the cause of projector failure:

(1) Setting of the line switches.

(2) Condition of the lamp.

(3) Condition of the compressor or motor.

(4) Setting of the thermal-cut-out switches in the motor starter.

(5) Setting of the pressure activated switches.

(6) Voltages at specified points.

A1281.01. The lamp-compartment enclosure is designed to afford protection against inadvertent exposure to excessive ultraviolet radiation from the lamp. The safety switch (S501) operated by the lamp-compartment door (A511) automatically opens the lamp circuit when the door is opened. Do not look at the lighted lamp, since the radiation may severely and permanently injure the eyes.

A1281.1. Line Switches.—(See Fig. A1-29 and A1-30) The normal function of the lines switches S504 and S506 is to provide for manual opening and closing of the power supply circuit to the entire projector; however, in the event of an extreme overload, these switches will open automatically. CAUTION: Always set both switches to the "off" position before doing any work in the projector housing when power is not required for voltage tests, etc. When either switch opens the circuit automatically, the switch lever will move to an intermediate position. When this occurs, switch both levers to the "off" position and look for evidence of direct short-circuiting or overheating of the exposed portions of the electrical circuit (see par. A1281.32).

A1281.2. Lamps.—Handle the quartz tube of the lamp only by the tissue paper in which it is wrapped, a clean cloth, etc. However, when direct contact with the lamp is unavoidable, use tissue paper or cloth to remove fingerprints on the tube before the arc is started; otherwise, salt-deposits of the fingers may cause the heated tube to crack.

A1281.21. Mercury Distribution.—Whenever a lamp is installed, distribute the mercury equally in the ends of the tube, being careful that no drops as large as the bore remain in the central portion of the tube. Distribute the mercury as follows:

(1) Hold the lamp by the metal ferrule at the end that is farther from the seal-off tip.

(2) Force all the mercury to the opposite end with one or more quick flips of the hand.

(3) Elevate the mercury-filled end until the tube is inclined about 30 degrees above the horizontal. Tap the lower end on a semi-yielding base, such as a pad of paper. About half of the mercury should separate from the pool in the elevated end.

(4) Hold the lamp by the ferrule at the elevated end. Vibrate the opposite end by lightly tapping it until the detached portion of the mercury has moved to the lower end.

A1281.211. When a lamp that has been operating fails to start, the distribution of the mercury should be checked and another attempt made to start the lamp before taking it out of service.

A1281.22. Replacement.—Before replacing a lamp, turn off the line switches in the projector. Access to the lamp is through the small inner door (A511) near the top of the projector housing.

A1281.221. Whenever the lamp has exploded, carefully remove sharp quartz fragments that remain on the parabolic reflector to avoid injury to the observer and damage to the reflector. Paper toweling, or soft cloth should be used, with a light brushing or sponging motion to enmesh the particles. The life of the reflector will be materially increased if the fragments are not rubbed across it. Dispose of the cloth after use.

A1281.222. When the contact surfaces (E506 and E508) of the lamp socket are corroded or pitted (see Fig. A1-24), clean the contacts with crocus cloth or fine sandpaper before installing a new lamp. To replace the lamp, press one ferrule of the lamp against the spring-loaded socket contact (E506) sufficiently to allow clearance for the other end of the lamp to be inserted in or removed from the opposite contact (see Fig. A1-25, A). Rotate the lamp after it is installed to seat the lamp in the contacts, and then turn the seal-off tip away from the air nozzles MS531. (See Fig. A1-25,B.) Do not bend the lamp support (A) or touch the quartz tube when making the installation.

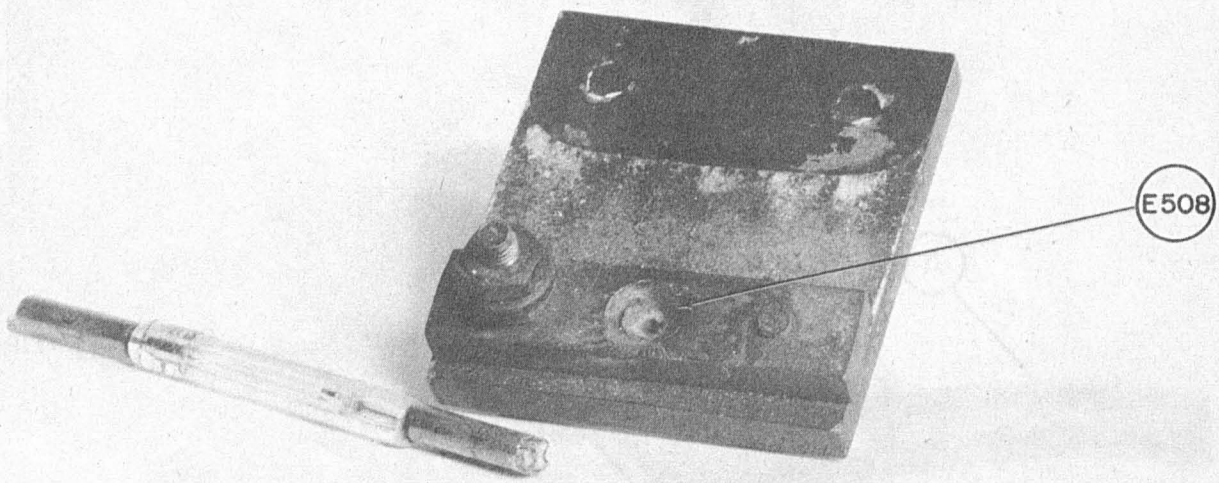

Fig. A1-24. Corroded lamp socket.

A1281.223. The lamp-circuit time recorder (B504) totalizes the time of compressor operation, and indicates the total directly to tenths of an hour. Read the meter at the time each lamp is installed and record the data in accordance with par. A1281.241(3).

A1281.23. Defective or Broken Lamps.—All lamps will be inspected for visual defects upon receipt. Defective and broken lamps will be classified as follows:

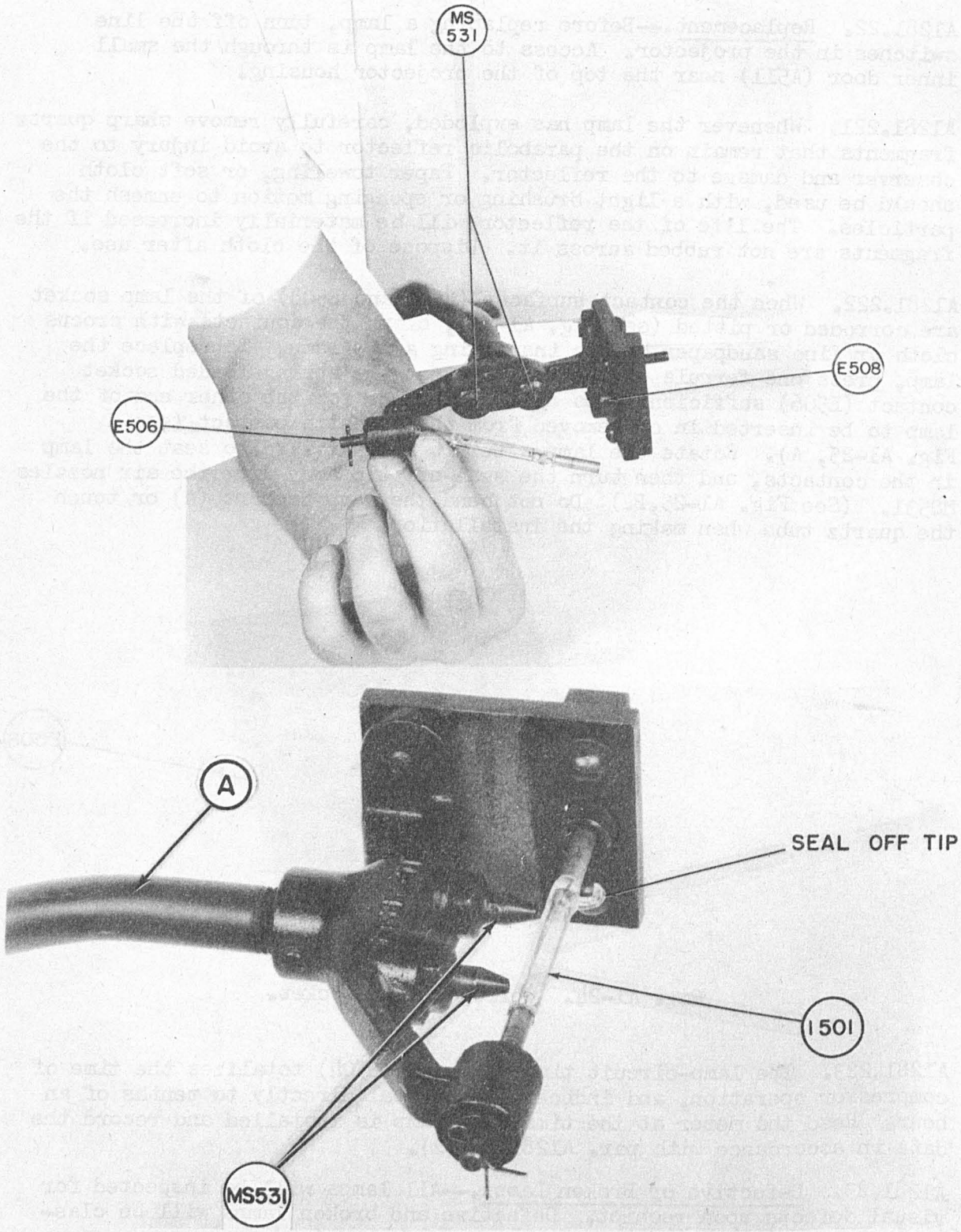

Fig. A1-25. Lamp installation procedure.

WB Form 457-3
(Formerly 1434)
April 1951

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

Quarterly Lamp Life Report

3 Quarter 19 51

Ceilometer Projector No. 5

Station Washington National Airport

Lamp Put in Service						Lamp Failed					Remarks
Lamp No.	Code No.	Meter Reading	Time & Date		Observer	Meter Reading	Time & Date		Observer	Lamp Life (Hrs)	Make entries such as: lamp exploded, broken while installing, etc.
101	18	4615.0	2100	6-10-51	A.B.C.	5003.2	1800	7/3/51	D.E.F.	388.2	
102	18	5003.2	1810	7/3/51	D.E.F.	meter failed	0800	7-7-51	A.B.C.	Estimated 56.0	meter failed sometime during period. meter replaced 7-7-51.
103	21	0000.0	0810	7-7-51	A.B.C.	0000.0	0810	7-7-51	A.B.C.	0.0	Lamp would not ignite.
104	23	0000.0	0820	7-7-51	A.B.C	0650.2	1200	8/10/51	HJJ	650.2	
105	25	0650.2	1210	8/10/51	HJJ	0650.2	1215	8/10/51	HJJ	0.0	LAMP EXPLODED AS SOON AS INSTALLED
106	25	0650.2	1215	8/10/51	HJJ	1530.8	1500	9-15-51	LMN	880.6	
107	25	1530.8	1800	9-15-51	LMN	Still in service at end of quarter, will include in next report.					
							Sum			1975.0	
							Number of lamps			6	
							Mean			329.1	
							Defective lamps			2	
							Lamps broken on receipt			1	
							Lamps broken when installed			1	
	Lamps on hand at end of quarter....8						Lamps received with loose ferrules			1	
	Defective lamps returned.....5										

Fig. A1-26. Quarterly lamp life report.

WB Form 457-3

(1) Lamps defective when received, e.g., lamps with loose ferrules.

(2) Lamps defective when placed in use, i.e., lamps failing to ignite, or exploding immediately when placed in use.

(3) Lamps broken prior to receipt.

(4) Lamps broken during installation.

Enter data for each category on Form 457-3 as specified in par. A1281.24.

A1281.231. Retain the lamps in categories (1) and (2), including the ferrules of exploded lamps in category (2), until the end of the quarter. Forward them in one package to the regional office when Form 457-3 is submitted. Number each lamp in category (2) with the corresponding serial number from the "Lamp No." column of Form 457-3.

A1281.24. WB Form 457-3.—(See Fig. A1-26) At the time each lamp is replaced, enter in chronological order the required lamp-life data in pencil on the original copy of the Quarterly Lamp Life Report. Carbon copies or typewritten copies may be prepared from the original copy as required. On the first day of each quarter, January 1, April 1, etc., forward to the regional office the original and at least one copy of the form for the preceding quarter. Include as many additional copies as may be required by the regional office.

A1281.241. Station Entries.—At the beginning of each quarter, enter in the heading of the form (1) the projector serial number from plate N501, (2) the quarter (first, second, etc.), (3) the year, and (4) the name of the station. Each time a lamp is replaced record the following data:

(1) Lamp Number.—Enter as number one the first lamp used in the installation, and number consecutively all lamps used thereafter. The continuity will be maintained from form to form.

(2) Code Number.—Enter the manufacturer's code number stamped on one of the lamp ferrules whenever provided; otherwise, enter a dash.

(3) Meter Reading.—Enter the reading of the time recorder to tenths of an hour, at the time the lamp is placed in use and when replaced.

(4) Time and Date.—Enter the twenty-four-hour-clock time and the month and date when the lamp is placed in use and is subsequently replaced.

(5) Observer Column.—Enter the initials of the observer making the replacement.

(6) Lamp Life.—Enter the difference to tenths of an hour,

between the meter reading at the time the lamp is installed and the time it is replaced.

(7) Remarks.—Enter the manner in which each lamp failed; e.g., "failed to light," "cracked," "lamp exploded," "broken during installation," etc.

Following the entries listed above, or on a second form, enter (a) the sum of the entries in the Lamp Life column, (b) the number of lamps in each of the categories in par. A1281.23, (c) the number of spare lamps on hand at the end of the quarter, and (d) the number of defective lamps forwarded to the regional office. Enter these data in the manner shown in Fig. A1-26.

A1281.3. Compressor and Motor.—Once a year have the motor overhauled at a motor-repair service.

A1281.31. When checking for trouble in the compressor or motor, turn off the line switches, check the compressor and motor for loose pulleys, and check the condition and tension of the drive belt. Adjustment of the position of the motor will usually be necessary when replacing the belt. Rotary compressors (Z502) and compressors driven by 1-1/2 hp motors require 47-inch V-type belts. Compressors driven by 3/4 hp motors require 49-inch V-type belts. The tension on V-type belts should be sufficient to prevent slipping under load, with about one inch of up-and-down play in the belt at a point about midway between the pulleys. If the motor appears to overheat, or the belt slips when the tension appears to be correctly adjusted, remove the belt. If the compressor pulley is abnormally difficult to turn, deactivate the ceilometer and notify the regional office, otherwise increase the belt tension or check for a defective motor (see par. A1281.32).

A1281.32. When adjustment of the belt tension is required, the motor bolts of 3/4 hp motors (B502) should be loosened and the position of the motor adjusted. An adjusting screw on the back of the motor base is turned clockwise to increase the belt tension of the 1-1/2 hp motor (B501) after the motor bolts have been loosened. When the pulleys are tight and the belt tension is correct, the cooling-system pressure-gage reading should agree approximately with the value shown on previous monthly maintenance reports. The pressure should be sufficient to close the low-pressure cut-out switch where one is used (see par. A1281.52).

A1281.33. Trouble observed in the motor or in the exposed wiring may be corrected locally by an electrician. Otherwise deactivate the ceilometer and notify the regional office. Motor trouble is usually indicated by voltage tests (see par. A1281.6), or by overheating of the motor, but determine that the compressor may be turned freely by hand when the belt is removed.

A1281.4. Motor Starter.—When either or both of the thermal cut-outs in the K502 motor starter (see Fig. A1-27) are open, they may be reset by depressing the RESET button on the face of the starter, or by removing the front cover and depressing the respective metal RESET levers. When

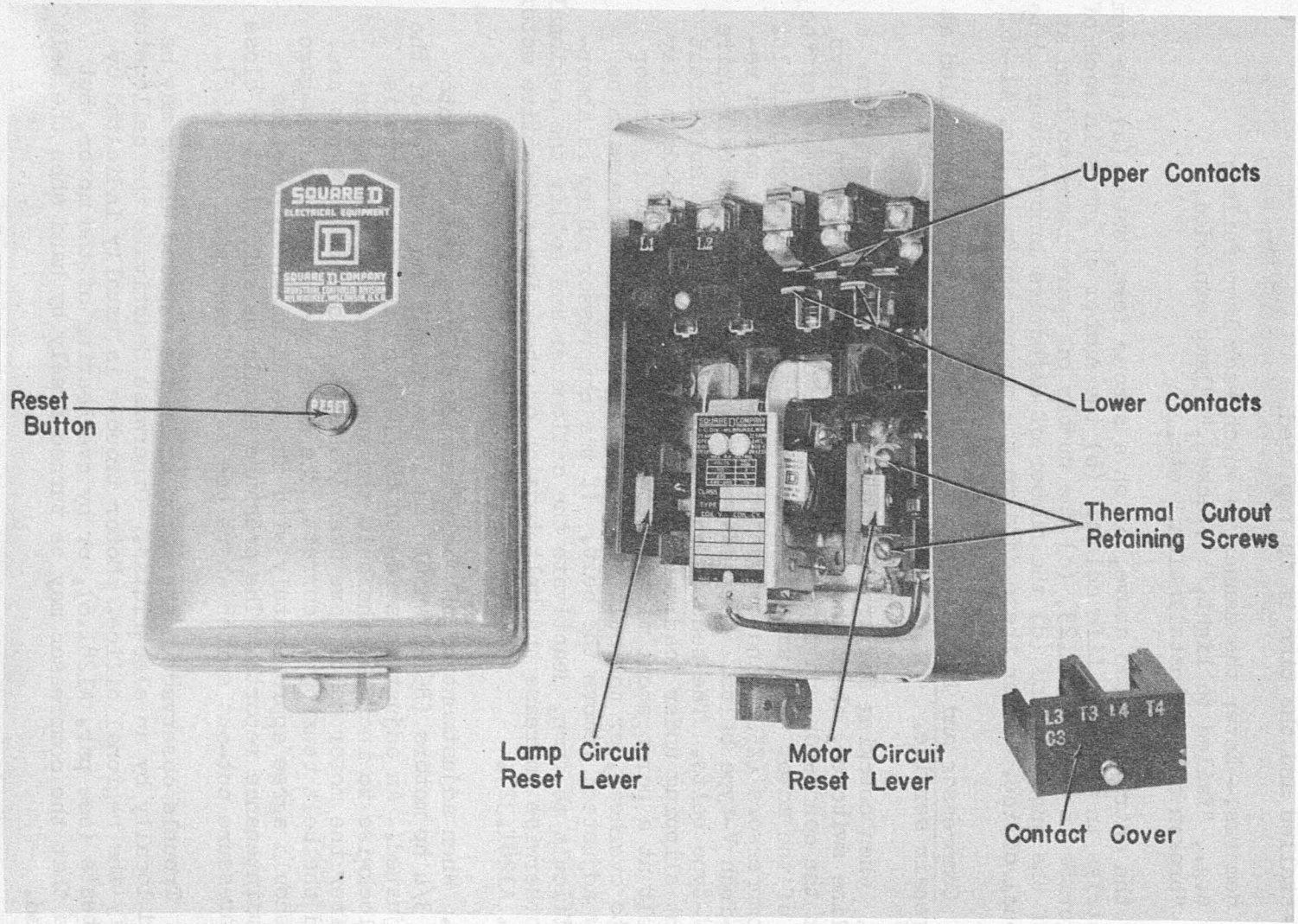

Fig. A1-27. Motor starter, K502.

repeated opening of the cut-outs occurs, remove the cover and determine, from the position of the reset levers which circuit is concerned. The left-hand cut-out is in the lamp circuit, the other is in the motor circuit. An open motor-circuit cut-out indicates trouble in either the motor or the associated wiring (see par. A1281.32). When the trouble is in the lamp circuit, deactivate the ceilometer and notify the regional office.

A1281.41. When no power is available through the motor starter, with the thermal cut-out switches closed, and 208 volts ± 10% present across terminals one and three of the lower terminal strip (E537), open the line switches (S504 and S506), inspect the condition of the contacts, and determine whether the contacts actually close when the reset levers are depressed. If the contacts and contact action are satisfactory, the relay coil may be defective. With the line switches turned off, clean dirty contacts with crocus cloth held firmly against a flat, thin stick or equivalent. Burned or pitted contacts, or other defects of the starter, may be repaired locally by an electrician if practicable; otherwise, deactivate the ceilometer and notify the regional office. When obtaining service for a defective relay locally, inform the electrician of the class and type numbers and the coil voltage (208 volts), as shown on the data plate on the face of the relay.

A1281.5. Pressure Control.—High- and low-pressure switches limit the operating pressure of the cooling system, except that in the case of a rotary-type compressor, a relief valve is used to limit the operating pressure to 5 to 6 pounds per square inch. Notify the regional office when a pressure switch becomes defective and cannot be repaired locally by an electrician.

A1281.51. High-Pressure Switch.—The high-pressure switch (S503 - see Fig. A1-28) is located in the power-supply circuit to the motor starter, and is connected into the circuit between terminals one and two of the lower strip (E537). When it is correctly adjusted by the technician it will open the circuit whenever the operating pressure is between 12 and 18 pounds. Although the rotary-type compressor does not develop sufficient pressure to operate the high-pressure switch, the switch is retained in the installation because it is a convenient means of turning off the power to the ceilometer lamp and motor circuits manually. Since the switch does not interrupt the power output from the autotransformer, it is used at stations where 117-volt power for a ceiling light is taken from the autotransformer in the projector (a T503 type transformer is used in these installations).

A1281.511. The switch is operated with the key (A) inserted in the longer slot (C) of knob (B). With this adjustment of the knob, the circuit remains open whenever it is opened manually or by a pressure overload. To open the circuit manually, lift the rod (D) adjacent to the knob. Pull

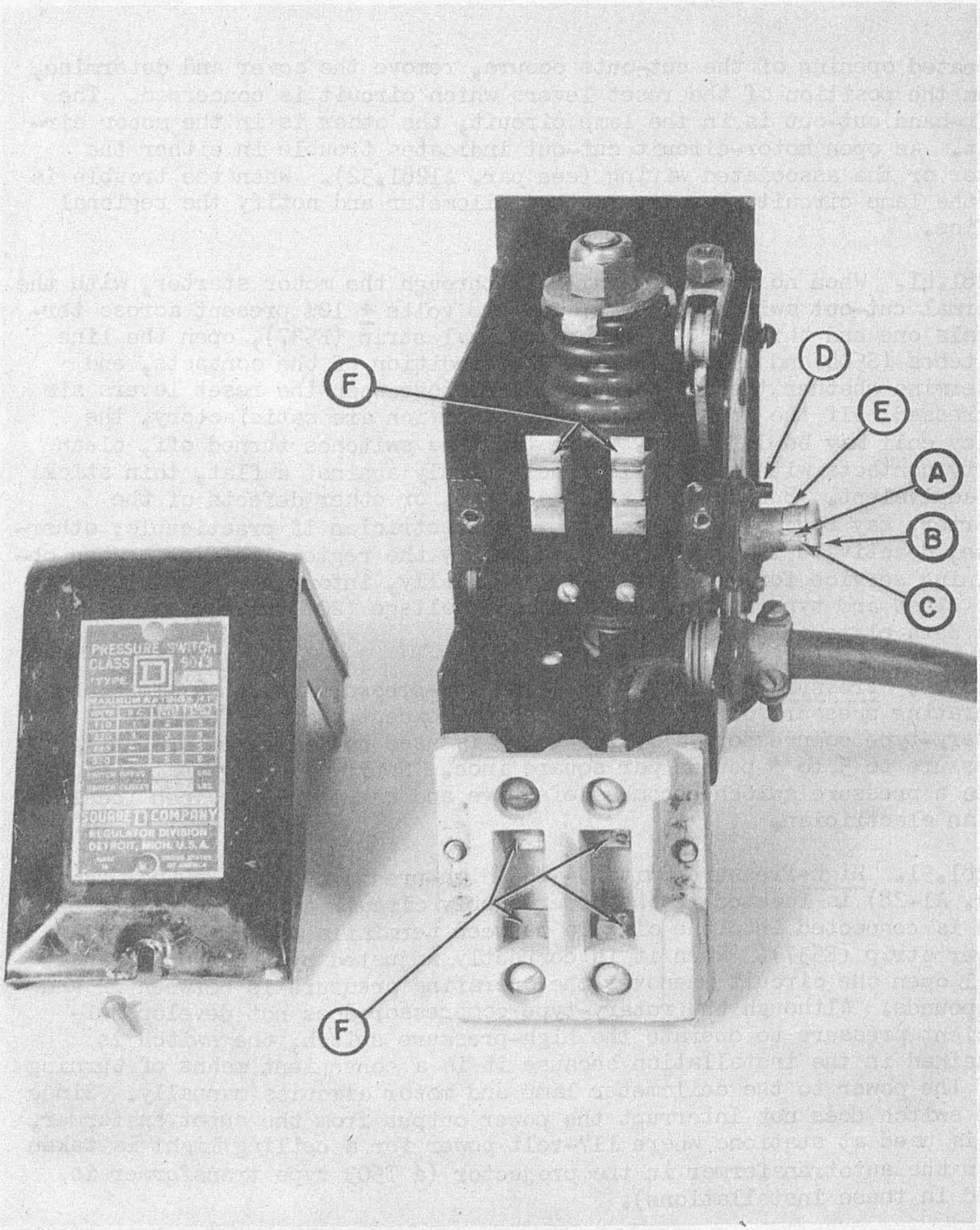

Fig. A1-28. High-pressure switch, S503, showing key (A) used in setting knob (B), deep keyway (C), shallow keyway (E), circuit-opening rod (D), and contacts (F).

outward on the knob to close the circuit, and release the knob in such a manner that the key again enters the longer slot. Do not operate the switch with the key in the shorter slot (E), because this adjustment provides for automatic resetting of the switch after an overload, and its use may permit repeated overloading to escape the attention of the observer until more serious trouble has developed.

A1281.52. Low-Pressure Switch.—The low-pressure cut-out switch (S502) should close the low-voltage side of the lamp circuit at a pressure approximately one half that of the normal operating pressure shown on previous monthly maintenance reports. The low-pressure switch used on projectors equipped with rotary compressors can be adjusted to close the circuit at a pressure of 3 to 4 pounds per square inch. A low-pressure switch may be defective owing to dirty contacts or a broken braided flexible lead to the movable contact. Polish dirty contacts with crocus cloth after turning off the line switches. If the switch cannot be repaired satisfactorily, install a jumper wire across terminals four and eight of the lower terminal strip (E537) to by-pass the switch, and notify the regional office by mail.

A1281.53. Relief Valve.—If a rotary compressor (Z502) is used, operate it at a pressure between five and six pounds per square inch. The pressure is adjusted by adding or removing weights (Z502-8) from the valve (see Fig. A1-23). When the pressure cannot be regulated to 5 to 6 pounds, report the condition to the regional office and operate the compressor only on an emergency basis.

A1281.6. Voltage Tests.—When the electrical components are responsible for projector failure, make voltage tests of the electrical circuits with the 0-300 volt, a-c range of the test voltmeter. CAUTION: Do not touch any of the terminals, especially the HV terminal on the stand-off insulator (E529) to the right of the upper terminal strip. Terminal HV, as well as all other points in the circuit between the lamp and the secondary coil of the lamp-ballast transformer (T501), is at 900-1200 volts above ground potential when the projector is activated. This potential is easily capable of producing a lethal shock. Most of the other terminals are, similarly, maintained at potentials capable of producing severe, if not lethal, shocks. Voltages are measured between terminals in the manner and order specified in the following subparagraphs. Numbered terminals preceded by the letter designator M refer to the terminals on the upper terminal strip (E514); those preceded by the letter S refer to similarly numbered terminals on the lower terminal strip (E537). Remove the terminal-strip covers for access to the terminals.

A1281.61. When a voltage is found to be unsatisfactory, the component to which it is related will not be considered unsatisfactory unless the voltage for the preceding step was satisfactory. However, when the test voltages for a component are satisfactory, it can be assumed that the

component as well as the components tested before it are operating satisfactorily. When the location of the trouble is unknown, conduct tests in the order given. Note that leads A and B may be connected to terminals M2, M3 or M4 in a combination that differs from that shown for a typical installation in Fig. A1-30. The first two of the following steps are performed with the line switches (S504 and S506) off; the rest of the steps are performed under full-load conditions whenever possible unless otherwise indicated. When, because of malfunctioning, the projector is not operating under full load, the test voltages at all points preceding that associated with the defective component are likely to be consistently higher than those specified in (2) through (12) for full-load operation.

(1) Power Supply.—Approximately 200 to 250 volts across the line switch terminals one and two, which are the terminals on the left side of the line switches.

(2) Line Switches Open.—Zero volts across terminals three and four of these switches indicates that there is no electrical leakage through the switches.

(3) Line Switches Closed.—208 volts ± 20% across the terminals to which leads A and C connect are indicative of satisfactory contact action.

(4) Autotransformer.—208 volts ± 10% across the terminals to which leads C and B connect.

(5) Leads to Terminals S2 and S3.—208 volts ± 10% across S2 and S3.

(6) High-Pressure Switch.—208 volts ± 10% across S1 and S3. When a test indicates no potential, turn off the line switches and check the condition of the pressure-switch contacts F (see Fig. A1-28). If the trouble cannot be located or corrected, place a jumper wire across terminals S1 and S2 to provide temporary service, and notify the regional office by mail.

(7) Motor Starter (See Fig. A1-27).—208 volts ± 10% across terminals S5 and S6 indicate that the thermal cut-out switch T1 and contacts L1 and L3 of the motor circuit are satisfactory. A voltage of 208 volts ± 10% across terminals S7 and S8 indicates that the thermal cut-out switch T2, and contacts L2 and L4 of the lamp circuit are satisfactory. Whenever these voltages are not satisfactory, proceed in accordance with par. A1281.41.

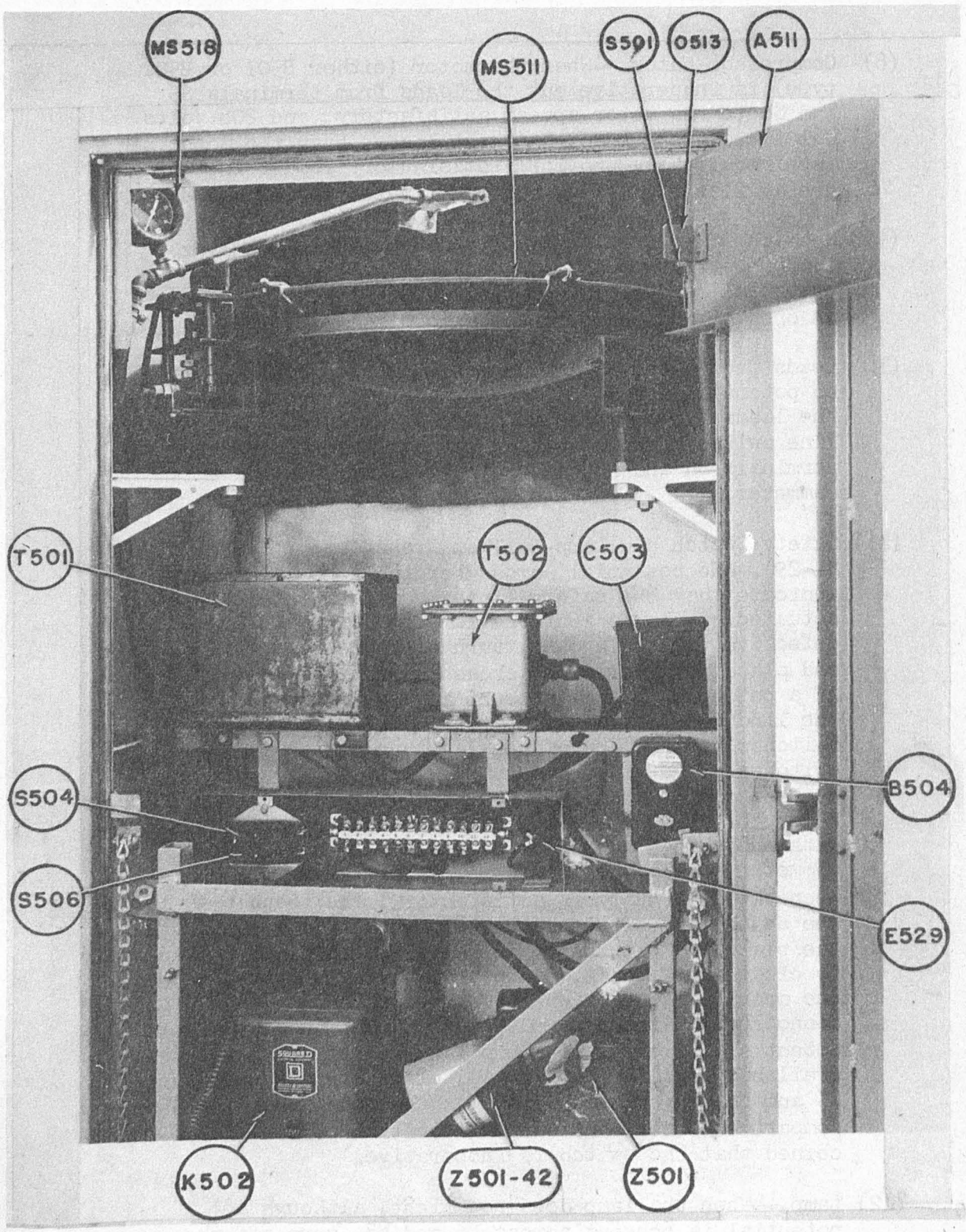

Fig. A1-29. Projector.

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(8) Compressor Motor.—When the motor (either B501 or B502 type) is inoperative but the leads from terminals S5 and S6 to the motor appear satisfactory, and 208 volts ± 10% are present across these leads, have the motor repaired locally provided satisfactory repair facilities are available. Otherwise, deactivate the ceilometer.

(9) When the lamp of a projector that is equipped with a low-pressure switch (S502) does not light with a potential across S7 and S8 but none across S4 and S7, an open circuit through the switch is indicated.

(10) Leads from S4 to M5 and from S7 to M6.—When there is no potential across M5 and M6, test the continuity of the leads from terminals S4 and S7 by turning off the line switches and measuring for continuity between terminals S4 and M5, and between S7 and M6 with an ohmmeter.

(11) Safety Switch and Lamp-Ballast Transformer (See Fig. A1-29).—No potential across terminals M6 and M8 may indicate that the safety (interlock) switch (S501) actuated by the door of the lamp compartment is defective. In this case, turn off the line switches and place a jumper wire across terminals M5 and M8. If a potential is now present across M6 and M8 with the line switches on, the trouble is in the safety switch circuit. Therefore, (a) turn off the line switches, (b) remove the jumper wire, and (c) disconnect one of the leads from the switch to either M5 or M8. Test for continuity through the switch with the switch button depressed, by connecting the ohmmeter across the terminal ends of the switch leads. When the continuity is satisfactory, the trouble is in the adjustment of the actuating bracket (0513). Adjust the plate so that the button will be depressed sufficiently to close the circuit, without being fully depressed when the door is closed. When continuity through the switch cannot be obtained, have the switch replaced by a competent electrician, if a similar replacement switch is available locally. Otherwise, place a jumper wire across M5 and M8. Display a notice on the outside of the lamp compartment door, and warn all station personnel concerned that the switch is inoperative.

(12) Lamp.—When the lamp does not light, although a potential is present across M6 and M8, turn off the line switches and determine whether the defect is

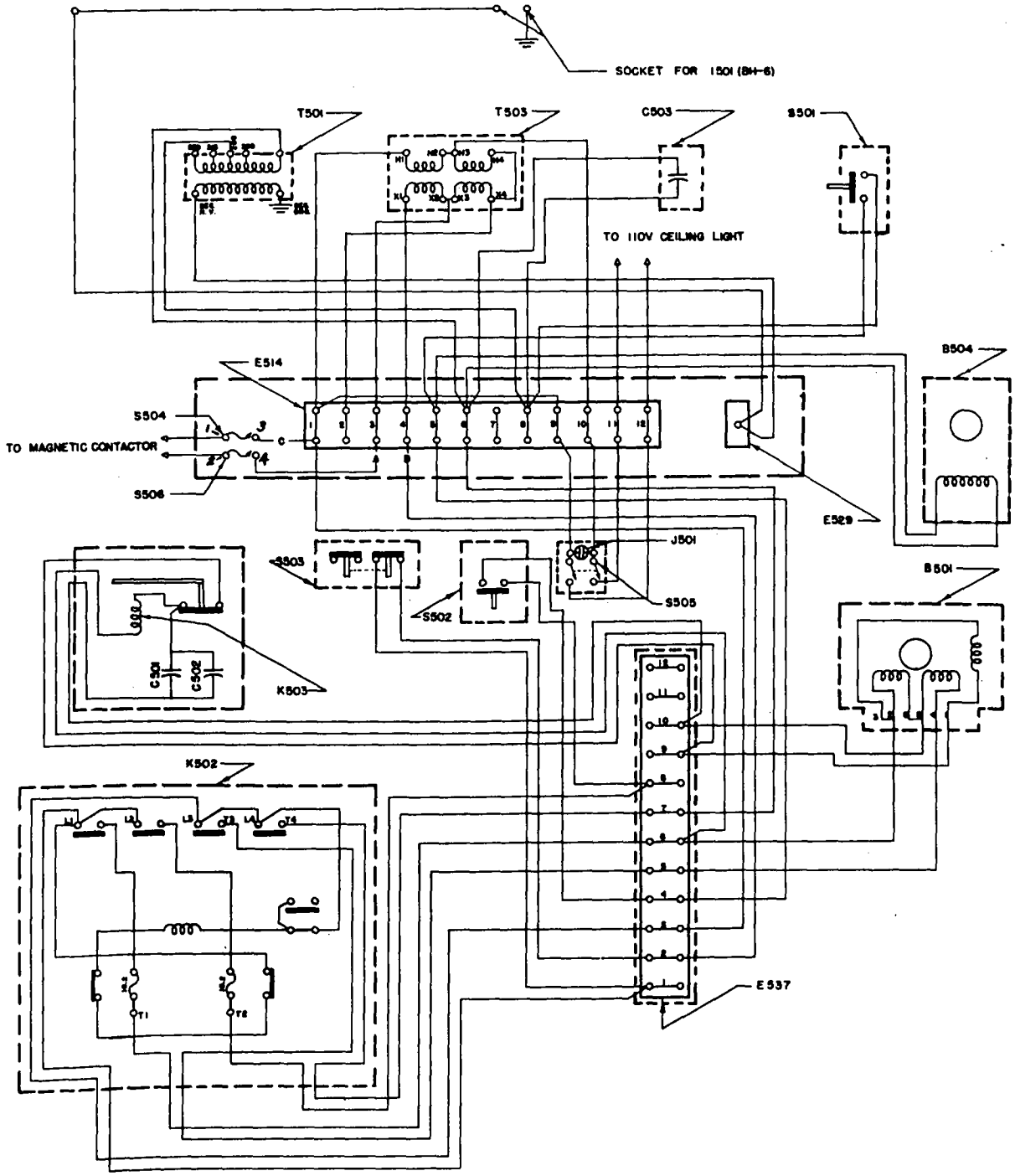

Fig. A1-30. Projector wiring diagram.

owing to the lamp or to pitted or corroded lamp sockets (see Fig. A1-26). If service cannot be resumed, deactivate the ceilometer and notify the regional office. CAUTION: Do not make any measurements in the 900- to 1200-volt portion of the lamp circuit; i.e., from the output side of the lamp-ballast transformer (T501), through terminal E529 to the lamp (see Fig. A1-29 and A1-30).

A1281.7. Ground Lead.—Report to the regional office any indication that the projector cabinet is not effectively connected to the ground by a metal lead firmly anchored in the ground.

A1282. Recorder.—When the recorder trace appears unsatisfactory, although accompanied by satisfactory output meter reactions, test for trouble in the recorder in accordance with the instructions applicable to the indications observed.

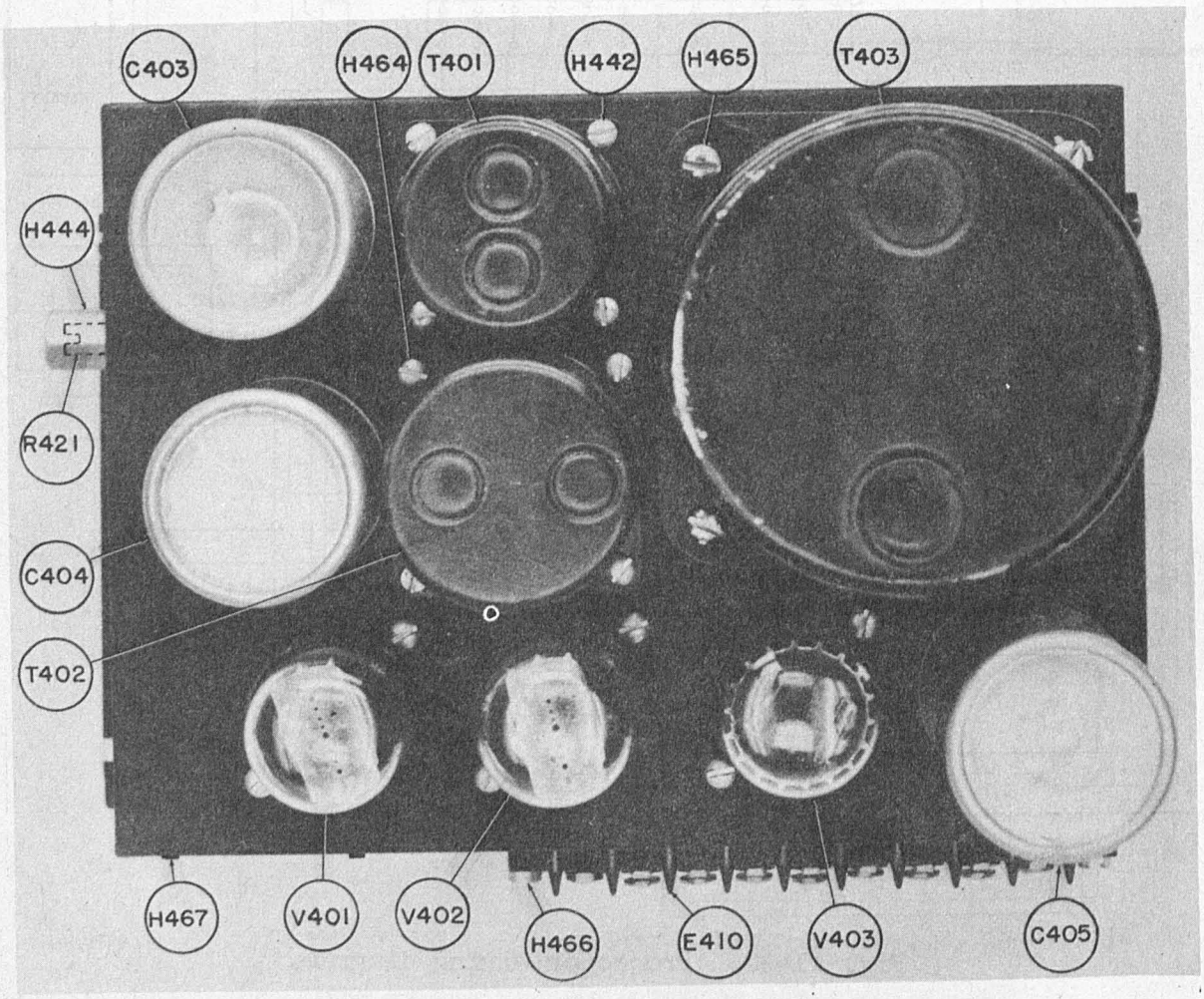

Fig. A1-31. Converter-amplifier of recorder.

A1282.1. Wide Trace.—A uniformly wide trace that occurs when a signal does not reach the detector is evidence of excessive recorder output. If in doubt whether a signal is reaching the detector, cover the scanner. Procede as follows when excessive recorder output is present:

(1) Turn the Recorder Gain control to zero, adjust the meter-selector switch (S409) to the stylus-motor position (see par. A1257.5), and note the output-meter reading for reference purposes.

(2) Substitute spare tubes, one at a time, for tubes V401 and V402 of the recorder amplifier (see Fig. A1-31).

(3) When substitution of tubes does not correct the trouble, adjust the bias to the threshold of oscillation, if possible, as follows:

(a) Remove the cap-nut (H444) covering the bias-adjustment screw (R421) on the left end of the recorder amplifier.

(b) Stop the oscillation of the stylus, if possible, by turning the screw. Adjust for the threshold of oscillation by turning the screw sufficiently to start oscillation, and then reversing the adjustment just sufficiently to stop it. Replace the cap-nut.

(4) If the threshold of oscillation cannot be reached within the range of adjustment provided, readjust to the reference reading obtained in (1), deactivate the recorder, and notify the regional office by mail.

A1282.2. Weak Trace or None.—When the only indication of trouble is a weak trace or none, follow the procedure specified in par. A1282.1, except that in (2) substitute spare tubes for tubes V401, V402, and V403.

A1282.3. Chart Cut by Stylus.—Whenever the stylus cuts a hole in the chart at the 0° end of the chart, loosen the retaining screws (H402 - see Fig. A1-6) and shift the stylus-lifting cam (O426) slightly to the right. If the stylus cuts the chart at other positions, report the condition to the regional office.

A1282.4. Reroll Clutch Tension.—Whenever the chart paper tends to tear on the back side of the marginal holes, the tension on the rewind clutch may be too great; whenever the paper is not held taut across the writing table, the tension may be too slight. Adjust the tension as follows:

(1) Remove the rewind roll (0440 - see Fig. A1-12).

(2) Hold either the knob (A) of the driving-center assembly (0435) or the washer inside the center (B), and turn the other to change the tension. The tension is increased by clockwise rotation of either the knob or washer. The washer is provided with two holes, diametrically opposed, and may be held or rotated with the aid of a sharp pointed object such as a nail or the end of a paper clip.

A1282.5. Lateral Adjustment of Feed Roll.—(See Fig. A1-6.) Place the feed roll in the correct position relative to the chart-drive roller by loosening the knurled locknut (0438) and turning the adjusting nut (0437) relative to the shaft. Clockwise rotation of the nut moves the feed roll to the left. Tighten the locknut to maintain the adjustment. Whenever the chart tends to tear on the left of the marginal holes, move the feed roll to the right, and vice-versa.

A1282.6. Lateral Adjustment of the Chart-Drive Roller.—The normal position of the roller (0432) should provide 27/32 inch between the guide pins on the left end of the roller and the inside edge of the left chart-drive frame. However, when 90° on the chart is persistently out of alignment with 90° on the elevation-angle scale, and the approximate amount and direction of the misalignment is the same from one roll of chart paper to the next, the lateral position of the drive roller should be adjusted. To obtain alignment, loosen the locknuts (H446) and adjust the bearings (0468) sufficiently to align the chart and to reduce end play to a minimum without increasing the effort required to turn the roller. Tighten the locknuts.

A1283. Detector.—"Adjust for balance," as used here, refers to the discriminator balance described in par. A1252.21. When balance cannot be accomplished, but some variation in the output meter reading is obtained through adjustment of the Grid Balance control (R215), control over the discriminator balance is termed "partial." When no variation can be obtained with the Grid Balance control, the condition is termed one of "no control." Indications of malfunctioning and the corresponding corrective maintenance procedure are described below:

(1) Excessive Output.—Excessive output indicates lack of balance in the discriminator. It is evidenced by a continuous, wide recorder trace and excessive steady deflection of the output meters when a reaction would not normally be expected - e.g., sky cloudless or scanner covered. If the discriminator cannot be balanced (see par. A1252.21), check for malfunctioning of the detector. Proceed in accordance with par. A1283.2 if the

control of balance is partial, and with par. A1283.1 if there is no control.

(2) No Output.—This is indicated by the absence of stylus oscillations and deflection of the pointers of the output meters under conditions normally requiring them. Proceed in accordance with par. A1283.1 if there is no control of balance, par. A1283.2 if the control is partial, and par. A1283.3 if the discriminator can be balanced.

(3) Weak Output (discriminator balanced).—This is indicated by lower amplitude of stylus oscillations and lower readings of the output meters than are normal for the existing distribution of aerosols. Proceed in accordance with par. A1283.3.

(4) Excessive Noise (discriminator balanced).—Noise is a term that includes several classes of unwanted reactions. The time of occurrence and the intensity of these reactions is usually random (see Fig. A1-20), in contrast with the phase and frequency relationship between the scanning cycle and the reactions to clouds and other atmospheric phenomena. Noise reactions may be caused by variations in the intensity of extraneous light of the same phase and frequency as the projected beam. It is not likely that noise of this type will materially increase the static-noise-voltages obtained in accordance with par. A1284. High static-noise-voltages are generally indicative of malfunctioning of the detector (see par. A1283.3).

A1283.01. Sequence of Operations in Trouble Correction.—In following the procedures referred to in (1) through (4) of par. A1283, proceed successively from step to step so long as no improvement results from the action taken in the preceding step. When improvement is observed, continue in accordance with the instructions applicable to the remaining indications of trouble. After a condition of no control of balance has been improved to partial control of balance, proceed in accordance with par. A1283.2(B). If balance has been obtained, proceed in accordance with par. A1283.3.

A1283.02. Substitution of Tubes.—In some cases the following instructions require that the discriminator be balanced when a substitution of tubes is made. In these cases, the discriminator will be balanced after each substitution until either improvement results or the supply of spare tubes becomes exhausted.

A1283.03. Preamplifier Servicing.—Whenever testing or other servicing of the preamplifier is required, proceed as follows before removing the cover on the back of the scanner housing in which the preamplifier is located:

(1) Disconnect the connector P103 of cable W3 (2-conductor cable from the battery box to the amplifier chassis) from the socket J103 on the amplifier chassis (see Fig. A1-34). This disconnects the battery.

(2) Discharge condenser C3 (in the preamplifier - see Fig. A1-32) by touching exposed portions of an insulated conductor simultaneously to contact 2 of J103 and to electrical ground (contact 4 of J103, the amplifier chassis, or other point at ground potential) for several seconds. Do not touch an uninsulated portion of the conductor while discharging the condenser. Contact 2 is the second contact in a clockwise direction from the guide slot in the metal shell of the connector. When in doubt as to the identification of the correct contact, connect each of the four contacts to ground until a spark discharge is obtained.

A1283.04. Filament Voltage of V1 Tube.—When the following instructions specify the measurement of the filament voltage of the V1 tube of the preamplifier, remove the back from the preamplifier (see par. A1283.03) and measure the voltage across the filament terminals shown in Fig. A1-32. The position of the filament terminals is the same in the GE preamplifier (not shown).

A1283.1. No Control of Balance.—Trouble in the discriminator (see Fig. A1-33) is indicated when the balance control (R215) has no effect on the readings of the output meters or on the characteristics of the recorder trace. Proceed as follows until improvement is obtained.

(1) Substitute spare tubes for the tube V204, and adjust for balance.

(2) Substitute spare tubes for tube V203, and adjust for balance.

(3) Remove tubes V201 and V202, and adjust for balance. If balance is obtained, replace tubes V201 and V202, and substitute spare tubes, first for one and then for both of the used tubes. Adjust for balance after each substitution.

If no improvement results notify the regional office.

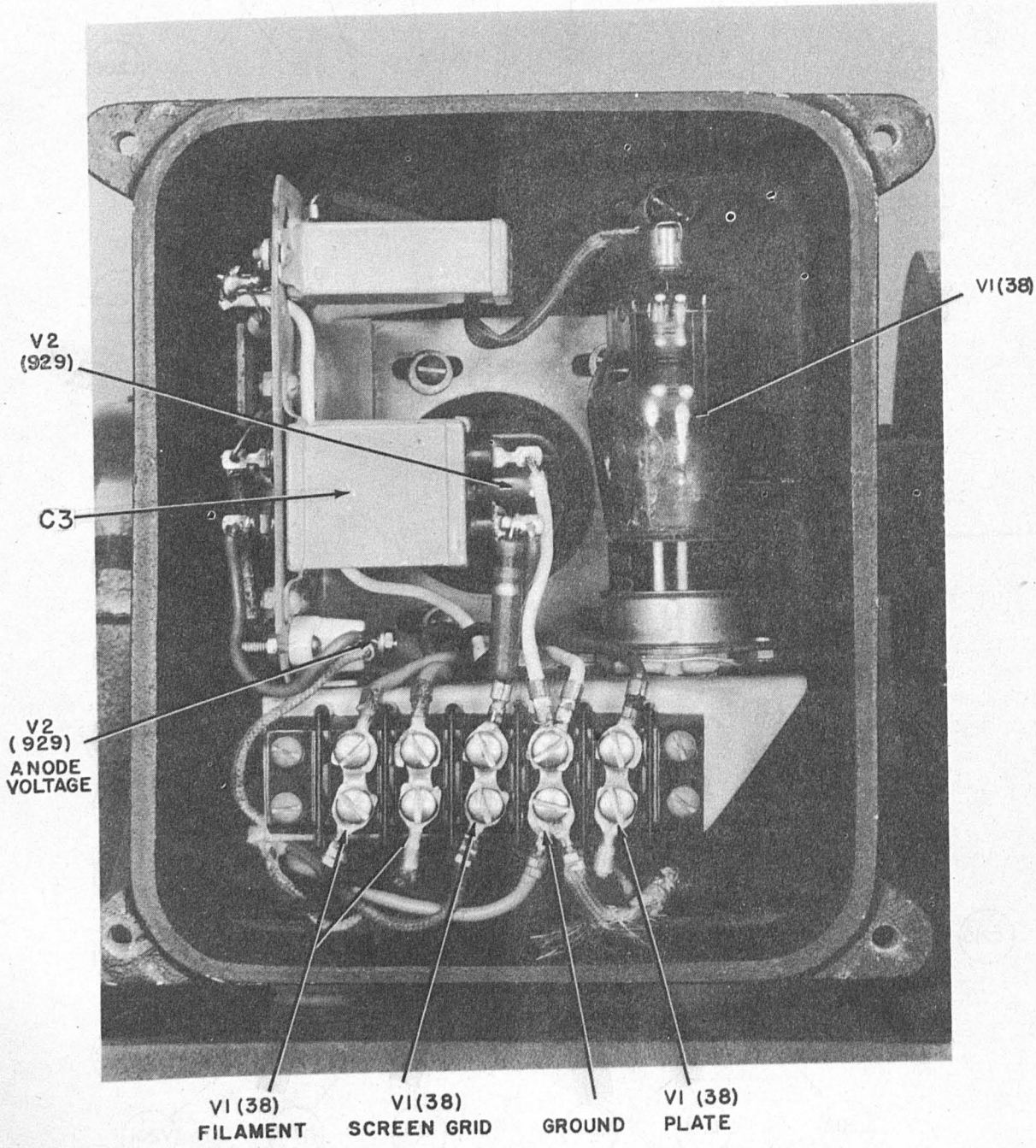

Fig. A1-32. Back of Crouse-Hinds scanner (cover removed) showing preamplifier.

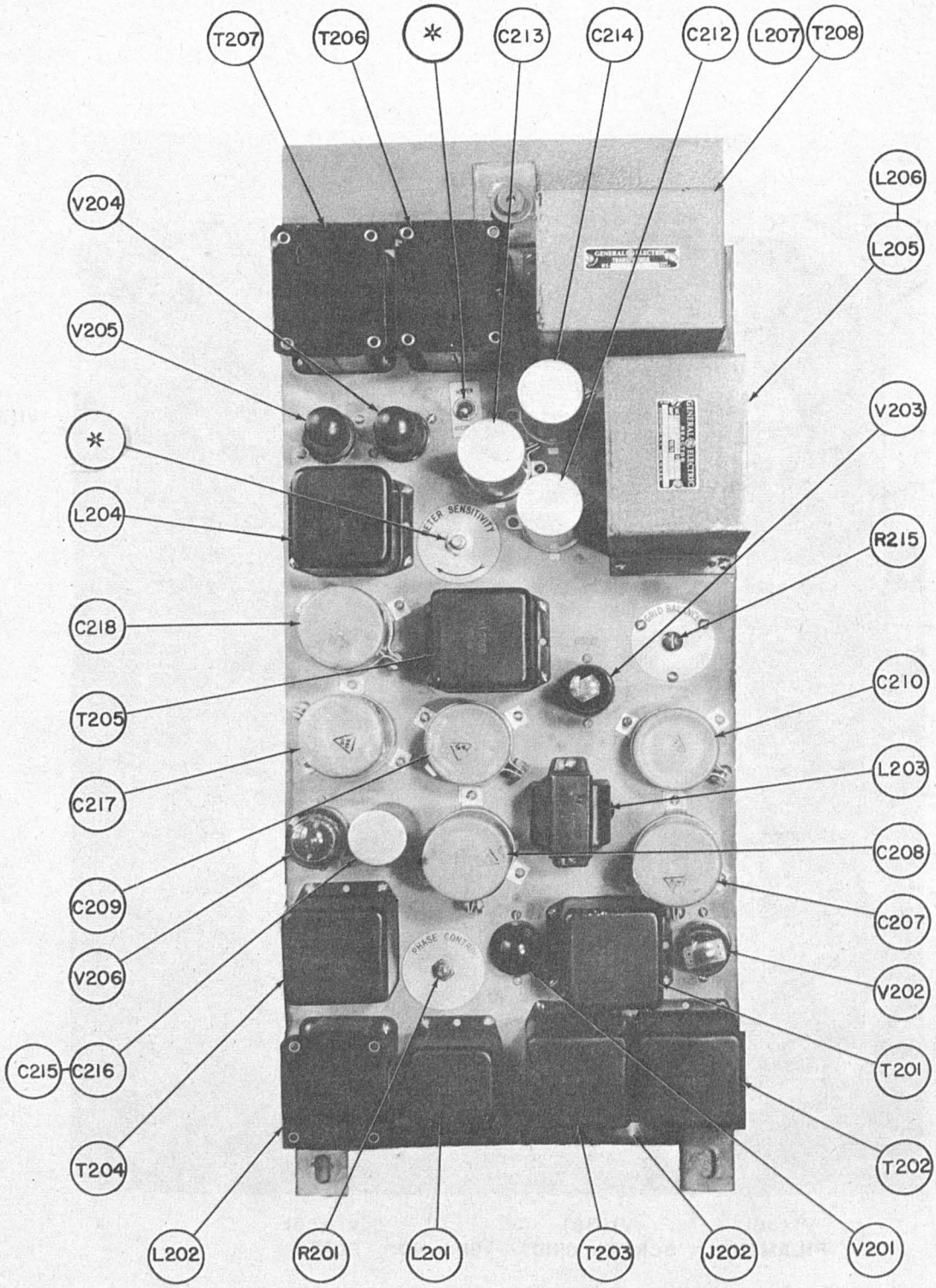

Fig. A1-33. Discriminator (Crouse-Hinds).

A1283.2. Partial Control of Balance.—If the minimum deflection of the pointer of the output meter exceeds the width of the pointer when the discriminator is adjusted for balance, test for trouble in the discriminator (see Fig. A1-33). Remove tubes V201 and V202, adjust for balance, and proceed as follows:

(A) If the deflection of the pointer still exceeds the width of the pointer, substitute spare tubes for tube V203, and adjust for balance (with tubes V201 and V202 removed).

(1) If the pointer deflection is still excessive after all spare tubes of the same type as V203 have been used in the test, notify the regional office that a defective output transformer (T205) is indicated.

(2) If balance is obtained, install tubes V201 and V202, and adjust for balance. When trouble persists, proceed in accordance with par. A1283.3. However, if the deflection of the pointer is still excessive, substitute spare tubes, first for one and then for both of these tubes. If the deflection remains too large after each substitution, notify the regional office.

(B) If the deflection of the pointer is satisfactory after tubes V201 and V202 have been removed, replace these tubes and substitute spare tubes first for one and then for both, and adjust for balance after each substitution. If balance is now obtained but trouble persists, proceed in accordance with par. A1283.3(2). However, if the deflection of the pointer is still too large, notify the regional office.

A1283.3. Discriminator Balanced.—If trouble is present and the discriminator is properly balanced in accordance with par. A1252.21:

(1) Examine the leads to the grid caps of amplifier tubes V101, V102, and V103 (see Fig. A1-34) for short circuits caused by contact of the grid cap or grid lead with the shield or other grounded portion of the chassis. Tape the leads and adjust the position of the caps, if necessary, to eliminate short circuits.

(2) Test the static-noise-sensitivity of the amplifier at a gain setting of 11 in accordance with par. A1284, and proceed in accordance with the applicable instructions in the following subparagraphs depending on whether the test measurements indicate the absence of static-noise-voltage; static-noise-voltage too low, too high or satisfactory.

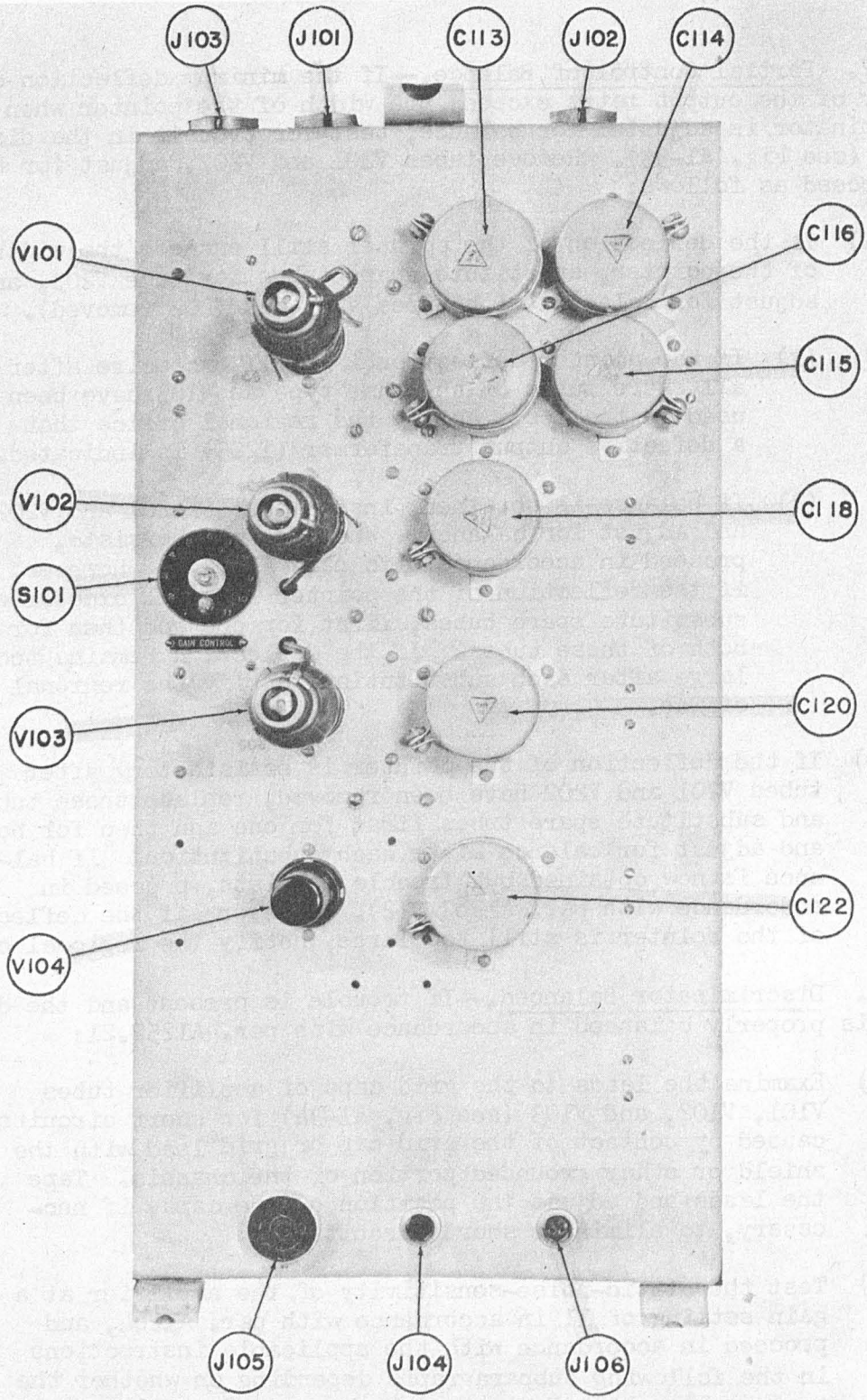

Fig. A1-34. Amplifier (Crouse-Hinds).

(3) Any trouble that cannot be eliminated in accordance with (1) and (2) should be reported to the regional office.

A1283.31. Absence of Static-Noise-Voltage.—When no static-noise-voltage is present at the test jacks J206 (see Fig. A1-35) with the gain control set in position 11, disconnect the connectors P201, P202, and P203 (of cables W101, W102, and W103 respectively) from connectors J201, J202 and J203 of the discriminator chassis.

(1) Test for voltages of the following approximate magnitude:

(a) 140 volts (± 10%), d-c between the contacts of J203.

(b) 140 volts (± 10%), d-c between J201 and electrical ground (e.g., between J201 and the discriminator chassis).

(c) 12 to 15 volts, d-c between contacts two and four of J202.

(d) 5.9 to 6.3 volts, a-c between contacts one and three of J202.

(2) If the specified a-c or d-c voltages are not present at J202, notify the regional office. If the specified voltages are not present at J201 or J203, replace tube V205, and measure the voltages again as in (1,a) and (1,b) after each replacement. If the specified voltage is now present, repeat the noise-sensitivity test. If the noise-voltage is:

(a) less than six volts, see par. A1283.32;

(b) more than eight volts, see par. A1283.33; or

(c) six to eight volts, but trouble persists, see par. A1283.34.

(3) When the voltages in (1) are satisfactory, disconnect the connectors P104, P105, and P106 from connectors J104, J105, and J106 respectively of the amplifier chassis (see Fig. A1-34), and test the continuity of each of the leads of the cables with an ohmmeter. When a cable is defective, request a replacement from the regional office. However, when the trouble persists after a replacement cable is installed or when the continuity is found to be satisfactory, substitute successively spare tubes for each of the amplifier tubes (see Fig. A1-34). If the noise-voltage is then:

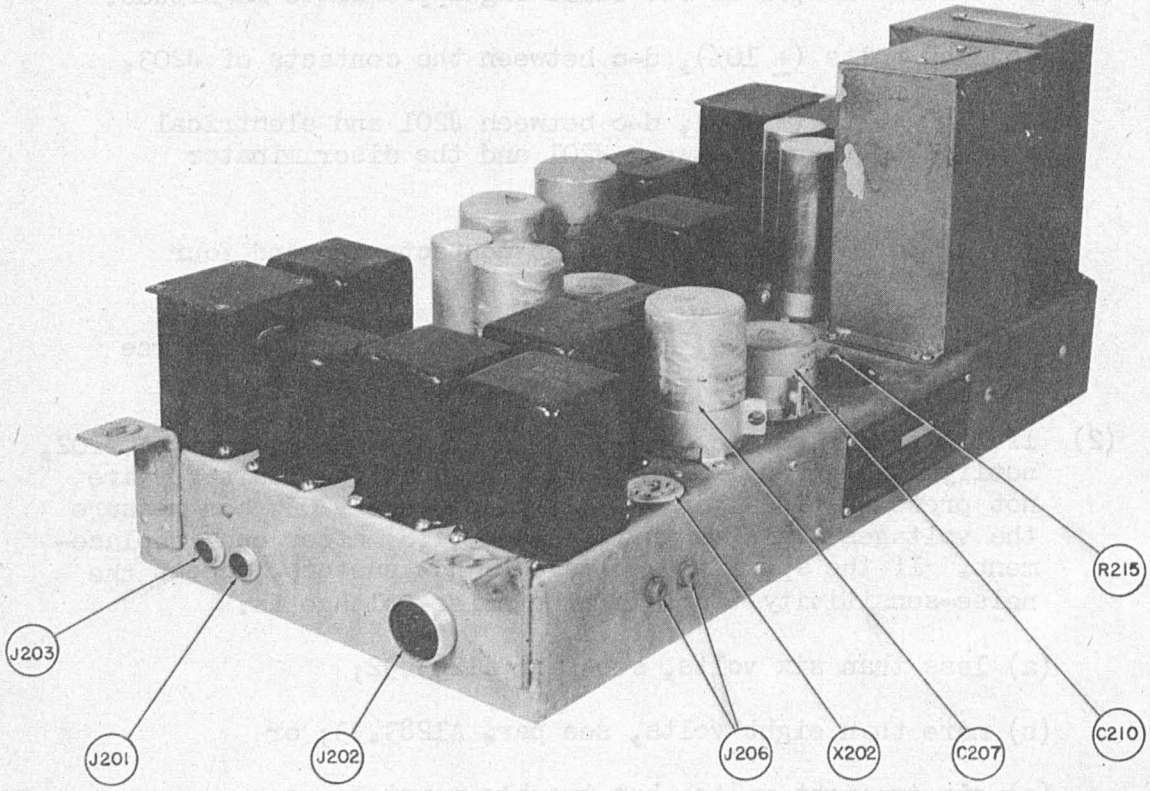

Fig. A1-35. Discriminator (Crouse-Hinds).

(a) below six volts, see par. A1283.32;

(b) above eight volts, see par. A1283.33; or

(c) six to eight volts, but trouble persists, see par. A1283.34.

If there is still no noise-voltage, notify the regional office.

A1283.32. Static-Noise-Voltage Too Low.—When the noise-voltage, measured at test jacks J205 (see Fig. A1-35) is less than six volts at gain position 11, proceed as follows:

(1) Measure the filament voltage across the V1 tube (see par. A1283.04 and A1283.03). The voltage should be between 5.9 and 6.3 volts; if it is not, notify the regional office.

(2) If the filament voltage is between 5.9 and 6.3 volts, substitute spare tubes for tube V1, and the amplifier tubes V101, V102, V103, and V104, successively. Measure the noise-voltage after each substitution. If the noise-voltage becomes satisfactory but trouble persists, proceed in accordance with par. A1283.34. However, if the noise-voltage becomes more than eight volts, proceed in accordance with par. A1283.33. When the noise-voltage remains less than six volts, disconnect cables W1 and W2 from the amplifier at chassis connectors J101 and J102 (see Fig. A1-34). Test for continuity of the leads of cables W1 and W2 with an ohmmeter after removing the back from the preamplifier (see par. A1283.03 and A1283.04). When the cable is found to be defective, request a replacement cable from the regional office. Notify the regional office when the trouble is not in the cable.

A1283.33. Static-Noise-Voltage Too High.—When the noise-voltage at jacks J206 (see Fig. A1-35) is above eight volts at gain control position 11, disconnect the preamplifier output from the amplifier by removing P102 from J102.

(1) A drop in the noise-voltage to 0 to 1 volt indicates that the preamplifier is probably defective. Reconnect P102 to J102, and remove P103 from J103 which disconnects battery E1 from photocell V2. The following tests are conducted with condenser C3 fully charged. Reconnect the battery momentarily to recharge the condenser.

(a) When the noise-voltage drops to six to eight volts

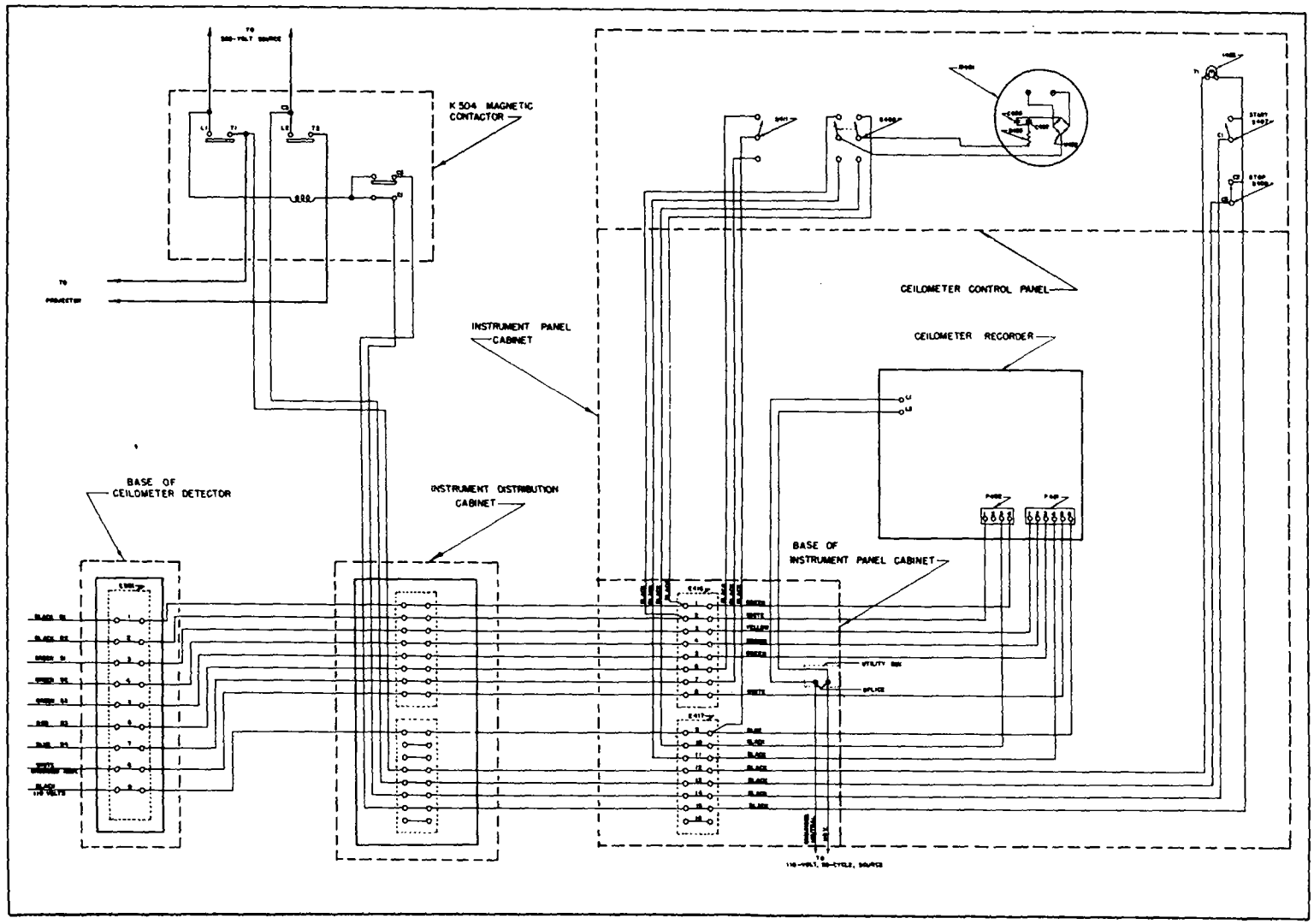

Fig. A1-36. Wiring diagram, showing wiring between the detector, magnetic contactor, control panel and recorder.

after the battery is disconnected, reconnect the battery and continue use of the ceilometer, but notify the regional office.

(b) If the noise-voltage is still above eight volts, discharge the condenser C3 (see par. A1283.03). A noise-voltage now of six to eight volts indicates trouble in the photocell (V2) or its circuit. Replace the V2 tube, reconnect P103 and, if the noise-voltage is still six to eight volts, proceed in accordance with par. A1283.34; otherwise, notify the regional office. If there was no improvement in the noise-voltage after discharging condenser C3, trouble in the V1 tube or its circuit is indicated. In this case, reconnect P103 to J103 and replace the V1 tube with spare tubes. Check the noise-voltage after each replacement. If no improvement results from the use of any of the spare tubes, notify the regional office.

(2) If the noise-voltage is greater than one volt after disconnecting the preamplifier, substitute spare tubes for amplifier tubes, V101, V102, V103, and V104, successively. Close the amplifier-compartment door, measure the noise-voltage after each replacement. If the noise-voltage is now 0 to 1 volt, proceed in accordance with par. A1283.34. If the noise-voltage is still more than 1 volt, notify the regional office.

A1283.34. Static-Noise-Voltage Satisfactory.—When trouble persists although the static-noise-voltage at jacks J206 (see Fig. A1-35) is six to eight volts at gain position 11, with scanner stationary, reduce the gain to seven, uncover the scanner, and determine whether the test-meter readings are satisfactory in accordance with par. A1284(5). If they are not, substitute spare tubes for the photocell (V2) and, if there is no improvement, notify the regional office. When satisfactory readings are obtained, turn on the Motor switch and determine whether the test-meter readings are still satisfactory with the scanner in motion (see par. A1284.1). If they are not, proceed as follows:

(1) Substitute spare tubes for tube V1, and make test-meter readings with the scanner in motion after each substitution.

(2) If there is no improvement, substitute spare tubes for the photocell tube (V2), and test the phototube sensitivity (see par. A1284(4, 5)) with the scanner in motion after each substitution.

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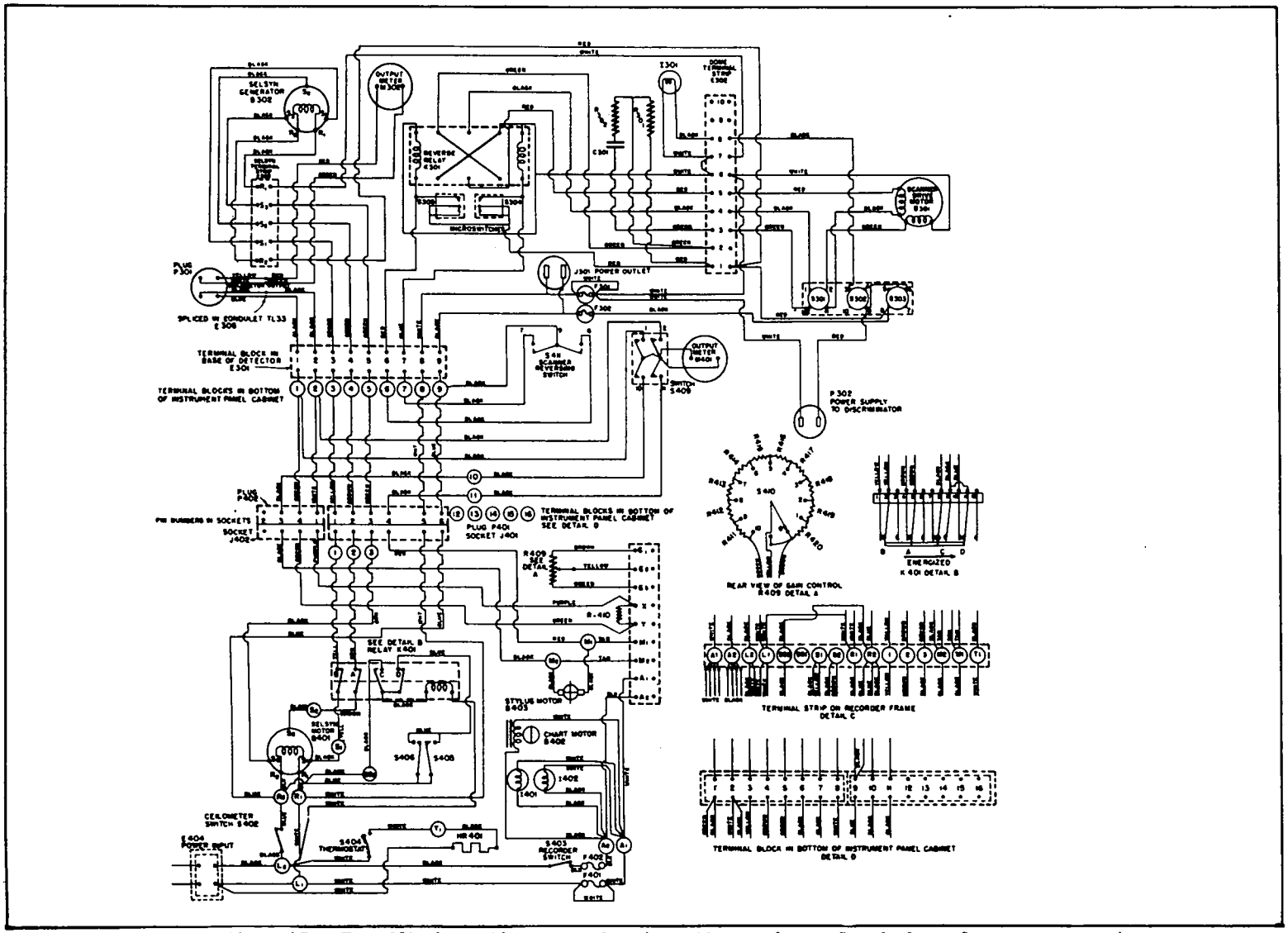

Fig. A1-37. Wiring diagram showing the external wiring for components of detector and recorder.

(3) If the phototube sensitivity and output-meter-readings are now satisfactory, report the circumstances on the monthly maintenance report; otherwise, notify the regional office that driving noise is indicated.

A1284. Static-Noise and Photocell-Sensitivity Checks.—Proceed as follows to test the sensitivity of the amplifier, preamplifier and photocell:

(1) Cover the scanner and elevate it to approximately 85°.

(2) Adjust the controls as for stand-by status, but turn off the Motor switch and adjust the amplifier gain control to position 11.

(3) Select the 0 to 60 volt a-c scale of the volt-ohmmeter, and insert the test leads in the phone tip jacks (J206) located on the chassis of the discriminator (see Fig. A1-35). The reading of the test meter (the static-noise-voltage) should be six to eight volts at the gain setting of 11.

(4) Lower the gain to position seven. The noise-voltage should decrease to 0 to 1 volt.

(5) With the gain setting still at position seven, uncover the scanner. The test-meter reading should indicate four to six volts on a clear day of average brightness. On an unusually bright day the readings may be higher, and on a cloudy, darker day the readings may be less. However, the readings should always lie between three and fifteen volts.

(6) If any of the test-meter readings are unsatisfactory, see par. A1283.3(3 and 4).

A1300. CEILING-LIGHT PROJECTORS

A1310. General.—A ceiling-light projector consists of a light source mounted at the focus of a parabolic reflector. The light is adjusted and aligned to project a vertical beam of light approximately three degrees in width.

A1311. The following instructions applicable to K100 (see Figs. A1-38 and A1-39) and K100B projectors are also generally applicable to older style projectors. The effectiveness of the lamp in the K100 and K100B projectors is increased by the use of a small reflector (A) mounted just

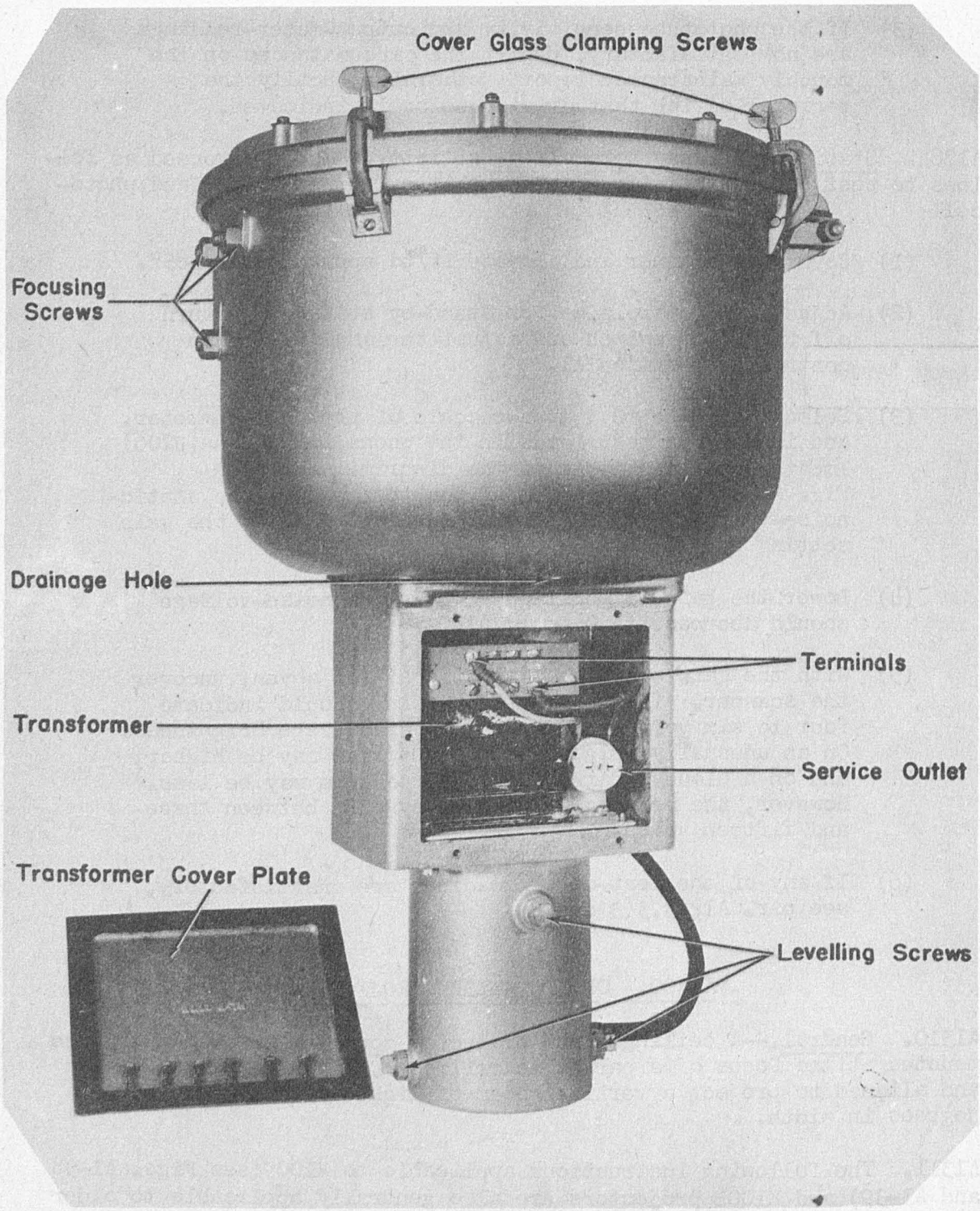

Fig. A1-38. Ceiling-light projector, K100.

above the lamp so that it increases the concentration of the light at the focal point of the parabolic reflector (B). A step-down transformer, mounted either in the lower portion of the reflector housing or housed separately below the light, provides the necessary line-voltage reduction for 11.8 volt lights (12-volt nominal voltage). A hinged glass cover (C) provides access to the lamp and reflector. Ventilation and drainage holes, about one-half inch in diameter and fitted with wire screens, are usually provided in the bottom of the housing. Setscrews in an adapter below the transformer are used to fasten the projector to a rigidly-mounted, vertical, four-inch pipe. The pipe support is usually set in a concrete base. The light is controlled by a switch in the power-supply cable. The switch should be located conveniently near the office or point of observation; preferably the latter where the observer may turn it off and on during an observation to facilitate identification of indistinct light spots. A pilot light is usually installed at the switch to indicate whether the light is on or off. Do not leave the lamp on longer than is necessary to take an observation. This precaution is particularly important at stations having projectors that use 1000 watt, 105-120 volt lamps.

A1320. Location.—At first-order stations, determine the length, orientation, and location of the baseline on the basis of the following considerations. At second-order stations, including SAWRS, the field aide or regional office representative responsible for the installation will make the determination on the same basis. The length and location of the baseline between the projector and the observation point should be selected after (1) considering the effect of obstructions along the possible baseline sites, (2) investigating the difficulty of laying the necessary cable and servicing the installation, (3) determining that the effects of background lighting are tolerable and (4) deciding upon the length of the baseline that will provide the greatest accuracy for the measurement of clouds at levels of most concern to the station. Ceiling lights located northward of the observation point reduce interference from moonlight. At stations with ILS runways, the projector should be located in the general direction of that runway if practicable. At other airport stations, it should be located in the general direction of the most frequently used runway. Baselines are normally limited to 500 to 1500 feet, with the optimum length 700 to 800 feet. The shorter baselines provide for relatively greater accuracy in the measurement of low clouds, with an attendant decrease in the accuracy of measurement of high clouds.

A1330. Maintenance of K100- and K100B-Type Projectors.—Once a week, and more frequently if necessary to insure full beam intensity, clean the cover glass on the projector housing and the reflecting surface of the reflectors. Inspect the drainage holes in the mirror and housing, and clean them as frequently as is necessary to insure adequate drainage and ventilation of the enclosure. When bright sunlight is shining into

the projector, the intensity of heat and light concentrated in the area above the parabolic reflector, especially near its focal point, may be sufficient to burn the skin or seriously injure the eyes. Dark glasses must always be worn when looking directly into the reflector or at the the lighted filament of the lamp. Liquid glass-cleaner and other non-abrasive cleaners (e.g. Bon-Ami), used with soft, clean cloths are recommended for cleaning the cover glass and reflectors. Avoid scratching or otherwise damaging the reflectors. Repair or replace the cover-glass gasket (E), if water is leaking into the housing.

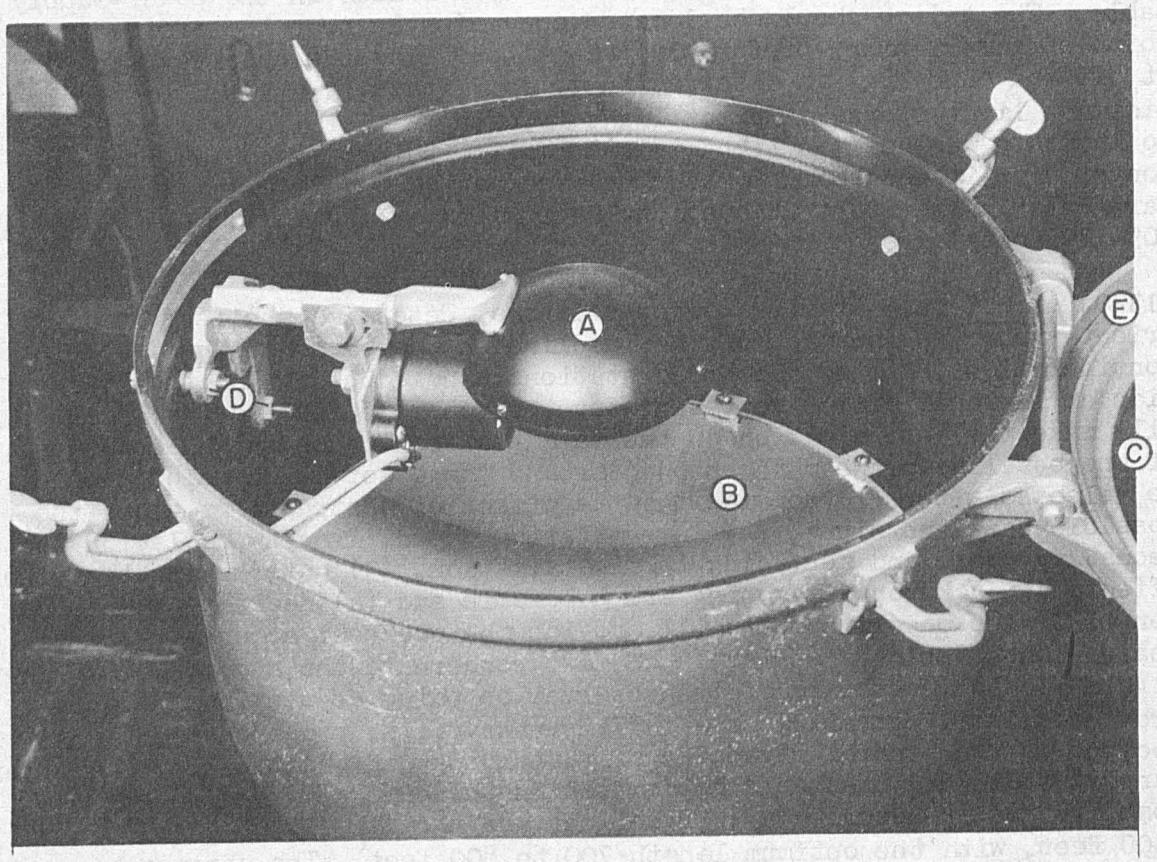

Fig. A1-39. Ceiling-light projector, K100, showing (A) secondary reflector, (B) parabolic reflector, (C) cover glass, (D) two of the three focusing screws, and (E) the gasket in the cover.

A1331. Lamps.--Replace defective lamps promptly with the type appropriate to the projector in use. Characteristics of the lamps most generally used are listed in Table A1-4.

TABLE A1-4. Ceiling-Light Lamps

Lamp Type	Lamp Voltage (Nominal)	Watts	Base	Projector Identification
G-25	12	420	Mogul Prefocus	Crouse-Hinds or Westinghouse, serial numbers 481 and above
G-30	105, 110, 115, or 120	250	Mogul Screw	
G-40	105, 110, 115, or 120	500 or 1000	Mogul Screw	
T-20	105, 110, 115, or 120	1000	Mogul Screw	

The efficiency of a ceiling light is reduced when:

(1) The lamp has begun to blacken.

(2) The operating voltage across an 11.8-volt lamp is less than 11.3 volts.

(3) The filament of the lamp sags to a noticeable extent.

(4) The lamp is out of focus, or the reflectors are in poor condition.

Whenever the intensity of the spot from a new lamp appears to be subnormal for existing conditions, try another new lamp and, if the condition persists, report the circumstances to the regional office. Voltage fluctuations may cause variations in intensity. Whenever these variations noticeably affect the efficiency of the light, the circumstances, including the times and frequency of the variations should be reported. Replace the lamp when it begins to blacken noticeably. The removal of mogul, screw-base type lamps may be facilitated by the application of a little powdered graphite to the threads before installing the lamp. The leverage afforded by the size and shape of the bulbs makes it easy to break the seal between the glass and the metal base if much force is used to turn it in the socket.

A1331.1. Lamp Focus.—The efficiency of the lamp is greatly reduced when the lamp filament is not correctly located at the focus of the parabolic reflector. Slight misadjustment may reduce the intensity of the spot as much as 50%. The best focus is realized when the spot on a well-defined cloud layer is the smallest (most intense) obtainable. This is the

equivalent of the narrowest beam width possible (approximately three degrees). The concentration of aerosols present at most stations is usually sufficient to indicate the pattern of light in the beam and whether multiple crossing rays (evidence of improper focus) are present. The installation of a replacement G-25, 12-volt, prefocus-base lamp is not likely to necessitate a change in the focus adjustment of projectors using this lamp. Check the focus at least once a year and whenever the width and intensity of the beam appear unsatisfactory. When adjusting the focus of the light as specified in the following subparagraphs, avoid stretching taut the power supply leads to the lamp.

A1331.11. A few housings have two peep holes 90 degrees apart, in the side of the housing at the level of the lamp filament. Opposite each of the holes on the inside of the housing is a reference mark, either a (+) symbol or a punch mark, which provides a line of sight through the focal point of the reflector. With the aid of adjusting screws, which secure the lamp support to the housing, align the lamp filament so that it rests in the line of sight between each peep hole and its opposite reference mark on the housing. When the filament is at the intersection of the two lines of sight, it is located at the focal point of the reflector. The lamp socket in projectors using G-30 or G-40 type of lamps should be rotated slightly, if necessary, to align the lamp so that the portion of the circle left incomplete by the almost circular filament is turned away from the parabolic reflector.

A1331.12. Whenever the pattern of the projected beam indicates that the lamp is out of focus, notify the regional office. At first-order stations adjust the focus, if possible, and notify the regional office whether appreciable improvement has been obtained. To adjust the focus of K100-style projectors (see Fig. A1-38), adjust the position of the lamp and secondary reflector assembly relative to the parabolic reflector until the spot projected on a low, well-defined cloud base is as small as possible. Some K100 projectors are provided with a cap screw (not used in later models of the type illustrated) in addition to the three focusing screws (D). After adjusting for focus tighten the cap screw only enough to hold the lamp and reflector assembly securely without the aid of the springs on the focusing studs.

A1332. Beam Alignment.—Check the verticality of the beam once a year and more frequently if observations indicate that the beam may not be vertical. Whenever required at first-order stations, align the beam as accurately as possible and report the adjustment to the regional office. Other stations should report evidence of misalignment to the regional office.

A1332.1. When aligning projectors provided with two leveling perches, such as K100 lights, use a spirit level and adjust the four leveling screws (C) until both perches are level (the perches are on the two sides

of the transformer housing not visible in Fig. A1-38). Never adjust the position of the leveling perches on the housing.

A1332.2. When aligning projectors not provided with leveling perches, such as the K100B, adjust the housing after carefully placing a straight-edged support diametrically across the outer edge of the parabolic reflector. Level the projector until a spirit level on the support is horizontal for two positions of the support 90 degrees apart horizontally.

A1332.3. Check the alignment of the beam after leveling the housing by comparing the verticality of the beam with the line of a plumb bob suspended freely approximately three feet from the observer. The verticality is satisfactory provided the beam is parallel to the line of the plumb bob when viewed from two positions 45 to 135 degrees apart horizontally and at a distance of 200 feet or more from the beam.

A1333. Transformers.—The step-down transformer used with 12-volt projectors is provided with terminals either numbered from one to eight or labeled in terms of line-voltage - i.e., 90, 95, etc., to 120 (see Fig. A1-38).

A1333.1. In the case of transformers in which the terminals are numbered from one to eight, the 12-volt leads to the lamp socket are attached to terminals two and three. One power-supply lead will be attached to terminal one, and the other will be attached to one of the remaining numbered terminals (terminals four to eight) that provide 11.3 to 11.8 but preferably 11.8 volts across the lamp socket when the lamp is in operation.

A1333.2. In the case of transformers in which the terminals are labeled in terms of the line voltage, one power-supply lead will be attached to the upper left terminal and the other will be attached to one of the labeled terminals that will provide 11.3 to 11.8, but preferably 11.8 volts, across the lamp socket when the lamp is in operation. The lamp-socket leads from the transformer are already attached to the socket and will not be disturbed. Operating voltages in excess of 11.8 volts materially reduce the life of the lamp. Lower voltages reduce the intensity of the spot. When the proper lamp voltage cannot be maintained, report the circumstances to the regional office.

A1334. Painting.—Personnel at first-order stations should keep the pipe supporting the light adequately painted. Rust spots should be sanded free of rust and painted with red lead or other metal primer followed by a top coat of aluminum paint.

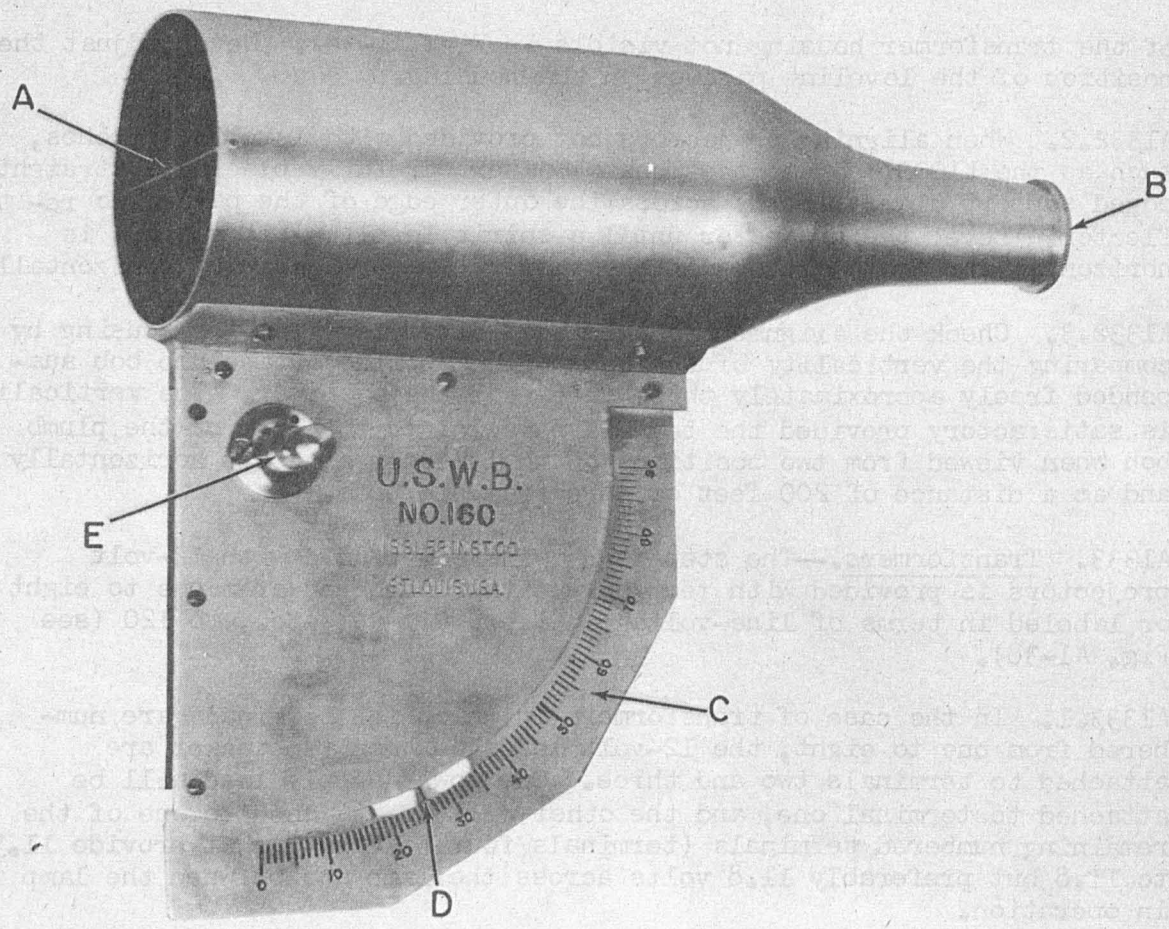

Fig. A1-40. Clinometer, K110, showing (A) cross hairs, (B) eyepiece, (C) elevation-angle scale, (D) index and (E) clutch and locknut for the index.

A1400. CLINOMETERS (FIG. A1-40)

A1410. General.—The clinometer consists of a hollow tube fitted with cross hairs (A) mounted in the large end, and an eyepiece (B) in the small end. An elevation-angle scale (C), calibrated in whole degrees from 0 to 90, is attached to the outside of the tube. The pendant-like indicator may be locked at any angle by means of a friction clutch on the shaft of the indicator. The index line (D) on the indicator matches the zero on the scale when the line of sight of the tube is horizontal, and matches the 90 on the scale when the line of sight is vertical. A box is provided for storage of the clinometer when it is not in use. The box should be mounted or placed in a dry protected inside location, as

convenient as possible to the observation point.

A1420. Operation.—Unlock the friction clutch by unscrewing the knurled locknut (E) on the indicator. Make sure that the indicator responds freely to slight changes in the elevation of the line of sight through the clinometer before determining the cloud height (see par. 1441).

A1430. Maintenance.—The clinometer should be protected adequately to prevent denting of the tube or scale mechanism, or dislocation of the cross hairs or eyepiece. Whenever the operation is faulty and the trouble cannot be corrected, requisition a new clinometer. Once a month:

(1) Inspect the scale graduations for legibility - clean the scale if necessary.

(2) Test the action of the clutch and indicator. When unlocked, the indicator should respond freely to elevation-angle changes of one or two degrees. If not, check for evidence of friction between the scale and the indicator, or in the clutch and bearings. One drop of light oil (SAE 10 or anemometer oil) on the bearings may improve the indicator action if neither the scale nor the indicator is dented or otherwise damaged. When the clutch is locked, ordinary vibration or light shocks should not disturb the index setting.

(3) Determine whether the alignment and condition of the cross hairs are satisfactory.

A1500. CEILING BALLOONS

A1510. Storage.—Storage at office temperatures will be satisfactory for cases of neoprene or natural latex balloons. Natural latex balloons should be stored away from cold walls and radiators, and neoprene balloons away from large electric motors or generators.

A1520. Inflation.—The nozzle used to inflate balloons weighs 45 grams. It is usually identified by the letters "HE" stamped on the nozzle. If it is not, stamp or scratch the letters on it.

A1521. Before inflating the balloon, remove any trapped air from it and stretch the neck sufficiently to insert the inflation nozzle. Inflate the balloon slowly. Turn off the gas (see pars. A1522 and A1523) as soon as the balloon begins to lift the nozzle. Add or remove gas slowly from the balloon as necessary. The balloon is properly inflated when

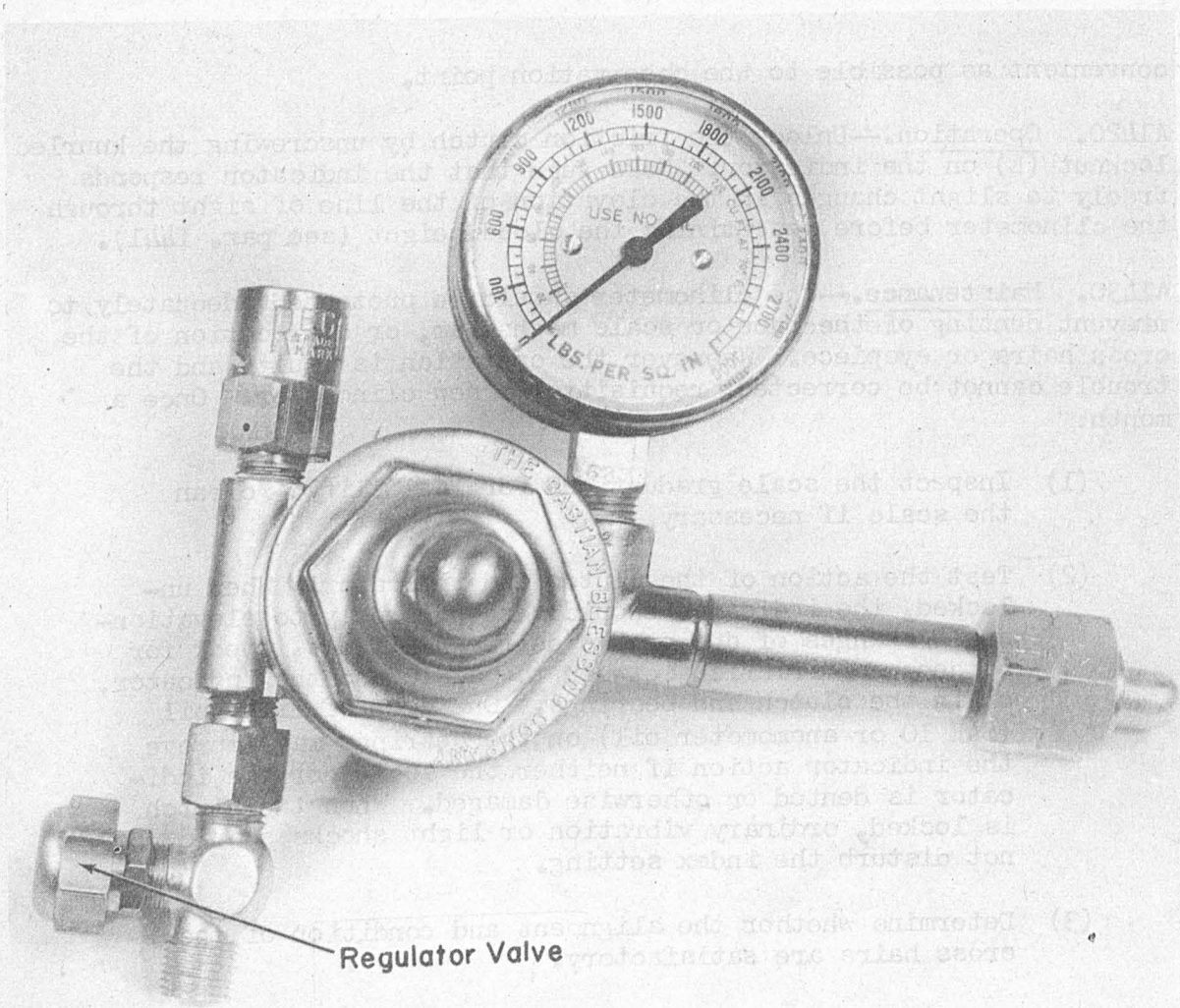

Fig. A1-41. Single-stage helium regulator, J410.

the nozzle is just lifted from the inflation platform after any motion of the balloon has stopped, i.e., 1/4 inch or less above the platform. Check for leaks in the balloon. Tie the neck of the balloon securely just above the nozzle and remove it from the nozzle. Double the end of the neck over the tied portion and tie the doubled portion or secure it with a rubber band. If the balloon is made of natural rubber, it may be twisted several times, removed from the nozzle and secured with rubber bands.

A1522. When a dual-gage type of regulator is used for balloon inflation, ascertain that the diaphram valve of the regulator is closed (counter-clockwise rotation of the control) sufficiently to prevent the escape of gas when the valve on the cylinder is opened. After the cylinder valve is opened fully, slowly open the regulator valve (clockwise) to an inflation pressure of five pounds or less on the low-pressure gage. The high-pressure gage indicates the cylinder pressure, which serves as an approximate indication of the amount of helium in the cylinder. When the balloon is inflated, close the regulator and cylinder valves completely. After the balloon has been removed from the nozzle, open the regulator valve until the pressure drops to zero, and check for escaping gas. If the cylinder valve is not leaking, close the regulator valve.

A1523. If a single-stage, helium regulator is used (see Fig. A1-41), ascertain that the regulator valve (A) is closed, open the valve on the cylinder completely, and open the regulator valve sufficiently to inflate the balloon slowly. When the balloon is inflated, close the regulator and cylinder valves. After the balloon has been removed from the nozzle, open the regulator valve and check for escaping gas. If the cylinder valve is not leaking, close the regulator valve.

A1600. ENTRY ON WBAN-10

A1621. Total Sky Cover (Col. 21 or 13).—At first-order observing stations where less than twenty-four record observations are taken daily, enter, in column 21, the value of total sky cover observed between sunrise and sunset at thirty minutes past the hours that personnel are on duty. Enter estimated total sky cover in parentheses for daylight hours that personnel are not on duty. Second-order observing stations that do not prepare WBAN-10B will enter total sky cover in column 13 adjacent to column 14A (see par. A11001.2).

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CHAPTER A2 - VISIBILITY*

A2011. Control-Tower Visibility Observations.—When Weather Bureau personnel cannot be assigned to the control tower, visibility observations at the control-tower level will be taken by CAA control-tower personnel. Weather station personnel (WB or CAA) will notify the control tower when to start or stop taking observations.

A2011.1. The minimum data to be recorded by control-tower personnel follows:

(1) Date and time of observation.

(2) Prevailing visibility.

(3) Remarks (such as visibility in different quadrants).

(4) Observer's initials.

When visual recording communication facilities, such as teletype or TelAutograph, are in use between the control tower and the weather station office, the transmitted copy will serve as the tower record. Otherwise, personnel at the tower will record the transmitted data on WBAN-10A, or on another tabulation sheet, and give it to the weather station observer at the close of each day. The record may be destroyed after 90 days.

A2011.2. The control-tower observation may be used for aircraft operations immediately after it is taken; however, it should be recorded and transmitted to the weather station office as promptly as possible.

A2400. ENTRY ON WBAN-10

A2410. Visibility (Col. 4).—The visibility will be observed and recorded at 30 minutes past the hour only at first-order observing stations 1) where less than 24 record observations are taken daily and 2) whenever an observer is on duty during periods when record observations are not taken.

*The paragraph numbers in this chapter correspond to related paragraphs, similarly numbered, in the WBAN portion.

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CHAPTER A3. ATMOSPHERIC PHENOMENA

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CHAPTER A3 - ATMOSPHERIC PHENOMENA*

A3510. Ice-Accretion Indicators.—Ice-accretion indicators are furnished selected stations only. The indicator consists of a strip of aluminum held in alignment by spring clips mounted on a wooden bracket. Several strips should be available for use with each bracket. Any location that will insure exposure of the indicator to precipitation, under any condition of wind speed and direction, will be satisfactory. The bracket should be so mounted that the exposed strip will be held in a vertical plane with the longer sides horizontal.

A3511. The strips will be stored in the shelter and protected from blowing rain to insure that when they are exposed they will be dry and that their temperature will be close to the temperature of the ambient air. One strip of the ice-accretion indicator will be exposed whenever freezing precipitation is expected.

A3512. When freezing precipitation is occurring, a strip free of ice will be exposed ten or fifteen minutes before taking an observation. It is essential that this interval of exposure be just prior to the observation to avoid the possibility of reporting freezing precipitation as occurring at the time of observation when, actually, ice on the indicator might have formed some time earlier.

A3900. ENTRY ON WBAN-10

A3910. Weather and Obstructions to Vision (Col. 5).—Weather and obstructions to vision will be observed and recorded at 30 minutes past the hour only at first-order observing stations 1) where less than 24 record observations are taken daily and 2) whenever an observer is on duty during periods when record observations are not taken.

A3934.2. Tornado (Col. 90).—Enter an accurate description of all meteorological elements accompanying the tornado. If space is insufficient in column 90, use a sheet of plain paper and attach it to WBAN-10B. Information on the following points is desirable:

(1) A map showing date, hour of occurrence, and path of the tornado.

(2) Appearance of clouds.

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*The paragraph numbers in this chapter correspond to related paragraphs, similarly numbered, in the WBAN portion.

(3) Character and amount of precipitation.

(4) Description of funnel, of the appearance of clouds above it, and of the distribution of debris.

(5) Number of persons killed and injured.

(6) Rate of movement.

(7) Estimated crop loss and property damage.

A3934.4. Aurora and Other Optical Phenomena (Col. 90).--Enter notes concerning various optical phenomena, such as auroras, halos (solar and lunar), rainbows, and mirages. Auroral displays should be carefully described, giving the time of beginning and ending, and the altitude and azimuth of each extremity and of the crown of any arch of light that may be formed. Azimuths should be recorded with North as zero. When an aurora extends past midnight, entry will be made for both dates. (Aurora should not be reported in aviation weather observations.)

A3934.6. Miscellaneous Phenomena (Col. 90).—At stations on the Great Lakes, enter the dates of opening and closing of navigation and of the season of wind warnings. In addition, enter available data on seiches (especially any pronounced or damaging sudden changes or fluctuations in the lake level and any periods of several hours of unusually high or low water). At stations on navigable rivers, enter the dates of the opening and closing of the navigation season. At all stations, enter notes on receipt of flood or storm warnings and advisories, and severity of damage done by floods or storms; and enter notes of unusual meteorological conditions, such as obstructions to vision at a distance, or wind shifts not entered on columns 9-11. Enter additional weather information not provided by the recording instruments and scheduled observations. Attach newspaper clippings of weather conditions of exceptional general or local interest. When space in column 90 is insufficient, entries will be continued on an additional sheet attached to it.

A3934.61. Frost.—Whenever a deposit of frost occurs on surface objects, record frost and designate the intensity (see par. 3506).

A3934.62. Freeze.—Record freeze whenever light, killing or hard freeze occurs; state the kind of vegetation injured or killed; degree of maturity at time of the freeze; estimated percentage of loss; and any other pertinent data.

A3934.63. Rime.—Record either soft rime or hard rime whenever it occurs.

CHAPTER A4. MEASUREMENT OF PRECIPITATION

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CHAPTER A4 - MEASUREMENT OF PRECIPITATION

A4100. D100, NON-RECORDING GAGE (EIGHT-INCH STANDARD) FIG. A4-1

A4110. General.--This gage consists of three parts: a receiver assembly, a measuring tube, and an overflow container. The receiver assembly consists of a circular (eight-inch inside diameter) collector ring and funnel. The inside cross-section area of the collector ring is ten times that of the measuring tube. The measuring stick used with this tube has a scale

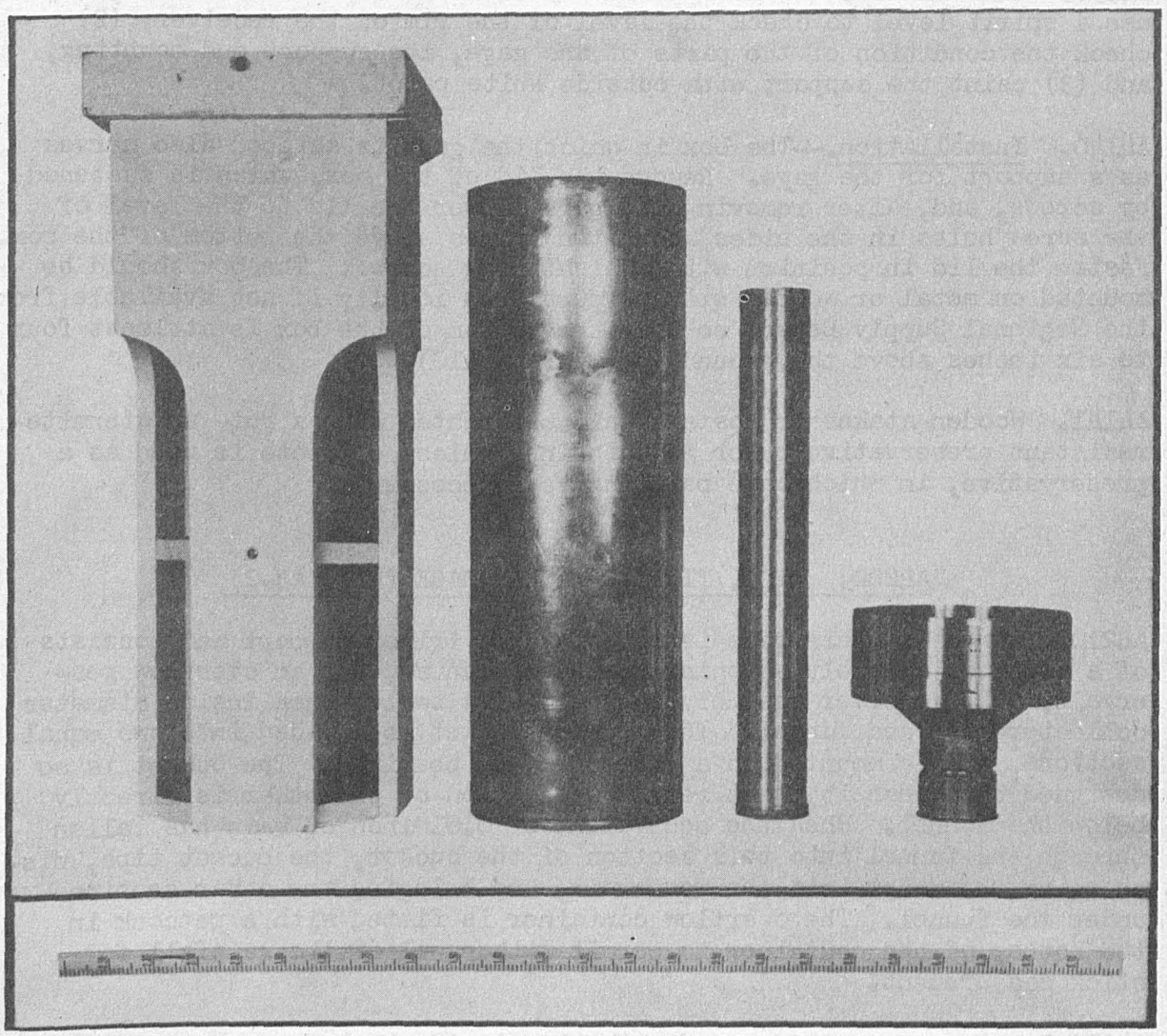

Fig. A4-1. D100, non-recording (eight-inch) precipitation gage. Left to right: wooden box support, overflow container, measuring tube, and receiver assembly. Below: measuring stick.

expanded in the same ratio. Therefore, one linear inch of rain in the measuring tube is read as ten-hundredths (0.10) of an inch on the scale. The measuring stick is graduated over a range of 2.40 inches of rainfall in increments of 0.01 inch.

A4120. Winter Operation.—When freezing temperatures or solid forms of precipitation are likely to occur, remove the receiver and the measuring tube, leaving the overflow can to catch any precipitation (see pars. 4041 and 4050).

A4130. Maintenance.—At least once a year at first-order stations, (1) use a spirit level to check the level of the rim of the receiver, (2) check the condition of the parts of the gage, its support and mounting, and (3) paint the support with outside white paint.

A4140. Installation.—The box in which the gage is shipped also serves as a support for the gage. Remove the lid of the box, which is fastened by screws, and, after removing the gage, lower the lid to the level of the screw holes in the sides about ten inches above the bottom of the box. Fasten the lid in position with the shipping screws. The box should be mounted on metal or wooden stakes (purchased locally if not available from the Regional Supply Depot) so that the bottom of the box is at least four to six inches above the ground (see par. A4410).

A4141. Wooden stakes or posts should be treated with a rot- and termite-resistant preservative prior to painting, unless creosote is used as a preservative, in which case painting is unnecessary.

A4200. D101, TIPPING-BUCKET GAGE (FIG. A4-2)

A4210. General.—This gage is mounted on a tripod support and consists of a receiver assembly, tipping bucket mechanism, and an overflow reservoir. The receiver assembly consists of a twelve-inch inside diameter collector-ring and funnel. The tipping bucket is divided into two equal sections, and is mounted on a pair of pivot bearings. The bucket is so designed that when it is at rest, one section or the other is directly below the funnel. When the equivalent of 0.01 inch of rain has fallen through the funnel into this section of the bucket, the bucket tips, discharging the water into the reservoir, and bringing the other section under the funnel. The overflow container is fitted with a petcock in the bottom of the container to permit withdrawal of the rainfall for stick measurement.

A4210.1. Accessory items used with the tipping-bucket gage consist of a measuring tube 10 inches deep having an inside diameter of approximately 3.8 inches, and a measuring stick. Since the ratio of the cross-section area of the collector to that of the measuring tube is ten to one, the

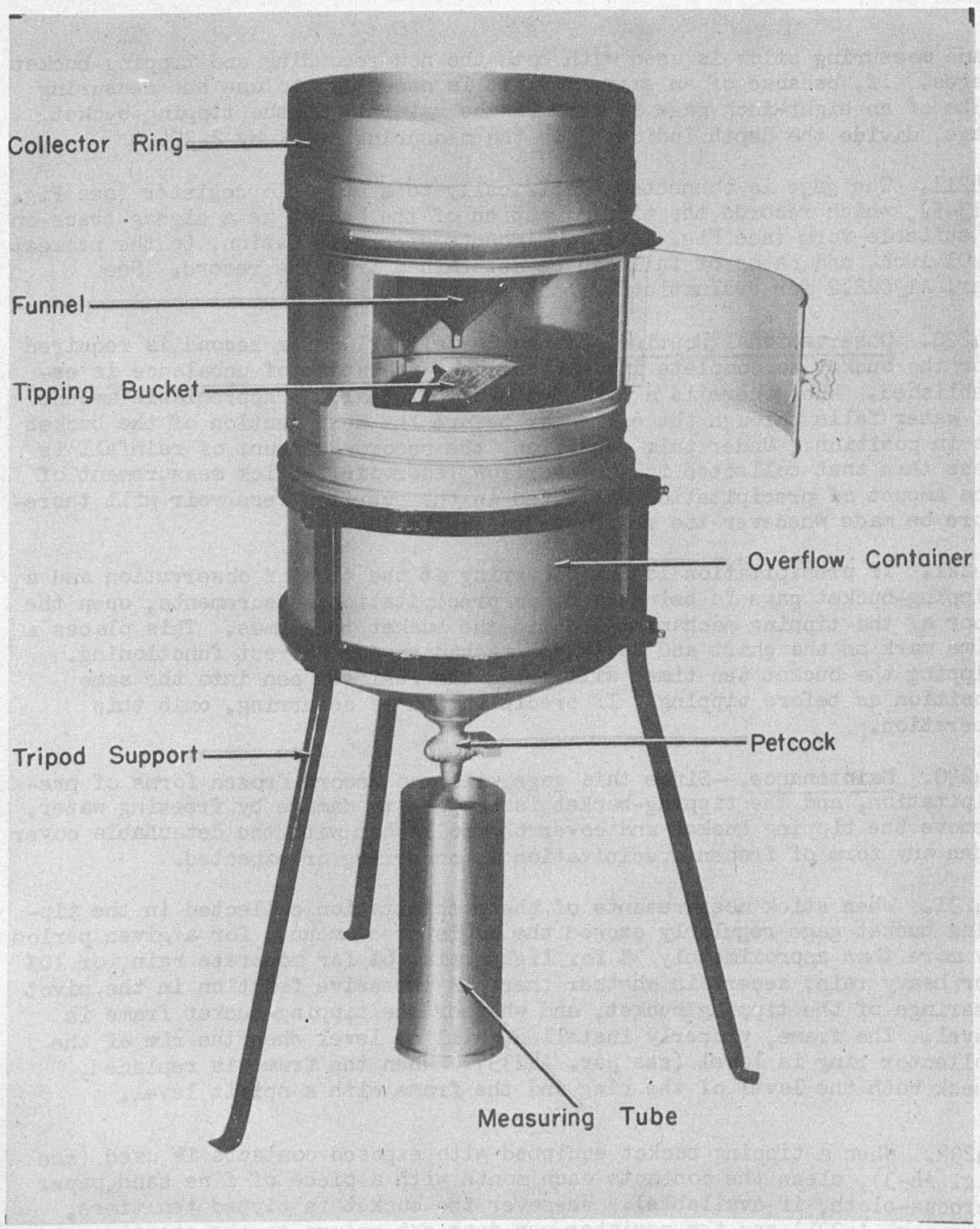

Fig. A4-2. D101, tipping-bucket rain gage.

same measuring stick is used with both the non-recording and tipping-bucket gages. If, because of an emergency, it is necessary to use the measuring tube of an eight-inch gage to measure the rainfall in the tipping-bucket gage, divide the depth indicated on the measuring stick by 2.25.

A4211. The gage is connected electrically to a multiple register (see Fig. A13-5), which records the tipping action of the bucket as a zigzag trace on a suitable form (see Fig. A4-10). Amounts of precipitation, to the nearest 0.01 inch, and rates of fall can be determined from the record. See par. A13022.2 for evaluation of this record.

A4220. Observational Routine.—Approximately 3/10 of a second is required for the bucket to complete its motion, once the state of unbalance is established. When there is a rapid rate of rainfall, an appreciable amount of water falls through the collector before the next section of the bucket is in position. Under this condition, the recorded amount of rainfall is less than that collected in the overflow reservoir. Stick measurement of the amount of precipitation collected in the overflow reservoir will therefore be made whenever the reservoir is emptied.

A4221. If precipitation is not occurring at the time of observation and a tipping-bucket gage is being used for precipitation measurements, open the door of the tipping mechanism and tip the bucket ten times. This places a time mark on the chart and tests the mechanism for correct functioning. Tipping the bucket ten times will bring the register pen into the same position as before tipping. If precipitation is occurring, omit this operation.

A4230. Maintenance.—Since this gage will not record frozen forms of precipitation, and the tipping-bucket is subject to damage by freezing water, remove the tipping bucket and cover the collector with the detachable cover when any form of frozen precipitation is occurring or expected.

A4231. When stick measurements of the precipitation collected in the tipping bucket gage regularly exceed the registered amounts for a given period by more than approximately 3% for light rain, 6% for moderate rain, or 10% for heavy rain, ascertain whether there is excessive friction in the pivot bearings of the tipping bucket, and whether the tipping-bucket frame is level. The frame, properly installed, will be level when the rim of the collector ring is level (see par. A4235). When the frame is replaced, check both the level of the ring and the frame with a spirit level.

A4232. When a tipping bucket equipped with exposed contacts is used (see Fig. A4-3), clean the contacts each month with a piece of fine sand paper (crocus-cloth, if available). Whenever the bucket is tipped ten times, (see par. A4221) and the register pen does not return to the starting point, inspect the contacts for any indications of malfunctioning.

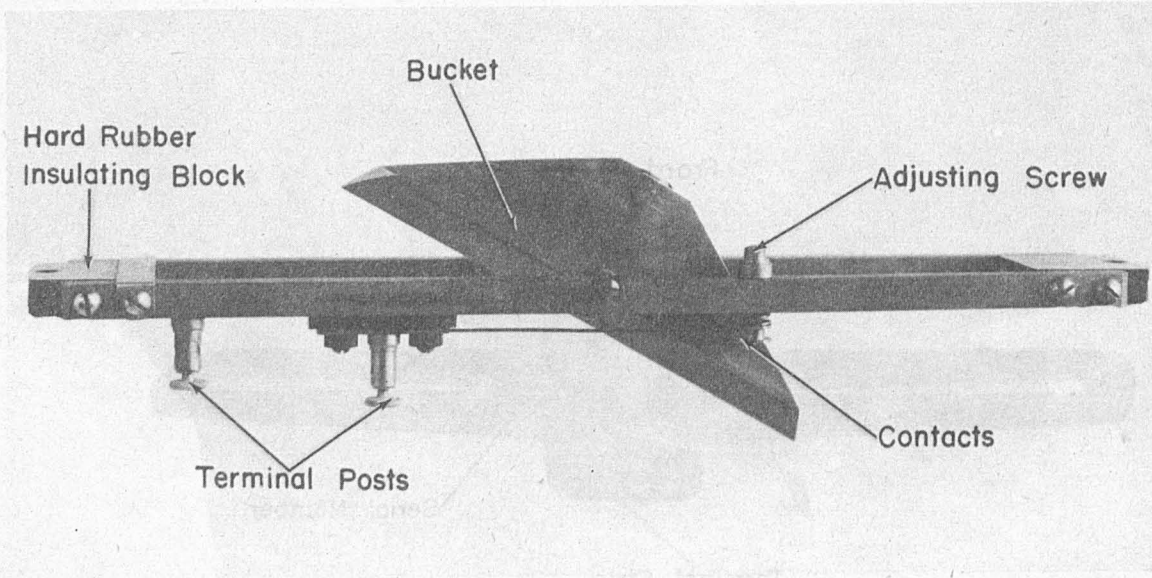

Fig. A4-3. Tipping bucket (exposed contacts).

Each month, clean and oil the bearings, and clean the cams on the front and rear of the bucket in order that they may ride freely over the projections on the contact springs. A piece of clean cloth wrapped around a matchstick may be used to clean the bearings. A drop of light oil (SAE 10 or anemom-oil) is sufficient for each bearing. Replace the bucket with the stop-pins toward the rear. If the bucket is replaced with the pins forward, it may recoil and cause two tips to register instead of one.

A4233. If the tipping bucket is equipped with a mercury-type switching mechanism (see Fig. A4-4), routine maintenance or adjustments are not required.

A4233.1. The serial number stamped on the frame of the mercury switch should correspond with the number stamped on the tipping bucket. When installing the switch, level the frame that supports the tipping bucket and adjust the glass mercury-tube in its mount. To mount the tube, push it downward in the clips until the tip rests on the bottom of the support, then turn the tube until the vertical, metal, plate-like armature in the tube is adjacent to the magnet on the tipping bucket, and the armature is free to move at right angles to the direction of movement of the magnet. The position of the magnet on the bucket is adjusted to provide accurate balance of the bucket, and should not be changed.

A4233.2. Whenever the glass mercury-tube is broken request a replacement tube.

A4234. Remove the bucket and clean it thoroughly with a mild scouring agent as frequently as is necessary to remove accumulated dust, etc.

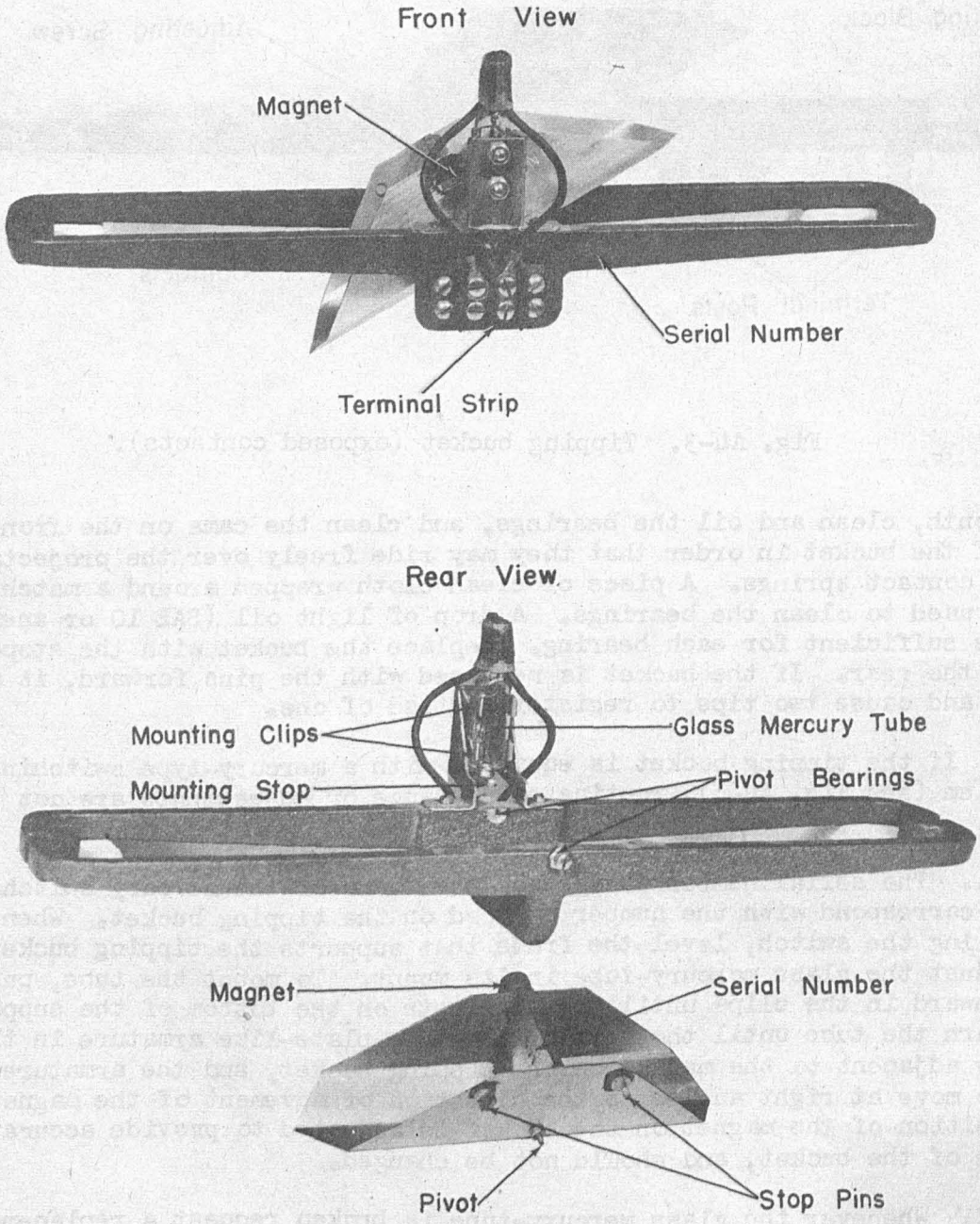

Fig. A4-4. Mercury-switch type of tipping-bucket rain gage (front and rear views).

A4235. At least once a year, check the level of the collector ring with a spirit level.

A4300. D110A or B, WEIGHING GAGE (FIG. A4-5)

A4310. General.--The universal-type weighing gage consists of a collector assembly, and a storage bucket mounted on a recording, weighing mechanism. The collector consists of an eight-inch (inside diameter) collector ring and a removable funnel. In addition, the D110B six-inch (recording capacity) gage is provided with a snow ring that operates as an extension of the collector ring for use when snow is expected. The weight of the accumulated precipitation is converted to equivalent inches of precipitation that is recorded in ink as a continuous trace on a chart. The amount of accumulated precipitation that may be recorded depends upon whether the pen linkage permits single or double traverse of the pen over the chart. The pen records on its ascent in the single-traverse type, and on its ascent and descent in the double-traverse type. Form 1028C, a 24-hour chart, is used on either the single- or dual-traverse gages. Stick measurements are not made of the precipitation accumulated in this gage. For ease of reading, the base of the gage should be at least 12 inches above the ground; preferably 18 to 24 inches, provided the foundation is firm enough to prevent normal vibration from disturbing the trace.

A4320. Routine Operating Procedure.

(1) When the gage is not charged with calcium chloride, empty the bucket whenever the chart is changed and as often between changes as necessary to avoid exceeding the single-traverse capacity of the gage.

(2) During periods of freezing temperatures and expected sleet and snow, remove the funnel in the bottom of the receiver, and if the gage is a D110-B, six-inch capacity gage, install the snow ring on the collector ring. With the empty bucket in position and the pen set at zero, charge the gage with antifreeze by placing in the bucket one quart of commercial anhydrous calcium chloride dissolved in one quart of water. Do not use a more concentrated solution. If the calcium chloride has not been packaged with oil added, cover the solution with a small amount of low viscosity motor oil (SAE 10) to prevent evaporation. Do not adjust the pen after the solution has been placed in the bucket. Empty and recharge the gage (a) whenever the gross accumulation (initial charge plus subsequent precipitation) dilutes the charge to such an extent that there is danger of damaging the bucket from solid freezing of the mixture, and (b) before the gross accumulation exceeds the single traverse capacity of the gage.

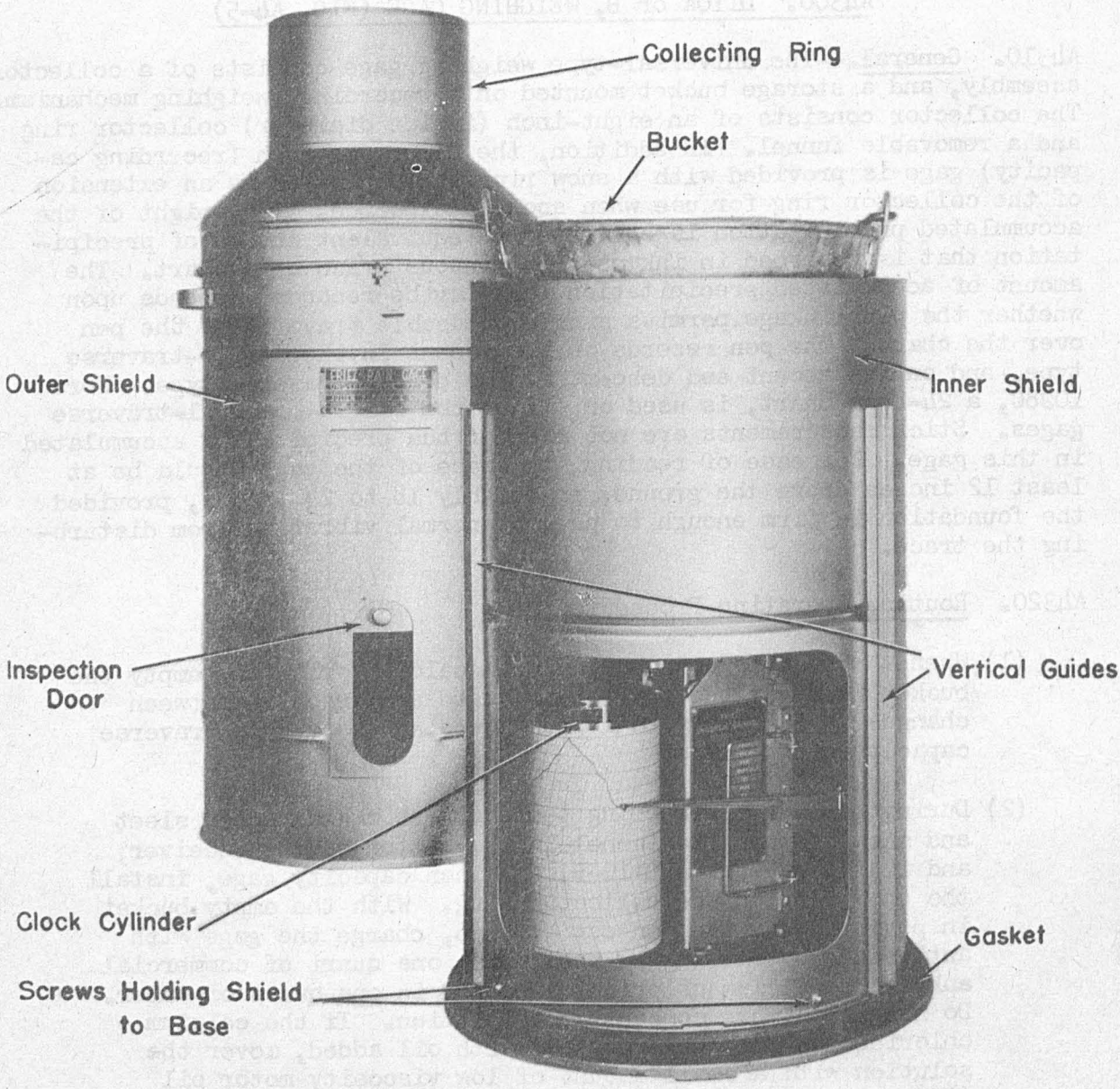

Fig. A4-5. D110A, weighing type of precipitation gage.

(3) At each observation inspect the mechanism to determine that the clock is running and the pen is recording. Make a time-check line at the time of the six-hourly observation when precipitation is occurring or has occurred during the preceding six hours and the precipitation record for the station is obtained from the weighing gage. The check line, approximately two ordinates in length, is made either by:

(a) removing the collector, and touching the bucket gently to elevate the pen; or,

(b) opening the inspection door and gently touching the lower portion of the weighing-bucket platform to elevate the pen; or,

(c) opening the inspection door and depressing the pen several ordinates. Do not elevate the pen except as specified in (a) or (b).

(4) If vibration or continuous repetition of the trace over the same ordinate causes the pen line to appear too wide for accurate evaluation of small amounts of precipitation, adjust the pen upward 0.25 inch and make a notation to this effect on the chart.

(5) Check the condition of the bucket and remove any loose dirt or sediment each time the bucket is emptied. If additional cleaning is indicated, use soap and water. Do not use alcohol or a petroleum-base solvent owing to the deleterious action of the solvent on the protective asphalt coating.

(6) At each synoptic and midnight observation during periods when the clock is inoperative, turn the cylinder clockwise about one-half inch and maintain the continuity of the record by entering measurements from a non-recording gage on a chart (see par. A4321.2(2(b)).

A4321. Replacing Charts.—Charts will be changed at the time of the 1830 GCT six-hourly observation (or as soon as possible thereafter if personnel are not on duty at that time):

(1) On the first of the month and on each Monday, Wednesday, and Friday. Where hourly precipitation entries are made on Form 1001B and WBAN-10B, the chart may be changed on Saturday instead of Friday.

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(2) Daily whenever sustained vibration produces a blurred trace corresponding to more than 0.04 inch of precipitation.

(3) Once a week on Friday (or Saturday - see (1)) when the clock is inoperative (see par. A4320(6)).

A4321.1. In handling and storing completed charts, avoid smearing damp portions of the trace.

A4321.2. To change a chart:

(1) Remove the collector ring and bucket, and either remove the cylindrical shield or lift it until it can be turned so that its vertical guides rest on the matching guides attached to the inner shield. Two thumb-levers, located near the inside top of the outer shield, are depressed to release the shield.

(2) (a) Make a time check on the chart by touching the bucket lightly.

(b) If the clock is stopped and precipitation occurred during the interval that the clock was not functioning, carefully turn the cylinder slightly to the right and to the left to identify the top of the precipitation trace in the event that vibration of the pen has lengthened the trace. Label the point "Clock Stopped."

(c) If the pen is not operating, mark the position of the pen on the chart with a dot and enclose the dot in a circle. Label the entry "Pen Dry."

(3) Lift the pen from the chart with the pen holder.

(4) Empty and replace the bucket, except that when the bucket is charged with anti-freeze, it will be emptied in accordance with par. A4320(2).

(5) Remove the chart cylinder from the gage by lifting the cylinder until it is entirely clear of the spindle and then tilting it until it can be removed through the opening in the inner shield.

(6) Remove the chart from the cylinder after withdrawing the flat, spring-type retaining clip.

(7) Wind the clock, being careful not to wind it too tightly.

(8) Fit the unused chart snugly to the cylinder and replace the retaining clip. When properly fitted, the bottom of the chart rests on the flange and the horizontal lines coincide where the right end of the chart overlaps the left end.

(9) Replace the cylinder on its spindle and lower it carefully until the gears have meshed.

(10) Adjust the cylinder for time (see par. A4326).

(11) Fill the pen about 3/4 full of ink and replace it on the chart.

(12) If the bucket is emptied, adjust the pen to the zero ordinate on the chart (see par. A4325).

(13) Check for satisfactory operation of the pen and clock and make a time check on the new chart by touching the bucket lightly.

(14) Replace the outer shield and collector ring.

A4322. Annotating Charts.—(See Fig. A4-6.) Enter the data listed below in ink.

(1) Before placing the chart on the gage, enter the station name, date and time, and the local time zone designator.

(2) After the chart is removed from the gage, enter:

(a) The date, the time of removal, and the time zone designator; and,

(b) where applicable, suitable notations (see par. A4321.2 (2(b and c)) to identify points where the clock stopped, pen was found dry, missing record, accumulation of sand and other foreign matter in the bucket during wind storms, etc.

A4323. Evaluating Charts.—(See Fig. A4-6.) Charts are evaluated only at first-order stations. After removing the chart from the gage, enter hourly amounts of precipitation in inches and hundredths midway between the hour lines. When precipitation occurred in amounts less than 0.005 inch, enter "T." When no precipitation occurred, make no entry. The total of the hourly amounts should equal the total rainfall registered on the gage. To determine, to the nearest 0.01 inch, the amount of precipitation during a designated period, subtract the reading (in

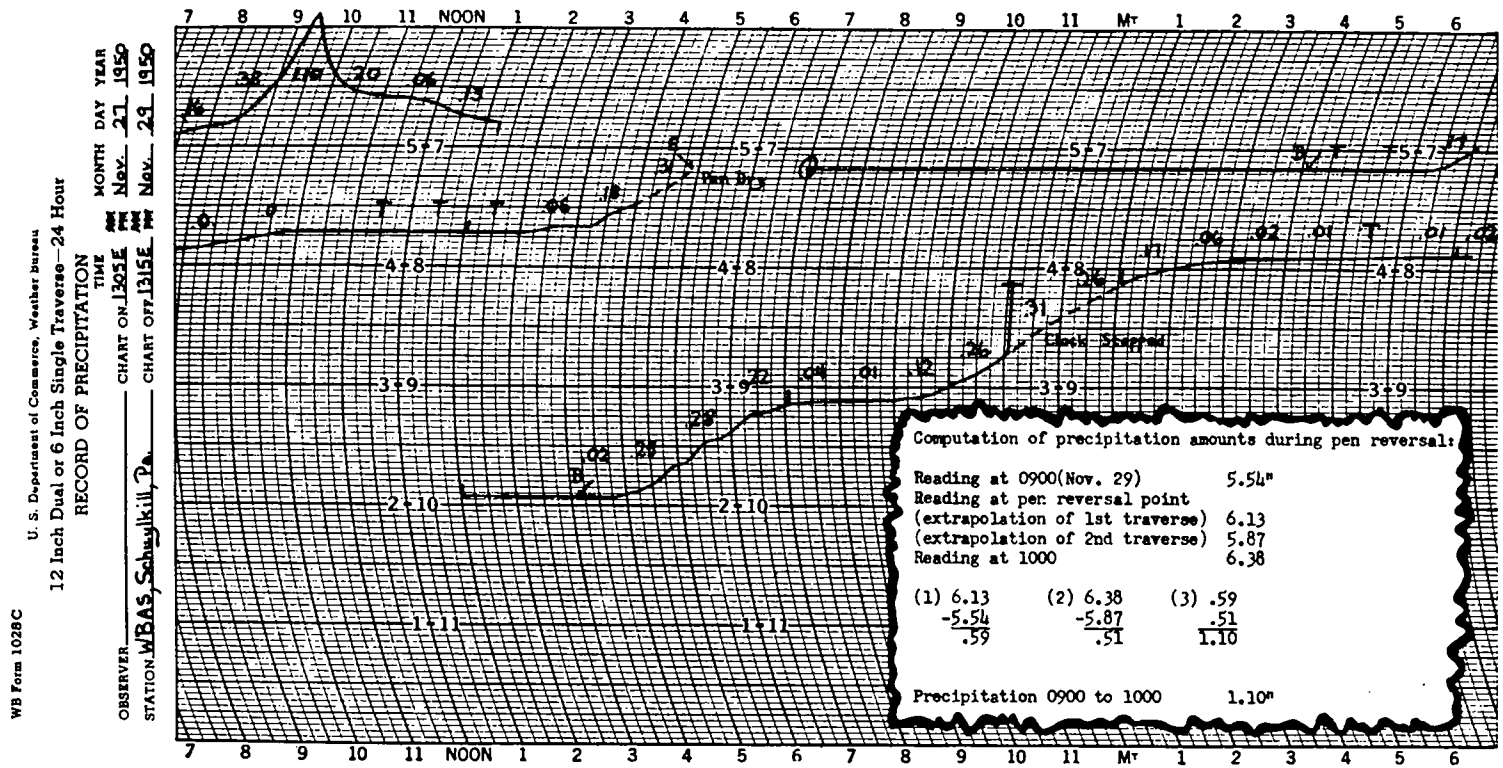


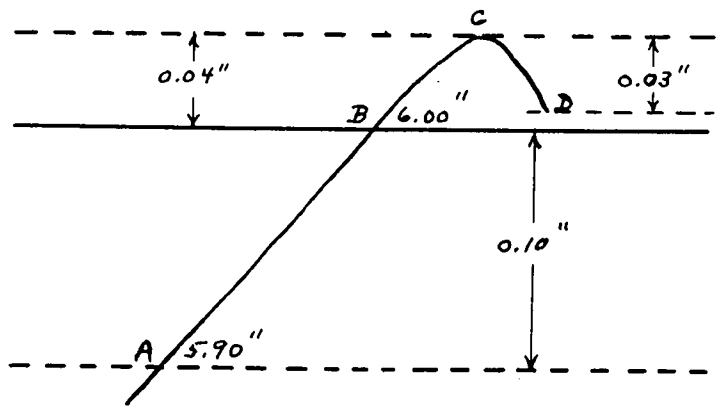
Fig. A4-6. WB Form 1028C, weighing-type precipitation-gage chart.

inches and hundredths, interpolating as necessary) at the beginning of the period from the reading at the end of the period.

A4323.1. Enter a check (✓) to indicate the time of beginning, and a reverse check (✓) to indicate the ending of precipitation, preceded by the letters "B" and "E", respectively.

A4323.2. Unless the pen reverses exactly at the uppermost ordinate of the chart (the 6.00-inch line of this type of dual traverse gage), indicated readings for the second traverse as taken from the 6-12 inch scale are in error. Therefore, when the pen traverse has reversed during the observation period at a point above or below the 6.00-inch line, computation of the precipitation for the period is facilitated by taking the sum of the precipitation equivalent of the segments of the trace obtained during the period (see the following example).

EXAMPLE



In this illustration, the reading from the 0-6 inch scale at the beginning of the observation period is 5.90 inches at point A; B is the point of intersection of the first traverse with the 6.00-inch line; C is the point of reversal of the trace; D is the end of the trace at the end of the observation period. The total precipitation for the period, ABCD, is found as follows:

(1) The difference between readings at points A and B is 6.00 minus 5.90 or 0.10 inch.

(2) The precipitation equivalent of the height of point C above the 6.00-inch line is 0.04 inch.

(3) The precipitation equivalent of the difference in height between points C and D is 0.03 inch.

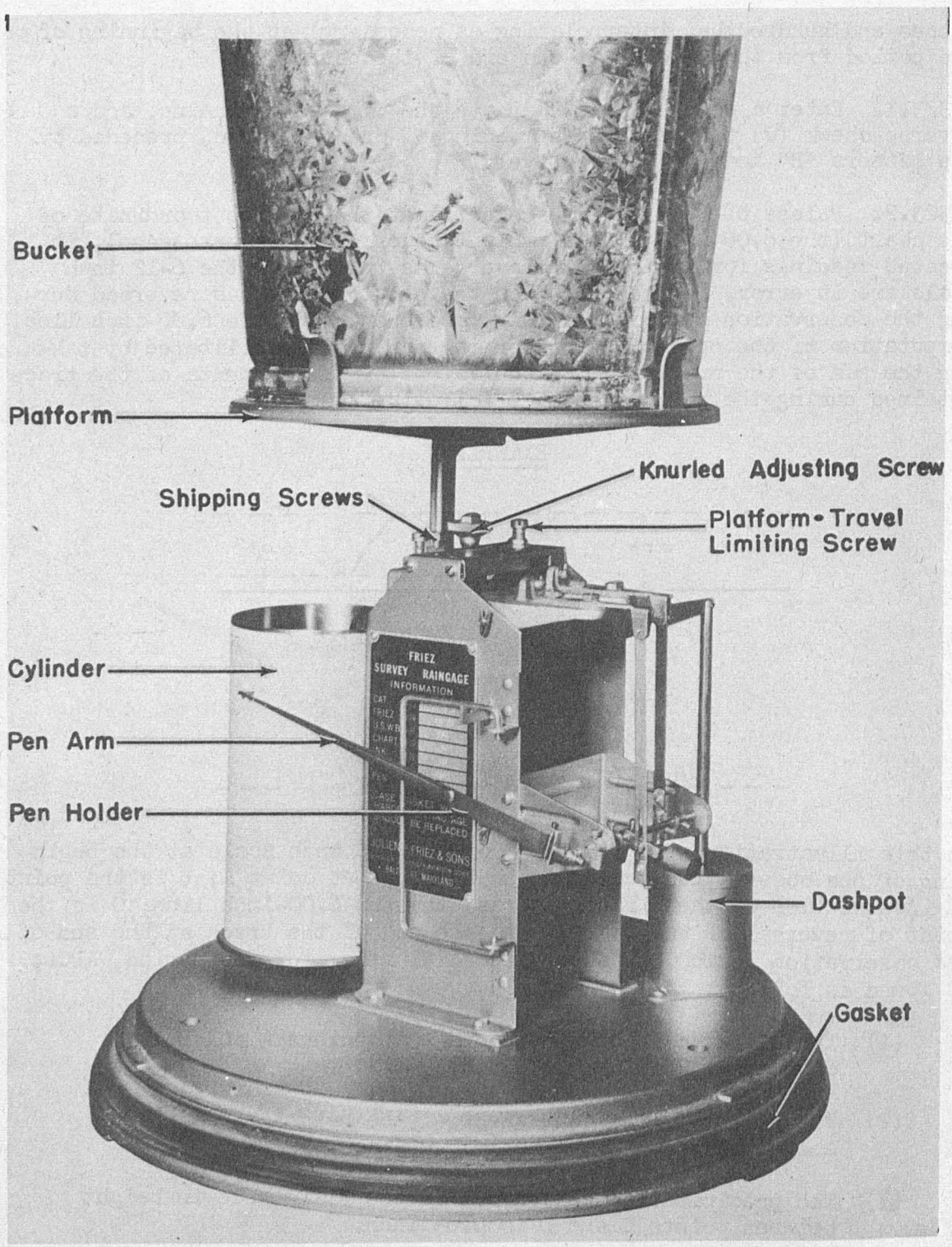


Fig. A4-7. Weighing mechanism.

(4) The sum of segments AB, BC, and CD is the sum of 0.10 plus 0.04 plus 0.03, or 0.17 inch, the precipitation during the time interval between points A and D.

A4323.3. If the pen reversed during heavy precipitation and the rainfall was recorded as a flat trace during reversal owing to loose linkage, extrapolate the ascending and descending portions of the curve to an appropriate apex.

A4323.4. When the missing record is less than 24 hours, interpolate hourly data and enter them on the chart in parentheses. When 24 hours or more of record are missing, hourly data will not be interpolated. (See par. A4321.2(2(b)).)

A4324. Disposition of Charts.—CAA stations will forward the charts for the week each Saturday to the WRPC's with the WBAN-10 forms. Other second-order stations and first-order stations will forward the charts for the month to the WRPC's on or before the second working day after the first of the month.

A4325. Zero Adjustment.—The gages are provided with a knurled, zero-adjustment nut located above the frame that supports the linkage mechanism (see Fig. A4-7). Turn the nut clockwise to lower the pen and counterclockwise to raise the pen. Adjust the pen to the zero line (lowest horizontal line) on the form only when the bucket is empty and in place on the weighing platform. Be careful not to change the adjustment of the three platform-travel-limiting and shipping screws adjacent to the zero-adjustment nut.

A4326. Time Adjustment.—To adjust the chart for time, turn the cylinder counterclockwise as viewed from above until the correct local standard time is indicated by the position of the pen with respect to the labeled time lines. The heaviest lines are labeled to indicate the beginning of each hour (L.S.T.). Additional lines are provided at 15-minute intervals. The cylinder should be adjusted to indicate the time to the nearest minute.

A4330. Maintenance.—At first-order Weather Bureau stations only, at least once a year (preferably about midway between visits of inspection personnel):

(1) Check the level of the dashpot fluid.

(2) Check the pen; clean and sharpen, or replace if necessary.

(3) Check the condition of the gasket at the bottom of the outer shield.

A4331. Dashpots.—If necessary to prevent loss of ink from the pen, and to minimize irregularities in the trace resulting from vibration and wind gusts, fill the dashpots with etheleyne glycol (Prestone, etc.), petroleum oil, or a similar fluid. Either keep the dashpot filled to a level approximately 3/8" from the top, or keep the dashpot entirely empty. This is important to prevent erroneous readings resulting from the effect of surface tension on the dasher. After filling the dashpot, move the weighing platform up and down several times to remove any air bubbles trapped under the dasher, and then check the level of fluid. Do not mix dashpot fluids, i.e., a glycerin-base type with an oil-base type fluid.

A4332. Clocks.—If the clock gains more than about two minutes a day at CAA or first-order Weather Bureau stations, adjust the timing regulator. (Observers at second-order stations should notify the supervising station.) If the clock is mounted in the record cylinder, open the small inspection plate in the top cover of the clock compartment (inside the cylinder as viewed from the top (see Fig. A7-7)) for access to the adjusting lever. If the clock is mounted on the spindle, the adjusting screw is mounted on the bottom of the plastic-covered escapement mechanism (see Fig. A4-8). Adjust the index toward "F" (Fast) if the clock is losing time, or toward "S" (Slow) if it is gaining time. It is preferable that such adjustments be made at the time of changing the chart in order to preserve the continuity of the record.

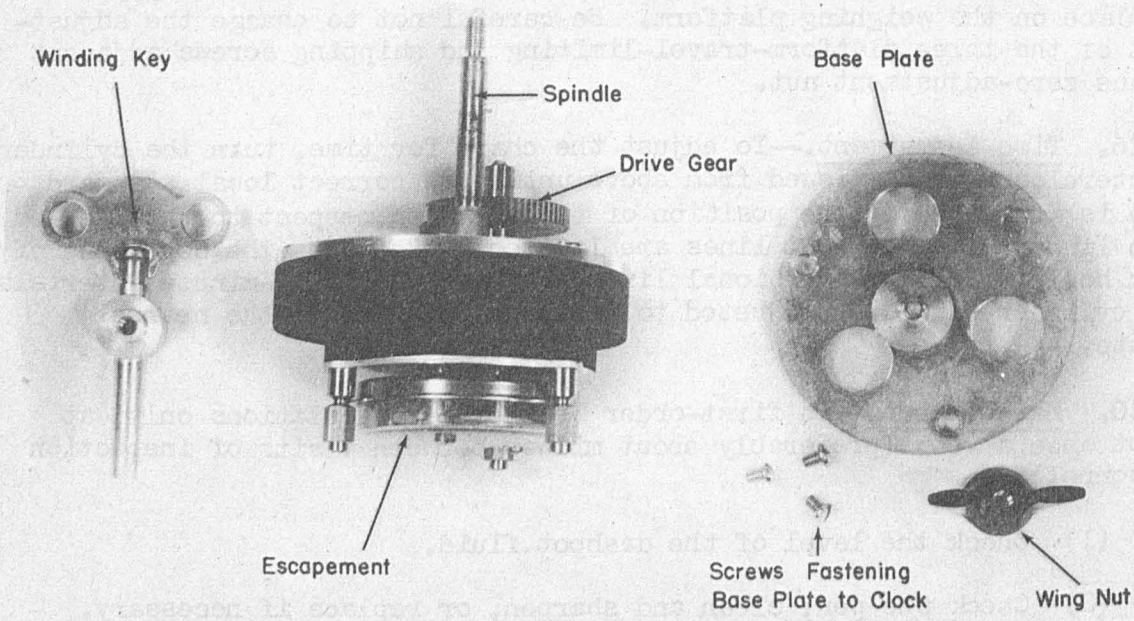


Fig. A4-8. D110-11, Macnick clock.

A4332.1. When a clock gains or loses more than ten minutes a day, another clock should be requested, except that at first-order Weather Bureau stations:

(1) It should be repaired if it is of a type that is mounted in the record cylinder and repairs by a local watchmaker are practicable, or

(2) a replacement escapement should be requested if it is of the type illustrated in Fig. A4-8.

A4332.11. To replace an escapement of the type shown in Fig. A4-8:

(1) Unscrew the assembly from the gage base. (If it does not unscrew readily by hand the clock stud may have a wing nut attached on the bottom side of the base which must be removed.)

(2) Remove the screws securing the clock to its base plate.

(3) Remove the plastic-covered escapement mechanism by turning it counterclockwise until it is free to be lifted from the case. If the spring is wound, it will unwind rapidly as the escapement is removed. Do not hold the clock in a manner that will permit the hand, clothing, etc., to become caught in the revolving drive gears. Be careful not to lose the small, floating drive shaft which may be separated from both the escapement and the spring assembly as the escapement is withdrawn.

(4) After the clock has been reassembled, rewind the spring.

A4332.2. The gear on replacement clocks of the type mounted in the chart cylinder have a number stamped on them, and they will generally mesh satisfactorily with a gear-type spindle of the same number. If they do not mesh satisfactorily, adjust the position of the pinion slightly after loosening the three screws near the periphery of the base of the cylinder. The spindle screws into the base of the gage, and in some cases may be further secured by a wing nut. If accessory items, such as spindle, gear, pinion, washer and wing nut, are received with a replacement clock, the equivalent items should be returned with the used clock.

A4332.21. The gear-type spindles are provided with a small horizontal hole in the shaft to facilitate its removal with a spindle wrench or a short rod, such as a nail. Ordinarily, the friction between the gear and the shaft is ample to permit initial loosening and final tightening of the spindle by hand. The leverage afforded by the spindle itself

should then be sufficient to permit removal or replacement by hand. Do not use pliers or other metal tools on the shaft or gear. If the threads do not mesh readily, request a replacement spindle.

A4332.22. The gear should not be free to turn after the spindle is tightened. Be sure that the outer, bevelled edge of the washer faces downward between the gear and the base of the gage. Center the washer when the spindle is tightened in order that the gear will be properly secured between the washer and the shoulder of the spindle.

A4333. Pens.—Clean the pen if sediment (dried ink, etc.) accumulates in it. To clean the pen, wash it thoroughly in water or, preferably, in alcohol. Scrape residual dried ink from the pen with a suitable sharp-edged instrument. Clean the nibs by pulling a piece of clean, hard-finish paper or cellophane between the nibs, and rewash the pen. Sharpen or replace the pen if it will no longer make a clearly legible trace.

A4333.1. The pen may be sharpened by inverting it and rubbing the edges gently over a fine-grain whetstone or a sheet of crocus cloth. After the point has been sharpened, rub it very lightly several times over the abrasive surface to remove any burrs that might catch on the chart and cause an erratic trace. A spare pen should be kept on hand for replacement purposes.

A4333.2. The pen is secured to the pen arm by a friction clamp. Avoid bending or otherwise damaging the pen-arm linkage when removing the pen. If the pen is not easily removed, use a knife edge or similar wedge to loosen the prongs that hold the pen to the arm.

A4334. Bucket.—At first-order stations where the bucket is charged with calcium chloride, paint the inside of the bucket once a year with asphalt paint. The bucket should be painted at temperatures above 70°F. to obtain a thin, even coating. Repaint the bucket more frequently if necessary to prevent exposure of the metal.

A4334.1. If, at any time, the contents of the bucket freeze solid, examine the bucket carefully for evidence of damage, e.g., bulging of the bottom, slow leaks, etc.

A4334.2. When a bucket becomes damaged or requires repainting at a second-order station, the Regional Office will be notified. At first-order stations, unserviceable buckets will be replaced with a galvanized bucket of the same capacity.

A4400. EXPOSURE AND SHIELDS

A4410. Exposure.--Precipitation gages should be located on a level plot of ground, at a distance from any object (including the instrument shelter) of at least two, and preferably four, times the height of the object above the top of the gage. All types of gages must be exposed with the rim of the receiver in a horizontal plane and at a level well above the average level of snow surfaces. Gages should not be installed on a roof without prior authorization by the Central Office.

A4420. Shields.--Stations where snowfall and strong wind frequently occur together will be furnished with approved shields (see Fig. A4-9). However, where two or more gages are installed, only one will be shielded, preferably the weighing gage.

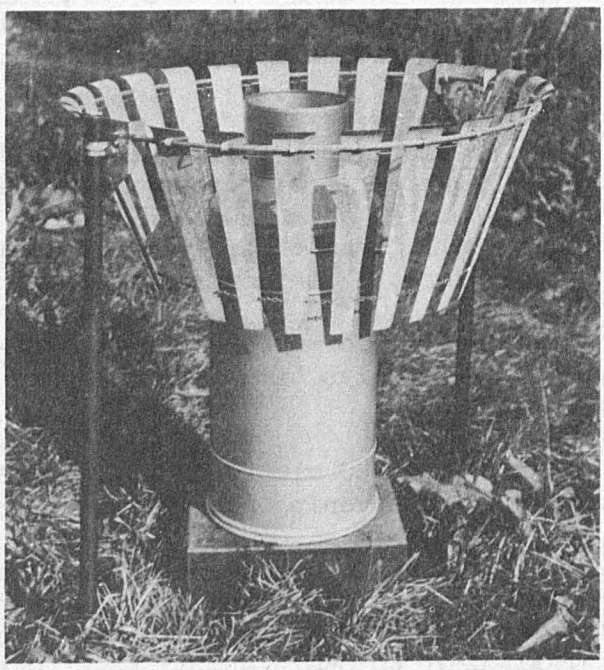


Fig. A4-9. D110A, weighing gage with a D131 Alter-type shield.

A4421. Alter-type shields (D131) are installed with the circular ring horizontal and the top of the blades approximately 1/2 to 3/4 inch above the level of the top of the receiver. The blades are suspended from the ring. They are free to pivot at the point of suspension within the limits imposed by the chain linking together the bottoms of the blades. The blades on the windward side of the gage deflect the wind downward and thereby increase the efficiency of the gage.

A4500. ENTRIES ON WBAN-10

A4510. Precipitation (Col. 40).—First-order stations equipped with recording gages, including weighing rain gages equipped with 24-, 12-, or 6-hour gears, will enter corrected hourly amounts of precipitation in inches and hundredths for the period beginning with the hour printed in column 16. Consider the hour identified as "00" in column 16 as beginning at 0000 LST and ending at 0059 LST; the hour identified as "01" as beginning at 0100 and ending at 0159, etc. Enter "T" for amounts of less than 0.005 inch. Omit entry if precipitation has not occurred during the hour. If the automatic record is incomplete, enter estimated hourly amounts in parentheses.

A4520. Twenty-four Hour Snowfall (Col. 69).—Whenever snowfall data for the period from midnight to midnight is incomplete, e.g., where no midnight observation is taken, use the available entries in column 45 as a guide in estimating the depth for this period and enter the value in parentheses.

A4530. Excessive Precipitation (Col. 90).—Precipitation is termed "excessive" when it equals or exceeds the amount specified for any one of the time-intervals listed in Table A4-1. Excessive precipitation data will be evaluated at all first-order stations equipped with a recording gage that is used for the station record (see par. 4030).

A4530.1. Whenever there are two or more separate time-intervals of excessive precipitation, successive time-intervals are regarded as belonging to the same period when:

(1) They occur less than 180 minutes apart, irrespective of the amount of intervening precipitation.

(2) They occur 180 minutes or more apart, and the amount of intervening precipitation equals 1.80 inches or more for every period of 180 consecutive minutes (0200 to 0500, 0201 to 0501, etc.).

When these conditions are not satisfied, successive time-intervals are regarded as being in separate periods. When there is only one time-interval of excessive precipitation, the duration of the period is the same as that of the time-interval. When there are two or more time-intervals in a single period, the duration of the period is the elapsed time between the beginning and end of the first and last intervals, respectively.

A4530.2. The maximum precipitation for all the time-intervals listed in Table A4-1 will be computed for each period of excessive precipitation

(see Fig. A4-10 or A4-11). The various time-intervals have no chronological relationship to each other, but each time-interval must be related in one of the following ways to the period of excessive precipitation by:

(1) Beginning in the period

(2) Ending in the period

(3) Including the period

(4) Being included by the period

A4530.3. The precipitation scale M000-21 may be used for evaluating maximum precipitation data on Form 1017 or 1017B (see Fig. A4-10). A pair of dividers may be used to assist in evaluating either this record or that of the weighing-type gage. Using the time lines on the record as a scale, set the dividers to equal the number of minutes in the time-interval being considered, and then determine the amount of precipitation bracketed by the dividers.

TABLE A4-1
EXCESSIVE PRECIPITATION

Time-interval (minutes)	Depth of precipitation (inches)	Time-interval (minutes)	Depth of precipitation (inches)
5	0.25	60	0.80
10	0.30	80	1.00
15	0.35	100	1.20
20	0.40	120	1.40
30	0.50	150	1.70
45	0.65	180	2.00

A4531. Excessive precipitation data will be entered in column 90 of WBAN-10B and in summary form annually on Form 4036. A rubber stamp is used to provide and identify spaces for the tabulation of these data. A separate tabulation will be made for each period of excessive precipitation in accordance with the following:

(1) The maximum amount determined in accordance with par. A4530.2 for each of the twelve intervals in Table A4-1 will be entered in the appropriate spaces. When equal intervals for adjacent periods overlap in part (see Fig. A4-12):

(a) Enter the greater amount in the tabulation for

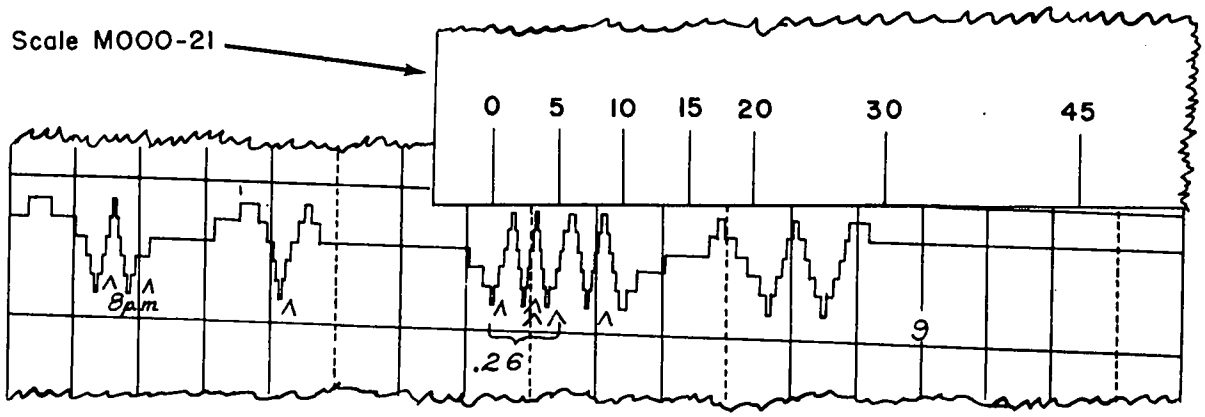
the corresponding period and enter a dash in the appropriate space of the other tabulation.

(b) When the amounts are equal, enter the value in the tabulation for the first period and a dash in the following.

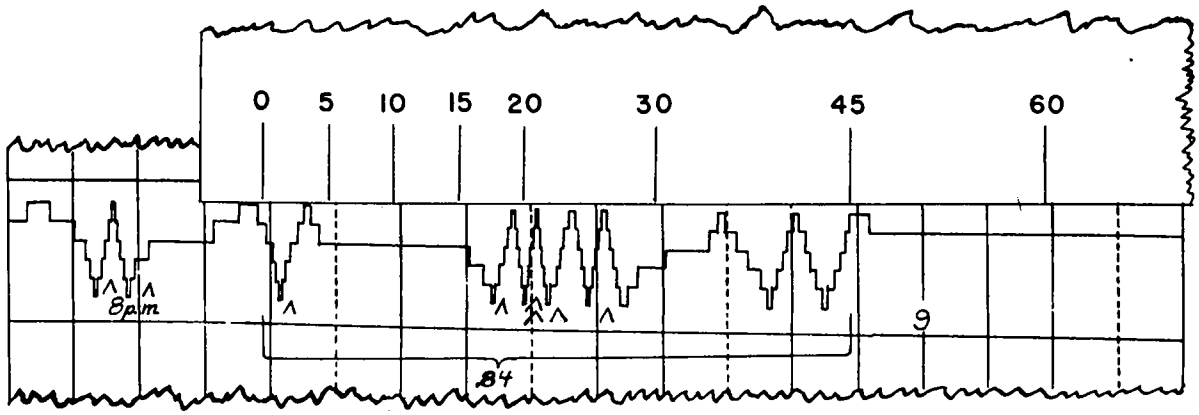
(2) Underscore all maximum amounts that equal or exceed the values specified in Table A4-1 for corresponding intervals of time.

(3) On WBAN-10B, tabulate excessive precipitation data on the form pertaining to the day in which the period ends. Enter these data on Form 4036 in chronological order, and ascribe to each tabulation the day in which the period ends.

(4) When excessive precipitation data cannot be evaluated for all intervals because of an incomplete record, enter an "M" in lieu of the missing values.



(A)

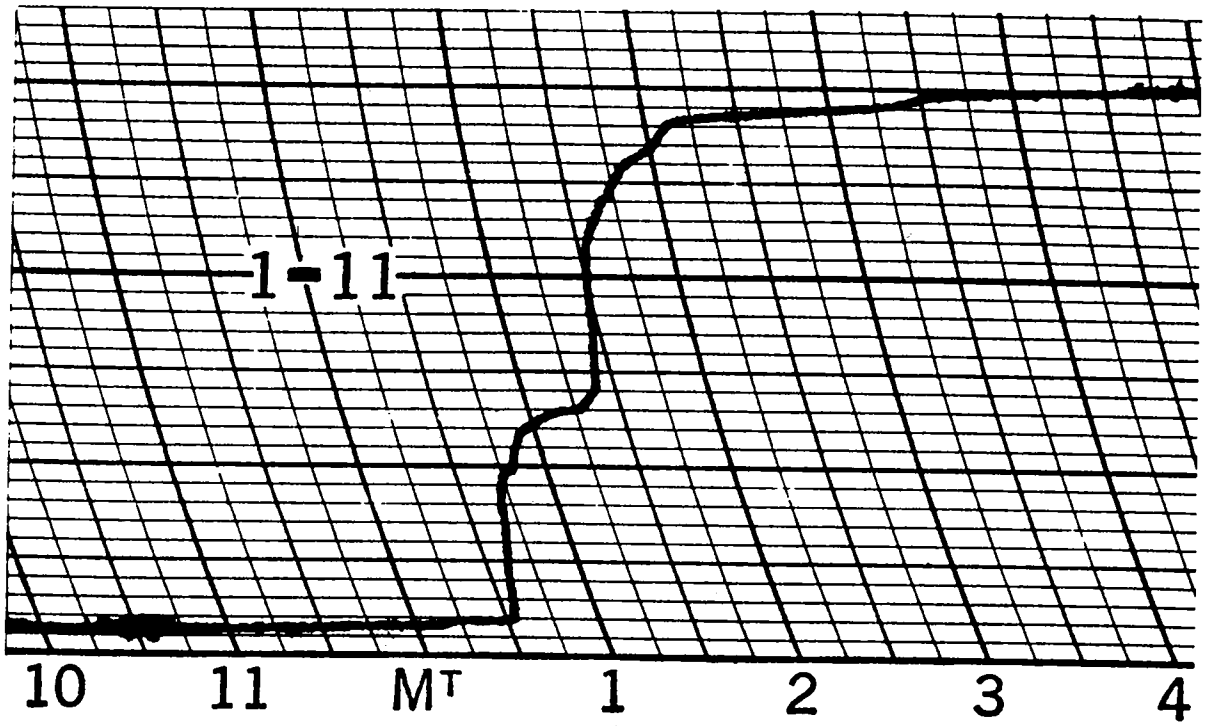


(B)

Duration of interval (minutes)	Precipitation	
	Time of beginning	Maximum amount (hundredths inch)
5	8:27 p.m.	0.26
10	8:27	0.45
15	8:27	0.48
20	8:27	0.53
30	8:27	0.71
45	8:09	0.84
60	7:54	1.05
80	7:50	1.10
100	7:50	1.10
120	7:50	1.10
150	7:50	1.10
180	7:50	1.10

(C)

Fig. A4-10. Evaluation of excessive precipitation data - tipping-bucket rain-gage record (Form 1017). The use of the M000-21 precipitation scale in selecting maximum amounts is illustrated in (A) and (B) for intervals of 5 and 45 minutes, respectively. The tabulation in (C) shows the maximum amounts selected for each of the 12 intervals in Table A4-1, and shows the time of beginning of each interval. Maximum amounts that are excessive are underscored.

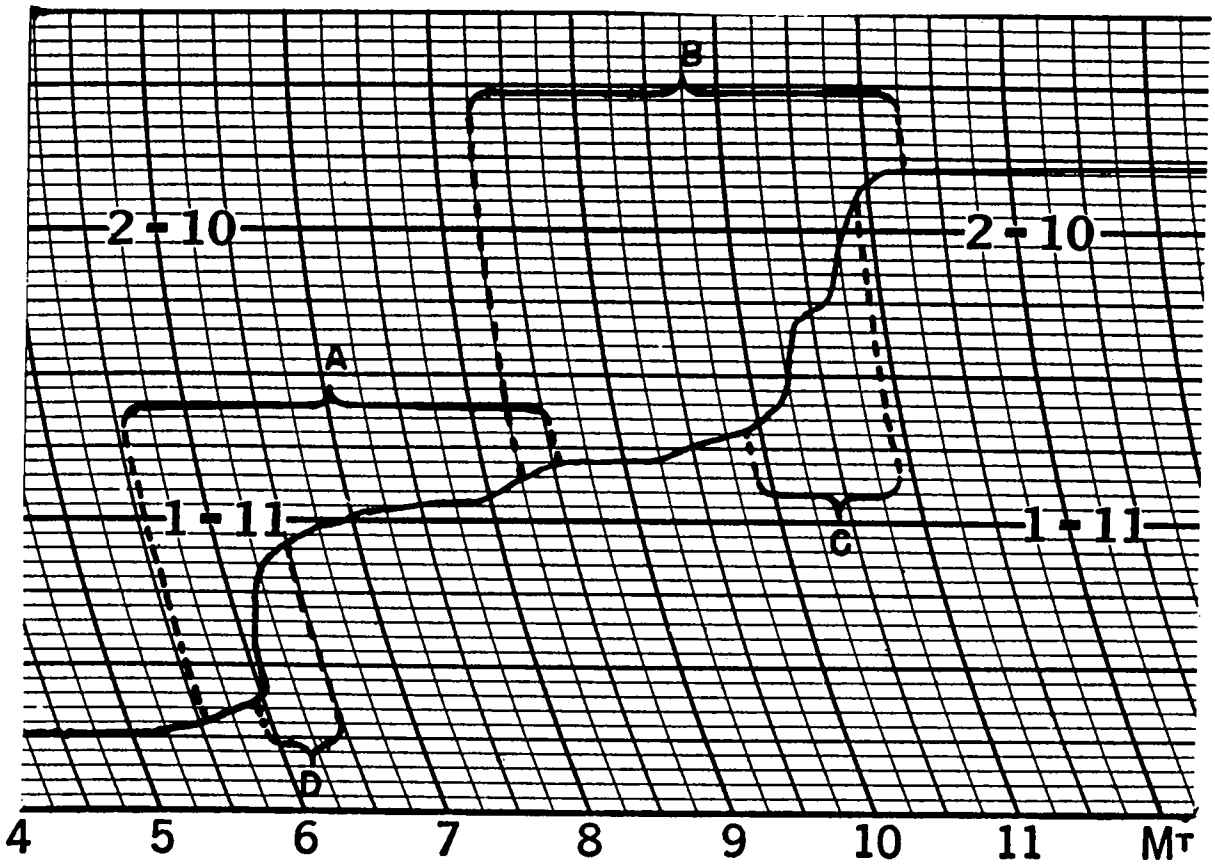


(A)

Duration of interval (minutes)	Precipitation	
	Time of beginning	Maximum amount (hundredths inch)
5	1:25 a.m.	0.17
10	1:25	0.33
15	1:20	0.44
20	1:20	0.51
30	1:20	0.62
45	1:20	0.70
60	12:35	0.94
80	12:30	1.20
100	12:30	1.31
120	12:30	1.33
150	12:30	1.35
180	12:30	1.38

(B)

Fig. A4-11. Evaluation of excessive precipitation data - weighing rain-gage record (Form 1028C). The maximum amount of precipitation for each of the 12 intervals of time listed in Table A4-1 pertaining to the record illustrated in (A), and the time of beginning of record for each interval, are tabulated in (B). Maximum amounts that are excessive are underscored.



Interval	5	10	15	20	30	45	60	80	100	120	150	180
Amounts for period D	.20	.35	.43	.46	.52	.58	.63	.69	.73	.76	.80	—
Amounts for period C	.18	.25	.33	.38	.45	.70	.82	.90	.95	1.00	1.00	1.06

Fig. A4-12. Excessive precipitation data. "A" indicates the time of occurrence of the maximum amount of precipitation associated with the period of excessive precipitation "D" for an interval of 180 minutes. Similarly, "B" indicates the maximum amount for 180 minutes associated with the period "C." The tabulation lists the excessive-precipitation data for the two periods of excessive precipitation. Note that "C" and "D" are separate periods of excessive precipitation, since they are separated by 180 minutes or more (203 minutes) in which the maximum amount of precipitation for 180 minutes does not equal or exceed 1.80 inch. Also note that since "A" and "B" overlap, only the greater amount is tabulated (see the entry for the 180-minute interval of the tabulation for period "C").

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A4540. Water Equivalent of Frozen Precipitation (Col. 90).—Whenever the depth of frozen precipitation on the ground exceeds one inch at first-order observing stations in the continental United States and at other designated observing stations, enter in column 90 the water equivalent as measured at approximately 1200 GCT each Monday. Enter the data in inches and hundredths preceded by the identification WATER EQUIV.

A4541. Transmit water equivalent data on Service C immediately following the group $9S_pS_pS_pS_p$, in the 1230 GCT report on Monday, whenever the S_pS_p portion of the group is 85 (see par. 1904.4, Synoptic Code, 1949). Use a slant (/) to separate these data from the $985s_ps_p$ group, e.g.

98505/50 - snow depth 5", water equivalent 0.50"
98502/9 - snow depth 2", water equivalent 0.09"
98511/110 - snow depth 11", water equivalent 1.10"

A4541.1. If Service A only is available, include these data in the 1228 GCT report on Monday, coded as in the preceding paragraph.

A4541.2. If neither Service C nor A is available, promptly after the observation transmit water equivalent data in plain language to the River District Office by TWX, telephone or telegraph, using the most economical of these methods.

A4542. Additional reports of water equivalent data may be sent to the River District Office either by mail or by one of the foregoing methods, in accordance with requests received from the Area Engineer or the River District Office.

A4543. When there is pronounced snow melt or other indications of the development of critical conditions, send emergency reports by the most expeditious method of communication until critical melting conditions no longer exist, or until instructed to discontinue reports by the Area Engineer or the River District Office.

CHAPTER A5. TEMPERATURE

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CHAPTER A5 - TEMPERATURE

A5000. LIQUID-IN-GLASS THERMOMETERS

A5010. General.—The range of thermometers in use at a station should exceed any expected maximum and minimum temperatures. During periods when temperatures below -38°F. may be expected, substitute an alcohol-filled (spirit-filled) dry-bulb thermometer for the mercury-filled dry-bulb thermometer (see par. 5130).

A5011. Maintenance.—At first-order Weather Bureau stations, maintain clear legible graduations by cleaning the thermometer and renewing the ivory black as frequently as necessary. Apply the ivory black with a matchstick to the full length of the graduated portion of the stem. Remove excess pigment by rubbing the surface of the thermometer stem lightly with blotting paper, soft cloth or tissue. A black china-marking pencil may be used in lieu of ivory black if relatively few markings require renewal. Clean loose dirt from the metal backs with a soft cloth or with a cloth wet with alcohol when a solvent is required. Remove oxide film from metal backs with a solution of sodium bicarbonate (ordinary baking soda).

A5020. Psychrometers.—(See Figs. A5-2 and A5-3.) Methods for ventilating psychrometers vary with the type of mounting. If the psychrometer is to be ventilated with a hand-powered fan (H030) mounted in a shelter (see Fig. A5-1), it is suspended, bulb end down, with both bulbs in front of the fan and about midway between the center of the fan and its periphery. When used in a medium-sized shelter (P300), the fan and its supporting frame are installed with the crank-shaft housing projecting through the louvered side. The bottom of the supporting frame in front of the fan should be approximately 2-1/2 inches above the bottom of the shelter. A hook to hold the psychrometer is screwed into the face of the instrument-mounting board about seven inches from the right end of the board, and at a height such that the wet-bulb of the suspended psychrometer is five inches above the bottom of the shelter.

A5021. Maintenance.—Once a week, check the condition of the thermometers, change the wick on the wet bulb, and clean the thermometers if foreign matter (crystalline mineral deposits on wet bulb, etc.) has accumulated. Deposits of foreign matter on the wicks will cause erroneous wet-bulb readings. In some localities, it may be necessary to replace wicks more frequently than once a week to prevent their becoming badly soiled. A solution of vinegar and water will usually prove effective in removing mineral deposits on the glass bulbs.

A5021.1. Once a week, clean the gear teeth and exposed surfaces of the

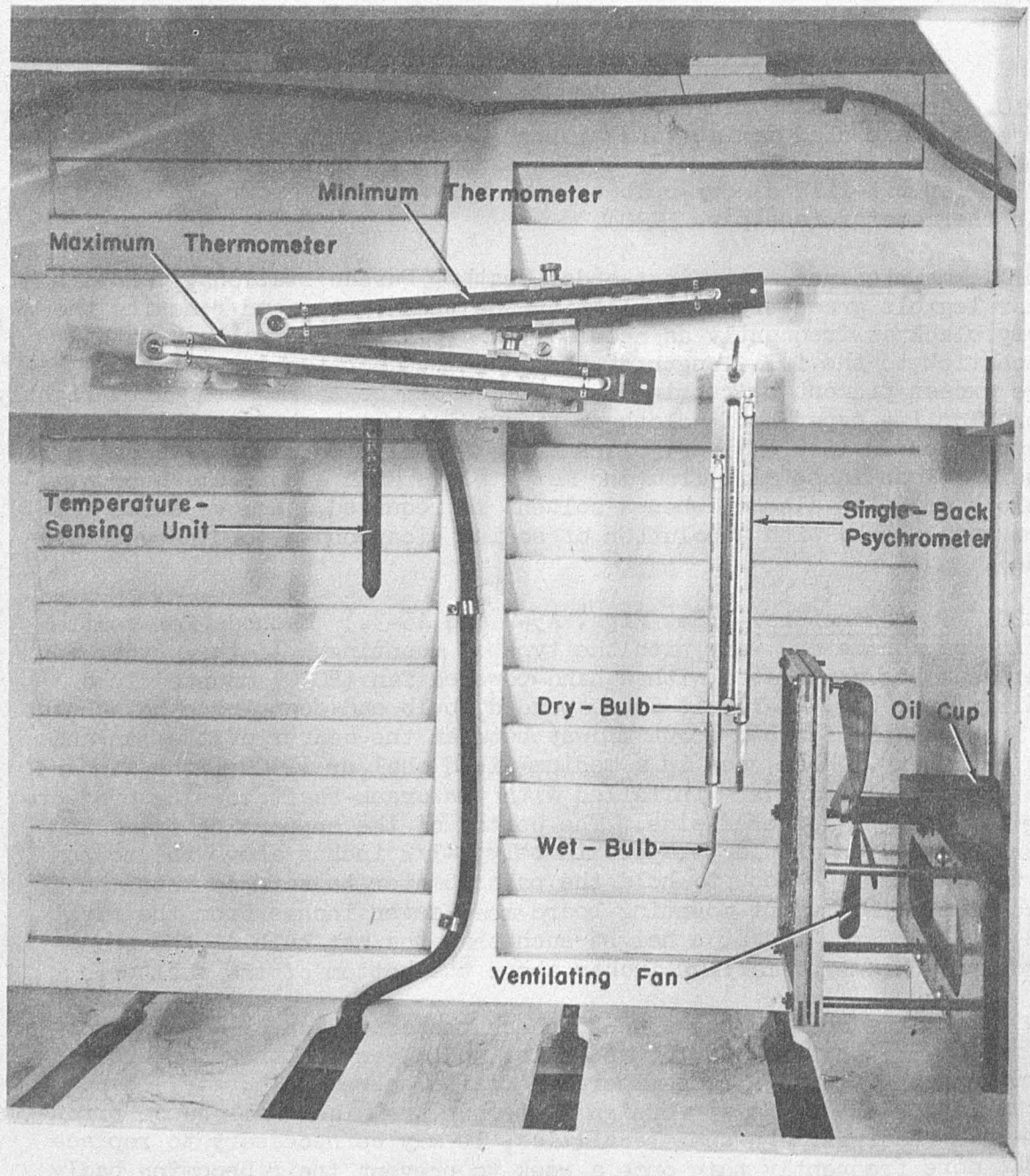

Fig. A5-1. Fan-ventilated, single-back psychrometer mounted in medium shelter with maximum and minimum thermometers and the temperature-sensing unit of the telethermoscope.

whirling psychrometer (H010) by removing dirty grease, oil, and loose dirt. Lubricate the bearings with a few drops of viscous motor oil (SAE 30 or higher) or, in the case of gear teeth and worn bearings, with a thin film of light grease (vaseline, etc.).

A5021.2. Oil the bearings of psychrometer fans (H030) at least once a month with one or two drops of light oil, such as anemometer oil if the bearings are only slightly worn, and SAE 10 or 20 if the bearings are more badly worn. To facilitate oiling, the hinges on the caps of the oil cups should face the rear of the shelter. The cups can be rotated with a pair of pliers if a No. 1 drill (.228 inch diameter) or equivalent diameter rod is inserted in each cup to prevent crushing it.

A5030. Maximum and Minimum Thermometers.—A maximum and a minimum thermometer are mounted on a common support (P020) that is designed to facilitate resetting them (see pars. 5162 and 5171), and to hold the thermometers in fixed positions between observations.

A5030.1. Installation.—The base plate of the support is mounted with the longer sides of the support vertical, and with the supporting stud for the minimum thermometer above and to the right of the maximum thermometer stud (see Fig. A5-4). The thermometer backs are held by clamps on the ends of the studs. When the support is installed in this manner and the thermometers are set, the bulb end of the minimum thermometer is inclined about five degrees below the horizontal, and the bulb end of the maximum thermometer is inclined about five degrees above the horizontal. The support is mounted at approximately eye-level, either on the mounting board or on a separate post (see Fig. A5-18). When the support is installed on the mounting board of the medium-sized shelter (P300), the left edge of the thermometer support should be about one inch to the right of the vertical center-line of the shelter, and not more than two inches to the left of this position if it is installed on a separate post. When installed in a large shelter (P310 or P311), the left edge of the support should be about nineteen inches from the left side of the shelter. When comparative readings indicate that vibration is responsible for erroneous minimum temperature readings from minimum thermometers, the support will be mounted on a separate wooden post, such as a 4" x 4", or other corrective action will be taken. The post, set in the ground, should extend through the floor of the shelter to, or slightly above, the level of the top of the cross board and immediately in front of the location specified for mounting the support on the cross board (see par. A5610). It should not touch any part of the shelter.

A5030.2 Maintenance.—Once a month, place a drop of SAE 10 or anemometer oil in the oil hole of the longer stud.

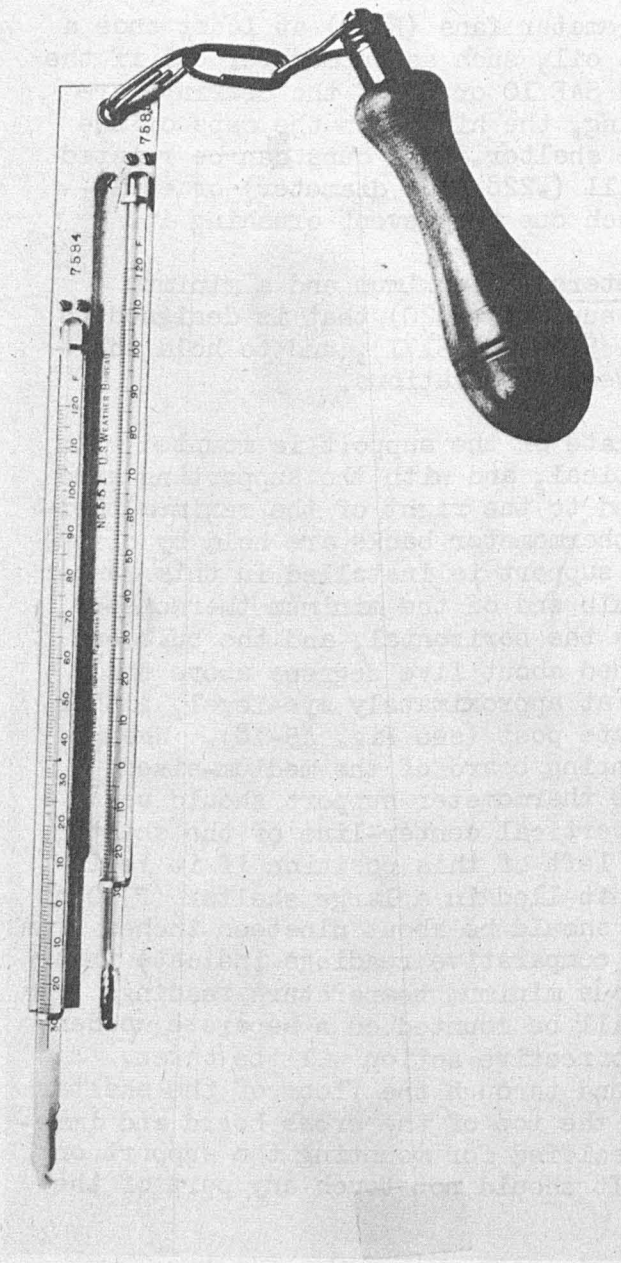

Fig. A5-2. Sling psychrometer.

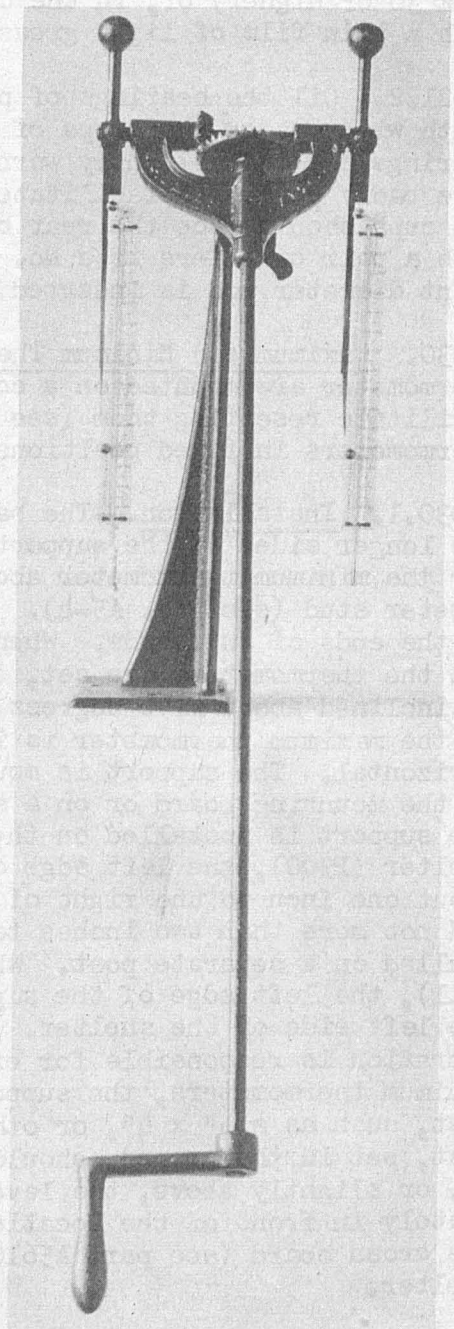

Fig. A5-3.
Whirling psychrometer.

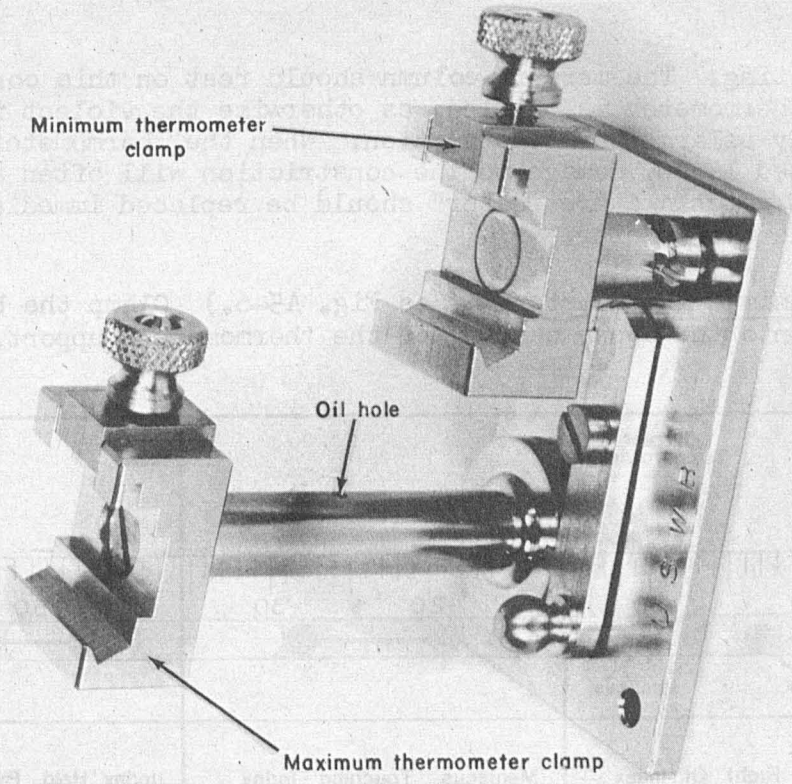

Fig. A5-4. Maximum and minimum thermometer support.

A5031. Maximum Thermometer.—(See Figs. A5-1 and A5-5.) Clamp the thermometer in the lower carrier of the support at a point 3-1/2 inches from the high-temperature end of the back.

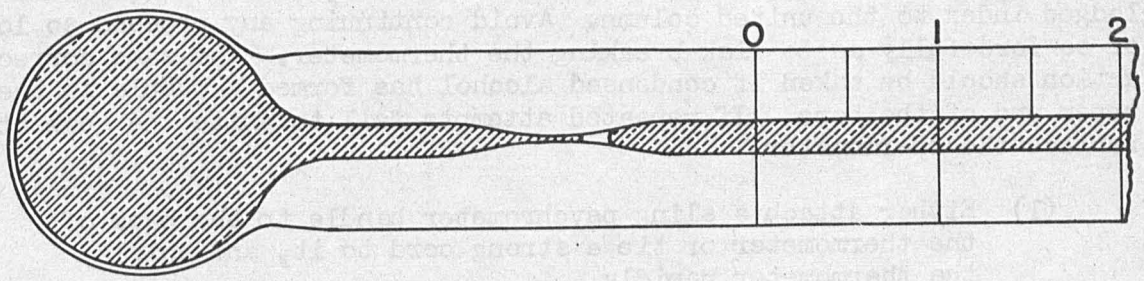

Fig. A5-5. Maximum thermometer, bulb end, showing restriction in bore.

A5031.1. Maintenance.—A defective maximum thermometer is termed a "retreater" when the constriction is so large that, as the temperature lowers, some of the mercury from the bore retreats through the constriction into the bulb. Even though carefully lowered prior to being read, some of the mercury in the stem of a "retreater" will pass through the constriction. When damage to the constriction occurs it is usually

upon resetting. The mercury column should rest on this constriction before the thermometer is whirled, as otherwise the violent impact of the mercury may enlarge the constriction. When the thermometer is examined in reflected light, damage to the constriction will often appear as an iridescent patch. A "retreater" should be replaced immediately with a serviceable thermometer.

A5032. Minimum Thermometer.—(See Fig. A5-6.) Clamp the back at its midpoint into the upper carrier of the thermometer support.

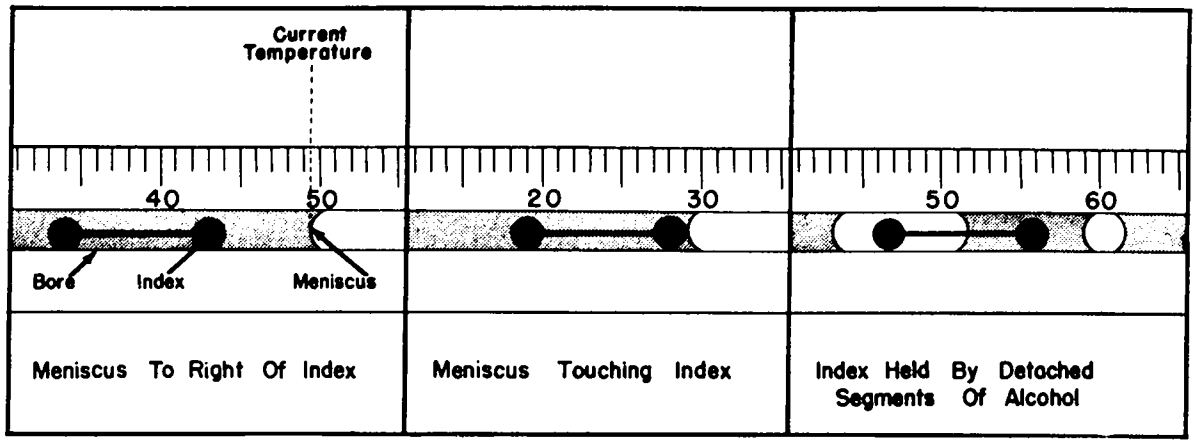

Fig. A5-6. Minimum thermometer.

A5032.1. Maintenance.—One of the methods described below will be used to reunite segments of a separated alcohol column, or to return a dislodged index to the united column. Avoid continuing any process so long or so forcefully as to risk breaking the thermometer. The same corrective action should be taken if condensed alcohol has formed a bubble in the upper end of the bore. If repeated attempts fail to unite the segments, replace the thermometer.

(1) Either attach a sling psychrometer handle to the back of the thermometer or tie a strong cord to it, and whirl the thermometer rapidly.

(2) Hold the thermometer with the bulb end extended away from the body and with the metal back of the thermometer held vertically. Quickly swing the thermometer downward through an arc of three or four feet (see Fig. A5-7). Stop the motion suddenly but without striking the thermometer against other objects.

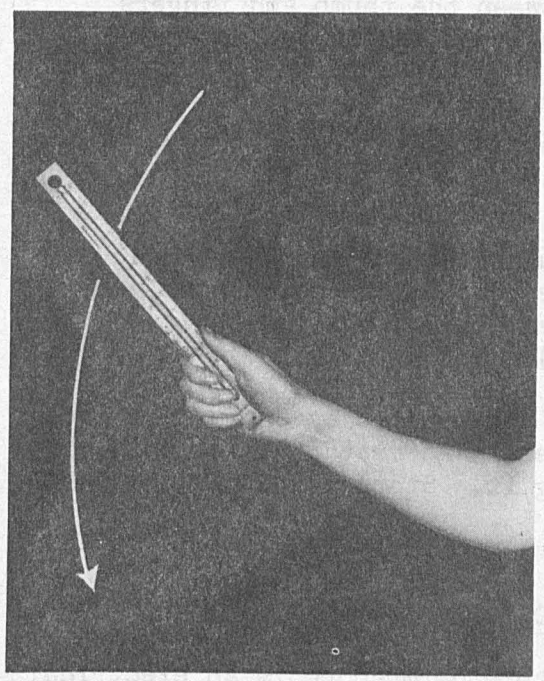

Fig. A5-7.

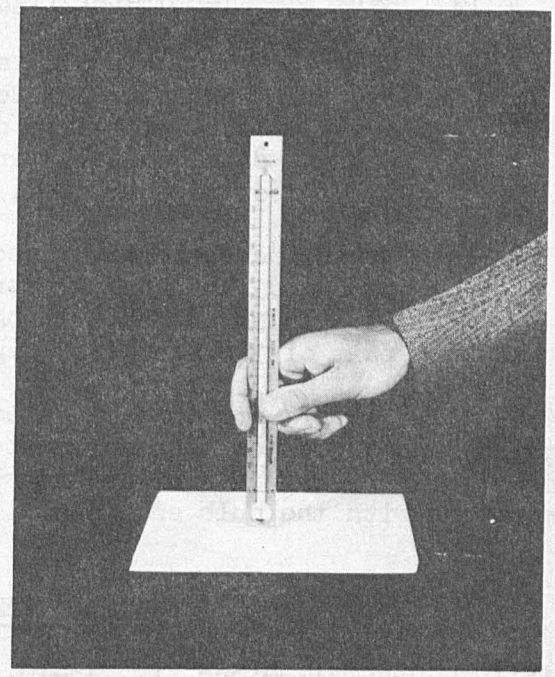

Fig. A5-8.

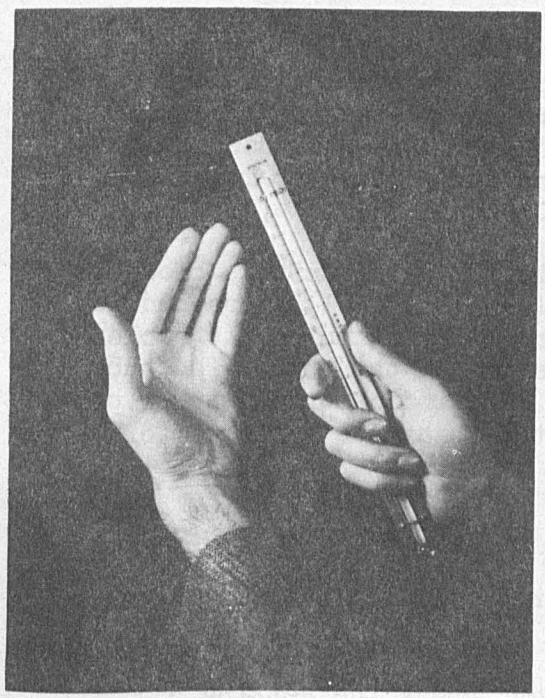

Fig. A5-9.

Fig. A5-7. Reuniting alcohol column of minimum thermometer by centrifugal force.

Fig. A5-8. Reuniting alcohol column of minimum thermometer by striking thermometer against firm object.

Fig. A5-9. Reuniting alcohol column of minimum thermometer by striking thermometer against palm of hand.

(3) Hold the thermometer lightly between the thumb and fingers with the bulb end down. Tap the lower end of the metal back against the top of a table or other firm object covered with several thicknesses of cloth or paper to prevent the impact from damaging the thermometer (see Fig. A5-8). Gradually increase the striking force until the defect is corrected.

(4) Grasp the thermometer securely with the bulb end extended downward, and sharply strike the edge of the metal back, at a point adjacent to the broken column, against the palm of the hand (see Fig. A5-9).

A5032.11. After correcting a defect in a thermometer by one of the foregoing methods, allow the thermometer to remain at rest with the bulb end down for at least an hour before resetting it. Store spare minimum thermometers with the bulb end down.

A5100. TELETHERMOSCOPE

A5110. General.—(See Fig. A5-10.) The telethermoscope is an electrical resistance thermometer for remote indication of air temperature. It consists essentially of a temperature-sensing element (C400) - a coil of nickel wire sealed in a brass tube - and an indicating device (C530). The indicating apparatus is a modified Wheatstone bridge having a galvanometer and a variable resistance attached to a dial with a scale graduated in degrees Fahrenheit. The temperature-sensing element, the resistance of which varies with temperature, completes the circuit. Temperature is read from the scale after the galvanometer has been adjusted to indicate a balanced circuit. The temperature scale, in one-degree intervals, extends from -40° or -50° to 120°F.

A5120. Installation.—Locate the temperature-sensing unit as close to the center of the shelter as practicable (see Fig. A5-1). Suspend it vertically from the back of the mounting board by clamping the cable to the board about one or two inches from the end of the tube. The tube should not touch any surrounding objects. The indicator is either panel-mounted in an instrument cabinet, or mounted in a case designed for desk use.

A5130. Observational Routine.—To obtain a temperature reading:

(1) Release the galvanometer pointer by sliding the clamping button.

(2) Before depressing the circuit key, check the setting of the pointer to see that the open circuit reference

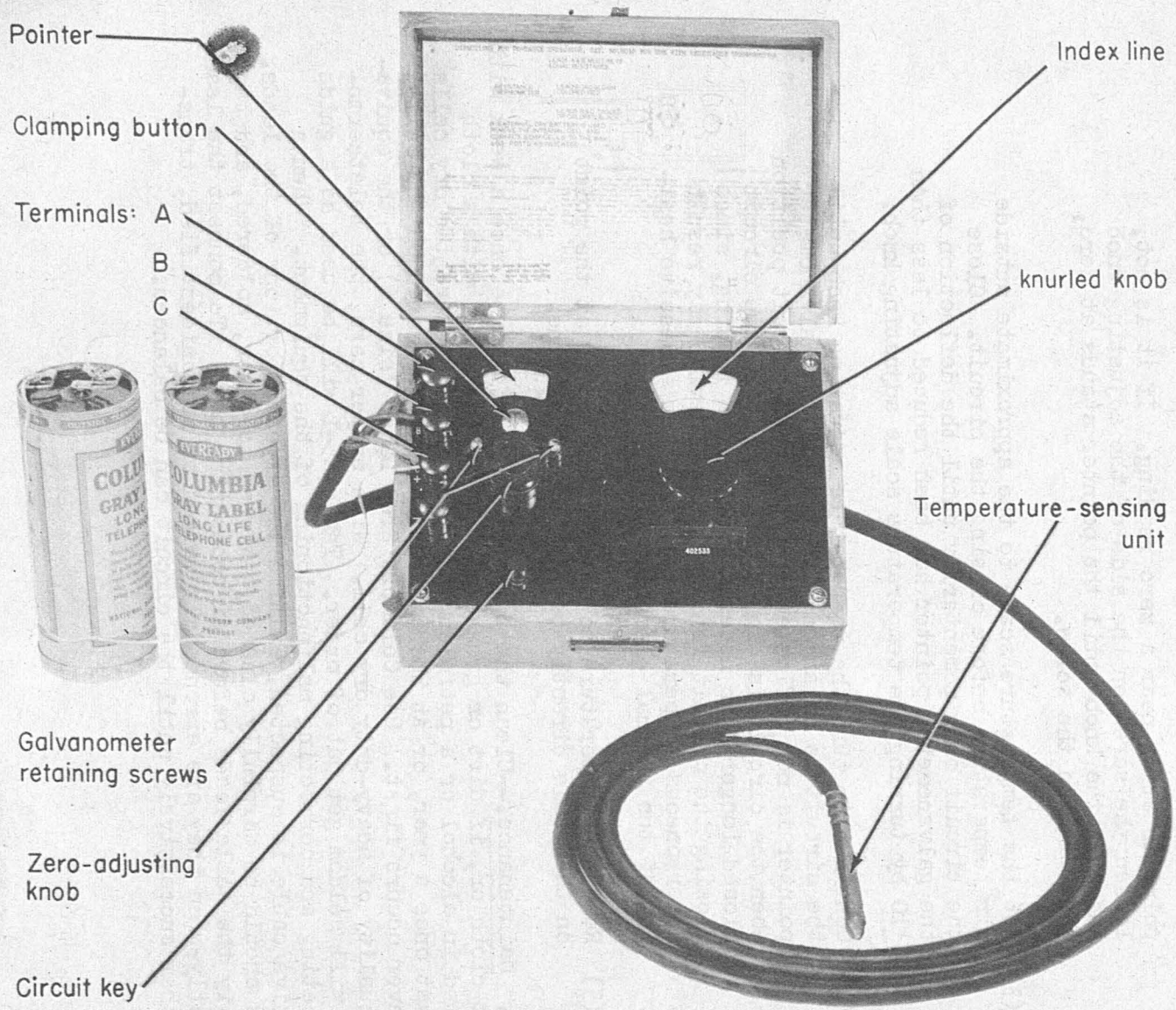

Fig. A5-10. Telethermoscope.

point is at or near a zero reading. If it is not, loosen the screw on the side of the adjusting knob and turn the knob until the pointer stands at zero, then tighten the screw.

(3) Set the temperature scale to the approximate outside air temperature before closing the circuit. Close the circuit only momentarily until the deflection of the galvanometer pointer has been reduced to less than ±10 by turning the temperature scale adjusting knob.

(4) Continue to turn the temperature adjusting knob until the circuit is balanced; i.e., until the galvanometer pointer is not deflected from its open-circuit position when the circuit is closed. Do not leave the circuit closed longer than necessary to take a reading, since closing the circuit for a prolonged period may result in erroneous temperature readings from excessive heating of the thermal element.

(5) Read the temperature to degrees and tenths at the point on the scale directly beneath the index line.

A5140. Maintenance.—Clean the temperature-sensing tube once a week with a soft cloth or, if dirt or grease adheres to the tube, with a cloth dampened in alcohol or a petroleum-base solvent. Replace the dry cells at least once a year, or at the expiration date indicated on the cells, whichever occurs first. Use Columbia Grey Label (size 6) or the equivalent quality of heavy-duty dry cell. With proper care, the telethermoscope will seldom get out of order. Table A5-1 will be used as a guide in locating and correcting malfunctioning of the equipment. When a defective cable is suspected, examine the exposed portions of the leads. Breaks should be carefully cleaned, twisted together, soldered, and taped. Identify the cable leads before disconnecting them. To connect the leads correctly when they are erroneously marked or are unidentified, transpose them successively until the circuit can be balanced.

Table A5-1
Trouble-Correction Guide for the Telethermoscope (C530)

Symptom	Procedure
(1) When the circuit key is depressed, the galvanometer pointer is deflected violently regardless of the temperature scale adjustment.	Test for an open circuit in the leads to the "A" and "B" binding posts.
(2) No deflection of galvanometer pointer (circuit closed) regardless of setting of temperature scale.	Test for a dead or disconnected power supply.
(3) Erratic movement of galvanometer pointer; impossible to make an exact balance.	Test leads for defective insulation or a poor connection at the binding posts.
(4) Sudden deflection of the pointer when the circuit is opened.	Test for defective insulation.
(5) Sluggish action of galvanometer pointer, or magnitude of deflection slight; impossible to make an exact balance.	Test the battery. If the battery is satisfactory, the galvanometer may be defective. As a further check on the galvanometer, disconnect the cable leads to indicator terminals A, B, and C, and replace them with the test coil (see Fig. A5-11). The circuit should then balance at a temperature setting of -20 degrees.

A5141. Use of Volt-Ohmmeter.—The continuity of the cable and the condition of the temperature-sensing coil may be tested with a volt-ohmmeter (supplied to raob and ceilometer stations only). Disconnect the leads from the indicator and measure the resistance between each pair of leads. The resistance between the ends of leads A and B, or A and C, should be between 80 and110 ohms. If the resistance between the ends of leads B and C is not infinite, these leads may be assumed to be satisfactory. Infinite resistance between the ends of any pair of leads is indicative of an open circuit.

A5142. Defective Galvanometer.—When it is determined that the galvanom-

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eter is defective, order a replacement from the Central Office. Upon receipt, remove the defective galvanometer from the indicator by loosening the screws fastening it to the plate, and return it to the Instrument Division. When other defects cannot be corrected locally inform the Regional Office.

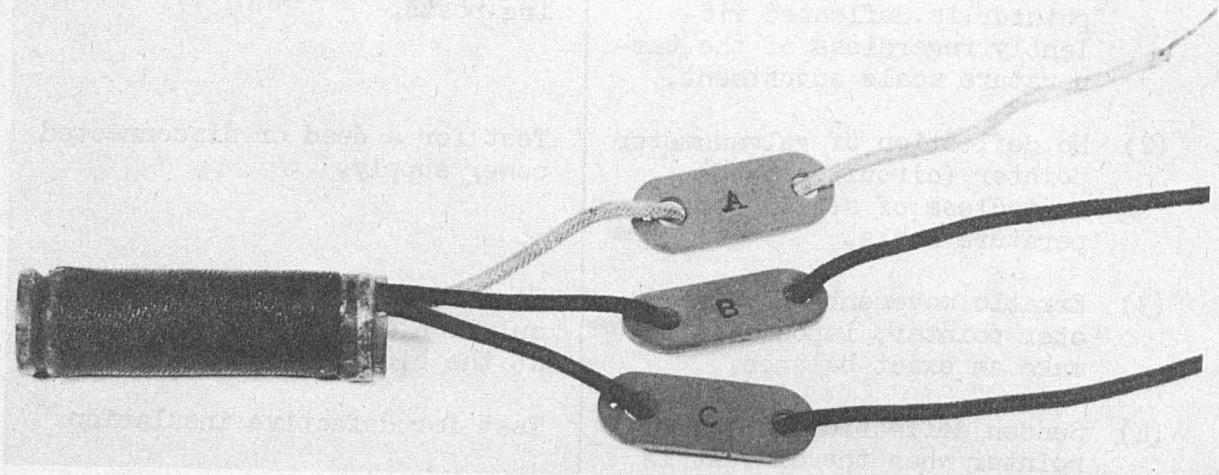

Fig. A5-11. Telethermoscope test coil.

A5200. TELETHERMOMETER

A5210. General.—The telethermometer is an electrical-resistance thermometer similar in principle of operation to the telethermoscope. It consists of a temperature-sensing element (C400) and a ratio-bridge type of indicator (C531). This indicator is self-balancing, and temperatures are read directly from it.

A5220. Temperature-Sensing Unit.—The temperature-sensing units used for both the telethermometer and the telethermoscope are interchangeable, although they differ in appearance. The unit, which is provided with a mounting bracket for attachment to a 3/4- to 7/8-inch board, will be installed as near the center of the shelter as practicable. When installation is made in a medium-sized shelter (P300), attach the unit, with the cable end uppermost, to the cross board at a point one or two inches to the left of the vertical center line of the shelter, or three to four inches from the center post if one is used (see Fig. A5-18). When installation is made in a large shelter (P310 or P311), install the unit either vertically with the cable end up, by attaching the bracket to the cross board, or horizontally with the tube pointed toward the back, by attaching the bracket to the vertical support for the cross board about twelve to fifteen inches above the bottom of the shelter.

A5230. Indicator.—(See Fig. A5-12.) The indicator (C531) is powered from a 110-volt, a-c power supply. The scale of the meter is graduated in one-degree increments from -50°F. to 120°F. Voltage fluctuations between 95 and 120 volts should not reduce the overall accuracy of the indications. The power-supply voltage should be measured across the power input to the instrument under varying load conditions (good and bad weather, night, day, etc.) until the normal voltage fluctuations are known for the circuit to which the instrument is attached. If the voltage supply is observed to fluctuate frequently below 95 volts and above 120 volts, notify the Regional Office promptly. The indicator is mounted either in a standard 19-inch, size E, instrument-panel mounting, or in an enclosed metal case for desk use.

A5240. Wiring.—A three-wire cable connects the temperature-sensing unit to the indicator. The cable may be any desired length (up to about 5000 feet) and size, provided that the resistance of any lead does not exceed five ohms. The resistance of the three leads must be equal. Solder and tape all joints carefully. Wrap the joints first with rubber tape and then with friction tape. Be careful not to attach the 115-volt, a-c power supply to terminals A, B, or C. Attach the red or green lead of the temperature-sensing unit to terminal A. The black and the white leads are interchangeable between terminals B and C.

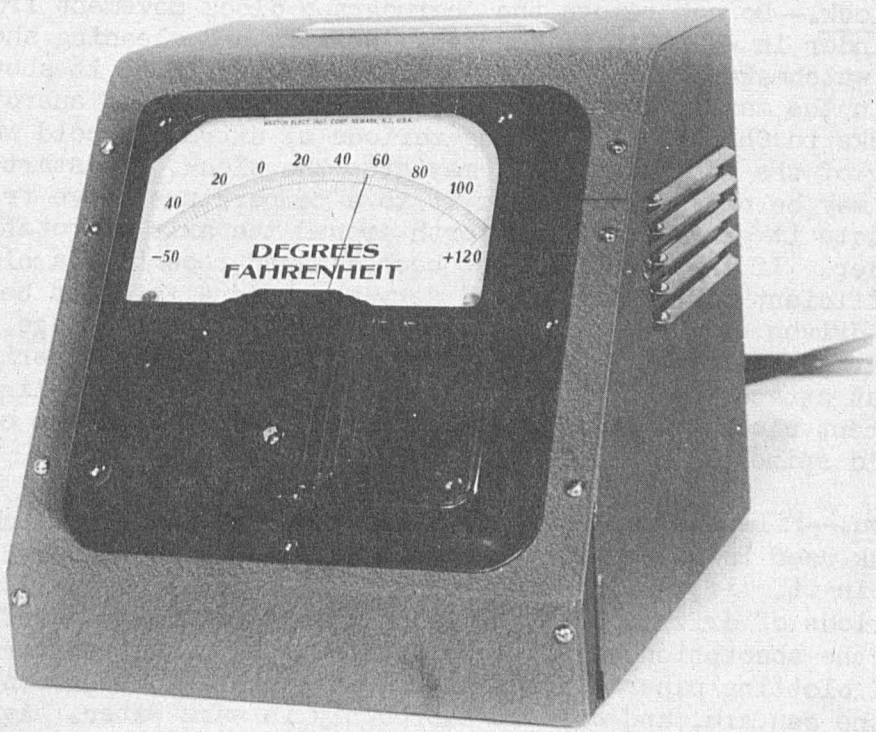

Fig. A5-12. Telethermometer.

A5250. Observational Routine.—Tap the indicator before each observation if periodic checks indicate that the pointer is subject to sticking. Note: The pointer on the indicator does not return to zero when the power is off.

A5260. Maintenance.—The temperature-sensing tube of the telethermometer should be cleaned weekly with a soft cloth to prevent an accumulation of dirt. If the indicator is known to be defective, order a replacement from the Central Office through the Regional Office. If the source of the trouble is in the temperature tube or cable, or the source is unknown, notify the Regional Office of the nature of the trouble.

A5300. THERMOGRAPH

A5310. Maintenance.—(See Fig. A5-13.) Once a week, remove any accumulation of dirt or grease. Use a soft cloth or camels-hair brush to brush loose dirt from the Bourdon tube. If any foreign substance should stick to the tube, remove it with a soft cloth dampened in water or alcohol, ammonia, or a suitable petroleum-base solvent, but do not use an abrasive cleaner on the tube. If the plating on the Bourdon tube tarnishes or flakes off, a new thermograph should be requisitioned.

A5311. Clock.—Do not remove the thermograph clock movement from the chart cylinder in which it is mounted. Repairs and cleaning should be done by a watchmaker. If the clock gains or loses time, it should be adjusted in the manner described under the maintenance of aneroid barograph clocks in Chapter A7. During periods of extremely cold weather, thickening of the lubricating oil may stop the clock. To start the clock, it may be necessary to warm it to a temperature above freezing and to rotate it gently back and forth around the axis of rotation of the cylinder. If the clock has not been cleaned recently, a cleaning may be sufficient to restore normal service. Undue friction between the clock-driven gear and pinion may also cause clock stoppage. The pinion gear position may be adjusted by means of the three peripheral screws that attach the clock mechanism to the base of the cylinder. If a replacement clock and spindle are received, return both the old clock and the old spindle.

A5312. Pen.—Fill the pen barrel not more than half-full of ink. The special ink used is somewhat hygroscopic because of the alcohol and glycerine in it. If, during conditions of high relative humidity or prolonged periods of drizzle or light rain, the pen tends to overflow as a result of the absorption of water by the ink, empty the pen barrel with a piece of blotting paper and refill. About once a month, remove the pen from the pen arm, and wash it thoroughly in warm water. Avoid bending the pen or pen arm. Replace the pen if it becomes too blunt to draw a fine line. If the ink does not flow readily from the pen, pull a small piece of hard, bond paper or cellophane between the nibs of the pen.

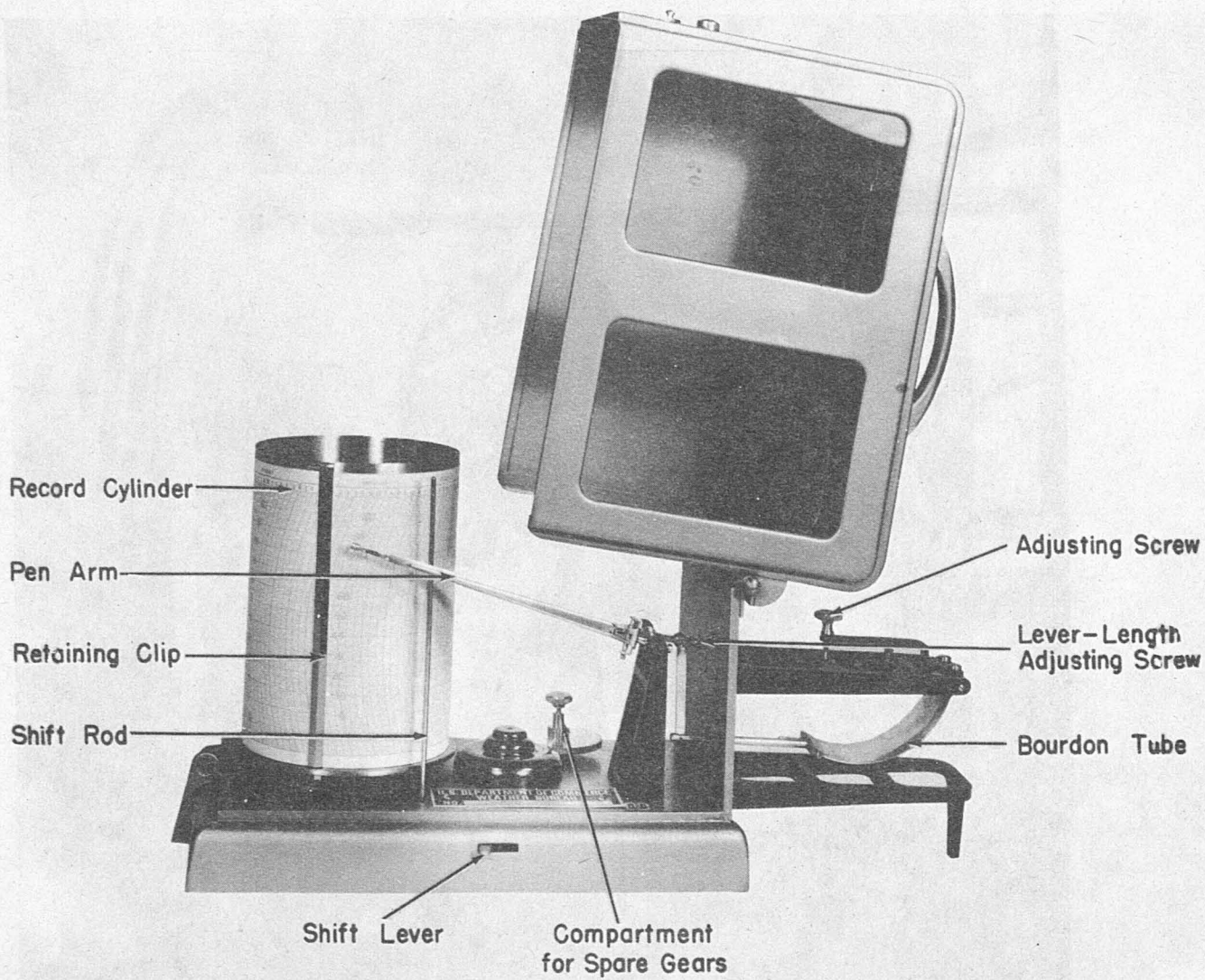

Fig. A5-13. Bourdon-tube thermograph.

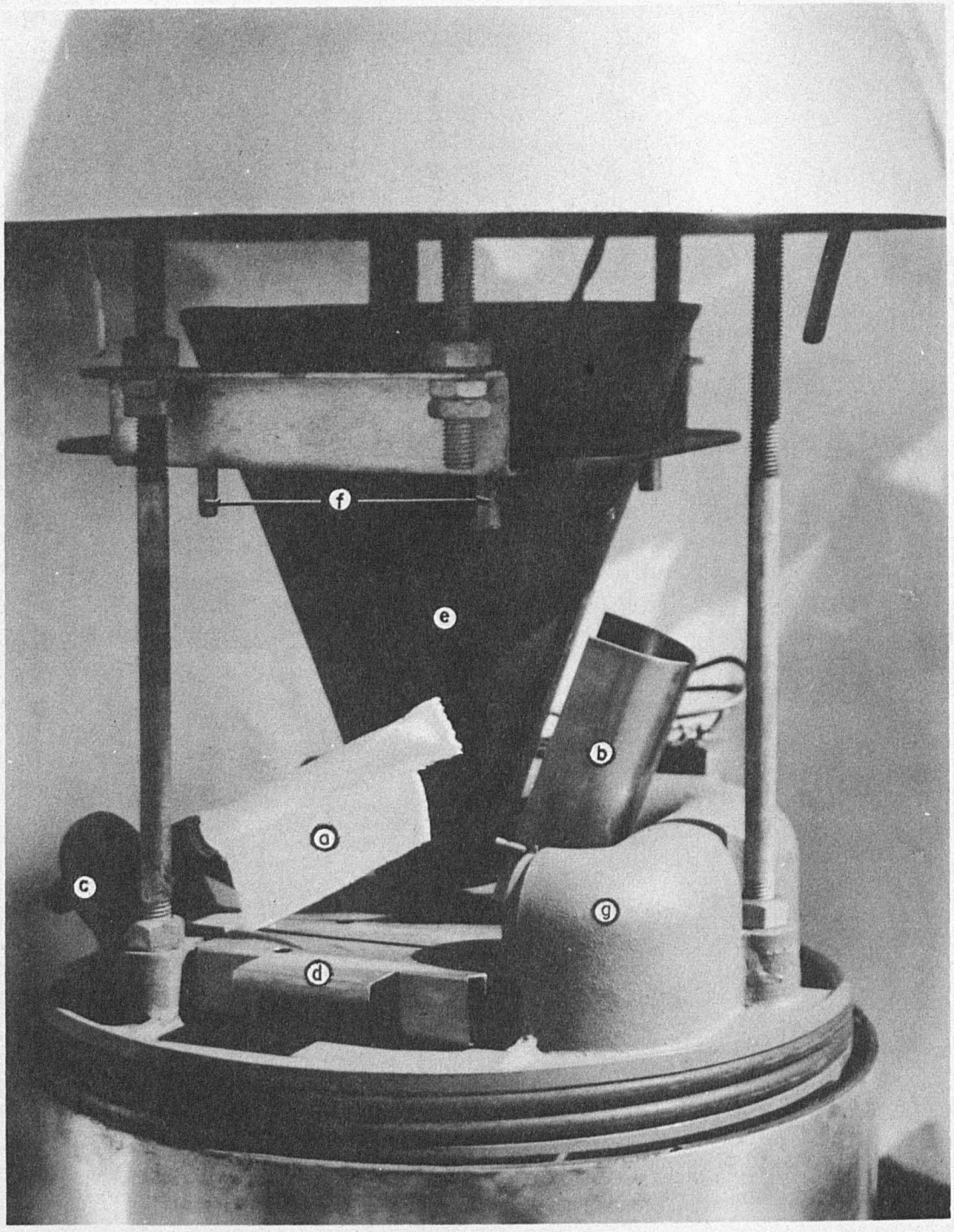

Fig. A5-14. Telepsychrometer - exposed unit. Illustrated are (a) wick on wet thermohm, (b) radiation cover for wick, (c) pivoted tilting support for wet thermohm, (d) water tray cover, (e) conical reservoir, (f) positioning pins for conical reservoir, (g) ventilation duct.

A5400. TELEPSYCHROMETER

A5410. General.—The telepsychrometer measures dry-bulb temperatures and wet-bulb depressions. The L&N (Leeds and Northrup) resistance measuring, multiple-point type of instrument measures dry-bulb temperatures from 20° to 120°F., and wet-bulb depressions from 0° to 50°F. at dry-bulb temperatures above freezing. The two basic units of the telepsychrometer are the sensing unit and the recorder. The length of cable connecting the sensing unit to the recorder should be kept to a minimum, and must not exceed 1000 feet.

A5411. Sensing Unit.—(See Fig. A5-14.) The sensing unit contains two continuously ventilated resistance thermometers, called thermohms, which correspond to the dry- and wet-bulb thermometers of mercurial psychrometers. One of the thermohms is covered by a wick that is partially immersed in a tray of water automatically replenished from a conical reservoir. To gain access to the thermohms and reservoir, loosen the knurled nuts on each of the three supporting legs near the bottom of the cylindrical housing. Turn the housing slightly before lowering it over the legs.

A5412. Recorder.—(See Fig. A5-15.) At approximately one-minute periods, the recorder prints alternately the current dry-bulb temperature and the depression of the wet bulb on a chart whose vertical lines represent 1° intervals of dry-bulb temperature and 0.5° intervals of depression (see Fig. A5-16). The dry-bulb temperature trace consists of a dot and the figure "1" printed simultaneously. The wet-bulb depression trace consists of a dot and the figure "2." The time (LST) is indicated on the chart by the horizontal lines identified by the figures 0 to 23 printed near the left margin.

A5412.1. A complete description of the recorder mechanism, charts, and details of operation and maintenance, will be found in the L&N booklet furnished with the recorder. The small calibration dial in the upper left corner of the recorder should not be adjusted except by a technician. To reduce the chance of accidental movement of the dial, use scotch tape to fasten it securely against the recorder chassis.

A5420. Observational Routine.—Read dry-bulb temperatures and wet-bulb depressions to degrees and tenths at the left edge of the dots.

A5421. Maximum and Minimum Temperature.—Read maximum and minimum dry-bulb temperatures, for any specified period, on the portion of trace "1" recorded farthest to the right and left, respectively, during the period.

A5422. Obtaining Psychrometric Data.—The method of obtaining temperature, depoint, and relative humidity values varies with operating

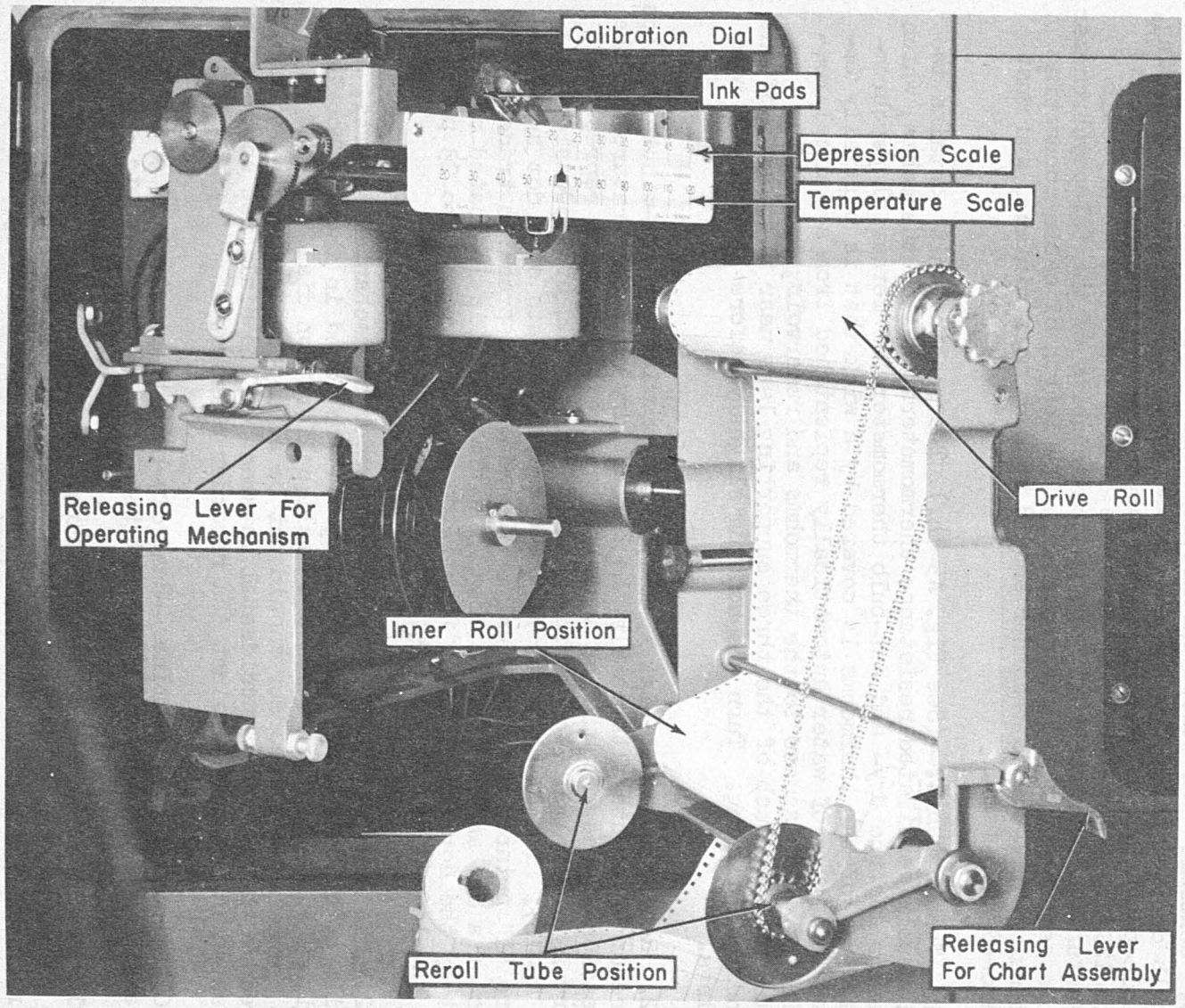

Fig. A5-15. Telepsychrometer recorder with chart assembly swung outward.

conditions as described below and is tabulated in Table A5-2. At wet-bulb temperatures, near freezing, determine that the wet bulb is unfrozen before using the wet-bulb depression data from the telepsychrometer.

(1) When the telepsychrometer wet-bulb temperature is higher than 33°F.:

(a) Obtain the dry-bulb temperature from the telepsychrometer.

(b) Compute wet-bulb, dew-point and relative-humidity values from the dry-bulb temperature and wet-bulb depression readings of the telepsychrometer.

(2) When the telepsychrometer wet-bulb temperature is 33°F. or less, and the dry-bulb temperature is above 20°F.:

(a) Obtain the dry-bulb temperature from the telepsychrometer.

(b) Derive dew-point data from wet- and dry-bulb readings of a mercurial-thermometer psychrometer. Whenever the dew point so computed is higher than the telepsychrometer dry-bulb temperature, both the dew point and the wet-bulb temperature will be regarded as the same as that of the telepsychrometer dry-bulb.

(c) With the exception stated in (b), the wet-bulb temperature will be determined from Diagram A5-1 or A5-2 (see par. A5422.1). The arguments are the dry-bulb temperature from the telepsychrometer and the dew point computed from mercurial psychrometer readings.

(d) Derive relative humidity values from the telepsychrometer dry-bulb temperature and the dew point obtained in (2(b)).

(3) When the telepsychrometer dry-bulb temperature is 20°F. or less, temperature, dew point, and relative humidity data will be obtained from mercurial or alcohol psychrometers.

TABLE A5-2. Methods for Obtaining Dry- and Wet-Bulb, Dew-Point, and Relative-Humidity Values at Stations Using Telepsychrometers.

Condition / Data to be derived	Telepsychrometer wet bulb higher than 33°F.	Telepsychrometer dry bulb higher than 20°F., wet bulb 33°F. or lower.	Telepsychrometer dry bulb 20°F. or less.
Dry Bulb	From telepsychrometer.	From telepsychrometer.	From psychrometer with mercurial or spirit thermometers.
Wet Bulb	From telepsychrometer dry-bulb temperature and wet-bulb depression	From telepsychrometer dry bulb and mercurial psychrometer dew point. (Use Diagram A5-1 and A5-2.)	do
Dew Point	From dry- and wet-bulb temperatures above.	From mercurial psychrometer dry- and wet-bulb values.	From mercurial psychrometer dry- and wet-bulb values.
Relative Humidity	do	From telepsychrometer dry bulb and mercurial psychrometer dew point.	do

A5422.1. Psychrometric Diagrams.—Diagram A5-1 is used at stations whose mean station pressure is 29.5 inches or more, and Diagram A5-2 is used at stations whose mean station pressure is less than 29.5 inches, to obtain the wet-bulb data required by par. A5422(2). To obtain the graphical value of wet-bulb temperature corresponding to the arguments dry-bulb temperature and dew point:

(1) Locate the intersection of the horizontal line corresponding to the dew-point temperature and the slanting line corresponding to the dry-bulb temperature. Interpolate to tenths of degrees when necessary.

(2) Read the wet-bulb temperature to tenths of degrees from the adjacent vertical lines.

EXAMPLE

Given: 1. Mercurial dew-point temperature of 20.0°.

2. Telepsychrometer dry-bulb temperature of 27.7°.

3. Mean station pressure of 29.62 inches.

Computation: Enter Diagram A5-1 along the horizontal 20.0° line and the slanting 27.7° line (interpolated). The vertical temperature line of 25.5° (interpolated), passing through their point of intersection, is the wet-bulb temperature.

A5423. Charts.—At each six-hourly observation, enter a short line followed by the notation "6H" to the right of the dry-bulb reading.

A5423.1. Each day, stamp the month, date, and year on the extreme right side of the form near the noon time line. At the time the form is removed from the recorder, enter the station name and the dates of beginning and ending of the record at the end of the traces and approximately midway between the margins of the form. Beneath the station name and near the end of the traces, identify the ordinates of the wet-bulb depression and dry-bulb scales by labeling them in increments of 10°F. Identify each set of labels as "1-dry bulb" and "2-depression."

A5423.2. Telepsychrometer records completed during the month will be forwarded to WRPC not later than the second working day of the following month.

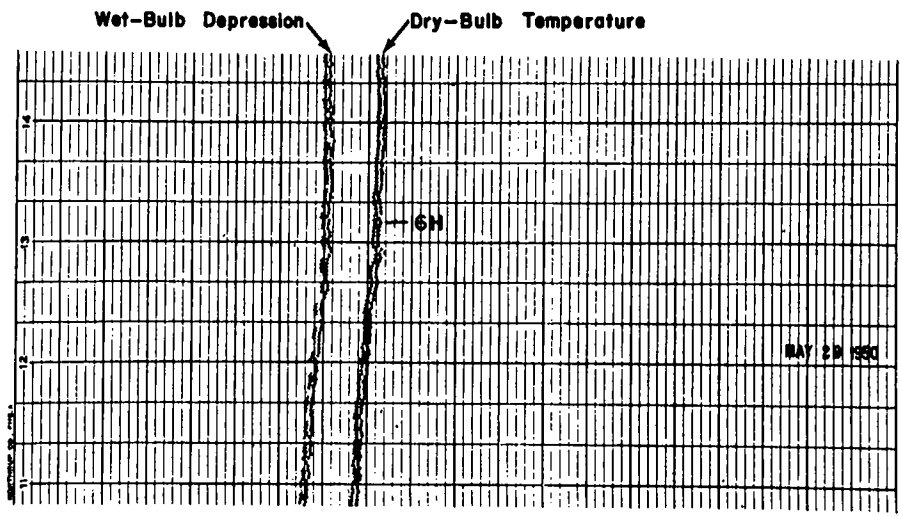

Fig. A5-16. Telepsychrometer chart.

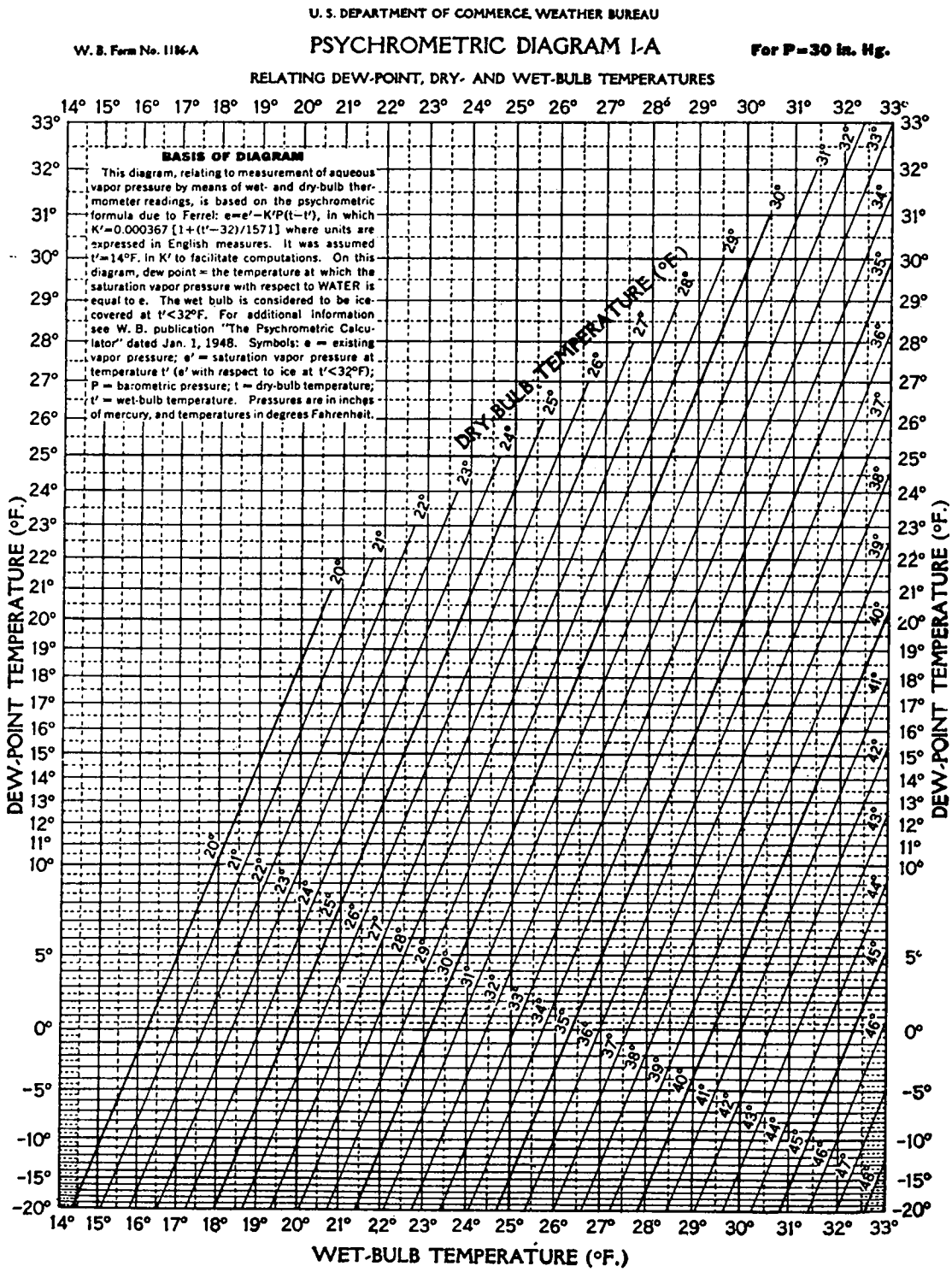

Diagram A5-1. Psychrometric diagram (for P= 30 in. Hg.)

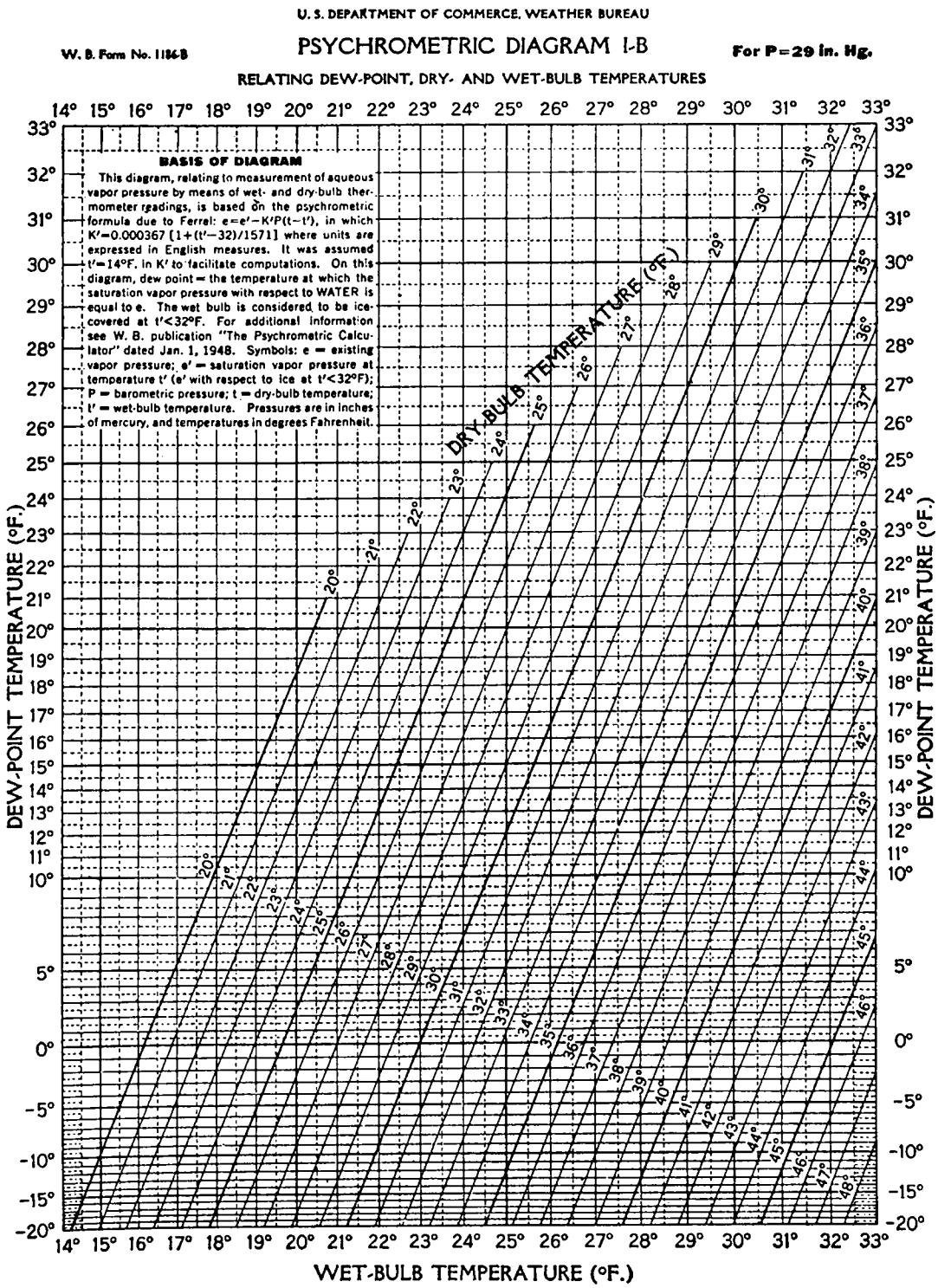

Diagram A5-2. Psychrometric diagram (for P= 29 in. Hg.)

A5424. Time Adjustment.—When a new roll of paper is first installed, or when the record is incorrect with respect to time, adjust the paper for time by turning the upper cylinder on the recorder, and enter the local standard time of the adjustment near the traces with arrows to indicate the points of adjustment.

A5430. Maintenance.—Service the equipment as required by the manufacturer's manual of instructions and the supplementary instructions below.

A5431. Sensing Unit.—Keep clean wicking on the wet thermohm. Discard the old wick and install a new one at least once a week, and more frequently if necessary to prevent it from becoming badly soiled. A pivot at one end of the wet thermohm permits the other end to be elevated for convenience in changing the wick. Clean the water tray when the wicking is changed. At least once a week, and more frequently if necessary, refill the conical reservoir with distilled water or rain water. To remove the reservoir for filling, lift it vertically upward until the positioning pins are clear of the supporting brackets. The reservoir is then removed horizontally. Check the ventilation ducts as frequently as is necessary to insure that the ducts do not become obstructed. Lubricate the fan motor bearings as specified in the manufacturer's instructions. To gain access to the motor, remove the conical cap on the exposure unit.

A5432. Recorder.—Before installing a new roll of chart paper on the recorder, unlatch the chart-drive frame and swing it outward until the centers for the supply roll and the rewind roll can be reached from the back of the frame (see Fig. A5-15). To insert a roll on the supply centers (innermost centers):

(1) Pull outward on the knob of the spring-loaded (left hand) center and remove the empty tube.

(2) Install the end of the roll on the right-hand center so that the circular perforations are toward the right.

(3) Release the spring-loaded center and align the left end of the roll.

(4) Thread the end of the paper (a) upward behind the guide rods, (b) over the drive roll at the top of the frame, and (c) downward across the face of the writing table, so that the margin of the paper with the elongated perforations lies under the signal disc on the edge of the writing table.

(5) Fit the perforations in the paper on the teeth of the drive roll so that the horizontal lines of the chart are parallel to the horizontal axis of the drive roll.

(6) Place the empty tube on the reroll centers by pulling outward on the knob of the spring-loaded rewind center and placing the notch in the right end of the tube over the key on the right-hand center.

(7) Release the knob and align the left end of the tube so that the spring-loaded center enters the end of the tube.

(8) Feed the end of the paper under the frame (the paper may be fed manually by turning the knob on the end of the drive roll), and attach the end of the paper on the reroll tube with tape or a gummed label.

(9) Turn the tube until several turns of paper have been rolled onto the tube and until the paper is taut across the face of the writing table.

(10) When the supply roll is properly aligned, the right end of the roll will be about 1/32" inside the flange on the right-hand reroll center. If it is not, loosen the knurled lock nut on the exposed end of the right-hand supply-roll center, and turn the knurled head of the adjusting screw as required to bring the paper into alignment.

(11) Tighten the lock nut, and swing the chart-drive frame back into its operating position.

A5432.1. Re-ink the ink pads as frequently as is necessary to prevent the impressions on the chart from becoming faint. Use a small piece of wood, such as a matchstick flattened at one end, to transfer the ink from the bottle to the pad. Place a small amount of ink on the pad and wait for the pad to absorb the ink. Repeat the operation until the pad is saturated. Remove any excess ink with a blotter.

A5432.2. Check the condition of the slidewire, moving parts, etc., once a month. Clean and lubricate the recorder, using medium weight, engine oil (about SAE 20), in accordance with lubrication instructions in the manufacturer's manual. Remove all excess oil. Keep the selector switches clean, and lubricate them with a thin film of vaseline. Clean the print-wheel-carriage shaft and guide rod by rubbing with an oily cloth.

A5500. INSTRUMENT SHELTERS AND EXPOSURES

A5510. Instrument Shelters.—The instrument shelter may be either the medium-sized type (P300 — see Fig. A5-17), or the large (P310 or P311) type. Both types have louvered sides with a double top to protect the

temperature-sensing units from precipitation, condensation, and radiation, while at the same time exposing them freely to the flow of air surrounding the shelter. In general, and unless otherwise specified in this chapter, temperature-sensing units will be mounted as close to the center of the shelter as practicable, and in a position where the operation of one instrument will not interfere with the operation of another. In any case, the temperature-sensing units will be mounted more than four inches from the sides, top, and bottom of the shelter.

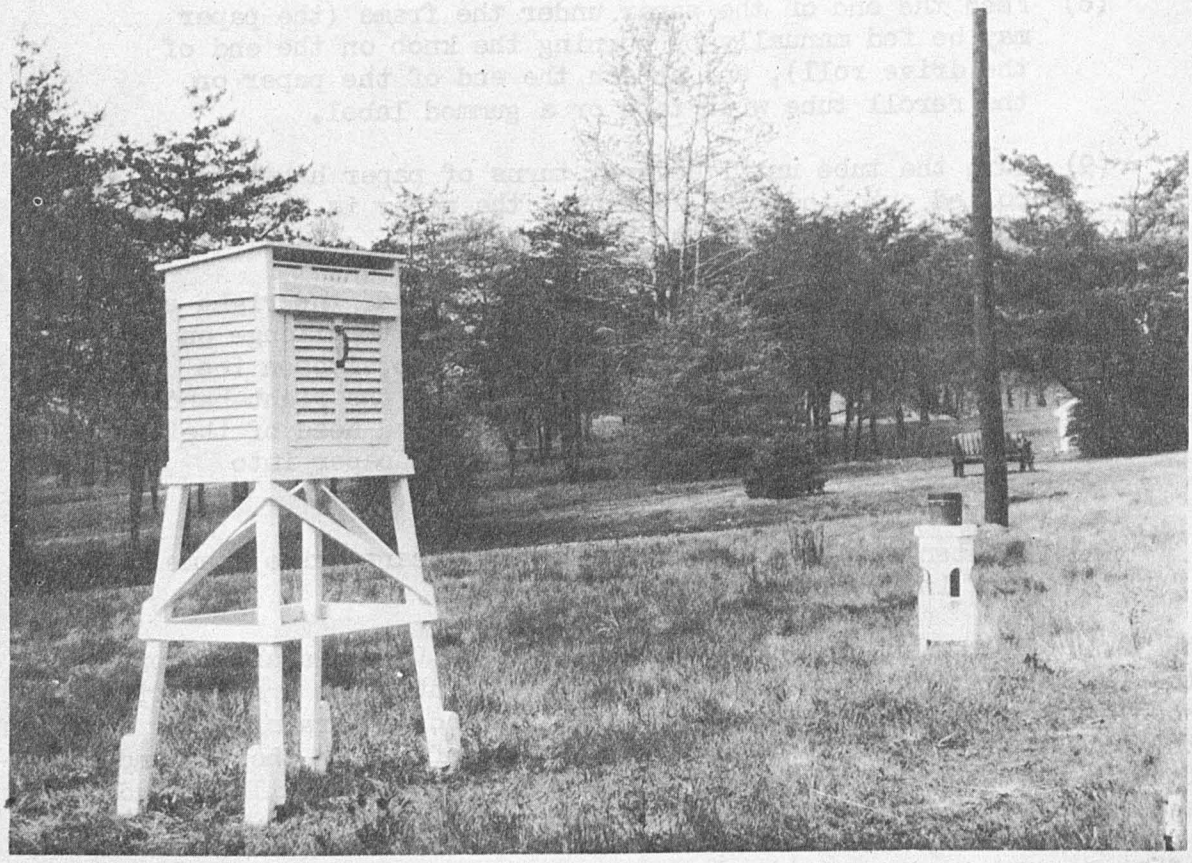

Fig. A5-17. Medium (cotton region) shelter with 8-inch gage.

A5520. Exposures.—(See Fig. A5-17.) Wherever possible, shelters will be installed over earth or sod at least 100 feet from any concrete or other hard-surfaced area, and not closer to any other object than four times the height of the object above the floor of the instrument shelter. Avoid roof installations if practicable. However, if it is necessary to locate the shelter on a roof, it should not be closer than 30 feet to any large, vertical reflecting surface (walls, etc.), exhaust fans, or cooling towers. The floor of the shelter should be approximately four feet

above the ground or roof, except that, if the shelter is mounted above a roof, the height may be greater than four feet in order to minimize radiation effects from the roof. To afford the interior of the shelter the greatest protection from direct solar radiation while the door is open, orient the shelter with the door facing north (in the Northern Hemisphere). Keep the shelter door closed when the instruments are not being read.

A5521. Illumination.—Use an electric lamp of not more than 25 watts in the shelter. Keep the lamp as far as practicable (at least ten inches) from any temperature-sensing element. Do not leave the lamp turned on any longer than is necessary to read the instruments.

A5522. Maintenance.—At first-order Weather Bureau stations, paint all surfaces of the shelter - outside and inside - at least yearly with glossy white, outside paint. If the metal supports show evidence of corrosion, clean the corroded area thoroughly, and apply a coat of red lead or other metal primer followed by a top coat of aluminum paint.

A5600. ENTRY ON WBAN-10

A5614. Entries in Columns 14A and 14B.—Authorization from the Central Office must be obtained for the entry of data other than dry- and wet-bulb temperature readings in columns 14A and 14B (see par. A11001.2). When the telepsychrometer wet-bulb temperature is 33° or lower and the telepsychrometer dry-bulb temperature is above 20°, enter the dry- and wet-bulb reading from the mercurial psychrometer in columns 14A and 14B respectively.

A5618. Dry Bulb (Col. 18).—Personnel at first-order observing stations where less than 24 record observations are taken daily will enter to whole degrees, the value of the corrected thermograph temperature indicated at thirty minutes past the hour when an hourly observation is not taken. If the thermograph fails, enter in parentheses the data obtained by interpolating between available recorded and observed data.

A5690. Telepsychrometer Operation (Col. 90).—Whenever operation of the telepsychrometer is interrupted, enter time operation ceased and resumed.

969474 O—51——12

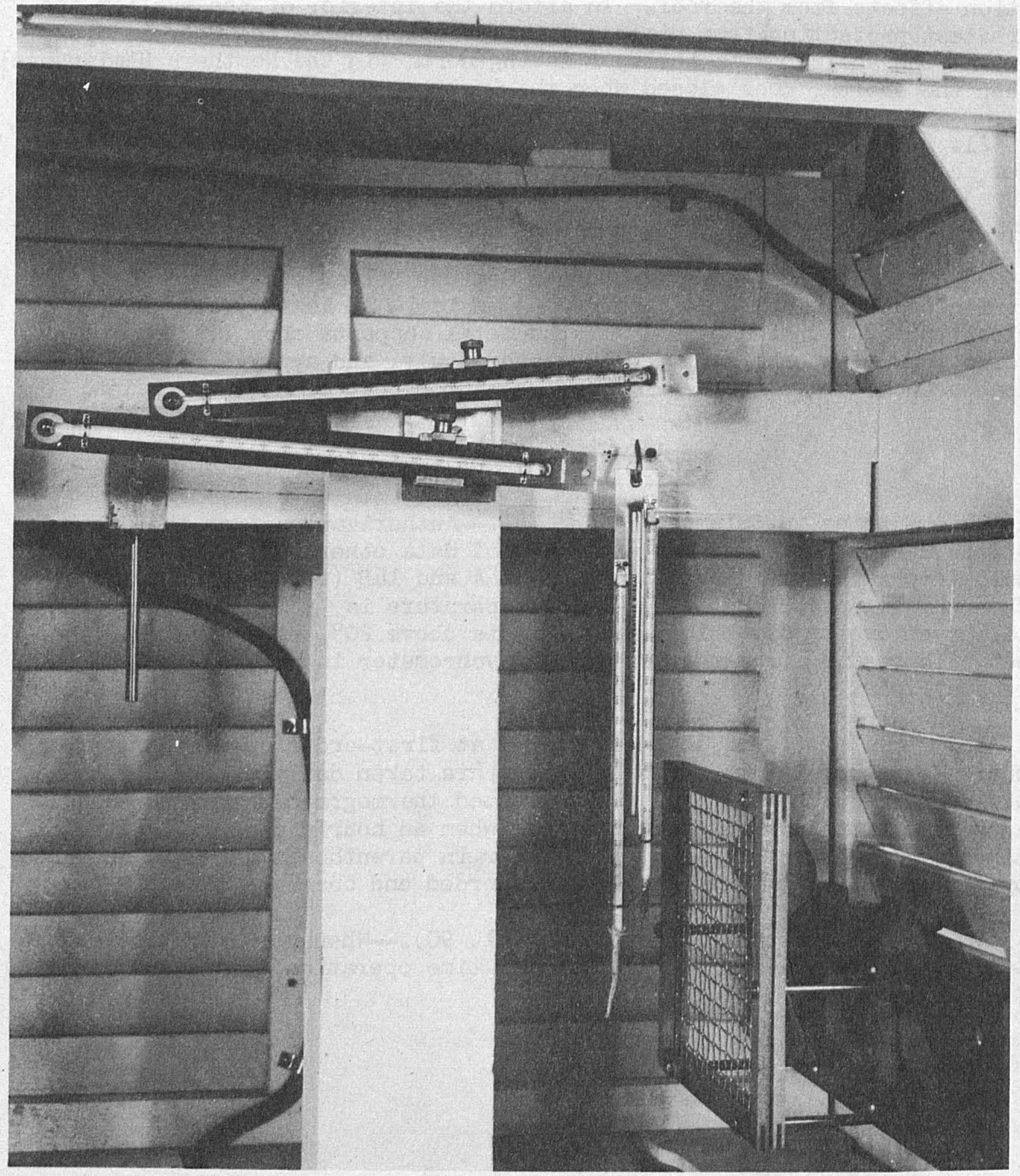

Fig. A5-18. Medium shelter - inside view. Illustrated are maximum and minimum thermometers mounted on separate (vertical) post, telethermometer sensing element, single-back psychrometer and ventilation fan.

CHAPTER A6. HUMIDITY MEASUREMENT

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CHAPTER A6 - HUMIDITY MEASUREMENT *

A6100. PSYCHROMETRIC COMPUTATIONS

A6121. Psychrometric Calculator.—(See Fig. A6-1.) When the wet-bulb temperature is 32° or more, use the high temperature range (Form 1183) of the calculator; when the wet-bulb temperature is less than 32°, use the low temperature range (Form 1184). In the latter case, disregard instruction 1(a) on the scale, since the wick will be brought to a frozen state as indicated in par. 5151.3. The dew point is always read from the T_W,DP scale. On the high temperature range (Form 1183), note that the T_W,DP scale from -10° to 32° is on the periphery of the calculator.

A6122. Psychrometric Calculator - Maintenance.—When not in use, the calculator must be kept in an envelope or drawer, or otherwise protected. Keep it out of direct sunlight and away from radiators or other objects with relatively high temperatures.

A6122.1. Clean the calculator monthly with a damp blotter. If a more thorough cleaning is necessary, disassemble it and wash it with soap and water, then rinse and dry it. Do not use acetone, benzene, lacquer thinners or other solvents. Care should be taken to reassemble the calculator with spacing washers between each moving part, and with the rotor disks on the proper faces of the base. Do not lubricate the pivot assembly, since oil may cause discoloration of the vinylite.

A6122.2. Four sets of reference marks are printed near the extremities of two mutually perpendicular diameters of the calculator. On the base, each reference mark consists of three short parallel lines, while on the disk, each consists of one single line. To check the centering of the disks, align a reference mark on one of the disks with the center line of a reference mark on the base. The other reference marks on the disk should then lie within the limits of the outer lines of corresponding reference marks on the base. Repeat this test for all four positions of the disk's reference marks with relation to the marks on the base. If each position does not satisfy the conditions of the test, do not use the calculator for official psychrometric computations. This check is required (a) upon receipt of the calculator, (b) after reassembling the device, and (c) periodically to prevent misalignment due to pivot wear.

A6420. Entries on WBAN-10 - Relative Humidity (Col. 20).—Entries in column 20 are made at first-order stations only.

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*The paragraph numbers in this chapter correspond to related paragraphs, similarly numbered, in the WBAN portion.

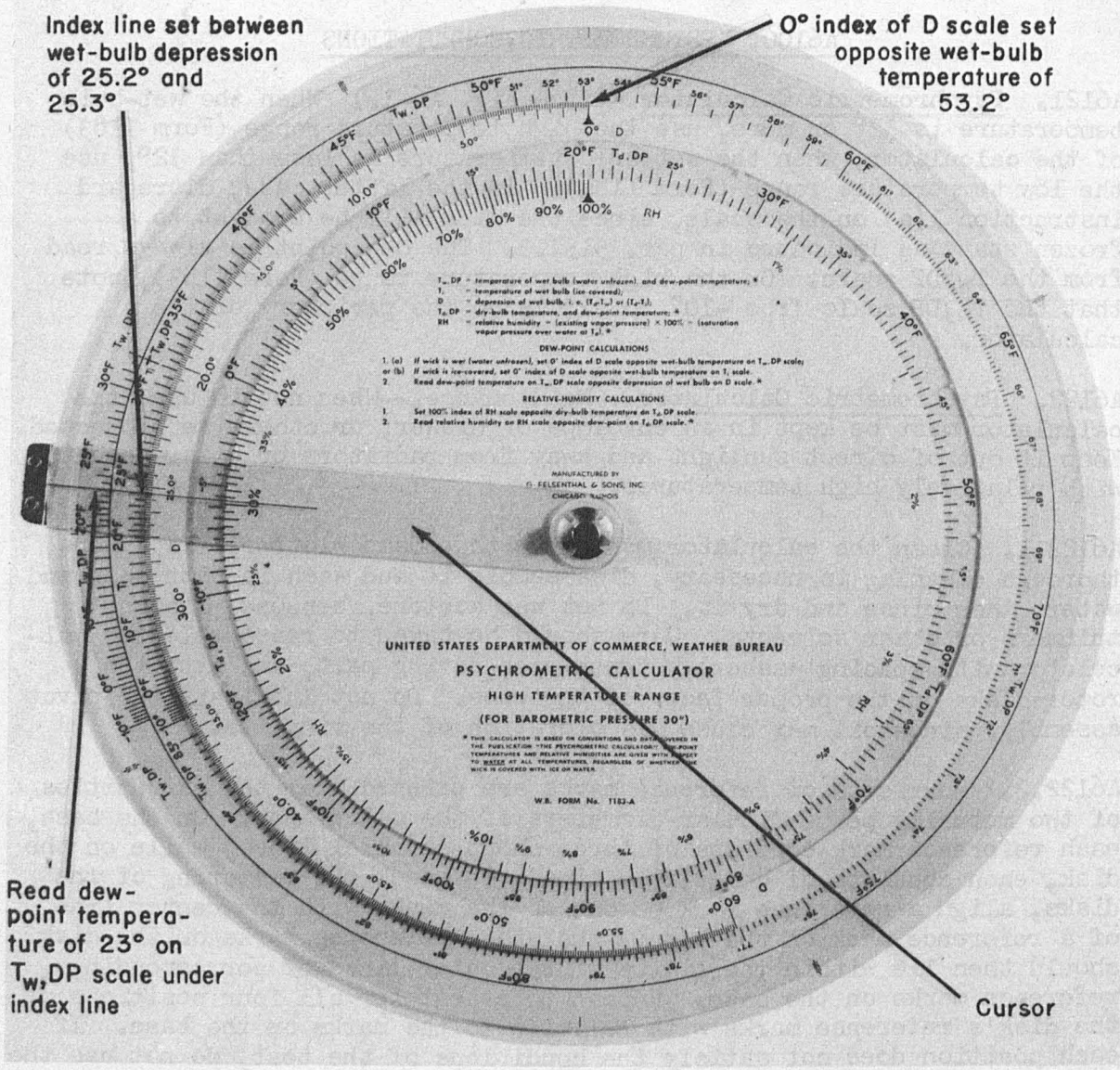

Fig. A6-1. Psychrometric calculator.

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CHAPTER A7 - PRESSURE

A7000. GENERAL

A7010. Barometer Comparisons.—Readings of barometers will be compared to ascertain whether the instruments are accurate and reliable, and to determine corrections, if any, that are applicable to readings of altimeter setting indicators and precision aneroid barometers. Insofar as practicable, these readings will be made when the pressure is not changing rapidly (i.e., less than 0.05 inch per hour) and the wind speed is less than 25 miles per hour. However, when the wind speed is greater than 15 miles per hour, the wind speed and direction will be entered in the Remarks column of the comparison form (Form 1027).

WB Form 1027 (revised)

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

Special
Insert Inspection, Semiannual, Interregional or Special

COMPARATIVE BAROMETER READINGS

Made at Richmond, Va. Date September 6, 19 51

1. Insp.	COMPARISON STANDARD BAROMETER BAROMETER NO. 1388			1. WBAS Station	COMPARED BAROMETER BAROMETER NO. 57			1. WBO Station	COMPARED BAROMETER BAROMETER NO. 1044		
166.850 FT. ACTUAL ELEVATION (HE)*				166.850 FT. ACTUAL ELEVATION (HE)*				169.587 FT. ACTUAL ELEVATION (HE)*			
TIME OF OBSERVATION 75th MERIDIAN TIME 24 HOUR CLOCK	ATTACHED THERMOMETER NEAREST 0.5° F OR 0.1°C	OBSERVED BAROMETER READING	A. BAROMETER READING CORRECTED FOR TEMPERATURE ONLY	ATTACHED THERMOMETER NEAREST 0.5° F OR 0.1°C	OBSERVED BAROMETER READING	B. BAROMETER READING CORRECTED FOR TEMPERATURE ONLY	C. DEPARTURE FROM COMPARISON STANDARD (B - A)	ATTACHED THERMOMETER NEAREST 0.5° F OR 0.1°C	OBSERVED BAROMETER READING	D. BAROMETER READING CORRECTED FOR TEMPERATURE ONLY	E. DEPARTURE FROM COMPARISON STANDARD (D - A)
1600	73.0	29.665	29.546	73.0	29.651	29.532	-.014	79.0	29.668	29.533	-.013
1615	73.0	29.666	29.547	74.0	29.644	29.522	-.025	79.0	29.670	29.535	-.012
1630	73.0	29.672	29.553	73.5	29.653	29.532	-.021	79.5	29.679	29.542	-.011
1645	73.0	29.674	29.555	73.5	29.658	29.537	-.018	79.5	29.685	29.548	-.007
1700	73.0	29.678	29.559	73.0	29.660	29.541	-.018	80.0	29.691	29.553	-.006
SUMS			147.760			147.664				147.711	
MEANS			29.552			29.533				29.542	
2. MERCURIAL BAROMETER: CORRECTION FOR SCALE ERRORS AND CAPILLARITY			-.004			+.001				-.002	
3. ANEROID BAROMETER: SCALE CORRECTION											
4. MERCURIAL BAROMETER: CORRECTION FOR GRAVITY (C)							10. DEPARTURE FROM COMPARISON STANDARD (8 - 7)				11. DEPARTURE FROM COMPARISON STANDARD (9 - 7)
5. CORRECTION FOR DIFFERENCE IN BAROMETER ELEVATIONS			-.003			-.003					
6. TOTAL CORRECTION			-.007			-.002				-.002	
7. COMPARABLE MEANS			29.545		8.	29.531	-.014		9.	29.540	-.005

OUTDOOR TEMPERATURES *

BEGINNING a. 62° b. 64° ENDING a. 61° b. 63° MEAN TEMPERATURE AIR COLUMN AND TEN 4 TEMPERATURES AND DIVIDE BY 4 62°

REMARKS AND RECOMMENDATIONS

Comparisons during observational survey and before cleaning #57.

Simultaneous comparisons between airport and city office barometers.

SUMMARY
(REQUIRED FOR INSPECTORS ONLY)

DEPARTURE INSPECTION BAROMETER NO. 1388 FROM HOME STATION COMPARISON STANDARD BAROMETER NO. 1182

BEFORE TRIP +.004 DATE 8/18/51 AFTER TRIP +.004 DATE 9/12/51

MEAN +.004 12.

DEPARTURE COMPARED BAROMETER NO. 57 FROM INSPECTION BAROMETER -.014 13.

DEPARTURE COMPARED BAROMETER NO. 57 FROM HOME STATION COMPARISON STANDARD (12 + 13) -.010 14.

DEPARTURE COMPARED BAROMETER NO. 1044 FROM INSPECTION BAROMETER -.005 15.

DEPARTURE COMPARED BAROMETER NO. 1044 FROM HOME STATION COMPARISON STANDARD (12 + 15) -.001 16.

(Name)

Field Aide
(Title)

R. O. #1 New York, N. Y.
(Home station)

SEE DETAILED INSTRUCTIONS ON REVERSE SIDE OF FORM FOR MEANING OF REFERENCE NUMBERS

a. Office of comparison standard barometer.
b. Office of compared barometer or barometers.
(c) Used only when mercurial and aneroid barometers are compared. Apply to mercurial barometer readings only.
* Elevation of every point above mean sea level.
* To be used only when barometers compared are not at the same elevation, to make results comparable.

Fig. A7-1. Form 1027, Comparative Barometer Readings.

A7010.1. When two or more mercurial barometers are located at a station, or at several stations in the same locality, the mercurial barometers and any precision aneroids also located at these stations will be compared semiannually, and more frequently if necessary, as specified on Form 1027. When mercurial barometers at two stations in the same locality (i.e., an airport station and a city office) are compared, the data for the airport will be corrected as specified in par. A7011. Special comparative readings will be made when a barometer is moved by station personnel (see par. A7123) or the accuracy of an instrument is suspected. Sample entries on Form 1027 are shown in Fig. A7-1. (See Table A7-1 for converting millibars to inches of mercury.)

A7010.2. Stations equipped with a precision aneroid barometer or an altimeter setting indicator will compare it with the station mercurial barometer as specified in par. A7221 and par. A7233, respectively.

A7011. Airport-City Office Comparison Corrections.—When a difference in height exists between airport and city office mercurial barometers, a correction to the mean of comparative readings from airport mercurial barometers is necessary to provide a mean that is comparable with simultaneous readings from the city office. The correction is obtained from Form 1060 (see Fig. A7-2) or from Table V of Circular F, and it is entered with the proper sign prefixed on line 5 of Form 1027 in the column containing data for the airport barometer. When the elevation of the airport barometer is:

(1) Lower than that of the city office barometer, the sign of the correction is negative.

(2) Higher than that of the city office barometer, the sign of the correction is positive.

The table of corrections on Form 1060 is prepared in terms of 1) the established difference in height between the barometers and 2) the mean outdoor temperature of the air at the airport and the city office during the comparison. The mean is obtained from the Outdoor Temperatures block of Form 1027.

WB Form 1060

U. S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

BAROMETER CORRECTION

To be applied to corrected mean (actual pressure) given on WB Form 1027, for

AIRPORT STATION

at BURBANK, CALIF. Hz 725 feet

to secure value directly comparable with similar simultaneous datum for

CITY OFFICE

at LOS ANGELES, CALIF. Hz 512 feet

Diff. between Airport and City Office 213 feet

Temperature	Correction	Temperature	Correction
All corrections plus ~~minus~~		40°	0.234
-20°	0.265	50°	0.230
-10°	0.259	60°	0.225
0°	0.254	70°	0.221
10°	0.248	80°	0.217
20°	0.243	90°	0.213
30°	0.239	100°	0.209

Temperature is mean of outdoor temperature at Airport and City Office. Hz is actual elevation of ivory point of barometer.

Prepared FEBRUARY 19, 1942

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Fig. A7-2.
Form 1060,
Barometer Correction

A7020. Computations of Height of 850-Millibar Surface - Mean Virtual Temperature.—Corrections for lapse rate and humidity required in the computation of mean virtual temperature will be derived from Table A7-2 (see par. 7430).

A7030. Exposure of Pressure-Sensing Instruments.—Select exposure sites where the instrument will not be subjected to rapid fluctuations of temperature or to jarring and continuous vibration. Avoid exposing the instruments to direct sunlight and radiant heaters, and to direct drafts, such as from open windows and doors. When an installation is regarded as unsatisfactory, or when contemplated changes in the office (air-conditioning, renovation, etc.), are considered likely to affect the exposure adversely, notify the Regional Office.

A7031. Aneroid barometers should, under ordinary circumstances, be mounted with the dial in a vertical position at a convenient level for reading. Aneroid barometers and altimeter setting indicators will operate satisfactorily in other than a vertical position. However, since a change in position may result in a change in the indicated reading, the instrument should be carefully checked against a mercurial barometer whenever a change in position is made. Instruments designed for connection to a static head system should be installed in a location where the connections can be made. Dial-type instruments are frequently provided with a detachable case or flange to be used when the instrument is wall mounted. Remove the case or flange when the instrument is to be flush mounted in an instrument panel or rack.

A7100. MERCURIAL BAROMETERS

A7110. General.—Where two mercurial barometers are maintained side by side, the instrument regularly used is designated as the "station barometer," and the other as the "station extra." These designations will not be changed without authorization from the Central Office. The station extra is to be used for emergency and reference purposes only. Do not use barometer lamps of more than 25 watts, or leave the lamp burning longer than required for the actual observation. Mercurial barometers, especially barometers of the adjustable cistern type, are very fragile. When a mercurial barometer is to be moved, the instructions in this section must be carefully observed to prevent breakage of the instrument and to reduce to a minimum the chances of introducing serious errors in the indicated readings.

A7111. Suspension.—Suspend the barometer freely and vertically from the supporting hook or rod, in the barometer box or on the barometer board, by means of the suspension ring at the top of the instrument.

A7112. Cistern Rings.—As an aid in maintaining adjustable-cistern barometers in a vertical position, a ring is attached to the mounting board to encircle without touching the cistern when the barometer is freely suspended. Adjust the suspension of the barometer, or the position of the cistern ring, to prevent the freely suspended barometer from touching the ring. An improved style of ring is provided with three set screws that clamp the cistern lightly in a vertical position, thereby facilitating rapid and accurate adjustment of the cistern without disturbing the vertical alignment of the instrument.

A7112.1. To adjust the cistern where the non-clamping type ring is used, steady the cistern against the side of the ring in a manner indicated in Fig. A7-3; i.e., by swinging the cistern end of the barometer in a direction such that the cistern touches the ring at a point where the line (AB) through the center of the cistern and the point of contact is at right angles to the line through the center of the cistern and the ivory point (I). When this is done properly, the mercury level with respect to the tip of the ivory point will not be changed when the barometer is released and returns to its vertical position.

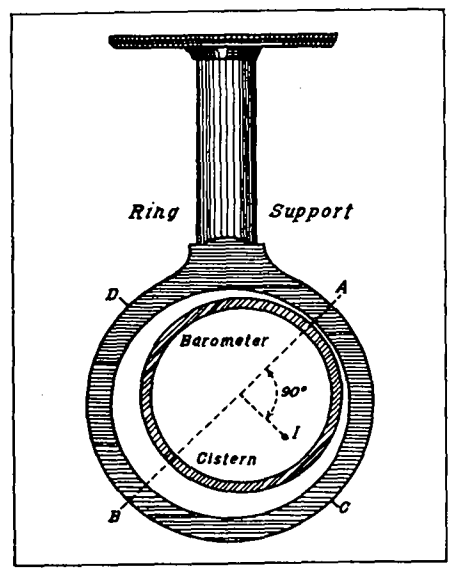

Fig. A7-3. Cistern ring.

A7120. Relocation of Mercurial Barometers.—Mercurial barometers will not be moved without prior authorization from the Regional Office, unless it is necessary to protect the instrument from shock or other conditions likely to damage it. In either case the circumstances will be reported immediately to the Regional Office and to the field aide through the Regional Office. If a sub-standard mercurial barometer is concerned, the Central Office will be notified. When the necessity for moving a barometer can be anticipated, authorization for the move should be requested promptly. The instructions in Circular F and the supplementary instructions in this chapter pertaining to the moving of mercurial barometers will be followed explicitly. When station personnel have been authorized by the Regional Office to move and reinstall the instrument, and the station is equipped with another instrument of the type listed in par. 7010, the barometer may be used for pressure observations following the move, provided that the move is completed in the manner

prescribed in par. A7123. When a barometer is moved in an emergency, it should be removed to and stored in a protected location in accordance with the following instructions.

A7121. Moving a G010, Adjustable-Cistern, Fortin-Type Barometer.—(See Fig. A7-4.) The adjustable cistern barometer must be handled carefully. Avoid any rapid accelerating or decelerating movement of the instrument, especially in a lengthwise direction; i.e., along the center line of the tube and cistern.

A7121.1. When the barometer is to be relocated, it may be moved by hand without adjustment of the cistern provided it is:

(1) Hand-held in a vertical position with the cistern end down throughout the move.

(2) Not subjected to shock or to sufficient vertical acceleration or deceleration to cause noticeable pumping of the mercury; i.e., rise and fall of the mercury in the tube.

When the barometer cistern is maintained in a fixed position by a clamping type cistern ring, the supporting board or box and the barometer may be moved intact so long as these provisions are carefully observed.

A7121.2. When it is impractical to transport the barometer in accordance with par. A7121.1, prepare the instrument for removal as follows:

(1) Turn the cistern screw clockwise until the top of the mercury column is lifted just above the top of the opening in the tubular metal shield. Do not force the screw after any decrease in the freedom of its movement is noted, since the mercury may have reached the top of the tube. At high altitude stations where the atmospheric pressure is relatively low (less than 26.50 inches of mercury), incline the barometer about 45 degrees after the cistern is filled with mercury and before filling the tube. This will reduce the risk of damage from the hydrostatic pressure involved.

(2) Remove the barometer from its support and incline it slowly until the cistern end is above the horizontal.

(3) Unscrew the cistern screw approximately one turn.

A7121.21. Transport the barometer with the cistern end above the horizontal, preferably with the instrument in a vertical position. The barometer should be well padded to protect it from shock.

A7121.3. So far as possible, the barometer should be stored at a tempera-

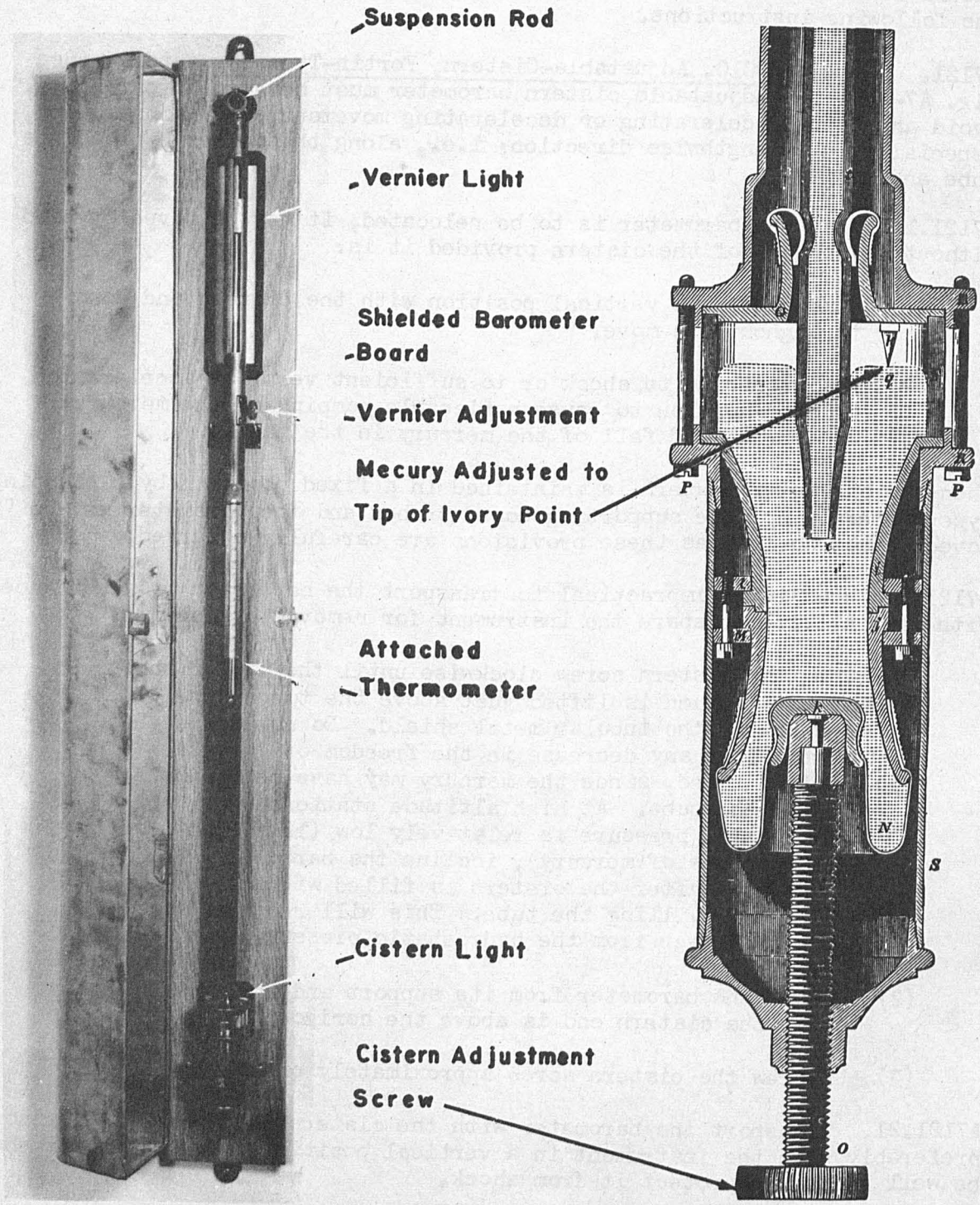

Fig. A7-4. Adjustable cistern, Fortin-type barometer, G010.

ture equal to or less than the temperature at the time of removal. It should be stored in a protected location with the cistern end above the horizontal.

A7121.4. Before lowering the cistern end of the barometer to or below the horizontal, advance the cistern screw approximately one turn provided it turns freely.

A7122. Moving an Adjustable-Cistern, Sub-standard Barometer.--When the barometer can be moved by hand in the manner specified in par. A7121.1, determine that the cap is on the vent in the top of the cistern before proceeding with the move. When it is impractical to move the barometer in the foregoing manner, remove the cap from the vent tube; then, with the adjusting screw, raise the mercury in the cistern until it enters the vent tube. Replace the vent cap and proceed in accordance with instructions in par. A7121.2.

A7123. Relocation Comparisons.--After a barometer has been relocated it may be used for pressure observations provided the readings of the barometer agree with those of another mercurial barometer, an altimeter setting indicator, or a precision aneroid barometer within 0.02 inch of mercury. The procedure for making the comparisons and determining the agreement between the instruments is specified in par. A7010 except as modified in the following sub-paragraphs.

A7123.1. When a mercurial barometer is to be moved, it will be termed the Compared Barometer. When two mercurial barometers are mounted side by side, the first to be moved will be termed the Compared Barometer and the other will be termed the Comparison-Standard. Three comparisons of five readings each are required. When the comparison-standard is an altimeter-setting indicator, (a) retain the same elevation scale setting of the indicator for all three sets of readings, (b) enter the uncorrected readings of the altimeter setting indicator on Form 1027 in col. A, and enter their mean value on the line entitled "Means" and on line 7 as the Comparable Mean, and (c) enter readings of the compared barometer, corrected for temperature only, in col. B, and their mean value opposite "Means", and on line 8 as the Comparable Mean (see Fig. A7-1). Entries on Form 1027 based on readings from precision aneroid or mercurial barometers are made in accordance with instructions on the form, except that, for purposes of comparisons made in connection with the removal of a mercurial barometer only, any difference in elevation between the mercurial barometers at the time of the second set of readings will not be accounted for by the entry of a correction on line 5. Comparisons are taken in the following order:

(1) When the comparison-standard is a precision-aneroid barometer or an altimeter-setting indicator, move the comparison-standard if necessary to place it at the level of the ivory point of the mercurial barometer before taking the first set of readings. Otherwise make a set of comparative readings immediately before moving the compared barometer.

(2) Make a second set of readings immediately after the compared barometer has been moved, but before the comparison-standard has been relocated.

(3) Make a third set of readings immediately after (2), with the comparison-standard located at the level of the ivory point of the compared barometer at the new location.

A7123.2. From the three sets of comparative readings taken during the move, determine from the entries on Form 1027 (a) whether the agreement between the instruments involved in the relocation is satisfactory, and (b) the amount of the removal correction applicable to readings of the removed mercurial barometers as a result of the move. Make the determination as follows (see example following the text):

(1) Compute the difference between the Comparable Mean for the compared barometer (entry 8) and that of the comparison-standard (entry 7) by subtracting the value of entry 8 from that of entry 7 for both the first and the second sets of readings. Note that when the comparison-standard is an altimeter setting indicator, the altimeter-setting entry, as entered on line 7 in accordance with these instructions, is compared with the corresponding entry on line 8 only for purposes of par. A7123.2 (a) & (b).

(2) Compute the algebraic difference between the two differences obtained in (1); i.e., subtract the difference pertaining to the first set of readings from that pertaining to the second set.

(3) Compute the difference between the Comparable Mean for the comparison-standard (entry 7) and that of the compared barometer (entry 8) for the third set of readings by subtracting the value of entry 8 from that for entry 7.

(4) Subtract algebraically the difference pertaining to the third set of readings from that pertaining to the second set.

(5) Compute the difference between the remainders obtained in (2) and (4).

(6) If the difference in (5) is not more than 0.02 inch, compute the mean of the two corrections obtained in (2) and (4); i.e., the algebraic sum of the corrections divided by the number of corrections. The result is the temporary removal correction for the mercurial barometers concerned.

(7) If the difference in (5) is more than 0.02 inch, the barometers concerned may not be used (see par. A7123) and the circumstances will be reported in accordance with par. A7120.

EXAMPLE

GIVEN

FROM Form 1027	COMPARABLE MEANS (inches of mercury)	
	Compared Barometer (entry 8)	Comparison-Standard * (entry 7)
First set of readings	A1: 29.000	B1: 30.000
Second set	A2: 29.052	B2: 30.005
Third set	A3: 29.048	B3: 30.050

* The comparison-standard in this instance is an altimeter setting indicator.

PROCEDURE

Step	Operation		Result (to nearest 0.001 inch)
	Symbolic	Numerical	
1. a.	(B1) minus (A1)	30.000 minus 29.000	+1.000
b.	(B2) minus (A2)	30.005 minus 29.052	+ .953
2.	(1b) minus (1a)	(.953) minus (1.000)	- .047
3.	(B3) minus (A3)	30.050 minus 29.048	+1.002
4.	(1b) minus (3)	(.953) minus (1.002)	- .049
5.	(2) minus (4)	(-.047) minus (-.049)	+ .002
6.	(2) plus (4) divided by two	$\frac{(-.047) \text{ plus } (-.049)}{2}$	- .048

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A7123.21. Where it is possible to measure the change in elevation of the ivory point with a steel tape or a measuring stick, check the accuracy of the removal correction computed in accordance with par. A7123.2 as follows:

(1) Measure the change in elevation to the nearest inch.

(2) Obtain the mean temperature of the air column from the Outdoor Temperatures block of Form 1027 prepared for the third set of readings.

(3) From Table V of Circular F, obtain the change in pressure corresponding to the values obtained in (1) and (2).

(4) Compute the difference between (a) the removal correction as obtained from par. A7123.2, and (b) the change in pressure obtained in (3).

WB Form 1059

U. S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

BAROMETER CORRECTION CARD

Station Barometer No. 823
at Milford, Utah
Mean An. Temp., 49° Mean Pres., 24.94"
Correction for scale errors and capillarity .... .000
Correction for local gravity { Latitude 38° 25' ; -.015
Actual elevation 5033.119 ; -.007
Correction to station elevation 5097.1 ; ---
See other side Sum of corrections .. ---

When the total correction for instrumental errors is + it is to be added, when — it is to be subtracted from the observed reading.

Attached thermometer No. .....
Correction in degrees Fahrenheit to reduce to standard air thermometer.

Scale r'd'g	32°	42°	52°	62°	72°	82°	92°
Correction	—0.	—0.	—0.	—0.	—0.	—0.	—0.

The attached thermometer will be read to the nearest half degree. Whenever the corrections to reduce to the standard air thermometer are 0.5 degree, or more, the appropriate correction will be applied to the observed temperature and the reading thus corrected will be entered on forms and employed in taking out the correction for temperature of the barometer.

This card will be kept conspicuously posted adjacent to its barometer.

Card issued October 7, 1947
(WB—3-12-48—3,000) 67

SPECIAL REMOVAL CORRECTIONS
(Required for large changes of elevation)

Station Milford, Utah

Barometer No. 823

Temperature	Removal correction	Sum of corrections
—20	-.066	-.088
—10	-.065	-.087
0	-.064	-.086
+10	-.063	-.085
20	-.061	-.083
30	-.060	-.082
40	-.059	-.081
50	-.057	-.079
60	-.056	-.078
70	-.055	-.077
80	-.054	-.076
90	-.052	-.074
100	-.051	-.073

Fig. A7-5. Form 1059

When the difference obtained in (4) exceeds 0.02 inch, verify the computations of both (a) and (b), and if the verified difference exceeds 0.02 inch, discontinue use of the barometer. When the difference does not exceed 0.02 inch, and (a) exceeds 0.001 inch, the correction (a) will be added algebraically to the "Sum of Corrections" obtained from Form 1059 (see Fig. A7-5), and the result will be used provisionally as the "Sum of Corrections" until appropriate verifying action has been taken by the Central Office. When the difference does not exceed 0.02 inch, and the correction (a) does not exceed 0.001 inch, the "Sum of Corrections" will not be changed.

A7200. ANEROID-TYPE INSTRUMENTS

A7210. Aneroid Barograph, G210.—(See Fig. A7-6.) This barograph has a 2-1/2 to 1 scale.

A7211. Maintenance.—Whenever a barograph is initially placed in operation, and whenever any adjustment of the pen or linkage mechanism has been made, check the relationship between the time-arc lines on the chart and the arc described by the pen between the top and bottom pressure-ordinate lines. To check this, adjust the pen to the lowest pressure-ordinate line by means of the adjusting knob, and lift the pen gently to the highest pressure-ordinate line (never depress the pen except by means of the adjusting knob). The relationship is correct if the pen point is equidistant from the nearest time line at both the top and bottom of the chart, and at any third point near the middle of the chart. If the distance separating the pen and the time line differs between the top and bottom of the chart, it is likely that the chart is poorly fitted to the cylinder. If the distances at the top and bottom of the chart are in agreement, but differ from the distance at or near the middle of the chart, the pen arm length requires adjustment (see par. A7211.21).

A7211.1. Dashpots.—Dashpot fluid should be used if continuing vibration or artificial pressure changes (such as those caused by slamming doors and gusts of wind through open doors and windows) cause an unsteady trace. Before filling the dashpot, remove the connecting-rod screw that links the connecting rod of the dasher to the overhead slot in the rocker arm, and remove the dasher. Fill the dashpot to within 1/4 inch of the top. However, when it becomes necessary to add fluid to the dashpot, drain, clean and refill it, particularly if there is doubt as to the nature of the fluid. Do not mix differing types of fluids, such as an oil-type fluid with one having a glycerine base. Replace the dasher, and before connecting it to the rocker arm, raise and lower it in the fluid several times to dislodge any air bubbles present beneath the dasher. The level of the liquid must be kept above the upper limit of travel of the dasher in order to eliminate surface-tension errors. After replacement of the connecting-rod screw, the connecting rod should be freely suspended from the screw and should have noticeable side-to-side play between the sides of the slot in the rocker arm.

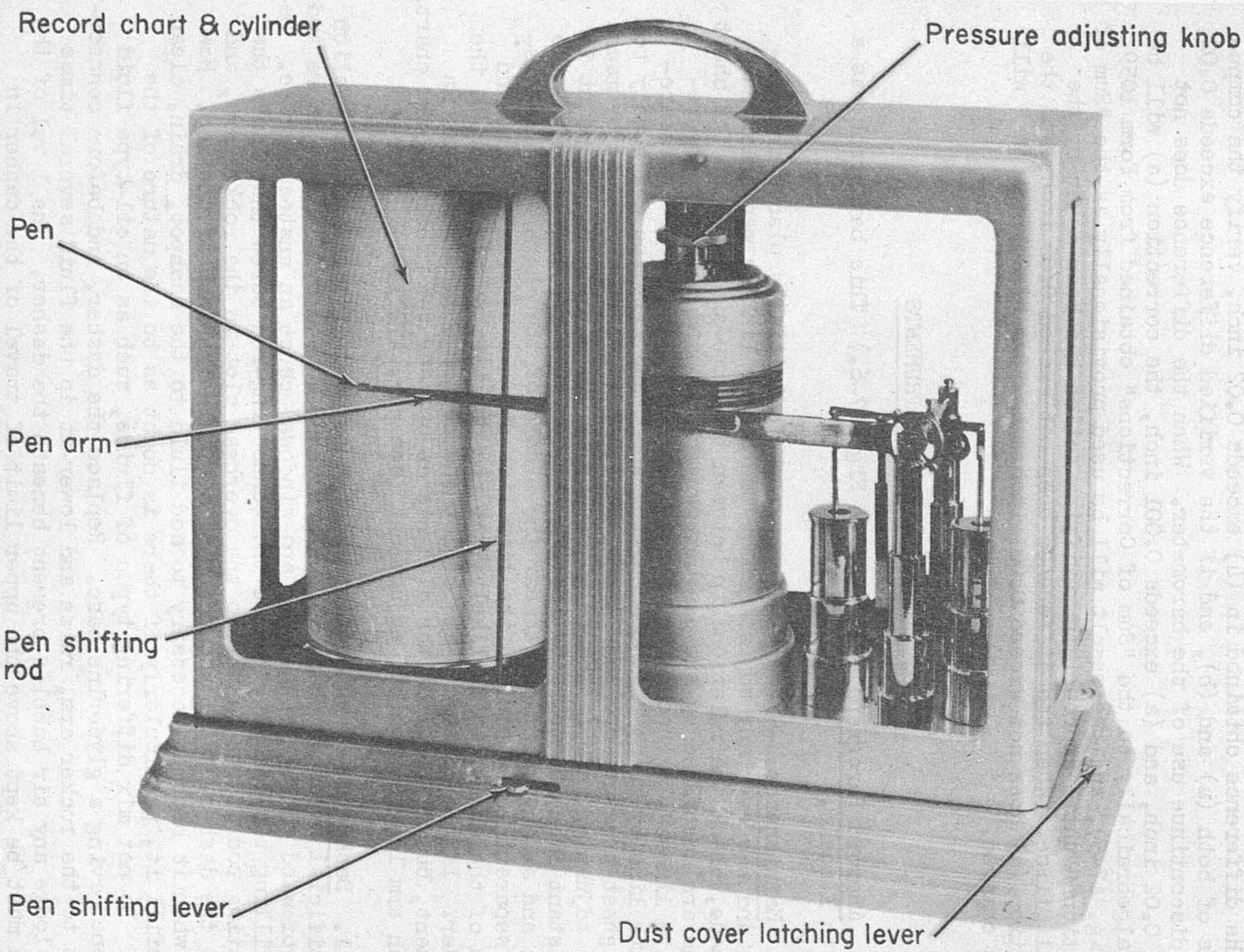

Fig. A7-6. Aneroid Barograph (2-1/2 to 1 scale), G210.

A7211.11. After filling the dashpot, check the operation of the instrument by depressing the pen to the bottom pressure-ordinate line by means of the pressure-adjustment knob, then lift the pen gently to the uppermost pressure ordinate and release it. The pen should begin its return rapidly and should decelerate uniformly until it comes to rest. If the return is non-uniform, it may be caused by (1) a sharp pen catching on the face of the form, (2) improperly functioning dashpots, or (3) tight spots in the linkage mechanism. Adjust the pressure trace, and check the pressure adjustment at intervals of two to three hours over several cycles of increasing and decreasing pressure. Whenever the correlation between the indicated pressure and the station pressure obtained from the mercurial barometer is erratic or otherwise abnormal, (1) repeat the procedure described in par. A7211.1 to eliminate air bubbles, and (2) check the level of the dashpot fluid. Even with damping fluid in the dashpots, tapping the case of the instrument lightly several times should be sufficient to remove any error resulting from sticking of the linkage. Whenever the effect of sticking is observed to be consistently or frequently more than 0.02 inch of mercury, and if the condition is not corrected by any of the foregoing procedures or by changing the pen (see par. A7211.2), report the condition to the Regional Office.

A7211.2. Pen.—Whenever the pen fails to feed ink automatically, the flow of ink may be started by drawing a piece of smooth, lint-free (preferably bond) paper between the nibs of the pen in order to wet the inner faces. The wetting action is improved and the chance of retaining paper fragments or other foreign particles between the nibs of the pen is decreased, if the paper is withdrawn with a motion directed away from the reservoir and toward the nibs of the pen. If the pen still fails to make a fine, clear line, remove it from the pen arm and clean it, Wash the pen thoroughly in water or, preferably in alcohol. Scrape dried ink from the pen and rewash it. Ink should not be allowed to collect on the outer faces of the points, since an excess of ink tends to collect dirt and may lead to interruption of the record. Replace any pen that becomes so worn that it no longer makes a fine, clear record.

A7211.21. The pen is secured by a friction clamp to the tapered point of the pen arm. To remove the pen, loosen it carefully to avoid bending the pen or pen arm, or otherwise damaging the linkage mechanism. If the pen is not easily removed by a light pull, use a knife edge to loosen the prongs that secure it to the pen arm. The effective pen arm length of 7.625 inches (the distance from the pen point to the axis of rotation of the arm) must be maintained when the pen is replaced.

A7211.22. If a faint or otherwise unsatisfactory record is obtained because of ink dilution, refill the pen with undiluted ink. Keep the reserve supply of ink well stopped to prevent dilution by absorption of water vapor.

A7211.3. Clock Adjustment.—To adjust a clock that consistently gains or

loses time, open the small inspection plate in the top cover of the clock compartment (inside the cylinder as viewed from the top - see Fig. A7-7). Carefully move the small index slightly toward "F" (Fast) if the clock is losing time, or toward "S" (Slow) if the clock is gaining time. It is preferable that timing adjustments be made at the time of changing the form to preserve continuity of the record.

A7212. Exposure.--Barographs will be exposed in accordance with instructions in par. A7030.

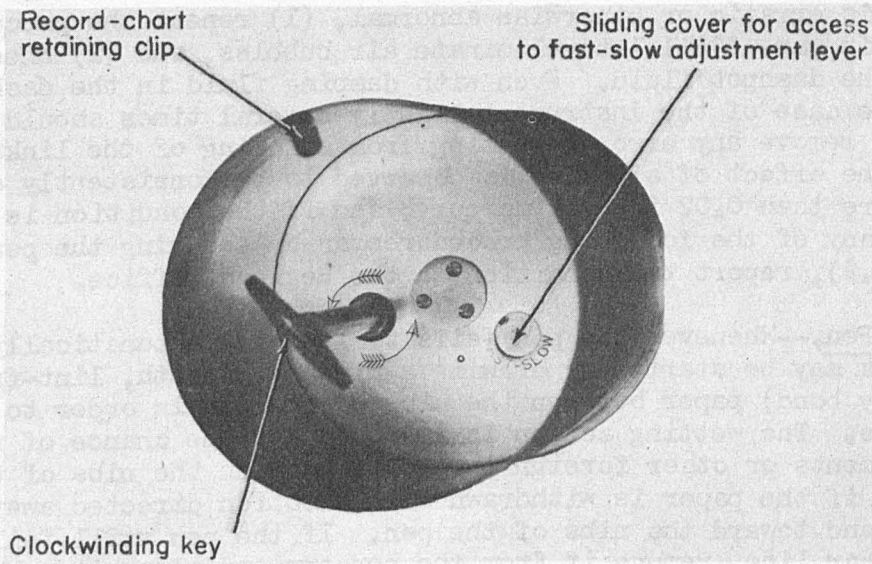

Fig. A7-7. Barograph clock, G210-1.

A7220. Aneroid Barometers - Precision Type.--(See Fig. A7-9.) The range of aneroid barometers is indicated by the graduated scale on the dial. The pressure scale should extend to at least 1.3 inches of mercury (approximately 45 mb.) higher, and 1.5 inches of mercury (approximately 50 mb.) lower, than the mean station pressure as taken from Form 1059.

A7221. Comparative Readings.--Comparative data from concurrent readings of the precision aneroid barometer and a mercurial barometer will be obtained as described below and entered on Form 1027B in accordance with instructions on the back of the form (see Fig. A7-8). Unless otherwise specified below, the form will be disposed of in accordance with instructions printed on the back of it. Concurrent readings taken within periods of several consecutive months should include readings taken during the occurrence of relatively high and low pressure.

WB Form 1027B

UNITED STATES DEPARTMENT OF COMMERCE, WEATHER BUREAU

BAROMETER COMPARISONS

(Comparison of altimeter setting indicators or aneroid barometers with mercurial barometers.)

Station: WBAS Upstate, Utah

Month and Year: July 1951

Day of Month	Time (LST)	Temperature Attached Thermometer	Mercurial Barometer No. 976			Aneroid Barometer (X) or Altimeter Setting Indicator ( ); Serial No. 5716 Elevation of Indicator in Feet Above Mean Sea Level: —				
			Uncorrected Reading	Station Pressure	Altimeter Setting	Uncorrected Reading	Differences and Means	Applied Correction	Elevation Scale Reading (feet)	Remarks
1	2	3	4	5	6	7	8	9	10	11
12	1340	67.5	29.016	982.6		982.8	-0.2			
13	1610	72.5	29.001	982.1		982.2	-0.1			
14	2045	70.0	29.047	983.6		983.8	-0.2			
15	2140	77.5	29.132	986.6		986.8	-0.2			
16	2035	74.5	29.063	984.2		984.3	-0.1			
17	1415	68.5	29.004	982.2		982.2	± 0.0			
18	1055	75.5	28.886	978.2		978.1	+0.1			
						TOTAL:	-0.7			
						MEAN:	-0.1			
19	1312	71.0	28.880	978.0		978.0	+0.1	-0.1		
20	1540	69.0	29.073	984.5		984.6	± 0.0	-0.1		

See instructions on reverse side.

WB Form 1027B

Fig. A7-8. Form 1027B, record of aneroid-mercurial barometer comparative readings.

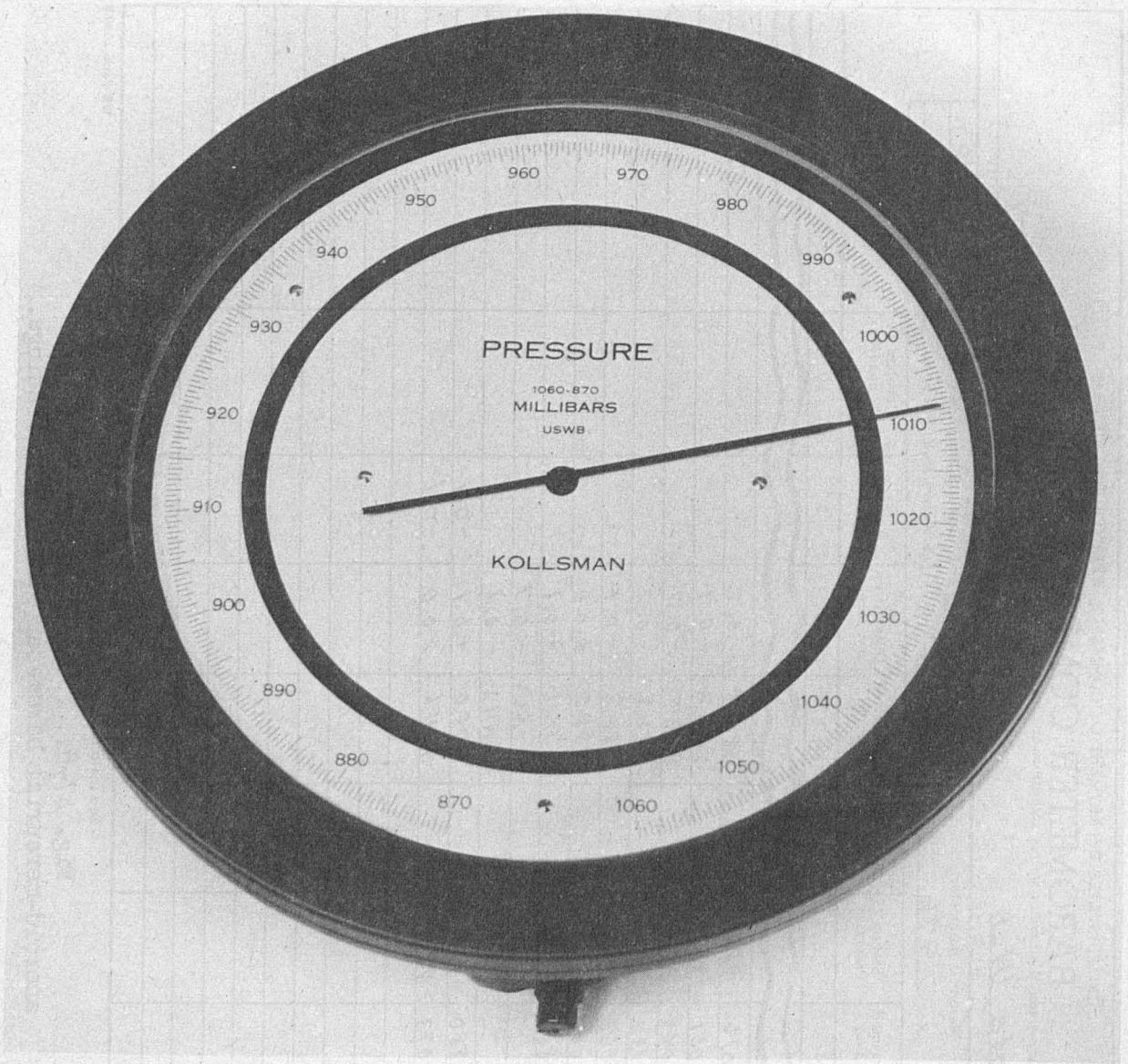

Fig. A7-9. Precision aneroid barometer (Kollsman), G121A-1.

A7221.1. After the aneroid barometer has been installed, comparative readings will be taken as follows:

(1) Take concurrent readings of the barometers once each day at various times, but preferably in the afternoon. Compute the station pressure, using the mercurial barometer reading (see Sec. 7200), and determine the

difference between the two barometers by subtracting the uncorrected reading of the aneroid barometer from this station-pressure value.

(2) After the differences for seven days have been determined, compute the algebraic mean of the differences. This mean will be added algebraically, as a correction, to subsequent uncorrected readings of the aneroid barometer to provide values of station pressure for purposes of Form 1027B only. This correction will be applied, (see par. 7252) until revised, to subsequent comparative barometer readings.

(3) Determine each day the difference obtained by subtracting the corrected aneroid readings obtained as in (2) from the station pressure based on readings of the mercurial barometer. After fourteen consecutive days in which none of these differences exceeds ± 0.3 mb., the corrected aneroid readings may be used as the station pressure for observational purposes.

(4) Continue to take concurrent daily readings at least 14 days longer, and to compute the difference between station pressure and the corrected readings of the aneroid barometer.

(5) After comparative readings have been taken daily for at least eight weeks, and after 14 consecutive days in which none of the differences in (4) have exceeded ± 0.3 mb., comparisons will be made once every seven days.

A7221.2. Whenever the differences specified above are exceeded, comparative readings will be taken as follows:

(1) Differences in excess of 0.3 mb. but not 0.6 mb. - Have the difference redetermined immediately, preferably by another observer. If the redetermined value does not exceed ± 0.3 disregard the first reading and follow the instructions in par. A7221.1(5). If the difference does exceed ± 0.3 mb., compute the algebraic mean of the two differences and post it as a revised correction applicable until the next day. For the remaining six days of a seven-day period, take daily readings, compute their difference, and, in addition, compute each day the cumulative mean of the differences for the elapsed portion of the period. The correction established on the first day will be used as the difference for that day when computing cumulative means. The cumulative mean for each day of the period

will be posted as the correction applicable until the following day. This seven-day procedure for the redetermination of a correction will be repeated if at any time during or following a redetermination the difference between the station pressure and the corrected aneroid reading exceeds 0.3 mb., but not 0.6 mb. After a correction has been redetermined, resume daily comparisons in the manner specified in pars. A7221.1(3) and (4); or, if these requirements have already been satisfied, resume comparisons in accordance with par. A7221.1(5).

(2) Differences in excess of + 0.6 mb. - Whenever the requirements of par. A7221.1(5) cannot be satisfied within three months, discontinue use of the aneroid barometer and notify the Central Office through the Regional Office.

A7221.3. Whenever the aneroid barometer is used for observational purposes, and there are indications that its readings are inaccurate, a series of five comparative readings will be taken approximately one hour apart. If the differences in station pressure between the aneroid and mercurial barometer vary over a range of more than 0.3 mb., discontinue use of the aneroid barometer and forward the data on Form 1027B to the Central Office through the Regional Office.

A7230. Altimeter Setting Indicator.—Altimeter setting indicators are provided with two scales - a pressure, or primary, scale, and an elevation, or secondary, scale (see Fig. A7-11 and -12). Indicators are designed for operation within the elevation range specified on the dial. Station personnel should not attempt to adjust the pressure-scale index independently of the position of the elevation scale.

A7231. Station Pressure.—The altimeter setting indicator may be used for the determination of station pressure in accordance with par. 7260, provided satisfactory comparisons are obtained periodically in accordance with par. A7233.

A7232. Adjusting Elevation Scale.—The position of the elevation scale and the related position of the pressure-scale pointer are adjusted by the elevation-scale adjusting screw, which on some instruments projects through a hole in the cover glass (see Fig. A7-12). The Kollsman type of instrument has a plug screw and washer in the bottom of the housing (see Fig. A7-11) to provide access to the adjusting screw. Care should be taken not to damage the washer, which prevents leakage at the plug screw. Turn the adjusting screw until the pointer of the pressure scale indicates the correct altimeter setting as obtained from the mercurial barometer (see Sec. 7500). Do not adjust the scale during periods of

rapidly changing pressure or high wind speeds (see par. A7010). If at any time after adjusting the elevation scale to indicate the correct altimeter setting, the corresponding elevation-scale reading is not within ± 100 feet of the actual altitude of the indicator above mean sea level, discontinue use of the instrument and notify the Central Office through the Regional Office. Normal aging usually results in a progressively increasing negative correction or decreasing positive correction. During the first year of operation it is likely that readjustment of the elevation scale will be necessary to provide readings of the required accuracy (see par. A7233).

A7233. Comparative Readings.—Comparative data from concurrent readings of the altimeter setting indicator and a mercurial barometer will be obtained as described below and entered on Form 1027B in accordance with instructions on the back of the form (see Fig. A7-10). Concurrent readings taken within periods of several consecutive months should include readings taken during the occurrence of relatively high and low pressure.

A7233.1. When the altimeter setting indicator has been installed, adjust the elevation scale (see par. A7232) so that the pressure scale reading corresponds to the altimeter setting computed from a concurrent reading of a mercurial barometer. Make the comparative readings as follows:

(1) Take concurrent readings of the altimeter setting indicator and a mercurial barometer once a day at various times, preferably in the afternoon. Obtain the altimeter setting (see Sec. 7500), and determine the difference by subtracting the uncorrected reading of the indicator from the altimeter setting. A difference that exceeds ± 0.020 inch will be verified immediately. If the second difference does not exceed ± 0.020 inch, disregard the first; otherwise, adjust the indicator (see par. A7232) to reduce the verified difference (mean of the two differences if they are not the same) to zero.

(2) After each period of seven consecutive days of comparative readings taken with the same elevation-scale adjustment of the indicator, compute the algebraic mean of the differences for the period.

(3) When neither seven-day mean difference of two consecutive seven-day periods has exceeded ± 0.010 inch, uncorrected readings of the indicator may be used as altimeter settings and for obtaining station pressure. However, when a mean difference exceeds ± 0.010 inch, adjust the instrument to reduce this difference to zero. Resume daily comparisons until these requirements have been satisfied.

WB Form 1027B

UNITED STATES DEPARTMENT OF COMMERCE, WEATHER BUREAU

BAROMETER COMPARISONS

(Comparison of altimeter setting indicators or aneroid barometers with mercurial barometers.)

Station: WBAS Center City, Va.

Month and Year: Sept.-Oct. 1951

Mercurial Barometer No. 1217

Aneroid Barometer ( ) or Altimeter Setting Indicator (X); Serial No.: 435

Elevation of Indicator in Feet Above Mean Sea Level: 167

Day of Month	Time (LST)	Temperature Attached Thermometer	Mercurial Barometer: Uncorrected Reading	Mercurial Barometer: Station Pressure	Mercurial Barometer: Altimeter Setting	Aneroid Barometer: Uncorrected Reading	Differences and Means	Applied Correction	Elevation Scale Reading (feet)	Remarks
1	2	3	4	5	6	7	8	9	10	11
15	1055	68.5	29.073	28.973	29.133	29.145	-0.012		144	
16	1610	67.5	29.184	29.086	29.246	29.270	-0.024		144	Difference excessive-
16	2045	68.0	29.186	29.087	29.247	29.270	-0.023		144	Adjusted for zero difference
17	1415	72.5	29.223	29.112	29.272	29.261	+0.011		121	
18	1737	75.0	29.249	29.131	29.291	29.293	-0.002		121	
19	2250	70.0	29.250	29.145	29.305	29.301	+0.004		121	
20	2021	75.0	29.132	29.014	29.174	29.167	+0.007		121	
21	1312	77.5	29.071	28.948	29.108	29.099	+0.009		121	
22	0411	78.0	29.058	28.934	29.094	29.091	+0.003		121	
23	0917	74.5	29.117	29.002	29.162	29.157	+0.005		121	
						Total:	+0.037			
						Mean:	+0.005			
30	1155	70.0	29.228	29.123	29.283	29.274	+0.009		121	
7	1207	72.5	29.252	29.141	29.301	29.285	+0.016		121	
14	0705	68.0	29.378	29.278	29.438	29.404	+0.034		121	Difference excessive -
14	0707	68.5	29.377	29.276	29.436	29.406	+0.030	+0.032	121	Daily comparisons
15	1147	75.5	29.245	29.126	29.286	29.275	+0.011	+0.022	121	resumed.
16	1010	72.0	29.127	29.018	29.178	29.161	+0.017	+0.020	121	
17	1512	71.0	29.042	28.936	29.096	29.111	-0.015		121	Difference excessive -
17	1515	71.0	29.041	28.935	29.095	29.106	-0.011		121	Use for altimeter
18	0210	69.0	29.211	29.109	29.269	29.272	-0.005		109	settings discontinued.
19	0705	68.0	29.263	29.164	29.324	29.326	-0.002		109	

See instructions on reverse side.

WB Form 1027B

Fig. A7-10. Form 1027B, record of altimeter-setting-indicator - mercurial-barometer comparative readings.

A7233.2. When the indicator is placed in use, continue daily comparative readings, computing the difference between the altimeter setting and the uncorrected reading of the indicator for 14 days more. If during these 14 days a difference, or a seven-day mean difference, exceeds the respective limits in par. A7233.1, adjust the indicator to reduce the verified difference or mean difference to zero, and resume daily comparisons until these limits have not been exceeded for 14 consecutive days.

A7233.3. After the conditions in par. A7233.2 have been satisfied and daily readings have been taken for at least eight weeks, comparisons will be made once every seven days unless a verified difference is obtained that exceeds the limits in par. A7233.1. When these limits are exceeded, adjust the indicator to reduce the verified difference or mean difference to zero and:

(1) Determine the difference between the altimeter setting and the uncorrected reading of the indicator. Post this difference as the correction (see par. 7530), and apply it to uncorrected indicator readings to obtain altimeter settings until a new correction is determined on the following day.

(2) On subsequent days, compute and post the value of the cumulative mean of the daily differences.

(3) After seven days in which none of the daily differences departs from the correction computed on the preceding day by more than ± 0.020 inch, and the cumulative mean does not exceed ± 0.010 inch, resume comparisons at seven-day intervals. However, if either of these values is exceeded within seven days, adjust the indicator to zero difference, and discontinue its use for observational purposes. Repeat the procedures in pars. A7233.1 -.2.

A7233.4. When more than four adjustments of the elevation scale are necessary within three months, discontinue use of the indicator and notify the Central Office through the Regional Office.

A7233.5. Whenever the altimeter setting indicator is used for observational purposes, and there are indications that its readings are inaccurate a series of five readings will be taken approximately one hour apart. If the differences between the uncorrected readings and the concurrent altimeter settings vary over a range of more than 0.020 inch, discontinue use of the indicator and forward the data on a copy of Form 1027B to the Central Office through the Regional Office.

A7233.6. Ascertain whether the altimeter setting indicator is sufficiently stable to satisfy the following conditions:

(1) The range of the last seven weekly comparisons is 0.030 inch or less.

(2) The mean difference between the altimeter setting indicator and the altimeter setting for the last seven weekly comparisons exceeds ± 0.005.

If both conditions are satisfied, adjust the altimeter setting indicator in the amount of the mean difference referred to in (2).

A7234. Disposition of Form 1027B.—Completed Forms 1027B will be retained at the station as specified on the back of the form; however a copy will be forwarded to the Central Office, Attention: SF&MO Division, when, after the first 14 days of comparisons, there are any entries of differences between the altimeter setting and the reading of the altimeter setting indicator which exceed ± 0.010 inch.

A7300. SEA-LEVEL PRESSURE

A7310. Sea-Level Reduction Tables.—Officials in charge desiring to change their sea-level pressure reduction tables, so that tabular values will be in millibars instead of inches of mercury, should request from the Central Office basic data and instructions to compute the desired values by a simple process of successive addition. The technique permits extension of tables so that results may be readily obtained for station pressure arguments having intervals of 0.01 inch of mercury.

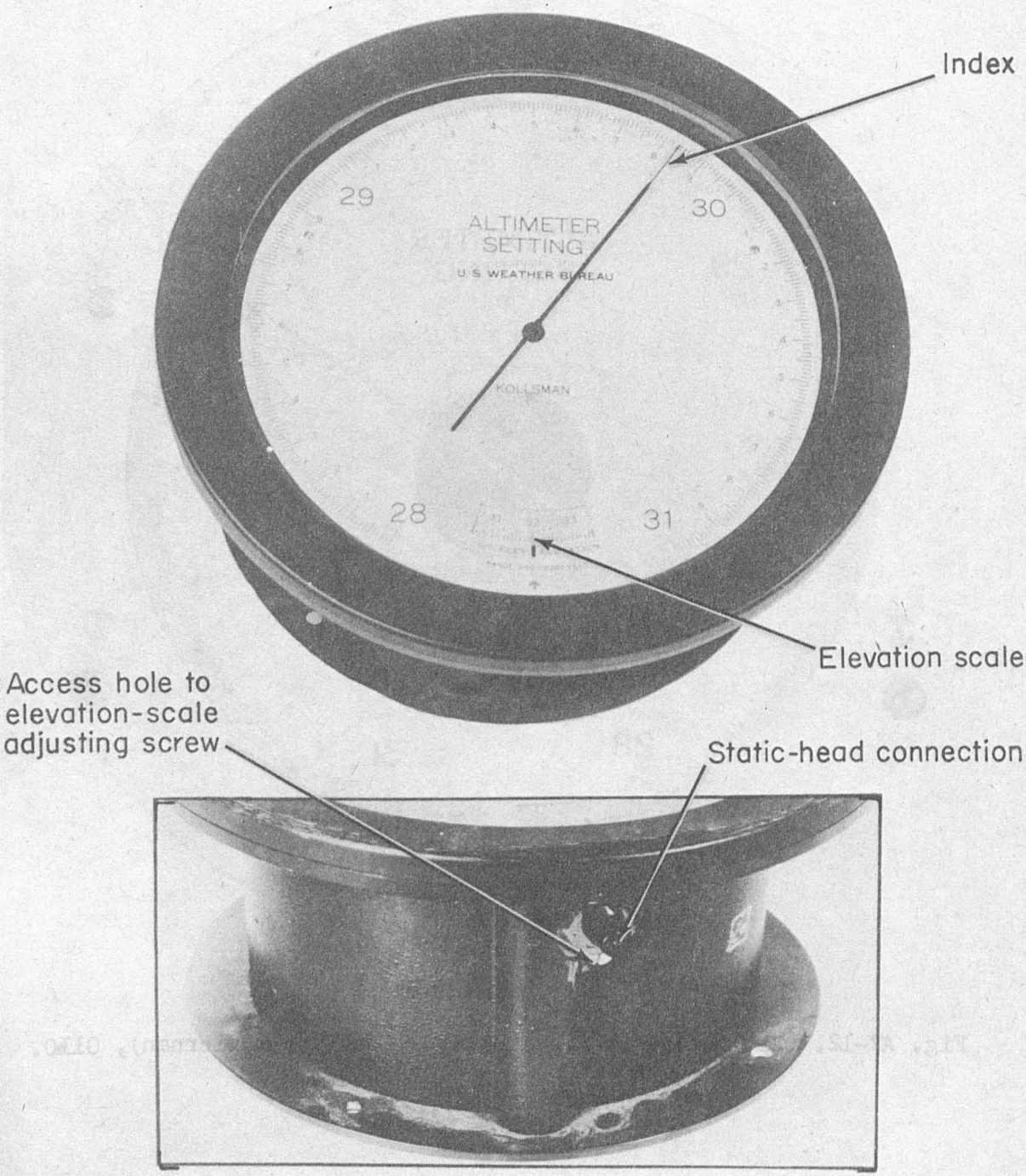

Fig. A7-11. Altimeter setting indicator (Kollsman), G110B-1.

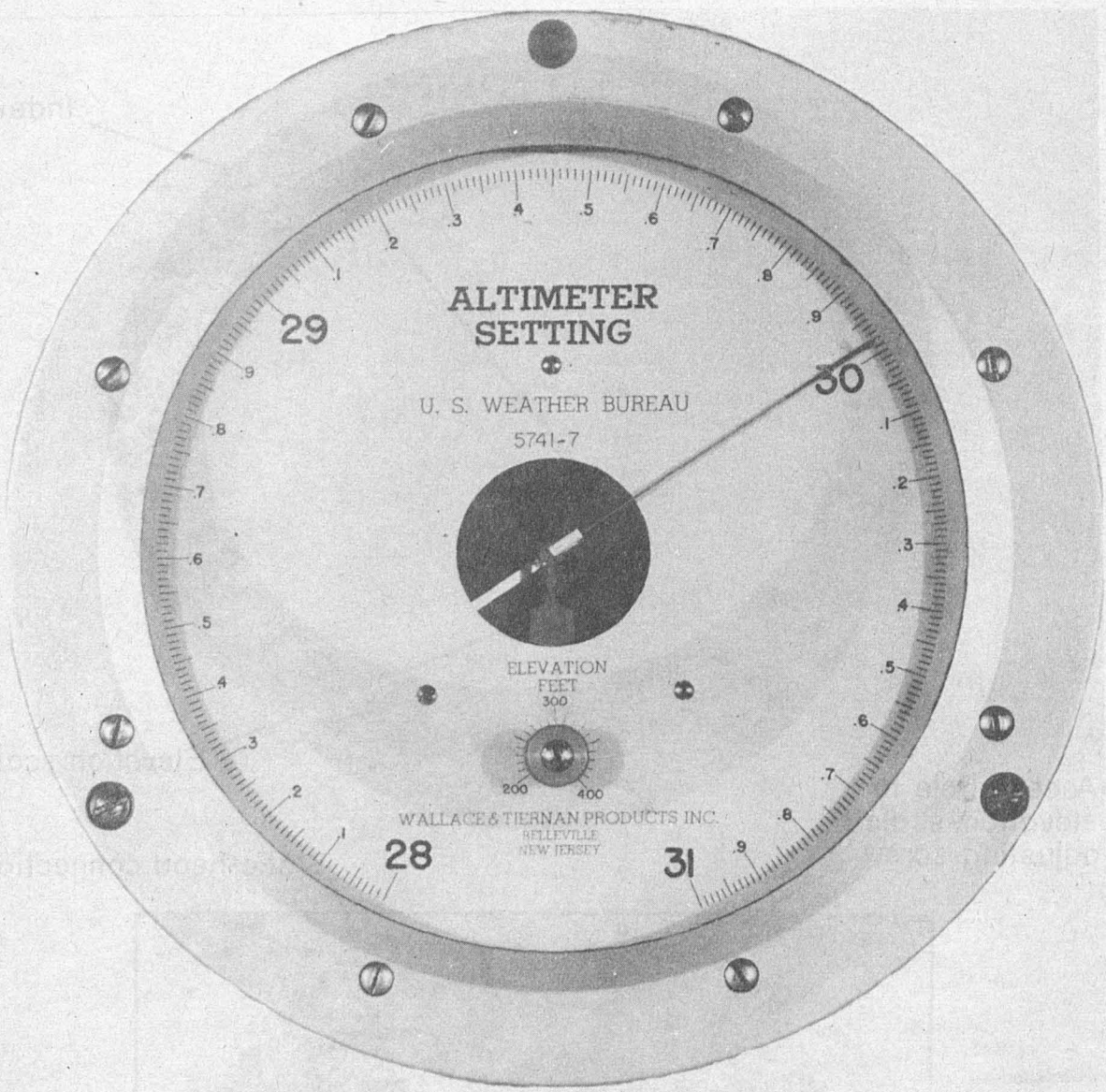

Fig. A7-12. Altimeter setting indicator (Wallace & Tiernan), G110.

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
700	20.672	20.675	20.678	20.681	20.684	20.687	20.690	20.693	20.696	20.699	700
701	702	705	708	710	713	716	719	722	725	728	701
702	731	734	737	740	743	746	749	752	755	758	702
703	761	764	767	770	772	775	778	781	784	787	703
704	790	793	796	799	802	805	808	811	814	817	704
705	20.820	20.823	20.826	20.829	20.832	20.835	20.837	20.840	20.843	20.846	705
706	849	852	855	858	861	864	867	870	873	876	706
707	879	882	885	888	891	894	897	899	902	905	707
708	908	911	914	917	920	923	926	929	932	935	708
709	938	941	944	947	950	953	956	959	961	964	709
710	20.967	20.970	20.973	20.976	20.979	20.982	20.985	20.988	20.991	20.994	710
711	997	21.000	21.003	21.006	21.009	21.012	21.015	21.018	21.021	21.024	711
712	21.026	21.029	21.032	21.035	21.038	21.041	21.044	21.047	21.050	21.053	712
713	056	059	062	065	068	071	074	077	080	083	713
714	086	088	091	094	097	100	103	106	109	112	714
715	21.115	21.118	21.121	21.124	21.127	21.130	21.133	21.136	21.139	21.142	715
716	145	148	150	153	156	159	162	165	168	171	716
717	174	177	180	183	186	189	192	195	198	201	717
718	204	207	210	213	215	218	221	224	227	230	718
719	233	236	239	242	245	248	251	254	257	260	719
720	21.263	21.266	21.269	21.272	21.275	21.277	21.280	21.283	21.286	21.289	720
721	292	295	298	301	304	307	310	313	316	319	721
722	322	325	328	331	334	337	339	342	345	348	722
723	351	354	357	360	363	366	369	372	375	378	723
724	381	384	387	390	393	396	399	402	404	407	724
725	21.410	21.413	21.416	21.419	21.422	21.425	21.428	21.431	21.434	21.437	725
726	440	443	446	449	452	455	458	461	464	466	726
727	469	472	475	478	481	484	487	490	493	496	727
728	499	502	505	508	511	514	517	520	523	526	728
729	528	531	534	537	540	543	546	549	552	555	729
730	21.558	21.561	21.564	21.567	21.570	21.573	21.576	21.579	21.582	21.585	730
731	588	591	593	596	599	602	605	608	611	614	731
732	617	620	623	626	629	632	635	638	641	644	732
733	647	650	653	655	658	661	664	667	670	673	733
734	676	679	682	685	688	691	694	697	700	703	734
735	21.706	21.709	21.712	21.715	21.717	21.720	21.723	21.726	21.729	21.732	735
736	735	738	741	744	747	750	753	756	759	762	736
737	765	768	771	774	777	780	782	785	788	791	737
738	794	797	800	803	806	809	812	815	818	821	738
739	824	827	830	833	836	839	842	844	847	850	739
740	21.853	21.856	21.859	21.862	21.865	21.868	21.871	21.874	21.877	21.880	740
741	883	886	889	892	895	898	901	904	906	909	741
742	912	915	918	921	924	927	930	933	936	939	742
743	942	945	948	951	954	957	960	963	966	969	743
744	971	974	977	980	983	986	989	992	995	998	744
745	22.001	22.004	22.007	22.010	22.013	22.016	22.019	22.022	22.025	22.028	745
746	031	033	036	039	042	045	048	051	054	057	746
747	060	063	066	069	072	075	078	081	084	087	747
748	090	093	095	098	101	104	107	110	113	116	748
749	119	122	125	128	131	134	137	140	143	146	749

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TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
750	22.149	22.152	22.155	22.158	22.160	22.163	22.166	22.169	22.172	22.175	750
751	178	181	184	187	190	193	196	199	202	205	751
752	208	211	214	217	220	222	225	228	231	234	752
753	237	240	243	246	249	252	255	258	261	264	753
754	267	270	273	276	279	282	285	287	290	293	754
755	22.296	22.299	22.302	22.305	22.308	22.311	22.314	22.317	22.320	22.323	755
756	326	329	332	335	338	341	344	347	349	352	756
757	355	358	361	364	367	370	373	376	379	382	757
758	385	388	391	394	397	400	403	406	409	411	758
759	414	417	420	423	426	429	432	435	438	441	759
760	22.444	22.447	22.450	22.453	22.456	22.459	22.462	22.465	22.468	22.471	760
761	474	476	479	482	485	488	491	494	497	500	761
762	503	506	509	512	515	518	521	524	527	530	762
763	533	536	538	541	544	547	550	553	556	559	763
764	562	565	568	571	574	577	580	583	586	589	764
765	22.592	22.595	22.598	22.600	22.603	22.606	22.609	22.612	22.615	22.618	765
766	621	624	627	630	633	636	639	642	645	648	766
767	651	654	657	660	663	665	668	671	674	677	767
768	680	683	686	689	692	695	698	701	704	707	768
769	710	713	716	719	722	725	727	730	733	736	769
770	22.739	22.742	22.745	22.748	22.751	22.754	22.757	22.760	22.763	22.766	770
771	769	772	775	778	781	784	787	789	792	795	771
772	798	801	804	807	810	813	816	819	822	825	772
773	828	831	834	837	840	843	846	849	852	854	773
774	857	860	863	866	869	872	875	878	881	884	774
775	22.887	22.890	22.893	22.896	22.899	22.902	22.905	22.908	22.911	22.914	775
776	916	919	922	925	928	931	934	937	940	943	776
777	946	949	952	955	958	961	964	967	970	973	777
778	976	978	981	984	987	990	993	996	999	23.002	778
779	23.005	23.008	23.011	23.014	23.017	23.020	23.023	23.026	23.029	23.032	779
780	23.035	23.038	23.041	23.043	23.046	23.049	23.052	23.055	23.058	23.061	780
781	064	067	070	073	076	079	082	085	088	091	781
782	094	097	100	103	105	108	111	114	117	120	782
783	123	126	129	132	135	138	141	144	147	150	783
784	153	156	159	162	165	167	170	173	176	179	784
785	23.182	23.185	23.188	23.191	23.194	23.197	23.200	23.203	23.206	23.209	785
786	212	215	218	221	224	227	230	232	235	238	786
787	241	244	247	250	253	256	259	262	265	268	787
788	271	274	277	280	283	286	289	292	294	297	788
789	300	303	306	309	312	315	318	321	324	327	789
790	23.330	23.333	23.336	23.339	23.342	23.345	23.348	23.351	23.354	23.356	790
791	359	362	365	368	371	374	377	380	383	386	791
792	389	392	395	398	401	404	407	410	413	416	792
793	419	421	424	427	430	433	436	439	442	445	793
794	448	451	454	457	460	463	466	469	472	475	794
795	23.478	23.481	23.483	23.486	23.489	23.492	23.495	23.498	23.501	23.504	795
796	507	510	513	516	519	522	525	528	531	534	796
797	537	540	543	545	548	551	554	557	560	563	797
798	566	569	572	575	578	581	584	587	590	593	798
799	596	599	602	605	608	610	613	616	619	622	799

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
800	23.625	23.628	23.631	23.634	23.637	23.640	23.643	23.646	23.649	23.652	800
801	655	658	661	664	667	670	672	675	678	681	801
802	684	687	690	693	696	699	702	705	708	711	802
803	714	717	720	723	726	729	732	734	737	740	803
804	743	746	749	752	755	758	761	764	767	770	804
805	23.773	23.776	23.779	23.782	23.785	23.788	23.791	23.794	23.797	23.799	805
806	802	805	808	811	814	817	820	823	826	829	806
807	832	835	838	841	844	847	850	853	856	859	807
808	861	864	867	870	873	876	879	882	885	888	808
809	891	894	897	900	903	906	909	912	915	918	809
810	23.921	23.924	23.926	23.929	23.932	23.935	23.938	23.941	23.944	23.947	810
811	950	953	956	959	962	965	968	971	974	977	811
812	980	983	986	988	991	994	997	24.000	24.003	24.006	812
813	24.009	24.012	24.015	24.018	24.021	24.024	24.027	24.030	24.033	24.036	813
814	039	042	045	048	050	053	056	059	062	065	814
815	24.068	24.071	24.074	24.077	24.080	24.083	24.086	24.089	24.092	24.095	815
816	098	101	104	107	110	113	115	118	121	124	816
817	127	130	133	136	139	142	145	148	151	154	817
818	157	160	163	166	169	172	175	177	180	183	818
819	186	189	192	195	198	201	204	207	210	213	819
820	24.216	24.219	24.222	24.225	24.228	24.231	24.234	24.237	24.239	24.242	820
821	245	248	251	254	257	260	263	266	269	272	821
822	275	278	281	284	287	290	293	296	299	302	822
823	304	307	310	313	316	319	322	325	328	331	823
824	334	337	340	343	346	349	352	355	358	361	824
825	24.364	24.366	24.369	24.372	24.375	24.378	24.381	24.384	24.387	24.390	825
826	393	396	399	402	405	408	411	414	417	420	826
827	423	426	428	431	434	437	440	443	446	449	827
828	452	455	458	461	464	467	470	473	476	479	828
829	482	485	488	491	493	496	499	502	505	508	829
830	24.511	24.514	24.517	24.520	24.523	24.526	24.529	24.532	24.535	24.538	830
831	541	544	547	550	553	555	558	561	564	567	831
832	570	573	576	579	582	585	588	591	594	597	832
833	600	603	606	609	612	615	617	620	623	626	833
834	629	632	635	638	641	644	647	650	653	656	834
835	24.659	24.662	24.665	24.668	24.671	24.674	24.677	24.680	24.682	24.685	835
836	688	691	694	697	700	703	706	709	712	715	836
837	718	721	724	727	730	733	736	739	742	744	837
838	747	750	753	756	759	762	765	768	771	774	838
839	777	780	783	786	789	792	795	798	801	804	839
840	24.806	24.809	24.812	24.815	24.818	24.821	24.824	24.827	24.830	24.833	840
841	836	839	842	845	848	851	854	857	860	863	841
842	866	869	871	874	877	880	883	886	889	892	842
843	895	898	901	904	907	910	913	916	919	922	843
844	925	928	931	933	936	939	942	945	948	951	844
845	24.954	24.957	24.960	24.963	24.966	24.969	24.972	24.975	24.978	24.981	845
846	984	987	990	993	995	998	25.001	25.004	25.007	25.010	846
847	25.013	25.016	25.019	25.022	25.025	25.028	25.031	25.034	25.037	25.040	847
848	043	046	049	052	055	058	060	063	066	069	848
849	072	075	078	081	084	087	090	093	096	099	849

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
850	25.102	25.105	25.108	25.111	25.114	25.117	25.120	25.122	25.125	25.128	850
851	131	134	137	140	143	146	149	152	155	158	851
852	161	164	167	170	173	176	179	182	184	187	852
853	190	193	196	199	202	205	208	211	214	217	853
854	220	223	226	229	232	235	238	241	244	247	854
855	25.249	25.252	25.255	25.258	25.261	25.264	25.267	25.270	25.273	25.276	855
856	279	282	285	288	291	294	297	300	303	306	856
857	309	311	314	317	320	323	326	329	332	335	857
858	338	341	344	347	350	353	356	359	362	365	858
859	368	371	373	376	379	382	385	388	391	394	859
860	25.397	25.400	25.403	25.406	25.409	25.412	25.415	25.418	25.421	25.424	860
861	427	430	433	436	438	441	444	447	450	453	861
862	456	459	462	465	468	471	474	477	480	483	862
863	486	489	492	495	498	500	503	506	509	512	863
864	515	518	521	524	527	530	533	536	539	542	864
865	25.545	25.548	25.551	25.554	25.557	25.560	25.563	25.565	25.568	25.571	865
866	574	577	580	583	586	589	592	595	598	601	866
867	604	607	610	613	616	619	622	625	627	630	867
868	633	636	639	642	645	648	651	654	657	660	868
869	663	666	669	672	675	678	681	684	687	689	869
870	25.692	25.695	25.698	25.701	25.704	25.707	25.710	25.713	25.716	25.719	870
871	722	725	728	731	734	737	740	743	746	749	871
872	752	754	757	760	763	766	769	772	775	778	872
873	781	784	787	790	793	796	799	802	805	808	873
874	811	814	816	819	822	825	828	831	834	837	874
875	25.840	25.843	25.846	25.849	25.852	25.855	25.858	25.861	25.864	25.867	875
876	870	873	876	878	881	884	887	890	893	896	876
877	899	902	905	908	911	914	917	920	923	926	877
878	929	932	935	938	941	943	946	949	952	955	878
879	958	961	964	967	970	973	976	979	982	985	879
880	25.988	25.991	25.994	25.997	26.000	26.003	26.005	26.008	26.011	26.014	880
881	26.017	26.020	26.023	26.026	26.029	26.032	26.035	26.038	26.041	26.044	881
882	047	050	053	056	059	062	065	067	070	073	882
883	076	079	082	085	088	091	094	097	100	103	883
884	106	109	112	115	118	121	124	127	130	132	884
885	26.135	26.138	26.141	26.144	26.147	26.150	26.153	26.156	26.159	26.162	885
886	165	168	171	174	177	180	183	186	189	192	886
887	194	197	200	203	206	209	212	215	218	221	887
888	224	227	230	233	236	239	242	245	248	251	888
889	254	256	259	262	265	268	271	274	277	280	889
890	26.283	26.286	26.289	26.292	26.295	26.298	26.301	26.304	26.307	26.310	890
891	313	316	319	321	324	327	330	333	336	339	891
892	342	345	348	351	354	357	360	363	366	369	892
893	372	375	378	381	383	386	389	392	395	398	893
894	401	404	407	410	413	416	419	422	425	428	894
895	26.431	26.434	26.437	26.440	26.443	26.445	26.448	26.451	26.454	26.457	895
896	460	463	466	469	472	475	478	481	484	487	896
897	490	493	496	499	502	505	508	510	513	516	897
898	519	522	525	528	531	534	537	540	543	546	898
899	549	552	555	558	561	564	567	570	572	575	899

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
900	26.578	26.581	26.584	26.587	26.590	26.593	26.596	26.599	26.602	26.605	900
901	608	611	614	617	620	623	626	629	632	634	901
902	637	640	643	646	649	652	655	658	661	664	902
903	667	670	673	676	679	682	685	688	691	694	903
904	697	699	702	705	708	711	714	717	720	723	904
905	26.726	26.729	26.732	26.735	26.738	26.741	26.744	26.747	26.750	26.753	905
906	756	759	761	764	767	770	773	776	779	782	906
907	785	788	791	794	797	800	803	806	809	812	907
908	815	818	821	823	826	829	832	835	838	841	908
909	844	847	850	853	856	859	862	865	868	871	909
910	26.874	26.877	26.880	26.883	26.886	26.888	26.891	26.894	26.897	26.900	910
911	903	906	909	912	915	918	921	924	927	930	911
912	933	936	939	942	945	948	950	953	956	959	912
913	962	965	968	971	974	977	980	983	986	989	913
914	992	995	998	27.001	27.004	27.007	27.010	27.012	27.015	27.018	914
915	27.021	27.024	27.027	27.030	27.033	27.036	27.039	27.042	27.045	27.048	915
916	051	054	057	060	063	066	069	072	075	077	916
917	080	083	086	089	092	095	098	101	104	107	917
918	110	113	116	119	122	125	128	131	134	137	918
919	139	142	145	148	151	154	157	160	163	166	919
920	27.169	27.172	27.175	27.178	27.181	27.184	27.187	27.190	27.193	27.196	920
921	199	202	204	207	210	213	216	219	222	225	921
922	228	231	234	237	240	243	246	249	252	255	922
923	258	261	264	266	269	272	275	278	281	284	923
924	287	290	293	296	299	302	305	308	311	314	924
925	27.317	27.320	27.323	27.326	27.328	27.331	27.334	27.337	27.340	27.343	925
926	346	349	352	355	358	361	364	367	370	373	926
927	376	379	382	385	388	391	393	396	399	402	927
928	405	408	411	414	417	420	423	426	429	432	928
929	435	438	441	444	447	450	453	455	458	461	929
930	27.464	27.467	27.470	27.473	27.476	27.479	27.482	27.485	27.488	27.491	930
931	494	497	500	503	506	509	512	515	517	520	931
932	523	526	529	532	535	538	541	544	547	550	932
933	553	556	559	562	565	568	571	574	577	580	933
934	582	585	588	591	594	597	600	603	606	609	934
935	27.612	27.615	27.618	27.621	27.624	27.627	27.630	27.633	27.636	27.639	935
936	642	644	647	650	653	656	659	662	665	668	936
937	671	674	677	680	683	686	689	692	695	698	937
938	701	704	706	709	712	715	718	721	724	727	938
939	730	733	736	739	742	745	748	751	754	757	939
940	27.760	27.763	27.766	27.769	27.771	27.774	27.777	27.780	27.783	27.786	940
941	789	792	795	798	801	804	807	810	813	816	941
942	819	822	825	828	831	833	836	839	842	845	942
943	848	851	854	857	860	863	866	869	872	875	943
944	878	881	884	887	890	893	895	898	901	904	944
945	27.907	27.910	27.913	27.916	27.919	27.922	27.925	27.928	27.931	27.934	945
946	937	940	943	946	949	952	955	958	960	963	946
947	966	969	972	975	978	981	984	987	990	993	947
948	996	999	28.002	28.005	28.008	28.011	28.014	28.017	28.020	28.022	948
949	28.025	28.028	28.031	28.034	28.037	28.040	28.043	28.046	28.049	28.052	949

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
950	28.055	28.058	28.061	28.064	28.067	28.070	28.073	28.076	28.079	28.082	950
951	084	087	090	093	096	099	102	105	108	111	951
952	114	117	120	123	126	129	132	135	138	141	952
953	144	147	149	152	155	158	161	164	167	170	953
954	173	176	179	182	185	188	191	194	197	200	954
955	28.203	28.206	28.209	28.211	28.214	28.217	28.220	28.223	28.226	28.229	955
956	232	235	238	241	244	247	250	253	256	259	956
957	262	265	268	271	273	276	279	282	285	288	957
958	291	294	297	300	303	306	309	312	315	318	958
959	321	324	327	330	333	336	338	341	344	347	959
960	28.350	28.353	28.356	28.359	28.362	28.365	28.368	28.371	28.374	28.377	960
961	380	383	386	389	392	395	398	400	403	406	961
962	409	412	415	418	421	424	427	430	433	436	962
963	439	442	445	448	451	454	457	460	462	465	963
964	468	471	474	477	480	483	486	489	492	495	964
965	28.498	28.501	28.504	28.507	28.510	28.513	28.516	28.519	28.522	28.525	965
966	527	530	533	536	539	542	545	548	551	554	966
967	557	560	563	566	569	572	575	578	581	584	967
968	587	589	592	595	598	601	604	607	610	613	968
969	616	619	622	625	628	631	634	637	640	643	969
970	28.646	28.649	28.652	28.654	28.657	28.660	28.663	28.666	28.669	28.672	970
971	675	678	681	684	687	690	693	696	699	702	971
972	705	708	711	714	716	719	722	725	728	731	972
973	734	737	740	743	746	749	752	755	758	761	973
974	764	767	770	773	776	778	781	784	787	790	974
975	28.793	28.796	28.799	28.802	28.805	28.808	28.811	28.814	28.817	28.820	975
976	823	826	829	832	835	838	841	843	846	849	976
977	852	855	858	861	864	867	870	873	876	879	977
978	882	885	888	891	894	897	900	903	905	908	978
979	911	914	917	920	923	926	929	932	935	938	979
980	28.941	28.944	28.947	28.950	28.953	28.956	28.959	28.962	28.965	28.967	980
981	970	973	976	979	982	985	988	991	994	997	981
982	29.000	29.003	29.006	29.009	29.012	29.015	29.018	29.021	29.024	29.027	982
983	030	032	035	038	041	044	047	050	053	056	983
984	059	062	065	068	071	074	077	080	083	086	984
985	29.089	29.092	29.094	29.097	29.100	29.103	29.106	29.109	29.112	29.115	985
986	118	121	124	127	130	133	136	139	142	145	986
987	148	151	154	156	159	162	165	168	171	174	987
988	177	180	183	186	189	192	195	198	201	204	988
989	207	210	213	216	219	221	224	227	230	233	989
990	29.236	29.239	29.242	29.245	29.248	29.251	29.254	29.257	29.260	29.263	990
991	266	269	272	275	278	281	283	286	289	292	991
992	295	298	301	304	307	310	313	316	319	322	992
993	325	328	331	334	337	340	343	345	348	351	993
994	354	357	360	363	366	369	372	375	378	381	994
995	29.384	29.387	29.390	29.393	29.396	29.399	29.402	29.405	29.408	29.410	995
996	413	416	419	422	425	428	431	434	437	440	996
997	443	446	449	452	455	458	461	464	467	470	997
998	472	475	478	481	484	487	490	493	496	499	998
999	502	505	508	511	514	517	520	523	526	529	999

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
1000	29.532	29.534	29.537	29.540	29.543	29.546	29.549	29.552	29.555	29.558	1000
1001	561	564	567	570	573	576	579	582	585	588	1001
1002	591	594	597	599	602	605	608	611	614	617	1002
1003	620	623	626	629	632	635	638	641	644	647	1003
1004	650	653	656	659	661	664	667	670	673	676	1004
1005	29.679	29.682	29.685	29.688	29.691	29.694	29.697	29.700	29.703	29.706	1005
1006	709	712	715	718	721	723	726	729	732	735	1006
1007	738	741	744	747	750	753	756	759	762	765	1007
1008	768	771	774	777	780	783	786	788	791	794	1008
1009	797	800	803	806	809	812	815	818	821	824	1009
1010	29.827	29.830	29.833	29.836	29.839	29.842	29.845	29.848	29.850	29.853	1010
1011	856	859	862	865	868	871	874	877	880	883	1011
1012	886	889	892	895	898	901	904	907	910	912	1012
1013	915	918	921	924	927	930	933	936	939	942	1013
1014	945	948	951	954	957	960	963	966	969	972	1014
1015	29.975	29.977	29.980	29.983	29.986	29.989	29.992	29.995	29.998	30.001	1015
1016	30.004	30.007	30.010	30.013	30.016	30.019	30.022	30.025	30.028	30.031	1016
1017	034	037	039	042	045	048	051	054	057	060	1017
1018	063	066	069	072	075	078	081	084	087	090	1018
1019	093	096	099	101	104	107	110	113	116	119	1019
1020	30.122	30.125	30.128	30.131	30.134	30.137	30.140	30.143	30.146	30.149	1020
1021	152	155	158	161	164	166	169	172	175	178	1021
1022	181	184	187	190	193	196	199	202	205	208	1022
1023	211	214	217	220	223	226	228	231	234	237	1023
1024	240	243	246	249	252	255	258	261	264	267	1024
1025	30.270	30.273	30.276	30.279	30.282	30.285	30.288	30.291	30.293	30.296	1025
1026	299	302	305	308	311	314	317	320	323	326	1026
1027	329	332	335	338	341	344	347	350	353	355	1027
1028	358	361	364	367	370	373	376	379	382	385	1028
1029	388	391	394	397	400	403	406	409	412	415	1029
1030	30.417	30.420	30.423	30.426	30.429	30.432	30.435	30.438	30.441	30.444	1030
1031	447	450	453	456	459	462	465	468	471	474	1031
1032	477	480	482	485	488	491	494	497	500	503	1032
1033	506	509	512	515	518	521	524	527	530	533	1033
1034	536	539	542	544	547	550	553	556	559	562	1034
1035	30.565	30.568	30.571	30.574	30.577	30.580	30.583	30.586	30.589	30.592	1035
1036	595	598	601	604	606	609	612	615	618	621	1036
1037	624	627	630	633	636	639	642	645	648	651	1037
1038	654	657	660	663	666	669	671	674	677	680	1038
1039	683	686	689	692	695	698	701	704	707	710	1039
1040	30.713	30.716	30.719	30.722	30.725	30.728	30.731	30.733	30.736	30.739	1040
1041	742	745	748	751	754	757	760	763	766	769	1041
1042	772	775	778	781	784	787	790	793	795	798	1042
1043	801	804	807	810	813	816	819	822	825	828	1043
1044	831	834	837	840	843	846	849	852	855	858	1044
1045	30.860	30.863	30.866	30.869	30.872	30.875	30.878	30.881	30.884	30.887	1045
1046	890	893	896	899	902	905	908	911	914	917	1046
1047	920	922	925	928	931	934	937	940	943	946	1047
1048	949	952	955	958	961	964	967	970	973	976	1048
1049	979	982	984	987	990	993	996	999	31.002	31.005	1049

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
1050	31.008	31.011	31.014	31.017	31.020	31.023	31.026	31.029	31.032	31.035	1050
1051	038	041	044	047	049	052	055	058	061	064	1051
1052	067	070	073	076	079	082	085	088	091	094	1052
1053	097	100	103	106	109	111	114	117	120	123	1053
1054	126	129	132	135	138	141	144	147	150	153	1054
1055	31.156	31.159	31.162	31.165	31.168	31.171	31.173	31.176	31.179	31.182	1055
1056	185	188	191	194	197	200	203	206	209	212	1056
1057	215	218	221	224	227	230	233	236	238	241	1057
1058	244	247	250	253	256	259	262	265	268	271	1058
1059	274	277	280	283	286	289	292	295	298	300	1059
1060	31.303	31.306	31.309	31.312	31.315	31.318	31.321	31.324	31.327	31.330	1060
1061	333	336	339	342	345	348	351	354	357	360	1061
1062	362	365	368	371	374	377	380	383	386	389	1062
1063	392	395	398	401	404	407	410	413	416	419	1063
1064	422	425	427	430	433	436	439	442	445	448	1064
1065	31.451	31.454	31.457	31.460	31.463	31.466	31.469	31.472	31.475	31.478	1065
1066	481	484	487	489	492	495	498	501	504	507	1066
1067	510	513	516	519	522	525	528	531	534	537	1067
1068	540	543	546	549	551	554	557	560	563	566	1068
1069	569	572	575	578	581	584	587	590	593	596	1069

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Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface)

Station Pressure (Inches)	Temperature °F																Station Pressure (inches)
	-50	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	+ 5	+10	+15	+20	+25	
20.60	+6	+6	+6	+6	+6	+6	+6	+6	+7	+7	+7	+7	+7	+8	+8	+8	20.60
20.70	6	6	6	6	6	6	6	6	6	7	7	7	7	7	8	8	20.70
20.80	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	8	20.80
20.90	5	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	20.90
21.00	5	5	5	6	6	6	6	6	6	6	6	6	7	7	7	7	21.00
21.10	5	5	5	5	6	6	6	6	6	6	6	6	6	7	7	7	21.10
21.20	5	5	5	5	5	5	6	6	6	6	6	6	6	6	7	7	21.20
21.30	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	7	21.30
21.40	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	7	21.40
21.50	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	21.50
21.60	4	4	5	5	5	5	5	5	5	5	5	5	6	6	6	6	21.60
21.70	4	4	4	4	5	5	5	5	5	5	5	5	5	6	6	6	21.70
21.80	4	4	4	4	4	4	5	5	5	5	5	5	5	5	6	6	21.80
21.90	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	6	21.90
22.00	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	6	22.00
22.10	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	22.10
22.20	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	22.20
22.30	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	22.30
22.40	3	3	3	4	4	4	4	4	4	4	4	4	4	4	5	5	22.40
22.50	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	22.50
22.60	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	5	22.60
22.70	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	22.70
22.80	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	22.80
22.90	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	22.90
23.00	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	23.00
23.10	2	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	23.10
23.20	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	23.20
23.30	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	23.30
23.40	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	23.40
23.50	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+3	+3	+3	+3	23.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F															Station Pressure (Inches)
	+30	+35	+40	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90	+95	+100	
20.60	+8	+9	+9	+10	+ 10	+11	+12	+12	+13	+14	+14	+14	+14	+14	+14	20.60
20.70	8	9	9	10	10	11	12	12	13	14	14	14	14	14	14	20.70
20.80	8	8	9	9	10	11	11	12	13	13	14	14	14	14	14	20.80
20.90	8	8	9	9	10	10	11	12	12	13	13	14	14	13	13	20.90
21.00	8	8	8	9	10	10	11	11	12	13	13	13	13	13	13	21.00
21.10	8	8	8	9	9	10	11	11	12	13	13	13	13	13	13	21.10
21.20	7	8	8	9	9	10	10	11	12	12	12	13	13	13	13	21.20
21.30	7	8	8	8	9	10	10	11	12	12	12	13	12	12	12	21.30
21.40	7	7	8	8	9	9	10	10	11	12	12	12	12	12	12	21.40
21.50	7	7	8	8	8	9	10	10	11	12	12	12	12	12	12	21.50
21.60	6	7	7	8	8	9	10	10	11	11	12	12	12	12	12	21.60
21.70	6	7	7	8	8	9	9	10	11	11	11	12	12	11	11	21.70
21.80	6	7	7	7	8	8	9	10	10	11	11	11	11	11	11	21.80
21.90	6	6	7	7	8	8	9	9	10	11	11	11	11	11	11	21.90
22.00	6	6	7	7	7	8	9	9	10	10	11	11	11	11	11	22.00
22.10	6	6	6	7	7	8	9	9	10	10	10	11	11	10	10	22.10
22.20	5	6	6	7	7	8	8	9	10	10	10	10	10	10	10	22.20
22.30	5	6	6	6	7	8	8	8	9	10	10	10	10	10	10	22.30
22.40	5	6	6	6	7	7	8	8	9	10	10	10	10	10	10	22.40
22.50	5	5	6	6	6	7	8	8	9	9	10	10	10	10	10	22.50
22.60	5	5	6	6	6	7	8	8	9	9	9	10	10	9	9	22.60
22.70	5	5	5	6	6	7	7	8	8	9	9	9	9	9	9	22.70
22.80	4	5	5	6	6	6	7	8	8	9	9	9	9	9	9	22.80
22.90	4	5	5	6	6	6	7	7	8	8	9	9	9	9	9	22.90
23.00	4	4	5	5	6	6	7	7	8	8	8	9	9	8	8	23.00
23.10	4	4	5	5	6	6	6	7	8	8	8	8	8	8	8	23.10
23.20	4	4	4	5	5	6	6	7	7	8	8	8	8	8	8	23.20
23.30	4	4	4	5	5	6	6	6	7	8	8	8	8	8	8	23.30
23.40	4	4	4	5	5	5	6	6	7	7	8	8	8	8	8	23.40
23.50	+3	+4	+4	+4	+5	+5	+6	+6	+7	+7	+7	+8	+8	+7	+7	23.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F																Station Pressure (Inches)
	-50	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	+ 5	+10	+15	+20	+25	
23.60	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+3	+3	+3	23.60
23.70	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	23.70
23.80	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	23.80
23.90	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	23.90
24.00	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	24.00
24.10	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	24.10
24.20	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	24.20
24.30	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	24.30
24.40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	24.40
24.50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	24.50
24.60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24.60
24.70	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	24.70
24.80	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	24.80
24.90	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	24.90
25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	25.00
25.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	25.10
25.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	25.20
25.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.30
25.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.40
25.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.50
25.60	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	25.60
25.70	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	25.70
25.80	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	25.80
25.90	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	25.90
26.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	26.00
26.10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26.10
26.20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26.20
26.30	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26.30
26.40	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	26.40
26.50	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	26.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F															Station Pressure (Inches)
	+30	+35	+40	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90	+95	+100	
23.60	+3	+4	+4	+4	+5	+5	+6	+6	+7	+7	+7	+7	+7	+7	+7	23.60
23.70	3	3	4	4	4	5	6	6	6	7	7	7	7	7	7	23.70
23.80	3	3	4	4	4	5	5	6	6	7	7	7	7	7	7	23.80
23.90	3	3	3	4	4	4	5	5	6	6	6	7	7	7	7	23.90
24.00	3	3	3	4	4	4	5	5	6	6	6	6	6	6	6	24.00
24.10	2	3	3	3	4	4	5	5	6	6	6	6	6	6	6	24.10
24.20	2	3	3	3	4	4	4	5	5	6	6	6	6	6	6	24.20
24.30	2	2	3	3	3	4	4	5	5	6	6	6	6	6	6	24.30
24.40	2	2	2	3	3	4	4	4	5	5	6	6	6	5	5	24.40
24.50	2	2	2	3	3	3	4	4	5	5	5	6	5	5	5	24.50
24.60	2	2	2	2	3	3	4	4	5	5	5	5	5	5	5	24.60
24.70	1	2	2	2	3	3	4	4	4	5	5	5	5	5	5	24.70
24.80	1	2	2	2	2	3	3	4	4	5	5	5	5	5	5	24.80
24.90	1	2	2	2	2	3	3	4	4	4	4	5	5	4	4	24.90
25.00	1	1	2	2	2	2	3	3	4	4	4	4	4	4	4	25.00
25.10	1	1	1	2	2	2	3	3	4	4	4	4	4	4	4	25.10
25.20	1	1	1	2	2	2	3	3	4	4	4	4	4	4	4	25.20
25.30	1	1	1	1	2	2	3	3	3	4	4	4	4	4	4	25.30
25.40	0	1	1	1	2	2	2	3	3	4	4	4	4	4	4	25.40
25.50	0	1	1	1	1	2	2	2	3	3	4	4	4	3	3	25.50
25.60	0	0	1	1	1	2	2	2	3	3	3	4	3	3	3	25.60
25.70	0	0	0	1	1	2	2	2	3	3	3	3	3	3	3	25.70
25.80	0	0	0	1	1	1	2	2	2	3	3	3	3	3	3	25.80
25.90	0	0	0	0	1	1	2	2	2	3	3	3	3	3	3	25.90
26.00	0	0	0	0	1	1	1	2	2	2	3	3	3	2	2	26.00
26.10	-1	0	0	0	0	+1	1	2	2	2	2	2	2	2	2	26.10
26.20	-1	0	0	0	0	+1	1	1	2	2	2	2	2	2	2	26.20
26.30	-1	0	0	0	0	0	+1	1	2	2	2	2	2	2	2	26.30
26.40	-1	-1	0	0	0	0	+1	1	2	2	2	2	2	2	2	26.40
26.50	-1	-1	-1	0	0	0	+1	1	1	2	2	2	2	2	2	26.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F																Station Pressure (Inches)
	-50	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	+ 5	+10	+15	+20	+25	
26.60	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	26.60
26.70	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	26.70
26.80	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	26.80
26.90	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	26.90
27.00	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	27.00
27.10	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	27.10
27.20	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	27.20
27.30	-2	-2	-2	-2	-3	-3	-2	-3	-3	-3	-3	-3	-2	-2	-2	-2	27.30
27.40	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-2	-2	27.40
27.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.50
27.60	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.60
27.70	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.70
27.80	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.80
27.90	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.90
28.00	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	28.00
28.10	-3	-3	-3	-3	-4	-4	-3	-4	-4	-4	-4	-4	-4	-3	-4	-3	28.10
28.20	-3	-3	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-3	28.20
28.30	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.30
28.40	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.40
28.50	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.50
28.60	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.60
28.70	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.70
28.80	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.80
28.90	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.90
29.00	-4	-4	-4	-4	-4	-4	-4	-4	-4	-5	-5	-5	-4	-5	-4	-4	29.00
29.10	-4	-4	-4	-4	-4	-5	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.10
29.20	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.20
29.30	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.30
29.40	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.40
29.50	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F															Station Pressure Inches
	+30	+35	+40	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90	+95	+100	
26.60	-1	-1	-1	-1	0	0	0	+1	+1	+2	+2	+2	+2	+1	+1	26.60
26.70	-1	-1	-1	-1	0	0	0	0	+1	1	1	2	1	1	1	26.70
26.80	-2	-1	-1	1	-1	0	0	0	+1	1	1	1	1	1	1	26.80
26.90	-2	-1	-1	-1	-1	0	0	0	+1	1	1	1	1	1	1	26.90
27.00	-2	-2	-1	-1	-1	-1	0	0	0	+1	1	1	1	1	1	27.00
27.10	-2	-2	-2	-1	-1	-1	0	0	0	+1	1	1	1	0	0	27.10
27.20	-2	-2	-2	-1	-1	-1	0	0	0	0	0	+1	0	0	0	27.20
27.30	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	0	0	27.30
27.40	-2	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	0	27.40
27.50	-2	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	0	27.50
27.60	-3	-2	-2	-2	-2	-2	-1	-1	0	0	0	0	0	0	0	27.60
27.70	-3	-2	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	27.70
27.80	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	0	0	0	-1	-1	27.80
27.90	-3	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	27.90
28.00	-3	-3	-3	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	28.00
28.10	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	28.10
28.20	-3	-3	-3	-3	-3	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	28.20
28.30	-4	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	-2	-2	28.30
28.40	-4	-3	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	-2	-2	-2	28.40
28.50	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	-2	28.50
28.60	-4	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	28.60
28.70	-4	-4	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	28.70
28.80	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	28.80
28.90	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	28.90
29.00	-4	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-2	-3	-3	29.00
29.10	-4	-4	-4	-4	-4	-4	-3	-3	-3	-2	-3	-2	-3	-3	-3	29.10
29.20	-5	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	-3	-3	29.20
29.30	-5	-4	-4	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	29.30
29.40	-5	-5	-5	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	29.40
29.50	-5	-5	-5	-5	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	29.50

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CHAPTER A8. WIND

A8000. OBSERVATIONAL

A8010. Magnetic Wind Directions.—Wind directions used for meteorological purposes are with reference to true north. Wind directions with reference to the magnetic north pole are sometimes required by CAA communications personnel providing air-ground communication service.

A8011. Evaluation.—Wind directions relative to true north are converted to wind directions, magnetic, as follows:

(1) When the direction relative to true north is taken from an indicator graduated in degrees:

(a) Add the magnetic declination to the true direction if the magnetic declination is west.

(b) Subtract the magnetic declination from the true direction if the magnetic declination is east.

(2) When the direction relative to true north is taken from an indicator that is graduated to 16 points of the compass, conversion is related to the declination as follows:

	Declination	Conversion Procedure
East:	(a) 0° - 11°	No conversion necessary.
	(b) 12° - 34°	The magnetic direction is the first compass point counterclockwise from the true direction.
	(c) 35° - 56°	The magnetic direction is the second compass point counterclockwise from the true direction.
West:	(a) 0° - 11°	No conversion necessary.
	(b) 12° - 34°	The magnetic direction is the first compass point clockwise from the true direction.
	(c) 35° - 56°	The magnetic direction is the second compass point clockwise from the true direction.

(Apply correspondingly larger conversion corrections for larger declinations.)

EXAMPLE	A	B
True wind direction	NW	SE
Magnetic declination	15° West	35° East
Wind direction, magnetic	NNW	E

A8020. Correction of Indicated Wind Speeds.—Indicated wind speeds will be corrected in accordance with Table A8-1. Note that the applicable correction for an installation is governed by the anemometer or the indicator, or both, and also by the speed range in use when the indicator is provided with multiple ranges.

A8030. Determination of True North.—Reference points for the determination of true north from a specified point of observation may be determined by one of the methods described in Circular O, which are preferable for use at stations equipped with a theodolite. The method best suited to the location of the station, and to the season and the time of day should be used. A clear or mostly clear day is required for the solar method, which is described below.

A8031. Solar Method.—

(1) Obtain the true solar time for the station in accordance with par. A16020.

(2) Select a tall, vertical object such as a pole or mast, whose vertical axis from top to base can be determined. The object must be close to the observation point. The top of the object should be pointed, or at least symmetrical in design around its vertical axis. The ground surrounding the object should be horizontal in the area in which its shadow appears.

(3) At a convenient time, two to four hours before true solar noon, mark the position of the mid-point of the end of the shadow cast on the level surface, and determine the departure in time from true solar noon at the time of marking.

(4) At true solar noon, mark the position of the mid-point of the end of the shadow on the surface.

(5) After true solar noon, at exactly the same interval of time as that of the departure from noon determined in (3), again mark the position of the mid-point of the end of the shadow cast on the surface at the same level as the mark made in accordance with (3).

TABLE A8-1. WIND-SPEED CORRECTIONS

Indicator or Wind System	Anemometer	Uncorrected Speed (m.p.h.)	Correction (m.p.h.)
F420 1/		2.5 to 75	0
		5.0 to 150 (Double Range)	-3
F420A 1/		2.0 to 75	0
		4.0 to 150 (Double Range)	-2
F430 1/		3 to 75	0
		6 to 150 (Double Range)	-3
	F101 (S-type) F102 (S-type) F103 (SA-type)		See Table 14
F210 or F222	F102	From pointer-swing value to 59 2/	0
		60 to 69	-1
		70 to 79	-2
		80 to 100	-3
F210 or F222	F103	From pointer-swing value to 87 2/	0
		88 to 94	+1
		95 to 100	+2
F431 1/		0 to 10	+3
		11 to 20	+2
		21 to 25	+1
		26 to 60	0
		61 to 65	+1
		66 and above	+2
	4-cup anemometers (except the S-EX type)		See Table 14
	4-cup S-EX type (Marvin experimental)	All speeds	+2
Aerovane		0 to 8	+1
		9 to 95	0

1/ Corrections are based on adjustment of the pointer, under calm conditions, to the lowest indicated speed given in this table for the type of indicator in use.

2/ The numerical value of the swing of the pointer is obtained in accordance with par. A8321.

(6) Determine the mid-point between the marks established in accordance with (3) and (5).

(7) Points (4) and (6), when accurately determined, will lie on a north-south line through the mid-point of the base of the object. When only one point, either (4) or (6), can be determined, the north-south line will be regarded as lying through that point and the mid-point of the base of the object.

(8) If the observation point is not along the north-south line described in (7), determine by measurement another line through the observation point parallel to (7), which will be the north-south line for the point of observation.

(9) As a point of reference for true north, select a convenient point on or near the horizon along the north-south line determined in (7) or (8) and to the north of the observation point.

A8040. Determination of Bearings.--When a north-south line has been established (see par. A8030), a theodolite may be used to obtain the bearings of reference objects from any point along the north-south line. When the bearings of reference objects are required from a point "B" that is not on the north-south line, the theodolite may be used to establish a supplementary north-south line through point "B" as follows (see Fig. A8-1):

(1) At point "A" on the established north-south line, orient the theodolite south = 360°, as in pibals.

(2) Superimpose the cross hairs on the image of a marker located at point "B", and read the azimuth scale. The reading is the bearing of point "B" from point "A".

(3) Move the theodolite to point "B" and orient it on point "A", using the bearing found in (2). With this orientation, true north will correspond to an azimuth angle of 360°, and the supplementary north-south line will therefore extend through point "B" to any object whose bearing is 360°.

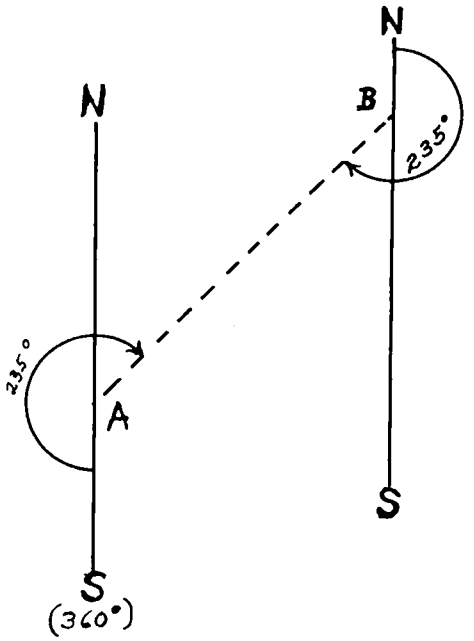

Fig. A8-1. Theodolite method of establishing a parallel north-south line. In this figure, it is desired to establish point "B" on a north-south line. The theodolite is set up at point "A" and oriented south = 360°. The bearing of point "B" is read on the azimuth scale as 235°. The theodolite is then set up at point "B" and oriented on point "A" = 235°. True north will be indicated by the theodolite at an azimuth reading of 360°. Any object with this bearing may therefore be used to establish a north-south line through point "B".

A805C. Prevailing Wind Direction.—The prevailing wind direction during a given period is the direction most frequently recorded at equal intervals of time throughout the period. When more than one direction is recorded an equal number of times, select as the prevailing direction the one having the largest number of adjacent directions recorded. Example: if prevailing hourly directions are recorded as E for one hour, SE for 10 hours, S for 10 hours, and SW for three hours, the prevailing direction for the day is South. When the wind speed or wind movement is less than one mile an hour, the wind direction will be considered indeterminate, and indicated directions obtained at such times will not be considered in determining the prevailing direction.

A8100. INSTRUMENTAL

A8110. Exposure and Related Maintenance.—So far as available sites permit, wind sensing equipment will be placed 30 to 35 feet above the ground on a freely exposed tower, and over terrain that is relatively level and free from obstructions to wind flow. In general, obstructions

include hills or other objects whose height above the ground at the exposure site is not more than ten times their distance from the site. Avoid sites where topography or other obstructions are known to create appreciable up-or-down drafts, eddy currents, or jet-flow effects. When a compromise must be made, expose the sensing units at least 12 feet above any obstruction within 100 feet of it, and at least as high as any obstruction within 100 to 200 feet of it. Supporting towers should not be of such bulk or shape as to create an appreciable obstruction to the wind flow.

A8111. Vertical Alignment.—Once a year, and more often if necessary, check the vertical alignment of the wind vane and anemometer, either with a spirit level, if the shape of the equipment is such that a level can be used for this purpose, or with a plumb bob. The alignment should be checked from two positions approximately 90° apart in azimuth. When it is necessary to make the comparison at a level below that of the anemometer, suspend the plumb bob approximately three feet from the eye, and stand at a distance from the equipment about equal to its height. Make necessary adjustments to secure vertical alignment.

A8120. General Maintenance.—Instructions in this Section for routine lubrication and cleaning are applicable to instruments operating under average conditions of exposure. More frequent lubrication and cleaning is required under severe operating conditions, such as those associated with exposures close to salt water, in an atmosphere polluted with industrial wastes, or in severe and frequent dust and sand storms. Squeaking bearings, scratches on bearing surfaces, and a noticeable accumulation of foreign matter (dirt, dirty oil film, corrosion, or moisture) on bearing surfaces, gear teeth, worm-gear threads, or within the instrument housing, indicate that more frequent cleaning and lubrication are required. Squeaking brushes in d-c generator-type anemometers should not be confused with squeaking bearings. Squeaking of the brushes usually decreases as the wind speed increases. In general, winter-type anemometer oil is satisfactory for use whenever anemometer lubrication is required. However, summer-type oil may be used at temperatures above 25° F. for lubricating F102 anemometers and other contact-type anemometers of similar general design that are also equipped with friction bearings at the upper end of the spindle. One or two drops of oil, applied with the end of a matchstick, are generally sufficient to oil each bearing surface. Other points of rolling or sliding friction, such as gear teeth, worm threads, sliding-contact surfaces, etc., should be oiled similarly. Carefully remove oil that spills or accumulates on non-lubricated portions of the equipment, especially electrical insulation and contact points. Direct contact with oil will cause the breakdown of some insulating materials. Oil film between contact points acts as an insulating material that may cause the equipment to fail. Oil film adjacent to moving parts tends to collect abrasive material that may gradually work into the bearings. Polish electrical contacts sufficiently to remove pitting or corrosion.

A8130. Accuracy of Wind Direction Indications.—At second-order stations, the accuracy of wind direction indications will be checked periodically by field aides. At first-order stations, check the accuracy of the indicated wind-direction readings once a year and, in addition, whenever the vane assembly is moved, the position of the switch is changed, or the switch is adjusted. Depending upon the type of equipment in use (see pars. A8131 and A8132), establish sufficient reference points to facilitate the routine checking of the wind direction indications. Establish the reference points in terms of the azimuth angle of each point measured clockwise from true north (see pars. A8030 through A8040). Check the vane by holding it at known azimuth angles and noting the correlation between the indicated readings and the corresponding azimuth angles of the vane.

A8131. Equipment Using 8- and 12-Position Switches.—(See pars. A8510 and A8520.) When the wind vane assembly has been moved or the position of the switch assembly altered, test the orientation of the switch and, depending upon the type of switch in use, the action of the contacts or commutators as follows:

(1) Obtain approximate alignment of the switch by orienting the "N" and "S" contacts or commutator segments in a north-south line, in that order. Omit this step in the case of contact-type wind vanes in which the contact cam is not in line with the axis of the wind vane.

(2) Rotate the vane slowly, and at the beginning of each contact, compare the azimuth angle of the vane with the correct angle as specified in Table A8-2. Whenever an angular error is generally common to all the switching points, adjust the position of the switch by turning the switch assembly sufficiently to eliminate the error (see Figs. A8-11 & A8-12). Small, random errors at individual points of change in direction are usually owing to poor vertical alignment of the contact arms or to poor condition and adjustment of the contacts (see par. A8511).

A8132. Direct-Reading Equipment.—Direct-reading equipment furnishes continuous indications of the position of the wind vane. It is necessary to test the accuracy of the readings for only one position of the wind vane. When indicated readings disagree with the position of the vane after the vane assembly is aligned in accordance with instructions for the type of equipment in use (see Section A8500), notify the Regional Office. A theodolite may be used at any point within view of the wind vane to test the agreement of the indicator with the vane for a single direction, as follows:

(1) Orient the theodolite south = 360°, as in pibals.

TABLE A8-2
Relation of Azimuth Angle to Switching Action of Wind-Vane Switches

Azimuth angle (measured clockwise from true north in degrees)	Switching Action	
	For 8-position use	For 4-position use
11-1/4	NE closes	
22-1/2		E closes
33-3/4	N open	
56-1/4	E closes	
67-1/2		N opens
78-3/4	NE opens	
101-1/4	SE closes	
112-1/2		S closes
123-3/4	E opens	
146-1/4	S closes	
157-1/2		E opens
168-3/4	SE opens	
191-1/4	SW closes	
202-1/2		W closes
213-3/4	S opens	
236-1/4	W closes	
247-1/2		S opens
258-3/4	SW opens	
281-1/4	NW closes	
292-1/2		N closes
303-3/4	W opens	
326-1/4	N closes	
337-1/2		W opens
348-3/4	NW opens	

(2) Superimpose the vertical cross hair on the image of the axis of the wind vane, and engage the azimuth screw to hold the theodolite in position. Read the azimuth scale.

(3) Rotate the wind vane and adjust the theodolite in elevation until the point of the wind vane appears at the intersection of the cross hairs. The direction indicated by the wind vane should agree with the reading made in (2).

A8200. RECORDERS

A8210. General.—Two types of wind recorders are in general use:

(1) The M000 triple register (or F320 double register) for use with contact-type anemometers (F101 or F102) and with wind vanes equipped with 4- or 12-position switches (F003, F004, or F005).

(2) The F311 speed and gust recorder for use with d-c, generator-type anemometers (F420-1, F420A-1, or F430-1).

A8220. Triple Register, M000; Double Register, F320.—In addition to the speed and direction of the wind as recorded by the F320 Double Register, rainfall and the duration of sunshine are recorded by an additional pen and magnet arrangement on the M000 register. (See Fig. A13-5.) Instructions for registers of these types are in Section A13000.

A8230. Speed and Gust Recorder, F311.—(See Fig. A8-2.) This recorder consists essentially of a one-milliampere meter, with a 3000-ohm input resistor. It is directly connected to the 3000-ohm output jack (recorder jack) of the F430 (WB design) or F420 (Electric Speed) wind speed indicator. When the recorder is used with the F420-A (Instruments Corporation) equipment, remove the 3000-ohm resistor connected across the "recorder" terminals of the indicator terminal block before connecting the input leads of the recorder to these terminals.

A8231. Operation.—With the chart-drive switch, on the front of the recorder chassis, in the low-speed position, the chart speed is two inches per hour. At this normal operating speed, the chart roll will last fourteen days. When the recorder is operated at high speed (see par. 8312), the paper speed is two inches per minute and the chart roll will hold approximately five and one-half hours of record.

A8231.1. Chart Entries.—Enter the station name, and the date and time of beginning and end of each completed chart. Whenever the recorder is

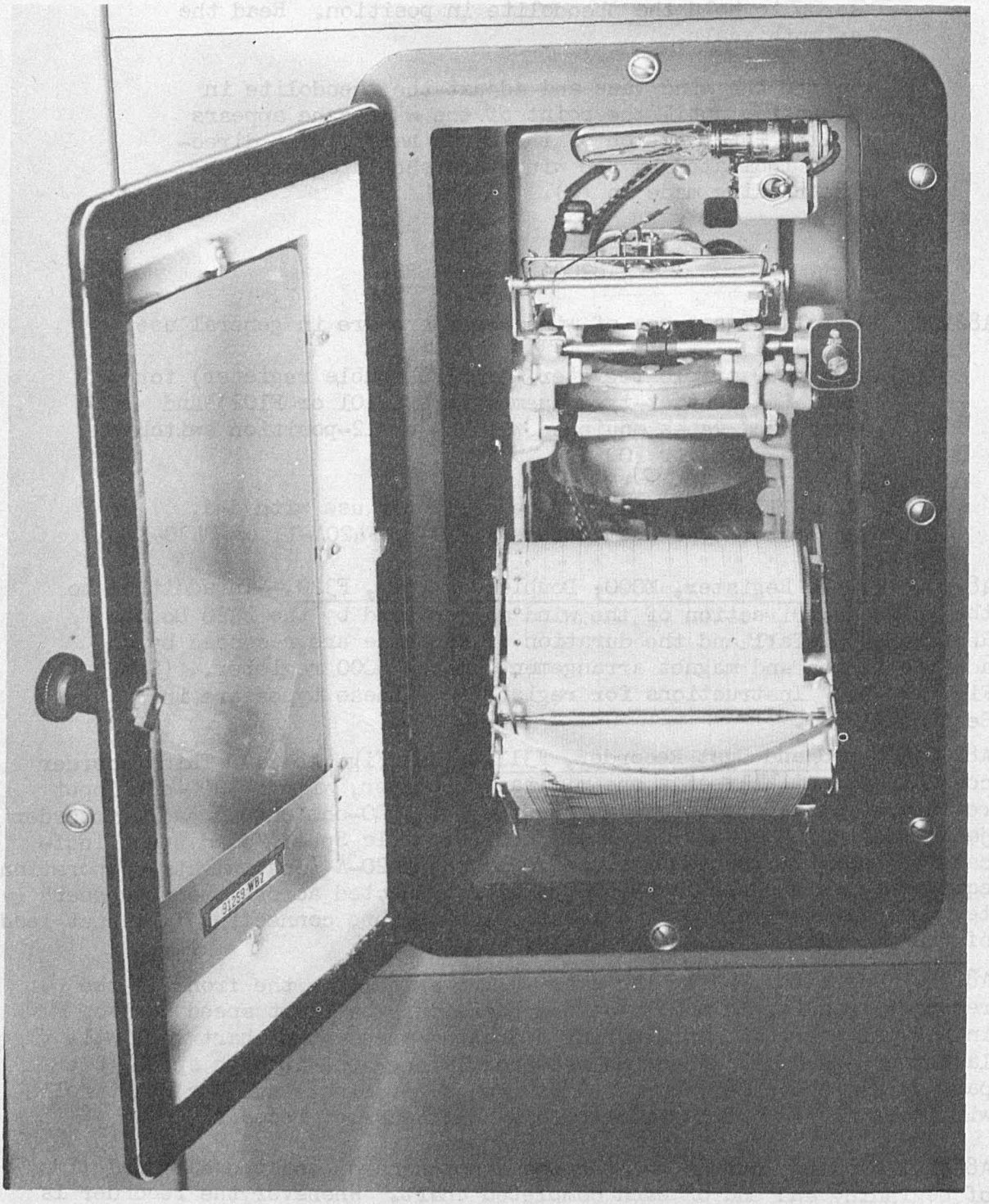

Fig. A8-2. Wind speed and gust recorder, F311.

operated at high speed, indicate the time of the beginning and end of high-speed operation at the corresponding points on the record.

A8231.2. Disposition of Charts.—Forward completed charts for the month to the Weather Records Processing Center not later than the second working day of the following month.

A8232. Maintenance.—Adjustment of the damping magnet will be made only by a technician.

A8232.1. Chart Replacement.—Replace the chart as frequently as necessary to avoid loss of record. Replace it in accordance with the manufacturer's manual of instructions and the following additional instructions. On recorders equipped with a chart-roll container that does not contain a supply bobbin, place the unused roll in the container so that the paper is unrolled from the front of the roll as the free end of the paper is withdrawn from the open top of the container.

A8232.2. Inking System.—Clean and refill the inking system in accordance with the manufacturer's instructions.

A8232.3. Lubrication.—At the times specified below, clean and lubricate the recorder in accordance with the manufacturer's manual of instructions.

(1) At least every three months, clean and oil the pivots and pinions of the reroll bobbin.

(2) At least every six months, lubricate the bearings of the reroll unit, gear trains, and timing drums.

(3) At least every two years, reoil the Telechron motors.

A8233. Installation and Accessories.—The recorder will be installed by a technician. The following accessory items are required for operation and on-station maintenance of the recorder:

(1) Ink (a minimum reserve of one bottle).

(2) Chart rolls (a minimum reserve of three rolls).

(3) One pen-cleaning wire.

(4) One pen-filling bulb.

(5) One inkwell filler.

A8300. INDICATORS

A8310. Speed and Direction Indicators (9-Light), F221A, B and C.--These indicators are actuated by contact-type anemometers and contact- or commutator-type wind vanes. A buzzer or gong is sometimes used in lieu of a center light for wind speed indications. Once a month test the operation of the lamps and lamp circuits. Test the direction lamps and their circuits by rotating the wind vane through several complete revolutions and observing whether all of the lamps operate in the proper sequence as the vane is revolved. As frequently as necessary, replace defective lamps with three-candle power, six- to eight-volt lamps. Some indicators use double-contact, bayonet-base (Mazda No. 64 or equivalent) lamps; other indicators use single-contact, miniature-bayonet-base (Mazda No. 44, 51, or equivalent) lamps. The Bendix-Friez-indicator lamps are located behind the dial. To remove the dial, pull outward on the bottom of the rim at the guide slot used to orient the dial with respect to the indicator housing and lamps. A transformer is used with the F221A indicator (see Fig. A8-3) to supply the required 6-8 volts when the indicator is to be powered from a 117-volt, a-c power supply. Some indicators are equipped with switches and variable resistors to control the intensity of the lights and to afford independent or simultaneous operation of the speed and direction lights.

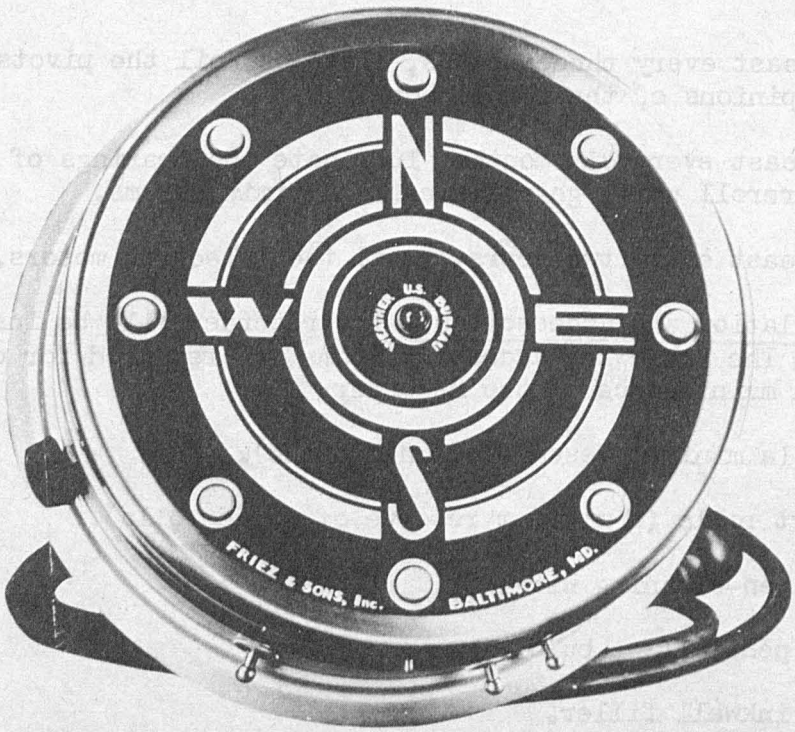

Fig. A8-3. Wind speed and direction indicator (9-light), F221A.

A8320. Speed Indicator (Condenser-Discharge Type), F210 and F222.—(See Fig. A8-4.) The Gurley condenser-discharge wind-speed indicator F210 and combined wind speed and direction indicator F222 are designed for use with 1/60-mile contact-type anemometers. About 24 hours of continuous operation of these indicators is required to stabilize the readings. These instruments may be used for wind-speed observations after (a) three consecutive readings, taken approximately an hour apart, indicate that the readings have stabilized; and (b) these readings have been checked for accuracy in the manner described in par. A8322. Keep the indicator meter in operation continuously except during maintenance periods. Installations in which the anemometer is wired directly to the indicator operate with a potential of approximately 50 volts across the leads to the anemometer. Do not remove the anemometer of these installations until the indicator has been disconnected from the power source. If the anemometer circuit is of six- to eight-volts and connected to the indicator circuit through a relay, the meter need not be disconnected from the power supply when the anemometer is removed for servicing.

A8321. Pointer-Swing.—The pointer-swing of the indicator is equal numerically to the maximum speed at which the pointer returns to zero between impulses, e.g., when the pointer returns to zero between impulses at any wind speed below 4 m.p.h., but does not drop to zero at higher speeds, 4 m.p.h. is termed the "swing" of the unit. If the swing exceeds 5 m.p.h., notify the Regional Office.

A8322. Accuracy Verification.—Before using the indicator readings for wind-speed observations, and at weekly intervals after the instrument is placed in service, check the accuracy of the instrument during a period of steady winds by counting the number of times that the main relay contacts close in a one-minute period (the number of relay-contact cycles per minute is equal to the mean one-minute wind speed). If the meter reading is steady during this period, the indicator reading should agree with the contact count within ± 1 m.p.h. If the disagreement exceeds this value, the unit should be adjusted at the low-scale-adjustment speed of ten miles per hour in the manner described in the following paragraphs. After making the adjustment recheck the accuracy of the readings. If the indicator is correct at speeds near ten miles per hour after a low-scale adjustment, but becomes erroneous at higher speeds, notify the Regional Office.

A8322.1. Low-Scale Adjustment.—Before adjusting the indicator, disconnect the anemometer from it. Establish momentary contact between terminals "1" and "2" at six-second intervals (10 contacts per minute). While this contact rate is being maintained, turn the zero-adjustment screw on the face of the meter until the up-scale swing of the pointer ends at the 10-miles-per-hour graduation each time contact is established between the terminals. An insulated wire, connected to one of the terminals, may be touched to the other terminal to establish the necessary

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contacts. After making this adjustment, turn the screw in the opposite direction by approximately one-half the total backlash movement of the screw. This latter adjustment, made to prevent subsequent shock or vibration from altering the meter adjustment, must not be great enough to alter the preceding adjustment. Finally, recheck the accuracy and stability of the adjustment by maintaining the test rate of 10-contacts-per-minute for three or four minutes.

A8323. Static-Charge Errors.--The glass of the meter dial should not be touched with the fingers or rubbed with a dry cloth or other dry material, since such action is likely to generate a sufficient charge of static electricity on the glass to cause serious errors in the readings. Use a dampened cloth or paper towel for cleaning the glass.

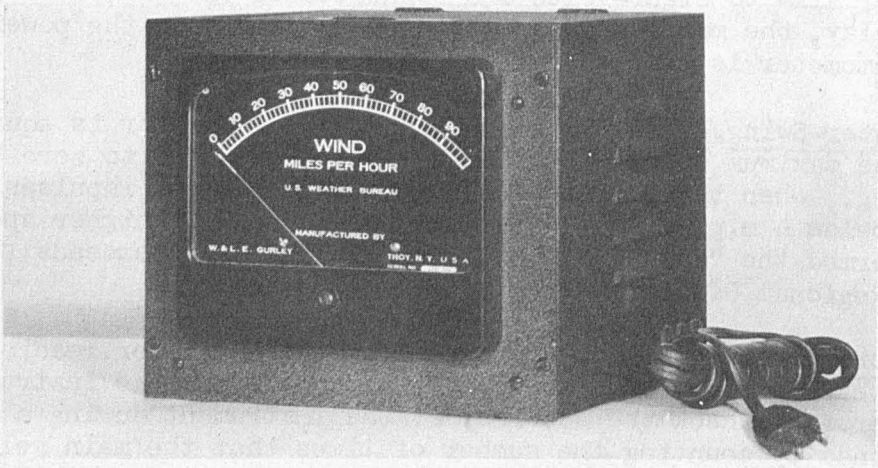

Fig. A8-4. Wind-speed indicator (condenser-discharge type), F210.

A8330. Speed and Direction Indicator, F431-3 and -4.--(Windial - see Fig. A8-5.) The indicators are operated from a 12-20 volt d-c power source. Not more than two indicators should be attached to a transmitter. When the unit is energized from a 117 volt a-c power source (nominal), a power converter in the cabinet converts 117 volts a-c to approximately 15 volts d-c. The six-volt dial lamps are connected in series; therefore, if one lamp fails, both lights will go out. To locate a defective lamp, substitute a good lamp for first one and then the other of the two lamps. Use a 6-8 volt, 0.25 ampere, miniature-bayonet-base, single-contact lamp, Mazda No. 44 or the equivalent. The knob on the front of the cabinet is used to control the intensity of the dial lights, and to turn them off. The instrument is protected from power overloads by a 3-AG, two-ampere fuse located in the back of the cabinet.

A8331. The direction indicator is graduated from 0 to 360 degrees, in increments of five degrees, and to eight compass points. The speed

indicator continuously indicates through approximately two revolutions of the pointer. It is graduated from 0 to 60 m.p.h. in one-mile increments, and from 60 to 125 m.p.h. in five-mile increments. Wind speed is read on the 0 to 60 m.p.h. scale during the first revolution of the pointer, and on the 60 to 125 m.p.h. scale during the second revolution of the pointer. The rest position of the pointer is about 0 m.p.h. (uncorrected), and the starting speed of the anemometer is approximately 3 m.p.h.; i.e., a wind speed of 3 m.p.h. or more is required for indicated readings greater than zero. Check the indicator occasionally under calm conditions to see that the rest position of the pointer is correct.

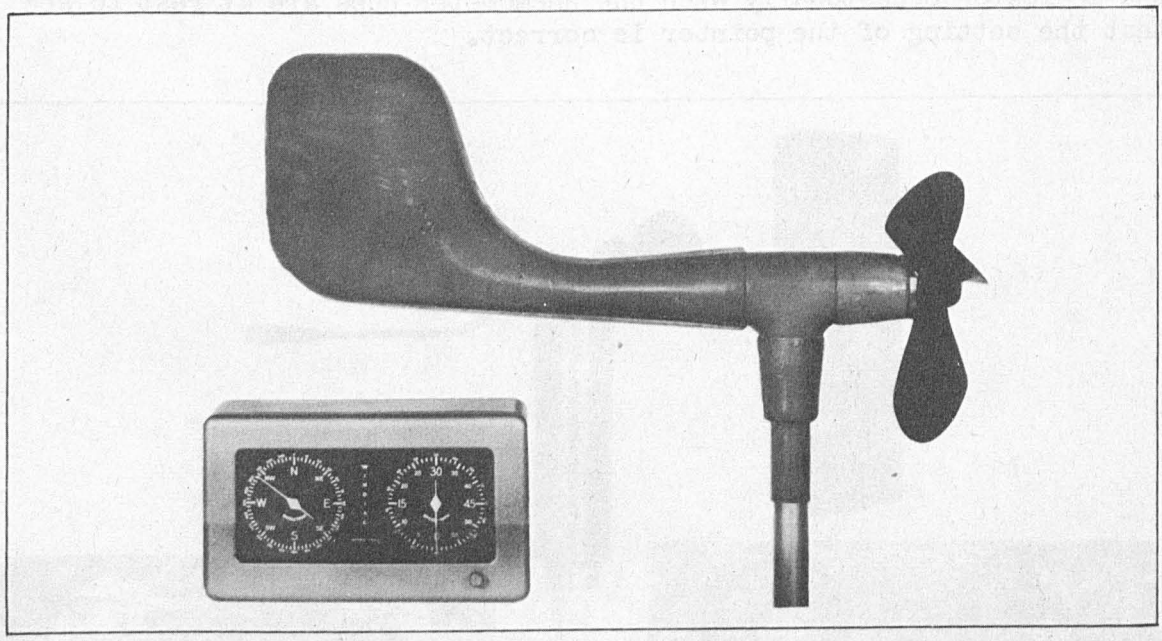

Fig. A8-5. Wind system (Windial), F431.

A8340. Speed and Direction Indicators, F430-3.--(See Fig. A8-6.) The indicators are mounted on a 19" x 6-31/32" panel. A sub-panel assembly behind the panel contains components of the transmitter circuits. The intensity of the dial lights is controlled by a knob on the front of the panel. To replace a dial lamp, remove the lamp socket from the back of the indicator by pulling outward on the stem of the socket with a side-to-side motion. Replace defective lamps with Mazda No. 44 (or equivalent) single-contact, miniature-bayonet-base lamps. Replace defective fuses with 3-AG, one-ampere fuses. A total of five speed-indicators and a recorder can be attached to this wind system. The addition of each indicator requires the removal of a 1500-ohm resistor connected across the respective indicator terminals. The installation of a recorder requires the removal of a 3000-ohm resistor (see par. A8230). Conversely, the removal of a recorder or indicator requires the replacement of the corresponding resistor.

A8341. The wind-speed indicator is a d-c milliammeter type, graduated from 0 to 75 m.p.h. in increments of 1 m.p.h.; the wind-direction indicator is a 117-volt (nominal), 60-cycle, a-c selsyn-type indicator, graduated from 0 to 360 degrees in increments of five degrees, with compass points indicated. When the range switch (below the dial) is in the 0-75 m.p.h. position, the true wind speed is the same as the indicated wind speed and is read directly from the dial. When the switch is in the 0-150 m.p.h. position, the uncorrected wind speed is twice the indicated speed. The rest position of the pointer is set at 3 m.p.h. to compensate for operational characteristics of the anemometer transmitter. Check the indicator occasionally when the anemometer cups are at rest to see that the setting of the pointer is correct.

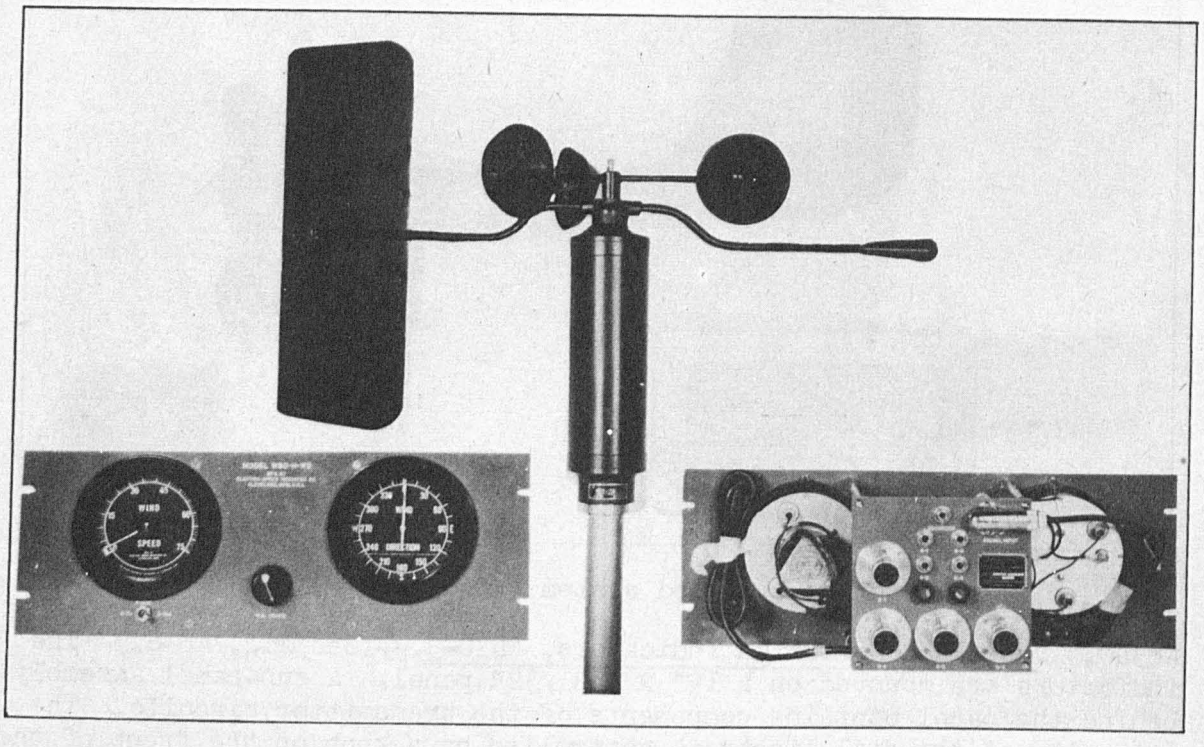

Fig. A8-6. Wind system, F430.

A8350. Speed and Direction Indicators, F420-8, F420-9.- (Electric Speed - see Fig. A8-7.) The indicators are mounted on a 19" x 6-31/32" panel. A sub-panel assembly behind the panel contains components of the transmitter circuits and a milliammeter. Read the milliammeter at least monthly, and notify the Regional Office if the pointer does not remain within the red portion of the scale. To replace a dial lamp, remove the lamp socket by pulling outward on the stem of the socket with a side-to-side motion. Replace defective lamps with Mazda No. 47, single-contact, miniature-

bayonet-base lamps. A total of three speed-indicators and a recorder may be attached to this wind system. The circuit must be modified as each indicator or recorder is added to the original system (see par. A8340).

A8351. The direction indicator is a 12-volt, d-c, selsyn type, graduated from 0 to 360 degrees in increments of five degrees, with compass points indicated. The wind-speed indicator is a d-c milliammeter type, graduated from 0-75 m.p.h. in increments of 1 m.p.h. When the range switch (below the dial) is in the 0-75 m.p.h. position, the true wind speed is the same as the indicated wind speed and is read directly from the dial. When the switch is in the 0-150 m.p.h. position, the uncorrected wind speed is twice the indicated wind speed (dial reading). The rest position of the pointer is set at 2.5 m.p.h. to compensate for operating characteristics of the transmitter. Check the indicator occasionally when the anemometer cups are at rest to see that the setting of the pointer has not been altered.

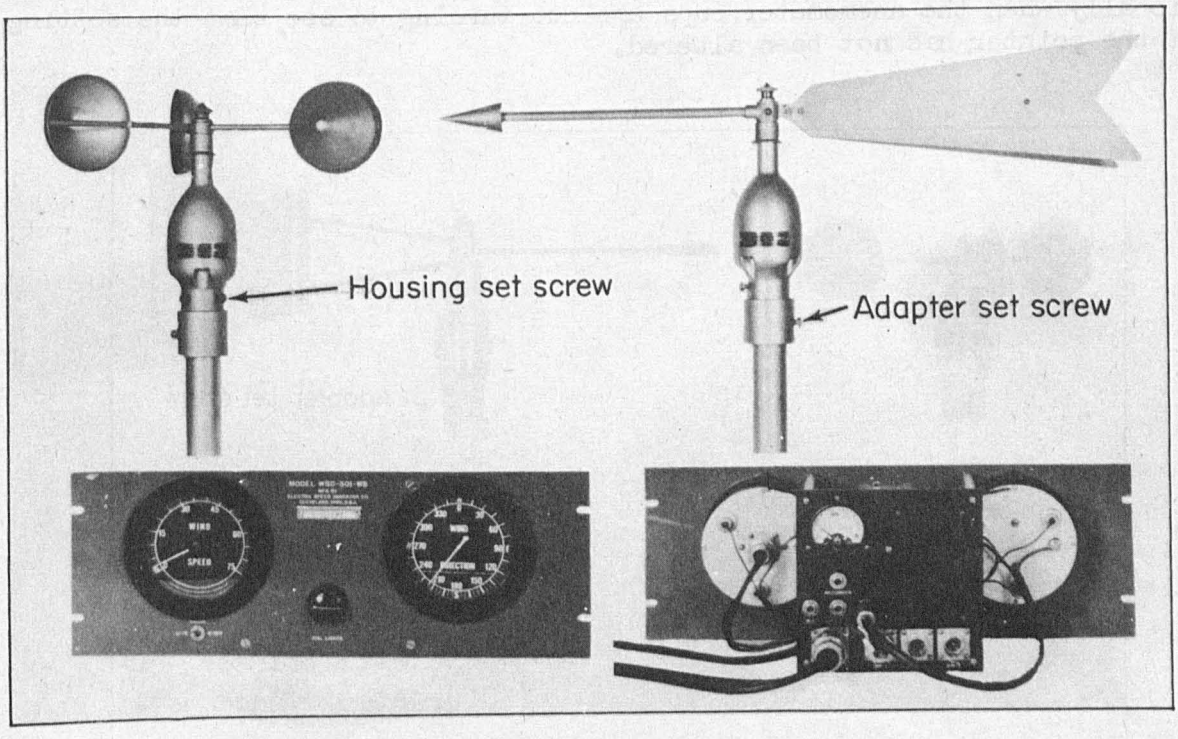

Fig. A8-7. Wind system (Electric Speed), F420.

A8360. Speed and Direction Indicators, F420A-8, F420A-9.—(Instruments Corp. - See Fig. A8-8.) The indicators with the speed-range-indicator lights and switch are mounted on a 19" x 6-31/32" panel. A sub-panel assembly behind the panel contains components of the transmitter circuits, the power supply, line fuse, and terminal connection block. To replace a range lamp, unscrew the jewel-type lens on the front of the panel. Press

the lamp inward and turn it counterclockwise until the lamp is free to be removed from its socket. Replace the lamp with a Mazda No. 47, single-contact, miniature-bayonet-base lamp. Replace defective line fuses with 3-AG, two-ampere fuses. Three speed-indicators and a recorder may be operated in the circuit of this wind system; however, the circuit must be modified as each additional indicator or recorder is attached (see par. A8340).

A8361. The direction indicator is a 12-volt, d-c selsyn type, graduated from 0 to 360 degrees in increments of five degrees, with compass points indicated. The speed indicator is a d-c milliammeter type, graduated from 0 to 75 m.p.h. in increments of 1 m.p.h. The indicator range in use is indicated by one of two lights flanking the range switch. When the 0 to 75 m.p.h. range lamp is lighted, the uncorrected wind speed is indicated directly on the dial. When the 0 to 150 m.p.h. range lamp is lighted, the uncorrected wind speed is twice the indicated wind speed. The rest position of the pointer is set at 2 m.p.h. to compensate for operating characteristics of the transmitter. Check the indicator occasionally when the anemometer cups are not turning to see that the setting of the pointer has not been altered.

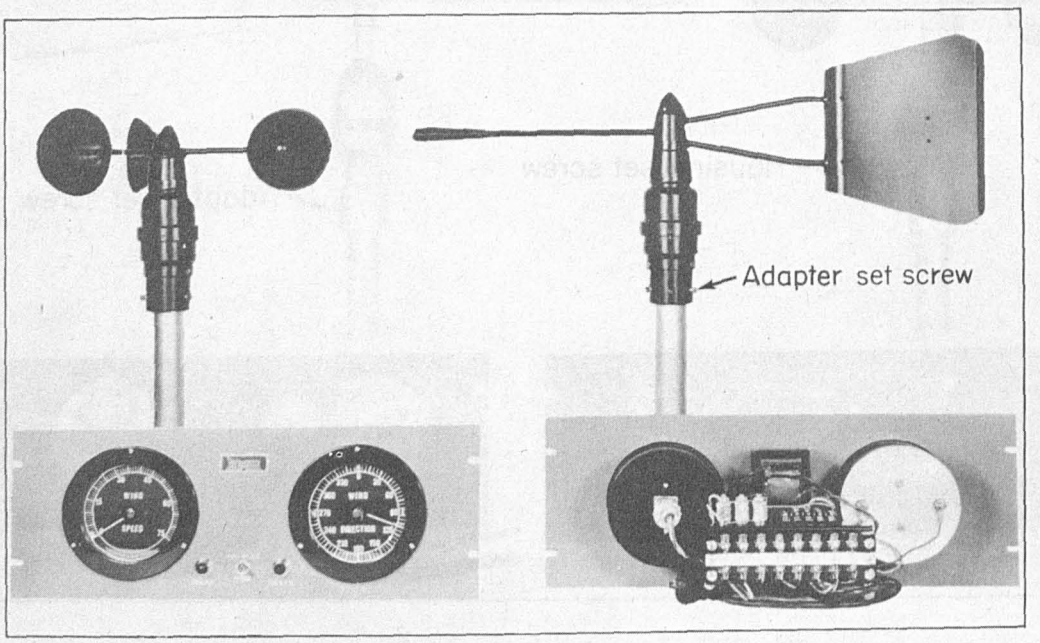

Fig. A8-8. Wind system (Instruments Corp.), F420A.

A8400. ANEMOMETERS

A8401. The maintenance instructions for F102 anemometers are also generally applicable to F101 one-mile-contact-type, 3-cup anemometers, and to 4-cup anemometers. The one-mile-contact action of the F101 anemometer is similar to that of the F102 anemometer.

A8410. Anemometers, F102.—(3-Cup, WB Type - See Fig. A8-9) The three-cup rotor mechanism of this anemometer drives a mechanical odometer through a gear train, and also actuates 1/60-mile and one-mile electrical contacts. The cups, the rotor, and the gear train are so designed that the passage of each 1/60 mile and one mile of wind causes the respective contacts to close momentarily. The odometer totalizes, in increments of one-tenth mile, the number of miles of wind that pass the anemometer.

A8411. Reading the Odometer.—The odometer totalizes 990 miles of wind movement before the dials return to zero. A reading to miles and tenths is made on two concentric dials, one of which is marked "miles" and the other "miles and tenths." These dials are read as follows:

(1) At the index (V-shaped depression) on the outer dial, read the value on the inner dial to hundreds and tens. When the index is between two graduations, take the lower value for the tens place.

(2) At the index just outside the upper left quadrant of the dials, read the outer dial to units and tenths. When the index is between two numbers (units) or two graduations (tenths), take the lower value.

(3) Add the values read in (1) and (2).

Note: Care must be exercised to avoid errors owing to backlash; e.g., if the reading in (1) appeared to be exactly 760 or a little more, and the reading in (2) appeared to be 9.1, the reading in (1) must be regarded as 750, and the complete reading as 759.1. If the complete reading was actually 769.1, the reading in (1) would be very close to 770.

A8412. Routine Maintenance.—The parenthetical letters in the following instructions refer to anemometer parts similarly identified in Fig. A8-9. An orifice is provided in the back of the housing of the anemometer for the inspection and oiling of the lower bearing of the spindle. Keep the orifice closed except during servicing operations to prevent the entrance of dust, moisture, or other foreign matter. At least once a week, check for satisfactory operation of the anemometer, and if the retaining nut (j) is not of the oil-reservoir type, remove the cups and place a drop of oil on the upper bearing (g). At least once a month clean and oil the anemometer. Before removing the anemometer, label the leads to insure correct replacement. To remove the anemometer, disconnect the leads and unscrew the set screw (1) several turns. Remove the anemometer with a twisting motion to loosen the fit between the pintle and the adapter at the lower end of the anemometer. Remove the cups and, after unscrewing the upper bearing with the anemometer wrench, remove the spindle. The pins in one end of the wrench are designed to fit the two holes in the top

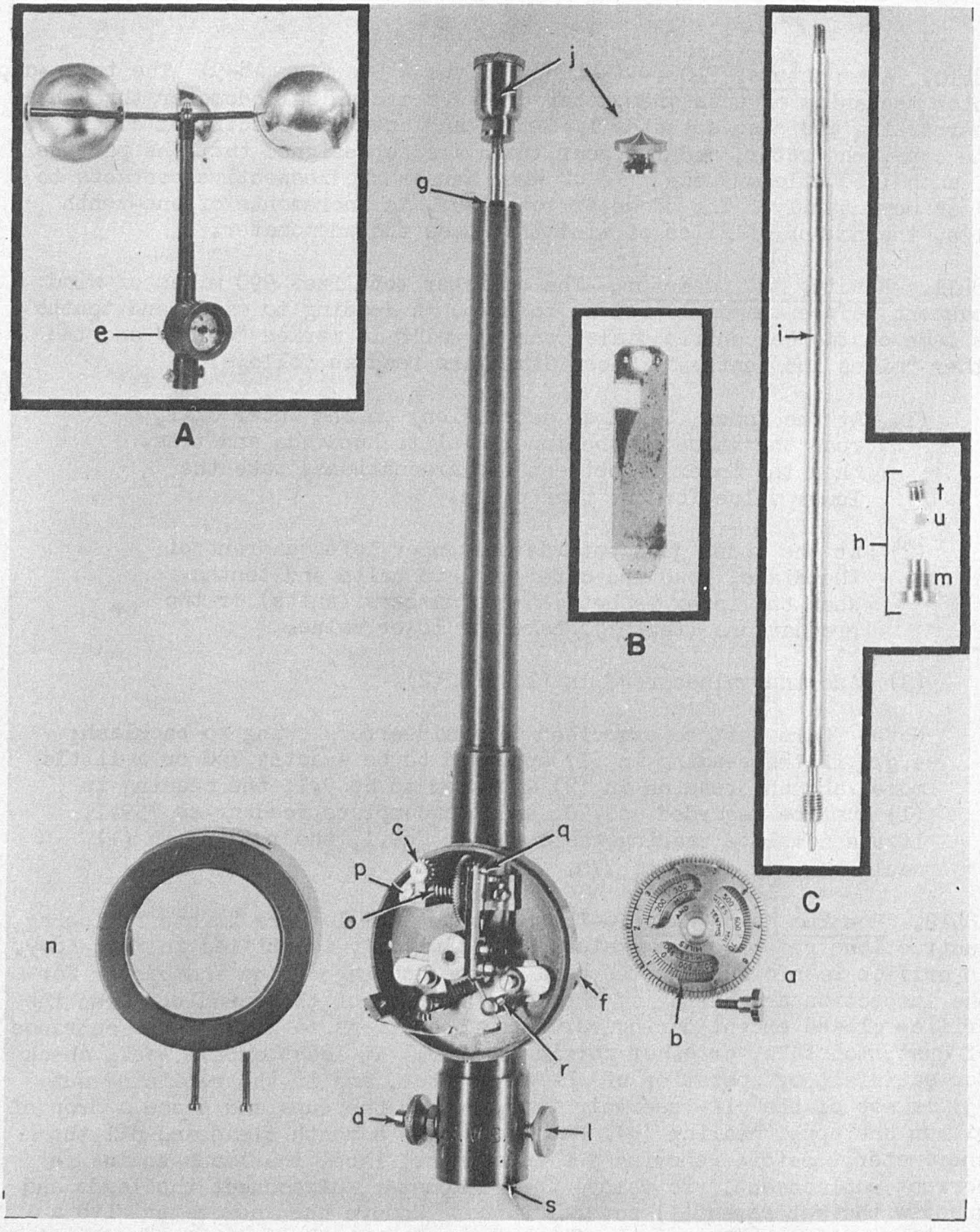

Fig. A8-9.
Three-cup anemometer, five-inch diameter cups,
1/60- and 1-mile contacts, F102.

face of the bearing. It is not necessary to remove the lower bearing more frequently than once a year provided the reservoir (m) is kept filled and the oil remains clean. A screwdriver is required to unscrew or replace the lower bearing. The slotted head of the bearing assembly is reached through the pintle-adapter end (s) of the anemometer housing. When the lower bearing is removed, unscrew the collar (t) and remove the steel thrust washer (u). Remove the odometer cover (n) after unscrewing the two retaining screws in the face of the cover. At least once a year, and more frequently if visible amounts of dirt have accumulated on the graduated faces or between the teeth of the odometer dials, remove the retaining screw and dials, being careful not to bend the spring-mounted arm of the one-mile-contact points. Similarly, if visible amounts of dirt have accumulated on the worm- and pinion-gear assembly (p), unscrew the index (c); remove the pinion gear; unscrew the pillow-block bearing screw (p); and remove the bearing and worm-gear unit.

A8412.1. Clean the inside of the anemometer housing, being careful not to bend the movable arms of either the 1/60-mile or one-mile contacts. Wash the spindle, bearings, gears, and similar disassembled parts in Varsol, Stansol, or similar petroleum-base solvent (gasoline, especially leaded gasoline, which is very poisonous, should not be used). Dry the parts thoroughly with clean, soft cloth or tissue before reassembling the instrument. The bearings and teeth should not show appreciable scratches, flat spots, or other signs of neglect or wear. When the lower bearing (h) is removed for cleaning, check the condition of the thrust-bearing washer and the pivot end of the spindle. For satisfactory operation, the rounded end of the spindle should not be flattened appreciably, and the thrust-washer face should be smooth, flat, and without cupping in the center. After noticeable cupping occurs in one face of the washer, use the other face as the bearing surface. Unless the rounded end of the spindle has worn badly, the bright spot (contact area) in the center of the thrust washer should not be larger than the head of a pin. Clean and replenish the oil reservoir with oil sufficient to insure that the reservoir will be filled when the lower end of the spindle is replaced in the bearing. Lightly oil all other bearings, gear teeth, and sliding contact areas, except electrical contacts, before reassembling the instrument. If the anemometer is equipped with the oil-reservoir type of retaining nut (j), refill the reservoir and check the condition of the wick. Once a year, clean the oil reservoir and refill it with clean oil. Oil from the reservoir is fed with cotton wicking to a small drilled hole in the top of the shaft, and thence through a right-angle channel to the upper bearing. Cotton wicking may be made from size 8 to 20 unmercerized cotton thread. Coil several turns of wicking in the bottom of the reservoir, and insert about one inch of the free end of the wick into the hole in the spindle when the instrument is reassembled.

A8412.2. The 1/60-mile-contact screw (q) and the one-mile-contact screw (r) are used to adjust the contact clearances in order to obtain satisfactory opening and closing of the contacts. When bent spring arms of

the movable contacts preclude satisfactory adjustment, rebend them until a satisfactory adjustment can be made. In adjusting either the movable or fixed contacts, secure definite electrical contact between them with as little friction as possible between the movable contact and the wheel pins that actuate it. The adjustment should be such that the contacts are closed for as short a portion of each cycle as is necessary to operate satisfactorily the indicator or register to which the anemometer is connected. Be careful that the spring arms are not bent to the extent that the actuating pins touch the arm of the movable one-mile contact ahead of the sharp projection on the arm, or ahead of the rounded projection on the back of the 1/60-mile-contact arm. Polish the electrical contacts if necessary to remove pitting or corrosion.

A8412.3. Reassemble the anemometer and check it for freedom of rotation of the spindle. Replace the anemometer on the pintle with a slight twisting motion until the anemometer is tightly seated. Secure the anemometer by turning the set screw (1) clockwise by hand. Connect the ground lead to terminal (d) by means of the knurled nut; connect the 1/60-mile-contact lead to the left rear terminal (e) on the back of the anemometer housing; and connect the one-mile contact-lead to the right rear terminal (f). Determine that the operation of the odometer and the operation of the electrical contacts are satisfactory as evidenced by the operation of the indicators and registers connected to the anemometer. For instructions pertaining to the vertical alignment, see par. A8111.

A8420. Anemometer, F103.—(WB Airway Type - See Fig. A8-10.) The three-cup rotor mechanism of this anemometer closes an electrical circuit momentarily with the passage of each 1/60 mile of wind. Normally, the anemometer is connected to a 6- to 8-volt circuit.

A8421. Routine Maintenance.—In addition to the attention required by Section A8100, at least once a month loosen the spindle retaining screw and remove the spindle rotor, and rainshield assembly. Be careful not to lose the flat washer between the rainshield and the ball bearing on anemometers with a serial number between 2312-SA and 2511-SA. Oil the ball bearing under the rainshield, the worm threads of the rotor spindle, and the spindle journal at the lower end of the rotor spindle. Use one or two drops on each surface. Replace the spindle and cup assembly, and tighten the retaining screw.

A8421.1. At least once every month, remove the anemometer for cleaning and oiling. Label the leads to the anemometer before disconnecting them from the terminal posts. Unscrew the thumb-clamp screw several turns and remove the anemometer with a slight twisting motion. Loosen the spindle retaining screw and remove the spindle, rotor, and rainshield assembly. If the cups are removed from the spindle, replace the cups for clockwise rotation as viewed from the top (see Fig. A8-10). Remove the front name-

plate cover for access to the lower spindle bearing and the contact points. When difficulty is encountered in cleaning or adjusting the gear train and contact mechanism through the front cover opening, remove the back cover plate and then remove the mechanism from the housing. Be careful to replace the cover in such manner that the original alignment, which secures minimum friction between the spindle and the lower bearing, is not changed. The lower bearing for the spindle carries the thrust of the spindle shaft on a steel ball bearing. Do not disturb the lower bearing-adjustment screw. The bearing is adjusted at the factory to assure low starting speed and calibration accuracy.

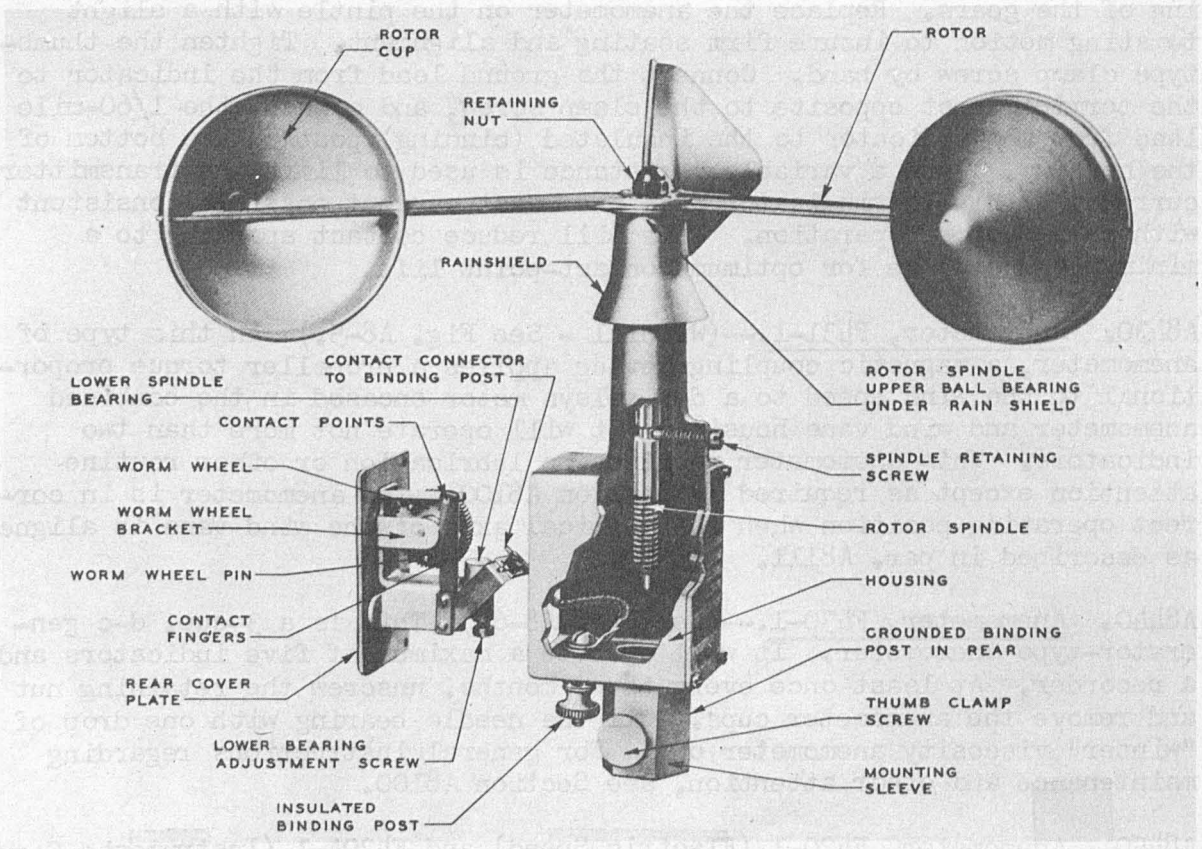

Fig. A8-10. Three-cup anemometer, 2-7/8-inch diameter cups, 1/60-mile contact, F103.

A8421.2. When the anemometer is cleaned, carefully check the condition and adjustment of the contacts. This is especially necessary when the anemometer operates on more than six to eight volts, as when it is connected directly to a condenser-discharge indicator. Adjust the position of the spring-mounted contact, either by means of an adjusting screw,

when one is provided, or by bending the spring until each contact of the rotating contact wheel successively makes a brief, but firm, sliding contact with the spring-mounted contact. The adjustment should be such that the contacts separate as rapidly and with as little arcing as possible. The maximum satisfactory contact clearance is approximately 0.02 inch. Blackened or pitted contacts indicate arcing (a source of radio interference). The adjustment that causes the least blackening of the contacts consistent with satisfactory operation should be maintained. Polish the contacts if necessary to remove pitting or corrosion.

A8421.3. When replacing the spindle and cup assembly, rotate the spindle by hand as it is inserted in the lower bearing in order to facilitate meshing of the gears. Replace the anemometer on the pintle with a slight twisting motion to insure firm seating and alignment. Tighten the thumb-type clamp screw by hand. Connect the ground lead from the indicator to the terminal post opposite to the clamp screw, and connect the 1/60-mile lead from the indicator to the insulated (binding) post on the bottom of the housing. When a variable resistance is used to limit the transmitter current, supply the indicator with the least current possible consistent with satisfactory operation. This will reduce contact sparking to a minimum and provide for optimum contact-point life.

A8430. Anemometer, F431-1.--(Windial - See Fig. A8-5.) In this type of anemometer, a magnetic coupling device applies a propeller torque proportional to the wind speed to a d-c selsyn motor encased in the combined anemometer and wind vane housing. It will operate not more than two indicators. This anemometer requires no lubrication or other routine attention except as required by Section A8100. The anemometer is in correct operating position when the vertical axis of the wind vane is aligned as described in par. A8111.

A8440. Anemometer, F430-1.--(See Fig. A8-6.) This is a 3-cup, d-c generator-type anemometer. It will operate a maximum of five indicators and a recorder. At least once every three months, unscrew the retaining nut and remove the anemometer cups. Oil the needle bearing with one drop of "winter" viscosity anemometer oil. For general instructions regarding maintenance and other attention, see Section A8100.

A8450. Anemometer, F420-1 (Electric Speed) and F420A-1 (Instruments Corp.).--(See Figs. A8-7 & A8-8.) These 3-cup, d-c generator-type anemometers will operate a maximum of three indicators and one recorder. They require no routine lubrication. See Section A8100 regarding general maintenance and other attention.

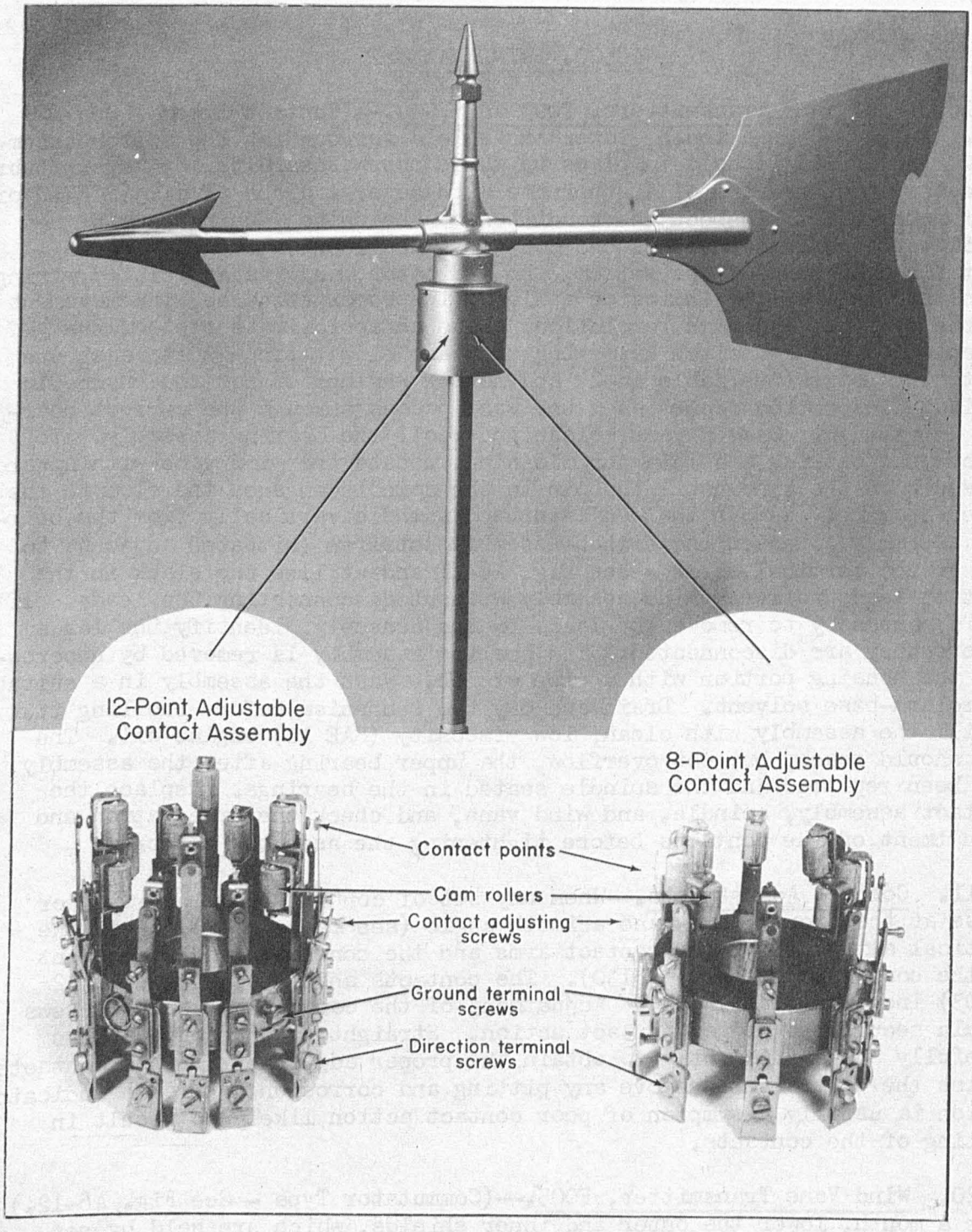

Fig. A8-11. Wind-direction transmitter, F003 or F004, and vane, F010. Either the F003-1 eight-point switch, or the F004-1 twelve-point switch, may be used in this type of installation.

A8500. WIND VANES

A8510. Wind Vane Transmitters, F003 and F004.—(Contact Types - See Fig. A8-11.) Once a month, lower the shield surrounding the switch assembly. The shield is held in place by three screws near its top edge. Lubricate the upper bearing of the spindle with several drops of oil (SAE 10 or anemometer oil). Inspect the condition of the switch, being careful not to disturb the adjustment of the contacts when lubricating the bearing. Test the operation of the switch, the indicator, and its associated wiring by noting whether the indicator follows, in proper sequence, the movement of the vane through each revolution. Make an approximate test of the orientation of the switch by moving the vane slowly through at least one switching point (See Table A8-2) and noting whether or not the change in indicated direction occurs when the vane passes through the correct bearing in azimuth. Once a year, clean and reoil the bearing assembly. To remove the bearing assembly for cleaning, rotate the wind vane with upward pressure on the vane until the pin in the spindle engages the slot in the upper bearing. Remove the wind vane and spindle vertically from the bearing assembly. Loosen the switch-assembly setscrew (situated adjacent to the ground terminal screw - see Fig. A8-11) and utilize the slack in the contact leads to remove the assembly without disconnecting the leads. If it is necessary to remove the leads to the assembly, identify the leads before they are disconnected. The bearing assembly is removed by unscrewing the housing portion with a pipe wrench. Wash the assembly in a suitable petroleum-base solvent. Drain and dry the mechanism before reoiling it. Refill the assembly with clean, low viscosity (SAE 10) engine oil. The oil should reach, but not overflow, the upper bearing after the assembly has been replaced and the spindle seated in the bearings. Replace the contact assembly, spindle, and wind vane, and check the orientation and adjustment of the contacts before tightening the assembly setscrew.

A8511. Contact Adjustments.—When any set of contacts does not open or close at the proper wind-vane azimuth angle (see Table A8-2), check the vertical alignment of the contact arms and the condition and adjustment of the contacts (see par. A8130). The contacts should open about 1/32 (0.03) inch when fully open. Adjustment of the contact-adjusting screws should secure the proper contact action. Straighten bent contact arms carefully and sufficiently to obtain the proper adjustment of the contacts. Polish the contacts to remove any pitting and corrosion. Erratic indicator action is usually a sympton of poor contact action likely to result in pitting of the contacts.

A8520. Wind Vane Transmitter, F005.—(Commutator Type - See Fig. A8-12.) Once a month, lower the outer and inner shields, which are held by setscrews, as shown in Fig. A8-12. Lubricate the upper bearing with several drops of oil (SAE 10 or anemometer oil). Wipe the commutator free of dirt, grease, etc. Test for the correct action and orientation of the commutator-type switch assembly in the manner specified in par. A8510.

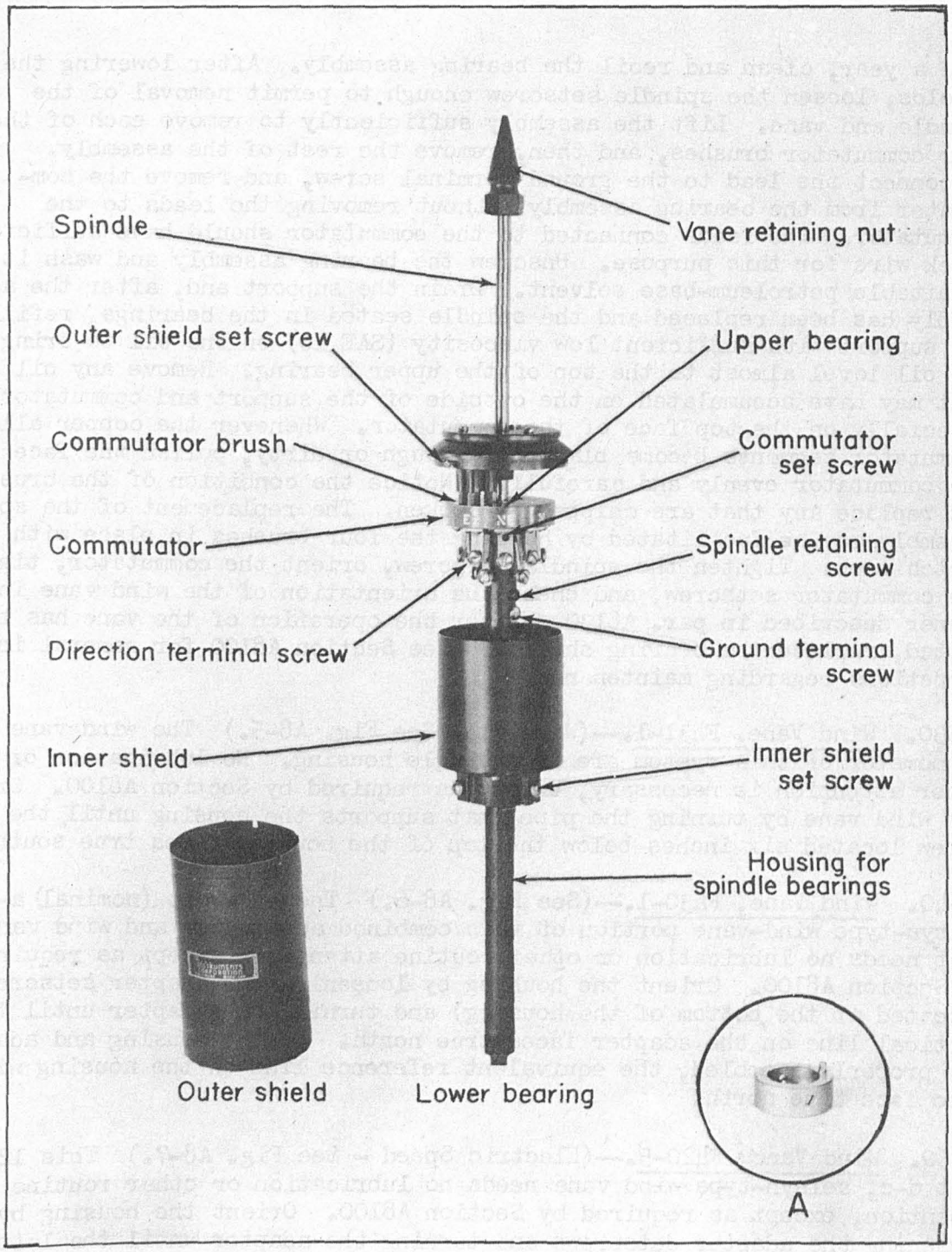

Fig. A8-12. Wind-direction transmitter (12-point commutator-type switch), F005. Inset A shows Adapter F005-1 which replaces recessed collar on metal vanes when used with F005 transmitter.

Once a year, clean and reoil the bearing assembly. After lowering the shields, loosen the spindle setscrew enough to permit removal of the spindle and vane. Lift the assembly sufficiently to remove each of the four commutator brushes, and then, remove the rest of the assembly. Disconnect the lead to the ground terminal screw, and remove the commutator from the bearing assembly without removing the leads to the commutator. The leads connected to the commutator should have sufficient slack wire for this purpose. Unscrew the bearing assembly and wash it in a suitable petroleum-base solvent. Drain the support and, after the assembly has been replaced and the spindle seated in the bearings, refill the support with sufficient low viscosity (SAE 10) engine oil to bring the oil level almost to the top of the upper bearing. Remove any oil that may have accumulated on the outside of the support and commutator, especially on the top face of the commutator. Whenever the copper alloy commutator segments become blackened, rough or dirty, polish the face of the commutator evenly and carefully. Notice the condition of the brushes and replace any that are chipped or broken. The replacement of the spindle assembly may be facilitated by holding the four brushes in place with scotch tape. Tighten the spindle setscrew, orient the commutator, tighten the commutator setscrew, and check the orientation of the wind vane in the manner described in par. A8130. After the operation of the vane has been tested, replace the bearing shields. See Section A8100 for general instructions regarding maintenance.

A8530. Wind Vane, F431-1.—(Windial - See Fig. A8-5.) The wind vane and anemometer of this system are in a single housing. No lubrication or other attention is necessary, except as required by Section A8100. Orient the wind vane by turning the pipe that supports the housing until the setscrew located six inches below the top of the housing faces true south.

A8540. Wind Vane, F430-1.—(See Fig. A8-6.) The 117-volt (nominal) a-c, selsyn-type wind-vane portion of this combined anemometer and wind vane unit needs no lubrication or other routine attention, except as required by Section A8100. Orient the housing by loosening the adapter setscrews (located at the bottom of the housing) and turning the adapter until the vertical line on the adapter faces true north. If the housing and adapter are properly assembled, the equivalent reference line on the housing will also face true north.

A8550. Wind Vane, F420-5.—(Electric Speed - See Fig. A8-7.) This 12-volt d-c, selsyn-type wind vane needs no lubrication or other routine attention, except as required by Section A8100. Orient the housing by loosening the adapter setscrews and turning the adapter until the letter "N" on the transmitter housing faces true north. When the housing and adapter are assembled and secured by the housing setscrew, the adapter is properly aligned with the transmitter housing.

A8560. Wind Vane, F420A-5.—(Instruments Corp. - See Fig. A8-8.) This 12-volt d-c, selsyn-type wind vane needs no lubrication or other routine attention, except as specified in Section A8100. Orient the housing by loosening the adapter setscrews and turning the housing until the letter "N" on the adapter faces true north.

A8600. ENTRY ON WBAN-10

A8601. Magnetic Wind Direction (Col. 13).—At stations where the magnetic wind direction is used in air-ground communications and where it differs from the true direction, enter the magnetic direction in parentheses either in column 13 or following the last element on Form 3024B, whichever form is more convenient for use by the communicator. This entry may be omitted if the communications station is provided with a wind direction indicator. (See par. A9183.11(5) for instructions relating to Form 3024B.)

A8602. Wind Direction and Speed.—At first-order stations equipped with a multiple register, and where less than 24 record observations daily are taken, the prevailing hourly wind direction (see par. A8050) and the corrected wind-speed data for the period beginning with the hour printed in column 16 will be entered in the right margin of WBAN-10B; e.g., enter "SW-18" for "Southwest, 18 miles per hour", and "DI-1" for "direction indeterminate, speed less than one mile per hour." The corrected data are obtained by applying the appropriate correction from Table 14 in par. 8231 to the uncorrected data taken from Form 1017 or 1017B.

A8603. Maximum Average Five-Minute Speed and Fastest Mile (Col. 90).—At first-order stations equipped with a multiple register, enter (1) the maximum average five-minute speed and the fastest mile, after applying the appropriate correction in each case from Table 14, par. 8231 to the uncorrected data taken from Form 1017 or 1017B, and (2) in each case, the associated direction and time of beginning to the nearest minute LST (see pars. A13021.3 and A13021.4). Identify each entry, using appropriate stamps. Enter estimated data in parentheses. At stations not equipped with a multiple register but where a local need exists for the highest observed one-minute wind speed and its associated direction, personnel will enter these data and place an asterisk beside the stamped identification.

969474 O—51——17

CHAPTER A9. TYPES OF OBSERVATIONS

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CHAPTER A9. TYPES OF OBSERVATIONS *

A9120.1. Off-Teletype Observations.—The time at which record observations at off-teletype stations are to be telephoned or telegraphed to a relay station will be specified by the Regional Office.

A9120.2. Omitted Observations.—A record observation may be omitted when a pilot balloon is being observed, provided the ceiling is above 9750 feet and the visibility is ten miles or better. Before the pibal is started in such cases, arrangements will be made with the CAA operator to transmit the code group "DCAVU" instead of the regular hourly observation. This code group means "Surface observation omitted on account of pibal, but ceiling is more than 9750 feet and visibility is more than ten miles." If a change in conditions requires the filing of a special observation, abandon the balloon. When it is impossible to transmit "DCAVU" without terminating the pibal, discontinue the pibal and transmit the scheduled record observation.

A9161. Erroneous Reports.—Errors found in a transmitted aviation record observation taken at the time of a 3- or 6-hourly observation or in a transmitted synoptic observation and not corrected in accordance with par. 9163 will be reported on Form 3069. Form 3069 may originate at any first-order station to call the attention of personnel at another station to discrepancies in these observations. Erroneous entries in station records will be corrected in accordance with par. 11032.

A9173. Time.—All reports filed for transmission on Service A as supplementary weather will contain a time group denoting the hour and minute (24-hour clock) of the observation and the local time zone indicator (e.g., 1037C). This group will be placed immediately following the station location identifier or, in the case of a special observation, following the "S" symbol (see par. 9172). Off-teletype stations, such as SAWRS, that make original transmission of reports to a Weather Bureau or a CAA station via company communication facilities or by telephone, will include the time group in the report. Stations transmitting reports by commercial telegraph will not include a time group (see par. A9175).

* The paragraph numbers in this chapter correspond so far as possible to related paragraphs in the WBAN portion.

WB Form 3069 (Rev. 1-1-49)

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

NOTIFICATION OF OBSERVATIONAL ERRORS

From WBAS, Sand Dune, Fla. (SNU) Date Nov. 8, 1951
(include station figure or letter designator of originating station)

To Chief, U.S. Weather Bureau The ☐ 6-hourly, ☐ 3-hourly, ☒ Airway, ☐ _____ weather report from (this) ~~(your)~~ station for 1308 (GCT) Nov. 8, 1951 (date) was ☐ received late, ☐ not received, ☐ not transmitted, ☒ apparently in error as follows:

REPORT	DATA		REPORT	DATA	
AIRWAY	☒ SENT ☐ RCVD.	CORRECTION	SYNOPTIC	☐ SENT ☐ RCVD.	CORRECTION
Designator			$iiiT_dT_d$		
Type of report			Nddff		
Time			VVwwW		
Ceiling a			PPPTT		
Sky	E30-⊕	30-⊕	$N_hC_LhC_MC_H$		
Visibility			D_Capp		
Weather	Q		RRR_ts		
Obstruction to vision			$N_sCh_sh_s$		
Pressure			$S_pS_pS_pS_p$		
Temperature			$d_wd_wP_wH_w$		
Dew point			$h_Sh_Sh_Sa_1$		
Wind direction			$R_{24}R_{24}R_{24}R_{24}$		
Wind speed	25	25Q45	$T_xT_xT_xT_x$		
Wind shift			Additional plain language data as sent ☐; received ☐:		
Alt. setting					
Remarks sent ☒; received ☐:					
G 45					
☐ Correction:			☐ Correction:		

For correct procedure, see the following instructions:

(OVER) 16—87789-1

Fig. A9-1. Entries on Form 3069, from station making error.

WB Form 3069 (Rev. 1-1-49)

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

NOTIFICATION OF OBSERVATIONAL ERRORS

From FAWS, Miami, Fla. Date Dec. 22, 1951
(include station figure or letter designator of originating station)

To WBAS, Sand Dune, Fla. (213) The ☒ 6-hourly, ☐ 3-hourly, ☐ Airway, ☐ _____ weather report from ~~(this)~~ (your) station for 1830 (GCT) Dec. 21, 1951 (date) was ☐ received late, ☐ not received, ☐ not transmitted, ☒ apparently in error as follows:

REPORT	DATA		REPORT	DATA	
AIRWAY	☐ SENT ☐ RCVD.	CORRECTION	SYNOPTIC	☐ SENT ☒ RCVD.	CORRECTION
Designator			$iiiT_dT_d$		
Type of report			Nddff		
Time			VVwwW	48022	48052
Ceiling			PPPTT		
Sky			$N_hC_LhC_MC_H$	86500	865//
Visibility			D_Capp		
Weather			RRR_ts		
Obstruction to vision			$N_sCh_sh_s$		
Pressure			$S_pS_pS_pS_p$		
Temperature			$d_wd_wP_wH_w$		
Dew point			$h_Sh_Sh_Sa_1$		
Wind direction			$R_{24}R_{24}R_{24}R_{24}$		
Wind speed			$T_xT_xT_xT_x$		
Wind shift			Additional plain language data as sent ☐; received ☐:		
Alt. setting					
Remarks sent ☐; received ☐:					
☐ Correction:			☐ Correction:		

For correct procedure, see the following instructions:

Cir. N, 6th. Ed. (Rev.), par. 3911

1949 Synoptic Code, pars. 1805.44 and 1805.54

(OVER) 16—87789-1

Fig. A9-2. Entries on Form 3069, from station detecting error.

A9175. Coding for Commercial Telegraph Transmission.—All symbols and intensity modifiers will be telegraphed in their word equivalents. The elements comprising the observation will be prepared for telegraphic transmission in the same order as that indicated in par. 9160. The word "special" and its number will be included preceding the meteorological data when that type of report is transmitted. Decimal points and the word "slant" will not be transmitted. The complete values of ceiling and cloud height, sea-level pressure, and altimeter setting will be transmitted, e.g., MEASURED 1200 10122 2990 for ceiling, sea-level pressure, and altimeter setting, respectively. The word "missing" will be used to indicate missing data pertaining to an element normally included in a report. The station identification and the time of the report will be omitted from the coded message.

A9176. Recoding Telegraphed Reports.—When the telegraphed message is prepared for teletype distribution at the receiving station, the station identification and time of the report will be supplied from the heading of the telegram and coded in accordance with pars. 9170 to 9173.

Example

Message filed at 6:00 a.m. at Hollister, California as received at San Francisco:

2000 SCATTERED ESTIMATED 5500 BROKEN 11000 OVERCAST 9 LIGHT RAIN 6563 NORTHEAST 11.

As prepared for teletype distribution:

HLL 0600P 20⊕E55⊕110⊕9R- 65/63×11

A9182. Communications Failure.—During periods of teletype service failure, aviation and synoptic observations will be routed to an adjacent station where facilities have not failed, utilizing services still in operation, in accordance with the Federal Airway Manual of Operations. If all services have failed, the first record or special observation following the breakdown will be telephoned or telegraphed to the station designated by the Weather Bureau Regional Office. Thereafter, record observations will be sent only at the times of 6-hourly synoptic observations, but all special observations will be telephoned or telegraphed promptly after they are taken. Station observational records will be kept as usual during this period. Weather Bureau stations will telegraph the observation and insert "XV" in the check column to the right of the address on the telegraph blank, or telephone the observation "collect"; CAA stations will transmit these observations in accordance with administrative instructions issued by that agency.

A9183. Filing Weather Reports for Transmission.—Telautograph or other

recording communications facility may be used to deliver observations to CAA personnel for transmission. Where a facility of this type is not available, enter the observations on Form 3024B and file them with communications personnel. These forms will not be used at stations where observing and communications duties are performed by the same personnel. (Exceptions may be authorized by the Regional Director wherever it is impracticable to use this form.) Since a permanent record of aviation observations is available on Form WBAN-10A, it is not necessary to retain copies of Form 3024B on which aviation observations are entered. However, copies of this form on which synoptic observations are entered will be retained for inspection by a field aide, after which they may be destroyed.

A9183.01. On Form 3024B, enter observations received from observing stations by telephone or other non-recording communications facility for transmission on teletype circuits. Retain a record copy of each observation for six months.

A9183.02. Additional copies of Form 3024B may be prepared as required for local needs.

A9183.1. Entries on Form 3024B.—Enter the date and time of filing the observation as a six-figure group in the upper right corner (a time stamp may be used for this purpose). The first two figures will indicate the day of the month, and the last four the filing time of the observation in terms of the 24-hour clock. A letter following the six figures will designate the time zone, e.g., 061932E, 110028Z etc. (see Table 17). Local or Greenwich time will be used in accordance with appropriate instructions for transmissions.

A9183.11. Entry of Aviation Observations (Including Pilot Reports and Additive Data):

(1) In the "Station" block enter station letter identification as listed in the Civil Aeronautics Administration manual "Location Identifiers".

(2) In the "Type" block, enter "S", followed by the serial number of the observation when the observation is a special or record-special, "L" when it is a local extra, and a check mark "✓" when it is a check observation. An entry will not be made for a record observation.

(3) In each "Time" block pertaining to special, local extra, and check observations, enter a four-figure (24-hour clock), time group, followed by the appropriate time-zone designator letter. Omit entry for record and record-special observations, except as required by instructions in par. 9163 concerning corrected observations.

(4) Succeeding entries will correspond to those in columns 3 to 13, inclusive, of Form WBAN-10A.

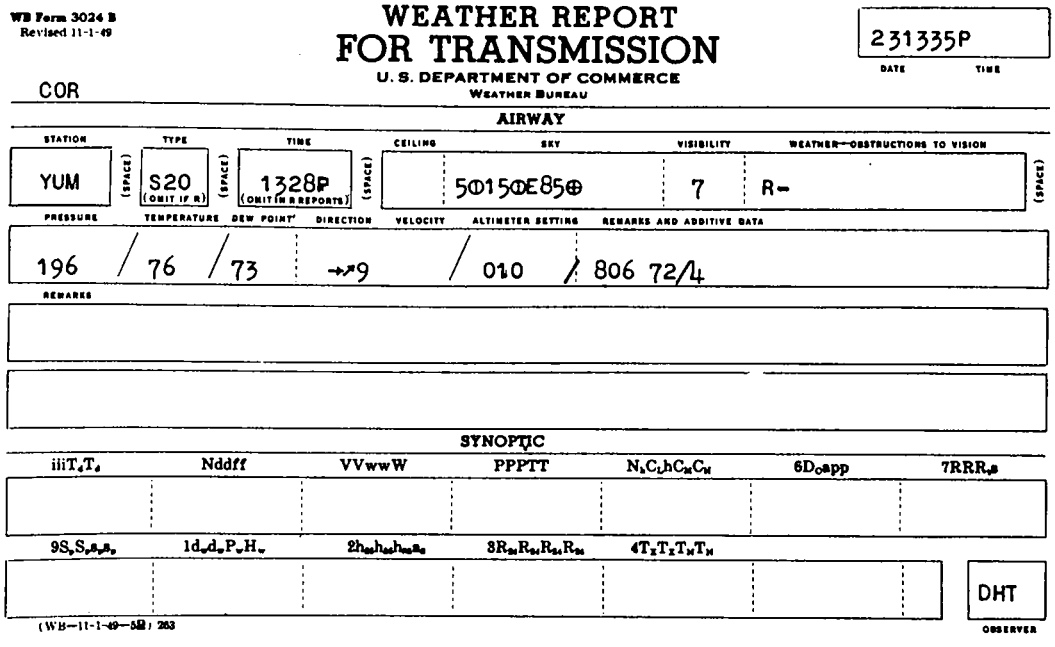
(5) At stations where magnetic wind directions are needed for air-ground communications, enter these data in parentheses following the last element on Form 3024B in accordance with par. A8601.

A9183.12. Entry of Synoptic Observations.—Enter coded messages in accordance with the current Synoptic Code.

A9183.13. Entry of Corrected Observations.—(See pars. 9161.1 and 11032.) Enter the authorized contraction for "correction" above the station designator block.

A9183.14. Observer's Initials.—The observer who prepares the form will initial it.

A9210. Synoptic Observations.—At stations where WBAN-10 is not prepared, synoptic observations will be prepared in accordance with Section A12600.


WB Form 3024 B
Revised 11-1-49

WEATHER REPORT
FOR TRANSMISSION
U. S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

231335P
DATE TIME

COR

AIRWAY

STATION	(SPACE)	TYPE (OMIT IF R)	(SPACE)	TIME (OMIT IN R REPORTS)	(SPACE)	CEILING	SKY	VISIBILITY	WEATHER—OBSTRUCTIONS TO VISION	(SPACE)
YUM		S20		1328P			5⦶15⦶E85⊕	7	R-	

PRESSURE	TEMPERATURE	DEW POINT	DIRECTION	VELOCITY	ALTIMETER SETTING	REMARKS AND ADDITIVE DATA
196	76	73	→↗9	010	806	72/4

REMARKS

SYNOPTIC

iiiT$_s$T$_s$	Nddff	VVwwW	PPPTT	N$_s$C$_L$hC$_M$C$_H$	6D$_c$app	7RRR$_e$s

9S$_p$S$_p$s$_p$s$_p$	1d$_w$d$_w$P$_w$H$_w$	2h$_{ss}$h$_{ss}$h$_{ss}$s$_{ss}$	3R$_{24}$R$_{24}$R$_{24}$R$_{24}$	4T$_X$T$_X$T$_N$T$_N$		

DHT
OBSERVER

(WB—11-1-49—5M) 263

Fig. A9-3. Entries on Form 3024B.

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CHAPTER A10. PILOTS' REPORTS

A10000. GENERAL

A10010. Log of Differing Local Weather Observations.—A log will be maintained of differences in local weather conditions observed by a pilot in flight from those observed at the ground. The pilot's position with respect to the station and the exact time he took the observation will invariably be entered in the log. The log should also contain any other information that, in the judgment of the observer, is pertinent to any subsequent investigation of differing weather observations. The log will be retained in the station files for at least one year, after which it may be destroyed. When this information is recorded in the communications log at CAA observation stations, a separate record need not be maintained.

A10020. Receipt of Pilot Reports.—In order that all pireps may become available for dissemination promptly after their receipt at the ground station, and to insure that any differences in reports of local weather may be discussed with pilots or ground personnel of commercial airlines before the relevant circumstances have been forgotten, the personnel at each station used as a terminal for commercial airlines will arrange with the ground personnel of the airlines for prompt delivery and, where necessary, discussion of pilots' reports.

CHAPTER A11. ENTRIES ON FORM WBAN-10

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CHAPTER A11. ENTRIES ON FORM WBAN-10*

A11001. WBAN-10A, B, and D.—WBAN-10A, B, and D will be prepared in duplicate. Additional copies required locally may be prepared.

A11001.1. WBAN-10A.—At stations scheduled to take less than 24 observations a day and where Form WBAN-10B is not prepared, a new WBAN-10A need not be started daily. Instead, enter the date on the line preceding the first entry for each day and enter the data consecutively.

A11001.2. WBAN-10B.—Preparation of WBAN-10B is not required at stations where ordinarily only dry- and wet-bulb temperatures and total sky cover are recorded on this form. Use only WBAN-10A, entering dry- and wet-bulb temperatures in columns 14A and 14B, and total sky cover in column 13 immediately adjacent to column 14A.

A11005. Disposition.—Completed WBAN-10 forms will be forwarded as indicated in the following paragraphs (see Introduction to the Addendum).

A11005.1. Original copies of completed WBAN-10 forms will be disposed of as follows:

(1) Mailed from first-order and CAA stations to the WRPC —

(a) Each Saturday. This will include all forms for the week through Friday. Mailing of these forms may be deferred until the following Monday at stations having multiple registers but only a limited staff available on Saturday to compute, check, and transcribe data from Form 1017.

(b) By the second working day of each month. This mailing will include forms for the last several days of the previous month and the supplemental WBAN-10A for the month on which pilots' reports are recorded.

(2) Mailed from second-order stations (including SAWR) to designated first-order stations by the second working day of the month.

(3) Returned after verification to the originating first-order station, where they will be retained as a part of the station record. Verified original WBAN-10 forms will not be returned to second-order stations (including CAA and SAWR).

*The paragraph numbers in this chapter correspond so far as possible to related material in the WBAN portion.

960474 O—51——18

A11005.2. Carbon copies of completed WBAN-10 forms will be disposed of as follows:

(1) At first-order stations, the copies will be forwarded to the Section Center after corrections, if any, have been made as specified in par. A11032.

(2) At second-order stations (including CAA and SAWR), the copies will be retained for ninety days, after which they may be destroyed.

A11006. Record Observations During a Pibal.—Data pertaining to a record observation omitted because of a pibal will be entered on WBAN-10 as follows:

(1) Data obtained by interpolation or from interpolated data will be entered in parentheses.

(2) Enter "R" in column 1.

(3) Enter, in columns 2 and 16, the reference time of the sequence in which the omitted observation normally would have appeared.

(4) Enter data pertaining to ceiling, sky, visibility, weather and obstructions to vision, and clouds and obscuring phenomena in the appropriate columns. These data will be observed during the pibal at the time the omitted observation is scheduled to be taken.

(5) To the extent that they are available, data from the thermograph and telepsychrometer will be used in obtaining the dry-bulb and dew-point values. Otherwise, obtain these values to tenths of a degree by interpolating between the dew-point and dry-bulb values of the record observations immediately preceding and following the missing observation. Enter these data to whole degrees in columns 7 and 8, and to tenths of a degree in column 18. When the dew point is obtained by interpolation, compute the wet-bulb value and enter it in column 19. Use the interpolated dry-bulb and dew-point values, and the dew-point table of either the abridged or complete Weather Bureau Psychrometric Tables, for this computation. When the interpolated dew point is below 32°, use Table 9 (Dew Point Conversion Table) to determine the dew point with respect to ice before using the Psychrometric Tables, to compute the wet-bulb temperature.

(6) Compute the relative humidity in the usual manner (see par. 6120) from the data obtained in accordance with (5).

(7) Enter data pertaining to sea-level pressure, altimeter setting, station pressure, pressure tendency, and net three-hour change. The basic data will be taken from the barograph trace. The dry-bulb temperature obtained in accordance with the preceding instructions will be used to obtain the 12-hour mean temperature for pressure reductions.

(8) Enter surface wind direction and speed. These data will be taken from multiple registers at stations equipped with them. At other stations, the wind data will be estimated during the pibal at the scheduled time of the omitted observation.

(9) Enter any remarks noted during the pibal, and additive data if appropriate. Enter the authorized contraction "FIBI" in parentheses in column 13.

A11021. Late Observations.—When an observation is taken late and no appreciable changes have occurred since the scheduled time, the entire observation will be entered in black pencil and enclosed in parentheses. When conditions have changed appreciably since the scheduled time, estimate the conditions probable at the observation time, using recording instruments wherever possible, and enter the observation in red pencil. In either case, the observation will be used for local control and broadcast purposes and for computation of sums and averages, but it will not be transmitted on Service "A".

A11032. Corrections to Weather Records.—Upon receipt of Form 5066, at all (except CAA) stations, make indicated corrections in red on retained (carbon) copies of WBAN-10.

CHAPTER A12. PREPARATION AND DISTRIBUTION OF FORMS 1001B and C, 1081 and 1083

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CHAPTER A12. PREPARATION AND DISTRIBUTION OF FORMS 1001B and C, 1081 and 1083

A12000. FORM 1001B - GENERAL

A12010. Preparation.—(See Fig. A12-1.) Form 1001B will be prepared in duplicate as the original record (manuscript copy) of observations at first-order stations where aviation observations are not taken; except that at stations not equipped with a multiple register and at which only one climatological observation (maximum and minimum temperature, and precipitation measurement) is taken daily, Form 1001C will be prepared as the original record in accordance with par. A12210. Black ink, or a well-sharpened Venus 3H drawing pencil or equivalent black-lead pencil, will be used except where red is specified (see par. A12013). Sufficient pencil pressure will be used to assure legible carbon copies and ample black-line contrast for microfilming the original records.

A12011. Disposition.—Completed forms will be mailed as follows unless special instructions have been issued. Forward the original copies of Form 1001B for the month to the WRPC by the second working day of the following month. When any form cannot be mailed by the specified date, forward an explanation to the WRPC on or before that date. Corrected carbon copies (see par. A12013) will be forwarded to the Section Center, and the originals will be retained as part of the permanent local record. Note that WBAN-10D will be prepared at all stations where Form 1001B is prepared.

A12012. Time.—Use 24-hour, local standard time, with 0000 as the beginning, and 2359 as the end of the day.

A12013. Correction of Entries.—Upon receipt of Form 5066 from the WRPC, enter the indicated corrections in red on retained (carbon) copies of Form 1001B.

A12014. Heading.—Enter the station name and date in the spaces provided.

A12015. Interpolated or Estimated Data.—Unless otherwise specified, data that are interpolated or estimated, entirely or in part, will be entered in parentheses on Form 1001B. Sums and averages obtained from these data will also be entered in parentheses.

A12016. Missing Data.—Whenever an entry is missing because sufficient recorded, estimated, or interpolated data are not available, enter an "M" instead of the missing value.

A12100. FORM 1001B - COLUMN ENTRIES

A12101. Time (Col. 1).—In the heading, enter the time zone indicator from Table 17.

A12102. Temperature (Col. 2).—Enter the corrected hourly thermograph temperature, in whole degrees, occurring midway between the hours printed in column 1, supplying minus signs where required. For example, the entry for the hour "12-13" will be the temperature indicated at 1230.

A12103. Precipitation (Col. 3).—Enter corrected or interpolated hourly amounts of precipitation in inches and hundredths as obtained from the automatic record, either tipping bucket or weighing gage (see par. 4030). Enter interpolated data in parentheses (see par. A12015). Enter "T" for amounts less than 0.005 inch. Omit entry if no precipitation has occurred during the hour. Enter the total precipitation for the day opposite "Sum".

A12104. Wind Direction (Col. 4).—Enter the prevailing wind direction, taken from Forms 1017 or 1017B, to eight compass points for each hour. Enter the prevailing direction for the day (see par. A8050) under "Prevailing". "Direction Indeterminate" (DI) will not be considered as the prevailing direction for the day.

A12105. Wind Speed (Col. 5).—Enter the corrected number of miles of wind for each hour. Wind speeds obtained from Forms 1017 or 1017B will be corrected in accordance with Table 14. Enter the total wind movement for the day opposite "Sum", and the mean hourly speed to tenths of a mile opposite "Average".

A12106. Sunshine (Col. 6).—Enter hourly sunshine in minutes as obtained from Forms 1017 or 1017B. If an hourly value is wholly estimated, enter it in parentheses. Opposite "Sum" enter the total minutes of sunshine for the day, and under "Possible" enter the possible number of minutes as given in the Station Sunshine Tables. Obtain percentage of sunshine by dividing the total minutes for the day, multiplied by 100, by the "Possible" as shown in the Sunshine Table and enter the result in whole percent at the foot of the column.

A12107. Sky Cover (Col. 7)[1].—Enter total tenths of sky cover, as required by par. 1530, for the hours that personnel are on duty between sunrise and sunset. Enter the estimated values in parentheses for the daylight hours during which no personnel are on duty. These entries correspond to observations taken at thirty minutes past the hour. Opposite "Sum" enter the total of the hourly entries. To obtain the sum, consider 9+ as 10 and 1- as 0. Enter the average hourly tenths of sky cover in the space provided. Do not use 9+ and 1- as averages.

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[1] Entries in columns 7-9 and 14 are not required from city offices if there is a first-order airport observing station in the locality.

A12108. Lowest Visibility (Col. 8)[1].—Using the values from Table 4C, enter the lowest prevailing visibility observed during each daylight hour that personnel are on duty.

A12109. Weather and Obstructions to Vision (Col. 9)[1].—Using the symbols printed on the form, enter in the order of their predominance the meteorological phenomena occurring at the time of the visibility observation entered in column 8. Enter obstructions to vision only when the visibility is six miles or less. Use intensity symbols for precipitation as indicated in par. 3910. (Use the symbol "S" to represent any form of snow, including snow grains, snow pellets, etc. Use other symbols similarly; e.g., "F" to represent ground fog and ice fog.)

A12110. Extra Columns (Col. 10-13).—Enter any additional data that are required locally and use the column headings for identifying these data.

A12114. Beginnings and Endings of Meteorological Phenomena, Remarks, Notes, etc. (Col. 14)[1].—Enter in chronological order (not necessarily opposite the hour printed in column 1 corresponding to the time of the phenomena) the times (LST) of beginnings and endings of precipitation and obstructions to vision. Use the symbols listed on the form and disregard intensities. (Use DL" to record distant lightning.) When the time of beginning or ending is unknown, enter the estimated time in parentheses. Example: R 0305-0325; RS 0325-(0350); S (0350)-1330. Intervals of 15 minutes or less between the time of ending and recommencement will not be recorded. If additional space is required, use column 61; columns 10-13 may also be used if not required for hourly data. The following data will also be entered in column 14:

1. Hailstorms (see par. 3934.1)
2. Tornadoes and water spouts (see pars. 3934.2 and A3934.2)
3. Lightning (see par. 3934.3)
4. Aurora (see pars. 3934.4 and A3934.4)
5. Harbor ice (see par. 3934.5)
6. Snow surface temperatures (see par. 5590)
7. Frost and freeze (see pars. 3934.6 and A3934.6)
8. Seiches (see pars. 3934.6 and A3934.6)
9. Navigation and wind warning seasons (see pars.3934.6 and A3934.6)
10. Miscellaneous (see par. 3934.6)

A12115. Scheduled Observations (Cols. 15-26).—Enter in these columns data observed at the time of scheduled observations.

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[1] Entries in columns 7-9 and 14 are not required from city offices if there is a first-order airport observing station in the locality.

A12116. Time (Col. 15).—Enter the time that the observation is begun, to the nearest minute (LST); e.g., 0110, 1805.

A12117. Station Pressure (Col. 16).—Enter mercurial- or precision-aneroid-barometer reading to the nearest 0.001 inch.

A12118. Dry and Wet Bulb (Cols. 17-18).—Enter these temperatures to the nearest degree and tenth, supplying minus signs where required.

A12119. Dew Point (Col. 19).—Enter the dew point to the nearest whole degree, supplying minus signs where required.

A12120. Relative Humidity (Col. 20).—Enter relative humidity to the nearest whole percent.

A12121. Maximum and Minimum Temperatures (Cols. 21-22).—At stations equipped with maximum and minimum thermometers, thermographs or telepsychrometers, enter the maximum and minimum temperatures to degrees and tenths for the period between successive observations. Take the data from the telepsychrometer or the maximum and minimum thermometers, if available; if not, use the thermograph (see Chapters 5 and A5). Note that these temperatures must be as high and low, respectively, as any temperature recorded within the period covered, including the current temperature.

A12123. Precipitation (Col. 23).—Enter total precipitation in inches and hundredths for the period between successive observations; e.g., 0.06. Use the gage specified in par. 4030. When precipitation has occurred in amounts less than 0.005 inch (trace), enter "T". When precipitation has not occurred, enter "0.00".

A12124. Snowfall, Sleet and Hail (Col. 24).—Enter to inches and tenths the depth of the total amount of frozen precipitation (snow, sleet, ice crystals and hail) occurring between the time of the preceding observation and the current observation (see par. 4230). When snow, sleet or hail has fallen in amounts of less than 0.05 inch enter "T" denoting trace. When none has occurred, enter "0.0". When snow, sleet or hail melted as it fell, enter "T" with a reference note "Melted as it fell" in column 14.

A12125. Depth of Frozen Precipitation (Col. 25).—Enter the depth of frozen precipitation (snow, sleet, ice crystals, hail and ice) on the ground, to the nearest inch. When snow, etc., is on the ground and the depth amounts to less than 0.5 inch, enter "T" denoting trace. Enter "0" when none is on the ground. Ice depth, which is the depth of sheet ice on the ground formed directly or indirectly from precipitation, should not be confused with "thickness of ice on water." Whenever snowfall melts and refreezes, the depth of ice formed will be included in the entries in this column. When the maximum depth of snow on the ground between observations, obtained either by measurement or by visual estimation, exceeds the measured

amount on the ground at the end of the period of observation, enter the maximum depth and the time of occurrence in remarks; e.g., "One inch of snow on ground at 1145." Maximum amounts of frozen precipitation obtained by visual estimation will not be entered in parentheses.

A12126. Height of 850-Mb. Surface (Col. 26).—At stations designated to compute this datum, enter in feet, to the nearest ten geopotential feet, the height of the 850-mb. surface above sea level.

A12127. Summary of Day (Cols. 27-38).—Enter data for the 24-hour period from midnight to midnight (LST) in these columns.

A12128. Maximum and Minimum Temperatures (Cols. 27 and 28).—Enter these data in whole degrees (see Chapters 5 and A5). Note that the maximum and minimum temperatures must be at least as high and low, respectively, as any temperature recorded through the day. At stations where midnight observations are not taken, the data will be secured from a thermograph, if available; otherwise, the entry will be omitted.

A12129. Average Temperature (Col. 29).—Enter the average temperature for the day, to whole degrees. This temperature is half the sum of the maximum and minimum temperatures for the day.

A12130. Normal Temperature (Col. 30).—Enter the normal temperature for the day, to whole degrees, when available. Use the normal for February 28 as the normal for February 29 also.

A12131. Precipitation - 24-Hour Amount (Col. 31).—Enter the total amount of precipitation (water equivalent of solid types) to the nearest 0.01 inch. If precipitation has occurred in amounts less than 0.005 inch, enter "T" denoting trace. If precipitation has not occurred, enter "0.00". The sum of any number of "T" observations will be regarded as a trace unless recording equipment indicates the total is 0.005 inch (liquid) or more.

A12132. Frozen Precipitation - 24-Hour Amount (Col. 32).—Enter to tenths of an inch the total amount of frozen precipitation (snow, sleet, ice crystals and hail) that falls during the 24-hour period. If there are separate falls, each of which melts before the following occurs, the total for the day will be the sum of the maximum depth of each fall. When the total 24-hour depth from midnight to midnight is not available, estimate the depth, using the data entered in column 24 as a guide. Enter the estimated value in parentheses. Record amounts in inches and tenths. When snow, sleet or hail melts as it falls, enter "T" with a reference note "Melted as it fell" in column 14. If snow, sleet or hail has fallen in amounts less than 0.05 inch, enter "T" denoting trace. If none has fallen, enter "0.0".

A12133. Depth of Frozen Precipitation (at 0030 GCT) (Col. 33).—Enter the depth of frozen precipitation (snow, sleet, ice crystals, hail and ice) on the ground at 0030 GCT to the nearest inch. Enter "T" for amounts less than 0.5 inch. Enter "0" when none is on the ground.

A12134. Maximum Average 5-Minute Wind Speed and Direction (Col. 34).—Enter the corrected maximum average 5-minute wind speed in whole miles per hour and the direction. The corrected speed is obtained by applying the appropriate correction from Table 14 to the uncorrected data from Form 1017 or 1017B.

A12135. Time of Maximum Average 5-Minute Wind Speed (Col. 35).—Enter the time of beginning to nearest minute (LST).

A12136. Fastest Mile and Direction (Col. 36).—Enter the corrected (see Table 14) fastest mile and the corresponding direction. When the fastest mile occurs more than once, and from two or more directions, enter the direction of the first occurrence followed by a footnote reference and an explanatory footnote; e.g., 1/ first of several occurrences. The uncorrected fastest mile and the direction data are taken from Forms 1017 or 1017B. When the data are estimated (see par. A13021.4), enter them in parentheses. If these data are required locally and the station is not equipped with a multiple register, the highest one-minute wind speed observed during the day and the corresponding direction may be entered in column 36. In this case, enter an asterisk in the heading of the column referring to the footnote: "*Fastest observed mile and direction."

A12137. Time of Fastest Mile (Col. 37).—Enter time of beginning to the nearest minute (LST).

A12138. River Stage (Col. 38).—At stations where a river gage is read, enter this reading to the nearest 0.1 foot.

A12139. Excessive Precipitation (Cols. 39 to 50).—Enter amount of excessive precipitation in these columns (see par. A4530). Tabulate excessive precipitation data and ascribe to it to the day in which the period ends. Whenever more than one tabulation is required for the same day, enter the data in column 61. Use a rubber stamp to provide and identify spaces for the additional tabulations.

A12151. Extra Columns (Cols. 51 to 53).—Enter any additional data that are required locally and identify these data in the respective column headings.

A12154. Station Pressure Computations (Lines 54 to 60).—Enter data in these lines in accordance with instructions in par. 7780.

A12161. Additional Remarks and Notes (Line 61).—Enter the character and time (LST) of sunrise and sunset, using the terms Clear, Cloudy, Foggy,

W. B. Form 1001 B

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

DAILY RECORD

Station Townville, State Date January 16, 1952

Time (L.S.T.) (1)	Temperature (°F) (2)	Precipitation (Inches) (3)	Wind Direction (4)	Wind Speed (M.P.H.) (5)	Sunshine (Minutes) (6)	Sky Cover (Scale 0-10) (7)	Lowest Visibility (Miles) (8)	Weather and Obstructions to Vision (9)	Relative Humidity (10)	(11)	(12)	(13)	Beginnings and endings of meteorological phenomena; Remarks, notes, etc. (14)
00-01	46		NW	20									
01-02	47		NW	17									
02-03	47	T	NW	20				R-					R (0237) - (0350)
03-04	51	T	NW	20				R-					
04-05	53		NW	22									
05-06	54		NW	20									
06-07	56		NW	20	0	7	7						
07-08	57		SW	22	22	3	10		92				
08-09	59		NW	23	60	1	10						
09-10	61		NW	24	60	0	12		89				
10-11	62		N	26	60	2	15+						
11-12	62		NW	21	9	5	15+		88				
12-13	62		NW	20	0	10	12						
13-14	64		NW	20	0	10	12		63				
14-15	(58)		NW	22	0	10	12						
15-16	55		SW	20	0	10	10		54				
16-17	52	T	W	19	0	10	10	R-					R 1631 - 1710
17-18	50	T	SW	17	0	10	7	R-					R 1732 - 1750
18-19	48		SW	18									
19-20	47	.02	SW	19				R-					R (1920) - cont.
20-21	45	.13	SW	19				R					
21-22	44	.53	SW	17				R+					
22-23	42	.71	SW	14				R+					
23-00	41	.15	SW	11				R					
SUM.	—	1.54	—	471	211	78	—	—					
AVER.	—	—	Prevailing	19.6	Pct. 610	6	—	—					
MISC.	—	—	NW	—	35 %	—	—	—					

SYMBOLS USED IN COLUMN 9

A—Hail, BS—Blowing snow, D—Dust, E—Sleet, F—Fog, H—Haze, K—Smoke, L—Drizzle, N—Sand, R—Rain, S—Snow, T—Thunderstorm, ZL—Freezing drizzle, ZR—Freezing rain

SCHEDULED OBSERVATIONS

Time (LST) (15)	Station Pressure (16)	Dry Bulb (17)	Wet Bulb (18)	Dew Point (19)	Rel. Hum. (20)	Temperature Max. (21)	Temperature Min. (22)	Precipitation (23)	Snowfall, Sleet, Hail (24)	Snow, Sleet, Hail, or Ice on the Ground (25)	Height 850 MB. Surface (26)
0845		59.0	57.9	57	94	59.0	44.9	T	0	0	
1215		62.0	59.8	59	88	63.0	58.5	0	0	0	

SUMMARY OF DAY (MIDNIGHT TO MIDNIGHT)

Temperature: 24 Hour Max. (27)	24 Hour Min. (28)	Average Temperature (29)	Normal Temperature (30)	24 Hour Precip. (Water Equiv.) (31)	24 Hour Snowfall Sleet Hail (32)	Snow, Sleet, Hail, or Ice on Grd. (33)	Wind (M. P. H.): Max. Av. 5 Minute Speed and Direction (34)	Time (LST) (35)	Fastest Mile and Direction (36)	Time (LST) (37)	River Stage (38)
64	41	52	33	1.54	0	0	30-N	1000	34-N 1/	1000	

EXCESSIVE PRECIPITATION

The excessive amounts for all 13 periods are entered whenever the amount for one or more periods equals or exceeds the rate of .01 inch per minute plus .30 inch.

Minutes: 5 (39)	10 (40)	15 (41)	20 (42)	30 (43)	45 (44)	60 (45)	80 (46)	100 (47)	120 (48)	150 (49)	180 (50)	(51)	(52)	(53)
.32	.63	.72	.74	.75	.88	1.01	1.07	1.13	1.30	1.40	1.47			

STATION PRESSURE COMPUTATIONS

Time (LST) (54)				
Attached thermometer (55)				
Observed barometer (56)				
Total correction (57)				
Station pressure (58)				
Barograph reading (59)				
Barograph correction (60)				

(61)

Additional remarks and notes

SR - 0642 CLDY

SS - 1702 CLDY

1/First of several occurrences.

Fig. A12-1. Entries on Form 1001B. Entries in columns 7, 8, 9, and 14 are not required at city offices where there is a local airport observing station.

Smoky, Dusty, or Hazy. Identify the entries by use of the abbreviations "SR" for sunrise and "SS" for sunset. See par. A12114 for additional entries. Enter maximum depth of snow on ground when required in accordance with par. A12125.

A12161.1. (Line 61).—At first-order stations whenever the depth of frozen precipitation on the ground exceeds one inch, enter the water equivalent of the total depth as determined at approximately 1200 GCT each Monday. Enter the data to inches and hundredths, preceded by the identification WATER EQUIV. These data will be transmitted in accordance with pars. A4541 to A4543.

A12200. WB FORM 1001C - PREPARATION AND DISTRIBUTION (SEE FIG. A12-2.)

A12210. Preparation.—Form 1001C will be prepared at all first-order observing stations unless otherwise authorized by the Central Office. The manuscript copy will be prepared in duplicate. At designated first-order stations, either a typewritten Form 1001C Format (see Sec. A12400), or a typewritten transcript of Form 1001C for photo-offset reproduction at the WRPC, will also be prepared. Two typewritten transcripts will be forwarded to the Central Office from other stations where Form 1001C is prepared. Sufficient additional typewritten transcripts will be prepared to meet immediate public service requirements.

A12211. Entries will be made daily on the manuscript forms in black ink, or with a well-sharpened, Venus, 3H drawing pencil or equivalent black-lead pencil. Use sufficient pencil pressure to assure legible carbon copies, and ample black-line contrast in microfilms of the original records. A clean, black ribbon should be used for typing, and especial care should be taken to enter the data neatly and uniformly within the column limits.

A12212. Enter the station name, month and year, and time zone (e.g., "Eastern") in the spaces provided.

A12213. Parentheses will not be used when estimated or interpolated data are transcribed to typewritten transcripts or the 1001C Format.

A12214. At city offices where Form 1001C is prepared as an original record in lieu of Form 1001B, in accordance with par. A12010, data will be entered as follows on Form 1001C:

(1) Columns 2 to 7 will be completed from autographic records.

(2) The maximum and minimum temperatures (to the nearest 0.1°F.) will be entered in columns 20 and 21, respectively, and

W. B. Form 1001-C

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

STATION METEOROLOGICAL SUMMARY

STATION WBAS Dellview, Texas MONTH January YEAR 1952

Central STANDARD TIME

DAY	TEMPERATURE °F. MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	DEGREE DAYS (BASE 65°)	PRECIPITATION (IN.) TOTAL (WATER EQUIV. ALONE)	SNOWFALL, SLEET, HAIL	SNOW, SLEET, HAIL, OR ICE ON GROUND AT 07:30 P.M.	WIND PREVAILING DIRECTION	AVERAGE SPEED (m.p.h.)	FASTEST MILE SPEED (m.p.h.) *	DIRECTION	SUNSHINE TOTAL (Hours and minutes)	PERCENT OF POSSIBLE	SKY COVER SUNRISE TO SUNSET (Tenths)	MIDNIGHT TO MIDNIGHT (Tenths)	THUNDERSTORM OR DISTANT LIGHTNING	VISIBILITY 14 MI. OR LESS CAUSED BY	20	21	22
1	58	32	45	0	20	T	0	0	SSE	9.8	30	S	1:42	17	10	7					
2	70	52	61	+16	4	0	0	0	S	9.9	17	SE	3:21	33	8	7					
3	72	35	54	+9	11	0	0	0	SSE	18.0	30	NW	7:16	72	4	6					
4	37	27	32	-13	33	0	0	0	NNW	10.8	22	NW	0:18	3	10	8					
5	51	26	38	-7	27	0	0	0	WNW	4.4	18	NW	9:20	93	2	3					
6	58	26	42	-3	23	0	0	0	W	3.1	8	S	7:42	76	6	3					
7	62	37	50	+5	15	0	0	0	S	7.0	23	SW	0:00	0	10	8					
8	72	52	62	+17	3	0	0	0	S	12.7	24	S	0:00	0	9	8					
9	79	37	58	+13	7	T	0	0	S	10.1	26	S	0:20	3	9	10					
10	39	28	34	-11	31	.02	T	0	NNW	9.8	18	N	0:00	0	10	10					
11	34	28	31	-14	34	.02	0	0	NNW	8.7	15	NW	0:00	0	10	10					
12	38	31	34	-11	31	.13	0	0	NNW	5.3	17	NE	0:00	0	10	10					
13	46	36	41	-4	24	.04	0	0	SE	2.1	9	S	0:00	0	10	10					
14	64	46	55	+10	10	T	0	0	S	7.1	17	S	0:00	0	10	10					
15	69	52	60	+15	5	.06	0	0	S	8.4	24	S	0:47	8	9	8					
16	52	30	41	-4	24	.57	0	0	N	14.4	25	N	0:00	0	10	10					
17	30	23	26	-19	39	.01	T	0	N	14.1	24	N	0:00	0	10	10					
18	42	27	34	-11	31	.30	T	0	W	7.8	21	W	4:50	47	4	6					
19	36	24	30	-15	35	0	0	0	N	6.0	14	N	9:18	90	3	1					
20	39	21	30	-15	35	0	0	0	SE	5.8	16	SE	0:31	5	9	7					
21	60	39	50	+4	15	.03	0	0	SSE	6.5	18	SE	3:12	31	8	8					
22	54	43	48	+2	17	.28	0	0	NE	5.5	18	SE	0:00	0	10	10		F			
23	71	54	62	+16	3	.18	0	0	SSE	11.5	24	SE	0:00	0	10	10					
24	67	24	46	0	19	5.14	0	0	NNW	14.2	26	N	0:00	0	10	10	T				
25	32	22	27	-19	38	.15	T	0	NNW	7.4	18	NW	0:00	0	10	10					
26	32	28	30	-16	35	.90	0	0	N	10.2	18	N	0:00	0	10	10					
27	52	30	41	-5	24	.46	0	0	SW	9.0	30	SW	7:09	68	3	5					
28	36	17	26	-20	39	T	T	0	NNW	14.9	29	N	0:35	6	9	6					
29	23	15	19	-28	46	T	T	0	N	17.6	31	N	0:00	0	10	8					
30	22	7	14	-33	51	.17	3.3	3	N	3.8	15	N	0:00	0	10	10					
31	26	2	14	-33	51	0	0	2	SSE	3.3	17	S	9:03	86	2	4		F			
SUM	1523	951				8.46	3.3			279.2			65:24		255	243					
AVE.	49.1	30.7								9.0	FASTEST	DIRECTION	318:04	%	8.2	7.8					
										MISC.	31	N		21							

TEMPERATURE DATA

AVERAGE MONTHLY 39.9
DEPARTURE FROM NORMAL -5.5
HIGHEST 79 ON 9th
LOWEST 2 ON 31st
NUMBER OF DAYS WITH—
MAX. 32° OR BELOW 6
MAX. 90° OR ABOVE 0
MIN. 32° OR BELOW 20
MIN. 0° OR BELOW 0
DEGREE DAYS (BASE 65°)—
TOTAL THIS MONTH 780
DEPARTURE FROM NORMAL +180
SEASONAL TOTAL 1612
DEPARTURE FROM NORMAL +88

PRECIPITATION DATA

TOTAL FOR THE MONTH 8.46 IN.
DEPARTURE FROM NORMAL +6.07 IN.
GREATEST IN 24 HOURS 5.14 ON 24th

SNOWFALL, SLEET, AND HAIL
TOTAL FOR THE MONTH 3.3 IN.
GREATEST IN 24 HOURS 3.3 ON 30th
GREATEST DEPTH ON GROUND 3 ON 30th

BAROMETRIC PRESSURE
MONTHLY AVERAGE STATION 29.597 1/ IN.
HIGHEST SEA-LEVEL 30.81 IN. ON 29th
LOWEST SEA-LEVEL 29.47 IN. ON 3rd

WEATHER

NUMBER OF DAYS—
CLEAR (Scale 0-3) 4
PARTLY CLOUDY (Scale 4-7) 3
CLOUDY (Scale 8-10) 24
WITH 0.01 INCH OR MORE PRECIP. 16
WITH 0.10 INCH OR MORE PRECIP. 10
WITH 0.50 INCH OR MORE PRECIP. 3
WITH 1.00 INCH OR MORE PRECIP. 1

DATES OF—
HAIL 0
SLEET 17, 18, 25
GLAZE 10, 11, 12, 17, 18, 24, 25, 26, 27.

SYMBOLS USED IN COLUMNS 18-19

A—Hail
BS—Blowing Snow
DL—Distant Lightning
D—Dust
E—Sleet
F—Fog
H—Haze
K—Smoke
L—Drizzle
R—Rain
S—Snow
T—Thunderstorm
ZL—Freezing Drizzle
ZR—Freezing Rain

1/ This datum pertains to an elevation of 762 feet.
* Fastest observed 1-minute wind speed and its direction.

Total precipitation 8.46 inches was greatest amount for any January in Dellview since 1913. Sunshine, 21% of possible, equals all-time record for least amount of sunshine in any month. Severe ice storm, 24th to 27th, disrupted communications, electric lights and power, and severly damaged trees.

U. S. GOVERNMENT PRINTING OFFICE 16—67389-6

Fig. A12-2. Entries on Form 1001C.

969474 O—51——19

precipitation in column 22, for the 24-hour period preceding the time of the climatological observation. These data will be obtained from autographic records for days on which no climatological observation was taken, and will be entered on the manuscript copies only. Identify these data in the respective column headings.

(3) Temperature and precipitation summaries will be entered at the bottom of the form.

(4) Entries in all other columns will be omitted.

A12220. Distribution.—Completed forms will be mailed by the second working day of the following month as follows:

(1) At designated first-order stations, mail the original of the manuscript copies and either the 1001C Format or the transcript copy of Form 1001C to the WRPC.

(2) At other first-order observing stations, mail the original of the manuscript copies to the WRPC and two copies of the transcript to the Central Office, attention C&HS Division.

(3) Typewritten transcripts prepared for photographic reproduction (those mailed to the WRPC) should be mailed unfolded in a large envelope, and protected by cardboard covers. See Sec. A12400 for additional mailing instructions for the 1001C Format.

A12230. Correction of Manuscript Copies.—Upon receipt of Form 5066 (Corrections to Weather Records) from the WRPC, the indicated corrections will be made in red on the retained (carbon) copy of Form 1001C. When the original copy of Form 1001C is returned from the WRPC, it will be retained in the station files and the corrected carbon copy will be forwarded to the Section Center, unless photo-offset copies are prepared at the WRPC, in which case the carbon copy may be destroyed.

A12300. ENTRIES OF SUMMARY DATA ON FORM 1001C

A12301. General.—With the exceptions outlined in par. A12214, data will be entered as specified below.

A12302. Maximum and Minimum Temperatures (Cols. 2 and 3).—Enter these data to whole degrees. Enter the sums to whole degrees and averages to tenths of a degree at the foot of the column.

A12304. Average Temperature (Col. 4).—Enter these data to whole degrees. The average temperature is half the algebraic sum of the daily maximum and minimum temperatures.

A12305. Departure from Normal (Col. 5).—When normals are available, compute the departure by subtracting algebraically the normal temperature from the daily average temperature. Example: Daily average temperature, 65°; normal temperature, 60°; departure = +5°. In leap years use the normal for February 28 as the normal for February 29 also.

A12306. Degree Days (Base 65°) (Col. 6).—Enter heating degree days to whole numbers (the difference between the daily average temperature and 65° when the daily average is less than 65°). Enter "0" when the daily average is 65° or higher.

A12307. Total Precipitation (Water Equivalent) (Col. 7).—Enter the total 24-hour precipitation, midnight to midnight, in inches and hundredths, as obtained from WBAN-10B or Form 1001B. Enter the sum of the daily amounts of precipitation at the foot of the column.

A12308. Snowfall, Sleet, Hail (Col. 8).—Enter 24-hour unmelted depth of frozen precipitation (snowfall, sleet or hail, etc.), midnight to midnight, in inches and tenths as obtained from WBAN-10B or Form 1001B. Enter estimated data in parentheses (see par. A12213). Enter total at the foot of the column.

A12309. Snow, Sleet, Hail or Ice on the Ground (Col. 9).—Enter the depth, to the nearest inch, of frozen precipitation (snow, sleet, hail, ice, etc.) on the ground at 0030 GCT, as obtained from WBAN-10B or Form 1001B. In the heading, enter the local standard time corresponding to 0030 GCT. On forms prepared for public distribution, this time should be in terms of the 12-hour clock, local time.

A12310. Prevailing Direction (Col. 10).—At stations where 24 record observations are taken daily, enter the prevailing direction to 16 points of the compass taken from column 9 of WBAN-10A for record observations. At stations equipped with triple registers, but not taking 24 record observations daily, enter the prevailing direction to eight points of the compass as determined from either the right margin of WBAN-10B or column 4 of Form 1001B. Omit entry at all other stations. ("DI" will be considered as a prevailing direction for the day; however, when the direction is indeterminate for an entire day, enter "Calm" across the columns 10 and 11.) Prevailing direction for the month will not be entered at the foot of column 10.

A12311. Average Wind Speed (Col. 11).—At stations where 24 record observations are taken daily, enter the average wind speed computed from the hourly-record-observation data in column 10 of WBAN-10A. At stations

equipped with triple registers but where 24 record observations daily are not taken, enter the average wind speed computed from the hourly wind data in either the right margin of WBAN-10B (see par. A8602) or column 5 of Form 1001B (see par. A12105). Omit this entry at all other stations. At the foot of the column, enter the sum of the daily average hourly speeds, and the average of these speeds as obtained by dividing the sum by the number of days in the month. Enter all data in this column to tenths of a mile.

A12312. Fastest Mile and Direction (Cols. 12 and 13).—Enter the speed and direction of the fastest mile or fastest observed one-minute speed as recorded on WBAN-10B (see par. A8603) or Form 1001B (see par. A12136). When the fastest mile occurs from two or more directions, enter the direction of the first occurrence followed by a footnote reference and an explanatory footnote, e.g., 1/ indicates only the first of several occurrences. Enter estimated data (see par. A13021.4) in parentheses (see par. A12213). At stations where the fastest observed one-minute wind speed and direction are entered instead of the fastest mile data, place an asterisk in the heading of column 12, and the following note just above the summary: "*Fastest observed one-minute wind speed and its direction."

A12314. Total Sunshine (Col. 14).—Enter the total sunshine in hours and minutes as obtained from WBAN-10B or Form 1001B, e.g., 0:32; 12:03. At the foot of the column, enter the total sunshine for the month similarly, and the possible sunshine as obtained from the Station Sunshine Tables.

A12315. Percent of Possible Sunshine (Col. 15).—Enter these data in whole percent as obtained by dividing the entry in column 14 by the possible sunshine listed in the Station Sunshine Tables. At the foot of the column, enter in whole numbers the percent of sunshine obtained by dividing the sum of column 14 by the possible sunshine entered below it, and multiplying the quotient by 100.

A12316. Sky Cover - Sunrise to Sunset (Col. 16).—Enter tenths of sky cover as obtained by averaging hourly entries on WBAN-10B or Form 1001B for the period from sunrise to sunset. Observations of sky cover that are made between sunset and sunrise will not be considered in computing average sky-cover entries in column 16 of Form 1001C. For example, if sunset occurs at 1722 EST, an observation of sky cover made at 1727 will not be included in the daily average of this column. At the foot of the column, enter the sum to whole numbers and the average to one decimal place. Obtain averages as indicated in par. A12107.

A12317. Sky Cover - Midnight to Midnight (Col. 17).—Enter data for the period from midnight to midnight, using the procedure described in par. A12316. Omit entry at stations where personnel are not on duty 24 hours a day.

A12318. Thunderstorms or Distant Lightning (Col. 18).—Enter "T" for thunderstorm or "DL" for distant lightning when observed during the period from midnight to midnight. Do not enter more than "T" or "DL" for a day. Enter "DL" only if thunder is not heard, except that if lightning occurs before midnight and thunder is heard after midnight, enter "DL" for the first day and "T" for the following day. Similarly, if thunder occurs before midnight and only lightning after midnight, enter "T" for the first day and "DL" for the following day. Enter both "T" and "DL" if lightning only is observed in one storm, and thunder is heard in another storm.

A12319. Visibility 1/4 Mile or Less, Caused By - (Col. 19).—Enter symbols for hydrometeors or lithometeors that reduce visibility to 1/4 mile or less. Whenever visibility is reduced by several phenomena, enter all in the order of their predominance, using applicable symbols, e.g., "F,R." Use only symbols printed on the form. Use "S" to represent all types of snow, including snow showers, grains, pellets and ice crystals; use other symbols similarly, e.g., "F" to represent both ground fog and ice fog. Entries will be based on the values recorded in column 8, Form 1001B, or column 5, WBAN-10A. Where data are taken from WBAN-10A, the entries will be based on the values recorded in column 5, regardless of whether these values pertain to the usual point of observation, or to the control-tower level. However, whenever the visibility is variable, an entry will be made in this column if at any time during the hour the prevailing visibility is 1/4 mile or less, even though this value is not recorded in column 5.

A12320. Extra Columns (Cols. 20, 21, 22).—Enter any additional data required locally and identify these data in respective column headings.

A12330. Temperature Data.—Enter these data as follows:

A12331. Average Monthly.—Enter, to degrees and tenths, one-half the algebraic sum of the average maximum and minimum temperatures for the month.

A12332. Departure from Normal.—At all stations for which normals have been computed, enter the departure of the average monthly temperatures from the monthly normal (see par. A12305). The monthly normal temperature for February is not changed during a leap year.

A12333. Highest and Lowest Temperatures.—Enter these data, as obtained from columns 2 and 3, and their dates of occurrence. If necessary, distinguish between identical temperature entries by referring to their values in tenths of degrees as entered on WBAN-10 or Form 1001B. If temperatures are identical to tenths, enter all dates.

A12334. Number of Days with Maximum 32° or Below, or 90° or Above; and Minimum 32° or Below, or 0° or Below.—Enter these data as obtained from columns 2 and 3.

A12335. Degree Days.—Enter the sum of the entries in column 6 and the departure from normal at all stations for which normals have been computed. Enter the seasonal total, using July 1 as the beginning of the season, and the departure from normal at all stations for which normals have been computed.

A12340. Precipitation Data.—Enter these data as follows:

A12341. Total for the Month.—Use the sum of column 7.

A12342. Departure from Normal.—Enter the monthly departure from normal at all stations for which normals have been computed (see par. A12305). The normal precipitation for February 29 will be the same as for February 28.

A12343. Greatest in 24 Hours.—Enter in inches and hundredths the greatest amount of precipitation recorded in any 24 hours and the date or dates of occurrence. When data from a recording gage are not available or are not used for record purposes (see par. 4030(1)), enter in parentheses the greatest amount of precipitation known to have fallen during any 24 hours of record, i.e., as obtained from column 23 of Form 1001B or column 44 of WBAN-10B. When the greatest amount occurred more than once and there is insufficient space for all the dates, enter the date of the first occurrence followed by a footnote reference and an explanatory footnote; e.g., 1/ indicates only the first of several occurrences.

A12343.1. When the 24-hour period begins on the last day of one month and ends on the first of the following, enter the data on Form 1001C for the month in which most of the precipitation fell. Include data for the entire period on this form, and do not repeat the compilation on Form 1001C for the other month, but enter an explanatory note on the bottom of the manuscript copies only. Note that the precipitation entry must equal or exceed the sum of the hourly precipitation amounts for any consecutive 24 hours of record within the month or ascribed to the month in accordance with the foregoing.

A12350. Snowfall, Sleet, and Hail.—Frozen precipitation data (snowfall, ice crystals, sleet, and hail) will be entered in accordance with the instructions below.

A12351. Total for the Month.—Use the sum of column 8.

A12352. Greatest in 24 Hours.—Determine the greatest depth of frozen precipitation that fell in 24 hours from the data column 8 (see par. A12308). Enter the value of this datum to inches and tenths. It will be entered in parentheses if it appears in column 8 in parentheses in one or more instances. Omit the parentheses when preparing transcribed copies or the Format. When the 24-hour period occurs at the end of one

month and the beginning of the following, the instructions in par. A12343 (regarding the entries of dates) also apply, as in the following example:

Example

Given: (1) 5.0 inches of snow fell on March 31 - April 1, with 2.0 inches falling on March 31 and 3.0 inches on April 1.

(2) With the exception of the snowfall on March 31, the greatest snowfall in March was 1.5 inches on March 15.

(3) The greatest amount of snowfall in April was 5.5 inches on April 5.

Entries for "Snowfall - Greatest in 24 hours".

(1) For March, "1.5 inches on March 15." (Note that, although two inches fell on March 31, the total precipitation on March 31 must be ascribed to April 1 in accordance with par. A12343.)

(2) For April, "5.5 inches on April 5."

(3) On the forms for both March and April explanatory notes should be entered at the bottom of Form 1001C, indicating that five inches of snow fell during the period March 31 to April 1, with two inches falling on March 31 and three inches on April 1.

A12353. Greatest Depth on Ground.—Enter this datum to the nearest inch, and the date or dates of occurrence. Enter "T" if the greatest depth of snow on the ground during the month was a trace. The entry must equal or exceed any entry in column 9 and is evaluated from the entries in columns 25, 33 and 61 of Form 1001B or columns 46, 70 and 90 of WBAN-10B. When the greatest amount occurred more than once and there is insufficient space for all the dates, enter the date of the first occurrence and a footnote (see par. A12343).

A12360. Barometric Pressure.—Enter barometric pressure data as follows:

A12361. Monthly Average Station Pressure.—Compute the value of the monthly average station pressure pertaining to the elevation H_b to thousandths of an inch as follows:

(1) Compute one half the sum of the average 0030 and 1230 GCT values of station pressure.

(2) Apply the "correction to adjust to 24-hour mean."

Reduce the monthly average station pressure pertaining to H_b to the value pertaining to H_{bc} (see Appendix I) by applying the necessary correction*, if any.

EXAMPLE

29.644	= average station pressure at 0030 GCT
+29.596	= average station pressure at 1230 GCT
59.240	= total
29.620	= mean of average 0030 and 1230 GCT station pressures
-.007	= correction to adjust to 24-hour mean*
29.613	= monthly average station pressure pertaining to H_b
-.016	= correction to adjust to elevation H_{bc}*
29.597	= monthly average station pressure pertaining to H_{bc}

A12361.1. Enter the monthly average station pressure pertaining to H_{bc} on the line captioned "Monthly Average Station," and a footnote stating the elevation of H_{bc} to whole feet on a line below the caption "Lowest Sea Level____in. on _____."

EXAMPLE

MONTHLY AVERAGE STATION 29.338 IN.1/
HIGHEST SEA LEVEL 30.71 IN. ON 14TH
LOWEST SEA LEVEL 29.53 IN. ON 21ST.
1/ This datum pertains to an elevation of 762 feet.

* These corrections are prepared at the Central Office for stations at which they are required. Other stations will assume the corrections to be zero, except that, in accordance with Appendix I, the Central Office should be notified of any indications that H_{bc} may differ from H_b.

A12362. Highest and Lowest Sea-Level Pressure.—Enter these data as obtained from the barograph trace, corrected in the manner specified in par. 7242, and reduced to sea level in accordance with pars. 7320 to 7324. Owing to the temperature factor involved in reducing station pressure at high-altitude stations to sea level, the lowest or highest station pressure indicated on the barogram may not provide the lowest or highest sea-level pressure. At such stations, inspect the barogram for, and reduce to sea level, other high or low station pressures which approach the extremes previously selected, and review the recorded sea-level pressures for the month to determine that the highest and lowest sea-level pressure values have been selected.

A12370. Weather.—Enter data as follows:

A12371. Number of Days Clear, Partly Cloudy, and Cloudy.—Obtain these data from column 16.

A12372. Number of Days with 0.01, 0.10, 0.50, and 1.00 Inch or More of Precipitation.—Obtain these data from column 7.

A12373. Dates of Hail, Sleet and Glaze.—Obtain these data from WBAN-10B or Form 1001B.

A12380. Summary.—In the spaces provided near the bottom of the form, enter notes regarding the occurrence of unusual or extreme weather conditions during the month. Include data on damaging rain, snow, glaze, hail, or wind storms, and unusually high or low temperatures.

A12400. FORM 1001C FORMAT (SEE FIG. A12-3)

A12410. General.—At stations equipped with typewriters having 14-inch carriages or longer, Form 1001C Format will be prepared monthly in lieu of the typewritten copy of Form 1001C specified in par. A12210. Entries on this form will be made in accordance with instructions in sections A12200 and A12300 for entries on Form 1001C, and the additional instructions below. Form 1001C Format may be mailed in a mailing tube, or it may be folded (but not creased) around a piece of cardboard by folding it along the line immediately below the abbreviation "Avg." Cut the cardboard to fit into a 12x16 inch envelope in a manner that will prevent displacement of the fold in the format.

A12411. Heading.—Enter station name, month and year, time zone, and, in degrees and minutes, the station latitude and longitude.

A12412. Time of Observation (Col. 9).—In the heading, enter the local standard time in terms of the 12-hour clock corresponding to 0030 GCT.

W. B. Form 1001 C

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

STATION METEOROLOGICAL SUMMARY

Lakeside, Ohio (Airport) Brookpark Road and Riverside Drive — February 1952

Latitude 41° 24' N. Longitude 80° 51' W. Eastern Standard time used

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet, Hail (In.)	Snow, Sleet, Hail or Ice on ground at 7:30 pm (In.)	Wind Prevailing direction	Average speed (m. p. h.)	Fastest mile Speed (m. p. h.)	Direction	Sunshine Total (hours and minutes)	Percent of possible	Sky cover Sunrise to sunset (tenths)	Midnight to midnight (tenths)	Thunderstorm or distant lightning	Weather restricting visibility to ¼ mile or less	Lake Temperature °F	Solar Radiation Gm/cal per cm²	22	23	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	19	12	16	-8	49	0.74	6.5	13	N	13.8	20	W	0:20	3	10	10			33	89			1
2	12	-5	4	-20	61	T	T	13	SW	15.8	26	SW	8:54	88	1	3			33	318			2
3	18	-8	5	-19	60	0	0	12	SSE	11.0	15	S	9:53	98	3	2			33	343			3
4	30	11	21	-4	44	0	0	9	S	9.9	15	S	7:35	74	9	8			33	279			4
5	32	22	27	+2	38	0.01	0.1	8	SSW	4.9	9	S	0	0	10	10			33	100			5
6	42	28	35	+10	30	0.12	0	7	SSE	10.4	26	SE	0	0	10	10			33	116			6
7	38	9	24	-1	41	0.52	1.9	6	WNW	21.4	33	W	0	0	10	10		S, BS	33	116			7
8	10	0	5	-20	60	0.15	1.4	8	WSW	16.8	27	W	1:50	18	9	10			33	221			8
9	19	1	10	-15	55	0.01	0.1	8	NNW	7.8	16	SW	8:40	83	5	4			32	295			9
10	35	-4	16	-9	49	0	0	6	SSE	9.6	24	S	9:25	90	5	4			32	297			10
11	43	34	39	+14	26	0	0	3	SSW	13.5	28	S	5:30	52	7	9			32	247			11
12	46	43	44	+18	21	0.02	0	0	SSW	14.2	25	SW	0	0	10	10			33	15			12
13	48	25	37	+11	28	0.12	0.1	T	N	12.8	20	N	0	0	10	10			32	23			13
14	26	19	23	-3	42	0.05	0.5	T	NNE	13.3	19	N	0:10	2	10	8			32	137			14
15	38	17	28	+2	37	T	0	0	ENE	6.9	14	N	3:15	31	8	7			33	245			15
16	45	26	36	+10	29	0.07	0	0	SE	13.8	24	SE	0:25	4	10	7			33	133			16
17	44	34	39	+12	26	0.31	0	0	SW	7.8	16	W	0	0	10	10			33	63			17
18	54	33	44	+17	21	0.02	0	0	SSE	6.2	18	SE	4:25	42	8	9			33	225			18
19	62	42	52	+25	13	0.09	0	0	SE	6.3	33	W	0:44	5	10	8			33	124			19
20	43	33	38	+11	27	0.10	0	0	NE	9.2	21	NE	0	0	10	10		L, F	33	72			20
21	36	34	35	+8	30	1.04	T	0	NNW	21.2	35	N	0	0	10	10			34	18			21
22	36	31	34	+6	31	0	0	0	NNW	12.1	19	N	0:05	0	10	10			34	119			22
23	38	28	33	+5	32	0	0	0	NNW	8.2	15	N	0	0	10	9			34	164			23
24	48	24	36	+8	29	0	0	0	NW	3.8	11	S	8:50	84	0	0			34	402			24
25	50	30	40	+12	25	0	0	0	S	8.3	15	SW	0:40	6	9	6			34	160			25
26	58	44	51	+23	14	0.25	0	0	S	15.0	34	W	0:35	5	10	8			34	61			26
27	45	30	38	+9	27	T	T	0	W	20.2	35	W	0	0	10	10			34	66			27
28	41	26	34	+5	31	1.13	T	0	ESE	10.7	25	E	2:56	27	10	10	T, DL		34	200			28
29																							29
30																							30
31																							31
Sum	1056	617				4.73	10.5			324.9			74:12		234	222			961	4648			Sum
Avg.	37.7	22.0								11.5	Fastest	Dir.	Possible	%	8.4	7.9			33.1	166.0			Avg.
										Miles	35	NW	308:46	24									Miles

T in columns 7, 8, and 9 indicates amount too small to measure.

TEMPERATURE: (°F)
Average monthly 29.9
Departure from normal +3.6
Highest 62 on 19th
Lowest -8 on 3rd
Number of days with —
Max. 32° or below 8
Max. 90° or above 0
Min. 32° or below 20
Min. 0° or below 4

HEATING DEGREE DAYS (base 65°):
Total this month 976
Departure from normal -86
Seasonal total (since July 1) 4458
Seasonal departure from normal -193

BAROMETRIC PRESSURE (In.)
Avg. station (elev. 762 feet, m.s.l.) 29.338
Highest sea level 30.71 on 14th
Lowest sea level 29.53 on 21st

PRECIPITATION: (In.)
Total for the month 4.73
Departure from normal 2.22
Greatest in 24 hours 1.13 on 20-21st 1/
Snow, Sleet and Hail —
Total for the month 10.6
Greatest in 24 hours 6.5 on 1st
Greatest depth on ground 13 on 1st-2nd
Dates of — Hail None
Sleet 13th Glaze 13th, 14th

Symbols used in columns 18-19

A - Hail
BS - Blowing snow
DL - Distant lightning
D - Dust
H - Sleet
F - Fog
H - Haze
K - Smoke
L - Drizzle
N - Sand
R - Rain
S - Snow
T - Thunderstorm
ZL - Freezing drizzle
ZR - Freezing rain

1/ indicates only the first of several occurrences. Average daily temperature departure since March 1, 1950: +6.5.

Total precipitation since March 1, 1950: 46.23; and departure: +12.41. February's value of average monthly temperature and total precipitation appear misleading unless details for the first ten days are reviewed. In that opening ten-day period, snowfall of ten inches equalled normal for the month; and four days with temperatures of zero or below exceeded the winter-season normal. All-time records for minimum temperature were set at -5° on the second and -8° on the third. A seasonal snowfall total of 62.9 inches was reached on the fourteenth. Only a few flurries occurred during the remainder of the month, when the weather was spring like and dry.

HOURLY PRECIPITATION

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1	.03	.01	.05	.04	.02	.03	.06	.09	.06	.07	.01	.02	.03	.04	T	.02	.01	.04	.03	.03	.02	T	.01	.02	1
2	T	T	T						T	T	T														2
3																									3
4																									4
5			T	T	T	T	T	T	T	T	T	.01	T	T	T										5
6																		T	T	T	.03	.02	.03	.04	6
7	.06	.06	.03	.03	.03	.01	T	T	.01	.01	T	.01	.01	T	.02	.02	.01	.02	.03	.03	.03	.03	.03	.03	7
8	T	T	T	T	.02	T	.01	.02	.02	T	.02	.03	.01	T	.01	.01	T	T	T	T		T	T	T	8
9	T		T	.01	T	T	T			T															9
10																									10
11																									11
12							T	T	T			T	T	T	T	T	.01	.01	T	T	T	T	T	T	12
13	T				T	T	.01	T	T	T	T	.01	T	.01	.01	.01	.01	.01	.01	T	T	.02	.01	.01	13
14	T	T	.02	.01	.01	.01	T	T				T	T	T	T	T									14
15									T																15
16																	.01	.04	T	.02					16
17	T	T	.02	.07	.07	.04	.04	.04	.03	T	T	T	T												17
18																								.02	18
19	.01	T	T	.02	.02	T	.02	.02	T	T															19
20				.01	T																T	.07	.01	.01	20
21	.10	.09	.06	.10	.23	.17	.05	.01	.03	.02	.08	.09	.01	T											21
22																									22
23																									23
24																									24
25																									25
26																									26
27												T	.07	.18	T										27
28														T											28
29															.98	.12	.03	T							29
30																									30
31																									31

Subscription Price: 50 cents per year including annual summary if published. Separate copies, monthly 5 cents each, annuals 10 cents each. Checks, postal notes and money orders should be made payable to the Treasurer of the United States. Remittances and correspondence regarding subscriptions should be sent to the Supt. of Documents, Government Printing Office, Washington 25, D.C.

Fig. A12-3. Entries on Form 1001C Format.

However, where hours of duty preclude an observation at that time, enter the local standard time of the regularly established climatological observation.

A12413. Extra Column (Col. 23).—Enter any additional data required locally, and identify these data in the column heading.

A12414. Barometric Pressure.—On the line captioned "Avg. Station....", enter the elevation H_{bc} (see Appendix I) to whole feet in the first space. Enter the reduced monthly average station pressure value that pertains to H_{bc} (see par. A12361) in the other space.

A12415. Hourly Precipitation.—Enter hourly precipitation in inches and hundredths in the spaces provided at the bottom of the form. Enter "T" for trace, and omit the entry if no precipitation has fallen.

A12500. FORM 1081

A12510. Preparation.—Form 1081 will be used at stations where the height of the 850-mb. surface is computed and where Form 1083 is not used. Only one copy will be prepared unless additional copies are required locally.

A12511. In lines one to seven, enter the data corresponding to items one to seven, respectively, of par. 7430. Entries in the columns of the form are to accord with the date and time of observation as indicated in the column headings. (See par. A7020 regarding computation of these data.)

A12520. Disposition.—Completed copies of Form 1081 may be destroyed after ninety days.

A12600. FORM 1083

A12610. Preparation.—(See Fig. A12-4.) Form 1083 will be used at all second-order synoptic stations and certain other designated stations for recording and coding 3- and 6-hourly synoptic observations. The use of Form 1083 as a work sheet for coding purposes, but not for record purposes, is optional at first-order stations where only 3- and 6-hourly synoptic observations are taken. Only one copy will be prepared unless additional copies are required locally. Where the form is prepared for record purposes, use a well-sharpened Venus 3H drawing pencil, or equivalent. Use sufficient pressure to produce clearly legible, black-line entries.

A12611. Enter station name and date in the spaces provided. Note that the date corresponds to that of Greenwich civil time. (See pars. 1404 and 1405 of the Synoptic Code for conversion table from local standard time

to Greenwich civil time.) On the last day of the month, entries will be made on Form 1083 for all observations up to midnight local standard time. Begin a separate form with the first observation at or following 0000 local standard time on the first of the month.

A12612. Enter 6-hourly observations in columns headed 0030Z, 0630Z, 1230Z, 1830Z; enter 3-hourly observations in columns headed 0330Z, 0930Z, 1530Z, and 2130Z. Omit entries for observations or elements not regularly recorded. Enter slants to indicate missing data pertaining to an observation or element usually recorded.

A12613. All entries in the column headed "Coded" will include the number of digits indicated by the corresponding symbol. Each dot following the letter indicates an additional coded digit; e.g., "R $\underset{24}{\cdot\cdot\cdot}$" indicates that four digits will be entered in the "Coded" column.

A12614. If data are entered on the reverse side of the form, enter a check in the box at the bottom of the page titled "Notes on Reverse Side."

A12620. Routing.—Forward the completed forms for the month, local standard time, on or before the fifth of the following month to the station designated by the regional director.

A12630. Itemized Entries (Line, column, or group entries 1-61).—All references in the instructions on the following pages of this chapter are to the 1949 Synoptic Code unless otherwise specified. The instructions are indexed under this paragraph number.

WB Form 1083
(Revised 1-1-49)

United States Department of Commerce, Weather Bureau
ORIGINAL RECORD OF 3- AND 6-HOURLY SYNOPTIC OBSERVATIONS

Station: JOHNSON CITY, COLORADO Date (GCT) July 2, 1951

Scheduled time of observation		0030Z (1930E)		0330Z (2230E)		0630Z (0130E)		0930Z (0430E)		1230Z (0730E)		1530Z (1030E)		1830Z (1330E)		2130Z (1630E)	
(1) Observation began (LST)		1706M		2008M		2307M		0209M		0510M		0808M		1105M		1410M	
	Symbol	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded
(2) Station identification	III	–	999	–	999	–	999	–	999	–	999	–	999	–	999	–	999
(3) Dew-point (°F)	T_dT_d	–	41	–	44	–	46	–	50	–	54	–	61	–	57	–	38
(4) Total amount of clouds	N	10	8	X	9	X	9	X	9	10	8	10	8	10	8	8	6
(5) Direction of surface wind	dd	ENE	07	SSE	16	SE	14	SSW	20	SSW	20	S	18	SW	23	NW	32
(6) Speed of surface wind	ff	5	04	4	04	7	06	14	12	7	06	15	13	21	18	22	19
(7) Visibility	VV	7	56	3/4	06	3/8	03	3/16	01	2½	20	8	64	10	80	15+	81
(8) Present weather	ww	–	02	–	58	–	58	–	51	–	10	–	02	–	80	–	01
(9) Past weather	W	–	2	–	2	–	6	–	6	–	5	–	2	–	2	–	8
(10) Sea-level pressure (mb)	PPP	–	173	–	156	–	112	–	075	–	088	–	125	–	173	–	227
(11) Dry-bulb temperature (°F)	TT	47.4	47	44.8	45	45.1	46	50.3	50	54.3	54	62.0	62	64.7	65	52.1	52
(12) Wet-bulb temperature (°F)	—	44.3	–	44.5	–	45.0	–	50.0	–	53.9	–	61.3	–	60.0	–	44.5	–
(13) Depression (Col. 11-12)	—	3.1	–	0.3	–	0.1	–	0.3	–	0.4	–	0.7	–	4.7	–	7.6	–
(14) Amount of clouds whose height is given by "h"	N_h	10	8	X	9	X	9	X	9	6	5	7	6	8	6	3	2
(15) Cloud types Sc, St, Cu, Cb	C_L	–	5	–	/	–	/	–	/	–	6	–	5	–	5	–	5
(16) Height of cloud (Ft)	h	16	4	X	0	X	0	X	0	6	2	23	5	25	5	45	6
(17) Cloud types Ac, As, Ns	C_M	–	/	–	/	–	/	–	/	–	2	–	2	–	2	–	7
(18) Cloud types, Ci, Cs, Cc	C_H	–	/	–	/	–	/	–	/	–	/	–	/	–	/	–	0
	6	–	6	–	6	–	6	–	6	–	6	–	6	–	6	–	6
(19) Direction of cloud	D_C	SE	3	X	9	X	9	X	9	X	9	S	4	W	6	NW	7
(20) Pressure tendency	a	–	8	–	8	–	6	–	8	–	4	–	3	–	3	–	1
(21) Amount of pressure change	pp	.040	14	.050	17	.100	34	.080	27	.040	14	.110	37	.130	44	.110	37
	7	–	7			–	7			–	7			–	7		
(22) Amount of precipitation (6-hr)	RR	0				.03	03			.01	01			T	00		
(23) Time of precipitation	R_t	–				–	6			–	2			–	1		
(24) Depth of snow on ground	s	0				0	0			0	0			0	0		
	9	–	9			–	9			–	9			–	9		
(25) Special phenomena (general)	S_pS_p	–				–				–				–	87		
(26) Special phenomena (detailed)	$s'p'_p$	–				–				–				–	16		
	1	–	1			–	1			–	1			–	1		
(27) Direction of waves	d_w	–				–				–				–			
(28) Period of waves	P_w	–				–				–				–			
(29) Height of waves	H_w	–				–				–				–			
	2	–	2	–	2	–	2	–	2	–	2	–	2	–	2	–	2
(30) Height of 850-mb surface	h''_m	–	494	–	490	–	479	–	470	–	474	–		–	500	–	512
(31) Pressure tendency for 3-hr period ending 3 hrs ago	a_3	–	5	–	8	–	8	–	6	–	8	–		–	3	–	3
	3	–	3			–	–			–	3			–	–		
(32) Amount of precipitation (24-hr)	R_{24}	–				–	–			–	0004			–	–		
	4	–	4			–	4			–	4			–	4		
(33) Maximum temperature	T_XT_X	48.3'	48H			47.4'	48H			54.3'	48HDA			64.9H	65H		
(34) Minimum temperature	T_NT_N	45.2'	43H			44.0'	43H			44.3'	44H			53.6	44H		
(35) Plain language data	—																

Computational Data

Sea-Level Pressure	(36) Attached thermometer	72.0		71.5		74.0		75.5	
	(37) Observed barometer	24.873		24.722		24.689		24.933	
	(38) Total correction	–.130		–.129		–.133		–.134	
	(39) Station pressure	24.743	24.695	24.593	24.515	24.556	24.670	24.799	24.910
	(40) Temperature 12 hrs ago (°F)	43.8	46.2	45.2	46.1	47.4	44.8	45.1	50.3
	(41) Current temperature (°F)	47.4	44.8	45.1	50.3	54.3	62.0	64.7	52.1
	(42) Sum (Col. 40 and 41)	91.2	91.0	90.3	96.4	101.7	106.8	109.8	102.4
	(43) Mean (Sum ÷ 2)	45.6	45.5	45.2	48.2	50.8	53.4	54.9	51.2
	(44) Sea-level pressure (in.)	30.04	29.99	29.86	29.75	29.79	29.90	30.04	30.20
Height of 850-MB Surface	(45) Current temperature (°F)	47.4	44.8	45.1	50.3	54.3	62.0	64.7	52.1
	(46) Current temperature (°F)	47.4	44.8	45.1	50.3	54.3	62.0	64.7	52.1
	(47) Temperature 6 hrs ago (°F)	45.2	46.7	47.4	44.8	45.1	50.3	54.3	62.0
	(48) Sum (Col. 45, 46, and 47)	140.0	136.3	137.6	145.4	153.7	174.3	183.7	166.2
	(49) Mean (Sum ÷ 3)	47	45	46	48	51	58	61	55
	(50) Correction from Table 9	+2	+2	+2	+3	+3	+4	+3	+3
	(51) Algebraic sum (Col. 49 and 50)	49	47	48	51	54	62	64	58
(52) Filing time		1718	2016	2317	0216	0516	0818	1117	1416
(53) Observer's initials		FUL	THQ	SJS	THQ	SJS	FUL	THQ	SJS

Notes on reverse side

Fig. A12-4. Entries on Form 1083.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
1. Observation began	Enter the time the observation was begun, in local standard time, followed by the time-zone indicator (E for Eastern, C for Central, etc.). Use 24-hour clock time, e.g., enter 6:00 P.M. as 1800.	
2. Station identification-iii	No entry	Enter assigned station number (paragraph 1801.1).
3. Dew point (°F.)-T_dT_d	No entry	Enter dew point temperature to the nearest whole degree unless dew point temperature is below 0°F., when a code figure will be entered as indicated in paragraph 1804.222.
4. Total amount of clouds-N	Enter total tenths of sky covered by clouds. Enter 0 if no clouds are present and the sky is not obscured, 1- if less than one tenth, and 9+ if more than nine tenths of clouds but with breaks. If sky is obscured by dust, fog, etc., enter X.	Select code figure from Table No. 2 in accordance with paragraph 1802.1.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
5. Direction of surface wind- dd	Enter direction of surface wind to 16 points of the compass, e.g., NNW, SE. Omit entry if wind is calm.	Stations equipped with wind direction indicators calibrated in degrees will code direction to tens of degrees, e.g., 330° will be coded "33." Stations equipped with 9-light indicators only will select code figure from the following table: Code Figure — Direction 00 — Calm 36 — N 02 — NNE 05 — NE 07 — ENE 09 — E 11 — ESE 14 — SE 16 — SSE 18 — S 20 — SSW 23 — SW 25 — WSW 27 — W 29 — WNW 32 — NW 34 — NNW
6. Speed of surface wind- ff	Enter speed of surface wind in miles per hour. Enter "C" for calm.	Enter speed in whole knots, using Conversion Table B.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
7. Visibility- VV	Enter the prevailing visibility in statute miles and fractions, using intervals specified in Table 4.	Select code figure from Table 4 (Statute Miles).
8.		
8. Present weather- ww	No entry	Select code figure from Table 5 in accordance with paragraph 1803.2.
9. Past weather- W	No entry	Select code figure from Table 6 in accordance with paragraph 1803.3.
10. Sea-level pressure (mbs)- PPP	No entry	Enter sea-level pressure in tens, units, and tenths of millibars. (Paragraph 1804.1)
11. Dry-bulb temperature (°F.)- TT	Enter dry-bulb temperature to tenths of degrees, supplying minus signs as required.	Enter dry-bulb temperature to the nearest whole degree, unless temperature is 100°F. or higher, or less than 0°F., when a code figure will be entered in accordance with paragraph 1804.22.
12. Wet-bulb temperature (°F.)	Enter wet-bulb temperature to tenths of degrees, supplying minus signs as required.	No entry

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
13. Depression	Enter difference between Lines 11 and 12.	No entry
14. Amount of clouds whose height is given by "h"- N_h	Enter tenths of sky covered by clouds whose height is given by "h" (see Table 9). Enter "0" if there are no clouds at or below 7999 feet and the sky is not obscured; 1- if less than one tenth, 9+ if more than nine tenths clouds but with breaks. Enter "X" if sky is obscured at or below 7999 feet.	Select code figure from Table 2.
15. Cloud types Sc, St, Cu, Cb- C_L	No entry	Select code figure from Table 8 in accordance with paragraph 1805.2.
16. Height of cloud (ft.)- h	Enter height above ground of clouds at or below 7999 feet in accordance with instructions in paragraph 1805.3. Enter heights to the nearest 100 feet from 0 to 4999 feet and to the nearest 500 feet from 5000 to 7999 feet; enter all heights in hundreds of feet; e.g., 4000 feet as 40. Enter a dash if no clouds at or below 7999 feet are present. Enter "X" if height is unknown for reasons stated in paragraphs 1805.38 and 1805.39.	Select code figure from Table 9.
17. Cloud types Ac, As, Ns- C_M	No entry	Select code figure from Table 10 in accordance with paragraph 1805.4.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

960474 O—51——20

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
18. Cloud types Ci, Cs, Cc- C_H	No entry	Select code figure from Table 11 in accordance with paragraph 1805.5.
19. Direction of cloud- D_C	Enter direction of C_M, C_H or C_L clouds to eight points of the compass, e.g., N, SW (paragraph 1806.2). Enter a dash when no clouds are present; X if direction is unknown or variable; and C if calm.	Select code figure from Table 12.
20. Pressure tendency- a	No entry	Select code figure from Table 13.
21. Amount of pressure change- pp	Enter to the nearest five thousandths of an inch the amount of pressure change during the past three hours.	Select code figure from Table 14. If the change exceeds 9.8 millibars (.290 inch), enter "99" with an asterisk and an additional group in Line 35 as instructed in paragraph 1806.47.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
22. Amount of precipitation (6-hr.)- RR	Enter total precipitation to nearest hundredth of an inch. Enter "0" if no precipitation has occurred in the past 6 hours. Enter "T" for trace if precipitation has occurred but less than 0.005 inch has fallen.	Select code figure from Table 15. If the 6-hourly amount of precipitation exceeds .99 inch, enter the hundredths of inches with an asterisk and report the number of whole inches in plain language in Line 35 as instructed in paragraph 1807.25. Omit entry if no precipitation has fallen in past 6 hours.
23. Time of precipitation- R_t	No entry	Select code figure from Table 16 in accordance with paragraph 1807.3. Omit entry if no precipitation has fallen in past 6 hours.
24. Depth of snow on ground- s	Enter total depth of snow to the nearest whole inch. Enter "0" if none is on the ground. Enter "T" for trace if snow is on the ground in amounts of less than 0.5 inch.	Select code figure from Table 17 in accordance with paragraph 1807.4. Omit entry if no precipitation has fallen in past 6 hours.
25. Special phenomena (general)- S_pS_p 26. Special phenomena (detailed)- s_ps_p	No entry	Enter special phenomena as instructed in paragraphs 1809.2 and 1809.3. If more than one special phenomena group is sent, enter additional groups in Line 35. Omit entry if no special phenomena are observed.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
27. Direction of waves- $d_w d_w$	No entry	Enter direction, period, and height of waves as instructed in paragraphs 1810.2-1810.4.
28. Period of waves- P_w		
29. Height of waves- H_w		
30. Height of 850-mb. surface- $h_{85}h_{85}h_{85}$	No entry	**Enter height of 850-mb. surface to nearest 10 geo-potential feet, omitting units digit (e.g., enter 5270 geo-potential feet as 527). (This datum is computed in Lines 45-51.)**
31. Pressure tendency for 3-hour period ending 3 hours ago- a_3	No entry	Select code figure from Table 13.
32. Amount of precipitation (24-hour)- $R_{24}R_{24}R_{24}R_{24}$	No entry	Enter total 24-hour precipitation to the nearest hundredth of an inch, omitting decimal point. (Paragraph 1812.2) Omit entry if a trace or less has fallen during the past 24 hours.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	OBSERVED	CODED
33. Maximum temperature- T_xT_x	Enter to the nearest tenth of a degree the maximum temperature for the past six hours, supplying minus signs as required.	Enter the maximum temperature to whole degrees for the periods indicated in paragraph 1813.2, unless temperature is 100°F. or higher, or less than 0°F., when a code figure in accordance with paragraph 1813.23 will be entered.
34. Minimum temperature- T_nT_n	Enter to the nearest tenth of a degree the minimum temperature for the last 6 hours, supplying minus signs as required.	Enter the minimum temperature to whole degrees for the periods indicated in paragraph 1813.3, unless temperature is 100°F. or higher, or less than 0°F., when a code figure in accordance with paragraph 1813.33 will be entered.
35. Plain language data	**Enter record temperatures, city data, mean data, etc., in plain language (paragraph 2001-3). These data are sent by designated first-order stations only.**	
36. Attached thermometer	Enter the temperature of the attached thermometer to the nearest 0.5°F. or C.	
37. Observed barometer	Enter the uncorrected observed reading to the nearest .001 inch.	
38. Total correction	Enter the sum of all corrections.	
39. Station pressure	Enter the difference between lines 37 and 38 to the nearest .001 inch. If mercurial barometer is not read, enter station pressure from barograph.	

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	
40. Temperature 12 hours ago (°F.)	Enter to nearest tenth the temperature 12 hours ago (Line 11).
41. Current temperature (°F.)	Enter current temperature to nearest tenth (Line 11).
42. Sum (Columns 40 and 41)	Enter sum of lines 40 and 41.
43. Mean (Sum ÷ 2)	Enter mean obtained by dividing sum in line 42 by 2.
44. Sea-level pressure (inches)	Enter to the nearest hundredth of an inch sea-level pressure obtained from Pressure Reduction Tables.
45. Current temperature (°F.) 46. Current temperature (°F.)	Enter current temperature to nearest tenth of a degree (Line 11).
47. Temperature 6 hours ago (°F.)	Enter to nearest tenth of a degree the temperature six hours ago (Line 11).
48. Sum (Columns 45, 46, and 47)	Enter sum of lines 45, 46, and 47.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A12630).

LINE	
49. Mean (Sum ÷ 3)	**Enter to the nearest whole degree the mean obtained by dividing the sum in Line 48 by 3.**
50. Correction from Table A7-2	Enter the lapse rate and humidity correction obtained from Table A7-2.
51. Algebraic sum (Columns 49 and 50)	Enter algebraic sum of lines 49 and 50.
52. Filing time	Enter time of filing (LST). Use 24-hour clock time (e.g., enter 1:30 P.M. as 1330).
53. Observer's initials	Enter initials.
54-57. Miscellaneous notes	Enter times of beginnings and endings of fog, smoke, dust, glaze, frost, tornado, lightning, halos, and special and unusual phenomena. Enter estimated times in parentheses. Use abbreviations printed on form.
58-61. Notes on precipitation and thunderstorms	Enter character, intensity, and times of beginning and ending of precipitation and thunderstorms. Enter estimated times in parentheses. Use abbreviations printed on form.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

CHAPTER A13. MULTIPLE REGISTERS AND SUNSHINE SWITCH

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CHAPTER A13. MULTIPLE REGISTERS AND SUNSHINE SWITCH

A13000. TRIPLE REGISTER, M000; AND DOUBLE REGISTER, F320.

A13010. General.—The instructions for the M000 triple register (see Fig. A13-1) are generally applicable to the F320 double register also. The double register records wind direction and wind movement on a single chart. The triple register records, in addition, both precipitation and sunshine.

A13011. Wind Direction.—For each of the cardinal directions a wind-direction magnet with pen arm attached is connected into the recorder circuit by the selective action of the wind vane through the appropriate

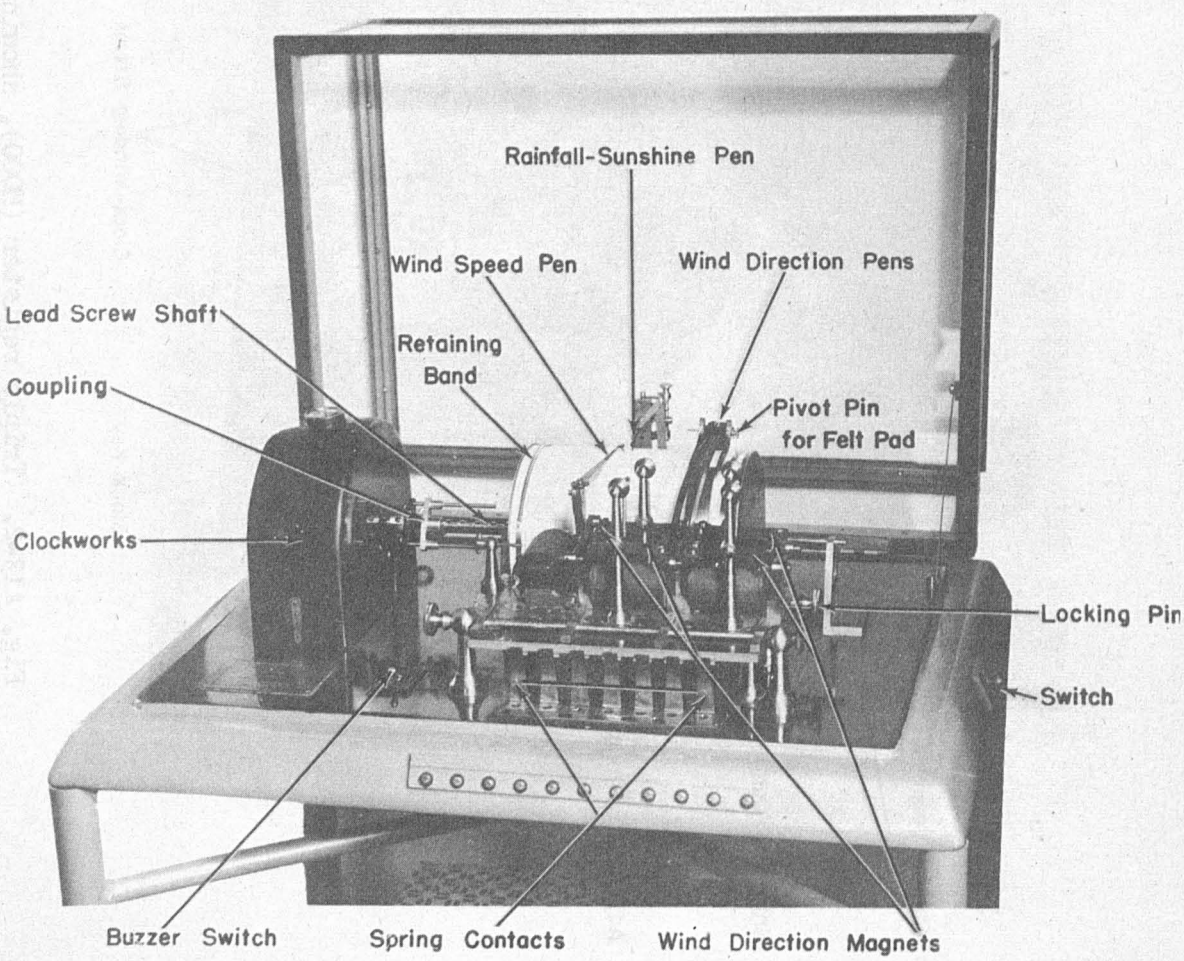

Fig. A13-1. Triple register, M000.

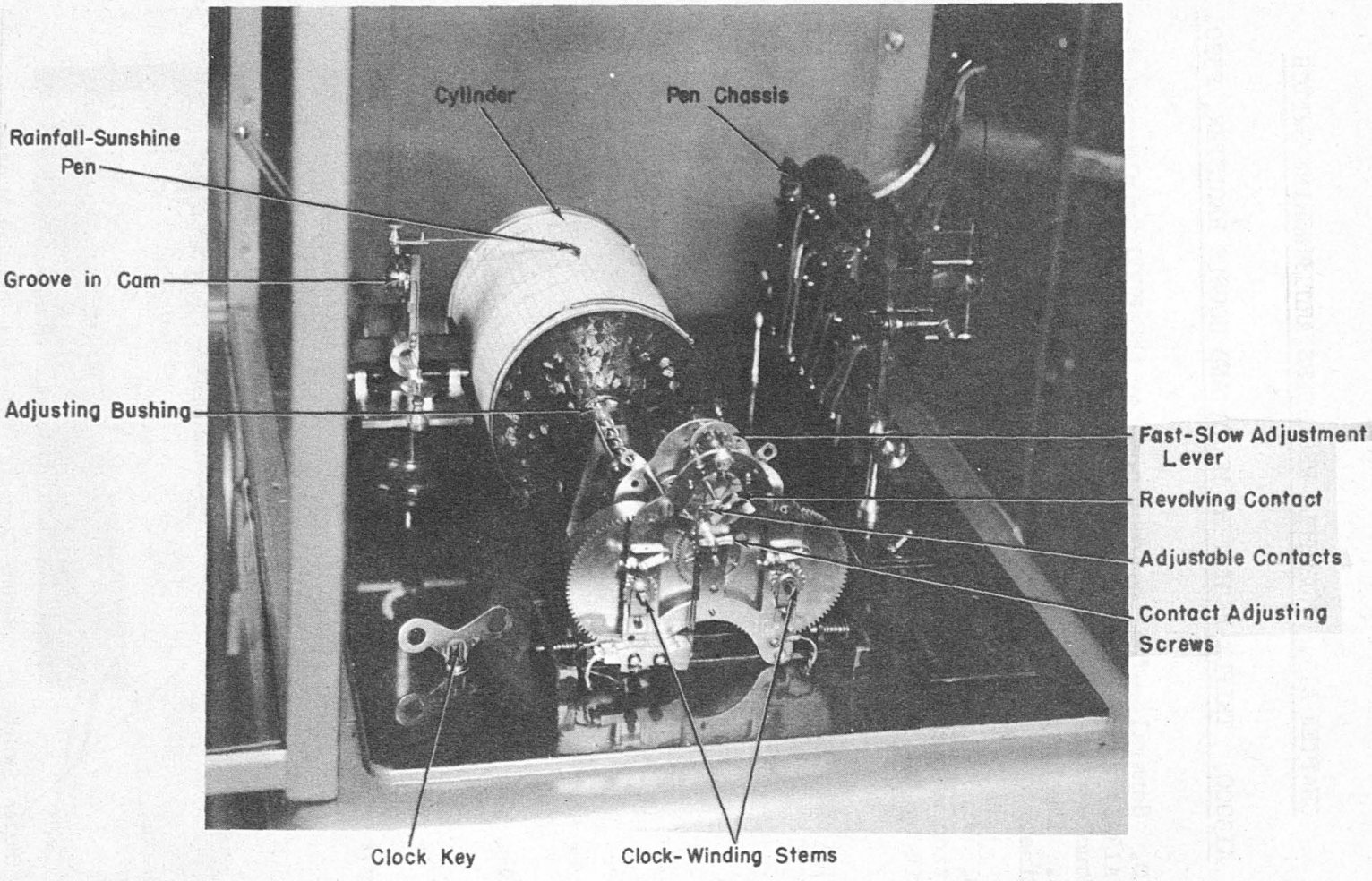

Fig. A13-2. Triple register (M000), showing clock mechanism.

position of a multiple-position switch. When a pair of clock-driven contacts (see Fig. A13-2) completes the circuit momentarily once a minute, the direction pen connected into the circuit at that time will record a dot aligned with a corresponding direction symbol printed on the chart; i.e., N, E, S, and W. Directions are recorded to eight points of the compass. The directions between adjacent cardinal points are indicated by simultaneous dots. The record is therefore not continuous, but consists of a series of dots at one-minute intervals. However, the direction may be recorded manually at any time. A switch near the front of the case is provided for this purpose.

A13012. Wind Movement.—Wind movement is recorded as a continuous pattern on the chart. The magnet that activates the pen is connected to the one-mile contact of an anemometer. The beginning of each momentary offset in the trace represents the beginning of a mile of wind except that, in the case of anemometers in which the circuit remains closed during the tenth mile of each 10-mile cycle of the contact mechanism, the offset in the trace is continued throughout the tenth mile. "B" and "C" of Fig. A13-3 illustrate one-mile segments of the trace. In both "B" and "C", points "a", "b", "c" and "d" represent both the beginning of the ninth, tenth, first and second miles respectively of successive 10-mile cycles, and the end of the eighth, ninth, tenth and first miles respectively. Bending of the contacts or other variations may result in errors in the length of segments of the trace representing miles of wind. Note that an error of this nature will usually cause an error in two successive miles of wind; an increase in the indicated speed of one mile and a corresponding decrease in the indicated speed of the other. Wherever the appearance of the record obtained under conditions of steady, low wind speeds indicates that one or more miles of each 10-mile cycle is consistently in error by one-tenth mile or more, notify the Regional Office.

A13012.1. The wind speed is measured with a scale similar to that shown in Fig. A13-3(A). Four ranges, 5-9, 10-19, 20-39, and 40-79 miles per hour are provided on the scale. Note that the 5-1/4 m.p.h. segment of the 5-9 m.p.h. range is divided in half to provide two 10-1/2 m.p.h. segments on the 10-19 m.p.h. range; and that the segments of the 20-39 and 40-79 ranges are obtained similarly. The speed of a recorded mile of wind corresponds to the value of the segment that is equal in length to the mile of wind (see Figs. A13-3(B) and (C)).

A13012.2. When an anemometer with 1/60-mile contacts is in use, a buzzer may be placed in the 1/60-mile circuit for use in obtaining one-minute average wind speeds (see par. 8230). The buzzer and a switch can be located on the base of the register.

A13013. Rainfall or Sunshine.—The rainfall-sunshine magnet of the triple register may be connected in parallel circuits to both a D101 tipping-bucket gage and an A080 sunshine switch. Each time either circuit is closed, the magnet-driven pen mechanism produces a short,

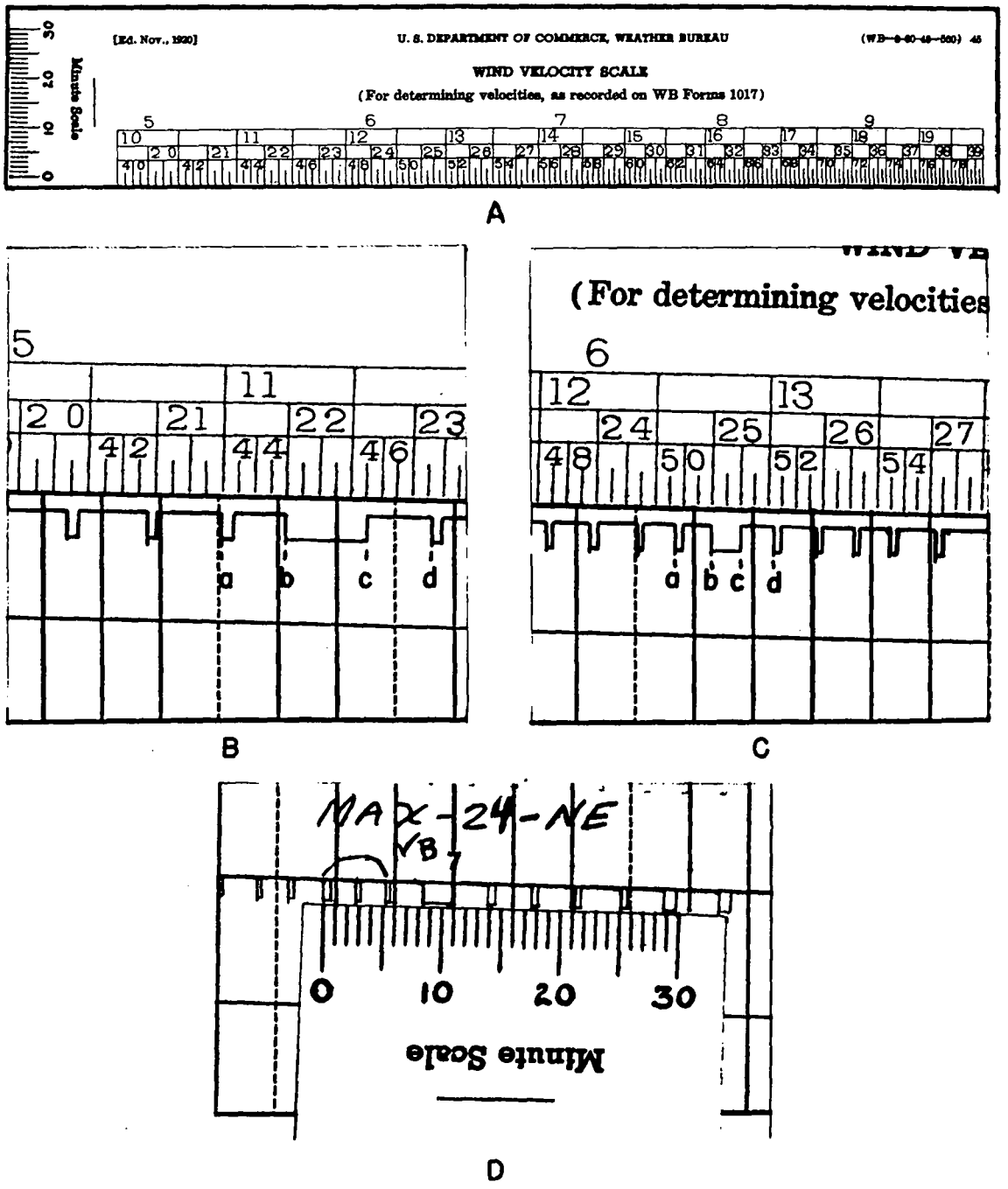

Fig. A13-3. Wind Velocity Scale and use of the scale on Form 1017 or 1017B. The scale is shown in "A". The speed of the ninth mile of a 10-mile cycle (the segment of trace between points "a" and "b") is shown as eleven miles per hour in "B". Similarly the speed of the tenth mile of a 10-mile cycle (the segment between points "b" and "c") is shown as 25 miles per hour in "C". The use of the Minute Scale in the determination of the maximum average five-minute wind speed is shown in "D".

lateral movement of the pen across the chart. Each cycle of ten movements produces a step-like pattern of five steps in one direction and five steps in the opposite direction. When the sunshine switch is closed, the circuit is completed at one-minute intervals by a set of contacts in the clock mechanism (see Fig. A13-2). The tipping-bucket circuit is closed each time 0.01 inch of rain is collected. The uniformity of the sunshine trace in contrast with the more irregular pattern of the rain gage trace facilitates identification of the two records.

A13020. Observational Routine.—The chart used on these registers is either Form 1017 or Form 1017B (see Fig. A13-4). Use Form 1017 at stations where the forms are changed at noon, and Form 1017B at stations where forms are changed at midnight. On Sundays and holidays, Form 1017 may be changed one or two hours earlier than usual. After changing forms, check for proper alignment of the form by depressing the wind direction pens and noting the alignment of the resulting dots with respect to the printed reference lines of the form. At stations where 24 record observations are taken daily, hourly wind-speed and direction data, and odometer (anemometer dial) readings, will not be entered on Form 1017 or 1017B. However, "maximum five-minute" and "fastest single-mile" wind speeds will be entered at all stations. When the precipitation record for the station is not obtained from the tipping-bucket gage, omit the precipitation entries required by par. A13022.2. Make all entries in pencil unless red ink is specified. Enter station name and date in the spaces provided.

A13020.1. Missing Record.—Whenever any portion of the record is missing or incorrect, enter appropriate explanatory notes. To prevent loss of record, avoid changing the charts or conducting maintenance of the exposed elements during periods of excessive precipitation or high winds. Whenever the period of missing record is less than twenty-four hours, use the available record and estimated or observed data of scheduled observations to interpolate for hourly data. Enter the interpolated data in parentheses. Whenever the record is missing for twenty-four hours or more, enter the station name, date, odometer readings, and stick measurements of precipitation on a blank record form for each day of missing record, and forward the form with the month's records.

A13021. Wind.—Enter wind movement and direction on Form 1017 or Form 1017B in accordance with the following instructions.

A13021.1. Hourly Wind Direction.—Determine the prevailing wind direction for each hour, and enter it to eight points of the compass midway between the hour lines. Enter "DI" for direction indeterminate" (see par. A8050).

A13021.2. Hourly Wind Movement (Uncorrected).—Enter the total number of miles for each hour above the trace and near the end of the hour interval.

Some anemometers maintain the ten-mile contact throughout the tenth mile of wind, which is helpful when counting miles of wind. If a contact other than the tenth is begun but not finished in the same hour, ascribe the mile of wind to the hour in which the contact was begun. In the case of the ten-mile contact, ascribe one mile of wind (the tenth mile of the 10-mile switching cycle) to the hour in which the contact is begun and another (the first mile of the next cycle) to the hour in which the contact ends. Enter the total uncorrected movement of the wind for each six hours and for the day in the spaces near the left margin. To reconcile the loss of one or more miles of wind during the changing of the forms, enter as a note on the left margin the number of miles of wind recorded after the last ten-mile contact on the preceding form. The sum of this number and the number of miles recorded on the new form before the end of the ten-mile cycle will equal ten if no record has been lost. If the sum is less than ten, the difference between the two will be added to the record with an explanatory note. When the anemometer is changed, the number of miles of wind movement recorded between the last ten-mile contact of the removed anemometer and the first ten-mile contact of the installed anemometer will not necessarily equal ten. The number of miles of wind movement occurring between these contacts is the number recorded, unless the circumstances are such that part of the record is considered missing (see par. A13020.1).

A13021.3. Maximum Average Five-Minute Speed.—Inspect the record for each day and find the maximum number of miles recorded within a five-minute period. Use a scale graduated in one-minute intervals or a draftsman's dividers set to equal a five-minute interval. Multiply by twelve the number of miles and tenths recorded in the five-minute period. This period will not necessarily coincide exactly with any of the consecutive five-minute periods delimited by the time lines of the chart (see Fig. A13-3(D)). The value obtained in this manner is the uncorrected maximum average five-minute speed. Enter this value immediately above the corresponding portion of the trace to the nearest whole mile and enter the associated prevailing direction (see par. A8050) for this period; e.g., MAX-39-NW. When the record for the day is incomplete, obtain these data from the satisfactory portion of the record and enter them in parentheses as an estimate.

A13021.4. Fastest Mile.—Enter the uncorrected fastest mile and the associated direction immediately below the trace; e.g., FAST-30-NE. A wind-speed scale is used to select the fastest mile. The use of the wind-speed scale and the method of determining the speed of the first and the tenth miles of a ten-mile cycle are described in par. A13012. When the record for the day is incomplete, obtain these data from an evaluation of both the satisfactory portion of the trace and of the data observed during the interval of incomplete record. Enter these data in parentheses as an estimate.

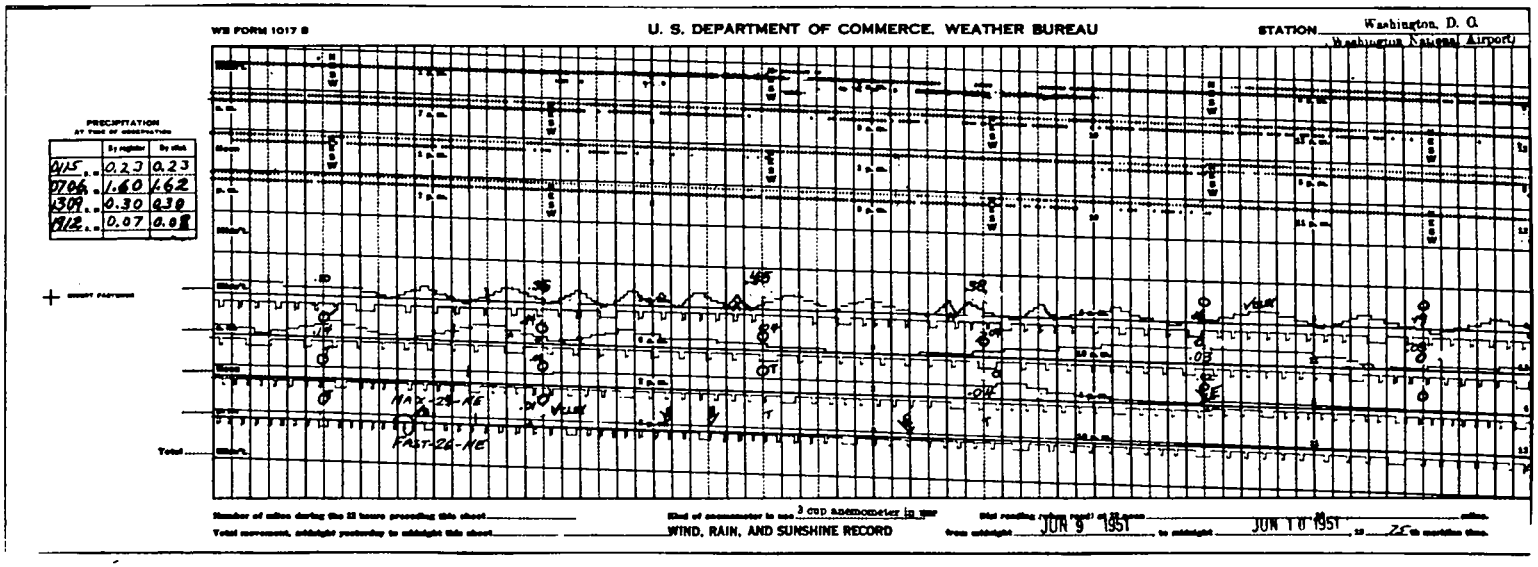

Fig. A13-4. Triple Register Chart, Form 1017B.

A13021.5. Total Wind Movement from Odometer-Type Anemometers.—The odometer will be read at stations where less than 24 scheduled observations are taken daily. It will be read at noon (LST) on the first day of the month and each Monday, or as soon thereafter as practicable during inclement weather. Enter the readings in spaces provided on the form, and the time (LST) in parentheses if other than noon. Whenever the record is missing for more than 24 hours, read the odometer daily at noon (see par. A8411) and enter the reading as specified in par. A13020.1. Compare total wind movement from the odometer readings with that from the record to make both totals agree (see par. A13020.1). Whenever the anemometer is changed, enter a note on the margin of the form giving date and time of change, odometer readings, identifying numbers, and types of both instruments.

A13022. Sunshine and Precipitation.—Although both sunshine and precipitation are recorded on the same trace (see par. A13013), the uniformity of the steps in the sunshine trace will distinguish it from a trace that represents precipitation. If both sunshine and precipitation occur almost simultaneously, interpret the record with the aid of observed data and enter appropriate notes. Enter sunshine and precipitation data on Form 1017 or Form 1017B in accordance with the following instructions.

A13022.1. Sunshine.—For each hour between sunrise and sunset, enter midway between the hour lines the minutes of sunshine determined from the sunshine steps of the trace (see par. A13013), except (a) when sunshine is observed[1] but not recorded, include minutes of observed sunshine in hourly entries, and (b) when the record is incomplete or incorrect, and sunshine observations have not been taken, enter in parentheses the minutes of sunshine estimated on the basis of hourly cloud data. For hours between sunrise and sunset when sunshine has not occurred, enter the figure "0".

A13022.11. Enter check marks on the sunshine trace indicating the exact time of sunrise and sunset, as obtained from the American Nautical Alumanac or similar tables prepared from this almanac. Indicate the character of sunrise and sunset just above the check; e.g., "clr", "cldy", etc.

A13022.2. Precipitation.—Each precipitation step on this trace indicates 0.01 inch of precipitation, and one complete cycle represents 0.10 inch. Correct hourly recorded amounts to agree with stick measurements (see par. A4220). Enter a caret "∧" in red ink to indicate the addition, and an "x" to indicate the deletion, of each 0.01 inch. Enter the corrected hourly amounts of precipitation in red ink above the trace and midway between the hour time-lines.

A13022.21. Enter a check mark "✓" to indicate the time of beginning, and a reverse check mark "↘" to indicate the time of ending of precipitation,

1/ Determine sunshine visually on the same intensity basis used in adjusting the sunshine switch (see par. A13130).

preceded by the letters "B" and "E", respectively. If these times are doubtful, enter the checks in parentheses. When precipitation is occurring at the time of the observation, make a pencil check on the precipitation trace to indicate the time of emptying the gage.

A13022.22. Enter six-hourly amounts of precipitation, as determined both from the uncorrected precipitation trace and the stick measurement (see par. A13020.1), in the block captioned "Precipitation at Time of Observation". Enter the time of the precipitation measurement also.

A13023. Replacement of Charts.—(See Fig. A13-1.) Replace the chart as follows:

(1) Unlock the chassis on which the wind direction pens and magnets are mounted and lift the unlocked end upward as far as it is free to travel. The chassis is unlocked by pulling outward on the knurled head of the locking pin at the right end of the chassis.

(2) Lift the hinged end of the rainfall-sunshine pen until it is free of the groove in the cam and rotate the pen horizontally through 90 degrees.

(3) Loosen the thumbscrew on the coupling that connects the lead-screw shaft of the cylinder to the clockwork, and slide the coupling from the end of the shaft. Remove the cylinder from its supports.

(4) Remove the retaining bands that hold the chart and remove the chart from the cylinder. (In handling and storing the charts, be careful not to smear damp portions of the trace.)

(5) Fit the replacement chart snugly to the cylinder with the bottom of the chart tight against the flange of the cylinder nearest the lead screw, and with the trimmed end (right end) of the chart overlapping the left. Align the trimmed end with the reference mark on the cylinder (small notch on the rim) before the retaining bands are replaced.

(6) Replace the cylinder so that the lead-screw shaft rests on the bearing nearer the clock.

(7) Slide the coupling on the end of the lead screw, and revolve the cylinder until it is adjacent to the lead-screw bearing.

(8) Lower the wind-direction chassis until the pens almost touch the chart, and rotate the cylinder just enough to align the pens correctly with the time lines on the chart.

(9) Lower the chassis and lock it in position. Tighten the thumbscrew on the coupling, and return the rainfall-sunshine pen to its operating position, with the guide pin seated in the groove of the cam.

(10) Check the operation of the pens, and the alignment of the wind-direction pens with the direction symbols on the chart.

Whenever satisfactory alignment cannot be obtained by (7) and (8), adjust the position of the cylinder along the lead screw by holding the cylinder and turning the milled end of the adjusting bushing located on the lead-screw end of the cylinder.

A13024. Chart Distribution.—Forward completed multiple register records for the month to the Weather Records Processing Center not later than the second working day of the following month. Include the records up to noon of the first day of the month if the chart is changed at noon.

A13030. Maintenance.—Maintenance instructions for the basic meteorological instruments used to activate the multiple register are in the following chapters and paragraphs:

(1) D101, Tipping-Bucket Rain Gage - Chapter A4.

(2) F102, F101, and 4-cup Anemometers - Chapter A8.

(3) F003, F004, and F005 Wind Vanes - Chapter A8.

(4) A080, Sunshine Switch - Par. A13140.

A13031. Pens.—Refill the reservoirs of the rainfall-sunshine and wind-speed pens each time the chart is changed, and whenever necessary to avoid loss of record. Once a month remove these pens from the pen arms and wash them in water or alcohol. Clean the pen points with a typewriter brush, or by drawing a piece of hard bond paper or cellophane through the nibs of the pens. If cleaning does not improve the legibility of a poor trace, replace the pen.

A13031.1. Each time the chart is changed, remove the felt-lined ink pad (used to ink the wind-direction pens) by withdrawing the pin on which it pivots. Place several drops of ink on the felt. When the exposed end of the felt becomes badly worn, trim off the worn portion and readjust the

position of the felt. Replace the felt when it becomes too short to be reused. If the ink pad does not pivot freely, clean both the retaining pin and bearings with water or alcohol. Dry the parts thoroughly, and lubricate the pin with a thin film of vaseline before replacing the pad.

A13032. Clock.—Wind both springs of the clock each time the chart is changed. If the clock gains or loses time, remove the clock cover and adjust the fast-slow lever. Do not lubricate the clock. Clock repairs should be made only by a competent watchmaker.

A13032.1. Corroded or pitted electrical contacts in the clock may prevent the circuit from closing, or may cause multiple action of the pens. Once a week, clean the electrodes of the spring contacts with fine sand paper or crocus cloth to prevent the accumulation of corrosion or pitting. Do not use emery cloth. Screws are provided for adjustment of the spring contacts. Maintain just enough wiping action between the rotating contact-arm and the electrodes to insure satisfactory electrical contact. Avert excessive corrosion and pitting of the contacts by maintaining only enough voltage across the contacts to provide satisfactory operation of the magnets. Adjust the voltage by changing the position of the slider on the wire-wound voltage-limiting resistors usually located under the base of the triple register. Each resistor is connected in series with one of the magnets, except that some models are provided with one resistor only, which is connected to the power supply leads to the register.

A13033. Power Supply.—(See Fig. A13-5.) A four- or six-volt storage battery is generally used to power the triple register. Where 117-volt (nominal) a-c current is available, the charge in the battery is maintained by a trickle charger (ordinarily operated at "half charge").

A13033.1. Check the height of the liquid in the cells of the battery once a month, or more frequently if the battery is kept in a very warm, dry atmosphere. Be sure that the liquid always completely covers the plates, but do not fill the battery to the top. The three small balls (red, green, and yellow), visible inside the glass battery, are of different specific gravity and serve to indicate the degree of charge retained by the battery. When all three balls float near the top of the electrolyte, the battery is fully charged. As the battery discharges, the balls sink successively toward the bottom of the battery. When two or more balls drop to the bottom, the battery is weak and the charger should be switched to "full charge".

A13033.2. Connect the positive terminal (+) of the battery to the positive terminal (+) of the charger, and the negative terminal (-) to the negative terminal (-). Damage to the charger or battery will result from mismatched terminals. The polarity of the battery terminals and the ends of the leads connecting the battery to the trickle charger

A13033.3. Before adjusting the charging rate, disconnect the charger from the 117-volt, a-c power supply. Three terminals are provided for adjusting the rate of charge. To obtain the full charging rate, use the metal bridge to connect the two terminals separated by the label FULL CHARGE. To obtain the lesser rate, clip the bridge over the two terminals separated by the label HALF CHARGE. A fuse in the battery circuit is mounted on the front of the charger. Replace defective fuses with 8AG, 2-ampere fuses. A holder for a spare fuse is located on the front of the charger.

A13034. Trouble Correction.—A four- to six-volt lamp or buzzer, or a d-c voltmeter, may be used to check for circuit continuity and the presence of adequate power supply at the check points. Normal brilliance of the lamp, or normal audibility of the buzzer, indicates the presence of sufficient voltage at these points. Approximately four-volts across the magnets is required to operate them. An ohmmeter may be used to test the continuity of leads, the magnet windings, etc. (see par. A1283.05). When all the magnets are inoperative, test the battery and inspect the leads from the power supply to the terminals on the register. If the register is equipped with only one voltage-limiting resistor, test it and determine that it is correctly adjusted. The common terminal for wind speed is usually identified as V or BAT; for wind direction, as $_{C}{}^{B}{}_{C}$ or CC; and for rainfall and sunshine, as RS or RAIN and SUN. When one or more, but not all, of the magnets are inoperative, determine that the voltage is adequate across the leads to the magnets at the time the circuit contacts are closed. If the register is equipped with a voltage-limiting resistor, and the voltage is low, test the resistor and adjust it as necessary. If the resistor is satisfactory (or the register is not equipped with one), test the circuit wiring from the magnet terminals to the corresponding terminals for the battery and register. Adequate voltage across the magnet leads indicates trouble in the magnet or its associated pen mechanism.

A13034.1. Inoperative wind speed and direction magnets may result from faulty operation of the spring contacts which serve to connect these magnets to the terminal strip. The contacts should be clean and should meet with adequate spring tension to insure a good circuit. Dirty contacts should be cleaned by sliding a folded piece of fine sand paper or crocus cloth between them. Be careful not to bend the springs.

A13034.2. Faulty wind direction and sunshine records may be caused by poor clock contacts. When only the rainfall record is affected, inspect the tipping-bucket contacts, and, if these contacts are in good condition, inspect the rainfall-circuit wiring and terminal connections.

should be clearly identified with spring clips or tags stamped with the signs "+" and "-". The polarity of the leads from the battery to the register is not important. The case of the register must not be connected to an electrical ground (to the instrument cabinet, plumbing, etc.), as otherwise the battery will be discharged.

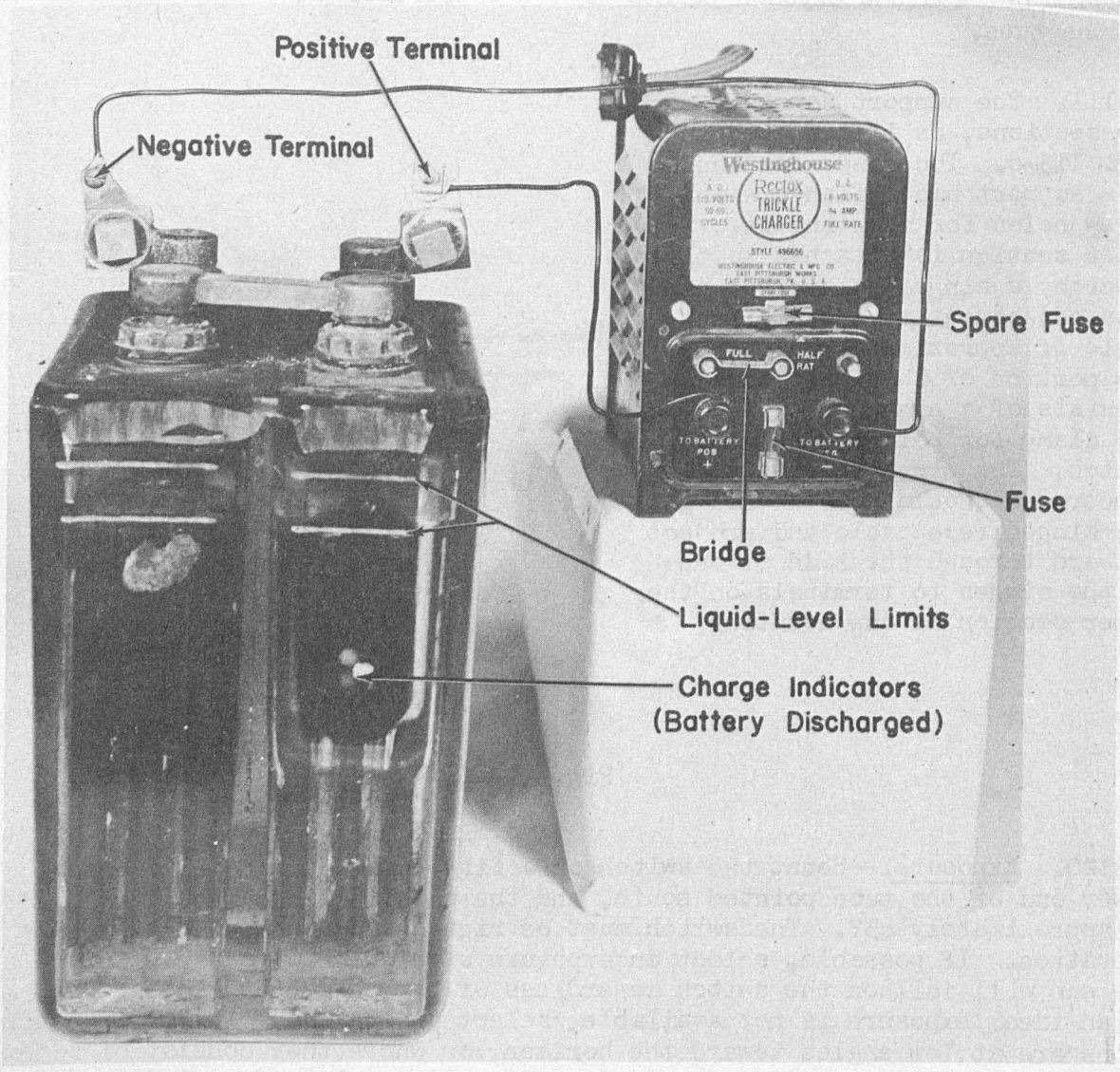

Fig. A13-5. Two-cell storage battery, 17-B-10, and trickle charger.

A13100. A080, SUNSHINE SWITCH

A13110. General.--(See Fig. A13-6.) The sunshine switch is essentially a differential thermometer with a clear bulb at one end and a black bulb at the other. The thermometer is sealed into a glass jacket from which the air has been exhausted to shield it from ambient temperature effects. The assembly is so mounted that the sun strikes both bulbs at the same angle. The black bulb is partially filled with mercury and alcohol. When the switch absorbs radiant heat, the gas pressure increases to a greater extent in the black bulb than in the clear bulb. Mercury is forced up a slender tube connecting the two bulbs and completes the circuit between the exposed points of two electrodes that are sealed in the tube.

A13111. The support consists of two sections, as illustrated in Fig. A13-6. The lower section of this support has a flange with screw holes for mounting it. The upper section is attached to the lower by a hinged joint that permits adjustment to the critical angle of approximately 45°. The top portion of the upper section consists of a hinged receptacle and clamp for holding the glass switch, The wires leading to the electrodes should be centered in the hinged receptacle and project outward through the side of one of the hinges to terminals on the upper section of the mounting.

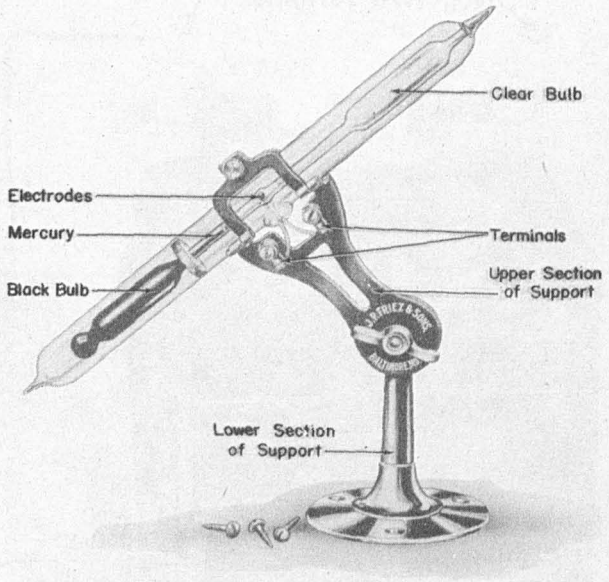

Fig. A13-6. Sunshine switch, A080.

A13120. Exposure.--Mount the switch on a firm base with the blackened lower end of the tube pointed south, and the tube inclined at an angle of approximately 45°. The switch must be rigidly mounted and free from vibration. If possible, select an exposure site where direct rays of the sun will fall on the switch regardless of the season or time of day. If an ideal exposure is not available, select a site where the obstructions are at low angles toward the horizon, or where they consist of objects that will cast a shadow on the switch for only a few minutes during the day.

A13130. Adjustment.—The adjustment of the switch should be such that on a clear day the switch will close approximately one hour after sunrise and open approximately one hour before sunset. On a cloudy day, the switch should open when clouds obscure the outline of the sun and, conversely, the switch should close approximately as soon as the sun becomes faintly visible through thinning clouds. If an adjustment considered satisfactory in relation to the effect of changes in cloud density is such that the switch remains open longer than 1-1/2 hours after sunrise and reopens more than 1-1/2 hours before sunset on a clear day, notify the Regional Office. A coarse adjustment is made by manually shaking the mercury from the upper to the lower bulb, until the mercury in the lower bulb is about 1/2 inch below the electrodes when the switch is held at approximately a 45° angle (the mercury remaining in the upper bulb is not important). In adjusting the level of the mercury, avoid disturbing the relatively brittle wires leading to the electrodes. Install the switch on its support and make a final adjustment, if necessary, by slightly altering its inclination from a 45° angle by means of the hinged support. Seasonal adjustments will probably be necessary to compensate for extreme changes in temperature, and for changes in the angular elevation of the sun. Approximate settings for various seasons of the year may be identified by placing marks across the edge of the hinged joint.

A13140. Maintenance.—Inspect the adjustment of the switch and clean it weekly, or more often, if necessary to maintain satisfactory performance (see par. A13130).

A13200. ENTRY ON WBAN-10

A13239. Sunshine (Col. 39).—Enter corrected hourly sunshine in minutes for the period beginning with the hour printed in column 16, as obtained from Form 1017 or 1017B. If the automatic record is incomplete or is known to be incorrect, enter estimated hourly values in parentheses.

CHAPTER A14. VERIFICATION OF FORMS

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CHAPTER A14. VERIFICATION OF FORMS

A14000. GENERAL

A14010. Purpose.—Records of meteorological observations are verified primarily for the purpose of maintaining a high standard of accuracy in taking and recording meteorological observations. Complete reference will be made to instructions governing the reporting and recording of any data found to be in error.

A14011. Officials in charge at verifying stations are requested to report to the Central Office types of discrepancies apparently resulting from the inadequacy of instructions.

A14100. AT ORIGINATING FIRST-ORDER STATIONS

A14101. All entries on observational records prepared at first-order stations will be verified by someone other than the original observer as soon as practicable after the observation is taken. The official in charge or a designated assistant will review all forms for completeness and general compliance with instructions prior to mailing them.

A14200. PREPARED AT SECOND-ORDER (OTHER THAN CAA) STATIONS

A14201. Observational records from second-order stations, other than CAA stations, will be verified at first-order verifying stations as follows:

(1) Verify every fifth observation as completely as possible.

(2) Inspect the remaining observations for general compliance with instructions and for consistency. Determine that marked departures between consecutive values of sea-level pressure, altimeter setting, dew point, etc., are not indicative of errors.

(3) Review all forms for completeness; e.g., station name, date, etc.

A14300. CORRECTING RECORD FORMS

A14310. Magnitude of Errors.—Corrections to recorded data are not required, and discrepancies will not be reported to the station nor errors charged, unless the magnitude of errors (the difference between the observer's and verifier's evaluation) exceeds:

(1) 0.01 inch (0.3 mb.) in station pressure, sea-level pressure, or altimeter settings.

(2) 1.0°F. in dew point, unless the recorded dew point is higher than the recorded wet-bulb temperature, in which case the dew point will be corrected and a discrepancy will be charged.

(3) 2% in relative humidity (using the dew-point temperature as originally computed by the observer, provided it was within the foregoing tolerance).

A14320. Preparation and Routing of WB Form 5066, Corrections to Weather Records.—Each month, Form 5066 will be prepared in quadruplicate at WRPC's and first-order verifying stations, and the copies will be routed to stations whose Forms 1001B and C, 1083, or WBAN-10 are verified, even though discrepancies are not charged.

A14321. Preparation.—(See Fig. A14-1.) At the top of Form 5066, enter the addresses of the originating and verifying stations and the date of preparing the form. Under the caption "Corrections to Weather Records," enter the dates necessary to complete the statement.

A14321.1. Enter additional data as required below, except that on forms addressed to first-order stations at which punched cards are prepared, omit the data pertaining to WBAN-10A and B (see par. A14322).

A14321.11. In the column headed:

(1) "Form Number, Date and Time," - enter the WB numbers of forms requiring correction, together with the dates and times of the corrected data. One entry of the form number will suffice for consecutive entries pertaining to the same form.

(2) "Data and Reference" - enter identification of the erroneous data, and enter references to instructions governing the reporting of the data (see Fig. A14-1). Since a copy of the form may not be retained at stations at which Form 1083 is prepared, the nature of the erroneous data should be identified in detail to enable the responsible observer to benefit from the references.

(3) "Recorded" - enter the uncorrected data.

(4) "Should Be" - enter the corrections.

(5) "Observer's Initials" - leave blank for use by observer responsible for the errors.

A14321.12. "Remarks" - enter appropriate references to instructions and comments concerning the appearance and general quality of forms and punched cards. At WRPC's enter comments relating to:

(1) Improper punching of Card No. 7 "WBAN Transmittal and Inventory".

(2) Inventory obviously in error.

(3) Missing or duplicate punched cards.

(4) Cards punched off-column.

(5) Holes improperly, or imperfectly punched.

(6) As separate entries, the total number of observational, and the total number of punching errors for the month.

A14322. Routing.—Send the original and one copy of Form 5066 directly to the observing station, and one copy to the Training Office. Retain one copy at the station. Erroneous punched cards from first-order stations will be attached to the original copy, with the correct data clearly indicated. This will eliminate the necessity for itemizing the errors. On forms for CAA and other second-order stations, the observational errors will be itemized as required by par. A14321.1.

A14330. Filing of Punched Cards and Form 5066.—Upon receipt of Form 5066, both copies of the form will be initialed by the observers responsible for the errors; except that in the absence of an observer, the official in charge of the station will enter the printed initials of the observer responsible followed by his own initials in parentheses. The official in charge, chief communicator, or designated assistant of either, will sign the original and forward it in accordance with the instructions printed on the form. The carbon copy and the punched cards (when returned) will be retained until inspected by a field aide. After inspection, cards and forms retained for more than six months may be destroyed.

A14331. Original copies of Form 5066 returned to the verifying station will be forwarded to the headquarters station of the field aide who regularly visits the observing station concerned. These forms will be retained for two years, after which they may be destroyed.

WB Form 5066

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

Weather Bureau Airport Station
Dannelly Field
Route 2
Montgomery, Alabama

Date July 12, 1951

Mr. John Doe
Weather Observer
Doeville, Alabama

MEMORANDUM

Corrections to Weather Records

In verifying forms from your station for June, 1951, corrections were made as set forth below. Each correction should be checked by the person who made the record or summarization. Please correct your retained records accordingly, being especially careful to include all resulting changes. The original and carbon should be initialed by the observers whose records have been corrected. The original will be signed by the Official in Charge and returned within 5 days after receipt to the office from which this memorandum was received. The carbon copy will be retained in the station files.

Form Number Date and Time	Data and Reference	Recorded	Should Be—	Observer's Initials
WBAN-10 05/1430	Col. 5 - Obstructions to Vision (Haze recorded 1330 and 1530. Visibility recorded 6 miles - Reference Cir. N., par. 3911.)	Omitted	H	
07/1230	Line 63 - Station Pressure	29.632	29.732	
25/1630	Col. 3 - Sky (Ref. Cir. N, par. 1511, example 8)	M10-⦶	10-⦶	
26/1230	Col. 47 - Max. Temp. - 6-hourly observation (Dry-bulb reading at 1230, 65.4 - Ref. Cir. N, par. 5550.)	63.9	65.4	
28/0630	Col. 48 - Min. Temp. - 6-hourly observation (Dry-bulb reading at 0530, 49.0)	50.2	49.0	

REMARKS: Station name and date omitted from WBAN-10A and B on 2nd, 11th, and 29th.

Date.....

All retained records have been corrected or noted on the reverse side.
(WB—10-26-60—40,000) 64

Official in Charge.

Fig. A14-1. Example of Form 5066 addressed to a second-order station.

CHAPTER A15. RADAR METEOROLOGICAL OBSERVATIONS

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CHAPTER A15. RADAR METEOROLOGICAL OBSERVATIONS

A15010. General.—Radar (radio direction and ranging) equipment consists essentially of a directional radio transmitter and a radio receiver that picks up the transmitted energy that is reflected by meteorological and non-meteorological phenomena. The types of radar equipment commonly used for meteorological observations employ a wave length of 3 cm. or 10 cm. The received impulses are presented in typical patterns upon an oscilloscope (termed "scope" in these instructions). The search for meteorological phenomena is termed "scanning." The reflected energy as presented on the scope is termed an "echo." Echoes are evaluated in terms of direction and distance from the station, intensity, tendency, orientation, location, length, width, direction and speed of movement, and height. These data are entered upon forms and coded either in the modified plain language RAREP code used at land stations, or the numerical RAREP code used at ocean stations.

A15011. Distance and speed will be entered in statute miles and miles per hour, respectively, at stations in continental United States, and in nautical miles and knots, respectively, at stations outside continental United States. It should be noted that most radar scopes now used in weather search are calibrated in nautical miles. If entry on the forms is to be made in statute miles, conversion from nautical to statute miles will be required in these cases.

A15012. Radar equipment assists the surface observer to evaluate meteorological situations within the range of the set. Limitations of the equipment must be understood when evaluating and using radar data. Certain forms of precipitation and lithometeors may be detected by radar, but wind and pressure systems associated with tornadoes, hurricanes, and thunderstorms cannot be detected. Correlation of the radar indications with the existing synoptic situation must therefore be carefully done. Furthermore, the absence of radar indications will not justify the inference that precipitation is not occurring, for water on the radar dome and precipitation may exclude indications of more distant precipitation areas, especially if 3 cm. radar is used.

A15013. The following paragraphs contain instructions for evaluating the echoes observed on the scope and for entering data on Form 610.3-1, "Radar Weather Observations, Land Station," and Form 610.3-2, "Radar Weather Observations, Ocean Station." Additional instructions for entry of data not directly bearing on the observation are included in Section A15500, together with instructions for disposition of the completed forms.

A15014. The Central Office is interested in obtaining photographs, drawings or sketches of unusual echoes, especially those of precipitation

areas associated with hurricanes, frontal systems, tornadoes and thunderstorms. The following suggestions are offered to personnel who wish to attempt to photograph the radar scope:

(1) Use fast film, similar to Kodak Super XX or Agfa Super Pan Press.

(2) Mount the camera on a tripod or other firm mount as close to the scope as the camera can be accurately focused.

(3) Exclude as much extraneous light as possible from the camera lens.

(4) Make a time exposure, using an aperture of F4.5 or F5.6. The duration of the time exposure should be the exact number of seconds required for one complete revolution of the radar antenna.

The Central Office will be glad to develop the film and return it with prints to the photographer. The material will be most useful if a complete airway observation, taken at the time of the echo, is forwarded with the film or drawing. All material should be identified with reference to the exact time and date of occurrence, location of the observing station, type of radar equipment, range setting and orientation.

A15100. OBSERVATION SCHEDULE

A15110. General.—Radar equipment is a valuable observational facility that will be used to the greatest possible extent whenever echoes are observed on the scope, and especially when hurricanes and other disturbances of unusual severity are forecast or reported in the vicinity. The scope will be observed for a minimum of three minutes. After echoes have been initially detected, the equipment will be maintained in operating or stand-by position until echoes are no longer observed. Unless otherwise specified, "echoes" as used in these instructions will refer to those having their origin in meteorological phenomena.

A15120. Time of Observations.—Depending upon the prevailing meteorological situation, observations will be taken as follows:

A. Land Stations

(1) At 0105 GCT and every three hours thereafter.

(2) In addition to (1) above, when frontal activity or precipitation is occurring or forecast, observations will be taken at 05 and 35 minutes past each hour, and filed, provided echoes are observed.

(3) In addition to (1) and (2) above, additional observations will be taken when:

(a) Echoes are noted on a previously clear scope.

(b) Speed of movement, after increasing by twice or more since the previous observation, equals or exceeds thirty miles per hour.

(c) Direction of movement changes by 45° or more since the previous observation.

(d) Scattered echoes become a solid line or a solid line changes to scattered echoes.

(e) The scope becomes clear.

(4) In addition to (1), (2), and (3) above, observations will be taken as required for local distribution (broadcast by CAA, pilot briefing, etc.).

B. Ocean Stations

(1) As soon as possible after each three-hourly observation.

A15200. PREPARATION OF RADAR FOR USE

A15210. General.—The radar equipment will be turned on and operated in accordance with instructions appropriate to its type. The following instructions concern adjustments of the controls and evaluation of scope patterns to secure optimum performance for weather search.

A15220. Tuning Procedure.—Direct the antenna by manual control to a known ground obstruction that will return an echo. Adjust the antenna in azimuth and elevation for maximum return, and reduce the gain of the receiver until the echo is just discernible on the scope. This point is termed the "threshold level." Turn the A.F.C.-manual switch (automatic frequency control) to the manual position. Retune the receiver and reduce the gain as necessary to maintain the signal at the threshold level. Turn the A.F.C.-manual switch to the A.F.C. position. If an increase in echo intensity is noted, repeat the above procedure. When no difference is noted, the equipment is correctly tuned, and the switch will be left in the A.F.C. position while taking the observation. Any decrease in signal strength when the switch is turned from manual to A.F.C. indicates malfunctioning of the equipment, which will be reported immediately to the technician.

A15221. After adjustments have been made in accordance with the previous paragraph, increase the gain of the receiver to as high a point as is consistent with prevailing interference. Tilt the antenna to about 3° above the horizon or to an angle that yields the best results for the station at the range being used.

A15222. Tuning of radar equipment on ocean-station vessels will be accomplished by Coast Guard personnel.

A15300. DETECTION AND EVALUATION OF ECHOES, LAND STATIONS

A15301. General.—A map of permanent obstructions through 360° around the station will be prepared to aid in distinguishing echoes of meteorological from those of non-meteorological origin. It is recommended that a transparent insert, upon which are plotted echoes of all permanent obstructions in terms of azimuth and range, be constructed to fit over the face of the scope. One insert should be made for each range.

A15302. Scanning.—Scan all ranges, starting with the longest, through several angles of antenna tilt during each observation. To obtain the most accurate and the best defined presentation of an echo, use the shortest range which will include it.

A15303. Spurious Echoes.—Spurious echoes may occasionally be received when meteorological conditions are such that the normal range of the ground pattern is greatly extended. When temperature inversions or rapid changes in moisture content with height prevail, the radar signal is not dispersed in a normal manner, but is concentrated near the earth's surface, below the area of temperature or moisture discontinuity. Spurious echoes will be noted on Form 610.3-1 but will not be transmitted.

A15304. Character.—Classify the echoes in accordance with the following list and enter the corresponding contraction on Form 610.3-1.

Character	Contraction
Scattered echoes	SCTD
Solid echo	SLD
Line of scattered echoes	LINE SCTD
Solid line of echoes	SLD LINE
Spiral band	SPRL BND

A15305. Intensity.—Observations of intensity will be made only at stations equipped with 10 cm. radar. Whenever available, an A-scope will be used to observe intensity. When an A-scope is not available, intensity will be estimated from careful observation of the PPI scope.

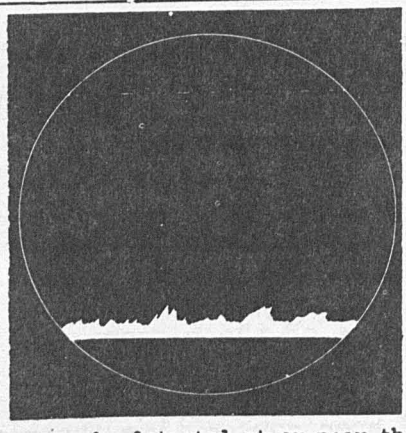
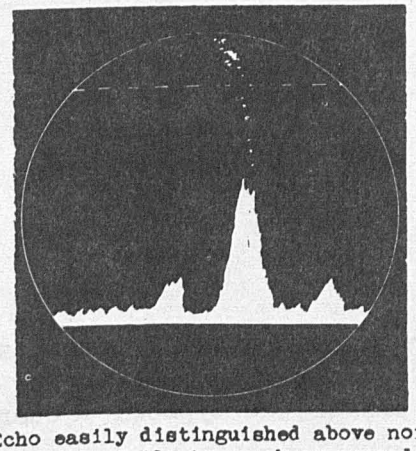
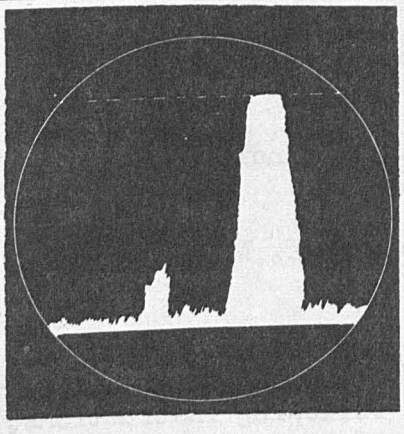
Appearance of A-scope	Intensity
 Echo can be detected at or near the noise level.	Weak if range is less than 50 miles. Moderate if range is more than 50 miles.
 Echo easily distinguished above noise level but fails to reach or exceed saturation.	Moderate if range is less than 50 miles. Strong if range is more than 50 miles.
 Echo completely saturates scope.	Strong if range is more than 20 miles. Moderate or strong if range is less than 20 miles.

Fig. A15-1. Relation of the appearance of A-scope to intensity.

A15305.1. Enter on Form 610.3-1, under the caption "Intensity," the appropriate contraction selected from the following list:

Intensity	Contraction
Weak	WK
Moderate	MDT
Strong	STRG

A15305.2. Use Fig. A15-1 to relate the appearance of the A-scope to the intensity.

A15306. Tendency.—The tendency will be based upon consecutive observations of intensity. Enter on Form 610.3-1, under the caption "Tendency," the appropriate contraction selected from the following list:

Tendency	Contraction
Increasing	INCRG
Unchanging	NO CHG
Decreasing	DCRG
Slowly	SLOLY
Rapidly	RPDLY

A15307. Position.—The shape and size of each echo and its direction and distance from the station, will be evaluated. To facilitate observing in these terms, the echoes will be visualized in one of the typical patterns:

(1) Direction and distance to ellipse pattern (see Figs. A15-2 and A15-3).

(2) Direction and distance to circular pattern (see Figs. A15-4 and A15-5).

(3) Direction and distance to combinations of individual echoes (see Figs. A15-7 and A15-8).

(4) Azimuth and range of spiral bands (see Figs. A15-9 and A15-10).

The echoes will be evaluated in terms of whichever pattern fits best. Each pattern is discussed below. After the direction and distance to the echo have been observed in accordance with the following instructions, enter the data on Form 610.3-1 under the captions Direction and Distance. Enter direction to sixteen points of the compass, and distance to the nearest whole statute mile. The direction and associated distance will be entered in adjacent columns. As many additional data as are necessary will be entered similarly.

A15307.1. Ellipse.—The scope pattern will be evaluated in terms of an ellipse when the major axis (length) through an echo or group of echoes is two or more times the minor axis (width), provided that the distance between adjacent echoes in a group is the same as or less than the distance through the largest echo.

A15307.11. Read the direction and corresponding distance from the center of the scope to the center of the major axis.

A15307.2. Circle.—The scope pattern will be evaluated in terms of a circle when an echo or group of echoes is so situated that the major axis could lie in more than one position through the area, provided that the distance between adjacent echoes in a group is the same as or less than the distance through the largest echo.

A15307.21. Read the direction and corresponding distance from the center of the scope to the center of the circle.

A15307.22. When precipitation at the station causes a bright, diffuse echo that completely covers the central portion of the scope, make distance readings to the edges of the echo at several points. No direction readings are required. The distance values will not be entered on Form 610.3-1, but will be used for a later determination of the width of the area (see Fig. A 15-6).

A15307.3. Individual Echoes.—If, in a group of echoes, the distance between adjacent echoes is greater than the distance through the largest echo, the echoes will be described individually. (See Fig. A15-7.)

A15307.31. When an individual precipitation area is the same size as, or smaller than, the width of the radar beam, the echo will appear as a short line. In this case, the major and minor axes will not be determined. The direction and distance to the echo will be reported in terms of the direction and distance to the center of the echo with respect to the station (see Fig. A15-8).

A15307.4. Spiral Bands.—Echoes reflected from precipitation areas associated with typhoons and hurricanes often approximate spiral bands. No attempt should be made to classify these echoes as ellipses or circles. Rather, azimuth, to the nearest ten degrees, and range readings will be recorded for as many points (usually at least three) on the center line of the echo as are necessary to define its extent accurately. When multiple bands exist, separate azimuth and range readings will be recorded for each band (see Figs. A15-9 and A15-10). Captions on Form 610.3-1 will be amended as necessary for entry of these data. The phrase contraction "AZRAN" will precede each group of azimuth and range data.

A15307.41. Information pertaining to the eye of the storm will be reported in remarks. (See par. A15315.2.)

A15308. Orientation.—The orientation of a scope pattern which is evaluated as a line will be entered to sixteen points of the compass (e.g., NNE-SSW, N-S, SW-NE, etc.) under the caption "Orientation."

A15309. Location.—The location of the echo(es) will be identified with respect to cities, geographical features, or air navigational facilities. When echoes are so numerous that it is impracticable to define them all, a general statement as to their location, including quadrant or sector, and distance from the station, will be made.

A15310. Length.—The length of a scope pattern that is evaluated as an ellipse will be measured from one end of the major axis to the other. Enter the length, to the nearest whole statute mile, under the caption "Length" on Form 610.3-1.

A15311. Width or Diameter.—The width of scope patterns will be described in terms of the diameter of a circle, the length of the minor axis of the ellipse, or the mean width of spiral bands, whichever is appropriate. Enter the width to the nearest whole statute mile under the caption "Width" on Form 610.3-1.

A15311.1. The width of scope patterns, when the size of the precipitation area is equal to, or less than, the width of the radar beam, will not be recorded.

A15311.2. Determine the width of a circular pattern by reading the distance to the nearest point of the circle and of the most distant point. Subtract the nearer from the more distant value. The remainder is the width.

A15311.3. When the minor axis of an ellipse is parallel or nearly so to a radial line from the center of the scope, determine the width similarly to that of a circle. Otherwise, estimate the distance by comparison with the distance between range markers. (See Fig. A15-3.) Note that the minor axis is equal to the maximum width of the ellipse.

A15311.4. When a roughly circular bright echo completely covers the central portion of the scope (as described in par. A15307.22, and illustrated in Fig. A15-6), the width will be reported as the diameter of the circle and a remark will be added at the end of the report to indicate that the echo is centered at the station.

A15311.5. The width of the spiral bands characteristic of the precipitation areas associated with hurricanes will be reported as the mean width of each band.

A15312. Direction of Movement.—Direction of movement is expressed in terms of the direction from which the echo is moving, and is based upon two consecutive observations taken about fifteen minutes apart.

A15312.1. To determine the direction of movement, plot the location of the center of the echo at each observation on a plotting board or an aeronautical chart covered with transparent material. Draw a line through the centers of both echoes. Determine the bearing from the second position to the first. This bearing is the direction of movement.

A15312.2. Enter on Form 610.3-1, under the caption "Direction," the direction of movement to sixteen points of the compass.

A15313. Speed of Movement.—The speed at which an echo moves will be expressed in miles per hour by dividing the distance in statute miles between the centers of the plotted echoes by the elapsed time between observations.

A15313.1. When the movement of the echo patterns is not uniform, adjust the antenna and receiver gain controls until all but the strongest or largest echoes have been excluded from the scope. A more uniform rate of movement will usually be obtained by tracking and plotting these echoes.

A15313.2. Enter the speed on Form 610.3-1 under the caption "Speed" to the nearest whole statute mile per hour.

A15314. Height.—The height of echoes will be determined at stations supplied with equipment appropriate to the purpose. All values of height refer to the uppermost limit of visible moisture that may be detected by radar. Therefore, it will not be assumed that height data refer to the tops of clouds. Moreover, height data at long ranges are inaccurate because the elevation angles are very small, and corrections are not made for the curvature of the earth and for deviations of the radar beam from normal propagation. At very close ranges, the vanishing point of an echo may occur at the leading edge of a storm, whereas the actual top of the storm may be considerably farther from the station and at a lower elevation angle. To limit the magnitude of these inaccuracies, determinations of height will be made only between the ranges of 15 to 50 miles.

A15314.1. If the vertical angle of the antenna beam can be varied, determine the apparent height of the echoes as follows:

(1) Using manual control, center the antenna on the most intense portion of the echo.

(2) Tilt the antenna and read the angle when the echo first disappears.

(3) Subtract half the vertical beam width from the angle read in (2).

(4) Multiply the sine of the angle found in (3) by the distance to the echo. The product will be the height in nautical or statute miles, depending upon the radar used.

(5) Convert the value found in (4) from miles to feet by multiplying the value by 6080, or 5280, depending on whether nautical or statute miles are used in (4) above. Add to the converted value the height of the station above mean sea level.

A15314.2. Enter the height on Form 610.3-1 under the caption "Height" to the nearest hundreds of feet; e.g., 25,000 would be entered as 250.

A15315. Remarks.—Enter under "Remarks" such data as will support and amplify the observation and such additional data as has not been reported by a surface-observation station. Authorized contractions will be used so far as possible in making entries. Remarks which are not transmitted will be entered in parentheses.

A15315.1. Enter data pertaining to unusual echo formations, e.g., inversions, precipitation areas centered at station, etc.

A15315.2. Enter additional data pertaining to echoes characteristic of the precipitation areas associated with hurricanes. The azimuth to the nearest whole degree, range, direction and speed of movement of the apparent eye will be recorded. If the eye of the storm is off the edge of the scope (out of range of the radar set), no attempt will be made to give the position of the eye. The terms "hurricane," "tropical storm," etc., will not be used in describing the echoes, either in public contacts or transmitted reports.

Examples of Remarks

Observed data:	Thunderstorm reported ten miles west of Washington National Airport moving from the southwest.
Entry under remarks:	TSTM RPRTD 10 W DCA MOVG FM SW.
Observed data:	Strong echo identified as tornado, 100 miles west of station, moving from southwest at 25 miles per hour.

Entry under remarks: STG ECHO IDNFYD AS TORNADO 100 WEST STN MOVG FM SW/25.

Observed data: Center of storm at 60 degrees and range 110 miles, diameter six miles, moving from southwest at 28 miles per hour.

Entry under remarks: CNTR AZRAN 60/110 DIAM 6 MOVG FM SW/28.

A15316. If more than one echo or group of echoes appears on the scope, the procedure described in this section will be repeated as necessary to define them all, except as provided in par. A15309.

A15400. EVALUATION OF ECHOES, OCEAN STATIONS

A15401. General.—At ocean stations, radar echoes are evaluated similarly, in many respects, to those at land stations. Whenever the process is similar, ocean-station personnel will be referred to the relevant instructions in section A15300. Since Coast Guard personnel operate the radar equipment, instructions for the detection of echoes will not be included in this manual.

A15402. At the scheduled time of beginning each radar observation, the observer will ascertain of the radarman whether meteorological echoes are visible on the scope. Whenever echoes are present, the observer will inspect the scope, evaluate the echoes, and code them. The coded data will be entered on Form 610.3-2 "Radar Weather Observations, Ocean Station." Whenever echoes are not present, an observation will not be made.

A15403. The Radar Storm Detection Code will be used to code the echoes. The code is bound at the end of this section, and it is also issued separately printed on cardboard. The code comprises seven tables, each of which is described below in terms of evaluated echoes.

A15404. If more than one echo or group of echoes appears on the scope, the procedure described in this section will be repeated as necessary to define them all.

A15410. Type of Echo.—Evaluate as elliptical or circular in accordance with pars. A15307.1-.41 Determine the length or diameter in accordance with pars. A15310-10.4. Code in Table 1. Code figures 0 and 1 will not be used by Weather Bureau stations.

A15420. Orientation.—Evaluate in accordance with par. A15308. Code in Table 2. When the type of echo is coded as circular (code figures 6 through 9 of Table 1), a slant mark will be used.

A15430. Echo Coverage of Circular Area.—When the type of echo is coded as circular (code figures 6 through 9 of Table 1), the code figure most closely approximating the amount of the circular area covered by the echo will be selected from Table 3. Note that this figure refers to the coverage of the circular area and not to the coverage of the entire scope face.

A15440. Width of Line of Echoes.—When the type of echo is coded as elliptical (code figures 2 through 5 of Table 1), evaluate in accordance with par. A15311.3. Code in Table 3A.

A15450. Direction of Center from Station.—Evaluate in accordance with par. A15307.11 and A15307.21. Code in Table 4.

A15460. Distance from Station.—Evaluate in accordance with pars. A15307.11 and A15307.21, except that nautical miles will be used. Code in Table 5.

A15470. Direction from Which Echo Pattern is Moving.—Evaluate in accordance with pars. A15312 and A15312.1. Code in Table 6.

A15480. Speed of Echo Movement.—Evaluate in accordance with pars. A15313 and A15313.1, except that knots will be used. Code in Table 7.

A15490. Height in Feet MSL, of Echo Top.—Evaluate in accordance with pars. A15314-A15314.1. Code in Table 8.

A15500. FORMS

A15510. General.—This section concerns instructions for entry of identification data on Form 610.3-1, "Radar Weather Observations, Land Station" and Form 610.3-2, "Radar Weather Observations, Ocean Station."

A15511. Enter the month, and year in the appropriate space in the upper right corner of the form, e.g., June 1949.

A15512. Enter the name of the station (and vessel, in the case of ocean stations) in the space in the upper left corner of the form.

A15513. Enter the type of radar in the space in the upper center of the form.

A15520. Land Station Form 610.3-1.—This form will be started at 0000 LST on the first day of each month. Data pertaining to more than one day may be entered on a single form. The following paragraphs are captioned to correspond with similarly captioned columns on Form 610.3-1. When echoes are observed but data required by the captions on Form 610.3-1 are missing or unknown, omit entries. If the equipment is inoperative, all entries will be omitted between the reports of cessation and resumption of operation.

A15521. Date.—Enter the date of the observation.

A15522. Time.—In the blank space at the head of the column, enter a letter to indicate the standard of time in use. Enter the time of completing the observation, to the nearest minute, in terms of the 24-hour clock.

A15523. Rarep Number.—The first radar report (RAREP) of the day will be numbered "1." The second will be numbered "2," etc. A new series of numbers will be started at 0000 LST.

A15524. Operational Status.—Enter a contraction pertaining to the operational status of the equipment as required by the table below. In the following list, "PPI" refers to the scope (plan position indicator); the additional letters refer to the "no echo" (NE), "out of service for maintenance" (OM), etc. These contractions may be used separately or in combination with echo reports.

Status	Contraction
Equipment performance normal, echoes not observed.	PPINE
Equipment out of service for maintenance. (Follow the contraction with a figure to indicate the number of hours that equipment is expected to be inoperative.)	PPIOM
Equipment inoperative owing to breakdown.	PPINO
Normal operation is resumed.	PPIOK
Observation omitted for a reason other than those above.	PPINR

A15525. Initials. The observer's initials will be entered in this column.

A15530. Ocean Station, Form 610.3-2.—A new form will be started at the beginning of each month, GCT, and at the beginning of each patrol. If equipment is inoperative, all entries will be omitted between the reports of cessation and resumption of operation.

A15531. Identification.—The captions at the head of each column are self explanatory. Entries will be made in accordance with instructions in Circular M. In the following list, all references are to Circular M.

(1) Day of month.

(2) Day of week (Y). See par. 2201.

(3) Octant of globe (Q). See par. 2301.

(4) Latitude and Longitude ($L_aL_aL_a$, $L_oL_oL_o$). See pars. 2401 and 2501.

(5) Greenwich Civil Time (GG). See par. 2601.

(6) The letters "SD" to identify the report as a "storm detection (radar)" report.

A15540. Disposition of Forms.—At the end of each month (or each patrol), mail the completed forms to the Central Office, attention SF&MO Division.

A15600. TRANSMISSION OF RADAR REPORTS

A15610. Land Station, Form 610.3-1.—RAREPS (radar reports) will be transmitted to report (1) echoes and associated data regarding location, height, intensity and movement, and (2) reports of inoperative equipment and resumption of service. When the scope becomes clear after one or more RAREPS, transmit "no echoes" (PPINE). A RAREP will not be transmitted thereafter until echoes are observed or the equipment fails. When the equipment fails, transmit the appropriate contraction once only; when operation is resumed, transmit the contraction "PPIOK" once only.

A15611. Transmission Schedules.—Regular and special RAREPS will be transmitted on the SW teletype collection of Service A, or at the first opportunity (when circuit time is available). The reports will be filed for transmission on Form 3024B or a suitable message blank.

A15612. Order and Content.—The content of RAREPS will vary with the meteorological situation being reported. Data will be reported and transmitted in the order listed below to the extent that they are available. The arrangement of material in a RAREP indicates the nature of the data; therefore, the omission of data will not be explained by code groups or special devices. All material will be taken from Form 610.3-1 on which the necessary data will have been recorded in units and phrase contractions appropriate to direct use in the code; e.g., data entered in statute miles will be coded in statute miles, and data entered in hundreds of feet will be coded in hundreds of feet, etc. Only such remarks as have not been reported by a surface observing station will be included in the transmitted report. A sample RAREP follows to illustrate the spacing and separation of the elements.

DCA 080240E RAREP3 SLD LINE MDT SLOLY INCRG SW/75 ORNTD N-S FM LURAY TO GORDONSVILLE TO CUMBERLAND 90 LONG 30 WIDE MOVG FM W/25 HGT 240 PPIOM3

Breakdown of this message for identification follows:

CONTENTS OF RAREP	CODED DATA	EXPLANATION
1. Station identification.....	DCA	Washington National Airport
2. Date and time, LST.....	080240E	Eighth day of month, 2:40 a.m., Eastern Standard Time
3. The term "RAREP" followed by a serial number.....	RAREP3	To identify the observation as the third radar report of the day
4. Character of the echo.....	SLD LINE	Solid line of echoes
5. Intensity of the echo.....	MDT	Moderate intensity
6. Tendency of the echo.....	SLOLY INCRG	Slowly increasing
7. Direction and distance to center of major axis of the ellipse.....	SW/75	Center of echo located 75 miles southwest Washington
8. Orientation.....	N-S	Echo is oriented from N-S
9. Location.....	FM LURAY TO GORDONSVILLE TO CUMBERLAND	To locate echo with regard to specific locations. Echo extends from the city of Luray through Gordonsville to Cumberland
10. Length.....	90 LONG	Echo is 90 miles long
11. Width.....	30 WIDE	Echo is 30 miles wide
12. The direction from which, and the speed with which, the echo is moving.....	MOVG FM W/25	Moving from the west at 25 m.p.h.
13. Height.....	HGT 240	24,000 feet MSL
14. Remarks.....	.....	As appropriate, see par. A15312
15. A contraction to report inoperative equipment or resumption of service.....	PPIOM3	Equipment out of service for maintenance for next three hours

A15620. Ocean Station, Form 610.3-2.—RAREPS will be transmitted from ocean stations as separate messages, addressed to the same destination as synoptic reports.

969474 O—51——23

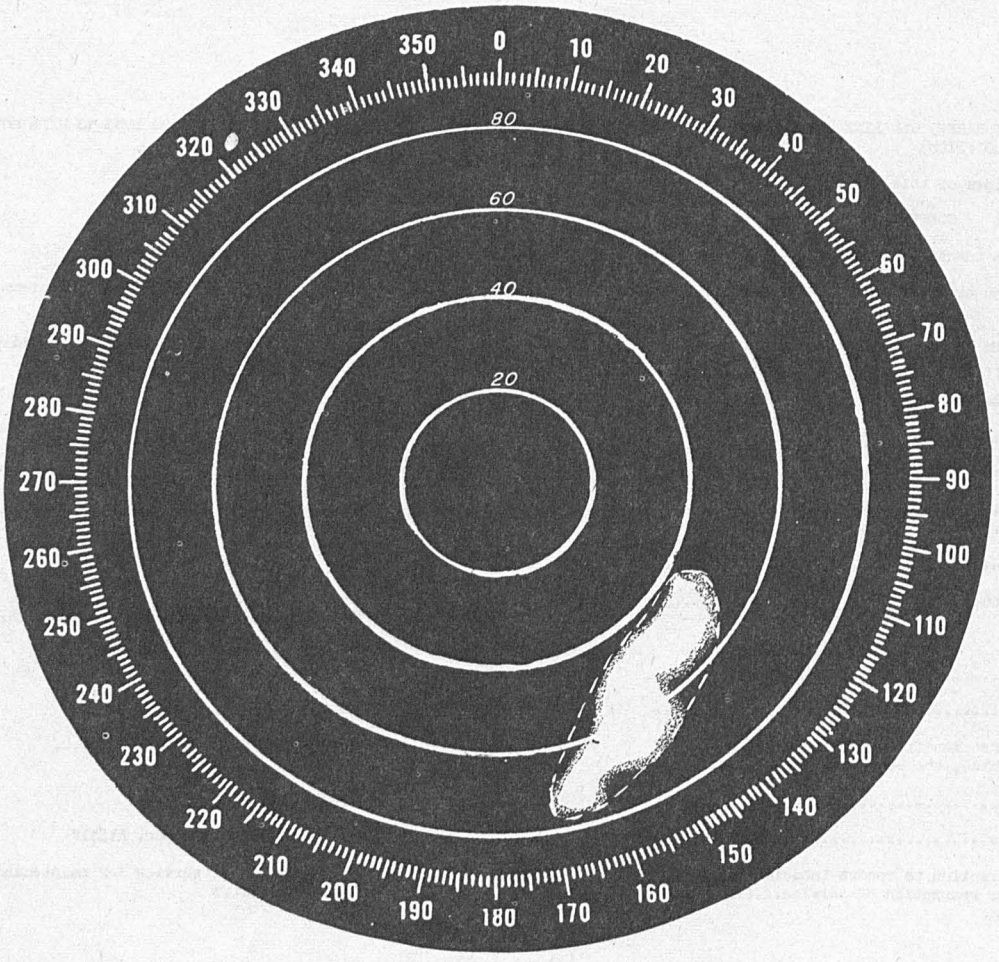


Fig. A15-2. Solid echo evaluated as ellipse.

The solid echo line is visualized as an ellipse. Ragged edges are not enclosed. The distance is the distance from the center of the scope to the center of the major axis of the ellipse. The width is the length of the minor axis. When the direction and speed of movement, and the type of radar in use, permit measurement of intensity and height, this echo would be evaluated as:

> Solid line of moderate echoes; tendency - no change; direction and distance to the center of the echo SE, 55 miles; oriented NE-SW; extending from Sanford to Orleans; 55 miles long; 22 miles wide; moving from SE at 20 miles per hour (or knots); height of the top of the echo 28,000 feet MSL.

At a land station, this would be coded as: SLD LINE MDT NO CHG SE/55 ORNTD NE-SW FM SANFORD TO ORLEANS 55 LONG 22 WIDE MOVG FM SE/20 HGT 280.

At an ocean station, this would be coded as: SD428 35345.

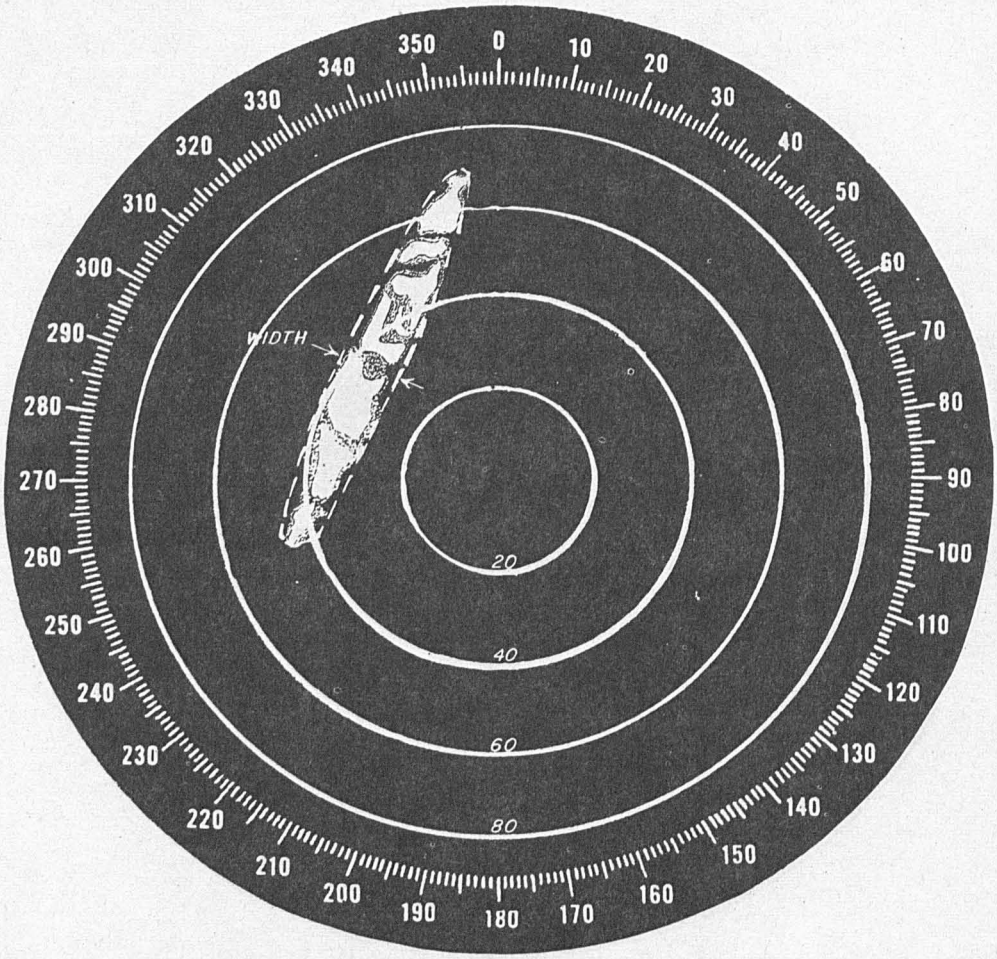


Fig. A15-3. Scattered echoes evaluated as ellipse.

The line of scattered echoes is visualized as an ellipse, since the distance between adjacent echoes in the group is less than the distance through the largest echo, and since the major axis is more than twice the minor axis. The azimuth bearings are recorded to sixteen points of the compass and distance readings to the nearest mile. The report of this echo would be evaluated as:

> Line of scattered echoes of moderate intensity; tendency - increasing slowly; direction and distance to the center of the echo NW, 35 miles; oriented NNE-SSW over Sandoz mountains; 80 miles long; 15 miles wide; moving from the northwest at 30 miles per hour (or knots); tops of echoes 20,000 feet MSL; Remarks, at 1430 C., a pilot reported a line of thunderstorms 50 miles northwest of the station.

At a land station, this would be coded as: LINE SCTD MDT INCRG SLOLY NW/35 ORNTD NNE-SSW OVR SANDOZ MTNS 80 LONG 15 WIDE MOVG FM NW/30 HGT 200 PIREP 1430C LINE TSTMS 50 NW STN.

At an ocean station, this would be coded as: SD117 73764.

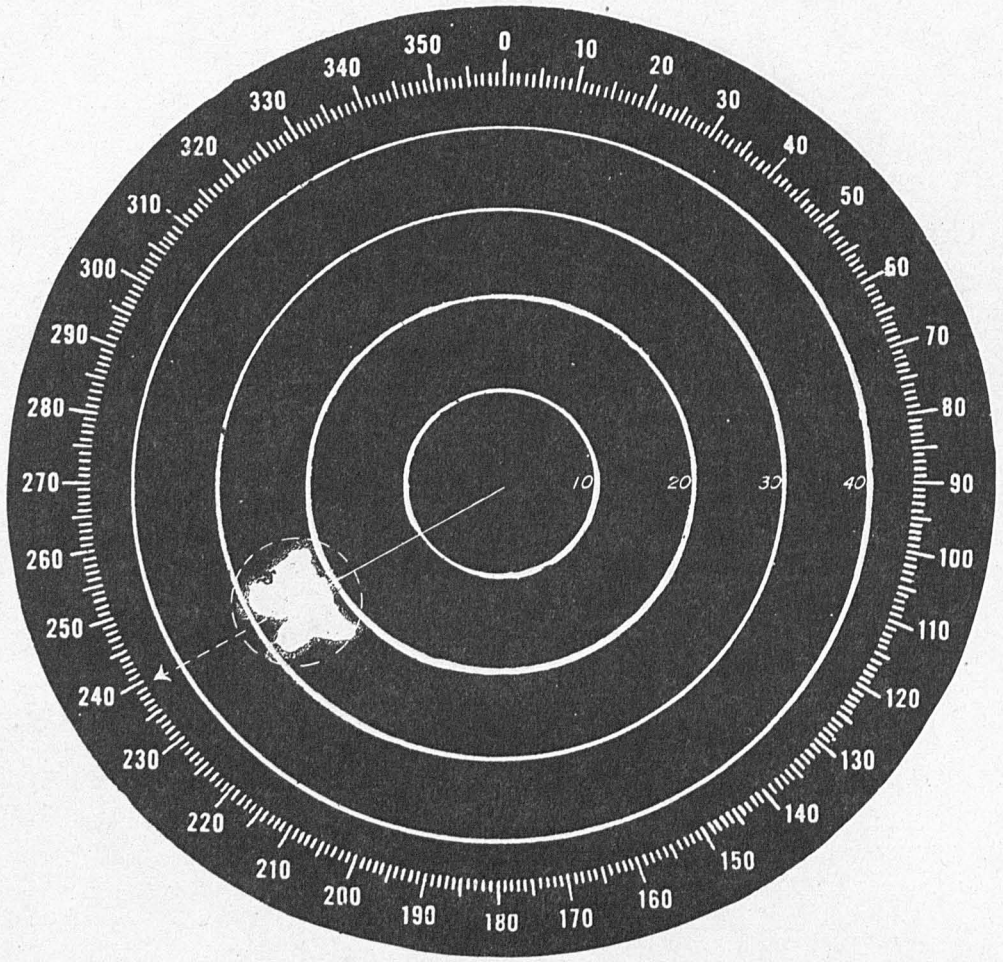


Fig. A15-4. Single echo evaluated as circle.

The single echo is visualized as a circle, since the major axis might lie in several directions. The azimuth and range pertain to the center of the circle. This report would be evaluated as:

> Solid, weak echo; tendency - decreasing; direction and distance to the center of the echo SW 25 miles in the vicinity of Childress; diameter 16 miles, moving from the SE at 15 miles per hour (or knots), height of top of echo 12,000 feet MSL.

At a land station, this would be coded as: SLD WK DCRG SW/25 VCNTY CDS DIAM 16 MOVG FM SE/15 HGT 120.

At an ocean station, this would be coded as: SD6/7 52332.

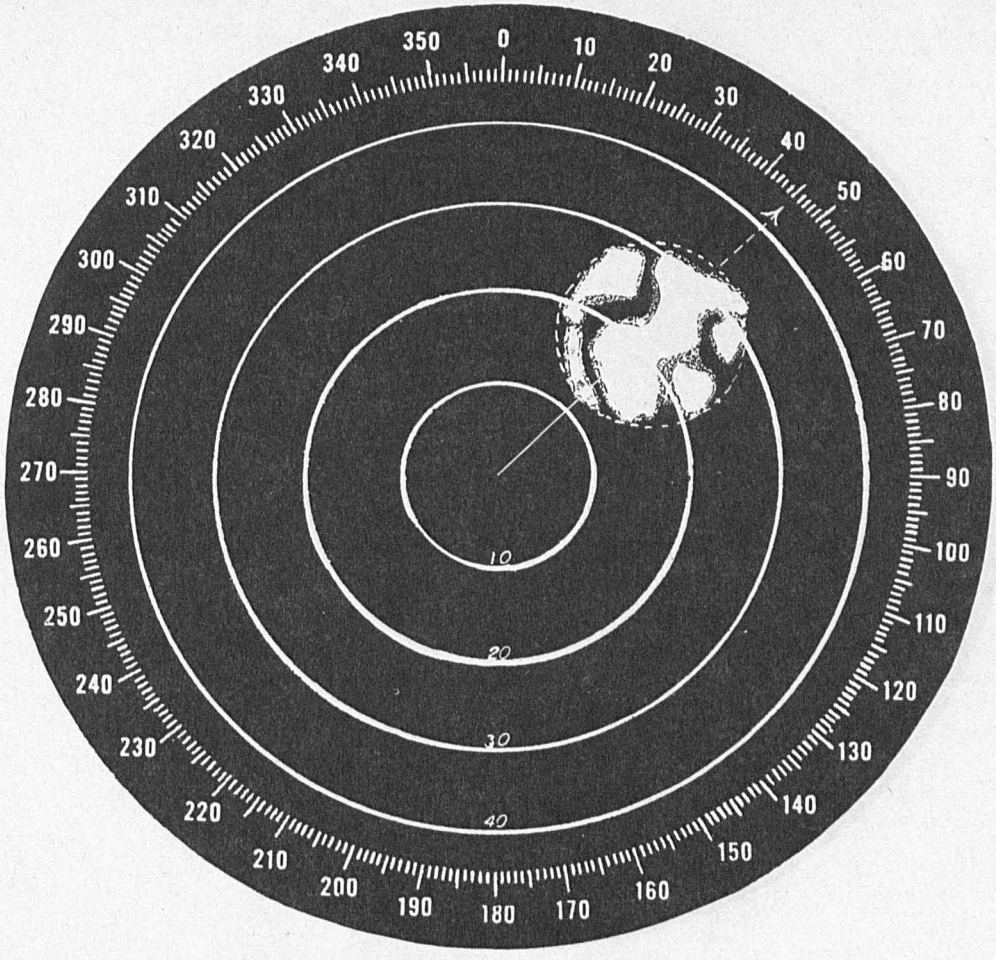


Fig. A15-5. Echoes evaluated as circle.

The echoes are visualized as a circle. The distance between the echoes in the group is less than the distance through the largest echo, and the major axis could lie in several directions through the group. Ragged edges of the echo may extend beyond the circle. This echo would be evaluated as:

> Scattered echoes of moderate intensity; tendency - increasing rapidly; direction and distance to the center of the echo NE 22 miles; over the Mt. Vernon fan marker; diameter 20 miles; moving from the ENE at 25 miles per hour (or knots); height of the tops of the echoes 30,000 feet MSL.

At a land station, this would be coded as: SCTD MDT INCRG RPDLY NE/22 OVR MTV DIAM 20 MOVG FM ENE/25 HGT 300.

At an ocean station, this would be coded as: SD6/6 12156.

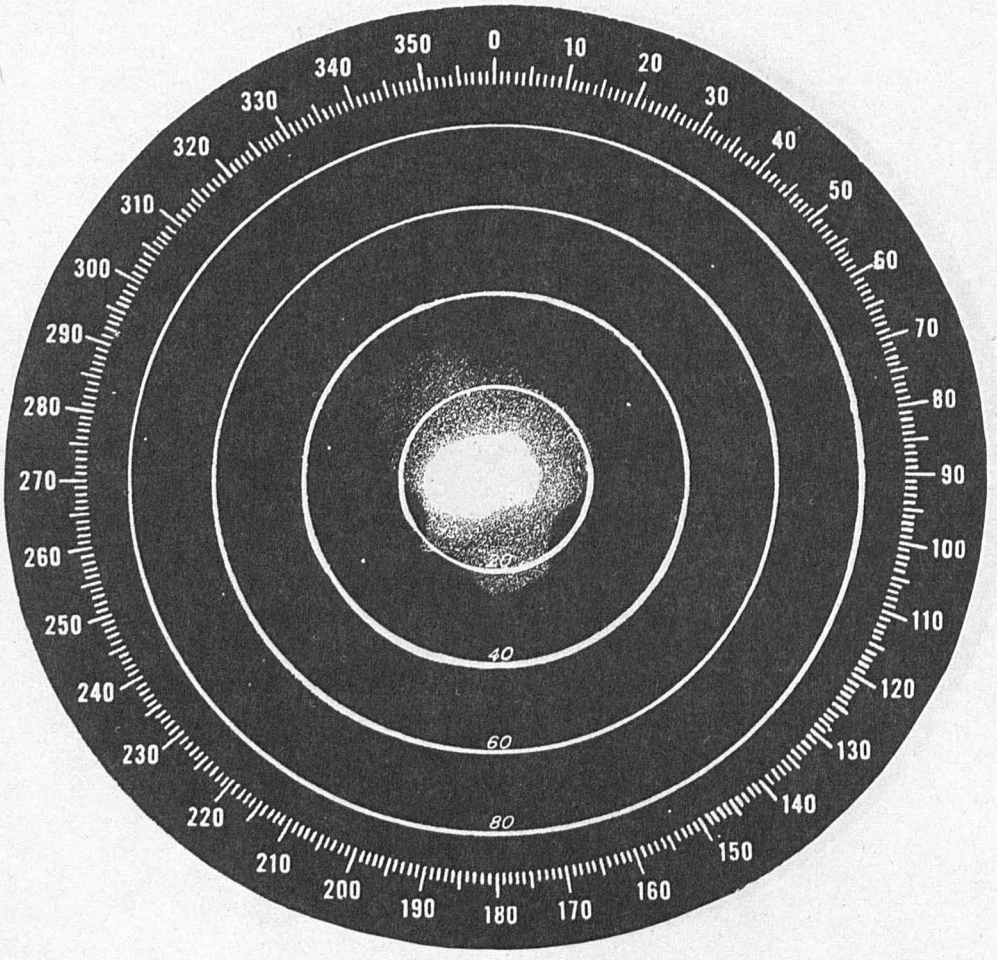


Fig. A15-6. Echo with heavy precipitation at station.

The echo is typical of one observed at a station equipped with 3 cm. radar when heavy precipitation is occurring at the station. It is possible that more distant echoes are blocked from the radar view by attenuation from moisture on the radome and by the precipitation. The circle in this case includes all the echo except the ragged edges. This echo would be evaluated as:

Solid echo; diameter 40 miles; centered at the station.

At a land station, this would be coded as: SLD DIAM 40 CNTRD AT STN.

At an ocean station this would be coded as: SD7/9 90///.

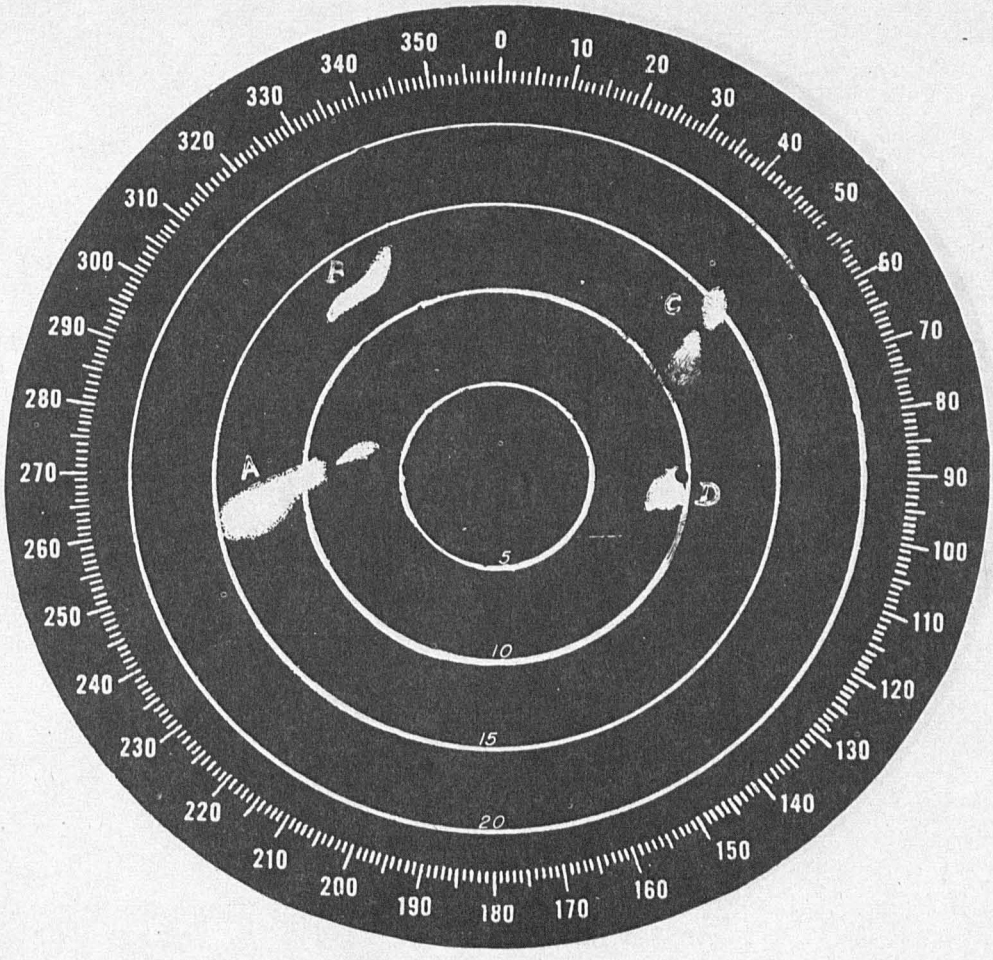


Fig. A15-7. Echoes evaluated as circles and ellipses.

Echoes A, B, and C are visualized as ellipses; and echo D is visualized as a circle. These patterns must be evaluated separately, since the distance between them in each case is more than the distance through the largest echo.

At a land station, this scope pattern would be coded as: SCTD MDT NO CHG W/11 ORNTD ENE-WSW VCNTY ALICE 10 LONG 3 WIDE SLD MDT INCRG NW/13 ORNTD NE-SW VCNTY CHALMERS 6 LONG 2 WIDE SCTD STRG NO CHG NE/13 ORNTD NE-SW VCNTY BLACK BUTTE 7 LONG 3 WIDE STRG NO CHG E/9 DIAM 2 MOVG FM SW/20.

At an ocean station, this report would be coded as: SD332 6154/ SD322 7154/ SD322 1154/ SD6/8 2054/.

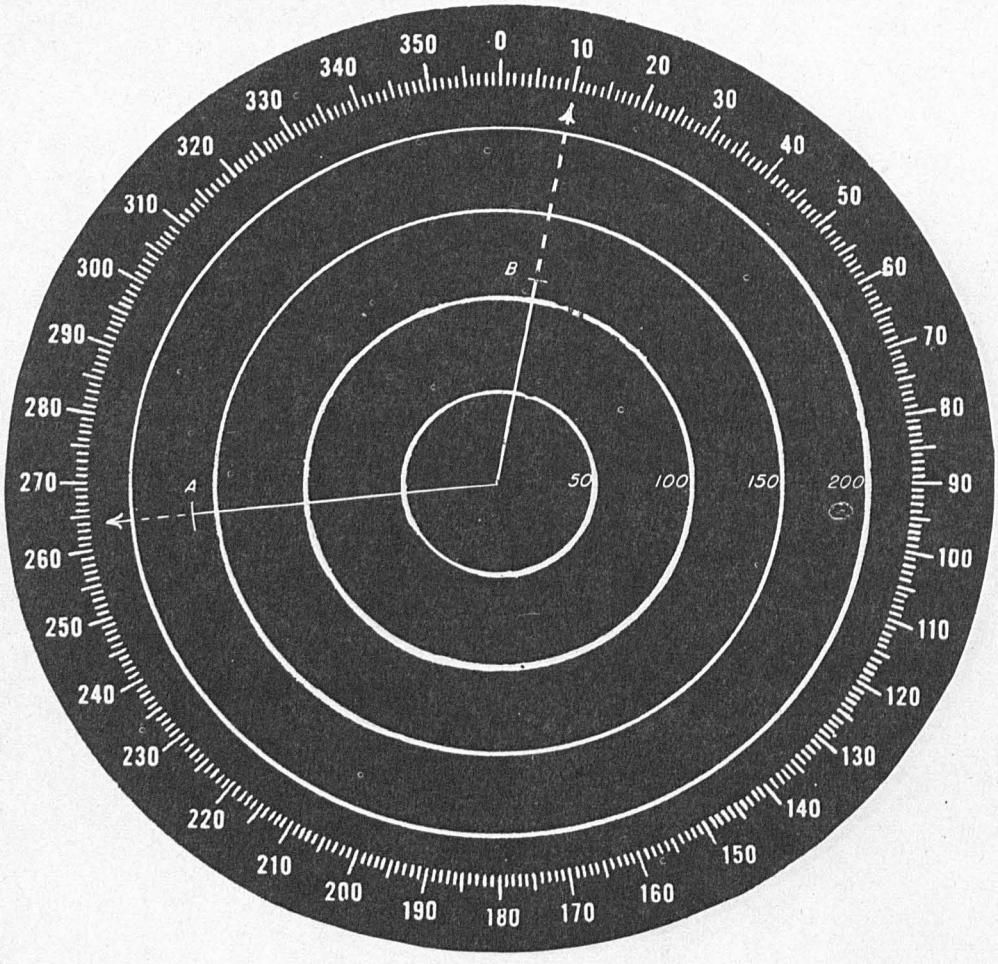


Fig. A15-8. Echoes of small isolated precipitation areas.

The short dashes at A and B are the echoes of small, isolated precipitation areas having a dimension the same as, or less than, the width of the radar beam. The direction and distance to the center of the echo are observed. Width and length are not observed. These echoes would be evaluated as:

> Solid weak echo; intensity - decreasing; direction and distance, west 170 miles. Solid weak echo; intensity - decreasing; direction and distance, north 120 miles.

At a land station this would be coded as: SLD WK DCRG W/170 SLD WK DCRG N/120.

At an ocean station this would be coded as: SD6// 6//// SD6// 8////.

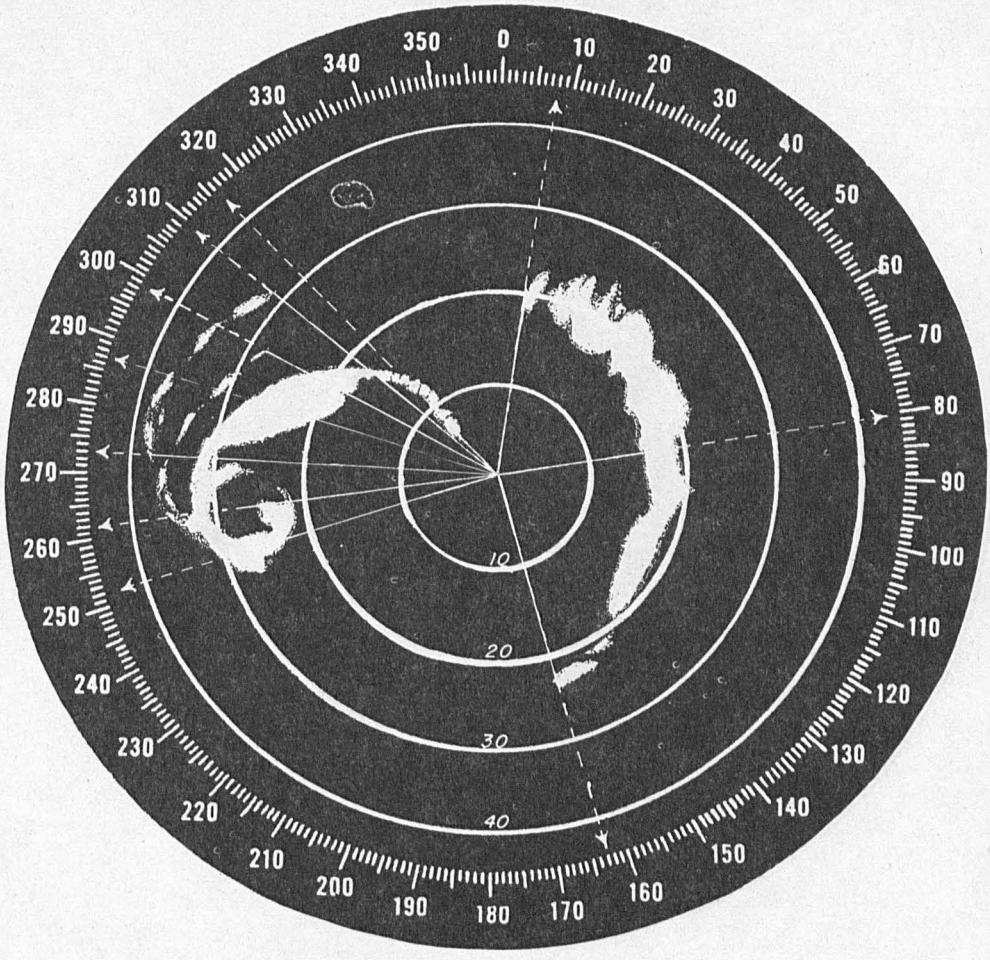


Fig. A15-9. Echoes of spiral bands.

Echoes of spiral precipitation bands similar to these sometimes result from typhoons or hurricanes. The position, diameter, direction and speed of movement, of the center, or "eye" of the storm, are reported in Remarks.

At a land station this echo would be coded as: SPRL BND STRG NO CHG AZRAN 26/23 25/26 29/24 32/06 3 WIDE SCTD SPRL BND AZRAN 26/33 27/35 30/28 1 WIDE SCTD SPRL BND AZRAN 27/37 29/37 31/32 1 WIDE SPRL BND STRG NO CHG AZRAN 01/20 08/17 16/22 4 WIDE HGT 400 CNTR AZRAN 262/27 DIAM 8 MOVG FM SW/30.

(See pars. A15307 and A15315.2 for decoding instructions.)

At an ocean station this would be coded as: SD283 2156/ SD7/4 6256/ APPARENT EYE AZIMUTH 262 RANGE 27 DIAMETER 8.

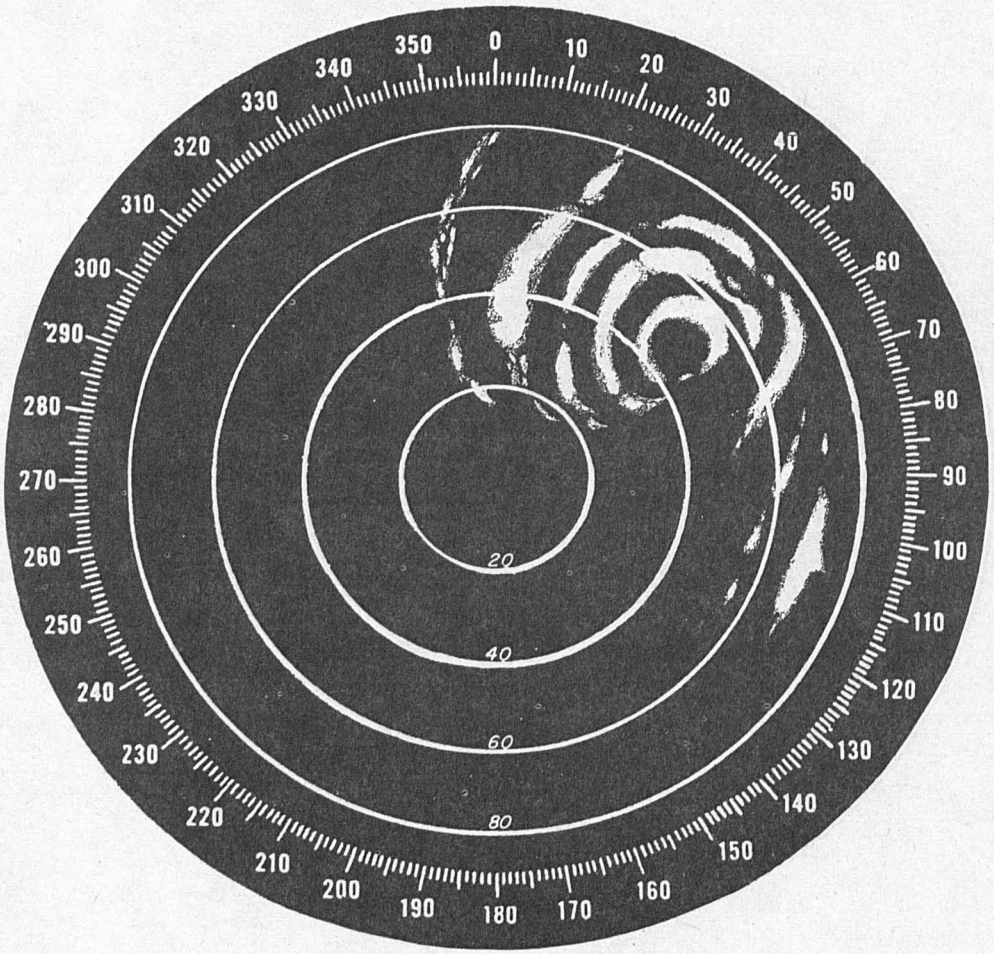


Fig. A15-10. Echoes of precipitation bands in multiple spirals.

Echoes of spiral precipitation bands similar to these sometimes result from typhoons and hurricanes. The center may not be as well defined as this; however, the apparent center is observed if it is on the scope.

At a land station this echo would be coded as: SPRL BND STRG NO CHG AZRAN 06/40 04/50 06/50 5 WIDE SPRL BND AZRAN 06/38 03/50 04/65 06/61 6 WIDE SCTD SPRL BND AZRAN 06/25 02/50 04/75 08/55 5 WIDE SCTD SPRL BND AZRAN 04/18 01/50 02/80 8 WIDE SCTD SPRL BND AZRAN 00/18 35/55 00/79 5 WIDE SCTD SPRL BND AZRAN 08/68 12/56 3 WIDE SPRL BND 09/70 12/68 5 WIDE HGT 450 CNTR AZRAN 054/48 DIAM 7 MOVG FM SE/28.

(See pars. A15307 and A15315.2 for decoding instructions.)

At an ocean station this would be coded as: SD9/4 1536/ APPARENT EYE AZIMUTH 54 RANGE 48 DIAMETER 7.

RAREP CODE TABLES

S	D	1	2	3 / 3A	4	5	6	7	8

TABLE 1. TYPE OF ECHO

*0	Frontal or instability line of echoes, solid
*1	" " " " " " scattered
2	Elliptical, less than 50 miles long, solid
3	" " " " " " scattered
4	" more " " " " solid
5	" " " " " scattered
6	Circular, less than 25 miles in diameter
7	" 25 - 50 miles in diameter
8	" 50 - 75 " " "
9	" more than 75 miles in diameter

* Will not be used at Weather Bureau stations.

TABLE 4. DIRECTION OF CENTER FROM THE STATION

0	(Not used)
1	Northeast
2	East
3	Southeast
4	South
5	Southwest
6	West
7	Northwest
8	North
9	Over station

TABLE 5. DISTANCE FROM STATION IN NAUTICAL MILES

0	Less than 10 or overhead
1	10 - 19
2	20 - 29
3	30 - 39
4	40 - 49
5	50 - 59
6	60 - 69
7	70 - 79
8	80 - 89
9	90 - 100
/	Over 100

TABLE 8. HEIGHT, IN FEET MSL, OF ECHO TOP

0	0 - 4999
1	5000 - 9999
2	10000 - 14999
3	15000 - 19999
4	20000 - 24999
5	25000 - 29999
6	30000 - 34999
7	35000 - 39999
8	40000 - 44999
9	45000 - 50000
/	Undetermined

TABLE 2. ORIENTATION

0	Not observed
1	NNE - SSW
2	NE - SW
3	ENE - WSW
4	E - W
5	ESE - WNW
6	SE - NW
7	SSE - NNW
8	S - N
/	Not applicable

TABLE 3. ECHO COVERAGE OF THE CIRCULAR AREA IN TENTHS

0	Less than 1/10
1	1/10
2	2/10
3	3/10
4	4/10
5	5/10
6	6/10
7	7/10
8	8/10
9	9/10 to 10/10
/	Not applicable

TABLE 3A. WIDTH OF LINE

0	Less than 1 nautical mile
1	1 or more but less than 2
2	2 " " " " " 4
3	4 " " " " " 6
4	6 " " " " " 8
5	8 " " " " " 10
6	10 " " " " " 15
7	15 " " " " " 20
8	20 " " " " " 30
9	30 " " " " " 50
/	Undetermined

TABLE 6. DIRECTION FROM WHICH ECHO PATTERN IS MOVING

0	No movement
1	Northeast
2	East
3	Southeast
4	South
5	Southwest
6	West
7	Northwest
8	North
9	(Not used)
/	Undetermined

TABLE 7. SPEED OF MOVEMENT OF ECHO IN KNOTS

0	No movement
1	5
2	10
3	15
4	20
5	25
6	30
7	35
8	40
9	45
/	Undetermined

Fig. A15-11

REFERENCE ELEVATIONS

ELEVATION DATA

1. General.—The following definitions and instructions pertain to reference elevations used as the basis for the determination of station elevation data and to elevations to which pressure data and other climatological data are related.

1.1. Reference Plane (H_r).—The reference plane for the station is a bench mark of permanent character and high precision, such as one erected by the United States Coast and Geodetic Survey, Geological Survey, Lake Survey, Army Engineering Corps, or the Mississippi River Commission. The reference plane selected will be used for all elevation measurements at the same station. Once adopted, the reference plane will not be changed without authorization from the Central Office. However, the Central Office will be notified of any known corrections to the reference plane later determined by a competent authority such as the United States Coast and Geodetic Survey. Whenever authorization has been received from the Central Office to use a corrected value of the reference plane, all elevations related to it will be corrected accordingly. An entry will be made in the station-history record (on Form 450-1) to indicate the date of the authorization, and the nature and amount of the correction. Whenever authorization has been received to adopt another reference plane as H_r, correct the value of the height of the fixed point on Form 450-1, to relate it correctly to the new reference plane and make an entry in the station-history record to indicate the date of the authorization, and the location and elevation of the plane.

1.2. Fixed Point (H_x).—The fixed point H_x is a benchmark established on or close to the building in which the station is located. The fixed point is used in making direct measurements of the height of the "ivory point" of the mercurial station barometer (see Chapter A7). It must therefore be selected so that a line of levels can readily be run back to the reference plane. Determine the elevation of the fixed point to the nearest tenth or hundredth of a foot according as the reference plane was determined to tenths or hundredths of a foot. This elevation will be established when the line of levels is run between the reference plane H_r and the barometer elevation H_z (see par. 2).

1.3. Elevation of Barometer (H_z).—The actual elevation of the "ivory point" of the mercurial station barometer above mean sea level is the barometer elevation H_z. Determine it to the nearest tenth or hundredth of a foot according as the reference plane was determined to tenths or hundredths of a foot.

1.4. Station Elevation (H_b).--The station elevation is the elevation above mean sea level to which individual station pressure values pertain at a given location. In general, the station elevation remains constant throughout the period of existence of a station, regardless of changes in actual elevation of the barometer. Stations at airport and city offices are regarded as having different values of H_b. Station elevation values are assigned by the Central Office on Form 1059. A new station elevation may be assigned where there is considerable difference between the original and the actual elevation of the ivory point of the barometer.

1.5. Elevation to which Certain Pressure Data for the Locality are Reduced (H_{bc}).--H_{bc} is an elevation above mean sea level to which monthly average station pressure data for the locality are related for the purpose of maintaining homogeneity in climatological records. Under some circumstances (as in cases where a station has remained in a city since January 1, 1900 without a change in the actual elevation of H_b), the value of H_{bc} and H_b will be identical. Where these pressure data have been obtained successively from several stations in the locality, H_{bc} may differ from the elevation H_b assigned individual stations at which the basic data were observed.

1.51. Whenever the value of H_{bc} differs from H_b, the Central Office will furnish a table giving corrections which, upon being applied to the monthly average station pressure pertaining to H_b, will yield the monthly average station pressure pertaining to H_{bc} (see par. A12361). However, the Central Office may assign a new value for H_{bc}, whenever the difference between H_b and H_{bc} obtained in accordance with par. 2.2 is so large that pressures reduced to H_{bc} from H_b cannot be regarded as representative of H_{bc}, thus justifying a break in the reference level for monthly average station pressure data for the locality.

1.6. Ground Elevation (H).--H is the elevation above mean sea level of the ground level to which the heights of exposed instruments at the station are related. It is the elevation of the ground at the instrument shelter in which the dry-bulb thermometer is exposed at stations where the shelter is located on the ground. Otherwise, it is the elevation of a point that is representative of the average elevation of the ground surrounding the building on which the shelter is located. Determine the ground elevation to the nearest foot.

1.7. Field Elevation (H_f).--H_f is the elevation above mean sea level of the highest portion of the usable landing area at airport stations. Its value is determined by the Civil Aeronautics Authority and will be recorded on Form 450-1 to the nearest foot.

1.8. Elevation of the Eight-Foot Plane above the Field (H_8).—H_8 is the elevation above mean sea level of the plane eight feet above the field elevation (H_f). Determine H_8 to the nearest foot.

2. Determination of Elevations.—Whenever (a) a station is established, (b) the elevation of the "ivory point" of the mercurial barometer is changed, or (c) the value of one of the elevations in par. 1 above is changed, have the value of the affected elevations redetermined, and correct all height-of-instrument and elevation data on Form 450-1 that are related to the redetermined elevations.

2.1. Elevations will be determined by a surveyor, city engineer, or other person competent in running levels. In many instances this survey of elevations will be made gratuitously by U. S. Government or city engineers. The levels will be run over a closed circuit. Usually, as in the case of a new station, the line of levels will be run from the reference plane through the fixed point to the barometer and back through the fixed point to the reference plane. In the case of relocation of an office to a location that is relatively close to the old fixed point, the line will be run from (a) the barometer elevation, H_z in the old office, through (b) the fixed points for both the old and new offices, to (c) the barometer elevation, H_z in the new office, and back through (d) both fixed points to (e) the barometer elevation H_z in the old office to complete the closed circuit. A line of levels will be run whenever a barometer is removed, except as provided in Chapter A7. A copy of the field notes (on Form 4004D), certified by the person running the survey, will be forwarded to the Central Office accompanying the revised portions of Form 450-1.

2.2. Determine H_{bc} from the history of station elevations for city and airport offices in the same locality as follows:

(a) Where pressure readings were being taken as of January 1, 1900, H_{bc} as used in these instructions corresponds to H_b as of January 1, 1900.

(b) Where pressure readings at the initial installation were first taken after January1, 1900, H_{bc} as used in these instructions corresponds to the first assigned station elevation, H_b.

Note that where H_b has been corrected in accordance with par. 1.1 but not reassigned, the corrected value is used as H_{bc}, since the change does not affect the assigned station elevation.

EXAMPLE

Station History for Homestead City, U.S.A. from Form 450-1.

Date of Change	Location of Station (buildings, etc.)	Elevation of Barometer, H_z	Station Elevation, H_b. (ft. and hundredths)
As of January 1, 1900	Smith Building 227 Locust St.	1943	1943
April 8, 1904	-14 foot correction to reference plane, H_r as result of new survey.	1929	1929
June 2, 1933	Willow Creek Airport Office opened. 1/	1967	1967
October 7,1934	Willow Creek Airport Office closed. 2/		
May 11, 1938	Mt. Loma Airport Office opened. 3/	2365	2365

1/ Pressure observations discontinued at the City Office soon after the Airport Station was opened.

2/ Pressure observations for the locality were discontinued on this date.

3/ Pressure observations for the locality were resumed on this date. On the basis of par. 1.5(a and b) and the station history, H_{bc} for the locality is 1929 feet, which is the elevation H_b, as of January 1, 1900 (corrected) for the station taking pressure data on that date.

3. Station History.--Notify the Central Office in instances where the station history for the locality appears to be incomplete, or where the supporting data do not indicate that Central Office authorization was obtained for changes in the location of, or corrections to, the value of elevations in par. 1 pertaining to the stations in the locality since January 1, 1900. At stations established prior to January 1, 1900, the assigned value of elevations effective on that date are given in Table 28,

Barometry Report, Part II, Annual Report to the Chief, U.S. Weather Bureau, 1900-1901.

4. Elevation Data on Form WBAN-10D.—The station elevation (H_b) used for entry on Form WBAN-10D will be the station elevation value shown on Form 1059.

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to

WBAN Manual and W. B. Addendum

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U. S. Department of Commerce
Weather Bureau

MANUAL OF SURFACE OBSERVATIONS
Circular N, Sixth Edition, Revised

WEATHER BUREAU ADDENDUM

Washington, D.C.
January 1, 1952

Addendum Change No. A1:

(1) Page A1-98, Fig. A1-41. Change the caption to read "Preset helium regulator, J412."

(2) Page A1-99, par. A1523, first line. Change "single-stage" to read "preset."

(3) Page A4-12, Fig. A4-6. Enclose the following hourly precipitation values in parentheses:

(a) ".31" and ".26" for 11 p.m. to midnight Nov. 27, and midnight to 1 a.m. Nov. 28, respectively.

(b) ".31" for 4 to 5 p.m. Nov. 28.

(4) Page A5-14, par. A5310, 6th and 7th lines. Delete "tarnishes or."

(5) Page A7-18, par. A7232, 5th line. Read as follows: "... bottom of the back side of the housing..."

(6) Page A7-23. Fig. A7-11. Delete "Access hole to elevation-scale adjusting screw" and the accompanying arrow. The access hole is not shown in this view (see par. A7232).

(7) Pages A12-4 and A12-5:

(a) Par. A12123, last line. Substitute "0" for "0.00."

(b) Par. A12124, 6th line. Substitute "0" for "0.0."

(c) Par. A12131, 5th line. Substitute "0" for "0.00."

(d) Par. A12132, last line. Substitute "0" for "0.0."

(8) Insert new page A4-1 ahead of present page A4-1; delete caption "Chapter A4 - Measurement of Precipitation" on present page A4-1 and renumber this page A4-1a.

(9) The remainder of the change consists of new pages A4-26 (revised), and A12-33 through A12-38.

CHAPTER A4 - MEASUREMENT OF PRECIPITATION

A4000. METHOD OF DETERMINING WATER EQUIVALENT

*A4053. Determination of Water Equivalent of Snow on Ground - Scale Method.--Selected stations are provided with a spring scale, for the determination of the water equivalent of the depth of snow on the ground. The scale is used in conjunction with the overflow container of an 8-inch non-recording precipitation gage (see par. A4110). A small hole (approximately 1/8-inch in diameter) should be drilled near the top of the overflow container to accommodate the hook on the scale. Determine water equivalent of a snow sample as follows:

(1) Attach the empty overflow container to the hook on the spring scale, and read the position of the pointer to the nearest hundredth inch.

(2) Obtain a snow sample in the overflow container in accordance with pars. 4051-4053.

(3) Attach the overflow container with the sample therein to the scale, and read the position of the pointer to the nearest hundredth inch.

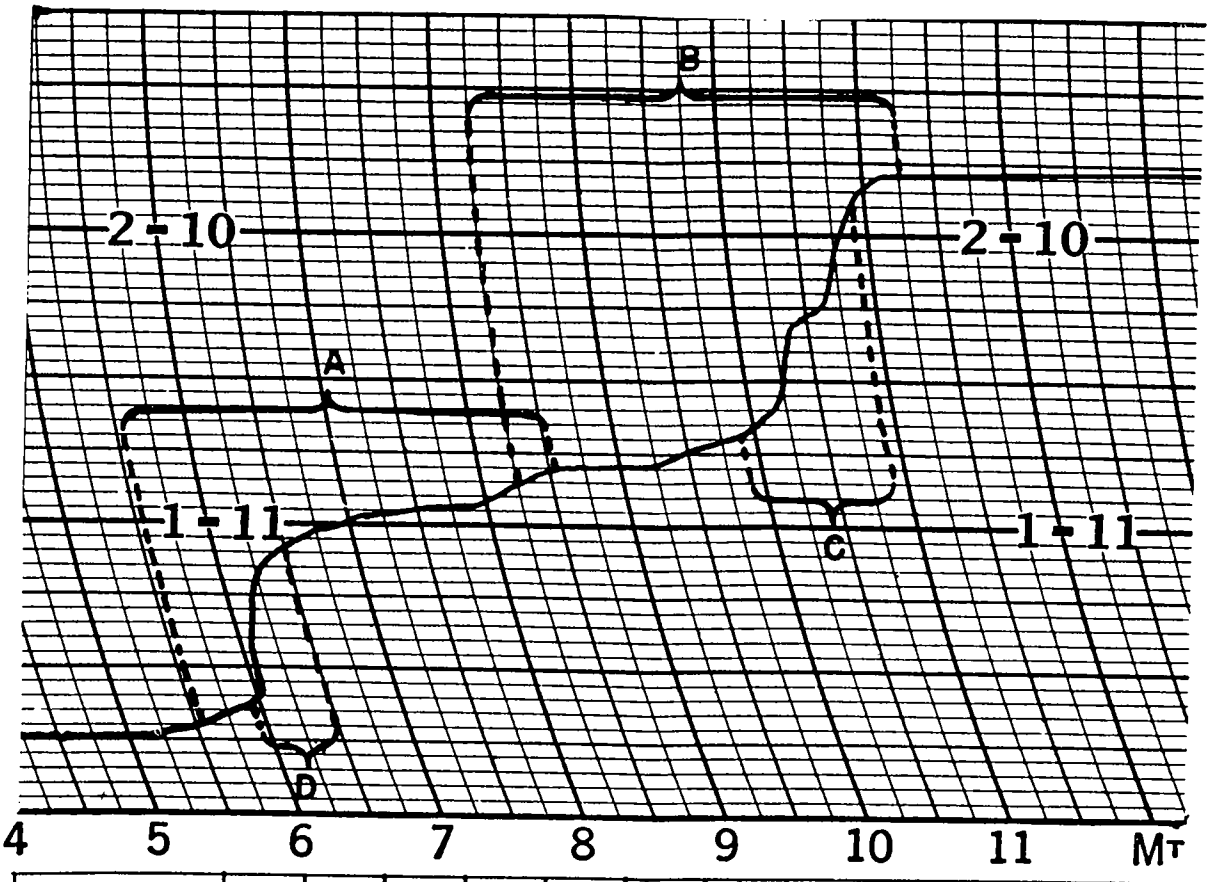
(4) Determine the water equivalent by subtracting the reading obtained in (1) from the reading obtained in (3).

EXAMPLE

(a) Reading of spring scale with empty container 2.40 inch

(b) Reading with snow sample in container 3.65 inch

(c) Water equivalent: 3.65 - 2.40 = 1.25 inch



Interval	5	10	15	20	30	45	60	80	100	120	150	180
Amounts for period D	.20	.35	.43	.46	.52	.58	.63	.69	.73	.76	.80	—
Amounts for period C	.18	.25	.33	.38	.45	.70	.82	.90	.95	1.00	1.00	1.06

Fig. A4-12. Excessive precipitation data. "A" indicates the time of occurrence of the maximum amount of precipitation associated with the period of excessive precipitation "D" for an interval of 180 minutes. Similarly, "B" indicates the maximum amount for 180 minutes associated with the period "C." The tabulation lists the excessive-precipitation data for the two periods of excessive precipitation. Note that "C" and "D" are separate periods of excessive precipitation, since they are separated by 180 minutes or more (203 minutes) in which the maximum amount of precipitation for 180 minutes does not equal or exceed 1.80 inch. Also note that since "A" and "B" overlap, only the greater amount is tabulated (see the entry for the 180-minute interval of the tabulation for period "C").

*A4540. Water Equivalent of Frozen Precipitation (Col. 80).--Whenever the depth of frozen precipitation on the ground exceeds one inch at first-order observing stations in the continental United States and at other designated observing stations, enter in column 80 the water equivalent as measured at approximately 1200 GCT daily. Enter the data in inches and hundredths, determined in accordance with pars. 4053 and A4053.

*A4541. Transmit water equivalent data on Service C immediately following the group $9S_pS_ps_ps_p$, in the 1230 GCT report on Tuesday and Friday whenever the S_pS_p portion of the group is 85 (see par. 1904.4, Synoptic Code, 1949). Use a slant (/) to separate these data from the $985s_ps_p$ group, e.g.

98505/50 - snow depth 5", water equivalent 0.50"
98502/9 - snow depth 2", water equivalent 0.09"
98511/110 - snow depth 11", water equivalent 1.10"

*A4541.1. If Service A only is available, include these data in the 1228 GCT report on Tuesday and Friday, coded as in the preceding paragraph.

A4541.2. If neither Service C nor A is available, promptly after the observation transmit water equivalent data in plain language to the River District Office by TWX, telephone or telegraph, using the most economical of these methods.

A4542. Additional reports of water equivalent data may be sent to the River District Office either by mail or by one of the foregoing methods, in accordance with requests received from the Area Engineer or the River District Office.

A4543. When there is pronounced snow melt or other indications of the development of critical conditions, send emergency reports by the most expeditious method of communication until critical melting conditions no longer exist, or until instructed to discontinue reports by the Area Engineer or the River District Office.

A12700. Marine Observations

A12701. The Weather Bureau will obtain condenser-intake thermometer readings from Coast Guard personnel by interphone, except that a Weather Bureau observer will personally read the condenser-intake thermometer for at least two non-consecutive scheduled observations each day.

A12702. Calibration of Condenser-Intake Thermometers.--By agreement with the Coast Guard, condenser-intake thermometers from ocean-station vessels are calibrated by the Weather Bureau. Readings of calibrated thermometers in this class will be corrected by adding algebraically the corrections furnished by the Weather Bureau Instrument Division. Interpolate as necessary for readings between corrections. A table or graph should be prepared locally by Weather Bureau personnel for this purpose and a copy furnished the Commanding Officer of the vessel.

A12702.1. When a calibrated condenser-intake thermometer is received from the Instrument Division, it should be examined for any separation of the column. If a separation is found, the thermometer should not be used for Weather Bureau observations. The local Coast Guard authorities should be requested to have it repaired or replaced, and the Central Office, attention Observations Section, informed of the action taken.

A12702.2. When the calibration corrections furnished by the Instrument Division exceed 2.0°F., the local Coast Guard authorities should be requested to have the thermometer replaced and the Central Office informed of the action taken.

A12704. Installation and Care of Pressure Equipment.--Mount the precision aneroid barometer and microbarograph as near as possible to the ship's center of gravity, with the microbarograph pen athwartship. No. 5 dashpot liquid should be used for the barograph.

A12704.1. The atmospheric pressure is transmitted to both instruments by means of metal tubing. Once each week, and after precipitation or heavy seas, the plenum of the pressure system should be drained as follows: Insert a wire in the petcock to insure complete drainage. If salt or soot deposits are present, remove the petcock and flush the inside of the plenum with fresh water. When ice has formed in any portion of the pressure system, use a torch, hot-air blower or some other suitable heat source to melt the ice. Heat should be applied from the bottom to the top of the system with the petcock removed so that water formed will drain out. During periods of very low temperature it may be necessary to reheat the plenum to remove completely any ice in the lines. Large accumulations of ice around the exposed static-tube orifice should be removed to prevent entry of excess water. Regular servicing of the pressure system should be done immediately after a scheduled surface observation.

A12704.2. Barometer Comparisons.--Prior to departure for patrol, and again promptly upon return to port, make a series of comparative readings between the ship's precision aneroid barometer and a barometer used as the comparison standard. If a precision aneroid inspection barometer is available, it will be used as the comparison standard following verification of the established correction of this barometer; otherwise, a nearby mercurial barometer (selected in accordance with par. A12704.21) will be used as the comparison standard. Enter comparative data on Form 1027A in accordance with instructions on the form and the following subparagraphs.

A12704.21. The barometer used as the comparison standard, either for verifying the correction of an inspection precision aneroid barometer or for comparative readings with a ship's barometer, will usually be the mercurial barometer appearing highest in the following list; however, if another barometer on the list is considerably closer to the compared barometer, either vertically or horizontally, it should be used as the comparison standard:

(1) A substandard barometer

(2) A field-aide, home-station barometer

(3) A station barometer

It is desirable to use the same barometer as the comparison standard for consecutive series of comparisons pertaining to the same ship's barometer. When the barometers are in separate locations, prearrange the time of readings so that they will be made simultaneously.

A12704.22. Verify the established correction for the inspection aneroid barometer by computing the difference between sea-level pressure as determined simultaneously from both the inspection barometer and the mercurial barometer selected in the foregoing manner. Compute the difference twice; once from sea-level pressures determined before the inspection barometer is carried aboard the ship, and again from pressures determined after the barometer is aboard. If neither difference exceeds 0.02 inch, the inspection barometer will be used as the comparison standard in accordance with par. A12704.23. If either difference exceeds 0.02 inch, use the mercurial barometer for checking the ship's barometer in accordance with par. A12704.24, and do not use the inspection barometer for this purpose until a new correction has been established for it in accordance with par. A7221.

A12704.221. To determine the difference in sea-level pressure between an inspection aneroid barometer and a mercurial barometer, apply the corrections, established in accordance with section 7200 and par. A7221.1, to obtain the respective station pressures, and reduce the station pressures to sea level in accordance with section 7300, using the current

outdoor temperature instead of the 12-hour mean value, and:

(1) When both instruments are at the same elevation, add algebraically the removal correction on Form 1059 of the comparison-standard mercurial barometer to the inspection barometer reading, and reduce the resultant sum to sea level by means of the reduction tables supplied for the mercurial barometer.

(2) When both instruments are not at the same elevation, reduce the inspection barometer reading to sea level by means of the following table (Table A12-1), and reduce the reading from the comparison-standard mercurial barometer in accordance with (1) above.

Pressure in inches												
Height in feet	Temperature, Fahrenheit											
	-20	-10	0	10	20	30	40	50	60	70	80	90
0	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.110	0.108	0.106	0.104	0.102
500	.125	.122	.120	.117	.115	.112	.110	.108	.106	.104	.102	.100
1000	.122	.120	.118	.115	.113	.110	.108	.106	.104	.102	.100	.098

Pressure in millibars												
Height in feet	Temperature, Fahrenheit											
	-20	-10	0	10	20	30	40	50	60	70	80	90
0	4.33	4.23	4.13	4.03	3.96	3.86	3.79	3.73	3.66	3.59	3.52	3.45
500	4.23	4.13	4.06	3.96	3.89	3.79	3.73	3.66	3.59	3.52	3.45	3.39
1000	4.13	4.06	4.00	3.89	3.83	3.73	3.66	3.59	3.52	3.45	3.39	3.32

Table A12-1. Table of pressure-differences per 100-foot difference in elevation for given values of elevation and temperature

A12704.23. When the ship's barometer is compared with an inspection aneroid barometer as the comparison standard (see par. A12704.221), make the comparison as follows:

(1) Enter in columns 3 and 4 of Form 1027A at least four comparative readings between the barometers, made preferably

one to two hours, but not less than one-half hour apart, with both instruments at the same elevation. Obtain the differences between the values in columns 3(b) and 4, and enter these differences in column 5, and the sum and mean of column 5 at the bottom of the column.

(2) The mean of column 5, as determined in (1), is the correction to be applied to the ship's aneroid barometer reading to obtain station pressure while on patrol. To obtain the correction necessary to reduce the ship's aneroid barometer readings to sea level, add 0.0011 inch (0.037 mb.) to the mean of column 5 for each foot that the barometer is above sea level.

EXAMPLE

Given:	Ship's aneroid barometer reading	1015.4 mb.
	Mean of column 5	0.5 mb.
	Height of barometer above sea level	17 ft.

Computations:

(1) Station pressure from observed pressure:

1015.4 mb. - ship's barometer reading
0.5 mb. - mean of column 5
1015.9 mb. - station pressure

(2) Elevation correction:

17 ft. x 0.037 mb. per ft. = 0.6 mb.

(3) Sea-level pressure from observed pressure:

1015.4 mb. - ship's barometer reading
0.5 mb. - mean of column 5
0.6 mb. - elevation correction
1016.5 mb. - sea-level pressure

(4) Sea-level pressure from station pressure:

1015.9 mb. - station pressure
0.6 mb. - elevation correction
1016.5 mb. - sea-level pressure

A12704.24. When the ship's barometer is compared with a mercurial barometer as the comparison standard (see par. A12704.221), make the

comparison as follows:

(1) Enter in columns 6 and 7 of Form 1027A at least four comparative readings between the barometers, made preferably one to two hours, but not less than one-half hour apart, and reduce the mercurial barometer readings to sea level in the manner specified in par. A12704.22. Obtain the differences between the values in columns 6 and 7, and enter these differences in column 8. Find the mean of the entries in column 8.

(2) The mean of column 8, as determined in (1), is the correction to be applied to the ship's aneroid barometer reading to obtain sea-level pressure. To obtain the correction necessary to convert the reading of the ship's aneroid barometer to station pressure, subtract 0.0011 inch (0.037 mb.) from the mean of column 8 for each foot that the barometer is above sea level.

EXAMPLE

Given:	Ship's aneroid barometer reading	30.055 in.
	Mean of column 8	.010 in.
	Height of barometer above sea level	14 ft.

Computation:

(1) Sea-level pressure:

30.055 in. - ship's barometer reading
0.010 in. - mean of column 8
30.065 in. - sea-level pressure

(2) Elevation correction: 1/

14 ft. x -0.0011 in. per ft. = -0.015 in.

(3) Station pressure:

30.065 in. - sea-level pressure
-0.015 in. - elevation correction 1/
30.050 in. - station pressure

1/ Note that this correction has the same numerical value as the correction to reduce station pressure to sea-level pressure, but the sign is opposite.

(4) Correction to convert observed pressure to station pressure:

0.010 in.	- mean of column 8
-0.015 in.	- elevation correction
-0.005 in.	- station-pressure correction for ship's barometer readings

A12704.25. Approval of the completed Form 1027A by the port supervisor should be secured before departure of the vessel; when this is impracticable, the official in charge of the patrol is authorized to approve the form. Form 1027A may be destroyed after six months. Comparative readings of the microbarograph with the inspection barometer are not necessary, since the microbarograph is checked with the ship's aneroid barometer each day in accordance with par. A12705.

A12705. Marine Microbarograph Readings.—When rolling of the ship causes the barograph pen to make a wide trace, or the indicator on the aneroid barometer to vibrate excessively, the mean position will be used for the station pressure. The pen should be touched lightly once each day at the 1200 GCT observation, and the correction to the microbarograph reading determined by comparing the corrected aneroid barometer reading with the microbarograph reading. These corrections will be entered at the corresponding points on the barogram after the latter has been removed from the cylinder.

A12706. Wind Equipment.—The wind equipment on ocean-station vessels, which is the property of the Coast Guard, should be inspected for proper performance by Weather Bureau personnel, usually during in-port periods. Any defects or poor exposures found should be promptly reported to the ship's commanding officer, and the Weather Bureau port supervisor. Comparisons of surface-wind speeds and directions should be made, whenever practicable, when two or more vessels are in port, and any significant differences should be brought to the attention of the ship's commanding officer and the Weather Bureau port supervisor.

A12707. Transmission of Surface Observations.—The word "Surface" will be prefixed to surface-observation messages from ocean-station vessels to identify the messages in ship-to-shore transmissions (see par. 12120).

A12708. Mailing Records.—After each patrol, WBAN-11A and B, WBAN-10D, and Form 1068 will be sent to the supervising station for prompt forwarding to Weather Records Processing Center, San Francisco. Two copies of a letter of transmittal, listing all records forwarded, should be enclosed. One copy of the letter will be returned by WRPC when the records are received. (See par. 12213.)

Change No. → A2

UNITED STATES DEPARTMENT OF COMMERCE • Charles Sawyer, Secretary
WEATHER BUREAU • F. W. Reichelderfer, Chief

MANUAL OF SURFACE OBSERVATIONS

Circular N, Sixth Edition, Revised

WEATHER BUREAU ADDENDUM

JULY 1952

WASHINGTON, D. C.

Instructions pertaining to Change Number A2, Addendum to Circular N, 6th Edition (Revised June 1, 1951).

(1) On page A7-i, 5th to 7th lines from bottom, change page "A7-18" to read "A7-18a".

(2) On page B2, Appendix I, change "Elevation to which Certain Pressure Data for the Locality are Reduced (H_{bc})" to read "Climatological Station Elevation (H_{bc})."

(3) This page may be discarded when indicated changes have been made.

(4) This change consists of the following pages:

Chapter	Pages
A1 -	iii, iv, 95-96, 96a&b, 97-100.
A2 -	1 & 2.
A3 -	1 & 2.
A4 -	i, ii, 19-20, 25-26.
A7 -	3, 4, 4a, 4b.
A8 -	i, ii, 5-6, 25-30.
A9 -	i, ii, 1-2, 2a, 2b, 3, 4.
A10 -	i, ii, 1-4.
A11 -	1-2.
A12 -	i, ii, 1-8.
A14 -	1-4.
A15 -	i, ii, 5-6, 9-14, 17-18, 21-26.
A16 -	i, ii, 1-34.
A17 -	i, iv, 1-32.
Index -	C1 - C16.

Page

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Partial Control of Balance....A1-81
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the points of maximum reaction, increase the amplifier gain one step at a time and check the reaction after each increase. Return the amplifier gain to position 8 before leaving the detector.

A1256. Deactivation.--To deactivate the ceilometer:

(1) Return the ceilometer to a stand-by status (see Table A1-2 or par. A1253).

(2) Deactivate the projector by moving switch S408 momentarily to the open-circuit position. Turn off the line switches S504 and S506 for all servicing operations within the projector that do not require power.

(3) Deactivate the detector and recorder by turning off the Recorder, Ceilometer, and Amplifier switches. To deactivate the detector for servicing the electronic portions (preamplifier, amplifier, and discriminator), turn off the Amplifier and Motor switches. The recorder-chart drive and the converter amplifier in the recorder (Z401) may be deactivated independently of the detector by turning off the Recorder switch. The scanner-drive motor may be turned off independently of the rest of the detector by turning off the Motor switch.

A1257. Adjustments.--Adjustments for gain and corrections for time and elevation angle are made as outlined below.

A1257.1. Gain - Clouds and Obscuring Phenomena not Present.--After the ceilometer has been adjusted for automatic scanning, keep the amplifier Gain control set to position 8, except as indicated in par. A1257.2, and the Recorder Gain control at 9 or 10.

A1257.2. Gain - Clouds or Obscuring Phenomena Present.--After these phenomena are detected, adjust the gain settings in the following order:

(1) Maintain the amplifier gain at position 8, unless a lower setting is required to keep the reactions of the output meter (to clouds and obscuring phenomena but not to signal from sources such as base-line reflectors) from exceeding fifteen on the meter at the recorder (fifteen with the meter-selector switch in the discriminator output position - see par. A1257.5), or 1.5 volts from the output meter at the detector. If a satisfactory setting cannot be obtained, inspect the detector for malfunctioning in accordance with par. A1283.

(2) When the ceilometer is in an automatic scanning status,

adjust the recorder gain so that the maximum oscillation of the stylus will be less than approximately 3/16 inch, unless otherwise specified by the electronics technician.

A1257.3. Recorder Time.—The heavier time lines on the chart identify the beginning of each hour (LST). To adjust the chart for time, turn the knob on the end of the chart-drive roll until the position of the stylus with respect to the adjacent time lines indicates the number of minutes after each hour.

A1257.4. Elevation Angle.—The elevation angle of the scanner is indicated by the lateral position of the stylus and index of the stylus assembly in the recorder, and is indicated on the scale in the detector. In order that agreement will be maintained when the Ceilometer switch is turned on, adjust the position of either the scanner or the stylus assembly until the scale readings at the detector and at the recorder are in agreement. If they are not in agreement when the synchro system is energized, the stylus assembly may move to either the 0° or 90° end of the elevation scale in the recorder and stop. To align the stylus assembly with the scanner, turn off the Ceilometer switch, move the stylus assembly to a convenient value between 45° and 90°, adjust the scanner manually (see par. A1257.41) to the value indicated at the recorder, and turn on the Ceilometer switch.

A1257.41. To adjust the elevation angle of the scanner manually:

(1) Turn off the Ceilometer switch.

(2) Remove the cover of the crank opening in the scanner assembly, engage the end of the crank shaft with the crank, and turn the crank until the desired angle is indicated on the elevation-angle scale in the scanner assembly.

A1257.42. If the stylus assembly stops beyond the 90° end of the scale, move the stylus assembly to the left or depress the magnetic cam follower (0404) until the follower touches the steel double cam (0403). If the magnetic connection is broken periodically, check for wax or other foreign material on the contact surfaces of the cam and cam follower.

*A1257.5. Meter-Selector Switch.—The meter-selector switch (S409) is used to place the output meter at the recorder in either the discriminator-output circuit or the stylus-motor circuit. The central position of the switch lever is the "off" position. Operate the ceilometer with the meter in the discriminator-output circuit, in which case the meter reading should be approximately zero until a signal is received. When the meter is in the stylus-motor circuit, the meter reading (with no signal input) will be approximately eight (i.e., 2.0 volts).

of the transformer housing not visible in Fig. A1-38). Never adjust the position of the leveling perches on the housing.

A1332.2. When aligning projectors not provided with leveling perches, such as the K100B, adjust the housing after carefully placing a straight-edged support diametrically across the outer edge of the parabolic reflector. Level the projector until a spirit level on the support is horizontal for two positions of the support 90 degrees apart horizontally.

A1332.3. Check the alignment of the beam after leveling the housing by comparing the verticality of the beam with the line of a plumb bob suspended freely approximately three feet from the observer. The verticality is satisfactory provided the beam is parallel to the lines of the plumb bob when viewed from two positions 45 to 135 degrees apart horizontally and at a distance of 200 feet or more from the beam.

*A1333. Transformers.--The step-down transformers used with 12-volt projectors are provided with terminals usually numbered from one to eight, or labeled in terms of line-voltage - i.e., 90, 95, etc., to 120 (see Fig. A1-38).

*A1333.1. The line-voltage leads are connected to the transformer in a manner that will provide 11.3 to 11.8, but preferably 11.8 volts across the lamp socket when the lamp is in operation under average to higher-than-average line-voltage conditions, such as are likely to exist during daytime measurements (these measurements should be made with an accurately calibrated voltmeter, such as one that has been recently compared with a power company instrument). Operating voltages in excess of 11.8 volts materially reduce the life of the lamp; lower voltages reduce the intensity of the spot. When the proper lamp voltage cannot be obtained or maintained, report the circumstances to the regional office.

*A1333.2. In the case of several types of transformers in which the terminals are numbered from one to eight, the following guide may aid in identifying the lamp-circuit and line-voltage-supply circuit terminals, and in selecting the terminals most likely to provide the proper lamp voltage under operating conditions.

*A1333.21. On most step-down transformers the leads for the secondary (low-voltage) windings are of heavier (larger diameter) wire than the leads of the primary windings. Where the serial number does not appear on transformers of the S-342248 series, the transformer may be identified by the numbered tags on the windings, since the heavy flattened wire leads of the secondary winding are numbered 7 and 8. Once the leads to the secondary winding of a ceiling light transformer have been identified, the leads may be connected to the lamp circuit. The proper pair of primary windings may be identified from the foregoing guide, or where the numbered tags are missing from the primary leads, use the low-voltage scale (of 20 volts range or more) of a voltmeter to measure the voltage across the lamp when each pair of primary leads is connected to the line-voltage supply.

Line Voltage	Westinghouse transformer			
	Series S-342248 (Separate primary and secondary windings.)		Series S-344176-B (Autotransformer type)	
	Connect line-voltage leads to terminals	Connect 12-volt-lamp-circuit leads to terminals	Connect line-voltage leads to terminals	Connect 12-volt-lamp-circuit leads to terminals
90	3-4	7-8		
95	2-4	7-8		
100	3-5	7-8	1-4	2-3
105	2-5	7-8	1-5	2-3
110	2-6	7-8	1-6	2-3
115	1-5	7-8	1-7	2-3
120	1-6	7-8	1-8	2-3

*A1333.3. In the case of transformers in which the terminals are labeled in terms of the line voltage, one power-supply lead is attached to the upper left terminal and the other is attached to the labeled terminal that most nearly provides the proper voltage across the lamp. The connections of the leads between the lamp socket and the transformer should not be disturbed.

A1334. Painting.--Personnel at first-order stations should keep the pipe supporting the light adequately painted. Rust spots should be sanded free of rust and painted with red lead or other metal primer followed by a top coat of aluminum paint.

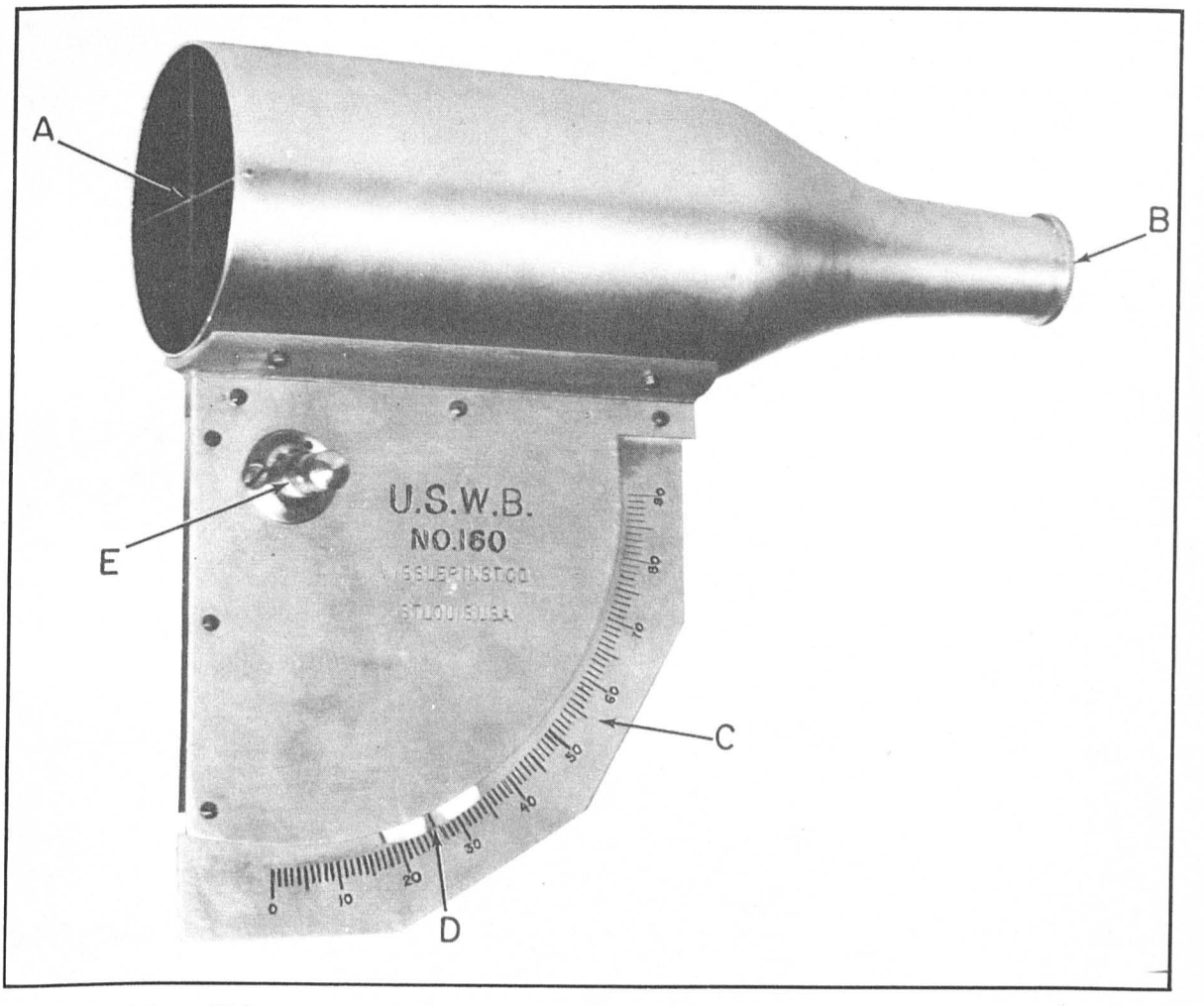

Fig. A1-40. Clinometer, K110, showing (A) cross hairs, (B) eyepiece, (C) elevation-angle scale, (D) index and (E) clutch and locknut for the index.

A1400. CLINOMETERS (FIG. A1-40)

A1410. General.--The clinometer consists of a hollow tube fitted with cross hairs (A) mounted in the large end, and an eyepiece (B) in the small end. An elevation-angle scale (C), calibrated in whole degrees from 0 to 90, is attached to the outside of the tube. The pendant-like indicator may be locked at any angle by means of a friction clutch on the shaft of the indicator. The index line (D) on the indicator matches the zero on the scale when the line of sight of the tube is horizontal, and matches the 90 on the scale when the line of sight is vertical. A box is provided for storage of the clinometer when it is not in use. The box should be mounted or placed in a dry protected inside location, as

convenient as possible to the observation point.

A1420. Operation.--Unlock the friction clutch by unscrewing the knurled locknut (E) on the indicator. Make sure that the indicator responds freely to slight changes in the elevation of the line of sight through the clinometer before determining the cloud height (see ¶ 1441).

A1430. Maintenance.--The clinometer should be protected adequately to prevent denting of the tube or scale mechanism, or dislocation of the cross hairs or eyepiece. Whenever the operation is faulty and the trouble cannot be corrected, requisition a new clinometer. Once a month:

(1) Inspect the scale graduations for legibility - clean the scale if necessary.

(2) Test the action of the clutch and indicator. When unlocked, the indicator should respond freely to elevation-angle changes of one or two degrees. If not, check for evidence of friction between the scale and the indicator, or in the clutch and bearings. One drop of light oil (SAE 10 or anemometer oil) on the bearings may improve the indicator action if neither the scale nor the indicator is dented or otherwise damaged. When the clutch is locked, ordinary vibration or light shocks should not disturb the index setting.

(3) Determine whether the alignment and condition of the cross hairs are satisfactory.

A1500. CEILING BALLOONS

A1510. Storage.--Storage at office temperatures will be satisfactory for cases of neoprene or natural latex balloons. Natural latex balloons should be stored away from cold walls and radiators, and neoprene balloons away from large electric motors or generators.

*A1520. Conditioning.--When balloons from a particular package have a tendency to burst during inflation or flight, remaining balloons from that package should be conditioned within about twenty-four hours before inflation. Conditioning consists of uniformly heating the balloon for thirty minutes to eight hours or more depending upon the temperature to which the balloon is heated; that is, thirty minutes at air temperatures near the boiling point of water (approximately 212°F.), or eight hours at temperatures near 120°F. Temperatures under 120°F. will not condition the balloon; temperatures much above the boiling point of water are likely to scorch or harden the rubber.

*A1521. Balloons may be heated by suspending them in a stream of hot air (above 120°F.) from a heating system, or by placing them on a hot-water

or steam radiator, or on the reflector of a small incandescent lamp (not over 100 watts). When a balloon is heated through contact with a solid object, the balloon should be turned occasionally to insure uniform conditioning of the rubber. This precaution is more important at relatively high temperatures. The temperature of a surface may be tested quickly with a few drops of water. If the water boils or evaporates rapidly, the surface is likely to be too hot for contact with the balloon.

*A1522. A balloon may also be conditioned in boiling water. Insert a plug of cork, or wood, etc. in the neck of the balloon to keep the water out, and immerse all of the balloon except the plugged end in the water for about five minutes. Shake all free water from the balloon, and have it relatively dry before inflation.

*A1530. Inflation.--The nozzle used to inflate balloons weighs 45 grams. It is usually identified by the letters "HE" stamped on the nozzle. If it is not, stamp or scratch the letters on it.

*A1531. The balloon should be dry inside, and relatively dry outside, especially in freezing weather, to prevent the formation of a film of ice on the rubber. Remove any trapped air by folding and squeezing the balloon carefully in the hand, then stretch the neck sufficiently to insert the inflation nozzle. Place the nozzle so that the tubing connecting the nozzle to the regulator rests on a support and is not suspended from the nozzle. Inflate the balloon slowly (see ¶ A1531.1). Turn off the gas as soon as the balloon begins to lift the nozzle. Add or remove gas slowly from the balloon as necessary. The balloon is properly inflated when the nozzle is suspended about 1/4 inch above the inflation platform after any motion of the balloon has stopped. Listen for leaks in the balloon. Tie the neck of the balloon securely just above the nozzle, and remove it from the nozzle. Double the end of the neck over the tied portion, and either tie the doubled portion or secure it with a rubber band.

*A1531.1. To inflate the balloon:

(1) Close the valve on the regulator by clockwise rotation of the control shown on the preset-type regulator in Fig. A1-41. Some dual-gage diaphram-type regulators require counterclockwise rotation.

(2) Open the cylinder valve fully by counterclockwise rotation of the handwheel (see precautions regarding helium cylinders under "Procurement of Helium" in the Weather Bureau Manual), and slowly open the regulator valve:

(a) Sufficiently to inflate the balloon in approximately one minute (two minutes in cold weather) where a single gage regulator is used.

(b) To an inflation pressure of five pounds or less as indicated on the low-pressure gage of dual-gage regulators 1/.

(3) When the balloon is inflated (see ¶ A1531):

(a) Close the regulator and cylinder valves completely. (See precautions regarding use of helium cylinders under "Procurement of Helium" in the Weather Bureau Manual.)

(b) Remove the balloon from the nozzle.

(c) Open the regulator valve and listen for escaping gas. When gas is escaping try to close the cylinder valve tighter (by hand only).

(d) Although the cylinder valve should be checked in the foregoing manner to eliminate unnecessary pressure on the regulator diaphram, the regulator valve should be closed in the event that leakage of gas through the cylinder valve cannot be stopped completely, especially in the case of cylinders that are nearly full of helium.

1/ The high-pressure gage indicates the cylinder pressure, which serves as an approximate indication of the amount of helium in the cylinder.

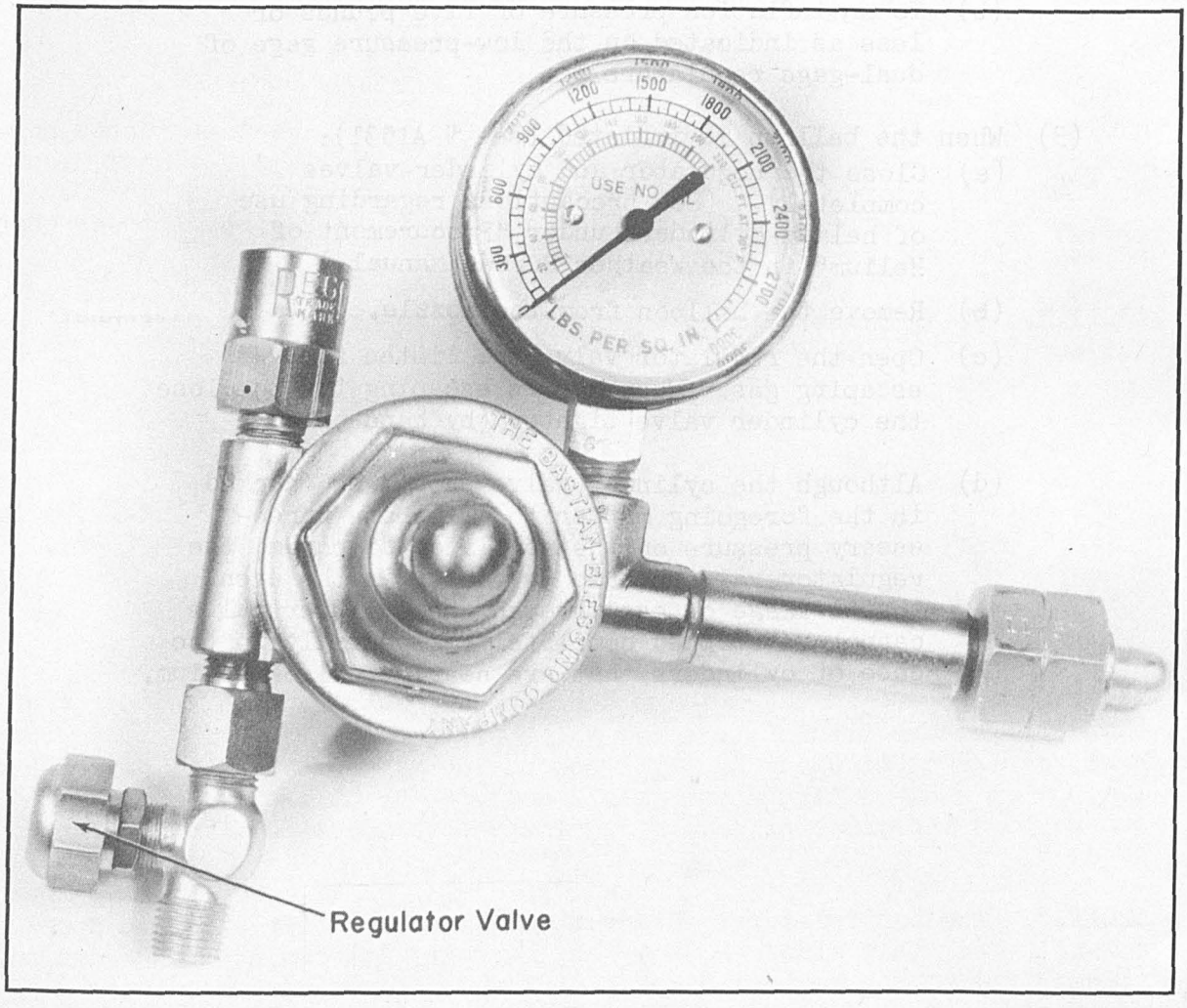

Fig. A1-41. Preset-helium regulator, J412.

A1600. HELIUM

*A1610. General.--Instructions pertaining to the procurement of helium and the inspection and use of helium cylinders are contained in Volume I, Chapter E-21 of the Administration Manual.

A1700. ENTRY ON WBAN-10

A1721. Total Sky Cover (Col. 21 or 13).--At first-order observing stations where less than twenty-four record observations are taken daily, enter, in column 21, the value of total sky cover observed between sunrise and sunset at thirty minutes past the hours that personnel are on duty. Enter estimated total sky cover in parentheses for daylight hours that personnel are not on duty. Second-order observing stations that do not prepare WBAN-10B will enter total sky cover in column 13 adjacent to column 14A (see ¶ A11001.2).

CHAPTER A2 - VISIBILITY [1]

A2011. Control-Tower Visibility Observations.—When Weather Bureau personnel cannot be assigned to the control tower, visibility observations at the control-tower level will be taken by CAA control-tower personnel. Weather station personnel (WB or CAA) will notify the control tower when to start or stop taking observations.

A2011.1. The minimum data to be recorded by control-tower personnel follows:

(1) Date and time of observation.

(2) Prevailing visibility.

(3) Remarks (such as visibility in different quadrants).

(4) Observer's initials.

When visual recording communication facilities, such as teletype or TelAutograph, are in use between the control tower and the weather station office, the transmitted copy will serve as the tower record. Otherwise, personnel at the tower will record the transmitted data on WBAN-10A, or on another tabulation sheet, and give it to the weather station observer at the close of each day. The record may be destroyed after 90 days.

A2011.2. The control-tower observation may be used for aircraft operations immediately after it is taken; however, it should be recorded and transmitted to the weather station office as promptly as possible.

A2400. ENTRY ON WBAN-10

*A2410. Visibility (Col. 4).--At first-order observing stations where less than 24 record observations are taken daily, observe and record the visibility at 30 minutes past the hour during periods when record observations are not taken and an observer is on duty.

[1] The paragraph numbers in this chapter correspond to related paragraphs, similarly numbered, in the WBAN portion.

CHAPTER A3 - ATMOSPHERIC PHENOMENA [1]

A3510. Ice-Accretion Indicators.--Ice-accretion indicators are furnished selected stations only. The indicator consists of a strip of aluminum held in alignment by spring clips mounted on a wooden bracket. Several strips should be available for use with each bracket. Any location that will insure exposure of the indicator to precipitation, under any condition of wind speed and direction, will be satisfactory. The bracket should be so mounted that the exposed strip will be held in a vertical plane with the longer sides horizontal.

A3511. The strips will be stored in the shelter and protected from blowing rain to insure that when they are exposed they will be dry and that their temperature will be close to the temperature of the ambient air. One strip of the ice-accretion indicator will be exposed whenever freezing precipitation is expected.

A3512. When freezing precipitation is occurring, a strip free of ice will be exposed ten or fifteen minutes before taking an observation. It is essential that this interval of exposure be just prior to the observation to avoid the possibility of reporting freezing precipitation as occurring at the time of observation when, actually, ice on the indicator might have formed some time earlier.

A3900. ENTRY ON WBAN-10

*A3910. Weather and Obstructions to Vision (Col. 5).--At first-order observing stations where less than 24 record observations are taken daily, observe and record weather and obstructions to vision at 30 minutes past the hour during periods when record observations are not taken, and an observer is on duty.

A3934.2. Tornado (Col. 90).--Enter an accurate description of all meteorological elements accompanying the tornado. If space is insufficient in column 90, use a sheet of plain paper and attach it to WBAN-10B. Information on the following points is desirable:

(1) A map showing date, hour of occurrence, and path of the tornado.

(2) Appearance of clouds.

[1] The paragraph numbers in this chapter correspond to related paragraphs, similarly numbered, in the WBAN portion.

(3) Character and amount of precipitation.

(4) Description of funnel, of the appearance of clouds above it, and of the distribution of debris.

(5) Number of persons killed and injured.

(6) Rate of movement.

(7) Estimated crop loss and property damage.

A3934.4. Aurora and Other Optical Phenomena (Col. 90).--Enter notes concerning various optical phenomena, such as auroras, halos (solar and lunar), rainbows, and mirages. Auroral displays should be carefully described, giving the time of beginning and ending, and the altitude and azimuth of each extremity and of the crown of any arch of light that may be formed. Azimuths should be recorded with North as zero. When an aurora extends past midnight, entry will be made for both dates. (Aurora should not be reported in aviation weather observations.)

A3934.6. Miscellaneous Phenomena (Col. 90).--At stations on the Great Lakes, enter the dates of opening and closing of navigation and of the season of wind warnings. In addition, enter available data on seiches (especially any pronounced or damaging sudden changes or fluctuations in the lake level and any periods of several hours of unusually high or low water). At stations on navigable rivers, enter the dates of the opening and closing of the navigation season. At all stations, enter notes on receipt of flood or storm warnings and advisories, and severity of damage done by floods or storms; and enter notes of unusual meteorological conditions, such as obstructions to vision at a distance, or wind shifts not entered on columns 9-11. Enter additional weather information not provided by the recording instruments and scheduled observations. Attach newspaper clippings of weather conditions of exceptional general or local interest. When space in column 90 is insufficient, entries will be continued on an additional sheet attached to it.

A3934.61. Frost.--Whenever a deposit of frost occurs on surface objects, record frost and designate the intensity (see par. 3506).

A3934.62. Freeze.--Record freeze whenever light, killing or hard freeze occurs; state the kind of vegetation injured or killed; degree of maturity at time of the freeze; estimated percentage of loss; and any other pertinent data.

A3934.63. Rime.--Record either soft rime or hard rime whenever it occurs.

CHAPTER A4. MEASUREMENT OF PRECIPITATION

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A4400. EXPOSURE AND SHIELDS

A4410. Exposure.--Precipitation gages should be located on a level plot of ground, at a distance from any object (including the instrument shelter) of at least two, and preferably four, times the height of the object above the top of the gage. All types of gages must be exposed with the rim of the receiver in a horizontal plane and at a level well above the average level of snow surfaces. Gages should not be installed on a roof without prior authorization by the Central Office.

A4420. Shields.--Stations where snowfall and strong wind frequently occur together will be furnished with approved shields (see Fig. A4-9). However, where two or more gages are installed, only one will be shielded, preferably the weighing gage.

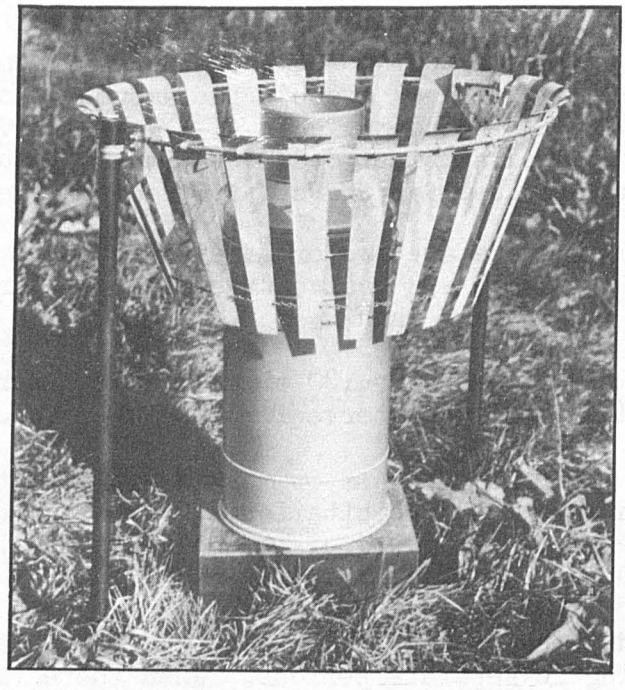


Fig. A4-9. D110A, weighing gage with a D131 Alter-type shield.

A4421. Alter-type shields (D131) are installed with the circular ring horizontal and the top of the blades approximately 1/2 to 3/4 inch above the level of the top of the receiver. The blades are suspended from the ring. They are free to pivot at the point of suspension within the limits imposed by the chain linking together the bottoms of the blades. The blades on the windward side of the gage deflect the wind downward and thereby increase the efficiency of the gage.

A4500. ENTRIES ON WBAN-10

A4510. Precipitation (Col. 40).—First-order stations equipped with recording gages, including weighing rain gages equipped with 24-, 12-, or 6-hour gears, will enter corrected hourly amounts of precipitation in inches and hundredths for the period beginning with the hour printed in column 16. Consider the hour identified as "00" in column 16 as beginning at 0000 LST and ending at 0059 LST; the hour identified as "01" as beginning at 0100 and ending at 0159, etc. Enter "T" for amounts of less than 0.005 inch. Omit entry if precipitation has not occurred during the hour. If the automatic record is incomplete, enter estimated hourly amounts in parentheses.

A4520. Twenty-four Hour Snowfall (Col. 69).—Whenever snowfall data for the period from midnight to midnight is incomplete, e.g., where no midnight observation is taken, use the available entries in column 45 as a guide in estimating the depth for this period and enter the value in parentheses.

*A4530. Excessive Precipitation (Col. 90).--Precipitation is termed "excessive" when it equals or exceeds the amount specified for any one of the time-intervals listed in Table A4-1. Excessive precipitation data will be evaluated at first-order stations 1/ equipped with a recording gage that is used for the station record (see ¶ 4030).

A4530.1. Whenever there are two or more separate time-intervals of excessive precipitation, successive time-intervals are regarded as belonging to the same period when:

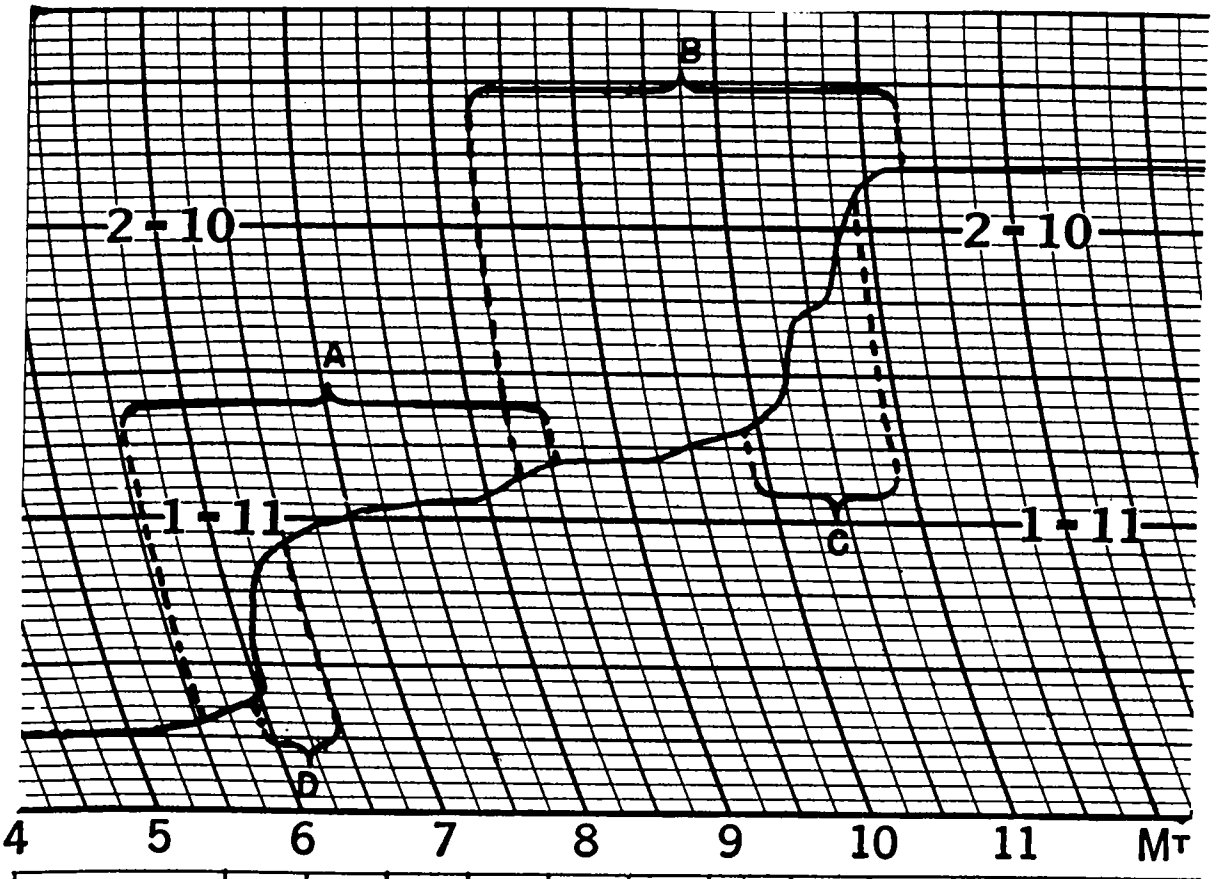
(1) They occur less than 180 minutes apart, irrespective of the amount of intervening precipitation.

(2) They occur 180 minutes or more apart, and the amount of intervening precipitation equals 1.80 inches or more for every period of 180 consecutive minutes (0200 to 0500, 0201 to 0501, etc.).

When these conditions are not satisfied, successive time-intervals are regarded as being in separate periods. When there is only one time-interval of excessive precipitation, the duration of the period is the same as that of the time-interval. When there are two or more time-intervals in a single period, the duration of the period is the elapsed time between the beginning and end of the first and last intervals, respectively.

A4530.2. The maximum precipitation for all the time-intervals listed in Table A4-1 will be computed for each period of excessive precipitation

1/ In localities having both an airport station and a city office, excessive precipitation will be computed for the city office only.



Interval	5	10	15	20	30	45	60	80	100	120	150	180
Amounts for period D	.20	.35	.43	.46	.52	.58	.63	.69	.73	.76	.80	—
Amounts for period C	.18	.25	.33	.38	.45	.70	.82	.90	.95	1.00	1.00	1.06

Fig. A4-12. Excessive precipitation data. "A" indicates the time of occurrence of the maximum amount of precipitation associated with the period of excessive precipitation "D" for an interval of 180 minutes. Similarly, "B" indicates the maximum amount for 180 minutes associated with the period "C." The tabulation lists the excessive-precipitation data for the two periods of excessive precipitation. Note that "C" and "D" are separate periods of excessive precipitation, since they are separated by 180 minutes or more (203 minutes) in which the maximum amount of precipitation for 180 minutes does not equal or exceed 1.80 inch. Also note that since "A" and "B" overlap, only the greater amount is tabulated (see the entry for the 180-minute interval of the tabulation for period "C").

*A4540. Water Equivalent of Frozen Precipitation (Col. 80).--First-order and other designated stations will transmit water equivalent data in accordance with ¶ 4370 and the following:

(1) Stations equipped with Service C will transmit water equivalent data on this service immediately following the group $9S_pS_ps_ps_p$, in the 1230 GCT report on Tuesday and Friday whenever the S_pS_p portion of the group is 85 (see ¶ 1904.4, Synoptic Code, 1949). Use a slant (/) to separate these data from the $985s_ps_p$ group, e.g.:

98505/50 - snow depth 5", water equivalent 0.50".

98502/9 - snow depth 2", water equivalent 0.09".

98511/110 - snow depth 11", water equivalent 1.10".

(2) Stations equipped with Service A only will include these data coded as in (1) in the 1228 GCT report on Tuesday and Friday.

(3) In each River District, stations that have neither Service C nor Service A will transmit water equivalent data in plain language to the River District Office by TWX, telephone, or telegraph, using the most economical of these methods.

(4) Stations not in a River District and not having either Service C or Service A will not transmit these data.

A4541. Additional reports of water equivalent data may be sent to the River District Office either by mail or by one of the foregoing methods, in accordance with requests received from the Area Engineer or the River District Office.

*A4542. When there is pronounced snow melt or other indications of the development of critical conditions, stations in a River District will send emergency reports by the most expeditious method of communication until critical melting conditions no longer exist, or until instructed to discontinue reports by the Area Engineer or the River District Office.

A7020. Computations of Height of 850-Millibar Surface - Mean Virtual Temperature.—Corrections for lapse rate and humidity required in the computation of mean virtual temperature will be derived from Table A7-2 (see par. 7430).

A7030. Exposure of Pressure-Sensing Instruments.—Select exposure sites where the instrument will not be subjected to rapid fluctuations of temperature or to jarring and continuous vibration. Avoid exposing the instruments to direct sunlight and radiant heaters, and to direct drafts, such as from open windows and doors. When an installation is regarded as unsatisfactory, or when contemplated changes in the office (air-conditioning, renovation, etc.), are considered likely to affect the exposure adversely, notify the Regional Office.

A7031. Aneroid barometers should, under ordinary circumstances, be mounted with the dial in a vertical position at a convenient level for reading. Aneroid barometers and altimeter setting indicators will operate satisfactorily in other than a vertical position. However, since a change in position may result in a change in the indicated reading, the instrument should be carefully checked against a mercurial barometer whenever a change in position is made. Instruments designed for connection to a static head system should be installed in a location where the connections can be made. Dial-type instruments are frequently provided with a detachable case or flange to be used when the instrument is wall mounted. Remove the case or flange when the instrument is to be flush mounted in an instrument panel or rack.

A7100. MERCURIAL BAROMETERS

A7110. General.—Where two mercurial barometers are maintained side by side, the instrument regularly used is designated as the "station barometer," and the other as the "station extra." These designations will not be changed without authorization from the Central Office. The station extra is to be used for emergency and reference purposes only. Do not use barometer lamps of more than 25 watts, or leave the lamp burning longer than required for the actual observation. Mercurial barometers, especially barometers of the adjustable cistern type, are very fragile. When a mercurial barometer is to be moved, the instructions in this section must be carefully observed to prevent breakage of the instrument and to reduce to a minimum the chances of introducing serious errors in the indicated readings.

A7111. Suspension.--Suspend the barometer freely and vertically from the supporting hook or rod, in the barometer box or on the barometer board, by means of the suspension ring at the top of the instrument.

A7112. Cistern Rings.--As an aid in maintaining adjustable-cistern barometers in a vertical position, a ring is attached to the mounting board to encircle without touching the cistern when the barometer is freely suspended. Adjust the suspension of the barometer, or the position of the cistern ring, to prevent the freely suspended barometer from touching the ring. An improved style of ring is provided with three set screws that clamp the cistern lightly in a vertical position, thereby facilitating rapid and accurate adjustment of the cistern without disturbing the vertical alignment of the instrument.

A7112.1. To adjust the cistern where the non-clamping type ring is used, steady the cistern against the side of the ring in a manner indicated in Fig. A7-3; i.e., by swinging the cistern end of the barometer in a direction such that the cistern touches the ring at a point where the line (AB) through the center of the cistern and the point of contact is at right angles to the line through the center of the cistern and the ivory point (I). When this is done properly, the mercury level with respect to the tip of the ivory point will not be changed when the barometer is released and returns to its vertical position.

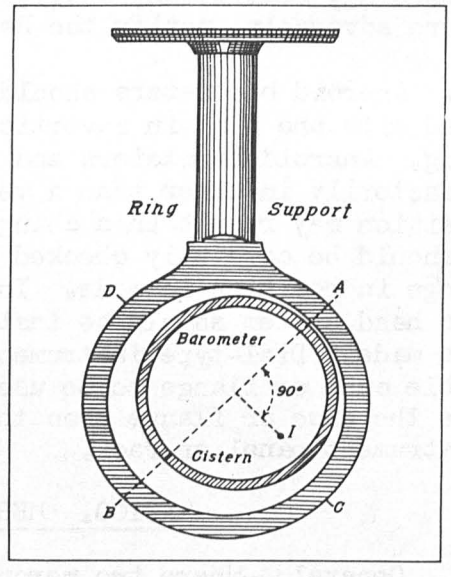


Fig. A7-3. Cistern ring.

A7120. Relocation of Mercurial Barometers.--Mercurial barometers will not be moved without prior authorization from the Regional Office, unless it is necessary to protect the instrument from shock or other conditions likely to damage it. In either case the circumstances will be reported immediately to the Regional Office and to the field aide through the Regional Office. If a sub-standard mercurial barometer is concerned, the Central Office will be notified. When the necessity for moving a barometer can be anticipated, authorization for the move should be requested promptly. The instructions in Circular F and the supplementary instructions in this chapter pertaining to the moving of mercurial barometers will be followed explicitly.

*A7120.1. When installing a barometer, mount it so that the height of the tip of the ivory point above the floor will be 33" minus one inch for each 1000 feet of elevation of the station; e.g., where the elevation of the barometer is to be 7500 feet (to the nearest 100 feet), install the barometer with the ivory point 33 minus 8, or 25 inches above the floor.

A7120.2. When station personnel have been authorized by the regional office to move and reinstall the instrument, and the station is equipped with another instrument of the type listed in ¶ 7010, the barometer may be used for pressure observations following the move, provided that the move is completed in the manner

difference between the two barometers by subtracting the uncorrected reading of the aneroid barometer from this station-pressure value.

(2) After the differences for seven days have been determined, compute the algebraic mean of the differences. This mean will be added algebraically, as a correction, to subsequent uncorrected readings of the aneroid barometer to provide values of station pressure for purposes of Form 1027B only. This correction will be applied, (see par. 7252) until revised, to subsequent comparative barometer readings.

(3) Determine each day the difference obtained by subtracting the corrected aneroid readings obtained as in (2) from the station pressure based on readings of the mercurial barometer. After fourteen consecutive days in which none of these differences exceeds ± 0.3 mb., the corrected aneroid readings may be used as the station pressure for observational purposes.

(4) Continue to take concurrent daily readings at least 14 days longer, and to compute the difference between station pressure and the corrected readings of the aneroid barometer.

(5) After comparative readings have been taken daily for at least eight weeks, and after 14 consecutive days in which none of the differences in (4) have exceeded ± 0.3 mb., comparisons will be made once every seven days.

*A7221.2. Whenever the difference between station pressure and a corrected reading of the aneroid barometer exceeds 0.3 mb., the difference will be verified immediately, preferably by another observer. If the verified difference:

(1) Does not exceed 0.3 mb., disregard the first value and proceed as specified in ¶ A7221.1, item (3) - (5).

(2) Exceeds 0.3 mb. but not 0.6 mb., compute the algebraic mean of the two differences and post the mean value as a revised correction applicable until the next day (see ¶ A7221.4).

(3) Exceeds 0.6 mb., discontinue use of the aneroid barometer and notify the Central Office through the regional office.

*A7221.3. After adjustment of the precision aneroid barometer at land stations to a correction of zero (by an inspector or technician), take a comparative reading one hour later and another two hours later. Compute the differences. If neither difference exceeds 0.3 mb., determine the algebraic mean of the two differences, and post this mean value as the correction applicable until the next day (see ¶ A7221.4). If either difference exceeds 0.3 mb., proceed in accordance with ¶ A7221.2, items (2) and (3).

*A7221.4. Whenever a posted correction has been redetermined as specified in ¶ A7221.2 or A7221.3, proceed as follows:

(1) Take comparative readings daily, determine their difference, and compute the cumulative sum of the differences. Use the posted correction determined as specified above as the first difference in the sum. Compute the algebraic mean value. Post each mean value as the correction applicable until the following day.

(2) Compute the posted correction as in (1) until it has been redetermined for seven consecutive days. If the difference between the station pressure and the corrected aneroid barometer exceeds 0.3 mb., repeat the procedure of ¶ A7221.2 (see also (3) and (4) below). The mean value obtained on the seventh day will be posted as the correction applicable until either the difference between comparative readings exceeds 0.3 mb. or the aneroid barometer is adjusted to zero.

(3) Whenever the requirements of ¶ A7221.1 have not been satisfied since the aneroid barometer was installed, and a posted correction has been redetermined as in (2), resume comparisons as in A7221.1(3). Whenever redeterminations occur so frequently that the requirements of ¶ A7221.1 cannot be satisfied within three months, discontinue use of the instrument and notify the Central Office through the regional office.

(4) Whenever redetermination of the posted correction is required after weekly comparisons have been initiated in accordance with ¶ A7221.1(5), resume daily comparisons for at least fourteen days. Whenever subsequent redeterminations are required before the foregoing procedure is completed, and weekly comparisons cannot be resumed within four weeks, discontinue use of the instrument and forward the comparison data on Form 1027B to the Central Office through the regional office.

*A7221.5. Whenever the aneroid barometer is used for observational purposes, and there are indications that its readings are inaccurate, a series of five comparative readings will be taken approximately one hour apart. If the differences in station pressure between the aneroid and mercurial barometer vary over a range of more than 0.3 mb., discontinue use of the aneroid barometer and forward the data on Form 1027B to the Central Office through the regional office.

A7230. Altimeter Setting Indicator.--Altimeter setting indicators are provided with two scales - a pressure, or primary scale, and an elevation, or secondary, scale (see Fig. A7-11 and -12). Indicators are designed for operation within the elevation range specified on the dial. Station personnel should not attempt to adjust the pressure-scale index independently of the position of the elevation scale.

A7231. Station Pressure.--The altimeter setting indicator may be used for the determination of station pressure in accordance with ¶ 7260, provided satisfactory comparisons are obtained periodically in accordance with ¶ A7233.

*A7232. Adjusting Elevation Scale.--The position of the elevation scale and the related position of the pressure-scale pointer are adjusted by the elevation-scale adjusting screw, which on some instruments projects through a hole in the cover glass (see Fig. A7-12). The Kollsman type of instrument has a plug screw and washer in the back side of the case (near the bottom) to provide access to the adjusting screw. Care should be taken not to damage the washer, which prevents leakage at the plug screw. Turn the adjusting screw until the pointer of the pressure scale indicates the correct altimeter setting as obtained from the mercurial barometer (see Sec. 7500). Do not adjust the scale during periods of

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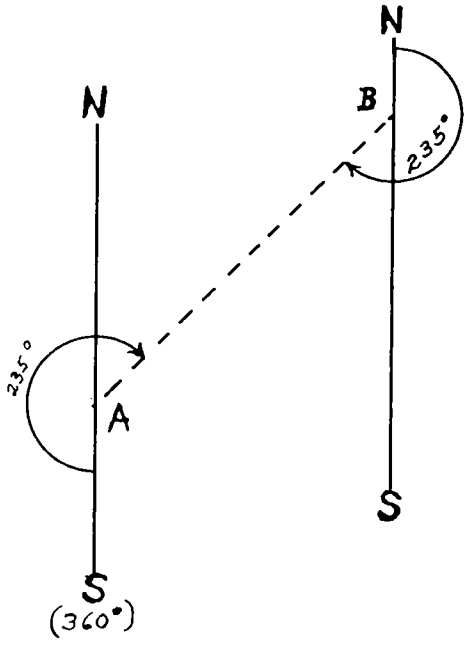

Fig. A8-1. Theodolite method of establishing a parallel north-south line. In this figure, it is desired to establish point "B" on a north-south line. The theodolite is set up at point "A" and oriented south = 360°. The bearing of point "B" is read on the azimuth scale as 235°. The theodolite is then set up at point "B" and oriented on point "A" = 235°. True north will be indicated by the theodolite at an azimuth reading of 360°. Any object with this bearing may therefore be used to establish a north-south line through point "B".

A8050. Prevailing Wind Direction.—The prevailing wind direction during a given period is the direction most frequently recorded at equal intervals of time throughout the period. When more than one direction is recorded an equal number of times, select as the prevailing direction the one having the largest number of adjacent directions recorded. Example: if prevailing hourly directions are recorded as E for one hour, SE for 10 hours, S for 10 hours, and SW for three hours, the prevailing direction for the day is South. When the wind speed or wind movement is less than one mile an hour, the wind direction will be considered indeterminate, and indicated directions obtained at such times will not be considered in determining the prevailing direction.

A8100. INSTRUMENTAL

*A8110. Exposure and Related Maintenance.—So far as available sites permit, wind sensing equipment will be placed 30 to 35 feet above the ground on a freely exposed tower, and over terrain that is relatively level and free from obstructions to wind flow. In general, obstructions

include hills or other objects whose height above the ground at the exposure site is not more than one-tenth their distance from the site. Avoid sites where topography or other obstructions are known to create appreciable up-or-down drafts, eddy currents, or jet-flow effects. When a compromise must be made, expose the sensing units at least 12 feet above any obstruction within 100 feet of them, and at least as high as any obstruction within 100 to 200 feet of them. Supporting towers should not be of such bulk or shape as to create an appreciable obstruction to the wind flow.

*A8111. Vertical Alignment.--At least once a year at first-order stations, check the vertical alignment of the wind vane and anemometer, either with a spirit level, if the shape of the equipment is such that a level can be used for this purpose, or with a plumb bob. The alignment should be checked from two positions approximately 90° apart in azimuth. When it is necessary to make the comparison at a level below that of the anemometer, suspend the plumb bob approximately three feet from the eye, and stand at a distance from the equipment about equal to its height. Make necessary adjustments to secure vertical alignment.

A8120. General Maintenance.--Instructions in this Section for routine lubrication and cleaning are applicable to instruments operating under average conditions of exposure. More frequent lubrication and cleaning is required under severe operating conditions, such as those associated with exposures close to salt water, in an atmosphere polluted with industrial wastes, or in severe and frequent dust and sand storms. Squeaking bearings, scratches on bearing surfaces, and a noticeable accumulation of foreign matter (dirt, dirty oil film, corrosion, or moisture) on bearing surfaces, gear teeth, worm-gear threads, or within the instrument housing, indicate that more frequent cleaning and lubrication are required. Squeaking brushes in d-c generator-type anemometers should not be confused with squeaking bearings. Squeaking of the brushes usually decreases as the wind speed increases. In general, winter-type anemometer oil is satisfactory for use whenever anemometer lubrication is required. However, summer-type oil may be used at temperatures above 25° F. for lubricating F102 anemometers and other contact-type anemometers of similar general design that are also equipped with friction bearings at the upper end of the spindle. One or two drops of oil, applied with the end of a matchstick, are generally sufficient to oil each bearing surface. Other points of rolling or sliding friction, such as gear teeth, worm threads, sliding-contact surfaces, etc., should be oiled similarly. Carefully remove oil that spills or accumulates on non-lubricated portions of the equipment, especially electrical insulation and contact points. Direct contact with oil will cause the breakdown of some insulating materials. Oil film between contact points acts as an insulating material that may cause the equipment to fail. Oil film adjacent to moving parts tends to collect abrasive material that may gradually work into the bearings. Polish electrical contacts sufficiently to remove pitting or corrosion.

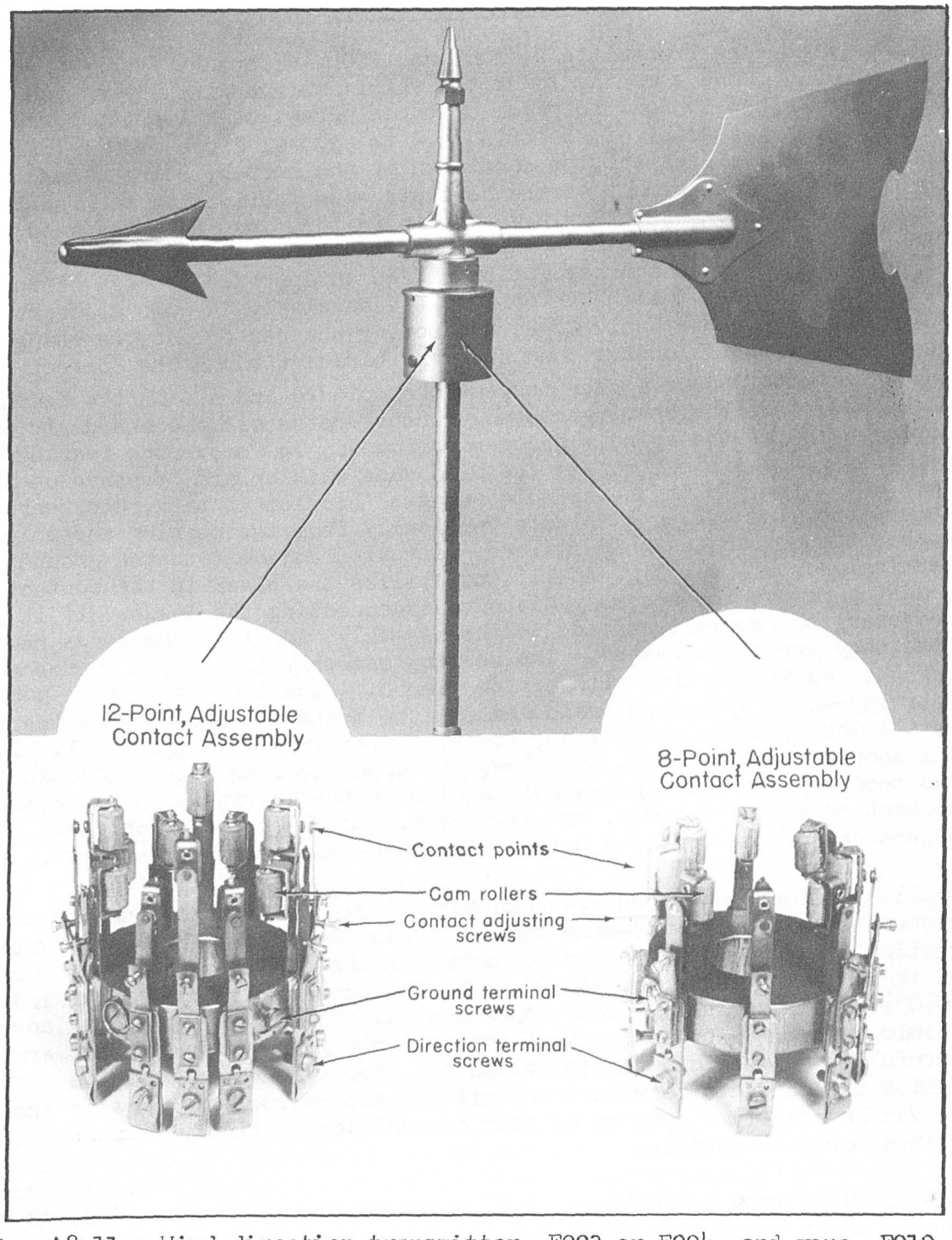

Fig. A8-11. Wind-direction transmitter, F003 or F004, and vane, F010. Either the F003-1 eight-point switch, or the F004-1 twelve-point switch, may be used in this type of installation.

A8500. WIND VANES

*A8510. Wind Vane Transmitters, F003 and F004.—(Contact Types - See Fig. A8-11.) Once a month, lower the shield surrounding the switch assembly. The shield is held in place by three screws near its top edge. Lubricate the upper bearing of the spindle with several drops of oil (SAE 10 or anemometer oil). Inspect the condition of the switch, being careful not to disturb the adjustment of the contacts when lubricating the bearing. Test the operation of the switch, the indicator, and its associated wiring by noting whether the indicator follows, in proper sequence, the movement of the vane through each revolution. Make an approximate test of the orientation of the switch by moving the vane slowly through at least one switching point (See Table A8-2) and noting whether or not the change in indicated direction occurs when the vane passes through the correct bearing in azimuth. Once a year inspect the spindle and oil in the bearing. Clean and reoil the bearing assembly whenever the oil becomes dirty or contaminated or the spindle becomes corroded. To remove the bearing assembly for cleaning, rotate the wind vane with upward pressure on the vane until the pin in the spindle engages the slot in the upper bearing. Remove the wind vane and spindle vertically from the bearing assembly. Loosen the switch assembly setscrew (situated adjacent to the ground terminal screw - see Fig. A8-11) and utilize the slack in the contact leads to remove the assembly without disconnecting the leads. If it is necessary to remove the leads to the assembly, identify the leads before they are disconnected. The bearing assembly is removed by unscrewing the housing portion with a pipe wrench. Wash the assembly in a suitable petroleum-base solvent. Drain and dry the mechanism before reoiling it. Refill the assembly with clean, low viscosity (SAE 10) engine oil. The oil should reach, but not overflow, the upper bearing after the assembly has been replaced and the spindle seated in the bearings. Replace the contact assembly, spindle, and wind vane, and check the orientation and adjustment of the contacts before tightening the assembly setscrew.

A8511. Contact Adjustments.—When any set of contacts does not open or close at the proper wind-vane azimuth angle (see Table A8-2), check the vertical alignment of the contact arms and the condition and adjustment of the contacts (see par. A8130). The contacts should open about 1/32 (0.03) inch when fully open. Adjustment of the contact-adjusting screws should secure the proper contact action. Straighten bent contact arms carefully and sufficiently to obtain the proper adjustment of the contacts. Polish the contacts to remove any pitting and corrosion. Erratic indicator action is usually a sympton of poor contact action likely to result in pitting of the contacts.

A8520. Wind Vane Transmitter, F005.—(Commutator Type - See Fig. A8-12.) Once a month, lower the outer and inner shields, which are held by setscrews, as shown in Fig. A8-12. Lubricate the upper bearing with several drops of oil (SAE 10 or anemometer oil). Wipe the commutator free of dirt, grease, etc. Test for the correct action and orientation of the commutator-type switch assembly in the manner specified in par. A8510.

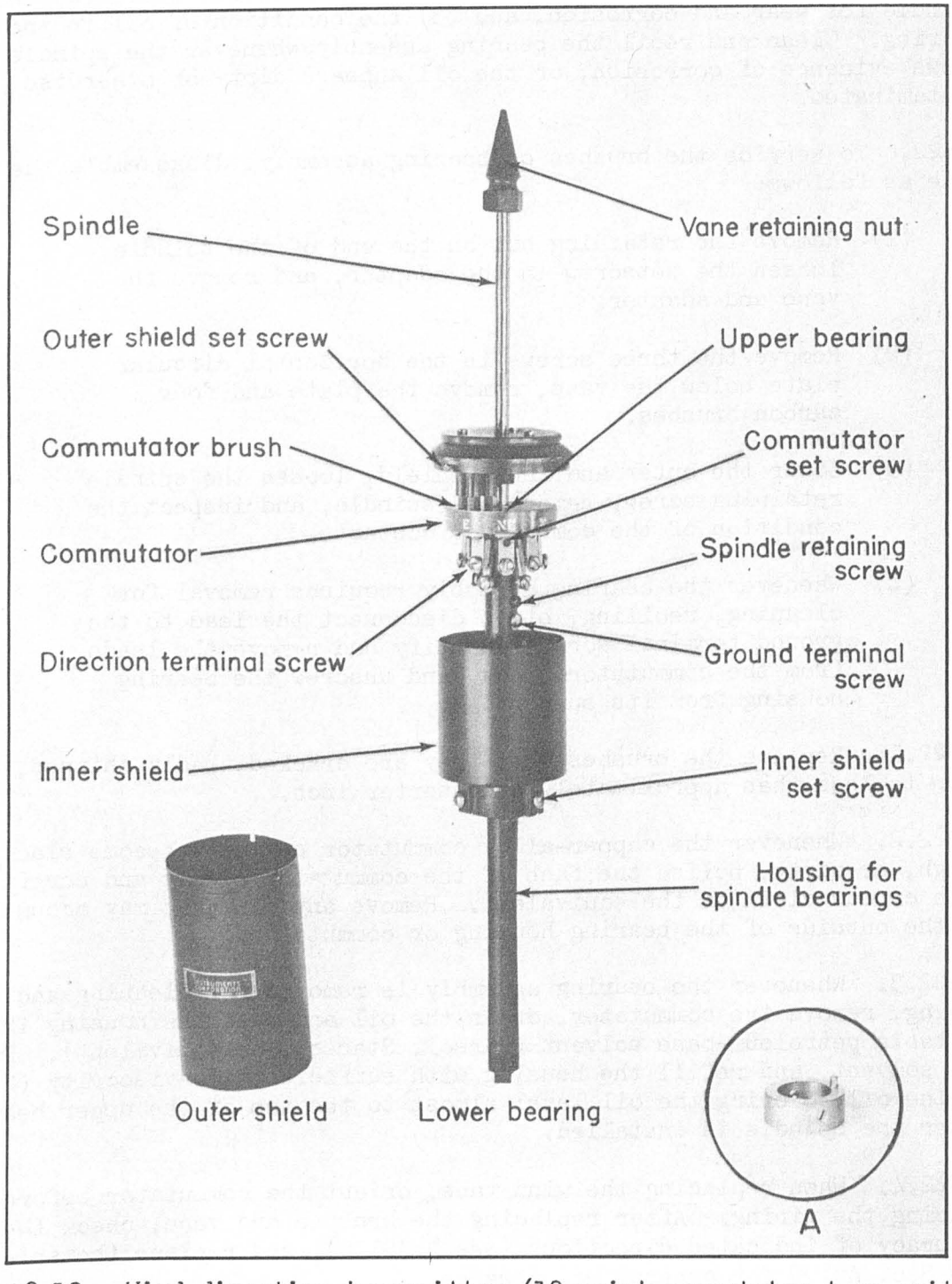

Fig. A8-12. Wind-direction transmitter (12-point commutator-type switch), F005. Inset A shows Adapter F005-1 which replaces recessed collar on metal vanes when used with F005 transmitter.

*A8521. Once a year inspect (1) the carbon brushes for wear, (2) the spindle for wear and corrosion, and (3) the condition of oil in the bearing. Clean and reoil the bearing assembly whenever the spindle shows evidence of corrosion, or the oil appears dirty or otherwise contaminated.

*A8522. To service the brushes or bearing assembly, disassemble the wind vane as follows:

(1) Remove the retaining nut on the end of the spindle, loosen the setscrew in the adapter, and remove the vane and adapter.

(2) Remove the three screws in the horizontal circular plate below the vane, remove the plate and four carbon brushes.

(3) Lower the outer and inner shield, loosen the spindle retaining screw, remove the spindle, and inspect the condition of the commutator contacts.

(4) Whenever the bearing assembly requires removal for cleaning, reoiling, etc., disconnect the lead to the ground terminal screw, identify and remove the leads from the commutator block, and unscrew the bearing housing from its support.

*A8522.1. Replace the brushes when they are cracked, badly chipped, or worn to less than approximately one-quarter inch.

*A8522.2. Whenever the copper-alloy commutator segments become blackened, rough, or dirty, polish the face of the commutator evenly and carefully with crocus cloth or the equivalent. Remove any oil that may accumulate on the outside of the bearing housing or commutator.

*A8522.3. Whenever the bearing assembly is removed for cleaning and reoiling, remove the commutator, drain the oil and wash the housing in a suitable petroleum-base solvent (Varsol, Stansol, or equivalent). Drain the solvent, and refill the housing with sufficient low-viscosity (SAE 10) engine oil to bring the oil level almost to the top of the upper bearing after the spindle is installed.

*A8522.4. When replacing the wind vane, orient the commutator before replacing the wiring. After replacing the brushes and vane, check the accuracy of indicated directions (see ¶ A8130), and replace the shields. See Sec. A8100 for general maintenance.

A8530. Wind Vane, F431-1.--(Windial - See Fig. A8-5.) The wind vane and anemometer of this system are in a single housing. No lubrication or

other attention is necessary, except as required by Sec. A8100. Orient the wind vane by turning the pipe that supports the housing until the setscrew located six inches below the top of the housing faces true south.

A8540. Wind Vane, F430-1.—(See Fig. A8-6.) The 117-volt (nominal) a-c, selsyn-type wind-vane portion of this combined anemometer and wind vane unit needs no lubrication or other routine attention, except as required by Section A8100. Orient the housing by loosening the adapter setscrews (located at the bottom of the housing) and turning the adapter until the vertical line on the adapter faces true north. If the housing and adapter are properly assembled, the equivalent reference line on the housing will also face true north.

A8550. Wind Vane, F420-5.—(Electric Speed - See Fig. A8-7.) This 12-volt d-c, selsyn-type wind vane needs no lubrication or other routine attention, except as required by Section A8100. Orient the housing by loosening the adapter setscrews and turning the adapter until the letter "N" on the transmitter housing faces true north. When the housing and adapter are assembled and secured by the housing setscrew, the adapter is properly aligned with the transmitter housing.

A8560. Wind Vane, F420A-5.—(Instruments Corp. - See Fig. A8-8.) This 12-volt d-c, selsyn-type wind vane needs no lubrication or other routine attention, except as specified in Section A8100. Orient the housing by loosening the adapter setscrews and turning the housing until the letter "N" on the adapter faces true north.

A8600. ENTRY ON WBAN-10

*A8601. Magnetic Wind Direction (Col. 13).—At stations where the magnetic wind direction is used in air-ground communications and where it differs from the true direction, enter the magnetic direction in parentheses either in column 13 or following the last element on Form 3024B, whichever form is more convenient for use by the communicator. This entry may be omitted if the communications station is provided with a wind direction indicator, or if wind data are not broadcast. (See ¶ A9183.11(5) for instructions relating to Form 3024B.)

*A8602. Wind Direction and Speed.—At first-order stations equipped with a multiple register, and where less than 24 record observations daily are taken, the prevailing hourly wind direction (see ¶ A8050) and the corrected wind-speed data for the period beginning with the hour printed in column 16 will be entered in the right margin of WBAN-10B in miles per hour; e.g., enter "SW-18" for "Southwest, 18 miles per hour," and "DI-1" for "direction indeterminate, speed less than one mile per hour." The corrected data are obtained by applying the appropriate correction from Table 14 in ¶ 8231 to the uncorrected data taken from Form 1017 or 1017B.

*A8603. Maximum Average Five-Minute Speed and Fastest Mile (Col. 90).-- At first-order stations equipped with a multiple register, enter (1) the maximum average five-minute speed and the fastest mile in miles per hour, after applying the appropriate correction in each case from Table 14, ¶ 8231 to the uncorrected data taken from Form 1017 or 1017B, and (2) in each case, the associated direction and time of beginning to the nearest minute LST (see ¶ A13021.3 and A13021.4). Identify each entry, using appropriate stamps. Enter estimated data in parentheses. At stations not equipped with a multiple register but where a local need exists for the highest observed one-minute wind speed and its associated direction, personnel will enter these data and place an asterisk beside the stamped identification.

CHAPTER A9. TYPES OF OBSERVATIONS

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CHAPTER A9. TYPES OF OBSERVATIONS 1/

A9120.1. Off-Teletype Observations.--The time at which record observations at off-teletype stations are to be telephoned or telegraphed to a relay station will be specified by the regional office.

A9120.2. Omission of Observations.--Contractions will be transmitted as follows to indicate the expected or actual omission of a scheduled observation:

(1) NORPI. Where Weather Bureau personnel are responsible for the operation of Service A teletypewriter facilities, and are scheduled to take both pibal and aviation weather observations during times when only one observer is on duty, append the contraction NORPI to a record or record-special observation when all the following conditions exist:

(a) When the ceiling is more than 9750 feet.

(b) The visibility is ten miles or more.

(c) It is expected that the pibal will preclude preparation and transmission of the next scheduled record observation.

(d) When it is impracticable, because of the time of beginning the pibal, to set up the SECO equipment to send DCAVU (see (2) below) in the next sequence collection.

(2) DCAVU. Whenever only one observer is on duty for taking both pibal and aviation weather observations, and where the aviation weather is transmitted on Service A by the CAA, arrange for transmission of the contraction DCAVU instead of the next scheduled record observation whenever it is expected that:

(a) The ceiling will remain above 9750 feet.

(b) The visibility will remain ten miles or more.

(c) The pibal will continue long enough to preclude preparation and transmission of the observation.

1/ The paragraph numbers in this chapter correspond so far as possible to related paragraphs in the WBAN portion.

If a change in conditions requires the filing of a special observation, abandon the balloon. Whenever it is impossible to transmit NORPI or DCAVU as specified above, discontinue the pibal in time to transmit the scheduled record observation.

*A9161. Erroneous or Missing Reports.--Report synoptic observations or aviation record observations taken at the time of a 3- or 6-hourly observation on Form 3069 (1) when these observations are taken but cannot be transmitted, (2) when errors in these observations are transmitted and not corrected in accordance with ¶ 9163. Form 3069 may originate at any first-order station to call the attention of personnel at another station to discrepancies in these observations. Erroneous entries in station records will be corrected in accordance with ¶ 11032.

A9173. Time.--All reports filed for transmission on Service A as supplementary weather will contain a time group denoting the hour and minute (24-hour clock) of the observation and the local time zone indicator (e.g., 1037C). This group will be placed immediately following the station location identifier or, in the case of a special observation, following the "S" symbol (see par. 9172). Off-teletype stations, such as SAWRS, that make original transmission of reports to a Weather Bureau or a CAA station via company communication facilities or by telephone, will include the time group in the report. Stations transmitting reports by commercial telegraph will not include a time group (see par. A9175).

WB Form 3069 (Rev. 1-1-49)

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

NOTIFICATION OF OBSERVATIONAL ERRORS

From WBAS, Sand Dune, Fla. (SNU) Date Nov. 8, 1951
(include station figure or letter designator of originating station)

To Chief, U.S. Weather Bureau The ☐ 6-hourly, ☐ 3-hourly, ☒ Airway, ☐ _____ weather report from (this) ~~(your)~~ station for 1308 (GCT) Nov. 8, 1951 (date) was ☐ received late, ☐ not received, ☐ not transmitted, ☒ apparently in error as follows:

REPORT	DATA		REPORT	DATA	
AIRWAY	☒ SENT ☐ RCVD.	CORRECTION	SYNOPTIC	☐ SENT ☐ RCVD.	CORRECTION
Designator			$iiiT_dT_d$		
Type of report			Nddff		
Time			VVwwW		
Ceiling			PPPTT		
Sky	E30-⊕	30-⊕	$N_bC_LhC_MC_H$		
Visibility			$D_c$app		
Weather	Q		RRR_is		
Obstruction to vision			$N_sCh_sh_s$		
Pressure			$S_pS_ps_ps_p$		
Temperature			$d_sd_sP_sH_s$		
Dew point			$h_{s3}h_{s3}h_{s3}a_3$		
Wind direction			$R_{24}R_{24}R_{24}R_{24}$		
Wind speed	25	25Q45	$T_sT_sT_sT_s$		
Wind shift			Additional plain language data as sent ☐; received ☐:		
Alt. setting					
Remarks sent ☒; received ☐:					
G 45					
☐ Correction:			☐ Correction:		

For correct procedure, see the following instructions:

(OVER) 16—57798-1

Fig. A9-1. Entries on Form 3069, from station making error.

WB Form 3069 (Rev. 1-1-49)

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

NOTIFICATION OF OBSERVATIONAL ERRORS

From FAWS, Miami, Fla. Date Dec. 22, 1951
(include station figure or letter designator of originating station)

To WBAS, Sand Dune, Fla. (213) The ☒ 6-hourly, ☐ 3-hourly, ☐ Airway, ☐ _____ weather report from ~~(this)~~ (your) station for 1830 (GCT) Dec. 21, 1951 (date) was ☐ received late, ☐ not received, ☐ not transmitted, ☒ apparently in error as follows:

REPORT	DATA		REPORT	DATA	
AIRWAY	☐ SENT ☐ RCVD.	CORRECTION	SYNOPTIC	☐ SENT ☒ RCVD.	CORRECTION
Designator			$iiiT_dT_d$		
Type of report			Nddff		
Time			VVwwW	48022	48052
Ceiling			PPPTT		
Sky			$N_bC_LhC_MC_H$	86500	865//
Visibility			$D_c$app		
Weather			RRR_is		
Obstruction to vision			$N_sCh_sh_s$		
Pressure			$S_pS_ps_ps_p$		
Temperature			$d_sd_sP_sH_s$		
Dew point			$h_{s3}h_{s3}h_{s3}a_3$		
Wind direction			$R_{24}R_{24}R_{24}R_{24}$		
Wind speed			$T_sT_sT_sT_s$		
Wind shift			Additional plain language data as sent ☐; received ☐:		
Alt. setting					
Remarks sent ☐; received ☐:					
☐ Correction:			☐ Correction:		

For correct procedure, see the following instructions:

Cir. N, 6th Ed. (Rev.), par. 3911

1949 Synoptic Code, pars. 1805.44 and 1805.54

(OVER) 16—57798-1

Fig. A9-2. Entries on Form 3069, from station detecting error.

A9175. Coding for Commercial Telegraph Transmission.—All symbols and intensity modifiers will be telegraphed in their word equivalents. The elements comprising the observation will be prepared for telegraphic transmission in the same order as that indicated in par. 9160. The word "special" and its number will be included preceding the meteorological data when that type of report is transmitted. Decimal points and the word "slant" will not be transmitted. The complete values of ceiling and cloud height, sea-level pressure, and altimeter setting will be transmitted, e.g., MEASURED 1200 10122 2990 for ceiling, sea-level pressure, and altimeter setting, respectively. The word "missing" will be used to indicate missing data pertaining to an element normally included in a report. The station identification and the time of the report will be omitted from the coded message.

A9176. Recoding Telegraphed Reports.—When the telegraphed message is prepared for teletype distribution at the receiving station, the station identification and time of the report will be supplied from the heading of the telegram and coded in accordance with pars. 9170 to 9173.

Example

Message filed at 6:00 a.m. at Hollister, California as received at San Francisco:

2000 SCATTERED ESTIMATED 5500 BROKEN 11000 OVERCAST
9 LIGHT RAIN 6563 NORTHEAST 11.

As prepared for teletype distribution:

HLL 0600P 20⦶E55⦶110⊕9R- 65/63×11

*A9182. Communications Failure.—During periods of teletype service failure, aviation and synoptic observations will be routed to an adjacent station where facilities have not failed, utilizing services still in operation, in accordance with the Federal Airway Manual of Operations. If all services have failed, the first record or special observation following the breakdown will be telephoned or telegraphed to the station designated by the Weather Bureau Regional Office. Thereafter, record observations will be sent only at the times of 6-hourly synoptic observations, but all special observations will be telephoned or telegraphed promptly after they are taken. Station observational records will be kept as usual during this period. Weather Bureau stations will telegraph the observation and insert "XV" in the check column to the right of the address on the telegraph blank, or telephone the observation "collect"; CAA stations will transmit these observations in accordance with administrative instructions issued by that agency. Form 3069 will be rendered for observations that are not transmitted (see ¶ A9161).

A9183. Filing Weather Reports for Transmission.—Telautograph or other

recording communications facility may be used to deliver observations to CAA personnel for transmission. Where a facility of this type is not available, enter the observations on Form 3024B and file them with communications personnel. These forms will not be used at stations where observing and communications duties are performed by the same personnel. (Exceptions may be authorized by the Regional Director wherever it is impracticable to use this form.) Since a permanent record of aviation observations is available on Form WBAN-10A, it is not necessary to retain copies of Form 3024B on which aviation observations are entered. However, copies of this form on which synoptic observations are entered will be retained for inspection by a field aide, after which they may be destroyed.

A9183.01. On Form 3024B, enter observations received from observing stations by telephone or other non-recording communications facility for transmission on teletype circuits. Retain a record copy of each observation for six months.

A9183.02. Additional copies of Form 3024B may be prepared as required for local needs.

A9183.1. Entries on Form 3024B.—Enter the date and time of filing the observation as a six-figure group in the upper right corner (a time stamp may be used for this purpose). The first two figures will indicate the day of the month, and the last four the filing time of the observation in terms of the 24-hour clock. A letter following the six figures will designate the time zone, e.g., 061932E, 110028Z etc. (see Table 17). Local or Greenwich time will be used in accordance with appropriate instructions for transmissions.

A9183.11. Entry of Aviation Observations: Additive Data):

(1) In the "Station" block enter station letter identification as listed in the Civil Aeronautics Administration manual "Location Identifiers".

(2) In the "Type" block, enter "S", followed by the serial number of the observation when the observation is a special or record-special, "L" when it is a local extra, and a check mark "✓" when it is a check observation. An entry will not be made for a record observation.

(3) In each "Time" block pertaining to special, local extra, and check observations, enter a four-figure (24-hour clock), time group, followed by the appropriate time-zone designator letter. Omit entry for record and record-special observations, except as required by instructions in par. 9163 concerning corrected observations.

CHAPTER A10. PILOTS' REPORTS

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CHAPTER A10. PILOTS' REPORTS[1/]

A10000. GENERAL

A10020. Log of Differing Local Weather Observations.—A log will be maintained of differences in local weather conditions observed by a pilot in flight from those observed at the ground. The pilot's position with respect to the station and the exact time he took the observation will invariably be entered in the log. The log should also contain any other information that, in the judgment of the observer, is pertinent to any subsequent investigation of differing weather observations. The log will be retained in the station files for at least one year, after which it may be destroyed. When this information is recorded in the communications log at CAA observation stations, a separate record need not be maintained.

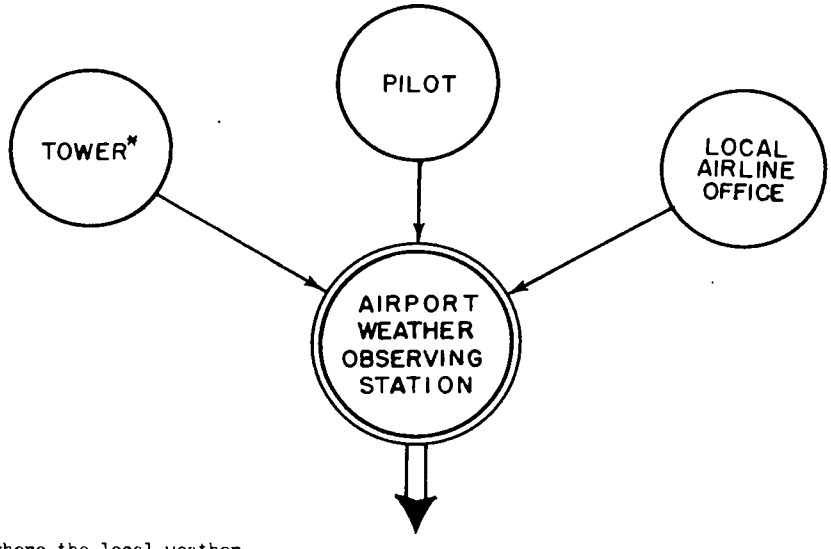
*A10030. Receipt of Pilot Reports.—In order that all pireps may become available for dissemination promptly after their receipt at the ground station, and to insure that any differences in reports of local weather may be discussed with pilots or ground personnel of commercial airlines before the relevant circumstances have been forgotten, the personnel at each station used as a terminal for commercial airlines will arrange with the ground personnel of the airlines for prompt delivery and, where necessary, discussion of pilots' reports. Common sources of pilots' reports, and the channels through which they should normally be routed, are diagramed in Fig. A10-1.

1/ The paragraph numbers in this chapter correspond so far as possible to related paragraphs in the WBAN portion.

Fig. A10-1

PIREPS ROUTING

(Weather observing station without local FAWS office.)

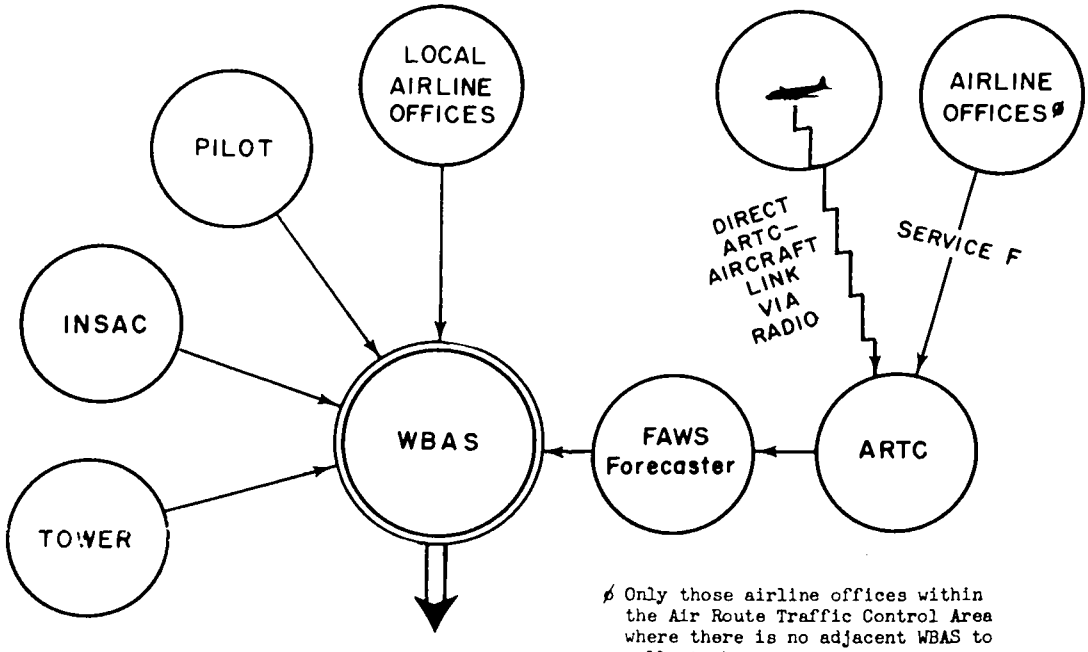


*Also INSAC where the local weather observing station is a WBAS

SERVICE A

PIREPS ROUTING

(WBAS with local FAWS office)



ø Only those airline offices within the Air Route Traffic Control Area where there is no adjacent WBAS to collect the reports

SERVICE A

A10200. DISSEMINATION (FORM 3024F)

*A10210. General.--Form 3024F, Weather Report for Transmission - Pilot Reports, is for optional use in recording pireps for communications purposes. Pireps may be entered on this form by air-ground communications personnel for convenience in relaying them to the local weather-observing station, or by observing personnel for furnishing pireps to communications personnel for transmission on Service A or for local broadcast. Additional copies may be prepared in accordance with local needs. File copies need not be retained. Entries on Form 3024F will be made in accordance with column headings and coding instructions in Sec. 10100. (See Fig. A10-2.)

WB Form 3024 F
(7-1-52)

WEATHER REPORT
FOR TRANSMISSION
U. S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

Date: Aug. 15, 1952

263

PILOT REPORTS

CHI (STATION) 1535C (TIME) PIREP

Location or extent of phenomena	Time of obsn.	PHENOMENA REPORTED	Altitude of phenomena	Type of Aircraft
15 S JOT	1515C	DISCHARGE	25	DC4
35 NW CHI	1522C	MDT TURBC	60	

Initials L.R.D.

Fig. A10-2. WB Form 3024F, Pilot Reports.

A10300. WBAN-12

*A10310. Preparation.--WBAN-12 (Pilot Reports - WB Form 1130E) will be prepared in duplicate at first-order observing stations only. Use a black lead drawing pencil (Venus 2H, 3H, or equivalent). Second-order stations will not record pireps, but will transmit them on Service A in accordance with ¶ 10210. The time ascribed to pireps that are transmitted but not recorded on WBAN-12 (see ¶ 10120(2)) will be the time that the pirep is prepared for transmission.

*A10320. Disposition.--Original copies of WBAN-12 will be mailed to the WRPC by the second working day of each month. They will be returned after verification to the originating station, where they will be retained as part of the station record. Carbon copies will be forwarded to the Section Center after corrections, if any, have been made as specified in ¶ A11032. When no pireps were recorded during the month of record, enter "No pireps" on the form and forward in the foregoing manner.

CHAPTER A11. ENTRIES ON FORM WBAN-10 1/

A11001. WBAN-10A, B, and D.—WBAN-10A, B, and D will be prepared in duplicate. Additional copies required locally may be prepared.

A11001.1. WBAN-10A.—At stations scheduled to take less than 24 observations a day and where Form WBAN-10B is not prepared, a new WBAN-10A need not be started daily. Instead, enter the date on the line preceding the first entry for each day and enter the data consecutively.

A11001.2. WBAN-10B.—Preparation of WBAN-10B is not required at stations where ordinarily only dry- and wet-bulb temperatures and total sky cover are recorded on this form. Use only WBAN-10A, entering dry- and wet-bulb temperatures in columns 14A and 14B, and total sky cover in column 13 immediately adjacent to column 14A.

A11005. Disposition.—Completed WBAN-10 forms will be forwarded as indicated in the following paragraphs (see Introduction to the Addendum).

A11005.1. Original copies of completed WBAN-10 forms will be disposed of as follows:

(1) Mailed from first-order and CAA stations to the WRPC —

(a) Each Saturday. This will include all forms for the week through Friday. Mailing of these forms may be deferred until the following Monday at stations having multiple registers but only a limited staff available on Saturday to compute, check, and transcribe data from Form 1017.

(b) By the second working day of each month. This mailing will include forms for the last several days of the previous month.

(2) Mailed from second-order stations (including SAWR) to designated first-order stations by the second working day of the month.

(3) Returned after verification to the originating first-order station, where they will be retained as a part of the station record.

(4) First-order verifying stations will forward WBAN-10 forms from SAWRS and A-type, second-order stations to the National Weather Records Center, Asheville, N. C., at quarterly intervals for the quarters: January - March, April - June, July - September, and October - December. Identify the shipment on the outer wrapper e.g., "SAWRS Records", and list the contents of the shipment in an accompanying letter. Forward a copy of the letter to the Central Office, Attention: O-2.

1/ The paragraph numbers in this chapter correspond so far as possible to the WBAN portion.

A11005.2. Carbon copies of completed WBAN-10 forms will be disposed of as follows:

(1) At first-order stations, the copies will be forwarded to the Section Center after corrections, if any, have been made as specified in par. A11032.

(2) At second-order stations (including CAA and SAWR), the copies will be retained for ninety days, after which they may be destroyed.

A11006. Record Observations During a Pibal.—Data pertaining to a record observation omitted because of a pibal will be entered on WBAN-10 as follows:

(1) Data obtained by interpolation or from interpolated data will be entered in parentheses.

(2) Enter "R" in column 1.

(3) Enter, in columns 2 and 16, the reference time of the sequence in which the omitted observation normally would have appeared.

(4) Enter data pertaining to ceiling, sky, visibility, weather and obstructions to vision, and clouds and obscuring phenomena in the appropriate columns. These data will be observed during the pibal at the time the omitted observation is scheduled to be taken.

(5) To the extent that they are available, data from the thermograph and telepsychrometer will be used in obtaining the dry-bulb and dew-point values. Otherwise, obtain these values to tenths of a degree by interpolating between the dew-point and dry-bulb values of the record observations immediately preceding and following the missing observation. Enter these data to whole degrees in columns 7 and 8, and to tenths of a degree in column 18. When the dew point is obtained by interpolation, compute the wet-bulb value and enter it in column 19. Use the interpolated dry-bulb and dew-point values, and the dew-point table of either the abridged or complete Weather Bureau Psychrometric Tables, for this computation. When the interpolated dew point is below 32°, use Table 9 (Dew Point Conversion Table) to determine the dew point with respect to ice before using the Psychrometric Tables, to compute the wet-bulb temperature.

CHAPTER A12. MARINE OBSERVATIONS

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CHAPTER A12. MARINE OBSERVATIONS [1]

*A12309.1. Exposure and Installation of Pressure Equipment.--The precision aneroid barometer mechanism and microbarograph are installed in gas tight chambers and are exposed to atmospheric pressure by means of pipes connecting the chambers to the outside of the ship. The instruments are installed as near as possible to the ship's center of gravity, with the microbarograph pen athwartship. Number 5 dashpot liquid should be used for the microbarograph.

A12309.2. Maintenance of Pressure Equipment.--Once each week, and after precipitation or heavy seas, the plenum of the pressure system should be drained as follows: Insert a wire in the petcock to insure complete drainage. If salt or soot deposits are present, remove the petcock and flush the inside of the plenum with fresh water. When ice has formed in any portion of the pressure system, use a torch, hot-air blower or some other suitable heat source to melt the ice. Heat should be applied from the bottom to the top of the system with the petcock removed so that water formed will drain out. During periods of very low temperature it may be necessary to reheat the plenum to remove completely any ice in the lines. Large accumulations of ice around the exposed static-tube orifice should be removed to prevent entry of excess water. Regular servicing of the pressure system should be done immediately after a scheduled surface observation.

A12309.3. Barometer Comparisons.--Prior to departure for patrol, and again promptly upon return to port, make a series of comparative readings between the ship's precision aneroid barometer and a barometer used as the comparison standard. If a precision aneroid inspection barometer is available, it will be used as the comparison standard following verification of the established correction of this barometer; otherwise, a nearby mercurial barometer (selected in accordance with ¶A12309.31) will be used as the comparison standard. Enter comparative data on Form 1027A in accordance with instructions on the form and the following subparagraphs.

A12309.31. The barometer used as the comparison standard, either for verifying the correction of an inspection precision aneroid barometer or for comparative readings with a ship's barometer, will usually be the mercurial barometer appearing highest in the following list; however, if another barometer on the list is considerably closer to the compared barometer, either vertically or horizontally, it should be used as the comparison standard:

(1) A substandard barometer

1/ The paragraph numbers in this chapter correspond so far as possible to related material in the WBAN chapter.

(2) A field-aide, home-station barometer

(3) A station barometer

It is desirable to use the same barometer as the comparison standard for consecutive series of comparisons pertaining to the same ship's barometer. When the barometers are in separate locations, prearrange the time of readings so that they will be made simultaneously.

A12309.32. Verify the established correction for the inspection aneroid barometer by computing the difference between sea-level pressure as determined simultaneously from both the inspection barometer and the mercurial barometer selected in the foregoing manner. Compute the difference twice; once from sea-level pressures determined before the inspection barometer is carried aboard the ship, and again from pressures determined after the barometer is aboard. If neither difference exceeds 0.02 inch, the inspection barometer will be used as the comparison standard in accordance with ¶ A12309.33. If either difference exceeds 0.02 inch, use the mercurial barometer for checking the ship's barometer in accordance with ¶ A12309.34, and do not use the inspection barometer for this purpose until a new correction has been established for it in accordance with ¶ A7221.

A12309.321. To determine the difference in sea-level pressure between an inspection aneroid barometer and a mercurial barometer, apply the corrections, established in accordance with Sec. 7200 and ¶ A7221.1, to obtain the respective station pressures, and reduce the station pressures to sea level in accordance with Sec. 7300, using the current outdoor temperature instead of the 12-hour mean value, and:

(1) When both instruments are at the same elevation, add algebraically the removal correction on Form 1059 of the comparison-standard mercurial barometer to the inspection barometer reading, and reduce the resultant sum to sea level by means of the reduction tables supplied for the mercurial barometer.

(2) When both instruments are not at the same elevation, reduce the inspection barometer reading to sea level by means of the following table (Table A12-1), and reduce the reading from the comparison-standard mercurial barometer in accordance with (1) above.

Pressure in inches												
Height in feet	Temperature, Fahrenheit											
	-20	-10	0	10	20	30	40	50	60	70	80	90
0	0.128	0.125	0.122	0.119	0.117	0.114	0.112	0.110	0.108	0.106	0.104	0.102
500	.125	.122	.120	.117	.115	.112	.110	.108	.106	.104	.102	.100
1000	.122	.120	.118	.115	.113	.110	.108	.106	.104	.102	.100	.098

Pressure in millibars												
Height in feet	Temperature, Fahrenheit											
	-20	-10	0	10	20	30	40	50	60	70	80	90
0	4.33	4.23	4.13	4.03	3.96	3.86	3.79	3.73	3.66	3.59	3.52	3.45
500	4.23	4.13	4.06	3.96	3.89	3.79	3.73	3.66	3.59	3.52	3.45	3.39
1000	4.13	4.06	4.00	3.89	3.83	3.73	3.66	3.59	3.52	3.45	3.39	3.32

Table A12-1. Table of pressure-differences per 100-foot difference in elevation for given values of elevation and temperature

A12309.33. When the ship's barometer is compared with an inspection aneroid barometer as the comparison standard (see ¶ A12309.321), make the comparison as follows:

(1) Enter in columns 3 and 4 of Form 1027A at least four comparative readings between the barometers, made preferably one to two hours, but not less than one-half hour apart, with both instruments at the same elevation. Obtain the differences between the values in columns 3(b) and 4, and enter these differences in column 5, and the sum and mean of column 5 at the bottom of the column.

(2) The mean of column 5, as determined in (1), is the correction to be applied to the ship's aneroid barometer reading to obtain station pressure while on patrol. To obtain the correction necessary to reduce the ship's aneroid barometer readings to sea level, add 0.0011 inch (0.037 mb.) to the mean of column 5 for each foot that the barometer is above sea level.

EXAMPLE

Given:	Ship's aneroid barometer reading	1015.4 mb.
	Mean of column 5	0.5 mb.
	Height of barometer above sea level	17 ft.

Computations:

(1) Station pressure from observed pressure:

1015.4 mb. - ship's barometer reading
0.5 mb. - mean of column 5
1015.9 mb. - station pressure

(2) Elevation correction:

17 ft. x 0.037 mb. per ft. = 0.6 mb.

(3) Sea-level pressure from observed pressure:

1015.4 mb. - ship's barometer reading
0.5 mb. - mean of column 5
0.6 mb. - elevation correction
1016.5 mb. - sea-level pressure

(4) Sea-level pressure from station pressure:

1015.9 mb. - station pressure
0.6 mb. - elevation correction
1016.5 mb. - sea-level pressure

A12309.34. When the ship's barometer is compared with a mercurial barometer as the comparison standard (see ¶ A12309.321), make the comparison as follows:

(1) Enter in columns 6 and 7 of Form 1027A at least four comparative readings between the barometers, made preferably one to two hours, but not less than one-half hour apart, and reduce the mercurial barometer readings to sea level in the manner specified in ¶ A12309.32. Obtain the differences between the values in columns 6 and 7, and enter these differences in column 8. Find the mean of the entries in column 8.

(2) The mean of column 8, as determined in (1), is the correction to be applied to the ship's aneroid

barometer reading to obtain sea-level pressure. To obtain the correction necessary to convert the reading of the ship's aneroid barometer to station pressure, subtract 0.0011 inch (0.037 mb.) from the mean of column 8 for each foot that the barometer is above sea level.

EXAMPLE

Given:	Ship's aneroid barometer reading	30.055 in.
	Mean of column 8	.010 in.
	Height of barometer above sea level	14 ft.

Computation:

(1) Sea-level pressure:

30.055 in. - ship's barometer reading
0.010 in. - mean of column 8
30.065 in. - sea-level pressure

(2) Elevation correction: 1/

14 ft. x -0.0011 in. per ft. = -0.015 in.

(3) Station pressure:

30.065 in. - sea-level pressure
-0.015 in. - elevation correction 1/
30.050 in. - station pressure

(4) Correction to convert observed pressure to station pressure:

0.010 in. - mean of column 8
-0.015 in. - elevation correction
-0.005 in. - station-pressure correction for ship's barometer readings

1/ Note that this correction has the same numerical value as the correction to reduce station pressure to sea-level pressure, but the sign is opposite.

A12309.35. Approval of the completed Form 1027A by the port supervisor should be secured before departure of the vessel; when this is impracticable, the official in charge of the patrol is authorized to approve the form. Form 1027A may be destroyed after six months. Comparative readings of the microbarograph with the inspection barometer are not necessary, since the microbarograph is checked with the ship's aneroid barometer each day in accordance with ¶ A12309.5.

*A12309.4. Aneroid Barometer Adjustments.--Some precision aneroid barometers may be adjusted to zero whenever the correction to actual pressure at the instrument (station pressure) exceeds one millibar. Adjustments will be made on the following basis: (1) No attempt should be made to zero-set the Friez Type (5731 series) aneroid barometers or any other aneroid where the zero-adjusting screw cannot be reached without disassembling part of the instrument or possible damage to the mechanism. (2) The adjustment screw for the Kollsman-type aneroids will be found underneath the plug screw that is located near the static connection opening in the aneroid case. The plug screw and washer should be replaced as soon as the adjustment has been completed. (3) A suitable notation of any adjustment will be made on Form 1027A carrying the comparisons. The direction and amount of the adjustment will be clearly indicated on the Form. Comparisons will be made both before and after the adjustment is made.

A12309.5. Marine Microbarograph Readings.--When rolling of the ship causes the barograph pen to make a wide trace, or the indicator on the aneroid barometer to vibrate excessively, the mean position will be used for the station pressure. The pen should be touched lightly once each day at the 1200 GCT observation, and the correction to the microbarograph reading determined by comparing the corrected aneroid barometer reading with the microbarograph reading. These corrections will be entered at the corresponding points on the barogram after the latter has been removed from the cylinder.

*A12311. Wind Equipment.--The wind equipment on ocean-station vessels, which is the property of the Coast Guard, should be inspected for proper performance by Weather Bureau personnel, usually during in-port periods. Wind vanes are oriented with the ship's bow corresponding to zero degrees on the indicator. Any defects or poor exposures found should be promptly reported to the ship's commanding officer, and the Weather Bureau port supervisor. Comparisons of surface-wind speeds and directions should be made, whenever practicable, when two or more vessels are in port, and any significant differences should be brought to the attention of the ship's commanding officer and the Weather Bureau port supervisor.

A12321. Sea-Water Temperature.--The Weather Bureau will obtain condenser-intake thermometer readings from Coast Guard personnel by interphone, except that a Weather Bureau observer will personally read the condenser-intake thermometer for at least two non-consecutive scheduled observations each day.

*A12321.1. Condenser-Intake Thermometers.--By agreement with the Coast Guard, condenser-intake thermometers from ocean-station vessels are calibrated by the Weather Bureau. When a calibrated thermometer is received from the Instrument Division, it should be examined for any separation of the column. When a separation is found, do not use the thermometer for Weather Bureau observations. Request the ship's Commanding Officer to have the thermometer replaced, and inform the Central Office of the action taken.

*A12321.11. Calibration.--Request the ship's Commanding Officer to have uncalibrated condenser-intake thermometers calibrated by the Weather Bureau Instrument Division. If it is necessary to use an uncalibrated condenser-intake thermometer, and whenever a condenser-intake thermometer has been in use for six months since calibration or preceding comparison, request the Commanding Officer to make the condenser-intake thermometer available for comparison (see ¶ A12321.12).

*A12321.12. Comparisons.--Immerse the condenser-intake thermometer and a Weather Bureau dry-bulb thermometer in a bucket of water (at least two gallons). Stir the thermometers at least three minutes and until three readings taken at thirty second intervals indicate no progressive change in temperature. If the average readings from each thermometer (using available corrections) differ by more than one degree Fahrenheit, request the ship's Commanding Officer to have the condenser-intake thermometer calibrated as soon as possible, and inform the Central Office of the action taken.

*A12321.13. Corrections.--When the calibration corrections furnished by the Instrument Division exceed 2.0°F., request the ship's Commanding Officer to have the thermometer replaced, and inform the Central Office of the action taken.

*A12321.131. Until the corrections furnished by the Instrument Division are found to be unsatisfactory on the basis of comparisons made in accordance with ¶ A12321.12, correct the readings of calibrated intake thermometers by applying these corrections algebraically. Corrections of less than one degree should be disregarded. Interpolate as necessary to obtain corrections for readings between calibration points. Prepare a table or graph for this purpose and furnish a copy to the Commanding Officer of the vessel.

*A12321.132. When it is necessary to use an uncalibrated thermometer, or one that appears unsatisfactory (see ¶ A12321.12), determine the difference obtained by subtracting the average of the three readings of the condenser-intake thermometer from the average of the three readings of the comparison standard (Weather Bureau dry-bulb thermometer), and apply this difference with the same sign as a correction to readings from the condenser-intake thermometer. Disregard differences of one degree or less.

EXAMPLE

(1) Simultaneous readings:

	Condenser-intake thermometer	Weather Bureau dry-bulb thermometer
	56.6	55.4
	56.5	55.2
	56.5	55.3
Total:	169.6	165.9
Average:	56.5	55.3

(2) Correction to condenser-intake thermometer readings: -1.2°F., i.e., 55.3 minus 56.5.

A12400. Transmission of Surface Observations.--The word "Surface" will be prefixed to surface-observation messages from ocean-station vessels to identify the messages in ship-to-shore transmissions (see ¶ 12120).

*A12500. Mailing Records.--After each patrol, WBAN-11A and B, WBAN-10D, and Form 1068 will be sent to the supervising station for prompt forwarding to the National Weather Records Center, Asheville, North Carolina. Two copies of a letter of transmittal, listing all records forwarded, should be enclosed. One copy of the letter will be returned by National Weather Records Center, when the records are received. (See ¶ 12213.)

CHAPTER A14. VERIFICATION OF FORMS

A14000. GENERAL

A14010. Purpose.--Records of meteorological observations are verified primarily for the purpose of maintaining a high standard of accuracy in taking and recording meteorological observations. Complete reference will be made to instructions governing the reporting and recording of any data found to be in error.

A14011. Officials in charge at verifying stations are requested to report to the Central Office types of discrepancies apparently resulting from the inadequacy of instructions.

A14100. AT ORIGINATING FIRST-ORDER STATIONS

A14101. All entries on observational records prepared at first-order stations will be verified by someone other than the original observer as soon as practicable after the observation is taken. The official in charge or a designated assistant will review all forms for completeness and general compliance with instructions prior to mailing them.

A14200. PREPARED AT SECOND-ORDER (OTHER THAN CAA) STATIONS

A14201. Observational records from second-order stations, other than CAA stations, will be verified at first-order verifying stations as follows:

(1) Verify every fifth observation as completely as possible.

(2) Inspect the remaining observations for general compliance with instructions and for consistency. Determine that marked departures between consecutive values of sea-level pressure, altimeter setting, dew point, etc., are not indicative of errors.

(3) Review all forms for completeness; e.g., station name, date, etc.

A14300. CORRECTING RECORD FORMS

*A14310. Magnitude of Errors.--Corrections to the following types of recorded data are not required, and discrepancies will not be reported to the station nor errors charged, unless the magnitude of errors (the difference between the observer's and verifier's evaluation) exceeds:

(1) 0.01 inch (0.3 mb.) in station pressure, sea-level pressure, or altimeter settings.

(2) 1.0°F. in dew point, unless the recorded dew point is higher than the recorded wet-bulb temperature, in which case the dew point will be corrected and a discrepancy will be charged.

(3) 2% in relative humidity (using the dew-point temperature as originally computed by the observer, provided it was within the foregoing tolerance).

*A14320. Preparation and Routing of WB Form 5066, Corrections to Weather Records.—Each month, Form 5066 will be prepared in quadruplicate at WRPC's and first-order verifying stations, and the copies will be routed to stations whose solar radiation records, or Forms 1001B and C, 1083, or WBAN-10, are verified, even though discrepancies are not charged.

A14321. Preparation.—(See Fig. A14-1.) At the top of Form 5066, enter the addresses of the originating and verifying stations and the date of preparing the form. Under the caption "Corrections to Weather Records," enter the dates necessary to complete the statement.

A14321.1. Enter additional data as required below, except that on forms addressed to first-order stations at which punched cards are prepared, omit the data pertaining to WBAN-10A and B (see par. A14322).

A14321.11. In the column headed:

(1) "Form Number, Date and Time," - enter the WB numbers of forms requiring correction, together with the dates and times of the corrected data. One entry of the form number will suffice for consecutive entries pertaining to the same form.

* (2) "Data and Reference" - enter identification of the erroneous data, and enter references to instructions governing the reporting of the data (see Fig. A14-1). Since a copy of the form may not be retained at stations at which Form 1083 is prepared, the nature of the erroneous data should be identified in detail and the initials of the observer indicated to enable the responsible observer to benefit from the references.

(3) "Recorded" - enter the uncorrected data.

(4) "Should Be" - enter the corrections.

(5) "Observer's Initials" - leave blank for use by observer responsible for the errors.

A14321.12. "Remarks" - enter appropriate references to instructions and comments concerning the appearance and general quality of forms and punched cards. At WRPC's enter comments relating to:

(1) Improper punching of Card No. 7 "WBAN Transmittal and Inventory".

(2) Inventory obviously in error.

(3) Missing or duplicate punched cards.

(4) Cards punched off-column.

(5) Holes improperly, or imperfectly punched.

(6) As separate entries, the total number of observational, and the total number of punching errors for the month.

A14322. Routing.—Send the original and one copy of Form 5066 directly to the observing station, and one copy to the Training Office. Retain one copy at the station. Erroneous punched cards from first-order stations will be attached to the original copy, with the correct data clearly indicated. This will eliminate the necessity for itemizing the errors. On forms for CAA and other second-order stations, the observational errors will be itemized as required by par. A14321.1.

A14330. Filing of Punched Cards and Form 5066.—Upon receipt of Form 5066, both copies of the form will be initialed by the observers responsible for the errors; except that in the absence of an observer, the official in charge of the station will enter the printed initials of the observer responsible followed by his own initials in parentheses. The official in charge, chief communicator, or designated assistant of either, will sign the original and forward it in accordance with the instructions printed on the form. The carbon copy and the punched cards (when returned) will be retained until inspected by a field aide. After inspection, cards and forms retained for more than six months may be destroyed.

A14331. Original copies of Form 5066 returned to the verifying station will be forwarded to the headquarters station of the field aide who regularly visits the observing station concerned. These forms will be retained for two years, after which they may be destroyed.

WB Form 5066

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

Weather Bureau Airport Station
Dannelly Field
Route 2
Montgomery, Alabama

Date July 12, 1952

Mr. John Doe
Weather Observer
Doeville, Alabama

MEMORANDUM

Corrections to Weather Records

In verifying forms from your station for June, 1952, corrections were made as set forth below. Each correction should be checked by the person who made the record or summarization. Please correct your retained records accordingly, being especially careful to include all resulting changes. The original and carbon should be initialed by the observers whose records have been corrected. The original will be signed by the Official in Charge and returned within 5 days after receipt to the office from which this memorandum was received. The carbon copy will be retained in the station files.

Form Number		Col	Data	Reference		Recorded	Should Be	
Date	Time			Cir	Par			
WBAN-10:								
05	1430	5	Obstructions to Vision (Haze recorded 1330 and 1530. Visibility recorded 6 miles	N	- 3911	Omitted	H	
07	1230		Line 63 - Station Pressure			29.632	29.732	
25	1630	3	Sky - (example 8)	N	- 1511	M10-⦶	10-⦶	
26	1230	47	Max. Temp. - 6-hourly observation (Dry-bulb reading at 1230, 65)	N	- 5550	63	65	
28	0630	48	Min. Temp. - 6-hourly observation (Dry-bulb reading at 0530, 49)			50	49	

REMARKS

DISCREPANCIES
Observational . . . 5
Punching 2
Total 7

Date.....

All retained records have been corrected or noted on the reverse side.

Official in Charge.
WB Form 5066

Fig. A14-1. Example of Form 5066 addressed to a second-order station.

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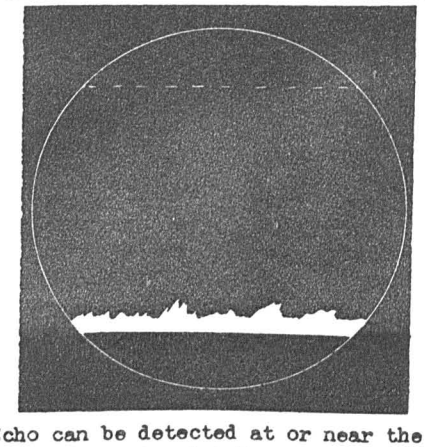
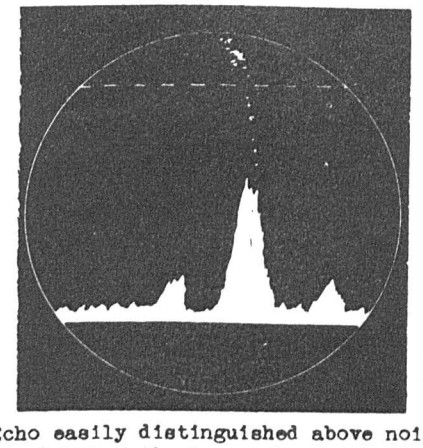
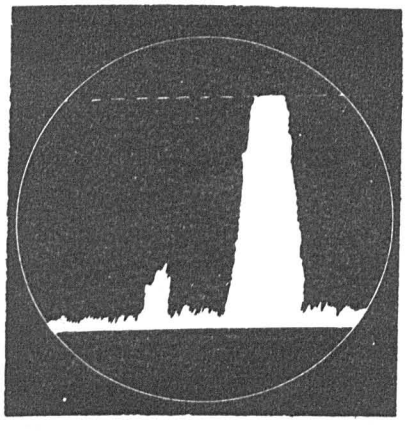
Appearance of A-scope	Intensity
 Echo can be detected at or near the noise level.	Weak if range is less than 50 miles. Moderate if range is more than 50 miles.
 Echo easily distinguished above noise level but fails to reach or exceed saturation.	Moderate if range is less than 50 miles. Strong if range is more than 50 miles.
 Echo completely saturates scope.	Strong if range is more than 20 miles. Moderate or strong if range is less than 20 miles.

Fig. A15-1. Relation of the appearance of A-scope to intensity.

*A15305.1. Enter on Form 610.3-1, under the caption "Intensity," the appropriate contraction selected from the following list:

Intensity	Contraction
Weak	WK
Moderate	MDT
Strong	STG

A15305.2. Use Fig. A15-1 to relate the appearance of the A-scope to the intensity.

A15306. Tendency.—The tendency will be based upon consecutive observations of intensity. Enter on Form 610.3-1, under the caption "Tendency," the appropriate contraction selected from the following list:

Tendency	Contraction
Increasing	INCRG
Unchanging	NO CHG
Decreasing	DCRG
Slowly	SLOLY
Rapidly	RPDLY

A15307. Position.—The shape and size of each echo and its direction and distance from the station, will be evaluated. To facilitate observing in these terms, the echoes will be visualized in one of the typical patterns:

(1) Direction and distance to ellipse pattern (see Figs. A15-2 and A15-3).

(2) Direction and distance to circular pattern (see Figs. A15-4 and A15-5).

(3) Direction and distance to combinations of individual echoes (see Figs. A15-7 and A15-8).

(4) Azimuth and range of spiral bands (see Figs. A15-9 and A15-10).

The echoes will be evaluated in terms of whichever pattern fits best. Each pattern is discussed below. After the direction and distance to the echo have been observed in accordance with the following instructions, enter the data on Form 610.3-1 under the captions Direction and Distance. Enter direction to sixteen points of the compass, and distance to the nearest whole statute mile. The direction and associated distance will be entered in adjacent columns. As many additional data as are necessary will be entered similarly.

A15312. Direction of Movement.--Direction of movement is expressed in terms of the direction from which the echo is moving, and is based upon two consecutive observations taken about fifteen minutes apart.

A15312.1. To determine the direction of movement, plot the location of the center of the echo at each observation on a plotting board or an aeronautical chart covered with transparent material. Draw a line through the centers of both echoes. Determine the bearing from the second position to the first. This bearing is the direction of movement.

A15312.2. Enter on Form 610.3-1, under the caption "Direction," the direction of movement to sixteen points of the compass.

A15313. Speed of Movement.--The speed at which an echo moves will be expressed in miles per hour by dividing the distance in statute miles between the centers of the plotted echoes by the elapsed time between observations.

A15313.1. When the movement of the echo patterns is not uniform, adjust the antenna and receiver gain controls until all but the strongest or largest echoes have been excluded from the scope. A more uniform rate of movement will usually be obtained by tracking and plotting these echoes.

A15313.2. Enter the speed on Form 610.3-1 under the caption "Speed" to the nearest whole statute mile per hour.

A15314. Height.--The height of echoes will be determined at stations supplied with equipment appropriate to the purpose. All values of height refer to the uppermost limit of visible moisture that may be detected by radar. Therefore, it will not be assumed that height data refer to the tops of clouds. Moreover, height data at long ranges are inaccurate because the elevation angles are very small, and corrections are not made for the curvature of the earth and for deviations of the radar beam from normal propagation. At very close ranges, the vanishing point of an echo may occur at the leading edge of a storm, whereas the actual top of the storm may be considerably farther from the station and at a lower elevation angle. To limit the magnitude of these inaccuracies, determinations of height will be made only between the ranges of 15 to 50 miles.

A15314.1. If the vertical angle of the antenna beam can be varied, determine the apparent height of the echoes as follows:

(1) Using manual control, center the antenna on the most intense portion of the echo.

(2) Tilt the antenna and read the angle when the echo first disappears.

(3) Subtract half the vertical beam width from the angle read in (2).

* (4) Determine the height using Fig. A15-12, or using the method given in (5) and (6).

(5) Multiply the sine of the angle found in (3) by the distance to the echo. The product will be the height in nautical or statute miles, depending upon the radar used.

(6) Convert the value found in (4) from miles to feet by multiplying the value by 6080, or 5280, depending on whether nautical or statute miles are used in (4) above. Add to the converted value the height of the station above mean sea level.

A15314.2. Enter the height on Form 610.3-1 under the caption "Height" to the nearest hundreds of feet; e.g., 25,000 would be entered as 250.

A15315. Remarks.—Enter under "Remarks" such data as will support and amplify the observation and such additional data as has not been reported by a surface-observation station. Authorized contractions will be used so far as possible in making entries. Remarks which are not transmitted will be entered in parentheses.

A15315.1. Enter data pertaining to unusual echo formations, e.g., inversions, precipitation areas centered at station, etc.

A15315.2. Enter additional data pertaining to echoes characteristic of the precipitation areas associated with hurricanes. The azimuth to the nearest whole degree, range, direction and speed of movement of the apparent eye will be recorded. If the eye of the storm is off the edge of the scope (out of range of the radar set), no attempt will be made to give the position of the eye. The terms "hurricane," "tropical storm," etc., will not be used in describing the echoes, either in public contacts or transmitted reports.

Examples of Remarks

Observed data:	Thunderstorm reported ten miles west of Washington National Airport moving from the southwest.
Entry under remarks:	TSTM RPRTD 10 W DCA MOVG FM SW.
Observed data:	Strong echo identified as tornado, 100 miles west of station, moving from southwest at 25 miles per hour.

* Entry under remarks: STG ECHO IDNFYD AS TORNADO 100W MOVG FM SW/25.

Observed data: Center of storm at 60 degrees and range 110 miles, diameter six miles, moving from southwest at 28 miles per hour.

Entry under remarks: CNTR AZRAN 60/110 DIAM 6 MOVG FM SW/28.

A15316. If more than one echo or group of echoes appears on the scope, the procedure described in this section will be repeated as necessary to define them all, except as provided in par. A15309.

A15400. EVALUATION OF ECHOES, OCEAN STATIONS

A15401. General.—At ocean stations, radar echoes are evaluated similarly, in many respects, to those at land stations. Whenever the process is similar, ocean-station personnel will be referred to the relevant instructions in section A15300. Since Coast Guard personnel operate the radar equipment, instructions for the detection of echoes will not be included in this manual.

A15402. At the scheduled time of beginning each radar observation, the observer will ascertain of the radarman whether meteorological echoes are visible on the scope. Whenever echoes are present, the observer will inspect the scope, evaluate the echoes, and code them. The coded data will be entered on Form 610.3-2 "Radar Weather Observations, Ocean Station." Whenever echoes are not present, an observation will not be made.

A15403. The Radar Storm Detection Code will be used to code the echoes. The code is bound at the end of this section, and it is also issued separately printed on cardboard. The code comprises seven tables, each of which is described below in terms of evaluated echoes.

A15404. If more than one echo or group of echoes appears on the scope, the procedure described in this section will be repeated as necessary to define them all.

A15410. Type of Echo.—Evaluate as elliptical or circular in accordance with pars. A15307.1-.41 Determine the length or diameter in accordance with pars. A15310-10.4. Code in Table 1. Code figures 0 and 1 will not be used by Weather Bureau stations.

A15420. Orientation.—Evaluate in accordance with par. A15308. Code in Table 2. When the type of echo is coded as circular (code figures 6 through 9 of Table 1), a slant mark will be used.

A15430. Echo Coverage of Circular Area.—When the type of echo is coded as circular (code figures 6 through 9 of Table 1), the code figure most closely approximating the amount of the circular area covered by the echo will be selected from Table 3. Note that this figure refers to the coverage of the circular area and not to the coverage of the entire scope face.

A15440. Width of Line of Echoes.—When the type of echo is coded as elliptical (code figures 2 through 5 of Table 1), evaluate in accordance with par. A15311.3. Code in Table 3A.

A15450. Direction of Center from Station.—Evaluate in accordance with par. A15307.11 and A15307.21. Code in Table 4.

A15460. Distance from Station.—Evaluate in accordance with pars. A15307.11 and A15307.21, except that nautical miles will be used. Code in Table 5.

A15470. Direction from Which Echo Pattern is Moving.—Evaluate in accordance with pars. A15312 and A15312.1. Code in Table 6.

A15480. Speed of Echo Movement.—Evaluate in accordance with pars. A15313 and A15313.1, except that knots will be used. Code in Table 7.

A15490. Height in Feet MSL, of Echo Top.—Evaluate in accordance with pars. A15314-A15314.1. Code in Table 8.

A15500. FORMS

A15510. General.—This section concerns instructions for entry of identification data on Form 610.3-1, "Radar Weather Observations, Land Station" and Form 610.3-2, "Radar Weather Observations, Ocean Station."

A15511. Enter the month, and year in the appropriate space in the upper right corner of the form, e.g., June 1949.

A15512. Enter the name of the station (and vessel, in the case of ocean stations) in the space in the upper left corner of the form.

A15513. Enter the type of radar in the space in the upper center of the form.

A15520. Land Station Form 610.3-1.—This form will be started at 0000 LST on the first day of each month. Data pertaining to more than one day may be entered on a single form. The following paragraphs are captioned to correspond with similarly captioned columns on Form 610.3-1. When echoes are observed but data required by the captions on Form 610.3-1 are missing or unknown, omit entries. If the equipment is inoperative, all entries will be omitted between the reports of cessation and resumption of operation.

A15521. Date.—Enter the date of the observation.

A15522. Time.—In the blank space at the head of the column, enter a letter to indicate the standard of time in use. Enter the time of completing the observation, to the nearest minute, in terms of the 24-hour clock.

A15523. Rarep Number.—The first radar report (RAREP) of the day will be numbered "1." The second will be numbered "2," etc. A new series of numbers will be started at 0000 LST.

A15524. Operational Status.—Enter a contraction pertaining to the operational status of the equipment as required by the table below. In the following list, "PPI" refers to the scope (plan position indicator); the additional letters refer to the "no echo" (NE), "out of service for maintenance" (OM), etc. These contractions may be used separately or in combination with echo reports.

Status	Contraction
Equipment performance normal, echoes not observed.	PPINE
Equipment out of service for maintenance. (Follow the contraction with a figure to indicate the number of hours that equipment is expected to be inoperative.)	PPIOM
Equipment inoperative owing to breakdown.	PPINO
Normal operation is resumed.	PPIOK
Observation omitted for a reason other than those above.	PPINR

A15525. Initials. The observer's initials will be entered in this column.

A15530. Ocean Station, Form 610.3-2.—A new form will be started at the beginning of each month, GCT, and at the beginning of each patrol. If equipment is inoperative, all entries will be omitted between the reports of cessation and resumption of operation.

*A15531. Identification.—The captions at the head of each column are self explanatory. Entries will be made in accordance with the following list:

(1) Day of month.

(2) Day of week (Y). See Table 28.

(3) Octant of globe (Q). See Table 24.

(4) Latitude and Longitude ($L_aL_aL_a$, $L_oL_oL_o$). See ¶ 12324(c) and 12325(a).

(5) Greenwich Civil Time (GG). See ¶ 12325(b).

(6) The letters "SD" to identify the report as a "storm detection (radar)" report.

A15540. Disposition of Forms.—At the end of each month (or each patrol), mail the completed forms to the Central Office, attention SF&MO Division.

A15600. TRANSMISSION OF RADAR REPORTS

A15610. Land Station, Form 610.3-1.—RAREPS (radar reports) will be transmitted to report (1) echoes and associated data regarding location, height, intensity and movement, and (2) reports of inoperative equipment and resumption of service. When the scope becomes clear after one or more RAREPS, transmit "no echoes" (PPINE). A RAREP will not be transmitted thereafter until echoes are observed or the equipment fails. When the equipment fails, transmit the appropriate contraction once only; when operation is resumed, transmit the contraction "PPIOK" once only.

*A15611. Transmission Schedules.--Regular and special RAREPS will be transmitted on the SW teletype collection of Service A. However, when it is considered desirable, a RAREP may be appended as a remark to an aviation weather observation in accordance with ¶ 11103. The reports will be filed for transmission on Form 3024B or a suitable message blank.

*A15612. Order and Content.—The content of RAREPS will vary with the meteorological situation being reported. Data will be reported and transmitted in the order listed below to the extent that they are available. The arrangement of material in a RAREP indicates the nature of the data; therefore, the omission of data will not be explained by code groups or special devices. All material will be taken from Form 610.3-1 on which the necessary data will have been recorded in units and phrase contractions appropriate to direct use in the code; e.g., miles data entered in hundreds of feet will be coded in hundreds of feet, etc. Only such remarks as have not been reported by a surface observing station will be included in the transmitted report. A sample RAREP follows to illustrate the spacing and separation of the elements.

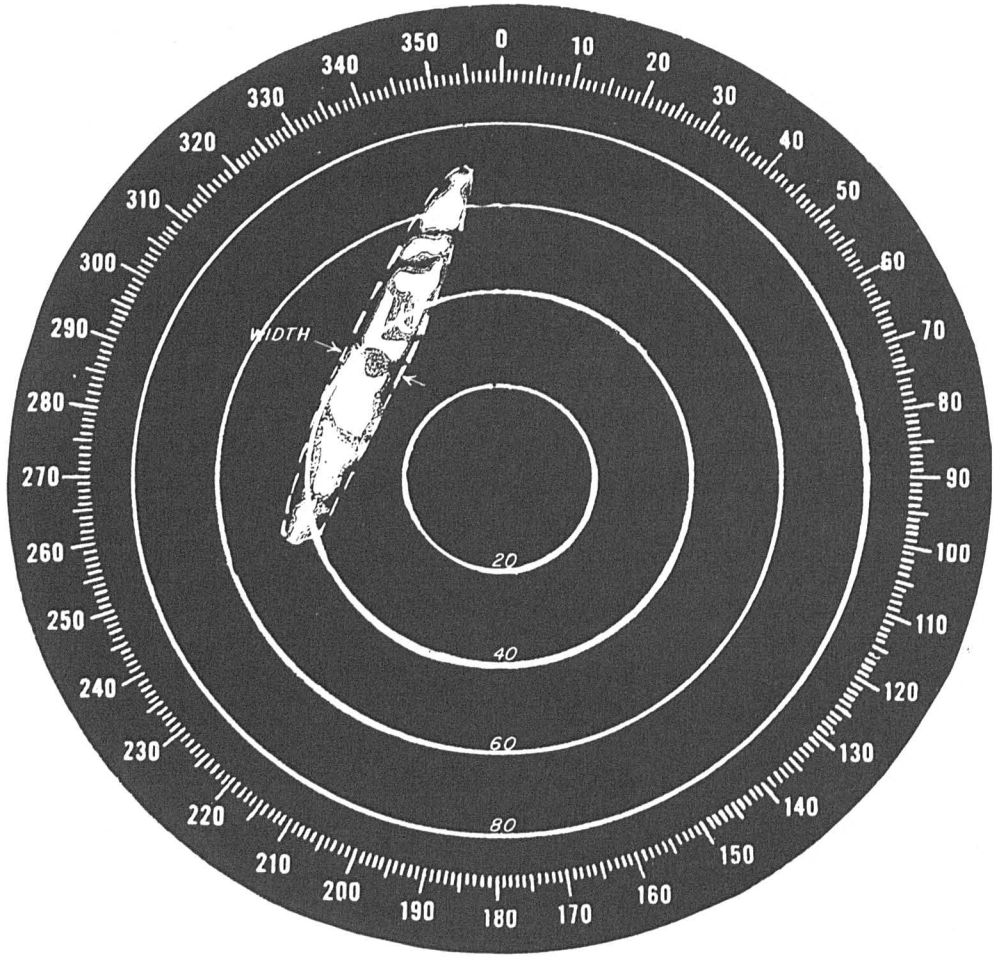


Fig. A15-3. Scattered echoes evaluated as ellipse.

The line of scattered echoes is visualized as an ellipse, since the distance between adjacent echoes in the group is less than the distance through the largest echo, and since the major axis is more than twice the minor axis. The azimuth bearings are recorded to sixteen points of the compass and distance readings to the nearest mile. The report of this echo would be evaluated as:

> Line of scattered echoes of moderate intensity; tendency - increasing slowly; direction and distance to the center of the echo NW, 35 miles; oriented NNE-SSW over Sandoz mountains; 80 miles long; 15 miles wide; moving from the northwest at 30 miles per hour (or knots); tops of echoes 20,000 feet MSL; Remarks, at 1430 C., a pilot reported a line of thunderstorms 50 miles northwest of the station.

At a land station, this would be coded as: LINE SCTD MDT INCRG SLOLY NW/35 ORNTD NNE-SSW OVR SANDOZ MTNS 80 LONG 15 WIDE MOVG FM NW/30 HGT 200 PIREP 1430C 50 NW LINE TSTMS.

At an ocean station, this would be coded as: SD117 73764.

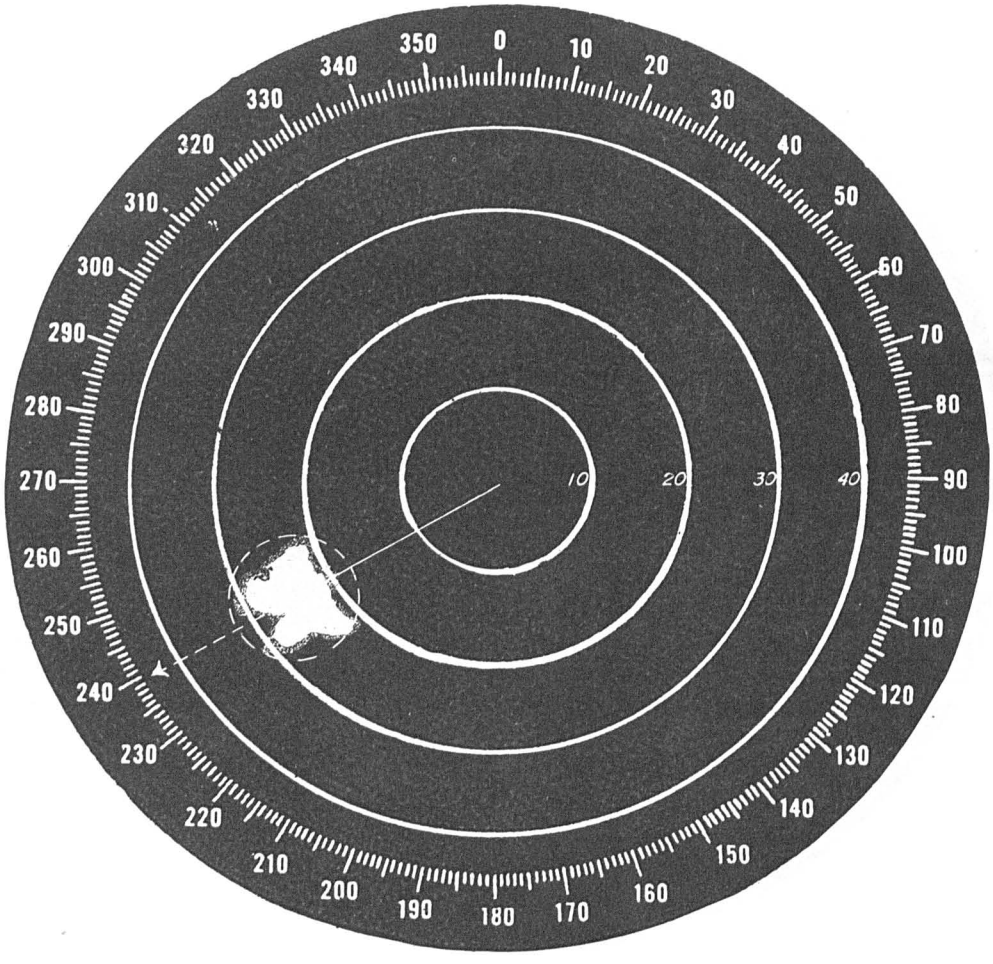


Fig. A15-4. Single echo evaluated as circle.

The single echo is visualized as a circle, since the major axis might lie in several directions. The azimuth and range pertain to the center of the circle. This report would be evaluated as:

> Solid, weak echo; tendency - decreasing; direction and distance to the center of the echo SW 25 miles in the vicinity of Childress; diameter 16 miles, moving from the SE at 15 miles per hour (or knots), height of top of echo 12,000 feet MSL.

At a land station, this would be coded as: SLD WK DCRG SW/25 VCNTY CDS DIAM 16 MOVG FM SE/15 HGT 120.

At an ocean station, this would be coded as: SD6/7 52332.

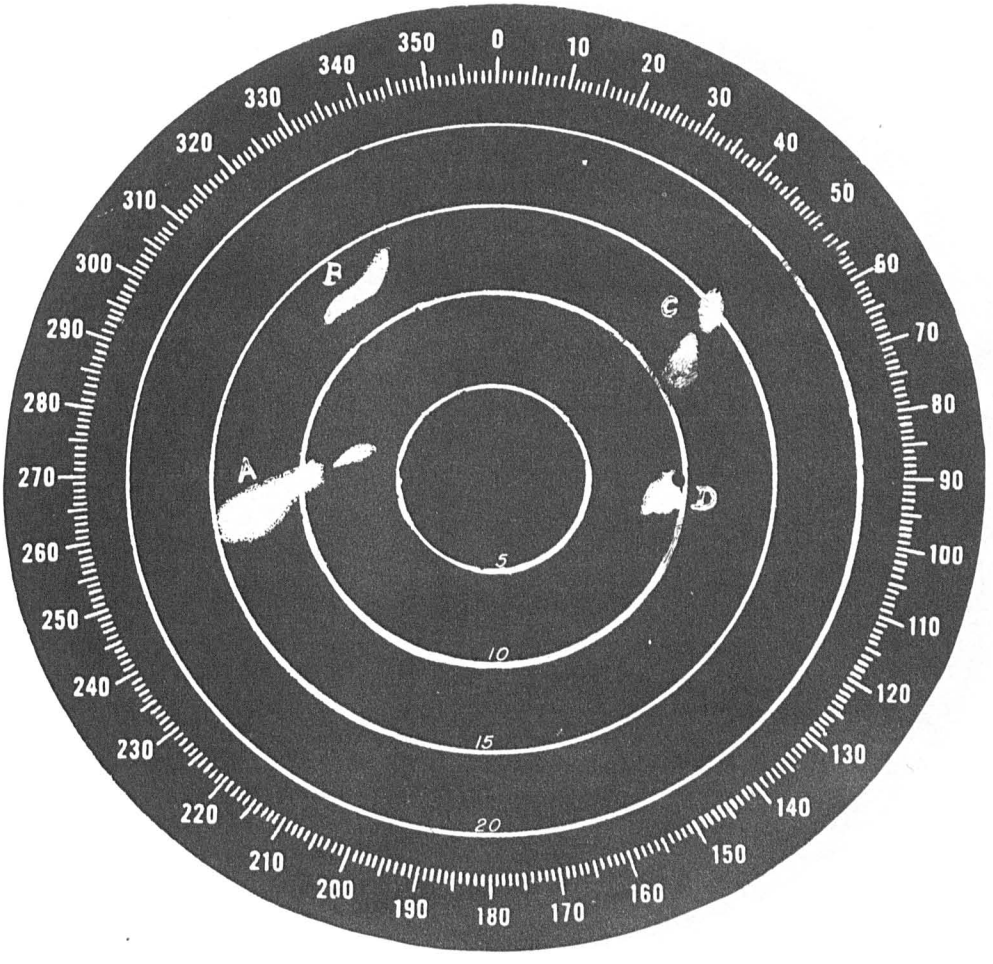


Fig. A15-7. Echoes evaluated as circles and ellipses.

Echoes A, B, and C are visualized as ellipses; and echo D is visualized as a circle. These patterns must be evaluated separately, since the distance between them in each case is more than the distance through the largest echo.

At a land station, this scope pattern would be coded as: SCTD MDT NO CHG W/11 ORNTD ENE-WSW VCNTY ALICE 10 LONG 3 WIDE SLD MDT INCRG NW/13 ORNTD NE-SW VCNTY CHALMERS 6 LONG 2 WIDE SCTD STG NO CHG NE/13 ORNTD NE-SW VCNTY BLACK BUTTE 7 LONG 3 WIDE STG NO CHG E/9 DIAM 2 MOVG FM SW/20.

At an ocean station, this report would be coded as: SD332 6154/ SD322 7154/ SD322 1154/ SD6/8 2054/.

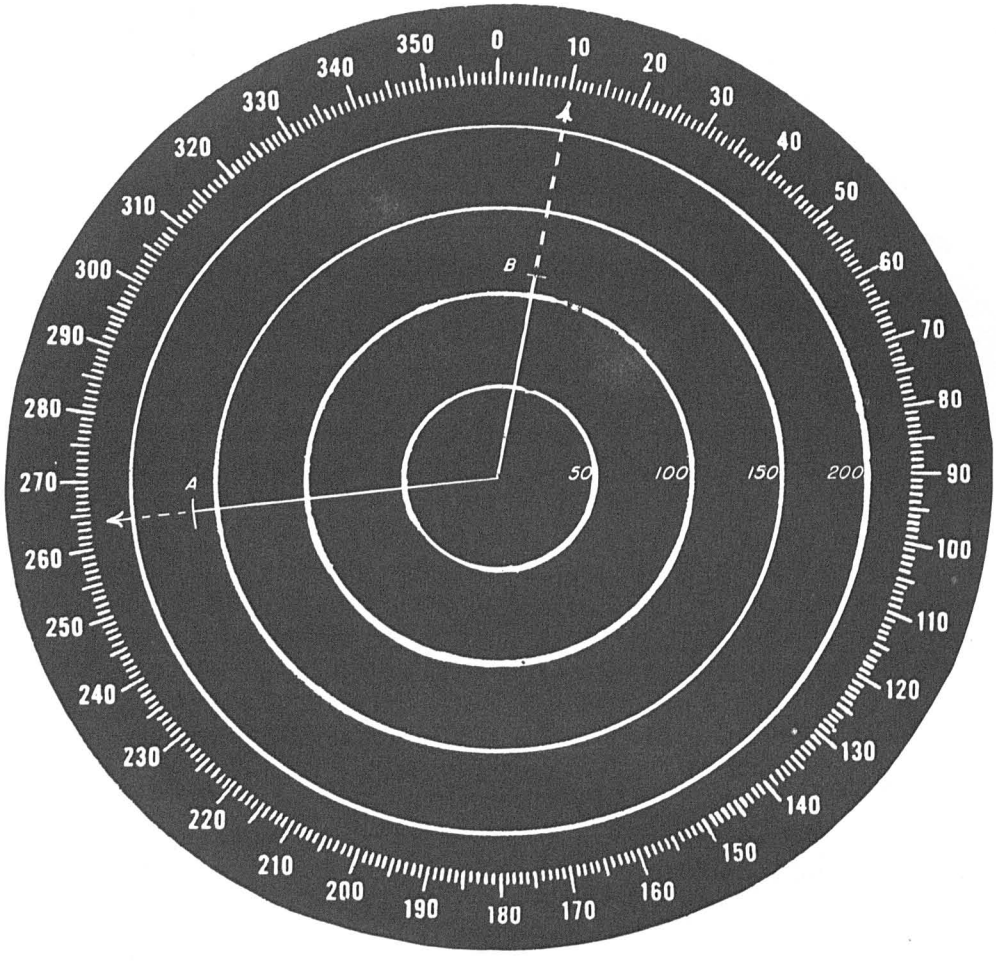


Fig. A15-8. Echoes of small isolated precipitation areas.

The short dashes at A and B are the echoes of small, isolated precipitation areas having a dimension the same as, or less than, the width of the radar beam. The direction and distance to the center of the echo are observed. Width and length are not observed. These echoes would be evaluated as:

> Solid weak echo; intensity - decreasing; direction and distance, west 170 miles. Solid weak echo; intensity - decreasing; direction and distance, north 120 miles.

At a land station this would be coded as: SLD WK DCRG W/170 SLD WK DCRG N/120.

At an ocean station this would be coded as: SD6// 6//// SD6// 8////.

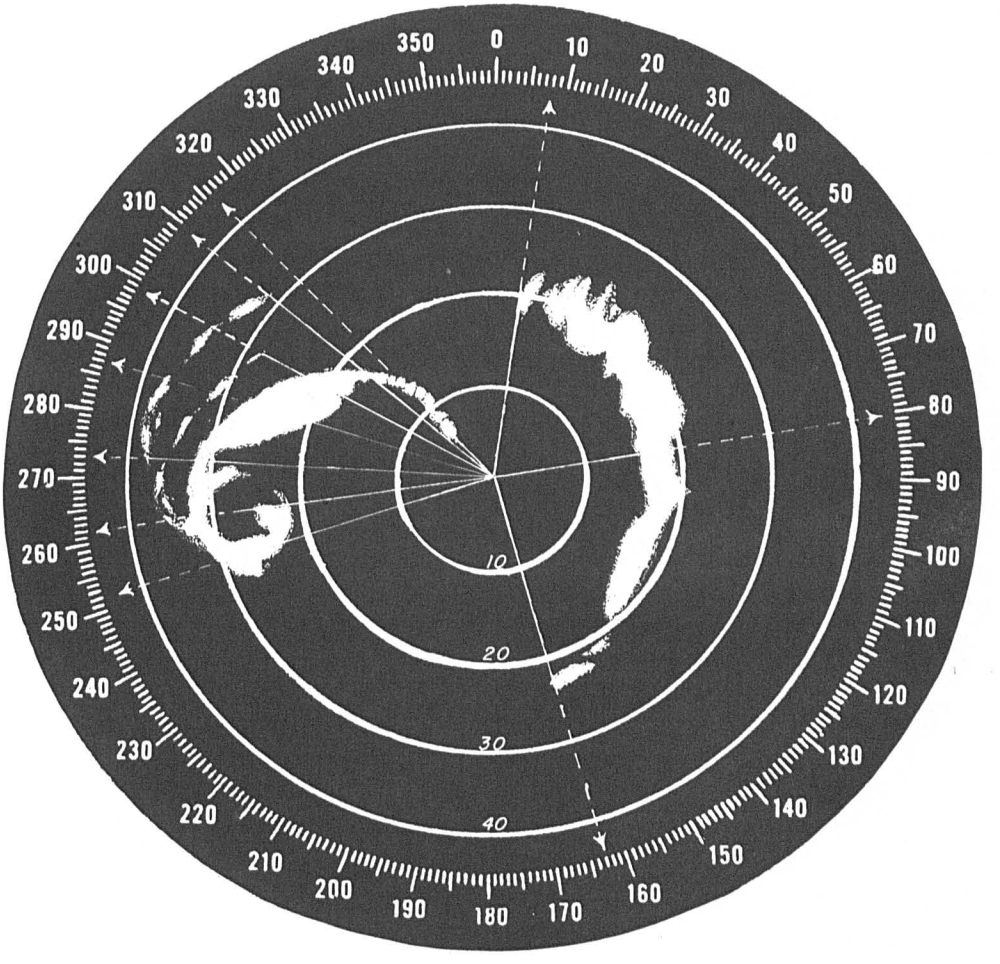


Fig. A15-9. Echoes of spiral bands.

Echoes of spiral precipitation bands similar to these sometimes result from typhoons or hurricanes. The position, diameter, direction and speed of movement, of the center, or "eye" of the storm, are reported in Remarks.

At a land station this echo would be coded as: SPRL BND STG NO CHG AZRAN 26/23 25/26 29/24 32/06 3 WIDE SCTD SPRL BND AZRAN 26/33 27/35 30/28 1 WIDE SCTD SPRL BND AZRAN 27/37 29/37 31/32 1 WIDE SPRL BND STG NO CHG AZRAN 01/20 08/17 16/22 4 WIDE HGT 400 CNTR AZRAN 262/27 DIAM 8 MOVG FM SW/30.

(See pars. A15307 and A15315.2 for decoding instructions.)

At an ocean station this would be coded as: SD283 2156/ SD7/4 6256/ APPARENT EYE AZIMUTH 262 RANGE 27 DIAMETER 8.

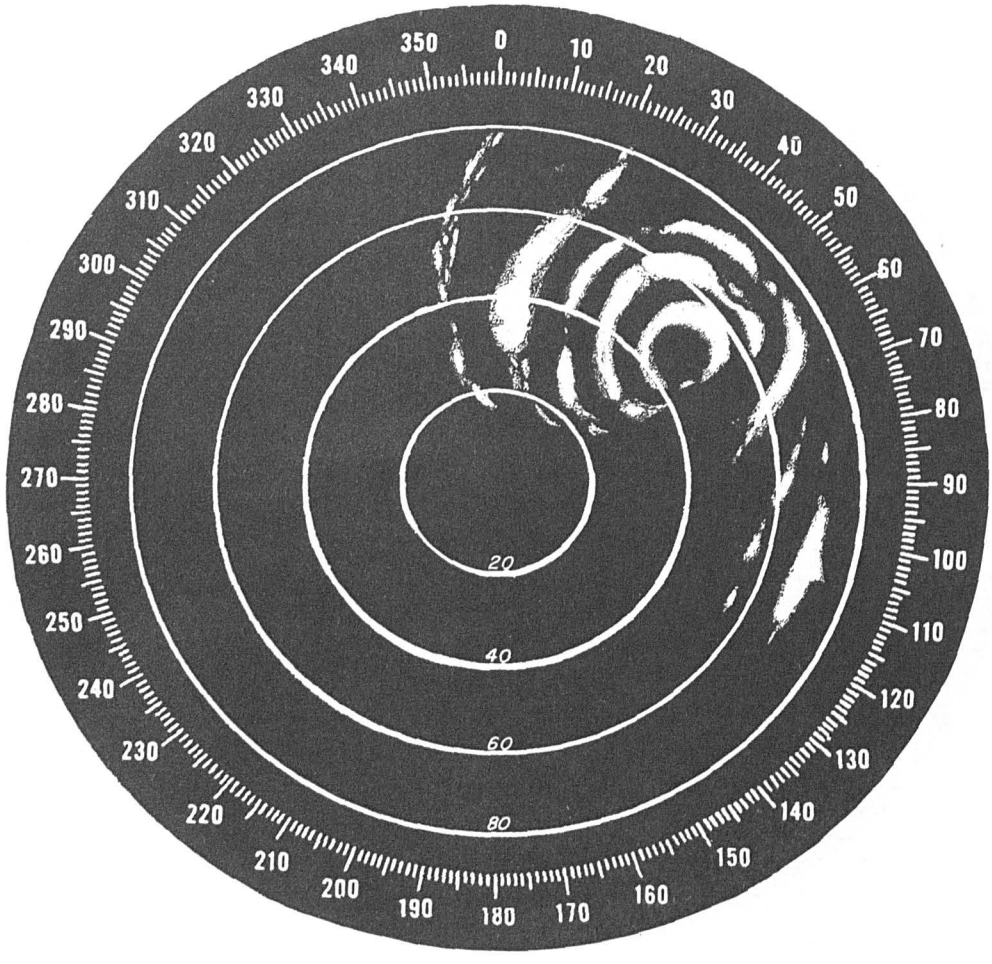


Fig. A15-10. Echoes of precipitation bands in multiple spirals.

Echoes of spiral precipitation bands similar to these sometimes result from typhoons and hurricanes. The center may not be as well defined as this; however, the apparent center is observed if it is on the scope.

At a land station this echo would be coded as: SPRL BND STG NO CHG AZRAN 06/40 04/50 06/50 5 WIDE SPRL BND AZRAN 06/38 03/50 04/65 06/61 6 WIDE SCTD SPRL BND AZRAN 06/25 02/50 04/75 08/55 5 WIDE SCTD SPRL BND AZRAN 04/18 01/50 02/80 8 WIDE SCTD SPRL BND AZRAN 00/18 35/55 00/79 5 WIDE SCTD SPRL BND AZRAN 08/68 12/56 3 WIDE SPRL BND 09/70 12/68 5 WIDE HGT 450 CNTR AZRAN 054/48 DIAM 7 MOVG FM SE/28.

(See pars. A15307 and A15315.2 for decoding instructions.)

At an ocean station this would be coded as: SD9/4 1536/ APPARENT EYE AZIMUTH 54 RANGE 48 DIAMETER 7.

RAREP CODE TABLES

S	D	1	2	3 / 3A	4	5	6	7	8

TABLE 1. TYPE OF ECHO

*0 Frontal or instability line of echoes, solid
*1 " " " " " " scattered
2 Elliptical, less than 50 miles long, solid
3 " " " " " " scattered
4 " more " " " " solid
5 " " " " " " scattered
6 Circular, less than 25 miles in diameter
7 " 25 - 50 miles in diameter
8 " 50 - 75 " " "
9 " more than 75 miles in diameter

* Will not be used at Weather Bureau stations.

TABLE 2. ORIENTATION

0 Not observed
1 NNE - SSW
2 NE - SW
3 ENE - WSW
4 E - W
5 ESE - WNW
6 SE - NW
7 SSE - NNW
8 S - N
/ Not applicable

TABLE 3. ECHO COVERAGE OF THE CIRCULAR AREA IN TENTHS

0 Less than 1/10
1 1/10
2 2/10
3 3/10
4 4/10
5 5/10
6 6/10
7 7/10
8 8/10
9 9/10 to 10/10
/ Not applicable

TABLE 3A. WIDTH OF LINE

0 Less than 1 nautical mile
1 1 or more but less than 2
2 2 " " " " " 4
3 4 " " " " " 6
4 6 " " " " " 8
5 8 " " " " " 10
6 10 " " " " " 15
7 15 " " " " " 20
8 20 " " " " " 30
9 30 " " " " " 50
/ Undetermined

TABLE 4. DIRECTION OF CENTER FROM THE STATION

0 (Not used)
1 Northeast
2 East
3 Southeast
4 South
5 Southwest
6 West
7 Northwest
8 North
9 Over station

TABLE 5. DISTANCE FROM STATION IN NAUTICAL MILES

0 Less than 10 or overhead
1 10 - 19
2 20 - 29
3 30 - 39
4 40 - 49
5 50 - 59
6 60 - 69
7 70 - 79
8 80 - 89
9 90 - 100
/ Over 100

TABLE 6. DIRECTION FROM WHICH ECHO PATTERN IS MOVING

0 No movement
1 Northeast
2 East
3 Southeast
4 South
5 Southwest
6 West
7 Northwest
8 North
9 (Not used)
/ Undetermined

TABLE 7. SPEED OF MOVEMENT OF ECHO IN KNOTS

0 No movement
1 5
2 10
3 15
4 20
5 25
6 30
7 35
8 40
9 45
/ Undetermined

TABLE 8. HEIGHT, IN FEET MSL, OF ECHO TOP

0 0 - 4999
1 5000 - 9999
2 10000 - 14999
3 15000 - 19999
4 20000 - 24999
5 25000 - 29999
6 30000 - 34999
7 35000 - 39999
8 40000 - 44999
9 45000 - 50000
/ Undetermined

Fig. A15-11

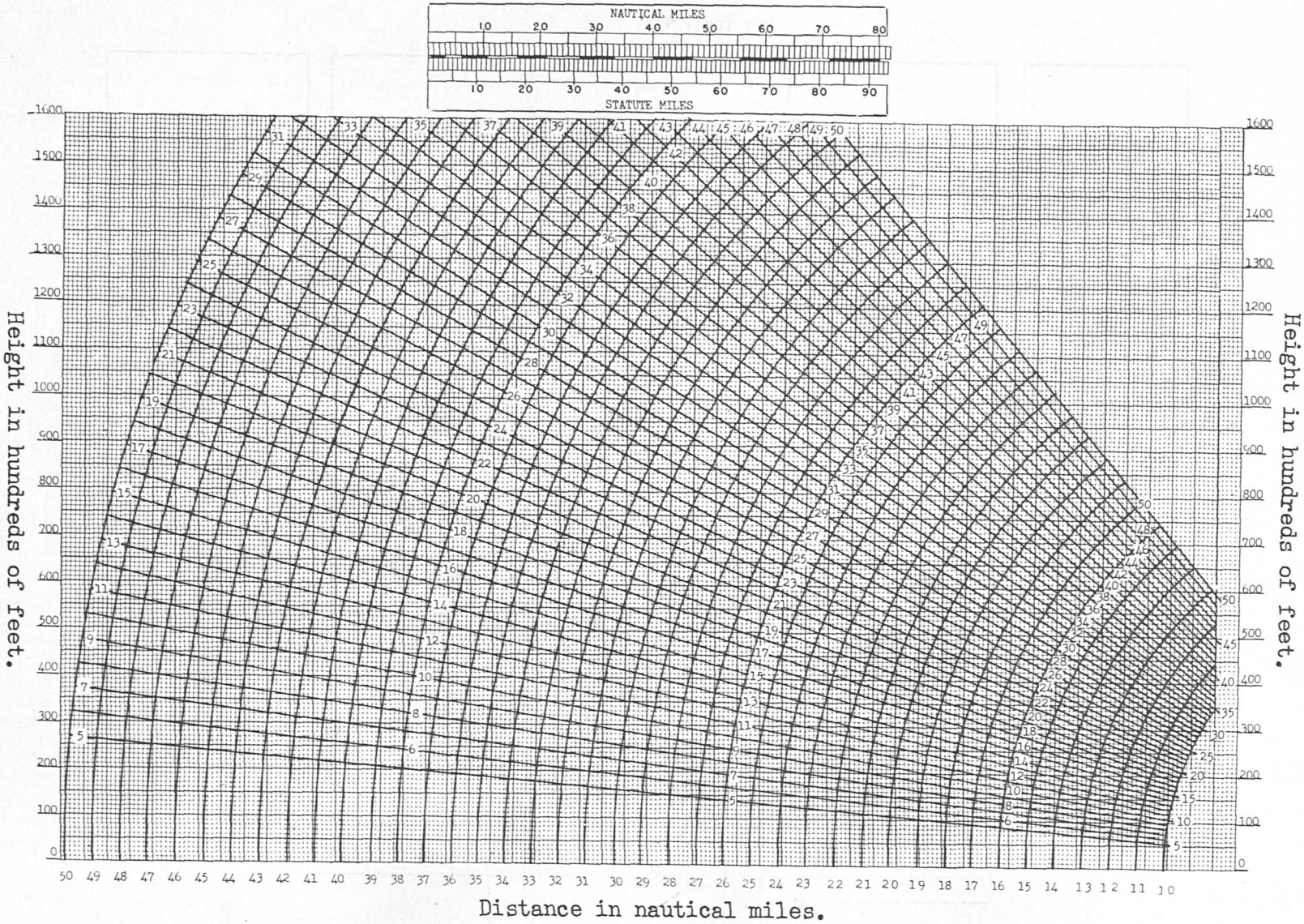


Fig. A15-12. Apparent height of echoes in nautical miles.

CHAPTER A16. SOLAR RADIATION

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CHAPTER A16. SOLAR RADIATION

A16000. OBTAINING THE RECORD

A16010. General.--Solar radiation is recorded as a continuous trace and, in some installations, is also integrated on a watt-hour meter. Two types of recorders are in general use: The roll-chart type (see Fig. A16-1), whose records are described in ¶ A16120; and the circular-chart type (see Fig. A16-2), whose records are described in ¶ A16130. Recorders will be left in continuous operation, except that the chart-drive switch on the roll-chart recorder may be turned off during the interval beginning one hour after sunset and ending one hour before sunrise during seasons when an appreciable saving in paper would be effected. Do not turn off the chart-drive switch during a standardization cycle (see ¶ A16421).

A16020. Time Standard.--All time and date entries on solar radiation records and summary forms are in terms of True Solar Time (TST). To convert standard zone time to true solar time:

* (1) Determine the number of degrees and minutes of longitude that the station is east or west of its closest standard meridian; i.e., the 75th, 90th, 105th meridian, etc.

(2) Convert minutes of longitude to quarters of degrees with Table A16-1.

TABLE A16-1 CONVERSION FROM MINUTES TO DEGREES

Minutes	Degrees
0' - 7'	0°
8' - 22'	1/4°
23' - 37'	1/2°
38' - 52'	3/4°
53' - 59'	1°

(3) Using the appropriate date and the value of longitude to degrees and quarters as determined in (1) and (2), find the corresponding tabular value in minutes from Table A16-2. Interpolate for the fractional degree.

(4) Add algebraically the value determined in (3) to the standard time to obtain the corresponding true solar time.

Example

Given: Station Longitude, 77°35'W.
Time, 5:00 a.m., 75th meridian time.
Date, January 1.

Determination of true solar time for the station:

(a) 77° 35' minus 75° 00' equals 2° 35' W.

(b) 2° 35' corresponds to 2-1/2° (Table A16-1).

(c) The correction for January 1 at 2-1/2° W from Table A16-2 is -14 minutes.

(d) 5:00 L.S.T. minus 14 minutes is 4:46 T.S.T.

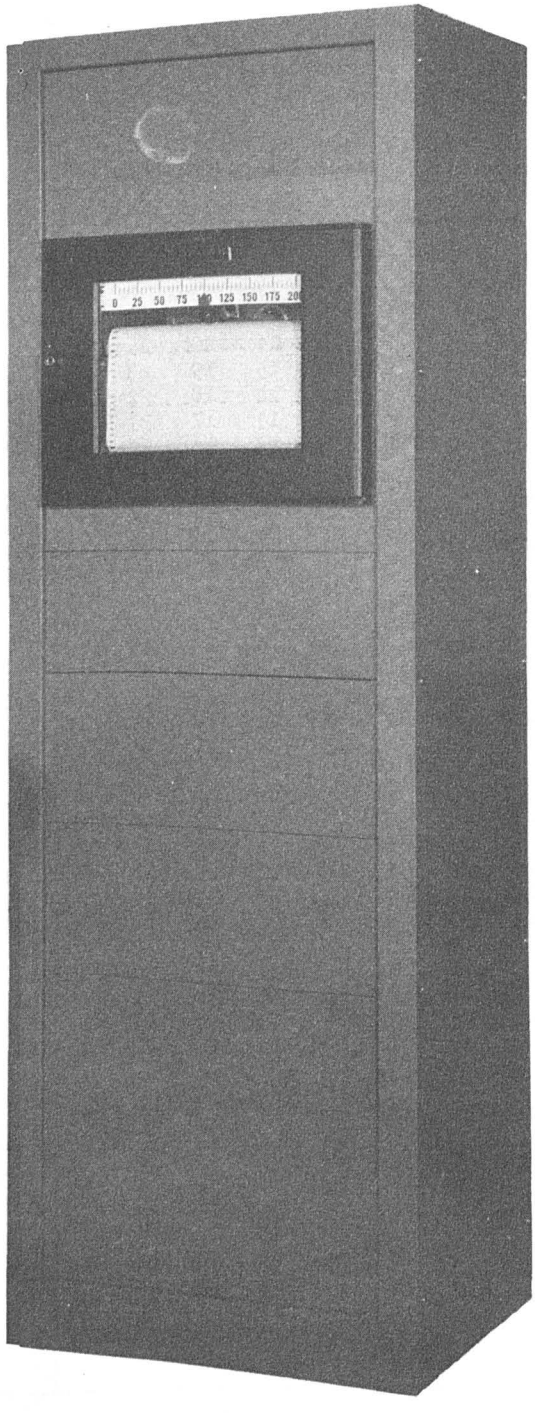

Fig. A16-1. Roll-chart recorder

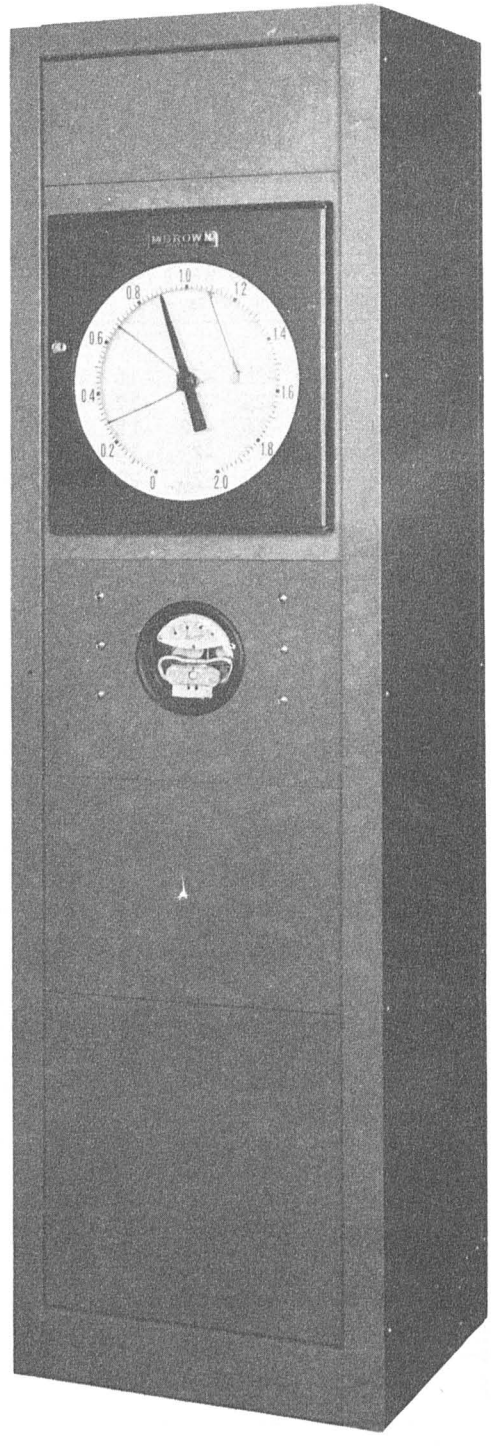

Fig. A16-2. Circular-chart recorder

Table A16-2. Number of minutes to be added algebraically to local standard time to obtain true solar time.

Equation of time values (Apparent-Mean) based on figures taken from the 1942 American Ephemeris and Nautical Almanac (for Washington Apparent Noon).

	Number of Degrees WEST of Meridian.									Number of Degrees EAST of Meridian.								
Date	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	Date
Jan.																		Jan.
1-3	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	1-3
4-5	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	4-5
6-7	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	6-7
8-9	-39	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	8-9
10-12	-40	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	10-12
13-15	-41	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	13-15
16-18	-42	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	16-18
19-21	-43	-39	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	19-21
22-25	-44	-40	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	22-25
26-30	-45	-41	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	26-30
31	-46	-42	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	31
Feb.																		Feb.
1-23	-46	-42	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	1-23
24-28	-45	-41	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	24-28
Mar.																		Mar.
1-5	-44	-40	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	1-5
6-9	-43	-39	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	6-9
10-13	-42	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	10-13
14-17	-41	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	14-17
18-20	-40	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	18-20
21-23	-39	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	21-23
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28-30	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	28-30
31	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	31
Apr.																		Apr.
1-2	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	1-2
3-6	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	3-6
7-9	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	7-9
10-13	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	10-13
14-17	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	14-17
18-22	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	18-22
23-27	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	23-27
28-30	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	28-30

Table A16-2 - continued. Number of minutes to be added algebraically to local standard time to obtain true solar time.

Equation of time values (Apparent-Mean) based on figures taken from the 1942 American Ephemeris and Nautical Almanac (for Washington Apparent Noon).

	Number of Degrees WEST of Meridian.									Number of Degrees EAST of Meridian.								
Date	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	Date
May																		May
1-6	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	1-6
7-21	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	7-21
22-31	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	22-31
June																		June
1-6	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	1-6
7-11	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	7-11
12-16	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	12-16
17-20	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	17-20
21-25	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	21-25
26-30	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	26-30
July																		July
1-5	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	1-5
6-12	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	6-12
13-31	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	13-31
Aug.																		Aug.
1-8	-38	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	1-8
9-14	-37	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	9-14
15-19	-36	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	15-19
20-23	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	20-23
24-27	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	24-27
28-30	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	28-30
31	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	31
Sept.																		Sept.
1-2	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	1-2
3-5	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	3-5
6-8	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	6-8
9-11	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	9-11
12-14	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	12-14
15-17	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	37	15-17
18-20	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	18-20
21-22	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	21-22
23-25	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	40	23-25
26-28	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	37	41	26-28
29-30	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	42	29-30

Table A16-2 - continued. Number of minutes to be added algebraically to local standard time to obtain true solar time.

Equation of time values (Apparent-Mean) based on figures taken from the 1942 American Ephemeris and Nautical Almanac (for Washington Apparent Noon).

	Number of Degrees WEST of Meridian.									Number of Degrees EAST of Meridian.								
Date	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	Date
Oct.																		Oct.
1	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	42	1
2-5	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	43	2-5
6-8	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	40	44	6-8
9-12	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	37	41	45	9-12
13-16	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	42	46	13-16
17-22	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	43	47	17-22
23-31	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	40	44	48	23-31
Nov.																		Nov.
1-14	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	40	44	48	1-14
15-19	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	43	47	15-19
20-23	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	42	46	20-23
24-26	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	37	41	45	24-26
27-29	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	40	44	27-29
30	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	43	30
Dec.																		Dec.
1-2	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	43	1-2
3-4	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	42	3-4
5-7	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	37	41	5-7
8-9	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	40	8-9
10-11	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	39	10-11
12-13	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	38	12-13
14-15	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	37	14-15
16-17	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	36	16-17
18-19	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	35	18-19
20-21	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	34	20-21
22-23	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	33	22-23
24-25	-32	-28	-24	-20	-16	-12	-8	-4	0	4	8	12	16	20	24	28	32	24-25
26-27	-33	-29	-25	-21	-17	-13	-9	-5	-1	3	7	11	15	19	23	27	31	26-27
28-30	-34	-30	-26	-22	-18	-14	-10	-6	-2	2	6	10	14	18	22	26	30	28-30
31	-35	-31	-27	-23	-19	-15	-11	-7	-3	1	5	9	13	17	21	25	29	31

*A16030. Adjustments for Time.--Check and adjust the chart for time between sunrise and sunset as frequently as necessary to maintain the position of the pen within ± two minutes of the true solar time (see ¶ A16020). Adjust roll charts so that the pen rests on one of the wider time lines at the beginning of an hour, TST. Adjust circular charts so that the pen indicates the true solar time with respect to the appropriately-labeled, radial time line. At each point of adjustment, and at sunrise, or as soon as practicable thereafter at stations where personnel are not on duty at that time, enter a short time check "✓" and the true solar time. When an adjustment of more than two minutes is made after the beginning of record each day, enter the amount and sign of the correction in parentheses.

A16040. Functioning of Equipment.--Inspect the record daily, and more often if necessary, to determine whether the trace is satisfactory. Standardize circular-chart recorders daily in accordance with ¶ A16431. Test for malfunctioning of the equipment or a change in the condition of exposure of the pyrheliometer whenever the pattern described by the trace departs widely from patterns made previously under similar meteorological conditions. Report to the regional office any malfunctioning of equipment that cannot be corrected locally. (See Sections A16300 and A16400.)

A16100. PROCESSING RECORDER RECORDS

A16110. General.--Observations of total solar and sky radiation received on a horizontal surface are evaluated in terms of langleys (gram-calories per square centimeter).

A16111. Erroneous Records.--The following conditions are indicative of erroneous records:

(1) A stationary pen as evidenced by a record of unvarying intensity. (See ¶ A16413.)

(2) Time lag in the response of the pen to cloud changes that normally cause an abrupt change in the pen position.

* (3) An abrupt change in the indicated amount of radiation following the removal of ice or other foreign matter.

When slight accumulations of frost, ice, etc. on the bulb make it impracticable to determine whether an increase in radiation results from cleaning the bulb, enter the nature of the conditions and the time of their beginning and ending adjacent to the questionable record.

A16120. Roll Charts.--When a portion of the record is unsatisfactory (missing or appears erroneous, see par. A16111), estimate the trace corresponding to the time interval of the unsatisfactory record provided (1) the sky condition during the interval was substantially the same as it was immediately preceding and following the interval, and (2) the interval is of two hours duration or less. Sketch the estimated trace on the chart as a smoothly interpolated curve connecting the ends of the satisfactory record. When the period of unsatisfactory record includes the beginning or end of measurable radiation for the day, estimate the normal time of the beginning or end of radiation from inspection of representative records on preceding and following days. At this estimated time on the zero reference line on the chart, plot one end of the estimated trace.

*A16121. Hourly Radiation.--Hourly radiation will be computed following the evaluation of the radiation for each 15- or 20-minute period, depending on the time scale of the chart paper. The record will be evaluated with a transparent evaluator graduated in increments of one langley per unit period. The evaluator may be used directly with records from 10-junction pyrheliometers. When the evaluator is used with records from 50-junction pyrheliometers, the readings from the evaluator must be multiplied by a factor obtained as specified in 6(b) to provide radiation values in terms of langleys per unit period. Hourly radiation values in langleys will be computed for each hour of record (including hours in which all or part of the record is estimated) as follows:

(1) Lay one side of the evaluator lengthwise along a time line corresponding to the beginning of a unit period. Note that the distance between boundary lines printed on this scale is such that when one coincides with the time line at the beginning of a period, the other coincides with the time line at the end of the period.

(2) Move the evaluator parallel to the two time lines until, on each side of the 0.0 line of the scale, equal areas are bounded by the trace, the respective time lines, and the 0.0 line of the scale. (See Fig. A16-3.)

(3) Draw a line across the entire period, coincident with the 0.0 line, after adjustment (2) has been made.

(4) With the evaluator in the position described in (2), read the scale to the nearest tenth at the intersection of the scale with the zero-radiation line on the chart.

(5) When a 10-junction pyrheliometer is used, the hourly radiation is the sum of the scalar readings for the hour.

(6) When a 50-junction pyrheliometer is used, (a) compute the sum of the scalar readings in each hour, (b) divide the calibration constant for the 10-junction pyrheliometer by the constant for the 50-junction pyrheliometer, and (c) multiply the quotient obtained in (b) by the sum obtained in (a). The result is the radiation for the hour in langleys. The calibration constants are entered on the standardization sheet furnished with each instrument.

Example

Given: Sum of scalar readings during a solar hour; 112.7
Calibration constant for 10-junction pyrheliometer of 2.16
Calibration constant for 50-junction pyrheliometer of 6.52

Computation: $\frac{2.16}{6.52} \times 112.7 = 37.3$ langleys

*A16122. Chart Entries (See Fig. A16-4).--Entries are made as follows:

(1) Between the 0-line and 5-line, enter the true solar hour, in terms of the 24-hour clock, on the corresponding time line.

(2) Parallel to the time lines and on the right side of the first fold (see ¶ A16150), enter

(a) Station name and date.

(b) Total daily radiation, computed and entered in accordance with ¶ A16214.

(c) Initials of computer and verifier.

(3) Between the 10- and 20-lines and near the midpoint of each unit period, enter the appropriate scalar readings. Enter readings obtained entirely or in part from an estimated record in parentheses. Make no entry for periods for which radiation has not been computed in accordance with ¶ A16121.

(4) Between the 5- and 10-lines, and near the midpoint of each solar hour interval, enter the corresponding value of hourly radiation. Enter, in parentheses, values that include any estimated data. When the entry of radiation for one or more of the unit periods of a given hour has been omitted as in (3), omit the entry of radiation data for the corresponding hour.

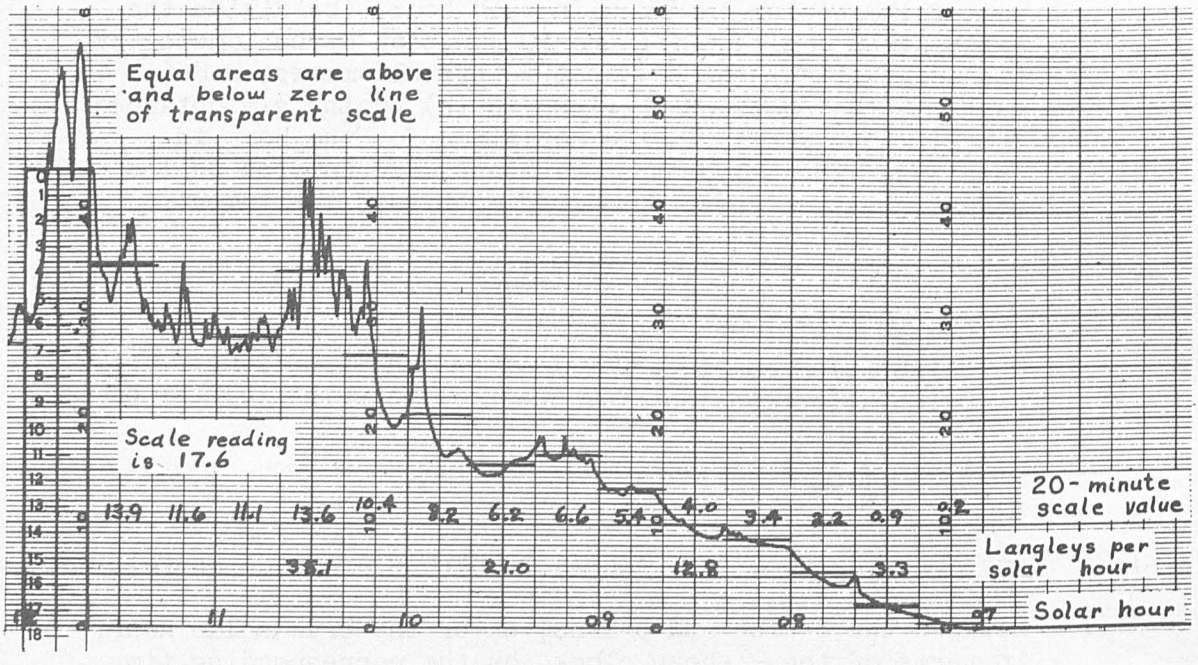


*Fig. A16-3. Roll-chart record (section - with evaluator)

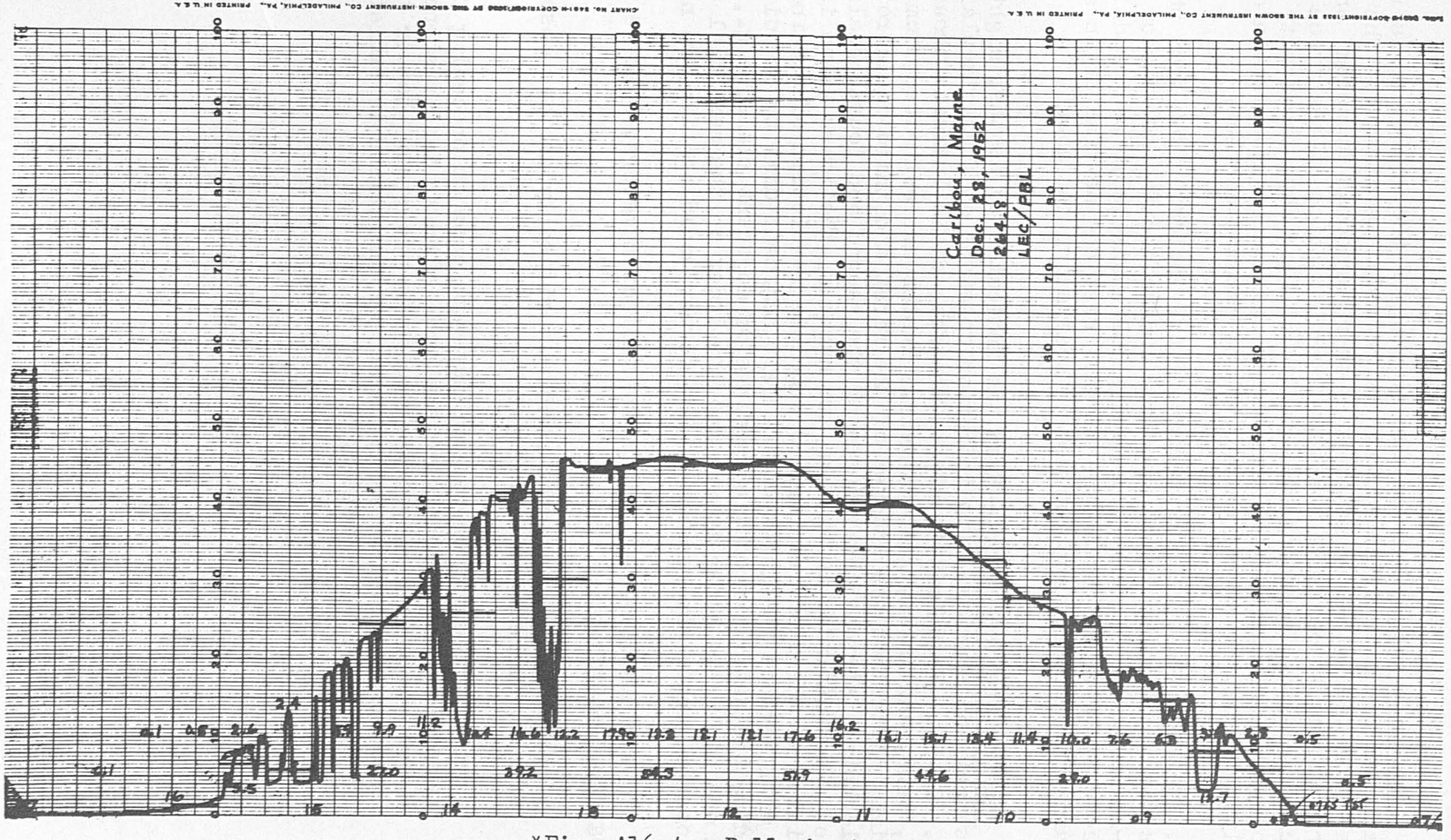


*Fig. A16-4. Roll chart record

A16130. Circular Charts.--When malfunctioning of the equipment is indicated, data for the days affected will be regarded as missing. The daily total read from the watt-hour meter will be regarded as "missing" only if it appears reasonably certain from the characteristics of the trace that the indicator reading is incorrect (see ¶ A16111). When the faulty record results only from mechanical failure of the pen, such as depletion of the ink supply, the reading of the meter will be assumed correct.

*A16130.1. Whenever the watt-hour factor of the indicator has been changed, enter the date and true solar time of the change and the new factor on Form 450-1, and under "Remarks" on Form 1130D (WBAN-10D), prepared in accordance with instructions on the forms. Post the new factor in a convenient and conspicuous place for use in evaluating the chart.

A16131. Reading the Indicator.—Read the indicator to tenths, nightly, between sunset and sunrise. The indicator consists of four circular dials (see Fig. A16-5). From left to right, the four dials indicate thousands, hundreds, tens, and units, respectively. Tenths are estimated from the fourth dial. Note that the indexes of the first and third dials rotate counterclockwise, whereas the indexes of the second and fourth dials rotate clockwise. When an index is between two numbers, the lower value is taken as pertaining to the dial reading. A complete revolution of the index on one dial will advance the index on the left adjacent dial by one division. When reading the meter, reconcile readings of adjacent dials, e.g., if the index on one dial were close to six and the index on the next dial on the right close to eight, the reading of the former would be five and not six.

A16131.1 To avoid errors in reading the indicator meters, observe the following precautions:

(1) If practicable, have the reading verified by another observer; if not, recheck the reading.

(2) Compare the data for consistency with data on preceding days when cloud conditions were similar. When an inconsistency is noted, examine the recorder record to ascertain whether the inconsistency was actually caused by variations in radiation, or by an erroneous reading.

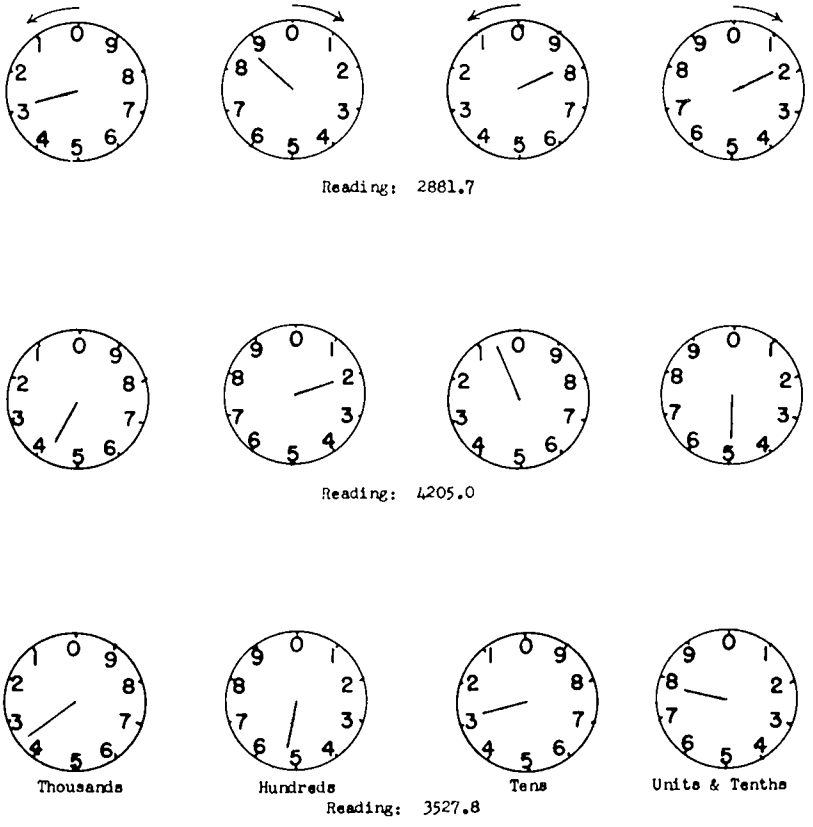


Fig. A16-5. Watt-hour meter

*A16132. Chart Entries.—(See Fig. A16-6.) Enter the following data near the midnight time line and in the approximate position illustrated in Fig. A16-6:

(a) Station name and date

(b) Indicator reading for the day

(c) Indicator reading for previous day

(d) Difference between (b) and (c)

(e) Daily radiation to tenths of langleys (see ¶ A16133 and A16134)

(f) Initials of computer and verifier

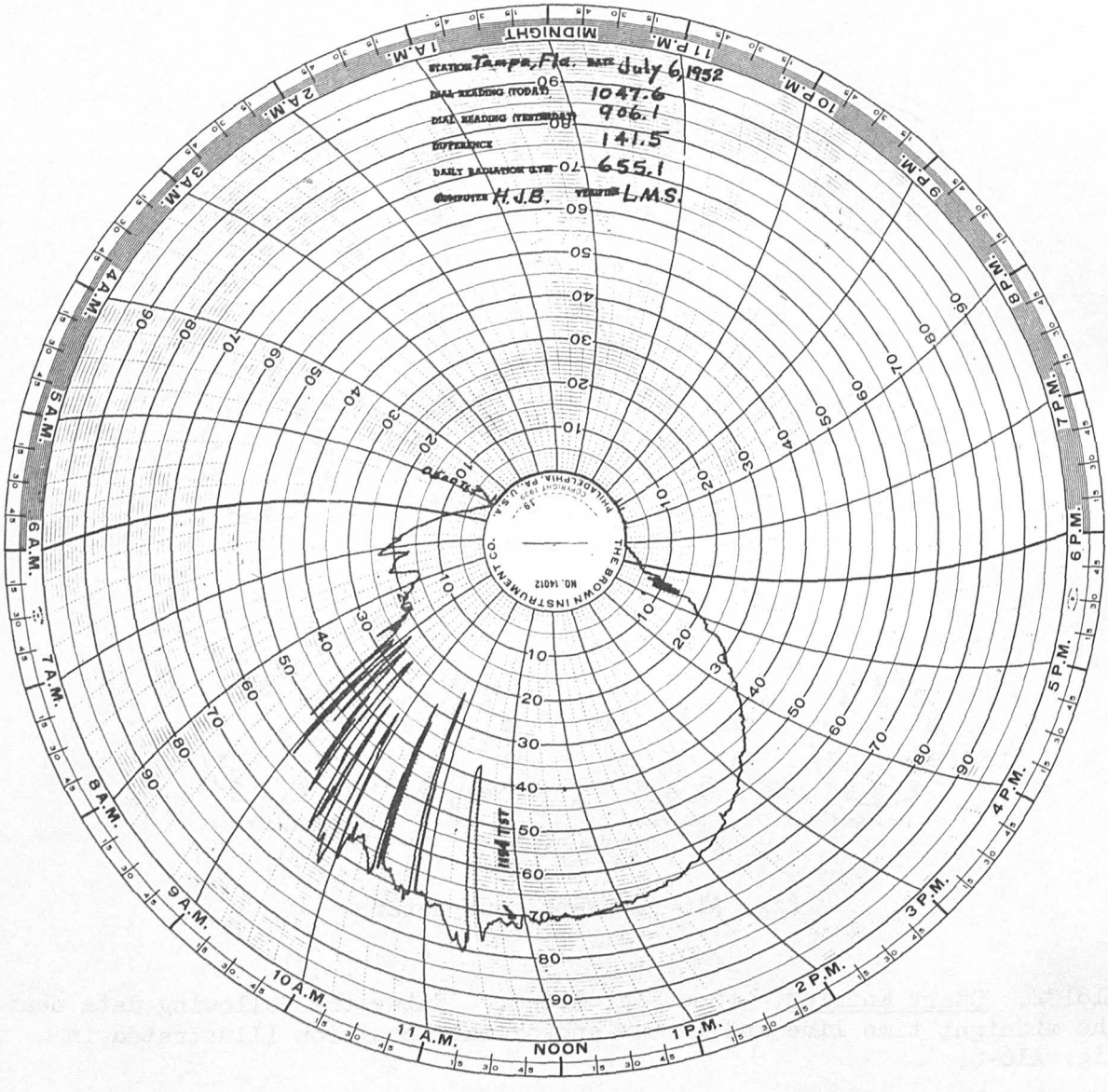


*Fig. A16-6. Circular-chart record

A16133. Computation of Total Solar Radiation - 10-Junction Pyrheliometers.-- When a 10-junction pyrheliometer is in use, obtain the total solar radiation in langleys by multiplying the difference referred to in par. A16132 (d) by the conversion factor usually stamped on a plate beneath the dials of the meter.

*

Example

Given: Daily reading of 9291.3
Reading on preceding day of 9274.7
Conversion factor 6.787

Computation: 9291.3 minus 9274.7 = 16.6
16.6 multiplied by 6.787 = 112.7 langleys (total daily radiation)

*A16134. Computation of Total Solar Radiation - 50-Junction Pyrheliometers.--When a 50-junction pyrheliometer is in use, obtain the total solar radiation in langleys as follows:

(1) Multiply the difference referred to in ¶ A16132(d) by the conversion factor specified in ¶ A16133.

(2) Divide the calibration constant of the 10-junction pyrheliometer by the calibration constant of the 50-junction pyrheliometer.

(3) Multiply the product obtained in (1) by the quotient obtained in (2). The result is the total solar radiation in langleys.

Note: The calibration constant is entered on the standardization sheet furnished with each pyrheliometer.

*

Example

Given: Daily reading of 7647.2
Reading on preceding day of 7546.2
Conversion factor of 6.243
Calibration constant for 10-junction pyrheliometer of 2.16
Calibration constant for 50-junction pyrheliometer of 6.52

Computation:

(1) 7647.2 minus 7546.2 = 101.0
101.0 multiplied by 6.243 = 630.5

(2) $\frac{2.16}{6.52} = .33$

(3) .33 multiplied by 630.5 = 208. langleys (total daily radiation)

*A16140. Verification.--All computed data and other manuscript entries on recorder records will be completely verified by someone other than the computer before mailing.

*A16150. Disposition.--Assemble recorder records in chronological order with the earliest date on top. Fasten circular charts together by inserting a round-head paper fastener through the smaller hole. Roll-charts for each day will be separated before submission, and will cover the period from one hour before sunrise to one hour after sunset. At northern stations when radiation is recorded continuously, separate the charts along the midnight time line. Fold each record, accordion fashion, in seven-inch folds with the first fold, upon which identification data are entered, facing outward.

*A16151. Weather Bureau stations within the continental United States will mail recorder records to the WRPC within five days after the end of 7- or 8-day periods. The periods begin on the same dates as summary periods specified in ¶ A16210.1.

*A16152. Weather Bureau stations outside the continental United States will mail recorder records with the associated Form 1027A (see ¶ A16220) to the Central Office.

*A16153. Cooperative stations will mail records in accordance with separate instructions.

A16200. SUMMARY DATA

*A16210. General.--Selected cooperative stations and all Weather Bureau stations outside the continental United States will summarize solar radiation data on Form 1091A, Solar and Sky Radiation Measurements. Form 1091A will not be prepared by stations that enter solar radiation data on punched cards. Entries will be made with a 3H drawing pencil or equivalent and the form will be prepared in triplicate. (See Fig. A16-7.)

*A16210.1. Summaries begin on the dates shown in Table A16-3 and cover four or five consecutive periods of seven to eight days. The summary starting in December and, during leap year, in June will comprise data for three 7-day periods and one 8-day period. Entries for the eighth day of an 8-day period will be entered on the line labeled "Means". Enter the date in the space labeled "Means" and delete "Means". Label the next lower line "Means" and enter the mean data for the period on that line.

A16211. Station Name and Date.--Enter the station name and the dates of the first and last entries in the spaces provided at the top of the form.

*A16212. Dates of Entries.--The periods covered by the summaries accord as nearly as practicable with calendar months. The date of the first entry on each summary form will be determined from Table A16-3.

Table A16-3 - Starting Dates of Summaries

Month	Date of First Entry (Common Years)	Date of First Entry (Leap Years)
Jan.	Jan. 1	Jan. 1
Feb.	Feb. 5	Feb. 5
Mar.	Mar. 5	Mar. 4
Apr.	Apr. 2	Apr. 1
May	May 7	May 6
June	June 4	June 3
July	July 2	July 2
Aug.	Aug. 6	Aug. 6
Sept.	Sept. 3	Sept. 3
Oct.	Oct. 1	Oct. 1
Nov.	Nov. 5	Nov. 5
Dec.	Dec. 3	Dec. 3

*A16213. Hourly Radiation.--Hourly radiation entries are made at stations equipped with roll-chart recorders. In the spaces provided, enter the date and, to tenths of a langley, the corresponding hourly radiation values from the evaluated record charts (see ¶ A16122) for the hour ending at the time indicated at the top of each column. Enter estimated data in parentheses. Enter "M" for hours for which data are missing, except that if data for an entire day are missing, enter the reason for the missing data.

A16214. Daily Radiation.--At stations equipped with roll-chart recorders, enter, to tenths, under the caption "Daily Total", the sum of all the hourly data (recorded and estimated) for each day. If the sum for any day contains more than three percent estimated data (i.e., hourly data entered in parentheses) enter the sum in parentheses. When hourly radiation entries for any portion of a day are omitted in accordance with ¶ A16213, enter an "M" in lieu of a daily total.

A16214.1. At stations equipped with a circular-chart recorder and an integrating indicator, enter daily-total-radiation values, to the nearest tenth of a langley, in chronological order under the caption "Daily Total"; and enter the corresponding dates similarly under the caption "Dates". If the daily total is missing, enter an "M" (see par. A16130) and the reason for omission of the total.

*A16215. Means of Hourly Radiation.--For each seven- or eight-day period (see ¶ A16210) compute means of hourly radiation for each hour that has four or more numerical entries (including entries in parentheses). Compute means by dividing the sum of all entries for the hour by the number of entries. Enter mean data on the line titled "Means". Enter "M" when means cannot be computed because of missing data. Enclose means that include estimated data in parentheses.

WB Form 1091 A — U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU — (WB 2-16-50-10M)

Solar and Sky Radiation measured at Fairbanks, Alaska from October 1 to October 28, 1952

Radiation in gr-cal per cm² of horizontal surface during hour ending (apparent time)

Date	A. M. 1	2	3	4	5	6	7	8	9	10	11	Noon	P. M. 1	2	3	4	5	6	7	8	9	10	11	Mid't	Daily Total
Oct. 1								1.1	14.8	28.6	35.5	31.2	33.5	26.6	24.8	8.6	2.3							LE/MT	206.4
2								(4.1)	18.2	30.4	41.8	47.7	49.3	42.5	32.2	17.4	2.7							LE/MT	286.3
3								2.0	13.8	26.4	39.9	45.9	45.7	33.1	33.1	17.9	3.8							LE/MT	261.6
4								0.1	6.3	7.4	(20.8)	9.5	10.3	3.6	3.1	0.7	0							RZ/TO	(61.8)
5								0.5	3.5	8.6	15.3	19.1	31.6	27.6	21.6	15.8	4.2							RZ/TO	147.8
6								0	0.9	3.8	9.5	8.6	7.2	9.7	3.8	1.1	0							RZ/TO	44.6
7								0.4	1.5	3.0	6.1	8.2	11.6	6.5	4.4	2.2	1.1							RZ/TO	45.0
Means								(1.2)	8.4	16.1	(24.1)	24.3	27.0	20.7	17.6	9.1	2.0							TO/BA	(150.5)
8								0	0.8	3.9	17.8	24.6	26.3	25.4	17.7	7.0	1.3							FV/IS	124.8
9								0.2	3.1	2.4	4.6	7.6	9.7	4.2	4.6	1.2	0							IS/AW	37.6
10								2.5	16.0	26.6	52.0	49.3	49.6	43.9	M	M	M							FV/LL	M
11								1.0	4.5	11.0	14.1	15.9	22.4	19.9	12.3	1.6	1.0							FV/LL	103.7
12								6.2	12.1	35.9	47.4	53.1	M	M	M	M	M							FV/LL	M
13								Recorder repaired and calibrated																IS/AW	M
14								0.5	1.1	4.4	17.1	22.4	26.0	33.8	22.8	14.9	7.1	0.1						WA/IS	150.2
Means								1.7	6.3	13.9	25.5	28.8	26.8	25.4	14.4	6.2	2.4							WA/IS	151.4

WB Form 1091 A — U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU — (WB 2-16-50-10M)

Solar and Sky Radiation measured at Annette, Alaska from October 1 to October 28, 1952

Radiation in gr-cal per cm² of horizontal surface during hour ending (apparent time)

Date	A. M. 1	2	3	4	5	6	7	8	9	10	11	Noon	P. M. 1	2	3	4	5	6	7	8	9	10	11	Mid't	Daily Total
Oct. 1																								WT/HEP	9.7
2																								WT/HEP	23.6
3																								WT/HEP	21.4
4																								WT/LF	68.9
5																								WT/LF	43.0
6																								HEP/LF	34.1
7																								HEP/LF	94.1
Means																								HEP/LF	42.1
8													Frost on pyrheliometer												M
9																								HEP/PT	141.5
10																								PT/WT	132.4
11																								PT/WT	98.0
12																								PT/WT	113.8
13																								PT/MG	100.2
14																								MG/LF	67.9
Means																								MG/LF	109.0

*Fig. A16-7. WB Form 1091A

*A16216. Means of Daily Totals.--At stations equipped with roll-chart recorders, compute the mean of daily totals by adding the means of hourly values for the period, computed in accordance with ¶ A16215. Enter this mean to tenths on the line titled "Mean" (see ¶ A16210) and under the caption "Daily Total". Enclose this mean in parentheses if one or more of the hourly means are enclosed in parentheses. Enter "M" in lieu of a numerical value if one or more of the hourly means are missing.

*A16216.1. At stations equipped with a circular-chart recorder, compute the mean of daily totals by dividing the sum of all daily totals by the number of entries. Enter "M" in lieu of a mean if there are less than four daily totals.

*A16217. Computers and Verifiers Initials.--Adjacent to the "Daily Total" entries, enter the initials of the computer, a slant, and the initials of the verifier of the daily entries and of the means.

*A16220. Disposition of Form 1091A.--Mail the original of Form 1091A to the WRPC within five days after the end of each period specified in Table A16-3. Mail the first carbon copy to the Central Office, attention Meteorological Physics Section, and the second carbon copy to Weather Bureau Office, SRFTU, Boston 9, Massachusetts. An additional copy may be prepared and retained locally if desired.

A16230. Disposition of Punched Cards.--Separate instructions are provided for the disposition of punched cards.

A16300. PYRHELIOMETER

A16310. General.--Solar radiation installations for the measurement of total solar and sky radiation consist of a pyrheliometer installed in a suitably exposed position and a recorder usually installed in the office.

A16320. Types.--Thermoelectric 180° pyrheliometers are used in measuring total solar and sky radiation. Two types are in use: a "10-junction" type in general use (Fig. A16-8), and a more sensitive "50-junction" type used at selected northern stations (above approximately 55°N. latitude) during months when solar radiation is less intense (see par. A16324).

A16321. Exposure.--The ideal exposure site for the pyrheliometer is one that is free from any obstructions above the horizontal plane of the sensing element, and that is readily accessible for maintenance of the instrument. If it is impossible to obtain such an exposure, the site must be as free from obstructions as possible, especially in the northern hemisphere, from east-northeast through south to west-northwest; or in the southern hemisphere, from east-southeast through north to west-southwest. If practicable, the pyrheliometer should be so located that (1) a shadow will not be cast on it at any time, (2) it is not in proximity to light-colored walls or other objects likely to reflect sunlight directly on the sensing element of the pyrheliometer, and (3) it is not subject to radiation from other sources.

A16322. Installation.--The pyrheliometer is mounted on a pedestal, the top of which is horizontal. Orient the pedestal so that the pyrheliometer

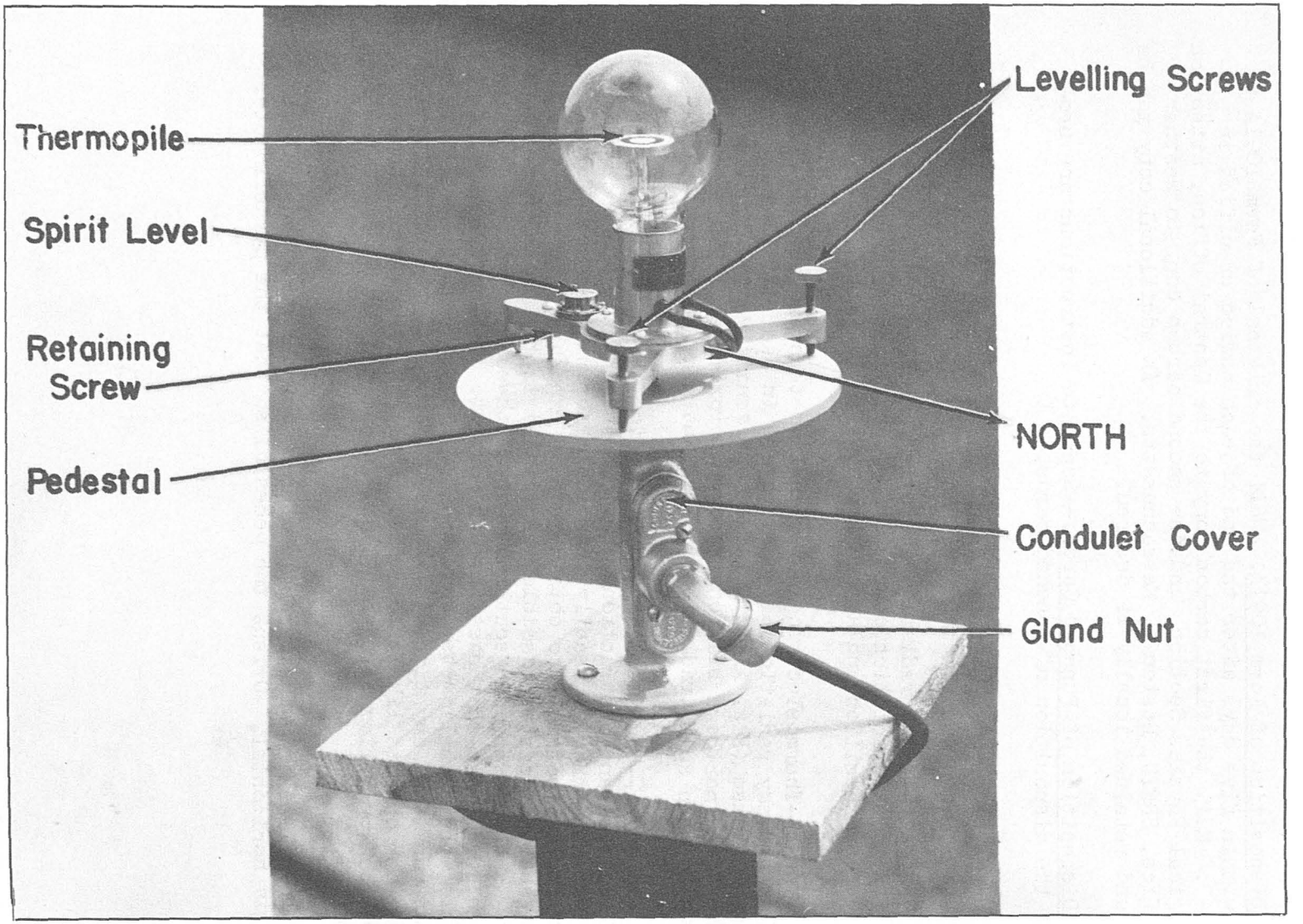


Fig. A16-8. Pyrheliometer - 10-junction

retaining screw is located directly south of the center of the pedestal. Center the pyrheliometer on the pedestal, and secure the instrument lightly with the retaining screw. Level the instrument with the leveling screws and with the spirit level that is mounted on the south leg of the instrument. Tighten the retaining screw, but not sufficiently to change the level setting of the instrument. When properly exposed, the sensing element is horizontal and the leads emerge from the north side of the instrument. At northern stations where the 50-junction pyrheliometer is used in winter to replace the 10-junction instrument (see par. A16324), care must be exercised to obtain a permanent copper-to-copper junction between the short leads from the pyrheliometer and the cable to the recorder; i.e., a junction that will not introduce thermal effects resulting either from temperature differences between the two connections or from gradual growth of an oxide film between the spliced wires. When disconnecting the pyrheliometer, melt the solder and remove as much of it as possible by striking the hot joint sharply against a firm object. Carefully straighten and separate the stranded leads, repeating the heating and striking process as necessary to separate the strands and to remove all but a thin film of solder. When connecting the pyrheliometer, scrape the strands to be twisted and soldered until a clean copper-to copper union is possible. Solder each splice with a minimum of free-running solder. Tape each splice, first with rubber tape and then with friction tape, and then tape the two together with friction tape. Replace the pedestal condulet cover, being careful not to pinch the splices, and tighten the gland nut on the squeeze connector.

A16323. Obstructions Above Free Horizon.—WB Form 1092, "Obstructions to Pyrheliometer or Illumination Cell" will be prepared (1) when the pyrheliometer is installed, (2) whenever the location of the instrument is changed, or (3) if a significant change occurs in the surrounding obstructions; i.e., obstructions likely to cast a shadow or reflected light on the pyrheliometer for even a brief period of the day. The form will be prepared in triplicate in accordance with the following instructions and in the manner illustrated in Fig. A16-9:

(1) Enter the elevation of the instrument to the nearest whole meter, msl.

(2) Plot the angular elevation above the pyrheliometer and the angular range in azimuth of all obstructions throughout the full 360° around the pyrheliometer. Obtain the elevation and range data by means of a theodolite set up as closely as possible to the pyrheliometer.

(3) On the same form, plot the path of the sun across the sky at the winter and summer solstice. The path of the sun is interpolated from a plot of the elevation and azimuth angles of the sun at (a) sunrise, (b) sunset, and (c) at hourly intervals between sunrise and sunset measured in whole hours from true solar noon. The time interval between the true solar noon and the time corresponding to a particular position of the sun is termed the "hour

angle" of the sun. During a.m. hours, the azimuth angle is said to be east and is obtained directly from Table A16-4. During p.m. hours, the azimuth angle is said to be west and is obtained by subtracting the east azimuth angle for the corresponding hour angle from 360 degrees. In table A16-4, only angles in azimuth are given for sunrise and sunset, since the altitude angle is zero regardless of the latitude. For hour angles between zero (true solar noon) and either sunrise or sunset, tabular values are given in pairs. The upper value is the solar altitude and the lower value is the east azimuth angle for any given set of arguments. The horizontal arguments are the hour angles to the nearest whole hour; the vertical arguments are values of latitude to the nearest five degrees. Tabular values are given to the nearest whole degree. Use as arguments latitude to the nearest whole degree and hour angle to the nearest whole hour. Interpolate as necessary to obtain values of solar altitude and azimuth to the nearest whole degree.

A16323.1. Values for 0° to 4° south latitude are identical with those for corresponding northern latitudes, except that azimuth values are computed from south instead of north and, in the case of the solstices, the seasons are reversed. For instance, in determining the solar altitudes and solar azimuths for the hour angles on the day of the southern winter solstice, consult the table for the corresponding hour angles for the day of the northern summer solstice.

A16323.2. The following example of the determination of the elevation and azimuth angles at a given hour angle at a northern latitude station is taken from the data shown in Fig. A16-9:

Example: Station latitude - 38°56'N (39°). Time - 1500 T.S.T. (hour angle three, west azimuth) at the time of the northern summer solstice.

(1) From Table A16-4, the altitude and east azimuth angles corresponding to a latitude of 39°N and an hour angle of three are 49°; and 99°, respectively.

(2) The west azimuth angle is obtained by subtracting 99 from 360; i.e., 261 degrees.

A16323.3. The hour angles and corresponding altitudes, and the east and west azimuth angles, are entered in the appropriate space on Form 1092. For each hour angle, plot the position of the sun on the chart and complete the path of the sun between sunrise and sunset by interpolation. On the chart, solar altitudes are represented by concentric ordinates, and east and west azimuth

angles (measured clockwise from zero) are represented by radial ordinates.

*A16323.4. As soon as the form is completed, mail the original copy to:

Weather Bureau Office
Solar Radiation Field Testing Unit
Boston 9, Massachusetts

Forward one carbon copy to the Central Office, attention, Meteorological Physics Section and retain the other copy. Airmail copies from stations outside the continental United States.

Table A16-4. Solar Altitudes and Azimuths at the Time of the SUMMER Solstice
(Expressed to the nearest whole degree)

Latitude	Hour Angle													Sunrise or Sunset	
	0	1	2	3	4	5	6	7	8	9	10	11	12	Hour Angle (h. m.)	Azimuth Angle (degrees)
0	67	62	53	40	27	14	0							6:00	67
	0	31	49	58	63	66	67								
5	72	67	56	43	29	16	2							6:09	66
	0	37	55	62	66	67	67								
10	77	70	58	45	31	18	4							6:17	66
	0	45	61	67	69	68	67								
15	82	74	61	47	33	19	6							6:26	66
	0	57	69	72	72	70	67								
20	87	76	62	48	35	21	8							6:37	65
	0	73	77	77	75	72	68								
21	88	76	62	48	35	21	8							6:39	65
	0	77	79	78	75	72	68								
22	89	76	62	49	35	22	9							6:40	65
	0	81	81	79	76	72	68								
23	90	76	62	49	35	22	9							6:43	64
	Z	85	83	80	77	73	68								
24	89	76	63	49	36	22	9							6:45	64
	180	89	85	81	78	73	68								
25	88	76	63	49	36	23	10							6:47	64
	180	93	87	82	78	74	69								
30	83	75	63	50	37	24	11							6:58	63
	180	113	97	88	82	76	69								
35	78	73	62	49	37	25	13	2						7:10	61
	180	127	106	94	86	78	70	62							
40	73	69	60	49	37	26	15	4						7:25	59
	180	138	114	100	89	80	72	63							
45	68	65	57	48	37	27	16	7						7:43	56
	180	145	122	105	93	83	73	63							
50	63	61	55	46	37	27	18	9	1					8:05	52
	180	151	128	110	97	85	74	64	53						
55	58	57	51	44	36	28	19	11	4					8:33	46
	180	155	133	115	101	88	76	65	53						
60	53	52	48	42	35	28	20	13	7	1				9:14	37
	180	157	137	119	104	90	78	65	53	40					
65	48	47	44	39	34	27	21	15	10	5	1	0		10:42	20
	180	160	140	123	107	93	80	67	54	41	27	0			
70	43	43	40	37	32	27	22	17	13	9	6	4	3	- -	-
	180	161	143	126	110	96	82	68	55	41	28	14	0		
75	38	38	36	34	30	26	23	19	15	13	10	9	8	- -	-
	180	163	145	129	113	98	84	69	56	42	28	14	0		
80	33	33	32	30	28	26	23	21	18	16	15	14	13	- -	-
	180	164	147	131	116	101	86	71	57	43	28	14	0		

Interpolate for values of solar altitude and azimuth corresponding to the nearest whole degree of latitude. The upper value of each pair of tabular values is the solar altitude and the lower value is the east azimuth angle. To find a west azimuth for a given hour angle, subtract the corresponding east azimuth angle from 360 degrees. Azimuths are east in the morning and west in the afternoon. North = 0°; Z = zenith.

Table A16-4 (continued). Solar Altitudes and Azimuths
at the Time of the WINTER Solstice
(Expressed to the nearest whole degree)

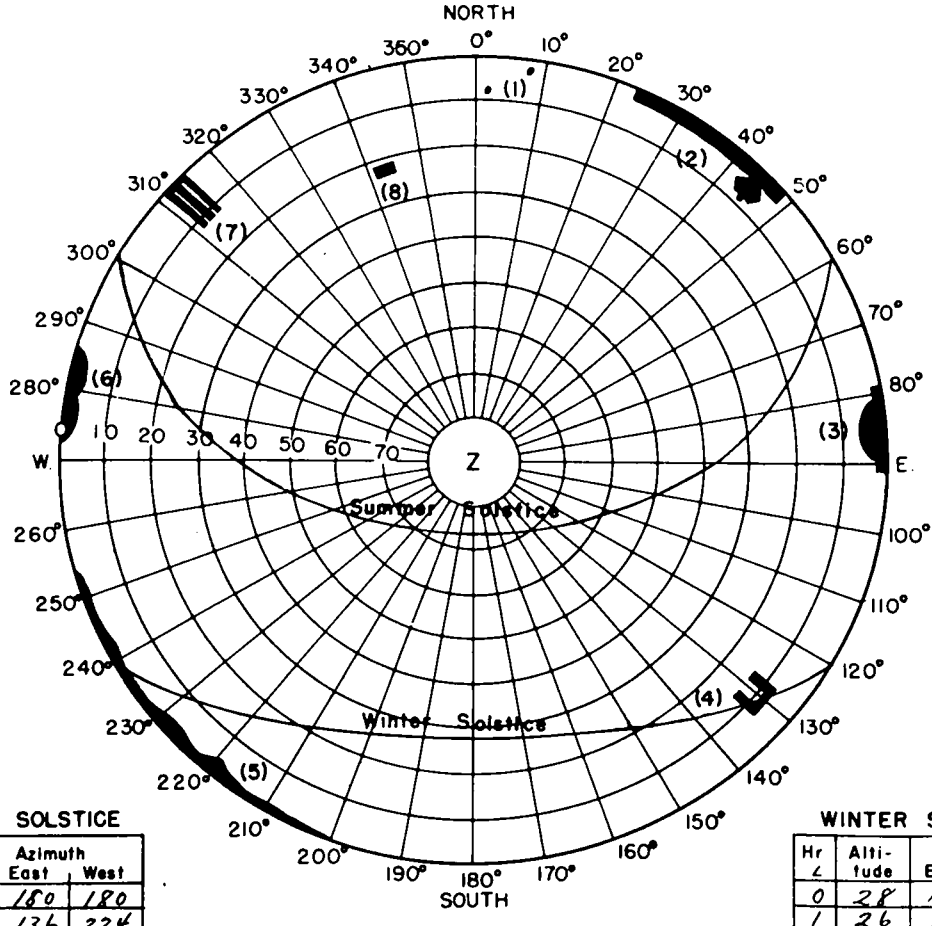
Latitude	Hour Angle						Sunrise or Sunset	
	0	1	2	3	4	5	Hour Angle (h. m.)	Azimuth Angle (degrees)
0	67 180	62 149	53 131	40 122	27 117	14 114	6:00	113
5	62 180	58 153	49 135	38 125	25 119	12 115	5:51	114
10	57 180	53 157	46 139	35 128	23 121	9 116	5:43	114
15	52 180	49 159	42 142	32 130	20 122	7 117	5:34	114
20	47 180	44 161	38 145	28 133	17 124	5 117	5:23	115
25	42 180	39 162	33 147	25 134	14 125	3 118	5:13	116
30	37 180	35 163	29 148	21 136	11 126	0 118	5:02	117
35	32 180	30 164	25 150	18 137	8 127		4:50	119
40	27 180	25 165	21 151	14 138	5 127		4:35	121
45	22 180	20 165	16 152	10 139	2 127		4:17	124
50	17 180	15 166	12 152	6 139			3:55	128
55	12 180	11 166	7 153	3 140			3:27	134
60	7 180	6 166	3 153				2:45	142
65	2 180	1 166					1:26	160

Interpolate for values of solar altitude and azimuth corresponding to the nearest whole degree of latitude. The upper value of each pair of tabular values is the solar altitude and the lower value is the east azimuth angle. To find a west azimuth for a given hour angle, subtract the corresponding east azimuth angle from 360 degrees. Azimuths are east in the morning and west in the afternoon. North = 0°.

W.B. FORM 1092 U.S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

OBSTRUCTIONS TO PYRHELIOMETER OR ILLUMINATION CELL

STATION Nameville, State LATITUDE 38 ° 56 ' NORTH
DATE February 15, 1950 LONGITUDE 77 ° 05 ' WEST
ELEVATION OF INSTRUMENT 10 METERS, MSL.



SUMMER SOLSTICE

Hr ∠	Altitude	Azimuth East	Azimuth West
0	74	180	180
1	70	136	224
2	60	112	248
3	49	99	261
4	37	88	272
5	26	80	280
6	15	72	288
7	4	63	297
SR	0	59	—
SS	0	—	301

LIST OF OBSTRUCTIONS

1.	ANTENNA POLES
2.	ADMINISTRATION BUILDING
3.	HANGAR
4.	APARTMENTS
5.	HILLS
6.	TREES
7.	STEEL MILLS
8.	COAL CHUTE
9.	
10.	
Prepared by	Cole

WINTER SOLSTICE

Hr ∠	Altitude	Azimuth East	Azimuth West
0	28	180	180
1	26	165	195
2	22	151	209
3	15	138	222
4	6	127	233
SR	0	121	—
SS	0	—	239

Fig. A16-9. WB Form 1092

A16324. Changing Pyrheliometers.--At northern stations supplied with both 50-junction and 10-junction pyrheliometers, the 50-junction pyrheliometer will be used during the fall, winter and spring. In the fall, after the sun has reached a low solar altitude such that the maximum deflection (amplitude) of the recorder pen at noon on a clear day is small, remove the 10-junction pyrheliometer and install the 50-junction instrument. The exchange should be made when the maximum deflection has decreased to a scalar reading of less than the ratio of the calibration constant for the 10-junction instrument to the constant for the 50-junction instrument multiplied by a factor of 100, e.g., if the constant for the 10-junction instrument is 2.5 and the constant for the 50-junction instrument is 7.5, the 50-junction instrument would be installed after the maximum amplitude of the trace on a clear day has decreased to less than $\frac{(100 \times 2.5)}{7.5}$, or 33.3 units as read on the graduated chart. In the spring, the 10-junction instrument will be installed after the maximum amplitude of the 50-junction trace reaches 90 to 95 units on a clear day. Enter the date and the true solar time of each exchange as a note on the recorder record. Regardless of whether the 10- or 50-junction instrument is in use, the calibration dial on the recorder will not be changed from the calibration value in millivolts appropriate to the 10-junction instrument (see ¶ A16411).

A16325. Maintenance.--Clean the bulb daily or more frequently if pollution is excessive or frost or ice accumulates on the bulb. Use a soft, clean cloth and water if necessary. Remove frost or ice-coatings with warmed cloths or any other device that will not scratch the glass. Wipe the glass dry immediately following the removal of the ice.

*A16325.1. Stations in areas where sandstorms or hailstorms occur are furnished with covers to protect the bulb of the pyrheliometer from damage. The covers are equipped with drawstrings, which enable the cover to be tightly fitted to the bulb. Place the cover over the bulb at the beginning of each storm. During the season when storms are likely to occur at night, the cover will be left on all night and removed before sunrise.

A16400. RECORDERS

*A16410. General.--Two types of Brown recorders are in general use: (1) a roll-chart type and (2) a circular-chart type which is used with a four-dial watt-hour meter as an integrating indicator. Maintenance and operation instructions in manufacturer's manuals specified in this chapter for Brown recorders are contained in the following manuals or their equivalent:

(1) Manual 15028G, Issue 2 for circular-chart recorders.

(2) Manual 15038G, Issue 4 for roll-chart recorders.

An L&N (Leeds and Northrop) recorder is also used at a few stations. Except for the general instructions in this chapter, instructions pertaining to the operation and maintenance of L&N recorders will be furnished to Weather Bureau stations requiring them upon request.

*A16410.1. All recorders are of the modified, commercial, self-balancing potentiometer type. Each recorder is calibrated by a technician to record over a range of 0 to 2.0 gm. cal./sq. cm./min. corresponding to the range of the individual 10-junction instrument to be used with it. The recorder is not recalibrated when a 50-junction is substituted for a 10-junction instrument (see ¶ A16324).

A16411. The circular calibration dial inside the recorder will be set by the technician to the value in millivolts indicated by the calibration sheet accompanying the station 10-junction pyrheliometer. Once set, the dial will be adjusted only by technicians during subsequent calibrations.

A16412. The location of the recorder should conform with the requirements stated in the manufacturer's manual of instructions that is supplied with each instrument. Any unavoidable changes that tend to make the location unsatisfactory, e.g., excessive dustiness, ambient temperatures above 110°F. or below 32°F. will be reported to the Regional Office.

A16413. Each observer should become familiar with the characteristics of the trace normally obtained under various meteorological conditions. The trace will vary constantly in amplitude between sunrise and sunset. The changes may be smooth or abrupt, but periods of record of 10 to 15 minutes or more without any change in amplitude, or a series of step-like changes in amplitude (brief periods of no change followed by abrupt increases or decreases), generally indicate malfunctioning of equipment. The slight curvature of the trace obtained near noon on a clear day should not be mistaken for a trace in which there is no change of amplitude. If faulty operation of a Brown recorder is suspected because of abnormalities in the trace or for other reasons, substitute spare tubes, one at a time, for the two 7F7 and the two 7N7 tubes in the recorder amplifier. One set of spare tubes should be kept available for replacement purposes, and used tubes should be retained for disposition by a technician.

A16420. Operation of Roll-Chart Type Recorder (Brown ElectroniK Recorder - See Fig. A16-10).—

(1) To start the recorder:

(a) Swing the chassis out of the case and turn on the power switch on the back of the chassis.

(b) After the amplifier tubes have warmed up for two minutes or more, turn on the chart-drive switch.

(c) Standardize the dry cell manually (see manufacturer's manual of instructions).

(d) Check the legibility of the trace.

(2) To stop the recorder:

(a) Turn off the chart-drive switch. CAUTION: If the recorder is in a standardization cycle, do not turn off the switch until the cycle is completed.

(b) If use of the recorder is being discontinued for servicing, or for more than 24 hours, turn off the power switch located on the back of the chassis.

A16421. Standardization.—When the recorder is in operation it initiates a standardization cycle automatically every thirty minutes. The cycle lasts for about thirty seconds. To avoid turning off the recorder chart-drive during a standardization cycle, standardize the instrument manually in accordance with the manufacturer's instructions until the audible and visual indications that accompany each cycle become familiar. A characteristic sound occurs during the cycle and another at the end of the cycle. Frequently, instability of the pen will be observed during the cycle as "pips" on the trace. These are brief changes in amplitude of about 30 seconds duration followed quickly by return of the pen to approximately the amplitude at the beginning of the cycle. The amplitude and direction of the change will depend upon the condition of the dry cell (see manufacturer's manual of instructions). Frequently a very slight readjustment in the amplitude of the trace will result from the standardization process.

*A16422. Maintenance.--

(1) Dry-Cell Renewal.--Instructions for installing the dry cell (a 1.5-volt, Columbia Gray Label dry cell or equivalent) are given in the manufacturer's manual of instructions. The special flexible-resistor type lead from the negative "BAT" terminal must be handled carefully and must not be replaced except with the same type of lead. The dry cell should be renewed immediately upon receipt of each new cell at six-month intervals and whenever the red, dry-cell-condition index drops to the "Renew" line, or the net change in the amplitude of the trace during the standardizing cycle becomes greater than normal.

(2) Slidewire.--The slidewire will be serviced by a technician.

(3) Chart Renewal.--Each roll of chart paper has a life of about thirty days of continuous operation at the chart-feed speed of two inches per hour. Renew the paper

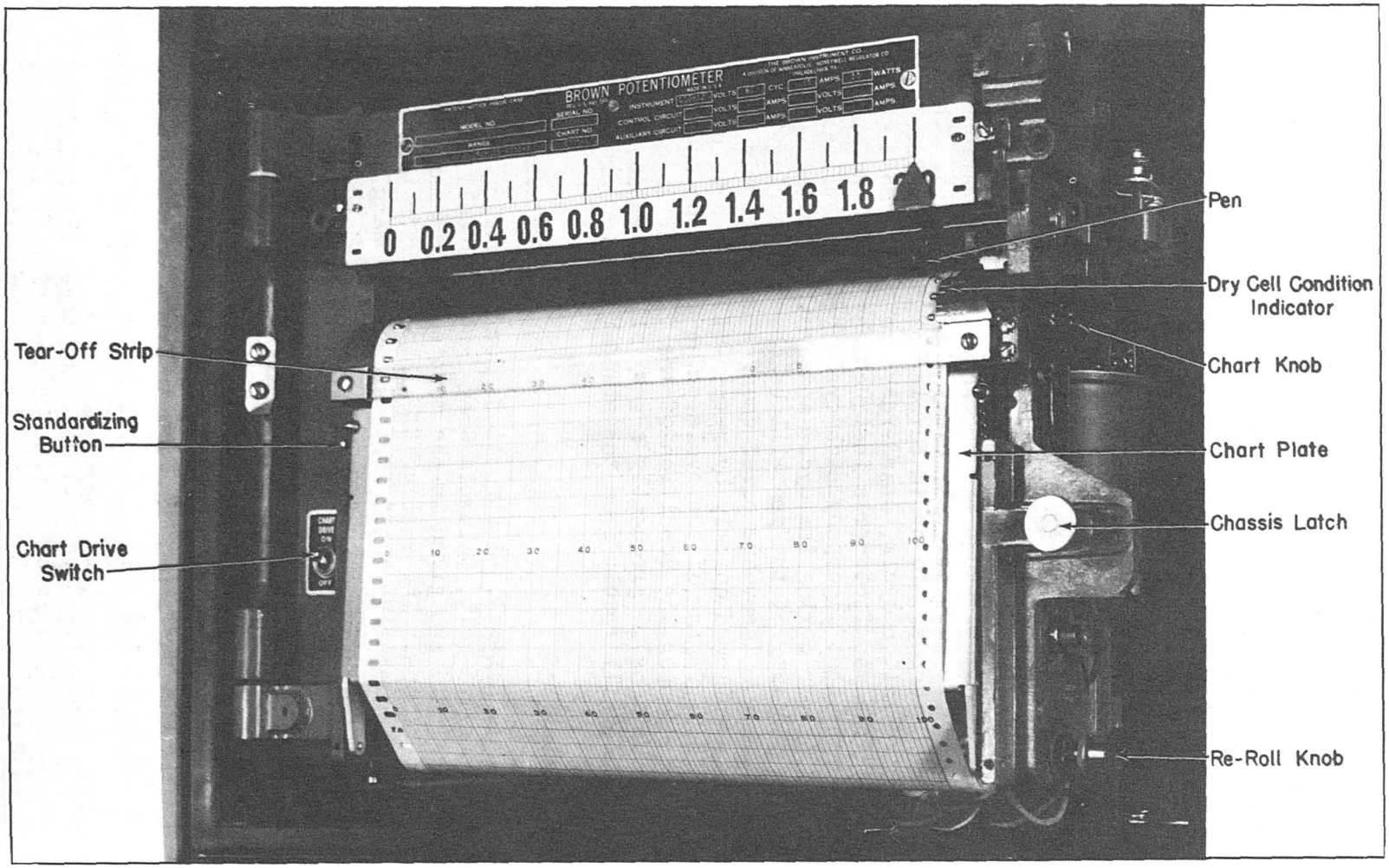


Fig. A16-10. Roll-chart recorder

between sunset and sunrise in accordance with the manufacturer's manual of instructions when it becomes evident that the remaining paper is not sufficient for for the following day, or at any other time if necessary to avoid loss of record.

(4) Pens.—Refill the pen whenever the chart is replaced, and more frequently if necessary to avoid loss of record. Clean the pen as frequently as necessary to insure a legible, uninterrupted record. Further instructions for installing, filling, and cleaning the pen are contained in the manufacturer's manual of instructions.

(5) Lubrication and Cleaning.--Clean and oil the recorder each month in accordance with the manufacturer's manual of instructions under "Monthly Maintenance."

(6) Continuous Balance Unit.—Instructions for adjusting the sensitivity of the unit, and instructions supplementary to those in par. A16413 for replacing defective amplifier tubes, are furnished by the manufacturer.

A16430. Operation of the Circular-Chart Type Recorder (Brown ElectroniK Recorder - See Fig. A16-11).—

(1) To start the recorder:

(a) Turn on the instrument power switch on the lower left side of the face plate.

(b) After the amplifier tubes have warmed up for two or three minutes, standardize the dry-cell current in accordance with the manufacturer's manual of instructions for "Standardizing the Battery Current".

(c) Re-standardize the dry-cell current after the instrument has been operating approximately two hours.

(2) To stop the recorder, turn off the power switch on the lower left side of the face plate (the recorder should be stopped only for servicing, or when it is to be out of operation for 24 hours or more).

*A16431. Standardization.--Normally the dry-cell current should be standardized each morning, and again at approximately noon. The morning standardization should be made when the pen reaches approximately ten ordinates on the chart and within two hours after sunrise when the pen does not reach this ordinate. Following the installation of a new cell standardize the cell at fifteen-minute intervals for the next two hours. Identify the noon standardization point by a short time check "✓"

followed by the true solar time. The current should be standardized using the method given in the manufacturer's manual of instructions.

*A16432. Maintenance (See Fig. A16-12).--

(1) Dry-Cell Renewal.--Instructions for installing the dry cell (a 1.5-volt Columbia Gray-Label dry cell or equivalent) are given in the manufacturer's manual of instructions. The special flexible-resistor type lead from the negative "-BAT" terminal must be handled carefully and must not be replaced except with the same type of lead. Replace the dry cell immediately upon receipt of each new cell at six-month intervals, and whenever the current can no longer be standardized.

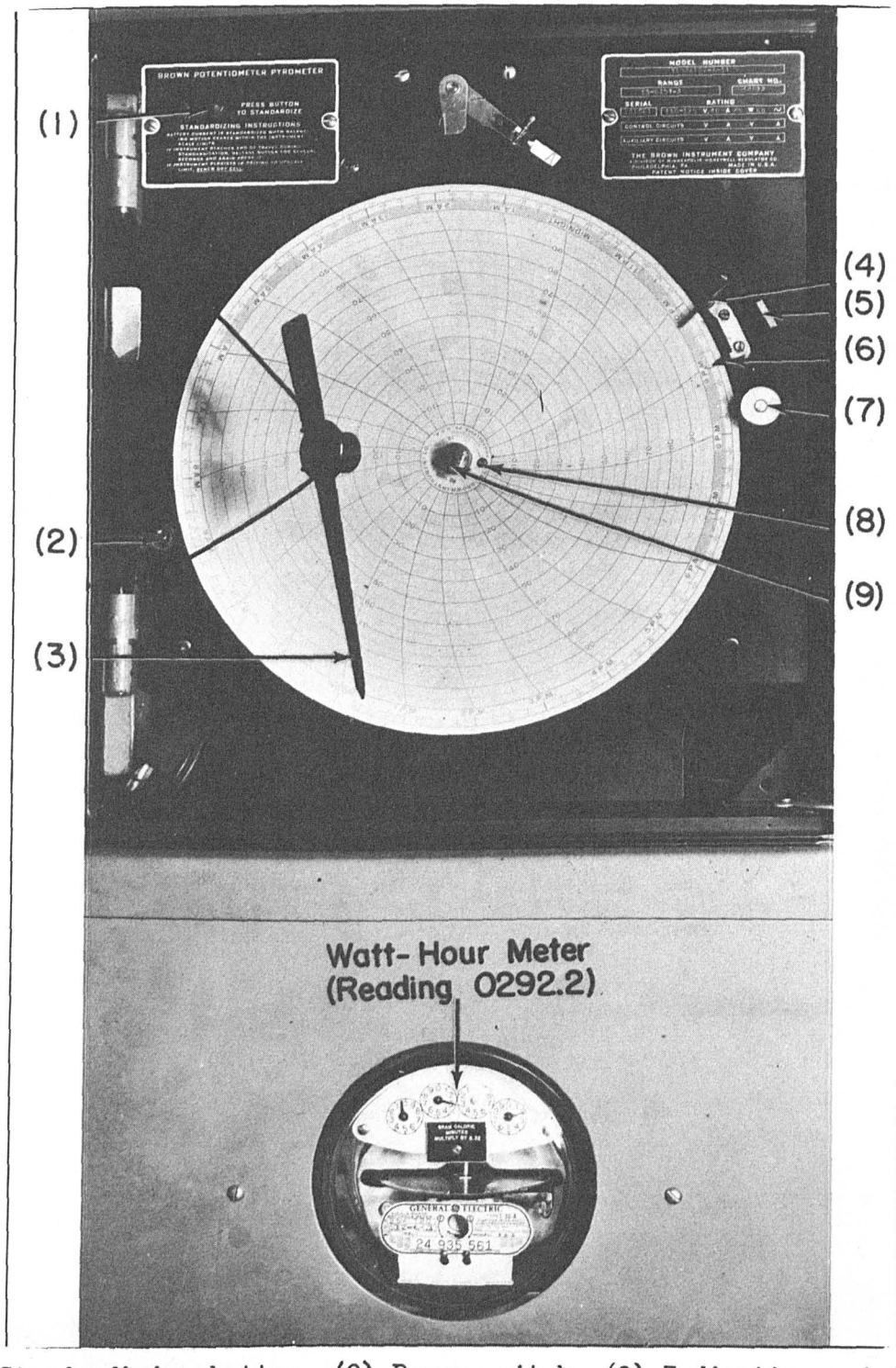
(2) Slidewire.--The slidewire will be serviced by a technician.

(3) Chart Renewal.--Circular charts will be replaced daily in accordance with the manufacturer's instructions.

(4) Pens.--Fill the pen each day at the time the chart is replaced. Clean the pen as frequently as is necessary to insure a legible record. Clean and fill the pen in accordance with the manufacturer's manual of instructions using ink provided for this instrument.

(5) Lubrication.--Oil the recorder each month in accordance with the manufacturer's manual of instructions under "Monthly Maintenance."

(6) Continuous-Balance Unit.--Instructions for adjusting the sensitivity of the unit, and instructions supplementary to those in par. A16413 for replacing defective amplifier tubes, are specified in the manufacturer's manual of instructions.



(1) Standardizing button, (2) Power switch, (3) Indicating pointer, (4) Pen holder, (5) Pen, (6) Time index, (7) Chassis latch, (8) Time index pin, (9) Chart hub.

Fig. A16-11. Circular-chart recorder (front)

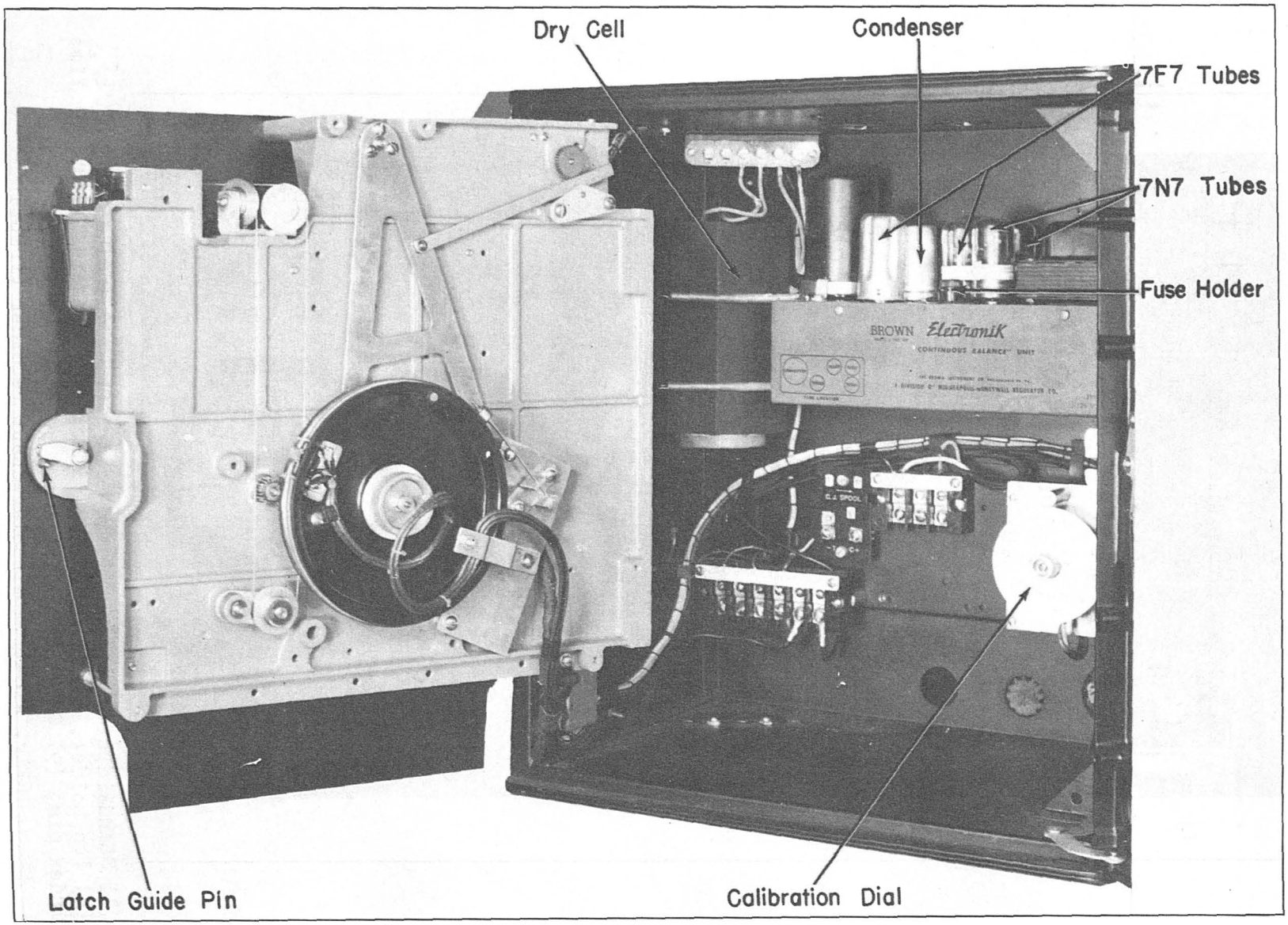


Fig. A16-12. Circular-chart recorder (inside)

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CHAPTER A17. PREPARATION AND DISTRIBUTION OF FORMS 1001B and C, 1081 and 1083

A17000. FORM 1001B - GENERAL

*A17010. Preparation.--(See Fig. A17-1.) Form 1001B will be prepared in duplicate as the original record (manuscript copy) of observations at first-order stations where aviation observations are not taken; except that at stations not equipped with a multiple register and at which only one climatological observation (maximum and minimum temperature, and precipitation measurement) is taken daily, Form 1001C will be prepared as the original record in accordance with ¶ A17210. Black ink, or a well-sharpened Venus 2H or 3H drawing pencil or equivalent black-lead pencil, will be used except where red is specified (see ¶ A17013). Sufficient pencil pressure will be used to assure legible carbon copies and ample black-line contrast for microfilming the original records.

A17011. Disposition.--Completed forms will be mailed as follows unless special instructions have been issued. Forward the original copies of Form 1001B for the month to the WRPC by the second working day of the following month. When any form cannot be mailed by the specified date, forward an explanation to the WRPC on or before that date. Corrected carbon copies (see ¶ A17013) will be forwarded to the Section Center, and the originals will be retained as part of the permanent local record. Note that WBAN-10D will be prepared at all stations where Form 1001B is prepared.

A17012. Time.--Use 24-hour, local standard time, with 0000 as the beginning, and 2359 as the end of the day.

A17013. Correction of Entries.--Upon receipt of Form 5066 from the WRPC, enter the indicated corrections in red on retained (carbon) copies of Form 1001B.

A17014. Heading.--Enter the station name and date in the spaces provided.

A17015. Interpolated or Estimated Data.--Unless otherwise specified, data that are interpolated or estimated, entirely or in part, will be entered in parentheses on Form 1001B. Sums and averages obtained from these data will also be entered in parentheses.

A17016. Missing Data.--Whenever an entry is missing because sufficient recorded, estimated, or interpolated data are not available, enter an "M" instead of the missing value.

A17100. FORM 1001B - COLUMN ENTRIES

A17101. Time (Col. 1).--In the heading, enter the time zone indicator from Table 17.

A17102. Temperature (Col. 2).--Enter the corrected hourly thermograph temperature, in whole degrees, occurring midway between the hours printed in column 1, supplying minus signs where required. For example, the entry for the hour "12-13" will be the temperature indicated at 1230.

A17103. Precipitation (Col. 3).--Enter corrected or interpolated hourly amounts of precipitation in inches and hundredths as obtained from the automatic record, either tipping bucket or weighing gage (see par. 4030). Enter interpolated data in parentheses (see par. A12015). Enter "T" for amounts less than 0.005 inch. Omit entry if no precipitation has occurred during the hour. Enter the total precipitation for the day opposite "Sum".

A17104. Wind Direction (Col. 4).--Enter the prevailing wind direction, taken from Forms 1017 or 1017B, to eight compass points for each hour. Enter the prevailing direction for the day (see par. A8050) under "Prevailing". "Direction Indeterminate" (DI) will not be considered as the prevailing direction for the day.

*A17105. Wind Speed (Col. 5).--Enter the corrected number of statute miles of wind for each hour. Wind speeds obtained from Forms 1017 or 1017B will be corrected in accordance with Table 14. Enter the total wind movement for the day opposite "Sum", and the mean hourly speed to tenths of a mile opposite "Average".

A17106. Sunshine (Col. 6).--Enter hourly sunshine in minutes as obtained from Forms 1017 or 1017B. If an hourly value is wholly estimated, enter it in parentheses. Opposite "Sum" enter the total minutes of sunshine for the day, and under "Possible" enter the possible number of minutes as given in the Station Sunshine Tables. Obtain percentage of sunshine by dividing the total minutes for the day, multiplied by 100, by the "Possible" as shown in the Sunshine Table and enter the result in whole percent at the foot of the column.

*A17107. Sky Cover (Col. 7) 1/.--Enter total tenths of sky cover, as required by ¶ 1530, for the hours that personnel are on duty between sunrise and sunset. Enter the estimated values in parentheses for the daylight hours during which no personnel are on duty. These entries correspond to observations taken at thirty minutes past the hour. Opposite "Sum" enter the total of the hourly entries. Enter the average hourly tenths of sky cover in the space provided.

1/ Entries in columns 7-9 and 14 are not required from city offices if there is a first-order airport observing station in the locality.

A17108. Lowest Visibility (Col. 8)[1].—Using the values from Table 4C, enter the lowest prevailing visibility observed during each daylight hour that personnel are on duty.

A17109. Weather and Obstructions to Vision (Col. 9)[1].—Using the symbols printed on the form, enter in the order of their predominance the meteorological phenomena occurring at the time of the visibility observation entered in column 8. Enter obstructions to vision only when the visibility is six miles or less. Use intensity symbols for precipitation as indicated in par. 3910. (Use the symbol "S" to represent any form of snow, including snow grains, snow pellets, etc. Use other symbols similarly; e.g., "F" to represent ground fog and ice fog.)

A17110. Extra Columns (Col. 10-13).—Enter any additional data that are required locally and use the column headings for identifying these data.

A17114. Beginnings and Endings of Meteorological Phenomena, Remarks, Notes, etc. (Col. 14)[1].—Enter in chronological order (not necessarily opposite the hour printed in column 1 corresponding to the time of the phenomena) the times (LST) of beginnings and endings of precipitation and obstructions to vision. Use the symbols listed on the form and disregard intensities. (Use DL" to record distant lightning.) When the time of beginning or ending is unknown, enter the estimated time in parentheses. Example: R 0305-0325; RS 0325-(0350); S (0350)-1330. Intervals of 15 minutes or less between the time of ending and recommencement will not be recorded. If additional space is required, use column 61; columns 10-13 may also be used if not required for hourly data. The following data will also be entered in column 14:

1. Hailstorms (see par. 3934.1)
2. Tornadoes and water spouts (see pars. 3934.2 and A3934.2)
3. Lightning (see par. 3934.3)
4. Aurora (see pars. 3934.4 and A3934.4)
5. Harbor ice (see par. 3934.5)
6. Snow surface temperatures (see par. 5590)
7. Frost and freeze (see pars. 3934.6 and A3934.6)
8. Seiches (see pars. 3934.6 and A3934.6)
9. Navigation and wind warning seasons (see pars.3934.6 and A3934.6)
10. Miscellaneous (see par. 3934.6)

A17115. Scheduled Observations (Cols. 15-26).—Enter in these columns data observed at the time of scheduled observations.

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[1] Entries in columns 7-9 and 14 are not required from city offices if there is a first-order airport observing station in the locality.

A17116. Time (Col. 15).—Enter the time that the observation is begun, to the nearest minute (LST); e.g., 0110, 1805.

A17117. Station Pressure (Col. 16).—Enter mercurial- or precision-aneroid-barometer reading to the nearest 0.001 inch.

A17118. Dry and Wet Bulb (Cols. 17-18).—Enter these temperatures to the nearest degree and tenth, supplying minus signs where required.

A17119. Dew Point (Col. 19).—Enter the dew point to the nearest whole degree, supplying minus signs where required.

A17120. Relative Humidity (Col. 20).—Enter relative humidity to the nearest whole percent.

*A17121. Maximum and Minimum Temperatures (Cols. 21-22).—At stations equipped with maximum and minimum thermometers, thermographs or telepsychrometers, enter the maximum and minimum temperatures to whole degrees for the period between successive observations. Take the data from the telepsychrometer or the maximum and minimum thermometers, if available; if not, use the thermograph (see Chapters 5 and A5). Note that these temperatures must be as high and low, respectively, as any temperature recorded within the period covered, including the current temperature.

*A17123. Precipitation (Col. 23).—Enter total precipitation in inches and hundredths for the period between successive observations; e.g., 0.06. Use the gage specified in par. 4030. When precipitation has occurred in amounts less than 0.005 inch (trace), enter "T". When precipitation has not occurred, enter "0".

*A17124. Snowfall, Sleet and Hail (Col. 24).—Enter to inches and tenths the depth of the total amount of frozen precipitation (snow, sleet, ice crystals and hail) occurring between the time of the preceding observation and the current observation (see par. 4230). When snow, sleet or hail has fallen in amounts of less than 0.05 inch enter "T" denoting trace. When none has occurred, enter "0". When snow, sleet or hail melted as it fell, enter "T" with a reference note "Melted as it fell" in column 14.

A17125. Depth of Frozen Precipitation (Col. 25).—Enter the depth of frozen precipitation (snow, sleet, ice crystals, hail and ice) on the ground, to the nearest inch. When snow, etc., is on the ground and the depth amounts to less than 0.5 inch, enter "T" denoting trace. Enter "0" when none is on the ground. Ice depth, which is the depth of sheet ice on the ground formed directly or indirectly from precipitation, should not be confused with "thickness of ice on water." Whenever snowfall melts and refreezes, the depth of ice formed will be included in the entries in this column. When the maximum depth of snow on the ground between observations, obtained either by measurement or by visual estimation, exceeds the measured

amount on the ground at the end of the period of observation, enter the maximum depth and the time of occurrence in remarks; e.g., "One inch of snow on ground at 1145." Maximum amounts of frozen precipitation obtained by visual estimation will not be entered in parentheses.

*A17126. Height of 850-Mb. Surface (Col. 26).--At stations designated to compute this datum, enter in feet, to the nearest ten geopotential feet, the height of the 850-mb. surface above sea level. Designated stations are selected from stations whose elevations are between 2500 and 9500 feet. Computations will be made in accordance with Section 7400.

A17127. Summary of Day (Cols. 27-38).—Enter data for the 24-hour period from midnight to midnight (LST) in these columns.

A17128. Maximum and Minimum Temperatures (Cols. 27 and 28).—Enter these data in whole degrees (see Chapters 5 and A5). Note that the maximum and minimum temperatures must be at least as high and low, respectively, as any temperature recorded through the day. At stations where midnight observations are not taken, the data will be secured from a thermograph, if available; otherwise, the entry will be omitted.

A17129. Average Temperature (Col. 29).—Enter the average temperature for the day, to whole degrees. This temperature is half the sum of the maximum and minimum temperatures for the day.

A17130. Normal Temperature (Col. 30).—Enter the normal temperature for the day, to whole degrees, when available. Use the normal for February 28 as the normal for February 29 also.

*A17131. Precipitation - 24-Hour Amount (Col. 31).—Enter the total amount of precipitation (water equivalent of solid types) to the nearest 0.01 inch. If precipitation has occurred in amounts less than 0.005 inch, enter "T" denoting trace. If precipitation has not occurred, enter "0". The sum of any number of "T" observations will be regarded as a trace unless recording equipment indicates the total is 0.005 inch (liquid) or more.

*A17132. Frozen Precipitation - 24-Hour Amount (Col. 32).—Enter to tenths of an inch the total amount of frozen precipitation (snow, sleet, ice crystals and hail) that falls during the 24-hour period. If there are separate falls, each of which melts before the following occurs, the total for the day will be the sum of the maximum depth of each fall. When the total 24-hour depth from midnight to midnight is not available, estimate the depth, using the data entered in column 24 as a guide. Enter the estimated value in parentheses. Record amounts in inches and tenths. When snow, sleet or hail melts as it falls, enter "T" with a reference note "Melted as it fell" in column 14. If snow, sleet or hail has fallen in amounts less than 0.05 inch, enter "T" denoting trace. If none has fallen, enter "0".

*A17133. Depth of Frozen Precipitation (at 1230 GCT) (Col. 33).--Enter the depth of frozen precipitation (snow, sleet, ice crystals, hail and ice) on the ground at 1230 GCT to the nearest inch. Enter "T" for amounts less than 0.5 inch. Enter "0" when none is on the ground.

A17134. Maximum Average 5-Minute Wind Speed and Direction (Col. 34).—Enter the corrected maximum average 5-minute wind speed in whole miles per hour and the direction. The corrected speed is obtained by applying the appropriate correction from Table 14 to the uncorrected data from Form 1017 or 1017B.

A17135. Time of Maximum Average 5-Minute Wind Speed (Col. 35).—Enter the time of beginning to nearest minute (LST).

*A17136. Fastest Mile and Direction (Col. 36).--Enter the corrected (see Table 14) fastest mile in statute miles per hour and the corresponding direction. When the fastest mile occurs more than once, and from two or more directions, enter the direction of the first occurrence followed by a footnote reference and an explanatory footnote; e.g., 1/first of several occurrences. The uncorrected fastest mile and the direction data are taken from Forms 1017 or 1017B. When the data are estimated (see ¶ A13021.4), enter them in parentheses. If these data are required locally and the station is not equipped with a multiple register, the highest one-minute wind speed in statute miles per hour observed during the day and the corresponding direction may be entered in column 36. In this case, enter an asterisk in the heading of the column referring to the footnote: "*Fastest observed mile and direction."

A17137. Time of Fastest Mile (Col. 37).—Enter time of beginning to the nearest minute (LST).

A17138. River Stage (Col. 38).—At stations where a river gage is read, enter this reading to the nearest 0.1 foot.

A17139. Excessive Precipitation (Cols. 39 to 50).—Enter amount of excessive precipitation in these columns (see par. A4530). Tabulate excessive precipitation data and ascribe to it to the day in which the period ends. Whenever more than one tabulation is required for the same day, enter the data in column 61. Use a rubber stamp to provide and identify spaces for the additional tabulations.

A17151. Extra Columns (Cols. 51 to 53).—Enter any additional data that are required locally and identify these data in the respective column headings.

A17154. Station Pressure Computations (Lines 54 to 60).—Enter data in these lines in accordance with instructions in par. 7780.

A17161. Additional Remarks and Notes (Line 61).—Enter the character and time (LST) of sunrise and sunset, using the terms Clear, Cloudy, Foggy,

W. B. Form 1001 B

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

DAILY RECORD

Station City, State Date January 16, 1953

Time (E.S.T.) (1)	Temperature (°F) (2)	Precipitation (Inches) (3)	Wind Direction (4)	Wind Speed (M.P.H.) (5)	Sunshine (Minutes) (6)	Sky Cover (Scale 0-10) (7)	Lowest Visibility (Miles) (8)	Weather and Obstructions to Vision (9)	Relative Humidity (10)	(11)	(12)	(13)	Beginnings and endings of meteorological phenomena; Remarks, notes, etc (14)
00-01	46		NW	20									
01-02	47		NW	17									
02-03	47	T	NW	20				R-					R (0237) - (0350)
03-04	51	T	NW	20				R-					
04-05	53		NW	22									
05-06	54		NW	20									
06-07	56		NW	20	0	7	7						
07-08	57		SW	22	22	3	10		92				
08-09	59		NW	23	60	1	10						
09-10	61		NW	24	60	0	12		89				
10-11	62		N	26	60	2	15+						
11-12	62		NW	21	9	5	15+		88				
12-13	62		NW	20	0	10	12						
13-14	64		NW	20	0	10	12		63				
14-15	(58)		NW	22	0	10	12						
15-16	55		SW	20	0	10	10		54				
16-17	52	T	W	19	0	10	10	R-					R 1631 - 1710
17-18	50	T	SW	17	0	10	7	R-					R 1732 - 1750
18-19	48		SW	18									
19-20	47	.02	SW	19				R-					R (1920) - cont.
20-21	45	.13	SW	19				R					
21-22	44	.53	SW	17				R+					
22-23	42	.71	SW	14				R+					
23-00	41	.15	SW	11				R					
SUM.	—	1.54	—	471	211	78	—	—					
AVER.	—	—	Prevailing	19.6	610	6	—	—					
MISC.	—	—	NW	—	35%	—	—	—					

SYMBOLS USED IN COLUMN 9

A—Hail, BS—Blowing snow, D—Dust, E—Sleet, F—Fog, H—Haze, K—Smoke, L—Drizzle, N—Sand, R—Rain, S—Snow, T—Thunderstorm, ZL—Freezing drizzle, ZR—Freezing rain, —

SCHEDULED OBSERVATIONS

Time (LST) (15)	Station Pressure (16)	Dry Bulb (17)	Wet Bulb (18)	Dew Point (19)	Rel. Humid. (20)	Temperature Max (21)	Temperature Min. (22)	Precipitation (23)	Snowfall, Sleet, Hail (24)	Snow, Sleet, Hail, or Ice on the Ground (25)	Height 60 MB Surface (26)
0645		59.0	57.9	57	94	59	45	T	0	0	
1215		62.0	59.8	59	88	63	59	0	0	0	

SUMMARY OF DAY (MIDNIGHT TO MIDNIGHT)

Temperature: 24 Hour Max. (27)	Temperature: 24 Hour Min. (28)	Temperature: Average Temperature (29)	Temperature: Normal Temperature (30)	24 Hour Precip (Water Equiv.) (31)	24 Hour Snowfall Sleet Hail (32)	Snow, Sleet, Hail, or Ice on Grd. (33)	Wind (M. P. H.): Max. Av. 5 Minute Speed and Direction (34)	Wind: Time (LST) (35)	Wind: Fastest Mile and Direction (36)	Wind: Time (LST) (37)	River Stage (38)
64	41	52	33	1.54	0	0	30-N	1000	34-N	1000	

EXCESSIVE PRECIPITATION

The excessive amounts for all 12 periods are entered whenever the amount for one or more periods equals or exceeds the rate of .01 inch per minute plus .20 inch.

Minutes: 5 (39)	10 (40)	15 (41)	20 (42)	30 (43)	45 (44)	60 (45)	80 (46)	100 (47)	120 (48)	150 (49)	180 (50)	(51)	(52)	(53)
.32	.63	.72	.74	.75	.88	1.01	1.07	1.13	1.30	1.40	1.47			

STATION PRESSURE COMPUTATIONS

Time (LST) (54)					
Attached thermometer (55)					
Observed barometer (56)					
Total correction (57)					
Station pressure (58)					
Barograph reading (59)					
Barograph correction (60)					

(61)

Additional remarks and notes

SR - 0642 CLDY

SS - 1702 CLDY

First of several occurrences.

Fig. A17-1. Entries on Form 1001B. Entries in columns 7, 8, 9, and 14 are not required at city offices where there is a local airport observing station.

Smoky, Dusty, or Hazy. Identify the entries by use of the abbreviations, "SR" for sunrise and "SS" for sunset. See ¶ A17114 for additional entries. Enter maximum depth of snow on ground when required in accordance with ¶ A17125.

A17161.1. (Line 61).--At first-order stations whenever the depth of frozen precipitation on the ground exceeds one inch, enter the water equivalent of the total depth as determined at approximately 1200 GCT each Monday. Enter the data to inches and hundredths, preceded by the identification WATER EQUIV. These data will be transmitted in accordance with ¶ A4540 to A4542.

A17200. WB FORM 1001C - PREPARATION AND DISTRIBUTION (SEE FIG. A17-2.)

*A17210. Preparation.--Form 1001C will be prepared in duplicate at all first-order observing stations unless otherwise authorized by the Central Office. Daily entries should be for the period midnight to midnight LST, except that where a midnight observation is not taken and autographic equipment is not in use, enter a note in remarks to indicate the observational period (e.g. "temperature data for period 1630C to 1630C").

*A17211. Entries will be made daily on the manuscript forms in black ink, or with a well-sharpened, Venus 2H or 3H drawing pencil, or equivalent black-lead pencil. Use sufficient pencil pressure to assure legible carbon copies, and ample black-line contrast in microfilms of the original records. A clean, black ribbon should be used for typing, and especial care should be taken to enter the data neatly and uniformly within the column limits.

A17212. Enter the station name, month and year, and time zone (e.g., "Eastern") in the spaces provided.

*A17214. At city offices where Form 1001C is prepared as an original record in lieu of Form 1001B, in accordance with ¶ A17010, data will be entered as follows on Form 1001C:

(1) Columns 2 to 7 will be completed from autographic records.

(2) The maximum and minimum temperatures to the nearest whole degree will be entered in columns 20 and 21, respectively, and precipitation in column 22, for the 24-hour period preceding the time of the climatological observation. These data will be obtained from autographic records for days on which no climatological observation was taken, and will be entered on the manuscript copies only. Identify these data in the respective column headings.

W. B. Form 1001 C

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

LOCAL CLIMATOLOGICAL DATA

(Formerly Station Meteorological Summary)

STATION WBAS Dellview, Texas Central STANDARD TIME MONTH December YEAR 1952

Day 1	Temperature °F: Maximum 2	Minimum 3	Average 4	Departure from Normal 5	Degree Days (Base 65°) 6	Precipitation (In.): Total (Water Equiv. Also) 7	Snowfall, Sleet, Hail 8	Snow, Sleet, Hail on Ground at 9	Wind: Prevailing Direction 10	Average Speed (m.p.h.) 11	Fastest Mile: Speed (m.p.h.) * 12	Direction 13	Sunshine: Total (Hours and minutes) 14	Percent of Possible 15	Sky Cover: S. Rise to Sunset (Tenths) 16	Midnight to Midnight (Tenths) 17	Thunderstorm or Distant Lightning 18	Visibility (Miles) Caused by 19	20	21	22
1	58	32	45	0	20	T	0	0	SSE	9.8	30	S	1:42	17	10	7					
2	70	52	61	+16	4	0	0	0	S	9.9	17	SE	3:21	33	8	7					
3	72	35	54	+9	11	0	0	0	SSE	18.0	30	NW	7:16	72	4	6					
4	37	27	32	-13	33	0	0	0	NNW	10.8	22	NW	0:18	3	10	8					
5	51	26	38	-7	27	0	0	0	WNW	4.4	18	NW	9:20	93	2	3					
6	58	26	42	-3	23	0	0	0	W	3.1	8	S	7:42	76	6	3					
7	62	37	50	+5	15	0	0	0	S	7.0	23	SW	0:00	0	10	8					
8	72	52	62	+17	3	0	0	0	S	12.7	24	S	0:00	0	9	8					
9	39	28	34	-11	31	.02	T	0	NNW	9.8	18	N	0:00	0	10	10					
10	34	28	31	-14	34	.02	0	0	NNW	8.7	15	NW	0:00	0	10	10					
11	38	31	34	-11	31	.13	0	0	NNW	5.3	17	NE	0:00	0	10	10					
12	46	36	41	-4	24	.04	0	0	SE	2.1	9	S	0:00	0	10	10					
13	64	46	55	+10	10	T	0	0	S	7.1	17	S	0:00	0	10	10					
14	79	37	58	+13	7	T	0	0	S	10.1	26	S	0:20	3	9	10					
15	69	52	60	+15	5	.06	0	0	S	8.4	24	S	0:47	8	9	8					
16	52	30	41	-4	24	.57	0	0	N	14.4	25	N	0:00	0	10	10					
17	30	23	26	-19	39	.01	T	0	N	14.1	24	N	0:00	0	10	10					
18	42	27	34	-11	31	.30	T	0	W	7.8	21	W	4:50	47	4	6					
19	36	24	30	-15	35	0	0	0	N	6.0	14	N	9:18	90	3	1					
20	39	21	30	-15	35	0	0	0	SE	5.8	16	SE	0:31	5	9	7					
21	60	39	50	+4	15	.03	0	0	SSE	6.5	18	SE	3:12	31	8	8					
22	54	43	48	+2	17	.28	0	0	NE	5.5	18	SE	0:00	0	10	10		F			
23	71	54	62	+16	3	.18	0	0	SSE	11.5	24	SE	0:00	0	10	10					
24	67	24	46	0	19	5.14	0	0	NNW	14.2	26	N	0:00	0	10	10	T				
25	32	22	27	-19	38	.15	T	0	NNW	7.4	18	NW	0:00	0	10	10					
26	32	28	30	-16	35	.90	0	0	N	10.2	18	N	0:00	0	10	10					
27	52	30	41	-5	24	.46	0	0	SW	9.0	30	SW	7:09	68	3	5					
28	36	17	26	-20	39	T	T	0	NNW	14.9	29	N	0:35	6	9	6					
29	23	15	19	-28	46	T	T	0	N	17.6	31	N	0:00	0	10	8					
30	22	7	14	-33	51	.17	3.3	3	N	3.8	15	N	0:00	0	10	10					
31	26	2	14	-33	51	0	0	2	SSE	3.3	17	S	9:03	86	2	4		F			
SUM	1523	951	--			8.46	3.3			279.2			65:24		255	243					
AVG.	49.1	30.7	--							9.0	FASTEST	DIRECTION	POSSIBLE	%	8.2	7.8					
										MISC	31	N	318:04	21							

TEMPERATURE DATA

AVERAGE MONTHLY 39.9
DEPARTURE FROM NORMAL -5.5
HIGHEST 79 ON 14th
LOWEST 2 ON 31st
NUMBER OF DAYS WITH—
MAX. 32° OR BELOW 6
MAX. 90° OR ABOVE 0
MIN. 32° OR BELOW 20
MIN. 0° OR BELOW 0
DEGREE DAYS (BASE 65°)—
TOTAL THIS MONTH 780
DEPARTURE FROM NORMAL +180
SEASONAL TOTAL 1612
DEPARTURE FROM NORMAL +88

PRECIPITATION DATA

TOTAL FOR THE MONTH 8.46 IN.
DEPARTURE FROM NORMAL +6.07 IN.
GREATEST IN 24 HOURS 5.14 ON 24th

SNOWFALL, SLEET, AND HAIL
TOTAL FOR THE MONTH 3.3 IN.
GREATEST IN 24 HOURS 3.3 ON 30th
GREATEST DEPTH ON GROUND 3 ON 30th

BAROMETRIC PRESSURE 1/
MONTHLY AVERAGE STATION 29.597 IN.
HIGHEST SEA-LEVEL 30.81 IN. ON 29th
LOWEST SEA-LEVEL 29.47 IN. ON 3rd

1/ This datum pertains to an elevation of 762 feet.

WEATHER

NUMBER OF DAYS
CLEAR (Scale 0-3) 4
PARTLY CLOUDY (Scale 4-7) 3
CLOUDY (Scale 8-10) 24
WITH 0.01 INCH OR MORE PRECIP 16
WITH 0.10 INCH OR MORE PRECIP 10
WITH 0.50 INCH OR MORE PRECIP 3
WITH 1.00 INCH OR MORE PRECIP 1

DATES OF—
HAIL 0
SLEET 17, 18, 25
GLAZE 9, 10, 11, 17, 18, 24, 25, 26, 27.

SYMBOLS USED IN COLUMNS 18–19

A=Hail
BS=Blowing Snow
DL=Distant Lightning
D=Dust
E=Sleet
F=Fog
H=Haze
K=Smoke
L=Drizzle
N=Sand
R=Rain
S=Snow
T=Thunderstorm
ZL=Freezing Drizzle
ZR=Freezing Rain

* Fastest observed 1-minute wind speed and its direction.

Total precipitation 8.46 inches was greatest amount for any January in Dellview since 1913. Sunshine, 21% of possible, equals all-time record for least amount of sunshine in any month. Severe ice storm, 24th to 27th, disrupted communications, electric lights and power, and severely damaged trees.

Fig. A17-2. Entries on Form 1001C.

(3) Temperature and precipitation summaries will be entered at the bottom of the form.

(4) Entries in all other columns will be omitted.

*A17220. Distribution.--The original manuscript copy will be mailed to the WRPC by the second working day of the following month, together with 1001C Format. (See Sec. A17400.)

A17230. Correction of Manuscript Copies.--Upon receipt of Form 5066 (Corrections to Weather Records) from the WRPC, the indicated corrections will be made in red on the retained (carbon) copy of Form 1001C. When the original copy of Form 1001C is returned from the WRPC, it will be retained in the station files and the corrected carbon copy will be forwarded to the Section Center, unless photo-offset copies are prepared at the WRPC, in which case the carbon copy may be destroyed.

A17300. ENTRIES OF SUMMARY DATA ON FORM 1001C

A17301. General.--With the exceptions outlined in ¶ A17214, data will be entered as specified below.

*A17302. Maximum and Minimum Temperatures(Cols. 2 and 3).--Enter these data to whole degrees. Enter the sums to whole degrees and averages to tenths of a degree at the foot of the column. If the observational period is other than midnight to midnight (see ¶ A17210), ascribe entries to the date on which the observational period ended.

A17304. Average Temperature (Col. 4).--Enter these data to whole degrees. The average temperature is half the algebraic sum of the daily maximum and minimum temperatures.

A17305. Departure from Normal (Col. 5).--When normals are available, compute the departure by subtracting algebraically the normal temperature from the daily average temperature. Example: Daily average temperature, 65°; normal temperature, 60°; departure = +5°. In leap years use the normal for February 28 as the normal for February 29 also.

*A17306. Degree Days (Base 65°) (Col. 6).--Enter heating degree days to whole numbers (the difference between the daily average temperature and 65° when the daily average is less than 65°). Enter "0" when the daily average is 65° or higher. Omit entry in this column if no maximum and minimum temperature readings are made during the period noon to midnight, LST, and a thermograph is not in use.

*A17307. Total Precipitation (Water Equivalent) (Col. 7).--Enter the total 24-hour precipitation in inches and hundredths, as obtained from WBAN-10B or Form 1001B. Enter the sum of the daily amounts of precipitation at the foot of the column. If the observational period is other than midnight to midnight (see ¶ A17210), ascribe entries to the date on which the observational period ended.

*A17308. Snowfall, Sleet, Hail (Col. 8).--Enter 24-hour unmelted depth of frozen precipitation (snowfall, sleet or hail, etc.) in inches and tenths as obtained from WBAN-10B or Form 1001B. Enter estimated data in parentheses (see ¶ A17213). Enter total at the foot of the column. If the observational period is other than midnight to midnight (see ¶ A17210), ascribe entries to the date on which the observational period ended.

*A17309. Snow, Sleet, Hail or Ice on the Ground (Col. 9).--Enter the depth, to the nearest inch, of frozen precipitation (snow, sleet, hail, ice, etc.) on the ground at 1230 GCT, as obtained from WBAN-10B or Form 1001B. In the heading, enter the local standard time corresponding to 1230 GCT. On forms prepared for public distribution, this time should be in terms of the 12-hour clock, local time.

A17310. Prevailing Direction (Col. 10).--At stations where 24 record observations are taken daily, enter the prevailing direction to 16 points of the compass taken from column 9 of WBAN-10A for record observations. At stations equipped with triple registers, but not taking 24 record observations daily, enter the prevailing direction to eight points of the compass as determined from either the right margin of WBAN-10B or column 4 of Form 1001B. Omit entry at all other stations. ("DI" will be considered as a prevailing direction for the day; however, when the direction is indeterminate for an entire day, enter "Calm" across the columns 10 and 11.) Prevailing direction for the month will not be entered at the foot of column 10.

*A17311. Average Wind Speed (Col. 11).--At stations where 24 record observations are taken daily, enter the average wind speed in miles per hour, computed from the hourly-record observation data in column 10 of WBAN-10A. At stations equipped with triple registers but where 24 record observations daily are not taken, enter the average wind speed computed from the hourly wind data in either the right margin of WBAN-10B (see ¶ A8602) or column 5 of Form 1001B (see ¶ A17105). Omit this entry at all other stations. At the foot of the column, enter the sum of the daily average hourly speeds, and the average of these speeds as obtained by dividing the sum by the number of days in the month. Enter all data in this column to tenths of a mile.

A17312. Fastest Mile and Direction (Cols. 12 and 13).--Enter the speed and direction of the fastest mile or fastest observed one-minute speed as recorded on WBAN-10B (see par. A8603) or Form 1001B (see par. A17136). When the fastest mile occurs from two or more directions, enter the direction of the first occurrence followed by a footnote reference and an explanatory footnote, e.g., 1/ indicates only the first of several occurrences. Enter estimated data (see par. A13021.4) in parentheses (see par. A17213). At stations where the fastest observed one-minute wind speed and direction are entered instead of the fastest mile data, place an asterisk in the heading of column 12, and the following note just above the summary: "*Fastest observed one-minute wind speed and its direction."

A17314. Total Sunshine (Col. 14).--Enter the total sunshine in hours and minutes as obtained from WBAN-10B or Form 1001B, e.g., 0:32; 12:03. At the foot of the column, enter the total sunshine for the month similarly, and the possible sunshine as obtained from the Station Sunshine Tables.

A17315. Percent of Possible Sunshine (Col. 15).--Enter these data in whole percent as obtained by dividing the entry in column 14 by the possible sunshine listed in the Station Sunshine Tables. At the foot of the column, enter in whole numbers the percent of sunshine obtained by dividing the sum of column 14 by the possible sunshine entered below it, and multiplying the quotient by 100.

A17316. Sky Cover - Sunrise to Sunset (Col. 16).--Enter tenths of sky cover as obtained by averaging hourly entries on WBAN-10B or Form 1001B for the period from sunrise to sunset. Observations of sky cover that are made between sunset and sunrise will not be considered in computing average sky-cover entries in column 16 of Form 1001C. For example, if sunset occurs at 1722 EST, an observation of sky cover made at 1727 will not be included in the daily average of this column. At the foot of the column, enter the sum to whole numbers and the average to one decimal place. Obtain averages as indicated in par. A17107.

A17317. Sky Cover - Midnight to Midnight (Col. 17).--Enter data for the period from midnight to midnight, using the procedure described in par. A17316. Omit entry at stations where personnel are not on duty 24 hours a day.

A17318. Thunderstorms or Distant Lightning (Col. 18).—Enter "T" for thunderstorm or "DL" for distant lightning when observed during the period from midnight to midnight. Do not enter more than "T" or "DL" for a day. Enter "DL" only if thunder is not heard, except that if lightning occurs before midnight and thunder is heard after midnight, enter "DL" for the first day and "T" for the following day. Similarly, if thunder occurs before midnight and only lightning after midnight, enter "T" for the first day and "DL" for the following day. Enter both "T" and "DL" if lightning only is observed in one storm, and thunder is heard in another storm.

A17319. Visibility 1/4 Mile or Less, Caused By - (Col. 19).—Enter symbols for hydrometeors or lithometeors that reduce visibility to 1/4 mile or less. Whenever visibility is reduced by several phenomena, enter all in the order of their predominance, using applicable symbols, e.g., "F,R." Use only symbols printed on the form. Use "S" to represent all types of snow, including snow showers, grains, pellets and ice crystals; use other symbols similarly, e.g., "F" to represent both ground fog and ice fog. Entries will be based on the values recorded in column 8, Form 1001B, or column 5, WBAN-10A. Where data are taken from WBAN-10A, the entries will be based on the values recorded in column 5, regardless of whether these values pertain to the usual point of observation, or to the control-tower level. However, whenever the visibility is variable, an entry will be made in this column if at any time during the hour the prevailing visibility is 1/4 mile or less, even though this value is not recorded in column 5.

A17320. Extra Columns (Cols. 20, 21, 22).—Enter any additional data required locally and identify these data in respective column headings.

A17330. Temperature Data.—Enter these data as follows:

A17331. Average Monthly.—Enter, to degrees and tenths, one-half the algebraic sum of the average maximum and minimum temperatures for the month.

A17332. Departure from Normal.—At all stations for which normals have been computed, enter the departure of the average monthly temperatures from the monthly normal (see par. A17305). The monthly normal temperature for February is not changed during a leap year.

*A17333. Highest and Lowest Temperatures.—Enter these data, as obtained from columns 2 and 3, and their dates of occurrence. If temperatures are identical, enter all dates.

A17334. Number of Days with Maximum 32° or Below, or 90° or Above; and Minimum 32° or Below, or 0° or Below.—Enter these data as obtained from columns 2 and 3.

A17335. Degree Days.—Enter the sum of the entries in column 6 and the departure from normal at all stations for which normals have been computed. Enter the seasonal total, using July 1 as the beginning of the season, and the departure from normal at all stations for which normals have been computed.

A17340. Precipitation Data.—Enter these data as follows:

A17341. Total for the Month.—Use the sum of column 7.

A17342. Departure from Normal.—Enter the monthly departure from normal at all stations for which normals have been computed (see par. A17305). The normal precipitation for February 29 will be the same as for February 28.

A17343. Greatest in 24 Hours.—Enter in inches and hundredths the greatest amount of precipitation recorded in any 24 hours and the date or dates of occurrence. When data from a recording gage are not available or are not used for record purposes (see par. 4030(1)), enter in parentheses the greatest amount of precipitation known to have fallen during any 24 hours of record, i.e., as obtained from column 23 of Form 1001B or column 44 of WBAN-10B. When the greatest amount occurred more than once and there is insufficient space for all the dates, enter the date of the first occurrence followed by a footnote reference and an explanatory footnote; e.g., 1/ indicates only the first of several occurrences.

A17343.1. When the 24-hour period begins on the last day of one month and ends on the first of the following, enter the data on Form 1001C for the month in which most of the precipitation fell. Include data for the entire period on this form, and do not repeat the compilation on Form 1001C for the other month, but enter an explanatory note on the bottom of the manuscript copies only. Note that the precipitation entry must equal or exceed the sum of the hourly precipitation amounts for any consecutive 24 hours of record within the month or ascribed to the month in accordance with the foregoing.

A17350. Snowfall, Sleet, and Hail.—Frozen precipitation data (snowfall, ice crystals, sleet, and hail) will be entered in accordance with the instructions below.

A17351. Total for the Month.—Use the sum of column 8.

*A17352. Greatest in 24 Hours.—Determine the greatest depth of frozen precipitation that fell in 24 hours from the data in column 24 of Form 1001B or column 45 of WBAN-10B. Enter the value of this datum to inches and tenths. When the 24-hour period occurs at the end of one

month and the beginning of the following, the instructions in par. A17343 (regarding the entries of dates) also apply, as in the following example:

Example

Given: (1) 5.0 inches of snow fell on March 31 - April 1, with 2.0 inches falling on March 31 and 3.0 inches on April 1.

(2) With the exception of the snowfall on March 31, the greatest snowfall in March was 1.5 inches on March 15.

(3) The greatest amount of snowfall in April was 5.5 inches on April 5.

Entries for "Snowfall - Greatest in 24 hours".

(1) For March, "1.5 inches on March 15." (Note that, although two inches fell on March 31, the total precipitation on March 31 must be ascribed to April 1 in accordance with par. A12343.)

(2) For April, "5.5 inches on April 5."

(3) On the forms for both March and April explanatory notes should be entered at the bottom of Form 1001C, indicating that five inches of snow fell during the period March 31 to April 1, with two inches falling on March 31 and three inches on April 1.

A17353. Greatest Depth on Ground.—Enter this datum to the nearest inch, and the date or dates of occurrence. Enter "T" if the greatest depth of snow on the ground during the month was a trace. The entry must equal or exceed any entry in column 9 and is evaluated from the entries in columns 25, 33 and 61 of Form 1001B or columns 46, 70 and 90 of WBAN-10B. When the greatest amount occurred more than once and there is insufficient space for all the dates, enter the date of the first occurrence and a footnote (see par. A17343).

A17360. Barometric Pressure.--Enter barometric pressure data as follows:

A17361. Monthly Average Station Pressure.--Compute the value of the monthly average station pressure pertaining to the elevation H_b to thousandths of an inch as follows:

(1) Compute one half the sum of the average 0030 and 1230 GCT values of station pressure.

(2) Apply the "correction to adjust to 24-hour mean."

Reduce the monthly average station pressure pertaining to H_b to the value pertaining to H_{bc} (see Appendix I) by applying the necessary correction ø, if any.

EXAMPLE

29.644 = average station pressure at 0030 GCT
+29.596 = average station pressure at 1230 GCT

59.240 = total
29.620 = mean of average 0030 and 1230 GCT station pressures
-.007 = correction to adjust to 24-hour mean*

29.613 = monthly average station pressure pertaining to H_b
-.016 = correction to adjust to elevation H_{bc}*

29.597 = monthly average station pressure pertaining to H_{bc}

A17361.1. Enter the monthly average station pressure pertaining to H_{bc} on the line captioned "Monthly Average Station," and a footnote stating the elevation of H_{bc} to whole feet on a line below the caption "Lowest Sea Level____in. on _____."

EXAMPLE

MONTHLY AVERAGE STATION 29.338 IN.1/
HIGHEST SEA LEVEL 30.71 IN. ON 14TH
LOWEST SEA LEVEL 29.53 IN. ON 21ST.
1/ This datum pertains to an elevation of 762 feet.

ø These corrections are prepared at the Central Office for stations at which they are required. Other stations will assume the corrections to be zero, except that, in accordance with Appendix I, the Central Office should be notified of any indications that H_{bc} may differ from H_b.

A17362. Highest and Lowest Sea-Level Pressure.—Enter these data as obtained from the barograph trace, corrected in the manner specified in par. 7242, and reduced to sea level in accordance with pars. 7320 to 7324. Owing to the temperature factor involved in reducing station pressure at high-altitude stations to sea level, the lowest or highest station pressure indicated on the barogram may not provide the lowest or highest sea-level pressure. At such stations, inspect the barogram for, and reduce to sea level, other high or low station pressures which approach the extremes previously selected, and review the recorded sea-level pressures for the month to determine that the highest and lowest sea-level pressure values have been selected.

A17370. Weather.—Enter data as follows:

A17371. Number of Days Clear, Partly Cloudy, and Cloudy.—Obtain these data from column 16.

A17372. Number of Days with 0.01, 0.10, 0.50, and 1.00 Inch or More of Precipitation.—Obtain these data from column 7.

A17373. Dates of Hail, Sleet and Glaze.—Obtain these data from WBAN-10B or Form 1001B.

A17380. Summary.—In the spaces provided near the bottom of the form, enter notes regarding the occurrence of unusual or extreme weather conditions during the month. Include data on damaging rain, snow, glaze, hail, or wind storms, and unusually high or low temperatures.

A17400. FORM 1001C FORMAT (SEE FIG. A17-3)

*A17410. General.--Form 1001C Format will be prepared monthly. Entries on this form will be made in accordance with instructions in Sections A17200 and A17300 for entries on Form 1001C, and the additional instructions below. Parentheses will not be used when estimated or interpolated data are transcribed. The format may be cut, whenever necessary, along the vertical light blue line near the center of the form to fit it into the typewriter,and each half typed separately. When the format is cut, the narrative summary should be typed in two columns with at least one-half inch space in the center. After typing join the two halves together with scotch tape applied to the back. Form 1001C Format may be mailed (see ¶ A17220) in a mailing tube, or it may be folded (but not creased) around a piece of cardboard by folding it along the line immediately below the abbreviation "Avg." Cut the cardboard to fit into a 12x16 inch envelope in a manner that will prevent displacement of the fold in the format.

A17411. Heading.--Enter station name, month and year, time zone, and, in degrees and minutes, the station latitude and longitude.

U S DEPARTMENT OF COMMERCE, WEATHER BUREAU

LOCAL CLIMATOLOGICAL DATA

Lakeside, Ohio (Airport) Brookpark Road and Riverside Drive — February 1953

Latitude 41° 24' N. Longitude 80° 51' W. Elevation (ground) 327 ft Eastern Standard time used

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet, Hail (In.)	Snow, Sleet, Hail or Ice on ground at 7:30 pm (In.)	Wind Prevailing direction	Average speed (m. p. h.)	Fastest mile Speed (m. p. h.)	Direction	Sunshine Total (hours and minutes)	Percent of possible	Sky cover Sunrise to sunset (tenths)	Midnight to midnight (tenths)	Thunderstorm or distant lightning	Weather restricting visibility to ¼ mile or less	Lake Temperature °F	Solar Radiation Gm/cal per cm²	22	23	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	19	12	16	-8	49	0.74	6.5	13	N	13.8	20	W	0:20	3	10	10			33	89			1
2	12	-5	4	-20	61	T	T	13	SW	15.8	26	SW	8:54	88	1	3			33	318			2
3	18	-8	5	-19	60	0	0	12	SSE	11.0	15	S	9:53	98	3	2			33	343			3
4	30	11	21	-4	44	0	0	9	S	9.9	15	S	7:35	74	9	8			33	279			4
5	32	22	27	+2	38	0.01	0.1	8	SSW	4.9	9	S	0	0	10	10			33	100			5
6	42	28	35	+10	30	0.12	0	7	SSE	10.4	26	SE	0	0	10	10			33	116			6
7	38	9	24	-1	41	0.51	1.9	6	WNW	21.4	33	W	0	0	10	10		S, BG	33	116			7
8	10	0	5	-20	60	0.15	1.4	8	WSW	16.8	27	W	1:50	18	9	10			33	221			8
9	19	1*	10	-15	55	0.01	0.1	8	NNW	7.8	16	SW	8:40	83	5	4			32	295			9
10	35	-4	16	-9	49	0	0	6	SSE	9.6	24	S	9:25	90	5	4			32	297			10
11	43	34	39	+14	26	0	0	3	SSW	13.5	28	S	5:30	52	7	9			32	247			11
12	46	41	44	+18	21	0.02	0	0	SSW	14.2	25	SW	0	0	10	10			33	15			12
13	48	25	37	+11	28	0.12	0.1	T	N	12.8	20	N	0	0	10	10			32	23			13
14	26	19	23	-3	42	0.05	0.5	T	NNE	13.3	19	N	0:10	2	10	8			32	137			14
15	38	17	28	+2	37	T	0	0	ENE	6.9	14	N	3:15	31	8	7			33	245			15
16	45	26	36	+10	29	0.07	0	0	SE	13.8	24	SE	0:25	4	10	7			33	133			16
17	44	34	39	+12	26	0.31	0	0	SW	7.8	16	W	0	0	10	10			33	63			17
18	54	33	44	+17	21	0.02	0	0	SSE	6.2	18	SE	4:25	41	8	9			33	225			18
19	62	42	52	+25	13	0.09	0	0	SE	6.3	33	W	0:44	5	10	8			33	124			19
20	43	33	38	+11	27	0.10	0	0	NE	9.2	24	NE	0	0	10	10		L, F	33	72			20
21	36	34	35	+8	30	1.04	T	0	NNW	21.2	35	N	0	0	10	10			34	18			21
22	36	31	34	+6	31	0	0	0	NNW	12.1	19	N	0:05	0	10	10			34	119			22
23	38	23	33	+5	32	0	0	0	NNW	8.2	15	N	0	0	10	9			34	154			23
24	48	24	36	+8	29	0	0	0	NW	3.8	11	S	8:50	84	0	0			34	402			24
25	50	30	40	+12	25	0	0	0	S	8.3	15	SW	0:40	6	9	6			34	140			25
26	58	44	51	+23	14	0.25	0	0	S	15.0	34	W	0:35	5	10	8			34	61			26
27	45	30	38	+9	27	T	T	0	W	20.2	35	W	0	0	10	10			34	66			27
28	41	26	34	+5	31	1.13	T	0	ESE	10.7	25	E	2:56	27	10	10	T, DL		34	200			28
29																							29
30																							30
31																							31
Sum	1056	617	—	—	—	4.73	10.5	—	—	324.9	—	—	74:12	—	234	222	—	—	961	4648	—	—	Sum
Avg	37.7	22.0	—	—	—	—	—	—	—	11.6	Fastest	Dir	Possible	%	8.4	7.9	—	—	33.1	166.0	—	—	Avg
										Misc	35	NW	308:46	24									Misc

T in columns 7, 8, and 9 indicates amount too small to measure.

TEMPERATURE (°F)
Average monthly 29.9
Departure from normal -3.6
Highest 62 on 19th
Lowest -8 on 3rd
Number of days with -
Max. 32° or below 8
Max. 90° or above 0
Min. 32° or below 20
Min. 0° or below 4

HEATING DEGREE DAYS (base 65°)
Total this month 976
Departure from normal -86
Seasonal total (since July 1) 4458
Seasonal departure from normal -193

BAROMETRIC PRESSURE (In.)
Avg station (elev. 762 feet, m.s.l.) 29.338
Highest sea level 30.71 on 14th
Lowest sea level 29.53 on 21st

PRECIPITATION (In.)
Total for the month 4.73
Departure from normal 2.22
Greatest in 24 hours 1.13 on 20-21st 1/
Snow, Sleet and Hail —
Total for the month 10.6
Greatest in 24 hours 6.5 on 1st
Greatest depth on ground 13 on 1st-2nd
Dates of — Hail None
Sleet 13th Glaze 13th, 14th

Symbols used in columns 18-19

A - Hail
BS - Blowing snow
DL - Distant lightning
D - Dust
S - Sleet
F - Fog
H - Haze
K - Smoke
L - Drizzle
M - Sand
R - Rain
S - Snow
T - Thunderstorm
ZL - Freezing drizzle
ZR - Freezing rain

Average daily temperature departure since March 1, 1950: +6.5. Total precipitation since March 1, 1950: 41.23; and departure: +12.41. February's value of average monthly temperature and total precipitation appear misleading unless details for the first ten days are reviewed. In that opening ten-day period, snowfall of ten inches equalled normal for the month; and four days with temperatures of zero or below exceeded the winter-season normal. All-time records for minimum temperature were set at -5° on the second and -8° on the third. A seasonal snowfall total of 62.5 inches was reached on the fourteenth. Only a few flurries occurred during the remainder of the month, when the weather was spring like and dry.

1/ Indicates only the first of several occurrences.

HOURLY PRECIPITATION

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1	.03	.01	.05	.04	.02	.03	.06	.09	.06	.07	.01	.02	.03	.04	T	.02	.01	.04	.03	.03	.02	T	.01	.02	1
2	T	T	T						T	T	T														2
3																									3
4																									4
5			T	T	T	T	T	T	T	T	T	.01	T	T	T			T	T	T	.03	.02	.03	.04	5
6																									6
7	.06	.06	.03	.03	.03	.01	T	T	.01	.01	T	.01	.01	T	.02	.02	.01	.02	.03	.03	.03	.03	.03	.03	7
8	T	T	T	T	.02	T	.01	.02	.02	T	.02	.03	.01	T	.01	.01	T	T	T	T		T	T	T	8
9	T		T	.01	T	T	T			T															9
10																									10
11																									11
12							T	T	T			T	T	T	T	T	.01	.01	T	T	T	T	T	T	12
13	T				T	T	.01	T	T	T	T	.01	T	.01	.01	.01	.01	.01	.01	T	T	.02	.01	.01	13
14	T	T	.02	.01	.01	.01	T	T				T	T	T	T	T									14
15									T																15
16																	.01	.04	T	.02					16
17	T	T	.02	.07	.07	.04	.04	.04	.03	T	T	T	T											.02	17
18																									18
19	.01	T	T	.02	.02	T	.02	.02	T	T											T	.07	.01	.01	19
20				.01	T																				20
21	.10	.09	.06	.10	.23	.17	.05	.01	.03	.02	.08	.09	.01	T											21
22																									22
23																									23
24																									24
25																									25
26												T	.07	.18	T										26
27														T											27
28															.98	.12	.03	T							28
29																									29
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Fig. A17-3. Entries on Form 1001C Format.

*A17412. Time of Observation (Col. 9).--In the heading, enter the local standard time in terms of the 12-hour clock corresponding to 1230 GCT. However, where hours of duty preclude an observation at that time, enter the local standard time of the regularly established climatological observation.

A17413. Extra Column (Col. 23).--Enter any additional data required locally, and identify these data in the column heading.

A17414. Barometric Pressure.--On the line captioned "Avg. Station....", enter the elevation H_{bc} (see Appendix I) to whole feet in the first space. Enter the reduced monthly average station pressure value that pertains to H_{bc} (see par. A17361) in the other space.

A17415. Hourly Precipitation.--Enter hourly precipitation in inches and hundredths in the spaces provided at the bottom of the form. Enter "T" for trace, and omit the entry if no precipitation has fallen.

*A17415.1. Where a station that takes six-hourly observations does not have a recording gage, enter the six-hourly precipitation in the column appropriate to the time of each six-hourly observation. Identify the entries by adding "6-" immediately preceding the heading "Hourly Precipitation."

A17500. FORM 1081

A17510. Preparation.--Form 1081 will be used at stations where the height of the 850-mb. surface is computed and where Form 1083 is not used. Only one copy will be prepared unless additional copies are required locally.

A17511. In lines one to seven, enter the data corresponding to items one to seven, respectively, of par. 7430. Entries in the columns of the form are to accord with the date and time of observation as indicated in the column headings. (See par. A7020 regarding computation of these data.)

A17520. Disposition.--Completed copies of Form 1081 may be destroyed after ninety days.

A17600. FORM 1083

*A17610. Preparation.--(See Fig. A17-4.) Form 1083 will be used at all second-order synoptic stations and certain other designated stations for recording and coding 3- and 6-hourly synoptic observations. The use of Form 1083 as a work sheet for coding purposes, but not for record purposes, is optional at first-order stations where only 3- and 6-hourly synoptic observations are taken. Only one copy will be prepared unless additional copies are required locally. Where the form is prepared for

record purposes, use a well-sharpened Venus 2H or 3H drawing pencil, or equivalent. Use sufficient pressure to produce clearly legible, black-line entries.

A17611. Enter station name and date in the spaces provided. Note that the date corresponds to that of Greenwich civil time. (See ¶ 1404 and 1405 of the Synoptic Code for conversion table from local standard time to Greenwich civil time.) On the last day of the month, entries will be made on Form 1083 for all observations up to midnight local standard time. Begin a separate form with the first observation at or following 0000 local standard time on the first of the month.

A17612. Enter 6-hourly observations in columns headed 0030Z, 0630Z, 1230Z, 1830Z; enter 3-hourly observations in columns headed 0330Z, 0930Z, 1530Z, and 2130Z. Omit entries for observations or elements not regularly recorded. Enter slants to indicate missing data pertaining to an observation or element usually recorded.

A17613. All entries in the column headed "Coded" will include the number of digits indicated by the corresponding symbol. Each dot following the letter indicates an additional coded digit; e.g., "R $\underset{24}{\cdot\cdot\cdot\cdot}$" indicates that four digits will be entered in the "Coded" column.

A17614. If data are entered on the reverse side of the form, enter a check in the box at the bottom of the page titled "Notes on Reverse Side."

A17620. Routing.—Forward the completed forms for the month, local standard time, on or before the fifth of the following month to the station designated by the regional director.

A17630. Itemized Entries (Line, column, or group entries 1-61).—All references in the instructions on the following pages of this chapter are to the 1949 Synoptic Code unless otherwise specified. The instructions are indexed under this paragraph number.

WB Form 1083
(Revised 1-1-49)

United States Department of Commerce, Weather Bureau
ORIGINAL RECORD OF 3- AND 6-HOURLY SYNOPTIC OBSERVATIONS

Station: City, State Date (GCT) July 7, 1952

Scheduled time of observation		0030Z (1930E)		0330Z (2230E)		0630Z (0130E)		0930Z (0430E)		1230Z (0730E)		1530Z (1030E)		1830Z (1330E)		2130Z (1630E)	
(1) Observation began (LST)		1706M		2008M		2307M		0209M		0510M		0808M		1105M		1410M	
	Symbol	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded	Observed	Coded
(2) Station identification	Iii	–	999	–	999	–	999	–	999	–	999	–	999	–	999	–	999
(3) Dew-point (°F)	T_dT_d	–	41	–	44	–	45	–	50	–	54	–	61	–	57	–	38
(4) Total amount of clouds	N	10	8	X	9	X	9	X	9	10	8	10	8	10	8	8	6
(5) Direction of surface wind	dd	ENE	07	SSE	16	SE	14	SSW	20	SSW	20	S	18	SW	23	NW	32
(6) Speed of surface wind	ff	5	04	4	04	7	06	14	12	7	06	15	13	21	18	22	19
(7) Visibility	VV	7	56	3/4	06	3/8	03	3/16	01	2 1/2	20	8	64	10	80	15+	81
(8) Present weather	ww	–	02	–	58	–	58	–	51	–	10	–	02	–	80	–	01
(9) Past weather	W	–	2	–	2	–	6	–	6	–	5	–	2	–	2	–	8
(10) Sea-level pressure (mbs)	PPP	–	173	–	156	–	112	–	075	–	088	–	125	–	173	–	227
(11) Dry-bulb temperature (°F)	TT	47.4	47	44.8	45	45.1	45	50.3	50	54.3	54	62.0	62	64.7	65	52.5	53
(12) Wet-bulb temperature (°F)	–	44.3	–	44.5	–	45.0	–	50.0	–	53.9	–	61.3	–	60.0	–	44.9	–
(13) Depression (Col. 11-12)	–	3.1	–	0.3	–	0.1	–	0.3	–	0.4	–	0.7	–	4.7	–	7.6	–
(14) Amount of clouds whose height is given by "h"	N_h	10	8	X	9	X	9	X	9	6	5	7	6	8	6	3	2
(15) Cloud types Sc, St, Cu, Cb	C_L	–	5	–	/	–	/	–	/	–	6	–	5	–	5	–	5
(16) Height of cloud (Ft)	h	16	4	X	0	X	0	X	0	6	2	23	5	25	5	45	6
(17) Cloud types Ac, As, Ns	C_M	–	/	–	/	–	/	–	/	–	2	–	2	–	2	–	7
(18) Cloud types, Ci, Cs, Cc	C_H	–	/	–	/	–	/	–	/	–	/	–	/	–	/	–	0
	8	–	6	–	6	–	6	–	6	–	6	–	6	–	6	–	6
(19) Direction of cloud	Dc	SE	3	X	9	X	9	X	9	X	9	S	4	W	6	NW	7
(20) Pressure tendency	a	–	8	–	8	–	6	–	8	–	4	–	3	–	3	–	1
(21) Amount of pressure change	pp	.040	14	.050	17	.100	34	.080	27	.040	14	.110	37	.130	44	.110	37
	7	–	7			–	7			–	7			–	7		
(22) Amount of precipitation (6-hr)	RR	0				.03	03			.01	01			T	00		
(23) Time of precipitation	R_t	–				–	6			–	2			–	1		
(24) Depth of snow on ground	s	0				0	0			0	0			0	0		
	9	–	9			–	9			–	9			–	9		
(25) Special phenomena (general)	S_pS_p	–				–				–				–	87		
(26) Special phenomena (detailed)	s_ps_p	–				–				–				–	16		
	1	–	1			–	1			–	1			–	1		
(27) Direction of waves	d_w	–				–				–				–			
(28) Period of waves	P_w	–				–				–				–			
(29) Height of waves	H_w	–				–				–				–			
	2	–	2	–	2	–	2	–	2	–	2	–	2	–	2	–	2
(30) Height of 850-mb surface	h_{850}	–	494	–	490	–	479	–	470	–	474	–	484	–	500	–	512
(31) Pressure tendency for 3-hr period ending 3 hrs ago	a_3	–	5	–	8	–	8	–	6	–	8	–	4	–	3	–	3
	3	–	3			–	–			–	3			–	–		
(32) Amount of precipitation (24-hr)	R_{24}	–				–	–			–	0004			–	–		
	4	–	4			–	4			–	4			–	4		
(33) Maximum temperature	T_xT_x	48°	48			47°	48			54°	48			65°	65		
(34) Minimum temperature	T_nT_n	45°	43			44°	43			44°	44			54°	44		
(35) Plain language data	–																

Computational Data

Sea-Level Pressure	(36) Attached thermometer	72.0		71.5		74.0		75.5	
	(37) Observed barometer	24.873		24.722		24.689		24.933	
	(38) Total correction	-.130		-.129		-.133		-.134	
	(39) Station pressure	24.743	24.695	24.593	24.515	24.556	24.670	24.799	24.910
	(40) Temperature 12 hrs ago (°F)	43.8	46.2	45.2	46.1	47.4	44.8	45.1	50.3
	(41) Current temperature (°F)	47.4	44.8	45.1	50.3	54.3	62.0	64.7	52.1
	(42) Sum (Col. 40 and 41)	91.2	91.0	90.3	96.4	101.7	106.8	109.8	102.4
	(43) Mean (Sum ÷ 2)	45.6	45.5	45.2	48.2	50.8	53.4	54.9	51.2
	(44) Sea-level pressure (in.)	30.04	29.99	29.86	29.75	29.79	29.90	30.04	30.20
Height of 850-MB Surface	(45) Current temperature (°F)	47.4	44.8	45.1	50.3	54.3	62.0	64.7	52.1
	(46) Current temperature (°F)	47.4	44.8	45.1	50.3	54.3	62.0	64.7	52.1
	(47) Temperature 6 hrs ago (°F)	45.2	46.7	47.4	44.8	45.1	50.3	54.3	62.0
	(48) Sum (Col. 45, 46, and 47)	140.0	136.3	137.6	145.4	153.7	174.3	183.7	166.2
	(49) Mean (Sum ÷ 3) 1/	47	45	46	48	51	58	61	55
	(50) Correction from Table 9)	+2	+2	+2	+3	+3	+4	+3	+3
	(51) Algebraic sum (Col. 49 and 50)	49	47	48	51	54	62	64	58
(52) Filing time		1718	2016	2317	0216	0516	0818	1117	1416
(53) Observer's initials		F.U.L.	J.H.D.	S.I.S.	R.E.M.	J.H.D.	J.H.D.	F.U.L.	F.U.L.

X Notes on reverse side

1/ This table is reproduced as Table A7-2 in this manual.

Fig. A17-4. Entries on Form 1083.

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
1. Observation began	Enter the time the observation was begun, in local standard time, followed by the time-zone indicator (E for Eastern, C for Central, etc.). Use 24-hour clock time, e.g., enter 6:00 P.M. as 1800.	
2. Station identification-iii	No entry	Enter assigned station number (paragraph 1801.1).
3. Dew point (°F.)-T_dT_d	No entry	Enter dew point temperature to the nearest whole degree unless dew point temperature is below 0°F., when a code figure will be entered as indicated in paragraph 1804.222.
*4. Total amount of clouds-N	Enter total tenths of sky covered by clouds to the nearest tenth. If sky is obscured by dust, fog, etc., enter X.	Select code figure from Table No. 2 in accordance with paragraph 1802.1.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

*Revised

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
5. Direction of surface wind- dd	Enter direction of surface wind to 16 points of the compass, e.g., NNW, SE. Omit entry if wind is calm.	Stations equipped with wind direction indicators calibrated in degrees will code direction to tens of degrees, e.g., 330° will be coded "33." Stations equipped with 9-light indicators only will select code figure from the following table: Code Figure — Direction 00 — Calm 36 — N 02 — NNE 05 — NE 07 — ENE 09 — E 11 — ESE 14 — SE 16 — SSE 18 — S 20 — SSW 23 — SW 25 — WSW 27 — W 29 — WNW 32 — NW 34 — NNW
6. Speed of surface wind- ff	Enter speed of surface wind in miles per hour. Enter "C" for calm.	Enter speed in whole knots, using Conversion Table B.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
7. Visibility- VV	Enter visibility in statute miles and fractions, using intervals specified in Table 4.	Select code figure from Table 4.
8. Present weather- ww	No entry	Select code figure from Table 5 in accordance with paragraph 1803.2.
9. Past weather- W	No entry	Select code figure from Table 6 in accordance with paragraph 1803.3.
10. Sea-level pressure (mbs)- PPP	No entry	Enter sea-level pressure in tens, units, and tenths of millibars. (Paragraph 1804.1)
11. Dry-bulb temperature (°F.)- TT	Enter dry-bulb temperature to tenths of degrees, supplying minus signs as required.	Enter dry-bulb temperature to the nearest whole degree, unless temperature is 100°F. or higher, or less than 0°F., when a code figure will be entered in accordance with paragraph 1804.22.
12. Wet-bulb temperature (°F.)	Enter wet-bulb temperature to tenths of degrees, supplying minus signs as required.	No entry

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
13. Depression	Enter difference between Lines 11 and 12.	No entry
*14. Amount of clouds whose height is given by "h"- N_h	Enter to the nearest tenth the amount of sky covered by clouds whose height is given by "h" (see Table 9). Enter "X" if sky is obscured at or below 7999 feet.	Select code figure from Table 2.
15. Cloud types Sc, St, Cu, Cb- C_L	No entry	Select code figure from Table 8 in accordance with paragraph 1805.2.
16. Height of cloud (ft.)- h	Enter height above ground of clouds at or below 7999 feet in accordance with instructions in paragraph 1805.3. Enter heights to the nearest 100 feet from 0 to 4999 feet and to the nearest 500 feet from 5000 to 7999 feet; enter all heights in hundreds of feet; e.g., 4000 feet as 40. Enter a dash if no clouds at or below 7999 feet are present. Enter "X" if height is unknown for reasons stated in paragraphs 1805.38 and 1805.39.	Select code figure from Table 9.
17. Cloud types Ac, As, Ns- C_M	No entry	Select code figure from Table 10 in accordance with paragraph 1805.4.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
18. Cloud types Ci, Cs, Cc- C_H	No entry	Select code figure from Table 11 in accordance with paragraph 1805.5.
19. Direction of cloud- D_C	Enter direction of C_M, C_H or C_L clouds to eight points of the compass, e.g., N, SW (paragraph 1806.2). Enter a dash when no clouds are present; X if direction is unknown or variable; and C if calm.	Select code figure from Table 12.
20. Pressure tendency- a	No entry	Select code figure from Table 13.
21. Amount of pressure change- pp	Enter to the nearest five thousandths of an inch the amount of pressure change during the past three hours.	Select code figure from Table 14. If the change exceeds 9.8 millibars (.290 inch), enter "99" with an asterisk and an additional group in Line 35 as instructed in paragraph 1806.47.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
22. Amount of precipitation (6-hr.) - RR	Enter total precipitation to nearest hundredth of an inch. Enter "0" if no precipitation has occurred in the past 6 hours. Enter "T" for trace if precipitation has occurred but less than 0.005 inch has fallen.	Select code figure from Table 15. If the 6-hourly amount of precipitation exceeds .99 inch, enter the hundredths of inches with an asterisk and report the number of whole inches in plain language in Line 35 as instructed in paragraph 1807.25. Omit entry if no precipitation has fallen in past 6 hours.
23. Time of precipitation- R_t	No entry	Select code figure from Table 16 in accordance with paragraph 1807.3. Omit entry if no precipitation has fallen in past 6 hours.
24. Depth of snow on ground- s	Enter total depth of snow to the nearest whole inch. Enter "0" if none is on the ground. Enter "T" for trace if snow is on the ground in amounts of less than 0.5 inch.	Select code figure from Table 17 in accordance with paragraph 1807.4. Omit entry if no precipitation has fallen in past 6 hours.
25. Special phenomena (general) - S_pS_p 26. Special phenomena (detailed) - s_ps_p	No entry	Enter special phenomena as instructed in paragraphs 1809.2 and 1809.3. If more than one special phenomena group is sent, enter additional groups in Line 35. Omit entry if no special phenomena are observed.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
27. Direction of waves- $d_w d_w$	No entry	Enter direction, period, and height of waves as instructed in paragraphs 1810.2-1810.4.
28. Period of waves- P_w		
29. Height of waves- H_w		
*30. Height of 850-mb. surface- $h_{85}h_{85}h_{85}$	No entry	Enter height of 850-mb. surface to nearest 10 geo-potential feet, omitting units digit (e.g., at stations whose elevation is between 2500 and 9500 feet, enter 5270 geo-potential feet as 527). (The temperature datum computed in Lines 45 - 51 is used in the computation of this height.)
31. Pressure tendency for 3-hour period ending 3 hours ago- a_3	No entry	Select code figure from Table 13.
32. Amount of precipitation (24-hour)- $R_{24}R_{24}R_{24}R_{24}$	No entry	Enter total 24-hour precipitation to the nearest hundredth of an inch, omitting decimal point. (Paragraph 1812.2) Omit entry if a trace or less has fallen during the past 24 hours.

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

*Revised

Itemized Entries on Form 1083 (under par. A17630).

LINE	OBSERVED	CODED
*33. Maximum temperature- T_xT_x	**Enter to the nearest whole degree** the maximum temperature for the past six hours, supplying minus signs as required.	Enter the maximum temperature to whole degrees for the periods indicated in paragraph 1813.2, unless temperature is 100°F. or higher, or less than 0°F., when a code figure in accordance with paragraph 1813.23 will be entered.
*34. Minimum temperature- T_nT_n	**Enter to the nearest whole degree** the minimum temperature for the last 6 hours, supplying minus signs as required.	Enter the minimum temperature to whole degrees for the periods indicated in paragraph 1813.3, unless temperature is 100°F. or higher, or less than 0°F., when a code figure in accordance with paragraph 1813.33 will be entered.
35. Plain language data	**Enter record temperatures, city data, mean data, etc., in plain language (paragraph 2001-3). These data are sent by designated first-order stations only.**	
36. Attached thermometer	Enter the temperature of the attached thermometer to the nearest 0.5°F. or C.	
37. Observed barometer	Enter the uncorrected observed reading to the nearest .001 inch.	
38. Total correction	Enter the sum of all corrections.	
39. Station pressure	Enter the difference between lines 37 and 38 to the nearest .001 inch. If mercurial barometer is not read, enter station pressure from barograph.	

NOTE: Unless otherwise specified references on this page are to the 1949 Synoptic Code.

Itemized Entries on Form 1083 (under par. A17630).

LINE	
40. Temperature 12 hours ago (°F.)	Enter to nearest tenth the temperature 12 hours ago (Line 11).
41. Current temperature (°F.)	Enter current temperature to nearest tenth (Line 11).
42. Sum (Columns 40 and 41)	Enter sum of lines 40 and 41.
43. Mean (Sum ÷ 2)	Enter mean obtained by dividing sum in line 42 by 2.
44. Sea-level pressure (inches)	Enter to the nearest hundredth of an inch sea-level pressure obtained from Pressure Reduction Tables (see Circular N ¶ 7320 and A7310).
45. Current temperature (°F.)	Enter current temperature to nearest tenth of a degree (Line 11).
46. Current temperature (°F.)	
47. Temperature 6 hours ago (°F.)	Enter to nearest tenth of a degree the temperature six hours ago (Line 11).
48. Sum (Columns 45, 46, and 47)	Enter sum of lines 45, 46, and 47.

Itemized Entries on Form 1083 (under par. A17630).

LINE	
49. Mean (Sum ÷ 3)	**Enter to the nearest whole degree the mean obtained by dividing the sum in Line 48 by 3.**
50. Correction from Table A7-2 of Circular N	Enter the lapse rate and humidity correction obtained from Table A7-2 of Circular N.
51. Algebraic sum (Columns 49 and 50)	Enter algebraic sum of lines 49 and 50.
52. Filing time	Enter time of filing (LST). Use 24-hour clock time (e.g., enter 1:30 P.M. as 1330).
53. Observer's initials	Enter initials.
54-57. Miscellaneous notes	Enter times of beginnings and endings of fog, smoke, dust, glaze, frost, tornado, lightning, halos, and special and unusual phenomena. Enter estimated times in parentheses. Use abbreviations printed on form.
58-61. Notes on precipitation and thunderstorms	Enter character, intensity, and times of beginning and ending of precipitation and thunderstorms. Enter estimated times in parentheses. Use abbreviations printed on form.

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to

WBAN Manual and W. B. Addendum

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Change No. → A3

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

MANUAL OF SURFACE OBSERVATIONS

Circular N, Sixth Edition, Revised

WEATHER BUREAU ADDENDUM

INSTRUCTIONS FOR DISTRIBUTION: Not for use at the following Weather Bureau second-order stations: 1) SAWR, 2) A-type, 3) CAA stations designated to receive "Circular N, abridged for CAA stations."

May 1953

WASHINGTON, D. C.

Instructions pertaining to Change A3:

(1) Page A4-4, Par. A4230, 3rd line: Delete "with the detachable cover" and substitute "or open the petcock."

(2) Page A4-7, Par. A4310, 5th line: Insert "sometimes" between "is" and "provided."

(3) Page A4-20, Par. A4520: Prefix first sentence with "At first-order stations."

(4) Page A5-3, Par. A5030.1, next to last sentence: Change "A5610" to "A5510".

(5) Page A7-4a, Par. A7120.1, second and fifth line: Change "minus" to "plus"; in fifth line, change "25" to "41."

(6) Page A7-22, Par. A7234, second line: Change semicolon to period and delete remaining part of paragraph.

(7) Page A11-1, Par. A11001, first line: Add "CAA" following "B".

(8) Page A11-1, Par. A11001.1 and A11001.2: Delete both paragraphs.

(9) Page A14-3, Par. A14331: Prefix "Unless otherwise requested by the Central Office" to first sentence.

(10) Page A16-16, Par. A16152, second line: Delete "1027A" and substitute "1091A".

(11) Page A17-8, Par. A17211: Delete last sentence.

(12) Page A17-9, Fig. A17-2: Enter "6:30A.M." in heading of Column 9.

(13) Page A17-16, Par. A17361.1, second line: Change comma to period following "Monthly Average Station", and delete rest of sentence. In example, delete superscript and associated footnote.

(14.) Insert attached revised pages (11 sheets).

THIS PAGE MAY BE DISCARDED AFTER MAKING THE ABOVE CHANGES.

Note that Forms 1001C and 1001C Format have been reprinted as Forms 733-1 and 733-1a respectively. Reference to the new numbers, with cross reference to the old numbers in key positions, will be made on revised pages as they are issued.

CHAPTER A3 - ATMOSPHERIC PHENOMENA 1/

A3510. Ice-Accretion Indicators.--Ice-accretion indicators are furnished selected stations only. The indicator consists of a strip of aluminum held in alignment by spring clips mounted on a wooden bracket. Several strips should be available for use with each bracket. Any location that will insure exposure of the indicator to precipitation, under any condition of wind speed and direction, will be satisfactory. The bracket should be so mounted that the exposed strip will be held in a vertical plane with the longer sides horizontal.

A3511. The strips will be stored in the shelter and protected from blowing rain to insure that when they are exposed they will be dry and that their temperature will be close to the temperature of the ambient air. One strip of the ice-accretion indicator will be exposed whenever freezing precipitation is expected.

A3512. When freezing precipitation is occurring, a strip free of ice will be exposed ten or fifteen minutes before taking an observation. It is essential that this interval of exposure be just prior to the observation to avoid the possibility of reporting freezing precipitation as occurring at the time of observation when, actually, ice on the indicator might have formed some time earlier.

A3900. ENTRY ON WBAN-10 2/

A3910. Weather and Obstructions to Vision (Col. 5).--At first-order observing stations where less than 24 record observations are taken daily, observe and record weather and obstructions to vision at 30 minutes past the hour during periods when record observations are not taken, and an observer is on duty.

A3934.2. Tornado (Col. 90).--Enter an accurate description of all meteorological elements accompanying the tornado. If space is insufficient in column 90, use a sheet of plain paper and attach it to WBAN-10B. Information on the following points is desirable:

(1) A map showing date, hour of occurrence, and path of the tornado.

(2) Appearance of clouds.

1/ The paragraph numbers in this chapter correspond to related paragraphs, similarly numbered, in the WBAN portion.

* 2/ Instructions in Section A3900 apply to first-order stations only.

(3) Character and amount of precipitation.

(4) Description of funnel, of the appearance of clouds above it, and of the distribution of debris.

(5) Number of persons killed and injured.

(6) Rate of movement.

(7) Estimated crop loss and property damage.

A3934.4. Aurora and Other Optical Phenomena (Col. 90).--Enter notes concerning various optical phenomena, such as auroras, halos (solar and lunar), rainbows, and mirages. Auroral displays should be carefully described, giving the time of beginning and ending, and the altitude and azimuth of each extremity and of the crown of any arch of light that may be formed. Azimuths should be recorded with North as zero. When an aurora extends past midnight, entry will be made for both dates. (Aurora should not be reported in aviation weather observations.)

A3934.6. Miscellaneous Phenomena (Col. 90).—At stations on the Great Lakes, enter the dates of opening and closing of navigation and of the season of wind warnings. In addition, enter available data on seiches (especially any pronounced or damaging sudden changes or fluctuations in the lake level and any periods of several hours of unusually high or low water). At stations on navigable rivers, enter the dates of the opening and closing of the navigation season. At all stations, enter notes on receipt of flood or storm warnings and advisories, and severity of damage done by floods or storms; and enter notes of unusual meteorological conditions, such as obstructions to vision at a distance, or wind shifts not entered on columns 9-11. Enter additional weather information not provided by the recording instruments and scheduled observations. Attach newspaper clippings of weather conditions of exceptional general or local interest. When space in column 90 is insufficient, entries will be continued on an additional sheet attached to it.

*A3934.61. Frost.--Record frost and designate the intensity (see par. 3506) as follows:

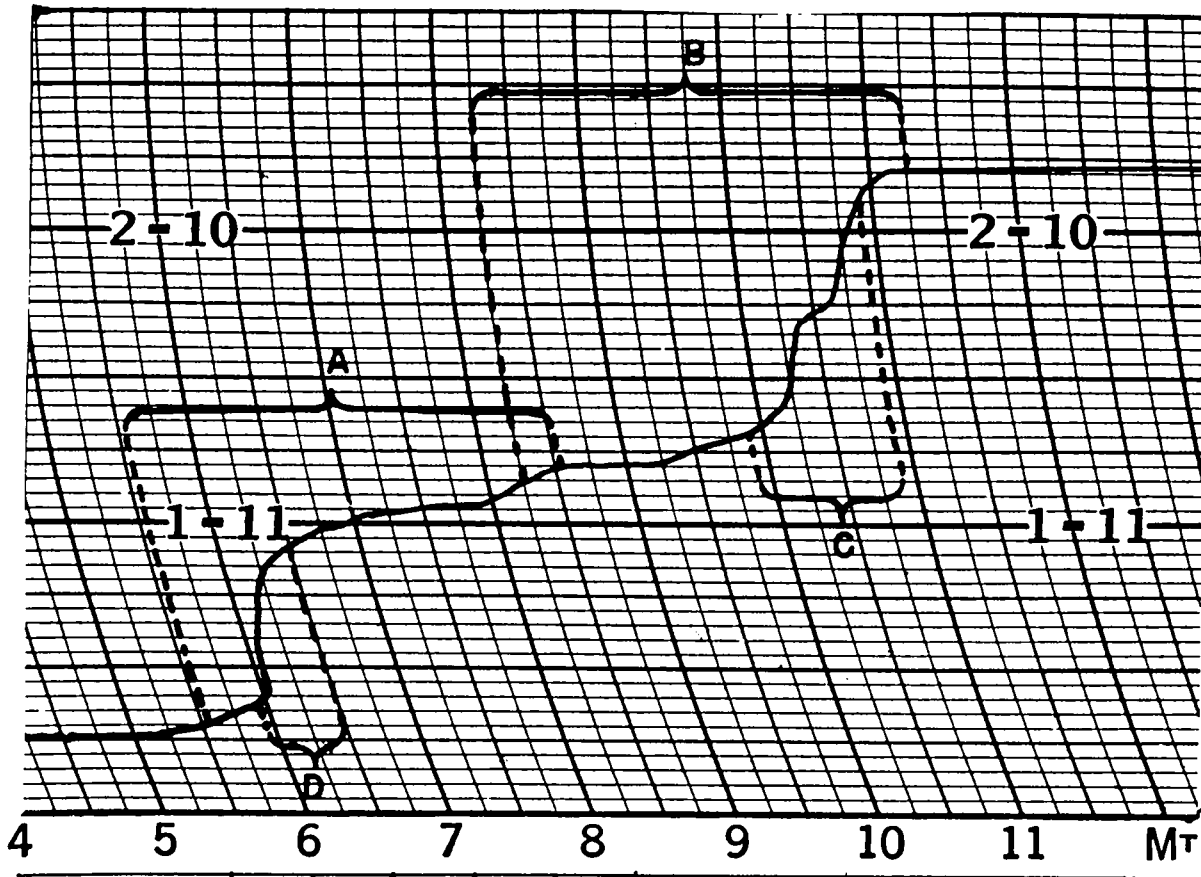
(1) In California, southern Arizona, Florida, and along the immediate Gulf Coast, enter date of occurrence throughout the year.

(2) In those portions of Washington and Oregon west of the Cascades and at all stations south of the 35th parallel except those in (1) above, enter date of occurrence after March 1 until first killing freeze in fall.

(3) At all other stations enter date of occurrence (a) on and after the date the normal mean temperature rises to 43° until the first killing freeze in the fall and (b) between May 1 and August 31.

*A3934.62.--Record freeze during periods indicated in Par A3934.61. Record intensity, kind of vegetation injured or killed, maturity of vegetation at time of freeze, estimated percentage of loss, and any other pertinent data.

A3934.63. Rime.--Record either soft rime or hard rime whenever it occurs.



Interval	5	10	15	20	30	45	60	80	100	120	150	180
Amounts for period D	.20	.35	.43	.46	.52	.58	.63	.69	.73	.76	.80	—
Amounts for period C	.18	.25	.33	.38	.45	.70	.82	.90	.95	1.00	1.00	1.06

Fig. A4-12. Excessive precipitation data. "A" indicates the time of occurrence of the maximum amount of precipitation associated with the period of excessive precipitation "D" for an interval of 180 minutes. Similarly, "B" indicates the maximum amount for 180 minutes associated with the period "C." The tabulation lists the excessive-precipitation data for the two periods of excessive precipitation. Note that "C" and "D" are separate periods of excessive precipitation, since they are separated by 180 minutes or more (203 minutes) in which the maximum amount of precipitation for 180 minutes does not equal or exceed 1.80 inch. Also note that since "A" and "B" overlap, only the greater amount is tabulated (see the entry for the 180-minute interval of the tabulation for period "C").

*A4540. Water Equivalent of Frozen Precipitation (Col. 80).—First-order stations in the continental United States and other designated stations will transmit water equivalent data in accordance with par. 4370 and the following:

(1) Stations equipped with Service C will transmit water equivalent data on this service immediately following the group $9S_pS_ps_ps_p$, in the 1230 GCT report on Tuesday and Friday whenever the S_pS_p portion of the group is 85 (see ¶ 1904.4, Synoptic Code, 1949). Use a slant (/) to separate these data from the $985s_ps_p$ group, e.g.:

98505/50 - snow depth 5", water equivalent 0.50".

98502/9 - snow depth 2", water equivalent 0.09".

98511/110 - snow depth 11", water equivalent 1.10".

(2) Stations equipped with Service A only will include these data coded as in (1) in the 1228 GCT report on Tuesday and Friday.

(3) In each River District, stations that have neither Service C nor Service A will transmit water equivalent data in plain language to the River District Office by TWX, telephone, or telegraph, using the most economical of these methods.

(4) Stations not in a River District and not having either Service C or Service A will not transmit these data.

***A4540.1. Where personnel are not on duty at 1230 GCT, omit water-equivalent observations.**

A4541. Additional reports of water equivalent data may be sent to the River District Office either by mail or by one of the foregoing methods, in accordance with requests received from the Area Engineer or the River District Office.

*A4542. When there is pronounced snow melt or other indications of the development of critical conditions, Weather Bureau stations in a River District will send emergency reports by the most expeditious method of communication until critical melting conditions no longer exist, or until instructed to discontinue reports by the Area Engineer or the River District Office.

above the ground or roof, except that, if the shelter is mounted above a roof, the height may be greater than four feet in order to minimize radiation effects from the roof. To afford the interior of the shelter the greatest protection from direct solar radiation while the door is open, orient the shelter with the door facing north (in the Northern Hemisphere). Keep the shelter door closed when the instruments are not being read.

*A5521. Illumination.--Use electric lamps rated at a total of not more than 30 watts in large or medium shelters. Keep the lamps as far as practicable (at least ten inches) from the closest temperature-sensing element. Do not leave the lamps turned on any longer than is necessary to read the instruments. Use a flashlight for illumination in the small shelter.

A5522. Maintenance.—At first-order Weather Bureau stations, paint all surfaces of the shelter - outside and inside - at least yearly with glossy white, outside paint. If the metal supports show evidence of corrosion, clean the corroded area thoroughly, and apply a coat of red lead or other metal primer followed by a top coat of aluminum paint.

A5600. ENTRY ON WBAN-10

*A5614. Entries in Columns 14A and 14B.—Authorization from the Central Office must be obtained for the entry of data other than dry- and wet-bulb temperature readings in columns 14A and 14B, which are entered here if only WBAN-10A is used (see par. 11001.1). When the telepsychrometer wet-bulb temperature is 33° or lower and the telepsychrometer dry-bulb temperature is above 20°, enter the dry- and wet-bulb reading from the mercurial psychrometer in columns 14A and 14B respectively.

A5618. Dry Bulb (Col. 18).—Personnel at first-order observing stations where less than 24 record observations are taken daily will enter to whole degrees, the value of the corrected thermograph temperature indicated at thirty minutes past the hour when an hourly observation is not taken. If the thermograph fails, enter in parentheses the data obtained by interpolating between available recorded and observed data.

A5690. Telepsychrometer Operation (Col. 90).—Whenever operation of the telepsychrometer is interrupted, enter time operation ceased and resumed.

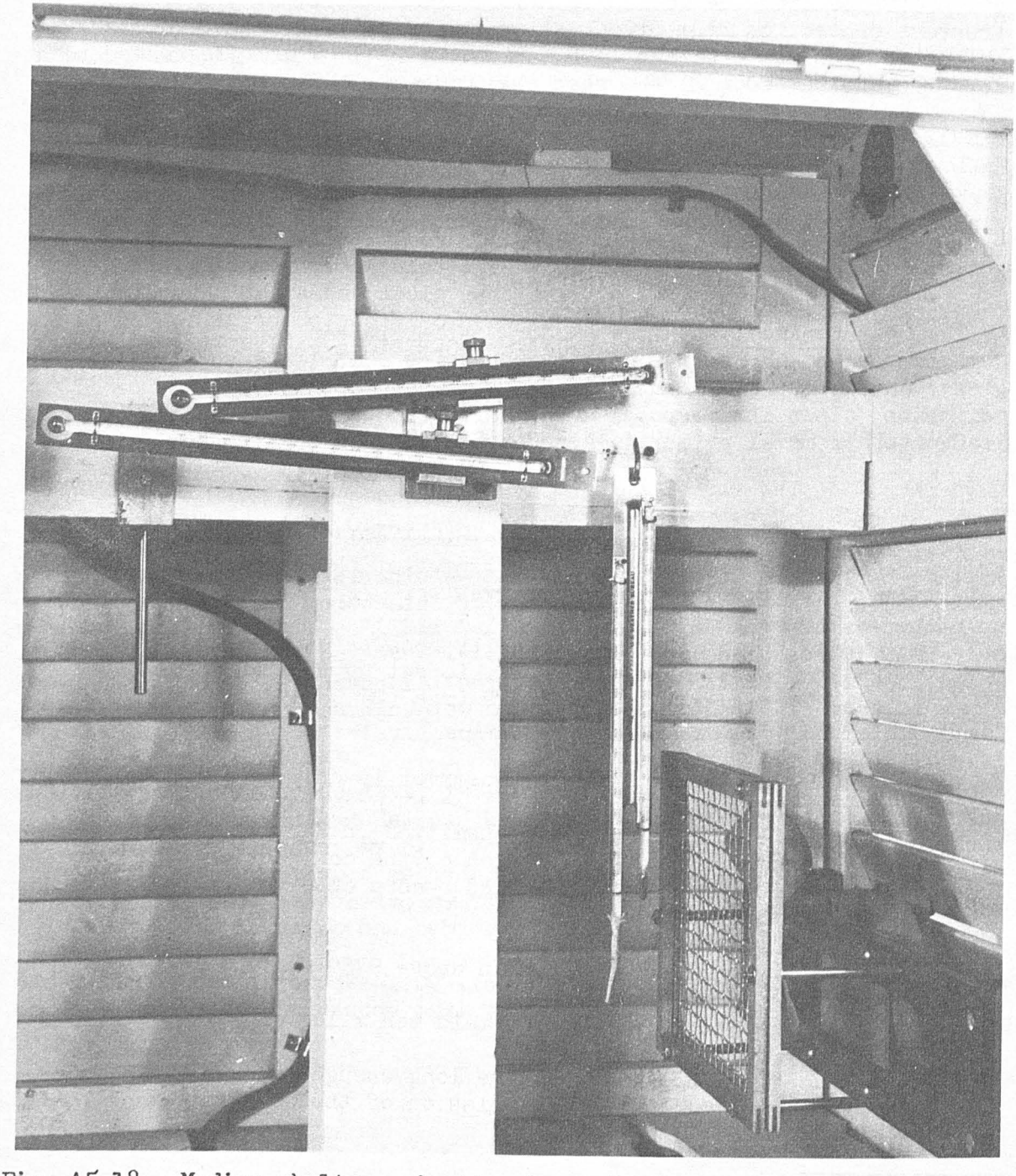


Fig. A5-18. Medium shelter - inside view. Illustrated are maximum and minimum thermometers mounted on separate (vertical) post, telethermometer sensing element, single-back psychrometer and ventilation fan.

CHAPTER A9. TYPES OF OBSERVATIONS 1/

A9120.1. Off-Teletype Observations.--The time at which record observations at off-teletype stations are to be telephoned or telegraphed to a relay station will be specified by the regional office.

A9120.2. Omission of Observations.--Contractions will be transmitted as follows to indicate the expected or actual omission of a scheduled observation:

* (1) NORPI. Where Weather Bureau personnel are responsible for the operation of Service A teletypewriter facilities, and are scheduled to take both pibal and aviation weather observations during times when only one observer is on duty, append the contraction NORPI to a record or record-special observation when all the following conditions exist:

(a) When the ceiling is more than 9750 feet.

(b) The visibility is ten miles or more.

(c) It is expected that the pibal will preclude preparation and transmission of the next scheduled record observation.

(d) When it is impracticable, because of the time of beginning the pibal, to set up the SECO equipment to send DCAVU (see (2) below) in the next sequence collection.

(2) DCAVU. Whenever only one observer is on duty for taking both pibal and aviation weather observations, and where the aviation weather is transmitted on Service A by the CAA, arrange for transmission of the contraction DCAVU instead of the next scheduled record observation whenever it is expected that:

(a) The ceiling will remain above 9750 feet.

(b) The visibility will remain ten miles or more.

(c) The pibal will continue long enough to preclude preparation and transmission of the observation.

1/ The paragraph numbers in this chapter correspond so far as possible to related paragraphs in the WBAN portion.

(3) FINO. At CAA or SAWR stations, when primary duties prevent taking an observation as scheduled (see Introduction), record and transmit "FINO" at the scheduled time. On WBAN-10, record type and scheduled time of omitted observations in Cols. 1 and 2, "FINO" in Col. 13, and initials in Col. 15. At CAA stations, if time permits before the next scheduled or special observation, enter (on the next line below) a delayed observation for local control and broadcast purposes, in accordance with Par. A11021.

If a change in conditions requires the filing of a special observation, abandon the balloon. Whenever it is impossible to transmit NORPI or DCAVU as specified above, discontinue the pibal in time to transmit the scheduled record observation.

*A9161. Erroneous or Missing Reports.--At first-order stations, report synoptic observations or aviation record observations taken at the time of a 3- or 6-hourly observation on Form 3069 (1) when these observations are taken but cannot be transmitted, (2) when errors in these observations are transmitted and not corrected in accordance with Par. 9163. Form 3069 may originate at any first-order station to call the attention of personnel at another station to discrepancies in these observations. Erroneous entries in station records will be corrected in accordance with Par. 11032.

A9173. Time.—All reports filed for transmission on Service A as supplementary weather will contain a time group denoting the hour and minute (24-hour clock) of the observation and the local time zone indicator (e.g., 1037C). This group will be placed immediately following the station location identifier or, in the case of a special observation, following the "S" symbol (see par. 9172). Off-teletype stations, such as SAWRS, that make original transmission of reports to a Weather Bureau or a CAA station via company communication facilities or by telephone, will include the time group in the report. Stations transmitting reports by commercial telegraph will not include a time group (see par. A9175).

A9175. Coding for Commercial Telegraph Transmission.--All symbols and intensity modifiers will be telegraphed in their word equivalents. The elements comprising the observation will be prepared for telegraphic transmission in the same order as that indicated in par. 9160. The word "special" and its number will be included preceding the meteorological data when that type of report is transmitted. Decimal points and the word "slant" will not be transmitted. The complete values of ceiling and cloud height, sea-level pressure, and altimeter setting will be transmitted, e.g., MEASURED 1200 10122 2990 for ceiling, sea-level pressure, and altimeter setting, respectively. The word "missing" will be used to indicate missing data pertaining to an element normally included in a report. The station identification and the time of the report will be omitted from the coded message.

A9176. Recoding Telegraphed Reports.--When the telegraphed message is prepared for teletype distribution at the receiving station, the station identification and time of the report will be supplied from the heading of the telegram and coded in accordance with pars. 9170 to 9173.

Example

Message filed at 6:00 a.m. at Hollister, California as received at San Francisco:

2000 SCATTERED ESTIMATED 5500 BROKEN 11000 OVERCAST
9 LIGHT RAIN 6563 NORTHEAST 11.

As prepared for teletype distribution:

HLL 0600P 20⦶E55⦶110⦶9R- 65/63×11

*A9182. Communications Failure.--During periods of teletypewriter service failure, aviation observations will be routed to an adjacent station where facilities have not failed, utilizing services still in operation, in accordance with the Federal Airway Manual of Operations. If all services have failed, the first record or special observation following the breakdown will be telephoned or telegraphed, prepaid (unless specifically instructed otherwise) to the nearest Weather Bureau or CAA station on the same circuit with facilities still functioning. At stations transmitting on more than one circuit, additional calls to other stations will be made as necessary to insure that the observation is entered on all circuits. Thereafter, record observations will be sent only at the times of 6-hourly synoptic observations, but all special observations will be telephoned or telegraphed promptly after they are taken. Station observational records will be kept as usual during this period.

*A9182.1. Weather Bureau stations will telegraph the observation and insert "XV" (priority designator) in the check column to the right of the address on the telegraph blank, or telephone the observation prepaid. Form 3069 will be rendered by first-order stations for observations that are not transmitted (see par. A9161).

*A9182.2. CAA stations will transmit these observations in accordance with administrative instructions issued by that agency.

*A9182.3. **Stations outside the United States may be furnished separate instructions by the Weather Bureau regional office.**

A9183. **Filing Weather Reports for Transmission.--Telautograph or other** recording communications facility may be used to deliver observations to CAA personnel for transmission. Where a facility of this type is not available, enter the observations on Form 3024B and file them with communications personnel. These forms will not be used at stations where observing and communications duties are performed by the same personnel. (Exceptions may be authorized by the Regional Director wherever it is impracticable to use this form.) Since a permanent record of aviation observations is available on Form WBAN-10A, it is not necessary to retain copies of Form 3024B on which aviation observations are entered. However, copies of this form on which synoptic observations are entered will be retained for inspection by a field aide, after which they may be destroyed.

A9183.01. On Form 3024B, enter observations received from observing stations by telephone or other non-recording communications facility for transmission on teletype circuits. Retain a record copy of each observation for six months.

A9183.02. Additional copies of Form 3024B may be prepared as required for local needs.

A9183.1. Entries on Form 3024B.--Enter the date and time of filing the observation as a six-figure group in the upper right corner (a time stamp may be used for this purpose). The first two figures will indicate the day of the month, and the last four the filing time of the observation in terms of the 24-hour clock. A letter following the six figures will designate the time zone, e.g., 061932E, 110028Z etc. (see Table 17). Local or Greenwich time will be used in accordance with appropriate instructions for transmissions.

A9183.11. Entry of Aviation Observations:

(1) In the "Station" block enter station letter identification as listed in the Civil Aeronautics Administration manual "Location Identifiers".

(2) In the "Type" block, enter "S", followed by the serial number of the observation when the observation is a special or record-special, "L" when it is a local extra, and a check mark "✓" when it is a check observation. An entry will not be made for a record observation.

(3) In each "Time" block pertaining to special, local extra, and check observations, enter a four-figure (24-hour clock), time group, followed by the appropriate time-zone designator letter. Omit entry for record and record-special observations, except as required by instructions in par. 9163 concerning corrected observations.

A13130. Adjustment.—The adjustment of the switch should be such that on a clear day the switch will close approximately one hour after sunrise and open approximately one hour before sunset. On a cloudy day, the switch should open when clouds obscure the outline of the sun and, conversely, the switch should close approximately as soon as the sun becomes faintly visible through thinning clouds. If an adjustment considered satisfactory in relation to the effect of changes in cloud density is such that the switch remains open longer than 1-1/2 hours after sunrise and reopens more than 1-1/2 hours before sunset on a clear day, notify the Regional Office. A coarse adjustment is made by manually shaking the mercury from the upper to the lower bulb, until the mercury in the lower bulb is about 1/2 inch below the electrodes when the switch is held at approximately a 45° angle (the mercury remaining in the upper bulb is not important). In adjusting the level of the mercury, avoid disturbing the relatively brittle wires leading to the electrodes. Install the switch on its support and make a final adjustment, if necessary, by slightly altering its inclination from a 45° angle by means of the hinged support. Seasonal adjustments will probably be necessary to compensate for extreme changes in temperature, and for changes in the angular elevation of the sun. Approximate settings for various seasons of the year may be identified by placing marks across the edge of the hinged joint.

A13140. Maintenance.—Inspect the adjustment of the switch and clean it weekly, or more often, if necessary to maintain satisfactory performance (see par. A13130).

A13200. ENTRY ON WBAN-10

*A13239. Sunshine (Col. 39).—Enter corrected hourly sunshine in minutes for the period beginning with the hour printed in column 16, as obtained from Form 1017 or 1017B. If the automatic record is incomplete or is known to be incorrect, enter estimated hourly values in parentheses. Omit entries of hourly sunshine if a totalizing indicator is used; instead, enter the total daily amount in hours and minutes at the foot of the column.

amount on the ground at the end of the period of observation, enter the maximum depth and the time of occurrence in remarks; e.g., "One inch of snow on ground at 1145." Maximum amounts of frozen precipitation obtained by visual estimation will not be entered in parentheses.

*A17126. Height of 850-Mb. Surface (Col. 26).--At stations designated to compute this datum, enter in feet, to the nearest ten geopotential feet, the height of the 850-mb. surface above sea level. Designated stations are selected from stations whose elevations are between 2500 and 9500 feet. Computations will be made in accordance with Section 7400.

A17127. Summary of Day (Cols. 27-38).--Enter data for the 24-hour period from midnight to midnight (LST) in these columns.

A17128. Maximum and Minimum Temperatures (Cols. 27 and 28).--Enter these data in whole degrees (see Chapters 5 and A5). Note that the maximum and minimum temperatures must be at least as high and low, respectively, as any temperature recorded through the day. At stations where midnight observations are not taken, the data will be secured from a thermograph, if available; otherwise, the entry will be omitted.

A17129. Average Temperature (Col. 29).--Enter the average temperature for the day, to whole degrees. This temperature is half the sum of the maximum and minimum temperatures for the day.

A17130. Normal Temperature (Col. 30).--Enter the normal temperature for the day, to whole degrees, when available. Use the normal for February 28 as the normal for February 29 also.

*A17131. Precipitation - 24-Hour Amount (Col. 31).--Enter the total amount of precipitation (water equivalent of solid types) to the nearest 0.01 inch. If precipitation has occurred in amounts less than 0.005 inch, enter "T" denoting trace. If precipitation has not occurred, enter "0". The sum of any number of "T" observations will be regarded as a trace unless recording equipment indicates the total is 0.005 inch (liquid) or more.

*A17132. Frozen Precipitation - 24-Hour Amount (Col. 32).--Enter to tenths of an inch the total amount of frozen precipitation (snow, sleet, ice crystals and hail) that falls during the 24-hour period. If there are separate falls, each of which melts before the following occurs, the total for the day will be the sum of the maximum depth of each fall. When the total 24-hour depth from midnight to midnight is not available, estimate the depth, using the data entered in column 24 as a guide. Enter the estimated value in parentheses. Record amounts in inches and tenths. When snow, sleet or hail melts as it falls, enter "T" with a reference note "Melted as it fell" in column 14. If snow, sleet or hail has fallen in amounts less than 0.05 inch, enter "T" denoting trace. If none has fallen, enter "0".

*A17133. Depth of Frozen Precipitation (at 1230 GCT) (Col. 33).--Enter the depth of frozen precipitation (snow, sleet, ice crystals, hail and ice) on the ground at 1230 GCT to the nearest inch. Enter "T" for amounts less than 0.5 inch. Enter "0" when none is on the ground. If personnel are not on duty at 1230 GCT, enter depth as measured at time as close as practicable to 1230 GCT, and indicate the time in Col. 61.

A17134. Maximum Average 5-Minute Wind Speed and Direction (Col. 34).—Enter the corrected maximum average 5-minute wind speed in whole miles per hour and the direction. The corrected speed is obtained by applying the appropriate correction from Table 14 to the uncorrected data from Form 1017 or 1017B.

A17135. Time of Maximum Average 5-Minute Wind Speed (Col. 35).—Enter the time of beginning to nearest minute (LST).

*A17136. Fastest Mile and Direction (Col. 36).--Enter the corrected (see Table 14) fastest mile in statute miles per hour and the corresponding direction. When the fastest mile occurs more than once, and from two or more directions, enter the direction of the first occurrence followed by a footnote reference and an explanatory footnote; e.g., 1/first of several occurrences. The uncorrected fastest mile and the direction data are taken from Forms 1017 or 1017B. When the data are estimated (see ¶ A13021.4), enter them in parentheses. If these data are required locally and the station is not equipped with a multiple register, the highest one-minute wind speed in statute miles per hour observed during the day and the corresponding direction may be entered in column 36. In this case, enter an asterisk in the heading of the column referring to the footnote: "*Fastest observed mile and direction."

A17137. Time of Fastest Mile (Col. 37).—Enter time of beginning to the nearest minute (LST).

A17138. River Stage (Col. 38).—At stations where a river gage is read, enter this reading to the nearest 0.1 foot.

A17139. Excessive Precipitation (Cols. 39 to 50).—Enter amount of excessive precipitation in these columns (see par. A4530). Tabulate excessive precipitation data and ascribe it to the day in which the period ends. Whenever more than one tabulation is required for the same day, enter the data in column 61. Use a rubber stamp to provide and identify spaces for the additional tabulations.

A17151. Extra Columns (Cols. 51 to 53).—Enter any additional data that are required locally and identify these data in the respective column headings.

A17154. Station Pressure Computations (Lines 54 to 60).—Enter data in these lines in accordance with instructions in par. 7780.

A17161. Additional Remarks and Notes (Line 61).—Enter the character and time (LST) of sunrise and sunset using the terms Clear, Cloudy, Foggy,

A17304. Average Temperature (Col. 4).--Enter these data to whole degrees. The average temperature is half the algebraic sum of the daily maximum and minimum temperatures.

A17305. Departure from Normal (Col. 5).--When normals are available, compute the departure by subtracting algebraically the normal temperature from the daily average temperature. Example: Daily average temperature, 65°; normal temperature, 60°; departure = +5°. In leap years use the normal for February 28 as the normal for February 29 also.

A17306. Degree Days (Base 65°) (Col. 6).--Enter heating degree days to whole numbers (the difference between the daily average temperature and 65° when the daily average is less than 65°). Enter "0" when the daily average is 65° or higher. Omit entry in this column if no maximum and minimum temperature readings are made during the period noon to midnight, LST, and a thermograph is not in use.

A17307. Total Precipitation (Water Equivalent) (Col. 7).--Enter the total 24-hour precipitation in inches and hundredths, as obtained from WBAN-10B or Form 1001B. Enter the sum of the daily amounts of precipitation at the foot of the column. If the observational period is other than midnight to midnight (see ¶ A17210), ascribe entries to the date on which the observational period ended.

A17308. Snowfall, Sleet, Hail (Col. 8).--Enter 24-hour unmelted depth of frozen precipitation (snowfall, sleet or hail, etc.) in inches and tenths as obtained from WBAN-10B or Form 1001B. Enter estimated data in parentheses (see ¶ A17213). Enter total at the foot of the column. If the observational period is other than midnight to midnight (see ¶ A17210), ascribe entries to the date on which the observational period ended.

***A17309. Snow, Sleet, Hail or Ice on the Ground (Col. 9).--Enter the depth, to the nearest inch, of frozen precipitation (snow, sleet, hail, ice, etc.) on the ground, as obtained from Col. 70 of WBAN-10 or Col. 33 of Form 1001B. In the heading, enter the local standard time of the observation.**

*A17310. Prevailing Direction (Col. 10).--At stations where 24 record observations are taken daily, enter the prevailing direction to 16 points of the compass taken from column 9 of WBAN-10A for record observations. At stations equipped with triple registers, but not taking 24 record observations daily, enter the prevailing direction to eight points of the compass as determined from either the right margin of WBAN-10B or column 4 of Form 1001B. Omit entry at all other stations. ("DI" will not be considered as a prevailing direction for the day; however, when the direction is indeterminate for an entire day, enter "Calm" across the columns 10 and 11.) Prevailing direction for the month will not be entered at the foot of column 10.

A17311. Average Wind Speed (Col. 11).--At stations where 24 record observations are taken daily, enter the average wind speed in miles per hour, computed from the hourly-record observation data in column 10 of WBAN-10A. At stations equipped with triple registers but where 24 record observations daily are not taken, enter the average wind speed computed from the hourly wind data in either the right margin of WBAN-10B (see ¶ A8602) or column 5 of Form 1001B (see ¶ A17105). Omit this entry at all other stations. At the foot of the column, enter the sum of the daily average hourly speeds, and the average of these speeds as obtained by dividing the sum by the number of days in the month. Enter all data in this column to tenths of a mile.

A17312. Fastest Mile and Direction (Cols. 12 and 13).--Enter the speed and direction of the fastest mile or fastest observed one-minute speed as recorded on WBAN-10B (see par. A8603) or Form 1001B (see par. A17136). When the fastest mile occurs from two or more directions, enter the direction of the first occurrence followed by a footnote reference and an explanatory footnote, e.g., 1/ indicates only the first of several occurrences. Enter estimated data (see par. A13021.4) in parentheses (see par. A17213). At stations where the fastest observed one-minute wind speed and direction are entered instead of the fastest mile data, place an asterisk in the heading of column 12, and the following note just above the summary: "*Fastest observed one-minute wind speed and its direction."

A17314. Total Sunshine (Col. 14).--Enter the total sunshine in hours and minutes as obtained from WBAN-10B or Form 1001B, e.g., 0:32; 12:03. At the foot of the column, enter the total sunshine for the month similarly, and the possible sunshine as obtained from the Station Sunshine Tables.

A17315. Percent of Possible Sunshine (Col. 15).--Enter these data in whole percent as obtained by dividing the entry in column 14 by the possible sunshine listed in the Station Sunshine Tables. At the foot of the column, enter in whole numbers the percent of sunshine obtained by dividing the sum of column 14 by the possible sunshine entered below it, and multiplying the quotient by 100.

*A17316. Sky Cover - Sunrise to Sunset (Col. 16).--Enter tenths of sky cover as obtained by averaging hourly entries on WBAN-10B or Form 1001B for the period from sunrise to sunset. Observations of sky cover that are made between sunset and sunrise will not be considered in computing average sky-cover entries in column 16 of Form 733-1 (formerly Form 1001C). For example, if sunset occurs at 1722 EST, an observation of sky cover made at 1727 will not be included in the computation. At the foot of the column, enter the sum to whole numbers and the average to one decimal place. Obtain averages as indicated in par. A17107.

A17317. Sky Cover - Midnight to Midnight (Col. 17).--Enter data for the period from midnight to midnight, using the procedure described in par. A17316. Omit entry at stations where personnel are not on duty 24 hours a day.

A17362. Highest and Lowest Sea-Level Pressure.—Enter these data as obtained from the barograph trace, corrected in the manner specified in par. 7242, and reduced to sea level in accordance with pars. 7320 to 7324. Owing to the temperature factor involved in reducing station pressure at high-altitude stations to sea level, the lowest or highest station pressure indicated on the barogram may not provide the lowest or highest sea-level pressure. At such stations, inspect the barogram for, and reduce to sea level, other high or low station pressures which approach the extremes previously selected, and review the recorded sea-level pressures for the month to determine that the highest and lowest sea-level pressure values have been selected.

A17370. Weather.—Enter data as follows:

A17371. Number of Days Clear, Partly Cloudy, and Cloudy.—Obtain these data from column 16.

A17372. Number of Days with 0.01, 0.10, 0.50, and 1.00 Inch or More of Precipitation.—Obtain these data from column 7.

A17373. Dates of Hail, Sleet and Glaze.—Obtain these data from WBAN-10B or Form 1001B.

A17380. Summary.—In the spaces provided near the bottom of the form, enter notes regarding the occurrence of unusual or extreme weather conditions during the month. Include data on damaging rain, snow, glaze, hail, or wind storms, and unusually high or low temperatures.

*A17400. FORM 733-1a, LOCAL CLIMATOLOGICAL SUMMARY (Format)

*A17410. General.--Form 733-1a (see Fig. A17-3), formerly 1001C Format, will be prepared monthly as follows:

(1) Parentheses will not be used when estimated or interpolated data are transcribed from Form 733-1 (formerly 1001C).
(2) Errors noted on published monthly (or annual) summaries will be corrected in the next monthly issue.
(3) The format may be cut to fit the typewriter whenever necessary, by cutting along the vertical light-blue line near its center, and each half typed separately; in which case, the narrative summary should be typed in two columns with at least one-half inch between the columns. After typing, join the two halves with scotch tape applied to the back.
(4) Form 733-1a may be mailed (see par. A17220) in a mailing tube, or it may be folded (but not creased) around a piece of cardboard by folding it along the line immediately below the abbreviation "Avg." Cut the cardboard to fit into a 12x16 inch envelope in a manner that will prevent displacement of the fold in the format.
(5) Entries will be made in accordance with instructions in Sections A17200 and A17300 for entries on Form 733-1, and the additional instructions in this section.

*A17411. Heading.--Enter station name, month and year, time zone, elevation, and, in degrees and minutes, the station latitude and longitude.

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

LOCAL CLIMATOLOGICAL DATA

LAKESIDE, OHIO (Municipal Airport) FEBRUARY 1954

Latitude 41° 24' N. Longitude 80° 51' W. Elevation (ground) 327 ft Eastern Standard time used

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet, Hail (In.)	Snow, Sleet, Hail or Ice on ground at 7:30 am (In.)	Wind Prevailing direction	Average speed (m. p. h.)	Fastest mile Speed (m. p. h.)	Direction	Sunshine Total (hours and minutes)	Percent of possible	Sky cover Sunrise to sunset (tenths)	Midnight to midnight (tenths)	Thunderstorm or distant lightning	Weather restricting visibility to ¼ mile or less	20	21	22	23	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	19	12	16	-8	49	0.74	6.5	13	N	13.8	20	W	0:20	3	10	10			33	89			1
2	12	-5	4	-20	61	T	T	13	SW	15.8	26	SW	8:54	88	1	3			33	318			2
3	18	-8	5	-19	60	0	0	12	SSE	11.0	15	S	9:53	98	3	2			33	343			3
4	30	11	21	-4	44	0	0	9	S	9.9	15	S	7:35	74	9	8			33	279			4
5	32	22	27	+2	38	0.01	0.1	8	SSW	4.9	9	S	0	0	10	10			33	100			5
6	42	28	35	+10	30	0.12	0	7	SSE	10.4	26	SE	0	0	10	10			33	116			6
7	38	9	24	-2	41	0.51	1.9	6	WNW	21.4	33	W	0	0	10	10		S, BS	33	116			7
8	10	0	5	-20	60	0.15	1.4	8	WSW	16.8	27	W	1:50	18	9	10			33	221			8
9	19	1	10	-15	55	0.01	0.1	8	NNW	7.8	16	SW	8:40	83	5	4			32	295			9
10	35	-4	16	-9	49	0	0	6	SSE	9.6	24	S	9:25	90	5	4			32	297			10
11	43	34	39	+14	26	0	0	3	SSW	13.5	28	S	5:30	52	7	9			32	247			11
12	46	41	44	+18	21	0.02	0	0	SSW	14.2	25	SW	0	0	10	10			33	15			12
13	48	25	37	+11	28	0.12	0.1	T	N	12.8	20	N	0	0	10	10			32	23			13
14	26	19	23	-3	42	0.05	0.5	T	NNE	13.3	19	N	0:10	2	10	8			32	137			14
15	38	17	28	+2	37	T	0	0	ENE	6.9	14	N	3:15	31	8	7			33	245			15
16	45	26	36	+10	29	0.07	0	0	SE	13.8	24	SE	0:25	4	10	7			33	133			16
17	44	34	39	+12	26	0.31	0	0	SW	7.8	16	W	0	0	10	10			33	63			17
18	54	33	44	+17	21	0.02	0	0	SSE	6.2	18	SE	4:25	41	8	9			33	225			18
19	60	42	52	+25	13	0.09	0	0	SE	6.3	33	W	0:44	5	10	8			33	124			19
20	43	33	38	+11	27	0.10	0	0	NE	9.2	21	NE	0	0	10	10		L, F	33	72			20
21	36	34	35	+8	30	1.04	T	0	NNW	21.2	35	N	0	0	10	10			34	18			21
22	36	31	34	+6	31	0	0	0	NNW	12.1	19	N	0:05	0	10	10			34	119			22
23	38	28	33	+5	32	0	0	0	NNW	8.2	15	N	0	0	10	9			34	154			23
24	48	24	36	+8	29	0	0	0	NW	3.8	11	S	8:50	84	0	0			34	402			24
25	50	30	40	+12	25	0	0	0	S	8.3	15	SW	0:40	6	9	6			34	160			25
26	58	44	51	+23	14	0.25	0	0	S	15.0	34	W	0:35	5	10	8			34	61			26
27	45	30	38	+9	27	T	T	0	W	20.2	35	W	0	0	10	10			34	66			27
28	42	26	34	+5	31	1.13	T	0	ESE	10.7	25	E	2:56	27	10	10	T, DL		34	200			28
29																							29
30																							30
31																							31
Sum	1056	617	—	—	—	4.73	10.5	—	—	324.9	—	—	74:12	—	231	222	—	—	961	4648			Sum
Avg	37.7	22.0	—	—	—					11.6	Fastest	Dir.	Possible	%	8.4	7.9	—	—	33.1	166.0			Avg.
										Misc.	35	NW	308:46	24	—	—	—	—	—	—			Misc.

T in columns 7, 8, and 9 indicates amount too small to measure.

TEMPERATURE: (°F)
Average monthly 29.9
Departure from normal +3.6
Highest 62 on 19th
Lowest -8 on 3rd
Number of days with —
Max. 32° or below 8
Max. 90° or above 0
Min. 32° or below 20
Min. 0° or below 4

HEATING DEGREE DAYS (base 65°):
Total this month 976
Departure from normal -86
Seasonal total (since July 1) 4458
Seasonal departure from normal -193

BAROMETRIC PRESSURE (In.)
Avg. station (elev. 762 feet, m. s. l.) 29.338
Highest sea level 30.71 on 14th
Lowest sea level 29.53 on 21st

PRECIPITATION: (In.)
Total for the month 4.73
Departure from normal 2.22
Greatest in 24 hours 1.13 on 20-21st 1/
Snow, Sleet and Hail —
Total for the month 10.6
Greatest in 24 hours 6.5 on 1st
Greatest depth on ground 13 on 1st-2nd
Dates of — Hail None
Sleet 13th Glaze 13th, 14th

Symbols used in columns 18-19
A - Hail
BS - Blowing snow
DL - Distant lightning
D - Dust
S - Sleet
F - Fog
H - Haze
K - Smoke
L - Drizzle
N - Sand
R - Rain
S - Snow
T - Thunderstorm
ZL - Freezing drizzle
ZR - Freezing rain

Average daily temperature departure since March 1, 1950: +6.5. Total precipitation since March 1, 1950: 46.43; and departure: +12.41. February's value of average monthly temperature and total precipitation appear misleading unless details for the first ten days are reviewed. In that opening ten-day period, snowfall of ten inches equalled normal for the month; and four days with temperatures of zero or below exceeded the winter-season normal. All-time records for minimum temperature were set at -5° on the second and -8° on the third. A seasonal snowfall total of 62.9 inches was reached on the fourteenth. Only a few flurries occurred during the remainder of the month, when the weather was spring like and dry.

1/ Indicates only the first of several occurrences.

HOURLY PRECIPITATION

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1	.03	.01	.05	.04	.02	.03	.06	.09	.06	.07	.01	.02	.03	.04	T	.02	.01	.04	.03	.03	.02	T	.01	.02	1
2	T	T	T						T	T	T														2
3																									3
4																									4
5			T	T	T	T	T	T	T	T	T	.01	T	T	T										5
6																		T	T	T	.03	.02	.03	.04	6
7	.06	.06	.03	.03	.03	.01	T	T	.01	.01	T	.01	.01	T	.02	.02	.01	.02	.03	.03	.03	.03	.03	.03	7
8	T	T	T	T	.02	T	.01	.02	.02	T	.02	.03	.01	T	.01	.01	T	T	T	T		T	T	T	8
9	T		T	.01	T	T	T			T															9
10																									10
11																									11
12							T	T	T			T	T	T	T	T	.01	.01	T	T	T	T	T	T	12
13	T				T	T	.01	T	T	T	T	.01	T	.01	.01	.01	.01	.01	.01	T	T	.02	.01	.01	13
14	T	T	.02	.01	.01	.01	T	T				T	T	T	T	T									14
15									T																15
16																	.01	.04	T	.02					16
17	T	T	.02	.07	.07	.04	.04	.04	.03	T	T	T	T												17
18																								.02	18
19	.01	T	T	.02	.02	T	.02	.02	T	T											T	.07	.01	.07	19
20				.01	T																				20
21	.10	.09	.06	.10	.23	.17	.05	.01	.03	.02	.08	.09	.01	T											21
22																									22
23																									23
24																									24
25																									25
26												T	.07	.18	T										26
27														T											27
28															.98	.12	.03	T							28
29																									29
30																									30
31																									31

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* Fig. A17-3. Entries on Form 733-1a (formerly 1001C Format)

*A17412. Time of Observation (Col. 9).--In the heading, enter the local standard time of the observation (in terms of 12-hour clock) as copied from Form 733-1 (see par. A17309).

A17413. Extra Column (Col. 23).--Enter any additional data required locally, and identify these data in the column heading.

A17414. Barometric Pressure.--On the line captioned "Avg. Station....", enter the elevation H_{bc} (see Appendix I) to whole feet in the first space. Enter the reduced monthly average station pressure value that pertains to H_{bc} (see par. A17361) in the other space.

A17415. Hourly Precipitation.--Enter hourly precipitation in inches and hundredths in the spaces provided at the bottom of the form. Enter "T" for trace, and omit the entry if no precipitation has fallen.

A17415.1. Where a station that takes six-hourly observations does not have a recording gage, enter the six-hourly precipitation in the column appropriate to the time of each six-hourly observation. Identify the entries by adding "6-" immediately preceding the heading "Hourly Precipitation."

A17500. FORM 1081

A17510. Preparation.--Form 1081 will be used at stations where the height of the 850-mb. surface is computed and where Form 1083 is not used. Only one copy will be prepared unless additional copies are required locally.

A17511. In lines one to seven, enter the data corresponding to items one to seven, respectively, of par. 7430. Entries in the columns of the form are to accord with the date and time of observation as indicated in the column headings. (See par. A7020 regarding computation of these data.)

A17520. Disposition.--Completed copies of Form 1081 may be destroyed after ninety days.

A17600. FORM 1083

*A17610. Preparation.--(See Fig. A17-4.) Form 1083 is provided for the recording and coding of 3- and 6-hourly synoptic observations. Use of the form is:

(1) required (for record purposes) at all second-order synoptic stations and certain other designated stations.

(2) optional (for use as a worksheet) at first-order stations where only 3- and 6-hourly synoptic observations are taken.

*A17610.1. Where use of the form is required (see (1) above):
(1) Use a well sharpened Venus 2H or 3H drawing pencil, or equivalent.
(2) Use sufficient pressure to produce clearly legible, black-line entries.
(3) Only one copy will be prepared unless additional copies are required locally.

A17611. Enter station name and date in the spaces provided. Note that the date corresponds to that of Greenwich civil time. (See ¶ 1404 and 1405 of the Synoptic Code for conversion table from local standard time to Greenwich civil time.) On the last day of the month, entries will be made on Form 1083 for all observations up to midnight local standard time. Begin a separate form with the first observation at or following 0000 local standard time on the first of the month.

A17612. Enter 6-hourly observations in columns headed 0030Z, 0630Z, 1230Z, 1830Z; enter 3-hourly observations in columns headed 0330Z, 0930Z, 1530Z, and 2130Z. Omit entries for observations or elements not regularly recorded. Enter slants to indicate missing data pertaining to an observation or element usually recorded.

A17613. All entries in the column headed "Coded" will include the number of digits indicated by the corresponding symbol. Each dot following the letter indicates an additional coded digit; e.g., "R $\underset{24}{\cdot\cdot\cdot}$" indicates that four digits will be entered in the "Coded" column.

A17614. If data are entered on the reverse side of the form, enter a check in the box at the bottom of the page titled "Notes on Reverse Side."

*A17620 Routing.--At stations preparing forms for record purposes, forward completed forms for the month, local standard time, on or before the fifth of the following month to the station designated by the regional director.

*A17621. At first-order stations in the continental United States designated as a checking or supervising station for Form 1083, or both, processed forms will be forwarded in accordance with instructions in Chapter 8, Volume III, Weather Bureau Manual.

A17630. Itemized Entries (Line, column, or group entries 1-61).--All references in the instructions on the following pages of this chapter are to the 1949 Synoptic Code unless otherwise specified. The instructions are indexed under this paragraph number.

Change No. → A4

WEATHER BUREAU DISTRIBUTION: Do not distribute to the following types of second-order stations - 1) SAWR. 2) A-type, 3) CAA stations designated to receive "Circular N, abridged for CAA stations."

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

MANUAL OF SURFACE OBSERVATIONS

(WEATHER BUREAU ADDENDUM)

CIRCULAR N

Sixth Edition

(Revised)

October 1, 1954

WASHINGTON, D. C.

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N

Change A4 consists of the following:

A. Pen-and-ink changes:

1. Page A8-3, Table A8-1, in the two columns captioned "....(mph)," add "or knots" within the parentheses, add a footnote reference and the footnote "As appropriate to calibration of the instrument used."

2. Page A8-15, Par. A8331, end of sentence on line 3, add "(statute miles)."

3. Page A8-16 - A8-18, Pars. A8341, A8351, and A8361, in the sentences that read "....from 0 to 75 m.p.h. in increments of 1 m.p.h.," delete "m.p.h." in both places in each sentence, and change to read ".... from 0 to 75 in unit increments, and is calibrated in knots;" delete "m.p.h." wherever it appears in the remainder of these paragraphs.

4. Page A8-19, Par. A8410, add "Indicated values are in statute miles."

5. Page A8-22, Par. A8420, end of first sentence, add "(statute miles)."

6. Page A9-2, delete Par. A9161.

7. Page A9-2a, delete Figs. A9-1 and A9-2.

8. Page A9-3, Par. A9182, 2nd line, following "aviation," insert "synoptic."

9. Page A9-3, Par. A9182.1, delete last sentence.

10. Page A11-1, Par. A11005.1, modify as follows:

    (a) at the end of item (1,a), add "(including B or D)."

    (b) following "Mailed from" in item (2), insert "other."

    (c) delete item (3).

    (d) item (4), renumber as "(3)", in the 3rd line, delete the remainder of the paragraph following "Asheville, N.C.", and substitute "monthly (via the station certifying the payroll, when appropriate), as soon as verification has been completed."

11. Page A11-2, Par. A11005.2(1), delete "forwarded to the Section Center," and substitute "retained as station records."

12. Page A11-3, Par. A11021, 1st sentence, prefix with "At first-order and CAA stations."

13. Page A11-3, Par. A11032, 1st line, following "of Form," delete "5066," and insert "920-9 (formerly Form 5066)."

14. Page A13-5, Par. A13020, 5th line from end of paragraph, following "all stations," add "in statute miles per hour."

15. Page A13-5, Par. A13021.2, line 2, insert "statute" ahead of "miles."

16. Page A13-6, Par. A13021.3, 6th line from end of paragraph, add "in statute miles per hour" following "five-minute speed."

17. Page A13-6, Par. A13021.4, 1st sentence, add "in statute miles per hour" following "Enter the uncorrected fastest mile."

18. Page A15-1, Par. A15010, first line of last sentence, delete "either", and in next line, end sentence after "RAREP code," after deleting rest of sentence.

19. Page A15-1, Par. A15011, first line, change "statute" to "nautical," change the second "miles" to read "knots", and delete the remainder of the paragraph.

20. Page A15-1, Par. A15013, 3rd line, delete remainder of sentence after "Land Station."

21. Page A15-3; Par. A15120 A, (3), (b), last line, change "miles per hour" to read "knots"; Par. A15120, delete item "B".

22. Page A15-4, Par. A15222, delete the paragraph.

23. Page A15-6, Par. A15307, 3rd line from bottom, change "statute" to "nautical."

24. Page A15-8, Par. A15309, 2nd line, delete "cities,....navigational facilities", and substitute "observing stations or nationally known points."

25. Page A15-8, Par. A15310, 3rd line, change "statute" to read "nautical".

26. Page A15-8, Par. A15311, 4th line, change "statute" to read "nautical".

27. Page A15-9, Par. A15313, 2nd line, change "miles per hour" to "knots", and "statute" to "nautical".

28. Page A15-9, Par. A15313.2, 2nd line, change "statute mile per hour" to "knot".

29. Page A15-10, Par. A15314.1; in item (4), delete "Fig. A15-12, or using" and add to the end of the sentence "or from a chart, when available, based on the elevation angle of the echo in degrees, and the slant range in nautical miles"; in item (5), 2nd line, following "distance to the echo", insert"(slant range in nautical miles)", and delete the second sentence; in item (6), 1st line, change "(4)" to "(5)", and between "from" and "miles", insert "nautical", and in 2nd line, delete remainder of sentence following "value by 6080".

30. Page A15-10 and A15-11, Par. A15315.2, 2nd and 3rd examples, under "Observed data:", change "miles per hour" to read "knots".

31. Page A15-11 and A15-12, delete all of Section A15400.

32. Page A15-12, Par. A15510, 3rd line, delete all after the first "Station."

33. Page A15-12, Par. A15512, delete "(and vessel, in....ocean stations)."

34. Page A15-13 and A15-14, Pars. A15530 and A15531, delete both paragraphs.

35. Page A15-14, Par. A15540, delete "(or each patrol)."

36. Page A15-14, Par. A15612, 5th line from bottom, change "miles" to "height."

37. Page A15-15, Par. A15612, item 12 of the example, under "EXPLANATION", change "m.p.h." to read "knots."

38. Page A15-15, Par. A15620, delete the paragraph.

39. Page A15-16; 5th line from bottom, delete "miles per hour (or," and the remaining parenthesis; delete the last line.

40. Page A15-17; 7th line from bottom, delete "miles per hour (or," and the remaining parenthesis; delete the last line.

41. Page A15-18; 5th line from bottom, delete "miles per hour (or," and the remaining parenthesis; delete the last line.

42. Page A15-19, 5th line from bottom in copies in which it appears, delete "miles per hour (or," and the remaining parenthesis; delete the last line.

43. Pages A15-20 - A15-24, delete the last sentence on each page.

44. Page A15-25, following "Fig. A15-11," add "(These tables are for decoding purposes only.)"

45. Page A15-26, delete Figure A15-12.

46. Page A17-1, Par. A17011, 6th line, delete "will be forwarded to the Section Center, and the originals;" and at the end of the second sentence, add a footnote reference and the footnote "Certified photographic copies for legal purposes will be requested from the NWRC if the authenticity of corrected carbon copies is questioned."

47. Page A17-2, Par. A17103, 4th line, correct reference to Par. "A12015" to read "A17015."

48. Page A17-12, Par. A17311, 3rd line, delete "in col. 10," and at end of first sentence, add "Convert values in knots to statute miles per hour."

49. Page A17-13, Par. A17320, add "For peak gust or other wind speed data, entries will be in miles per hour."

50. Page A17-19, Par. A17413, add "For peak gust or other wind speed data, entries will be in miles per hour."

51. Page A17-20, Par. A17621, delete "in the continental United States."

52. Page A17-21, Fig. A17-4, under columns captioned "Coded" and opposite "Direction of cloud" on line (19), delete "9" in columns captioned "0330Z," "0630Z," and "0930Z," and substitute "/" in each case.

53. Page A17-23, item 6, under column captioned "OBSERVED", delete "Enter speed of...."C" for calm", substitute "No entry," and under the column captioned "CODED", delete "using Conversion Table B."

54. Page C5 of Index, under "Forms", change "1001C Format" to "733-1a," and under "5066", change the reference to "A14320," to "A14330," the reference "A14330" to "A14340", and "5066" to "920-9."

55. Page A10-4, Par. A10320, 2nd line, delete 2nd sentence, and in 3rd sentence, delete "forwarded to the Section Center" and substitute "retained in the station files".

B. Page changes consist of pages A13-3, A13-4 and A13-4a, a new Chapter A14 (pages A14-1, A14-2, and A14-3).

When the indicated changes have been made, this page may be initialed and filed in Circular N as a substitute for entries specified for entry on the "Record of Changes" page.

position of a multiple-position switch. The circuit is closed momentarily at 1-minute intervals, at which time the magnet-driven pen prints one or two dots in line with direction symbols on the chart. These dots indicate direction to eight compass points; thus a dot opposite N indicates North, dots opposite S and E indicates Southeast, etc. Direction may be recorded manually at any time. A switch for this purpose is provided near the front of the case.

*A13012. Wind Movement.-- Statute miles of wind are indicated by intermittent offsets in the trace (see Fig. A13-4). To facilitate counting, ten-mile cycles are identified by a prolonged offset during every tenth mile of wind. The magnet-driven pen-arm is connected to the 1-mile contact of a suitable anemometer.

*A13012.1. F102 Anemometers.-- Miles of wind may be measured either from beginning to beginning or from end to end of consecutive pairs of offsets, except as follows (see example below):

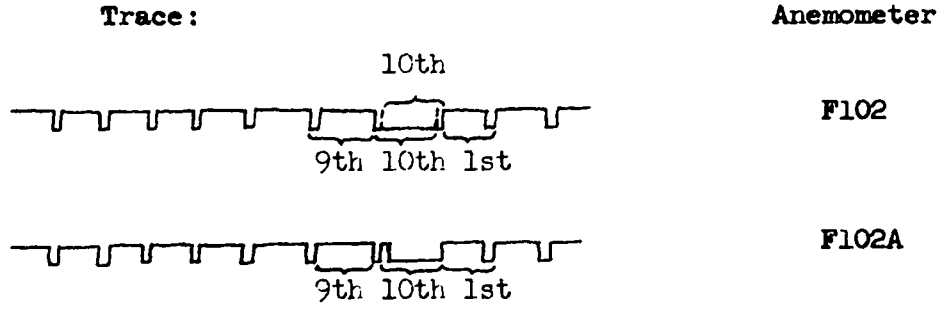
(1). 1st mile - measure from end of prolonged offset to end of next offset.

(2). 9th mile - measured from beginning of prolonged offset to beginning of the preceding offset.

(3). 10th mile - a mile should correspond to approximately 92% of the distance from beginning to end of the prolonged offset (see par. A13012.4), i.e., wind speed is approximately 8% more than the scale value corresponding to the distance from beginning to end of the offset.

*A13012.2. F102A and Anemometers with Similar 10th-Mile Contacts.-- Miles of wind will be measured between the ends of consecutive pairs of offsets (see example below).

EXAMPLES



The bracketed distances represent miles of wind

*A13012.3. Wind Speed.-- Use the appropriate range of the scale shown in Fig. A13-3(A) to measure the average speed of a mile of wind, in miles per hour to the nearest unit value, in terms of the length of the corresponding segment of the trace. Four ranges are provided; 5-9, 10-19, 20-39, and 40-79.

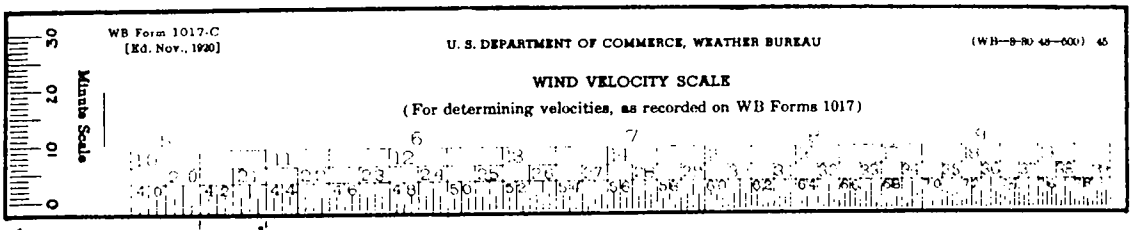
*A13012.31. A buzzer placed in the 1/60-mile circuit of a suitable anemometer, such as the F102 or F102A, may be used in obtaining one-minute average wind speeds (see par. 8230). The buzzer and a switch can be installed on the base of the register.

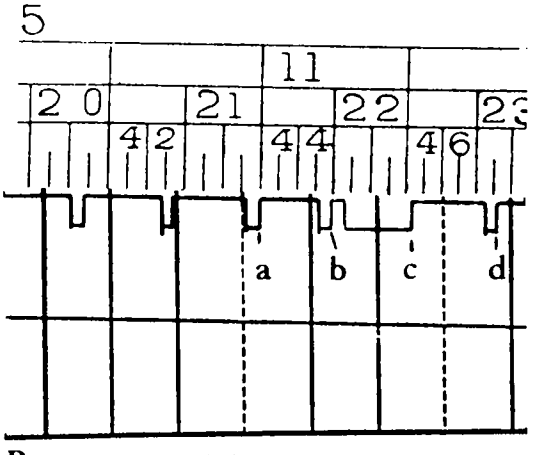
*A13012.4. Contact Mechanism Errors.-- Poor adjustment of the spring-mounted contacts of F102 anemometers, or bent pin contacts may result in systematic errors, repeated from one cycle to another. For example, a bent pin between two miles of wind reduces the indicated length of one mile as much as it lengthens the other. Spring-mounted contacts should be adjusted for optimum operation; otherwise, when an error is suspected or known to exceed 10%, requisition a replacement from the Regional Office.

*A13012.41. For F102 or F102A anemometers, the error in an indicated mile of wind may be determined from the difference between 640 (the number of turns of the cups in one mile) and the number of turns during an indicated mile.

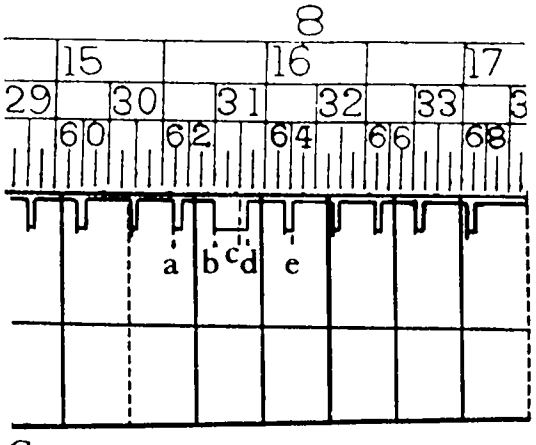
A13013. Rainfall or Sunshine.-- The rainfall-sunshine magnet of the triple register may be connected in parallel circuits to both a D101 tipping-bucket gage and an 080 sunshine switch. Each time either circuit is closed, the magnet-driven pen mechanism produces a short,

(Continued on page A13-5)

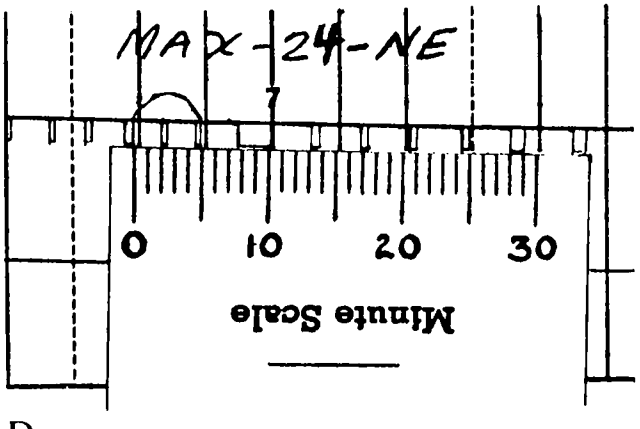




B F102A Anemometer.



C F102 Anemometer.



D

*Fig. A13-3. Wind scale for use with Form 1017 or 1017B, as shown in "A." Four ranges are provided. Note that "ab" represents 5-1/4 mph (top range); that one half of "ab" represents 10-1/2 mph (2nd range); 1/4 represents 21 mph, and that any one of the eight scale divisions between "a" and "b" represents 42 mph (bottom range). In "B," note that "ab," the 9th mile of a ten-mile cycle, corresponds to 11 mph on the scale; in "C," the tenth mile, "bc" (approximately 92% of "bd"), corresponds to 31 mph; in "D," use of the Minute Scale is shown in the determination of Maximum Average Five-Minute Wind Speed, i.e., 2 miles in 5 minutes equals 2 x 12, or 24 mph.

CHAPTER A14. VERIFICATION OF FORMS

A14000. GENERAL

*A14010. Purpose.--Verification is primarily for the purpose of maintaining a high standard of accuracy in the taking and recording of observations.

*A14020. Adequacy of Instructions.--Officials in charge at verifying stations are requested to report to the Central Office types of discrepancies apparently resulting from the inadequacy of instructions.

A14100. AT ORIGINATING FIRST-ORDER STATIONS

*A14101. Someone other than the observer taking the observation will verify all entries on observational records as soon as practicable after the observation is taken. The official in charge, or designated assistant, will review all forms for completeness and general compliance with instructions prior to mailing them.

A14200. PREPARED AT SECOND-ORDER (OTHER THAN CAA) STATIONS

A14201. Observational records from second-order stations, other than CAA stations, will be verified at first-order verifying stations as follows:

(1) Verify every fifth observation as completely as possible.

(2) Inspect the remaining observations for general compliance with instructions and for consistency. Determine that marked departures between consecutive values of sea-level pressure, altimeter setting, dew point, etc., are not indicative of errors.

(3) Review all forms for completeness; e.g., station name, date, etc.

A14300. CORRECTING RECORD FORMS

*A14310. Correction Procedures.--Corrections will be listed on Form 920-9 only when the difference between the observer's and verifier's evaluation exceeds:

(1) 0.01 inch (0.3 mb.) for { station pressure. / sea-level pressure. / altimeter setting,

(2) 1.0°F. in dew point, or whenever the recorded dew point is higher than the recorded wet-bulb temperature.

(3) 2% in relative humidity (using the dew-point temperature as originally computed by the observer, provided it was within the tolerances specified in (2), above).

*A14320. Punched Cards.--Indicate the correct data clearly on erroneous punched cards from first-order stations, and attach them to the original of Form 920-9 (see Par. A14332).

*A14330. Corrections to Weather Records - WB Form 920-9.--(See Fig. A14-1.) At WRPC's and first-order verifying stations, prepare Form 920-9 (formerly Form 5066) in duplicate each month to report corrections to WB Forms 733-1, 733-1a, 1001B, 1083, WBAN forms, and solar radiation records. Prepare the form even when there are no corrections to be reported.

*A14331. Preparation.-- At the top of Form 920-9, enter the addresses of the originating and verifying stations, and date of preparation of the form. Under the caption "Corrections to Weather Records," enter the dates necessary to complete the statement.

*A14331.1. Data pertaining to WBAN-10 forms from first-order stations where punched cards are prepared will not be entered (see Par. A14320); data pertaining to the other record forms will be entered as follows:

A. In the column headed:

(1) "Form number, Date and Time" - enter dates and time of corrected data for each form, preceded by a single entry of the appropriate WB or WBAN form number.

(2) "Data and Reference" - Identify erroneous data and refer to instructions governing reporting of the data (see Fig. A14-1). The nature of corrections to Form 1083 should be identified in detail, since a copy may not be available at the originating station for reference.

(3) "Recorded" - enter the uncorrected data.

(4) "Should be" - enter the corrections.

(5) "Changes" - enter the total number of changes made, including changes to punched cards.

*A14332. Disposition. Send original to the observing station (with erroneous punched cards when sent to a first-order station - see Par. A14320). Retain one copy at the station.

*A14340. Filing of Punched Cards and Forms 920-9.--Upon receipt of Form 920-9 the official in charge or designated assistant will review the list of corrections to determine whether any of them are indicative of misinterpreted instructions and whether remedial action is required. If any correction listed appears to be erroneous, he should attach his comments and return the form to the WRPC. If no comments are in order, the form (and also the cards punched at Weather Bureau first-order stations) will be retained until inspected by the field aide, or for 6 months, after which, they should be destroyed."

WB Form 920-9
(Formerly 5066)
Rev. Eff. 3-1-54

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

Weather Bureau Airport Station
Dannelly Field
Route 2
Montgomery, Alabama

Date July 12, 1955

Mr. John Doe
Weather Observer
Doeville, Alabama

MEMORANDUM

Corrections to Weather Records

In verifying forms from your station for June, 1955, changes were made as shown below. These changes are listed only for your information in the hope that bringing them to your attention will assist you in maintaining the highest quality of observational practices. If you believe a change has been made incorrectly, we shall appreciate your returning this form with your comments. Otherwise, it need not be returned. Instructions for disposition of this Memorandum are in Circular N.

Form Number		Col.	Data	Reference		Recorded	Should Be--
Date	Time			Cir.	Par.		
WBAN-10:							
05	1428	5	Obstructions to Vision (Haze recorded 1327 and 1530. Visibility recorded 6 miles	N - 3911		Omitted	H
07	1230		Line 63 - Station Pressure			29.632	29.732
25	1629	3	Sky - (Example 8)	N - 1511		M10-○	10-○
26	1227	47	Max. Temp. - 6-hourly observation (Dry-bulb reading at 1228, 65)	N - 5550		63	65
28	0629	48	Min. Temp. - 6-hourly observation (Dry-bulb reading at 0528, 49)			50	49

CHANGES
Total 7

Meteorologist in Charge

Commerce-Weather Bureau, Washington, D. C. 64

WB Form 920-9

Fig. A14-1. Example of Form 920-9 addressed to a second-order station.