
FILE E
EQUIPMENT

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SONOBUOY- MISCEALANEOUS NOTES/ ARTICLES	E 2
ARMY MANUAL TM11-4876, DIRECTORY OF SIGNAL CORPS METEOROLOGICAL EQUIPMENT	E 3
ARMY MANUAL TM11-444, SOUND RANGING SET GR-3-C	E 4
ARMY MANUAL TM11-2405, METEOROLOGICAL BALLOONS	E 5



51

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2028-134/56 daw

10 February 1956

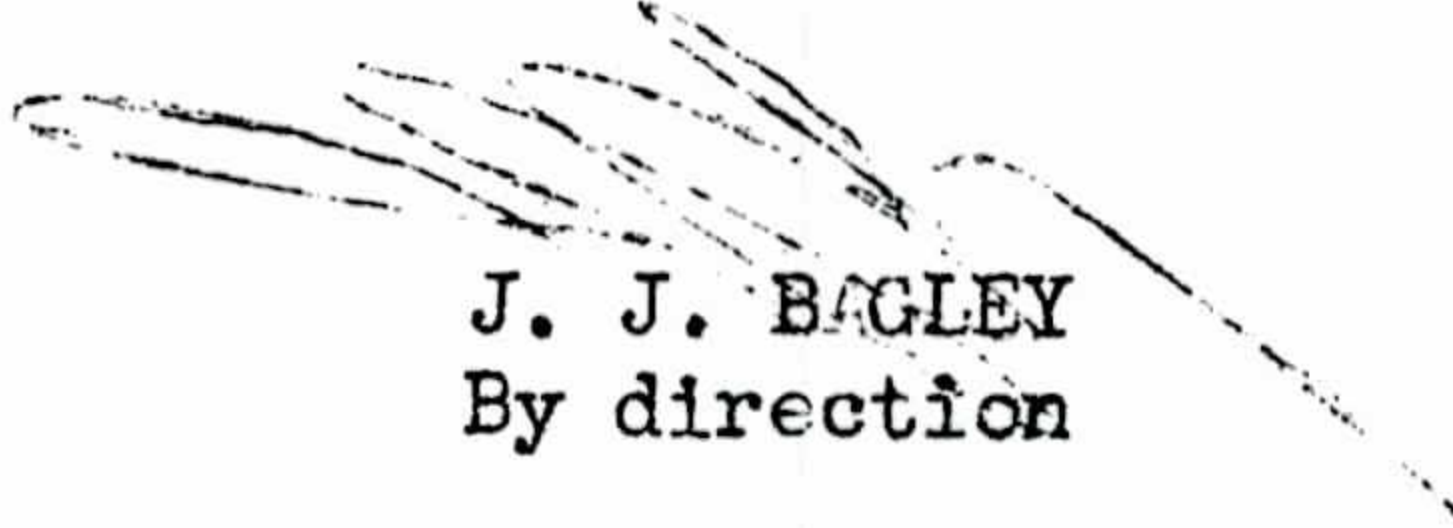
From: Director, Naval Research Laboratory
To : All Holders

Subj: NRL Report R-2844 "REDESIGN OF AN/GRT-1B EXPENDABLE RADIO
SONO-BUOY" dated May 1946.

Ref : (a) NRL Ltr. 1570-732/55 cta dtd 18 November 1955

1. The subject report has been downgraded from "CONFIDENTIAL" to "UNCLASSIFIED" by authority of reference (a).
2. It is requested that all file copies be marked in accordance with paragraph 0420 of the U. S. Navy Security Manual for classified matter.

S. M. TUCKER



J. J. BAGLEY
By direction



NAVAL RESEARCH LABORATORY REPORT

AN 5965063

REDESIGN OF AN/CRT-1B
EXPENDABLE RADIO SONO BUOY

5-431

By

F.J. Hollweck

- Report R-2844 -

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SHIP-SHORE RADIO DIVISION
RADIO COUNTERMEASURES SECTION

23 May 1946

AD B 965063

REDESIGN OF AN/CRT-1B
EXPENDABLE RADIO SONO BUOY

5-431

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- Report R-2844 -



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Approved by

E.A. Speakman - Head, Radio Countermeasures Section

Mr. L.A. Gebhard
Superintendent, Ship-
Shore Radio Division

Commodore, H.A. Schade, USN
Director, Naval Research
Laboratory

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Ship Problem S-1099R-C

ABSTRACT

This report describes the redesign of the Expendable Radio Sona Buoy AN/CRT-1B. Extensive use of these buoys in anti-submarine warfare suggested several improvements could be introduced, in particular a means of releasing the parachute when the buoy was waterborne and a battery power supply that would have improved storage characteristics. In general all elements of the design have been satisfactorily completed, including the metal top cap, parachute and dye bag assembly, flexible antenna hydrophone release, water activated battery and actuating device. Satisfactory improvement of transmitter frequency shift due to mechanical misalignment was attained by addition of shields at critical portions of the high frequency oscillator circuits. Drop tests of several units proved the basic design was sound, though failures were experienced due to some defects, in particular, faulty carbo-wax plugs.

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PLATE 2 - Top Deck Details. Cap Removed.

PLATE 3 - Top Cap Details. Exploded View.

PLATE 4 - Photograph of Water Activated Battery.

PLATE 5 - Photograph of Buoy. Lower End Details. Unarmed.

PLATE 6 - Photograph of Buoy. Lower End Details. Armed.

Distribution:

BuShips Code 938 (7)
5 for Code 940
2 for Code 945
USN NEL, San Diego, Calif. (1)
USN USL, New London, Conn. (1)

INTRODUCTION

1. Under an NDRC contract, development work on redesigning the AN/CRT-1B Expendable Radio Sono Buoy was initiated by Emerson Radio and Phonograph Corp. Upon contract termination, the partially completed project was transferred to NRL where development was continued under reference (1). The original work required only a method of releasing the parachute when the unit was waterborne. Operational use of the buoys had demonstrated that the parachute of the AN/CRT-1B buoys frequently fouled the antenna causing reduction of radiated power and, in even a mild wind, acted as a sail to cause the buoy to drift excessively from its original position. Reference (1) also includes a directive that the dry battery power supply be replaced by a water activated unit. Shelf life of the miniature high voltage dry batteries had proven to be severely restricted, undoubtedly contributing to operational failures and increasing the maintenance load. Additional work was required to improve the frequency shift characteristics of the transmitter with normal misalignment of the transmitter in the shielded, outer case.

DESCRIPTION

2. Certain mechanical features involved in this design are generally similar to those of the AN/CRT-4 Directional Radio Sono Buoy in that the parachute and dye bag are assembled in a separate container forming the cap of the buoy as shown in Plate 1. This top assembly is secured to the deck of the buoy at three places by shear wires passed through slotted pieces around the perimeter of the top casting as seen in Plate 2. The antenna is folded down the buoy and secured, at the tip, to a hinged latch attached to the hydrophone release bar. Also as a part of this bar is the device for piercing the thin copper seal over the end of the battery tube. The parachute static line terminates in a metal ring which is attached to a spring loaded metal rod passing through a forked arrangement on the buoy deck as shown in Plate 2. A light line, also best seen in Plate 2, is secured to the antenna just above the rubber boot and terminates at the free end in a pin which locks the parachute release rod in the armed position.

OPERATION

3. The sequence of operation as the buoy is launched is such that when the falling unit reaches the limit of the tie line secured to the airplane, the aluminum pins holding the cap to the buoy top are sheared and the buoy falls away from the top assembly. This draws, first, the dye slick from the top can and then the parachute, when the static line is fully extended. At the instant the buoy again stresses the tie line to the airplane, a key arrangement in the cap separates the tie line and parachute allowing the buoy and parachute to fall free and the top cap is released to fall away. The buoy then drops to the surface at a velocity controlled by the parachute. As the unit strikes the water surface, end on, the hydrophone release bar is displaced upward by the impact

simultaneously forcing the piercing pin through the battery seal and releasing the antenna, the bar then falls away permitting the hydrophone to drop out to the limit of the connecting cable. Releasing of the tip allows the antenna to spring to a vertical position. During this erection, the light line secured to the antenna, Plate 2, withdraws the pin from the antenna release bar, which being spring loaded is ejected, permitting release of the parachute static line ring and the parachute separates from the buoy.

BATTERY

4. The buoy transmitter is powered by a water activated battery pack, Type CS-180, as manufactured by Burgess Battery Co. under BuShips specifications, CS-180, a part of general battery specifications R17B17 (Int.). Performance tests of these batteries were reported in reference (2). The assembly, as shown in Plate 4, comprising high and low voltage sections, is enclosed in an evacuated metal container with a copper tube extending downward, when assembled in the buoy, and covered at the end by a thin (.007") copper foil seal. In operation the end seal is punctured as the buoy strikes and water, by pressure differential, is forced into the evacuated container. Upon saturation of the cell material the battery is activated and gas is generated as a product of the electrolytic action. As the gas pressure increases, excess water is gradually displaced from the battery. This clearing is essential, particularly in the high voltage section, to prevent dissipation of power through the relatively low resistance of the water. The only pre-flight preparation required is to arm the battery piercing device. This is normally maintained in an unarmed position as shown in Plate 5 to prevent accidental piercing of the battery seal in handling. Arming requires the simple operation of removing one screw, revolving the piercing mechanism counter-clockwise to the position shown in Plate 6 and replacing the screw. Some failures have been encountered in the battery units so far tested, several failing to activate probably due to leakage and loss of vacuum and some units have been found to have excessive solder on the end seals preventing easy piercing. Future service use of these units would demand considerably greater care in manufacturing procedure.

TRANSMITTER

5. The transmitter is generally similar to that used in the AN/CRT-1B with minor modifications. To improve the power output obtainable with the reduced plate voltage from the CS-180 water activated battery the screen dropping resistor in the final R.F. amplifier was removed increasing the screen grid potential to the total supply voltage. This raised the power output to approximately the same level as measured under standard conditions.

6. Under some conditions the unmodulated carrier center frequency shift was found to be prohibitive due to varying spacing between the R.F. circuits and the outside case shield. To alleviate this, fixed shields were added to the transmitter chassis in several critical places which reduced this shift to a permissible minimum.

7. The antenna in place of being a sectional telescoping unit as previously used, is a solid section of rod connected approximately 10 inches from the top deck to a flat spring material which is enclosed in a tapered rubber boot lined with cellular rubber. This arrangement allows the antenna to be bent and folded down along the buoy case in the armed condition. The rubber boot and liner afford added resilience, the liner also protecting the outer rubber boot from being pinched and cut by the antenna springs. The 'U' bend in the antenna rod just below the top deck was added to allow for mounting of a marker such as Type N6A195 water activated night marker as reported in reference (3).

TOP ASSEMBLY

8. The top cap assembly includes three separate parts: outer shell, inner can and the removable nose piece, all shown in Plate 3. The smaller inner can contains the parachute, packed randomly, in the upper half and the dye slick in the lower section, the tab of which is shown in Plate 3 with a small line to be secured to the buoy deck. The parachute and dye slick are held in position by fibre discs which snap into beads turned in the container. The top of this inner cap is sunken to allow space for the tie line which is concentrically wound therein, the end of which plays out to be secured to the airplane. This entire assembly is located in the upper half of the main outer shell. The lower portion of the outer shell is void to take the folded antenna. The removable "nosepiece" allows connecting of the parachute ring and the dye slick tab to the top deck upon assembly. This piece during operation also drops away first to prevent the antenna from binding and permitting easy separation of the cap and buoy. The top deck, as seen in Plate 2, is cast aluminum and is secured to the buoy case by four screws, sealing being accomplished by a rubber gasket. Plate 2 also shows the details of the shearing arrangement, the parachute release mechanism and the rubber protective plug over the water solvent carbo-wax insert. Failure of this carbo-wax plug during operational tests is attributable to shrinkage during cooling after the plug was poured. Investigation revealed that the metal top plate dissipated heat so rapidly during cooling of the wax as to cause excessive shrinkage. This plug will henceforth be poured into a light metal ring which can then be threaded into the buoy deck.

9. Though not included in this design, it was intended to provide a power input plug in the top deck for pre-flight check from a separate, external power supply. This plug, covered by a water tight cap, is required because the water activated battery is a 'one shot' unit and can not be activated for routine tests.

10. The paper tubes used on the AN/CRT-1B have presented certain manufacturing problems, particularly the sealing of exposed plies when holes were drilled. Even though treated, these exposed plies frequently caused failures by rapidly absorbing water and causing premature swelling and leakage. For these reasons a plywood tube was used in the present development. This tube, manufactured by the Plymold Corp. of Lawrence, Mass. has enormous strength as compared to the pressed paper variety and requires no extra consideration when sawed or drilled.

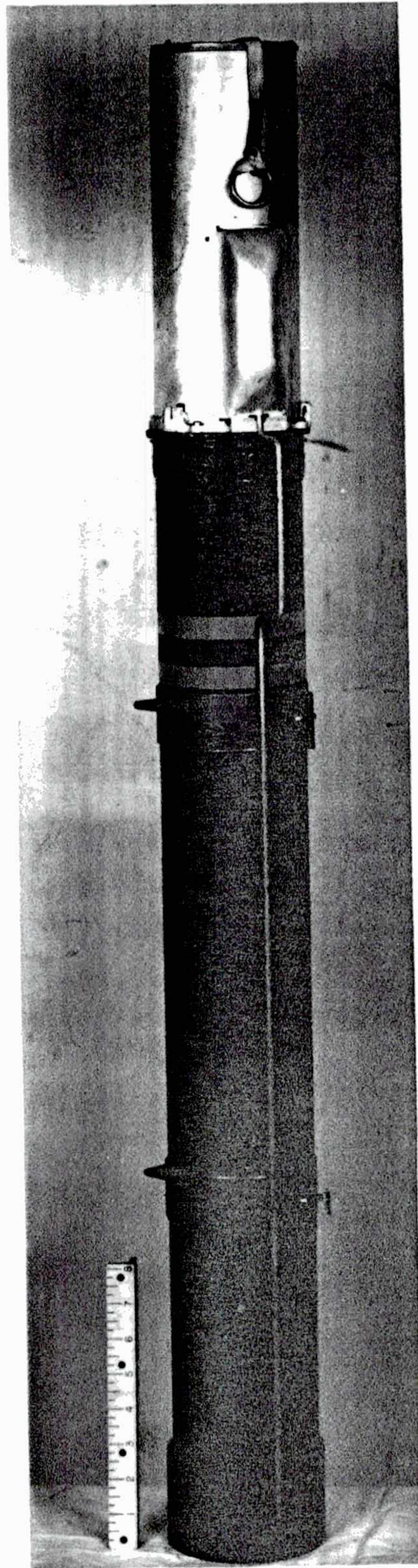
CONCLUSIONS

11. This development is considered to have the following improvements and features as compared with the AN/CRT-1B:

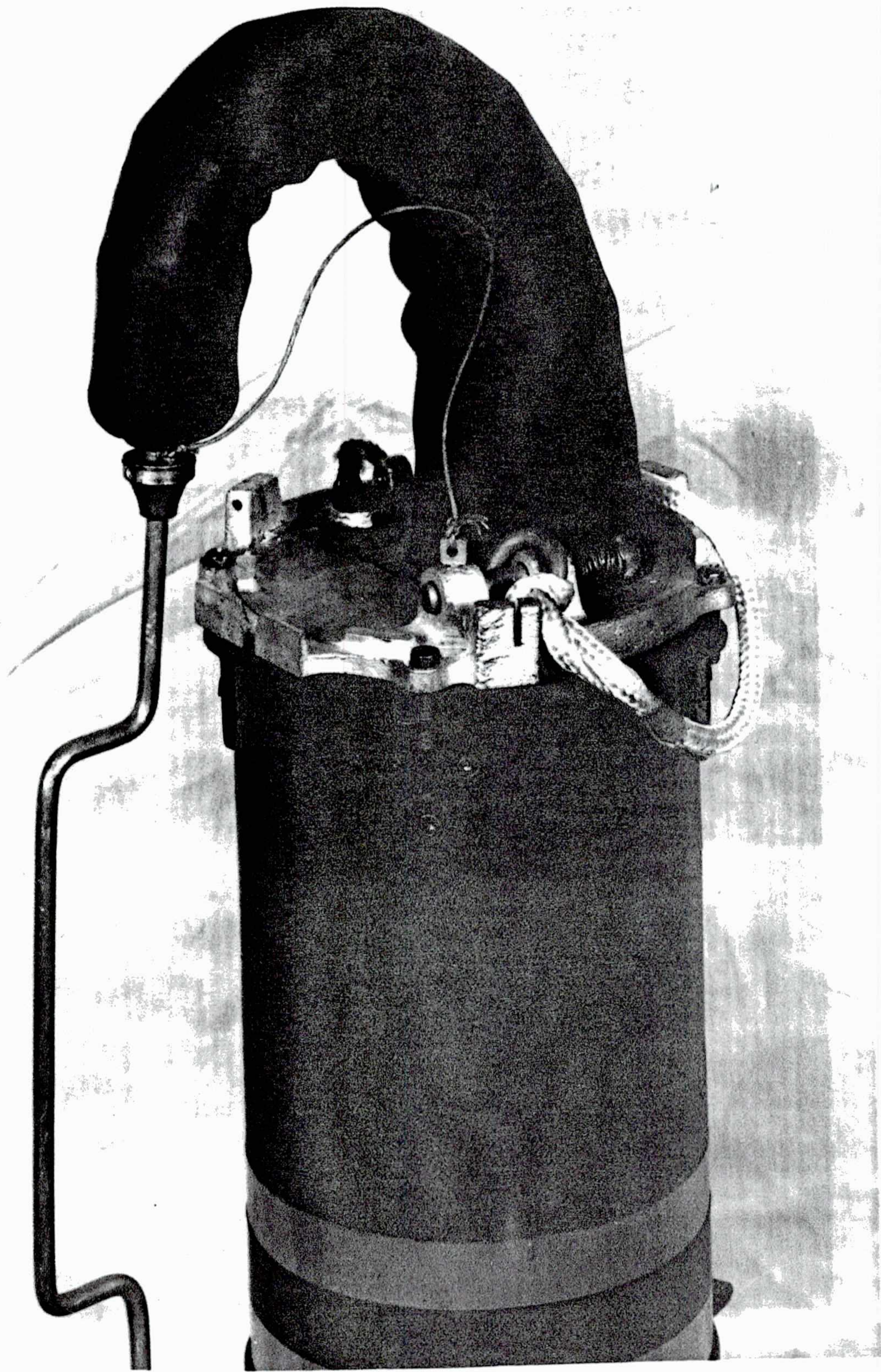
- (a) Release of parachute when the buoy is waterborne should alleviate certain unfavorable conditions found in previous design.
- (b) The water activated battery, having an indefinite shelf life, should solve an extremely serious problem existant from the use of dry cells with restricted storage life.
- (c) The folded, one piece antenna will completely eliminate all failures due to collapsing antennas, noisy contacts from telescoping joints and dangers of antennas binding or breaking at any time during the launching sequence.
- (d) The plywood tube will entirely remove all premature failures of buoys due to absorption of water as occurs in current units.
- (e) Deletion of power switch eliminates troubles due to corrosion in AN/CRT-1B switches as currently reported.
- (f) Entire unit can be assembled and sealed at factory for immediate service without disassembling to mount batteries.

References

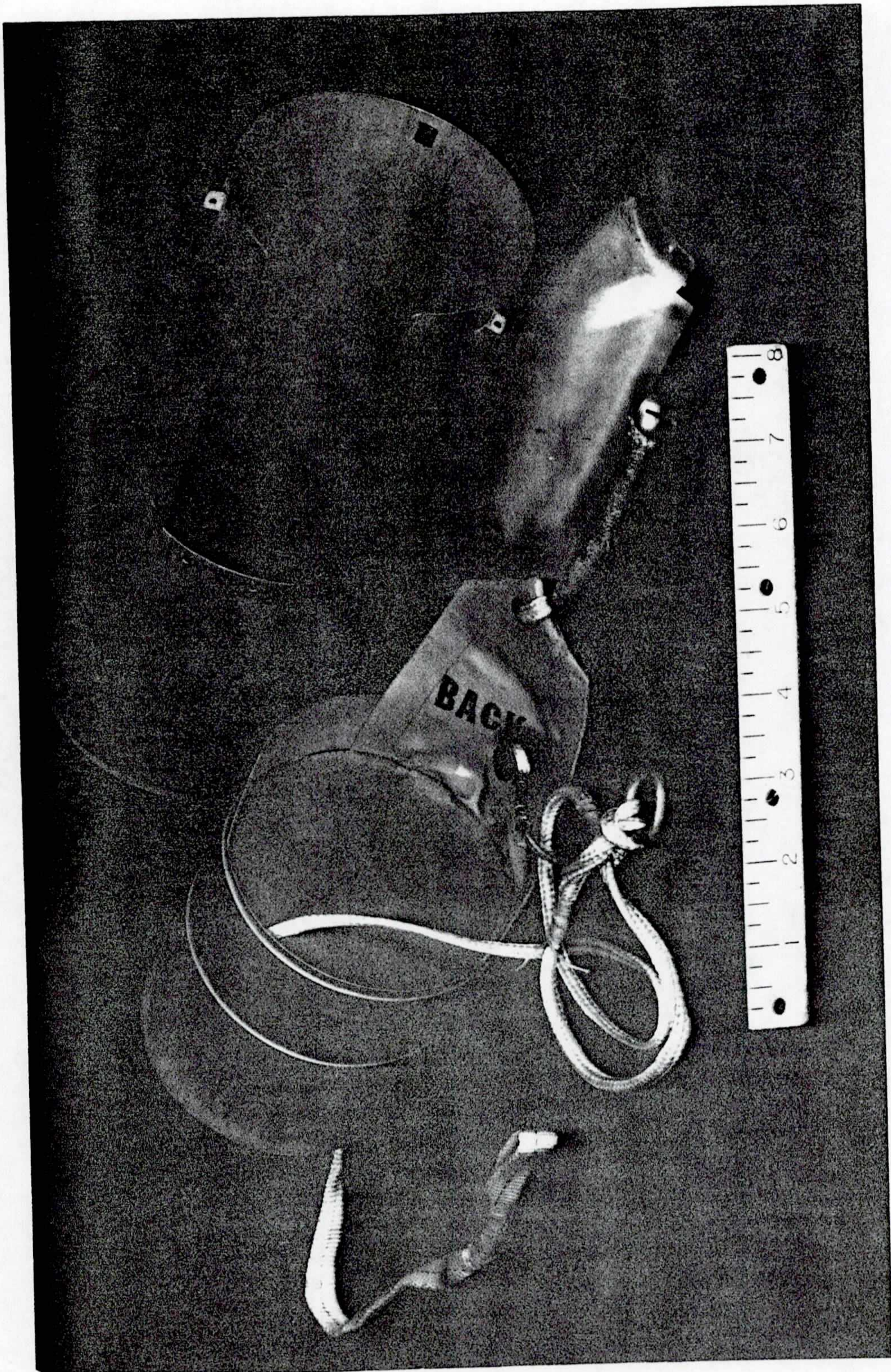
1. BuShips ltr. File No. 945-3140 of 6 April 1945 to Director NRL. (Secretary Radio Problem Priorities Board).
2. NRL ltr. to Chief of the Bureau of Ships. Serial R-360-102/45. File no. S68/94(368) of 30 June 1945. Test of Water Activated A-B Battery Pack, Type 4PC37-66MC14.
3. NRL ltr. to Chief of the Bureau of Ships. Serial C-360-136/45 of 26 July 1945. Method of Mounting N6A195 Water Activated Night Marker. Problem S1117R-C.



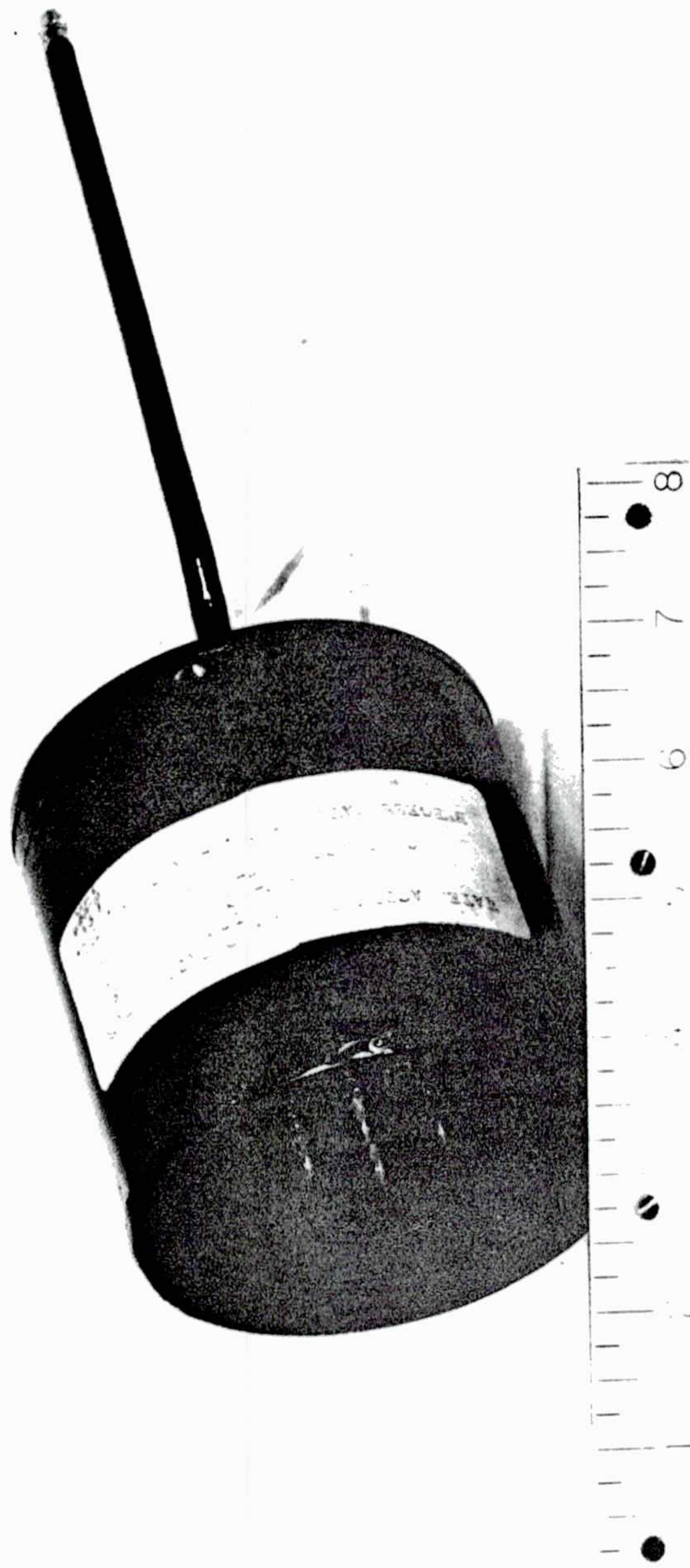
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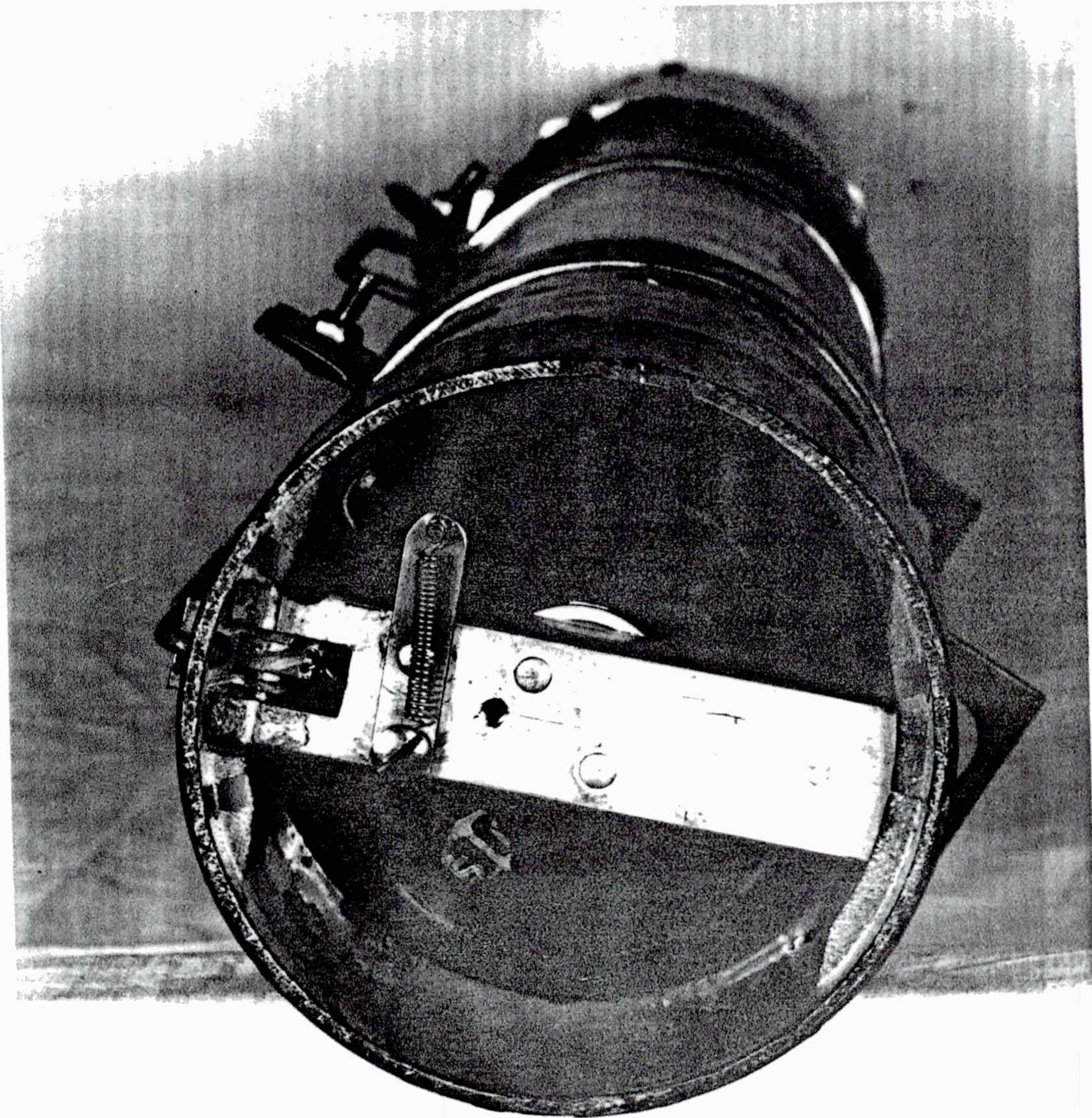
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TOP DECK DETAILS



REDESIGN - EXPENDABLE RADIO SONO BUOY
TOP CAP DETAILS

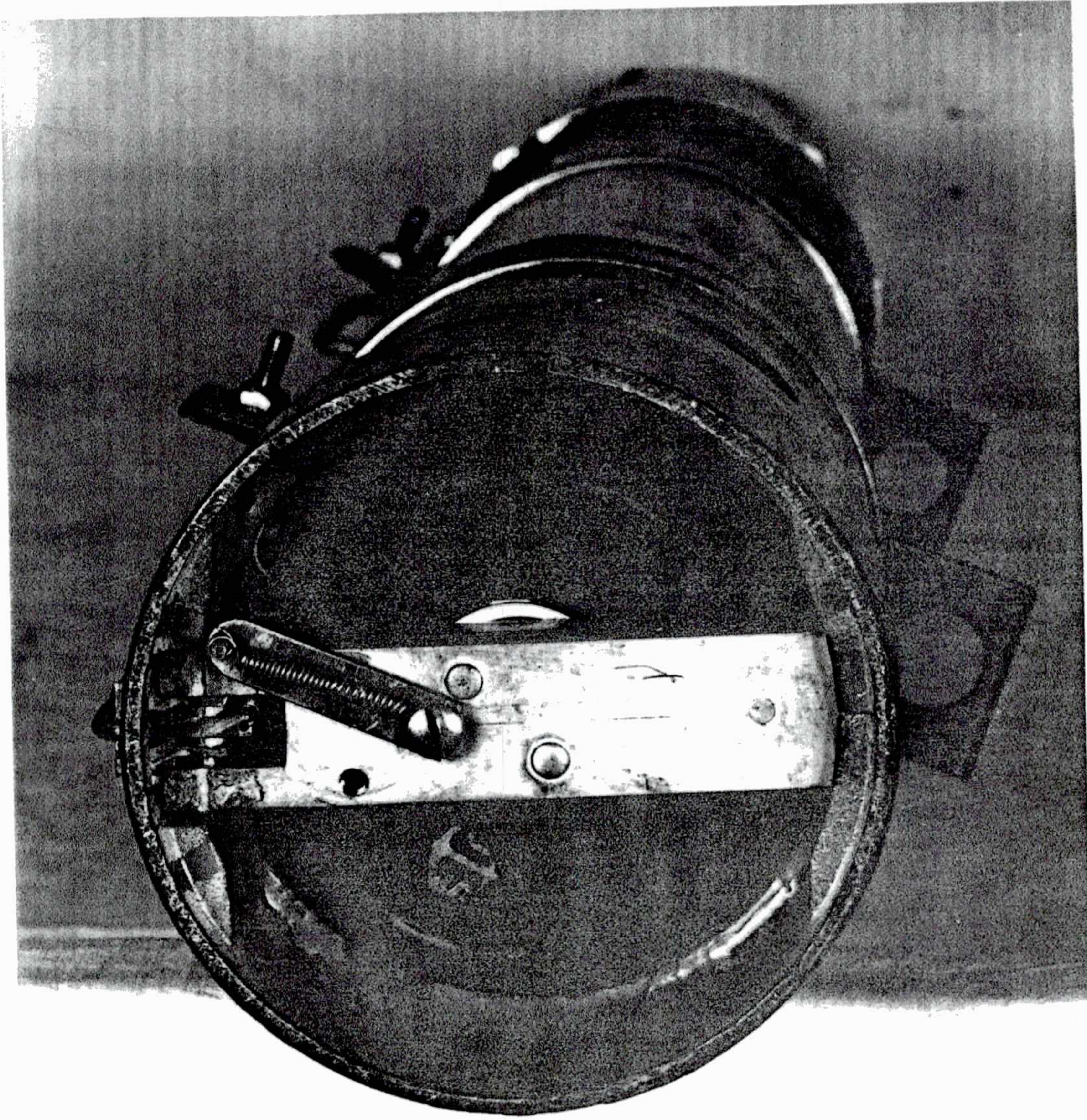


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WATER ACTIVATED BATTERY



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LOWER END DETAILS - UNARMED

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LOWER END DETAILS - ARMED

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JUL 19 1946

To: Chief of Bureau of Ships
Attn: Code 938

Subj: Redesign of AN/CRT-1B Expendable Radio
Sono Buoy. Report on Problem S-1099R-C,
by F. J. Hollweck, Forwarding of.

Encl: (HW)
(A) Seven (7) copies of subject report R-2844.

1. Enclosure (A) is forwarded herewith.

J. B. J. Glanzman
Lt. Comdr., USN
By direction of the Director
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NAVAL RESEARCH LABORATORY REPORT

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REDESIGN OF AN/CRT-1B
EXPENDABLE RADIO SONO BUOY

5-431

By

F.J. Hollweck

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SHIP-SHORE RADIO DIVISION
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23 May 1946

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REDESIGN OF AN/CRT-1B
EXPENDABLE RADIO SONO BUOY

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Director, Naval Research
Laboratory

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BuShips Problem S-1099R-C

ABSTRACT

This report describes the redesign of the Expendable Radio Sono Buoy AN/CRT-1B. Extensive use of these buoys in anti-submarine warfare suggested several improvements could be introduced, in particular a means of releasing the parachute when the buoy was waterborne and a battery power supply that would have improved storage characteristics. In general all elements of the design have been satisfactorily completed, including the metal top cap, parachute and dye bag assembly, flexible antenna hydrophone release, water activated battery and actuating device. Satisfactory improvement of transmitter frequency shift due to mechanical misalignment was attained by addition of shields at critical portions of the high frequency oscillator circuits. Drop tests of several units proved the basic design was sound, though failures were experienced due to some defects, in particular, faulty carbo-wax plugs.

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-b-

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3. The sequence of operation as the buoy is launched is such that when the falling unit reaches the limit of the tie line secured to the airplane, the aluminum pins holding the cap to the buoy top are sheared and the buoy falls away from the top assembly. This draws, first, the dye slick from the top can and then the parachute, when the static line is fully extended. At the instant the buoy again stresses the tie line to the airplane, a key arrangement in the cap separates the tie line and parachute allowing the buoy and parachute to fall free and the top cap is released to fall away. The buoy then drops to the surface at a velocity controlled by the parachute. As the unit strikes the water surface, end on, the hydrophone release bar is displaced upward by the impact

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TOP ASSEMBLY

8. The top cap assembly includes three separate parts: outer shell, inner can and the removable nose piece, all shown in Plate 3. The smaller inner can contains the parachute, packed randomly, in the upper half and the dye slick in the lower section, the tab of which is shown in Plate 3 with a small line to be secured to the buoy deck. The parachute and dye slick are held in position by fibre discs which snap into beads turned in the container. The top of this inner cap is sunken to allow space for the tie line which is concentrically wound therein, the end of which plays out to be secured to the airplane. This entire assembly is located in the upper half of the main outer shell. The lower portion of the outer shell is void to take the folded antenna. The removable "nosepiece" allows connecting of the parachute ring and the dye slick tab to the top deck upon assembly. This piece during operation also drops away first to prevent the antenna from binding and permitting easy separation of the cap and buoy. The top deck, as seen in Plate 2, is cast aluminum and is secured to the buoy case by four screws, sealing being accomplished by a rubber gasket. Plate 2 also shows the details of the shearing arrangement, the parachute release mechanism and the rubber protective plug over the water solvent carbo-wax insert. Failure of this carbo-wax plug during operational tests is attributable to shrinkage during cooling after the plug was poured. Investigation revealed that the metal top plate dissipated heat so rapidly during cooling of the wax as to cause excessive shrinkage. This plug will henceforth be poured into a light metal ring which can then be threaded into the buoy deck.

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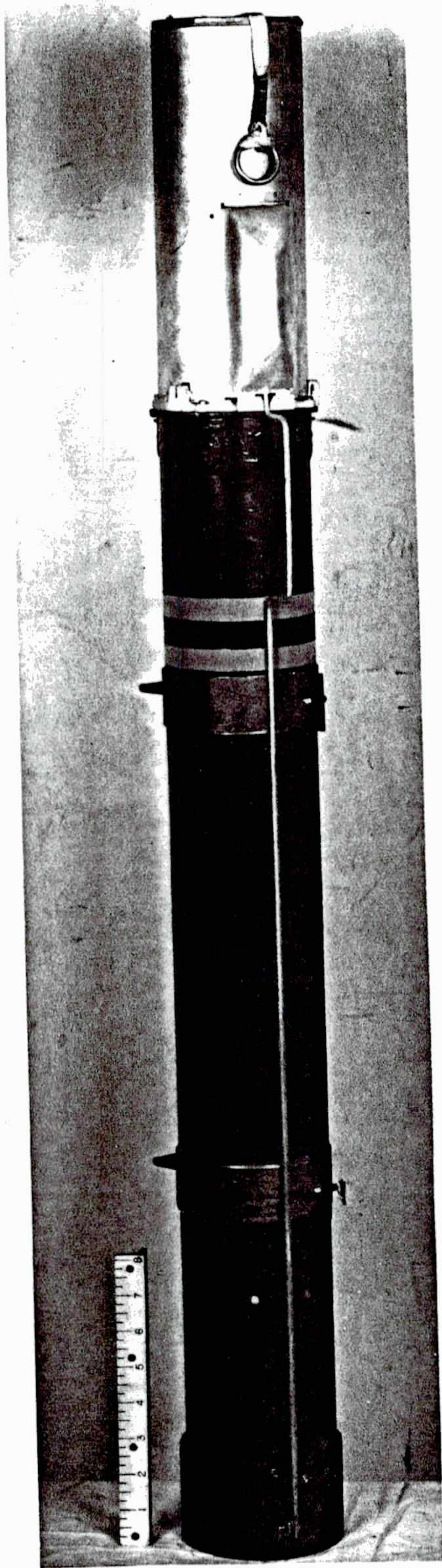
CONCLUSIONS

11. This development is considered to have the following improvements and features as compared with the AN/CRT-1B:

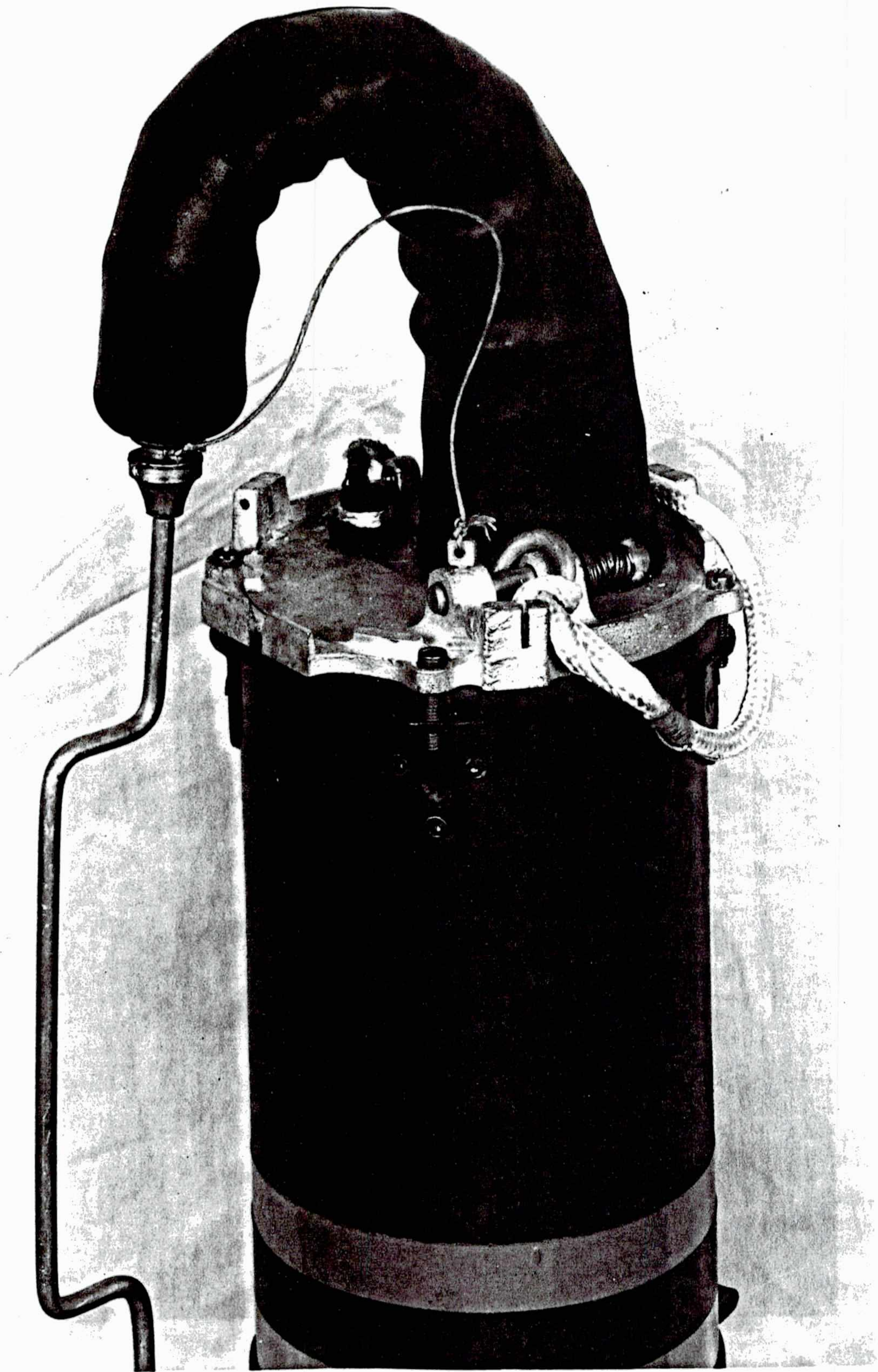
- (a) Release of parachute when the buoy is waterborne should alleviate certain unfavorable conditions found in previous design.
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- (e) Deletion of power switch eliminates troubles due to corrosion in AN/CRT-1B switches as currently reported.
- (f) Entire unit can be assembled and sealed at factory for immediate service without disassembling to mount batteries.

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REDESIGN - EXPENDABLE RADIO SONO BUOY
FULLY ASSEMBLED



REDESIGN - EXPENDABLE RADIO SONO BUOY
TOP DECK DETAILS

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PLATE 2



REDESIGN - EXPENDABLE RADIO SONO BUOY
TOP CAP DETAILS

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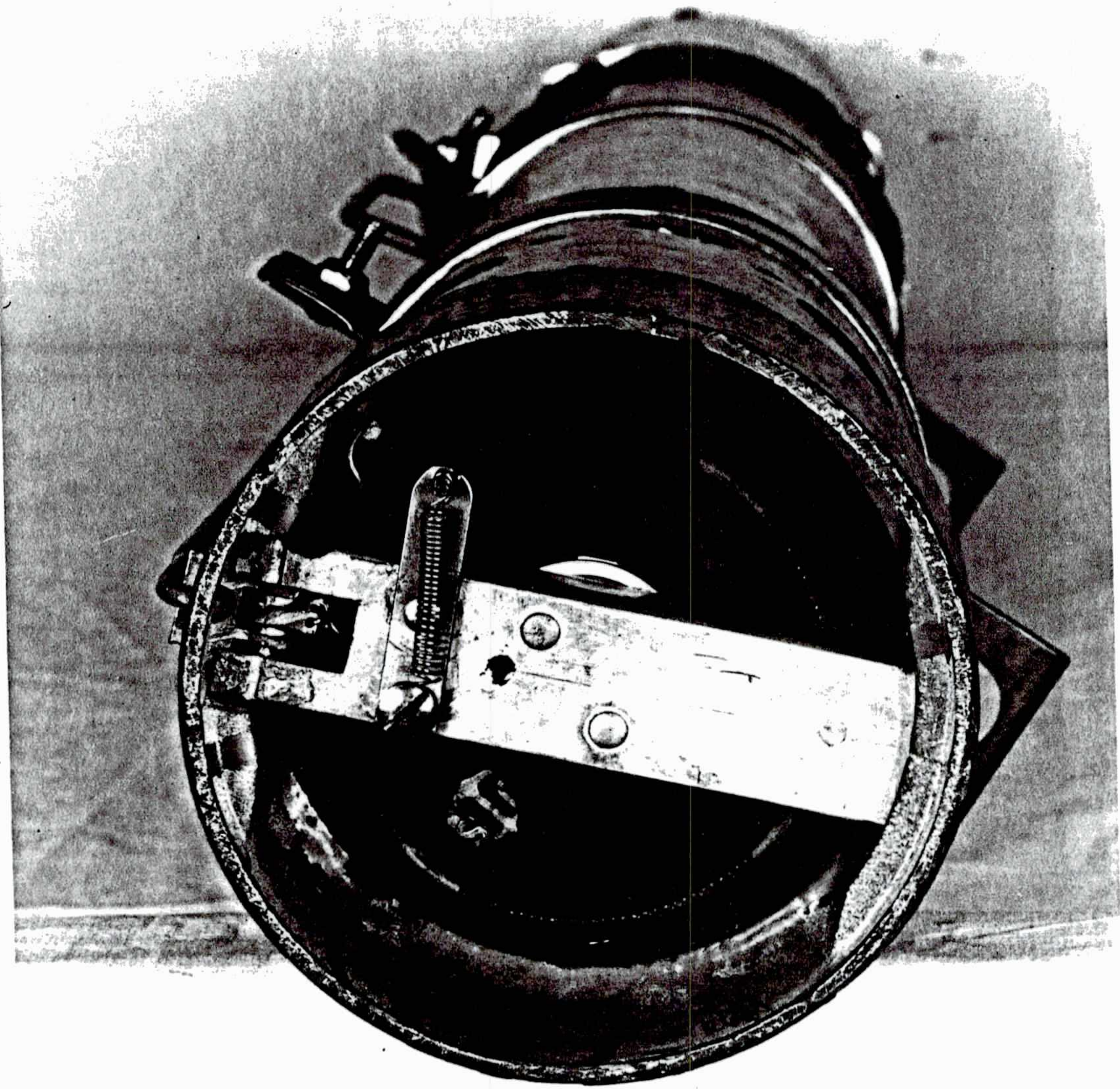
PLATE 3



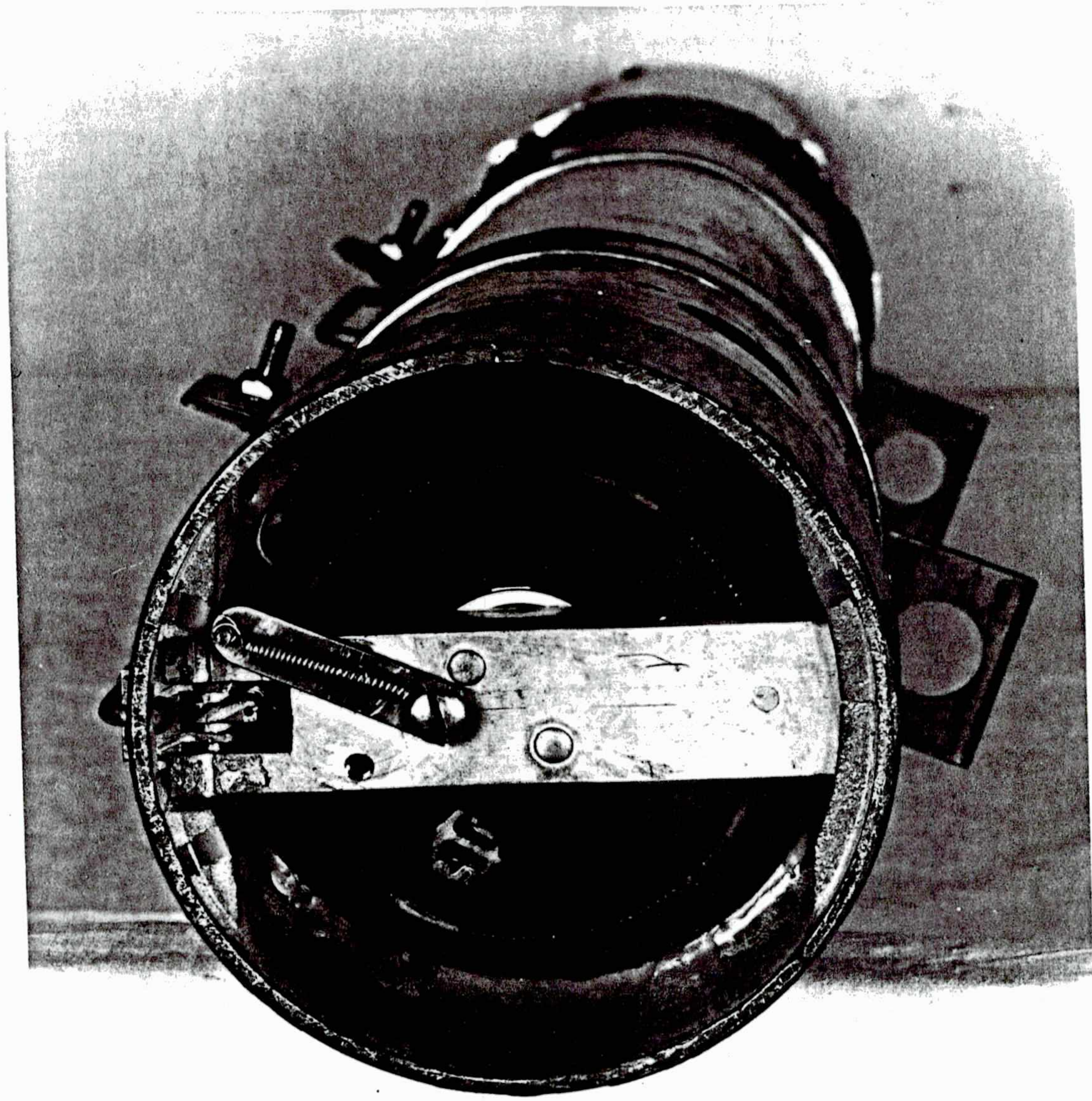
REDESIGN - EXPENDABLE RADIO SONO BUOY
WATER ACTIVATED BATTERY

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PLATE 4



REDESIGN - EXPENDABLE RADIO SONO BUOY
LOWER END DETAILS - UNARMED



REDESIGN - EXPENDABLE RADIO BUOY
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C-568/94(1243C)
C-1240-196/46

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JUL 1 9 1946

To: Chief of Bureau of Ships
Attn: Code 938

Subj: Redesign of AN/CRT-1B Expendable Radio
Sono Buoy. Report on Problem S-1099R-C,
by F. J. Hollweck, Forwarding of.

Encl: (HW)
(A) Seven (7) copies of subject report R-2844.

1. Enclosure (A) is forwarded herewith.

J. B. J. Glanzman
Lt. Comdr., USN
By direction of the Director
Naval Research Laboratory

Distribution

BuShips, Code 938 (7)
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BuAer, CO-AN 16-30CRT1-2-M,
 HANDBOOK OF MAINTENANCE
 INSTRUCTIONS FOR RADIO
 TRANSMITTING EQUIPMENT
 AN/CRT-1B, $\frac{1}{4}$ in. thick,
 April 15, 1945.
 UNCLASSIFIED

HB-190
 Radio
 transmitters-
 Handbooks.
 I. AN/CRT-1B.

551-3119

Peggy
 Brew &
 Ball

BuAer, AN 16-30 CRT 3-2,
 HANDBOOK OF MAINTENANCE
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 AN/CRT-3,
 $\frac{1}{2}$ in. thick, April 11, 1945.
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HB-974
 Radio-
 Instruction
 manuals.
 I. AN/CRT-3.

967-LP - 190
 - 5020

~~NS 98393~~

0967-LP - 190 - 5010

993-

USAF, Aircraft Radio Lab.,
 ARL Memo. Rept. L40,
 RADIO TRANSMITTING EQUIPMENT
 AN/CRT-1 (CA-1), 5 pp., 1943.
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NRL X84331
 Radio
 transmitters.
 I. AN/CRT-1
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RADIO & M/F equip
AN/CRT-1B

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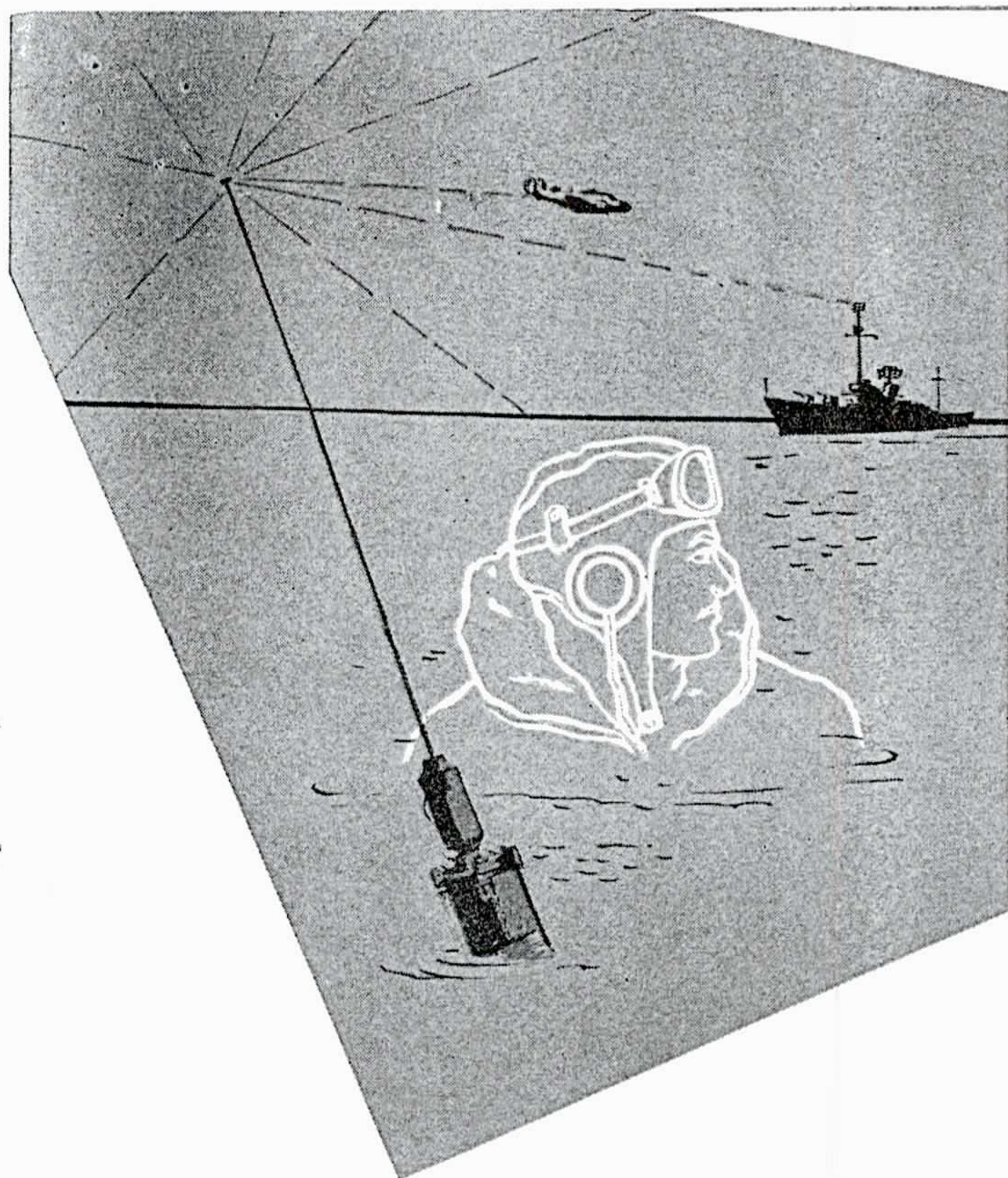
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501-5671 ✓



Radio Sonobuoy

in the same approximate direction and rate as the survivors in the water.

The radio sonobuoy weighs but 13 pounds, is 4¾ inches in diameter, 45 inches in length, and its antenna extends to approximately 40 inches. While its operating life, using the normal primary dry cell battery, is 6 hours, it is believed that expected improvements in battery design will considerably lengthen the operating life.

There are two methods in use for homing on, or locating, the radio sonobuoy. (1) Surface vessels upon which sonar equipment is installed, may use either the radio and sonar echo ranging, or the radio direction finder method and, (2) Aircraft may use either the intensity, or the radio direction finder method.

Surface vessels carrying sonar equipment, and using the radio and sonar echo ranging method, will require the installation of a vertical dipole antenna on the mainmast, and a frequency-modulated receiver near the sonar stack. The output of the frequency-modulated receiver is then fed into the sonar stack. In operation, the ping from the sonar equipment is transmitted under water where it is received in the hydrophone of the radio sonobuoy which then transmits the ping back by radio, where it is received by the dipole antenna. It is then conveyed by coaxial cable to the frequency-modulated receiver, then fed back to the sonar equipment.

The range reading on the sonar equipment must be multiplied by two, because the signal travels only one way by sound—the other way by radio. Special training of sonar operators is not required, because search procedure is normal. The operating range is approximately 12,000 yards.

When aircraft or surface vessels use the radio direction finder method, an antenna must first be calibrated. This may be done easily, quickly, and without the aid of special instruments. The radio direction finder method utilizes the antenna lobes, because it has been found practically impossible to install an antenna below the top of the mast in the 70 megacycle frequency range so that it will not have a useful lobe pattern for radio direction finder purposes.

The antenna system for the sonobuoy receiver used in these installations may be rotated in azimuth by swinging ship or, in the case of an aircraft, by using a standard 2-minute turn. In addition to its proved practicability, this method does not require any new equipment.

THE radio sonobuoy (AN/CRT-1B) is a self-contained, miniature broadcasting station which, by means of a torsionally wound hydrophone, picks up sound in the water. Using an FM transmitter for high fidelity performance, it transmits these underwater sounds to a receiver installed in an aircraft or surface vessel. The radio sonobuoy is also capable of picking up and transmitting supersonic frequencies.

It is a frequency-modulated transmitter that may be carried in an aircraft and dropped in the water, when ditching, for use of the plane's own crew; or it may be carried by a search aircraft and dropped to survivors in the water.

The radio sonobuoy offers many interesting and valuable potentials of service in the field of search and rescue, not the least of which is speed in locating survivors of an emergency. Used in conjunction with the proper type of search radio receiver, it enables search aircraft or surface vessels to home on, and locate, survivors. It also provides survivors with facilities for voice transmission to the rescue group, thus making it possible for them to make known their needs, and to guide the rescue group to a rendezvous. The buoy can be retained in the vicinity of the survivors by means of a light line or, if this is impractical—the buoy being nine-tenths submerged—will drift

For radio direction finder operations, the antenna is calibrated simply by plotting voltages developed in the radio receiver by the radio signal, as a function of the different relative bearings of the sonobuoy. This plot represents a picture of the antenna lobe pattern. The calibration curve may also be used to estimate the range of reception of the radio sonobuoy when on different relative bearings. The lobe pattern is a plot of the relative signal strength versus the relative bearing of a sonobuoy from a ship. It will be noted that the pattern is roughly symmetrical, with the two major lobes of maximum sensitivity located on a bearing just forward of either beam. The lobe pattern is also simple, and free of disturbing minor lobes, yet it is shaped so that good bearing accuracy may be obtained in radio direction finder operations.

Calibration must be done at sea, just after radio and antenna installations have been completed. The results of the antenna lobe patterns are averaged for each bearing, and plotted on either polar coordinate paper, or on a standard maneuvering board.

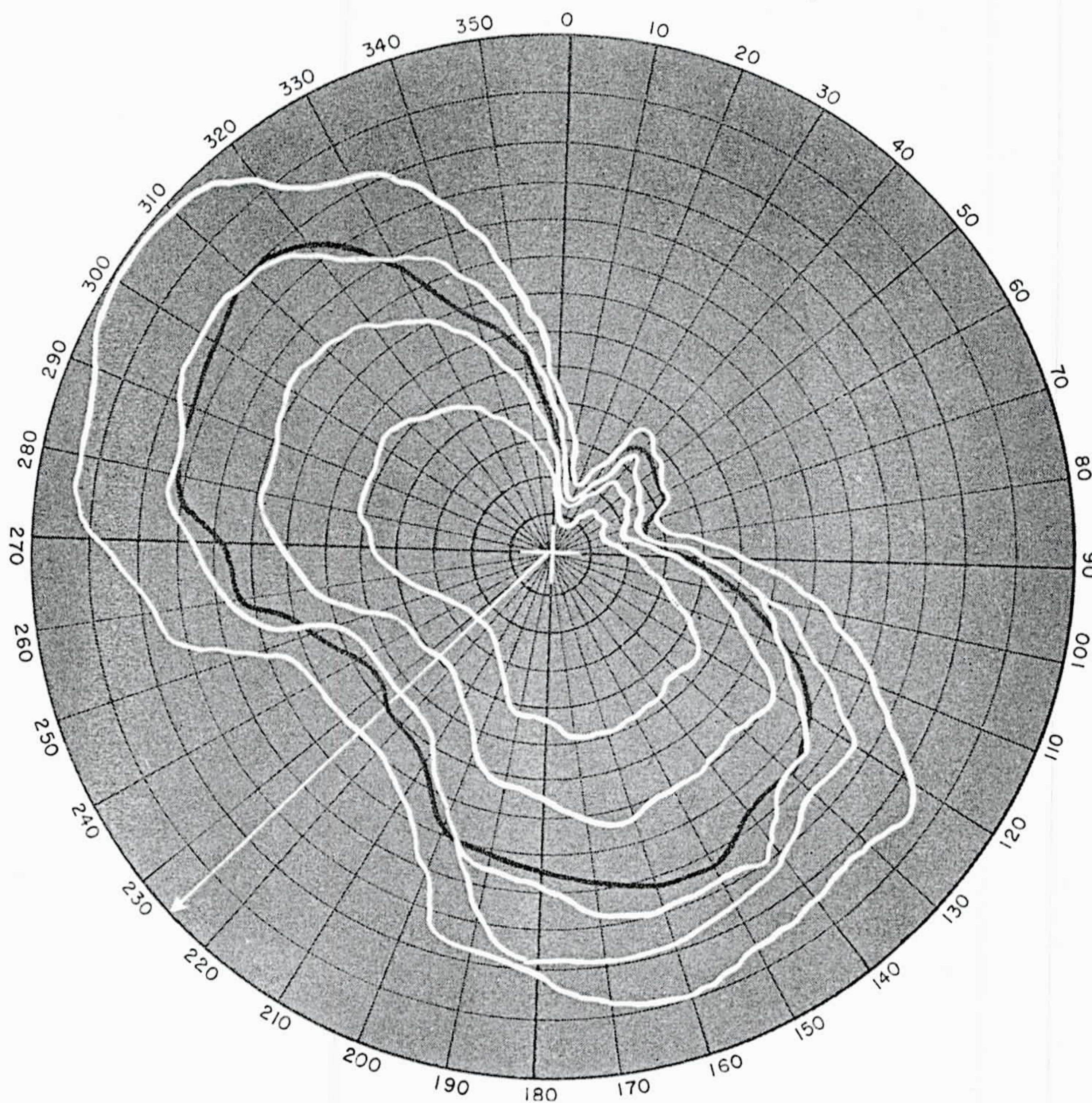
Where a surface vessel is involved, the procedure

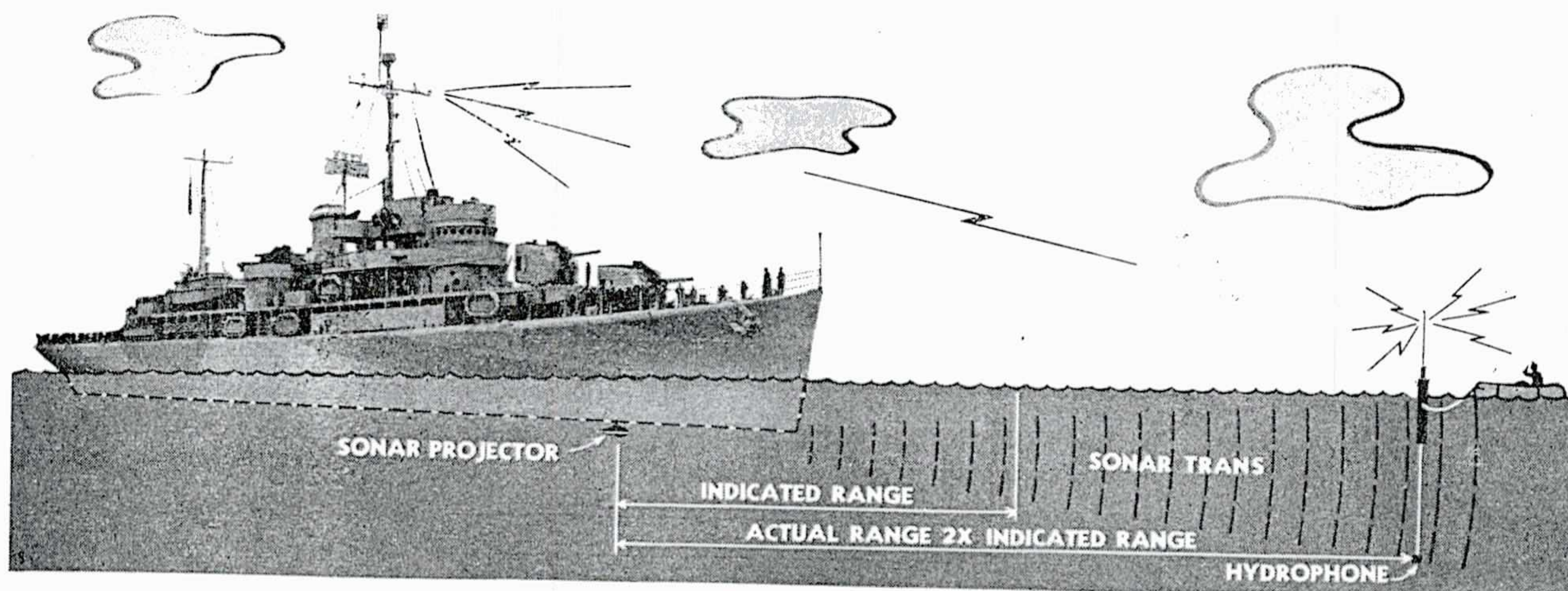
for calibrating would be first, to place a radio sonobuoy at some known bearing from the vessel's position. Then the vessel should commence to circle, making the turns as tight and as small as practicable. Small circles are necessary in order to avoid errors in parallax.

Three persons will be required to handle the calibration operation—the first to call out the vessel's heading every 10° as it swings; the second, to call out the relative signal strength immediately after the vessel's heading is reported; the third, to act as recorder and tabulate the results.

Results are tabulated for four complete 360° turns. These are then averaged out and plotted on the polar coordinate paper or standard maneuvering board. After plotting the field patterns of the antenna lobes, an arrow is drawn in the direction of the radio sonobuoy. This same procedure is followed when the system is used by aircraft.

For use in radio direction finder operations, a transparent overlay must be constructed of the antenna lobe pattern, as plotted from the meter readings ob-





tained in the calibration. In radio direction finder operations this overlay, marked with a suitable index point, is matched with a lobe pattern made by plotting signal strength readings as a function of the true bearing of the vessel's head, and the true bearing of the radio sonobuoy read opposite the index point.

Radio direction finding on an unknown bearing of a radio sonobuoy consists of plotting the sonobuoy's signal strength as a function of the vessel's head, matching the antenna lobe pattern obtained in calibration with the resulting plot, then reading the true bearing of the radio sonobuoy opposite the index point. The operation, which is essentially the same as that used for antenna calibration, is as follows:

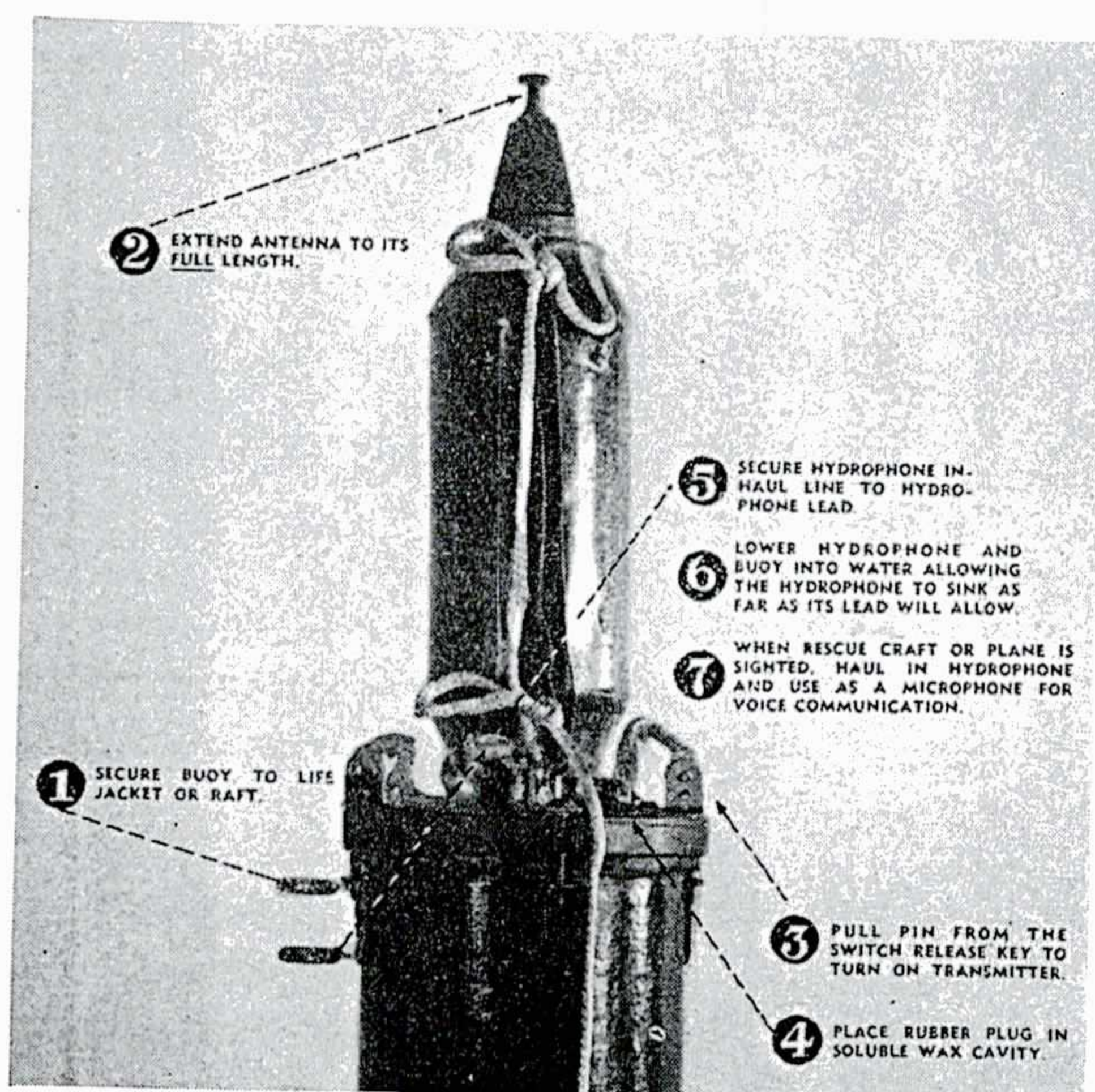
The vessel should be swung through 360° , and the meter readings plotted during the swings. Then match the plotted pattern with the transparent overlay, and read the radio sonobuoy true bearing opposite the index point. The meter readings are proportional to the relative strength of the received radio sonobuoy signal, and are plotted each 10° as the vessel swings. They are plotted on a standard maneuvering board as a function of the true bearing of the vessel's head as she swings through 360° .

The plotted meter readings obtained as the vessel swings represent an antenna lobe pattern with the transmitting radio sonobuoy on an unknown bearing. This bearing pattern is matched to the calibrated antenna lobe pattern inscribed on the transparent overlay. The matching is accomplished by placing the transparent overlay over the maneuvering board, and rotating it about the center, or zero range, point.

The calibrated antenna lobe pattern on the transparent overlay has an index arrow. When the two patterns are matched, the index points to the true bearing of the radio sonobuoy. Read the bearing on

the same bearing circle as that used for the bearing of the vessel's head.

While continued training is necessary to produce a smoothly operating rescue team, no particular training is required for placing the radio sonobuoy in operation. It should be pointed out, however, that survivors should be instructed not to speak into the hydrophone while search parties are radio direction finding, because this causes the intensity of the signal to change and vary the results obtained in plotting the antenna lobes. After the bearing has been determined by the search group, and they have come within the range of vision of the survivors, then the survivors should use the hydrophone for communicating with the rescue group to effect rendezvous by giving instructions for enabling the aircraft to pass over the survivors.



TO :
FROM : NAWCADWAR CODE 8131

PHONE NO. : 917036932059

JUL. 22. 1994 2:15PM P 1
PHONE NO. : 2154411869

July 22, 1994

Dear Lt. McAndrew:

Enclosed is a drawing of the radio sonobuoy you requested. I found this drawing in the reference book "Listening Systems", published in Washington, D.C. in 1946 by the Office of Scientific Research and Development . The drawing is Page 2 of this fax.

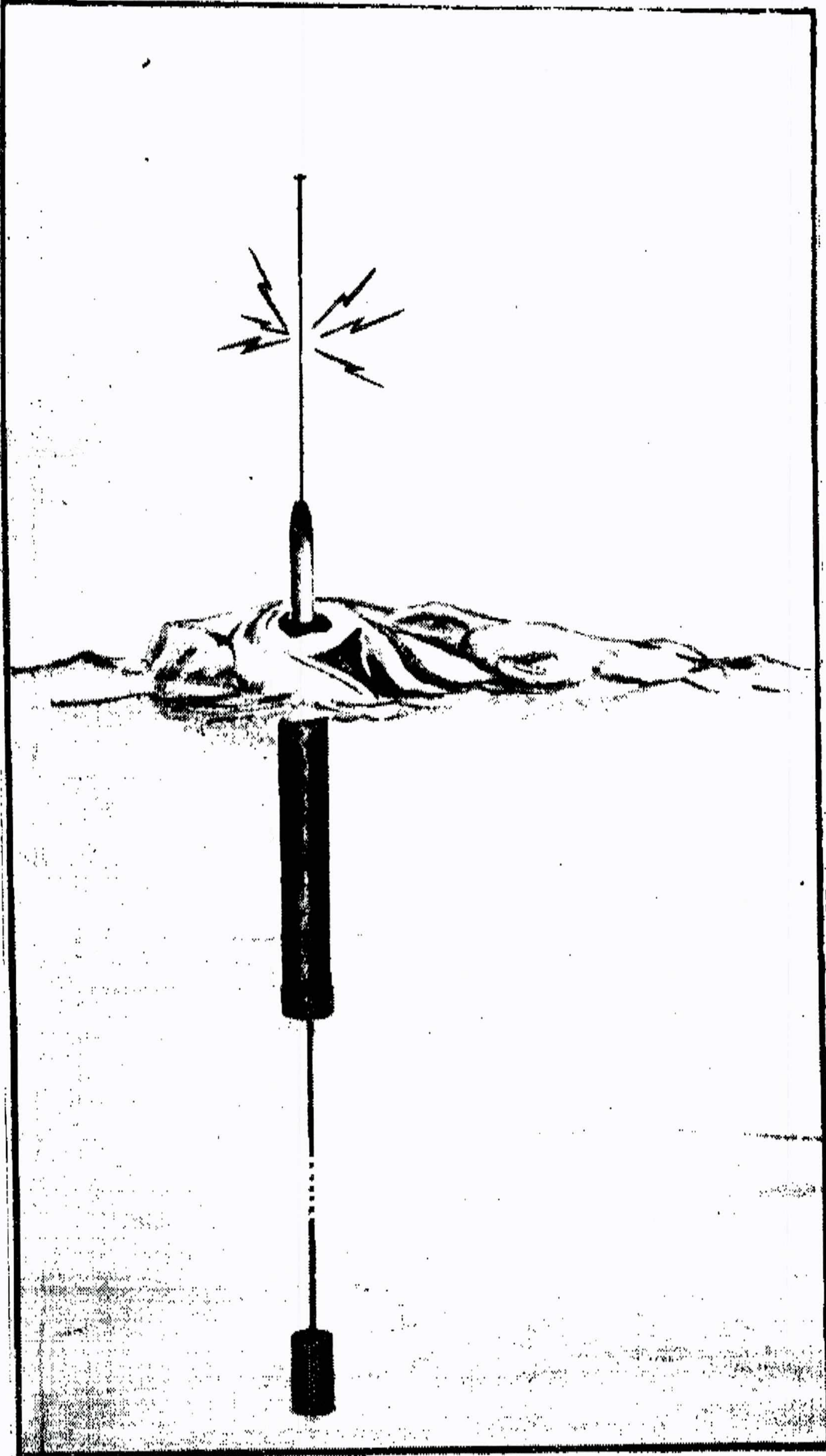
If this is not what you want and this technical library can be of more assistance to you please contact us again.

Regards,

Patricia A. Miller

Page 1 of 3

115 0400



Expen

The U.S. Navy type 100 sonobuoy, designed by means of a radio receiver and used by submarines by radio direction finding. The sonobuoy consists of a transmitter and receiver. The transmitter, along with the receiver, is incorporated in a single unit weighing about 30 pounds. The transmitter and receiver are housed in a compartment head from which the mechanical transmitter and receiver are connected. The transmitter and receiver are about 30 feet apart. The transmitter has a life of 2 years which is the same as the buoy. The receiver pattern is used for location by the submarine. The buoy is carried by the submarine and has 12 channels of frequency of 100 to 1000 kHz.

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FIGURE 1. The expendable radio sonobuoy [ERSB].

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MAY 25, 1945

VOL. 4, NO. 10

CLASSIFICATION NOTICE

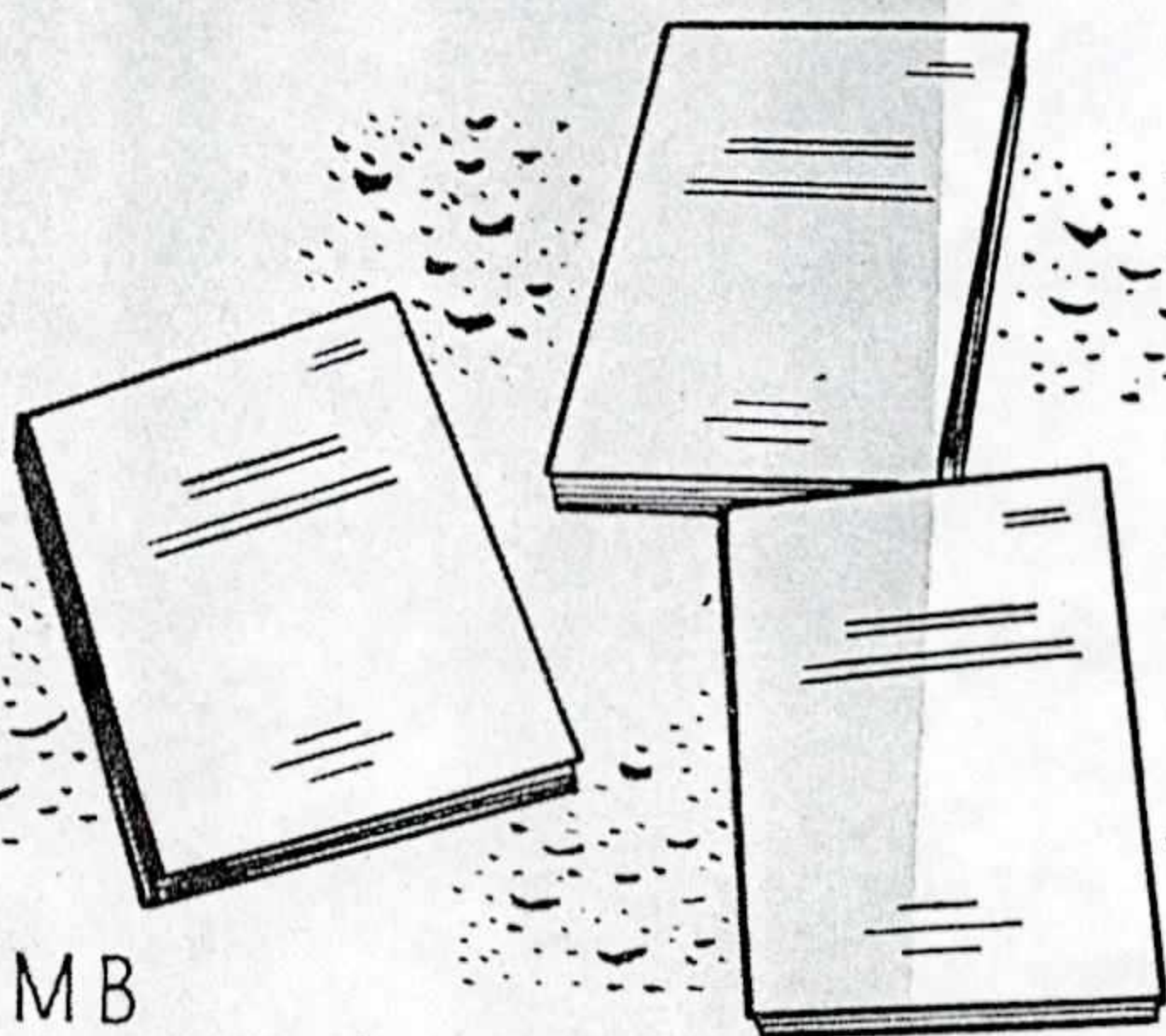
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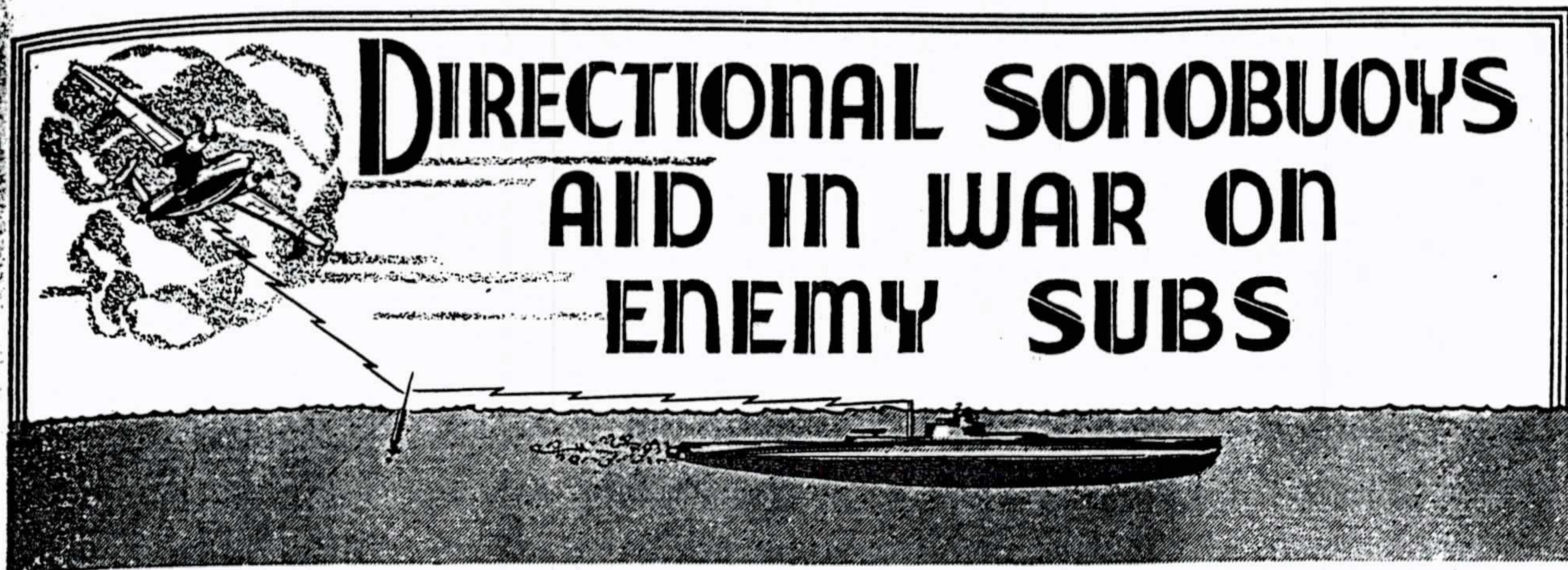


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HOW TO ORDER ACG PUBLICATIONS

The Technical Information Unit of the Airborne Coordinating Group publishes the following technical books (contents approved by BuAer Engineering Division) at the direction of the Bureau of Aeronautics, Navy Department. The Airborne Radar Maintenance Bulletin, CO-NAVAER-08-1-511; The Airborne Radio Maintenance Notes, CO-NAVAER-08-1-505; The Airborne Electrical Maintenance Notes, NAV-AER-08-1-507 (all monthly supplements); Binders for each (use same NAVAER numbers with an "a" after the number); and the DIGEST of Airborne Radio and Radar News, CO-NAVAER-08-1-503, (semimonthly). These should be ordered by NavAer number from the BuAer Publications Branch, Navy Department, Washington 25, D. C., using NavAer Form 140 found in the back of "NavAer Publications Index (NavAer 00-500)."

AIRBORNE COORDINATING GROUP



AN/CRT-4 PASSES TESTS, GOES INTO MASS PRODUCTION

HUNTING enemy submarines with radio sonobuoys, a method which has paid dividends in the past year, will be made easier and more effective by a new directional sonobuoy which not only tells a searching aircraft that an underwater craft is near but also points out its direction from the buoy. The directional sonobuoys, designated AN/CRT-4, have successfully passed tactical tests completed recently by ASDevLant and will go into production as soon as necessary materials are available, probably in May. The schedule calls for 200 the first month, with production gradually building up to 2,000 per month by the fifth month.

Like the older, nondirectional AN/CRT-1, -1A, and -1B models, the new sonobuoy is a miniature automatic radio broadcasting station placed underwater to pick up underwater sounds and transmit them to an aircraft or surface craft receiver. In effect, it permits a pilot to hold his ear to the ocean and listen to any submarines lurking beneath.

Indicator Needle Points Out Sub

When nondirectional sonobuoys are used, a pilot who suspects a submarine is near, lays a pattern of several miniature transmitters, each of which broadcasts on a different frequency. He can then listen to the different buoys in turn and, if a submarine is near, will hear submarine noises, or swishing hisses. His only means of knowing the direction of the submarine is to estimate where, within the pattern, the sound is loudest. When the new directional sonobuoy is used, the pilot will not only hear the hiss but will also see an indicator needle point out the magnetic bearing in degrees of the submarine from each buoy.

Plane Can Follow Sub

Sound equipment, sonic, and supersonic is also used to detect submarines from surface craft, but a listening post high in the sky permits more surprise in an attack. By the time a ship is close enough to detect a submarine by sound, the sub can also detect the ship and take immediate evasive or offensive action. When an aircraft receives

sonobuoy signals, however, it can follow the course of a submerged submarine without revealing its own presence. The plane can then bomb the submarine while it is submerged or can track the submarine until surface craft arrive on the scene. If a submarine uses Schnorkel—the device which permits it to recharge batteries with its Diesel Motors without surfacing—sonobuoys will transmit the Diesel sound more clearly than the sound of the electric motors used while underwater. Once the sub-

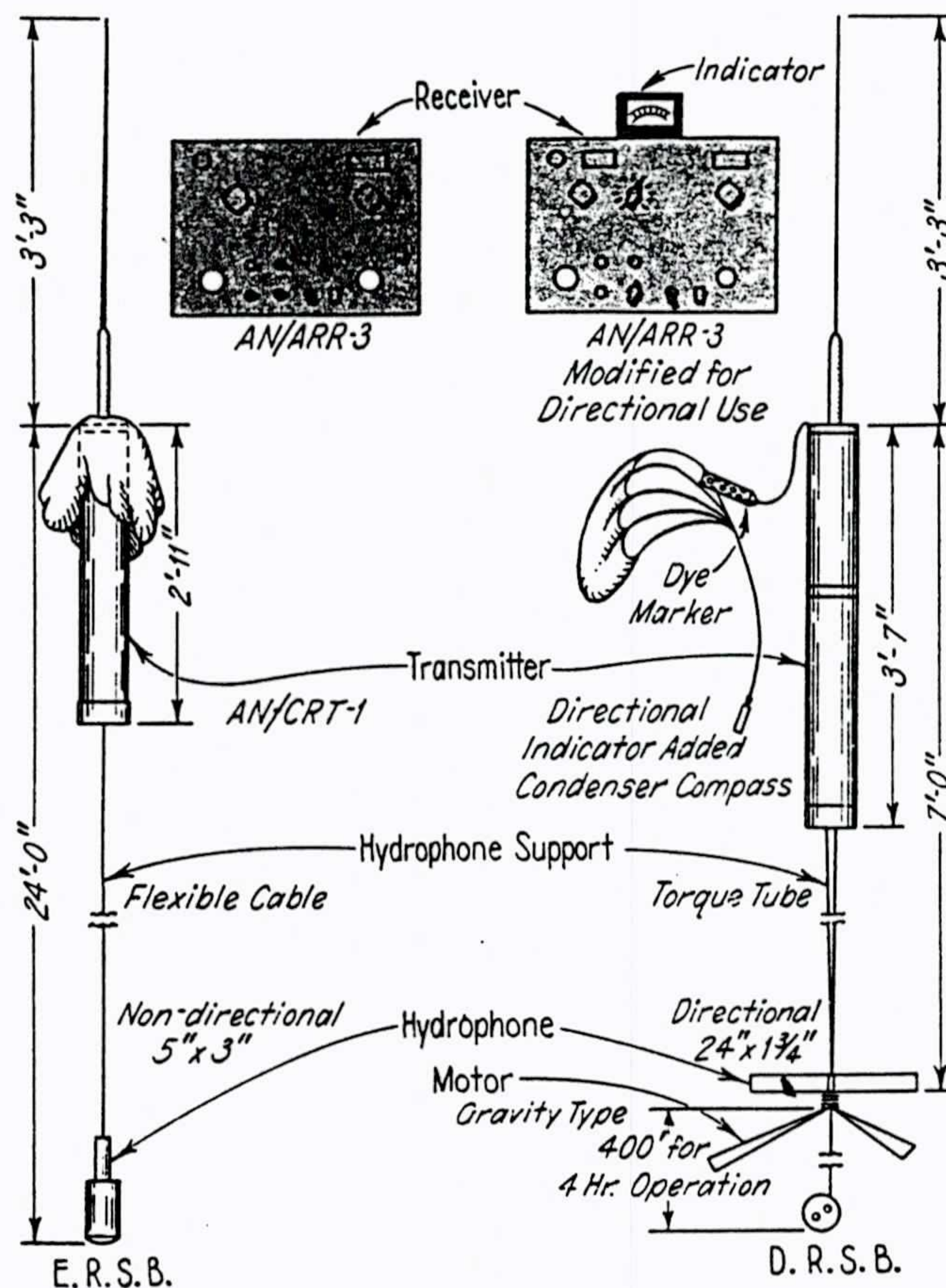
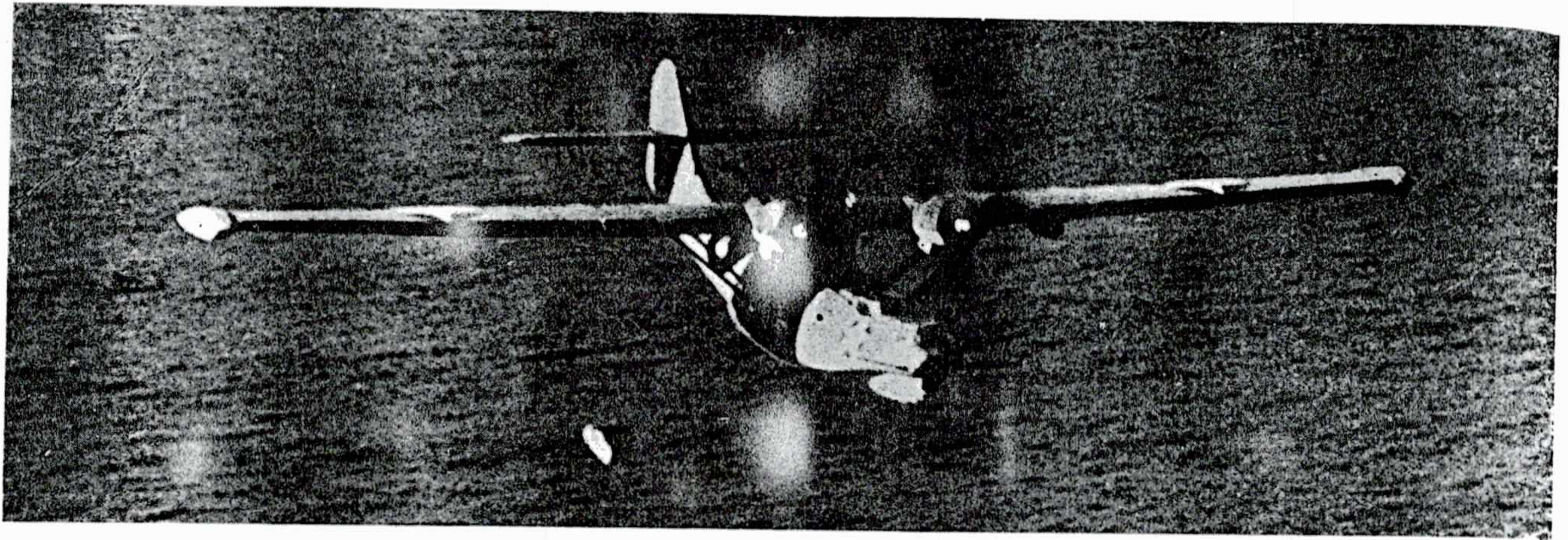


Figure 1—Comparison of nondirectional (left) and directional Sonobuoy (right)



PBY drops depth bomb while on patrol in far Pacific waters

marine is sighted or detected, Schnorkel may actually help rather than hinder a sonobuoy search.

The AN/CRT-4 directional radio sonobuoy is a compact combination of hydrophone and transmitter in a container 57 inches long; 7- $\frac{1}{2}$ inches in diameter and weighing approximately 31 pounds. A sketch comparing the non-directional (AN/CRT-1, -1A, and -1B) and the directional buoy is shown in Figure 1. An exterior view and a cutaway view of the directional sonobuoy are shown in Figures 2 and 3. Twelve different frequencies, designated by color, are provided, one frequency to each buoy. It has not yet been decided which types of aircraft will carry the new directional sonobuoys, but of the older models all

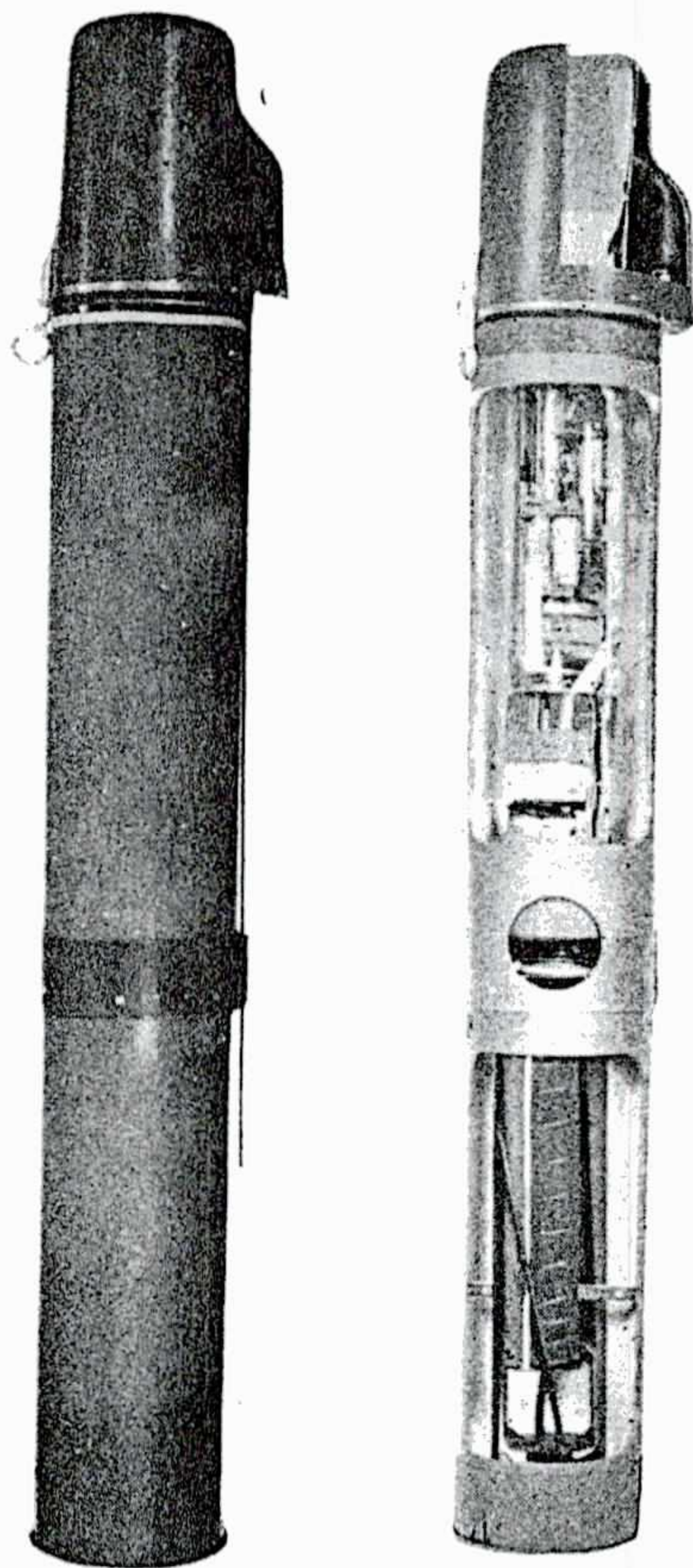


Figure 2—Exterior Figure 3—Cutaway

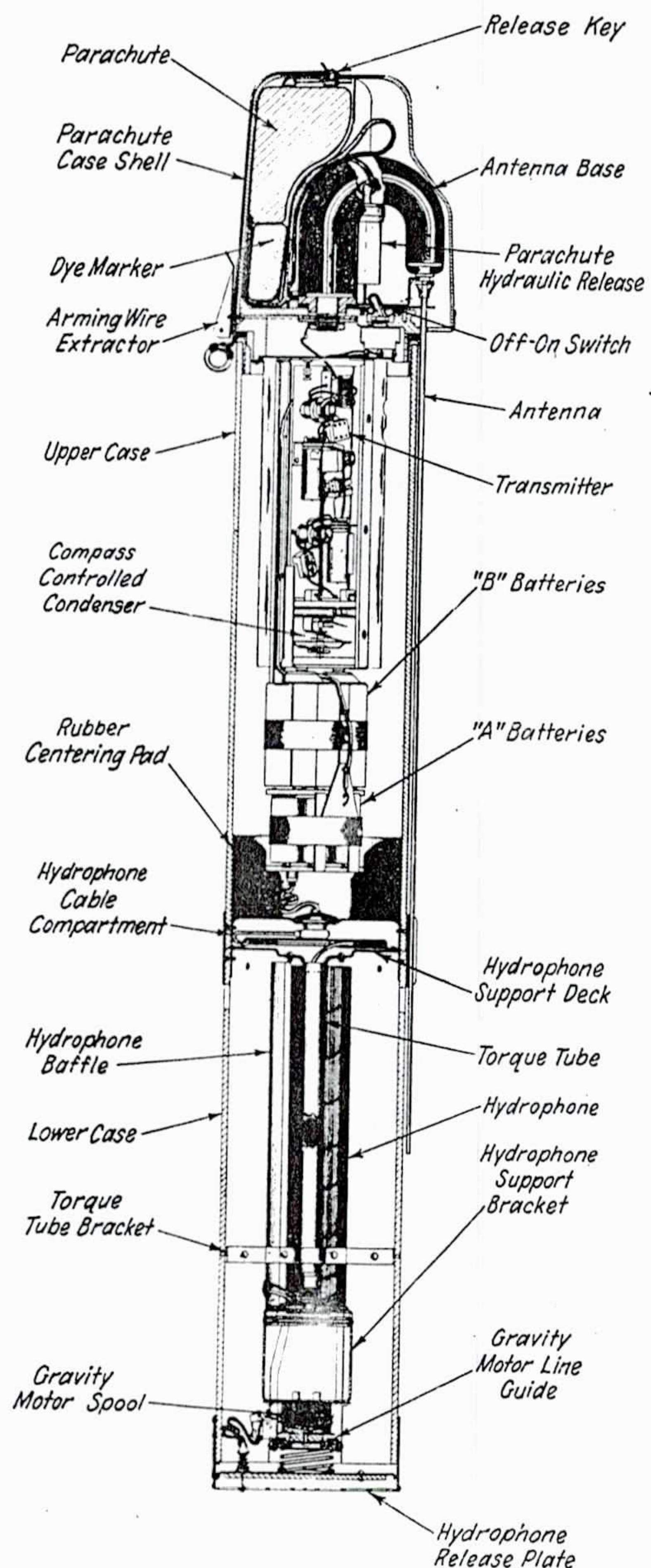


Figure 4—Essential parts of the directional Sonobuoy

PBY drops depth bomb while on patrol in far Pacific waters

marine is sighted or detected, Schnorkel may actually help rather than hinder a sonobuoy search.

The AN/CRT-4 directional radio sonobuoy is a compact combination of hydrophone and transmitter in a container 14 inches long; 7-1/2 inches in diameter and weighing approximately 31 pounds. A sketch comparing the non-directional (AN/CRT-1, -1A, and -1B) and the directional sonobuoy is shown in Figure 1. An exterior view and a cutaway view of the directional sonobuoy are shown in Figures 2 and 3. Twelve different frequencies, designated by color, are provided, one frequency to each buoy. It has not yet been decided which types of aircraft will carry the new directional sonobuoys, but of the older models all

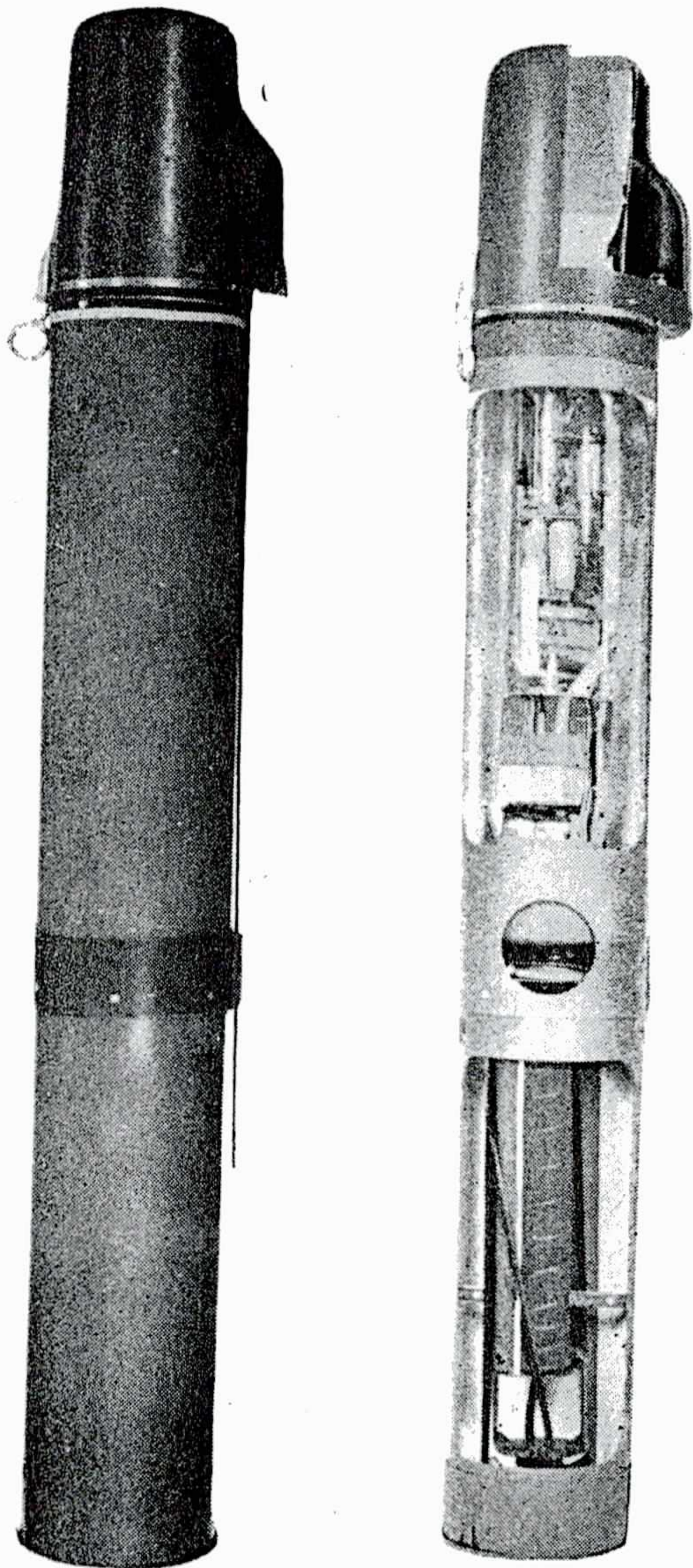


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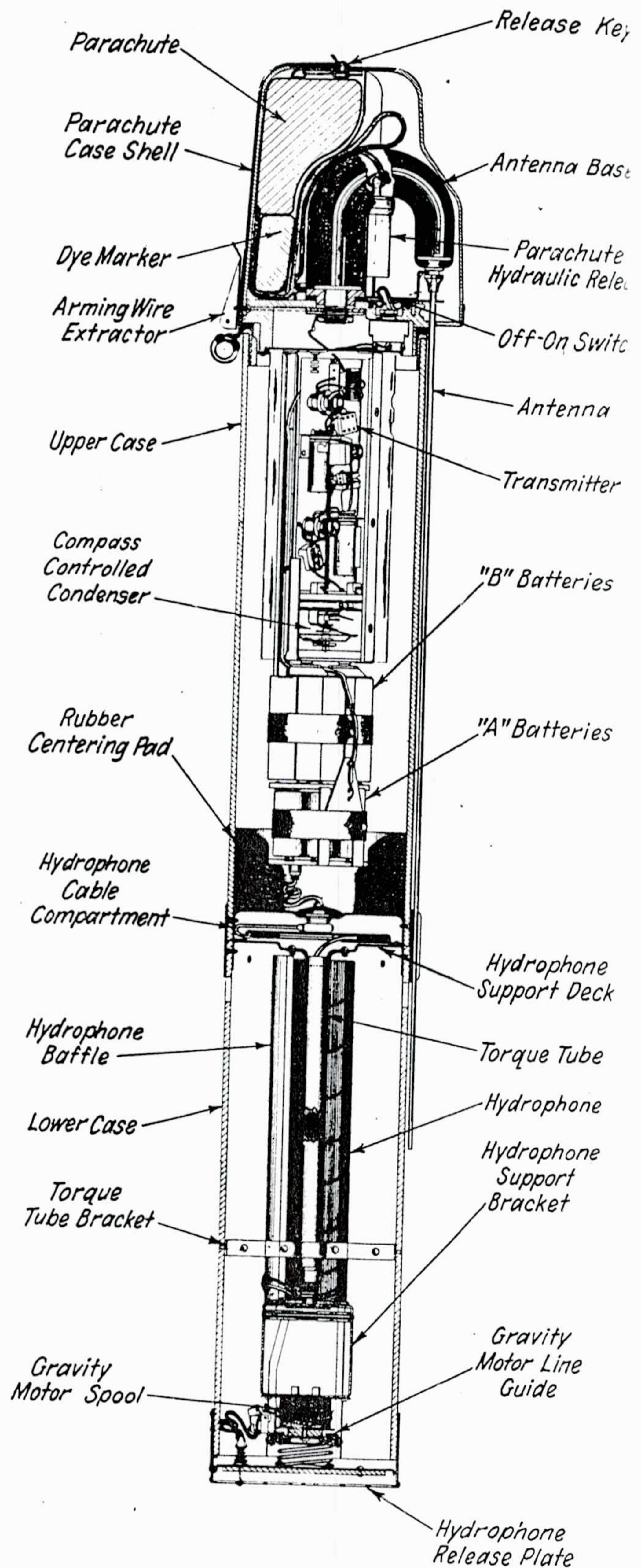
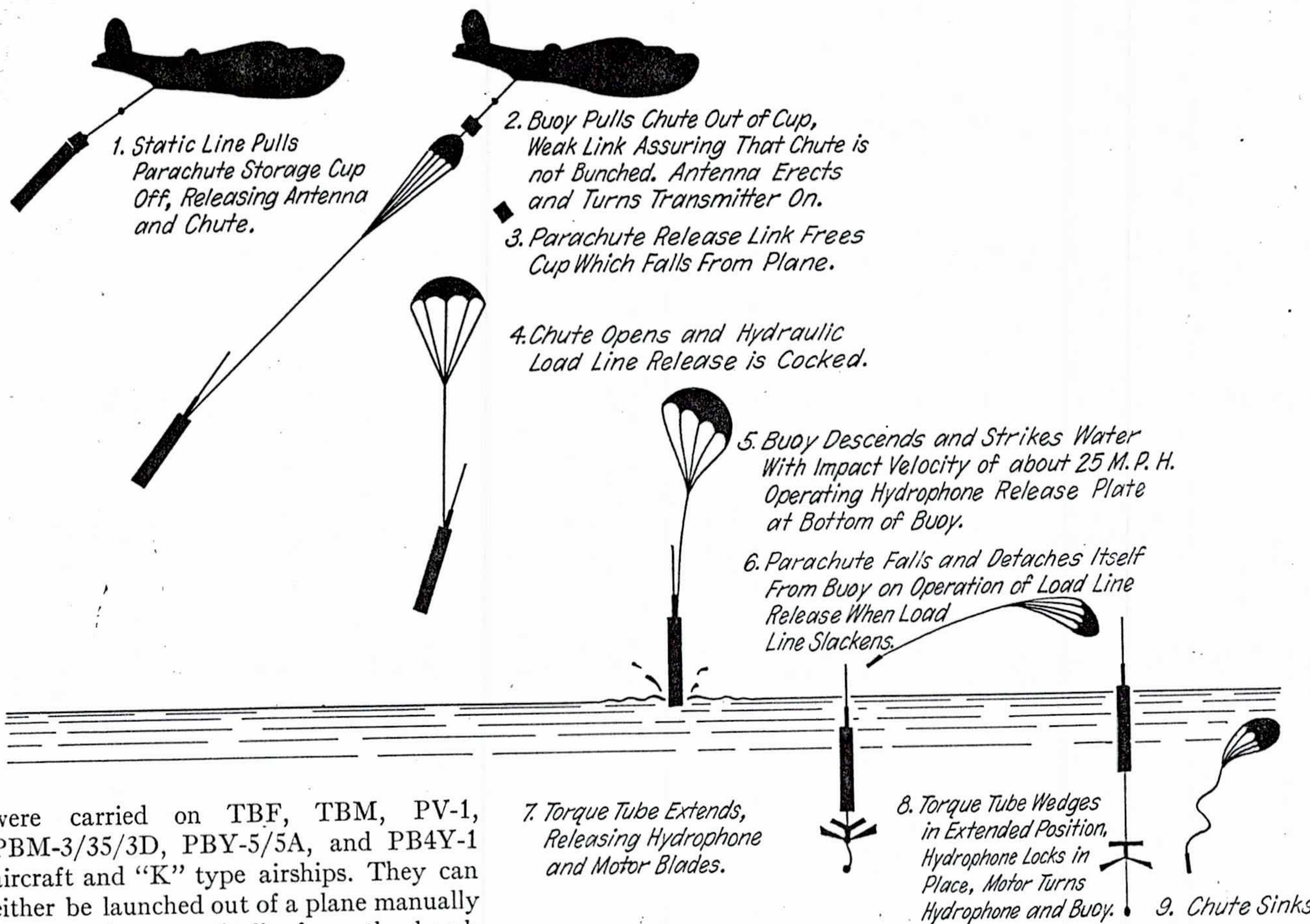


Figure 4—Essential parts of the directional Sonobuoy

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HOW A SONOBUOY IS DROPPED FROM A PBM



were carried on TBF, TBM, PV-1, PBM-3/35/3D, PBY-5/5A, and PB4Y-1 aircraft and "K" type airships. They can either be launched out of a plane manually or released automatically from the bomb bay.

Parachute Detaches Itself

As the buoy drops, several changes automatically occur: The static line pulls the top cap off, the parachute billows out, the antenna is erected and the transmitter is turned on. The parachute cocks the hydraulic load line release, decreases the forward velocity, thereby allowing the buoy to enter the water vertically at about 25 miles per hour. Upon striking the water, the parachute falls and detaches itself, the torque tube extends releasing the hydrophone and motor blades, the torque tube wedges in an extended position and the hydrophone locks in place. The 24-inch hydrophone extends seven feet below the surface and the entire equipment rotates 3 to 5 r.p.m. The top of the buoy remains just above the water, its location marked by a fluorescent dye contained in a bag attached to the top of the buoy.

If a submarine is near, the rotating hydrophone picks up sound waves which are amplified and transmitted to the receiver in the aircraft. A small compass and variable condenser is housed in the transmitter which slightly varies the carrier frequency. This variation in frequency is measured in the aircraft receiver and the meter calibrated to indicate magnetic headings. In the plane the radio operator and pilot use special receiving equipment to watch and listen to the sonobuoy signals. As the rotating

buoy broadcasts, the meter attached to the receiver swings through 360 degrees approximately every 15 seconds in step with the variation in frequency caused by the compass and condenser in the transmitter. When the rotating hydrophone faces the submarine, the signal will be the loudest and at that point the pilot or operator can read the bearing from his meter. If the pilot drops a second directional sonobuoy and triangulates, he can estimate the submarine's approximate location.

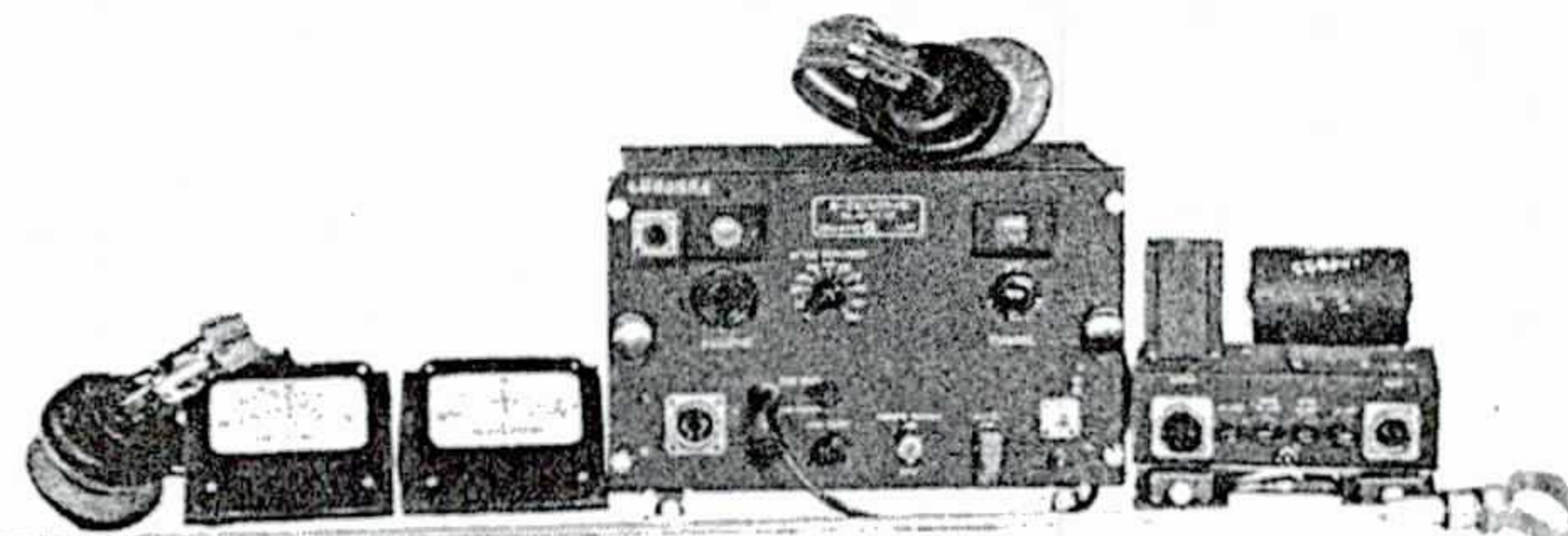


Figure 5—The parts of a modified AN/ARR-3B receiving equipment

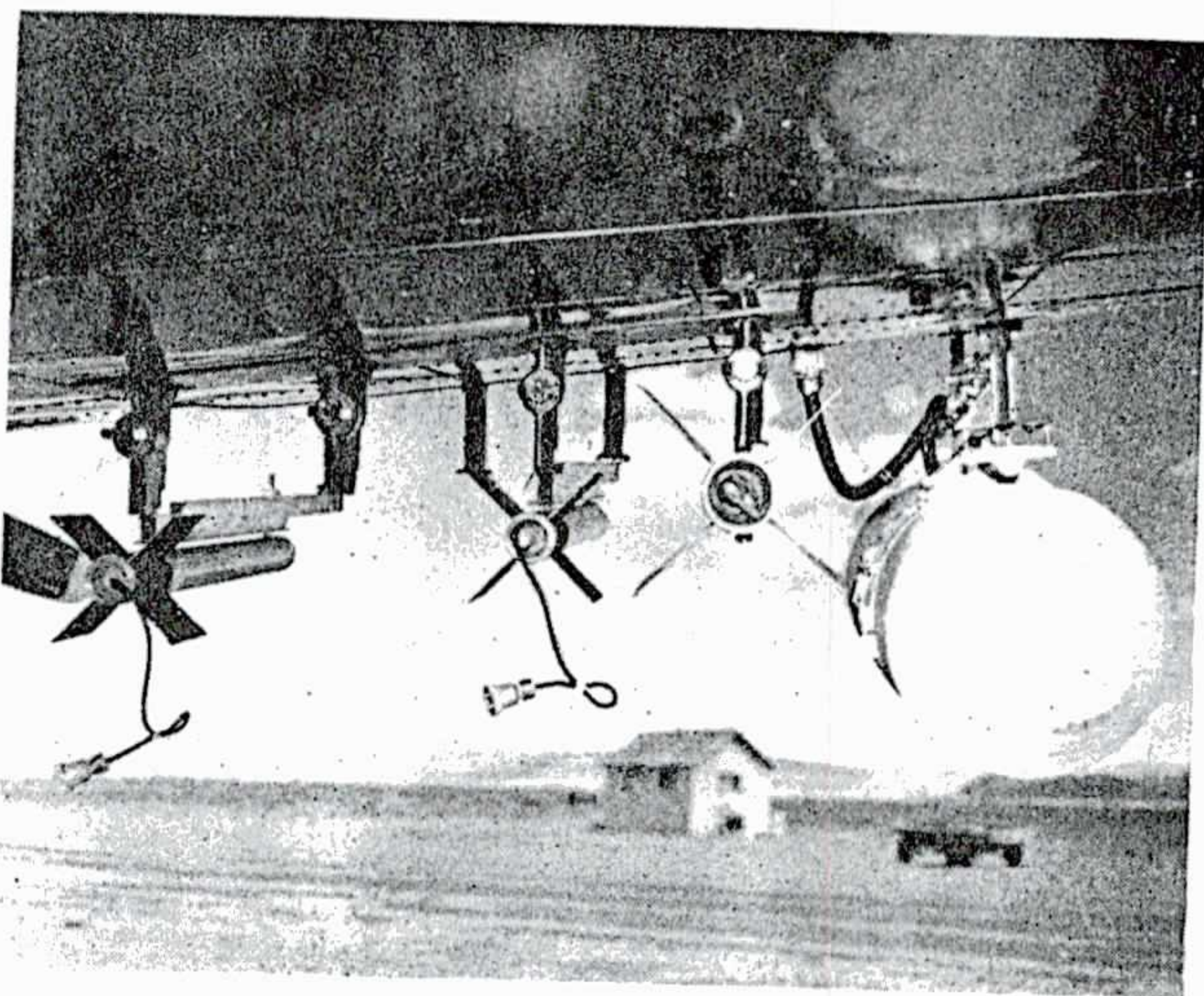
Sonobuoy Completely Redesigned

A few nondirectional AN/ARR-3B receivers have been modified for directional use, but the standard directional receiver for fleet use will be a completely redesigned set,

(Continued on Page 18)

Interference between APS-4 and WING ROCKETS

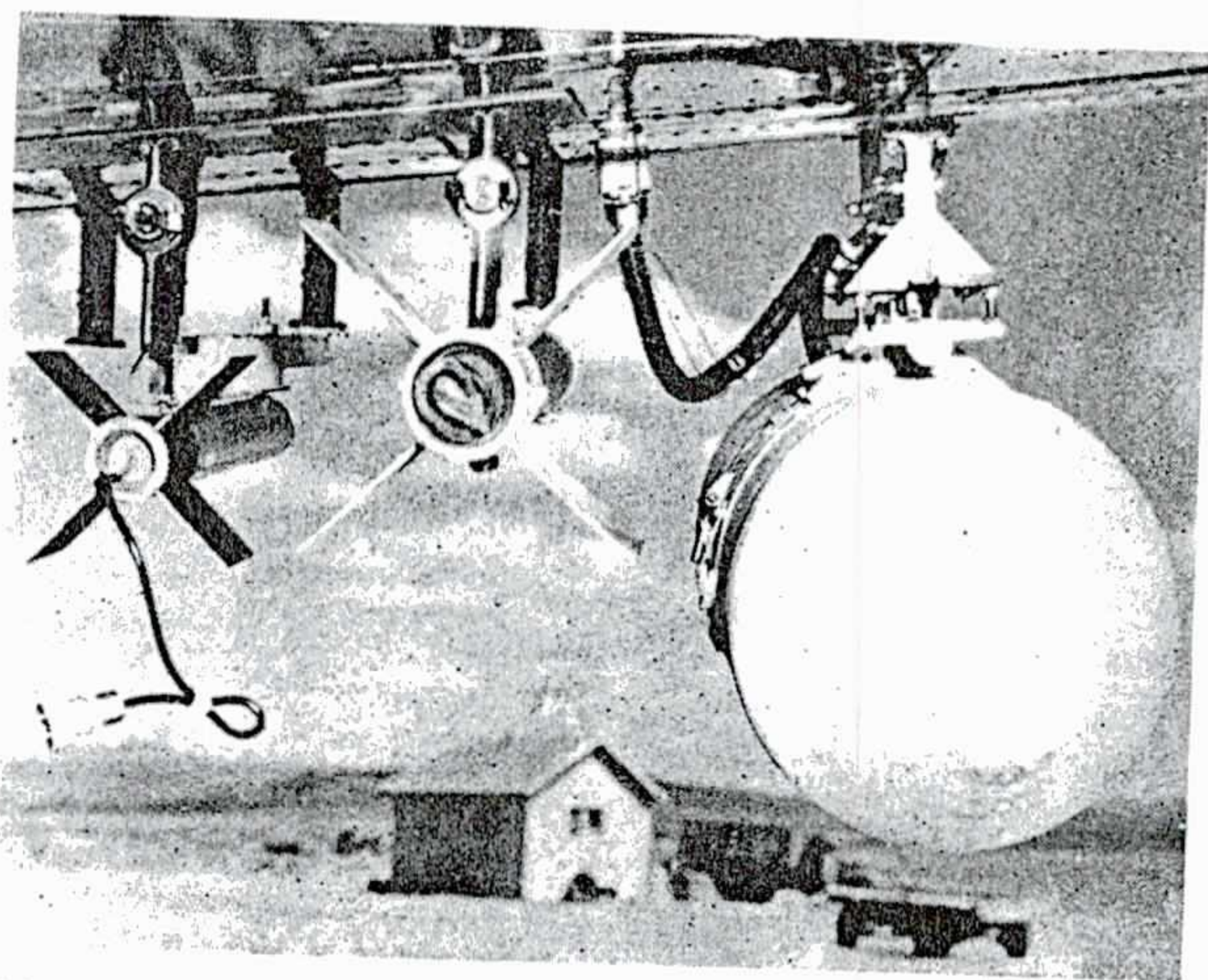
The service is advised not to load the starboard in-board rocket launcher on the SB2C-SBF-SBW when the AN/APS-4 radar is carried to prevent the rocket fins from severing the radar's cable. This information is brought to the attention of all personnel concerned with



Rocket mount and APS-4 mount on a TBM. Note outboard rocket fin intersecting the APS-4 cable

the subject aircraft in the BuAer SB2C-SBF-SBW Aircraft Bulletin No. 167 dated 5 April 1945.

On the TBM aircraft the starboard outboard rocket launcher shall not be loaded (when the AN/APS-4 radar



Close-up of the rocket fin intersecting the APS-4 cable

is carried) because of a similar interference between the radar and rocket fins. This information is brought to the attention of all personnel concerned with the subject aircraft in the BuAer TBF-TBM Aircraft Bulletin No. 162 dated approximately 15 Feb. 1945.

The interference may be clearly seen in the two photographs accompanying this article.

DIRECTIONAL SONOBUOYS WAR ON SUBS—Continued

the AN/ARR-16B, which provides visual indication of the submarine's direction, simpler operation and improved performance. The various parts of a modified AN/ARR-3B receiving equipment are shown in Figure 5.

For efficient use of sonobuoys, special training is necessary for both pilots and radio operators. The pilot must be skilled in dropping the buoys at the correct points, and both must learn to recognize a submarine sound and also to read bearings from the indicator. A special trainer to give instruction in the use of both directional and non-directional sonobuoys is being built.

Maintenance of sonobuoys and the associated receiving equipment also requires special training. Test equipment will be available by the time the directional sonobuoys



and receivers are ready for fleet use. A Maintenance Manual, CO-AN-08-30CRT4-2-M, will be distributed with the equipment.

Besides serving in anti-submarine warfare, sonobuoys can be used as air-sea rescue aids. Some activities have designated one frequency exclusively for emergency use. If a plane is downed, its position can be marked with a sonobuoy of the emergency frequency and another plane within radio range and equipped with a sonobuoy receiver can home on the survivors by listening to the buoy. If surface craft are equipped with sonobuoy receivers, they may use their sonar equipment to echo range on the buoy and thereby get range and bearing of the buoy. The directional sonobuoy transmitter will operate for 2 to 4 hours, powered by batteries, and then will sink. Its signals can be received by aircraft 35 to 40 miles while flying at an altitude of 5000 feet and approximately 8 to 10 miles at an altitude of 500 feet.

Radio Sonobuoy

in the same approximate direction and rate as the survivors in the water.

The radio sonobuoy weighs but 13 pounds, is $4\frac{3}{4}$ inches in diameter, 45 inches in length, and its antenna extends to approximately 40 inches. While its operating life, using the normal primary dry cell battery, is 6 hours, it is believed that expected improvements in battery design will considerably lengthen the operating life.

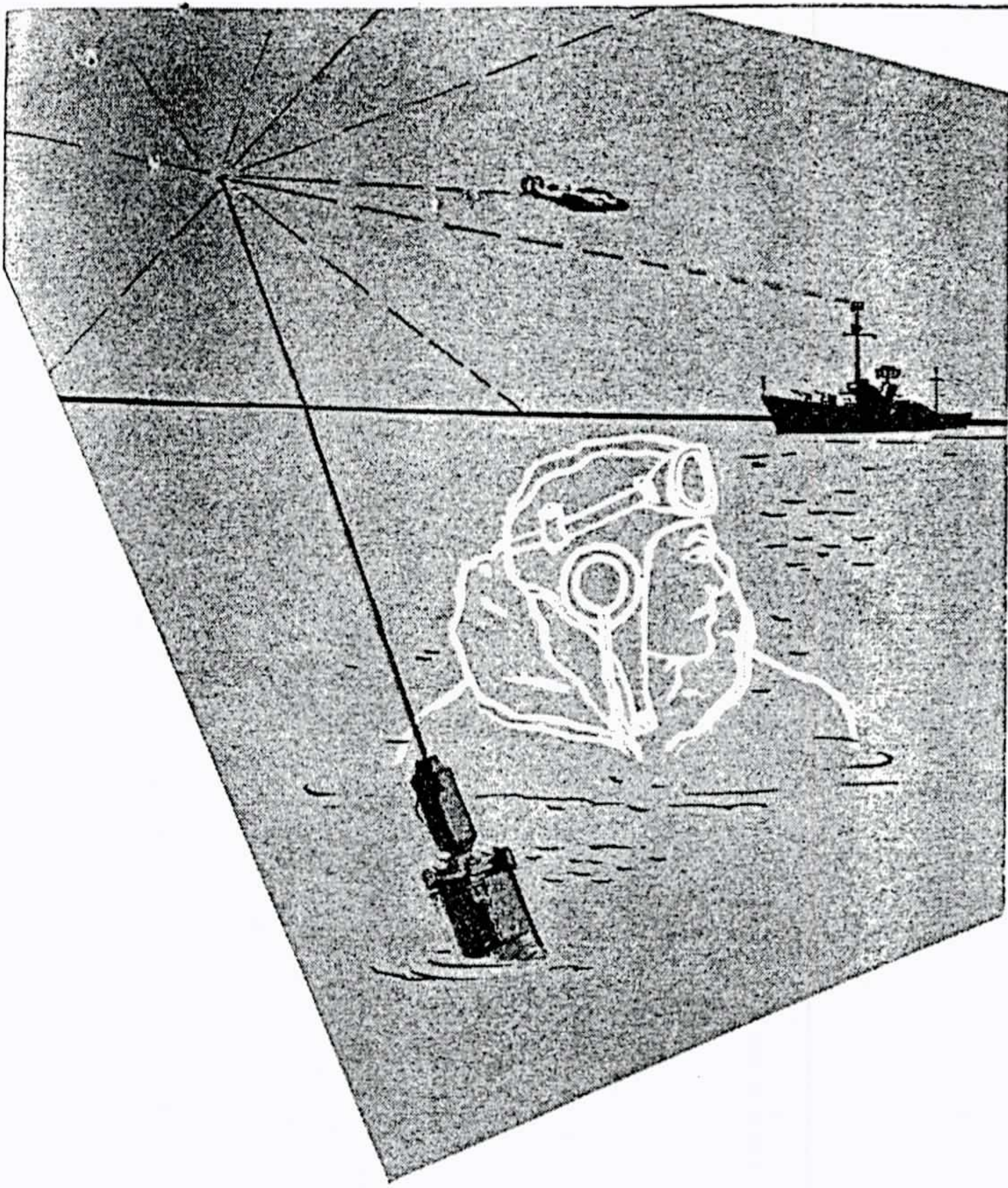
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Surface vessels carrying sonar equipment, and using the radio and sonar echo ranging method, will require the installation of a vertical dipole antenna on the mainmast, and a frequency-modulated receiver near the sonar stack. The output of the frequency-modulated receiver is then fed into the sonar stack. In operation, the ping from the sonar equipment is transmitted under water where it is received in the hydrophone of the radio sonobuoy which then transmits the ping back by radio, where it is received by the dipole antenna. It is then conveyed by coaxial cable to the frequency-modulated receiver, then fed back to the sonar equipment.

The range reading on the sonar equipment must be multiplied by two, because the signal travels only one way by sound—the other way by radio. Special training of sonar operators is not required, because search procedure is normal. The operating range is approximately 12,000 yards.

When aircraft or surface vessels use the radio direction finder method, an antenna must first be calibrated. This may be done easily, quickly, and without the aid of special instruments. The radio direction finder method utilizes the antenna lobes, because it has been found practically impossible to install an antenna below the top of the mast in the 70 megacycle frequency range so that it will not have a useful lobe pattern for radio direction finder purposes.

The antenna system for the sonobuoy receiver used in these installations may be rotated in azimuth by swinging ship or, in the case of an aircraft, by using a standard 2-minute turn. In addition to its proved practicability, this method does not require any new equipment.



THE radio sonobuoy (AN/CRT-1B) is a self-contained, miniature broadcasting station which, by means of a torsionally wound hydrophone, picks up sound in the water. Using an FM transmitter for high fidelity performance, it transmits these underwater sounds to a receiver installed in an aircraft or surface vessel. The radio sonobuoy is also capable of picking up and transmitting supersonic frequencies.

It is a frequency-modulated transmitter that may be carried in an aircraft and dropped in the water, when ditching, for use of the plane's own crew; or it may be carried by a search aircraft and dropped to survivors in the water.

The radio sonobuoy offers many interesting and valuable potentials of service in the field of search and rescue, not the least of which is speed in locating survivors of an emergency. Used in conjunction with the proper type of search radio receiver, it enables search aircraft or surface vessels to home on, and locate, survivors. It also provides survivors with facilities for voice transmission to the rescue group, thus making it possible for them to make known their needs, and to guide the rescue group to a rendezvous. The buoy can be retained in the vicinity of the survivors by means of a light line or, if this is impractical—the buoy being nine-tenths submerged—will drift

For radio direction finder operations, the antenna is calibrated simply by plotting voltages developed in the radio receiver by the radio signal, as a function of the different relative bearings of the sonobuoy. This plot represents a picture of the antenna lobe pattern. The calibration curve may also be used to estimate the range of reception of the radio sonobuoy when on different relative bearings. The lobe pattern is a plot of the relative signal strength versus the relative bearing of a sonobuoy from a ship. It will be noted that the pattern is roughly symmetrical, with the two major lobes of maximum sensitivity located on a bearing just forward of either beam. The lobe pattern is also simple, and free of disturbing minor lobes, yet it is shaped so that good bearing accuracy may be obtained in radio direction finder operations.

Calibration must be done at sea, just after radio and antenna installations have been completed. The results of the antenna lobe patterns are averaged for each bearing, and plotted on either polar coordinate paper, or on a standard maneuvering board.

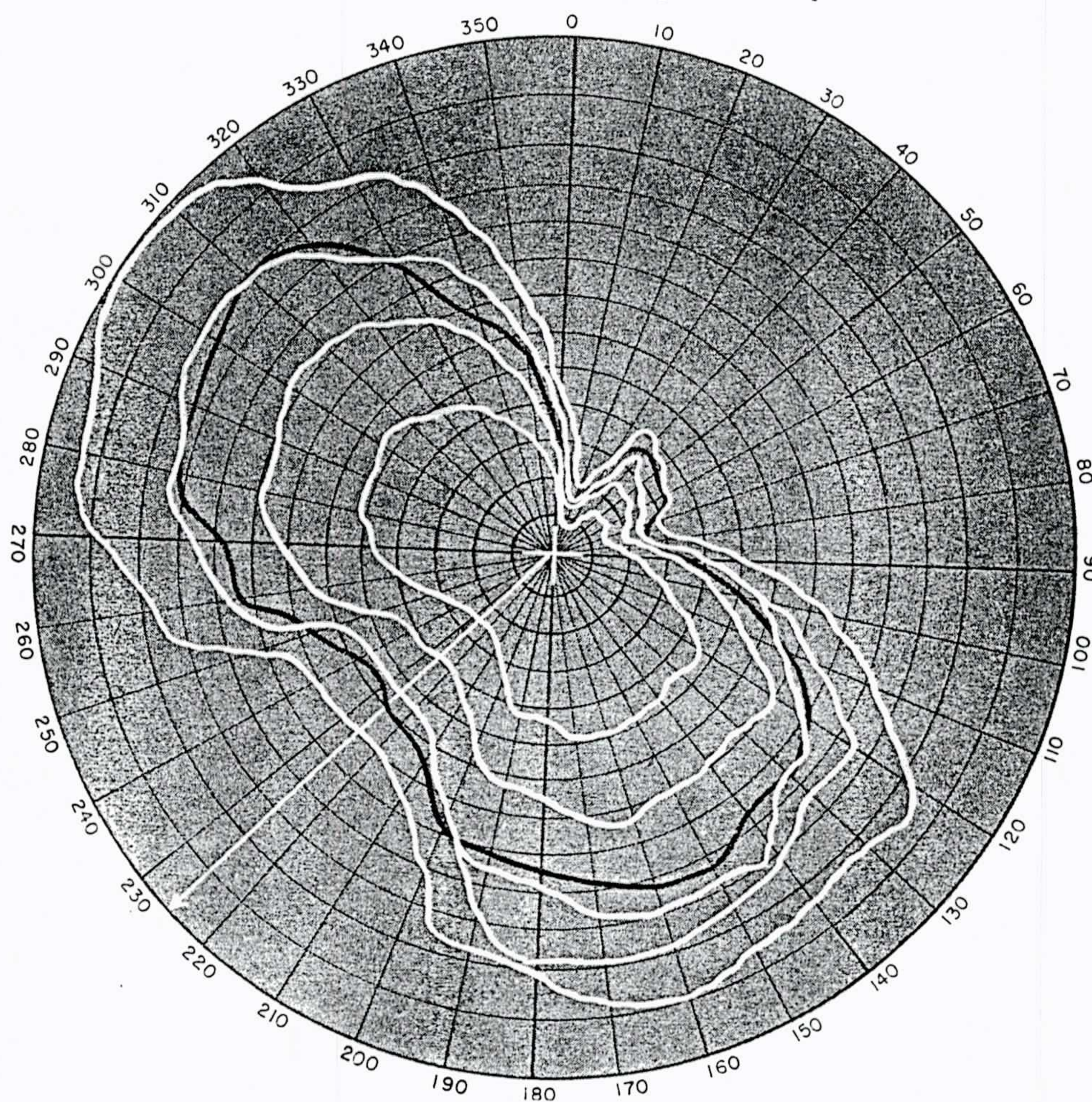
Where a surface vessel is involved, the procedure

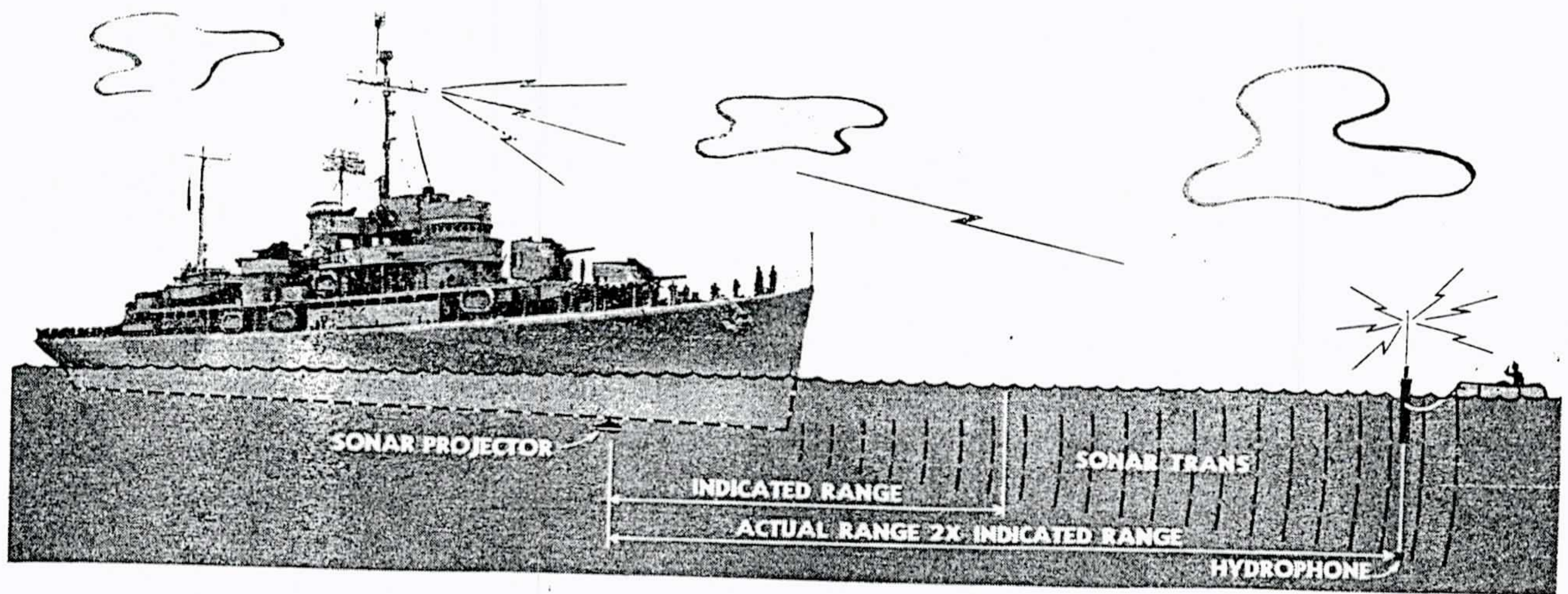
for calibrating would be first, to place a radio sonobuoy at some known bearing from the vessel's position. Then the vessel should commence to circle, making the turns as tight and as small as practicable. Small circles are necessary in order to avoid errors in parallax.

Three persons will be required to handle the calibration operation—the first to call out the vessel's heading every 10° as it swings; the second, to call out the relative signal strength immediately after the vessel's heading is reported; the third, to act as recorder and tabulate the results.

Results are tabulated for four complete 360° turns. These are then averaged out and plotted on the polar coordinate paper or standard maneuvering board. After plotting the field patterns of the antenna lobes, an arrow is drawn in the direction of the radio sonobuoy. This same procedure is followed when the system is used by aircraft.

For use in radio direction finder operations, a transparent overlay must be constructed of the antenna lobe pattern, as plotted from the meter readings ob-





tained in the calibration. In radio direction finder operations this overlay, marked with a suitable index point, is matched with a lobe pattern made by plotting signal strength readings as a function of the true bearing of the vessel's head, and the true bearing of the radio sonobuoy read opposite the index point.

Radio direction finding on an unknown bearing of a radio sonobuoy consists of plotting the sonobuoy's signal strength as a function of the vessel's head, matching the antenna lobe pattern obtained in calibration with the resulting plot, then reading the true bearing of the radio sonobuoy opposite the index point. The operation, which is essentially the same as that used for antenna calibration, is as follows:

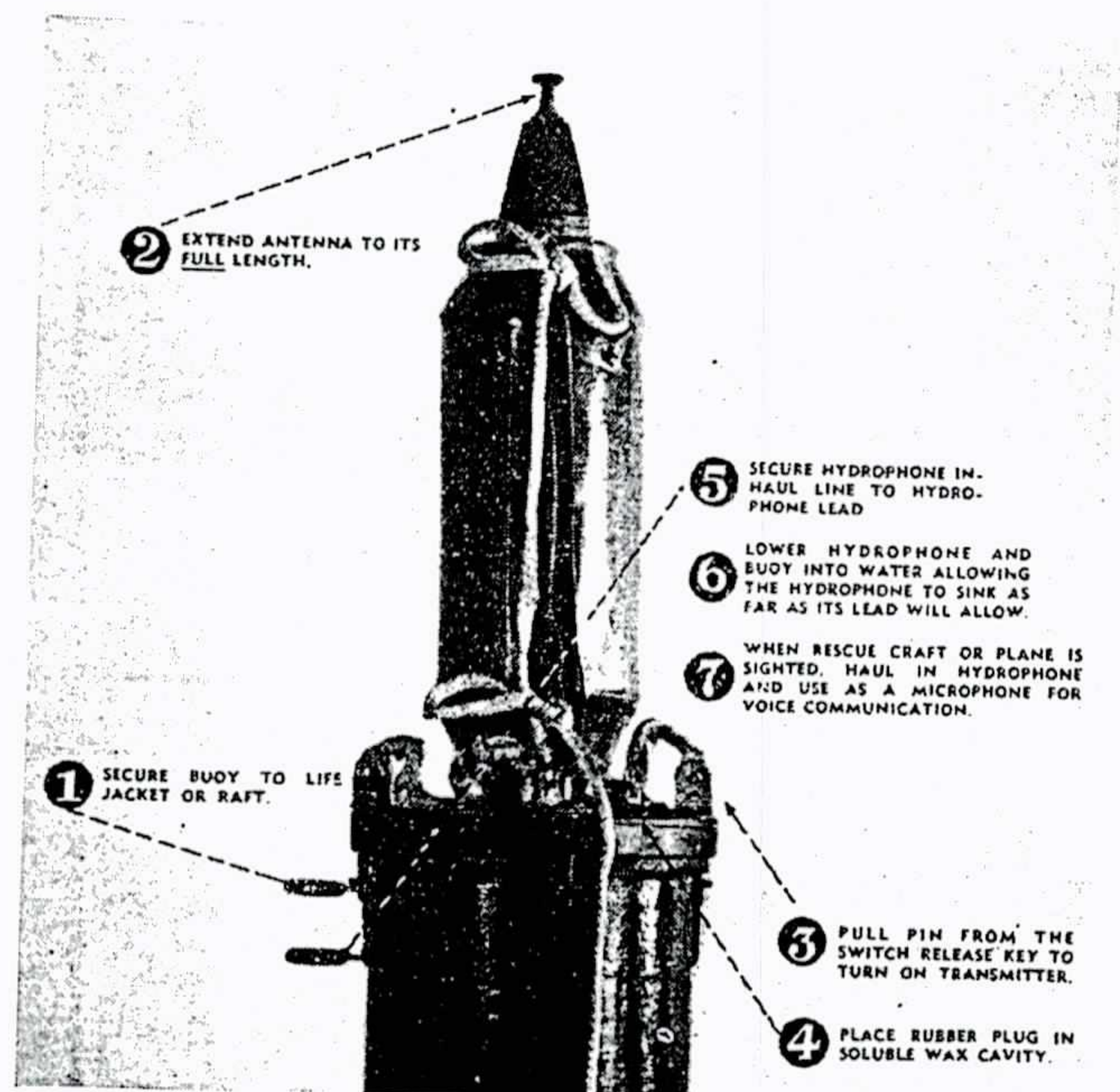
The vessel should be swung through 360° , and the meter readings plotted during the swings. Then match the plotted pattern with the transparent overlay, and read the radio sonobuoy true bearing opposite the index point. The meter readings are proportional to the relative strength of the received radio sonobuoy signal, and are plotted each 10° as the vessel swings. They are plotted on a standard maneuvering board as a function of the true bearing of the vessel's head as she swings through 360° .

The plotted meter readings obtained as the vessel swings represent an antenna lobe pattern with the transmitting radio sonobuoy on an unknown bearing. This bearing pattern is matched to the calibrated antenna lobe pattern inscribed on the transparent overlay. The matching is accomplished by placing the transparent overlay over the maneuvering board, and rotating it about the center, or zero range, point.

The calibrated antenna lobe pattern on the transparent overlay has an index arrow. When the two patterns are matched, the index points to the true bearing of the radio sonobuoy. Read the bearing on

the same bearing circle as that used for the bearing of the vessel's head.

While continued training is necessary to produce a smoothly operating rescue team, no particular training is required for placing the radio sonobuoy in operation. It should be pointed out, however, that survivors should be instructed not to speak into the hydrophone while search parties are radio direction finding, because this causes the intensity of the signal to change and vary the results obtained in plotting the antenna lobes. After the bearing has been determined by the search group, and they have come within the range of vision of the survivors, then the survivors should use the hydrophone for communicating with the rescue group to effect rendezvous by giving instructions for enabling the aircraft to pass over the survivors.



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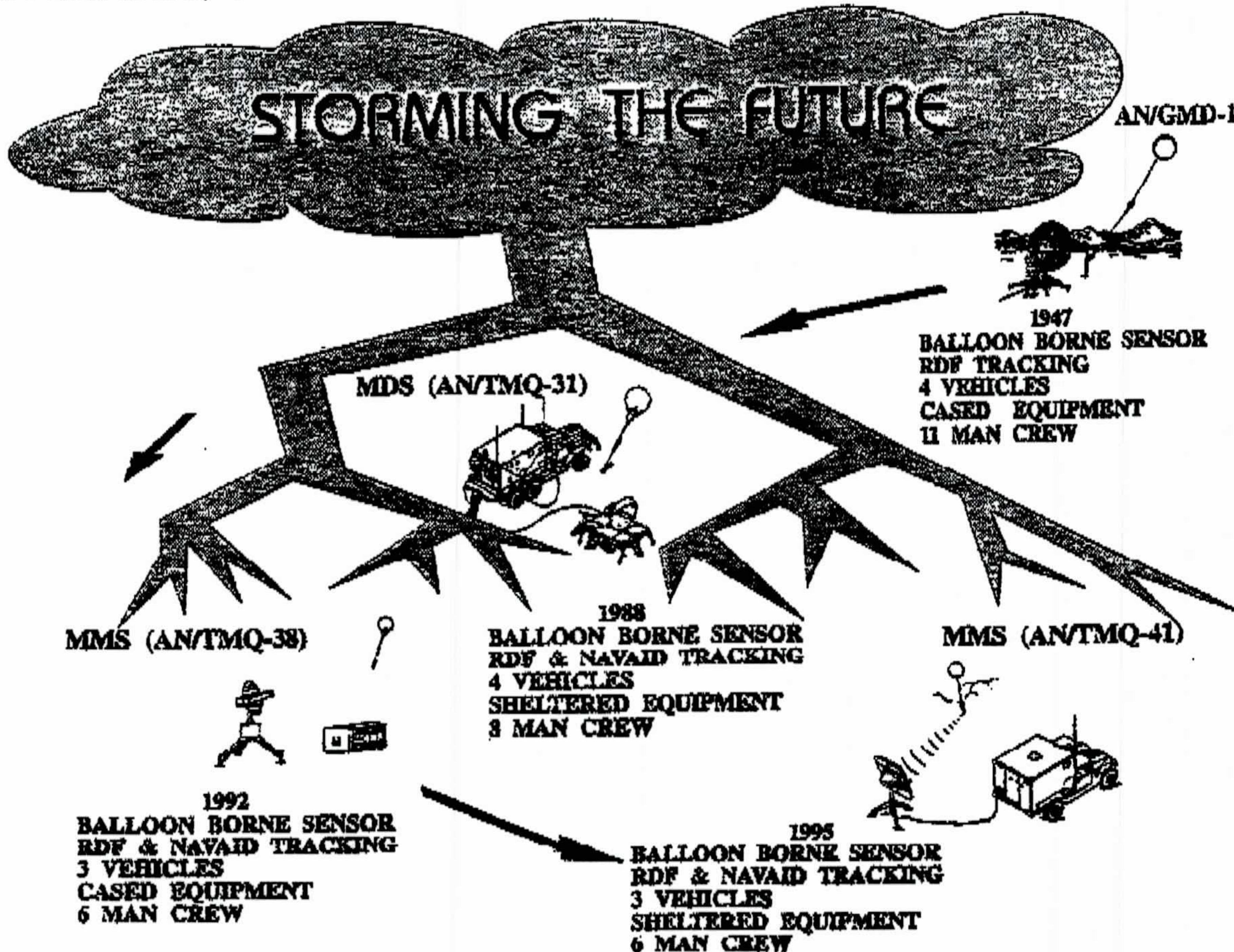
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TM 750-5-3
ML-307/AP

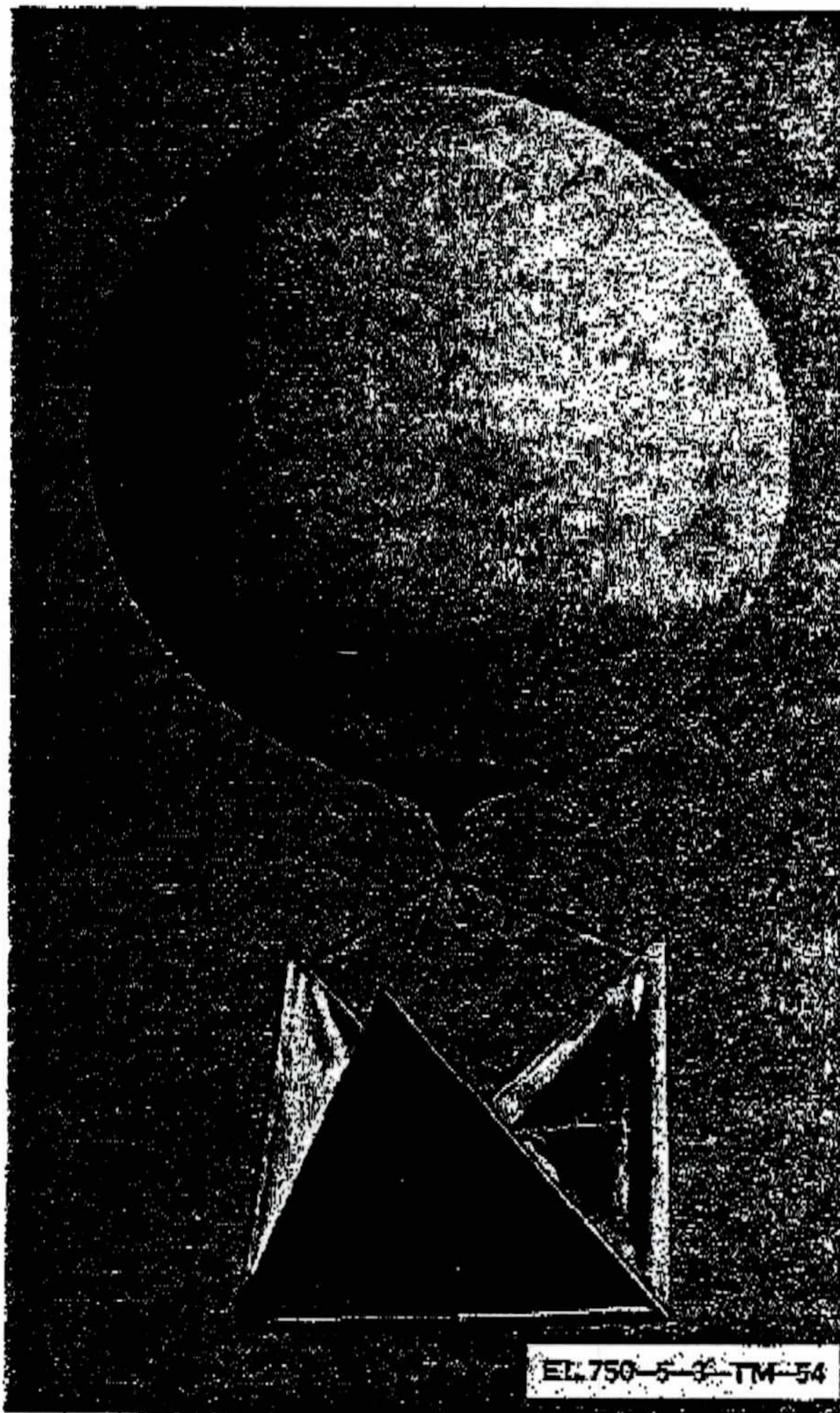


Figure 54. Pilot Balloon Target ML-307/AP.

1. **NOMENCLATURE:** Pilot Balloon Target ML-307/AP.
2. **TYPE CLASSIFICATION:** Standard A.
3. **SECURITY REQUIREMENTS:** Unclassified.
4. **PRIMARY USE OR CONCEPT OF EMPLOYMENT:**
Used to assist in radar tracking of pilot balloons.

5. BRIEF FUNCTIONAL DESCRIPTION:

Pilot Balloon Target ML-307/AP is a collapsible radar reflector which is attached to a pilot balloon to assist in tracking the balloon. The ML-307/AP is used with available radar equipment to determine upper wind direction and upper wind velocity. Pilot Balloon Target ML-307/AP is made of aluminum foil with wooden reinforcements to prevent collapse aloft and consists of a square plane with fins mounted on top.

6. TECHNICAL CHARACTERISTICS:

- Construction..... Triangular shaped, aluminum foil backed on bals frame.
- Dimensions.....: 50 in. long, 50 in. wide, 3 in. high.
- Approximate weight... 100 g.

7. MAJOR COMPONENT:

Pilot Balloon Target ML-307/AP.

8. SET, SYSTEM, FACILITY, AND CONFIGURATION APPLICATIONS:

This unit is used in a system with available radar equipment and pilot balloons.

9. ADDITIONAL EQUIPMENT REQUIRED AND AUXILIARY EQUIPMENT:

a. Additional Equipment.

Radar equipment.
Pilot Balloon ML-159, ML-160, ML-161, and Pilot Balloon Target ML-306/AP.

b. Auxiliary Equipment.. None.

10. TOOLS AND TEST EQUIPMENT: None.

11. REFERENCE DATA AND LITERATURE:

TM 11-6660-218-12, -25P.. AN/TMQ-4

12. REPAIR PARTS SUPPORT CAPABILITY:

No density.

13. TRAINING REQUIREMENTS:

Operator MOS 93-F-20.

14. TYPICAL BASIS OF ISSUE.

15. PRICE DATA:

- a. Major item \$0.24
- b. Repair parts (1-year cost based on 100 equipments). Expendable, nonrepairable.

16. ITEM REPLACED: None.

17. REMARKS:

Issued as a replacement unit.

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WASHINGTON 25, D. C., 12 April 1951

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[AG 413.6 (5 Dec 50)]

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Major General, USA
The Adjutant General

J. LAWTON COLLINS
Chief of Staff, United States Army

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FOREWORD

This is the seventh of a series of nine separate manuals, each covering the standard, substitute standard, and limited standard Signal Corps equipments in a particular field. The nine manuals cover, respectively, radio communication equipment, wire communication equipment, ground radar and recognition equipment, radio direction finding equipment, power equipment, photographic equipment, meteorological equipment, test equipment, and miscellaneous equipment.

This volume is arranged in two chapters. Chapter I includes principal items of equipment; chapter II includes miscellaneous meteorological items. The items of equipment are presented in each chapter by nomenclature type numbers in alphabetical and numerical sequence. The nomenclature type names of the equipments are listed alphabetically in the index at the back of the manual.

An illustration and the following information are given for each item of equipment included in chapter I:

- Nomenclature
- Status
- Signal Corps stock number
- Technical literature
- Description and application
- Technical characteristics
- Principal components
- Weights and volumes

The following information is given for each item of equipment included in chapter II:

- Nomenclature
- Application and brief description
- Signal Corps stock number
- Status

The following abbreviations are used in this manual:

ac	alternating current	hr	hour
a-m	amplitude-modulated	ID	inside diameter
amp	ampere	in	inch
approx	approximately	kc	kilocycle
C	centigrade	lb	pound
cps	cycles per second	lg	long
cu	cubic	mb	millibar
e-w	continuous-wave	mc	megacycle
cyc	cycle	mi	mile
dbm	decibels below 1 mw	mph	miles per hour
dc	direct current	mw	milliwatt
diam	diameter	OD	outside diameter
DPDT	double-pole, double-throw	p/o	part of
F	Fahrenheit	psi	pounds per square inch
f-m	frequency-modulated	r-f	radio-frequency
fpm	feet per minute	rpm	revolutions per minute
ft	foot	std	standard
h	high	ma	microampere
Hg	mercury	u/w	used with
hp	horsepower	v	volt
		w	watt

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CHAPTER I
PRINCIPAL ITEMS OF METEOROLOGICAL EQUIPMENT

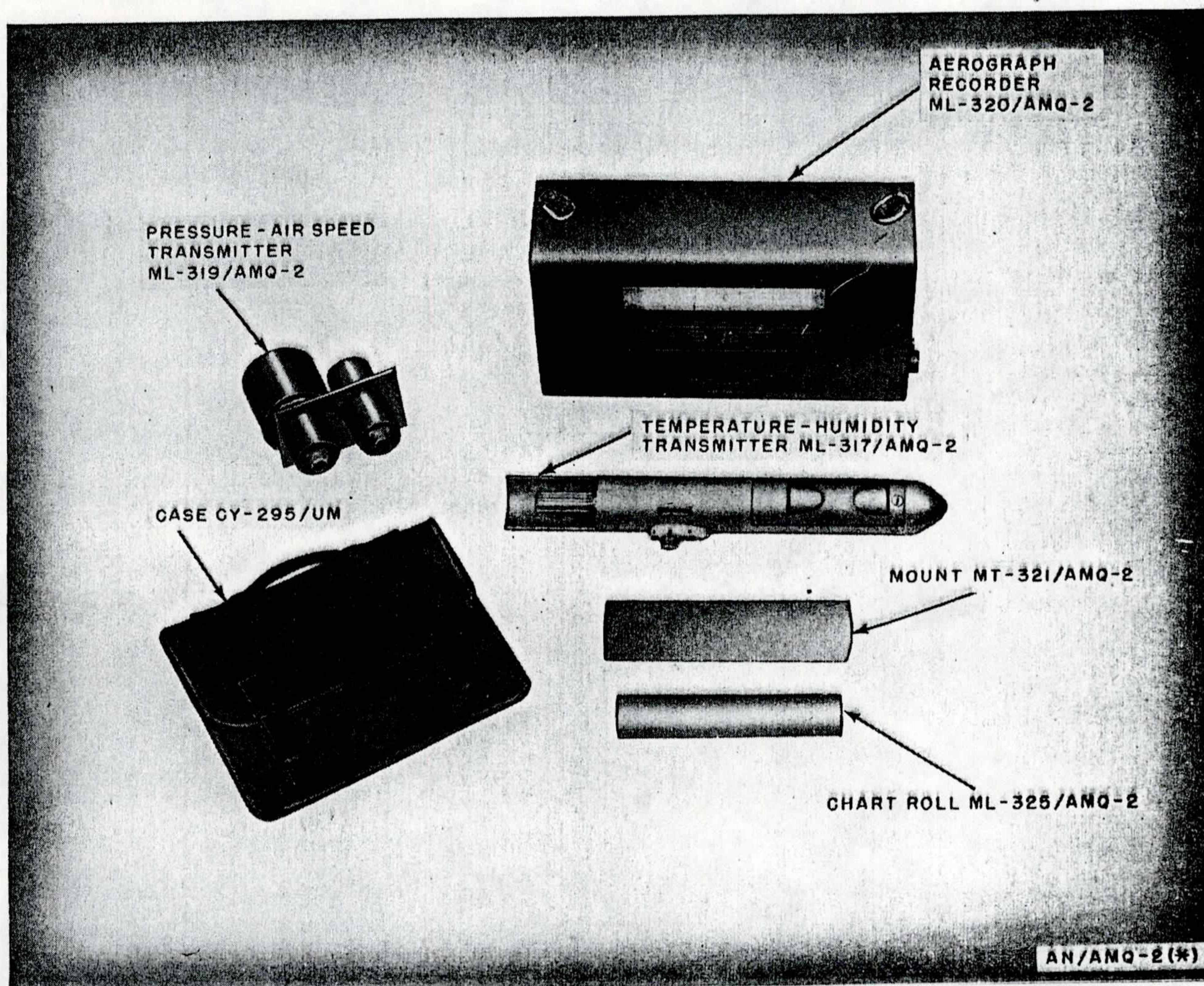


Figure 1. Aerograph Equipment AN/AMQ-2, major components (less scale and calculators).

Status: Substitute/Std. Stock No.: 7A7-2.
Reference: TM 11-2408.

Aerograph Equipment AN/AMQ-2(*) represents Aerograph Equipments AN/AMQ-2 and AN/AMQ-2A. Aerograph Equipment AN/AMQ-2(*) is designed for installation on aircraft. It is synchro-type remote indicating equipment used to measure and to provide instantaneous readings and continuous records of the temperature, pressure, and relative humidity of the atmosphere, together with the indicated air

speed of the aircraft on which the equipment is mounted. The data thus obtained are corrected and evaluated for use in weather analysis. Aerograph Equipment AN/AMQ-2(*) consists of a temperature-humidity transmitter, a pressure-air speed transmitter, a remote-indicating recorder, and humidity and temperature indicators. A time-evaluator scale and the calculators necessary for converting and correcting the data obtained from the recorder are included.

This manual supersedes so much of TM 11-487, 2 October 1944, as pertains to meteorological equipment

CHAPTER I
PRINCIPAL ITEMS OF METEOROLOGICAL EQUIPMENT

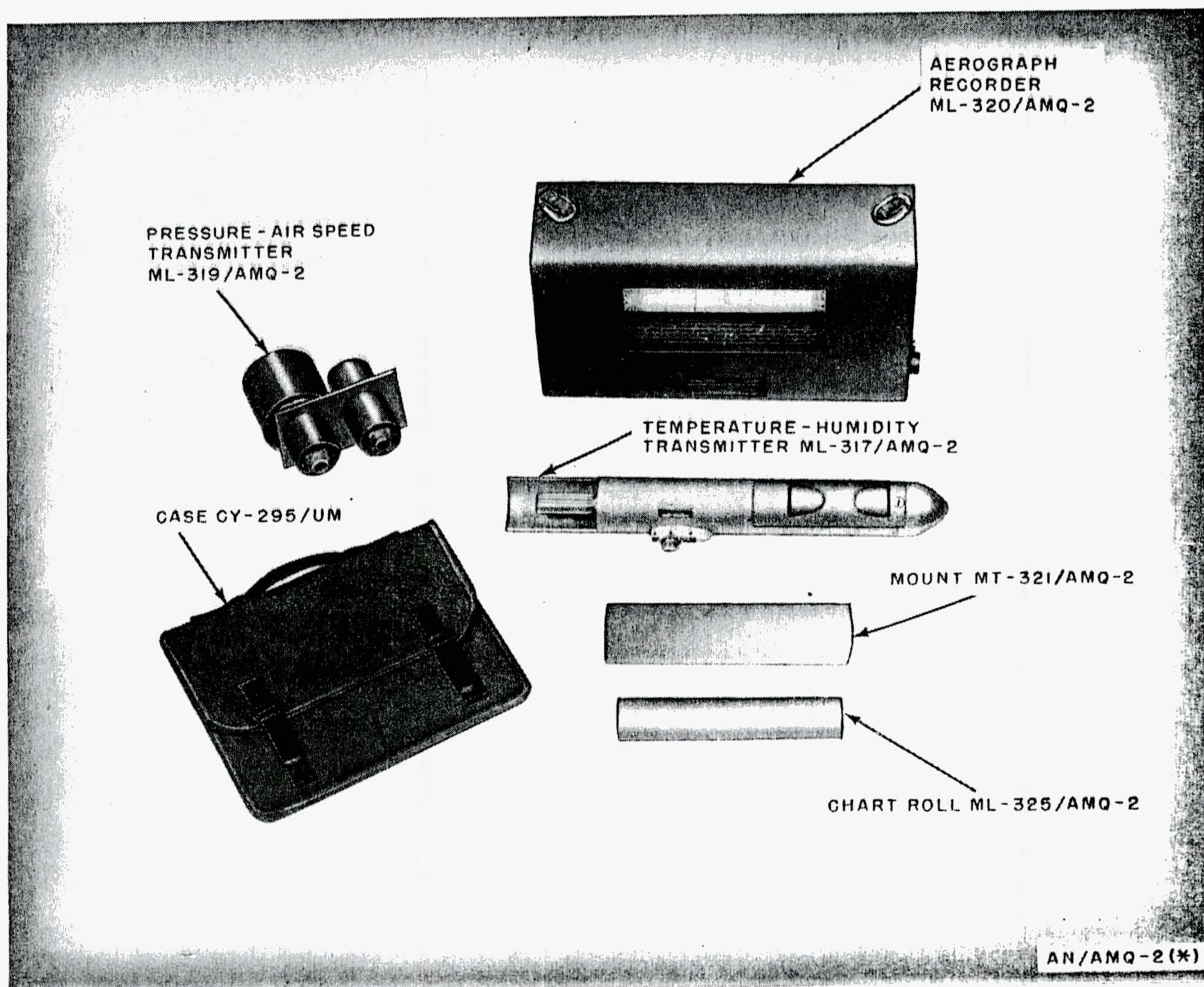


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TECHNICAL CHARACTERISTICS

Data obtained	Actuating element	Range	Accuracy	Chart trace
Temperature.....	Bimetal Thermometer.....	-70° C to +50° C..	± 1°.....	Red.
Relative humidity.....	Hair hygrometer.....	10% to 100%.....	± 10%.....	Purple.
Atmospheric pressure.....	2-cell aneroid diaphragm, temperature compensated.	200 mb to 1,060 mb..	± 8 mb.....	Green.
Air speed.....	Single-cell, spring-loaded diaphragm, temperature compensated.	70 mph to 300 mph..	± 5 mph.....	Brown.

TRANSMITTING AND RECEIVING UNITS: Self-synchronous type.

CHART DRIVE: Low-inertia, 26-v, 400-cyc motor.

CHART SPEED: 12 in. per hr.

POWER REQUIREMENT: 25-v or 115-v, 400-cyc power source of airplane.

PRINCIPAL COMPONENTS

Temperature-Humidity Transmitter ML-317/AMQ-2.

Pressure-Air Speed Transmitter ML-319/AMQ-2.

Aerograph Recorder ML-320/AMQ-2 (AN/AMQ-2 only).

Aerograph Recorder ML-320A/AMQ-2 (AN/AMQ-2A only).

Mount MT-321/AMQ-2.

Scale ML-321/AMQ-2 (AN/AMQ-2 only).

Scale ML-412/AMQ-2A (AN/AMQ-2A only).

Temperature Indicator ID-271/AMQ-2 (AN/AMQ-2A only).

Humidity Indicator ML-272/AMQ-2 (AN/AMQ-2A only).

Chart Roll ML-325/AMQ-2.

Psychrometric Calculator ML-322/UM.

Pressure Calculator ML-323/UM.

Air Speed Calculator ML-324/UM.

Mixing Ratio Calculator ML-326/UM.

Case CY-295/UM.

WEIGHT

The total weight of this equipment, unpacked, is approximately 42 pounds.

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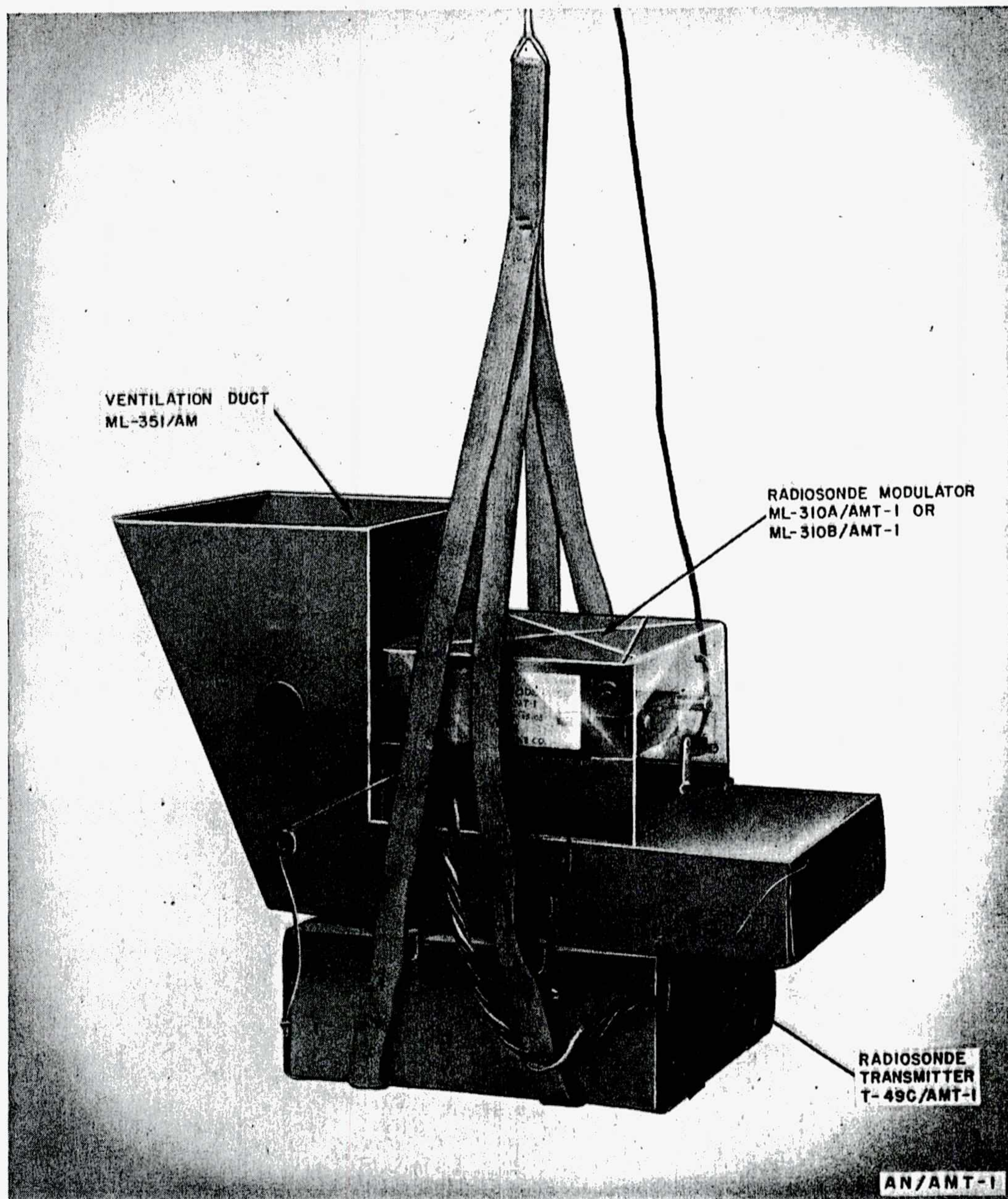


Figure 2. Radiosonde AN/AMT-1; Radiosonde Transmitter T-49C/AMT-1 assembled with Radiosonde Modulator ML-310A/AMT-1 or ML-310B/AMT-1.

Status: Standard. *Stock No.:* 7A8325-1. *Reference:* TM 11-2430.

Radiosonde AN/AMT-1 is a meteorological instrument which is sent aloft, suspended from a free balloon, to obtain soundings of the temperature, pressure, and relative humidity of the upper atmosphere. It automatically transmits amplitude-modulated radio-frequency signals interrupted at a frequency which varies in accordance

with the conditions of temperature and humidity of the atmosphere at the altitude of the radiosonde. A baroswitch connects the circuits to the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These signals are received, recorded, and interpreted at a ground receptor station.

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MODIFIED HANDLING AUTHORIZED AN/AMT-1

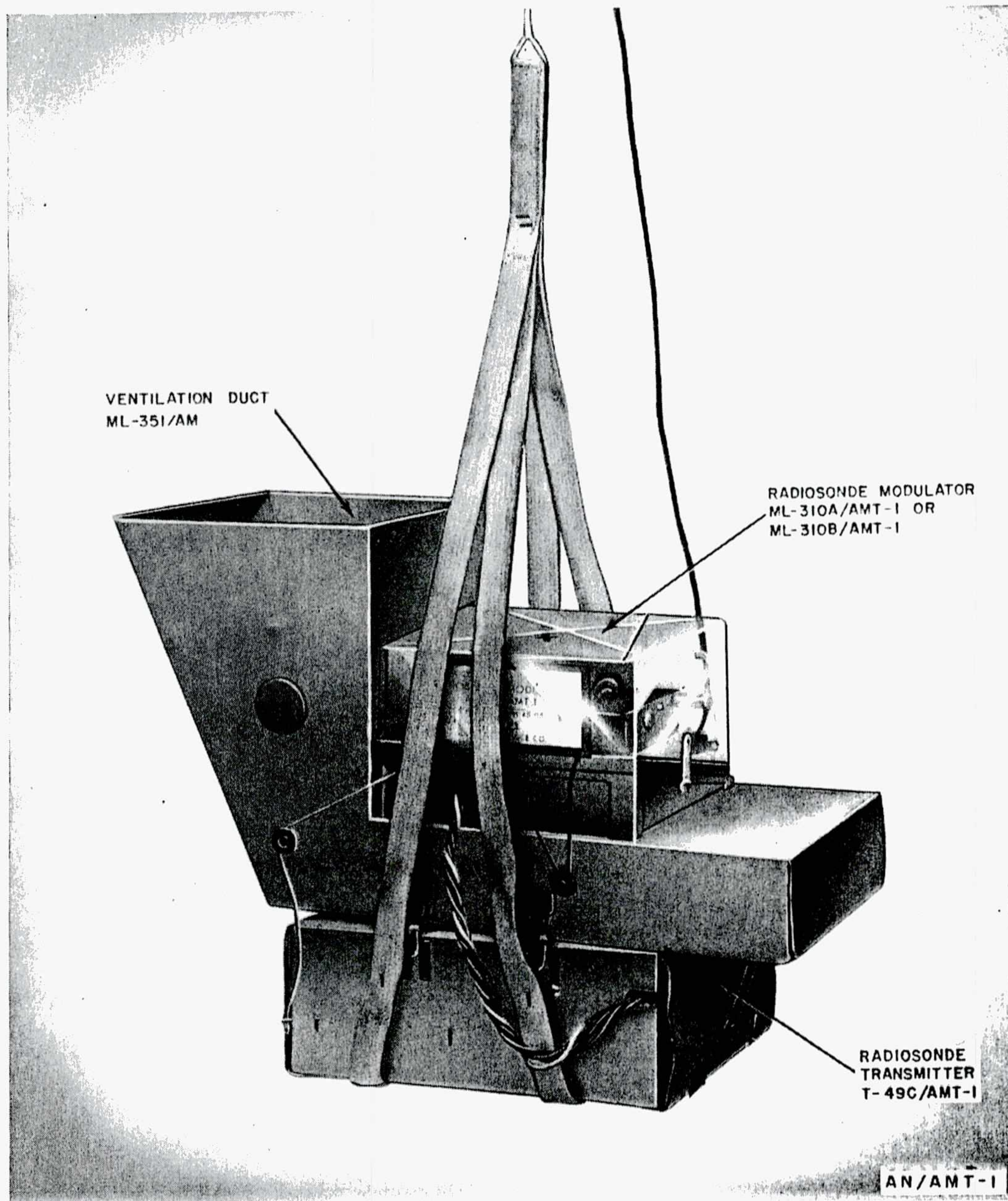


Figure 2. Radiosonde AN/AMT-1; Radiosonde Transmitter T-49C/AMT-1 assembled with Radiosonde Modulator ML-310A/AMT-1 or ML-310B/AMT-1.

Status: Standard. Stock No.: 7A8325-1. Reference: TM 11-2430.

Radiosonde AN/AMT-1 is a meteorological instrument which is sent aloft, suspended from a free balloon, to obtain soundings of the temperature, pressure, and relative humidity of the upper atmosphere. It automatically transmits amplitude-modulated radio-frequency signals interrupted at a frequency which varies in accordance

with the conditions of temperature and humidity of the atmosphere at the altitude of the radiosonde. A baroswitch connects the circuits to the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These signals are received, recorded, and interpreted at a ground receptor station.

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TECHNICAL CHARACTERISTICS

RANGE OF MEASUREMENTS

ATMOSPHERIC PRESSURE: 1,060 mb to 10 mb.

TEMPERATURE: +60° C to -90° C.

RELATIVE HUMIDITY: 15 percent to 100 percent.

EFFECTIVE ALTITUDE: Up to 60,000 ft.

RADIOSONDE TRANSMITTER T-49C/AMT-1.

FREQUENCY RANGE: 70 to 74 mc.

PRESET FREQUENCY: 72.2 mc.

TYPE OF SIGNAL: A-m, intermittent continuous wave.

MODULATED BY: Relaxation (squegging) oscillator.

ANTENNA: Dipole, center-fed.

TUBE: 3A5.

POWER SUPPLY: Battery BA-67 (used with, but not furnished with, the radiosondes). Battery Pack BB-208/AMT with storage battery adapter, Sig C

stock No. 2Z303-3, may be used as an emergency substitute for Battery BA-67.
SIGNALS RECEIVED BY: Radiosonde Receptors AN/FMQ-1 and -1A.

PRINCIPAL COMPONENTS

Radiosonde Modulator ML-310/AMT-1 or ML-310A/AMT-1, ML-310B/AMT-1, ML-310D/AMT-1, or ML-310E/AMT-1.

Radiosonde Transmitter T-49C/AMT-1.

WEIGHTS AND VOLUMES

Note. Radiosonde Modulators ML-310/AMT-1 (any model) and Radiosonde Transmitters T-49C/AMT-1 are packed separately, each 24 to a container.

	Export Weight (lb)	packed Volume (cu ft)
Radiosonde Modulator ML-310/AMT-1 (any model)	65	3.82
Radiosonde Transmitter T-49C/AMT-1	61	3.95

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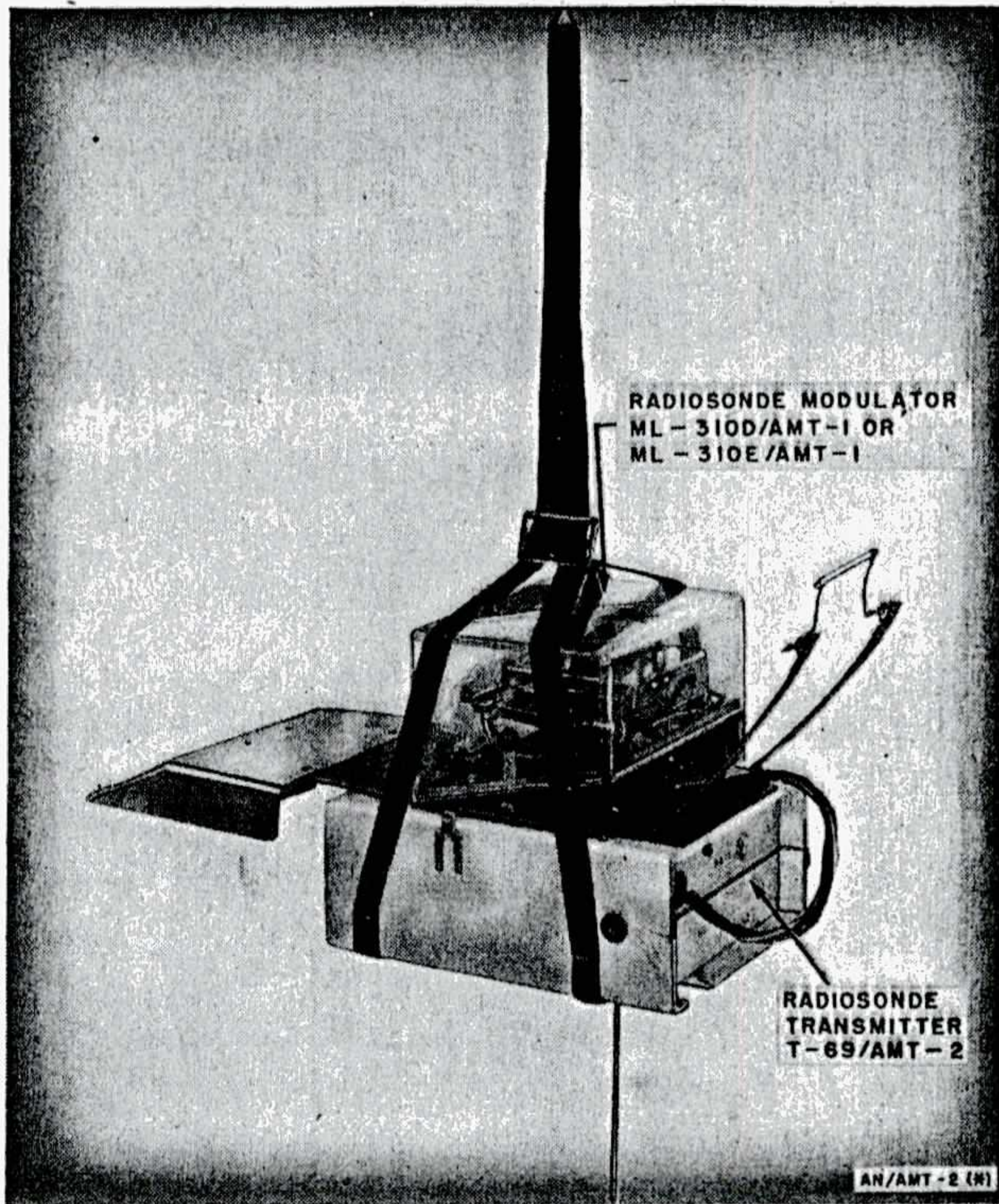


Figure 3. Radiosonde AN/AMT-2; Radiosonde Transmitter T-69/AMT-2 assembled with Radiosonde Modulator ML-310D/AMT-1 or ML-310E/AMT-1.

Status: Standard. Stock No.: 7A8325-2 (AN/AMT-2), 7A8325-2A (AN/AMT-2A). Reference: TM 11-2430 (AN/AMT-2), TM 11-2433 (AN/AMT-2A).

Radiosonde AN/AMT-2(*) represents Radiosondes AN/AMT-2 and AN/AMT-2A. Radiosonde AN/AMT-2 is a meteorological instrument which is sent aloft, suspended from a free balloon, to obtain soundings of the temperature, pressure, and relative humidity of the upper atmosphere. It automatically transmits frequency-modulated, radio-frequency signals interrupted at a frequency which varies in accordance with the conditions of temperature and humidity at the altitude of the radiosonde. A baroswitch connects the circuits to the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These signals are received, recorded, and interpreted at a ground receptor station. By tracking the radiosonde with a radio direction finder, wind direction and speed may be determined also. Radiosonde AN/AMT-2A is similar to Radiosonde AN/AMT-2 and serves the same purposes, but differs from it in appearance and design and in certain technical characteristics.

TECHNICAL CHARACTERISTICS

	AN/AMT-2	AN/AMT-2A
RANGE OF MEASUREMENTS:		
ATMOSPHERIC PRESSURE	1,060 mb to 10 mb	1,060 mb to 5 mb.
TEMPERATURE	+60° C to -90° C	+60° C to -90° C.
RELATIVE HUMIDITY	15% to 100%	15% to 100%.
EFFECTIVE ALTITUDE	60,000 ft	100,000 ft or more.
TRANSMITTING ELEMENT:		
FREQUENCY RANGE	390 mc to 410 mc	400 mc to 406 mc.
PRESET FREQUENCY	403 mc	403 mc.
TYPE OF SIGNAL	F-m	F-m.
MODULATED BY	Relaxation (squegging) oscillator	Relaxation (squegging) oscillator.
ANTENNA	Half-wave dipole	Half-wave dipole.
POWER SUPPLY	Battery Pack BB-208/AMT (3 Batteries BB-51 and 1 Battery BB-52).	Battery Pack BA-259.
SIGNALS RECEIVED BY	Radiosonde Receptor AN/FMQ-2 Radio Set SCR-658	Radiosonde Receptor AN/FMQ-2. Radio Set SCR-658.

Note. Radiosonde Receptors AN/FMQ-1 and AN/FMQ-1A may be used to record the signals transmitted by Radiosondes AN/AMT-2 and AN/AMT-2A after they have been received by Radio Set SCR-658.

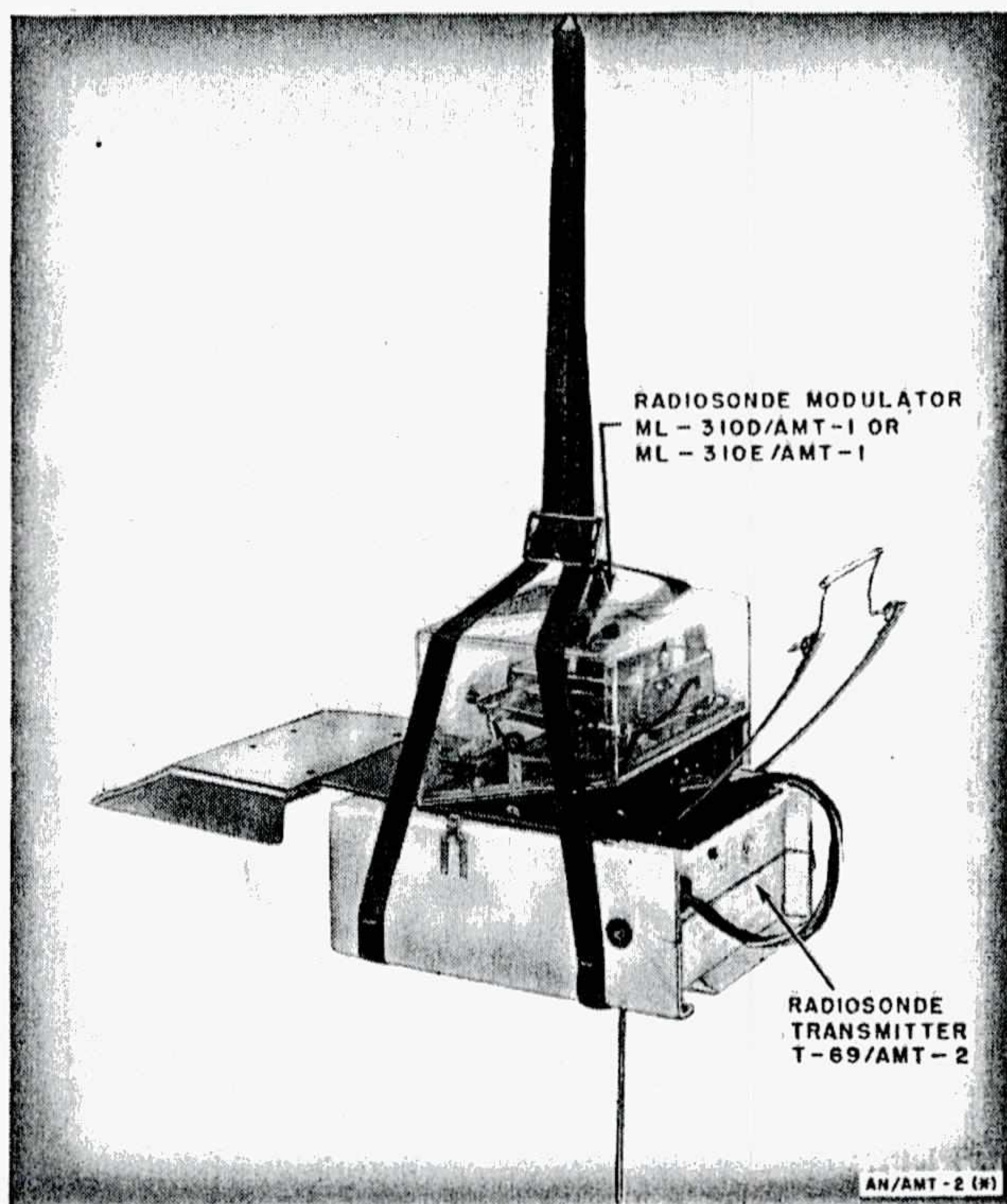


Figure 3. Radiosonde AN/AMT-2; Radiosonde Transmitter T-69/AMT-2 assembled with Radiosonde Modulator ML-310D/AMT-1 or ML-310E/AMT-1.

Status: Standard. Stock No.: 7A8325-2 (AN/AMT-2), 7A8325-2A (AN/AMT-2A). Reference: TM 11-2430 (AN/AMT-2), TM 11-2433 (AN/AMT-2A).

Radiosonde AN/AMT-2(*) represents Radiosondes AN/AMT-2 and AN/AMT-2A. Radiosonde AN/AMT-2 is a meteorological instrument which is sent aloft, suspended from a free balloon, to obtain soundings of the temperature, pressure, and relative humidity of the upper atmosphere. It automatically transmits frequency-modulated, radio-frequency signals interrupted at a frequency which varies in accordance with the conditions of temperature and humidity at the altitude of the radiosonde. A baroswitch connects the circuits to the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These signals are received, recorded, and interpreted at a ground receptor station. By tracking the radiosonde with a radio direction finder, wind direction and speed may be determined also. Radiosonde AN/AMT-2A is similar to Radiosonde AN/AMT-2 and serves the same purposes, but differs from it in appearance and design and in certain technical characteristics.

TECHNICAL CHARACTERISTICS

	AN/AMT-2	AN/AMT-2A
RANGE OF MEASUREMENTS:		
ATMOSPHERIC PRESSURE	1,060 mb to 10 mb	1,060 mb to 5 mb.
TEMPERATURE	+60° C to -90° C	+60° C to -90° C.
RELATIVE HUMIDITY	15% to 100%	15% to 100%.
EFFECTIVE ALTITUDE	60,000 ft	100,000 ft or more.
TRANSMITTING ELEMENT:		
FREQUENCY RANGE	390 mc to 410 mc	400 mc to 406 mc.
PRESET FREQUENCY	403 mc	403 mc.
TYPE OF SIGNAL	F-m	F-m.
MODULATED BY	Relaxation (squegging) oscillator	Relaxation (squegging) oscillator.
ANTENNA	Half-wave dipole	Half-wave dipole.
POWER SUPPLY	Battery Pack BB-208/AMT (3 Batteries BB-51 and 1 Battery BB-52).	Battery Pack BA-259.
SIGNALS RECEIVED BY	Radiosonde Receptor AN/FMQ-2 Radio Set SCR-658	Radiosonde Receptor AN/FMQ-2. Radio Set SCR-658.

Note. Radiosonde Receptors AN/FMQ-1 and AN/FMQ-1A may be used to record the signals transmitted by Radiosondes AN/AMT-2 and AN/AMT-2A after they have been received by Radio Set SCR 658.

AN/AMT-3

PRINCIPAL COMPONENTS

- AN/AMT-2:
 Radiosonde Modulator ML-310/AMT-1 or ML-310A/AMT-1, ML-310B/AMT-1, ML-310D/AMT-1, or ML-310E/AMT-1.
 Radiosonde Transmitter T-69/AMT-2 (any model).
- AN/AMT-2A:
 Sensing Element (includes Temperature Element ML-419/AMT-4 and Humidity Element ML-418/AMT-4).
 Transmitting Element.

WEIGHTS AND VOLUMES

AN/AMT-2:
Note. Radiosonde Modulators ML-310/AMT-1 and Radiosonde Transmitters T-69/AMT-2 are packed separately, each 24 to a container.

	<i>Export packed</i>	
	<i>Weight (lb)</i>	<i>Volume (cu ft)</i>
Radiosonde Modulator ML-310/AMT-1 (any model).....	65	3.82
Radiosonde Transmitter T-69/AMT-2 (any model).....	64	4.05

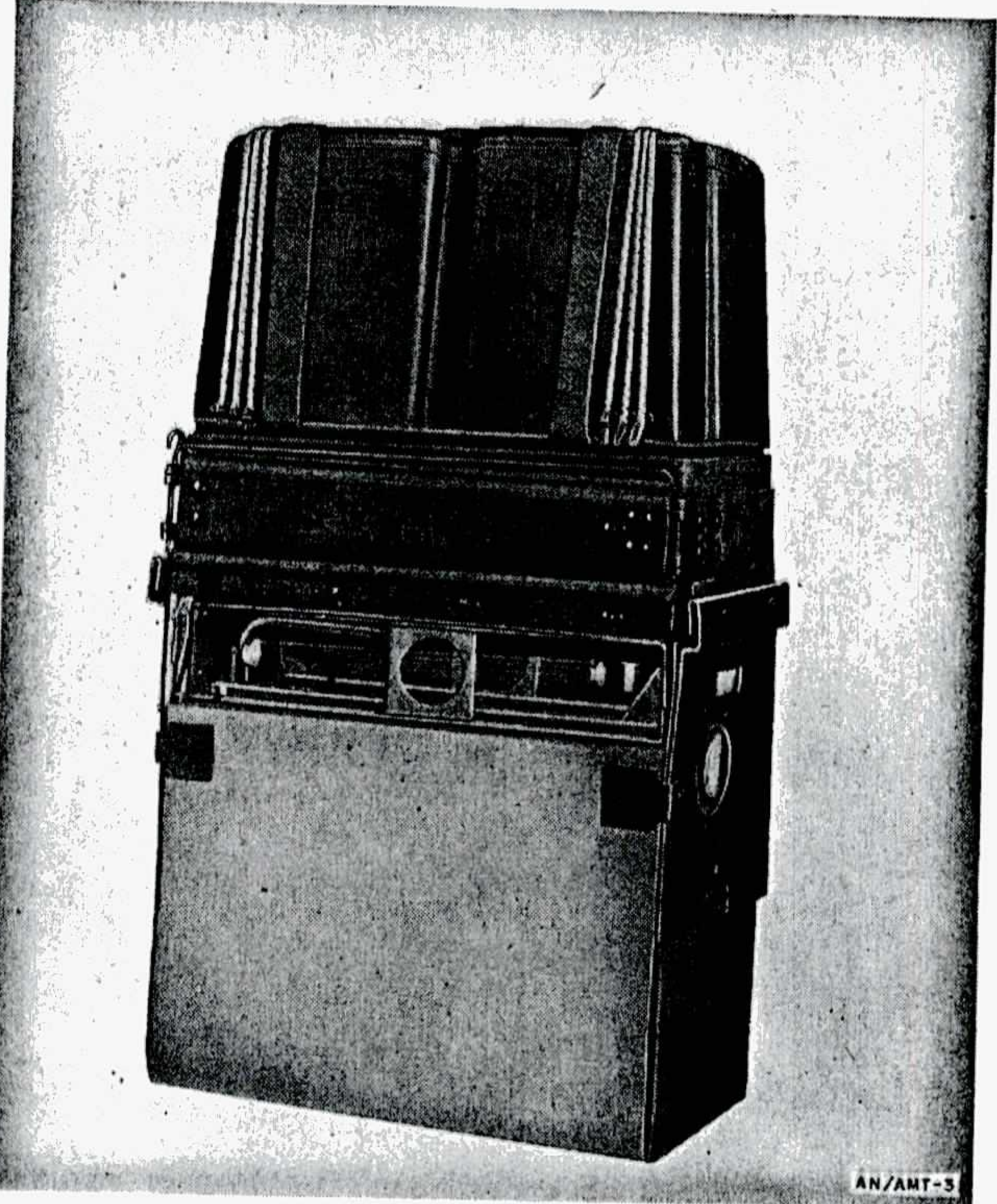


Figure 4. Radiosonde AN/AMT-3, assembled for operation.

Status: Standard. Stock No.: 7A8325-3. Reference: TM 11-2431.

Radiosonde AN/AMT-3 is an instrument designed for taking meteorological soundings of a vertical column of the atmosphere. The radiosonde is dropped from a weather reconnaissance aircraft and descends by parachute. During its descent, the instrument transmits signals in Morse code that provide data from which measurements of the pressure, temperature, and relative humidity of the atmosphere through which the

radiosonde passes can be determined. These signals may be received by the aircraft from which the radiosonde was released or by other suitable receivers within range of the transmitter. Radiosonde AN/AMT-3 is used in arctic or remote ocean areas, where the installation of ground equipment is impractical, to obtain information for use in weather forecasting and aircraft operation planning.

TECHNICAL CHARACTERISTICS

- TYPE OF ELEMENT**
 TEMPERATURE: Bimetal thermometer.
 PRESSURE: Double-bellows aneroid cell.
 HUMIDITY: Hair hygrometer.
- RANGE OF MEASUREMENTS**
 ATMOSPHERIC PRESSURE: 250 mb to 1,060 mb.
 TEMPERATURE: -80° C to +60° C.
 RELATIVE HUMIDITY: 15 percent to 100 percent.
- EFFECTIVE RANGE:** Between 35,000 ft altitude and sea level.
- RATE OF DESCENT:** 1,200 fpm, or less.
- TRANSMITTER**
 TYPE: Single-tube, crystal-controlled, c-w.
 FREQUENCY RANGE: 2 to 6 mc.
 PRESET FREQUENCY: 3,135 kc.
 TUBE: 3A4.
 POWER OUTPUT: Approx .3 w.
 RANGE: Up to 200 mi.
 ANTENNA: End-fed, half-wave vertical.
 POWER SUPPLY: 2 Batteries BA-67 (not furnished with the equipment).
 SIGNALS RECEIVED BY: Radio Receiver BC-348 (any model) or any other c-w receiver of suitable frequency range.

WEIGHT AND VOLUME

Unpacked and assembled for flight, Radiosonde AN/AMT-3 weighs approximately 7¼ pounds. The over-all, outside dimensions of each packaged radiosonde are 10⅞ x 6⅝ x 19¼ inches (.78 cu ft). Several packaged radisondes are packed together in a nailed, wooden box.

AN/AMT-3

PRINCIPAL COMPONENTS

AN/AMT-2:

Radiosonde Modulator ML-310/AMT-1 or ML-310A/AMT-1, ML-310B/AMT-1, ML-310D/AMT-1, or ML-310E/AMT-1.

Radiosonde Transmitter T-69/AMT-2 (any model).

AN/AMT-2A:

Sensing Element (includes Temperature Element ML-419/AMT-4 and Humidity Element ML-418/AMT-4).

Transmitting Element.

WEIGHTS AND VOLUMES

AN/AMT-2:

Note. Radiosonde Modulators ML-310/AMT-1 and Radiosonde Transmitters T-69/AMT-2 are packed separately, each 21 to a container.

	<i>Export packed</i>	
	<i>Weight (lb)</i>	<i>Volume (cu ft)</i>
Radiosonde Modulator ML-310/AMT-1 (any model).....	65	3.82
Radiosonde Transmitter T-69/AMT-2 (any model).....	64	4.05

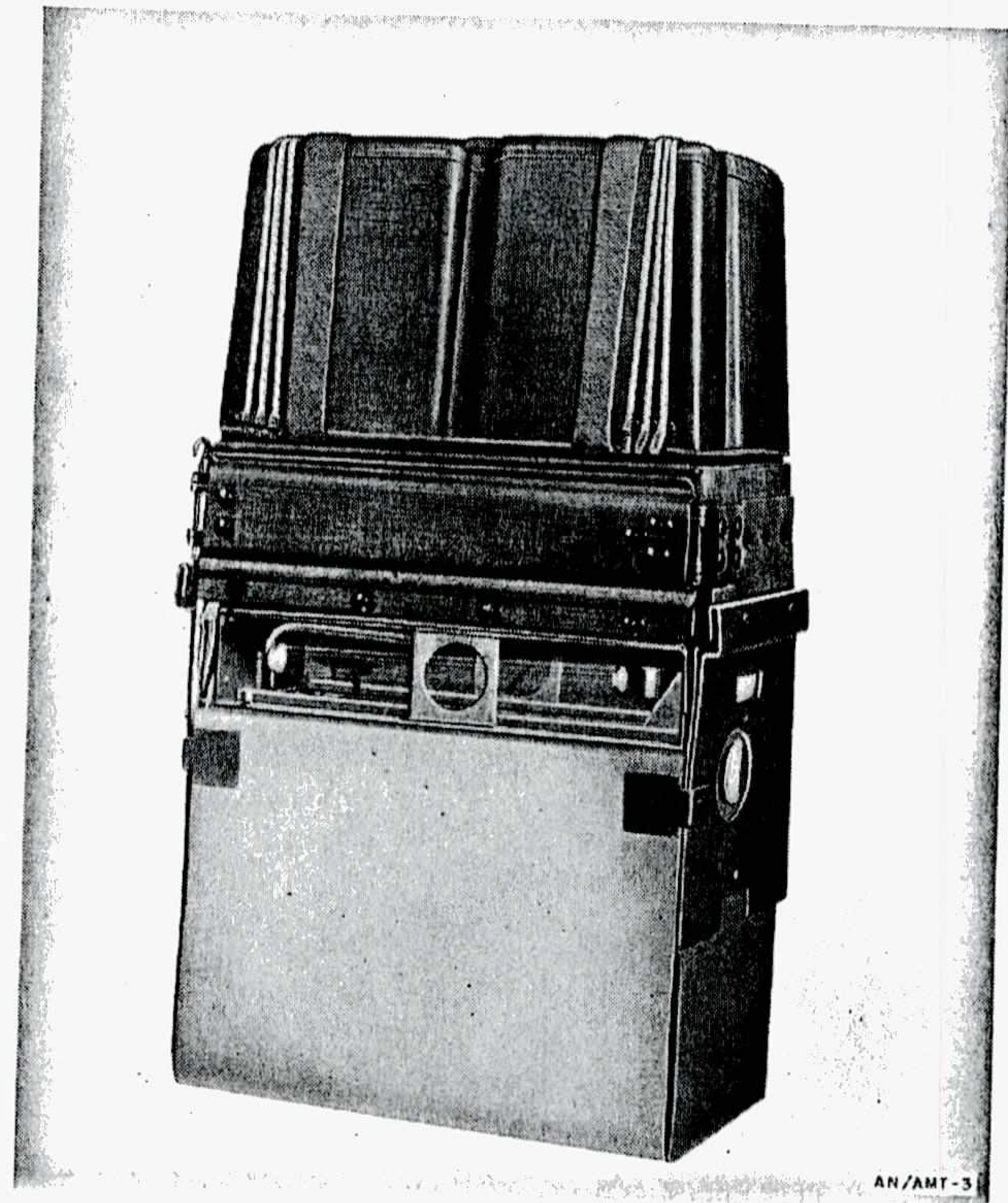


Figure 4. Radiosonde AN/AMT-3, assembled for operation.

Status: Standard. *Stock No.:* 7A8325-3. *Reference:* TM 11-2431.

Radiosonde AN/AMT-3 is an instrument designed for taking meteorological soundings of a vertical column of the atmosphere. The radiosonde is dropped from a weather reconnaissance aircraft and descends by parachute. During its descent, the instrument transmits signals in Morse code that provide data from which measurements of the pressure, temperature, and relative humidity of the atmosphere through which the

radiosonde passes can be determined. These signals may be received by the aircraft from which the radiosonde was released or by other suitable receivers within range of the transmitter. Radiosonde AN/AMT-3 is used in arctic or remote ocean areas, where the installation of ground equipment is impractical, to obtain information for use in weather forecasting and aircraft operation planning.

TECHNICAL CHARACTERISTICS

TYPE OF ELEMENT

- TEMPERATURE: Bimetal thermometer.
- PRESSURE: Double-bellows aneroid cell.
- HUMIDITY: Hair hygrometer.

RANGE OF MEASUREMENTS

- ATMOSPHERIC PRESSURE: 250 mb to 1,060 mb.
- TEMPERATURE: -80° C to +60° C.
- RELATIVE HUMIDITY: 15 percent to 100 percent.
- EFFECTIVE RANGE: Between 35,000 ft altitude and sea level.

RATE OF DESCENT: 1,200 fpm, or less.

TRANSMITTER

- TYPE: Single-tube, crystal-controlled, c-w.
- FREQUENCY RANGE: 2 to 6 mc.
- PRESET FREQUENCY: 3,135 kc.
- TUBE: 3A4.
- POWER OUTPUT: Approx .3 w.
- RANGE: Up to 200 mi.
- ANTENNA: End-fed, half-wave vertical.
- POWER SUPPLY: 2 Batteries BA-67 (not furnished with the equipment).
- SIGNALS RECEIVED BY: Radio Receiver BC-348 (any model) or any other c-w receiver of suitable frequency range.

WEIGHT AND VOLUME

Unpacked and assembled for flight, Radiosonde AN/AMT-3 weighs approximately 7¼ pounds. The over-all, outside dimensions of each packaged radiosonde are 10⅞ x 6⅞ x 19¼ inches (.78 cu ft). Several packaged radisondes are packed together in a nailed, wooden box.

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MODIFIED HANDLING AUTHORIZED AN/AMT-4

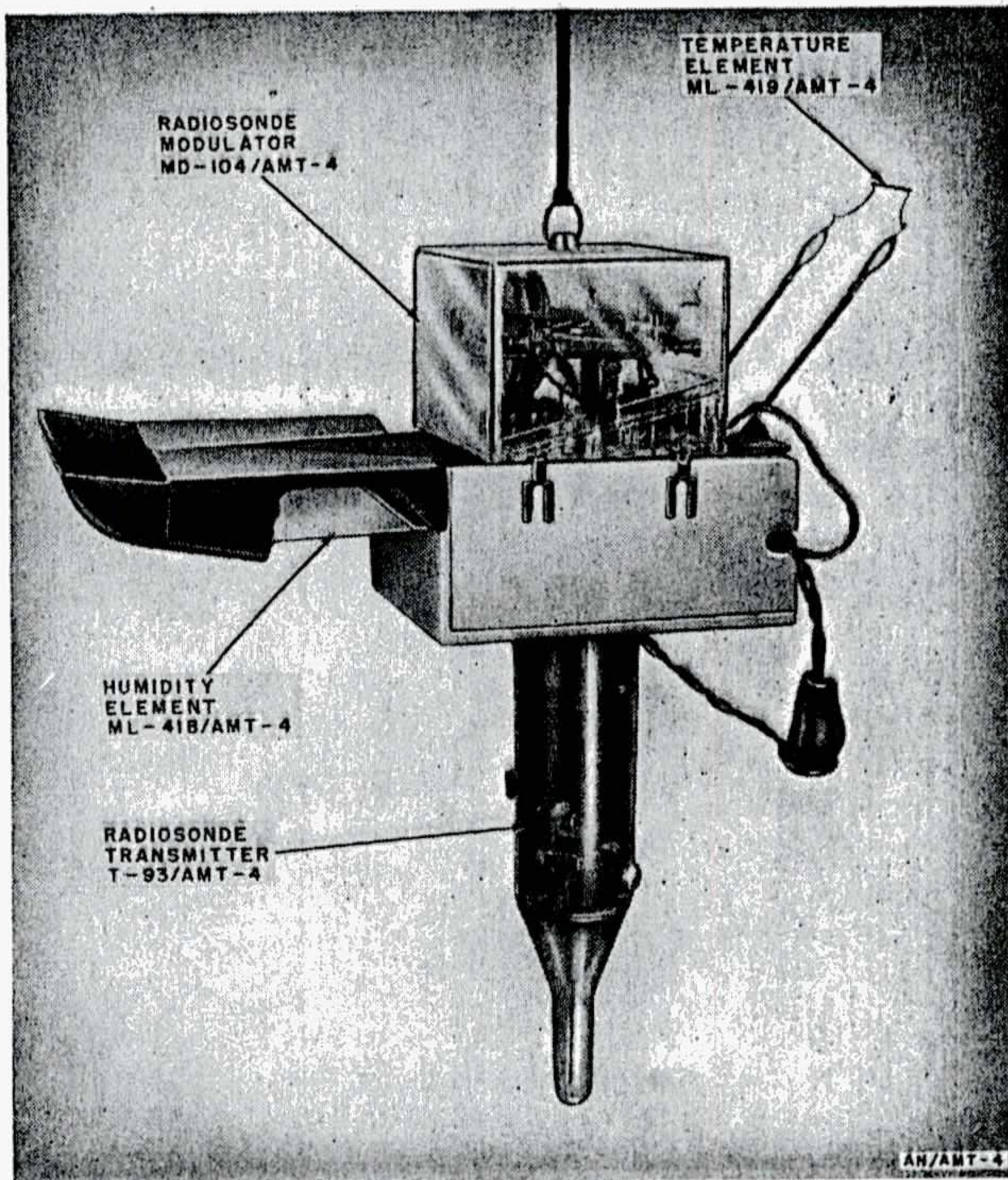


Figure 5. Radiosonde AN/AMT-4.

Status: Standard. Stock No.: 7A8325-4. Reference: TM 11-2432.

Radiosonde AN/AMT-4 is a meteorological instrument which is sent aloft, suspended from a free balloon, to obtain meteorological soundings of the upper atmosphere. It automatically transmits amplitude-modulated, radio-frequency signals, interrupted at a frequency which varies in accordance with the conditions of temperature and humidity of the atmosphere at the altitude of the radiosonde. A baroswitch connects the circuits to the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These signals are received, recorded, and interpreted at a ground receptor

station. Radiosonde AN/AMT-4 produces, also, a signal by means of which it may be tracked by a radio direction finder, so that wind direction and speed may be determined. The data obtained are used in weather forecasting, for planning aircraft operations, and for calculating corrections to compensate for the effects of wind and air density on artillery fire.

TECHNICAL CHARACTERISTICS

RANGE OF MEASUREMENTS

ATMOSPHERIC PRESSURE: 1,060 mb to 5 mb.

TEMPERATURE: +60° C to -90° C.

RELATIVE HUMIDITY: 15 percent to 100 percent.

EFFECTIVE ALTITUDE: Approx 100,000 ft.

RADIOSONDE TRANSMITTER T-93/AMT-4.

FREQUENCY RANGE: 1,600 to 1,700 mc.

PRESET FREQUENCY: 1,680 mc \pm 2 mc.

TYPE OF SIGNAL: A-m.

MODULATED BY: Blocking oscillator.

ANTENNA: Dipole.

TUBES: 5794 (cavity tube) and 1U4.

POWER SUPPLY: Battery Pack BA-259/AM or Battery Pack BB-208/AMT plus 1 additional Battery BB-51 (batteries used with, but not furnished with, the radiosonde).

SIGNALS RECEIVED BY: Rawin Set, AN/GMD-1.

SIGNALS RECORDED BY: Radiosonde Receptor AN/FMQ-1 or AN/FMQ-1A.

PRINCIPAL COMPONENTS

Radiosonde Modulator MD-104/AMT-4 (includes Temperature Element ML-419/AMT-4 and Humidity Element ML-418/AMT-4).

Radiosonde Transmitter T-93/AMT-4.

WEIGHTS

	Unpacked (ea)
Radiosonde Modulator MD-104/AMT-4	350 grams.
Radiosonde Transmitter T-93/AMT-4	300 grams.
Battery Pack BA-259/AM (not furnished)	500 grams.
Battery Pack BB-208/AMT and 1 Battery BB-51 (not furnished).	686 grams.

Note. For shipment, 24 modulators with accessories and spare parts are packaged together in one shipping container, and 24 transmitters are packaged together in a second shipping container.

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MODIFIED HANDLING AUTHORIZED AN/AMT-4

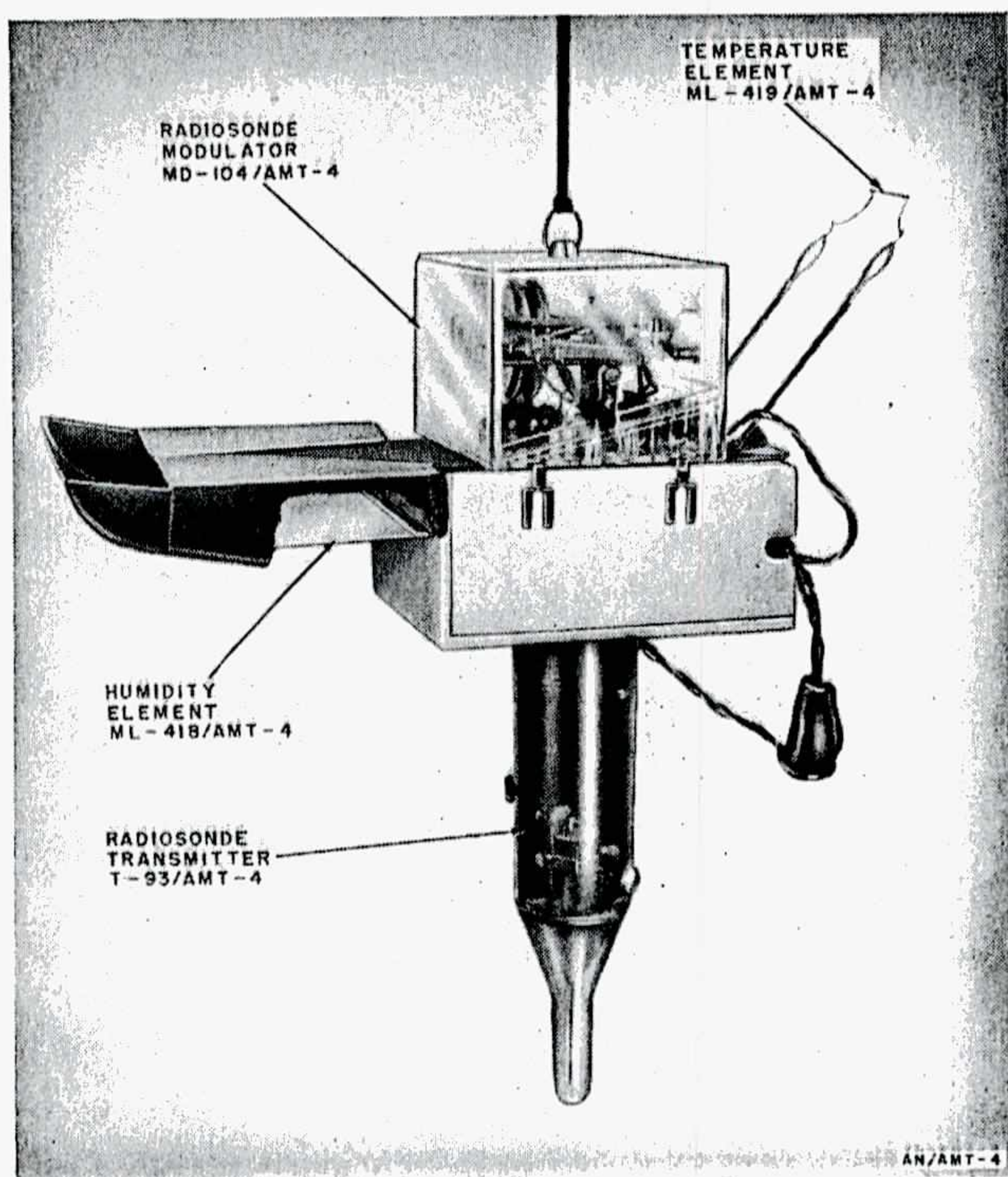


Figure 5. Radiosonde AN/AMT-4.

Status: Standard. Stock No.: 7A8325-4. Reference: TM 11-2432.

Radiosonde AN/AMT-4 is a meteorological instrument which is sent aloft, suspended from a free balloon, to obtain meteorological soundings of the upper atmosphere. It automatically transmits amplitude-modulated, radio-frequency signals, interrupted at a frequency which varies in accordance with the conditions of temperature and humidity of the atmosphere at the altitude of the radiosonde. A baroswitch connects the circuits to the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These signals are received, recorded, and interpreted at a ground receptor

station. Radiosonde AN/AMT-4 produces, also, a signal by means of which it may be tracked by a radio direction finder, so that wind direction and speed may be determined. The data obtained are used in weather forecasting, for planning aircraft operations, and for calculating corrections to compensate for the effects of wind and air density on artillery fire.

TECHNICAL CHARACTERISTICS

RANGE OF MEASUREMENTS

ATMOSPHERIC PRESSURE: 1,060 mb to 5 mb.

TEMPERATURE: +60° C to -90° C.

RELATIVE HUMIDITY: 15 percent to 100 percent.

EFFECTIVE ALTITUDE: Approx 100,000 ft.

RADIOSONDE TRANSMITTER T-93/AMT-4.

FREQUENCY RANGE: 1,600 to 1,700 mc.

PRESET FREQUENCY: 1,680 mc \pm 2 mc.

TYPE OF SIGNAL: A-m.

MODULATED BY: Blocking oscillator.

ANTENNA: Dipole.

TUBES: 5794 (cavity tube) and 1U4.

POWER SUPPLY: Battery Pack BA-259/AM or Battery Pack BB 208/AMT plus 1 additional Battery BB 51 (batteries used with, but not furnished with, the radiosonde).

SIGNALS RECEIVED BY: Rawin Set, AN/GMD 1.

SIGNALS RECORDED BY: Radiosonde Receptor AN/FMQ-1 or AN/FMQ 1A.

PRINCIPAL COMPONENTS

Radiosonde Modulator MD 104/AMT 4 (includes Temperature Element ML 419/AMT-4 and Humidity Element ML-418/AMT-4).

Radiosonde Transmitter T-93/AMT-4.

WEIGHTS

	Unpacked (ca)
Radiosonde Modulator MD 104/AMT-4	350 grams.
Radiosonde Transmitter T-93/AMT-4	300 grams.
Battery Pack BA-259/AM (not furnished)	500 grams.
Battery Pack BB 208/AMT and 1 Battery BB-51 (not furnished).	686 grams.

Note. For shipment, 24 modulators with accessories and spare parts are packaged together in one shipping container, and 24 transmitters are packaged together in a second shipping container.

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Figure 6. Radiosonde Receptor AN/FMQ-1.

TECHNICAL CHARACTERISTICS

- RADIOSONDE RECEIVER R-17/FMQ-1
 - TYPE: Superregenerative.
 - R-F RANGE: 56 to 85 mc.
 - TYPE OF SIGNALS RECEIVED: A-m.
 - NUMBER OF TUBES: 8.
 - POWER REQUIREMENT: 115-v to 125-v, 60-cyc ac.
 - ANTENNA: Coaxial vertical dipole.
- FREQUENCY METER TS-29/FMQ-1
 - A-F RANGE: 0 to 200 cps.
 - NUMBER OF TUBES: 8.
 - POWER REQUIREMENT: 115-v, 60-cyc ac.
- RADIOSONDE RECORDER RD-3/FMQ-1
 - CURRENT RANGE: 0 to 500 ma.
 - NUMBER OF TUBES: 2.
 - RATE OF PAPER FEED: .4 in. per minute.
- AMPLIFIER AM-7/FMQ-1
 - TYPE: Pulse.
 - NUMBER OF TUBES: 6.
 - POWER REQUIREMENT: 115-v, 60-cyc ac.
- VOLTAGE REGULATOR CN-2/FMQ-1
 - INPUT VOLTAGE: 105 v to 125 v.
 - INPUT CURRENT: 2.3 amp.
 - INPUT FREQUENCY: 60 ± 2 cps.
 - OUTPUT VOLTAGE: 115 v, ± .5 percent.
 - OUTPUT CURRENT: 1.3 amp.
 - PHASE: Single.
- ANTENNA ASSEMBLY AS-11/FMQ-1
 - TYPE: Coaxial vertical dipole.
 - TRANSMISSION LINE: Radio-Frequency Cable RG-11/U, flexible coaxial (solid dielectric); 75-ohm nominal impedance; 200 ft lg.

Note. The technical characteristics listed above for the individual components of Radiosonde Receptor AN/FMQ-1(*) apply equally to any model of the component.

PRINCIPAL COMPONENTS

- Radiosonde Receiver R-17/FMQ-1
- Radiosonde Recorder RD-3/FMQ-1
- Frequency Meter TS-29/FMQ-1
- Amplifier AM-7/FMQ-1
- Voltage Regulator CN-2/FMQ-1
- Rack Assembly MT-47/FMQ-1
- Antenna Assembly AS-11/FMQ-1 (two)

Note. Any model of any of the above equipments may be used as a component of Radiosonde Receptor AN/FMQ-1(*) .

WEIGHTS AND VOLUMES

	Domestic packed	Export packed
Total weight (lb).....	1,015	1,309
Total volume (cu ft).....	96	138.1
Ship tons.....		3.45

Status: Limited/Std. Stock No.: 7A1326. Reference: TM 11-2403.

Radiosonde Receptor AN/FMQ-1(*) represents Radiosonde Receptors AN/FMQ-1 and AN/FMQ-1A. Radiosonde Receptor AN/FMQ-1(*) is an assembly of electronic and electromechanical devices especially designed to receive, indicate, and record in printed form radio-frequency signals modulated at an audio-frequency rate that are transmitted by radiosondes such as Radiosondes AN/AMT-1 and AN/AMT-2. The receptor can be used independently for 72.2-megacycle operation (AN/AMT-1); for 403-megacycle operation (AN/AMT-2), Radio Set SCR-658 is used in conjunction with the receptor. All the components of Radiosonde Receptor AN/FMQ-1(*), except the antennas, are mounted on one rack.



Figure 6. Radiosonde Receptor AN/FMQ-1.

Status: Limited/Std. Stock No.: 7A1326. Reference: TM 11-2403.

Radiosonde Receptor AN/FMQ-1(*) represents Radiosonde Receptors AN/FMQ-1 and AN/FMQ-1A. Radiosonde Receptor AN/FMQ-1(*) is an assembly of electronic and electromechanical devices especially designed to receive, indicate, and record in printed form radio-frequency signals modulated at an audio-frequency rate that are transmitted by radiosondes such as Radiosondes AN/AMT-1 and AN/AMT-2. The receptor can be used independently for 72.2-megacycle operation (AN/AMT-1); for 403-megacycle operation (AN/AMT-2), Radio Set SCR-658 is used in conjunction with the receptor. All the components of Radiosonde Receptor AN/FMQ-1(*), except the antennas, are mounted on one rack.

TECHNICAL CHARACTERISTICS

- RADIOSONDE RECEIVER R-17/FMQ-1**
TYPE: Superregenerative.
R-F RANGE: 56 to 85 mc.
TYPE OF SIGNALS RECEIVED: A-m.
NUMBER OF TUBES: 8.
POWER REQUIREMENT: 115-v to 125-v, 60-eye ac.
- ANTENNA: Coaxial vertical dipole.**
- FREQUENCY METER TS-29/FMQ-1**
A-F RANGE: 0 to 200 cps.
NUMBER OF TUBES: 8.
POWER REQUIREMENT: 115-v, 60-eye ac.
- RADIOSONDE RECORDER RD-3/FMQ-1**
CURRENT RANGE: 0 to 500 ma.
NUMBER OF TUBES: 2.
RATE OF PAPER FEED: .4 in. per minute.
- AMPLIFIER AM-7/FMQ-1**
TYPE: Pulse.
NUMBER OF TUBES: 6.
POWER REQUIREMENT: 115-v, 60-eye ac.
- VOLTAGE REGULATOR CN-2/FMQ-1**
INPUT VOLTAGE: 105 v to 125 v.
INPUT CURRENT: 2.3 amp.
INPUT FREQUENCY: 60 ± 2 cps.
OUTPUT VOLTAGE: 115 v, ± .5 percent.
OUTPUT CURRENT: 1.3 amp.
PHASE: Single.
- ANTENNA ASSEMBLY AS-11/FMQ-1**
TYPE: Coaxial vertical dipole.
- TRANSMISSION LINE: Radio-Frequency Cable RG-11/U, flexible coaxial (solid dielectric); 75-ohm nominal impedance; 200 ft lg.**

Note. The technical characteristics listed above for the individual components of Radiosonde Receptor AN/FMQ-1(*) apply equally to any model of the component.

PRINCIPAL COMPONENTS

- Radiosonde Receiver R-17/FMQ-1
- Radiosonde Recorder RD-3/FMQ-1
- Frequency Meter TS-29/FMQ-1
- Amplifier AM-7/FMQ-1
- Voltage Regulator CN-2/FMQ-1
- Rack Assembly MT-47/FMQ-1
- Antenna Assembly AS-11/FMQ-1 (two)

Note. Any model of any of the above equipments may be used as a component of Radiosonde Receptor AN/FMQ-1(*) .

WEIGHTS AND VOLUMES

	Domestic packed	Export packed
Total weight (lb).....	1,015	1,309
Total volume (cu ft).....	96	138.1
Ship tons.....		3.45

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AN/FMQ-2
TECHNICAL CHARACTERISTICS

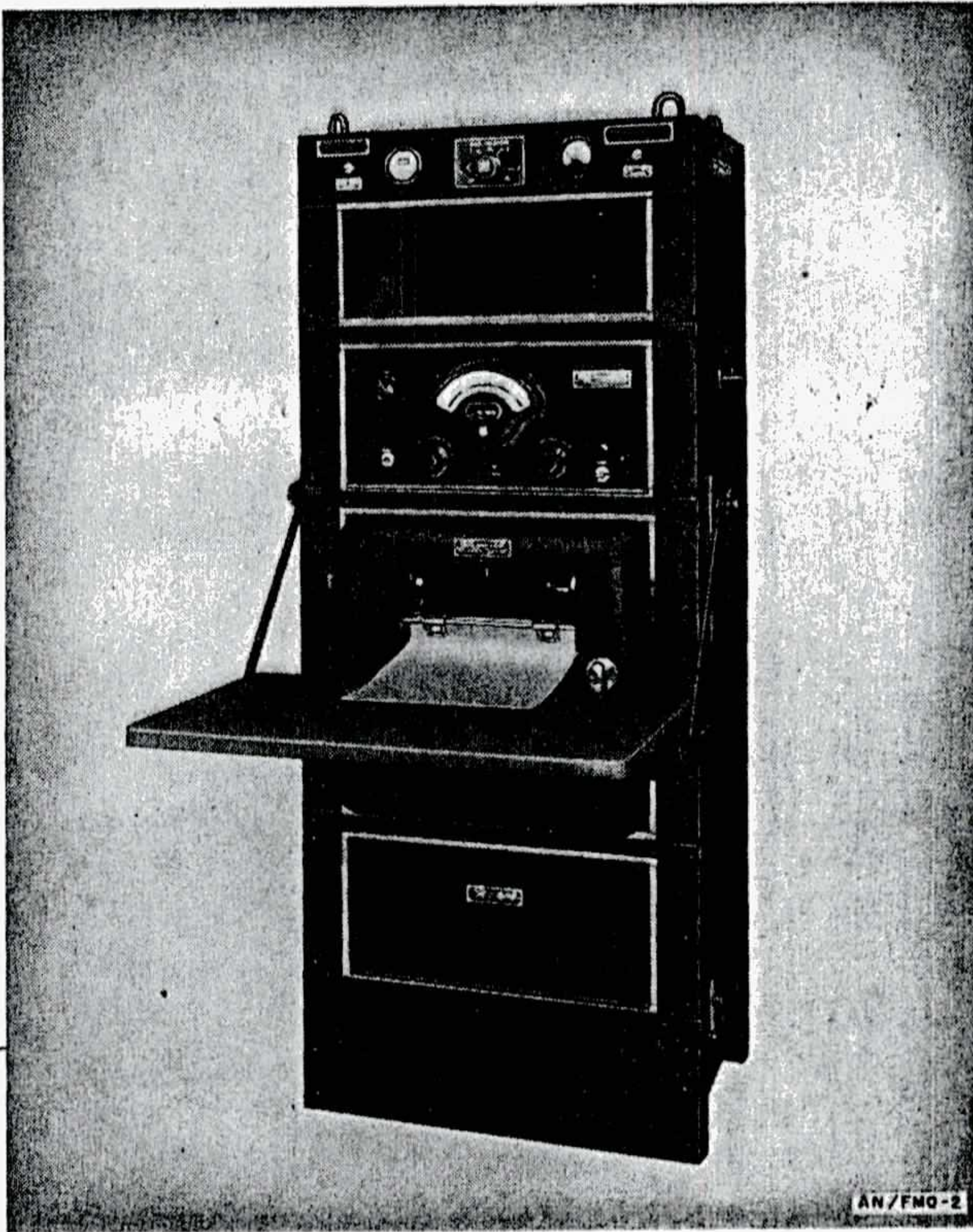


Figure 7. Radiosonde Receptor AN/FMQ-2, less Radiosonde Receiver R-228/FMQ-2 and Antenna Assembly AS-289/FMQ-2.

Status: Standard. Stock No.: 7A1326-2. Reference: TB 11-2403-4.

Navships 91266

Radiosonde Receptor AN/FMQ-2 is an assembly of electronic and electromechanical devices especially designed to receive, indicate, and record in printed form radio-frequency signals, frequency-modulated at an audio-frequency rate, that are transmitted by radiosondes such as Radiosondes AN/AMT-2, AN/AMT-2A, and AN/AMT-7 (Navy equipment). When wind speed and direction are desired also, Radio Set SCR-658 is used in conjunction with the receptor to track the radiosonde. All the components of AN/FMQ-2, except the antenna, are mounted on one rack.

- RADIOSONDE RECEIVER R-228/FMQ-2**
TYPE: Superheterodyne.
R-F RANGE: 390 to 410 mc.
INTERMEDIATE FREQUENCY: 21.25 mc.
TYPE OF SIGNALS RECEIVED: F-m and/or pulsed.
NUMBER OF TUBES: 20.
POWER REQUIREMENT: 115-v $\pm 10\%$, 50/60-cyc, single-phase ac; 1.25 amp.
ANTENNA: Vertical, half-wavelength, concentric dipole.
- FREQUENCY METER TS-29B/FMQ-1**
AUDIO-FREQUENCY RANGE: 0 to 200 cps.
NUMBER OF TUBES: 8.
POWER REQUIREMENT: 115-v, 60-cyc ac.
- RADIOSONDE RECORDERS RD-3B/FMQ-1 and RD-3C/FMQ-1**
CURRENT RANGE: 0 to 500 ma.
NUMBER OF TUBES: 2.
RATE OF PAPER FEED: .4 in. per minute.
- AMPLIFIER AM-7B/FMQ-1**
TYPE: Pulse.
NUMBER OF TUBES: 6.
POWER REQUIREMENT: 115-v, 60-cyc ac.
- VOLTAGE REGULATOR CN-2A/FMQ-1**
INPUT VOLTAGE: 105 to 125 v.
INPUT CURRENT: 2.3 amp.
INPUT FREQUENCY: 60 ± 2 cps.
OUTPUT VOLTAGE: 115 v $\pm .5$ percent.
OUTPUT CURRENT: 1.3 amp.
PHASE: Single.
- ANTENNA ASSEMBLY AS-389/FMQ-2**
TYPE: Vertical, half-wave, concentric dipole
CHARACTERISTIC IMPEDANCE: 52 ohms
TRANSMISSION LINE: Radio Frequency Cable RU-8/U, coaxial (solid dielectric); 52 ohms characteristic impedance.

PRINCIPAL COMPONENTS

- Radiosonde Receiver R-228/FMQ-2
- Radiosonde Recorder RD-3B/FMQ-1 or RD-3C/FMQ-1
- Frequency Meter TS-29B/FMQ-1
- Amplifier AM-7B/FMQ-1
- Voltage Regulator CN-2A/FMQ-1
- Rack Assembly MT-678/FMQ-2
- Antenna Assembly AS-389/FMQ-2

WEIGHTS

	<i>Domestic packed</i>	<i>Export packed</i>
Total weight (lb, estimated)	1,036	1,372

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AN/FMQ-2
TECHNICAL CHARACTERISTICS



Figure 7. Radiosonde Receptor AN/FMQ-2, less Radiosonde Receiver R-228/FMQ-2 and Antenna Assembly AS-289/FMQ-2.

Status: Standard. Stock No.: 7A1326-2. Reference: TB 11-2403-4.

Navships 91266

Radiosonde Receptor AN/FMQ-2 is an assembly of electronic and electromechanical devices especially designed to receive, indicate, and record in printed form radio-frequency signals, frequency-modulated at an audio-frequency rate, that are transmitted by radiosondes such as Radiosondes AN/AMT-2, AN/AMT-2A, and AN/AMT-7 (Navy equipment). When wind speed and direction are desired also, Radio Set SCR-658 is used in conjunction with the receptor to track the radiosonde. All the components of AN/FMQ-2, except the antenna, are mounted on one rack.

RADIOSONDE RECEIVER R-228/FMQ-2

TYPE: Superheterodyne.
R-F RANGE: 390 to 410 mc.
INTERMEDIATE FREQUENCY: 21.25 mc.
TYPE OF SIGNALS RECEIVED: F-m and/or pulsed.
NUMBER OF TUBES: 20.
POWER REQUIREMENT: 115-v $\pm 10\%$, 50/60-eye, single-phase ac; 1.25 amp.
ANTENNA: Vertical, half-wavelength, concentric dipole.

FREQUENCY METER TS-29B/FMQ-1

AUDIO-FREQUENCY RANGE: 0 to 200 cps.
NUMBER OF TUBES: 8.
POWER REQUIREMENT: 115-v, 60-eye ac.

RADIOSONDE RECORDERS RD-3B/FMQ-1 and RD-3C/FMQ-1

CURRENT RANGE: 0 to 500 ma.
NUMBER OF TUBES: 2.
RATE OF PAPER FEED: .4 in. per minute.

AMPLIFIER AM-7B/FMQ-1

TYPE: Pulse.
NUMBER OF TUBES: 6.
POWER REQUIREMENT: 115-v, 60-eye ac.

VOLTAGE REGULATOR CN-2A/FMQ-1

INPUT VOLTAGE: 105 to 125 v.
INPUT CURRENT: 2.3 amp.
INPUT FREQUENCY: 60 ± 2 cps.
OUTPUT VOLTAGE: 115 v $\pm .5$ percent.
OUTPUT CURRENT: 1.3 amp.
PHASE: Single.

ANTENNA ASSEMBLY AS-389/FMQ-2

TYPE: Vertical, half-wave, concentric dipole
CHARACTERISTIC IMPEDANCE: 52 ohms
TRANSMISSION LINE: Radio Frequency Cable RU-8/U, coaxial (solid dielectric); 52 ohms characteristic impedance.

PRINCIPAL COMPONENTS

- Radiosonde Receiver R-228/FMQ-2
- Radiosonde Recorder RD-3B/FMQ-1 or RD-3C/FMQ-1
- Frequency Meter TS-29B/FMQ-1
- Amplifier AM-7B/FMQ-1
- Voltage Regulator CN-2A/FMQ-1
- Rack Assembly MT-678/FMQ-2
- Antenna Assembly AS-389/FMQ-2

WEIGHTS

	Domestic packed	Export packed
Total weight (lb, estimated)	1,036	1,372

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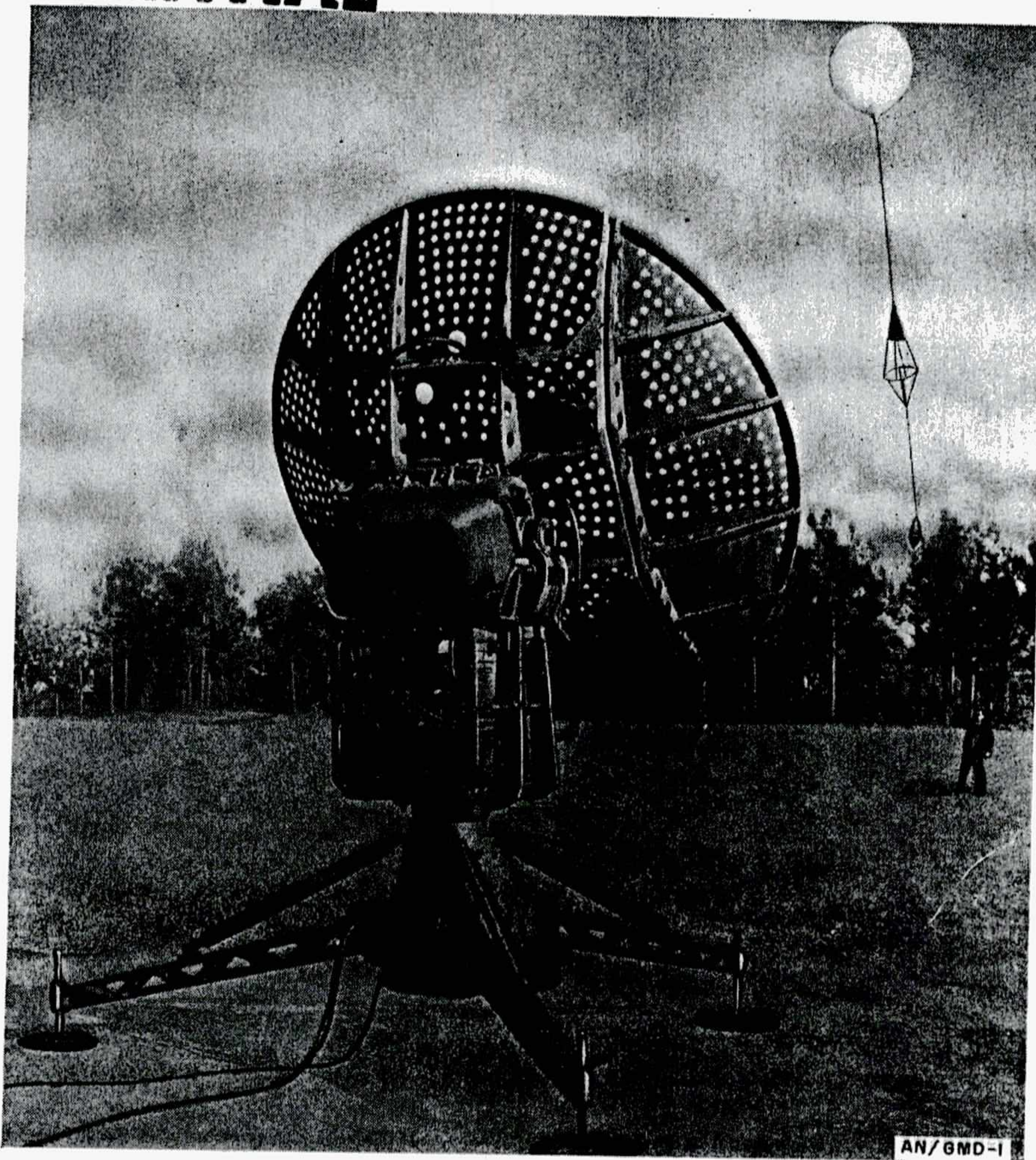


Figure 8. Rawin Set AN/GMD-1, outdoor, over-all view of main assembly.

Status: Standard. Stock No. 7A1332. Reference: TM 11-271.

Rawin Set AN/GMD-1 is a radio direction finder which is designed to track, automatically, a balloon-borne radiosonde to altitudes in excess of 100,000 feet, over horizontal distances up to 125 miles. The set indicates and records the azimuth and elevation angles of the radiosonde, and receives, amplifies, and passes to a recorder the radiosonde amplitude-modulated signals from which temperature, relative humidity, and atmospheric pressure are computed. Wind direction and speed are determined by plotting the azimuth and elevation angles with the altitude (computed from the temperature and pressure data). The equipment consists of a main assembly and control recorder; the main assembly is composed of a supporting pedestal, a radio receiver equipped with a servo system, an elevation unit assembly, an

antenna assembly, and an antenna control. Rawin Set AN/GMD-1 is part of a rawinsonde system which obtains meteorological information used to make weather forecasts and to make corrections for the effects of atmospheric conditions on the trajectory of projectiles.

TECHNICAL CHARACTERISTICS

EFFECTIVE ALTITUDE: 100,000 ft (when used with Radiosonde AN/AMT-4).

EFFECTIVE HORIZONTAL DISTANCE: 125 mi.

TYPES OF SIGNALS RECEIVED: A-m and f-m.

FREQUENCY RANGE: 1,660 to 1,700 mc.

POWER INPUT: 115-v, 60-cyc ac; 1,500 w.

POWER SUPPLY: Provides 105-v dc, regulated; 6.3-v ac; and 180-v dc for use in various systems.

ANTENNA SYSTEM

TYPE OF ANTENNA: Vertical dipole; 2 sections, each $\frac{1}{4}$ wavelength long at 1,680 mc.

TYPE OF REFLECTOR: Parabolic.

TYPE OF SCANNING: Conical.

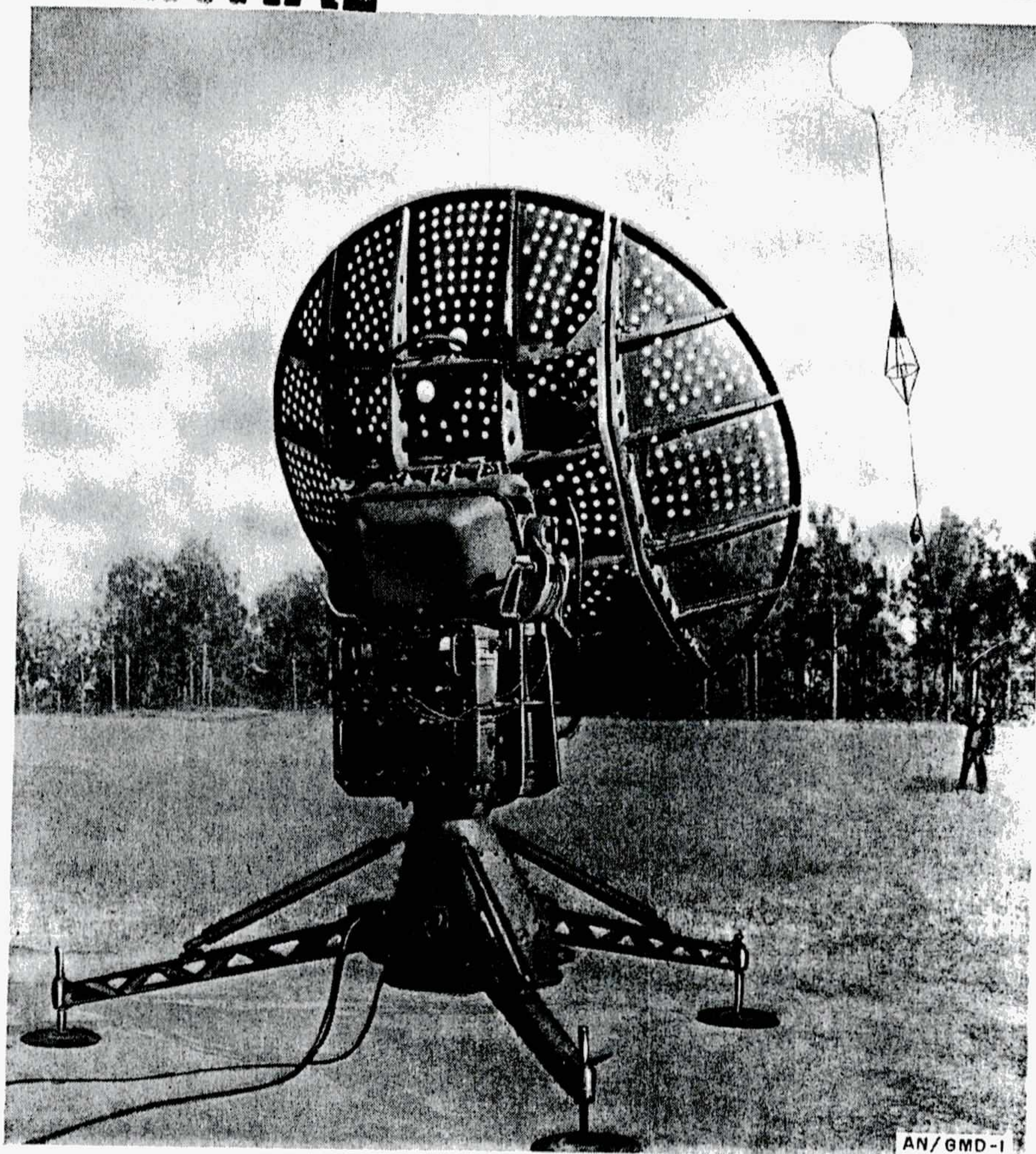


Figure 8. Rawin Set AN/GMD-1, outdoor, over-all view of main assembly.

Status: Standard. Stock No. 7A1332. Reference: TM 11-271.

Rawin Set AN/GMD-1 is a radio direction finder which is designed to track, automatically, a balloon-borne radiosonde to altitudes in excess of 100,000 feet, over horizontal distances up to 125 miles. The set indicates and records the azimuth and elevation angles of the radiosonde, and receives, amplifies, and passes to a recorder the radiosonde amplitude-modulated signals from which temperature, relative humidity, and atmospheric pressure are computed. Wind direction and speed are determined by plotting the azimuth and elevation angles with the altitude (computed from the temperature and pressure data). The equipment consists of a main assembly and control recorder; the main assembly is composed of a supporting pedestal, a radio receiver equipped with a servo system, an elevation unit assembly, an

antenna assembly, and an antenna control. Rawin Set AN/GMD-1 is part of a rawinsonde system which obtains meteorological information used to make weather forecasts and to make corrections for the effects of atmospheric conditions on the trajectory of projectiles.

TECHNICAL CHARACTERISTICS

EFFECTIVE ALTITUDE: 100,000 ft (when used with Radiosonde AN/AMT-4).

EFFECTIVE HORIZONTAL DISTANCE: 125 mi.

TYPES OF SIGNALS RECEIVED: A-m and f-m.

FREQUENCY RANGE: 1,660 to 1,700 mc.

POWER INPUT: 115-v, 60-cyc ac; 1,500 w.

POWER SUPPLY: Provides 105-v dc, regulated; 6.3-v ac; and 180-v dc for use in various systems.

ANTENNA SYSTEM

TYPE OF ANTENNA: Vertical dipole; 2 sections, each $\frac{1}{4}$ wavelength long at 1,680 mc.

TYPE OF REFLECTOR: Parabolic.

TYPE OF SCANNING: Conical.

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SPINNER MOTOR: Induction, capacitor start and run; 115-v, 60-cyc ac; 1,750 rpm.

SPINNER GENERATOR: 1,750 rpm; 15-v, 30-cyc ac; 2 phase, 2 wire, self-excited.

RECEIVING SYSTEM

TYPE OF RECEIVER: Superheterodyne.

NORMAL FREQUENCY: 1,680 mc.

INTERMEDIATE FREQUENCY: 30 mc.

FREQUENCY CONTROL: Automatic.

INPUT IMPEDANCE (receiver): 50 ohms.

C-R OSCILLOSCOPE TUBE: 3JP1.

PRESENTATION (selected by oscilloscope setting):

a Error signal; b Modulated rf; c Relative position of transmitter.

ANTENNA POSITIONING SYSTEM

TRACKING: 3 types; automatic, local manual, remote manual.

DRIVE MOTORS (elevation and azimuth); 60-v dc, 1.4 amp split stator, reversible; 1/20 hp at 5,000 rpm.

TACHOMETER GENERATORS (elevation and azimuth): 2.1-v dc at 100 rpm; self-excited, permanent magnet.

POSITION INDICATION AND RECORDING SYSTEM

SYNCHRO GENERATORS (elevation and azimuth): Type IV single-phase, self-synchronous; energizing voltage 115-v, 60-cyc ac.

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SYNCHRO MOTORS (elevation and azimuth):

Type V single-phase, self-synchronous; energizing voltage 115-v, 60-cyc ac.

TYPE OF RECORDING: Time, elevation angles, and azimuth angles printed on tape.

PRINTER MOTOR: 115-v, 60-cyc ac, synchronous type; capacitor run; single phase.

USED WITH: Radiosonde AN/AMT-4; Radiosonde Receptor AN/FMQ-1.

PRINCIPAL COMPONENTS

Pedestal AB-159/GMD-1

Antenna Assembly AS-462/GMD-1

Antenna Control C-578/GMD-1

Receiver R-301/GMD-1

Control Recorder CM-577/GMD-1

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb).....	2, 140	3, 654
Total volume (cu ft).....	155. 83 (approx)	242. 5
Ship tons.....		6. 6

Note. For export shipment, Rawin Set AN/GMD-1 is packed in 11 wooden crates. For domestic shipment, the outrigger assembly, the antenna reflector sections, and the two cable reels are shipped unpacked; the other components are shipped in seven transit cases. Usually, all components are arranged and transported in a 1-ton trailer.

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AN/GMQ-1(*)

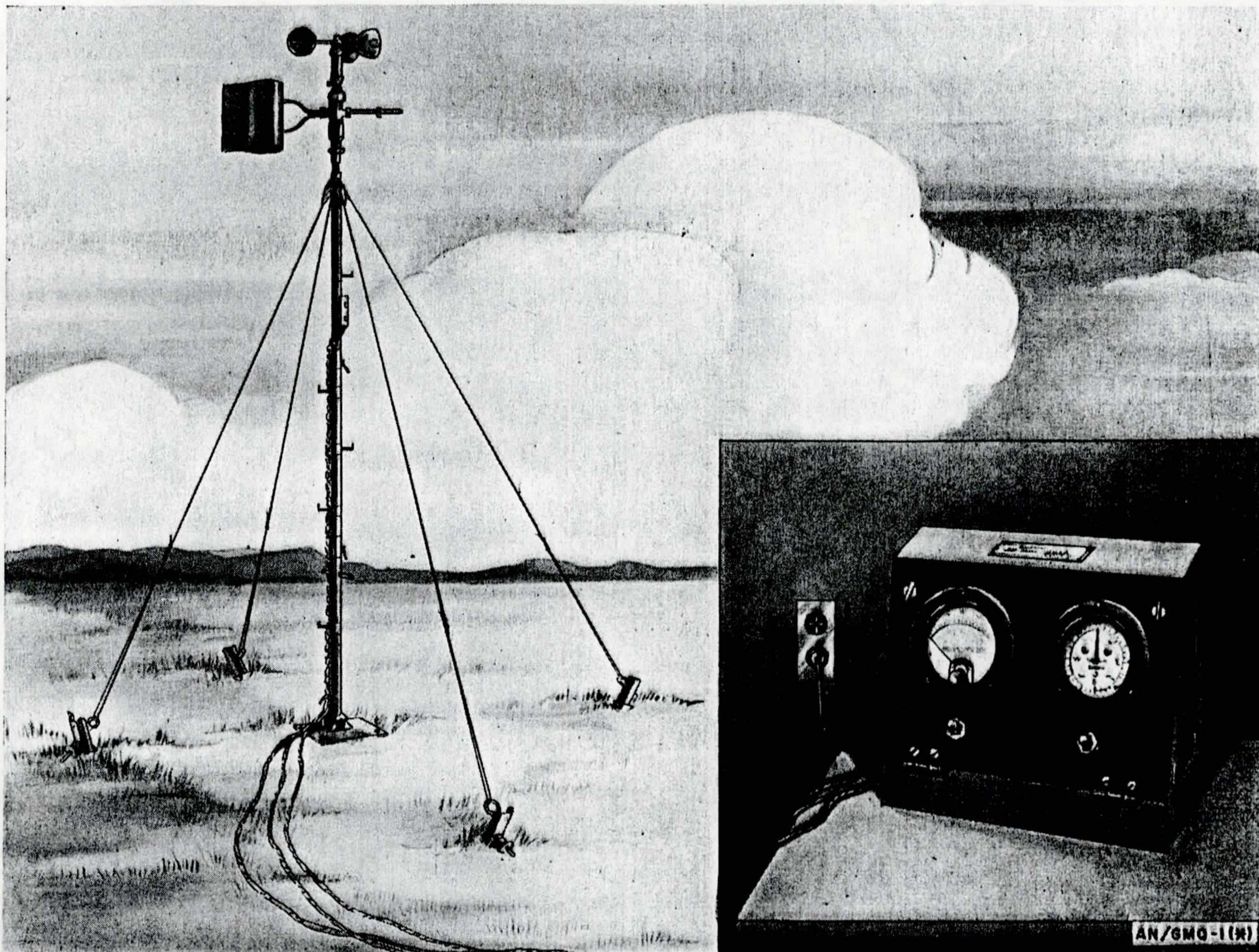


Figure 9. Wind Equipment AN/GMQ-1A in use.

Status: Standard. Stock No.: 7A3400-1. Reference: TM 11-429.

Wind Equipment AN/GMQ-1(*) represents Wind Equipments AN/GMQ-1 and AN/GMQ-1A. Wind Equipment AN/GMQ-1(*) consists of a support, a wind transmitter (anemometer and wind vane) for measuring, and a wind panel for indicating the instantaneous speed and direction of surface winds. Carrying cases are provided for transporting the equipment. The support may be installed permanently on the roof of a building or semipermanently anywhere on the ground. The wind panel is installed indoors wherever it is convenient. Wind Equipment AN/GMQ-1A has a transmitter made from improved corrosion-resistant material and includes a rectifier power unit and connecting cord which permit operation of the equipment from a 115-volt, 60-cycle power source.

TECHNICAL CHARACTERISTICS

WIND SPEED SYSTEM

ANEMOMETER: Cup-rotor, a-c generator type.

RANGE: 2 to 150 mph.

POWER REQUIREMENT: None.

WIND DIRECTION SYSTEM

WIND VANE ASSEMBLY: Vane shell, vane tail, and counterbalance; includes a rheostat unit.

POWER REQUIREMENT: 4 Batteries BA-30, connected in series-parallel, furnishing 3-v dc; or Rectifier Power Unit PP-196/GMQ-1 (supplied with AN/GMQ-1A only, but when available may be used with AN/GMQ-1) furnishing 24-v dc when connected to a 115-v a-c source.

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AN/GMQ-1(*)

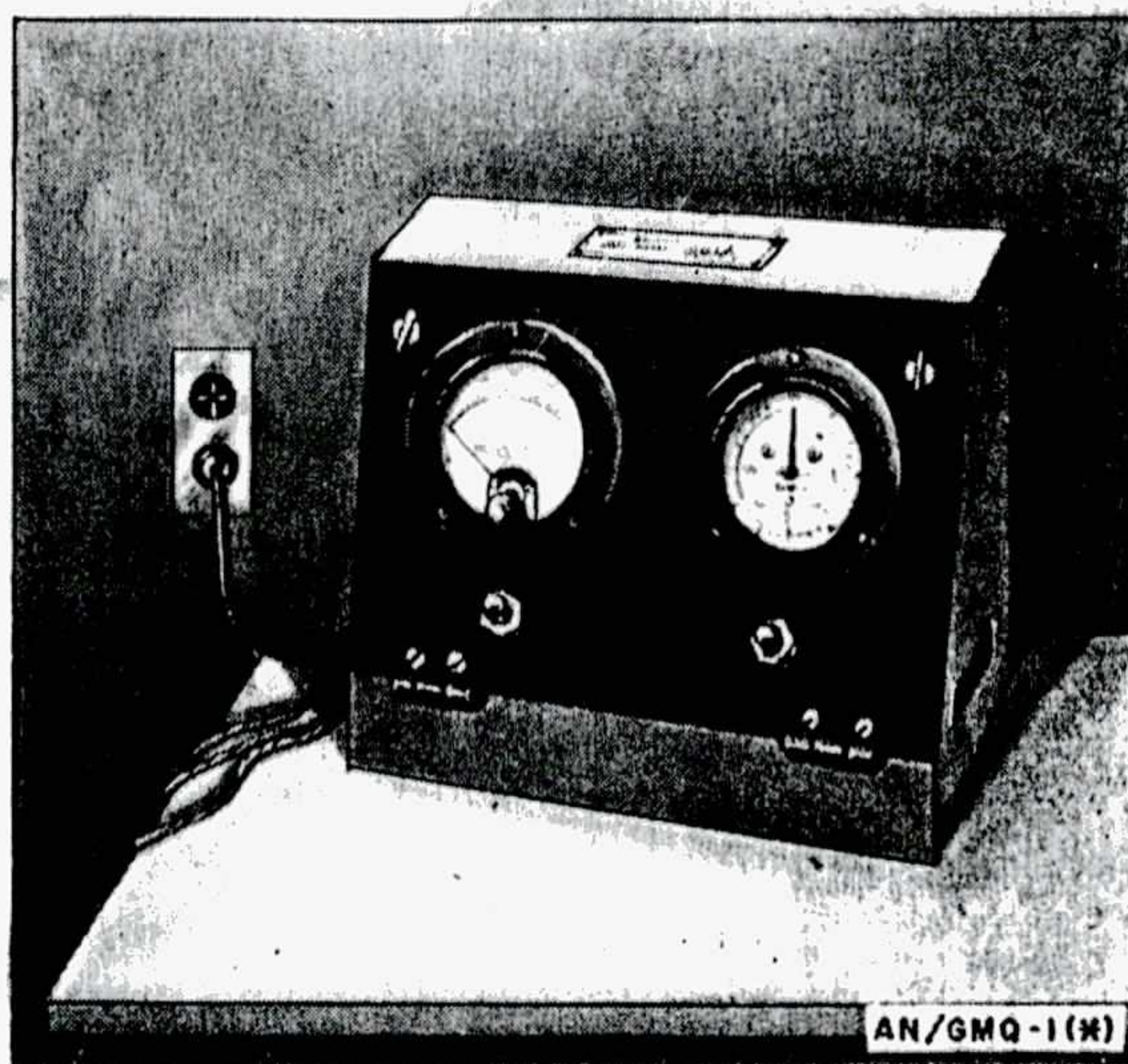
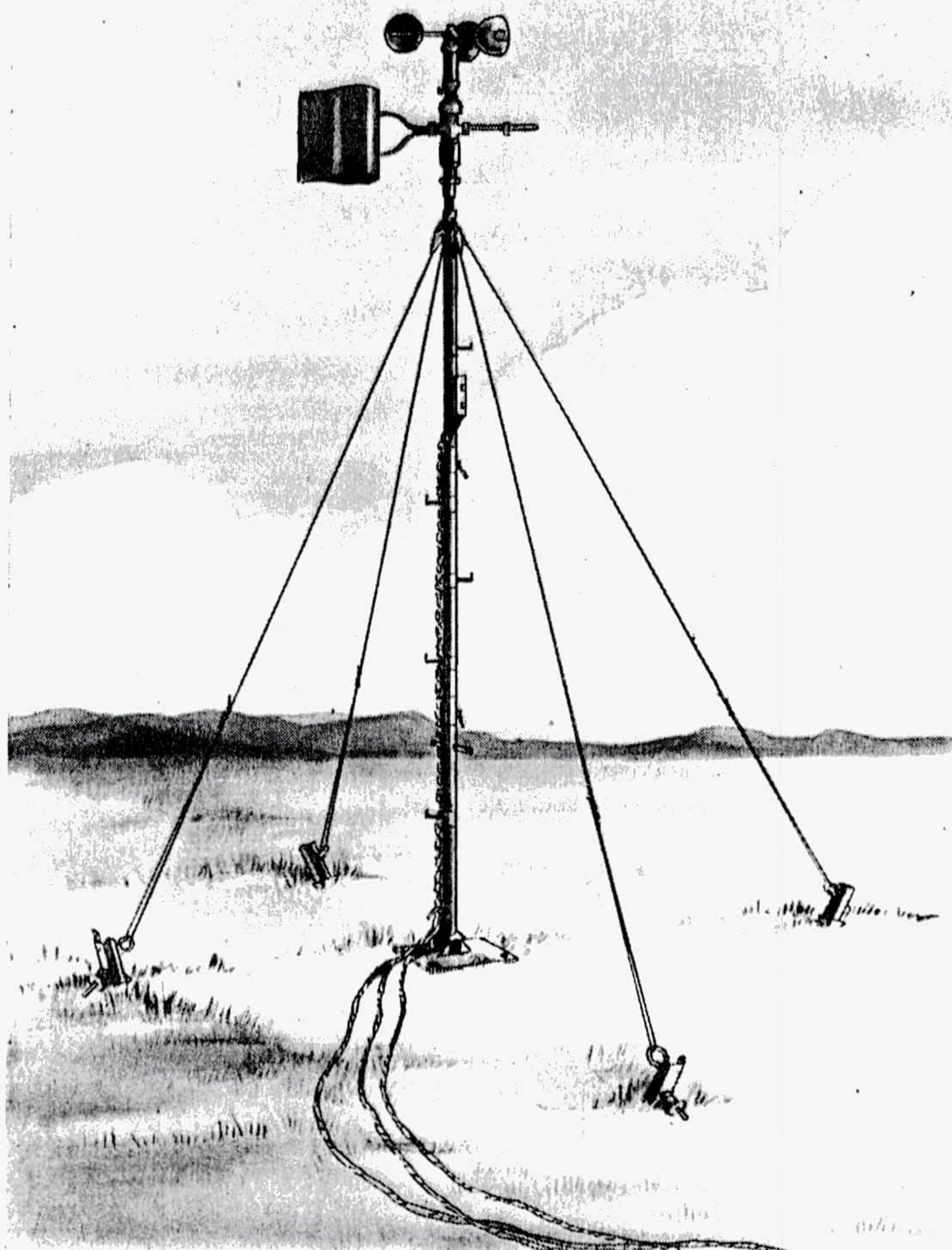


Figure 9. Wind Equipment AN/GMQ-1A in use.

Status: Standard. Stock No.: 7A3400-1. Reference: TM 11-429.

Wind Equipment AN/GMQ-1(*) represents Wind Equipments AN/GMQ-1 and AN/GMQ-1A. Wind Equipment AN/GMQ-1(*) consists of a support, a wind transmitter (anemometer and wind vane) for measuring, and a wind panel for indicating the instantaneous speed and direction of surface winds. Carrying cases are provided for transporting the equipment. The support may be installed permanently on the roof of a building or semipermanently anywhere on the ground. The wind panel is installed indoors wherever it is convenient. Wind Equipment AN/GMQ-1A has a transmitter made from improved corrosion-resistant material and includes a rectifier power unit and connecting cord which permit operation of the equipment from a 115-volt, 60-cycle power source.

TECHNICAL CHARACTERISTICS

WIND SPEED SYSTEM

ANEMOMETER: Cup-rotor, a-c generator type.
RANGE: 2 to 150 mph.
POWER REQUIREMENT: None.

WIND DIRECTION SYSTEM

WIND VANE ASSEMBLY: Vane shell, vane tail, and counterbalance; includes a rheostat unit.

POWER REQUIREMENT: 4 Batteries BA-30, connected in series-parallel, furnishing 3-v dc; or Rectifier Power Unit PP-196/GMQ-1 (supplied with AN/GMQ-1A only, but when available may be used with AN/GMQ-1) furnishing 24-v dc when connected to a 115-v a-c source.

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WIND INDICATING SYSTEM

WIND SPEED METER: Rectifier-type, a-c milliammeter; 2 scales: lower from 0 to 30 mph, graduated in 1 mph intervals; upper from 0 to 150 mph, graduated in 5 mph intervals.

Accuracy: Within 1½ mph up to 30 mph. Within 3 mph from 30 to 75 mph. Within 4 percent of scale reading from 75 to 150 mph.

WIND DIRECTION METER: Low-voltage dc, self-synchronous repeater; scale graduated in 10° intervals, cardinal and intercardinal points designated by letters.

Accuracy: Within 3° at any point of the compass.

SUPPORT: 15-ft, sectional steel mast; includes accessories required for erection.

PRINCIPAL COMPONENTS

Wind Transmitter ML-203-B

Wind Panel ML-204-B

Rectifier Power Unit PP-196/GMQ-1 (AN/GMQ-1A only)

Cord CX-891/GMQ-1 (AN/GMQ-1A only)

Support ML-206-A

Carrying Case ML-207-B

Carrying Case ML-208-A

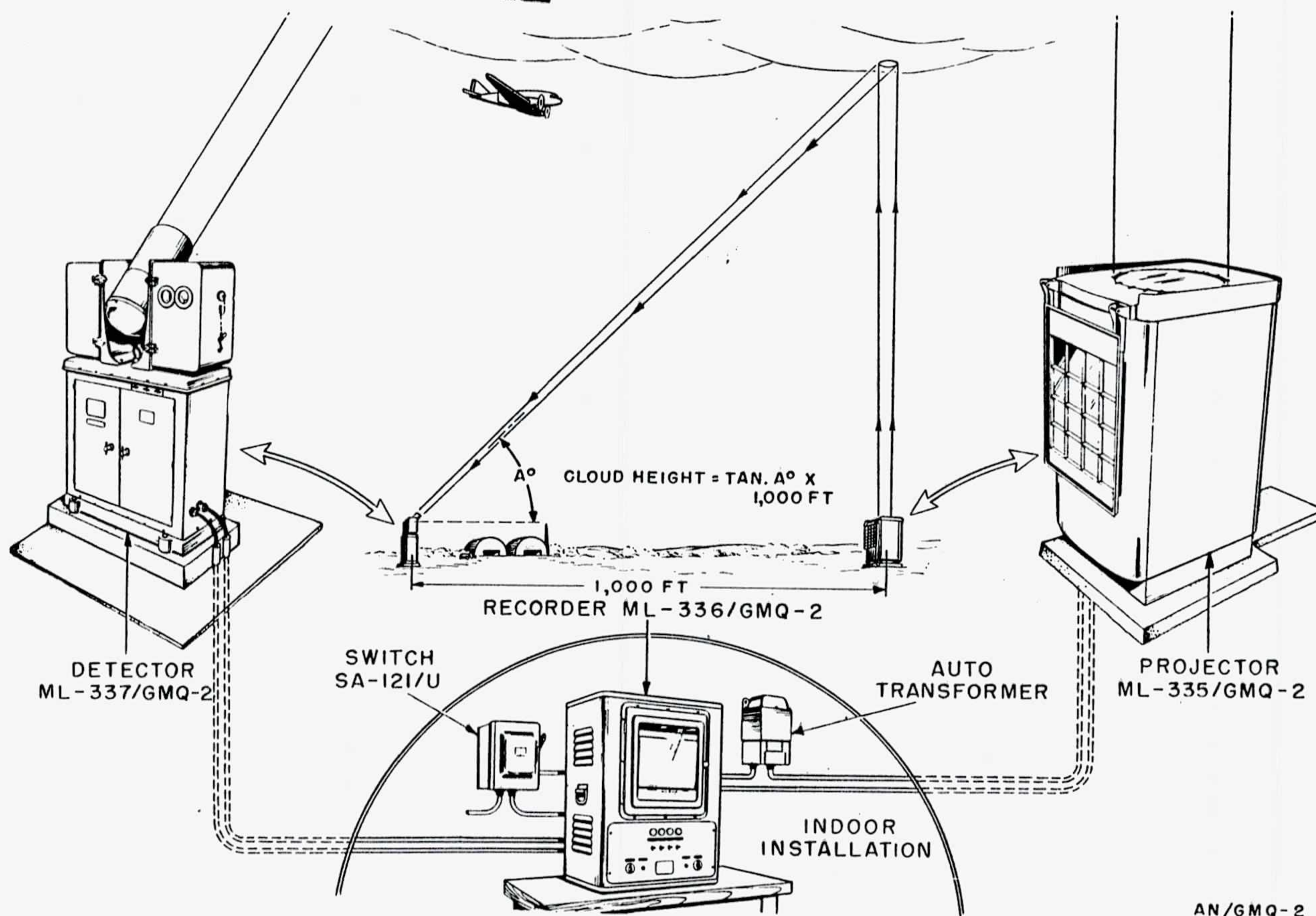
WEIGHT AND VOLUME

Total weight, crated (lb) 270

Total volume, crated (cu ft) 10

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AN/GMQ-2

Figure 10. Ceilometer Set AN/GMQ-2, schematic arrangement.

Status: Standard. Stock No.: 7A490-2. Reference: TM 11-2419.

Ceilometer Set AN/GMQ-2 produces, automatically, an accurate record, continuous day and night, of cloud height data. It consists of electric, electronic, and electromechanical devices which measure and permanently record data from which may be calculated the height of a cloud above ground level. The equipment is designed for permanent installation and is used chiefly at air bases to ascertain ceilings.

TECHNICAL CHARACTERISTICS

PROJECTOR

- SCANNING ANGLE: 0° to 90° (automatic or manual).
- BEAM CANDLEPOWER: 25,000,000.
- BEAM SPREAD: .8° x 4.8°.
- MODULATION FREQUENCY: 120 cps.
- PERCENT MODULATION: 90 percent.

DETECTOR

- SENSITIVITY (ratio of daylight intensity to reflected modulated light): 10⁶:1.
- AMPLIFIER: Fixed, tuned to 120 cye; bandwidth 85 to 165 cye.
- AMPLIFIER VOLTAGE GAIN: 2 X 10⁶.
- OUTPUT: .50 ua and/or 10 mw at 120 cye over 100-ohm line.
- SCANNING RATE: 1 cycle each 12 minutes.

RECORDER

- SIGNAL RECORDER: Ink mechanism.
- ANGLE OF INCLINATION RECORDER: Inkless marking mechanism.
- CHART SPEED: 3, 6, or 12 in. per hr (regulated by selected gear train).

- MIRROR: Parabolic, 24-in. precision; 10-in. focal length.
- LAMP: 900 w; GE Type B-H6 Mercury.
- LAMP LIFE: 25 hr, average.
- AIR COMPRESSOR RATING: 6.4 cu ft free air (sea level) at 17 lb gage pressure at 550 rpm.
- MOTOR RATING: ¾ hp capacitor induction, 1,175 rpm, 115-v, 60-cyc, single-phase.

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AN/GMQ-3

SWITCH

TYPE: Knife-blade; two-pole, single-throw.
LOAD CIRCUITS: 2; one, fused at 60 amp, supplies projector; the other, fused at 10 amp, supplies detector and recorder.

POWER CHARACTERISTICS

SUPPLY REQUIRED: 115-v, 60-cyc, single-phase ac. (All major units must operate from same phase.)
MAXIMUM STARTING CURRENT: 52 amp.
NORMAL OPERATING CURRENT: 20.5 amp.
DETECTOR HEATER CURRENT: 2.6 amp.
POWER FACTOR (normal operation): 87 percent.

PRINCIPAL COMPONENTS

Name	Dimensions (in., unpacked)
Projector ML-335/GMQ-2	63 x 35 x 47.
Detector ML-336/GMQ-2	29 x 16 x 19½.
Recorder ML-337/GMQ-2	64 x 19 x 39.
Switch SA-121/U	15½ x 13½ x 7¼.
Test Set TS-555/GMQ-2.	

WEIGHTS AND VOLUMES

	Unpacked	Domestic packed	Export packed
Total weight (lb)	3,490	4,430	5,610
Total volume (cu ft)	125	220	291
Ship tons			7.27

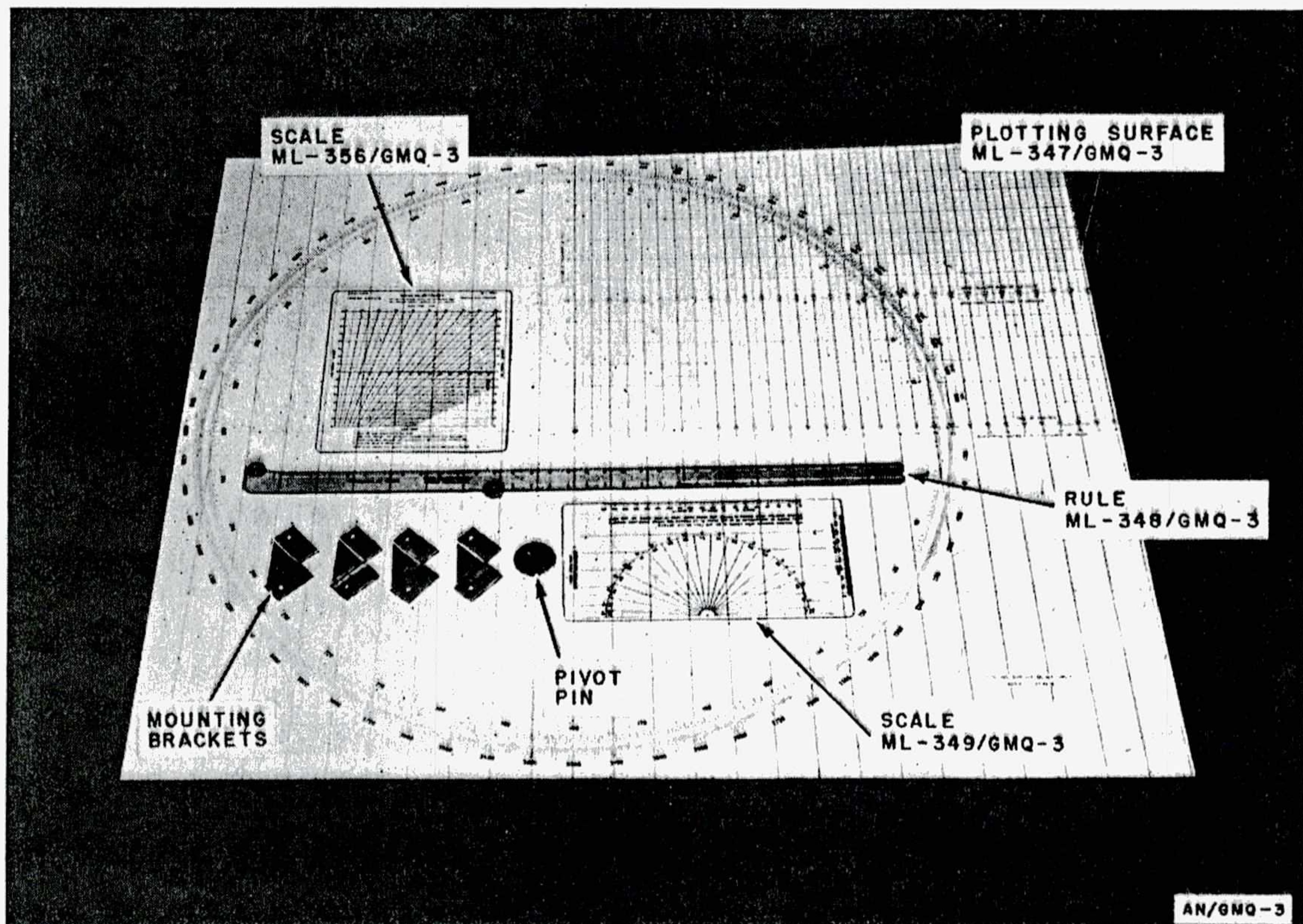


Figure 11. Plotting Set AN/GMQ-3, components.

Status: Standard. Stock No.: 7A1283-3. Reference: TM 11-2418.

Plotting Set AN/GMQ-3 is used to compute graphically and to plot to scale, from data obtained from meteorological balloon soundings, speed and direction of winds aloft with reference to distance, time, and altitude. The equipment consists of a plotting chart and a variety of scales and rules. It may be used on a table or similar flat surface, or may be mounted on Plotting Board ML-122.

PRINCIPAL COMPONENTS

Plotting Surface ML-347/GMQ-3
Rule ML-348/GMQ-3
Scale ML-349/GMQ-3
Scale ML-356/GMQ-3

WEIGHTS AND VOLUME

	Unpacked	Export packed
Total weight (lb)	1.56	2.5
Total volume (cu ft)		.15

15

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AN/GRD-1A

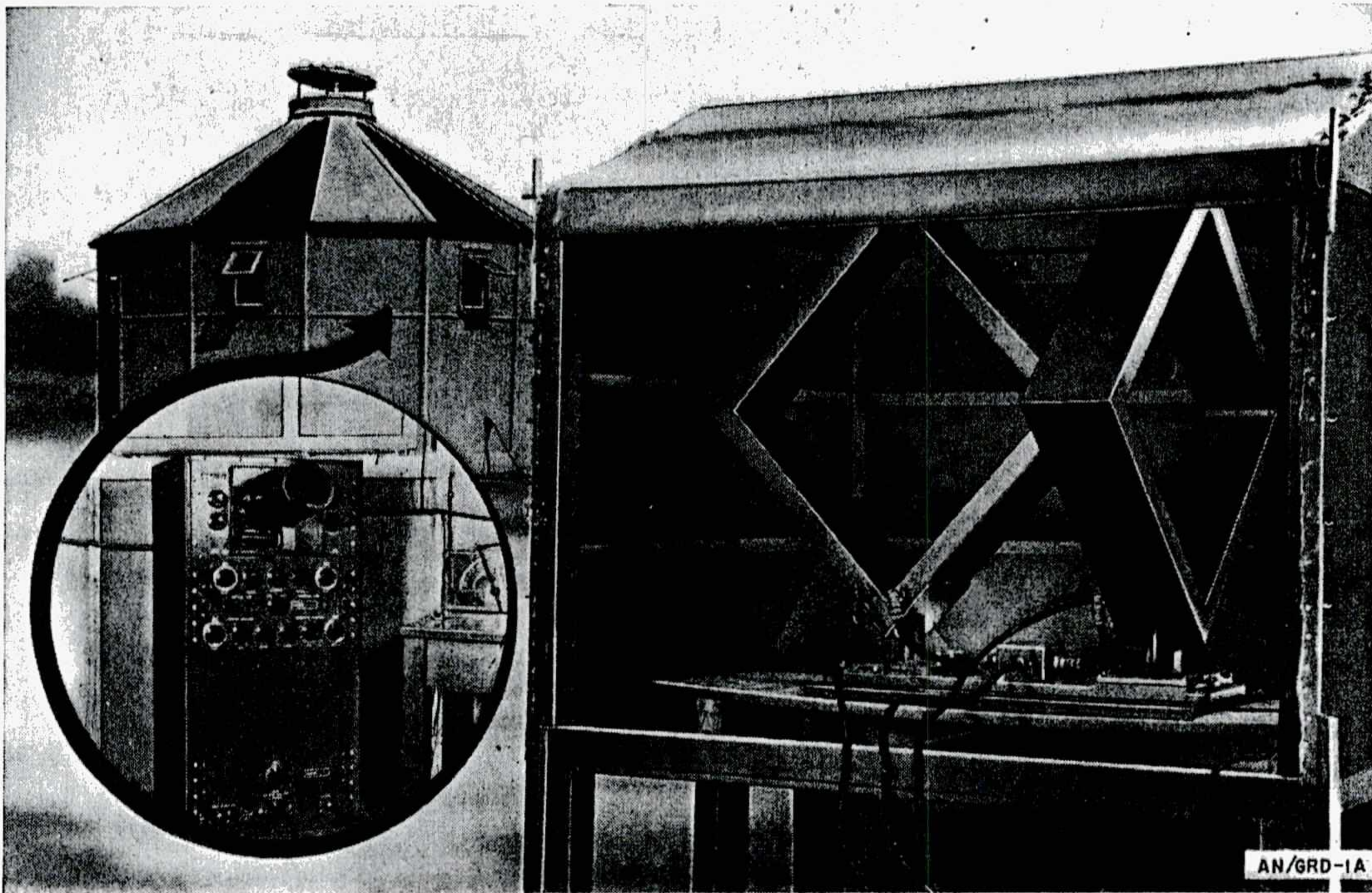


Figure 12. Static Direction Finder AN/GRD-1A, typical installation.

Status: Standard. Stock No.: 7A856-1A. Reference: TM 11-2693.

Static Direction Finder AN/GRD-1A is used to detect and locate static discharges which occur in the atmosphere. The equipment consists of a loop antenna system, an amplification system, a cathode-ray oscilloscope indicator provided with an azimuth scale, and the necessary operating accessories. Two or more simultaneous readings are made with identical equipments separated by several hundred miles and are communicated by radio to a central plotting station where the location of the discharge is determined by triangulation. Plotting Equipment PT-203/GRD-1 is used with Static Direction Finders AN/GRD-1A for plotting the azimuths determined by the direction-finding equipment. Camera PH-557/TFH, Developer PH-559/TFQ, and Viewer PH-558/TFP are used to prepare and observe photographic records of the traces on the oscilloscope screen. These equipments are described in TM 11-487F.

TECHNICAL CHARACTERISTICS

FREQUENCY RANGE: 8 to 12 kc.
 OPERATING RANGE: 2,000 mi.
 NUMBER OF TUBES: 30.
 ANTENNAS: 2, loop type.
 POWER REQUIREMENT: 115-v, 50/60-cyc ac.
 CURRENT CONSUMPTION: 4 amp.

PRINCIPAL COMPONENTS

Name	Over-all dimensions (in.)		
	Length	Height	Depth
Cabinet Assembly OA-16/GRD-1A.	20 $\frac{7}{8}$	41 $\frac{13}{16}$	16 $\frac{59}{64}$
Indicator ID-159/GRD-1A.			
Amplifier AM-107/GRD-1A.			
Rectifier-Oscillator PP-179/GRD-1A.			
Loop Antenna AT-114/GRD-1A (Serial A).	50 $\frac{1}{4}$	54 $\frac{1}{2}$	11
Loop Antenna AT-114/GRD-1A (Serial B).	50 $\frac{1}{4}$	54 $\frac{1}{2}$	11
Mounting MT-436/GRD-1A	48 $\frac{5}{8}$	6 $\frac{1}{16}$	12
Calibrator TS-410/GRD-1A	10 $\frac{11}{16}$	8 $\frac{3}{8}$	9 $\frac{1}{8}$
Chest CY-424/GRD-1A	34 $\frac{3}{4}$	27 $\frac{1}{2}$	19 $\frac{1}{2}$

ASSOCIATED EQUIPMENT

(Used with, but not a part of, Static Direction Finder AN/GRD-1A.)

Timing Unit TD-8/GRD-1A
 Camera PH-557/TFH
 Developer PH-559/TFQ
 Viewer PH-558/TFP
 Plotting Equipment PT-203/GRD-1

WEIGHT AND VOLUME

	Export packed
Total weight (lb).....	1,400
Total volume (cu ft).....	72
Ship tons.....	1.8

AN/GRD-1A

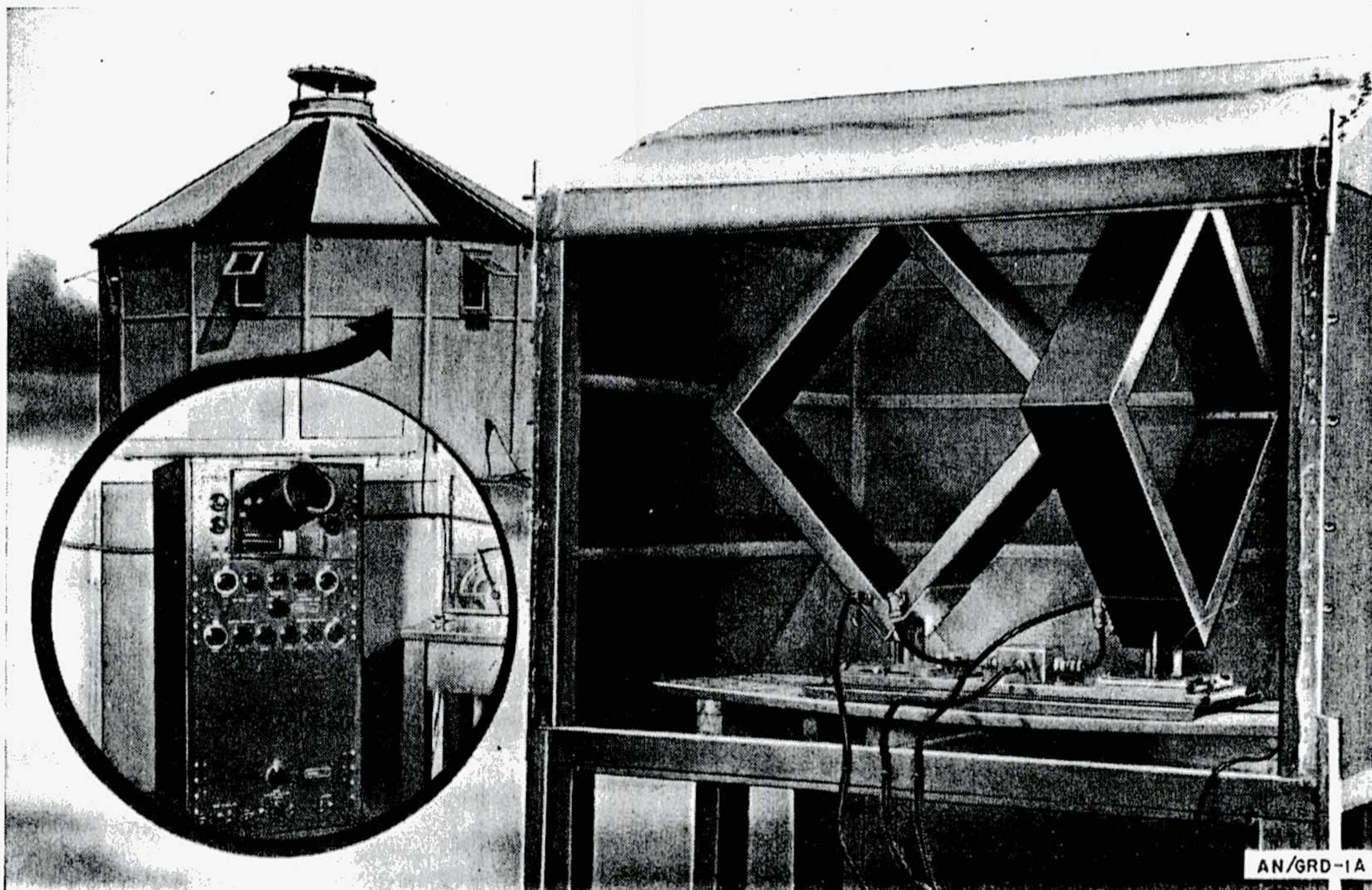


Figure 12. Static Direction Finder AN/GRD-1A, typical installation.

Status: Standard. Stock No.: 7A856-1A. Reference: TM 11-2693.

Static Direction Finder AN/GRD-1A is used to detect and locate static discharges which occur in the atmosphere. The equipment consists of a loop antenna system, an amplification system, a cathode-ray oscilloscope indicator provided with an azimuth scale, and the necessary operating accessories. Two or more simultaneous readings are made with identical equipments separated by several hundred miles and are communicated by radio to a central plotting station where the location of the discharge is determined by triangulation. Plotting Equipment PT-203/GRD-1 is used with Static Direction Finders AN/GRD-1A for plotting the azimuths determined by the direction-finding equipment. Camera PH-557/TFH, Developer PH-559/TFQ, and Viewer PH-558/TFP are used to prepare and observe photographic records of the traces on the oscilloscope screen. These equipments are described in TM 11-487F.

TECHNICAL CHARACTERISTICS

FREQUENCY RANGE: 8 to 12 kc.
 OPERATING RANGE: 2,000 mi.
 NUMBER OF TUBES: 30.
 ANTENNAS: 2, loop type.
 POWER REQUIREMENT: 115-v, 50/60-cyc ac.
 CURRENT CONSUMPTION: 4 amp.

PRINCIPAL COMPONENTS

Name	Over-all dimensions (in.)		
	Length	Height	Depth
Cabinet Assembly OA-16/GRD-1A.	20 $\frac{7}{8}$	41 $\frac{13}{16}$	16 $\frac{59}{64}$
Indicator ID-159/GRD-1A.			
Amplifier AM-107/GRD-1A.			
Rectifier-Oscillator PP-179/GRD-1A.			
Loop Antenna AT-114/GRD-1A (Serial A).	50 $\frac{1}{4}$	54 $\frac{1}{2}$	11
Loop Antenna AT-114/GRD-1A (Serial B).	50 $\frac{1}{4}$	54 $\frac{1}{2}$	11
Mounting MT-436/GRD-1A	48 $\frac{5}{8}$	6 $\frac{1}{16}$	12
Calibrator TS-410/GRD-1A	10 $\frac{11}{16}$	8 $\frac{5}{8}$	9 $\frac{1}{8}$
Chest CY-424/GRD-1A	34 $\frac{3}{4}$	27 $\frac{1}{2}$	19 $\frac{1}{2}$

ASSOCIATED EQUIPMENT

(Used with, but not a part of, Static Direction Finder AN/GRD-1A.)

Timing Unit TD-8/GRD-1A
 Camera PH-557/TFH
 Developer PH-559/TFQ
 Viewer PH-558/TFP
 Plotting Equipment PT-203/GRD-1

WEIGHT AND VOLUME

	Export packed
Total weight (lb).....	1,400
Total volume (cu ft).....	72
Ship tons.....	1.8

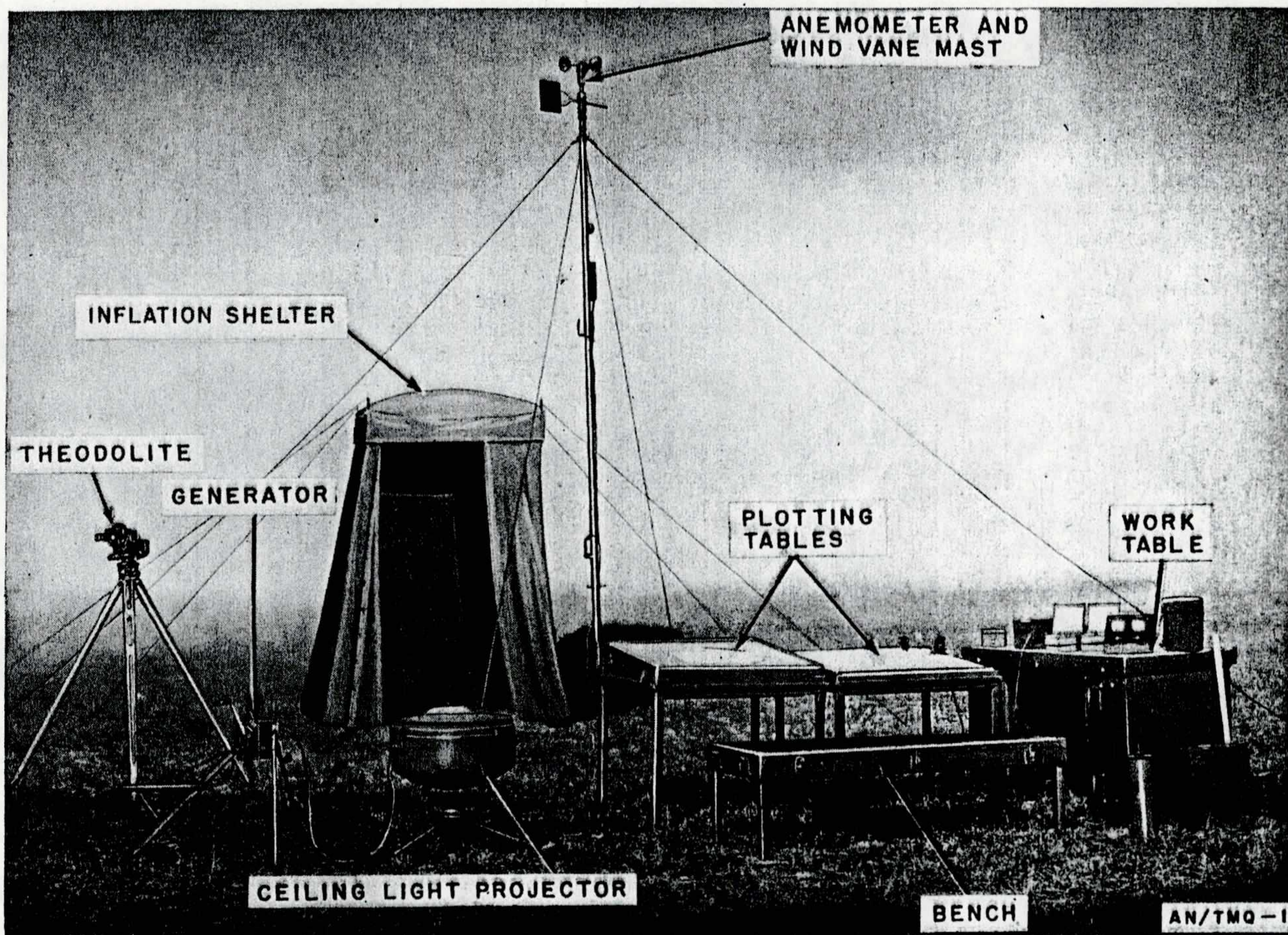


Figure 13. Meteorological Station AN/TMQ-1 set up for operation.

Status: Standard. Stock No.: 7A1124-1. Reference: TM 11-2406.

Meteorological Station AN/TMQ-1 is an easily transportable weather station for temporary use in tactical operations. It includes equipment for obtaining and evaluating a wide variety of meteorological data. The major part of the components of the station is packed in six carrying cases which can be assembled into furniture. With the addition of communication facilities, supplies, and local weather maps, the station may be used to plot weather maps and make weather forecasts.

TECHNICAL CHARACTERISTICS

DATA OBTAINABLE: Surface wind direction and speed.
Winds aloft direction and speed.
Surface temperature, atmospheric pressure, and relative humidity.
Cloud height (ceiling).
Amount of precipitation.

SHELTER: None, or any available tent, building, or cargo truck.

PRINCIPAL COMPONENTS

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-178/TMQ-1	37 x 33 x 13	160	9.2
1 Plotting Board ML-122.			
1 Rule ML-126.			
1 Scale ML-177.			
1 Slide Rule ML-59.			
Charts, forms, and stationery.			
Case CY-179/TMQ-1	31 x 24 x 12	130	5.2
2 Barometer ML-102.			
1 Gauge ML-217 and Support ML-209.			
2 Psychrometer ML-24.			
1 Telephone EE-8 (component of timing and Telephone Set ML-110).			
1 Wind Transmitter ML-203.			
1 Wind Panel ML-204.			
8 Battery BA-30.			
1 Tool Equipment.			
1 TE-33.			

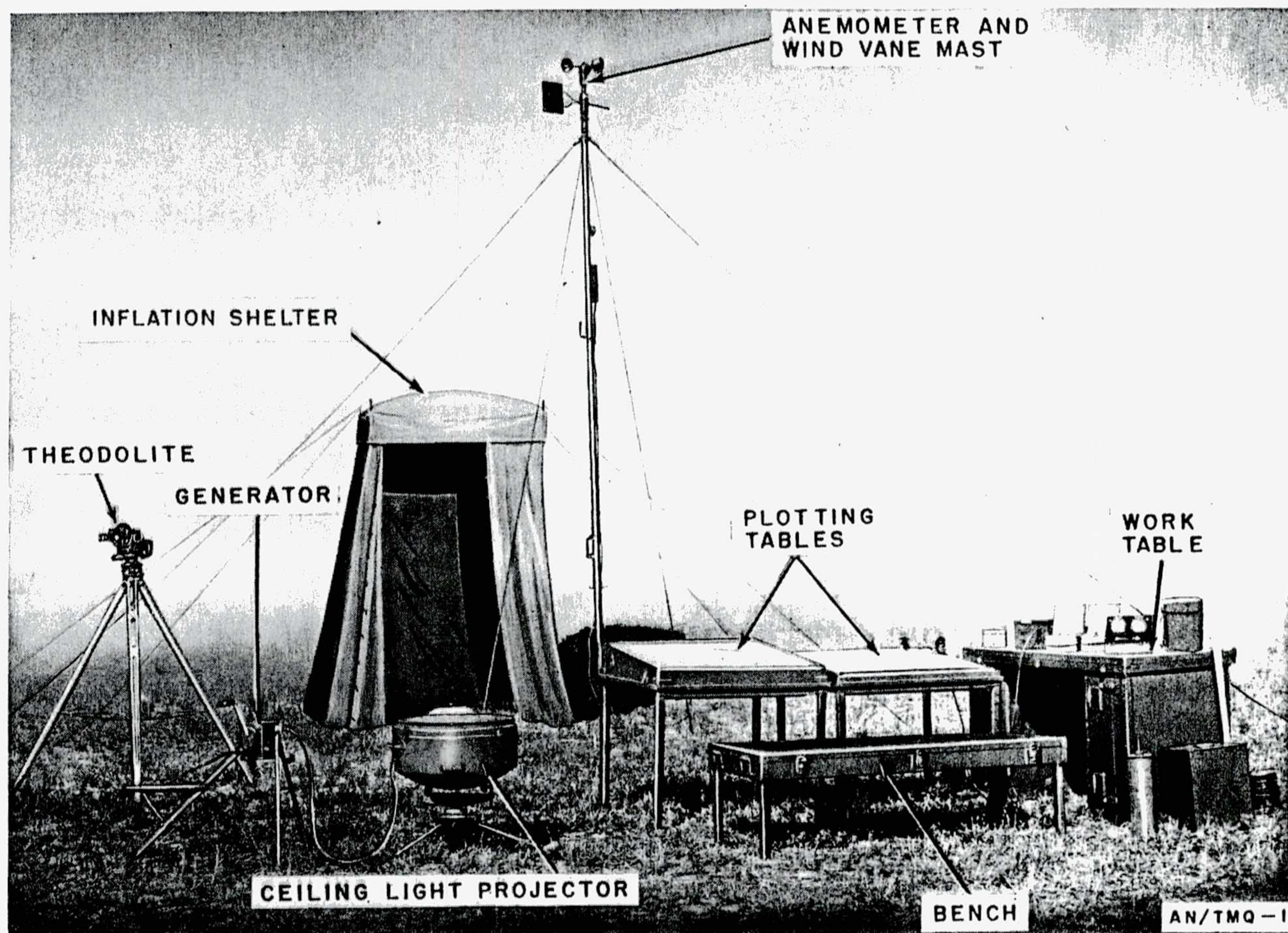


Figure 13. Meteorological Station AN/TMQ-1 set up for operation.

Status: Standard. Stock No.: 7A1124-1. Reference: TM 11-2406.

Meteorological Station AN/TMQ-1 is an easily transportable weather station for temporary use in tactical operations. It includes equipment for obtaining and evaluating a wide variety of meteorological data. The major part of the components of the station is packed in six carrying cases which can be assembled into furniture. With the addition of communication facilities, supplies, and local weather maps, the station may be used to plot weather maps and make weather forecasts.

TECHNICAL CHARACTERISTICS

DATA OBTAINABLE: Surface wind direction and speed.
Winds aloft direction and speed.
Surface temperature, atmospheric pressure, and relative humidity.
Cloud height (ceiling).
Amount of precipitation.

SHELTER: None, or any available tent, building, or cargo truck.

PRINCIPAL COMPONENTS

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-178/TMQ-1	37 x 33 x 13	160	9.2
1 Plotting Board ML-122.			
1 Rule ML-126.			
1 Scale ML-177.			
1 Slide Rule ML-59.			
Charts, forms, and stationery.			
Case CY-179/TMQ-1	31 x 24 x 12	130	5.2
2 Barometer ML-102.			
1 Gauge ML-217 and Support ML-209.			
2 Psychrometer ML-24.			
1 Telephone EE-8 (component of timing and Telephone Set ML-110).			
1 Wind Transmitter ML-203.			
1 Wind Panel ML-204.			
8 Battery BA-30.			
1 Tool Equipment.			
1 TE-33.			

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-180/TMQ-1 1 Support ML-206. 1 Tripod ML-78. Hardware.	63 x 26 x 7	215	6.6
Case CY-181/TMQ-1 2 Hydrogen Generator ML-303/TM. 1 Timing and Telephone Set ML-110 (components). 1 Theodolite ML-247 Miscellaneous pibal equipment and accessories.	31 x 24 x 15	145	6.5
Case CY-97/TMQ-2 1 Ceiling Light Projector ML-318/TMQ-2.	27 x 27 x 23	130	9.7

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-206/TMQ-2 1 Clinometer ML-119. 1 Generator G-5/TMQ-2. Inflation Shelter S-13/TM	36 x 22 x 12	115	5.5
Balloons ML-50, ML-51, ML-64. Lanterns ML-91. Calcium Hydride Charges ML-304/TM.	70 x 22 x 12	170	10.7

WEIGHT AND VOLUME

Total weight (lb)	2,227	<i>Export packed</i>
Total volume (cu ft)	100	
Ship tons	2.5	

Status: Standard. Stock No.: 7A1012-3. Reference: TM 11-2413.

Hydrogen Generator Set AN/TMQ-3 consists of six Hydrogen Generators ML-303/TM (two spares), a Manifold ML-344/TMQ-3, four lengths of Hose ML-81, punches, and a Carrying Case Cy-219/TMQ-3. The set is used with four Calcium Hydride Charges ML-305/TM or ML-305A/TM, or with Calcium Hydride Charges ML-305/TM or ML-305A/TM in combination with Calcium Hydride Charges ML-304/TM or ML-304A/TM to produce hydrogen gas to inflate 30-, 100-, or 350-gram meteorological balloons. The calcium hydride charges are not components of Hydrogen Generator Set AN/TMQ-3.

WEIGHTS AND VOLUME

	Domestic		Export
	Unpacked	packed	
Total weight (lb)	45	75	75
Total volume (cu. ft.)	3.5		

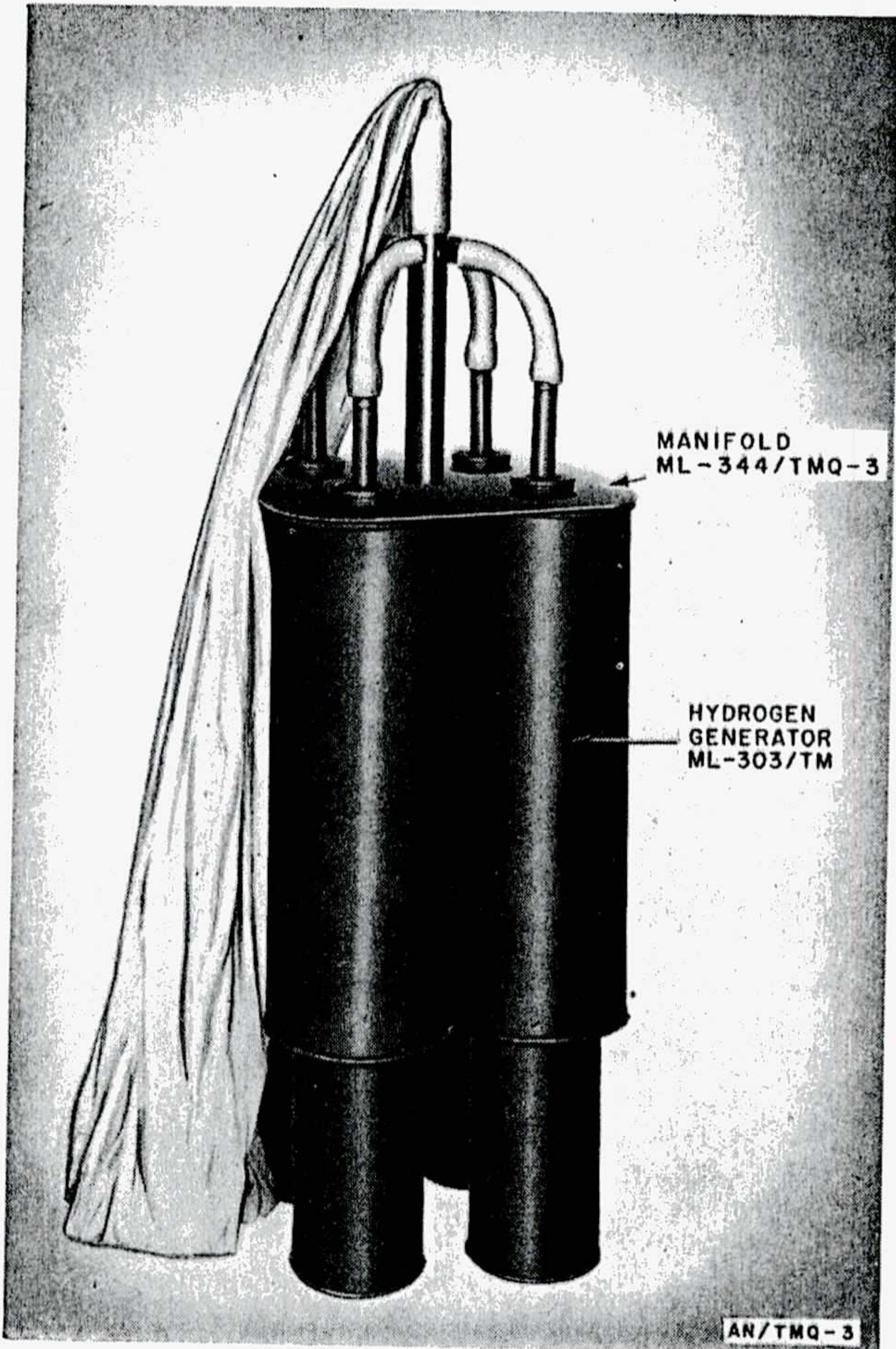


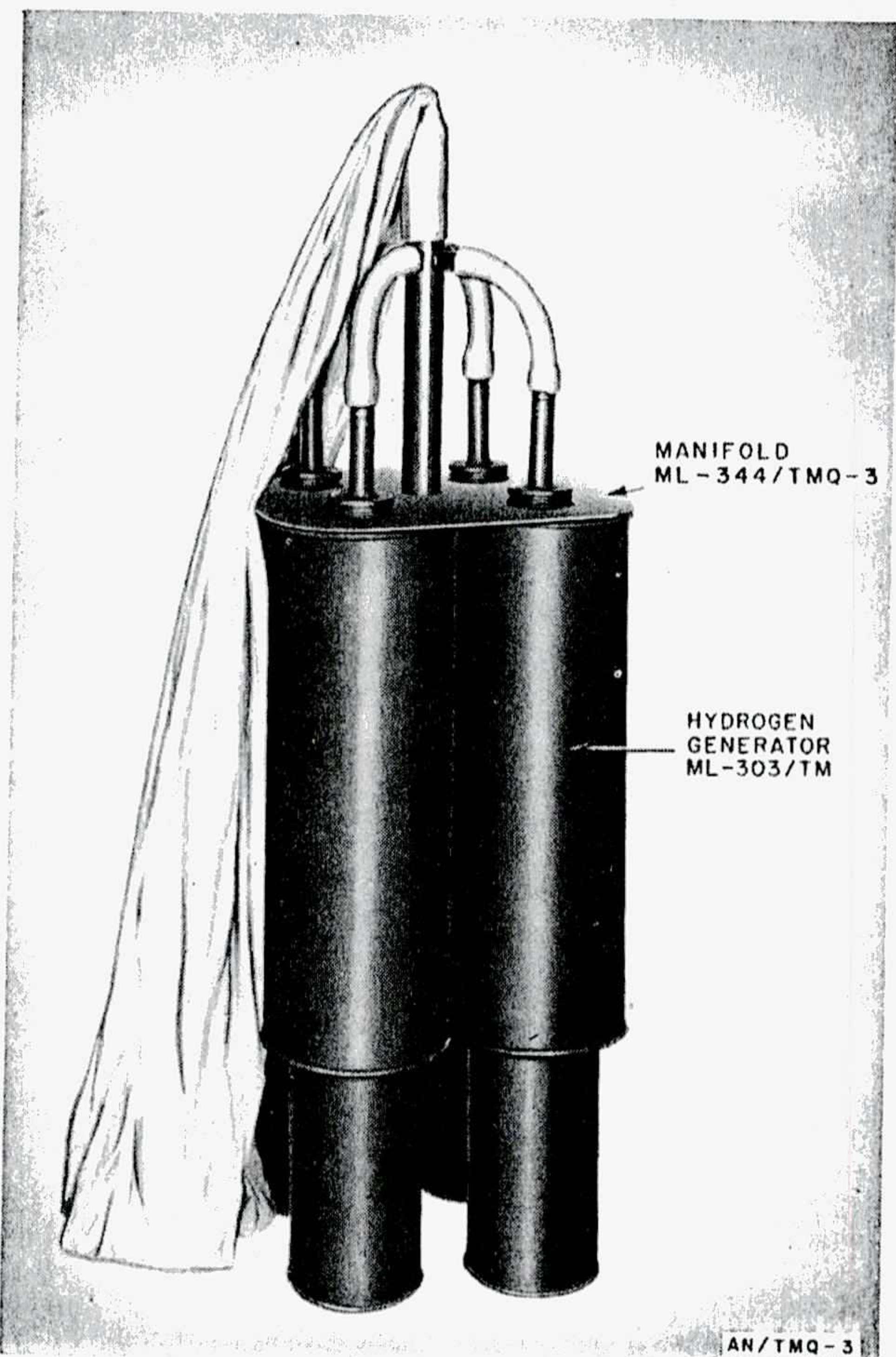
Figure 14. Hydrogen Generator Set AN/TMQ-3, assembled.

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-180/TMQ-1 1 Support ML-206. 1 Tripod ML-78. Hardware.	63 x 26 x 7	215	6.6
Case CY-181/TMQ-1 2 Hydrogen Generator ML-303/TM. 1 Timing and Telephone Set ML-110 (components). 1 Theodolite ML-217 Miscellaneous pibal equipment and accessories.	31 x 24 x 15	145	6.5
Case CY-97/TMQ-2 1 Ceiling Light Projector ML-318/TMQ-2.	27 x 27 x 23	130	9.7

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-206/TMQ-2 1 Clinometer ML-119. 1 Generator G-5/TMQ-2.	36 x 22 x 12	115	5.5
Inflation Shelter S-13/TM	70 x 22 x 12	170	10.7
Balloons ML-50, ML-51, ML-64. Lanterns ML-91. Calcium Hydride Charges ML-304/TM.			

WEIGHT AND VOLUME

	Export packed
Total weight (lb)	2,227
Total volume (cu ft)	100
Ship tons	2.5



Status: Standard. Stock No.: 7A1012-3. Reference: TM 11-2413.

Hydrogen Generator Set AN/TMQ 3 consists of six Hydrogen Generators ML-303/TM (two spares), a Manifold ML-344/TMQ-3, four lengths of Hose ML-81, punches, and a Carrying Case Cy-219/TMQ-3. The set is used with four Calcium Hydride Charges ML-305/TM or ML-305A/TM, or with Calcium Hydride Charges ML-305/TM or ML-305A/TM in combination with Calcium Hydride Charges ML-304/TM or ML-304A/TM to produce hydrogen gas to inflate 30-, 100-, or 350-gram meteorological balloons. The calcium hydride charges are not components of Hydrogen Generator Set AN/TMQ-3.

WEIGHTS AND VOLUME

	Domestic		Export packed
	Unpacked	packed	
Total weight (lb)	45	75	75
Total volume (cu. ft.)	3.5		

Figure 14. Hydrogen Generator Set AN/TMQ-3, assembled.

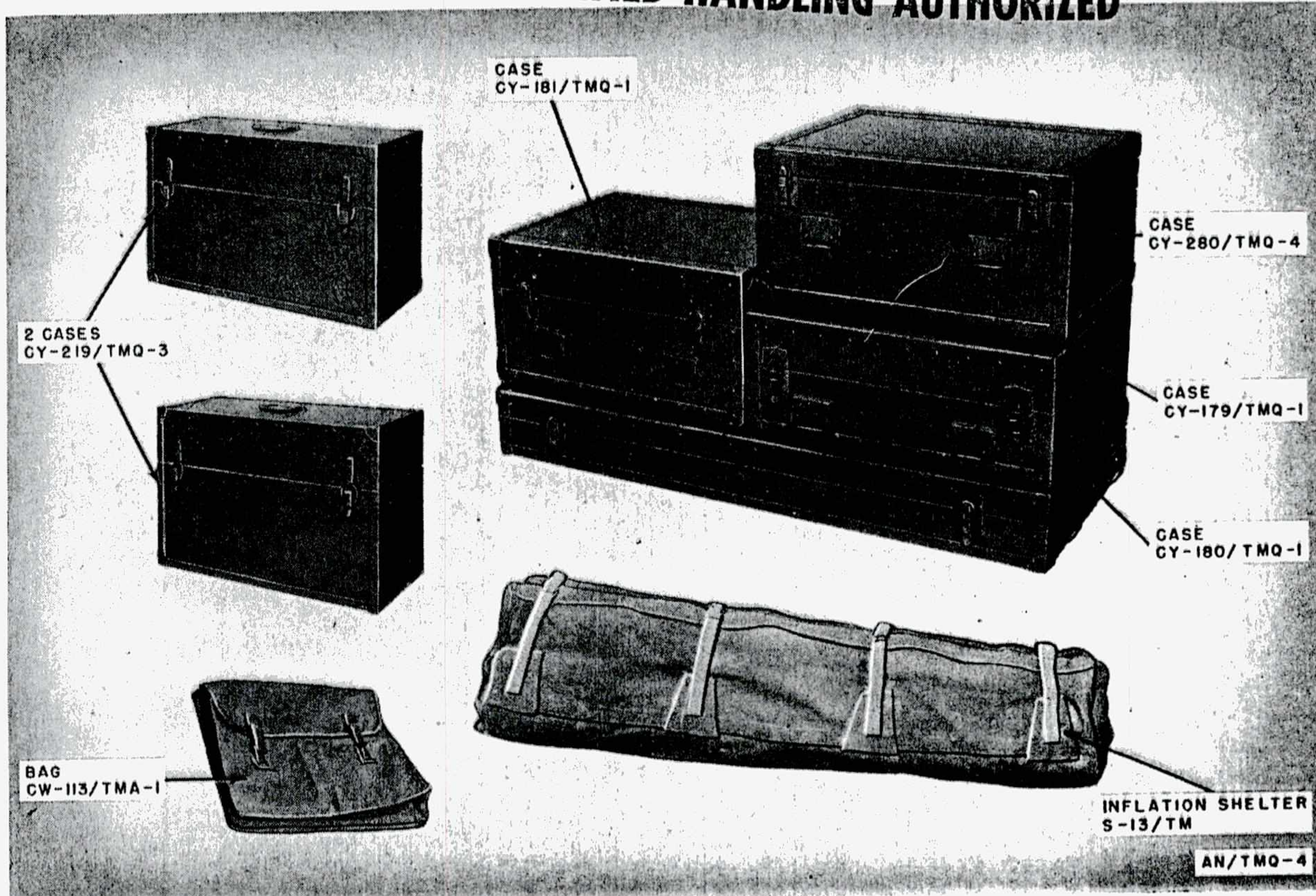


Figure 15. Meteorological Station Set AN/TMQ-4, major components packed for export.

Status: Standard. Stock No.: 7A1124-2 (general use), 7A1124-2.1 (tropical use). Reference: TM 11-2426.

Meteorological Station Set AN/TMQ-4 is an assemblage of equipment for measuring and computing meteorological data used by ground artillery units to make corrections for the effect of atmospheric conditions on the trajectory of projectiles. The set, designed for rapid installation and removal, can be set up in the open or in any available shelter; three of the six wooden carrying cases can be assembled into furniture. Accessories, equipment, and supplies (for use with radiosonde receiving and recording equipment), and pilot balloon tracking equipment are included.

TECHNICAL CHARACTERISTICS

DATA OBTAINABLE: Surface wind direction and speed.
 Winds aloft direction and speed.
 Surface temperature, atmospheric pressure, and relative humidity.
 Temperature, pressure, and relative humidity of the upper atmosphere.

ASSOCIATED EQUIPMENT: Radiosonde Receptor AN/FMQ-1.
 Radio Set SCR-658.
 Power Unit PE-75.

PRINCIPAL COMPONENTS

Name	Dimensions (in.)	Weights (lb)	Volume (cu ft)
Case CY-179/TMQ-1.....	32 x 24 x 12	130	5.2
Barometer ML-102.			
Wind Panel ML-204.			
Wind Transmitter ML-203.			
Psychrometer ML-24.			
Psychrometer ML-224.			
Telephone EE-8.			
Miscellaneous tools and accessories.			
Case CY-180/TMQ-1.....	63 x 26 x 7	215	6.65
Support ML-206.			
Tripod ML-78.			
Case CY-181/TMQ-1.....	32 x 24 x 15	145	6.66
Theodolite ML-247.			
Timing and Telephone Set ML-110.			
Miscellaneous pibal equipment and accessories.			

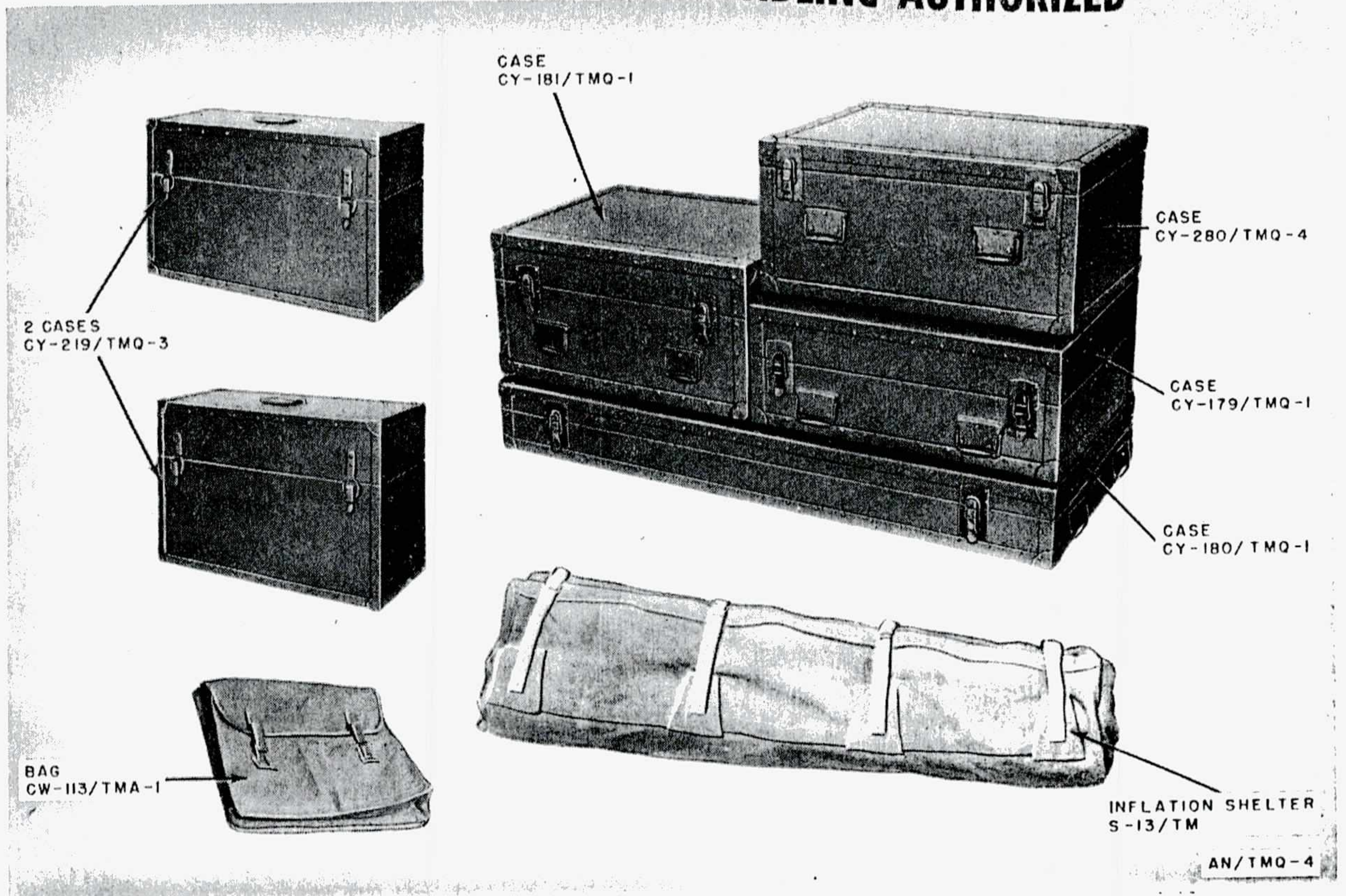


Figure 15. Meteorological Station Set AN/TMQ-4, major components packed for export.

Status: Standard. Stock No.: 7A1124-2 (general use), 7A1124-2.1 (tropical use). Reference: TM 11-2426.

Meteorological Station Set AN/TMQ-4 is an assemblage of equipment for measuring and computing meteorological data used by ground artillery units to make corrections for the effect of atmospheric conditions on the trajectory of projectiles. The set, designed for rapid installation and removal, can be set up in the open or in any available shelter; three of the six wooden carrying cases can be assembled into furniture. Accessories, equipment, and supplies (for use with radiosonde receiving and recording equipment), and pilot balloon tracking equipment are included.

TECHNICAL CHARACTERISTICS

DATA OBTAINABLE: Surface wind direction and speed.
Winds aloft direction and speed.
Surface temperature, atmospheric pressure, and relative humidity.
Temperature, pressure, and relative humidity of the upper atmosphere.

ASSOCIATED EQUIPMENT: Radiosonde Receptor AN/FMQ-1.
Radio Set SCR 658.
Power Unit PE 75.

PRINCIPAL COMPONENTS

Name	Dimensions (in.)	Weights (lb)	Volume (cu ft)
Case CY-179/TMQ-1	32 x 24 x 12	130	5.2
Barometer ML-102.			
Wind Panel ML-204.			
Wind Transmitter ML-203.			
Psychrometer ML-24.			
Psychrometer ML-224.			
Telephone EE-8.			
Miscellaneous tools and accessories.			
Case CY-180/TMQ-1	63 x 26 x 7	215	6.65
Support ML-206.			
Tripod ML-78.			
Case CY-181/TMQ-1	32 x 24 x 15	145	6.66
Theodolite ML-247.			
Timing and Telephone Set ML-110.			
Miscellaneous pibal equipment and accessories.			

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

MC-573

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Case CY-280/TMQ-4..... Battery Charger PE-163 and accessories. Test Equipment TS-30/FMQ-1. Ballon Shroud MC-573. Miscellaneous accessories.	32 x 21 x 15	150	5.9
Case CY-219/TMQ-3..... Hydrogen Generator set AN/TMQ-3 (2 furnished).	27 x 12 x 18	45	3.5

Name	Dimensions (in.)	Weights (lb)	Volumes (cu ft)
Bag CW-113/TMA-1..... Plotting set AN/TMA-1. Computing and plotting equipment and supplies.	21 x 21 x 5	15	1.3
Inflation Shelter S-13/TM Expendable items in quantity. Radiosonde AN/AMT-2. Battery Pack BB-208/AMT. Calcium Hydride Charges ML-340/TM, ML-304A/TM, ML-305/TM, and ML-305A/TM. Balloons ML-50, ML-51, ML-54, ML-131, ML-159, ML-160, and ML-161. Balloon accessories.	70 x 22 x 12	170	10.7

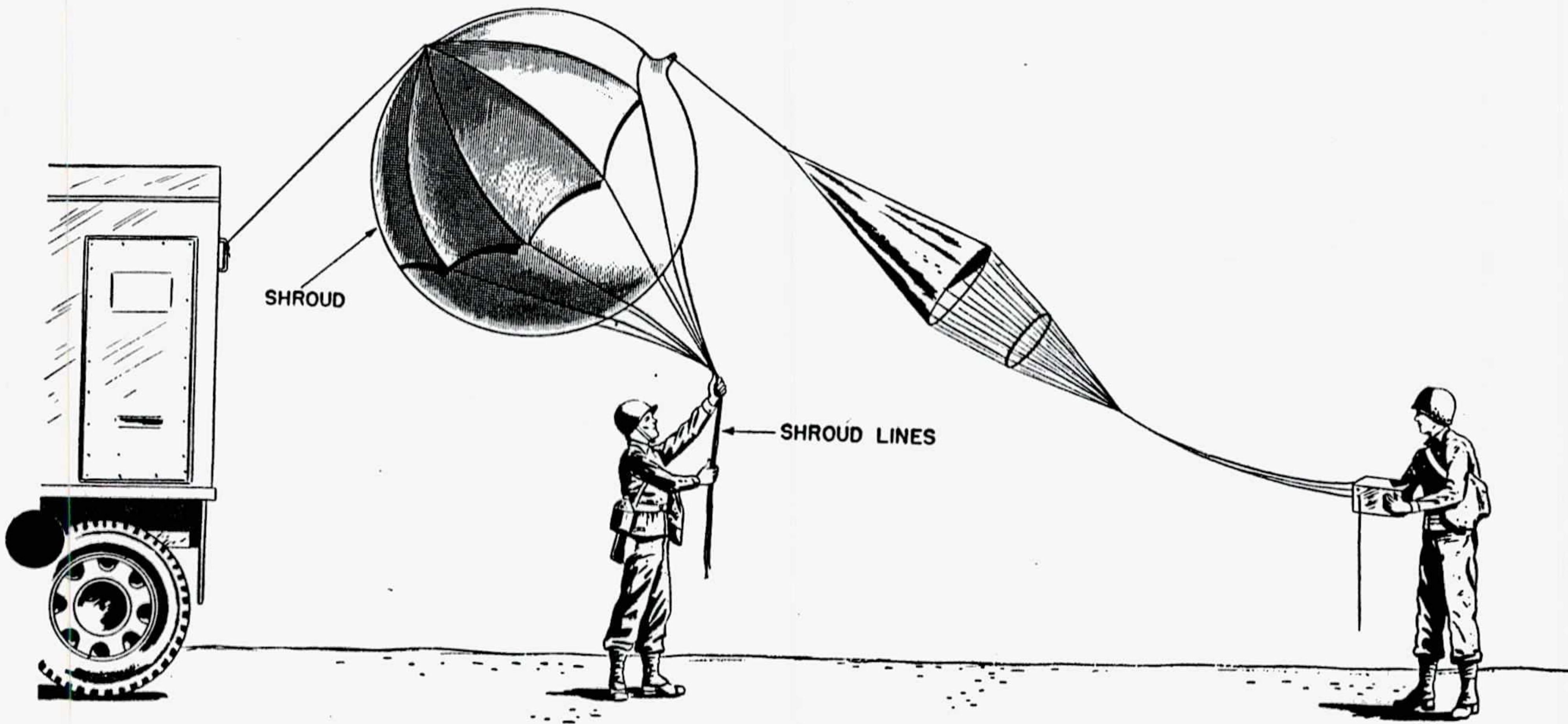


Figure 16. Balloon Shroud MC-573 in use.

Status: Standard. Stock No. 7A202-573. Reference: TM 11-2426.

Balloon Shroud MC-573 is a hemispherical, nylon canopy which is used when the balloon release point is some distance from the inflation shelter, to facilitate handling radiosonde balloons and to protect them from injury during high or gusty winds. The shroud is 6 feet, 6 inches in

diameter and has 11 ropes. It is used with 350-, 700-, and 1200-gram sounding balloons.

WEIGHT AND VOLUME

	Export packed
Total weight (lb).....	8.75
Total volume (cu ft).....	.25

Note. Balloon Shrouds MC-573 are packed eight to a container.

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

Status: Standard. Stock No.: 7A302. Reference: TM 11-428.

Barometer ML-2-(*) represents Barometers ML-2 through ML-2-G. Barometer ML-2-(*) is a Fortin-type (adjustable cistern) mercurial barometer intended for permanent installation indoors. All models (except the oldest, which has an inch scale only) have both an inch scale and a millibar scale; all are provided with vernier scales and thermometers. Barometer ML-2-(*) is usually installed in Case ML-48 which is designed to provide a safe and convenient means of suspending the instrument and steadying it properly in a vertical position. The case is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

BAROMETER

RANGE: From 22 to 32 inches of mercury; from 810 to 1,110 millibars (ranges differ slightly with various models).

INCH SCALE: Graduated in $\frac{1}{20}$ of an inch; each integral inch is numbered.

MILLIBAR SCALE: Graduated in whole millibars; 100-millibar intervals have complete numerical designation, intervening 10-millibar intervals numbered in units of 10.

INCH VERNIER: Permits readings to .002 ($\frac{1}{500}$) inch.

MILLIBAR VERNIER: Permits readings to .05 ($\frac{1}{20}$) millibar.

THERMOMETER

FAHRENHEIT RANGE: -10° to $+100^{\circ}$, graduated in whole degrees.

CENTIGRADE RANGE: -23° to $+38^{\circ}$, graduated in $\frac{1}{2}$ degrees.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	20
Total volume (cu ft).....	1.0

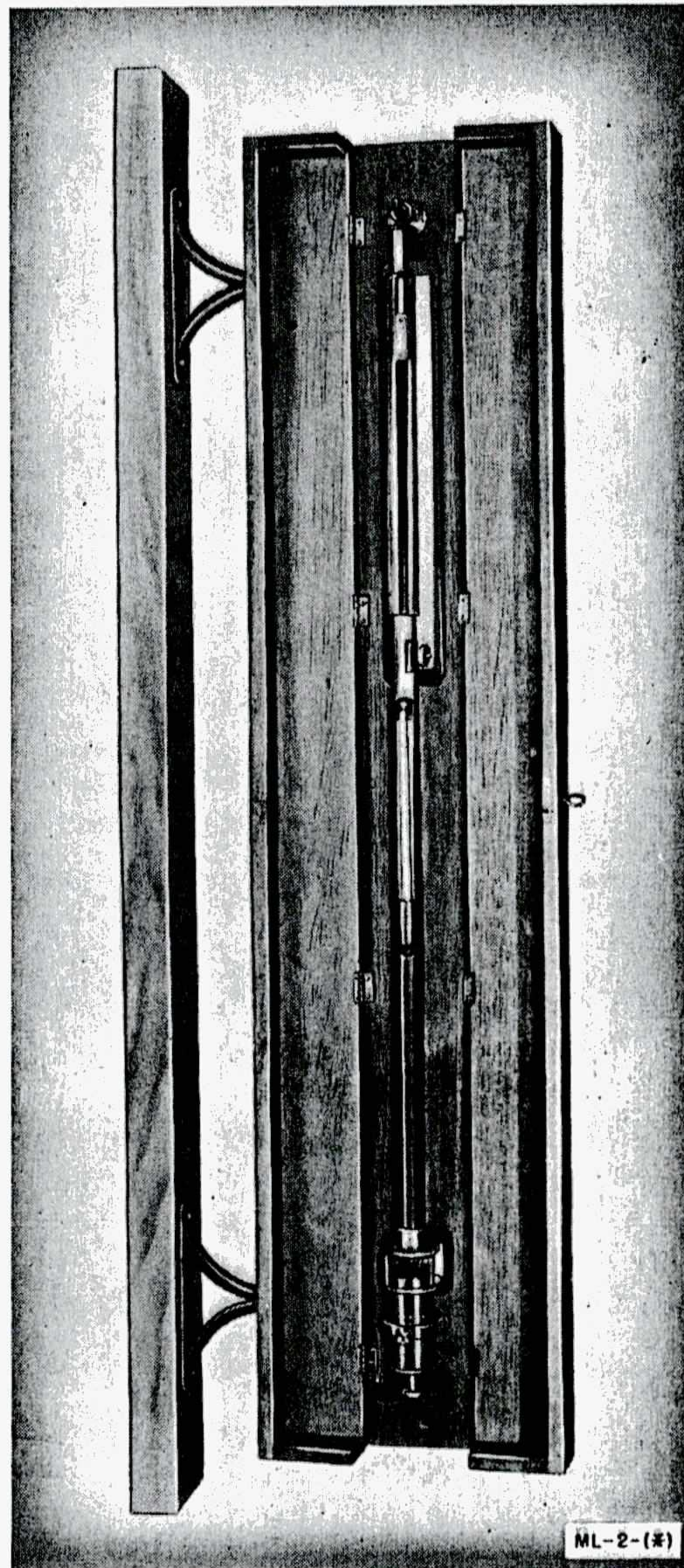


Figure 17. Barometer ML-2-(*) installed in Case ML-48.

Status: Standard. Stock No.: 7A302. Reference: TM 11-428.

Barometer ML-2-(*), represents Barometers ML-2 through ML-2-G. Barometer ML-2-(*), is a Fortin-type (adjustable cistern) mercurial barometer intended for permanent installation indoors. All models (except the oldest, which has an inch scale only) have both an inch scale and a millibar scale; all are provided with vernier scales and thermometers. Barometer ML-2-(*), is usually installed in Case ML-48 which is designed to provide a safe and convenient means of suspending the instrument and steadying it properly in a vertical position. The case is not furnished with the equipment.

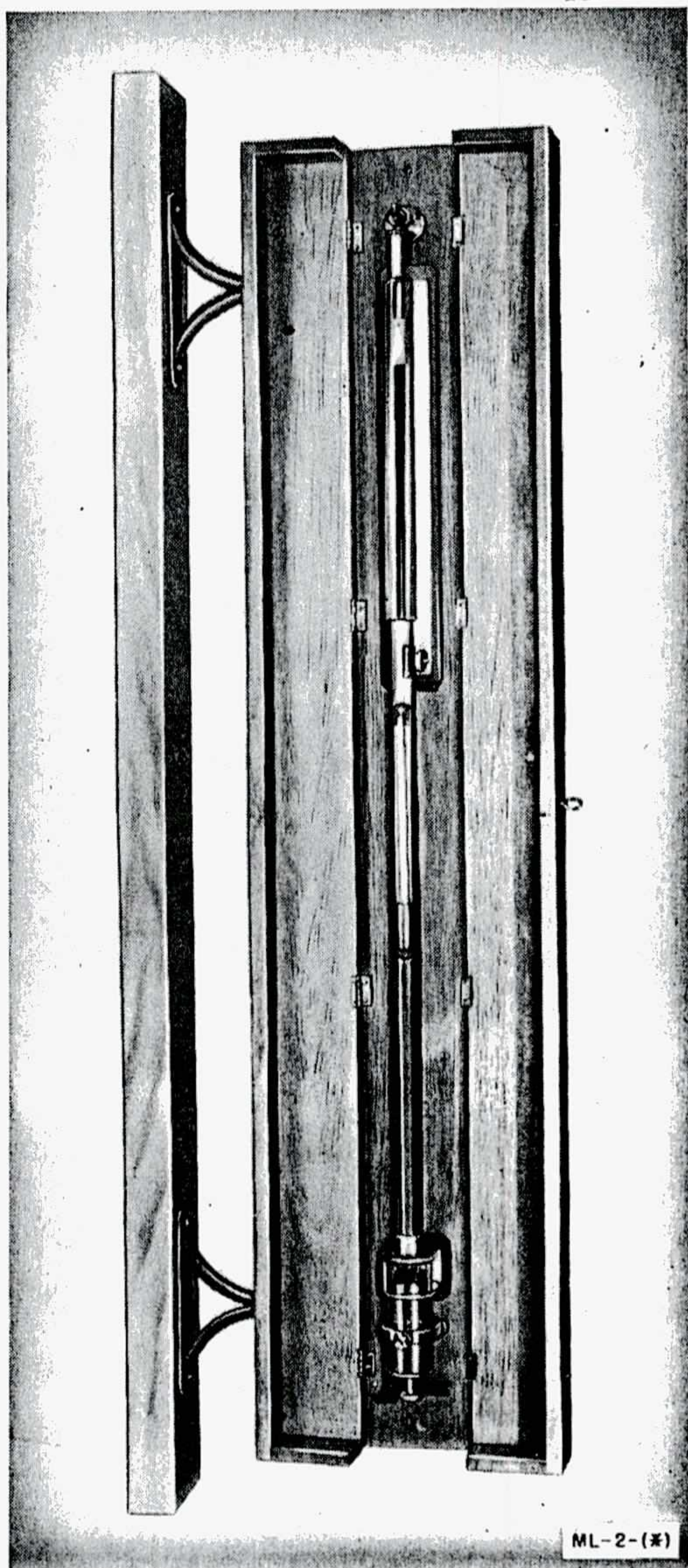


Figure 17. Barometer ML-2-(*), installed in Case ML-48.

TECHNICAL CHARACTERISTICS

BAROMETER

RANGE: From 22 to 32 inches of mercury; from 810 to 1,110 millibars (ranges differ slightly with various models).

INCH SCALE: Graduated in 1/20 of an inch; each integral inch is numbered.

MILLIBAR SCALE: Graduated in whole millibars; 100-millibar intervals have complete numerical designation, intervening 10-millibar intervals numbered in units of 10.

INCH VERNIER: Permits readings to .002 (1/500) inch.

MILLIBAR VERNIER: Permits readings to .05 (1/20) millibar.

THERMOMETER

FAHRENHEIT RANGE: -10° to +100°, graduated in whole degrees.

CENTIGRADE RANGE: -23° to +38°, graduated in 1/2 degrees.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	20
Total volume (cu ft).....	1.0

ML-3-(*)

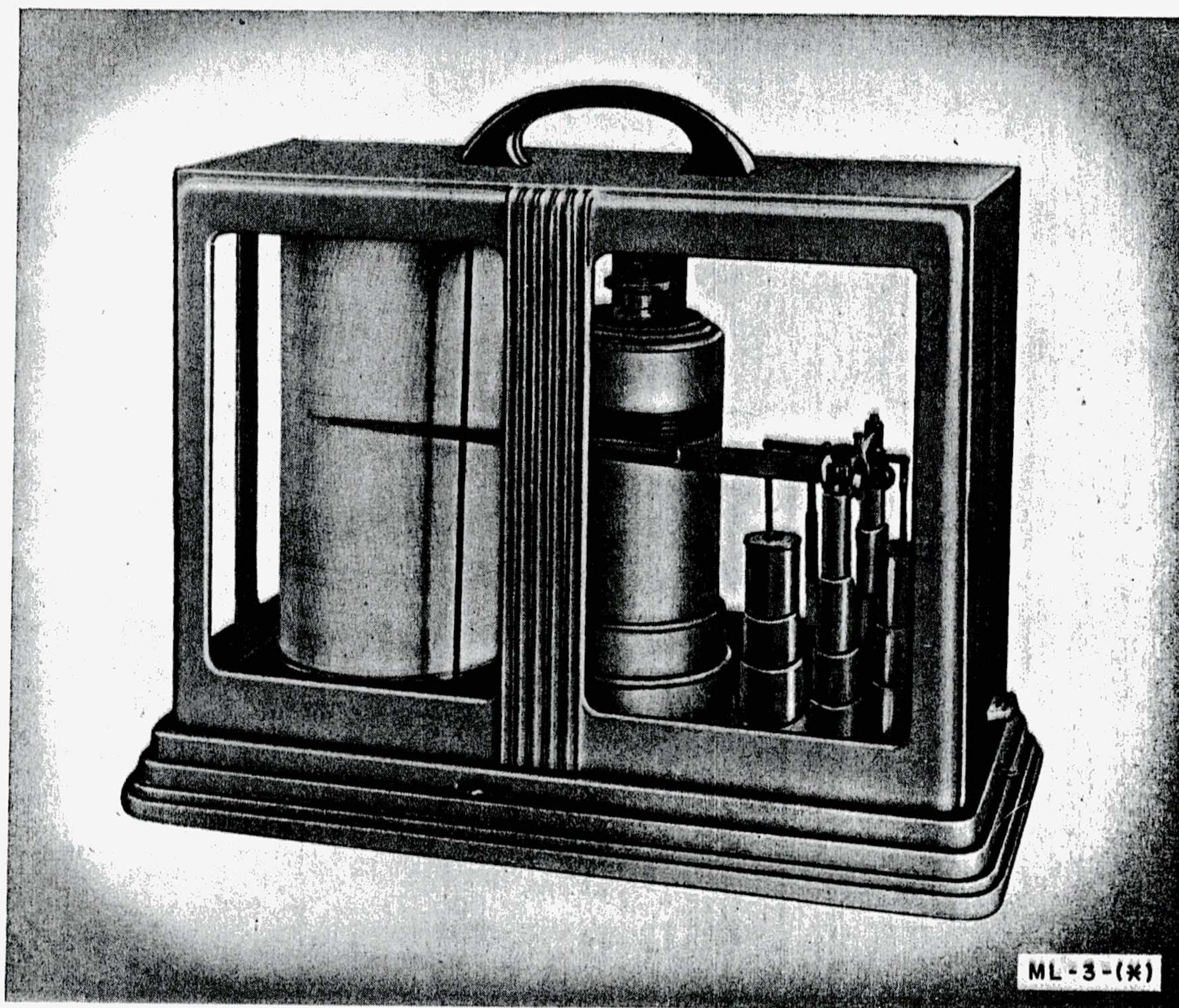


Figure 18. Barograph ML-3-(*).

Status: Standard. Stock No.: 7A203A. Reference: TM 11-425.

Barograph ML-3-(*) represents Barographs ML-3-A through -D. Barograph ML-3-(*) is a portable, precision instrument which measures and records atmospheric pressure. It makes a continuous, visible record for a 4-day period on a single chart. In locations where physical vibration is excessive, Mounting ML-178 may be used with the barograph; this mounting is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

TYPE OF BAROMETER: Aneroid.

PRESSURE-SENSITIVE UNIT: Two bellows of thin, hard brass.

RANGE: 2.5 in. of mercury; adjustable between 23.5 and 31 in. of mercury.

RECORDING SYSTEM: Pen, actuated through a system of levers, on a paper chart mounted on a rotating cylinder.

CYLINDER DRIVE: Clock ML-145, 8-day type, constant speed; produces 1 revolution of cylinder in approximately 4½ days.

CHART: Barograph Chart ML-236 (Sig C stock No. 7A5292-236).

WEIGHT AND VOLUME

Total weight (lb)	-----	<i>Export packed</i>
Total volume (cu ft)	-----	29
		1.52

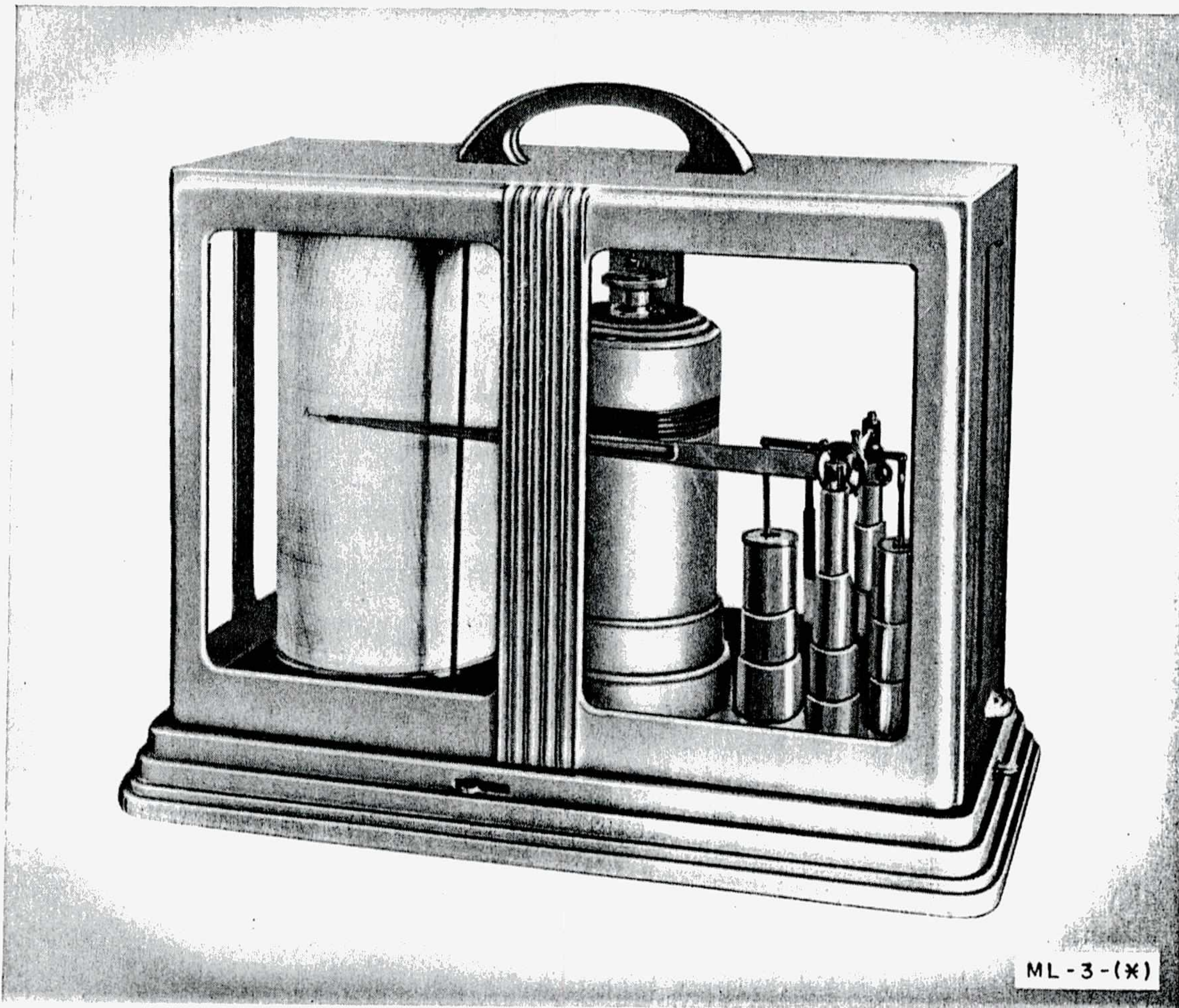


Figure 18. Barograph ML-3-(*).

Status: Standard. *Stock No.:* 7A203A. *Reference:* TM 11-425.

Barograph ML-3-(*) represents Barographs ML-3-A through -D. Barograph ML-3-(*) is a portable, precision instrument which measures and records atmospheric pressure. It makes a continuous, visible record for a 4-day period on a single chart. In locations where physical vibration is excessive, Mounting ML-178 may be used with the barograph; this mounting is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

TYPE OF BAROMETER: Aneroid.

PRESSURE-SENSITIVE UNIT: Two bellows of thin, hard brass.

RANGE: 2.5 in. of mercury; adjustable between 23.5 and 31 in. of mercury.

RECORDING SYSTEM: Pen, actuated through a system of levers, on a paper chart mounted on a rotating cylinder.

CYLINDER DRIVE: Clock ML-145, 8-day type, constant speed; produces 1 revolution of cylinder in approximately 4½ days.

CHART: Barograph Chart ML-236 (Sig C stock No. 7A5292-236).

WEIGHT AND VOLUME

Total weight (lb)	29
Total volume (cu ft)	1.52

*Export
packed*

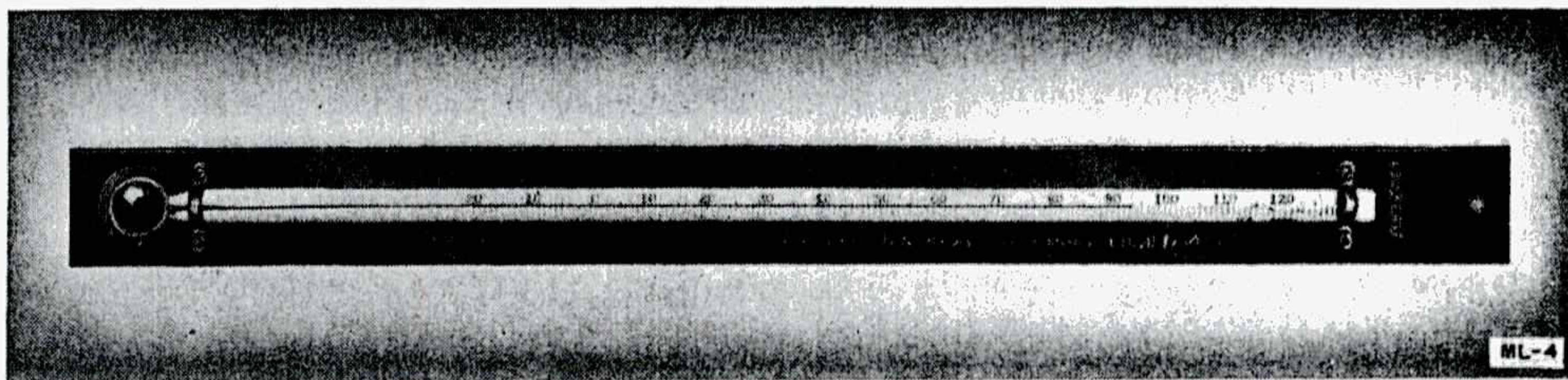


Figure 19. Thermometer ML-4.

Status: Standard. Stock No.: 7A1804.1 (general use), 7A1804.2 (tropical use), 7A1804.3 (Arctic use). Reference: TM 11-2417.

Thermometer ML-4 is a mercury-in-glass thermometer which registers the highest (maximum) temperature to which it has been exposed after being set. It is graduated in degrees Fahrenheit. Thermometer ML-4 is available in three temperature ranges: general, tropical, and arctic. The thermometer may be mounted on Support ML-54, a special bracket designed to hold Thermometers ML-4 and ML-5; the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

TYPE: Maximum registering.

THERMAL ELEMENT: Mercury.

RANGE (approx degrees Fahrenheit):

GENERAL: -10 to +125.

TROPICAL: +10 to +145.

ARCTIC: -35 to +125.

ACCURACY (° F.): ±0.8°, below 0°.

±0.6°, from 0° to +32°.

±4° above +32°.

GRADUATIONS: Intervals of 1° F., etched on glass stem; each multiple of 10° is numbered.

MOUNTING: Metal frame.

OPERATING POSITION: Bulb approximately 5° above the horizontal.

WEIGHT AND VOLUME

Total weight (lb.)	.....	<i>Export packed</i>
Total volume (cu ft)	.....

ML-5

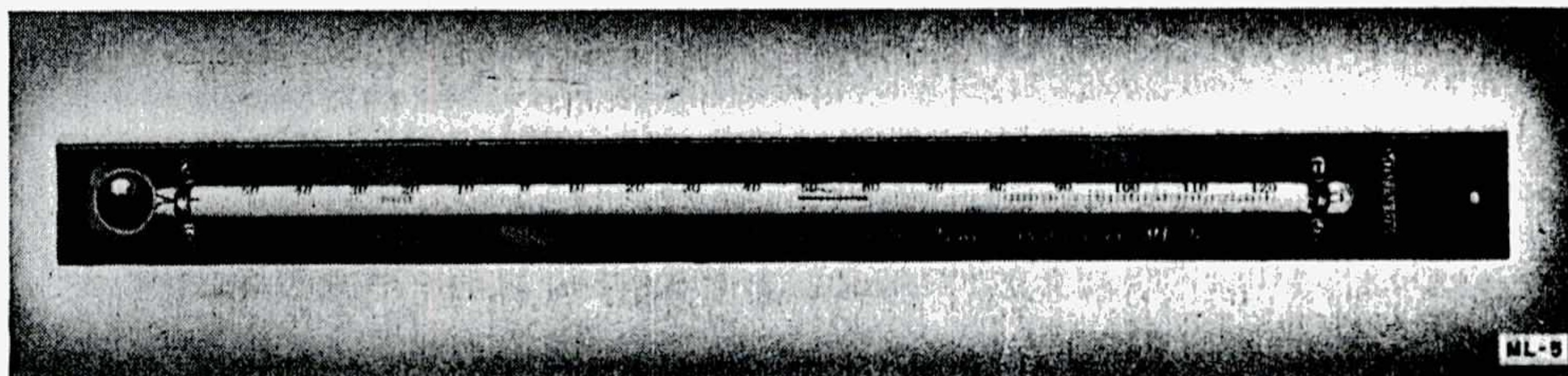


Figure 20. Thermometer ML-5.

Status: Standard. Stock No.: 7A1805.1 (general use), 7A1805.2 (tropical use), 7A1805.3 (Arctic use). Reference: TM 11-2417.

Thermometer ML-5 is an alcohol-in-glass thermometer which registers the lowest (minimum) temperature to which it has been exposed after being set. It is graduated in degrees Fahrenheit. Thermometer ML-5 is available in three temperature ranges: general, tropical, and Arctic. The thermometer may be mounted on Support ML-54, a special bracket designed to hold Thermometers ML-4 and ML-5; the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

TYPE: Minimum registering.

THERMAL ELEMENT: Alcohol.

RANGE (approx degrees Fahrenheit):

GENERAL: -60° to +100°.

TROPICAL: -40° to +120°.

ARCTIC: -90° to +80°.

ACCURACY (° F.): ±1.8°, below -50°.

±1.6°, from -50° to -30°.

±1.2°, from -30° to 0°.

±.8°, from 0° to +32°.

±.4°, above +32°.

GRADUATIONS: Intervals of 1° F., etched on glass stem; each multiple of 10° is numbered.

MOUNTING: Metal frame.

OPERATING POSITION: Bulb slightly below horizontal.

WEIGHT AND VOLUME

Total weight (lb)	.....	<i>Export packed</i>
Total volume (cu ft)	.....



Figure 19. Thermometer ML-4.

Status: Standard. Stock No.: 7A1804.1 (general use), 7A1804.2 (tropical use), 7A1804.3 (Arctic use). Reference: TM 11-2417.

Thermometer ML-4 is a mercury-in-glass thermometer which registers the highest (maximum) temperature to which it has been exposed after being set. It is graduated in degrees Fahrenheit. Thermometer ML-4 is available in three temperature ranges: general, tropical, and arctic. The thermometer may be mounted on Support ML-54, a special bracket designed to hold Thermometers ML-4 and ML-5; the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

TYPE: Maximum registering.

THERMAL ELEMENT: Mercury.

RANGE (approx degrees Fahrenheit):

GENERAL: -10 to +125.

TROPICAL: +10 to +145.

ARCTIC: -35 to +125.

ACCURACY (° F.): ±0.8°, below 0°.

±0.6°, from 0° to +32°.

±4° above +32°.

GRADUATIONS: Intervals of 1° F., etched on glass stem; each multiple of 10° is numbered.

MOUNTING: Metal frame.

OPERATING POSITION: Bulb approximately 5° above the horizontal.

WEIGHT AND VOLUME

Total weight (lb.)

Export packed

.57

Total volume (cu ft)

.05

ML-5

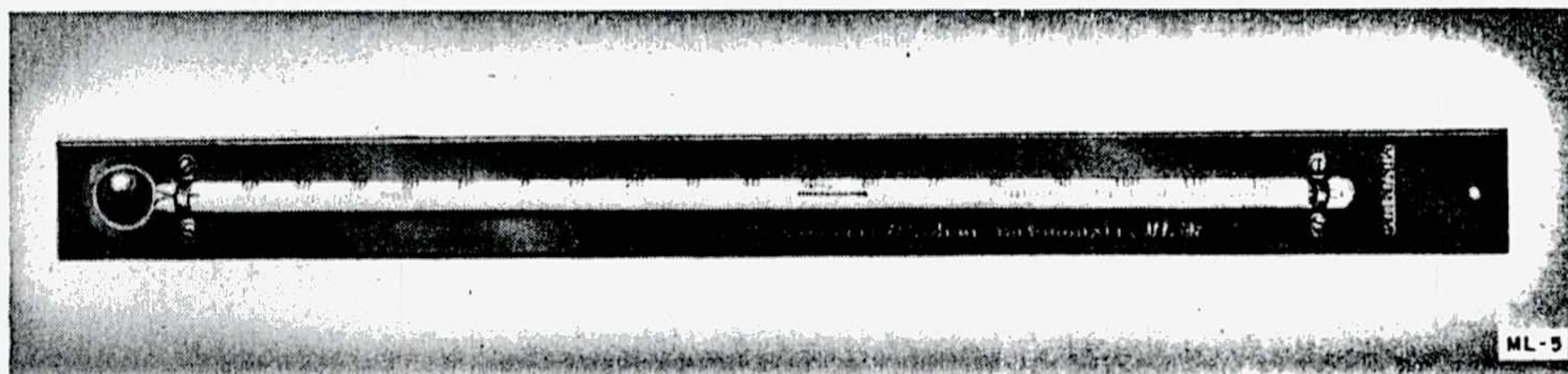


Figure 20. Thermometer ML-5.

Status: Standard. Stock No.: 7A1805.1 (general use), 7A1805.2 (tropical use), 7A1805.3 (Arctic use). Reference: TM 11-2417.

Thermometer ML-5 is an alcohol-in-glass thermometer which registers the lowest (minimum) temperature to which it has been exposed after being set. It is graduated in degrees Fahrenheit. Thermometer ML-5 is available in three temperature ranges: general, tropical, and Arctic. The thermometer may be mounted on Support ML-54, a special bracket designed to hold Thermometers ML-4 and ML-5; the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

TYPE: Minimum registering.

THERMAL ELEMENT: Alcohol.

RANGE (approx degrees Fahrenheit):

GENERAL: -60° to +100°.

TROPICAL: -40° to +120°.

ARCTIC: -90° to +80°.

ACCURACY (° F.): ±1.8°, below -50°.

±1.6°, from -50° to -30°.

±1.2°, from -30° to 0°.

±.8°, from 0° to +32°.

±.4°, above +32°.

GRADUATIONS: Intervals of 1° F., etched on glass stem; each multiple of 10° is numbered.

MOUNTING: Metal frame.

OPERATING POSITION: Bulb slightly below horizontal.

WEIGHT AND VOLUME

Total weight (lb.)

Export packed

.3

Total volume (cu ft)

.12

23

ML-9

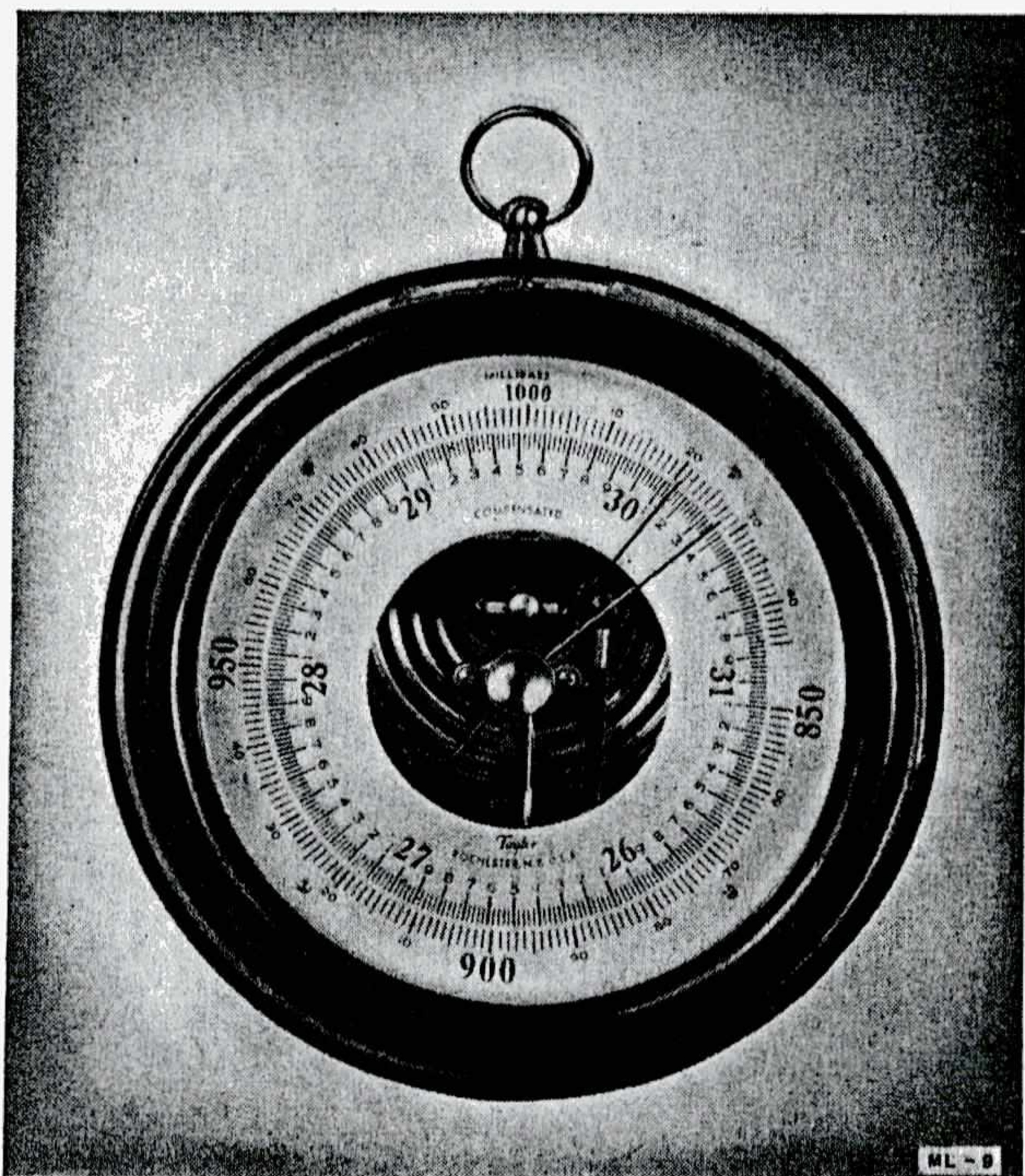


Figure 21. Barometer ML-9.

Status: Limited/Std. Stock No.: 7A309. Reference: TM 3-240.

Barometer ML-9 is a portable, rugged, easy-to-read, aneroid-type barometer which is used under service conditions, and when extreme accuracy is not essential, to determine changes in atmospheric pressure over several hour periods. It indicates atmospheric pressure in inches of mercury and in millibars.

TECHNICAL CHARACTERISTICS

- TYPE: Aneroid.
- PRESSURE-SENSITIVE ELEMENT: Partially evacuated, metal cell.
- INDICATOR: Pointer actuated through a lever system.
- RANGE: 25 to 31 inches of mercury; 850 to 1,045 millibars.
- INCH SCALE: Graduated in $\frac{1}{50}$ of an inch; integral inches and tenths are numbered.
- MILLIBAR SCALE: Graduated in whole millibars; numbered every 10 millibars.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 3.9
Total volume (cu ft).....	.2

ML-16

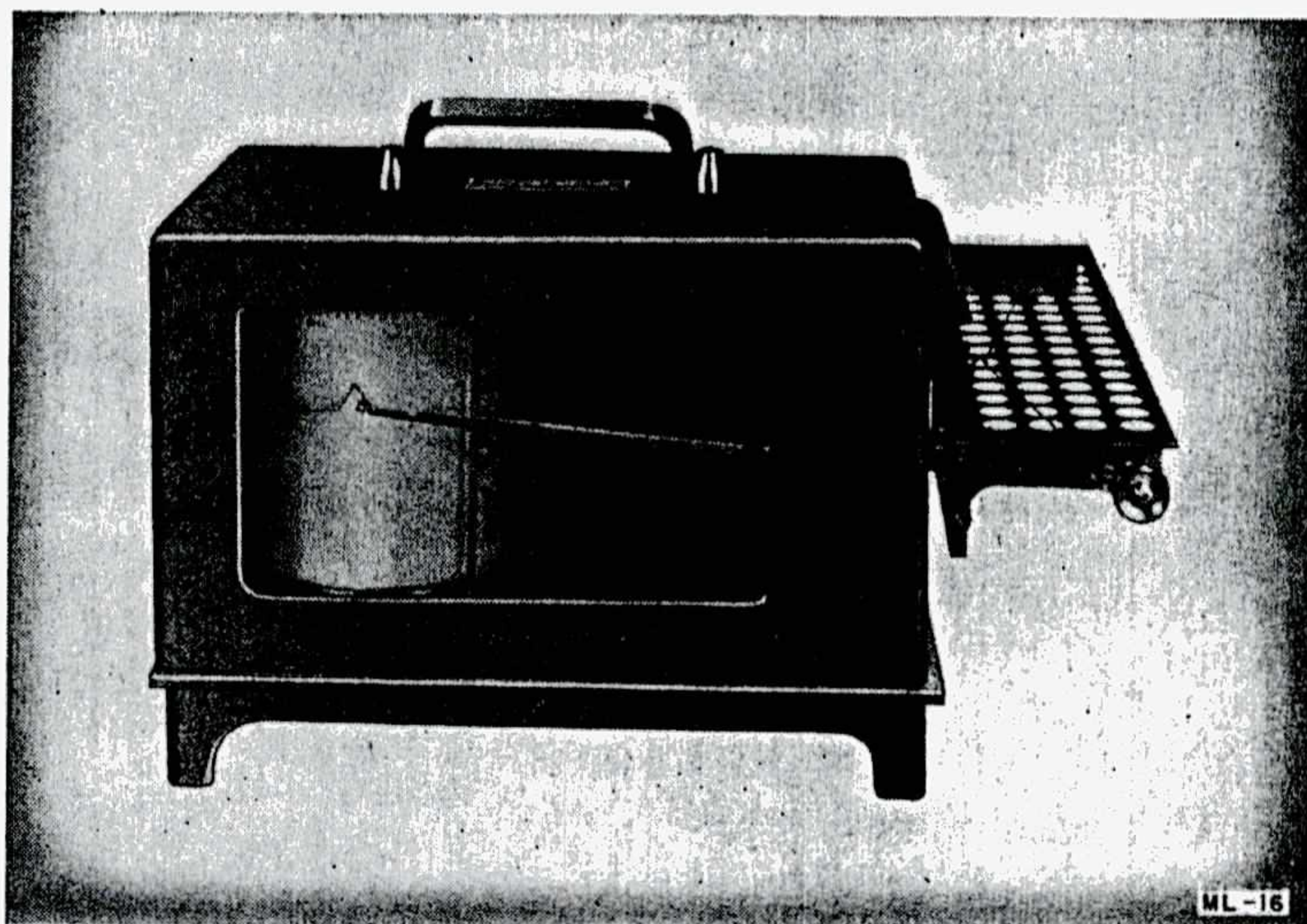


Figure 22. Hygrograph ML-16.

Status: Limited/Std. Stock No.: 7A1016B. Reference: TM 1-235.

Hygrograph ML-16 is a self-contained, portable instrument which measures relative humidity and produces on a chart a continuous, visible record of the measurements. The record may be made continuous over a 1-day or a 7-day period.

TECHNICAL CHARACTERISTICS

RANGE: 0 to 100 percent.

- ACTUATING ELEMENT: Strand of approximately 50 human hairs.
- RECORD: Continuous, 1 day or 7 days.
- RECORDER: Pen, actuated through a system of linkages.
- DRIVE: Clock ML-60-A, with daily and weekly gears and pinions.
- CHART: SC Form 130.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 17
Total volume (cu ft).....	1.65

ML-9

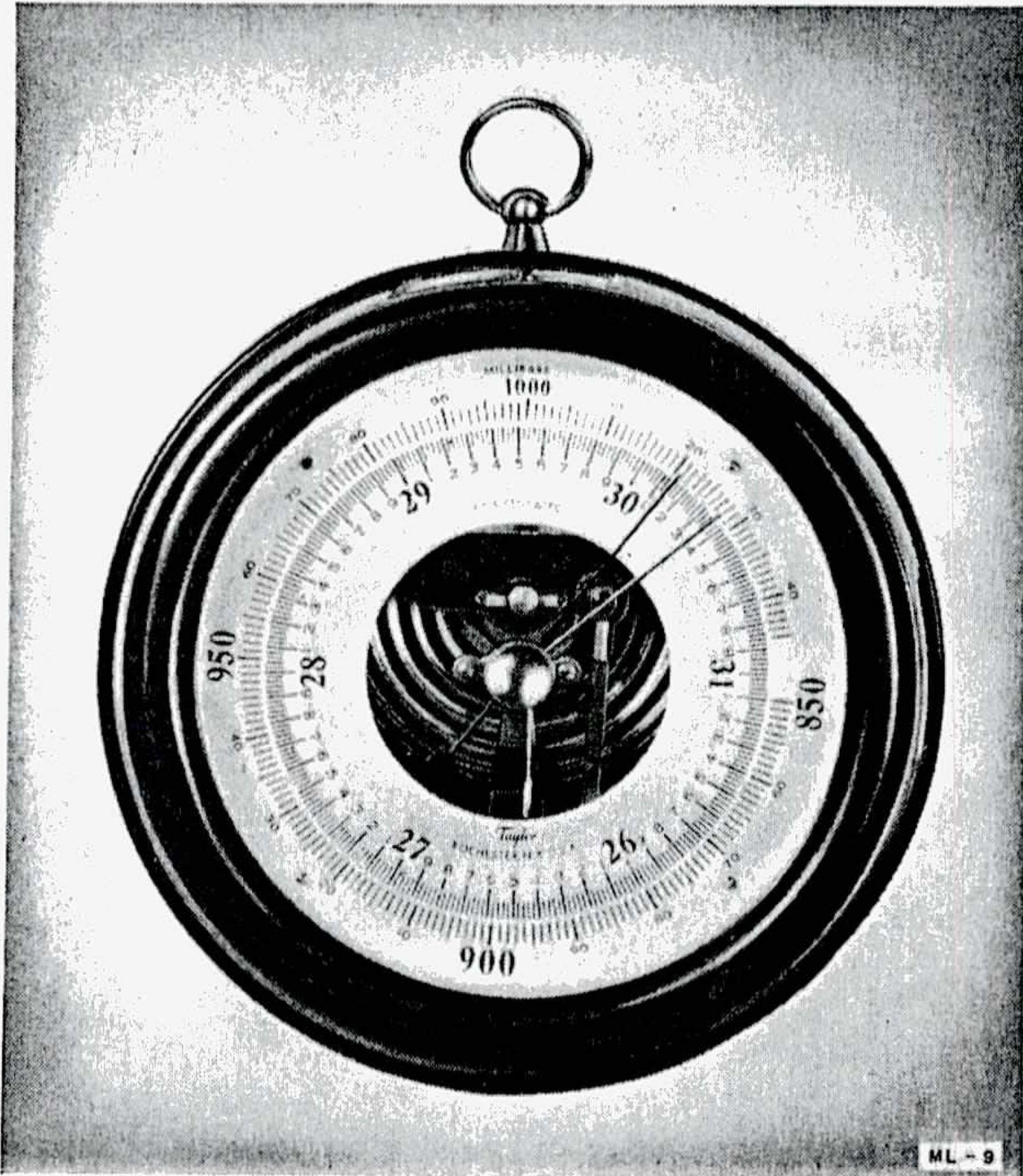


Figure 21. Barometer ML-9.

Status: Limited/Std. Stock No.: 7A309. Reference: TM 3-240.

Barometer ML-9 is a portable, rugged, easy-to-read, aneroid-type barometer which is used under service conditions, and when extreme accuracy is not essential, to determine changes in atmospheric pressure over several hour periods. It indicates atmospheric pressure in inches of mercury and in millibars.

TECHNICAL CHARACTERISTICS

- TYPE: Aneroid.
- PRESSURE-SENSITIVE ELEMENT: Partially evacuated, metal cell.
- INDICATOR: Pointer actuated through a lever system.
- RANGE: 25 to 31 inches of mercury; 850 to 1,045 millibars.
- INCH SCALE: Graduated in $\frac{1}{50}$ of an inch; integral inches and tenths are numbered.
- MILLIBAR SCALE: Graduated in whole millibars; numbered every 10 millibars.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	3.9
Total volume (cu ft).....	.2

ML-16

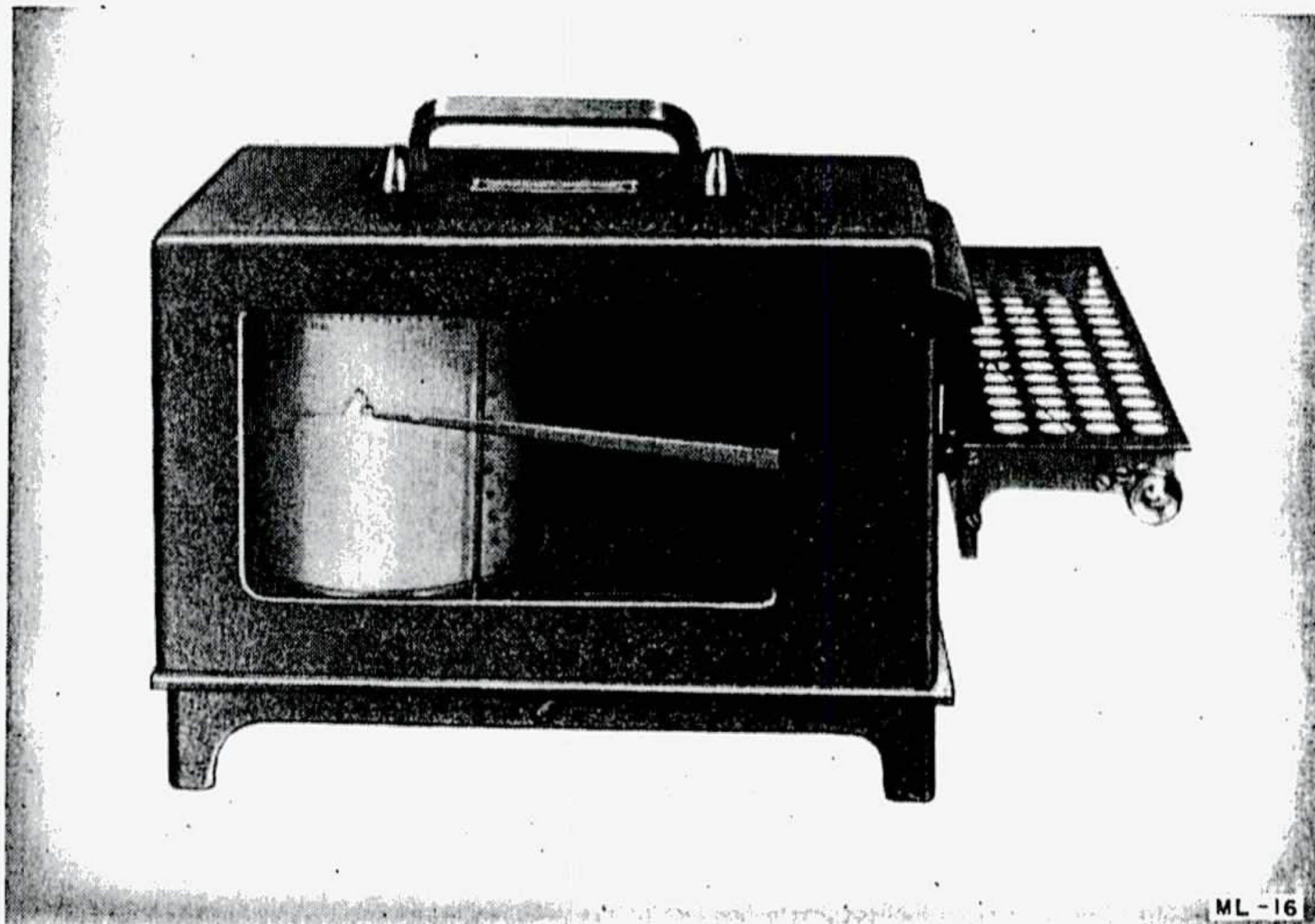


Figure 22. Hygrograph ML-16.

Status: Limited/Std. Stock No.: 7A1016B. Reference: TM 1-235.

Hygrograph ML-16 is a self-contained, portable instrument which measures relative humidity and produces on a chart a continuous, visible record of the measurements. The record may be made continuous over a 1-day or a 7-day period.

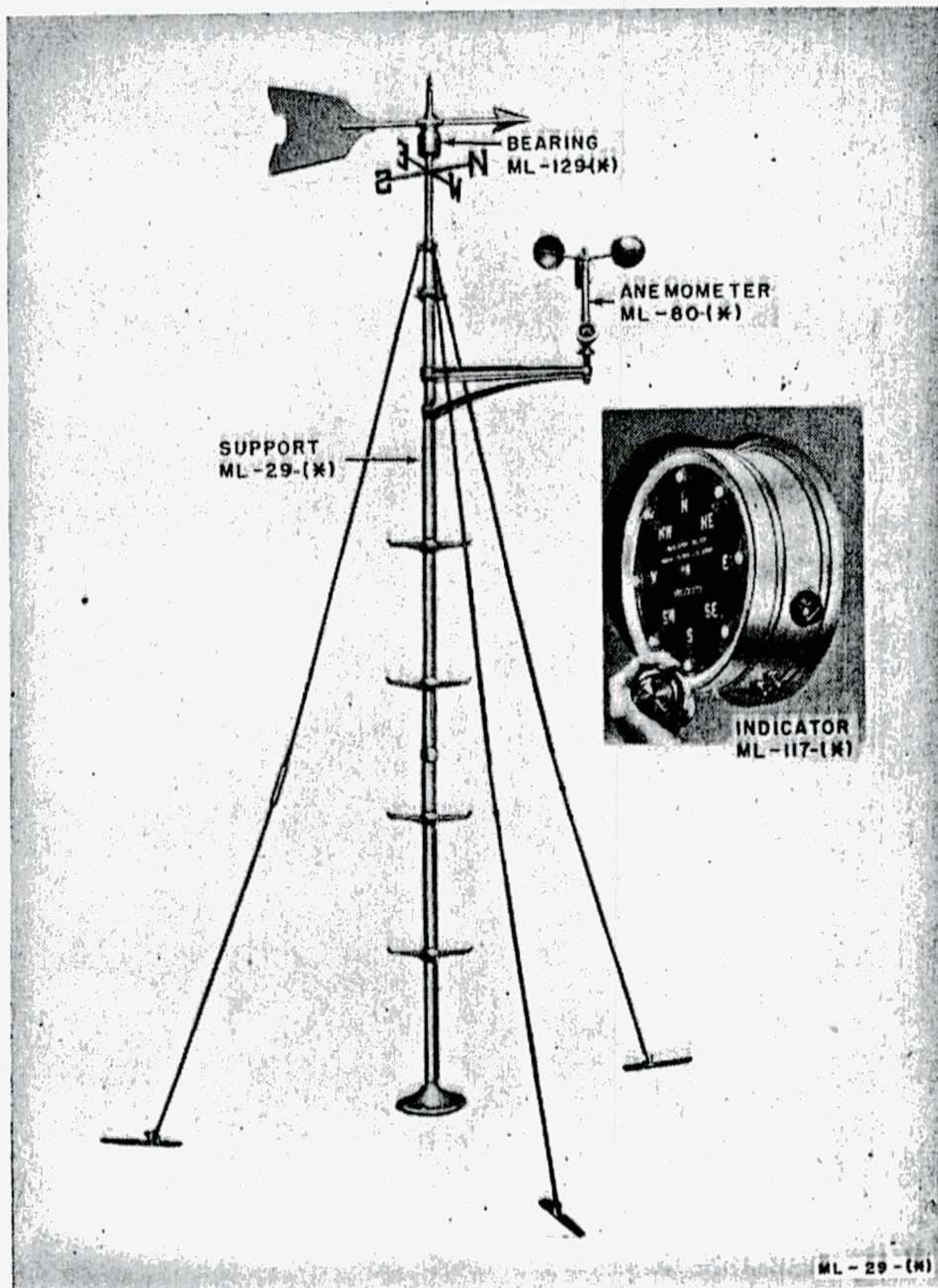
TECHNICAL CHARACTERISTICS

RANGE: 0 to 100 percent.

- ACTUATING ELEMENT: Strand of approximately 50 human hairs.
- RECORD: Continuous, 1 day or 7 days.
- RECORDER: Pen, actuated through a system of linkages.
- DRIVE: Clock ML-60-A, with daily and weekly gears and pinions.
- CHART: SC Form 130.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	17
Total volume (cu ft).....	1.65



Status: Limited/Std. Stock No.: 7A1729 (all models except ML-29-C), 7A1729C (ML-29-C).
Reference: TM 11-424.

Support ML-29-(*), represents Supports ML-29 through ML-29-E. The models are essentially alike, but have minor differences in construction and technical characteristics. Support ML-29-(*), is a wind-instrument support designed for installation on a roof or elevated platform. It is provided with guys and steps, a wind vane and bearing, four fixed direction arms, and an extended arm and brace for the support of Anemometer ML-80. Most models have provisions for the use of a wind speed and direction indicator. Support ML-29-(*), Anemometer ML-80, and Indicator ML-117 comprise a complete system for determining surface wind direction and for measuring and indicating surface wind speed.

Figure 23. Support ML-29-(*), with Anemometer ML-80.

TECHNICAL CHARACTERISTICS

	ML-29	ML-29-A	ML-29-B	ML-29-C	ML-29-D	ML-29-E
HEIGHT (ft).....	7 or 12	12	12	12	12	12
BEARING.....	ML-129	ML-129-A	ML-129-B; ML-129-E.	ML-129-C	ML-129-D	ML-129-B; ML-129-E.
CONTACTS.....	None	4	8	12	8	8
NUMBER OF COM- PASS POINTS.....	None	8	8	16 and 8	8	8
ANEMOMETER.....	ML-80-(*)	ML-80-(*)	ML-80-(*)	ML-80; ML-80-B.	ML-80-A	ML-80; ML-80-B.
INDICATOR.....	None	None	ML-117-(*)	ML-117-(*)	ML-117-A	ML-117-(*)

PRINCIPAL COMPONENTS

- Mast
- Bearing ML-129 (see table above)
- Set of direction arms
- Wind vane

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb).....	102	168
Total volume (cu ft).....		15.5

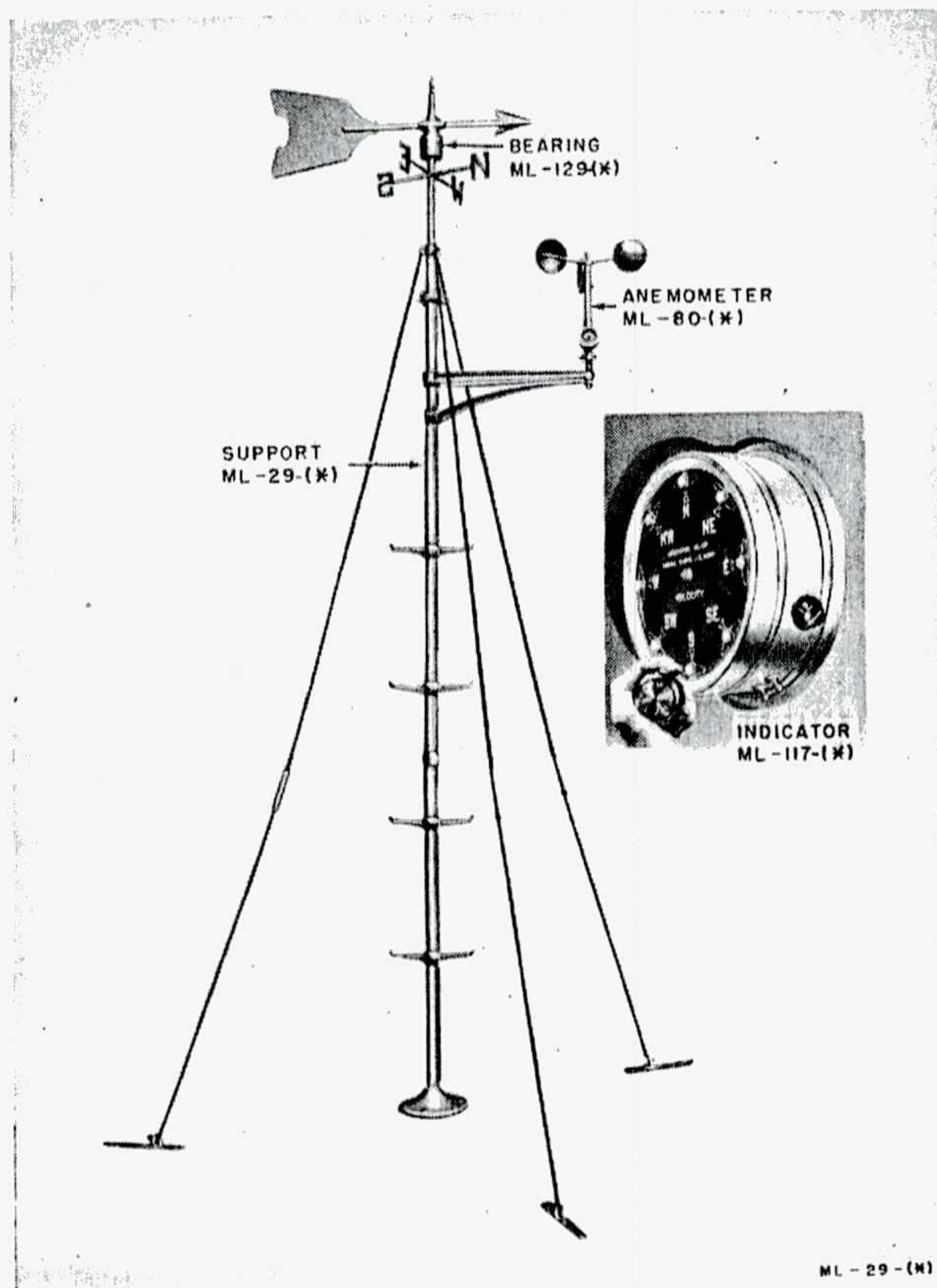


Figure 23. Support ML-29-(*), with Anemometer ML-80.

Status: Limited/Std. Stock No.: 7A1729 (all models except ML-29-C), 7A1729C (ML-29-C).
Reference: TM 11-424.

Support ML-29-(*), represents Supports ML-29 through ML-29-E. The models are essentially alike, but have minor differences in construction and technical characteristics. Support ML-29-(*), is a wind-instrument support designed for installation on a roof or elevated platform. It is provided with guys and steps, a wind vane and bearing, four fixed direction arms, and an extended arm and brace for the support of Anemometer ML-80. Most models have provisions for the use of a wind speed and direction indicator. Support ML-29-(*), Anemometer ML-80, and Indicator ML-117 comprise a complete system for determining surface wind direction and for measuring and indicating surface wind speed.

TECHNICAL CHARACTERISTICS

	ML-29	ML-29-A	ML-29-B	ML-29-C	ML-29-D	ML-29-E
HEIGHT (ft).....	7 or 12	12	12	12	12	12
BEARING.....	ML-129	ML-129-A	ML-129-B; ML-129-E.	ML-129-C	ML-129-D	ML-129-B; ML-129-E.
CONTACTS.....	None	4	8	12	8	8
NUMBER OF COM- PASS POINTS.....	None	8	8	16 and 8	8	8
ANEMOMETER.....	ML-80-(*)	ML-80-(*)	ML-80-(*)	ML-80; ML-80-B.	ML-80-A	ML-80; ML-80-B.
INDICATOR.....	None	None	ML-117-(*)	ML-117-(*)	ML-117-A	ML-117-(*)

PRINCIPAL COMPONENTS

- Mast
- Bearing ML-129 (see table above)
- Set of direction arms
- Wind vane

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb).....	102	168
Total volume (cu ft).....		15.5

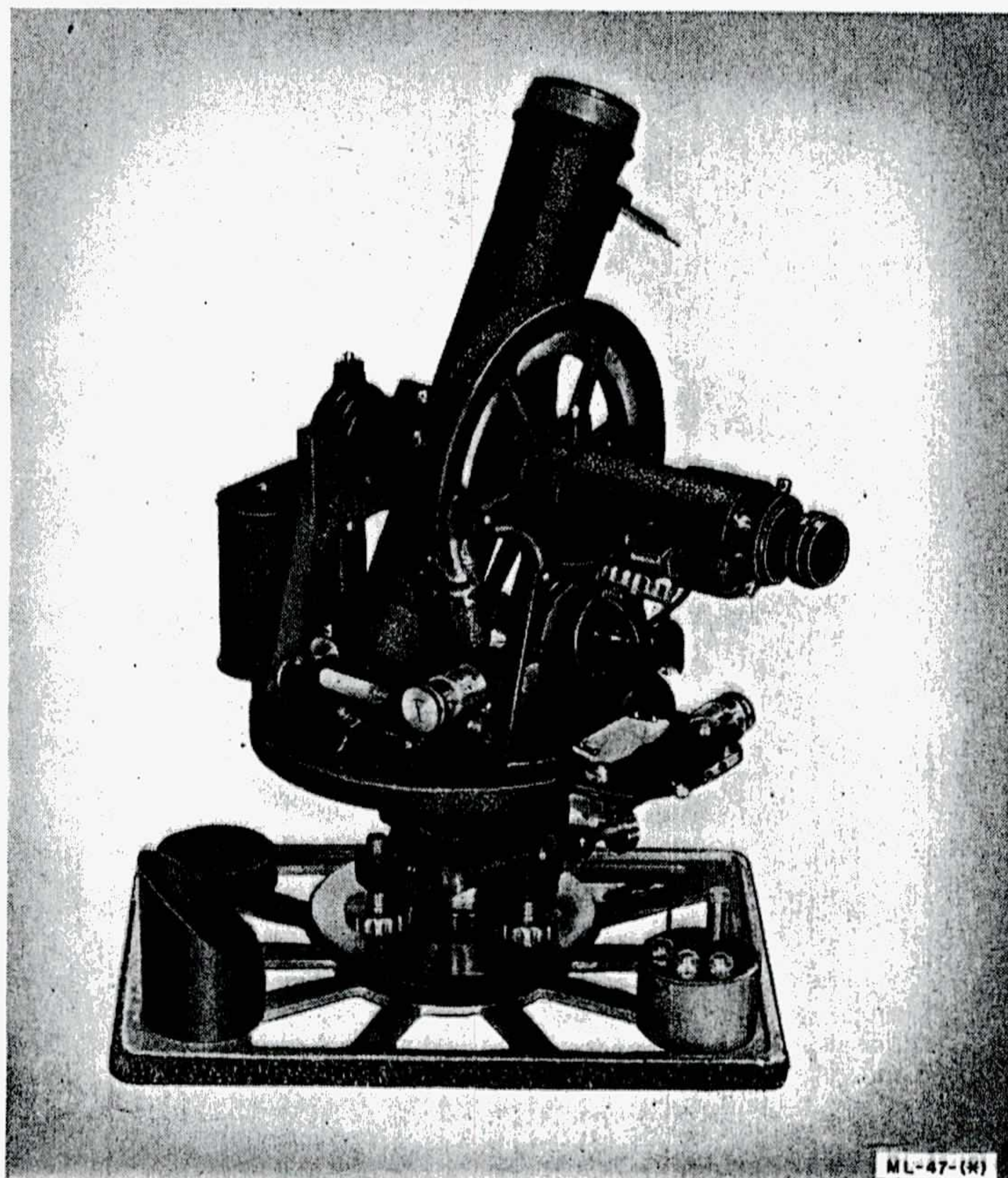


Figure 24. Theodolite ML-47-(C).

Status: Limited/Std. Stock No.: 7A1747C.
Reference: TM 11-423.

Theodolite ML-47-(*), represents Theodolites ML-47-C through -R. Theodolite ML-47-(*), is a portable, right-angle-telescope type surveying instrument. It is used to follow and measure the movement of a pilot balloon as it rises through the atmosphere and is carried horizontally by the air flow. Readings of the angle of elevation and the azimuth of the balloon are made at regular intervals to determine the speed and direction of the wind at various levels. Theodolite ML-47-(*), is usually mounted on Tripod ML-78-(*); for fixed installation, it may be mounted on Theodolite Mount ML-180. Compass ML-197 and Telescope ML-146 are attached to Theodolite ML-47-R; they may be fitted to any other model of Theodolite ML-47-(*), (Telescope ML-146 can be installed only by experienced instrument makers having suitable shop facilities).

Note. Theodolite ML-47-R is identical to Theodolite ML-247.

TECHNICAL CHARACTERISTICS

TELESCOPE

- TYPE: Right-angle, with prism.
- POWER: Approximately 20 diameters.
- FIELD: Approximately 2°.
- EYEPIECE: Inverting, adjustable, with cross hairs.
- FOCUS: Adjustable.

SCALES

- ELEVATION: Graduated in whole degrees, vernier reading to .1°.
- AZIMUTH: Graduated in whole degrees, vernier reading to .1°; range, 360°.
- SIGHTS: Fixed, for sighting vertical angles up to 45°; extension for sighting vertical angles up to 85°.
- ILLUMINATION: 3 incandescent lamp assemblies; current supplied by 2 batteries BA-30.

ACCESSORY EQUIPMENT: Tripod ML-78.

- Theodolite Mount ML-180.
- Compass ML-197 (p/o ML-47-R).
- Telescope ML-146 (p/o ML-47-R).

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb).....	40	83
Total volume (cu ft).....	1.8	8.0

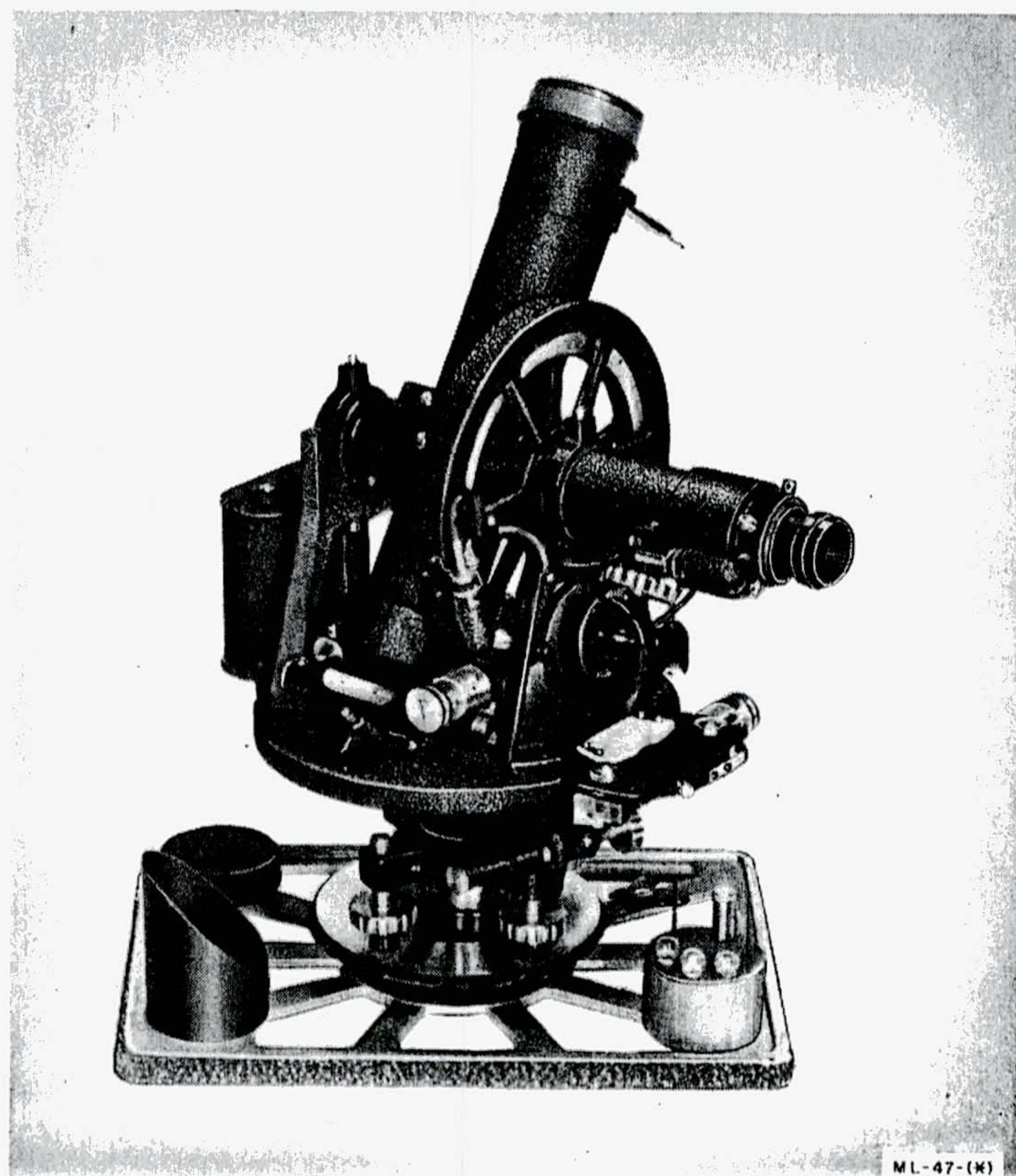


Figure 24. Theodolite ML-47-(C).

Status: Limited/Std. Stock No.: 7A1747C.
Reference: TM 11-423.

Theodolite ML-47-(*) represents Theodolites ML-47-C through -R. Theodolite ML-47-(*) is a portable, right-angle-telescope type surveying instrument. It is used to follow and measure the movement of a pilot balloon as it rises through the atmosphere and is carried horizontally by the air flow. Readings of the angle of elevation and the azimuth of the balloon are made at regular intervals to determine the speed and direction of the wind at various levels. Theodolite ML-47-(*) is usually mounted on Tripod ML-78-(*); for fixed installation, it may be mounted on Theodolite Mount ML-180. Compass ML-197 and Telescope ML-146 are attached to Theodolite ML-47-R; they may be fitted to any other model of Theodolite ML-47-(*) (Telescope ML-146 can be installed only by experienced instrument makers having suitable shop facilities).

Note. Theodolite ML-47-R is identical to Theodolite ML-247.

TECHNICAL CHARACTERISTICS

TELESCOPE

- TYPE: Right-angle, with prism.
- POWER: Approximately 20 diameters.
- FIELD: Approximately 2°.
- EYEPIECE: Inverting, adjustable, with cross hairs.
- FOCUS: Adjustable.

SCALES

- ELEVATION: Graduated in whole degrees, vernier reading to .1°.
- AZIMUTH: Graduated in whole degrees, vernier reading to .1°; range, 360°.
- SIGHTS: Fixed, for sighting vertical angles up to 45°; extension for sighting vertical angles up to 85°.
- ILLUMINATION: 3 incandescent lamp assemblies; current supplied by 2 batteries BA-30.
- ACCESSORY EQUIPMENT: Tripod ML-78.

- Theodolite Mount ML-180.
- Compass ML-197 (p/o ML-47-R).
- Telescope ML-146 (p/o ML-47-R).

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb)...	40	83
Total volume (cu ft)...	1.8	8.0

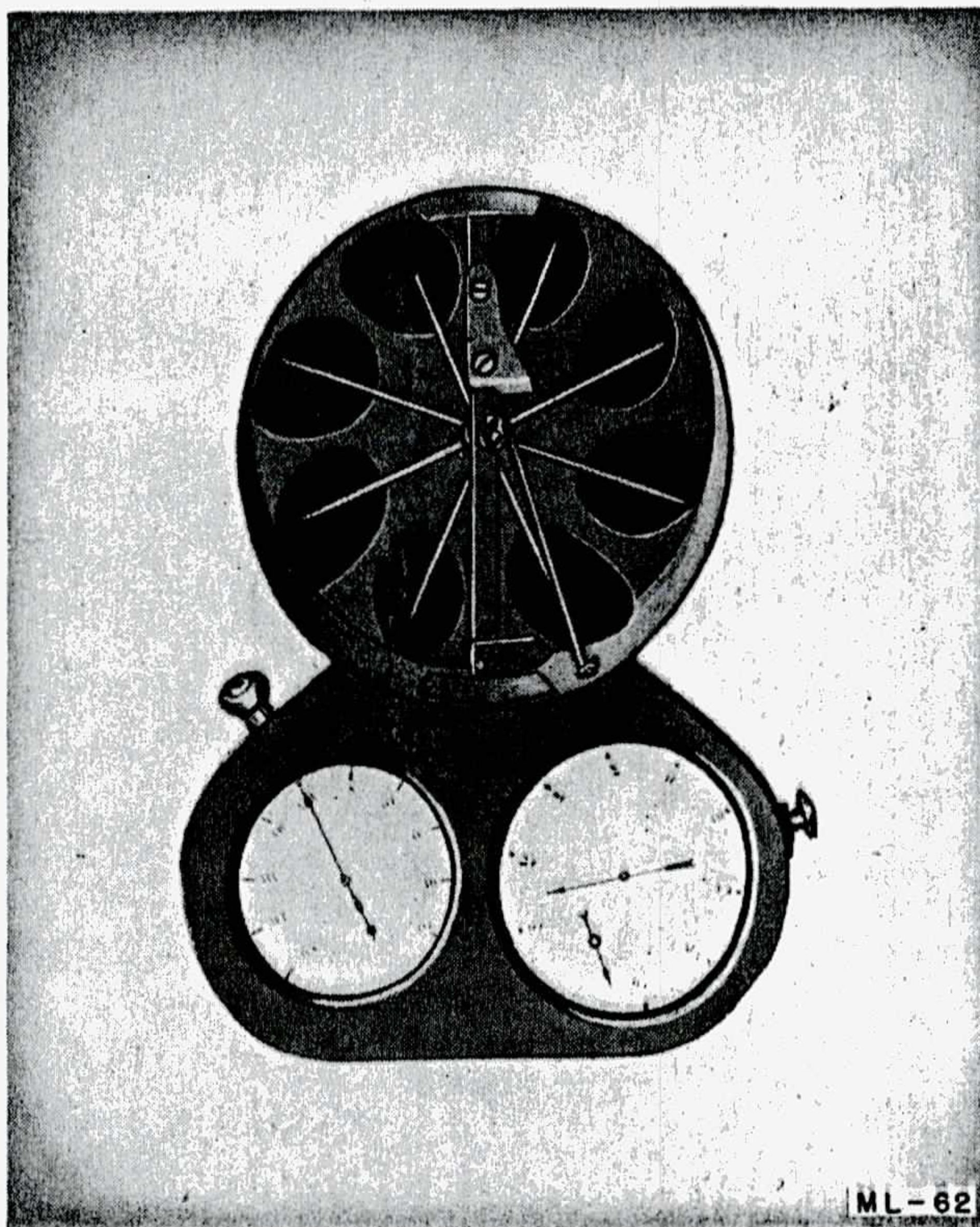


Figure 25. Anemometer ML-62.

Status: Standard. Stock No.: 7A62. Reference: TM 1-235.

Anemometer ML-62 is a hand-held instrument which is used to determine wind speed in areas where the installation of a permanent type of anemometer is impractical. A revolution counter indicates, in meters for the elapsed operating time, total wind movement, from which wind speed may be determined. A stop watch is built into the equipment.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	5.4
Total volume (cu ft).....	.15

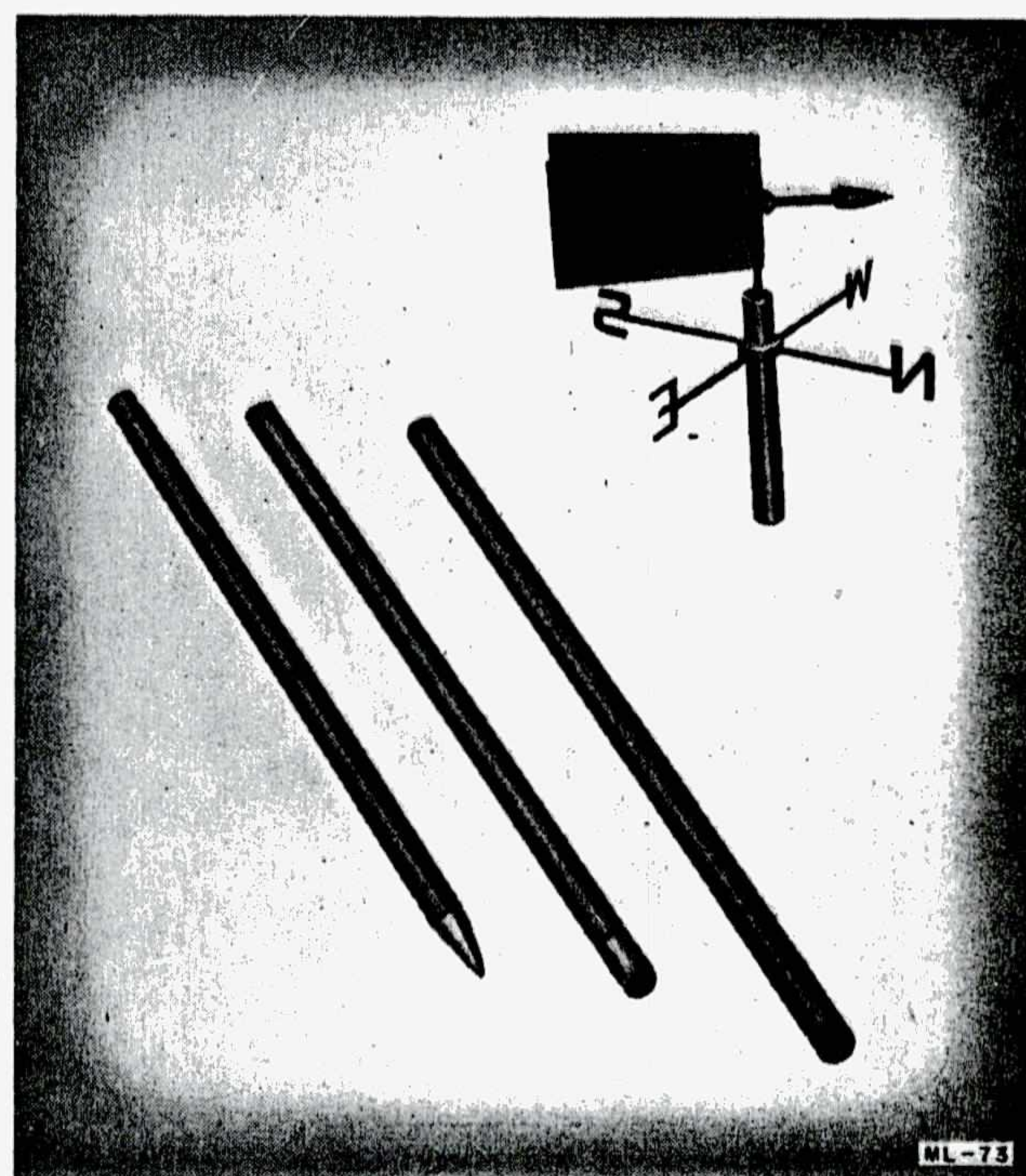


Figure 26. Wind Vane ML-73.

Status: Standard. Stock No.: 7A2073. Reference: TM 1-235.

Wind Vane ML-73 is a portable instrument which is used to determine wind direction in areas where a more permanent installation is impractical. It indicates, but does not record, wind direction. The equipment consists of a wind vane head which includes a direction pointer and four direction arms; a support made up of three separable sections; and two carrying cases.

TECHNICAL CHARACTERISTICS

DATA OBTAINABLE: Surface wind direction only.
SUPPORT

SECTIONS: 3, each 29½ in. lg, provided with socket joints; 1 section pointed for insertion into the ground; either 2 or 3 sections may be used.
HEIGHT: 2 sections, 57 in.; 3 sections, 85 in.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	7
Total volume (cu ft).....	.75

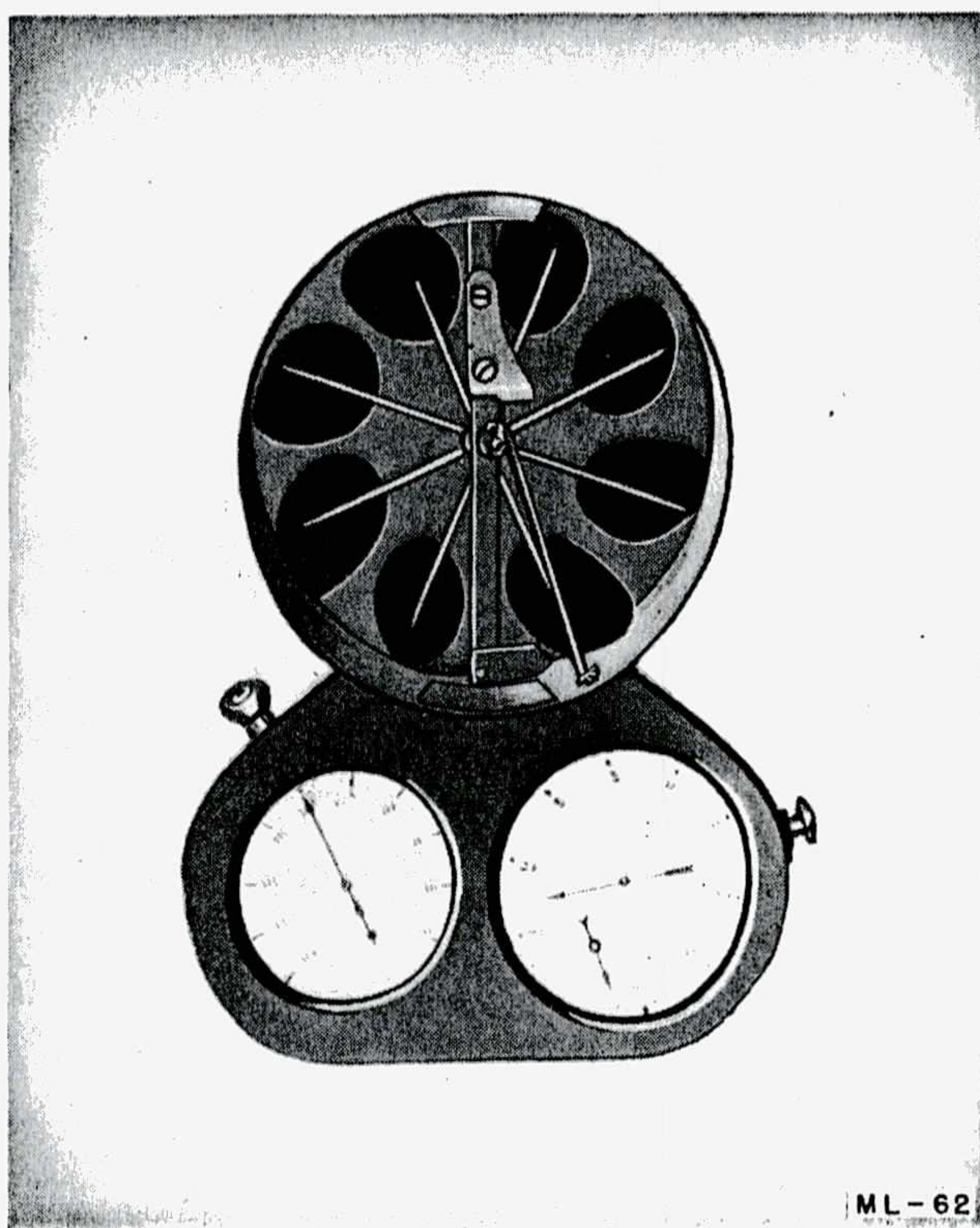


Figure 25. Anemometer ML-62.

Status: Standard. Stock No.: 7A62. Reference: TM 1-235.

Anemometer ML-62 is a hand-held instrument which is used to determine wind speed in areas where the installation of a permanent type of anemometer is impractical. A revolution counter indicates, in meters for the elapsed operating time, total wind movement, from which wind speed may be determined. A stop watch is built into the equipment.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb)	5.4
Total volume (cu ft) .....	.15

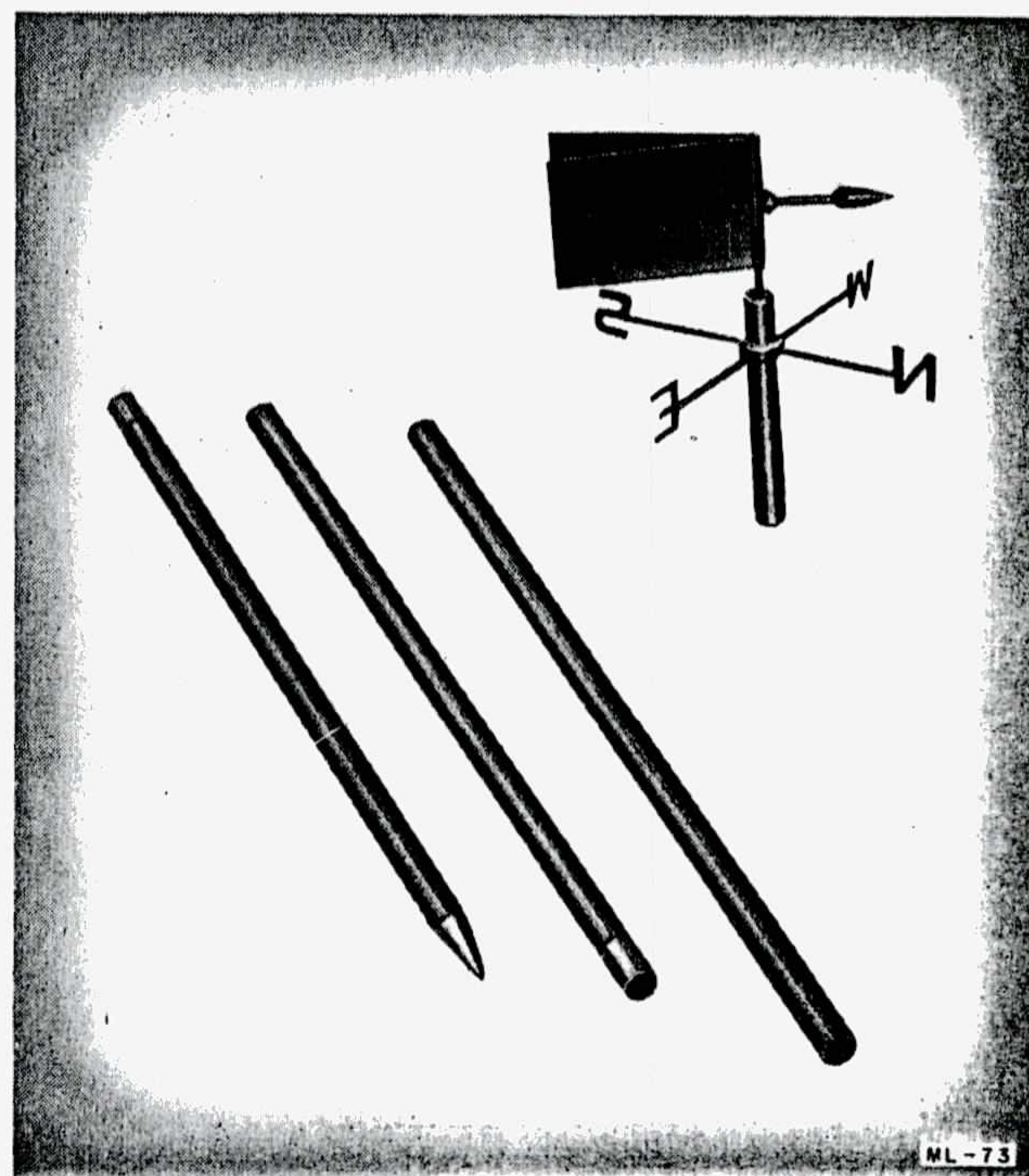


Figure 26. Wind Vane ML-73.

Status: Standard. Stock No.: 7A2073. Reference: TM 1-235.

Wind Vane ML-73 is a portable instrument which is used to determine wind direction in areas where a more permanent installation is impractical. It indicates, but does not record, wind direction. The equipment consists of a wind vane head which includes a direction pointer and four direction arms; a support made up of three separable sections; and two carrying cases.

TECHNICAL CHARACTERISTICS

DATA OBTAINABLE: Surface wind direction only.
SUPPORT

SECTIONS: 3, each 29½ in. lg, provided with socket joints; 1 section pointed for insertion into the ground; either 2 or 3 sections may be used.
HEIGHT: 2 sections, 57 in.; 3 sections, 85 in.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb)	7
Total volume (cu ft) .....	.75

ML-74-A

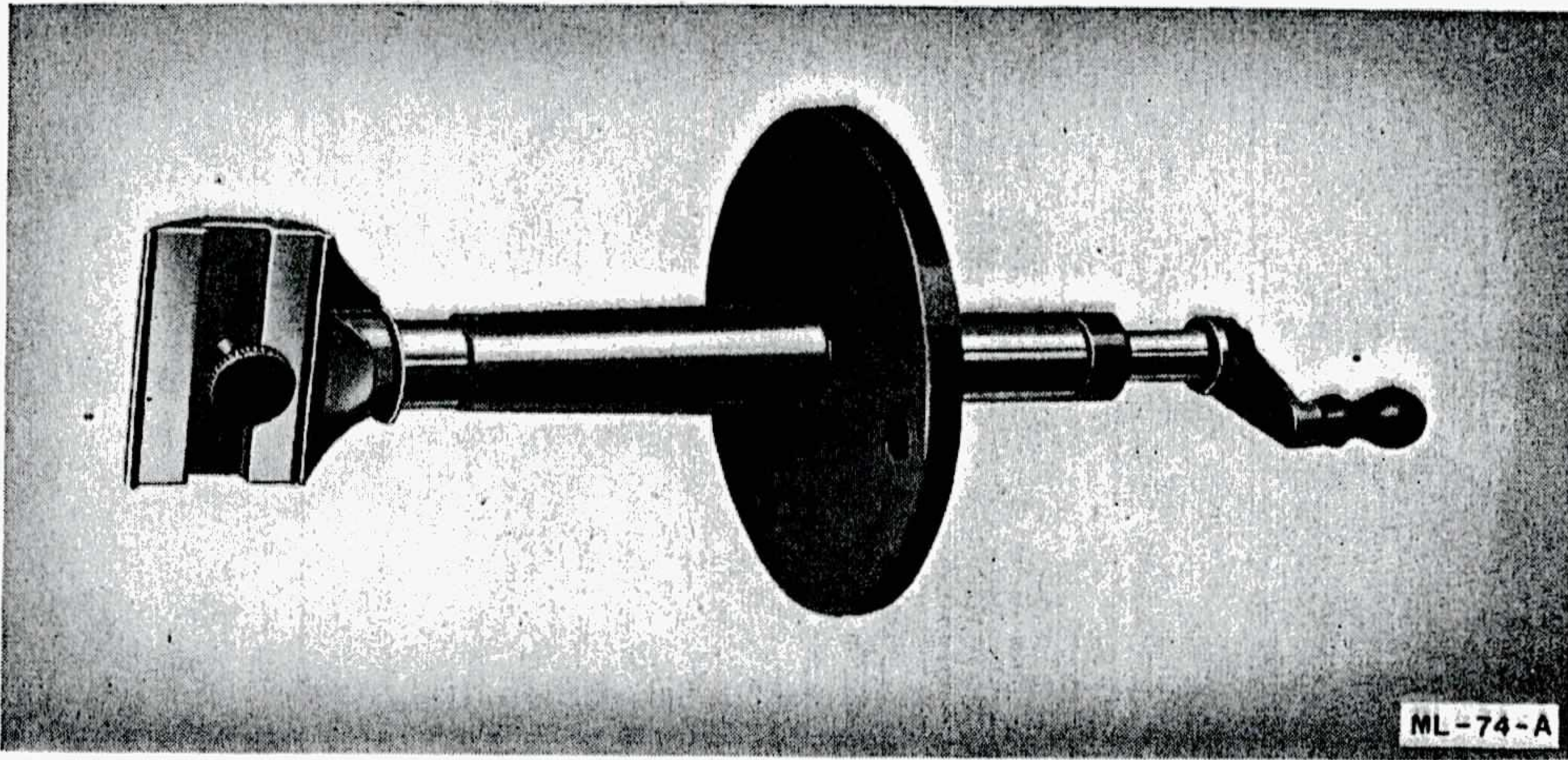


Figure 27. Rotor ML-74-A.

Status: Standard. Stock No.: 7A1474A. Reference: TM 11-2417.

Rotor ML-74-A is a hand-operated mechanical device for ventilating Psychrometer ML-24 or ML-224; it is designed for use with Shelter ML-41-A or -B, a small, raised, louvered structure which is used to house temperature- and humidity-measuring instruments and which is provided with mounting boards for the installation of Support ML-54 and Rotor ML-74-A. The rotor consists of a steel shaft with a crank handle

on one end and a fixture for attaching the psychrometer on the other end. A metal casing forms a housing for the shaft and provides a means for mounting the rotor on the side wall of the shelter. The shaft extends through a hole in the wall of the shelter and the device is cranked from the outside.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	1.67
Total volume (cu ft).....	.08

ML-74-A

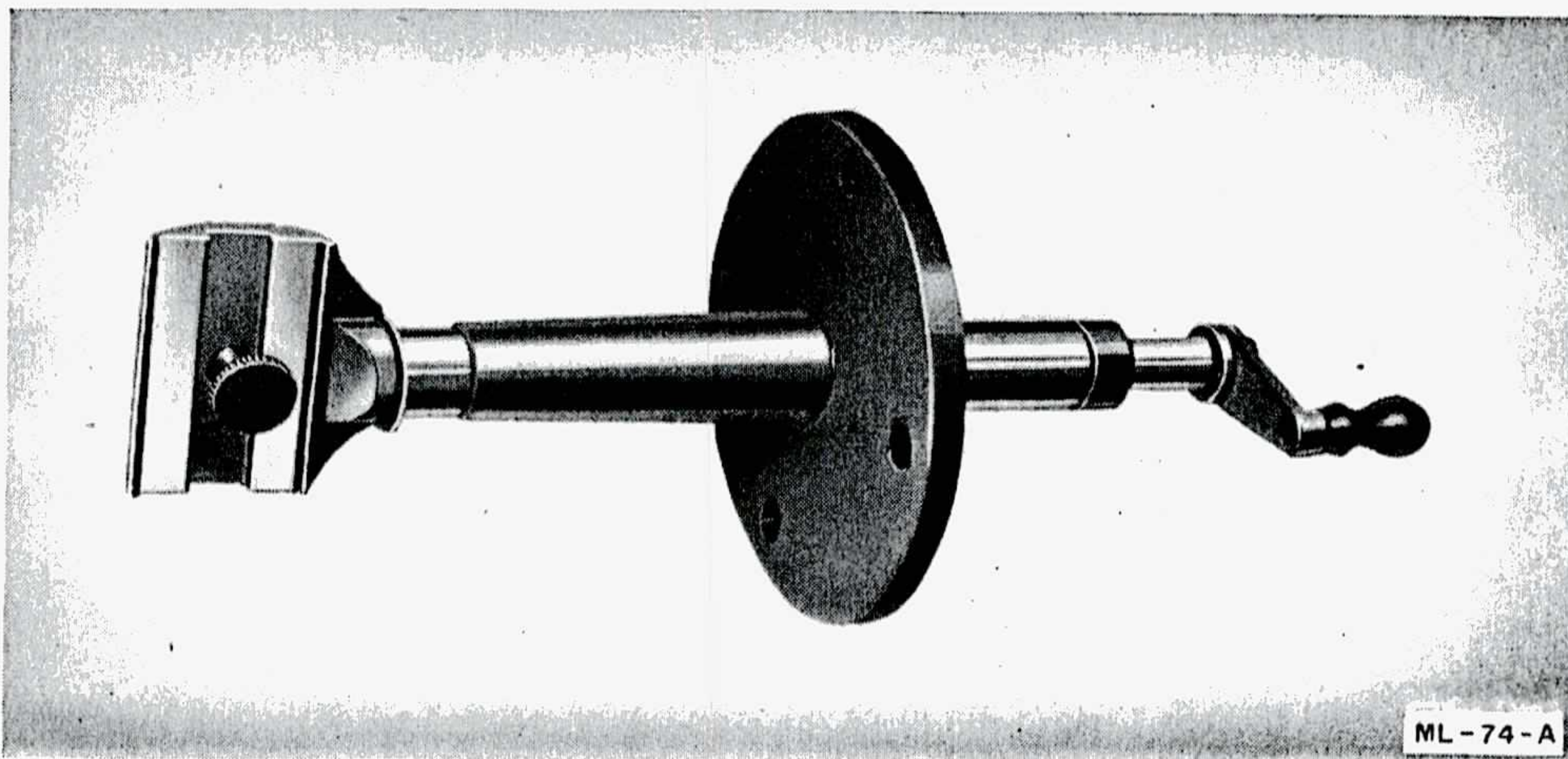


Figure 27. Rotor ML-74-A.

Status: Standard. Stock No.: 7A1474A. Reference: TM 11-2417.

Rotor ML-74-A is a hand-operated mechanical device for ventilating Psychrometer ML-24 or ML-224; it is designed for use with Shelter ML-41-A or -B, a small, raised, louvered structure which is used to house temperature- and humidity-measuring instruments and which is provided with mounting boards for the installation of Support ML-54 and Rotor ML-74-A. The rotor consists of a steel shaft with a crank handle

on one end and a fixture for attaching the psychrometer on the other end. A metal casing forms a housing for the shaft and provides a means for mounting the rotor on the side wall of the shelter. The shaft extends through a hole in the wall of the shelter and the device is cranked from the outside.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	1.67
Total volume (cu ft).....	.08

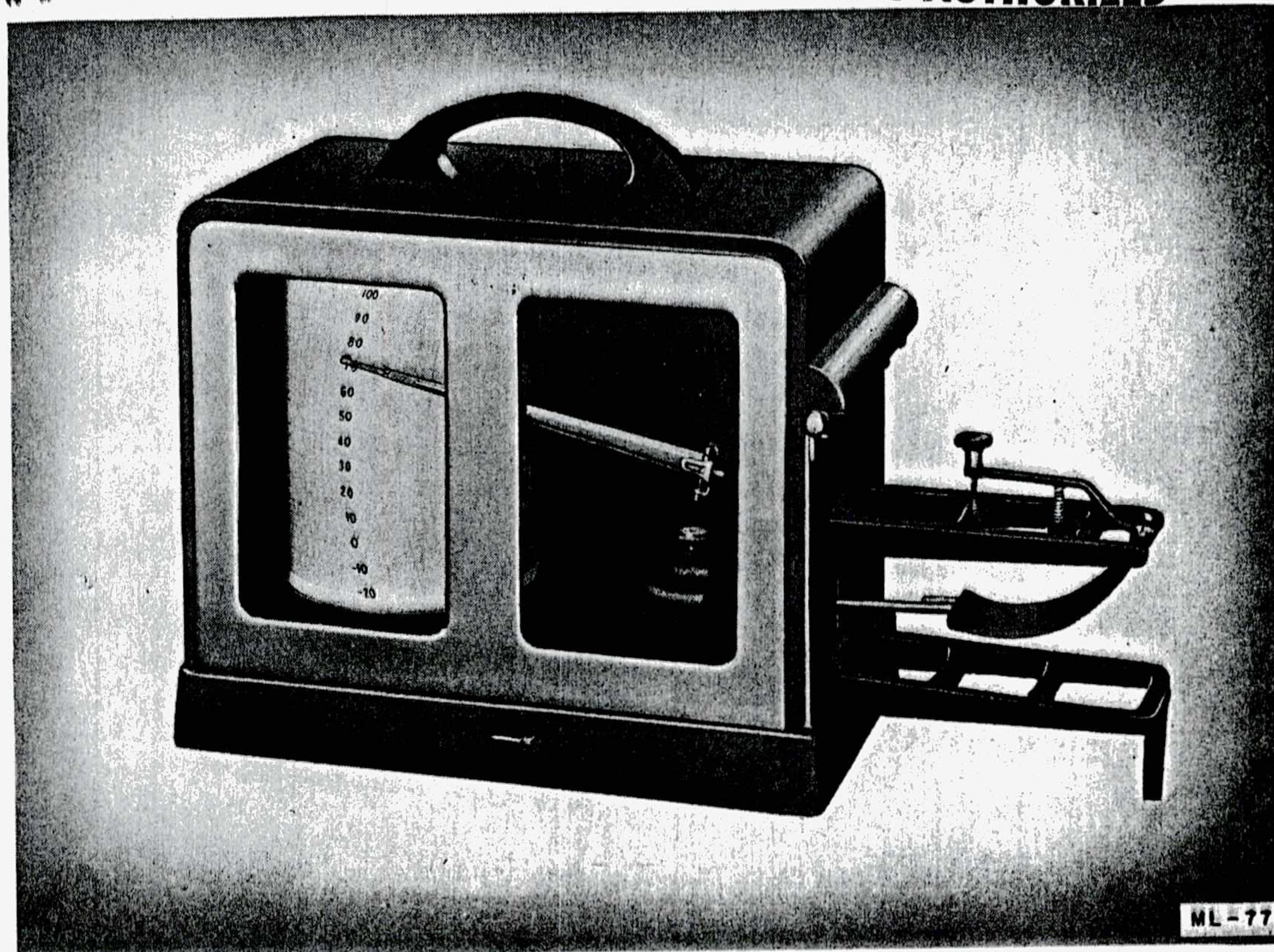


Figure 28. Thermograph ML-77.

Status: Standard. Stock No.: 7A1777. Reference: TM 11-426.

Thermograph ML-77 is a portable instrument which produces a record, continuous over a period of either 1 day or 1 week, of temperatures within the range between -20° F. and $+120^{\circ}$ F., or between -50° F. and $+80^{\circ}$ F., depending on the adjustment and the chart used. It is intended for general use. Thermograph ML-277, which is similar to Thermograph ML-77, is intended for arctic use and therefore has a bimetal sensing element.

TECHNICAL CHARACTERISTICS

TEMPERATURE SENSITIVE ELEMENT: Bourdon tube (alcohol in a curved, metal tube).

RECORDING ELEMENT: Pen, actuated through a system of linkages.

RANGE OF RECORD: 130° F. (-20° F. to $+110^{\circ}$ F. or -50° F. to $+80^{\circ}$ F.).

CONTINUITY OF RECORD: 1 week or 1 day, depending on the gears used.

CHART DRIVE: Clock ML-79-A; 8-day movement with 29-hour and 176-hour gear pinions (the daily gears normally are not used).

CHARTS (Weekly): Thermograph Chart ML-235; range, -20° F. to $+110^{\circ}$ F. Thermograph Chart ML-234; range, -50° F. to $+80^{\circ}$ F.

CHART GRADUATIONS: Temperature, 1° F. divisions, labeled at 10° intervals; a reading to $.1^{\circ}$ F. can be made. Time, 2-hour interval divisions.

ACCESSORY EQUIPMENT: Ink, special register, green (Sig C stock No. 7A1100).
(Used with, but not supplied with, Thermograph ML-77).

Ink, special register, purple (Sig C stock No. 7A1101).

Ink, special register, red (Sig C stock No. 7A1102).

Oil, watch, Grade No. 1 (Sig C stock No. 6G1139.1).

Thermograph Chart ML-234 (Sig C stock No. 7A5291-234).

Thermograph Chart ML-235 (Sig C stock No. 7A5291-235).

WEIGHTS AND VOLUMES

	Unpacked	Domestic packed	Export packed
Total weight (lb).....	10	15	19
Total volume (cu ft).....	.36	1.2	1.5

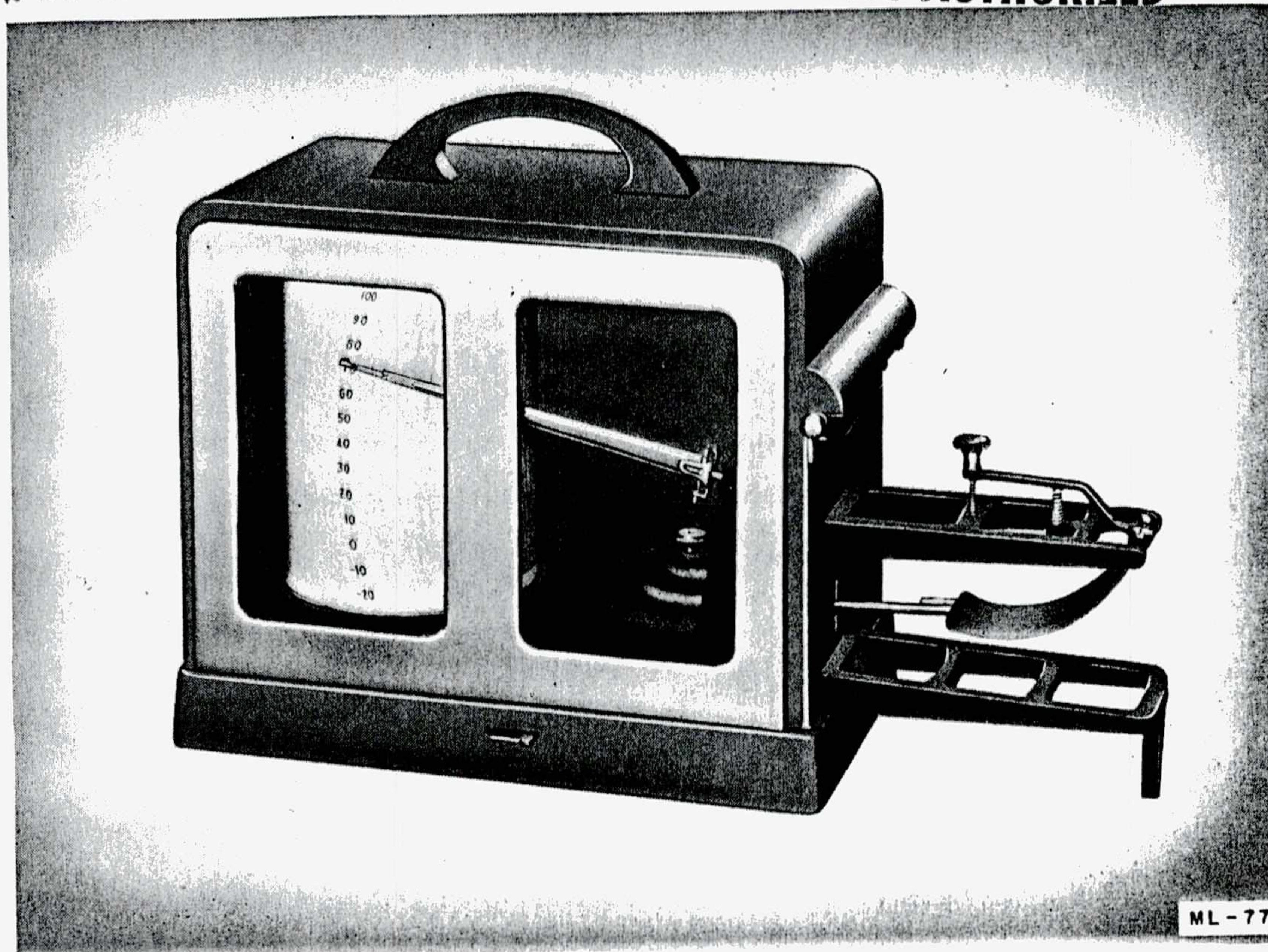


Figure 28. Thermograph ML-77.

Status: Standard. Stock No.: 7A1777. Reference: TM 11-426.

Thermograph ML-77 is a portable instrument which produces a record, continuous over a period of either 1 day or 1 week, of temperatures within the range between -20° F. and $+120^{\circ}$ F., or between -50° F. and $+80^{\circ}$ F., depending on the adjustment and the chart used. It is intended for general use. Thermograph ML-277, which is similar to Thermograph ML-77, is intended for arctic use and therefore has a bimetal sensing element.

TECHNICAL CHARACTERISTICS

- TEMPERATURE SENSITIVE ELEMENT: Bourdon tube (alcohol in a curved, metal tube).
- RECORDING ELEMENT: Pen, actuated through a system of linkages.
- RANGE OF RECORD: 130° F. (-20° F. to $+110^{\circ}$ F. or -50° F. to $+80^{\circ}$ F.).
- CONTINUITY OF RECORD: 1 week or 1 day, depending on the gears used.
- CHART DRIVE: Clock ML-79-A; 8-day movement with 29-hour and 176-hour gear pinions (the daily gears normally are not used).

CHARTS (Weekly): Thermograph Chart ML-235; range, -20° F. to $+110^{\circ}$ F. Thermograph Chart ML-234; range, -50° F. to $+80^{\circ}$ F.

CHART GRADUATIONS: Temperature, 1° F. divisions, labeled at 10° intervals; a reading to $.1^{\circ}$ F. can be made. Time, 2-hour interval divisions.

ACCESSORY EQUIPMENT: Ink, special register, green (Sig C stock No. 7A1100).
(Used with, but not supplied with, Thermograph ML-77).

Ink, special register, purple (Sig C stock No. 7A1101).

Ink, special register, red (Sig C stock No. 7A1102).

Oil, watch, Grade No. 1 (Sig C stock No. 6G1139.1).

Thermograph Chart ML-234 (Sig C stock No. 7A5291-234).

Thermograph Chart ML-235 (Sig C stock No. 7A5291-235).

WEIGHTS AND VOLUMES

	Unpacked	Domestic packed	Export packed
Total weight (lb).....	10	15	19
Total volume (cu ft).....	.36	1.2	1.5

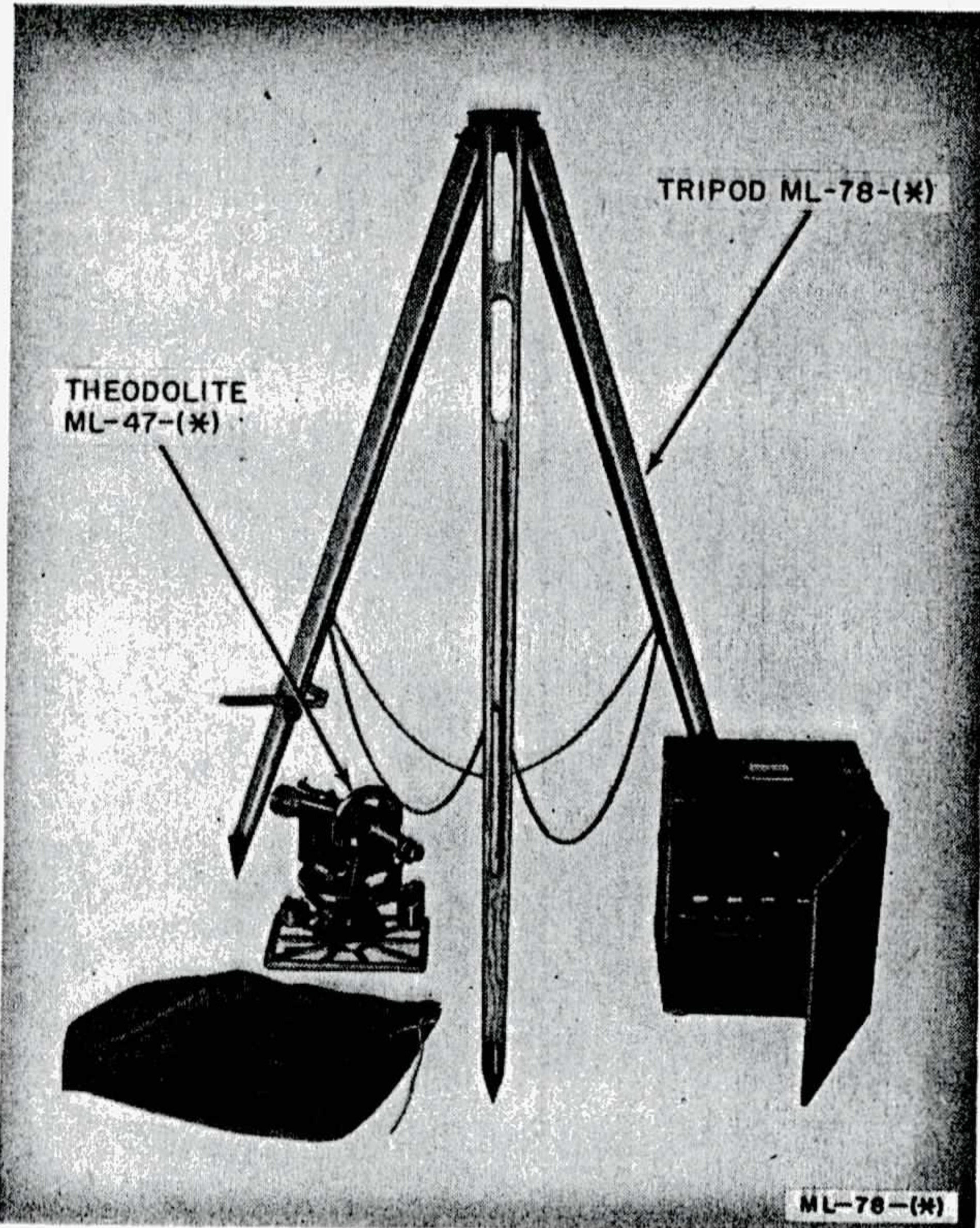


Figure 29. Tripod ML-78-(*).

Status: Standard. Stock No.: 7A1878. Reference: TM 11-423.

Tripod ML-78-(*) represents Tripod ML-78-C through -R. The wooden, nonextension type legs are steel tipped; the threaded metal head is protected by a cap when the tripod is not in use. Tripod ML-78-(*) is used as a portable support for Theodolite ML-47-(*) and Theodolite ML-247.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 65.6
Total volume (cu ft).....	1.85

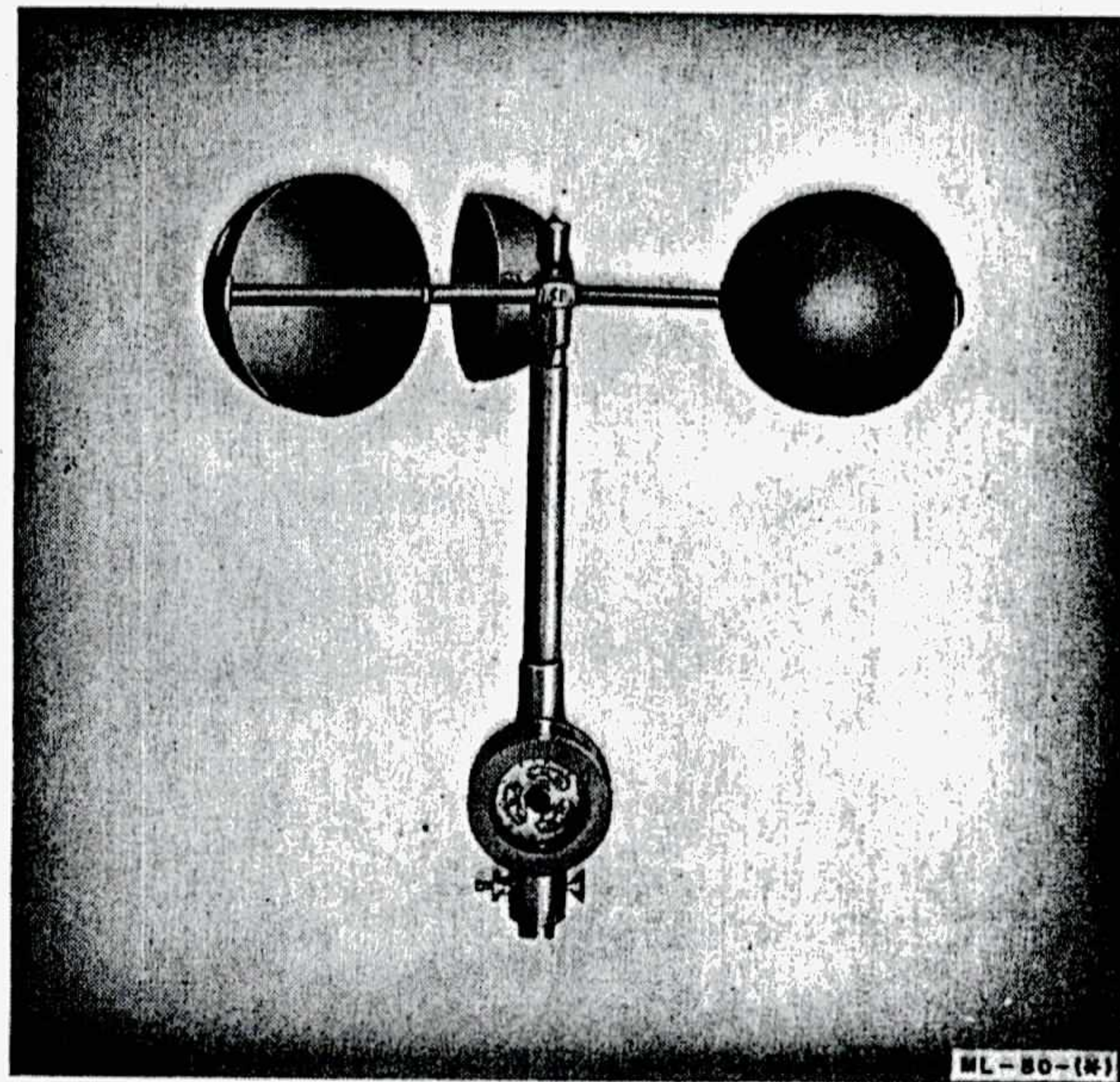


Figure 30. Anemometer ML-80 or ML-80-B.

Status: Limited/Std. Stock No.: 7A80. Reference: TM 11-424.

Anemometer ML-80-(*) represents Anemometers ML-80, ML-80-A and ML-80-B. Anemometer ML-80 or ML-80-B consists of a three-cup rotor mounted on a spindle that is geared to a registering mechanism with a visible dial on which total wind movement can be read in miles, and to an electrical contacting mechanism by means of which wind speed is determined in miles per hour. Anemometer ML-80-A has no visible dial, but otherwise differs from Anemometers ML-80 and ML-80-B in construction only. Anemometer ML-80-(*) is mounted on Support ML-29 and is connected electrically with Indicator ML-117; it may be wired also to a double or quadruple register which records wind speed and direction.

Note. A table which shows the models of Anemometer ML-80, Support ML-29, and Indicator ML-117 that may be used together is included with the data on Support ML-29.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 10.9
Total volume (cu ft).....	1.33

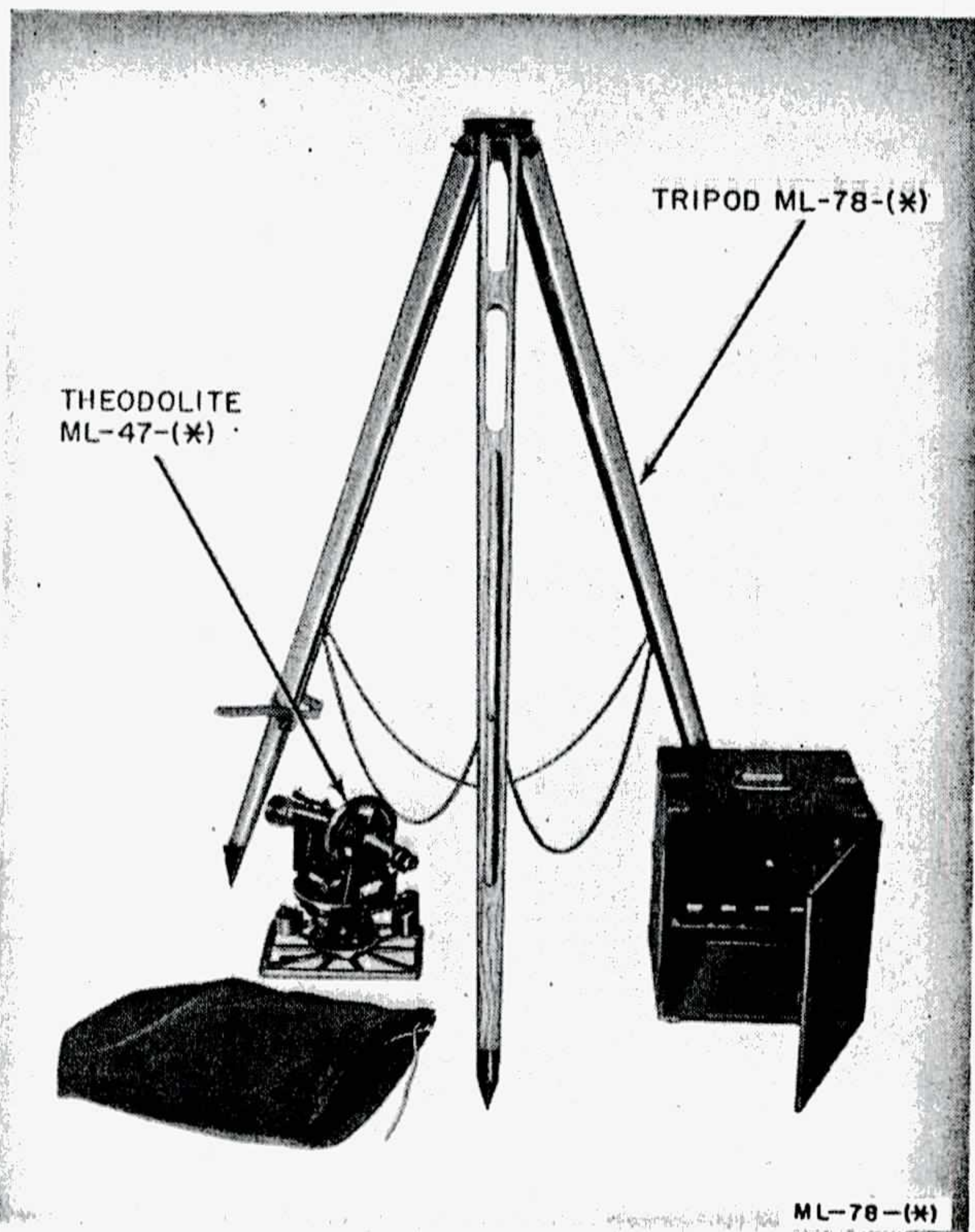


Figure 29. Tripod ML-78-(*).

Status: Standard. Stock No.: 7A1878. Reference: TM 11-423.

Tripod ML-78-(*). Represents Tripod ML-78-C through -R. The wooden, nonextension type legs are steel tipped; the threaded metal head is protected by a cap when the tripod is not in use. Tripod ML-78-(*). is used as a portable support for Theodolite ML-47-(*). and Theodolite ML-247.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 65.6
Total volume (cu ft).....	1.85

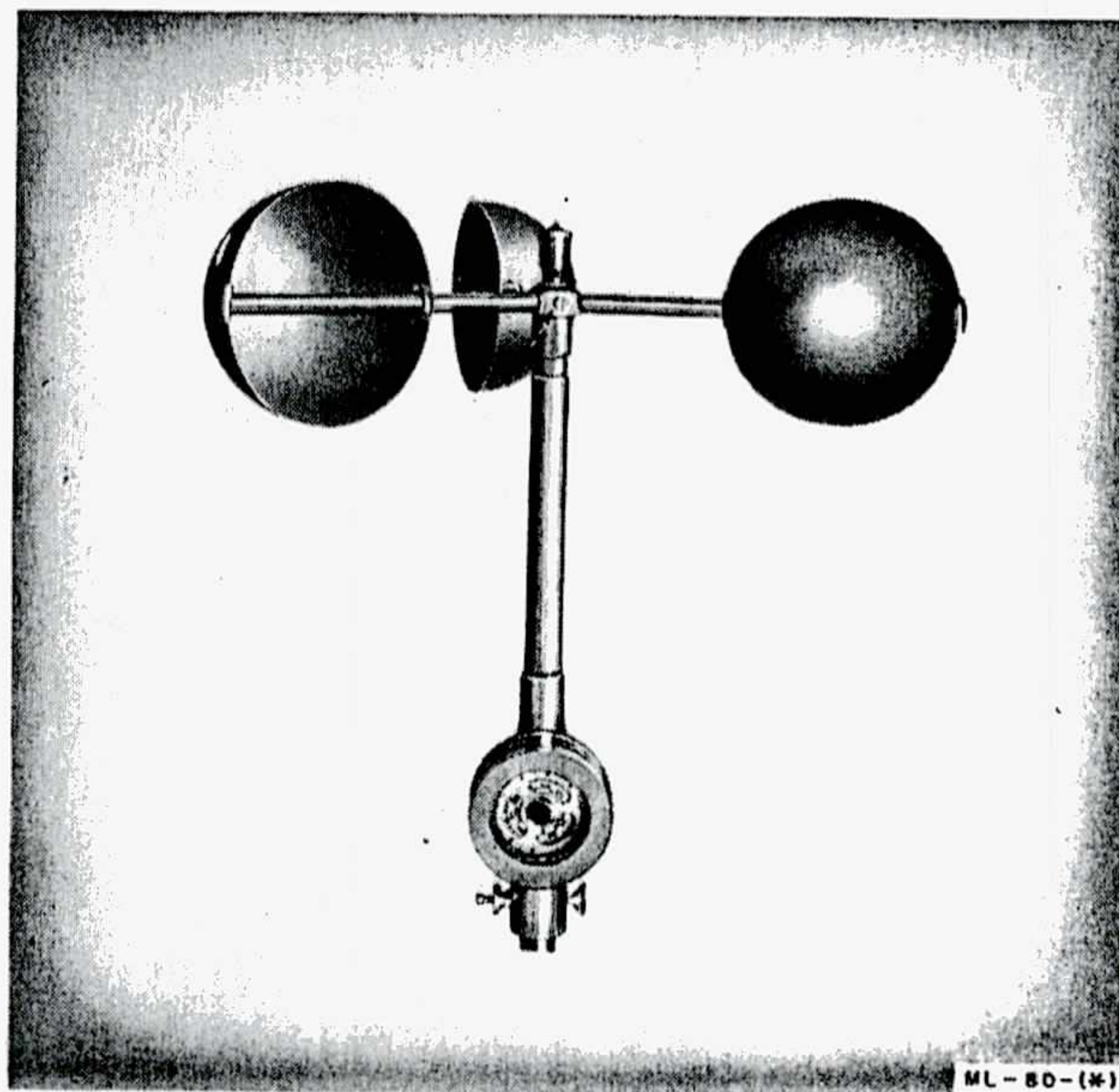


Figure 30. Anemometer ML-80 or ML-80-B.

Status: Limited/Std. Stock No.: 7A80. Reference: TM 11-424.

Anemometer ML-80-(*). represents Anemometers ML-80, ML-80-A and ML-80-B. Anemometer ML-80 or ML-80-B consists of a three-cup rotor mounted on a spindle that is geared to a registering mechanism with a visible dial on which total wind movement can be read in miles, and to an electrical contacting mechanism by means of which wind speed is determined in miles per hour. Anemometer ML-80-A has no visible dial, but otherwise differs from Anemometers ML-80 and ML-80-B in construction only. Anemometer ML-80-(*). is mounted on Support ML-29 and is connected electrically with Indicator ML-117; it may be wired also to a double or quadruple register which records wind speed and direction.

Note. A table which shows the models of Anemometer ML-80, Support ML-29, and Indicator ML-117 that may be used together is included with the data on Support ML-29.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 10.9
Total volume (cu ft).....	1.33



Figure 31. Barometers ML-102-(*), with carrying cases.

Status: Standard. Stock No.: 7A312. Reference: TM 11-427.

Barometer ML-102-(*), represents Barometers ML-102-B, -D, -E, and -F. Barometer ML-102-(*), is a precision, aneroid barometer intended for use in mobile stations and for transportation by hand or in vehicles. In addition to the principal function of determining changes in atmospheric pressure, it may be used also to determine

approximate differences in elevation. Barometer ML-102-E is provided with a nomograph for determining difference in elevation from barometric pressures, and a temperature-correction chart; Barometer ML-102-D is provided with a temperature-correction and temperature-conversion chart. Carrying cases are furnished with all models of the equipment.

930761-51-6



Figure 31. Barometers ML-102-(*), with carrying cases.

Status: Standard. Stock No.: 7A312. Reference: TM 11-427.

Barometer ML-102-(*), represents Barometers ML-102-B, -D, -E, and -F. Barometer ML-102-(*), is a precision, aneroid barometer intended for use in mobile stations and for transportation by hand or in vehicles. In addition to the principal function of determining changes in atmospheric pressure, it may be used also to determine

approximate differences in elevation. Barometer ML-102-E is provided with a nomograph for determining difference in elevation from barometric pressures, and a temperature-correction chart; Barometer ML-102-D is provided with a temperature-correction and temperature-conversion chart. Carrying cases are furnished with all models of the equipment.

930761-51-6

TECHNICAL CHARACTERISTICS

	ML-102-B, -E, -F	ML-102-D
PRESSURE RANGE	22 to 31.5 in. of mercury; 745 to 1,085 mb	745 to 1,065 mb.
INCH SCALE GRADUATIONS	1/50 (0.2) in. from 26 to 31 in.; 1/10 and integral inches numbered.	(Millibar scale only).
MILLIBAR SCALE GRADUATIONS	2 scales, whole millibars; outer, 895 to 1,085 mb; inner, 745 to 895 mb; numbered every 5 mb.	2 scales, 1/2 millibars; outer, 900 to 1,065 mb; inner, 745 to 900 mb; numbered every 10 mb.
READING POSITION	Vertical	Horizontal.
DIMENSIONS (in., without case)	6 3/4 x 6 3/4 x 4	6 3/4 x 6 3/4 x 4.

WEIGHTS AND VOLUMES

	Un-packed	Export packed
Total weight, including carrying case (lb, approx):		
ML-102-B, -F	7.5	17
ML-102-D	4.5	13.5
ML-102-E	10.5	20
Total volume (cu ft)		.692



Figure 32. Register ML-103-A, cover removed.

Status: Limited/Std. Stock No.: 7A1333A.
Reference: TM 1-235.

Register ML-103-(*), represents Registers ML-103-A and -B. Register ML-103-(*), is a two-purpose, electromechanical recording instrument. When electrically connected to a suitable wind vane and Anemometer ML-80, it produces a

continuous record, on a single chart, of wind direction and wind speed. A buzzer, electrically connected with the anemometer, provides a means of determining approximate, instantaneous wind speed.

TECHNICAL CHARACTERISTICS

RECORDS PRODUCED: Wind speed, register electrically connected to 1-mile terminal of Anemometer ML-80.

Wind direction, register electrically connected to cam collar of wind vane.

RECORD: Continuous over a period of 24 hours.

CHART DRUM DRIVE: Clock; produces 4 revolutions of drum in 24 hours.

RECORDERS: 2 wind-direction pens; 1 wind-speed pen.

RECORDER ACTUATION: 5 electromagnets, energized by impulses from the wind instruments.

CHART: SC FORM 97.

INSTANTANEOUS WIND SPEED: Buzzer electrically connected to 1/60-mile terminal of Anemometer ML-80.

POWER REQUIREMENT: 6 v for each circuit.

POWER SOURCE: Battery system, or 110-v ac with step-down transformer and rectifier.

WEIGHT AND VOLUME

Total weight (lb)	Export packed
Total volume (cu ft)	68
	4

TECHNICAL CHARACTERISTICS

	ML-102-B, -E, -F	ML-102-D
PRESSURE RANGE	22 to 31.5 in. of mercury; 745 to 1,085 mb	745 to 1,065 mb.
INCH SCALE GRADUATIONS	1/50 (0.2) in. from 26 to 31 in.; 1/10 and integral inches numbered.	(Millibar scale only).
MILLIBAR SCALE GRADUATIONS	2 scales, whole millibars; outer, 895 to 1,085 mb; inner, 745 to 895 mb; numbered every 5 mb.	2 scales, 1/2 millibars; outer, 900 to 1,065 mb; inner, 745 to 900 mb; numbered every 10 mb.
READING POSITION	Vertical	Horizontal.
DIMENSIONS (in., without case)	6 3/4 x 6 3/4 x 4	6 1/4 x 6 1/4 x 1.

WEIGHTS AND VOLUMES

	Un-packed	Export packed
Total weight, including carrying case (lb, approx):		
ML-102-B, -F	7.5	17
ML-102-D	4.5	13.5
ML-102-E	10.5	20
Total volume (cu ft)		.692

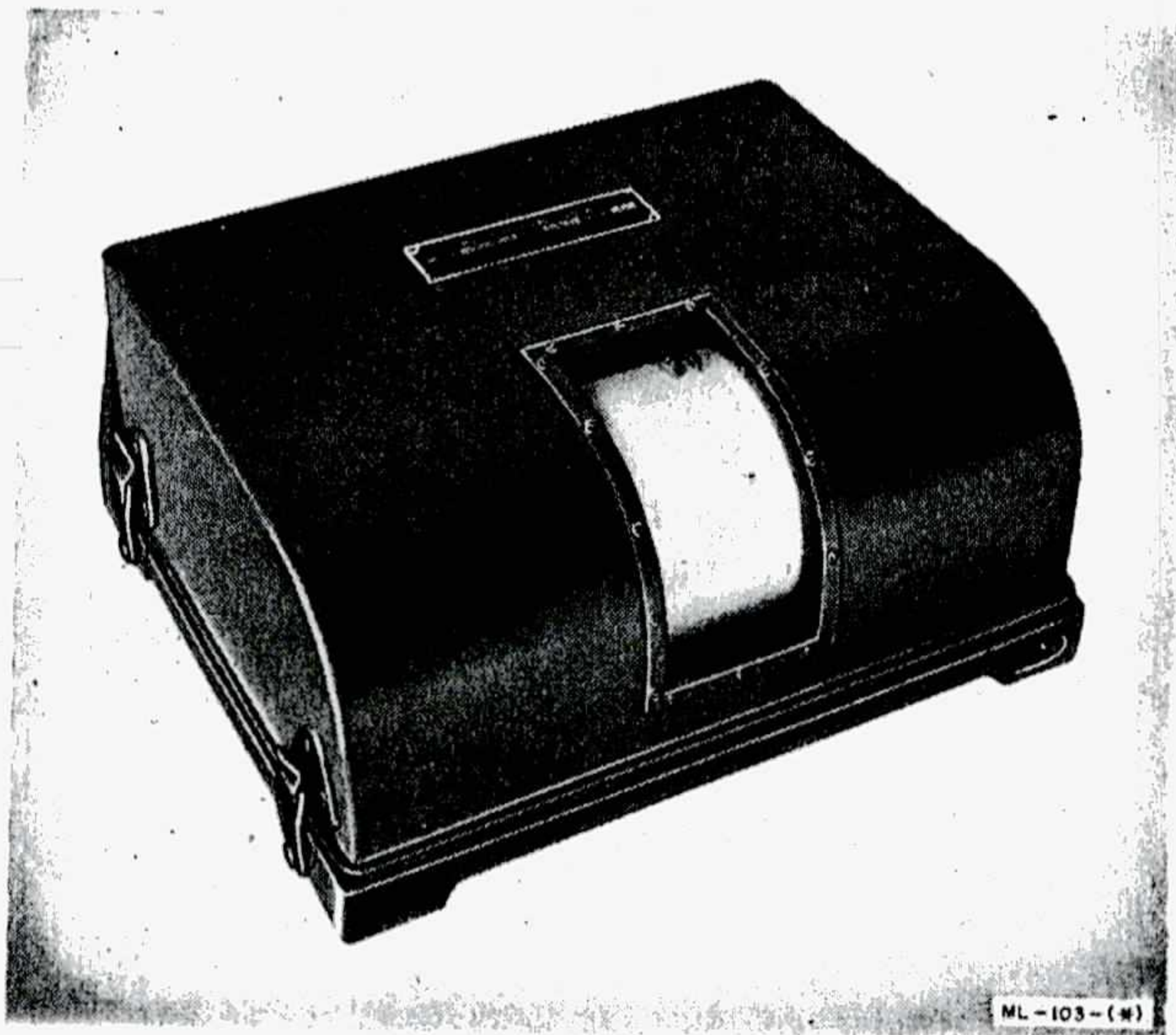


Figure 32. Register ML-103-A, cover removed.

Status: Limited/Std. Stock No.: 7A1333A.
Reference: TM 1-235.

Register ML-103-(*), represents Registers ML-103-A and -B. Register ML-103-(*), is a two-purpose, electromechanical recording instrument. When electrically connected to a suitable wind vane and Anemometer ML-80, it produces a

continuous record, on a single chart, of wind direction and wind speed. A buzzer, electrically connected with the anemometer, provides a means of determining approximate, instantaneous wind speed.

TECHNICAL CHARACTERISTICS

RECORDS PRODUCED: Wind speed, register electrically connected to 1-mile terminal of Anemometer ML-80.

Wind direction, register electrically connected to cam collar of wind vane.

RECORD: Continuous over a period of 24 hours.

CHART DRUM DRIVE: Clock; produces 4 revolutions of drum in 24 hours.

RECORDERS: 2 wind-direction pens; 1 wind-speed pen.

RECORDER ACTUATION: 5 electromagnets, energized by impulses from the wind instruments.

CHART: SC FORM 97.

INSTANTANEOUS WIND SPEED: Buzzer electrically connected to 1/60-mile terminal of Anemometer ML-80.

POWER REQUIREMENT: 6 v for each circuit.

POWER SOURCE: Battery system, or 110-v ac with step-down transformer and rectifier.

WEIGHT AND VOLUME

Total weight (lb)	68
Total volume (cu ft)	4

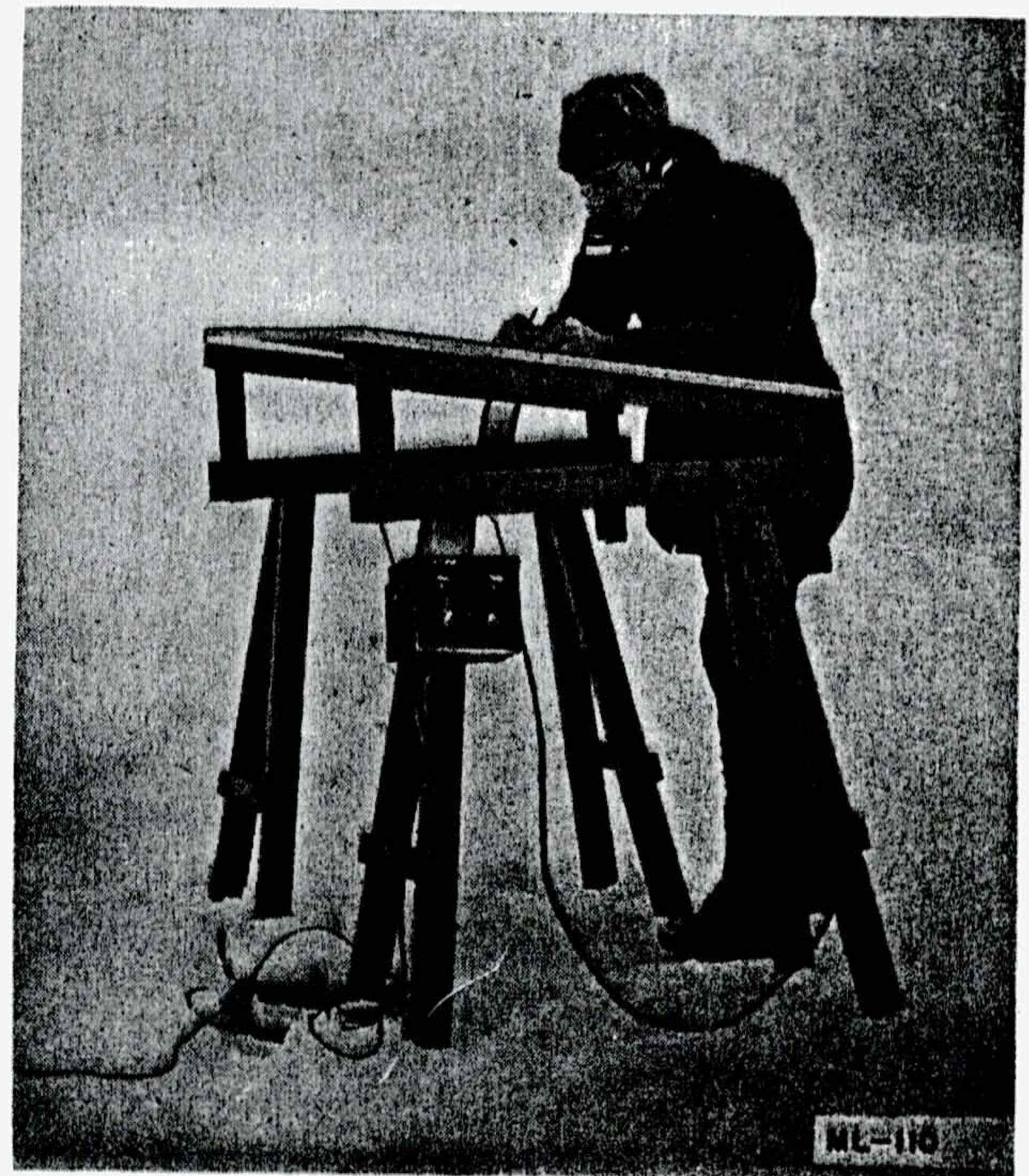


Figure 33. Timing and Telephone Set ML-110 in use.

Status: Standard. Stock No.: 7A1850. Reference: TM 11-334.

Timing and Telephone Set ML-110 provides two-way voice communication between a plotting station and one or two theodolite observers of pilot balloons. Timing signals are superimposed at regular intervals upon the communication line to assist the observer. The telephone equipment is sound-powered; the tone-generator unit requires battery power. A reel for laying and recovering wire over short distances is included.

TECHNICAL CHARACTERISTICS

COMMUNICATION EQUIPMENT

TRANSMITTER: Lightweight, chest type.

RECEIVER: Single-receiver headset.

POWER: Sound-powered.

RANGE: Up to approximately 3 miles.

INSTALLATION: Outdoors; portable.

TIMING EQUIPMENT

TONE: 1,000 cps; generated by interrupter; volume control provided.

TIMER: Modified 8-day clock.

tone DURATION: Approximately 7 seconds.

INTERVAL: 1 minute.

POWER: 2 batteries BA-30, or 3-v external battery.

INSTALLATION: Outdoors or indoors; on the ground, hung by strap or mounted on fixed or temporary support.

PRINCIPAL COMPONENTS

- 1 Time Interval Unit ML-138
- 2 Head and Chest Set HS-25, HS-25-A or -B
- 2 Jack JK-54 (one in use, one spare)
- 2 Plug PL-57 (one in use, one spare)
- 1 Strap ST-42
- 1 Reel RL-39 or RL-39-A
- 1/4-mile Wire W-130-A

WEIGHT AND VOLUME

	<i>Domestic or export packed</i>
Total weight (lb).....	58
Total volume (cu ft).....	4

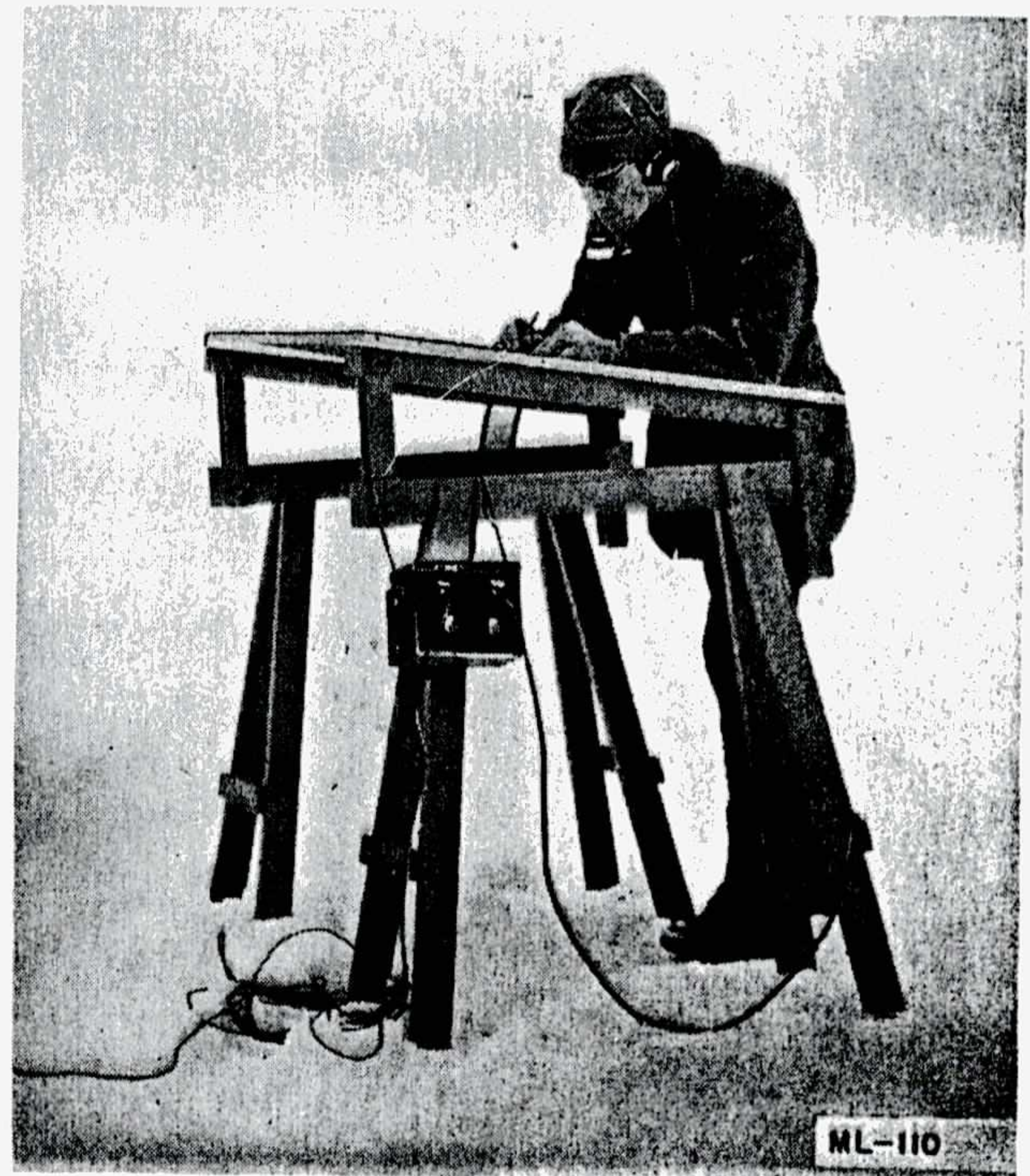


Figure 33. Timing and Telephone Set ML-110 in use.

Status: Standard. Stock No.: 7A1850. Reference: TM 11-334.

Timing and Telephone Set ML-110 provides two-way voice communication between a plotting station and one or two theodolite observers of pilot balloons. Timing signals are superimposed at regular intervals upon the communication line to assist the observer. The telephone equipment is sound-powered; the tone-generator unit requires battery power. A reel for laying and recovering wire over short distances is included.

TECHNICAL CHARACTERISTICS

COMMUNICATION EQUIPMENT

TRANSMITTER: Lightweight, chest type.

RECEIVER: Single-receiver headset.

POWER: Sound-powered.

RANGE: Up to approximately 3 miles.

INSTALLATION: Outdoors; portable.

TIMING EQUIPMENT

TONE: 1,000 cps; generated by interrupter; volume control provided.

TIMER: Modified 8-day clock.

TONE DURATION: Approximately 7 seconds.

INTERVAL: 1 minute.

POWER: 2 batteries BA-30, or 3-v external battery.

INSTALLATION: Outdoors or indoors; on the ground, hung by strap or mounted on fixed or temporary support.

PRINCIPAL COMPONENTS

- 1 Time Interval Unit ML-138
- 2 Head and Chest Set HS-25, HS 25-A or -B
- 2 Jack JK-54 (one in use, one spare)
- 2 Plug PL 57 (one in use, one spare)
- 1 Strap ST-42
- 1 Reel RL-39 or RL-39-A
- ¼-mile Wire W-130-A

WEIGHT AND VOLUME

	<i>Domestic or export packed</i>
Total weight (lb).....	58
Total volume (cu ft).....	4

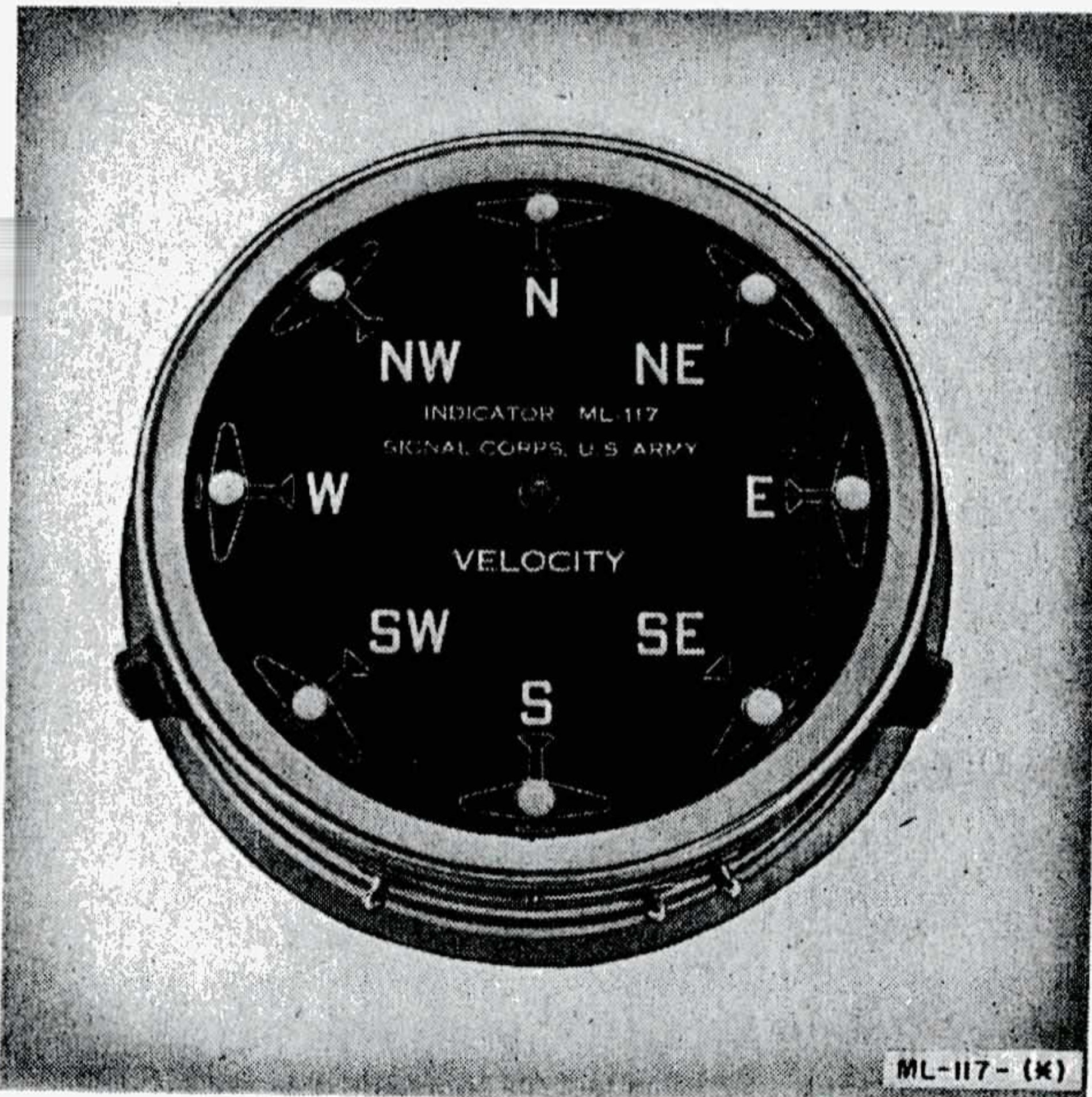


Figure 34. Indicator ML-117 or ML-117-B.

Status: Limited/Std. Stock No.: 7A1090. Reference: TM 11-424.

Indicator ML-117-(*), represents Indicators ML-117, ML-117-A, and ML-117-B. Indicator ML-117-(*), is a wind-indicating instrument used with Support ML-29 and Anemometer ML-80. It provides an indication of wind direction, as

determined by the wind vane, and a means of determining instantaneous wind speed, as determined by the anemometer.

Note. A table which shows the models of Indicator ML-117-(*), Support ML-29, and ML-80 that may be used together is included with the data on Support ML-29.

TECHNICAL CHARACTERISTICS

WIND DIRECTION INDICATION

METHOD: 8 incandescent lamps, 1 indicating each cardinal and intercardinal compass point; connected electrically with 8 sets of contacts on cam collar of wind vane Bearing ML-129 (p/o Support ML-29).
COMPASS POINTS INDICATED: 16 (2 adjacent lamps lighted simultaneously indicate wind direction between cardinal and intercardinal points).

WIND SPEED DETERMINATION

METHOD: Buzzer or incandescent lamp, selected by its respective toggle switch; number of buzzes or flashes counted in 1 minute indicates wind speed in mph.

POWER REQUIREMENT: 6-v to 8-v ac or dc, or 110-v, 60-cyc ac (built-in transformer); DPDT switch for supply change-over.

INSTALLATION: Indoors, up to 300 ft from Support ML-29.

WEIGHTS AND VOLUMES

	Un-packed	Export packed
Total weight (lb).....	5	10
Total volume (cu ft).....	.19	.7

ML-119-(*)

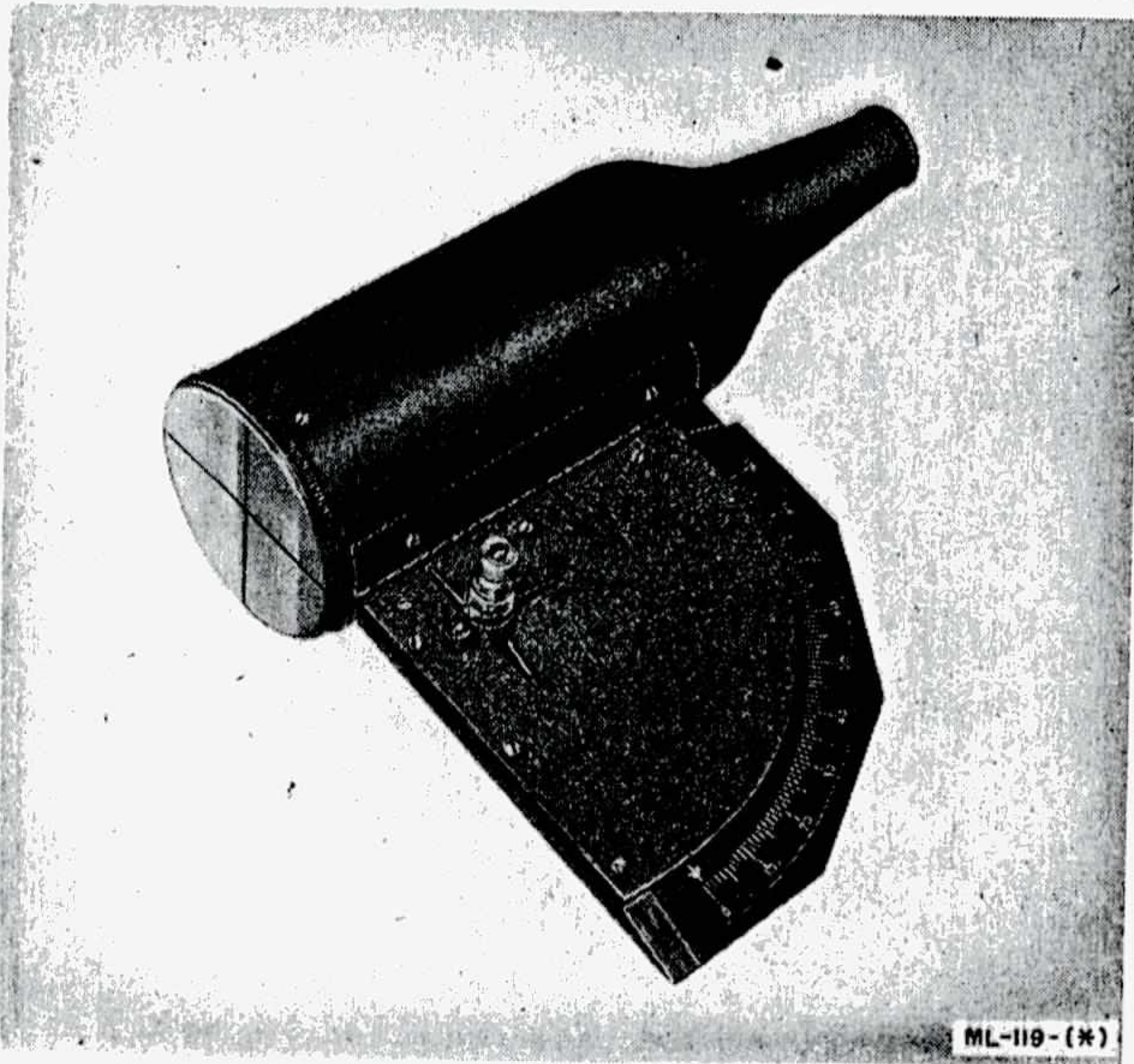


Figure 35. Clinometer ML-119-C.

Status: Standard. Stock No.: 7A509. Reference: TM 11-2423.

Clinometer ML-119-(*), represents Clinometers ML-119-C through -F. Clinometer ML-119-(*), is an optical instrument that consists of a lensless sighting tube with cross wires at the larger end, and a quadrant plate assembly; the quadrant is graduated in whole degrees from 0° to 90°. The clinometer is used by an observer, located at one end of a measured base line, to determine the angle of elevation of a spot of light thrown on a cloud by a ceiling light projector located at the opposite end of the base line. Data thus obtained are used to compute cloud height (ceiling). The equipment, including the carrying case, weighs about 5½ pounds.

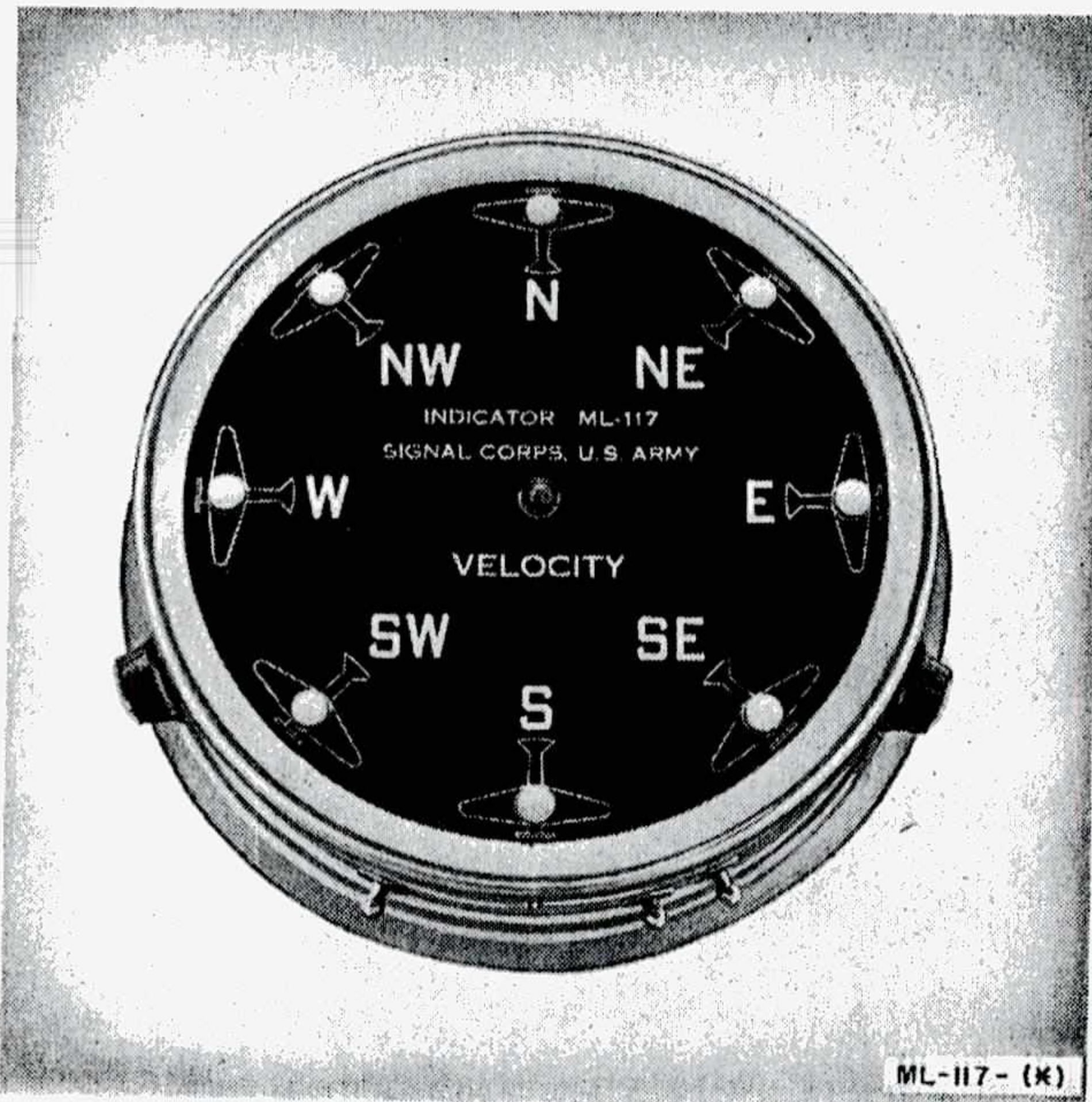


Figure 34. Indicator ML-117 or ML-117-B.

Status: Limited/Std. Stock No.: 7A1090. Reference: TM 11-424.

Indicator ML-117-(*) represents Indicators ML 117, ML-117-A, and ML-117-B. Indicator ML-117-(*) is a wind-indicating instrument used with Support ML-29 and Anemometer ML-80. It provides an indication of wind direction, as

determined by the wind vane, and a means of determining instantaneous wind speed, as determined by the anemometer.

Note. A table which shows the models of Indicator ML-117-(*), Support ML-29, and ML-80 that may be used together is included with the data on Support ML-29.

TECHNICAL CHARACTERISTICS

WIND DIRECTION INDICATION

METHOD: 8 incandescent lamps, 1 indicating each cardinal and intercardinal compass point; connected electrically with 8 sets of contacts on cam collar of wind vane Bearing ML-129 (p/o Support ML-29).
 COMPASS POINTS INDICATED: 16 (2 adjacent lamps lighted simultaneously indicate wind direction between cardinal and intercardinal points).

WIND SPEED DETERMINATION

METHOD: Buzzer or incandescent lamp, selected by its respective toggle switch; number of buzzes or flashes counted in 1 minute indicates wind speed in mph.
 POWER REQUIREMENT: 6-v to 8-v ac or dc, or 110-v, 60-cycle ac (built-in transformer); DPDT switch for supply change-over.
 INSTALLATION: Indoors, up to 300 ft from Support ML-29.

WEIGHTS AND VOLUMES

	Un-packed	Export packed
Total weight (lb).....	5	10
Total volume (cu ft).....	.19	.7

ML-119-(*)



Figure 35. Clinometer ML-119-C.

Status: Standard. Stock No.: 7A509. Reference: TM 11-2423.

Clinometer ML-119-(*) represents Clinometers ML-119-C through -F. Clinometer ML-119-(*) is an optical instrument that consists of a lensless sighting tube with cross wires at the larger end, and a quadrant plate assembly; the quadrant is graduated in whole degrees from 0° to 90°. The clinometer is used by an observer, located at one end of a measured base line, to determine the angle of elevation of a spot of light thrown on a cloud by a ceiling light projector located at the opposite end of the base line. Data thus obtained are used to compute cloud height (ceiling). The equipment, including the carrying case, weighs about 5½ pounds.

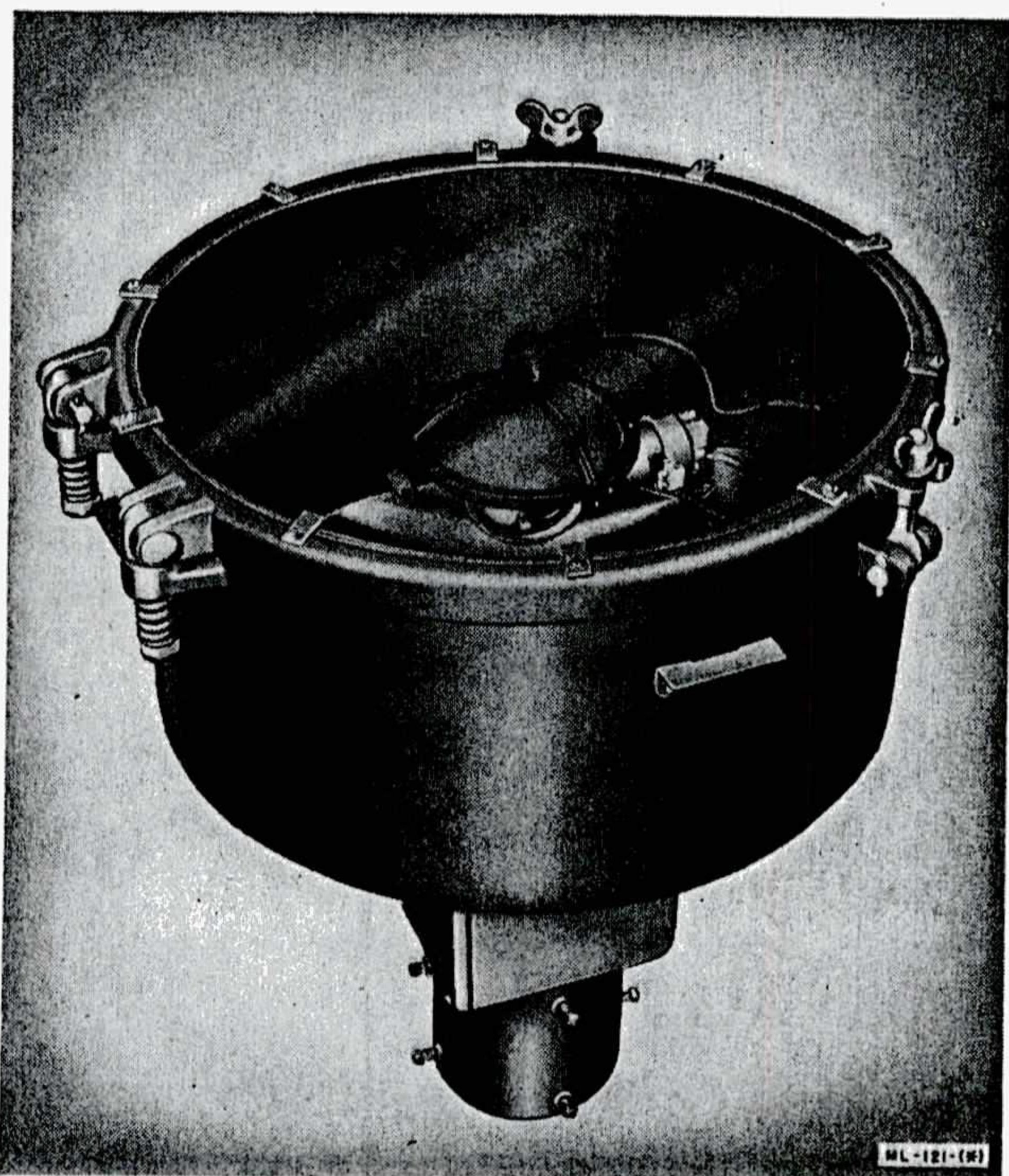


Figure 36. Ceiling Light Projector ML-121-E.

Status: Standard. Stock No.: 7A481. Reference: TM 11-421.

Ceiling Light Projector ML-121-(*), represents Ceiling Light Projectors ML-121-A through -G. Ceiling Light Projector ML-121-(*), directs a beam of light, concentrated by a reflector system and a focusing arrangement, vertically from the ground to the zenith. It produces a visible,

illuminated spot on the cloud base. Used with Clinometer ML-119, ceiling heights up to 10,000 feet may be computed. This projector is designed for fixed installation and night use. Control Set ML-212, a remote-control system, may be used with Ceiling Light Projector ML-121-(*), to permit controlling the equipment from the point at which observations are being made.

TECHNICAL CHARACTERISTICS

INSTALLATION: Fixed, mounted on 4-in. diam standard iron pipe (not a component of the equipment).

RANGE OF MEASUREMENT: Up to 10,000 ft; night use only.

LAMP: 12-v, 35-amp, 420-w; G-25 bulb, C-2 filament, mogul prefocus base.

BEAM CANDLEPOWER: 2,000,000.

BEAM SPREAD: 4°.

LIFE OF LAMP: Approx 100 hrs.

POWER SUPPLY: 90-v to 120-v, 60-cyc (ML-121-A requires 25-cyc) ac; taps provided in 5-v steps; transformer capacity, 450 v.

DIMENSIONS: 21½ in. diam by 28¾ in. high.

ACCESSORY EQUIPMENT: Clinometer ML-119.

(Not furnished with Ceiling Light Projector ML-121-(*). Control Set ML-212.)

WEIGHTS AND VOLUMES

Total weight (lb):	Do-		
	Unpacked	estic packed	Export packed
Cast iron:			
ML-121-B, -C, -E, -F, -G	127	185	305
ML-121-D	140	180	305
Aluminum alloy:			
ML-121-A, -B	82	135	240
ML-121-D	90	128	240
Total volume (cu ft)			19

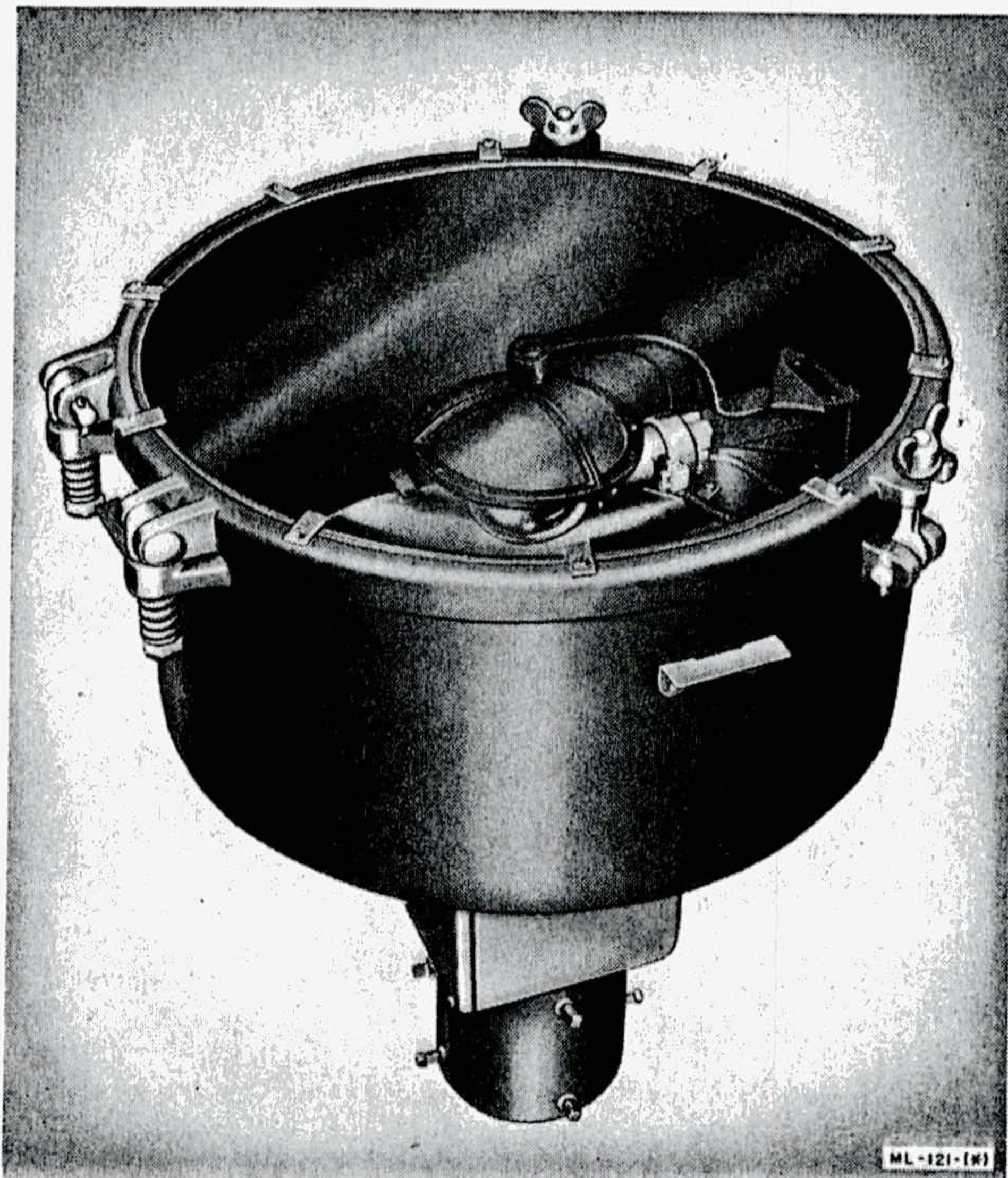


Figure 36. Ceiling Light Projector ML-121-E.

Status: Standard. Stock No.: 7A481. Reference: TM 11-421.

Ceiling Light Projector ML-121-(*), represents Ceiling Light Projectors ML-121-A through -G. Ceiling Light Projector ML-121-(*), directs a beam of light, concentrated by a reflector system and a focusing arrangement, vertically from the ground to the zenith. It produces a visible,

illuminated spot on the cloud base. Used with Clinometer ML-119, ceiling heights up to 10,000 feet may be computed. This projector is designed for fixed installation and night use. Control Set ML-212, a remote-control system, may be used with Ceiling Light Projector ML-121-(*), to permit controlling the equipment from the point at which observations are being made.

TECHNICAL CHARACTERISTICS

- INSTALLATION: Fixed, mounted on 4-in. diam standard iron pipe (not a component of the equipment).
- RANGE OF MEASUREMENT: Up to 10,000 ft; night use only.
- LAMP: 12-v, 35-amp, 420-w; G-25 bulb, C-2 filament, mogul prefocus base.
- BEAM CANDLEPOWER: 2,000,000.
- BEAM SPREAD: 4°.
- LIFE OF LAMP: Approx 100 hrs.
- POWER SUPPLY: 90-v to 120-v, 60-cycle (ML-121-A requires 25-cycle) ac; taps provided in 5-v steps; transformer capacity, 450 v.
- DIMENSIONS: 21½ in. diam by 28¾ in. high.
- ACCESSORY EQUIPMENT: Clinometer ML-119. (Not furnished with Ceiling Light Projector ML-121-(*)).

WEIGHTS AND VOLUMES

Total weight (lb):	Do-		Export
	Unpacked	mestic packed		packed
Cast iron:			
ML-121-B, -C, -E, -F, -G	127	185	305
ML-121-D	140	180	305
Aluminum alloy:			
ML-121-A, -B	82	135	240
ML-121-D	90	128	240
Total volume (cu ft)			19

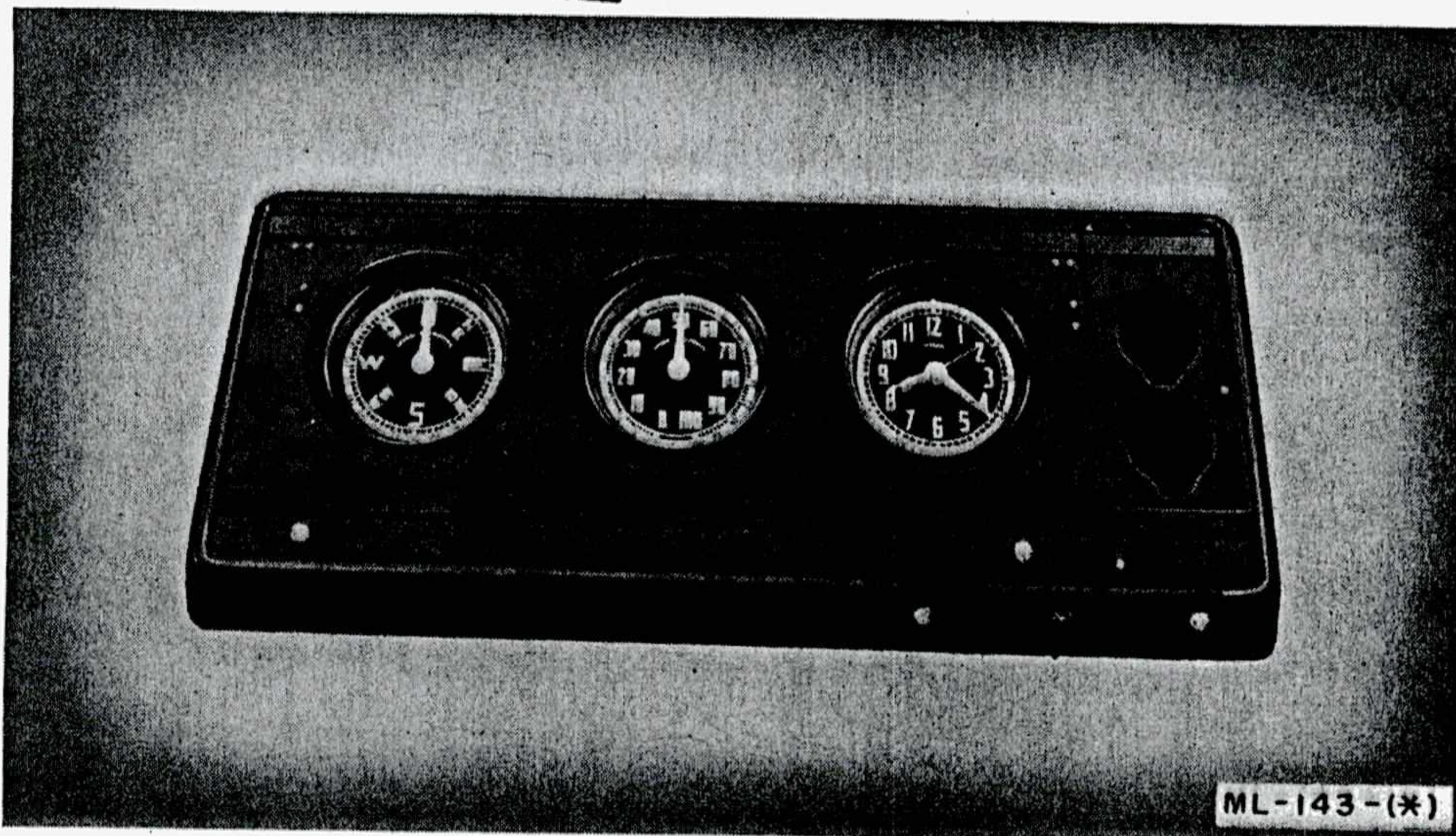


Figure 37. Weather Panel ML-143-B, C, or D.

Status: Standard. Stock No.: 7A1943D. Reference: TM 11-2414.

Weather Panel ML-143-(*), represents Weather Panels ML-143-A through -D. Weather Panel ML-143-(*), is designed for use in the control tower of a weather station using a synchro-type wind indicating system. It consists of a wind direction indicator, a wind intensity indicator, and an electric clock, all mounted behind an inclined panel and inclosed in a metal cabinet. Panel cut-outs for the installation of two sensitive altimeters (not furnished with the equipment) are provided; an electric vibrator, which is switched on when the altimeters are to be read, is included. The panel is equipped with indirect-lighting rings controlled by a switch and rheostat. Weather Panel ML-143-(*), requires 110-volt, 60-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

INDICATOR OPERATION: Self-synchronous motor with pointer attached to shaft.

WIND DIRECTION INDICATOR: Range, 360°; dial graduated in 5° intervals, numbered every 15°; lettered at 8 points of the compass.

WIND INTENSITY INDICATOR: Range, 0 to 100

mph; dial graduated in 1 mph intervals; two labeled scales, one numbered every 10 mph, the other every 5 mph.

CLOCK: Self-starting synchronous electric, with sweep second hand, power-interruption signal, and ON-OFF switch.

POWER REQUIREMENT: 110-v, 60-cyc, single-phase ac.

LIGHTING TRANSFORMER: 110/6-v, 60-cyc.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Weather Panel ML-183-A or -B.

Wind Recorder ML-144-A, -B, -C, or -D.

Terminal Box ML-171.

Junction Box ML-169.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

Note. Weather Panel ML-143-(*), is packed two panels to a shipping container.

	<i>Export packed</i>
Total weight (lb).....	80
Total volume (cu ft).....	8.7

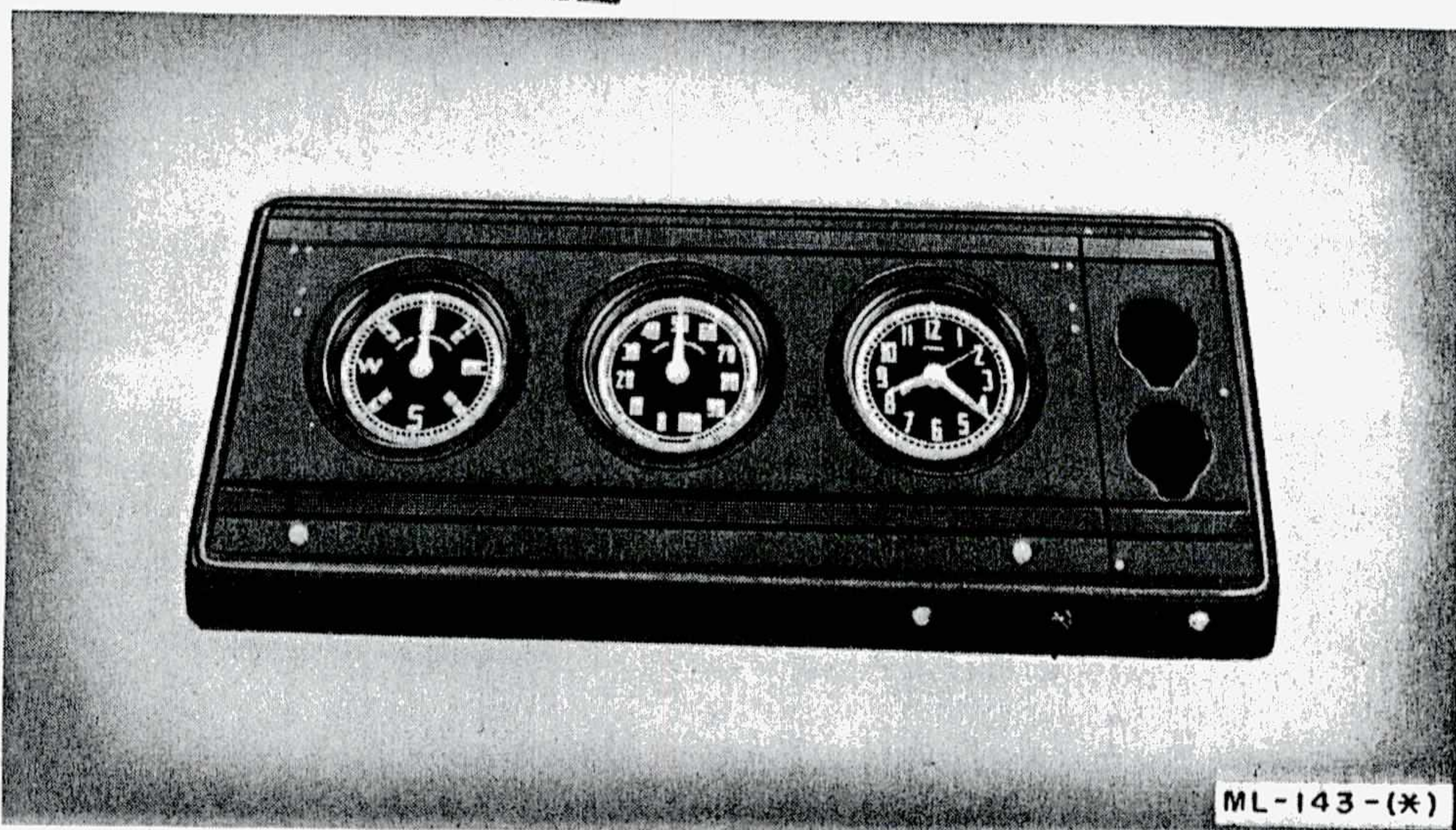
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Figure 37. Weather Panel ML-143-B, C, or D.

Status: Standard. Stock No.: 7A1943D. Reference: TM 11-2414.

Weather Panel ML-143-(*), represents Weather Panels ML-143-A through -D. Weather Panel ML-143-(*), is designed for use in the control tower of a weather station using a synchro-type wind indicating system. It consists of a wind direction indicator, a wind intensity indicator, and an electric clock, all mounted behind an inclined panel and inclosed in a metal cabinet. Panel cut-outs for the installation of two sensitive altimeters (not furnished with the equipment) are provided; an electric vibrator, which is switched on when the altimeters are to be read, is included. The panel is equipped with indirect-lighting rings controlled by a switch and rheostat. Weather Panel ML-143-(*), requires 110-volt, 60-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

INDICATOR OPERATION: Self-synchronous motor with pointer attached to shaft.

WIND DIRECTION INDICATOR: Range, 360°; dial graduated in 5° intervals, numbered every 15°; lettered at 8 points of the compass.

WIND INTENSITY INDICATOR: Range, 0 to 100

mph; dial graduated in 1 mph intervals; two labeled scales, one numbered every 10 mph, the other every 5 mph.

CLOCK: Self-starting synchronous electric, with sweep second hand, power-interruption signal, and ON-OFF switch.

POWER REQUIREMENT: 110-v, 60-cyc, single-phase ac.

LIGHTING TRANSFORMER: 110/6-v, 60-cyc.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Weather Panel ML-183-A or -B.

Wind Recorder ML-144-A, -B, -C, or -D.

Terminal Box ML-171.

Junction Box ML-169.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

Note. Weather Panel ML-143-(*), is packed two panels to a shipping container.

	Export packed
Total weight (lb).....	80
Total volume (cu ft).....	8.7

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CONFIDENTIAL

ML-144-(*)

MODIFIED HANDLING AUTHORIZED

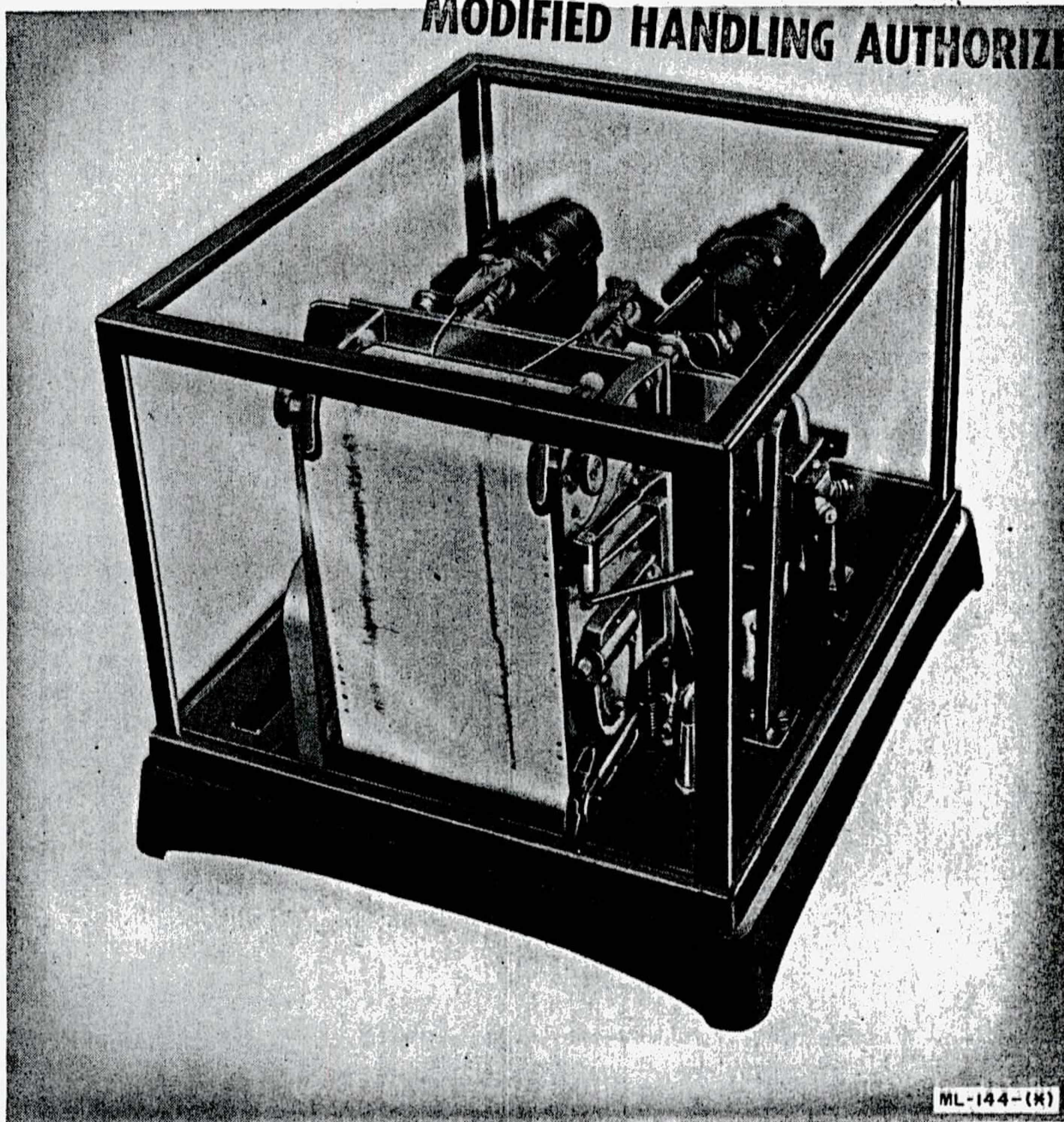


Figure 38. Wind Recorder ML-144-(*).

Status: Standard. Stock No.: 7A2008A. Reference: TM 11-2414.

Wind Recorder ML-144-(*), represents Wind Recorders ML-144-A through -D. Wind Recorder ML-144-(*), is designed for use in the weather office of a station using a synchro-type wind indicating system. It produces continuous, separate records of wind direction and wind intensity on parallel sections of a single chart. Wind Recorder ML-144-(*), requires 110-volt, 60-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

RECORDERS: Two pen mechanisms, one for wind direction record, one for wind intensity record.

RECORDER DRIVE: Self-synchronous motor for each pen, interwired with self-synchronous generator of respective transmitter.

CHART DRIVE: Synchronous electric motor.

CHART SPEED: ¼-in., 1½ in., 3 in. (standard), 6 in., or 12 in. per hr.

CHART: Chart Roll ML-172; 93 ft lg, graduated for standard speed of 3 in. per hr.

POWER REQUIREMENT: 110-v, 60-cyc, single-phase ac.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B -C, or -D.

Wind Intensity Transmitter ML-151-A, -B -C, or -D.

Weather Panel ML-143-A, -B, -C, or -D and/or ML-183-A or -B.

Junction Box ML-169.

Terminal Box ML-171.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	110
Total volume (cu ft).....	7.5

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

MODIFIED HANDLING AUTHORIZED

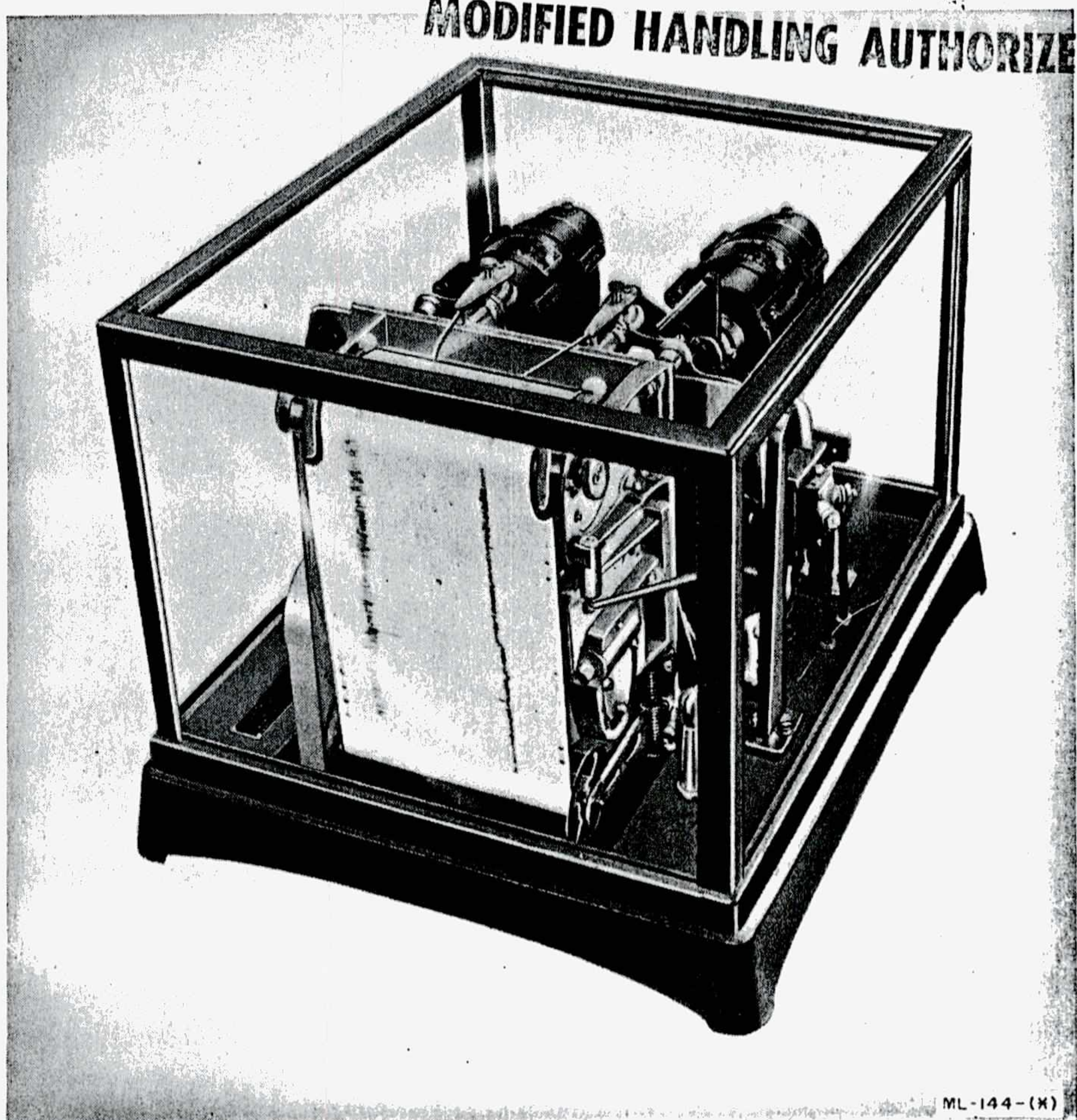


Figure 38. Wind Recorder ML-144-(*).

Status: Standard. Stock No.: 7A2008A. Reference: TM 11-2414.

Wind Recorder ML-144-(*), represents Wind Recorders ML-144-A through -D. Wind Recorder ML-144-(*), is designed for use in the weather office of a station using a synchro-type wind indicating system. It produces continuous, separate records of wind direction and wind intensity on parallel sections of a single chart. Wind Recorder ML-144-(*), requires 110-volt, 60-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

- RECORDERS: Two pen mechanisms, one for wind direction record, one for wind intensity record.
- RECORDER DRIVE: Self-synchronous motor for each pen, interwired with self-synchronous generator of respective transmitter.
- CHART DRIVE: Synchronous electric motor.
- CHART SPEED: 3/4-in., 1 1/2 in., 3 in. (standard), 6 in., or 12 in. per hr.

- CHART: Chart Roll ML-172; 93 ft lg, graduated for standard speed of 3 in. per hr.
- POWER REQUIREMENT: 110-v, 60-cyc, single-phase ac.
- ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B -C, or -D.
Wind Intensity Transmitter ML-151-A, -B -C, or -D.
Weather Panel ML-143-A, -B, -C, or -D and/or ML-183-A or -B.
Junction Box ML-169.
Terminal Box ML-171.
Panel Board ML-170.
Calibrator ML-211.

WEIGHT AND VOLUME

Total weight (lb).....	110
Total volume (cu ft).....	7.5

Export packed

ML-151-(*)

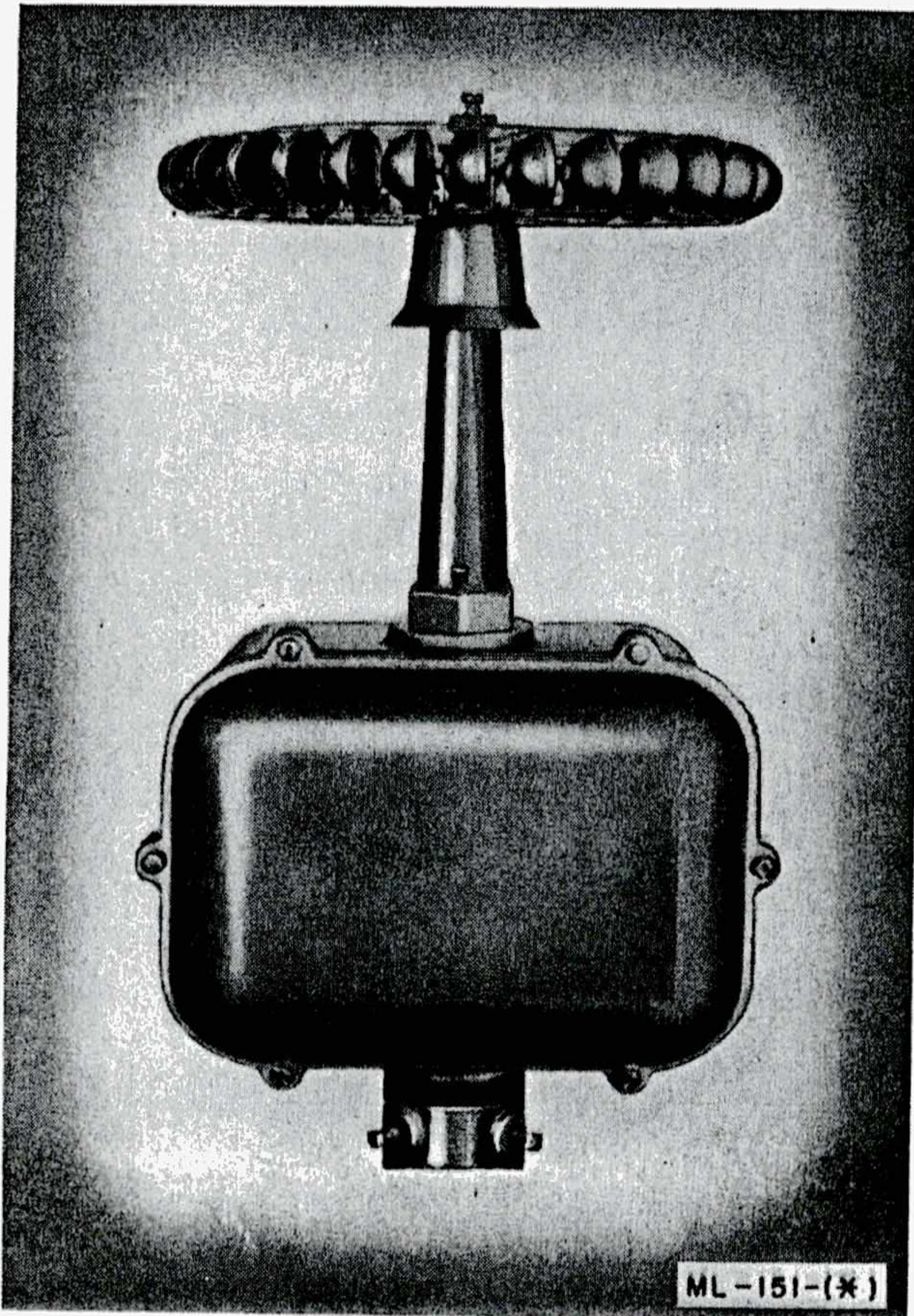


Figure 39. Wind Intensity Transmitter ML-151-(*).

Status: Standard. Stock No.: 7A2007-151A.
Reference: TM 11-2414.

Wind Intensity Transmitter ML-151-(*), represents Wind Intensity Transmitters ML-151-A through -D. Wind Intensity Transmitter ML-151-(*), is an anemometer designed for use in a synchro-type wind indicating system; wind intensities up to 100 miles per hour can be measured. It consists of a multicup, spring-restrained rotor coupled by a direct-gear drive to the shaft of a self-synchronous generator. A plug-jack type terminal block is provided for connecting the transmitter electrically to a weather panel and a

wind recorder located indoors. The transmitter assembly is mounted on a guyed support with a cross arm equipped with obstruction lights. The base plate, steps, guy rod ring, and guy rod anchors are included; the remainder of the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

- TYPE: Synchro generator.
- RANGE: 0 to 100 mph.
- ROTOR: Multicup, spring-restrained (bridled); maximum angular movement 330°; oscillations magnetically damped.
- GENERATOR: Synchro-type.
- CASE: Weatherproof; gasketed front cover, spindle bearing liquid-sealed with mercury.
- MOUNTING: Sleeve, fitted with clamp screws for attachment to 2-in. diam pipe support.
- LOCATION: On roof of control tower or weather office building, at least 10 ft from the wind direction transmitter and not over 5,000 ft from the most remote receiving unit.
- SUPPORT: 2-in. diam pipe; if erected on control tower roof, 8 to 12 ft lg; if erected on weather station roof, 10 to 15 ft lg.
- WIRE: Up to 3,000 ft, use No. 14 B & S gage; from 3,000 ft to 5,000 ft, use No. 12 B & S gage.
- ASSOCIATE EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.
Weather Panel ML-143-A, -B, -C, or -D and/or ML-183-A or -B and/or Wind Recorder ML-144-A, -B, -C, -D when 110-v, 60-cyc ac is available.
Weather Panel ML-173-B, and Wind Recorder ML-174-B when 46-v, 25-cyc ac is available.
Junction Box ML-169.
Terminal Box ML-171.
Panel Board ML-170.
Calibrator ML-211.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 65
Total volume (cu ft).....	5.8

ML-151-(*)

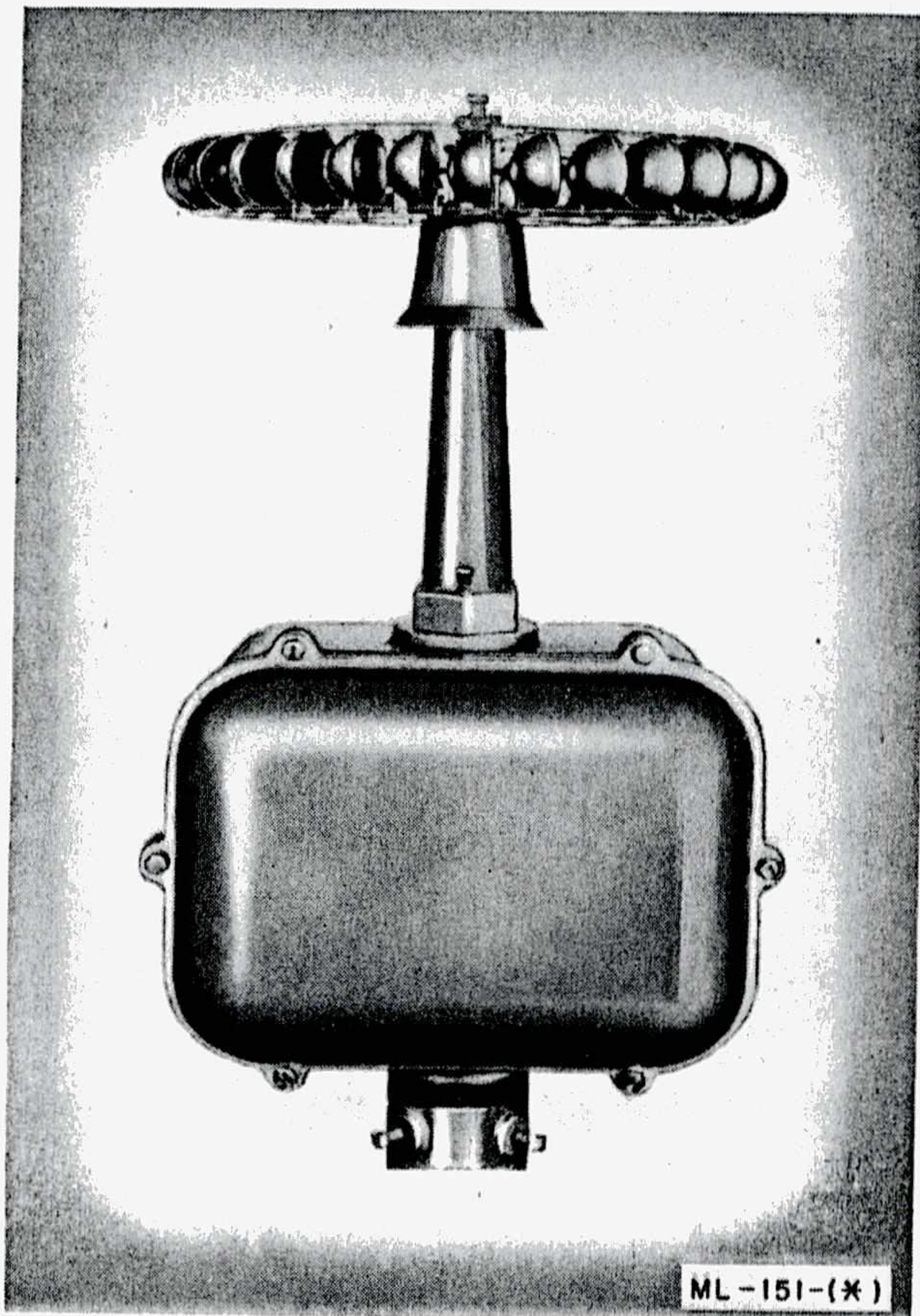


Figure 39. Wind Intensity Transmitter ML-151-(*).

wind recorder located indoors. The transmitter assembly is mounted on a guyed support with a cross arm equipped with obstruction lights. The base plate, steps, guy rod ring, and guy rod anchors are included; the remainder of the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

- TYPE: Synchro generator.
- RANGE: 0 to 100 mph.
- ROTOR: Multicup, spring-restrained (bridled); maximum angular movement 330°; oscillations magnetically damped.
- GENERATOR: Synchro-type.
- CASE: Weatherproof; gasketed front cover, spindle bearing liquid-sealed with mercury.
- MOUNTING: Sleeve, fitted with clamp screws for attachment to 2-in. diam pipe support.
- LOCATION: On roof of control tower or weather office building, *at least* 10 ft from the wind direction transmitter and *not over* 5,000 ft from the most remote receiving unit.
- SUPPORT: 2-in. diam pipe; if erected on control tower roof, 8 to 12 ft lg; if erected on weather station roof, 10 to 15 ft lg.
- WIRE: Up to 3,000 ft, use No. 14 B & S gage; from 3,000 ft to 5,000 ft, use No. 12 B & S gage.

- ASSOCIATE EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.
- Weather Panel ML-143-A, -B, -C, or -D and/or ML-183-A or -B and/or Wind Recorder ML-144-A, -B, -C, -D when 110-v, 60-cyc ac is available.
- Weather Panel ML-173-B, and Wind Recorder ML-174-B when 46-v, 25-cyc ac is available.
- Junction Box ML-169.
- Terminal Box ML-171.
- Panel Board ML-170.
- Calibrator ML-211.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 65
Total volume (cu ft).....	5.8

Status: Standard. Stock No.: 7A2007-151A.
Reference: TM 11-2414.

Wind Intensity Transmitter ML-151-(*), represents Wind Intensity Transmitters ML-151-A through -D. Wind Intensity Transmitter ML-151-(*), is an anemometer designed for use in a synchro-type wind indicating system; wind intensities up to 100 miles per hour can be measured. It consists of a multicup, spring-restrained rotor coupled by a direct-gear drive to the shaft of a self-synchronous generator. A plug-jack type terminal block is provided for connecting the transmitter electrically to a weather panel and a

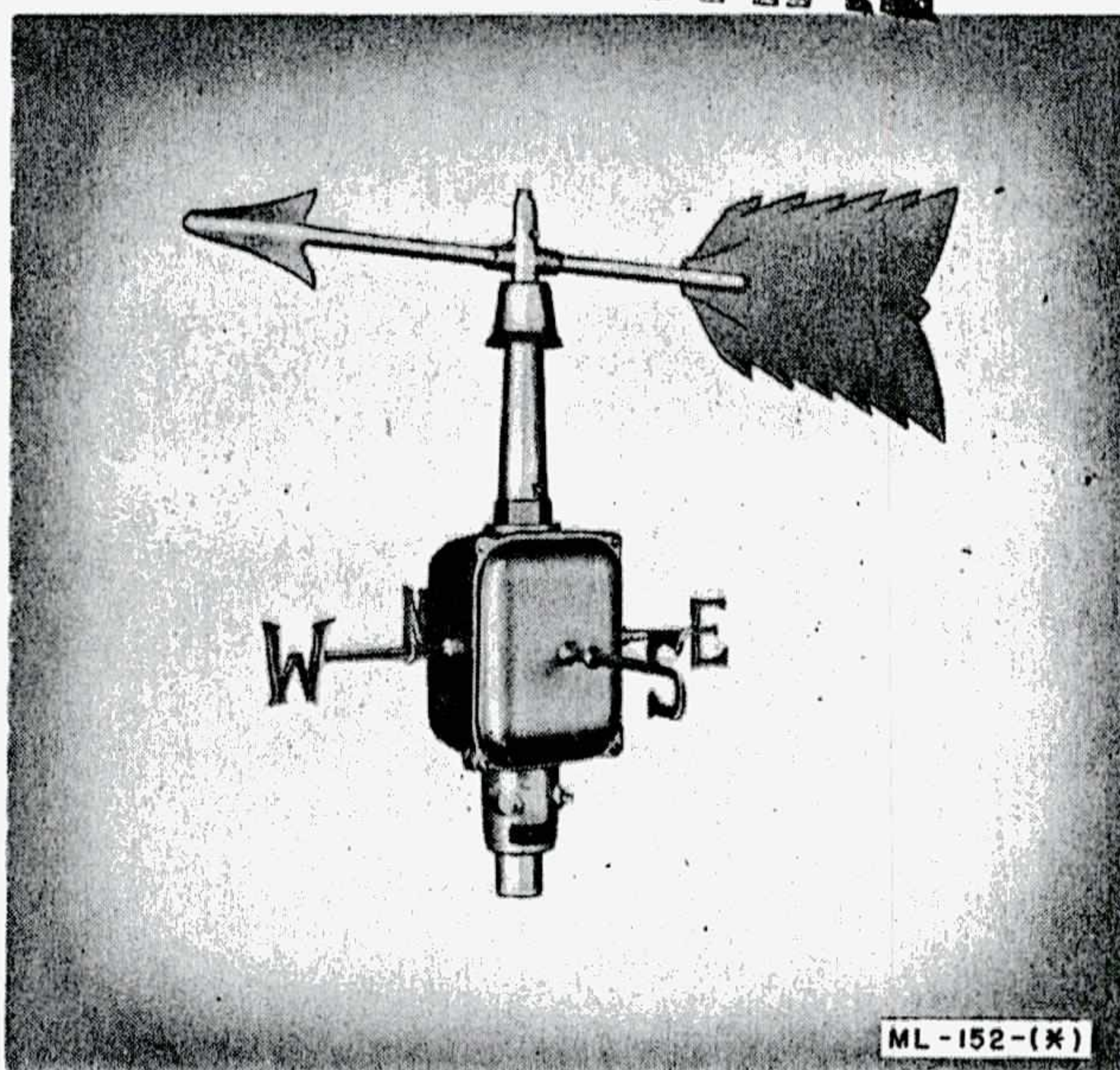


Figure 40. Wind Direction Transmitter ML-152-(*).

Status: Standard. Stock No.: 7A2002-152A.
Reference: TM 11-2414.

Wind Direction Transmitter ML-152-(*), represents Wind Direction Transmitters ML-152-A through -D. Wind Direction Transmitter ML-152-(*), is designed for use in a synchro-type wind indicating system. It consists of a metal wind vane mounted on a spindle which is mechanically coupled to the shaft of a self-synchronous generator. A plug-jack type terminal block is provided for connecting the transmitter electrically with a weather panel and a wind recorder located indoors. Wind-direction letters extending from the sides of the transmitter case provide outdoor, visible indication of wind direction. The transmitter assembly is mounted on a guyed support with a cross arm equipped with obstruc-

tion lights. The base plate, steps, guy rod ring, and guy rod anchors are included; the remainder of the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

- TYPE: Synchro generator.
- RANGE: 360°, direction letters N, E, S, and W.
- ROTOR: Vane.
- GENERATOR: Synchro-type.
- CASE: Weatherproof; gasketed front cover, spindle bearing liquid-sealed with mercury.
- MOUNTING: Sleeve, fitted with clamp screws for attachment to a 2-in. diam pipe support.
- LOCATION: On roof of control tower or weather office building, at least 10 ft from the wind intensity transmitter and not over 5,000 ft from the most remote receiving unit.
- SUPPORT: 2-in. diam pipe; if erected on control tower roof, 8 to 12 ft lg; if erected on weather station roof, 10 to 15 ft lg.
- WIRE: Up to 3,000 ft, use No. 14 B & S gage; from 3,000 ft to 5,000 ft, use No. 12 B & S gage.
- ASSOCIATED EQUIPMENT: Wind Intensity Transmitter ML-151-A, -B, -C, or -D.
Weather Panel ML-143-A, -B, -C, or -D and/or ML-183-A or -B and/or Wind Recorder ML-144-A, -B, -C, or -D when 110-v, 60-cyc ac is available.
Weather Panel ML-173-B and Wind Recorder ML-174-B when 46-v, 25-cyc ac is available.
Panel Board ML-170.
Junction Box ML-169.
Terminal Box ML-171.
Calibrator ML-211.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	70
Total volume (cu ft).....	6.2

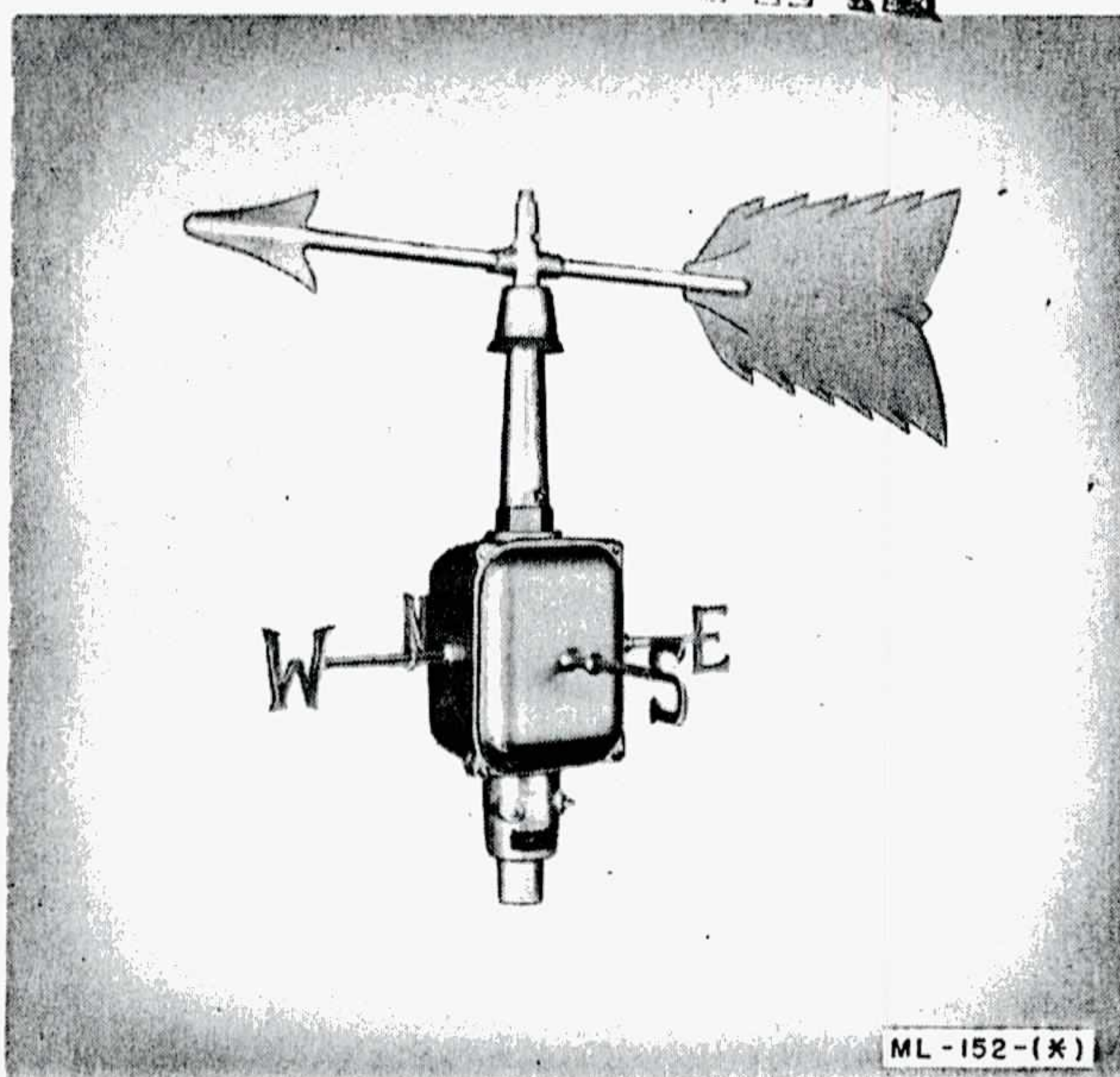


Figure 40. Wind Direction Transmitter ML-152-(*).

Status: Standard. Stock No.: 7A2002-152A.
Reference: TM 11-2414.

Wind Direction Transmitter ML-152-(*), represents Wind Direction Transmitters ML 152 -A through -D. Wind Direction Transmitter ML-152-(*), is designed for use in a synchro-type wind indicating system. It consists of a metal wind vane mounted on a spindle which is mechanically coupled to the shaft of a self-synchronous generator. A plug-jack type terminal block is provided for connecting the transmitter electrically with a weather panel and a wind recorder located indoors. Wind-direction letters extending from the sides of the transmitter case provide outdoor, visible indication of wind direction. The transmitter assembly is mounted on a guyed support with a cross arm equipped with obstruc-

tion lights. The base plate, steps, guy rod ring, and guy rod anchors are included; the remainder of the support is not furnished with the equipment.

TECHNICAL CHARACTERISTICS

- TYPE: Synchro generator.
- RANGE: 360°, direction letters N, E, S, and W.
- ROTOR: Vane.
- GENERATOR: Synchro-type.
- CASE: Weatherproof; gasketed front cover, spindle bearing liquid-sealed with mercury.
- MOUNTING: Sleeve, fitted with clamp screws for attachment to a 2-in. diam pipe support.
- LOCATION: On roof of control tower or weather office building, at least 10 ft from the wind intensity transmitter and not over 5,000 ft from the most remote receiving unit.
- SUPPORT: 2-in. diam pipe; if erected on control tower roof, 8 to 12 ft lg; if erected on weather station roof, 10 to 15 ft lg.
- WIRE: Up to 3,000 ft, use No. 14 B & S gage; from 3,000 ft to 5,000 ft, use No. 12 B & S gage.
- ASSOCIATED EQUIPMENT: Wind Intensity Transmitter ML-151-A, -B, -C, or -D.
Weather Panel ML-143-A, -B, -C, or -D and/or ML-183-A or -B and/or Wind Recorder ML-144-A, -B, -C, or -D when 110-v, 60-cyc ac is available.
Weather Panel ML-173-B and Wind Recorder ML-174-B when 46-v, 25-cyc ac is available.
Panel Board ML-170.
Junction Box ML-169.
Terminal Box ML-171.
Calibrator ML-211.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	70
Total volume (cu ft).....	6.2

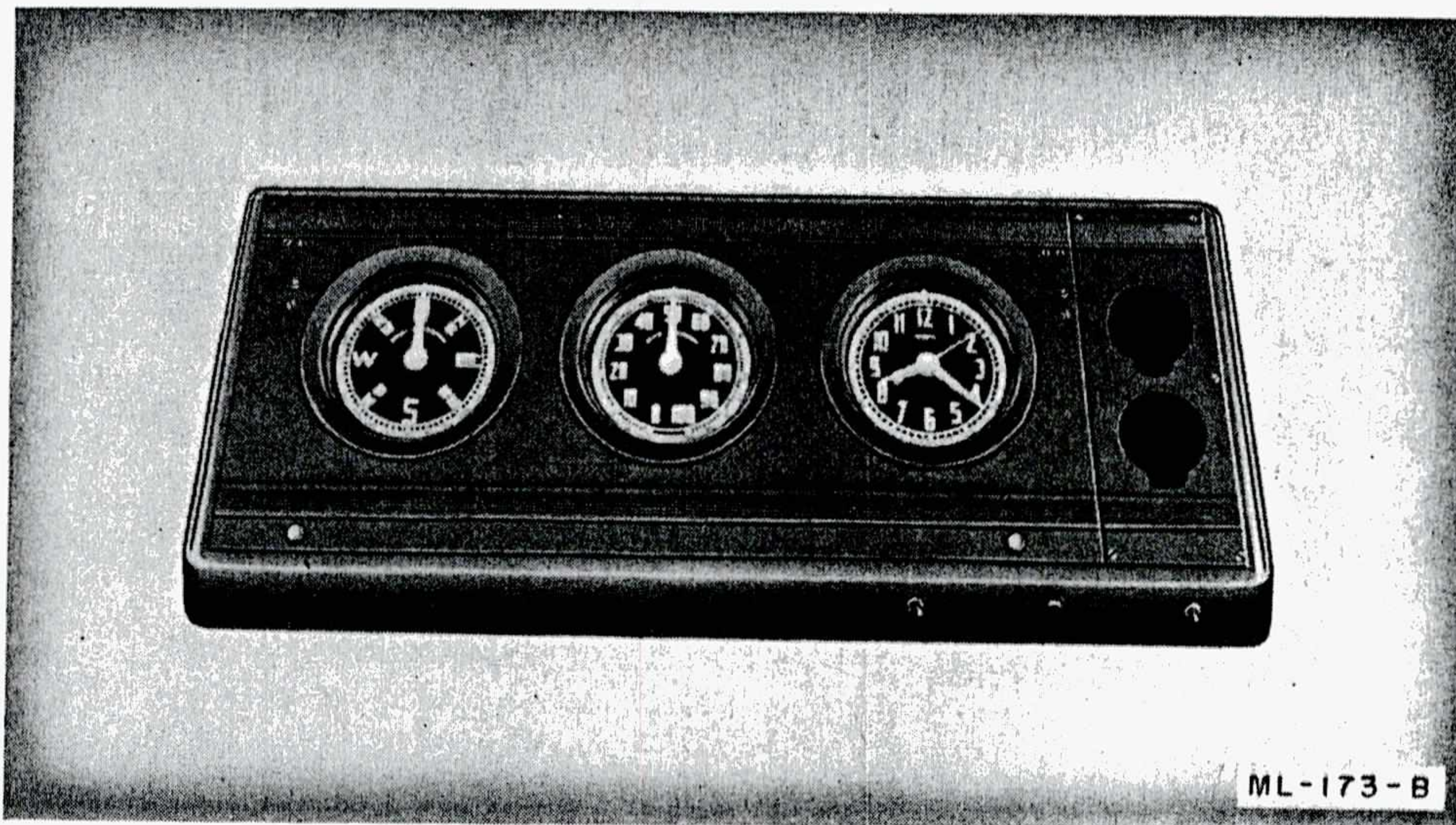


Figure 41. Weather Panel ML-173-B.

Status: Standard. Stock No.: 7A1973B. Reference: TM 11-2414.

Weather Panel ML-173-B is designed for use in the control tower of a weather station using a synchro-type wind indicating system. It consists of a wind direction indicator, a wind intensity indicator, and an electric clock, all mounted behind an inclined panel and inclosed in a metal cabinet. Panel cut-outs for the installation of two sensitive altimeters (not furnished with the equipment) are provided; an electric vibrator, which is switched on when the altimeters are to be read, is included. The panel is equipped with indirect-lighting rings controlled by a switch and rheostat. Weather Panel ML-173-B requires 46-volt, 25-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

- INDICATOR OPERATION: Self-synchronous motor with pointer attached to shaft.
- WIND DIRECTION INDICATOR: Range, 360°; dial graduated in 5° intervals, numbered every 15°; lettered at 8 points of the compass.
- WIND INTENSITY INDICATOR: Range, 0 to 100

mph; dial graduated in 1 mph intervals, two labeled scales, one numbered every 10 mph, the other every 5 mph.

CLOCK: Self-starting, synchronous electric, with sweep second hand, power-interruption signal and ON-OFF switch.

POWER REQUIREMENT: 46-v, 25-cyc, single-phase ac (where available power is 115-v, 25-cyc ac, use 115/46-v, 25-cyc step-down transformer).

LIGHTING TRANSFORMER: 46/6-v, 25-cyc.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Wind Recorder ML-174-B.

Terminal Box ML-171.

Junction Box ML-169.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

Note. Weather Panel ML-173-B is packed two panels to a shipping container.

	<i>Export packed</i>
Total weight (lb).....	80
Total volume (cu ft).....	8.7

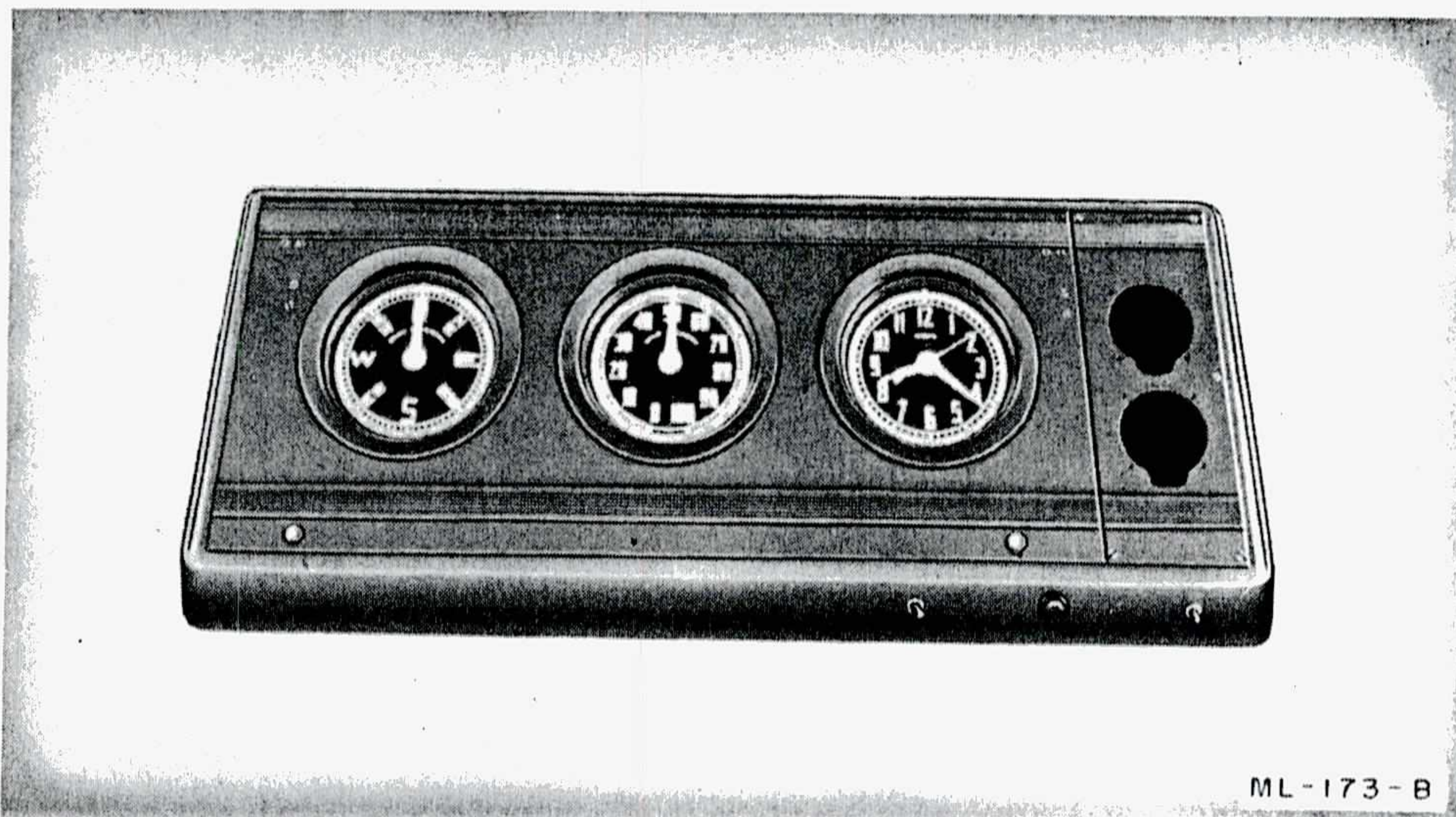


Figure 41. Weather Panel ML-173-B.

Status: Standard. Stock No.: 7A1973B. Reference: TM 11-2414.

Weather Panel ML-173-B is designed for use in the control tower of a weather station using a synchro-type wind indicating system. It consists of a wind direction indicator, a wind intensity indicator, and an electric clock, all mounted behind an inclined panel and inclosed in a metal cabinet. Panel cut-outs for the installation of two sensitive altimeters (not furnished with the equipment) are provided; an electric vibrator, which is switched on when the altimeters are to be read, is included. The panel is equipped with indirect-lighting rings controlled by a switch and rheostat. Weather Panel ML-173-B requires 46-volt, 25-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

- INDICATOR OPERATION: Self-synchronous motor with pointer attached to shaft.
- WIND DIRECTION INDICATOR: Range, 360°; dial graduated in 5° intervals, numbered every 15°; lettered at 8 points of the compass.
- WIND INTENSITY INDICATOR: Range, 0 to 100

mph; dial graduated in 1 mph intervals, two labeled scales, one numbered every 10 mph, the other every 5 mph.

CLOCK: Self-starting, synchronous electric, with sweep second hand, power-interruption signal and ON-OFF switch.

POWER REQUIREMENT: 46-v, 25-cyc, single-phase ac (where available power is 115-v, 25-cyc ac, use 115/46-v, 25-cyc step-down transformer).

LIGHTING TRANSFORMER: 46/6-v, 25-cyc.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Wind Recorder ML-174-B.

Terminal Box ML-171.

Junction Box ML-169.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

Note. Weather Panel ML-173-B is packed two panels to a shipping container.

	<i>Export packed</i>
Total weight (lb)	80
Total volume (cu ft)	8.7

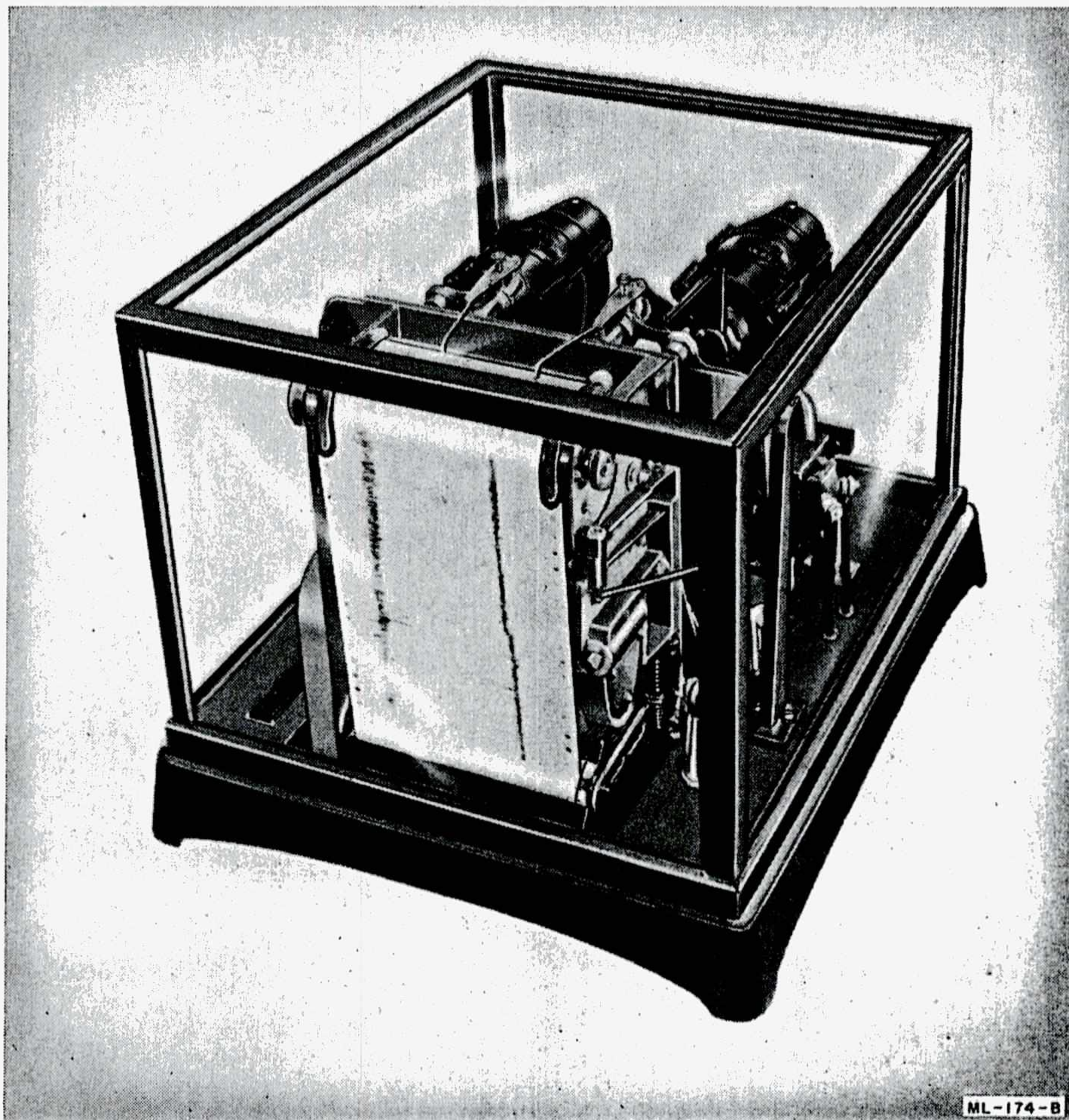


Figure 42. Wind Recorder ML-174-B.

Status: Standard. Stock No.: 7A2008-174B.
Reference: TM 11-2414.

Wind Recorder ML-174-B is designed for use in the weather office of a station using a synchro-type wind indicating system. It produces continuous, separate records of wind direction and wind intensity on parallel sections of a single chart. Wind Recorder ML-174-B requires 46-volt, 25-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

RECORDERS: Two pen mechanisms, one for wind direction record, one for wind intensity record.

RECORDER DRIVE: Self-synchronous motor for each pen, interwired with self-synchronous generator of respective transmitter.

CHART DRIVE: Synchronous electric motor.

CHART SPEED: ¼-in., 1½ in., 3 in. (standard), 6 in., or 12 in. per hr.

CHART: Chart Roll ML-172; 93 ft lg, graduated for standard speed of 3 in. per hr.

POWER REQUIREMENT: 46-v, 25-cyc, single-phase ac (where available power is 115-v, 25-cyc ac, use a 115/46-v step-down transformer).

ASSOCIATED EQUIPMENT:

Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Weather Panel ML-173-B.

Junction Box ML-169.

Terminal Box ML-171.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb).....	110
Total volume (cu ft).....	7.5

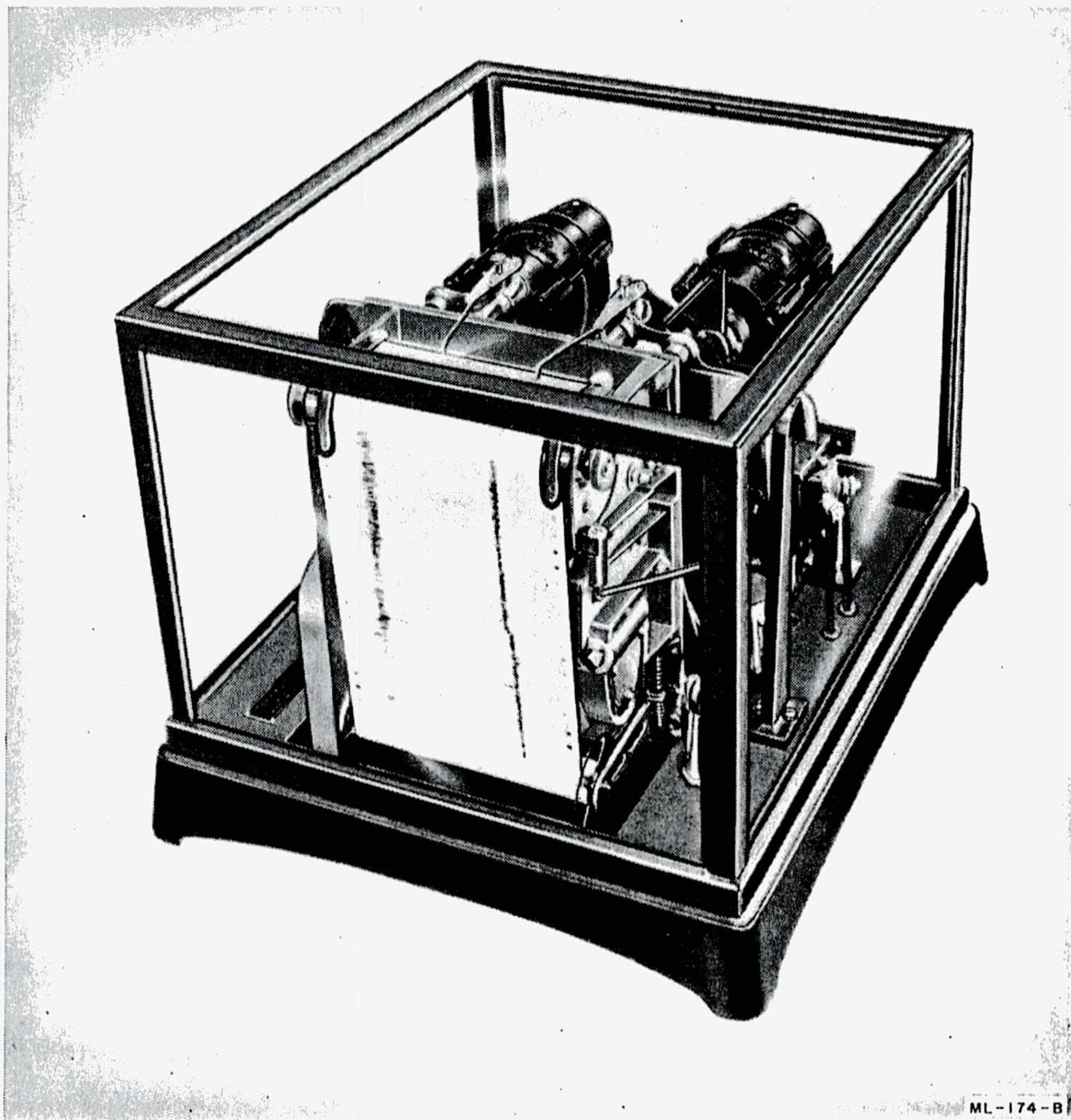


Figure 42. Wind Recorder ML-174-B.

Status: Standard. *Stock No.:* 7A2008-174B.
Reference: TM 11-2414.

Wind Recorder ML-174-B is designed for use in the weather office of a station using a synchro-type wind indicating system. It produces continuous, separate records of wind direction and wind intensity on parallel sections of a single chart. Wind Recorder ML-174-B requires 46-volt, 25-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

RECORDERS: Two pen mechanisms, one for wind direction record, one for wind intensity record.

RECORDER DRIVE: Self-synchronous motor for each pen, interwired with self-synchronous generator of respective transmitter.

CHART DRIVE: Synchronous electric motor.

CHART SPEED: ¼-in., 1½ in., 3 in. (standard), 6 in., or 12 in. per hr.

CHART: Chart Roll ML-172; 93 ft lg, graduated for standard speed of 3 in. per hr.

POWER REQUIREMENT: 46-v, 25-cycle, single-phase ac (where available power is 115-v, 25-cycle ac, use a 115/46-v step-down transformer).

ASSOCIATED EQUIPMENT:

Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Weather Panel ML-173-B.

Junction Box ML-169.

Terminal Box ML-171.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

	<i>Export packed</i>
Total weight (lb)	110
Total volume (cu ft)	7.5

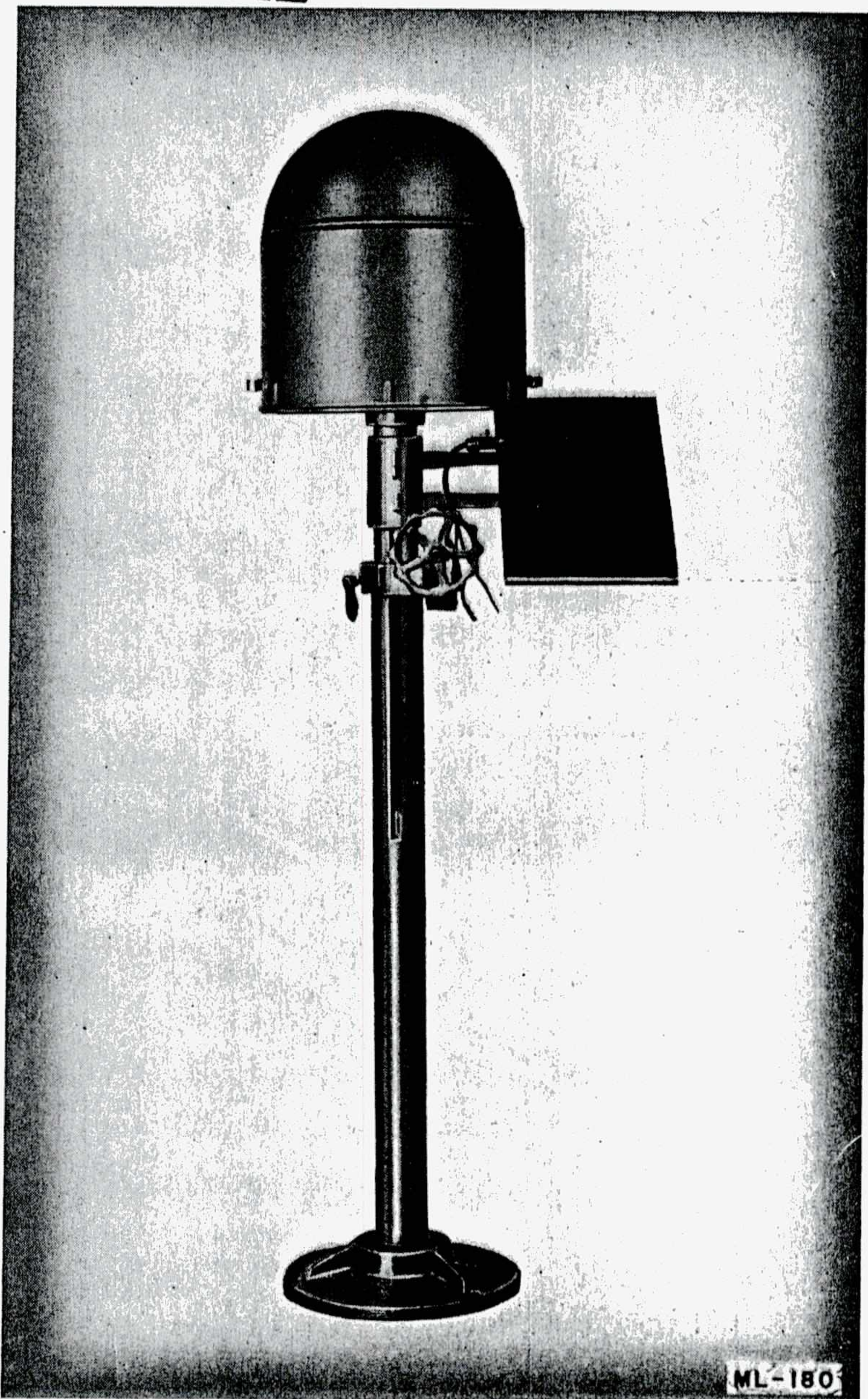


Figure 43. Theodolite Mount ML-180.

Status: Standard. *Stock No.:* 7A1750. *Reference:* TM 11-423.

Theodolite Mount ML-180 is a metal, adjustable-height support for Theodolites ML-47-(*) and ML-247. It is designed for permanent installation on an observation platform. The mount consists of two vertical pipes, one of which telescopes within the other and can be raised or

lowered by means of a wheel. The bottom of the outer pipe is screwed into a mounting base; the top of the inner pipe carries a plate with a screw-threaded tripod head for attaching the theodolite. The equipment includes a metal hood which fits over and protects the instrument, and a data shelf with a lamp. Packed for export, Theodolite Mount ML-180 weighs 19 pounds.

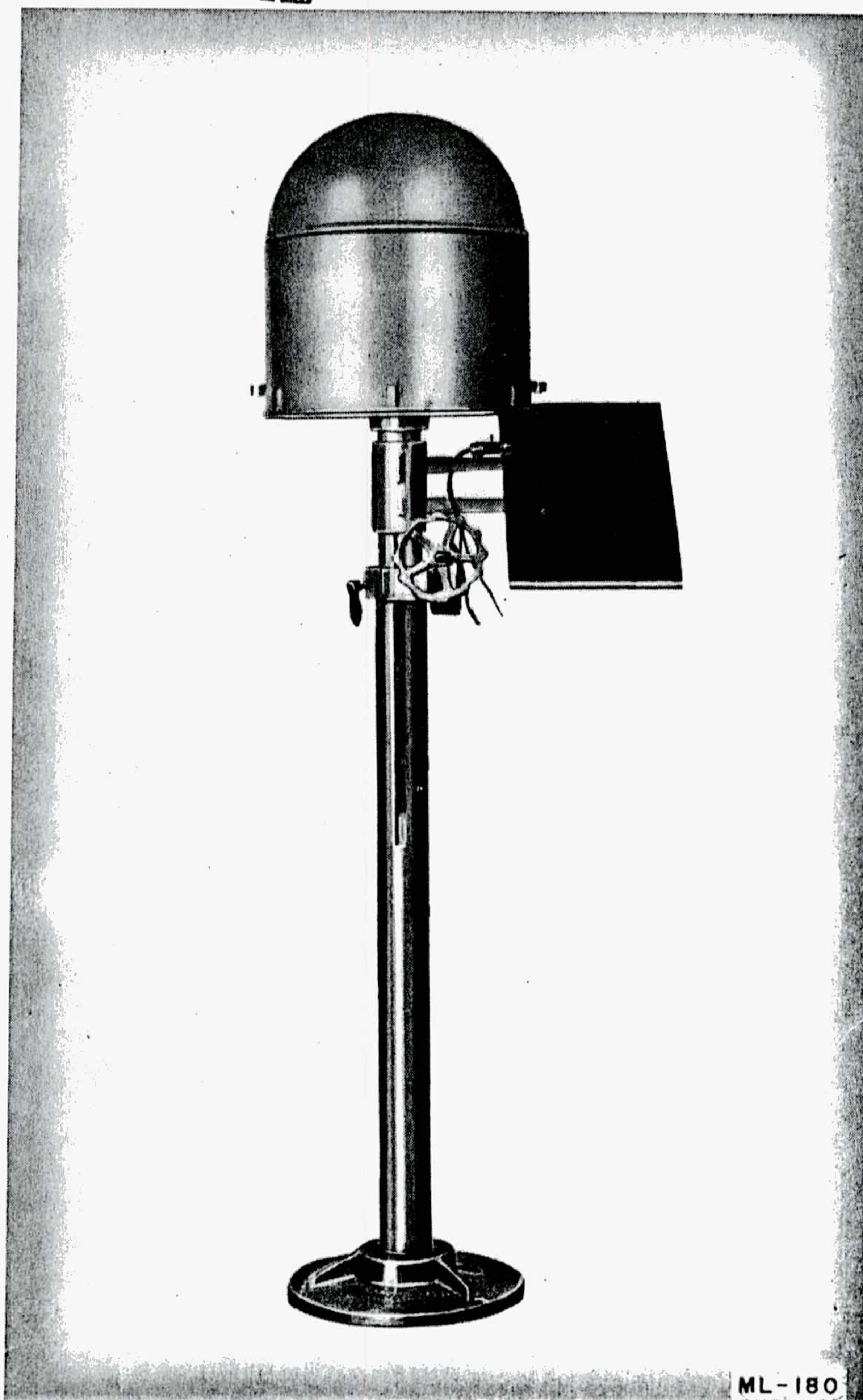
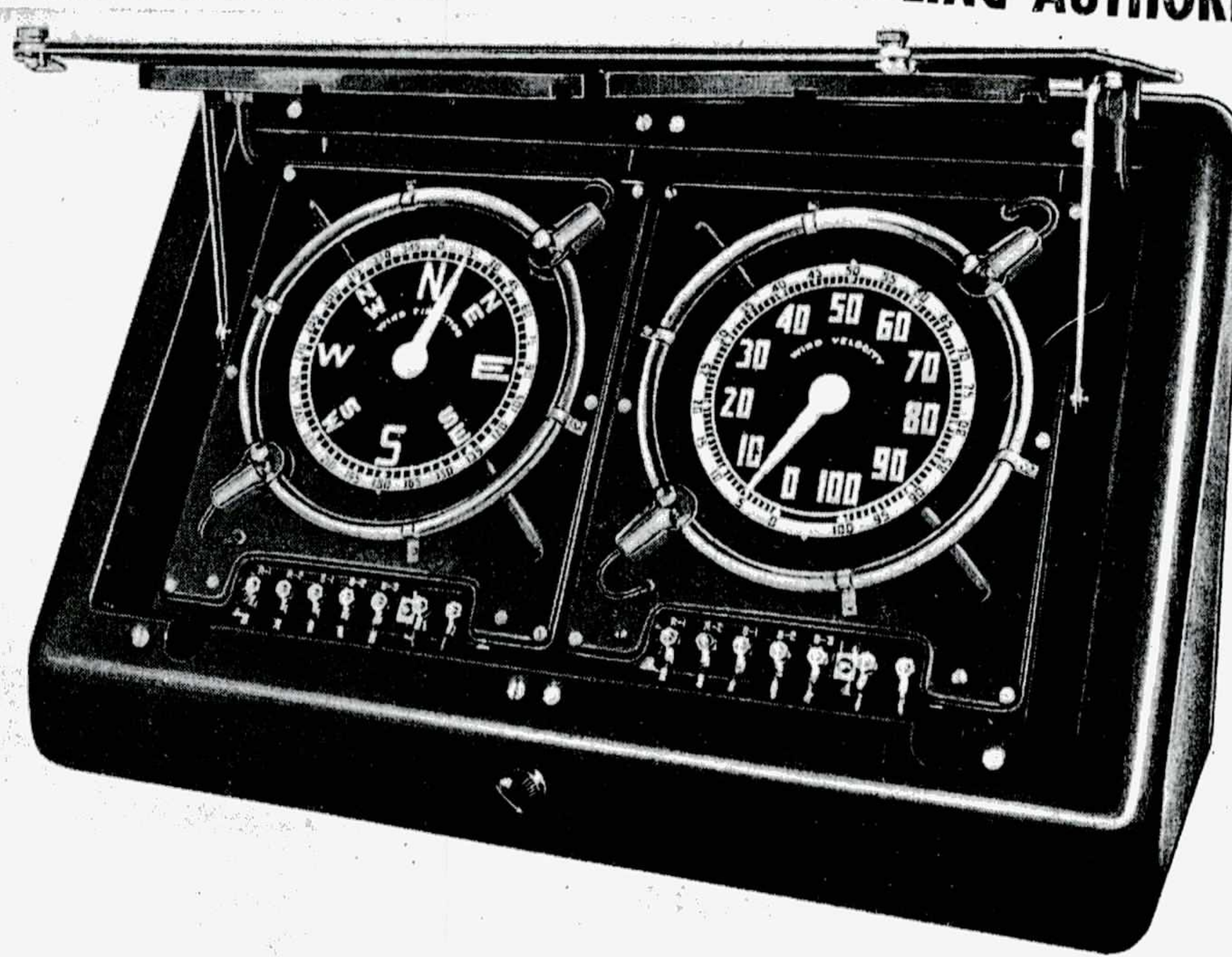


Figure 43. Theodolite Mount ML-180.

Status: Standard. *Stock No.:* 7A1750. *Reference:* TM 11-423.

Theodolite Mount ML-180 is a metal, adjustable-height support for Theodolites ML-47-(*) and ML-247. It is designed for permanent installation on an observation platform. The mount consists of two vertical pipes, one of which telescopes within the other and can be raised or

lowered by means of a wheel. The bottom of the outer pipe is screwed into a mounting base; the top of the inner pipe carries a plate with a screw-threaded tripod head for attaching the theodolite. The equipment includes a metal hood which fits over and protects the instrument, and a data shelf with a lamp. Packed for export, Theodolite Mount ML-180 weighs 19 pounds.



ML-183-(*)

Figure 44. Weather Panel ML-183-(*).

Status: Standard. *Stock No.:* 7A1983A. *Reference:* TM 11-2414.

Weather Panel ML-183-(*), represents Weather Panels ML-183-A and ML-183-B. Weather Panel ML-183-(*), is designed for use in the weather office of a station using a synchro-type wind indicating system. It consists of a wind direction indicator and a wind intensity indicator, both mounted behind an inclined panel and enclosed in a metal cabinet. Each unit is provided with an indirect lighting ring controlled by a rheostat switch. Weather Panel ML-183-(*), requires 110-volt, 60-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

INDICATOR OPERATION: Self-synchronous motor with pointer attached to shaft.

WIND DIRECTION INDICATOR: Range, 360°; dial graduated in 5° intervals, numbered every 15°; lettered at 8 points of the compass.

WIND INTENSITY INDICATOR: Range, 0 to 100 mph; dial graduated in 1 mph intervals; two labeled

scales, one numbered every 10 mph, the other every 5 mph.

POWER REQUIREMENT: 110-v, 60-cyc, single-phase ac.

LIGHTING TRANSFORMER: 110/6 v, 60 cyc.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Weather Panel ML-143-A, -B, -C, or -D.

Wind Recorder ML-144-A, -B, -C, or -D.

Terminal Box ML-171.

Junction Box ML-169.

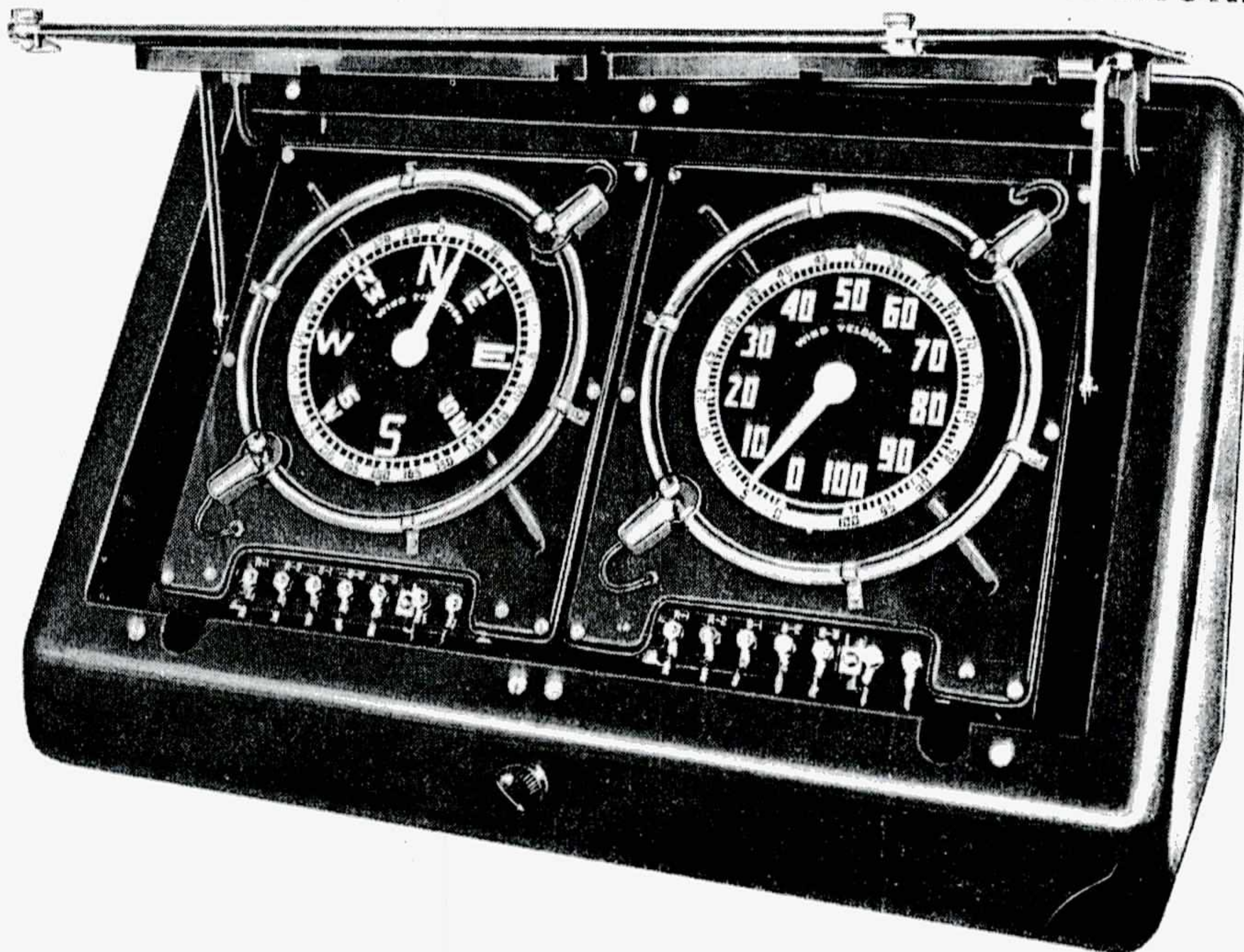
Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

Note. Weather Panel ML-183-(*), is packed two panels to a shipping container.

	<i>Export packed</i>
Total weight (lb).....	80
Total volume (cu ft).....	8.7



ML-183-(*)

Figure 44. Weather Panel ML-183-(*).

Status: Standard. Stock No.: 7A1983A. Reference: TM 11-2414.

Weather Panel ML-183-(*), represents Weather Panels ML-183-A and ML-183-B. Weather Panel ML-183-(*), is designed for use in the weather office of a station using a synchro-type wind indicating system. It consists of a wind direction indicator and a wind intensity indicator, both mounted behind an inclined panel and enclosed in a metal cabinet. Each unit is provided with an indirect lighting ring controlled by a rheostat switch. Weather Panel ML-183-(*), requires 110-volt, 60-cycle alternating current for operation.

TECHNICAL CHARACTERISTICS

INDICATOR OPERATION: Self-synchronous motor with pointer attached to shaft.

WIND DIRECTION INDICATOR: Range, 360°; dial graduated in 5° intervals, numbered every 15°; lettered at 8 points of the compass.

WIND INTENSITY INDICATOR: Range, 0 to 100 mph; dial graduated in 1 mph intervals; two labeled

scales, one numbered every 10 mph, the other every 5 mph.

POWER REQUIREMENT: 110-v, 60-cyc, single-phase ac.

LIGHTING TRANSFORMER: 110/6 v, 60 cyc.

ASSOCIATED EQUIPMENT: Wind Direction Transmitter ML-152-A, -B, -C, or -D.

Wind Intensity Transmitter ML-151-A, -B, -C, or -D.

Weather Panel ML-143-A, -B, -C, or -D.

Wind Recorder ML-144-A, -B, -C, or -D.

Terminal Box ML-171.

Junction Box ML-169.

Panel Board ML-170.

Calibrator ML-211.

WEIGHT AND VOLUME

Note. Weather Panel ML-183-(*), is packed two panels to a shipping container.

	Export packed
Total weight (lb)	80
Total volume (cu ft)	8.7

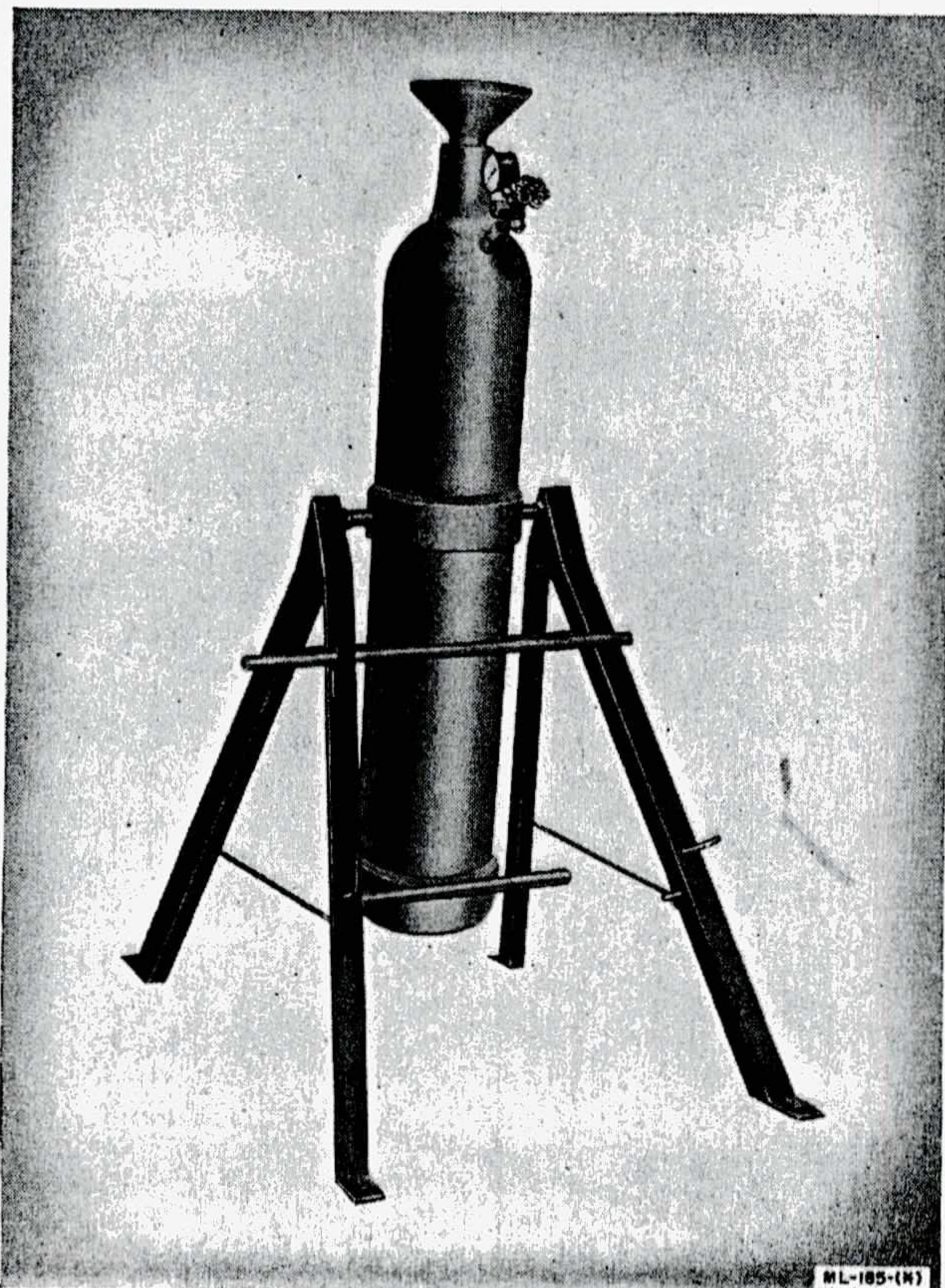


Figure 45. Generator ML-185-B.

Status: Standard. Stock No.: 7A975-85. Reference: TM 11-2400.

Generator ML-185-(*), represents Generators ML-185-A, ML-185-B, and ML-185-C. Generator ML-185-(*), includes complete, transportable equipment for generating hydrogen gas to inflate meteorological balloons. The equipment consists of a steel cylinder with plug, outlet and regulating valve, pressure gauge, hose coupling, and safety devices; a support assembly, and the necessary tools and accessories. Hydrogen gas is

generated by the reaction of sodium hydroxide (caustic soda), water, and either ferrosilicon or aluminum. The chemicals are not furnished with the equipment. Sufficient hydrogen gas can be produced in 2 hours to inflate one 350-gram balloon or two to three 100-gram balloons.

TECHNICAL CHARACTERISTICS

CYLINDER

- TYPE: Seamless steel.
- SIZE: 9¹/₁₆ in. OD; 56 in. lg.
- CAPACITY 11¹/₂ gal (approx 2,600 cu in).
- PRESSURE: Body will withstand 5,000 psi.
- SAFETY DEVICES: 2 (1 cylinder, 1 valve); rupture at pressures exceeding 3,000 psi.
- PRESSURE GAUGE: Range 0 to 3,000 psi, calibrated in pounds per square inch.

HYDROGEN GAS YIELD

- FERROSILICON PROCESS: 85 to 90 cu ft in 2 hours with air temperature 70° F to 90° F.
- ALUMINUM PROCESS: 120 cu ft in 2 hours with air temperature 60° F. to 90° F.

MAXIMUM PRESSURE

- FERROSILICON PROCESS: 1,600 to 2,100 psi when generator is hot; 1,200 to 1,500 psi when generator is cold.
- ALUMINUM PROCESS: Approx 2,300 psi when generator is hot.

CHEMICAL CHARGE

- FERROSILICON PROCESS: 5 lbs sodium hydroxide (Sig C stock No. 6G197), 4¹/₂ lb ferrosilicon (Sig C stock No. 6G550).
- ALUMINUM PROCESS: Caustic Soda Charge ML-388/UM (Sig C stock No. 7A476-388).
Aluminum Charge ML-389/UM (Sig C stock No. 7A43-389).

WATER: Fresh or sea.

CYLINDER SUPPORT: Two, folding, metal A-frames.

WEIGHTS AND VOLUMES

	<i>Un- packed</i>	<i>Domestic pack</i>
Total weight (lb)-----	500	620
Total volume (cu ft)-----	-----	22.6

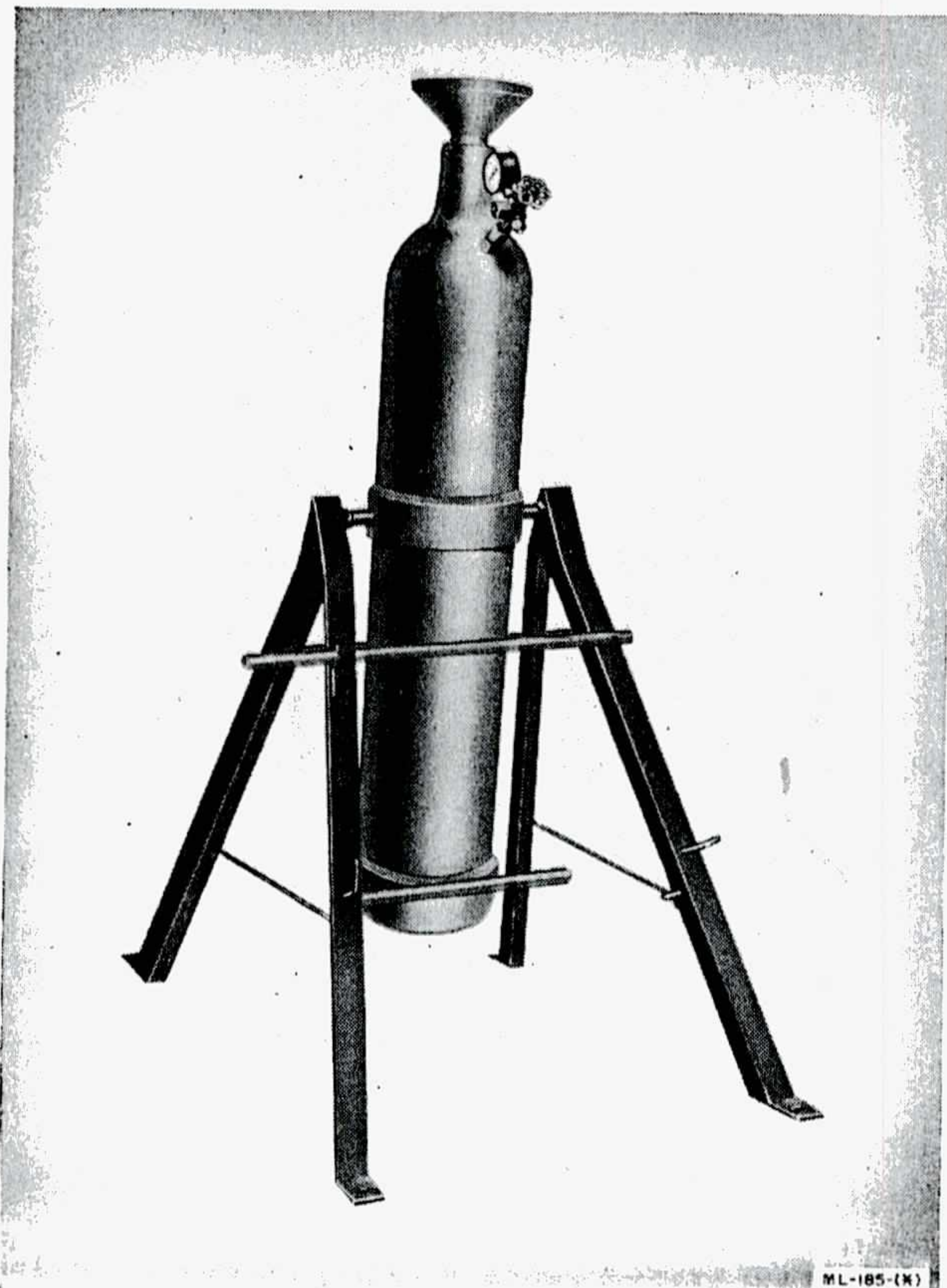


Figure 45. Generator ML-185-B.

generated by the reaction of sodium hydroxide (caustic soda), water, and either ferrosilicon or aluminum. The chemicals are not furnished with the equipment. Sufficient hydrogen gas can be produced in 2 hours to inflate one 350-gram balloon or two to three 100-gram balloons.

TECHNICAL CHARACTERISTICS

CYLINDER

- TYPE: Seamless steel.
- SIZE: 9⁹/₁₆ in. OD; 56 in. lg.
- CAPACITY 11¹/₂ gal (approx 2,600 cu in).
- PRESSURE: Body will withstand 5,000 psi.
- SAFETY DEVICES: 2 (1 cylinder, 1 valve); rupture at pressures exceeding 3,000 psi.
- PRESSURE GAUGE: Range 0 to 3,000 psi, calibrated in pounds per square inch.

HYDROGEN GAS YIELD

- FERROSILICON PROCESS: 85 to 90 cu ft in 2 hours with air temperature 70° F to 90° F.
- ALUMINUM PROCESS: 120 cu ft in 2 hours with air temperature 60° F. to 90° F.

MAXIMUM PRESSURE

- FERROSILICON PROCESS: 1,600 to 2,100 psi when generator is hot; 1,200 to 1,500 psi when generator is cold.
- ALUMINUM PROCESS: Approx 2,300 psi when generator is hot.

CHEMICAL CHARGE

- FERROSILICON PROCESS: 5 lbs sodium hydroxide (Sig C stock No. 6G197), 4¹/₂ lb ferrosilicon (Sig C stock No. 6G550).
- ALUMINUM PROCESS: Caustic Soda Charge ML-388/UM (Sig C stock No. 7A476-388).
Aluminum Charge ML-389/UM (Sig C stock No. 7A43-389).

WATER: Fresh or sea.

CYLINDER SUPPORT: Two, folding, metal A-frames.

WEIGHTS AND VOLUMES

	<i>Un- packed</i>	<i>Domestic pack</i>
Total weight (lb)-----	500	620
Total volume (cu ft)-----	-----	22.6

Status: Standard. Stock No.: 7A975-85. Reference: TM 11-2400.

Generator ML-185-(*), represents Generators ML-185-A, ML-185-B, and ML-185-C. Generator ML-185-(*), includes complete, transportable equipment for generating hydrogen gas to inflate meteorological balloons. The equipment consists of a steel cylinder with plug, outlet and regulating valve, pressure gauge, hose coupling, and safety devices; a support assembly, and the necessary tools and accessories. Hydrogen gas is

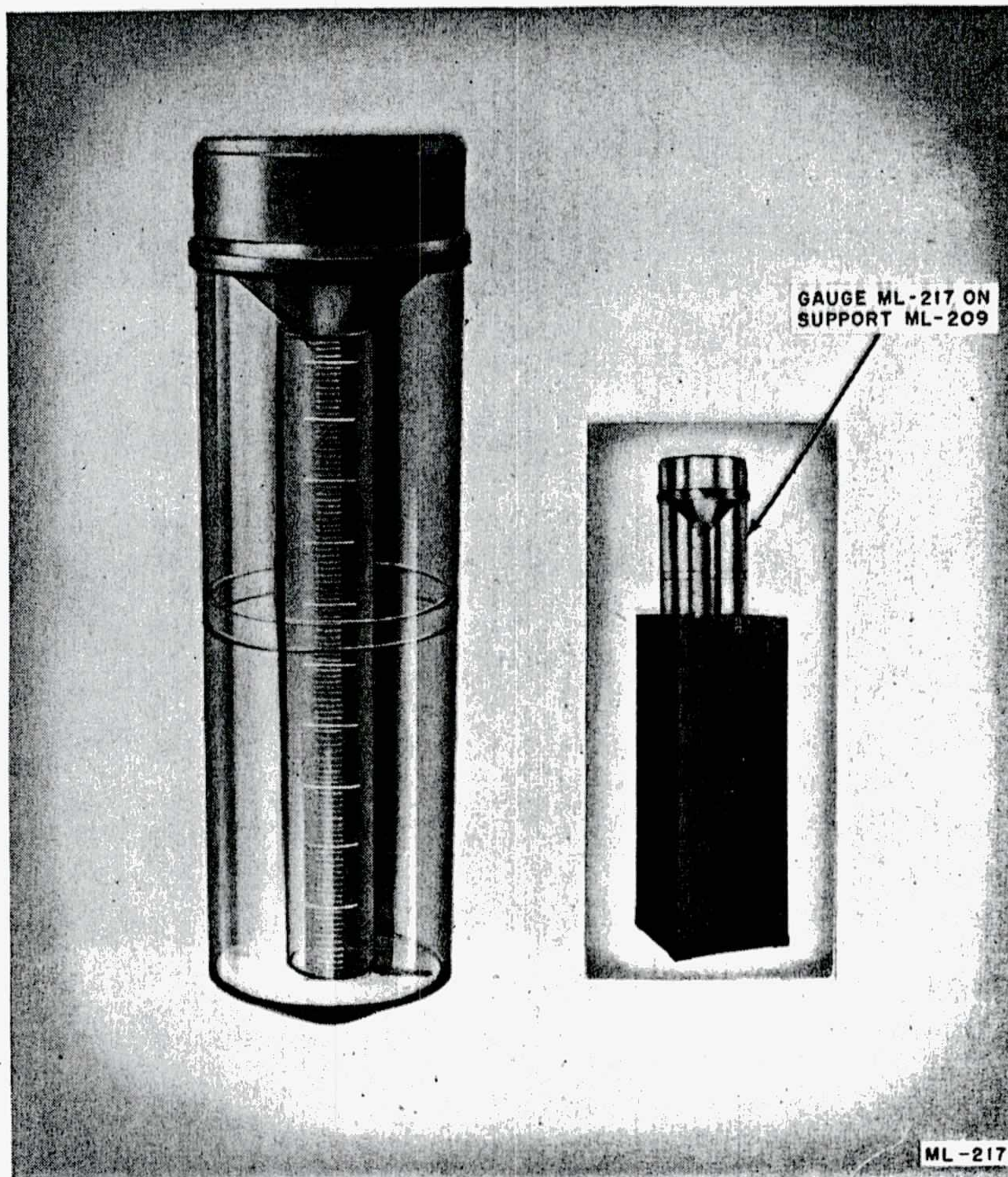


Figure 46. Gauge ML-217 on Support ML-209.

Status: Standard. Stock No.: 7A937. Reference: TM 11-2406.

Gauge ML-217 is a nonrecording gauge used at portable weather stations to measure precipitations of rain, snow, or hail in terms of inches of rainfall. The gauge is fabricated of transparent plastic; graduations, in steps of .01 inch, from 0 up to 1 inch, are engraved on the measuring tube, enabling the observer to read the amount of precipitation directly from the gauge. Support

ML-209, which serves also as a carrying case, is used with Gauge ML-217, but is not a part of the equipment.

WEIGHTS AND VOLUMES

	Un-packed (net)	Export packed (including carrying case)
Total weight (lb).....	1.25	7.5
Total volume (cu ft).....	.2	.72

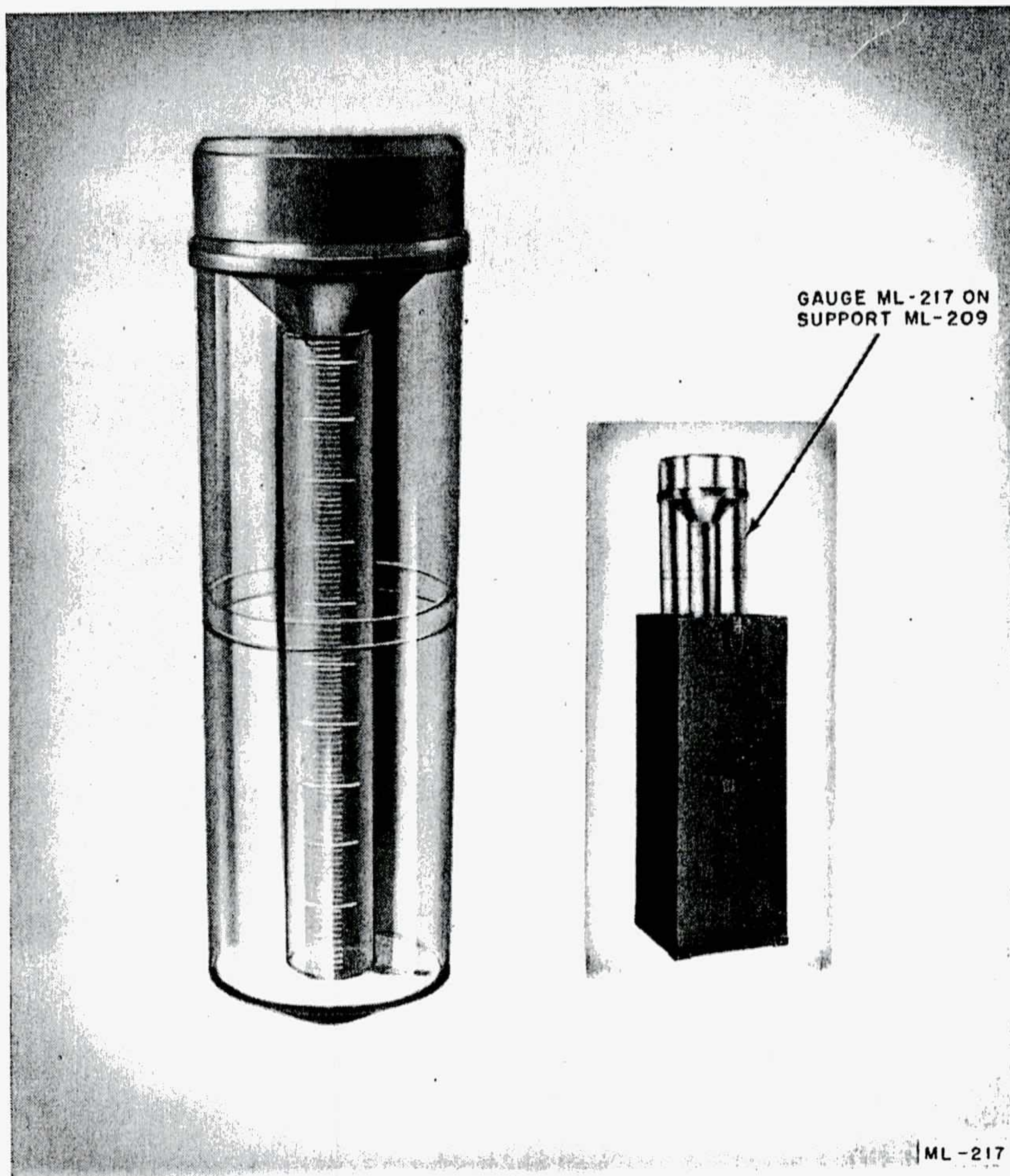


Figure 46. Gauge ML-217 on Support ML-209.

Status: Standard. Stock No.: 7A937. Reference: TM 11-2406.

Gauge ML-217 is a nonrecording gauge used at portable weather stations to measure precipitations of rain, snow, or hail in terms of inches of rainfall. The gauge is fabricated of transparent plastic; graduations, in steps of .01 inch, from 0 up to 1 inch, are engraved on the measuring tube, enabling the observer to read the amount of precipitation directly from the gauge. Support

ML-209, which serves also as a carrying case, is used with Gauge ML-217, but is not a part of the equipment.

WEIGHTS AND VOLUMES

	Un-packed (net)	Export packed (including carrying case)
Total weight (lb)	1.25	7.5
Total volume (cu ft) .....	.2	.72

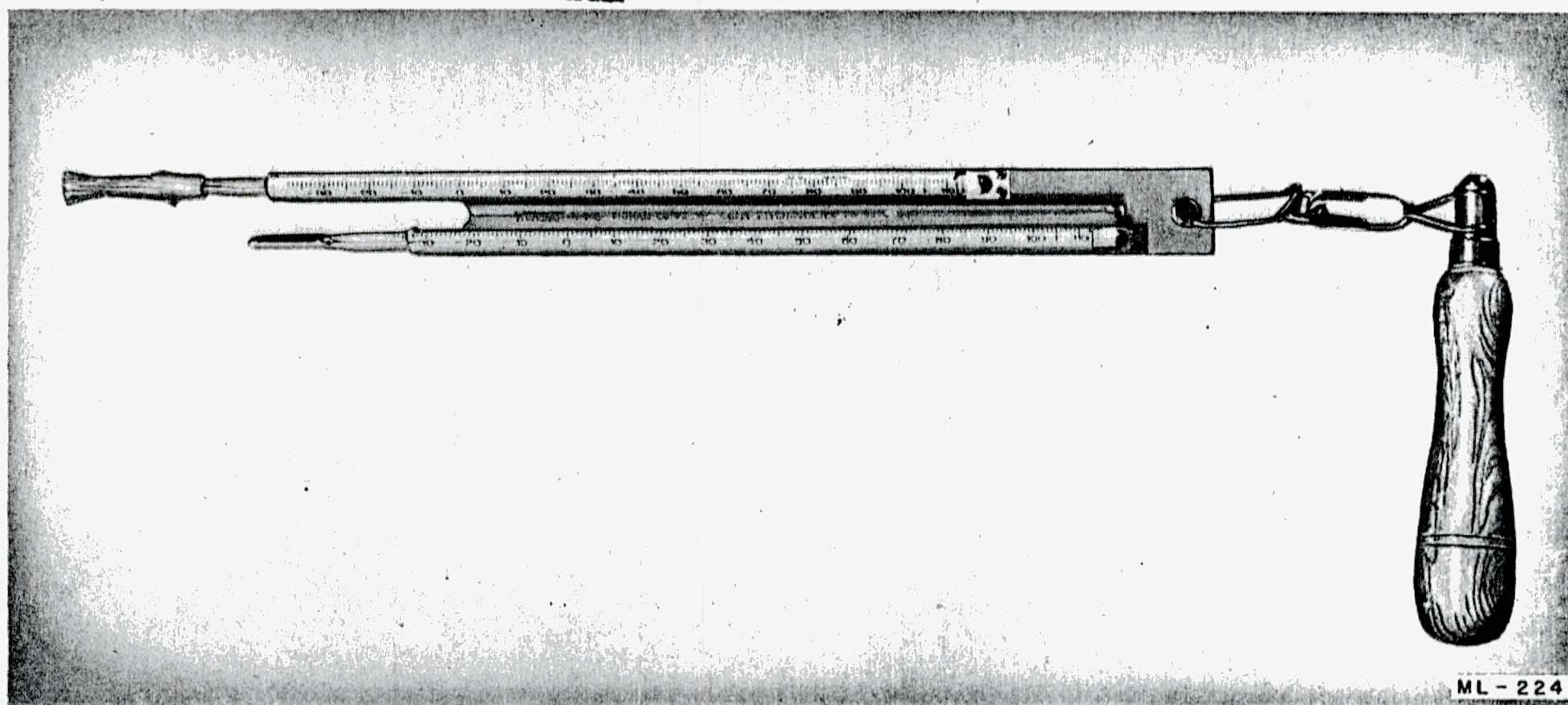


Figure 47. Psychrometer ML-224.

Status: Standard. Stock No.: 7A1324-224. Reference: TM 11-2417.

Psychrometer ML-224 consists of two, identical, mercury-in-glass thermometers mounted parallel to each other on a metal back which is attached, by means of a link and swivel, to a hardwood handle. In use, the bulb of one thermometer is covered with a wet cloth (wick) and the psychrometer is rotated rapidly about an axis at right angles to its length. From the two differing temperature readings thus obtained, the relative humidity, dew point, and the vapor pressure of the atmosphere may be calculated. Psychrometer ML-224 is available with thermometers having general or tropical temperature ranges. Psychrometer ML-24 is identical to Psychrometer ML-224 except that the scale of the former is

graduated in degrees Fahrenheit and that of the latter is graduated in degrees centigrade.

TECHNICAL CHARACTERISTICS

- TYPE OF THERMOMETERS: Mercury-in-glass.
- SCALE GRADUATIONS: Whole degrees centigrade, numerical designation at each multiple of 10°.
- TEMPERATURE RANGE (approximate degrees C):
 - General, -37° to +46°.
 - Tropical, -12° to +63°.
- ACCURACY (° C): ±.4°, below -18°.
 ±.3°, from -18° to 0°.
 ±.2°, above 0°.
- VENTILATION: Accomplished by hand sling or by use of Rotor ML-74-A.

WEIGHT AND VOLUME

Total weight (lb).....	<i>Export packed</i> 2.1
Total volume (cu ft).....	.15

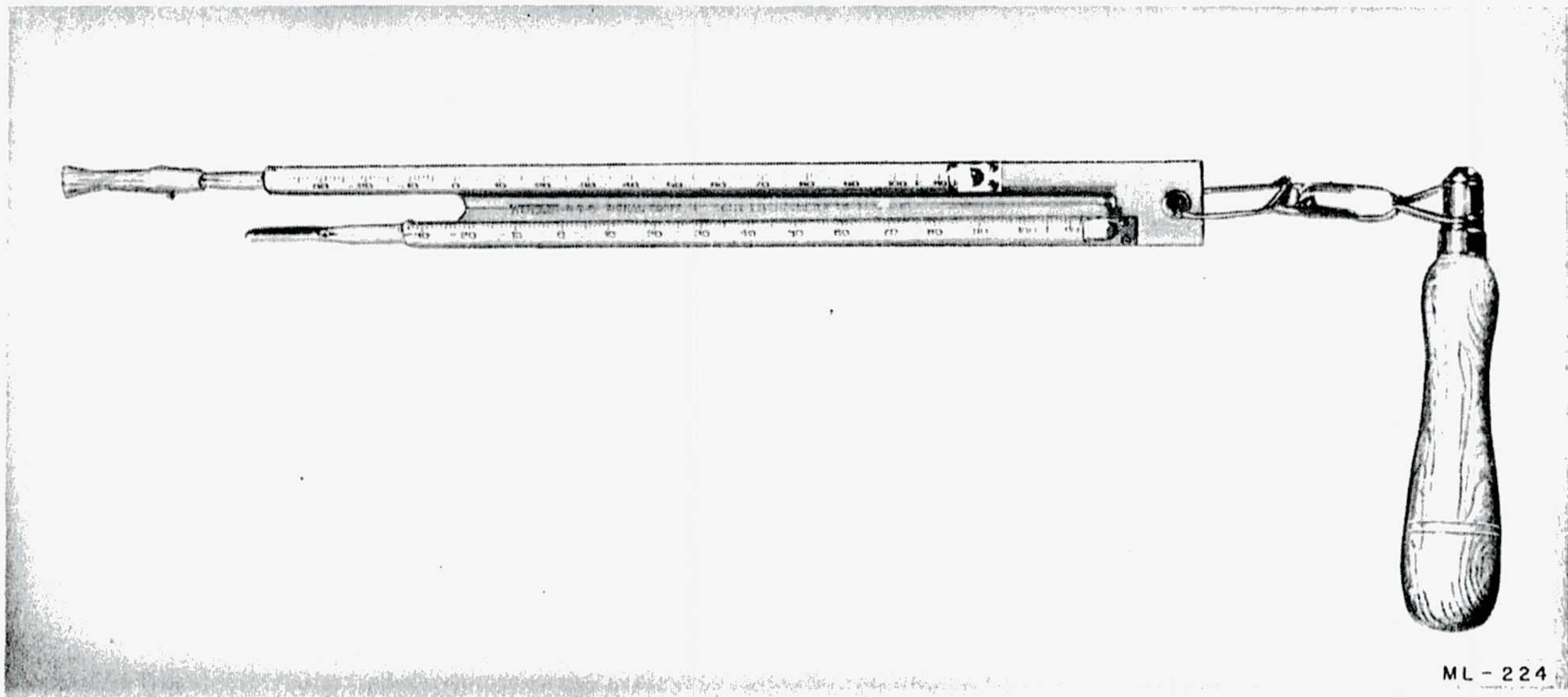


Figure 47. Psychrometer ML-224.

Status: Standard. Stock No.: 7A1324-224. Reference: TM 11-2417.

Psychrometer ML-224 consists of two, identical, mercury-in-glass thermometers mounted parallel to each other on a metal back which is attached, by means of a link and swivel, to a hardwood handle. In use, the bulb of one thermometer is covered with a wet cloth (wick) and the psychrometer is rotated rapidly about an axis at right angles to its length. From the two differing temperature readings thus obtained, the relative humidity, dew point, and the vapor pressure of the atmosphere may be calculated. Psychrometer ML-224 is available with thermometers having general or tropical temperature ranges. Psychrometer ML-24 is identical to Psychrometer ML-224 except that the scale of the former is

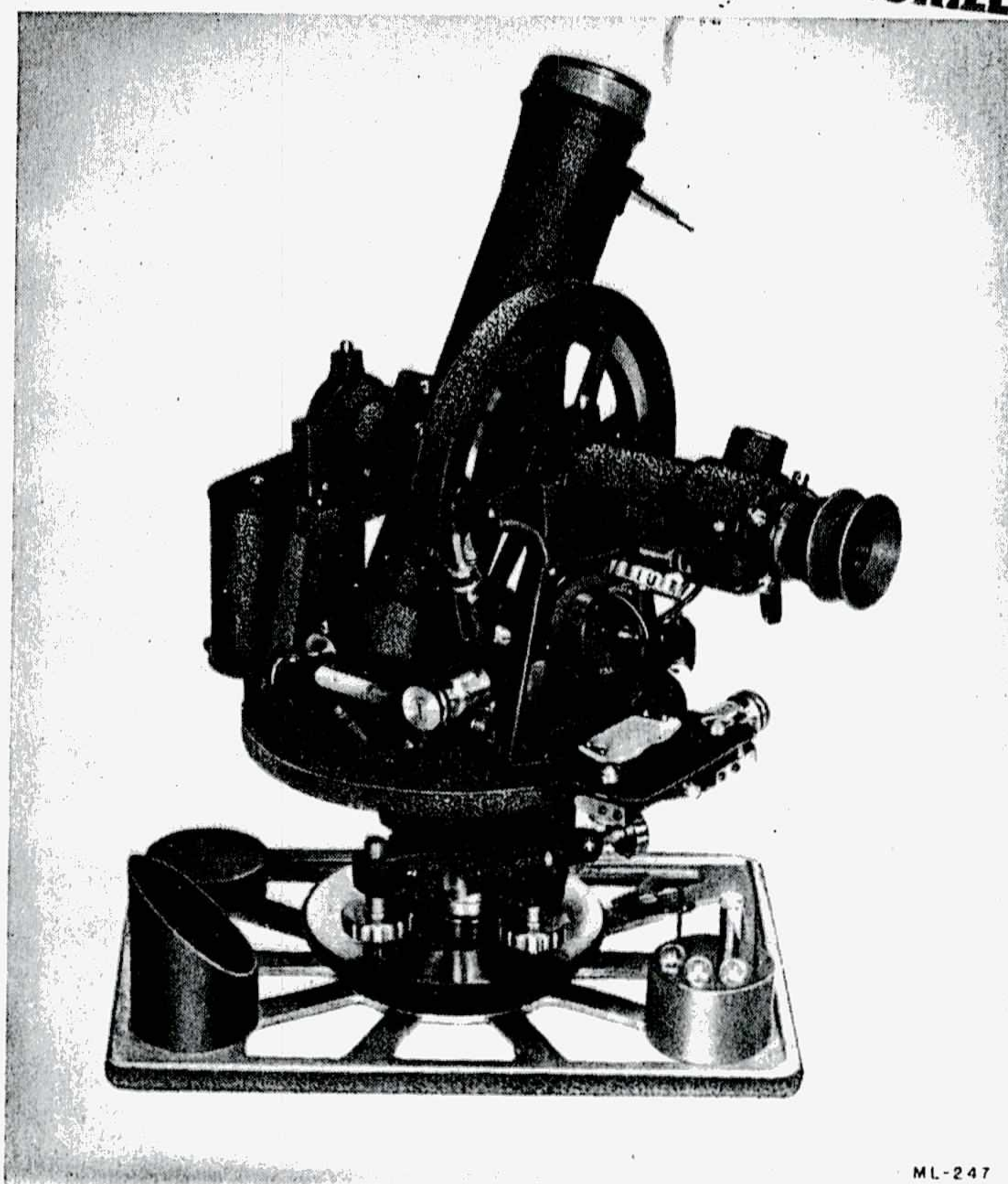
graduated in degrees Fahrenheit and that of the latter is graduated in degrees centigrade.

TECHNICAL CHARACTERISTICS

- TYPE OF THERMOMETERS: Mercury-in-glass.
- SCALE GRADUATIONS: Whole degrees centigrade, numerical designation at each multiple of 10°.
- TEMPERATURE RANGE (approximate degrees C):
 - General, -37° to +46°.
 - Tropical, -12° to +63°.
- ACCURACY (° C): ±.4°, below -18°.
±.3°, from -18° to 0°.
±.2°, above 0°.
- VENTILATION: Accomplished by hand sling or by use of Rotor ML-74-A.

WEIGHT AND VOLUME

Total weight (lb)	<i>Export packed</i> 2.1
Total volume (cu ft)	.15



ML-247

Figure 48. Theodolite ML-247.

Status: Standard. *Stock No.:* 7A1747-247.
Reference: TM 11-423.

Theodolite ML-247 is a portable, right-angle-telescope type surveying instrument provided with a compass and with an auxiliary object lens which widens the field and is particularly useful in making night observations. The theodolite is used to follow and measure the movement of a pilot balloon as it rises through the atmosphere and is carried horizontally by the air flow. Readings of the azimuth and elevation of the balloon are taken at regular intervals to determine the speed and direction of the wind at various levels. Theodolite ML-247 is usually mounted on Tripod ML-78-(*); for fixed installation, it may be mounted on Theodolite Mount ML-180; the tripod and mount are not included with the equipment.

Note. Theodolite ML-247 is identical to Theodolite ML-47-R.

TECHNICAL CHARACTERISTICS

TELESCOPE (main)

- TYPE: Right-angle, with prism.
- POWER: Approximately 20 diameters.
- FIELD: Approximately 2°.

- EYEPIECE: Inverting, adjustable, with cross hairs.
- FOCUS: Adjustable.
- TELESCOPE (auxiliary).
- POWER: Approximately 4 diameters (in combination with eyepiece of main telescope).
- FIELD: Approximately 10°.
- SCALES
- ELEVATION: Graduated in whole degrees, vernier reading to .1°.
- AZIMUTH: Graduated in whole degrees, vernier reading to .1°; range, 360°.
- SIGHTS: Fixed, for sighting vertical angles up to 45°; extension, for sighting vertical angles up to 85°.
- ILLUMINATION: 3 incandescent lamp assemblies; current supplied by 2 Batteries BA-30.
- ACCESSORY EQUIPMENT: Tripod ML-78-(*).
Theodolite Mount ML-180.

PRINCIPAL COMPONENTS

- Theodolite ML-47-(*), (any model except ML-47-R)
- Compass ML-197
- Telescope ML-146

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb)	41.2	85.9
Total volume (cu ft)	1.8	3.9

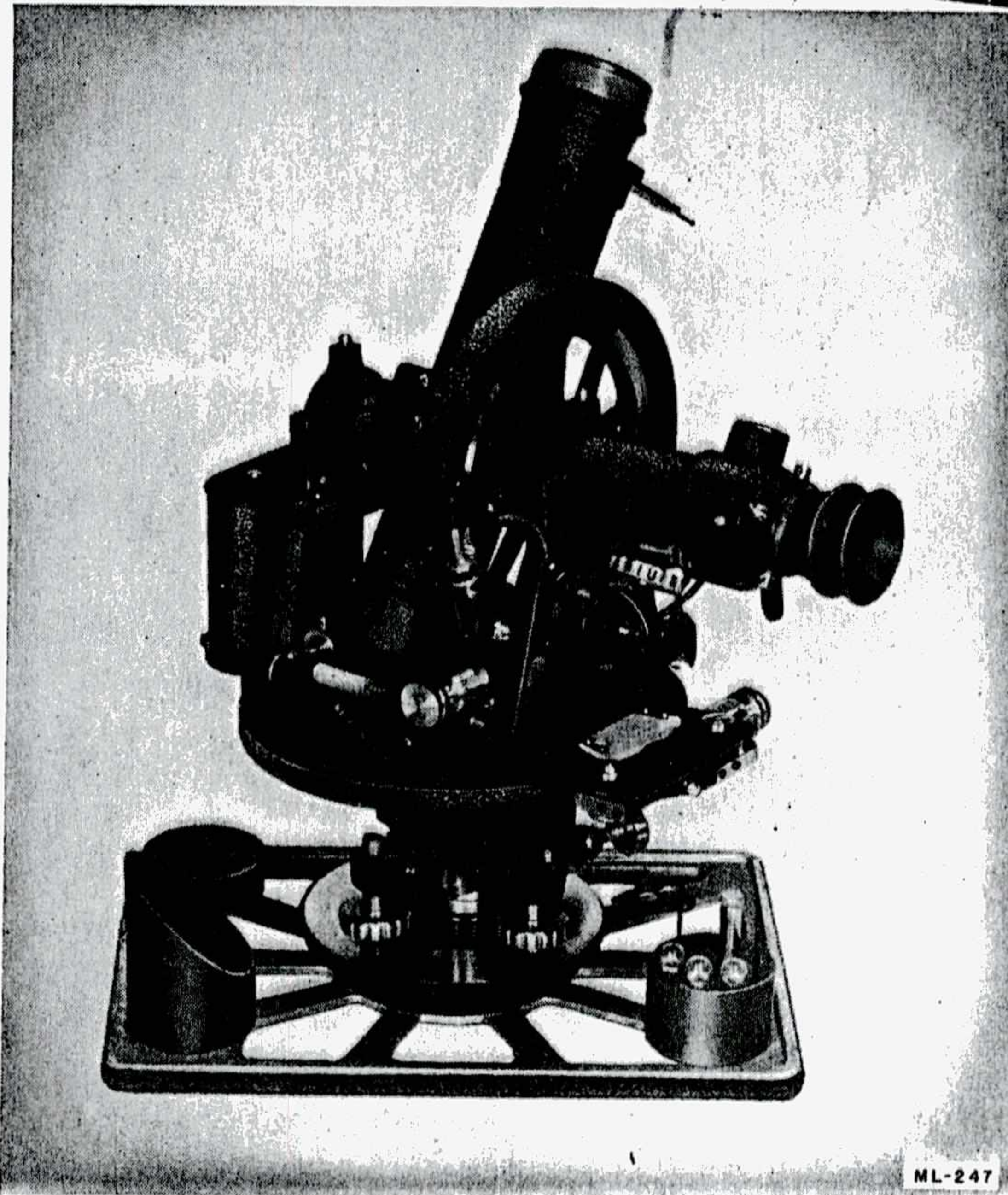


Figure 48. Theodolite ML-247.

Status: Standard. *Stock No.:* 7A1747-247.
Reference: TM 11-423.

Theodolite ML-247 is a portable, right-angle-telescope type surveying instrument provided with a compass and with an auxiliary object lens which widens the field and is particularly useful in making night observations. The theodolite is used to follow and measure the movement of a pilot balloon as it rises through the atmosphere and is carried horizontally by the air flow. Readings of the azimuth and elevation of the balloon are taken at regular intervals to determine the speed and direction of the wind at various levels. Theodolite ML-247 is usually mounted on Tripod ML-78-(*); for fixed installation, it may be mounted on Theodolite Mount ML-180; the tripod and mount are not included with the equipment.

Note. Theodolite ML-247 is identical to Theodolite ML-47-R.

TECHNICAL CHARACTERISTICS

TELESCOPE (main)

TYPE: Right-angle, with prism.
POWER: Approximately 20 diameters.
FIELD: Approximately 2°.

EYEPIECE: Inverting, adjustable, with cross hairs.
FOCUS: Adjustable.
TELESCOPE (auxiliary):
POWER: Approximately 4 diameters (in combination with eyepiece of main telescope).
FIELD: Approximately 10°.

SCALES

ELEVATION: Graduated in whole degrees, vernier reading to .1°.
AZIMUTH: Graduated in whole degrees, vernier reading to .1°; range, 360°.
SIGHTS: Fixed, for sighting vertical angles up to 45°; extension, for sighting vertical angles up to 85°.

ILLUMINATION: 3 incandescent lamp assemblies; current supplied by 2 Batteries BA-30.

ACCESSORY EQUIPMENT: Tripod ML-78-(*).
Theodolite Mount ML-180.

PRINCIPAL COMPONENTS

Theodolite ML-47-(*), (any model except ML-47-R)
Compass ML-197
Telescope ML-146

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb).....	41.2	85.9
Total volume (cu ft).....	1.8	3.9

ML-277

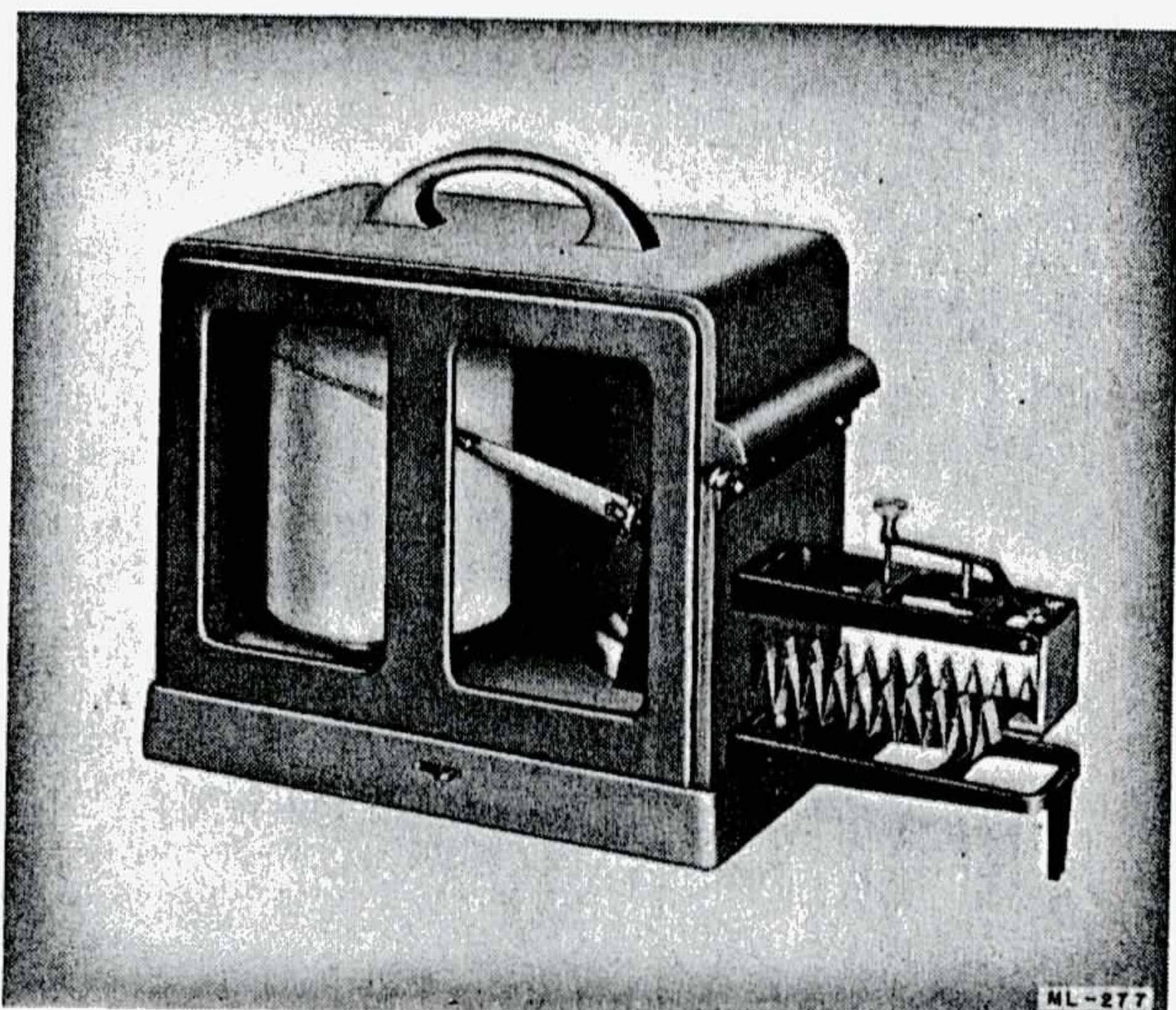


Figure 49. Thermograph ML-277.

Status: Standard. Stock No.: 7A1797. Reference: TM 11-426.

Thermograph ML-277 is a portable instrument which produces a record, continuous over a period of 1 day or 1 week, of temperatures within the range between -80° F. and $+50^{\circ}$ F. or between -50° F. and $+80^{\circ}$ F. Thermograph ML-277 is intended for arctic use; it is similar to Thermograph ML-77 which is designed for general use.

TECHNICAL CHARACTERISTICS

TEMPERATURE-SENSITIVE ELEMENT: Bimetallic strip, Invar and brass; early models have corrugated radiation fins.

RECORDING ELEMENT: Pen, actuated through a system of linkages.

CHART DRIVE: Clock ML-279; 8-day movement with 29-hour and 176-hour gear pinions (the daily gears normally are not used).

CHARTS (Weekly): Thermograph Chart ML-234, range -50° F. to $+80^{\circ}$ F.

Thermograph Chart ML-233, range -80° F. to $+50^{\circ}$ F.

CHART GRADUATIONS: Temperature: 1° F. divisions, labeled at 10° intervals; a reading to $.1^{\circ}$ F. can be taken. Time: 2-hour interval divisions.

CONTINUITY OF RECORD: 1 week or 1 day, depending on gears used.

RANGE OF RECORD: 130° F. (-80° F. to $+50^{\circ}$ F. or -50° F. to $+80^{\circ}$ F.).

ACCESSORY EQUIPMENT: Ink, low temperature (Sig C stock No. 7A1099). (Not furnished with ML-277.)

Oil, low temperature (Sig C stock No. 7A1977/01).

Thermograph Chart ML-234, -50° F. to $+80^{\circ}$ F. (Sig C stock No. 7A5291-234).

Thermograph Chart ML-233, -80° F. to $+50^{\circ}$ F. (Sig C stock No. 7A5291-233).

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb)	10	18
Total volume (cu ft)	.36	1.2 (approx)

ML-307(*)/AP



Figure 50. Pilot Balloon Target ML-307/AP or ML-307A/AP ready for flight.

Status: Standard. Stock No.: 7A1237. Reference: TM 1-235.

Pilot Balloon Target ML-307(*)/AP represents Pilot Balloon Targets ML-307/AP; ML-307A/AP, and ML-307B/AP. Pilot Balloon Target ML-307(*)/AP is a reflector which is attached to a 100- or 350-gram pilot balloon to assist in tracking it by radar. It is composed of a combination of triangular-shaped surfaces constructed of light, paper-backed aluminum foil supported by balsa sticks; it weighs approximately 100 grams. The target folds into a flat triangle for shipment. Pilot Balloon Target ML-307(*)/AP is designed to function best with Radio Sets SCR-584 (any model), SCR-545 (tracking components), and SCR-614 (any model). The targets are packed 24 to a shipping container.

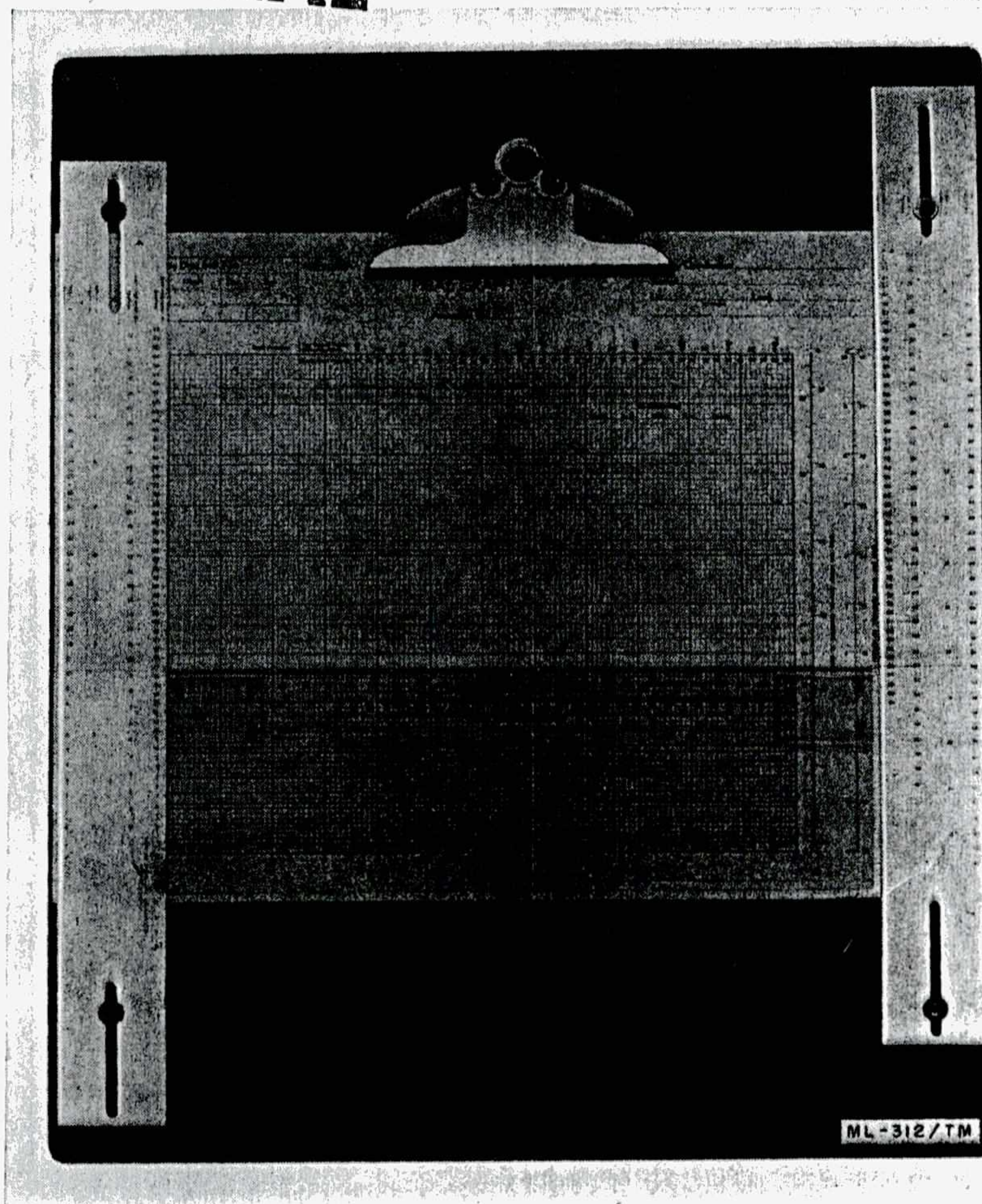


Figure 51. Graphing Board ML-312/TM.

Status: Standard. Stock No.: 7A979-312. Reference: TM 11-2429.

Graphing Board ML-312/TM is meteorological plotting equipment designed specifically for plotting wind-direction and wind-speed curves directly on Winds Aloft Graph, SC Form 426A (Sig C stock No. 6D426A), which is prepared from winds aloft observations, or on Form WBAM-20A. The

graphing board has provisions for securing the graph in the proper position and includes scales for plotting data obtained by rawin or by 30- or 100-gram balloon pibal observations. Velocities of winds at standard levels readily can be obtained from the wind-direction and wind-speed curves of a completed graph.

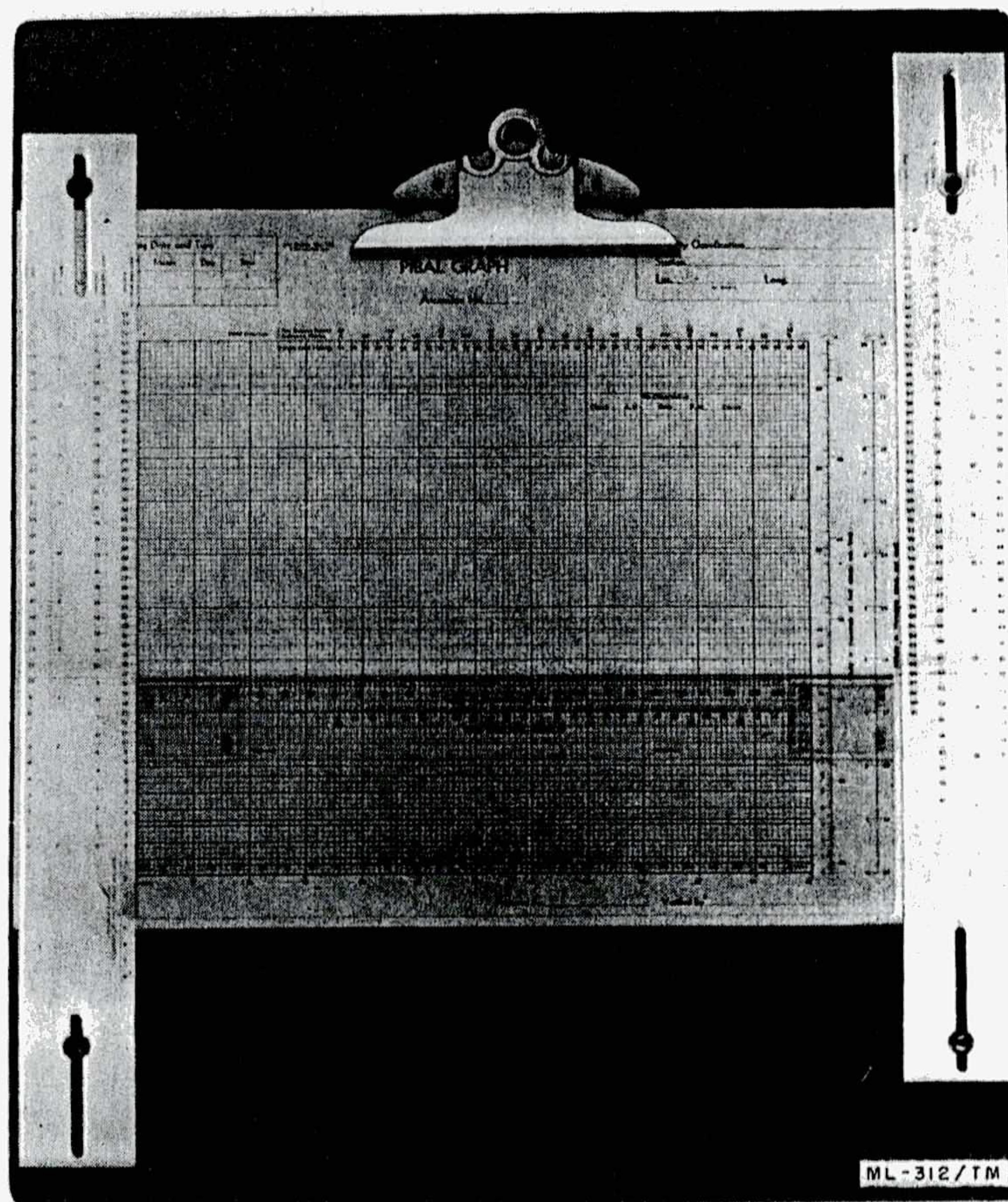


Figure 51. Graphing Board ML-312/TM.

Status: Standard. Stock No.: 7A979-312. Reference: TM 11-2429.

Graphing Board ML-312/TM is meteorological plotting equipment designed specifically for plotting wind-direction and wind-speed curves directly on Winds Aloft Graph, SC Form 426A (Sig C stock No. 6D426A), which is prepared from winds aloft observations, or on Form WBAM-20A. The

graphing board has provisions for securing the graph in the proper position and includes scales for plotting data obtained by rawin or by 30- or 100-gram balloon pibal observations. Velocities of winds at standard levels readily can be obtained from the wind-direction and wind-speed curves of a completed graph.

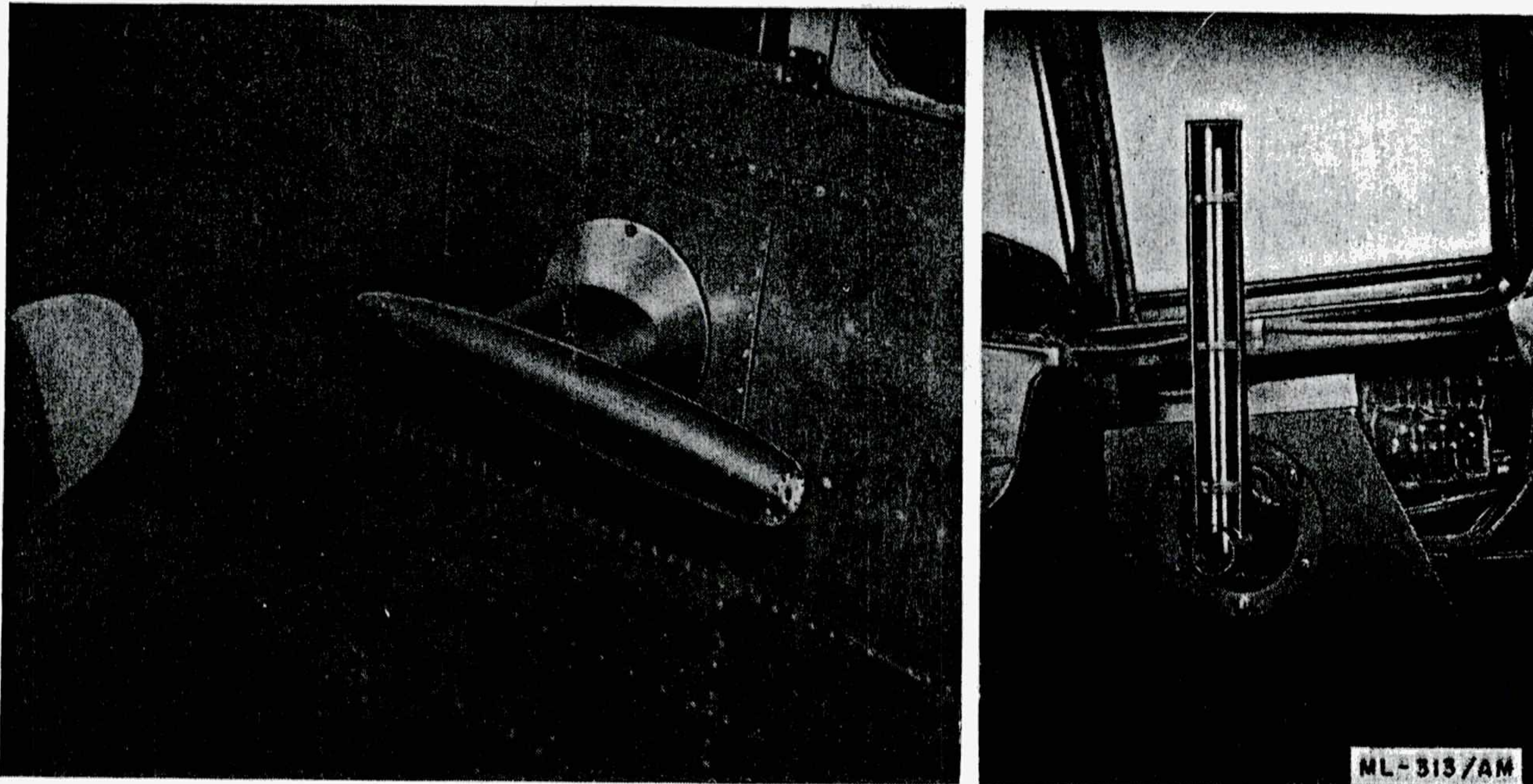


Figure 52. Psychrometer Equipment ML-313/AM, components.

Status: Standard. Stock No. 7A1322-313. Reference: TM 11-2415.

Psychrometer Equipment ML-313/AM is designed for installation on aircraft. A ventilator mounted on the fuselage holds a psychrometer support so that the two thermometer bulbs (a wet and a dry) are exposed in the air stream and the thermometer scales are inside the cabin where they can be read easily. Calculating devices are provided as part of the equipment to simplify the evaluation of the observed data. The relative humidity, dew point, vapor pressure, and temperature of the atmosphere at the level of flight can be determined from the thermometer readings. The data thus obtained are used as standards to calibrate aerographs or other airborne humidity and temperature measuring devices.

TECHNICAL CHARACTERISTICS

THERMOMETERS

TYPE: Right-angle; mercury-in-glass; wet-bulb and dry-bulb.

RANGES: From -35° C to $+15^{\circ}$ C; from $-.2^{\circ}$ C

to $+50^{\circ}$ C (thermometers are provided in two ranges).

ACCURACY: $\pm .1^{\circ}$ C.

SCALES: Centigrade, graduated in intervals of $.1^{\circ}$.

SUPPORT: Aluminum; lucite retainers and clamps; wire thermometer guards; bayonet-clutch type attachment to ventilator.

VENTILATOR: Aluminum; streamlined; double, conical air passage.

PRINCIPAL COMPONENTS

- 5 Thermometers, $-.2^{\circ}$ C to $+50^{\circ}$ C (3 spares) (Sig C stock No. 7A1322-313/T1).
- 5 Thermometers, -35° C to $+15^{\circ}$ C (3 spares) (Sig C stock No. 7A1322-313/T2).
- 2 Supports
- 1 Ventilator
- 1 Carrying case
- 1 Air Speed Calculator ML-324/UM
- 1 Pressure Calculator ML-323/UM
- 1 Psychrometer Calculator ML-322/UM
- 1 Case CY-295/UM (not supplied with all equipments)

WEIGHT AND VOLUME

Total weight (lb)	72
Total volume (cu ft)	6.5

Domestic packed

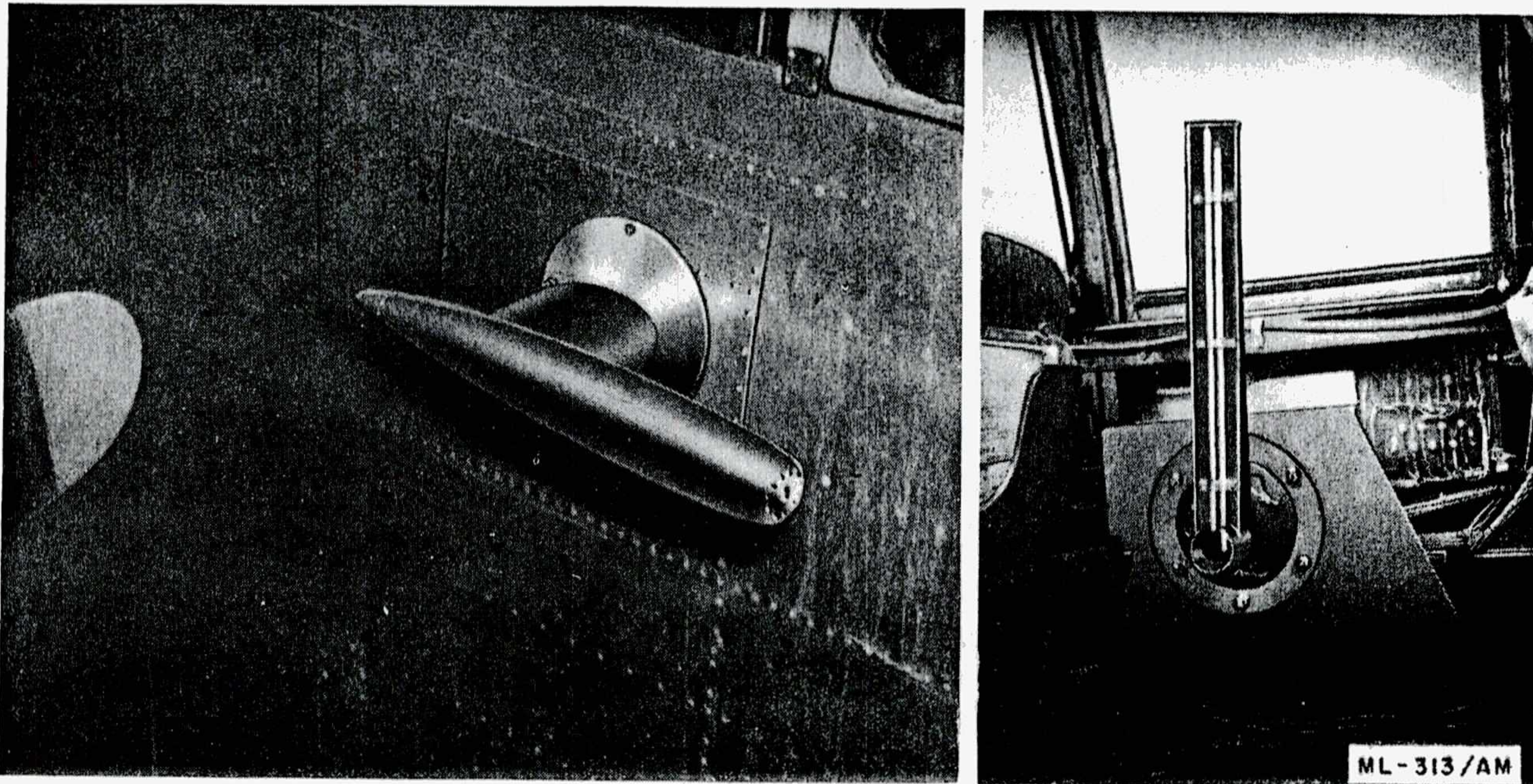


Figure 52. Psychrometer Equipment ML-313/AM, components.

Status: Standard. Stock No. 7A1322-313. Reference: TM 11-2415.

Psychrometer Equipment ML-313/AM is designed for installation on aircraft. A ventilator mounted on the fuselage holds a psychrometer support so that the two thermometer bulbs (a wet and a dry) are exposed in the air stream and the thermometer scales are inside the cabin where they can be read easily. Calculating devices are provided as part of the equipment to simplify the evaluation of the observed data. The relative humidity, dew point, vapor pressure, and temperature of the atmosphere at the level of flight can be determined from the thermometer readings. The data thus obtained are used as standards to calibrate aerographs or other airborne humidity and temperature measuring devices.

TECHNICAL CHARACTERISTICS

THERMOMETERS

TYPE: Right-angle; mercury-in-glass; wet-bulb and dry-bulb.

RANGES: From -35° C to $+15^{\circ}$ C; from -0.2° C

to $+50^{\circ}$ C (thermometers are provided in two ranges).

ACCURACY: $\pm 0.1^{\circ}$ C.

SCALES: Centigrade, graduated in intervals of $.1^{\circ}$.

SUPPORT: Aluminum; lucite retainers and clamps; wire thermometer guards; bayonet-clutch type attachment to ventilator.

VENTILATOR: Aluminum; streamlined; double, conical air passage.

PRINCIPAL COMPONENTS

- 5 Thermometers, -0.2° C to $+50^{\circ}$ C (3 spares) (Sig C stock No. 7A1322-313/T1).
- 5 Thermometers, -35° C to $+15^{\circ}$ C (3 spares) (Sig C stock No. 7A1322-313/T2).
- 2 Supports
- 1 Ventilator
- 1 Carrying case
- 1 Air Speed Calculator ML-324/UM
- 1 Pressure Calculator ML-323/UM
- 1 Psychrometer Calculator ML-322/UM
- 1 Case CY-295/UM (not supplied with all equipments)

WEIGHT AND VOLUME

Total weight (lb)

Total volume (cu ft)

Domestic
packed

72

6.5

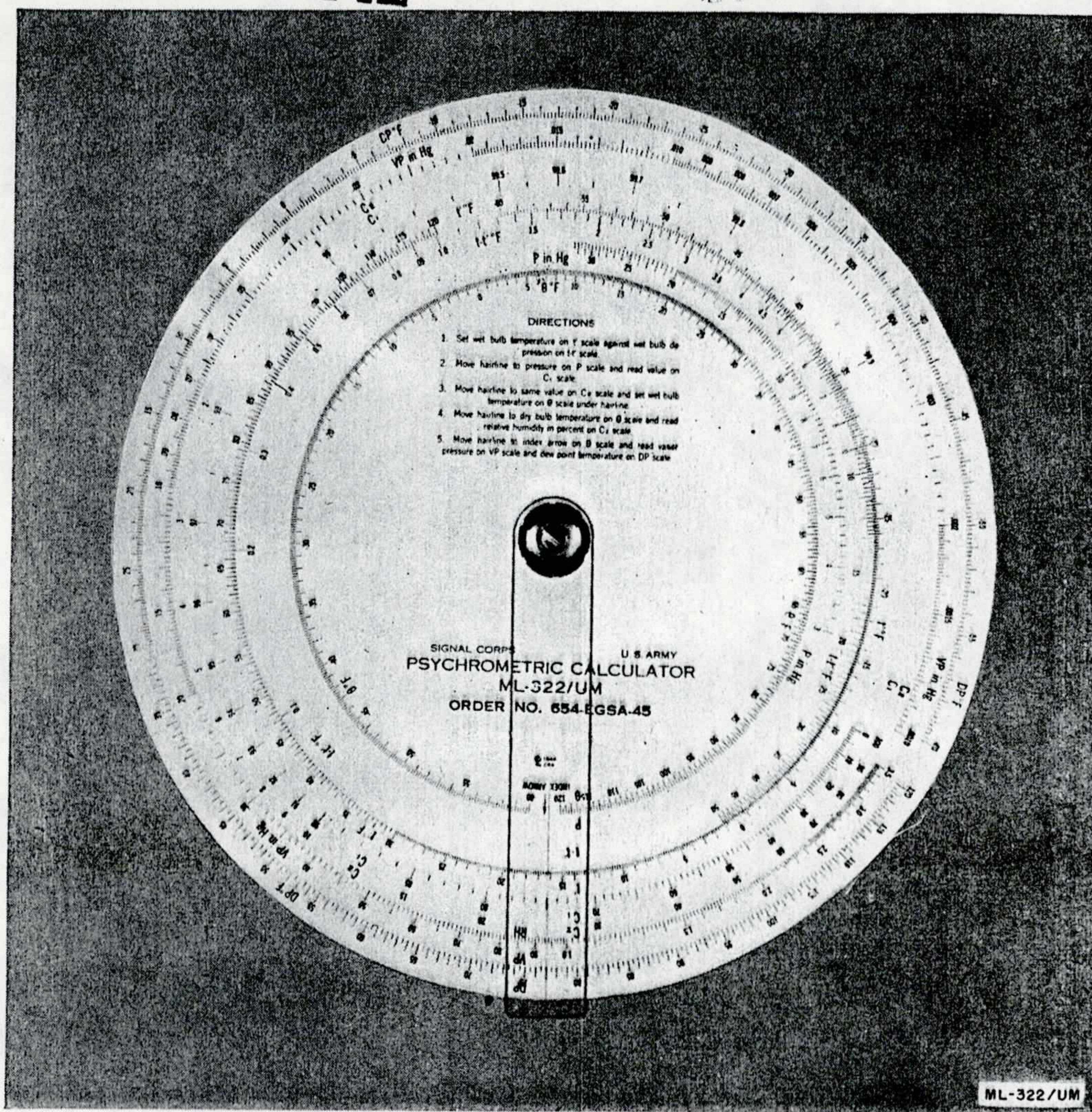


Figure 53. Psychrometric Calculator ML-322/UM, front.

Status: Standard. Stock No.: 7A5895-322. Reference: TM 11-2422.

Psychrometric Calculator ML-322/UM is a special, circular slide rule which eliminates most of the mathematics usually involved in using psychrometric tables or applying psychrometric formulas. It is used primarily to compute relative humidity, dew point, and vapor pressure from observed dry- and wet-bulb thermometer readings and atmospheric pressure readings. It is used, also, with airborne humidity-measuring devices to correct the indicated values of relative humidity for the dynamic effects of air speed. The calculator may be used for centigrade—Fahrenheit conversions, for millibar—inches or millibar—millimeters of mercury conversions, and for ordinary multiplication and division. Directions for its use are printed on the calculator. Psychrometric

Calculator ML-322/UM is a component of Aero-graph Equipments AN/AMQ-2(*) and AN/AMQ-3 and of Psychrometric Equipment ML-313/AM.

TECHNICAL CHARACTERISTICS

RANGES: Temperature in degrees F., -60° to +120°.
 Pressure in in. of mercury, 3.0 to 32.5.
 Temperature in degrees C, -40° to +50°.
 Pressure in mb, 100 to 1,000.

READINGS: Temperature scales can be read to .1°.
 Pressure scales can be read to .1 in. Hg and to nearest 5 mb.
 Vapor pressure scales can be read to 3 significant figures in both in. Hg and mb.
 Relative humidity can be read to nearest whole percent; fractions of a percent can be estimated.

ACCURACY: Relative humidity, ± 1 percent.
 Dew point, ± .2 percent.
 Vapor pressure, ± 5 in third significant figure.

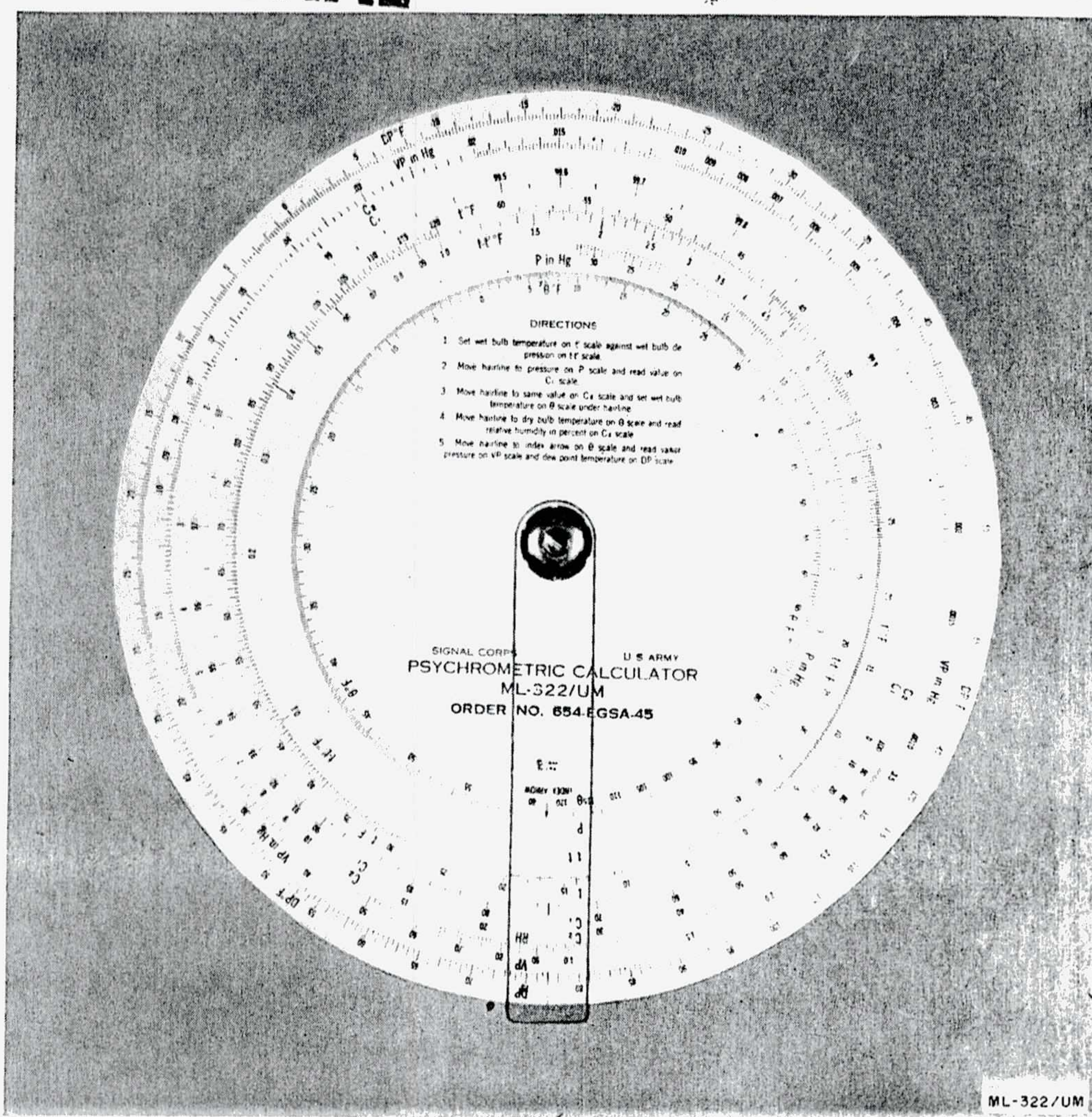


Figure 53. Psychrometric Calculator ML-322/UM, front.

Status: Standard. Stock No.: 7A5895-322. Reference: TM 11-2422.

Psychrometric Calculator ML-322/UM is a special, circular slide rule which eliminates most of the mathematics usually involved in using psychrometric tables or applying psychrometric formulas. It is used primarily to compute relative humidity, dew point, and vapor pressure from observed dry- and wet-bulb thermometer readings and atmospheric pressure readings. It is used, also, with airborne humidity-measuring devices to correct the indicated values of relative humidity for the dynamic effects of air speed. The calculator may be used for centigrade—Fahrenheit conversions, for millibar—inches or millibar—millimeters of mercury conversions, and for ordinary multiplication and division. Directions for its use are printed on the calculator. Psychrometric

Calculator ML-322/UM is a component of Aero-graph Equipments AN/AMQ-2(*) and AN/AMQ-3 and of Psychrometric Equipment ML-313/AM.

TECHNICAL CHARACTERISTICS

- RANGES: Temperature in degrees F., -60° to +120°.
 Pressure in in. of mercury, 3.0 to 32.5.
 Temperature in degrees C, -40° to +50°.
 Pressure in mb, 100 to 1,000.
- READINGS: Temperature scales can be read to .1°.
 Pressure scales can be read to .1 in. Hg and to nearest 5 mb.
 Vapor pressure scales can be read to 3 significant figures in both in. Hg and mb.
 Relative humidity can be read to nearest whole percent; fractions of a percent can be estimated.
- ACCURACY: Relative humidity, ±1 percent.
 Dew point, ±.2 percent.
 Vapor pressure, ±5 in third significant figure.

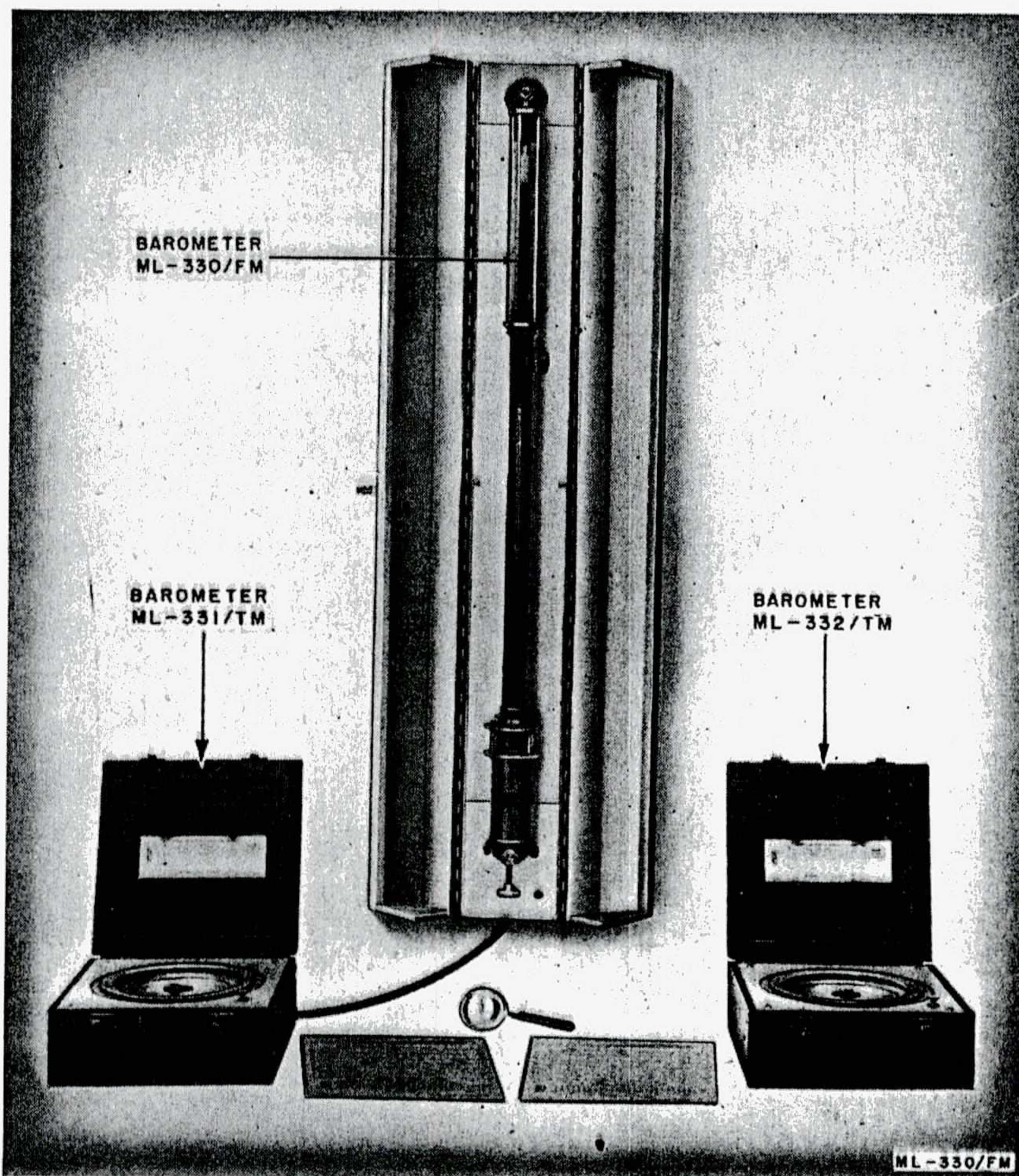


Figure 54. Set of barometers (ML-330/FM, ML-331/TM, and ML-332/TM) for use in weather squadron headquarters.

Status: Standard. Stock No.: 7A317-330. Reference: TM 11-2421.

Barometer ML-330/FM is a mercurial barometer of laboratory precision which is individually calibrated by comparison with the United States Army primary-standard barometers at Evans Signal Laboratory. It is available in two ranges, one for general use and one for use in high altitudes. It is mounted in a metal case which is equipped with fluorescent lights that illuminate the upper part of the glass tube and the cistern of the barometer; a thermometer is attached to the casing. A special carrying case for transporting the barometer is provided. Barometers ML-331/TM, ML-332/TM, and ML-333/TM, precision aneroid barometers which have different ranges, are used

Actual scale range	
1.	23.5 to 32.8 in. Hg (9.3 in.). 800 to 1,110 mb (310 mb).
2.	21.2 to 32.8 in. Hg (11.6 in.). 717 to 1,110 mb (393 mb).

in conjunction with Barometer ML-330/FM. Three barometers, one Barometer ML-330/FM and a pair of these aneroid barometers (in any combination of ranges), comprise a set of standard reference barometers; a set is used in each weather squadron headquarters of the Air Weather Service. Barometer ML-330/FM is installed permanently in the weather squadron headquarters as the standard for the region; the pair of aneroid barometers is used in the field to check station barometers.

TECHNICAL CHARACTERISTICS

TYPE: Mercury, Fortin-type (adjustable cistern).
RANGE OF SCALES (Barometer ML-330/FM is issued in one of two scale ranges):

Effective scale range	
1.	23.7 to 31.3 in. Hg (7.6 in.). 805 to 1,060 mb (225 mb).
2.	21.5 to 31.3 in. Hg (9.8 in.). 725 to 1,060 mb (335 mb).

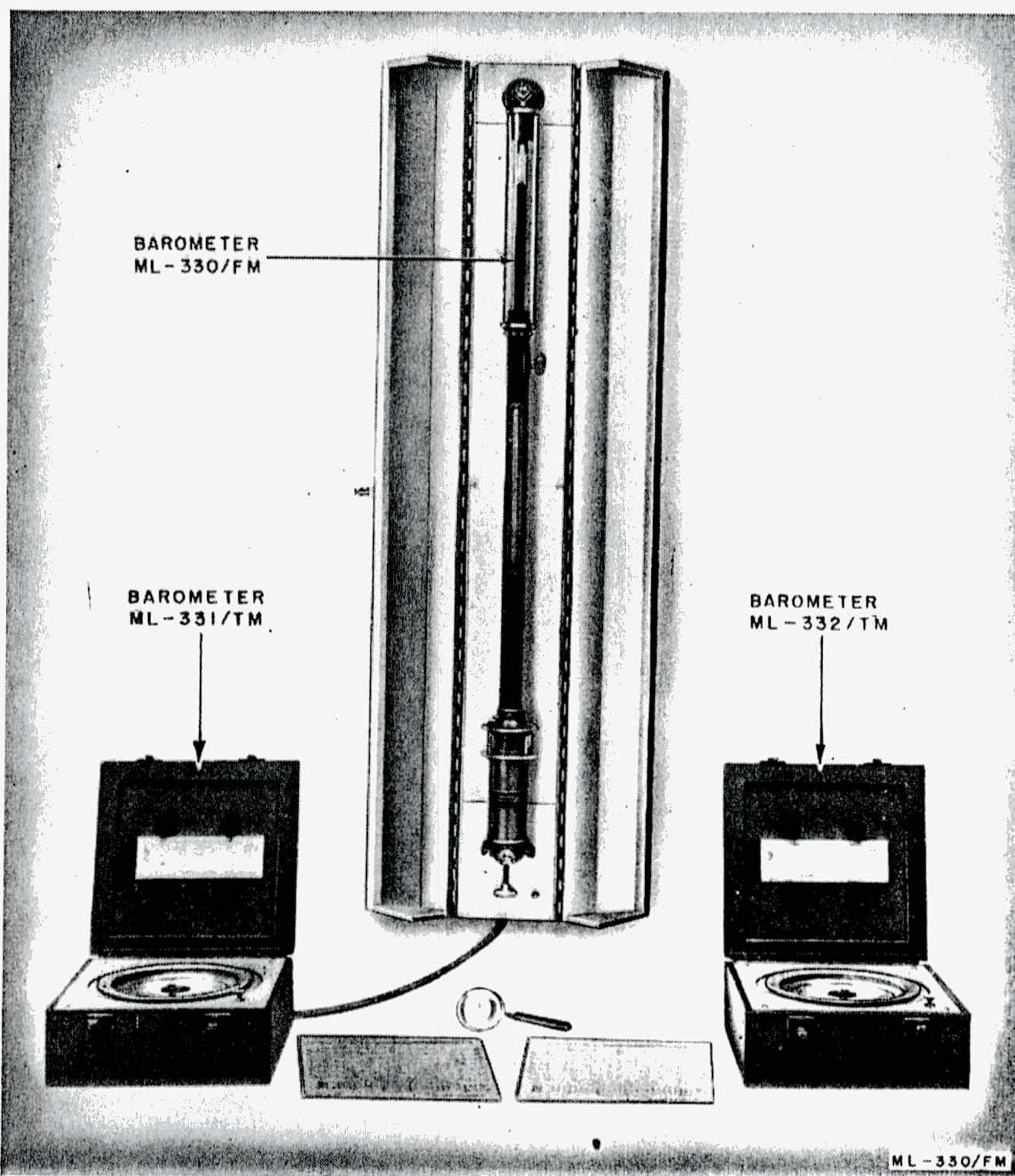


Figure 54. Set of barometers (ML-330/FM, ML-331/TM, and ML-332/TM) for use in weather squadron headquarters.

Status: Standard. Stock No.: 7A317-330. Reference: TM 11-2421.

Barometer ML-330/FM is a mercurial barometer of laboratory precision which is individually calibrated by comparison with the United States Army primary-standard barometers at Evans Signal Laboratory. It is available in two ranges, one for general use and one for use in high altitudes. It is mounted in a metal case which is equipped with fluorescent lights that illuminate the upper part of the glass tube and the cistern of the barometer; a thermometer is attached to the casing. A special carrying case for transporting the barometer is provided. Barometers ML-331/TM, ML-332/TM, and ML-333/TM, precision aneroid barometers which have different ranges, are used

in conjunction with Barometer ML-330/FM. Three barometers, one Barometer ML-330/FM and a pair of these aneroid barometers (in any combination of ranges), comprise a set of standard reference barometers; a set is used in each weather squadron headquarters of the Air Weather Service. Barometer ML-330/FM is installed permanently in the weather squadron headquarters as the standard for the region; the pair of aneroid barometers is used in the field to check station barometers.

TECHNICAL CHARACTERISTICS

TYPE: Mercury, Fortin-type (adjustable cistern).
 RANGE OF SCALES (Barometer ML-330/FM is issued in one of two scale ranges):

- Actual scale range*
1. { 23.5 to 32.8 in. Hg (9.3 in.).
 { 800 to 1,110 mb (310 mb).
 2. { 21.2 to 32.8 in. Hg (11.6 in.).
 { 717 to 1,110 mb (393 mb).

- Effective scale range*
- 23.7 to 31.3 in. Hg (7.6 in.).
 805 to 1,060 mb (225 mb).
 - 21.5 to 31.3 in. Hg (9.8 in.).
 725 to 1,060 mb (335 mb).

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

ML-331/TM

INCH SCALE: Graduated in twentieths of an inch; each integral inch is numbered.

MILLIBAR SCALE: Graduated in whole millibars; 100-millibar intervals have complete numerical designation, intervening 10-millibar intervals are numbered in units of 10.

INCH VERNIER: Permits reading to .002 ($\frac{1}{500}$) in.

MILLIBAR VERNIER: Permits reading to .05 ($\frac{1}{20}$) mb.

THERMOMETER: Fahrenheit range -30° to $+130^{\circ}$; scale graduated in $\frac{1}{2}^{\circ}$ F intervals.

ASSOCIATED EQUIPMENT: Barometer ML-331/TM.
Barometer ML-332/TM.
Barometer ML-333/TM.

WEIGHT AND VOLUME

Total weight (lb) packed for transportation (Barometer ML-330/FM must be hand carried)..... 40
Total volume (cu ft)..... 1.9

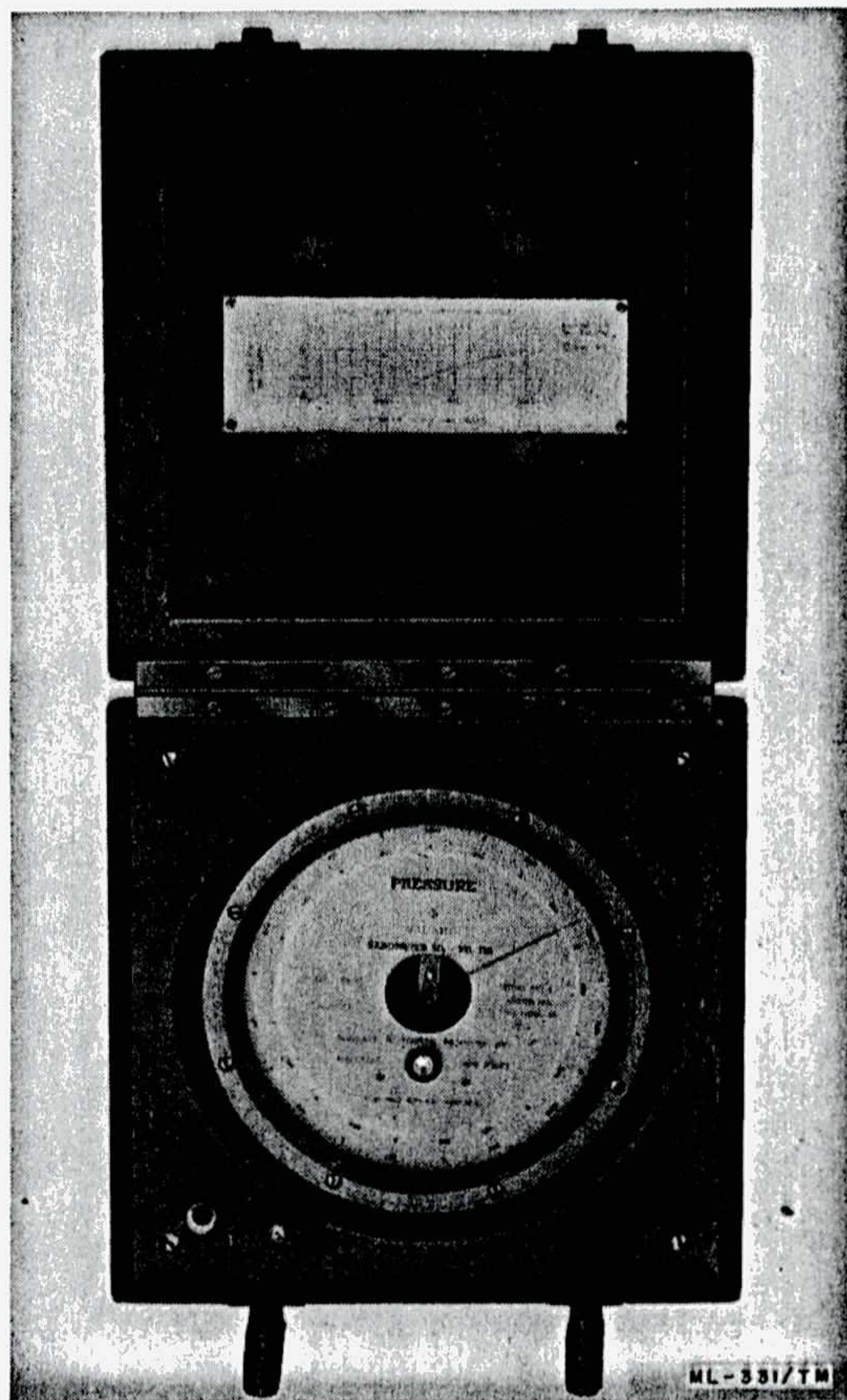


Figure 55. Barometer ML-331/TM.

Status: Standard. Stock No.: 7A316-331 (ML-331/TM), 7A316-332 (ML-332/TM), 7A316-333 (ML-333/TM). Reference: TM 11-2421.

Barometers ML-331/TM, ML-332/TM, and ML-333/TM are precision aneroid barometers identical except for their ranges and the maximum elevation at which they can be used. The aneroid mechanism, dial, and pointer of each are sealed in a metal case with a plate-glass cover. There are provisions for completely sealing this case from the outside air and for controlling the air pressure within the case when it is sealed.

The metal case is shock-mounted in a hardwood case; a padded, canvas carrying case is provided. A scale calibration chart, which represents the deviation of the instrument from the United States Army primary-standard barometers at Evans Signal Laboratory, is prepared at the laboratory for each individual instrument and supplied with it. Mercurial Barometer ML-330/FM is used in conjunction with Barometers ML-331/TM, ML-332/TM, and ML-333/TM. Three barometers, one Barometer ML-330/FM, and a pair of the aneroid barometers (in any combination of ranges), comprise a set of standard reference barometers; a set is used in each weather squadron headquarters of the Air Weather Service. Barometer ML-330/FM is installed permanently in the weather squadron headquarters as the standard for the region; the pair of aneroid barometers is used in the field to check station barometers.

TECHNICAL CHARACTERISTICS

TYPE: Aneroid; beryllium-copper, corrugated cell without spring.

RANGE:

Model	Extent of scale (mb)	Range (mb)	Approx max elevation at which instrument can be used (ft)
ML-331/TM.....	840 to 1,040.....	200	5,000
ML-332/TM.....	745 to 1,040.....	295	8,000
ML-333/TM.....	540 to 1,030.....	490	16,000

SCALE: Millibar only; graduated in half-millibars; full numerical designation every 10 millibars.

ASSOCIATED EQUIPMENT: Barometer ML-330/FM.

WEIGHT AND VOLUME

Total weight (lb) packed for transportation (Barometers ML-331/TM, ML-332/TM, and ML-333/TM must be hand-carried)..... 14
Total volume of this equipment (cu ft)..... .6

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

ML-331/TM

INCH SCALE: Graduated in twentieths of an inch; each integral inch is numbered.

MILLIBAR SCALE: Graduated in whole millibars; 100-millibar intervals have complete numerical designation, intervening 10-millibar intervals are numbered in units of 10.

INCH VERNIER: Permits reading to .002 ($\frac{1}{500}$) in.

MILLIBAR VERNIER: Permits reading to .05 ($\frac{1}{20}$) mb.

THERMOMETER: Fahrenheit range -30° to $+130^{\circ}$; scale graduated in $\frac{1}{2}^{\circ}$ F intervals.

range -30° to $+55^{\circ}$; scale graduated in $\frac{1}{2}^{\circ}$ F intervals.

ASSOCIATED EQUIPMENT: Barometer ML-331/TM.
Barometer ML-332/TM.
Barometer ML-333/TM.

WEIGHT AND VOLUME

Total weight (lb) packed for transportation (Barometer ML-330/FM must be hand carried) 40
Total volume (cu ft) 1.9

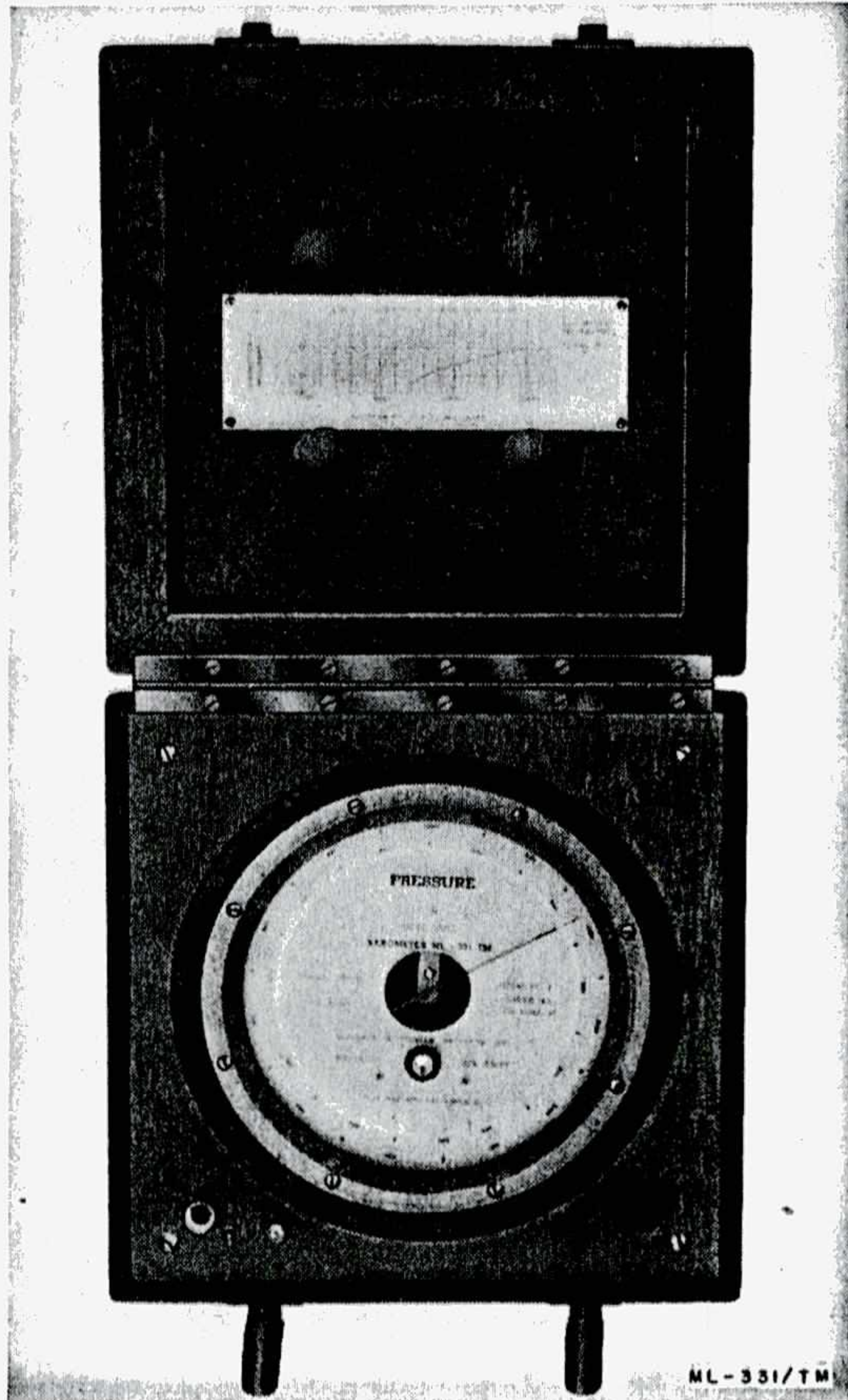


Figure 55. Barometer ML-331/TM.

Status: Standard. *Stock No.:* 7A316-331 (ML-331/TM), 7A316-332 (ML-332/TM), 7A316-333 (ML-333/TM). *Reference:* TM 11-2421.

Barometers ML-331/TM, ML-332/TM, and ML-333/TM are precision aneroid barometers identical except for their ranges and the maximum elevation at which they can be used. The aneroid mechanism, dial, and pointer of each are sealed in a metal case with a plate-glass cover. There are provisions for completely sealing this case from the outside air and for controlling the air pressure within the case when it is sealed.

The metal case is shock-mounted in a hardwood case; a padded, canvas carrying case is provided. A scale calibration chart, which represents the deviation of the instrument from the United States Army primary-standard barometers at Evans Signal Laboratory, is prepared at the laboratory for each individual instrument and supplied with it. Mercurial Barometer ML-330/FM is used in conjunction with Barometers ML-331/TM, ML-332/TM, and ML-333/TM. Three barometers, one Barometer ML-330/FM, and a pair of the aneroid barometers (in any combination of ranges), comprise a set of standard reference barometers; a set is used in each weather squadron headquarters of the Air Weather Service. Barometer ML-330/FM is installed permanently in the weather squadron headquarters as the standard for the region; the pair of aneroid barometers is used in the field to check station barometers.

TECHNICAL CHARACTERISTICS

TYPE: Aneroid; beryllium-copper, corrugated cell without spring.

RANGE:

Model	Extent of scale (mb)	Range (mb)	Approx max elevation at which instrument can be used (ft)
ML-331/TM	840 to 1,040	200	5,000
ML-332/TM	745 to 1,040	295	8,000
ML-333/TM	540 to 1,030	490	16,000

SCALE: Millibar only; graduated in half-millibars; full numerical designation every 10 millibars.

ASSOCIATED EQUIPMENT: Barometer ML-330/FM.

WEIGHT AND VOLUME

Total weight (lb) packed for transportation (Barometers ML-331/TM, ML-332/TM, and ML-333/TM must be hand-carried) 14
Total volume of this equipment (cu ft)6

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

ML-352/UM

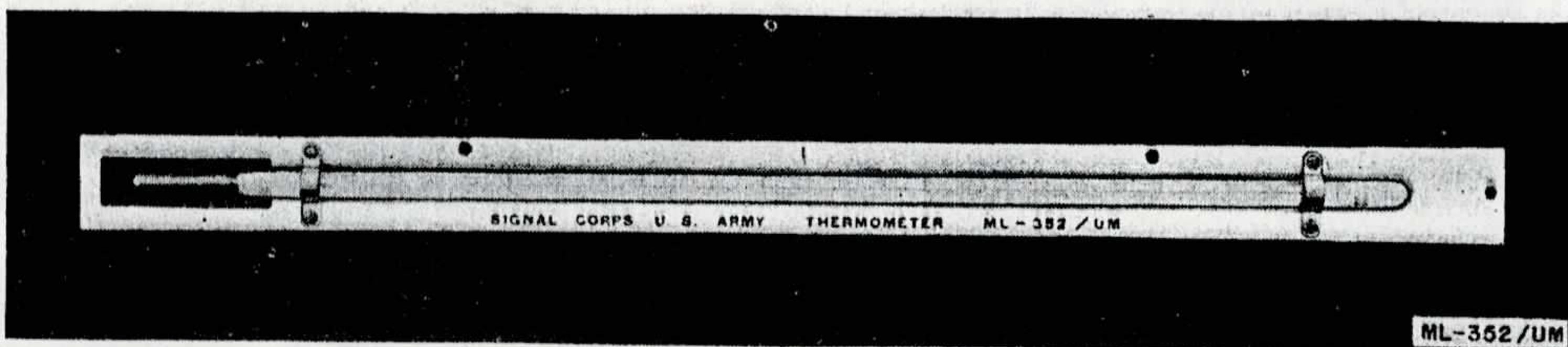


Figure 56. Thermometer ML-352/UM.

Status: Standard. Stock No.: 7A1814/352.

Thermometer ML-352/UM is a thallium amalgam-in-glass thermometer intended for arctic use. It has a range from -65° F. to $+35^{\circ}$ F.; a chamber in the top of the tube permits expansion of the thermal element in temperatures up to $+160^{\circ}$ F. without damage to the instrument.

TECHNICAL CHARACTERISTICS

- THERMAL ELEMENT: Thallium amalgam.
- SCALE: Range, -65° F. to $+35^{\circ}$ F.
Graduations, whole degrees and half degrees.
- ACCURACY: $\pm .3^{\circ}$ F.
- REPEATABILITY: $\pm .02^{\circ}$ F.
- READABILITY: $\pm .02^{\circ}$ F., throughout range.

ML-353/AM

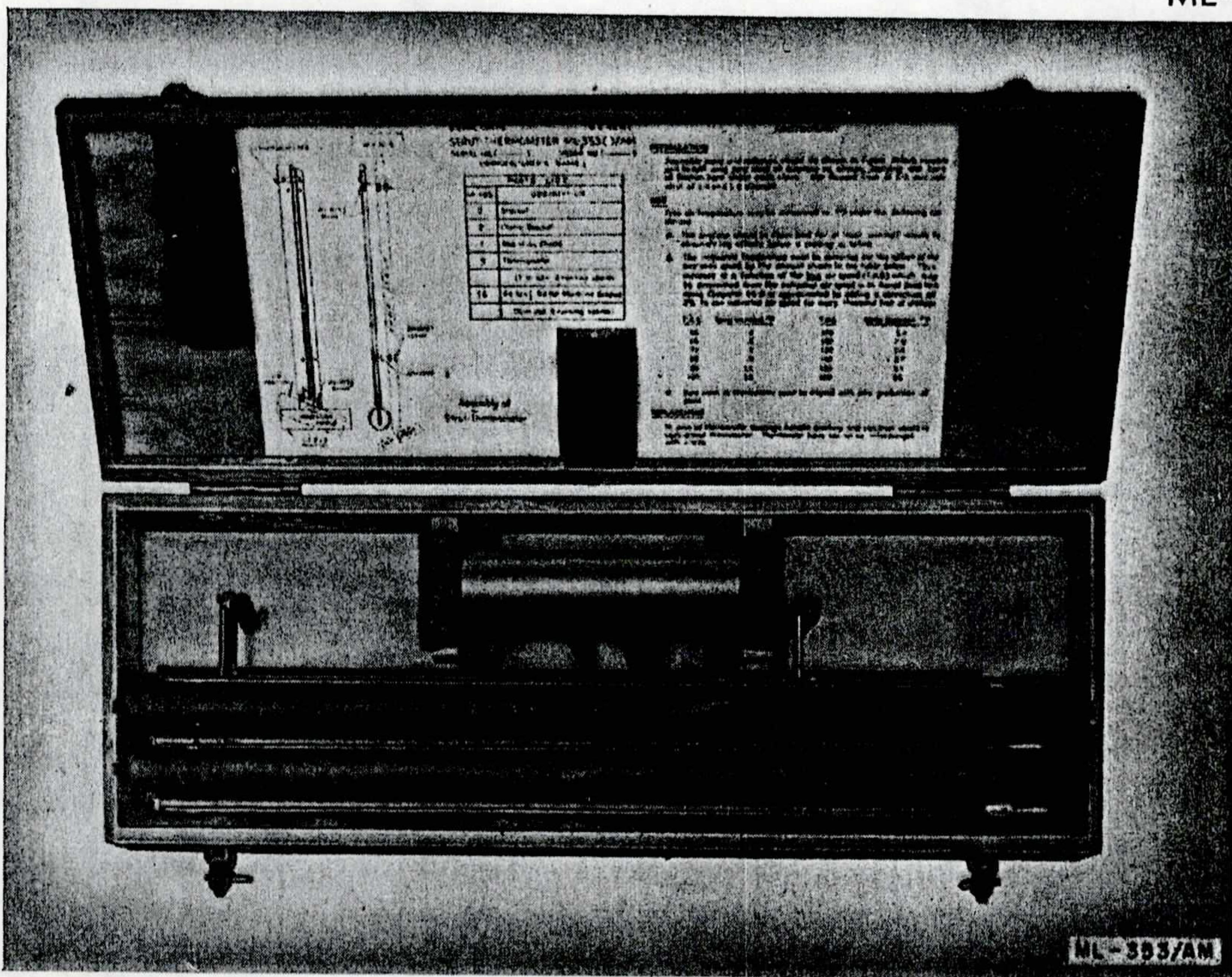


Figure 57. Strut Thermometer ML-353/AM, in carrying case.

Status: Standard. Stock No.: 7A1815-353.

Strut Thermometer ML-353/AM is a lens-type, liquid-in-glass thermometer with a radiation shield. It is mounted externally on L-2, L-4, or L-5 aircraft to measure the temperature of the free air. The range of the thermometer is between -40° F and $+120^{\circ}$ F. The equipment includes

two spare thermometers and a carrying case. Instructions for the installation and use of the thermometer are mounted in the lid of the case.

WEIGHT AND VOLUME

Total weight (lb).....	Unpacked
Total volume (cu ft).....	6 (approx)
	.38

ML-352/UM

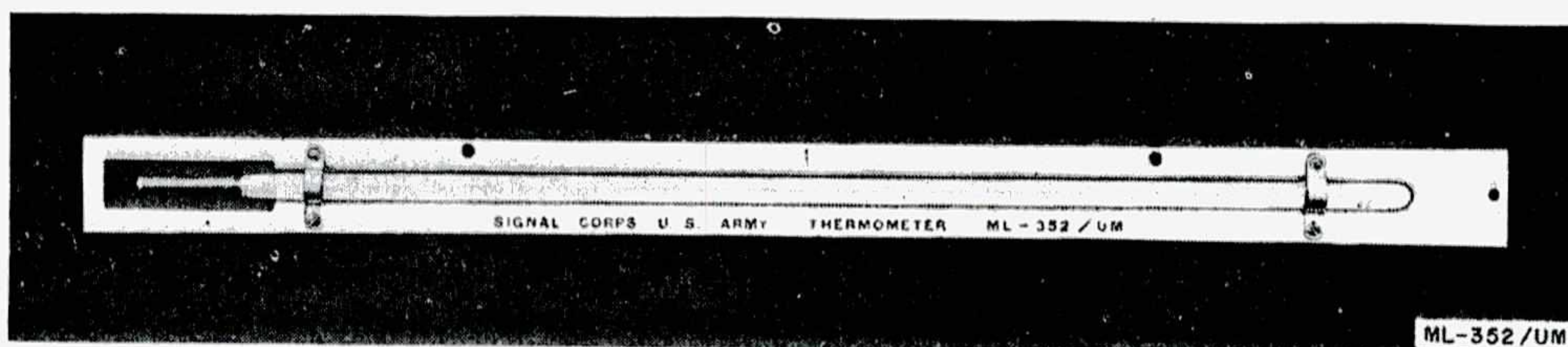


Figure 56. Thermometer ML-352/UM.

Status: Standard. Stock No.: 7A1814/352.

Thermometer ML-352/UM is a thallium amalgam-in-glass thermometer intended for arctic use. It has a range from -65° F. to $+35^{\circ}$ F.; a chamber in the top of the tube permits expansion of the thermal element in temperatures up to $+160^{\circ}$ F. without damage to the instrument.

TECHNICAL CHARACTERISTICS

THERMAL ELEMENT: Thallium amalgam.
 SCALE: Range, -65° F. to $+35^{\circ}$ F.
 Graduations, whole degrees and half degrees.
 ACCURACY: $\pm .3^{\circ}$ F.
 REPEATABILITY: $\pm .02^{\circ}$ F.
 READABILITY: $\pm .02^{\circ}$ F., throughout range.

ML-353/AM

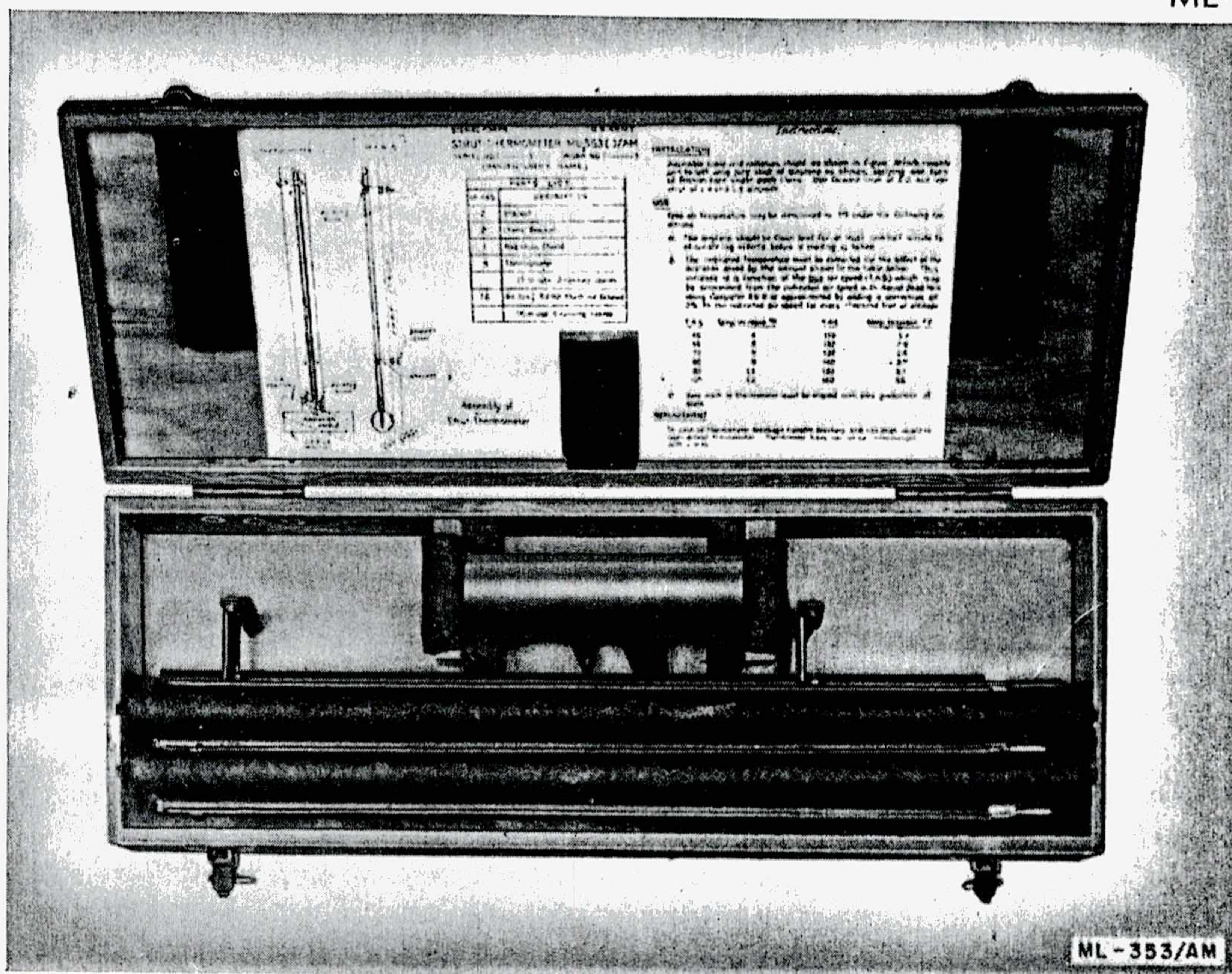


Figure 57. Strut Thermometer ML-353/AM, in carrying case.

Status: Standard. Stock No.: 7A1815-353.

Strut Thermometer ML-353/AM is a lens-type, liquid-in-glass thermometer with a radiation shield. It is mounted externally on L-2, L-4, or L-5 aircraft to measure the temperature of the free air. The range of the thermometer is between -40° F and $+120^{\circ}$ F. The equipment includes

two spare thermometers and a carrying case. Instructions for the installation and use of the thermometer are mounted in the lid of the case.

WEIGHT AND VOLUME

Total weight (lb)	Unpacked
Total volume (cu ft)	6 (approx)
	.38

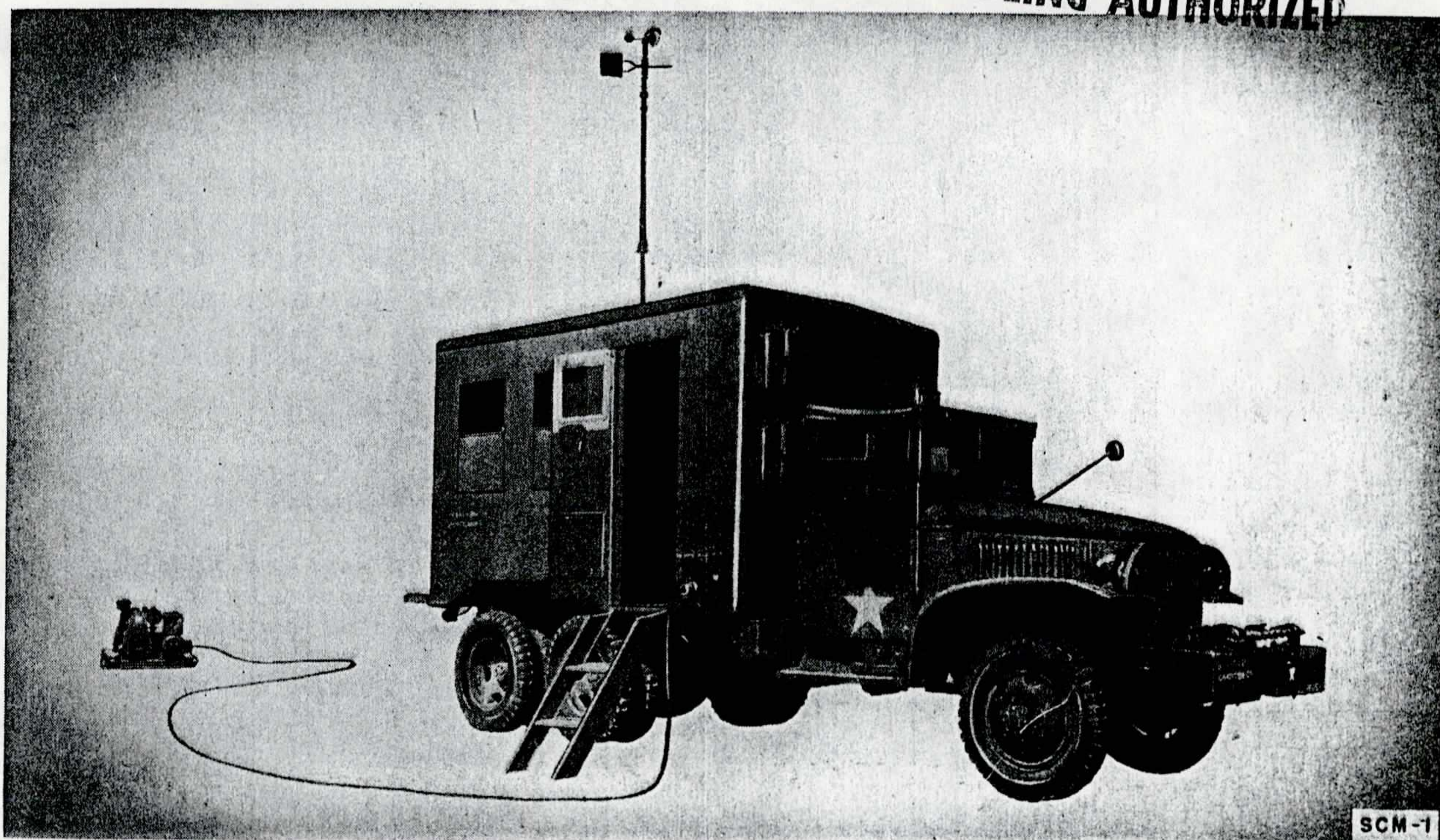


Figure 58. Mobile Meteorological Station SCM-1, in use.

Status: Standard. Stock No.: 7A1200-1A. Reference: TM 11-2409.

Mobile Meteorological Station SCM-1 is a complete weather station designed for making observations in the field. All the equipment is contained and transported in, or transported in or on, a van-type, 2½-ton, 6 by 6 truck (certain of the components must be removed from the truck and set up outside for operation). Meteorological data can be obtained on the direction and speed of surface winds and winds aloft, barometric pressure, air temperature, relative humidity, amount of precipitation, and ceiling height. Communication facilities, map-display equipment, and the necessary charts, tables, and supplies for preparing weather forecasts are included. Four cabinets, a storage chest, and a plotting table are built into the truck; there are provisions for the inclusion of teletypewriter and radiosonde equipment. The station may be operated from an ordinary, 110- to 115-volt, alternating-current power source or from an independent power unit that is supplied with the station.

PRINCIPAL COMPONENTS

Barograph ML-3, modified, and Mounting ML-178, modified.

Barometer ML-2, mounted in Case ML-48, modified.
 Barometer ML-102.
 Ceiling Light Projector ML-318/TMQ-2.
 Clinometer ML-119.
 Clock.
 Gauge ML-217 and Support ML-209.
 Pibal equipment, including meteorological balloons and associated equipment; Generator ML-185 and associated equipment; Inflation Shelter S-13/TM; and Plotting Board ML-122 with Rule ML-126 and Scale ML-177.
 Power Unit PE-75-().
 Psychrometer ML-24.
 Theodolite ML-247 and Tripod ML-78-(*).
 Timing and Telephone Set ML-110.
 Truck K-53.
 Wind indicating equipment, including Wind Transmitter ML-203-B, Wind Panel ML-204-B, and Support ML-206-B.

AUXILIARY EQUIPMENT

Note. Space and suitable mountings are provided in the truck for the following equipment which is not furnished with Mobile Meteorological Station SCM-1:

Radiosonde AN/AMT-1.
 Radiosonde Receptor AN/FMQ-1.
 Teletypewriter TG-7-B.

WEIGHT AND VOLUME

Total weight (lb).....	16,000
Total volume (cu ft).....	1,600
Ship tons.....	40



Figure 58. Mobile Meteorological Station SCM-1, in use.

Status: Standard. Stock No.: 7A1200-1A. Reference: TM 11-2409.

Mobile Meteorological Station SCM-1 is a complete weather station designed for making observations in the field. All the equipment is contained and transported in, or transported in or on, a van-type, 2½-ton, 6 by 6 truck (certain of the components must be removed from the truck and set up outside for operation). Meteorological data can be obtained on the direction and speed of surface winds and winds aloft, barometric pressure, air temperature, relative humidity, amount of precipitation, and ceiling height. Communication facilities, map-display equipment, and the necessary charts, tables, and supplies for preparing weather forecasts are included. Four cabinets, a storage chest, and a plotting table are built into the truck; there are provisions for the inclusion of teletypewriter and radiosonde equipment. The station may be operated from an ordinary, 110- to 115-volt, alternating-current power source or from an independent power unit that is supplied with the station.

PRINCIPAL COMPONENTS

Barograph ML-3, modified, and Mounting ML-178, modified.

- Barometer ML 2, mounted in Case ML-48, modified.
- Barometer ML 102.
- Ceiling Light Projector ML 318/TMQ 2.
- Clinometer ML 119.
- Clock.
- Gauge ML 217 and Support ML 209.
- Pibal equipment, including meteorological balloons and associated equipment; Generator ML 185 and associated equipment; Inflation Shelter S-13/TM; and Plotting Board ML-122 with Rule ML-126 and Scale ML-177.
- Power Unit PE-75 ().
- Psychrometer ML 21.
- Theodolite ML 247 and Tripod ML 78 (*).
- Timing and Telephone Set ML-110.
- Truck K-53.
- Wind indicating equipment, including Wind Transmitter ML 203-B, Wind Panel ML 204 B, and Support ML-206-B.

AUXILIARY EQUIPMENT

Note. Space and suitable mountings are provided in the truck for the following equipment which is not furnished with Mobile Meteorological Station SCM-1:

- Radiosonde AN/AMT-1.
- Radiosonde Receptor AN/FMQ-1.
- Teletypewriter TG-7-B.

WEIGHT AND VOLUME

Total weight (lb).....	16,000
Total volume (cu ft).....	1,600
Ship tons.....	40

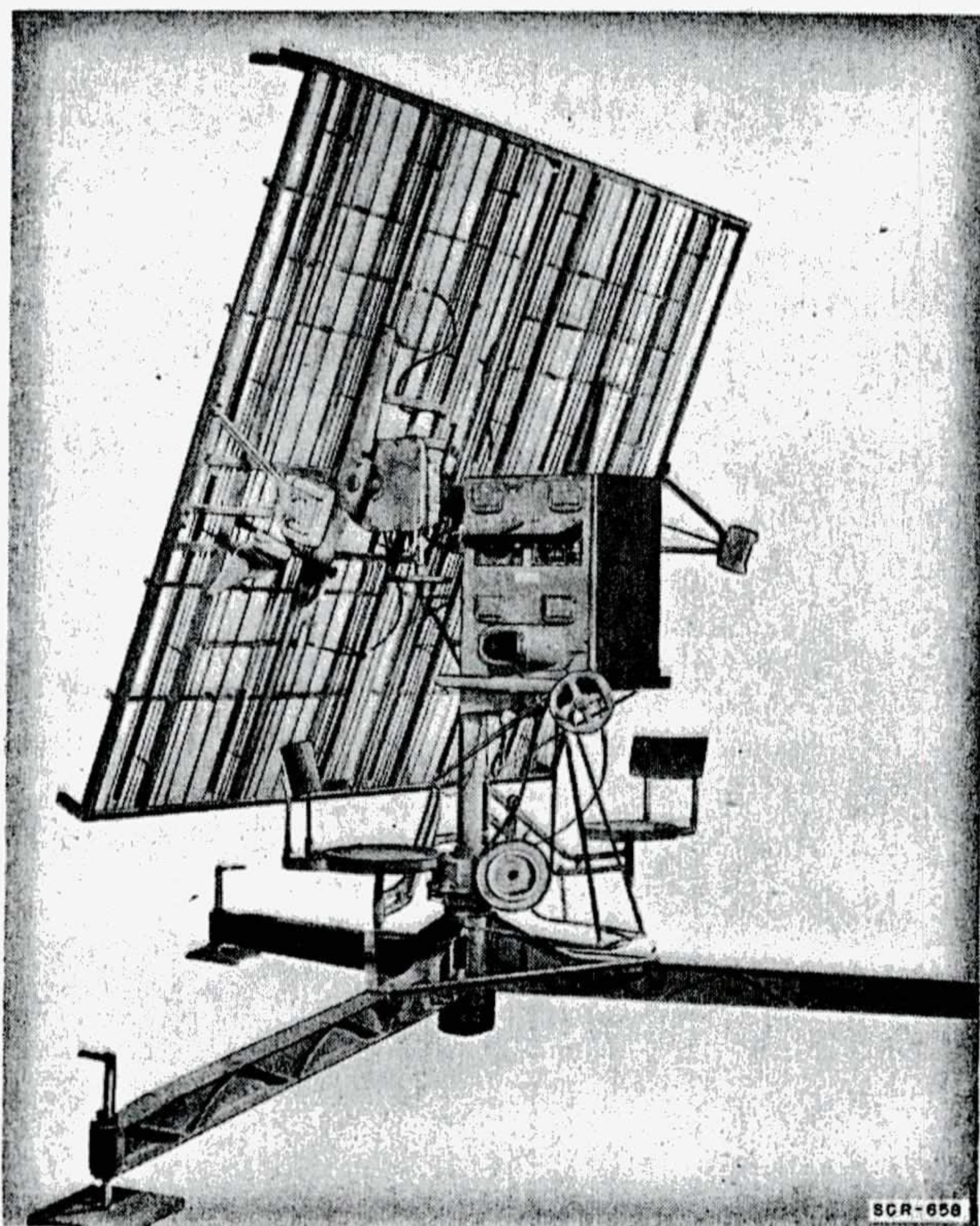


Figure 59. Radio Set SCR-658, less power unit.

Status: Standard. Stock No.: 7A1331-658. Reference: TM 11-1158A.

Radio Set SCR-658 is a transportable radio direction finder used to track balloon-borne radio transmitters. It is designed to operate as part of a meteorological system which determines direction and speed of winds aloft; used with a frequency-modulated radiosonde and the proper radiosonde recorder, the system also furnishes data concerning relative humidity, temperature, and atmospheric pressure at various altitudes. The information obtained is used by the United States Air Force to forecast weather conditions and to aid pilots and navigators; it is used by

ground artillery units to make corrections for the effect of atmospheric conditions on the trajectory of projectiles. The equipment consists principally of a directional receiving antenna with a lobe-switching assembly, a receiver-indicator with an oscilloscope indicator and a frequency-modulated radio receiving channel, and a power unit. Radio Set SCR-658 can be disassembled and transported on a 1-ton trailer or by airplane.

TECHNICAL CHARACTERISTICS

- SIGNALS RECEIVED: F-m and c-w.
- FREQUENCY RANGE: 400 to 406 mc; normal operating frequency, 403 mc.
- TYPE OF PRESENTATION: 4 vertical pips on oscilloscope screen; 2 indicate azimuth, 2 elevation.
- ANTENNA: Directional receiving; vertically polarized dipole array with screen reflector; consists of thirty-two 1/2-wavelength elements spaced 1/2 wavelength apart, arranged in 4 bays.
- ANTENNA SWITCH: Provides lobe switching for double-tracking in both azimuth and elevation; driven by synchronous-type, 1,800-rpm motor.
- POWER REQUIREMENT: 115-v or 230-v, 50- to 70-cyc ac.
- POWER CONSUMPTION: 245 w (approx).
- POWER SOURCE: PE-214-B or commercial.
- OPERATORS REQUIRED: 1 or 2.
- USED WITH: Radiosondes AN/AMT-2 and AN/AMT-2A.
Radiosonde Receptors AN/FMQ-1, AN/FMQ-1A, and AN/FMQ-2.

PRINCIPAL COMPONENTS

- 1 Antenna AN-159
- 1 Support FT-478
- 2 Antenna Switch Assembly SW-231 (1 spare)
- 2 Receiver Indicator BC-1364 (1 spare)
- 2 Power Unit PE-214-B (1 spare)
- 1 Shelter HO-29
- 1 Trailer Adapter Kit (Sig C stock No. 7A1331-658-K1)
- 8 Chests (for transporting equipment)

WEIGHTS

	Unpacked	Domestic Packed	Export Packed
Total weight (lb).....	1,000	2,129	5,511

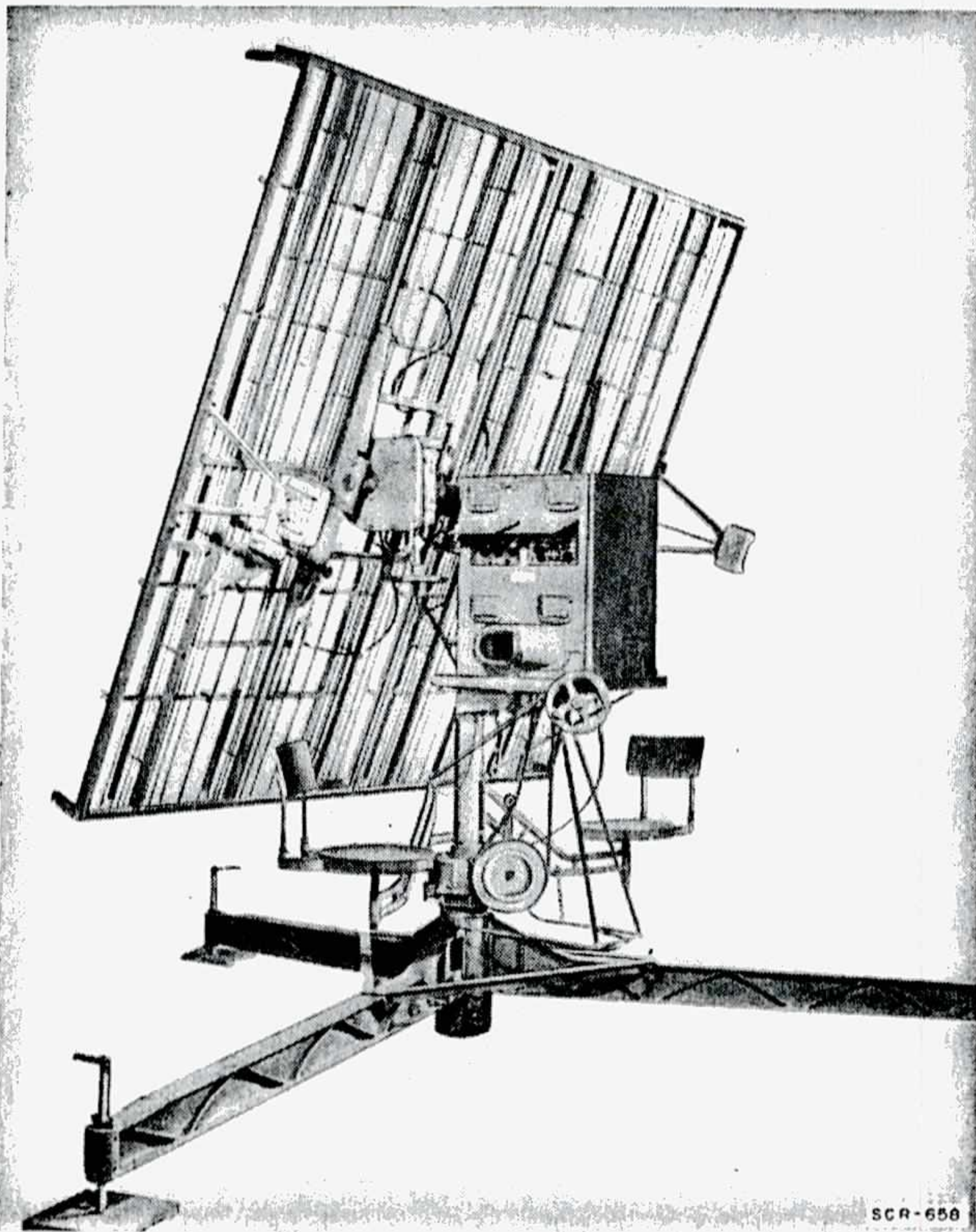


Figure 59. Radio Set SCR-658, less power unit.

Status: Standard. Stock No.: 7A1331-658. Reference: TM 11-1158A.

Radio Set SCR-658 is a transportable radio direction finder used to track balloon-borne radio transmitters. It is designed to operate as part of a meteorological system which determines direction and speed of winds aloft; used with a frequency-modulated radiosonde and the proper radiosonde recorder, the system also furnishes data concerning relative humidity, temperature, and atmospheric pressure at various altitudes. The information obtained is used by the United States Air Force to forecast weather conditions and to aid pilots and navigators; it is used by

ground artillery units to make corrections for the effect of atmospheric conditions on the trajectory of projectiles. The equipment consists principally of a directional receiving antenna with a lobe-switching assembly, a receiver-indicator with an oscilloscope indicator and a frequency-modulated radio receiving channel, and a power unit. Radio Set SCR-658 can be disassembled and transported on a 1-ton trailer or by airplane.

TECHNICAL CHARACTERISTICS

SIGNALS RECEIVED: F-m and e-w.

FREQUENCY RANGE: 400 to 406 mc; normal operating frequency, 403 mc.

TYPE OF PRESENTATION: 4 vertical pips on oscilloscope screen; 2 indicate azimuth, 2 elevation.

ANTENNA: Directional receiving; vertically polarized dipole array with screen reflector; consists of thirty-two $\frac{1}{2}$ -wavelength elements spaced $\frac{1}{2}$ wavelength apart, arranged in 4 bays.

ANTENNA SWITCH: Provides lobe switching for double-tracking in both azimuth and elevation; driven by synchronous-type, 1,800-rpm motor.

POWER REQUIREMENT: 115-v or 230-v, 50- to 70-cyc ac.

POWER CONSUMPTION: 245 w (approx).

POWER SOURCE: PE-214-B or commercial.

OPERATORS REQUIRED: 1 or 2.

USED WITH: Radiosondes AN/AMT-2 and AN/AMT-2A.

Radiosonde Receptors AN/FMQ-1, AN/FMQ-1A, and AN/FMQ-2.

PRINCIPAL COMPONENTS

- 1 Antenna AN-159
- 1 Support FT-478
- 2 Antenna Switch Assembly SW-231 (1 spare)
- 2 Receiver Indicator BC-1364 (1 spare)
- 2 Power Unit PE-214-B (1 spare)
- 1 Shelter HO-29
- 1 Trailer Adapter Kit (Sig C stock No. 7A1331-658-K1)
- 8 Chests (for transporting equipment)

WEIGHTS

	Unpacked	Domestic Packed	Export Packed
Total weight (lb)-----	1,000	2,129	5,511

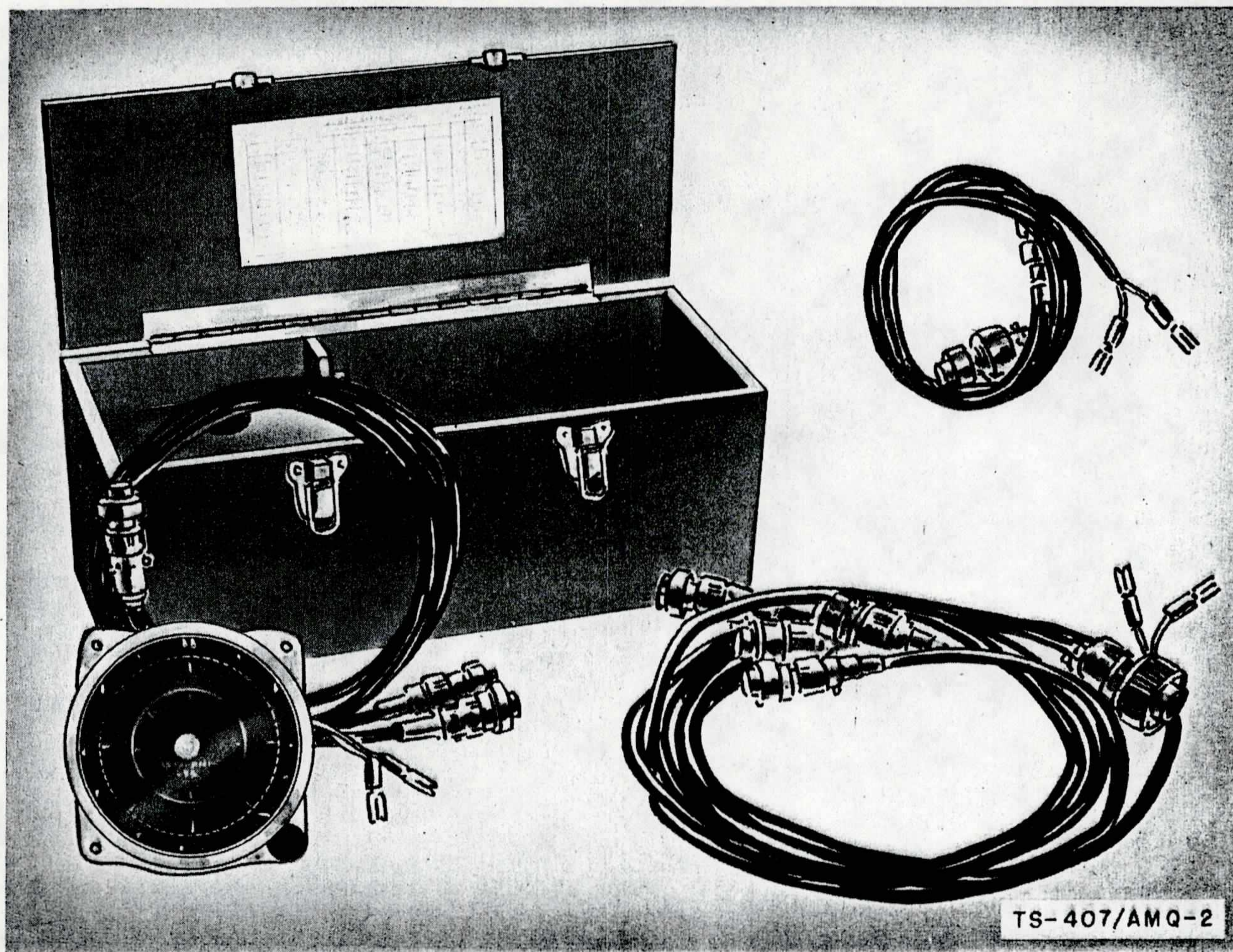


Figure 60. Aerograph Calibration Set TS-407/AMQ-2.

Status: Limited/Std. Stock No.: 7A8114-407.
Reference: TM 11-2428.

Aerograph Calibration Set TS-407/AMQ-2 is used exclusively to test and calibrate the self-synchronous transmitter, receiver, and indicator units of Aerograph Equipments AN/AMQ-2 and AN/AMQ-2A. The major component of the set is a master self-synchronous test unit which contains a self-synchronous motor with a pointer attached to the end of the rotor shaft. The pointer operates over a dial with five concentric scales, four calibrated for the various functions of the aerograph equipment, the fifth, a reference scale for the others. The unit may be used as a master transmitter or as a master indicator. Flexible cables for making electrical connections between the master self-synchronous unit and the instruments to be tested or calibrated are provided. The equipment is contained in a wooden carrying case.

Note. Aerograph Calibration Set TS-643/AMQ-2A (Sig C stock No. 7A8114-643) is identical to Aerograph Calibration Set TS-407/AMQ-2 except for the spacing of the temperature scale markings on the dial. It has the same characteristics and serves the same purposes.

TECHNICAL CHARACTERISTICS

FUNCTIONS

TESTS OR CALIBRATES: Temperature-Humidity Transmitter ML-317/AMQ-2 (both functions).
Pressure-Air Speed Transmitter ML-319/AMQ-2 (both functions).
Aerograph Recorder ML-320/AMQ-2.
Aerograph Recorder ML-320A/AMQ-2.
Temperature Indicator ML-271/AMQ-2.
Humidity Indicator ML-272/AMQ-2.

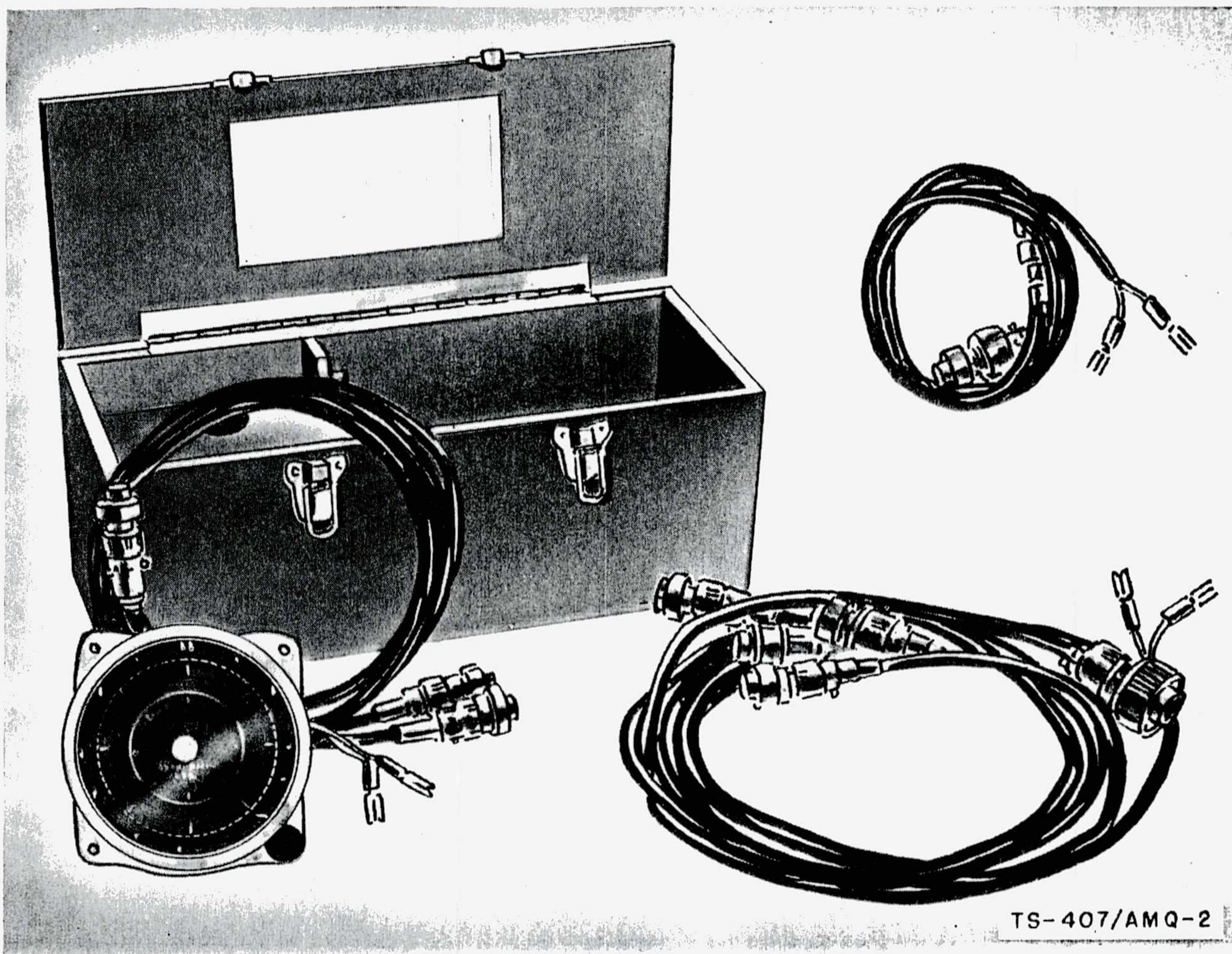


Figure 60. Aerograph Calibration Set TS-407/AMQ-2.

Status: Limited/Std. Stock No.: 7A8114-407.
Reference: TM 11-2428.

Aerograph Calibration Set TS-407/AMQ-2 is used exclusively to test and calibrate the self-synchronous transmitter, receiver, and indicator units of Aerograph Equipments AN/AMQ-2 and AN/AMQ-2A. The major component of the set is a master self-synchronous test unit which contains a self-synchronous motor with a pointer attached to the end of the rotor shaft. The pointer operates over a dial with five concentric scales, four calibrated for the various functions of the aerograph equipment, the fifth, a reference scale for the others. The unit may be used as a master transmitter or as a master indicator. Flexible cables for making electrical connections between the master self-synchronous unit and the instruments to be tested or calibrated are provided. The equipment is contained in a wooden carrying case.

Note. Aerograph Calibration Set TS-643/AMQ-2A (Sig C stock No. 7A8114-643) is identical to Aerograph Calibration Set TS-407/AMQ-2 except for the spacing of the temperature scale markings on the dial. It has the same characteristics and serves the same purposes.

TECHNICAL CHARACTERISTICS

FUNCTIONS

- TESTS OR CALIBRATES:
- Temperature-Humidity Transmitter MI-317/AMQ-2 (both functions).
 - Pressure-Air Speed Transmitter MI-319/AMQ-2 (both functions).
 - Aerograph Recorder MI-320/AMQ-2.
 - Aerograph Recorder MI-320A/AMQ-2.
 - Temperature Indicator MI-271/AMQ-2.
 - Humidity Indicator MI-272/AMQ-2.

CONFIDENTIAL MODIFIED HANDLING AUTHORIZED

SCALES

FIRST (outside scale): Graduated in degrees of a circle, from 0° to 360°, in 1° intervals; numerical designations at 20° intervals; used as a reference for all other scales.

SECOND: Graduated in millibars from 200 mb to 1060 mb, in 5 mb intervals; numerical designations at 100 mb intervals; used for atmospheric pressure indications.

THIRD: Graduated in degrees centigrade, from -70° to +50°, in 1° intervals numerical designations at 10° intervals; used for temperature indications.

FOURTH: Graduated in miles per hour from 70 mph to 300 mph, in 5 mph intervals; numerical designations at 50 mph intervals; used for air-speed indications.

FIFTH: Graduated for percent relative humidity, from 10 percent to 100 percent; each interval represents 5 percent; numerical designations every second interval; used for indications of relative humidity.

ACCURACY: To $\pm\frac{1}{2}^\circ$ of arc; to $\pm\frac{1}{4}^\circ$ of arc (required for pressure and temperature functions) with use of correction card.

POWER REQUIREMENT: Transmitters—26-v or 40-v, 400-cyc ac.

Recorders—40-v, 400-cyc ac (Use the voltage for which the recorder is wired, 26-v or 115-v, 400-cyc ac; the transformer of the recorder will deliver 40-v, 400-cyc ac to the unit).

Indicators—26-v, 400-cyc ac only.

WEIGHTS AND VOLUMES

	<i>Unpacked</i>	<i>Export packed</i>
Total weight (lb).....	9.75	12
Total volume (cu ft).....	.36	.5



Figure 61. Test Set TS-538/U, with accessories.

Status: Standard. Stock No.: 3F4325-538.
Reference: TM 11-5014.

Test Set TS-538/U is a portable, self-contained unit designed for use as a signal generator, frequency meter, and power monitor. It is used to test the operation of radiosonde equipment and may be used also to check the power output of transmitters and the bandwidth, alignment, and sensitivity of receivers which operate within its frequency range. Test Set TS-538/U is intended specifically to measure the frequency and power output of Radiosonde Transmitter T-93/AMT-4 (part of Radiosonde AN/AMT-4) and to measure the sensitivity, bandwidth, and tracking accuracy of Rawin Set AN/GMD-1.

TECHNICAL CHARACTERISTICS

- OSCILLATOR OUTPUT FREQUENCY: 1,630 to 1,730 mc.
- TYPES OF OSCILLATOR OUTPUT: Cw or interrupted cw.
- DURATION OF INTERRUPTION: Adjustable, from 40 to 60 microseconds.

FREQUENCY OF INTERRUPTION: 5 to 200 times per second (depends on duration of interruption).
OUTPUT POWER: -20 to -107 dbm (controlled by calibrated attenuator).

ATTENUATOR ACCURACY: ± 1 dbm from -20 to -70 dbm.
 ± 3 dbm from -70 to -107 dbm.

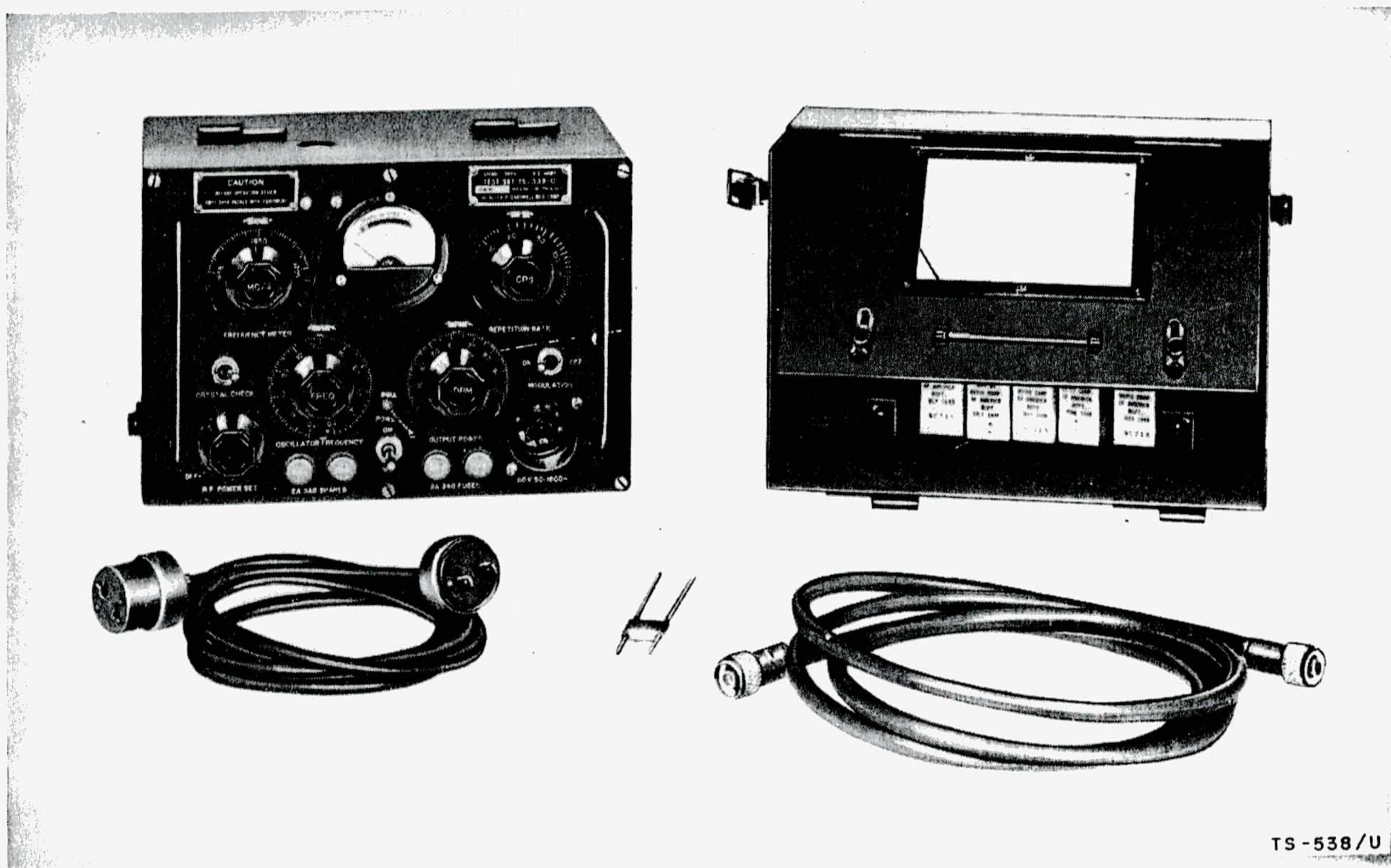
RANGE OF FREQUENCY METER: 1,630 to 1,730 mc.
ACCURACY OF FREQUENCY METER: ± 2 mc.
POWER MONITOR SENSITIVITY: 150 to 250 mw at 10 inches.

TYPES OF TUBES: Blocking oscillator 6J6.
Multivibrator 6J6.
Cathode follower 6J6.
R-f oscillator A-2352.
Voltage regulator 0B2.
Rectifier 6X4.

POWER REQUIREMENT: 117-v ± 10 percent, 50 to 1,600 cps ac.

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb).....	23.5	40
Total volume (cu ft).....	.7	2.9



TS-538/U

Figure 61. Test Set TS-538/U, with accessories.

Status: Standard. Stock No.: 3F4325-538.
Reference: TM 11-5014.

Test Set TS-538/U is a portable, self-contained unit designed for use as a signal generator, frequency meter, and power monitor. It is used to test the operation of radiosonde equipment and may be used also to check the power output of transmitters and the bandwidth, alignment, and sensitivity of receivers which operate within its frequency range. Test Set TS-538/U is intended specifically to measure the frequency and power output of Radiosonde Transmitter T-93/AMT-4 (part of Radiosonde AN/AMT-4) and to measure the sensitivity, bandwidth, and tracking accuracy of Rawin Set AN/GMD-1.

TECHNICAL CHARACTERISTICS

- OSCILLATOR OUTPUT FREQUENCY: 1,630 to 1,730 mc.
- TYPES OF OSCILLATOR OUTPUT: Cw or interrupted cw.
- DURATION OF INTERRUPTION: Adjustable, from 40 to 60 microseconds.

FREQUENCY OF INTERRUPTION: 5 to 200 times per second (depends on duration of interruption).
OUTPUT POWER: -20 to -107 dbm (controlled by calibrated attenuator).

ATTENUATOR ACCURACY: ±1 dbm from -20 to -70 dbm.
±3 dbm from -70 to -107 dbm.

RANGE OF FREQUENCY METER: 1,630 to 1,730 mc.
ACCURACY OF FREQUENCY METER: ±2 mc.
POWER MONITOR SENSITIVITY: 150 to 250 mw at 10 inches.

TYPES OF TUBES: Blocking oscillator 6J6.
Multivibrator 6J6.
Cathode follower 6J6.
R-f oscillator A-2352.
Voltage regulator 0B2.
Rectifier 6X4.

POWER REQUIREMENT: 117-v ±10 percent, 50 to 1,600 cps ac.

WEIGHTS AND VOLUMES

	Unpacked	Export packed
Total weight (lb)	23.5	40
Total volume (cu ft)	.7	2.9

MISCELLANEOUS METEOROLOGICAL ITEMS

AM-7()/FMQ-1, Amplifier: Electronic, includes preamplifier unit; feeds Radiosonde Recorder RD-3(*)/FMQ-1; mounts in Rack Assembly MT-47(*)/FMQ-1 or MT-678/FMQ-2; 10 x 19 x 8½ in. P/o Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2.

Sig C stock No.: 7A46-7.

Status: Standard.

AS-11()/FMQ-1, Antenna Assembly: Receiving, dipole type; frequency, 72.2 mc; input impedance 75 ohms; 200-ft coaxial transmission line feed; 1-piece metal construction, approx 11 ft lg x 5 in. diam. P/o Radiosonde Receptor AN/FMQ-1(*)

Sig C stock No.: 7A1326/A1.

Status: Limited/Std.

AS-389/FMQ-2, Antenna Assembly: Receiving; vertical, half-wave, concentric dipole-type composed of two quarter-wavelength sections; center frequency 400 mc; characteristic impedance approx 52 ohms; 100-ft coaxial transmission line feed with characteristic impedance of 52 ohms. P/o Radiosonde Receptor AN/FMQ-2.

Sig C stock No.: 2A264-389.

Status: Standard.

CN-2()/FMQ-1, Voltage Regulator: Regulates 90-v to 130-v a-c input to constant 115-v a-c output under load; 5¼ x 13 x 5¼ in. P/o Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2.

Sig C stock No.: 7A1680.

Status: Standard.

CY-295/UM, Case (fig. 64): Canvas; designed for carrying Psychrometric Calculator ML-322/UM, Air Speed Calculator ML-324/UM, Pressure Calculator ML-323/UM, and forms and stationery; 14½ x 12 x 2 in. P/o Psychrometer Equipment ML-313/AM and Aerograph Equipment AN/AMQ-2(*)

Sig C Stock No.: 7A451-295.

Status: Standard.

MC-191, Typewriter: Standard, nonportable typewriter fitted with special keys and type bars; lower-case position agate type, all capitals; upper-case position numerals and weather symbols. Used to make copies of material received

via, or for transmission via, weather teletype networks.

Sig C stock No.: 7A1933-191.

Status: Standard.

MK-27/FMQ-1 Expendable Hardware Items:

Cable, connectors, clamps, lugs, and hardware for field maintenance and repair of radiosonde Receptors AN/FMQ-1(*) and FMQ-2.

Sig C stock No.: 7A980-27

Status: Standard.

ML-27, Register: Four-purpose, electromechanical recording instrument; produces continuous record, on single chart, of wind direction, wind speed, rainfall, and duration of sunshine (sunshine recorder not used); includes means of determining approx instantaneous wind speed. U/w Support ML-29, Gauge ML-30, and Anemometer ML-80.

Sig C stock No.: 7A1327.

Status: Limited/Std.

ML-30, Gauge: Tipping-bucket type, electromechanical rain gauge; measures precipitation in increments of .01 in. U/w Register ML-27 to determine amount and rate of rainfall.

Sig C stock No.: 7A930.

Status: Limited/Std.

ML-64-(), Balloon: 30-gram pilot balloon; rubber, 6-in. spherical; red.

Sig C stock No.: 7A164.

Status: Standard.

ML-81, Hose (fig. 63): Grade A, heavy rubber tubing used in inflation of meteorological balloons; ¾-in. OD x ⅛-in. wall thickness; 5-ft and 6-in. lengths p/o Hydrogen Generator Set AN/TMQ-3; 15-ft length u/w Balloon ML-391/AM.

Sig C stock No.: 7A981 (5-ft length); 7A981-6 (6-in. length); 7A981-10 (10-ft length); 7A981-15 (15-ft length).

Status: Standard.

ML-90, Candle (fig. 65): Stearic acid and paraffin; ⅞-in. diam x 1¼ in. lg; u/w Lantern ML-91 for pilot-balloon night flights in all climatic regions.

Sig C stock No.: 7A401.

Status: Standard.

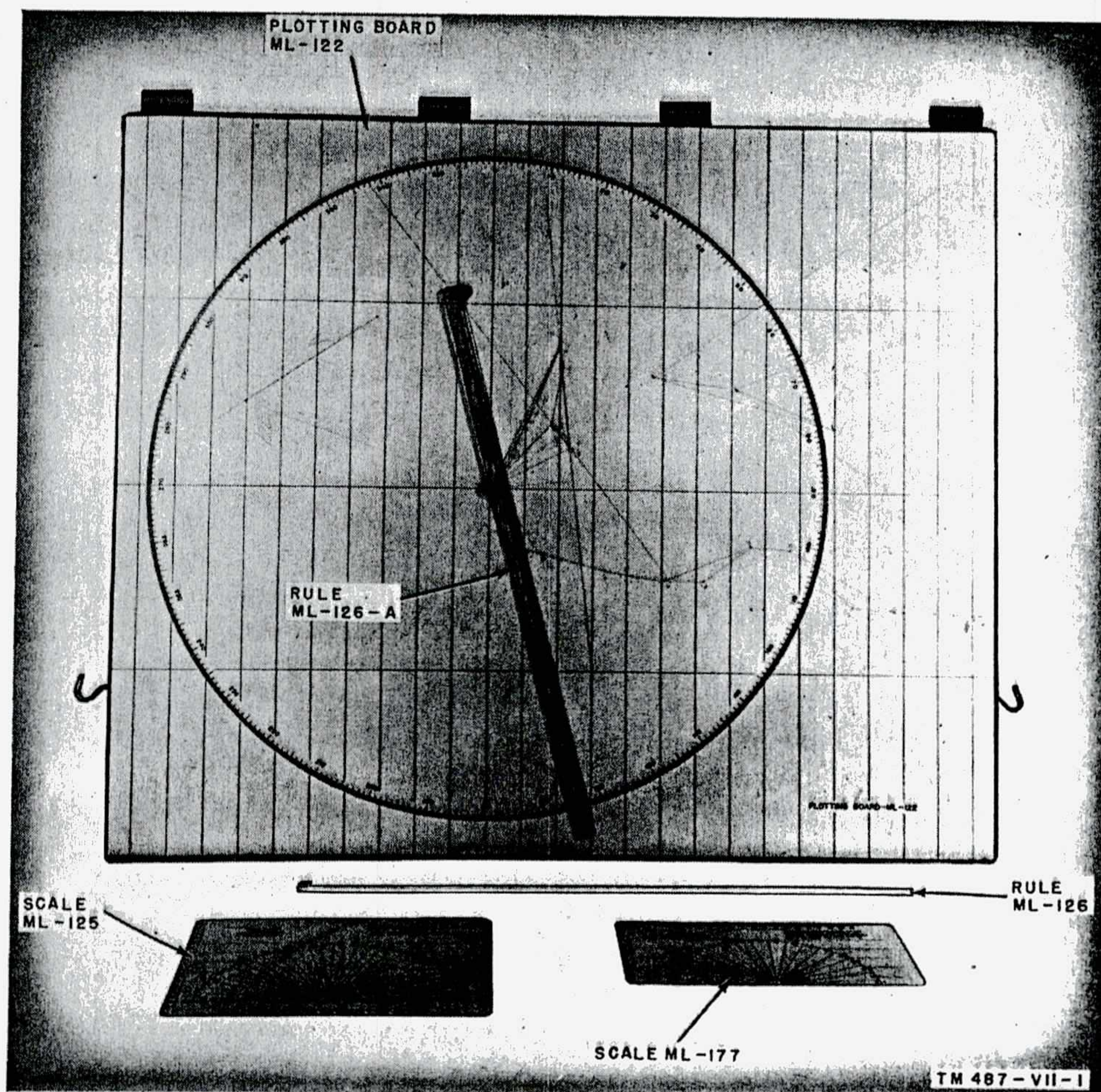


Figure 62. Pibal plotting equipment.

ML-91, Lantern (fig. 65): Paper; used with Candle ML-90 for pilot-balloon night flights.

Sig C stock No.: 7A1105.

Status: Standard.

ML-106, Chart: Equivalent potential temperature diagram, with isobars and isotherms of the condensation level. U/w meteorological ground station equipment.

Sig C stock No.: 7A506.

Status: Limited/Std.

ML-122, Plotting Board (fig. 62): Portable; plywood with phenolic surface inscribed with horizontal and vertical grid lines and an azimuth circle graduated in intervals of $.2^\circ$; 30 x 35 in. P/o Meteorological Station AN/TMQ-1 and Mobile Meteorological Station SCM-1; u/w Plotting Set AN/GMQ-3, Scale ML-125, and Rule ML-126.

Sig C stock No.: 7A1262.

Status: Standard.

ML-125, Scale (fig. 62): Used, when observations are made with 30-gram pilot balloons, with Plotting Board ML-122 to determine wind direction and speed for each zone as measured from the plot of zone winds on the plotting board.

Sig C stock No.: 7A1625.

Status: Standard.

ML-126, Rule (fig. 62): Brass (tropical use) or vinyl resin (general use); used to plot horizontal projection of balloon position for each minute after release. Approx 23 x $1\frac{1}{4}$ x $\frac{1}{8}$ in. P/o Plotting Board ML-122.

Sig C stock No.: 7A1500-126 (tropical use); 7A1500-126A (general use).

Status: Standard.

ML-129-(), Bearing: Bearing for wind vane; most models include contacts providing means of transmitting wind direction to an indicator. P/o Support ML-29-(*); a table showing models

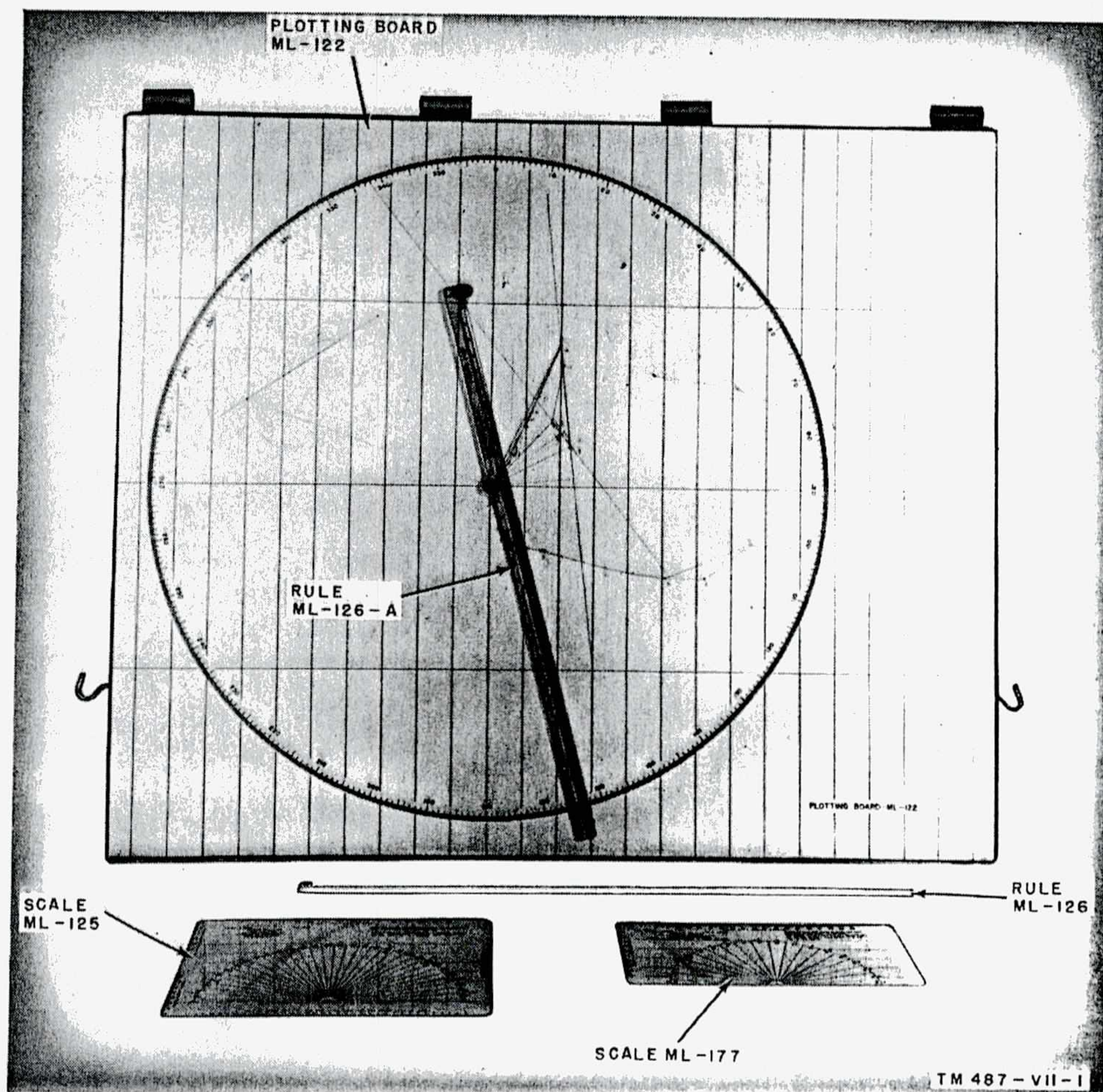


Figure 62. Pibal plotting equipment.

ML-91, Lantern (fig. 65): Paper; used with Candle ML-90 for pilot-balloon night flights.

Sig C stock No.: 7A1105.

Status: Standard.

ML-106, Chart: Equivalent potential temperature diagram, with isobars and isotherms of the condensation level. U/w meteorological ground station equipment.

Sig C stock No.: 7A506.

Status: Limited/Std.

ML-122, Plotting Board (fig. 62): Portable; plywood with phenolic surface inscribed with horizontal and vertical grid lines and an azimuth circle graduated in intervals of $.2^\circ$; 30 x 35 in. P/o Meteorological Station AN/TMQ-1 and Mobile Meteorological Station SCM-1; u/w Plotting Set AN/GMQ-3, Scale ML-125, and Rule ML-126.

Sig C stock No.: 7A1262.

Status: Standard.

ML-125, Scale (fig. 62): Used, when observations are made with 30-gram pilot balloons, with Plotting Board ML-122 to determine wind direction and speed for each zone as measured from the plot of zone winds on the plotting board.

Sig C stock No.: 7A1625.

Status: Standard.

ML-126, Rule (fig. 62): Brass (tropical use) or vinyl resin (general use); used to plot horizontal projection of balloon position for each minute after release. Approx 23 x $1\frac{1}{4}$ x $\frac{1}{8}$ in. P/o Plotting Board ML-122.

Sig C stock No.: 7A1500-126 (tropical use); 7A1500-126A (general use).

Status: Standard.

ML-129-(), Bearing: Bearing for wind vane; most models include contacts providing means of transmitting wind direction to an indicator. P/o Support ML-29-(*); a table showing models

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of Bearing ML-129-(*) and Support ML-29-(*) used together is included with data on ML-29-(*).

Sig C stock Nos.: 7A367; 7A367A; 7A367B; 7A367C.

Status: Limited/Std.

ML-146, Telescope: An auxiliary object lens and swinging mirror attached to the eyepiece tube of theodolites to widen the field of view. P/o Theodolites ML-47-R and ML-247.

Sig C stock No.: 7A1760-146.

Status: Standard.

ML-155, Balloon: 30-gram pilot balloon; rubber, 6-in. spherical; orange.

Sig C stock No.: 7A175.

Status: Standard.

ML-156, Balloon: 30-gram pilot balloon; rubber, 6-in. spherical; yellow.

Sig C stock No.: 7A176.

Status: Standard.

ML-157, Balloon (fig. 63): 10-gram ceiling balloon; 3½ in. spherical; black, dark blue, or purple.

Sig C stock No.: 7A177.

Status: Standard.

ML-158, Balloon (fig. 63): 10-gram ceiling balloon; 3½ in. spherical; red.

Sig C stock No.: 7A178.

Status: Standard.

ML-159-(), Balloon (fig. 65): 100-gram pilot balloon; rubber or substitute, 16-in. spherical; white or uncolored.

Sig C stock No.: 7A179.

Status: Standard.

ML-160, Balloon: 100-gram pilot balloon; 16-in. spherical; black.

Sig C stock No.: 7A180.

Status: Standard.

ML-161, Balloon: 100-gram pilot balloon; 16-in. spherical; red.

Sig C stock No.: 7A181.

Status: Standard.

ML-162, Balloon: 700-gram sounding balloon; 48-in. spherical; uncolored.

Sig C stock No.: 7A182.

Status: Standard.

ML-169, Junction Box: Part of the wiring equipment of a synchro-type wind-indicating system; furnished completely assembled. U/w Wind Intensity Transmitter ML-151-(*) and Wind Direction Transmitter ML-152-(*).

Sig C stock No.: 7A1149A.

Status: Standard.

ML-170, Control Panel: 250-v, 30-amp general

control panel for synchro-type wind-indicating equipment; includes four 30-amp fuses, 2-pole tumbler switch with plug fusing; 20 x 19½ x 4½ in.

Sig C stock No.: 7A1220A.

Status: Standard.

ML-171, Terminal Box: Part of the accessory wiring equipment for synchro-type wind-indicating equipment; includes one 6-pole, one 2-pole, and one 5-pole, single-throw, no-fuse, knife-type battery switches. U/w Weather Panels ML-143-(*), ML-173-B, and ML-183-(*); and Recorders ML-144-(*) and ML-174-B.

Sig C stock No.: 7A1771A.

Status: Standard.

ML-177, Scale (fig. 62): Used with Plotting Board ML-122 to obtain speed and direction of wind from pilot-balloon observations; transparent plastic, 10 x 5 in.

Sig C stock No.: 7A1677.

Status: Standard.

ML-178, Mounting: Special shockmount for Barograph ML-3-(*).

Sig C stock No.: 7A1199-178.

Status: Standard.

ML-182, Chart Roll: Recording chart; paper roll 20 yd lg. U/w Radiosonde Recorder RD-3(*)/FMQ-1; (p/o Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2).

Sig C stock No.: 7A507-182.

Status: Standard.

ML-186, Nozzle (fig. 63): Used to connect 10-gram balloons to source of gas; wooden cylinder 1½ in. diam x 2½ in. h, with end fittings for attaching balloon and ⅛-in. rubber tubing.

Sig C stock No.: 7A1199A-186.

Status: Standard.

ML-187, Coupling (fig. 63): Reducing fitting for connecting Hose ML-81, leading from gas source, to ⅛-in. tubing leading to inflation nozzle. U/w Nozzle ML-186.

Sig C stock No.: 7A850-187.

Status: Standard.

ML-188, Tubing (fig. 63): Rubber; for inflation of ceiling balloons; ⅛-in. ID, ½-in. wall, 24 in. lg. U/w Nozzle ML-186 and Coupling ML-187.

Sig C stock No.: 7A1928.

Status: Standard.

ML-193, Hydrogen Regulator (fig. 65): Consists of high-pressure gage indicating pressures from 0 to 3,000 psi, a diaphragm-type reducing valve, a low-pressure gage indicating pressures from 0 to 50 psi, and fittings for attachment to

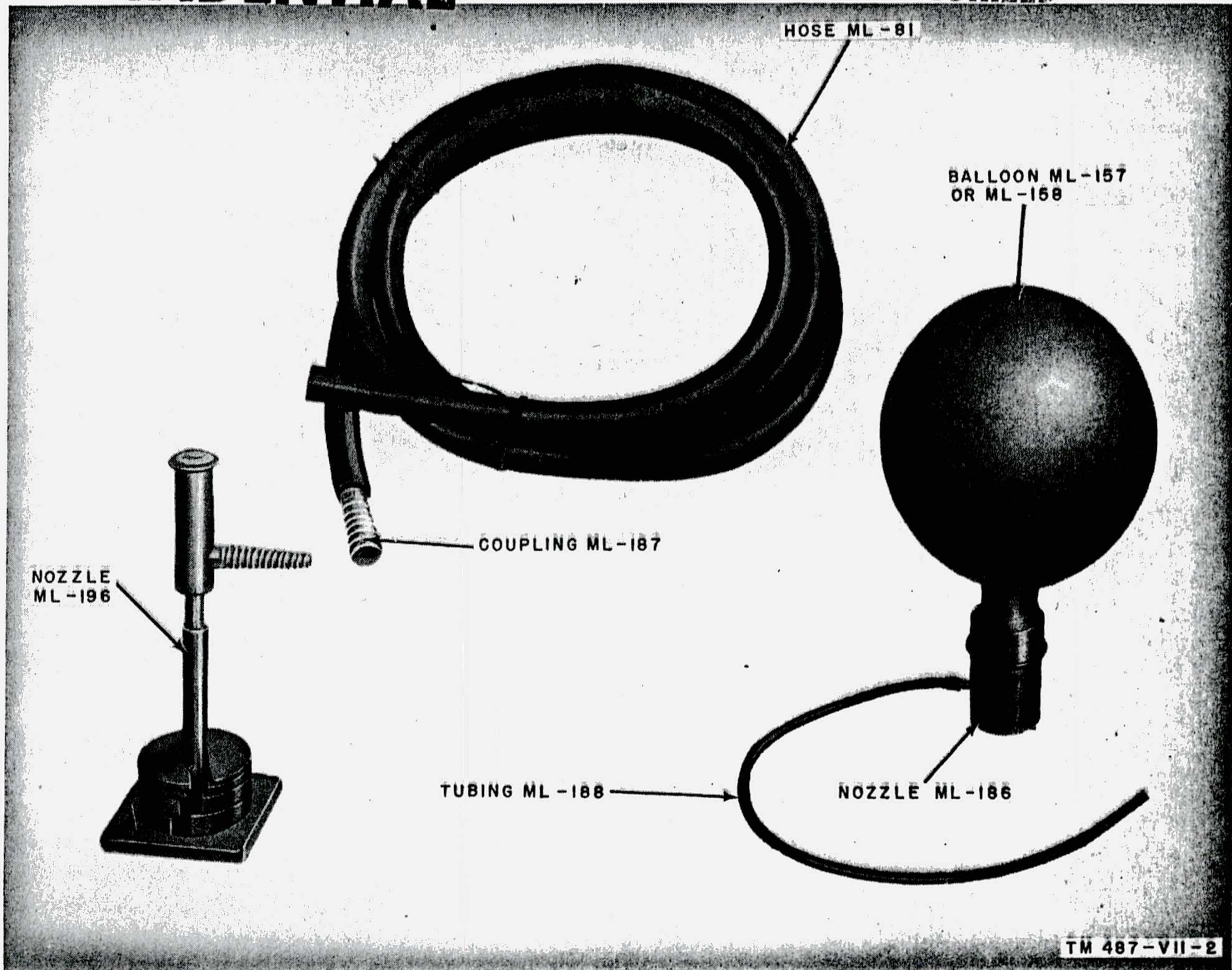


Figure 63. Balloon inflation equipment.

standard hydrogen gas cylinder (cannot be used with a hydrogen generator) and for attachment of Hose ML-81 and/or Coupling ML-49. Provides an indication of pressure within the gas cylinder, a means of throttling the rate of gas discharge, and an indication of rate of inflation of balloons.

Sig C stock No.: 7A1334-193.

Status: Standard.

ML-196, Nozzle (fig. 63): Used for inflation of sounding balloons; includes 5 extra weights. U/w Balloon ML-131 and Hose ML-81.

Sig C stock No.: 7A1199A-196.

Status: Standard.

ML-209, Support: Wooden, box-type support with removable top cover; approx 5½ x 5½ x 14 in. Used as support and shipping container for Gauge ML-217.

Sig C stock No.: 7A1743-209.

Status: Standard.

ML-211, Calibrator: Mechanical device for testing the accuracy of Wind Intensity Transmitter ML-151-(*); includes a torque wheel for installation in place of the rotor, and 12 assorted weights representing various wind intensities; components, including necessary tools, packed in carrying case.

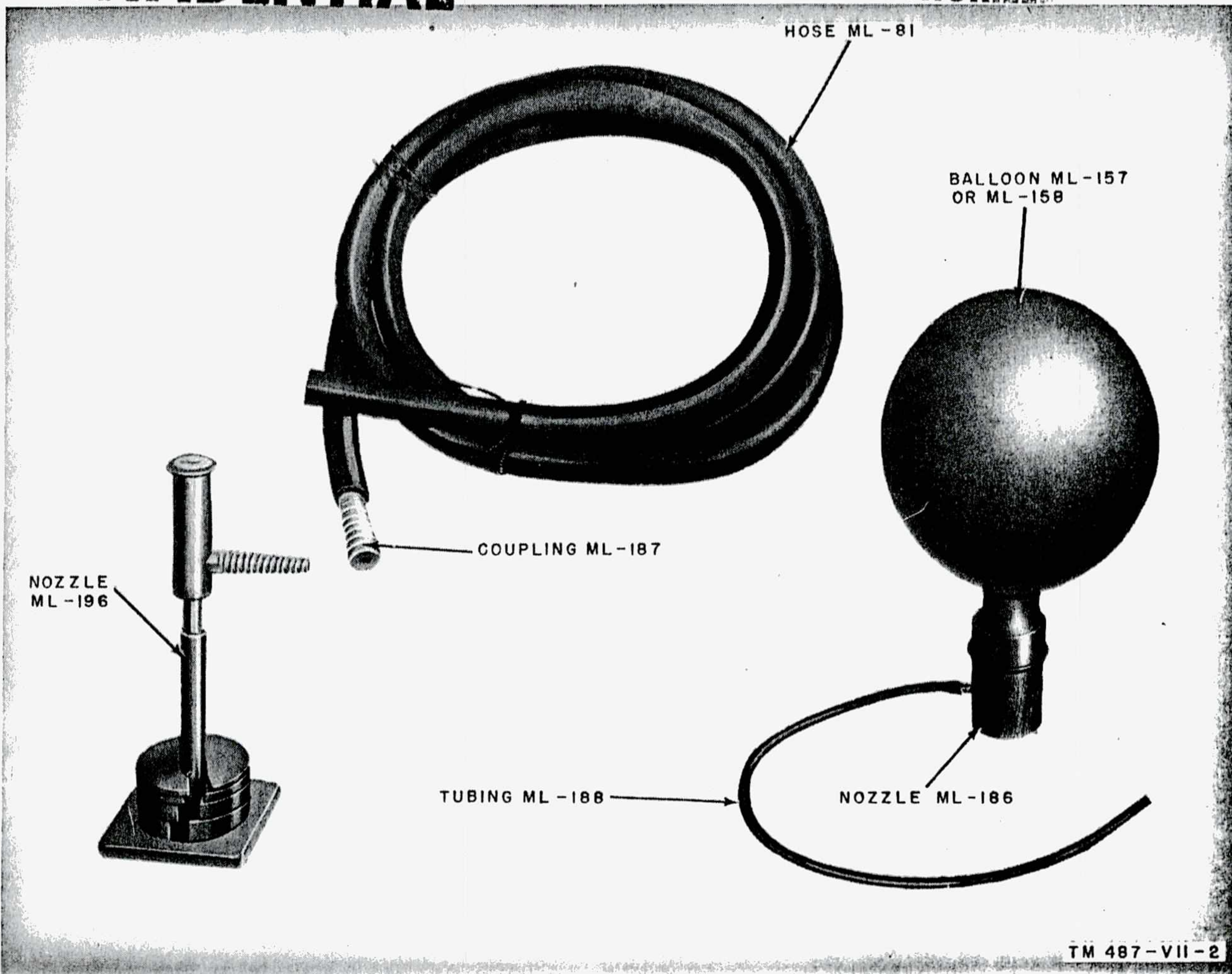
Sig C stock No.: 7A390.

Status: Standard.

ML-212, Control Set: A remote-control system utilizing existing telephone or other circuits; consists of switch with pilot light, a heavy-duty relay, a transformer, a 12-v relay and a master switch; installation diagram included U/w Ceiling Light Projector ML-121-(*).

Sig C stock No.: 7A792.

Status: Standard.



TM 487-VII-2

Figure 63. Balloon inflation equipment.

standard hydrogen gas cylinder (cannot be used with a hydrogen generator) and for attachment of Hose ML-81 and/or Coupling ML-49. Provides an indication of pressure within the gas cylinder, a means of throttling the rate of gas discharge, and an indication of rate of inflation of balloons.

Sig C stock No.: 7A1334-193.

Status: Standard.

ML-196, Nozzle (fig. 63): Used for inflation of sounding balloons; includes 5 extra weights. U/w Balloon ML-131 and Hose ML-81.

Sig C stock No.: 7A1199A-196.

Status: Standard.

ML-209, Support: Wooden, box-type support with removable top cover; approx 5½ x 5½ x 14 in. Used as support and shipping container for Gauge ML-217.

Sig C stock No.: 7A1743-209.

Status: Standard.

ML-211, Calibrator: Mechanical device for testing the accuracy of Wind Intensity Transmitter ML-151-(*); includes a torque wheel for installation in place of the rotor, and 12 assorted weights representing various wind intensities; components, including necessary tools, packed in carrying case.

Sig C stock No.: 7A390.

Status: Standard.

ML-212, Control Set: A remote-control system utilizing existing telephone or other circuits; consists of switch with pilot light, a heavy-duty relay, a transformer, a 12-v relay and a master switch; installation diagram included U/w Ceiling Light Projector ML-121-(*).

Sig C stock No.: 7A792.

Status: Standard.

ML-216, Hose: Braided copper, flexible, high pressure; 8 ft lg with identical couplings each end which fit Generator ML-185-(*) and standard hydrogen gas cylinder; used to transfer gas from generator to storage cylinder. U/w Hydrogen Generator ML-185-(*).

Sig C stock No.: 7A986-216.

Status: Standard.

ML-304A/TM, Calcium Hydride Charge: 90 percent calcium hydride in metal can with scored holes; threaded for attachment to Hydrogen Generator ML-303/TM. Generates hydrogen gas to inflate one 30-gram balloon to produce free lift of 155 grams. U/w Hydrogen Generator ML-303-TM and Hydrogen Generator Set AN/TMQ-3.

Sig C stock No.: 7A384-304A.

Status: Standard.

ML-305A/TM, Calcium Hydride Charge: 90 percent calcium hydride in metal can with scored holes; threaded for attachment to Hydrogen Generator ML-303/TM. Generates hydrogen gas to inflate one 100-gram balloon to produce free lift of 650 grams. U/w Hydrogen Generator ML-303/TM and Hydrogen Generator Set AN/TMQ-3.

Sig C stock No.: 7A384-305A.

Status: Standard.

ML-315/GM, Pressure-Height Slide Rule: Special slide rule, 15 in. square with movable, circular scale; rule arm has scales for pressure, temperature, altitude, and vertical temperature corrections.

Sig C stock No.: 7A1661-315.

Status: Substitute/Std.

ML-317()/AMQ-2, Temperature-Humidity Transmitter: Instrument used with associated indicator and/or recorder to measure temperature and relative humidity of the atmosphere; electrically connected to Aerograph Recorder ML-320/AMQ-2; contained in Mounting MT-321/AMQ-2 and mounted externally on aircraft. P/o Aerograph Equipment AN/AMQ-2(*).

Sig C stock No.: 7A8158-317.

Status: Substitute/Std.

ML-319()/AMQ-2, Pressure-Air Speed Transmitter: Instrument connected to the pitot-static line of an airplane to measure air speed of aircraft on which it is mounted and atmospheric pressure at level of flight; electrically connected to Aerograph Recorder ML-320/

AMQ-2. P/o Aerograph Equipment AN/AMQ-2(*).

Sig C stock No.: 7A1842-319.

Status: Substitute/Std.

ML-320/AMQ-2, Aerograph Recorder: Provides indication of immediate values and a permanent record of data obtained and transmitted by Temperature-Humidity Transmitter ML-317(*)/AMQ-2 and Pressure-Air Speed Transmitter ML-319(*)/AMQ-2; prints on Chart Roll ML-325/AMQ-2. P/o Aerograph Equipment AN/AMQ-2 (Aerograph Equipment AN/AMQ-2A uses Aerograph Recorder ML-320A/AMQ-2).

Sig C stock No.: 7A8126-320.

Status: Substitute/Std.

ML-321/AMQ-2, Scale: Determines, from record of Aerograph Recorder ML-320/AMQ-2, values of temperature, relative humidity, atmospheric pressure, and air speed that existed simultaneously at any selected time. P/o Aerograph Equipment AN/AMQ-2 (Aerograph Equipment AN/AMQ-2A uses Scale ML-412/AMQ-2A).

Sig C stock No.: 7A5950-321.

Status: Substitute/Std.

ML-323/UM, Pressure Calculator (fig. 64): A circular slide rule with special scales; used to obtain true atmospheric pressure, in millibars, at the level of flight from given values of the altitude setting in inches of mercury and the altimeter reading in feet. P/o Aerograph Equipments AN/AMQ-2(*) and AN/AMQ-3 and Psychrometer Equipment ML-313/AM.

Sig C stock No.: 7A5896-323.

Status: Standard.

ML-324/UM, Air Speed Calculator (fig. 64): A circular slide rule with special scales; converts indicated air speed to true air speed, using temperature and pressure data. P/o Aerograph Equipments AN/AMQ-2(*) and AN/AMQ-3 and Psychrometer Equipment ML-313/AM.

Sig C stock No.: 7A5896-324.

Status: Standard.

ML-325/UM, Chart Roll: Recording chart used with Aerograph Recorder ML-320(*)/AMQ-2; 10¾ in. wd x 100 ft lg. P/o Aerograph Equipment AN/AMQ-2(*).

Sig C stock No.: 7A5200-325.

Status: Substitute/Std.

ML-326/UM, Mixing Ratio Calculator: A calculating device for computing the mixing ratio; scale ranges: mixing ratio, 1 to 40 grams per kilo-

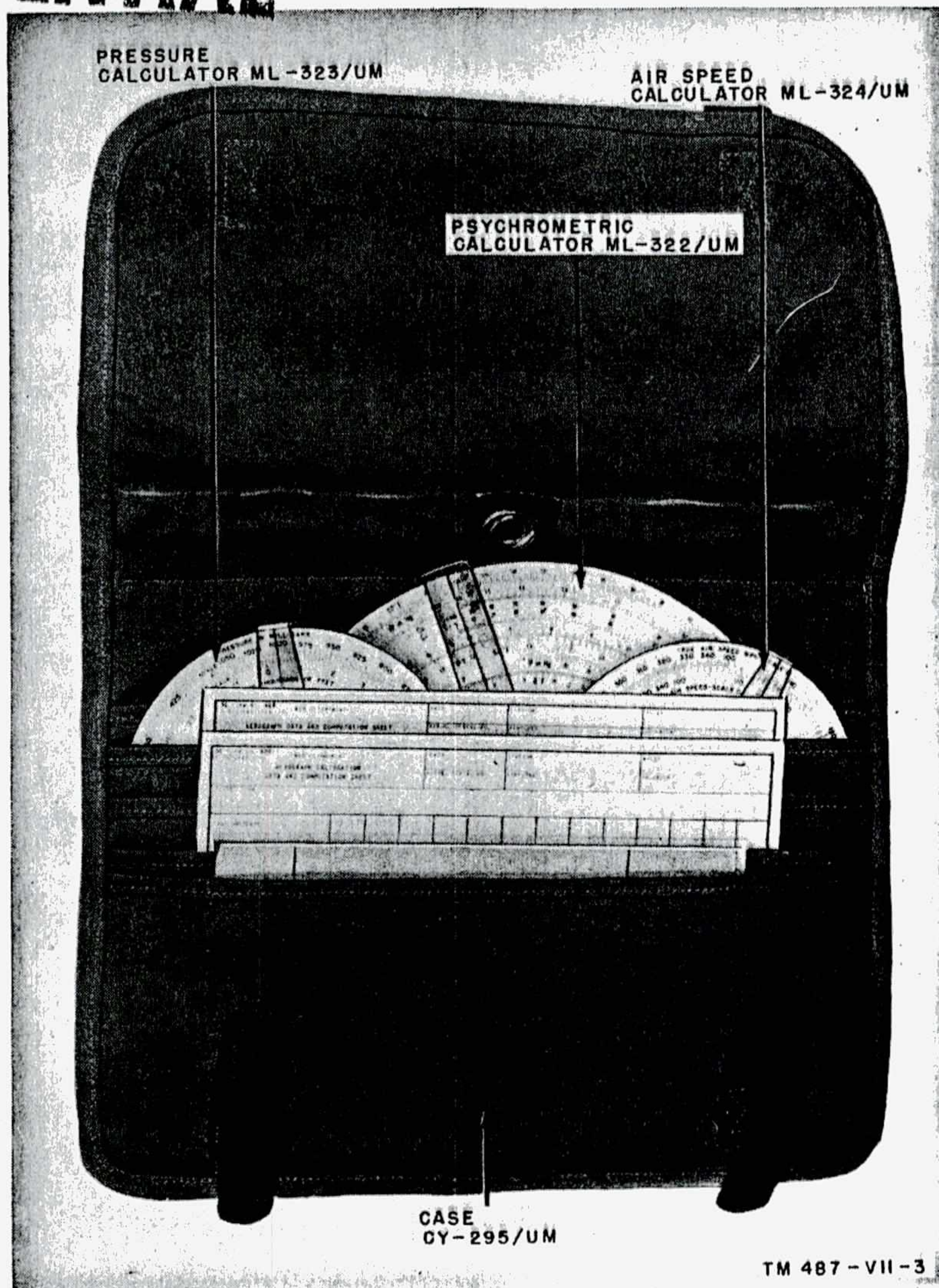


Figure 64. Case CY-295/UM, with calculators.

gram; temperature, -40°C to $+45^{\circ}\text{C}$; relative humidity, 1 percent to 100 percent; atmospheric pressure, 100 mb to 1,060 mb. P/o Aerograph Equipment AN/AMQ-2(*).

Sig C stock No.: 7A5900.

Status: Standard.

ML-351/AM, Ventilation Duct: Right-angle duct constructed of aluminum-foil-covered corrugated board; provides air circulation and protection from weather for temperature and humidity elements of Radiosonde Modulators ML-310/AMT-1, ML-310A/AMT-1, and ML-310B/AMT-1. P/o Radiosondes AN/AMT-1 and AN/AMT-2.

Sig C stock No.: 7A1935-351.

Status: Standard.

ML-357/GM, Straight Edge: Plain, transparent plastic straight edge, 12 in. lg. U/w Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2 in the evaluation of records.

Sig C stock No.: 7A1326/S1.

Status: Standard.

ML-358/GM, Straight Edge: Scoring or creasing rule; corrosion-resistant steel, 18 in. lg.; used in preparation of adiabatic charts. U/w Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2 in the evaluation of records.

Sig C stock No.: 7A1326/S2.

Status: Standard.

ML-366/UM, Scale: Vinylite scale with indications top and bottom of mean altitudes of various artillery zones in the upper air; de-

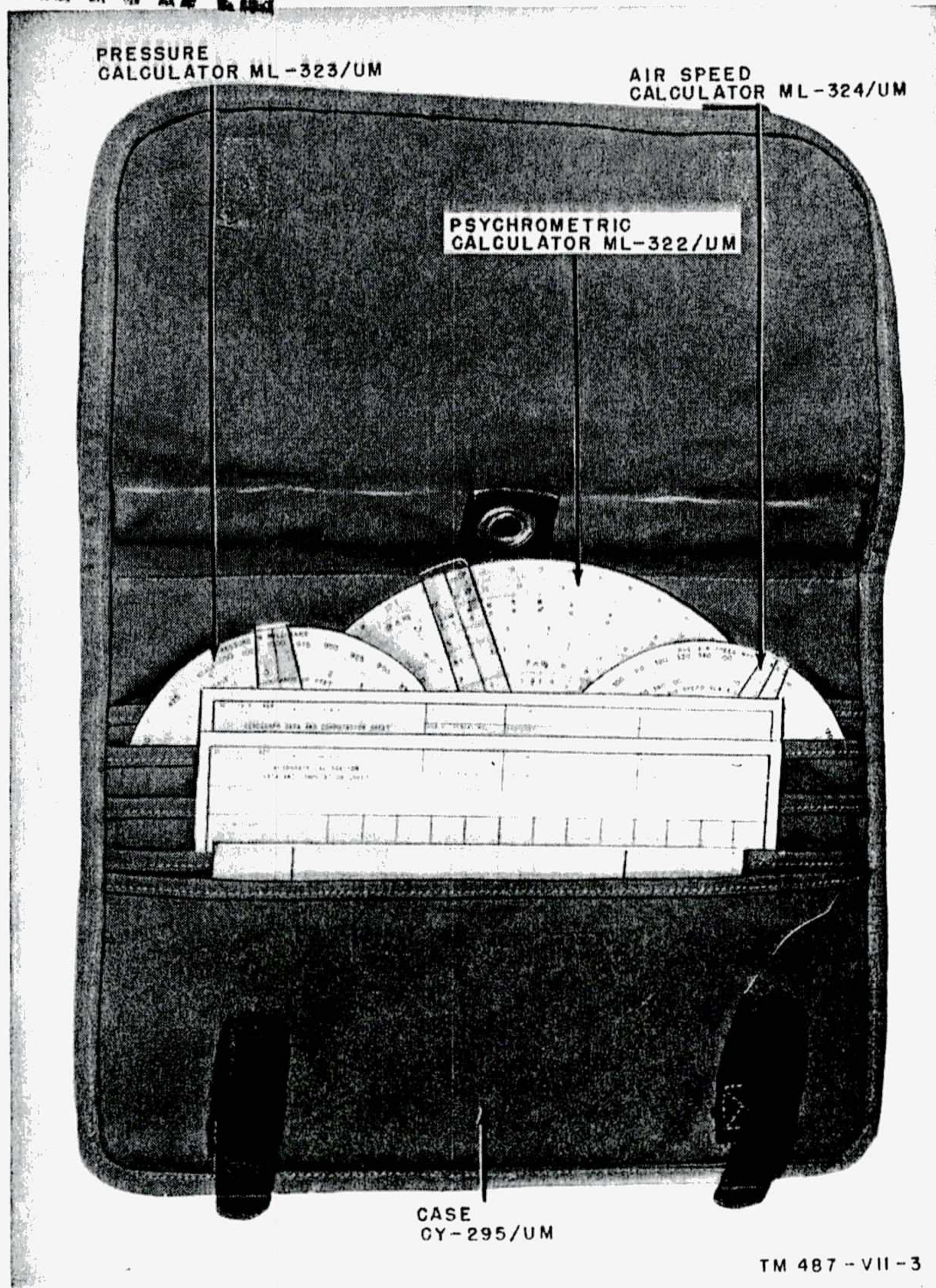


Figure 64. Case CY-295/UM, with calculators.

gram; temperature, -40°C to $+45^{\circ}\text{C}$; relative humidity, 1 percent to 100 percent; atmospheric pressure, 100 mb to 1,060 mb. P/o Aerograph Equipment AN/AMQ-2(*).

Sig C stock No.: 7A5900.

Status: Standard.

ML-351/AM, Ventilation Duct: Right-angle duct constructed of aluminum-foil-covered corrugated board; provides air circulation and protection from weather for temperature and humidity elements of Radiosonde Modulators ML-310/AMT-1, ML-310A/AMT-1, and ML-310B/AMT-1. P/o Radiosondes AN/AMT-1 and AN/AMT-2.

Sig C stock No.: 7A1935-351.

Status: Standard.

ML-357/GM, Straight Edge: Plain, transparent plastic straight edge, 12 in. lg. U/w Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2 in the evaluation of records.

Sig C stock No.: 7A1326/S1.

Status: Standard.

ML-358/GM, Straight Edge: Scoring or creasing rule; corrosion-resistant steel, 18 in. lg.; used in preparation of adiabatic charts. U/w Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2 in the evaluation of records.

Sig C stock No.: 7A1326/S2.

Status: Standard.

ML-366/UM, Scale: Vinylite scale with indications top and bottom of mean altitudes of various artillery zones in the upper air; de-

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signed to be used with weather, altitude, pressure, density chart WRC-10-1.

Sig C stock No.: 7A1638-366.

Status: Standard.

ML-367/AM Launching Reel: A device on which the cord attaching a sounding balloon to a radiosonde is wound; facilitates launching balloon-borne radiosondes in winds exceeding 15 mph.

Sig C stock No.: 7A1109-367.

Status: Standard.

ML-373/GM, Balloon Nozzle: An inflation device consisting of a valve with inlet connection for attaching Hose ML-81, and two outlet nozzles; used to inflate and weigh off 30- and 100-gram meteorological balloons.

Sig C stock No.: 7A201-373.

Status: Standard.

ML-378/AM, Temperature Element: Ceramic-type resistance thermometer connected into the temperature-measuring circuit of a radiosonde modulator to measure the temperature of the upper atmosphere; range, -90° C to $+60^{\circ}$ C. P/o Radiosonde Modulators ML-310A/AMT-1 and ML-310B/AMT-1.

Sig C stock No.: 7A597A-378.

Status: Standard.

ML-380/AM, Humidity Element: Resistance-type hygrometer connected into the humidity-measuring circuit of a radiosonde modulator to measure the relative humidity of the upper atmosphere; range, 15 percent to 100 percent through temperature range of -40° C to $+60^{\circ}$ C. P/o Radiosonde Modulator ML-310(*)/AMT-1.

Sig C stock No.: 7A399-380.

Status: Standard.

ML-391/AM, Balloon: 1,400-gram sounding balloon, extremely high-altitude bursting; neoprene latex, spherical; uncolored. Used for daytime radiosonde ascents only.

Sig C stock No.: 7A183.

Status: Standard.

ML-429/UM, Psychrometric Calculator: A circular slide rule with special scales; used to compute dew point and relative humidity from observed dry- and wet-bulb thermometer temperature values and atmospheric pressure values; two temperature ranges: low, from -60° F to $+32^{\circ}$ F.; high, from -10° F. to $+85^{\circ}$ F. U/w ground psychrometric instruments.

Status: Standard.

MT-47()/FMQ-1, Rack Assembly: Inclosed, steel, relay cabinet, service door in back, folding writing table in front; mounts Radiosonde Receiver R-17(*)/FMQ-1, Frequency Meter TS-29 (*)/FMQ-1, Radiosonde Recorder RD-3(*)/FMQ-1, Amplifier AM-7(*)/FMQ-1, and Voltage Regulator CN-2(*)/FMQ-1. P/o Radiosonde Receptor AN/FMQ-1(*).

Sig C stock No.: 7A8337-47.

Status: Standard.

MT-321/AMQ-2, Mounting: A streamlined strut used to contain Temperature-Humidity Transmitter ML-317/AMQ-2 and to attach it to the exterior of aircraft. P/o Aerograph Equipment AN/AMQ-2(*).

Sig C stock No.: 7A1130-321.

Status: Substitute/Std.

MT-678/FMQ-2, Rack Assembly: Inclosed, steel relay cabinet, service door in back, folding writing table in front; mounts Radiosonde Receiver R-228/FMQ-2, Frequency Meter TS-29B/FMQ-1, Radiosonde Recorder RD-3B/FMQ-1 or RD-3C/FMQ-1, Amplifier AM-7B/FMQ-1, and Voltage Regulator CN-2A/FMQ-1. P/o Radiosonde Receptor AN/FMQ-2.

Sig C stock No.: 2Z7383-678.

Status: Standard.

R-17()/FMQ-1, Radiosonde Receiver: Superregenerative type; receives a-m signals; includes built in rectifier and loudspeaker; 8 tubes; frequency range 56 to 85 mc; 28 x 26 x 12 in. P/o Radiosonde Receptor AN/FMQ-1(*).

Sig C stock No.: 7A8340-17.

Status: Limited/Std.

R-228/FMQ-2, Radiosonde Receiver: Superheterodyne type; receives f-m or pulsed signals; includes built-in loudspeaker, cathode-ray tuning indicator, and full-wave rectifier; 20 tubes; frequency range 390 to 410 mc; intermediate frequency 21.25 mc. P/o Radiosonde Receptor AN/FMQ-2.

Sig C stock No.: 2C4180-228.

Status: Standard.

RD-3(*)/FMQ-1, Radiosonde Recorder: Records in code on Chart Roll ML-182 audio-modulated radiosonde signals representing atmospheric pressure, temperature, and relative humidity; includes preamplifier stage for connection to Amplifier AM-7(*)/FMQ-1; mounts in Rack Assembly MT-47(*)/FMQ-1 or MT-678/FMQ-2; 20½ x 18 x 19 in. P/o Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2.

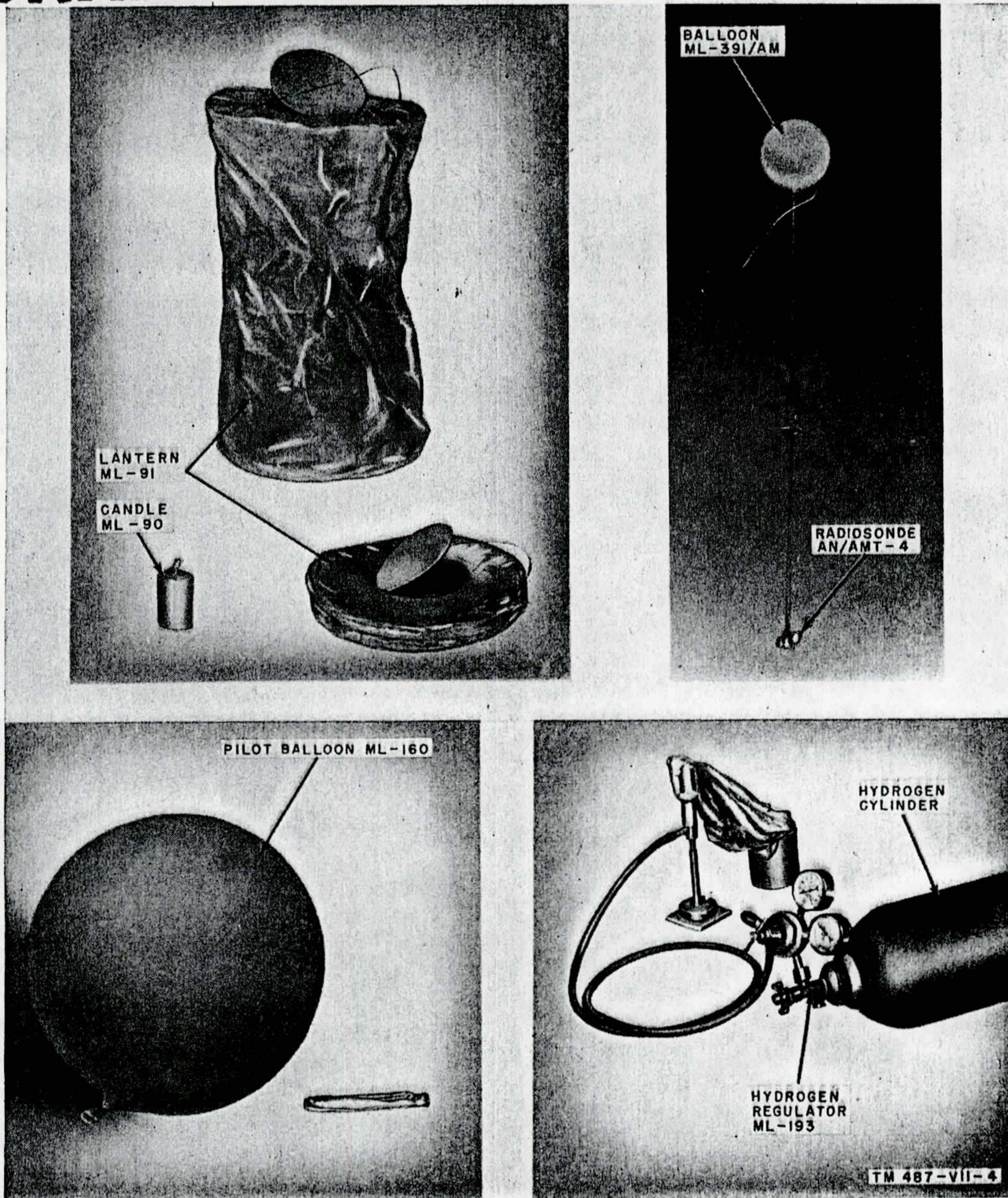


Figure 65. Miscellaneous pilot and sounding balloon equipment.

Sig C stock No.: 7A1326-3.

Status: Standard.

SCM-12, Meteorological Observation Set: An assemblage of equipment for making and evaluating pilot-balloon observations; includes balloons and accessories, hydrogen generator and charges, psychrometer, theodolite, timing and telephone set, plotting equipment, and supplies. Used by the Field Artillery to make meteorological observations to determine the direction and speed of winds aloft and to compute ballistic winds.

Sig C stock Nos.: 7A1200-SCM-12 (general use);

7A1200-SCM-12.1 (tropical use).

Status: Standard.

TK-17()/FMQ-1, Tool Equipment: Tools for field maintenance and repair of Radiosonde Receptor AN/FMQ-1(*); packed in two chests, weight approx 200lb. U/w, not p/o, Radiosonde Receptor AN/FMQ-1(*).

Sig C stock No.: 7A1856-17.

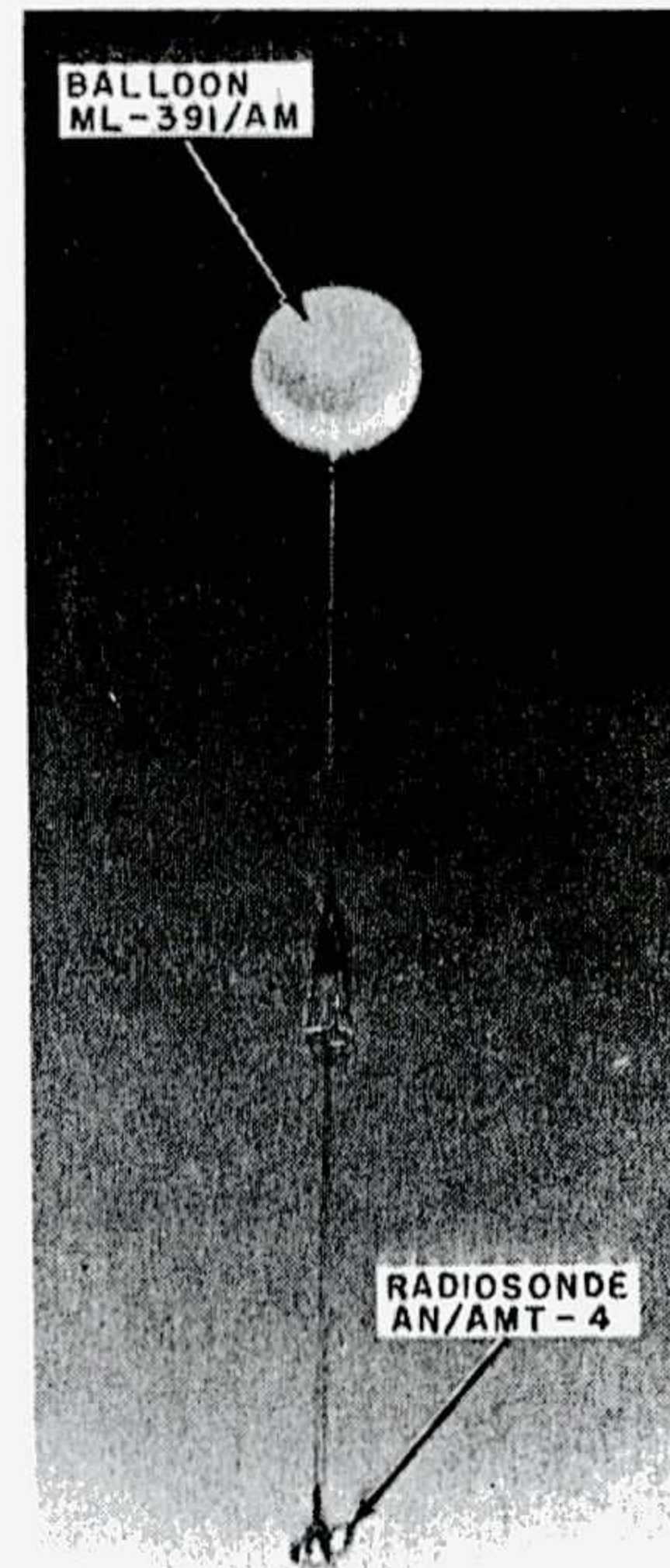
Status: Standard.

TS-29()/FMQ-1, Frequency Meter: Electronic; indicates output frequency of Radiosonde Re-



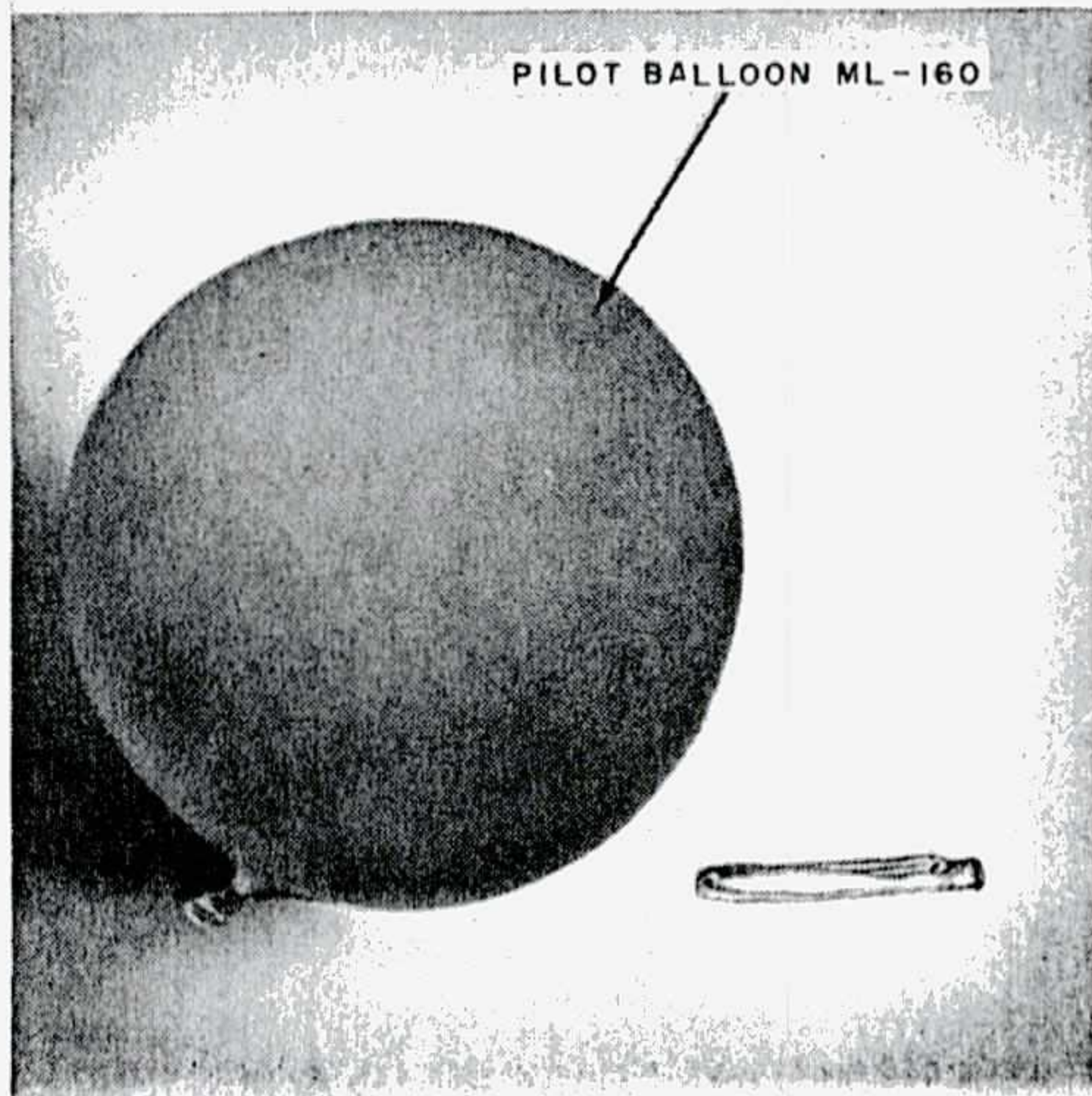
LANTERN
ML-91

CANDLE
ML-90

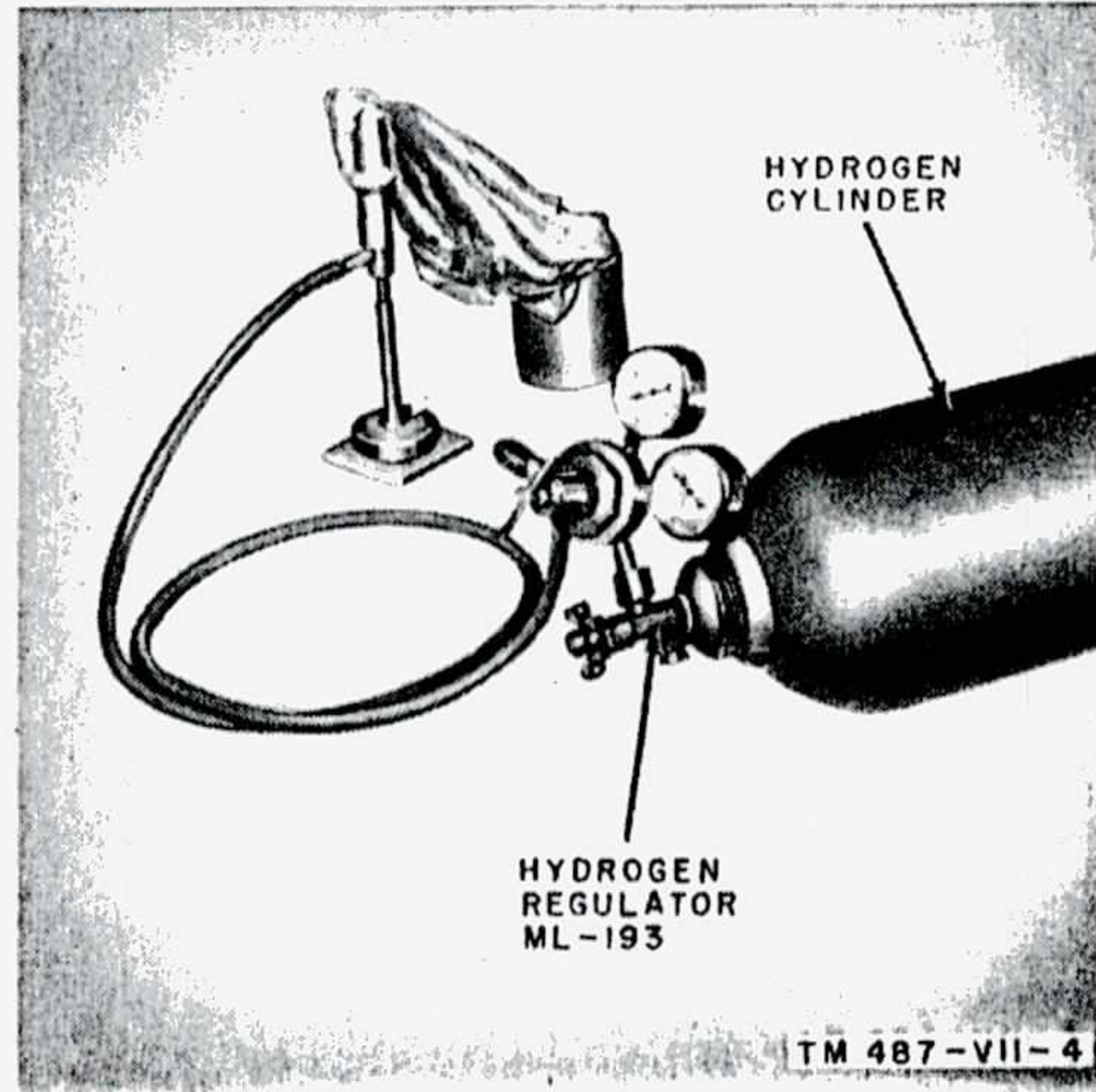


BALLOON
ML-391/AM

RADIOSONDE
AN/AMT-4



PILOT BALLOON ML-160



HYDROGEN
CYLINDER

HYDROGEN
REGULATOR
ML-193

TM 487-VII-4

Figure 65. Miscellaneous pilot and sounding balloon equipment.

Sig C stock No.: 7A1326-3.

Status: Standard.

SCM-12, Meteorological Observation Set: An assemblage of equipment for making and evaluating pilot-balloon observations; includes balloons and accessories, hydrogen generator and charges, psychrometer, theodolite, timing and telephone set, plotting equipment, and supplies. Used by the Field Artillery to make meteorological observations to determine the direction and speed of winds aloft and to compute ballistic winds.

Sig C stock Nos.: 7A1200-SCM-12 (general use);

7A1200-SCM-12.1 (tropical use).

Status: Standard.

TK-17()/FMQ-1, Tool Equipment: Tools for field maintenance and repair of Radiosonde Receptor AN/FMQ-1(*); packed in two chests, weight approx 200lb. U/w, not p/o, Radiosonde Receptor AN/FMQ-1(*).

Sig C stock No.: 7A1856-17.

Status: Standard.

TS-29()/FMQ-1, Frequency Meter: Electronic; indicates output frequency of Radiosonde Re-

ceiver R-17(*)/FMQ-1 on panel meter; converts a-f output of receiver to dc proportional in value to output frequency of receiver and supplies this controlling current to Radiosonde Recorder R-3(*)/FMQ-1; mounts in Rack Assembly MT-47(*)/FMQ-1 or MT-678/FMQ-2; 28 x 26 x 12 in. P/o Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2.

Sig C stock No.: 7A889-29.

Status: Standard.

TS-65()/FMQ-1, Frequency Standard: Portable, self-contained equipment used to aline and calibrate Frequency Meter TS-29(*)/FMQ-1 and Radiosonde Recorder RD-3(*)/FMQ-1; delivers audio frequency of 10, 20, 40, 60, 80,

100, 120, 140, 160, 180, or 190 cps, as selected P/o Maintenance Equipment MK-8(*)/FMQ-1; u/w Radiosonde Receptors AN/FMQ-1(*) and AN/FMQ-2.

Sig C stock No.: 7A889-65.

Status: Standard.

TS-287()/GM, Battery Tester: Self-contained, dual-scale, d-c voltmeter used to test the closed-circuit voltages of radiosonde batteries; ranges 0 to 7.5-v and 0 to 150-v dc; used to test Battery BA-67; 3 x 3 x 3 in. U/w Radiosonde Transmitter T-49C/AMT-1 (p/o Radiosonde AN/AMT-1) and Radiosonde AN/AMT-3.

Sig C stock No.: 7A1325/V1.

Status: Standard.

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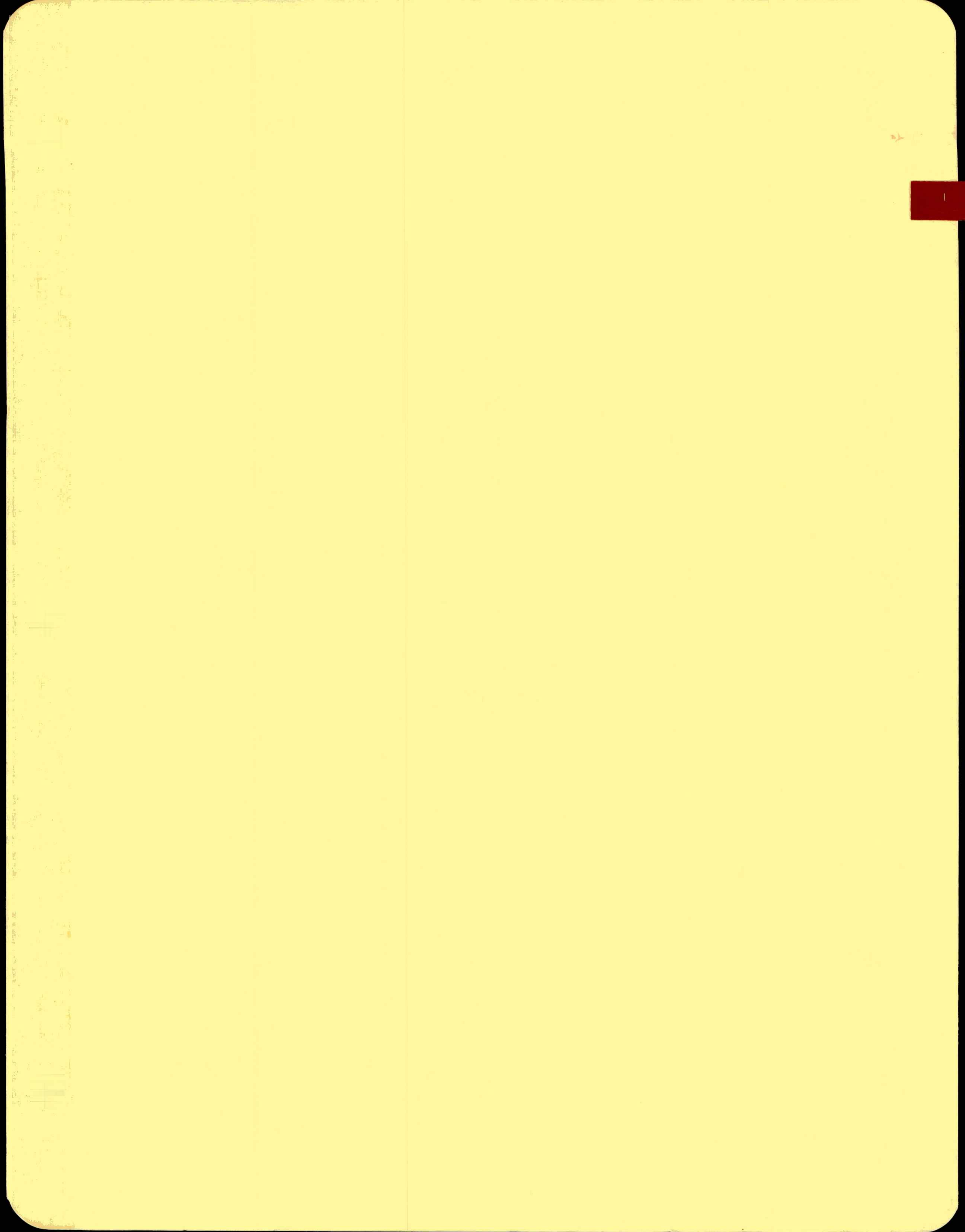
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TM 11-444

WAR DEPARTMENT

TECHNICAL MANUAL

†
SOUND RANGING SET GR-3-C

12 June, 1943

Technical manual published by Engineering Laboratory
Order No. 3378-SCGDL-43 and No. 935 P & B
Furnished for the information and guidance of all con-

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TECHNICAL MANUAL
No. 11-444

WAR DEPARTMENT
Washington, 12 June, 1943

SOUND RANGING SET GR-3-C

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SAFETY NOTICE

THIS EQUIPMENT USES VOLTAGES HIGH ENOUGH TO BE DANGEROUS TO HUMAN LIFE. DON'T ATTEMPT ANY REPAIR OR ADJUSTMENT WITHIN THE EQUIPMENT WHILE THE CURRENT IS ON. DON'T UNDERTAKE THE REPAIR OF THIS EQUIPMENT OR ITS ASSOCIATED COMPONENTS UNLESS YOU ARE AUTHORIZED TO DO SO.

DESTRUCTION NOTICE

WHY—To prevent the enemy from using or salvaging equipment for his benefit.

WHEN—Ordered by your commander, or when you are in immediate danger of capture.

HOW—1. Smash.—Use sledges, axes, hand-axes, pick-axes, crowbars, heavy tools, trucks, tanks, etc.

2. Cut.—Use axes, hand-axes, machete etc.

3. Burn.—Use gasoline, kerosene, alcohol, oil, flammable liquids, incendiary grenades, etc.

4. Explosives.—Use firearms, grenades, TNT, etc.

5. Disposal.—Bury broken pieces in slit trenches or other holes. Throw in streams, scatter.

6. USE ANYTHING IMMEDIATELY AVAILABLE FOR THE DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. Smash.—Oscillograph equipment IE-14-(*), galvanometer magnet with oscillograph units, spare oscillograph lamps, automatic camera, magazine, motor, lenses, mirror, fork, timing motor, counter, clock, sockets, terminals, ends, bottom.

Control Board BD-85-(*): all meters, knobs, terminals, attenuators, transformers, fuses, sockets, resistor, jack, top, side, ends, bottom.

Relay unit BK-9-(*): relays, rheostat, resistors, capacitor, housing.

Switchboard BD-62-(*): panel, sockets, drops, key switches, resistors, jacks, fuses, relays, transformer, coils, top, bottom.

Other central station equipment: batteries, telephone chest sets, supporting frame, protector housing and assembly, all test sets, all tool sets, spare parts, photographic plates, chest.

Microphone T-21-(*): microphone unit including head and plugs, tubes, relay, batteries, capacitors, resistor, chassis, housing, shelter, Protector AR-4.

Output Unit BE-51: meter, resistor, switch, case.

Outpost Connecting Box BE-71: terminals, capacitor, box.

2. Cut.—All cords, wires, tubing, bags, covers.

3. Burn.—Pile up and burn all broken pieces, covers, wires, cords, circuit diagrams, instruction book, ing paper, photographic materials.

4. Explosives.—Use any explosives on parts.

5. Disposal.—Bury all broken pieces. Microphone can be buried in microphone holes.

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SAFETY NOTICE

EQUIPMENT USES VOLTAGES HIGH ENOUGH TO BE DANGEROUS TO HUMAN LIFE. DON'T ATTEMPT ANY REPAIR OR ADJUSTMENT WITHIN THE EQUIPMENT WHILE CURRENT IS ON. DON'T UNDERTAKE THE REPAIR OF THE EQUIPMENT OR ITS ASSOCIATED COMPONENTS UNLESS YOU ARE AUTHORIZED TO DO SO.

DESTRUCTION NOTICE

WHY—To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—Ordered by your commander, or when you are in immediate danger of capture.

HOW—1. Smash.—Use sledges, axes, hand-axes, pick-axes, hammers, crowbars, heavy tools, trucks, tanks, etc.

2. Cut.—Use axes, hand-axes, machete etc.

3. Burn.—Use gasoline, kerosene, alcohol, oil, flame-throwers, incendiary grenades, etc.

4. Explosives.—Use firearms, grenades, TNT, etc.

5. Disposal.—Bury broken pieces in slit trenches, fox-holes, other holes. Throw in streams, scatter.

6. USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. Smash.—Oscillograph equipment IE-14-(*): galvanometer magnet with oscillograph units, spare oscillograph units, lamps, automatic camera, magazine, motor, lenses, mirrors, tuning fork, timing motor, counter, clock, sockets, terminals, top, sides, ends, bottom.

Control Board BD-85-(*): all meters, knobs, terminals, keys, attenuators, transformers, fuses, sockets, resistor, jack strip, panel, top, side, ends, bottom.

Relay unit BK-9-(*): relays, rheostat, resistors, capacitor, chassis, housing.

Switchboard BD-62-(*): panel, sockets, drops, keys, capacitors, resistors, jacks, fuses, relays, transformer, coils, top, back, ends, bottom.

Other central station equipment: batteries, telephones, headsets, chest sets, supporting frame, protector housing and internal assembly, all test sets, all tool sets, spare parts, photographic supplies, chest.

Microphone T-21-(*): microphone unit including condenser head and plugs, tubes, relay, batteries, capacitors, resistors, sockets, chassis, housing, shelter, Protector AR-4.

Output Unit BE-51: meter resistor, switch, case.

Outpost Connecting Box BE-71: terminals, capacitor, choke-coil, box.

2. Cut.—All cords, wires, tubing, bags, covers.

3. Burn.—Pile up and burn all broken pieces, chests, bags, covers, wires, cords, circuit diagrams, instruction books, recording paper, photographic materials.

4. Explosives.—Use any explosives on parts not smashed.

5. Disposal.—Bury all broken pieces. Microphone stations can be buried in microphone holes.

SOUND RANGING SET GR-3

Section I DESCRIPTION

Use and characteristics
 Major components
 Packing of major components
 Description of central station equipment
 Description of microphone equipment
 Description of outpost equipment

1. USE AND CHARACTERISTICS.

a. Sound Ranging Set GR-3-C is designed to detect artillery fire or shell detonation and record the difference of time of the sound wave at a maximum of eight microphones. The microphones may be placed in various geometric configurations (line, arc, triangle, space array) at intervals of a maximum of 2,000 yards. Either one of two outpost stations may be placed forward of the array of microphones at a distance sufficient to detect the sound wave and start operations of the recording equipment before the sound reaches the microphones.

b. The signal detected by each microphone is localized and transmitted over wire lines to a central station where it is recorded photographically by an oscillograph. The recording identifies characteristics of the sound waves and is used in determining the differences in times of arrival of the same sound at different microphones. This is explained in detail in FM 7-2, Artillery Field Manual, The Observation Battalion.

c. The weights of the individual chests when packed for transportation are as follows:

Chest	Weight, pounds
CH-40- (*)	205
CH-44- (*)	70
CH-45- (*)	116
CH-46- (*)	75
CH-47- (*)	95
CH-48- (*)	160

(*) The asterisk within parenthesis denotes the fixed letter.

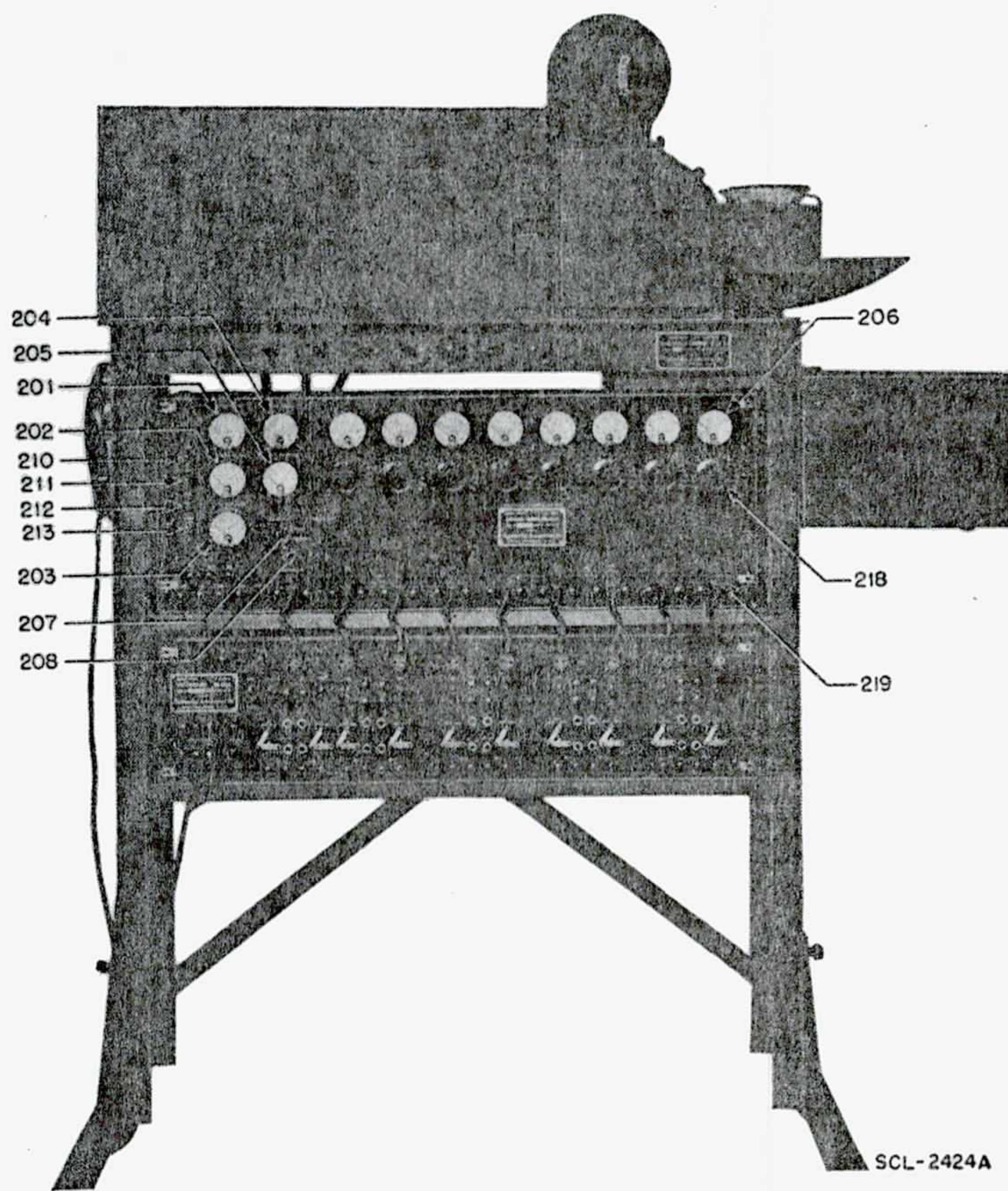


Figure 1.—Sound Ranging Set GR-3-C—recording equipment assembly.

SOUND RANGING SET GR-3-C**Section I****DESCRIPTION**

	Paragraph
Use and characteristics	1
Major components	2
Packing of major components	3
Description of central station equipment	4
Description of microphone equipment	5
Description of outpost equipment	6

1. USE AND CHARACTERISTICS.

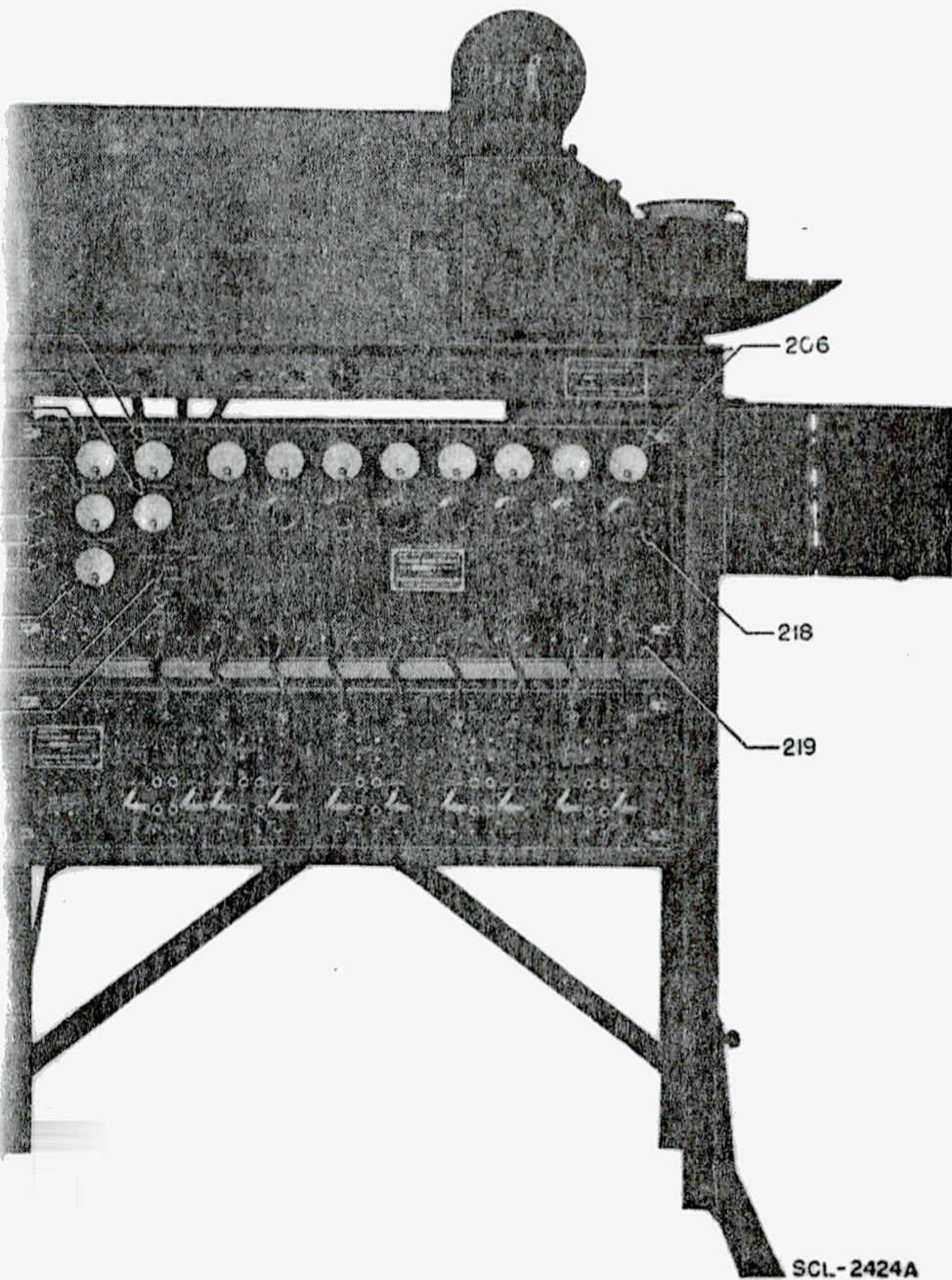
a. Sound Ranging Set GR-3-C is designed to detect the sound of artillery fire or shell detonation and record the difference in arrival time of the sound wave at a maximum of eight microphone locations. The microphones may be placed in various geometrical configurations (line, arc, triangle, space array) at intervals up to a maximum of 2,000 yards. Either one of two outposts are located forward of the array of microphones at a distance sufficient to intercept the sound wave and start operations of the recording equipment before the sound reaches the microphones.

b. The signal detected by each microphone is locally amplified and transmitted over wire lines to a central station where it is recorded photographically by an oscillograph. The record exhibits identifying characteristics of the sound waves and is used for reading the differences in times of arrival of the same sound at the different microphones. This is explained in detail in FM 6-120, Field Artillery Field Manual, The Observation Battalion.

c. The weights of the individual chests when packed for transportation are as follows:

<i>Chest</i>	<i>Weight, packed</i>
CH-40- (*)	205 lbs.
CH-44- (*)	70 lbs.
CH-45- (*)	116 lbs.
CH-46- (*)	75 lbs.
CH-47- (*)	95 lbs.
CH-48- (*)	160 lbs.

(*) The asterisk within parenthesis denotes the applicable suffix letter.



1.—Sound Ranging Set GR-3-C—recording equipment assembly.

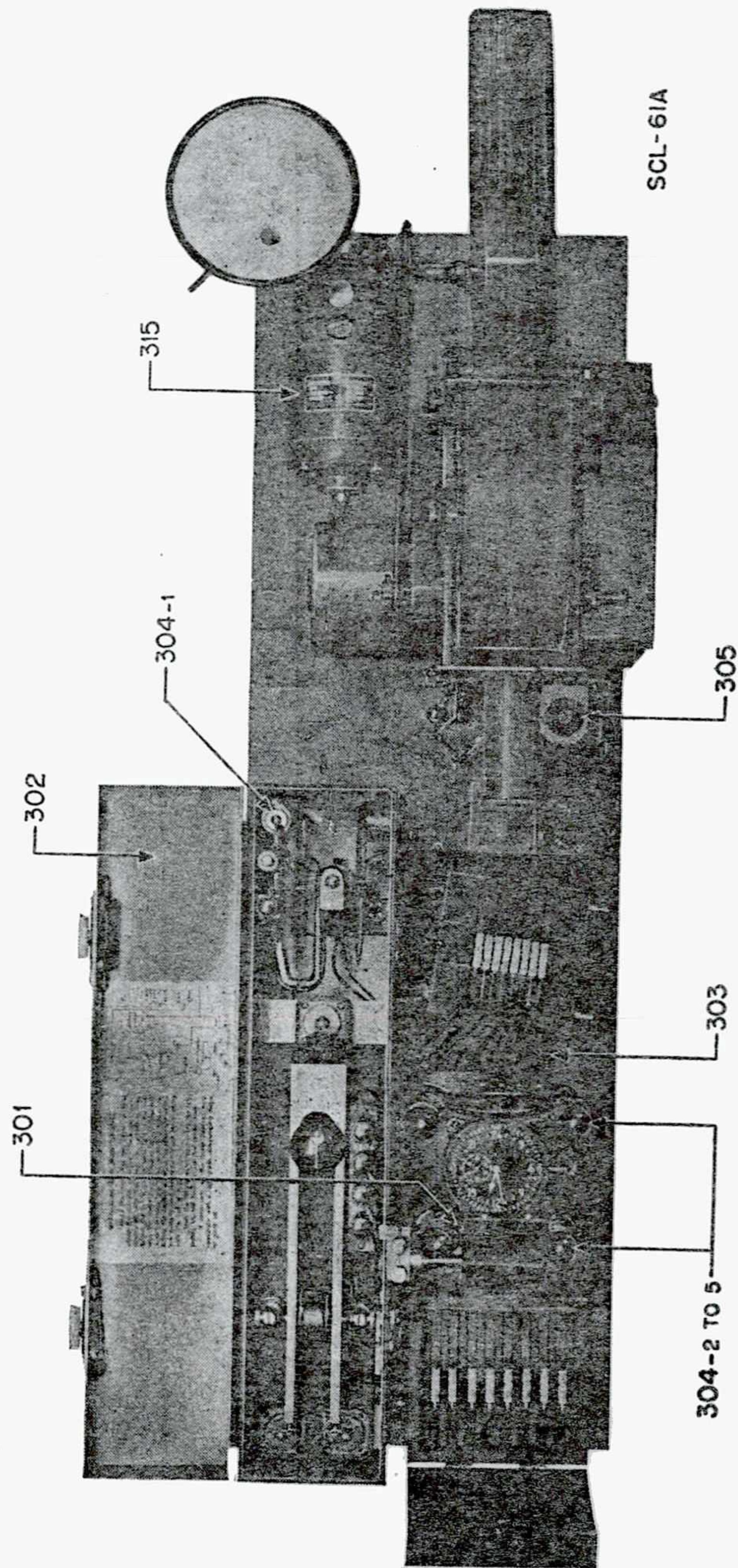


Figure 2.—Oscillograph Equipment IE-14(*)—top view with covers removed.

d. The set, as issued, does not include necessary field wire, battery charger, or transportation equipment. Spare parts, accessories, and supplies sufficient for operation during normal supply intervals are included. The complete equipment, including packed chests ready for transport, and all auxiliary equipment, weighs approximately 2,600 pounds and displaces approximately 60 cubic feet.

e. References made to type numbers, followed by parentheses (*), will be understood to cover interchangeable components as follows:

Reference	Includes
Chest CH-40-(*)	Chests CH-40-B and CH-40-C
Chest CH-44-(*)	Chests CH-44-A and CH-44-C
Chest CH-45-(*)	Chests CH-45-A and CH-45-C
Chest CH-46-(*)	Chests CH-46-A and CH-46-C
Chest CH-47-(*)	Chests CH-47-A and CH-47-C
Chest CH-48-(*)	Chests CH-48-A and CH-48-C
Control Board BD-85-(*)	Control Boards BD-85-A and BD-85-C
Handset TS-9-(*)	Handsets TS-9-A through TS-9-Q
Microphone T-21-(*)	Microphones T-21-B and T-21-C
Oscillograph Equipment IE-14-(*)	Oscillograph Equipments IE-14 and IE-14-C.
Relay Unit BK-9-(*)	Relay Units BK-9 and BK-9-C
Switchboard BD-62-(*)	Switchboards BD-62-B and BD-62-C
Telephone EE-8-(*)	Telephones EE-8-A and EE-8-B
Test Set EE-65-(*)	Test Sets EE-65-A through EE-65-D

2. MAJOR COMPONENTS.

The major components of Sound Ranging Set GR-3-C are as follows:

	Dimensions (in inches)	Unit Weight (pounds)
Oscillograph Equipment IE-14-(*)	19 x 11 x 36½	90
Control Board BD-85-(*)	12½ x 8¾ x 32¾	36

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SOUND RANGING SET GR-3-C

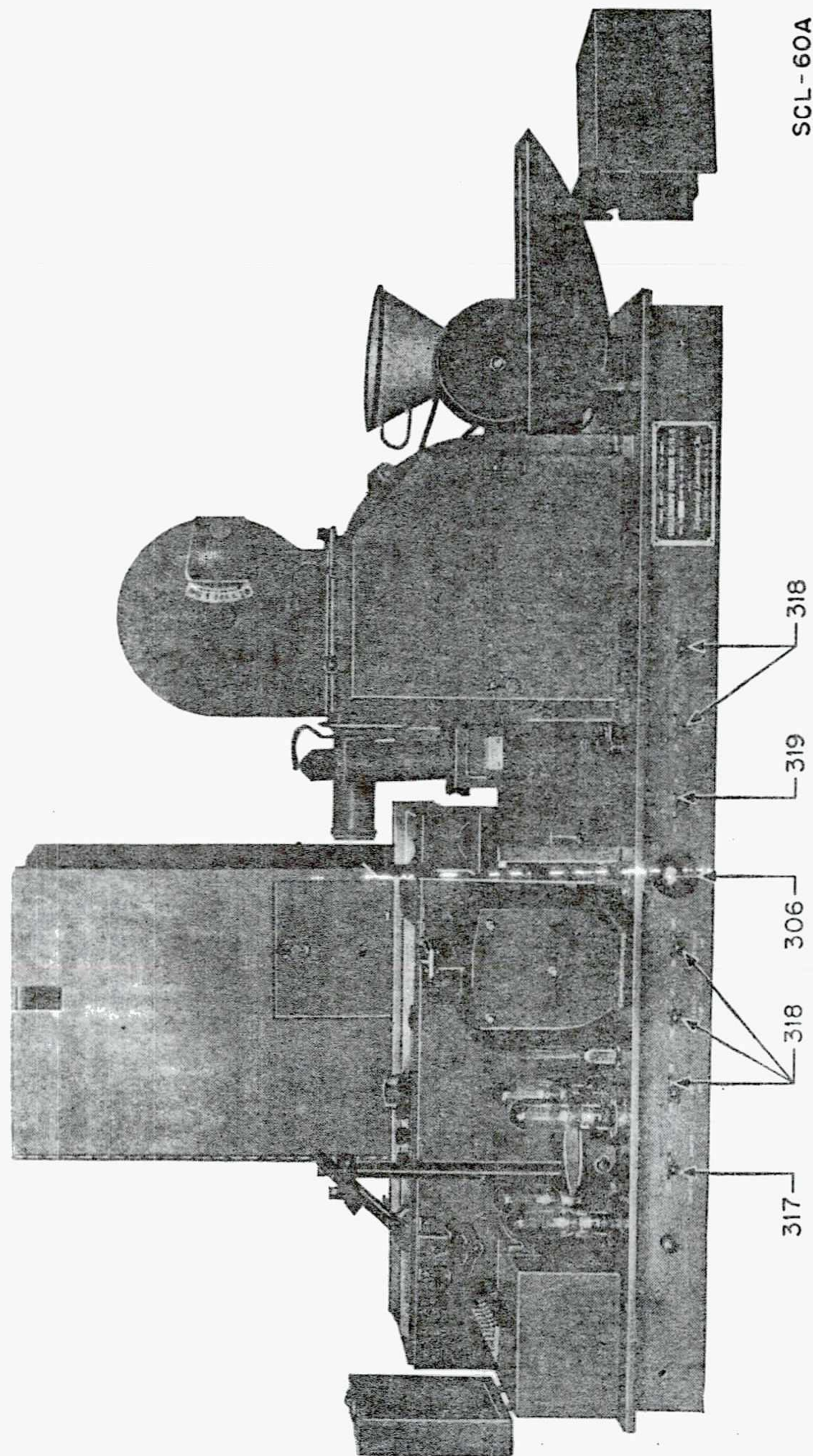


Figure 3.—Oscillograph Equipment IE-14(*)—side view with covers removed

	<i>Dimensions (in inches)</i>	<i>Unit Weight (pounds)</i>
Switchboard BD-62-(*)	8½ x 8 ¾ x 32¾	27.4
Relay Unit BK-9-(*) (includes one spare)	4½ x 8 x 4½	6
Protector AR-8	16 x 12 diam.	13
Microphone T-21-(*)	16 x 6 diam.	24
Microphone Shelters BE-66-A	21 diam.	4
Protector AR-4	7⅝ x 3½ x 3	1
Bag (for microphone) BG-97	18 x 5 x 2	1
Outpost Unit BE-51	2½ x 3¼ x 7	6
Outpost Connecting Box BE-71	4½ x 2 x 1½	1
Telephones EE-8-(*)	3½ x 7⅞ x 9½	4
Tool Set TE-6	6 cu. ft.	108
Tool Equipment TE-37	4 x 2 diam.	.75
Test Set EE-65-(*). (See note)	8 x 10 x 6	14
Test Set I-56-C	11 x 13½ x 9½	26
Chest CH-40-(*)	11 x 25¼ x 47½	35
Chest CH-44-(*)	15¾ x 14½ x 25½	46
Chest CH-45-(*)	13¼ x 15½ x 48½	57
Chest CH-46-(*)	13⅛ x 12½ x 36½	34
Chest CH-47-(*)	16⅝ x 12¼ x 38¼	37
Chest CH-48-(*)	17⅜ x 14¾ x 43¼	53
Chest BC-5	28⅞ x 18⅞ x 12	35
Cover (for oscillograph assembly) BG-74	18 x 18 x 4	8.5

Note: Test Sets EE-65-A (3F4065A) through EE-65-D (3F-4065D) may be issued.

3. PACKING OF MAJOR COMPONENTS.

All units of the equipment can be packed in chests for convenient transportation so that ordinary handling will not affect per-

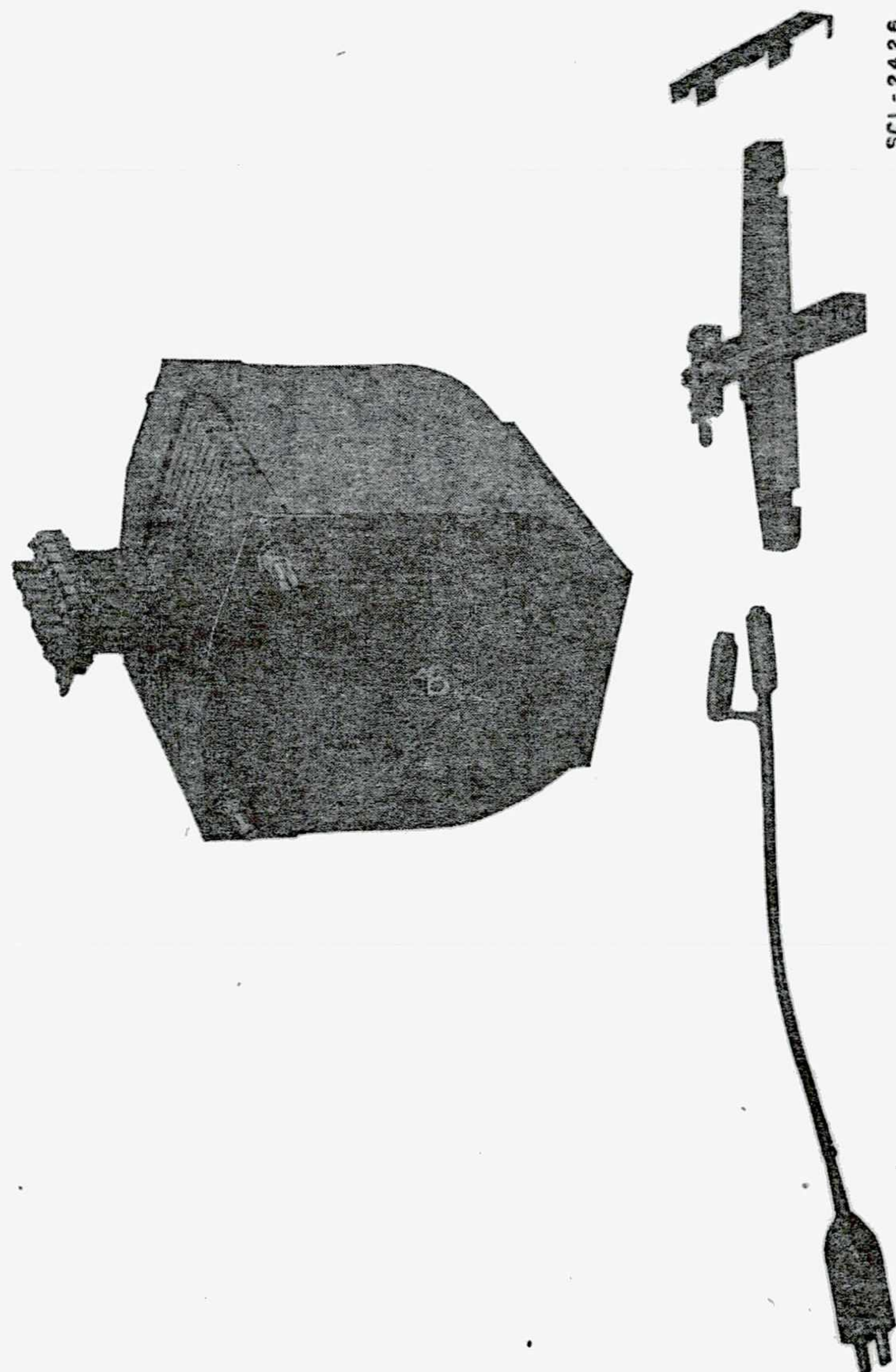


Figure 4.—Galvanometer magnet assembly, Cord CD-475, and Oscillograph Unit M-166-A.

formance. Chest BC-5 is used for general purposes. The other chests (figs. 5 and 6) are used specifically as follows:

- a. Chest CH-40-(*)
Microphones T-21-(*)
- b. Chest CH-44-(*)
Lamps
Tubes
Miscellaneous small items
- c. Chest CH-45-(*)
Relay Unit BK-9-(*) (spare)
Framework of Oscillograph Equipment IE-14-(*)
Magazines, fixing tray, and roller
- d. Chest CH-46-(*)
Switchboard BD-62-(*)
- e. Chest CH-47-(*)
Control Board BD-85-(*)
Relay BK-9-(*)
- f. Chest CH-48-(*)
Oscillograph Equipment IE-14-(*), less framework

4. DESCRIPTION OF CENTRAL STATION EQUIPMENT.

a. General.

The central station equipment includes the following:

- (1) Recording equipment assembly
- (2) Testing equipment
- (3) Tools
- (4) Photographic supplies
- (5) Batteries and spare parts
- (6) Packing equipment
- (7) Protector AR-8
- (8) Cord CD-250-A

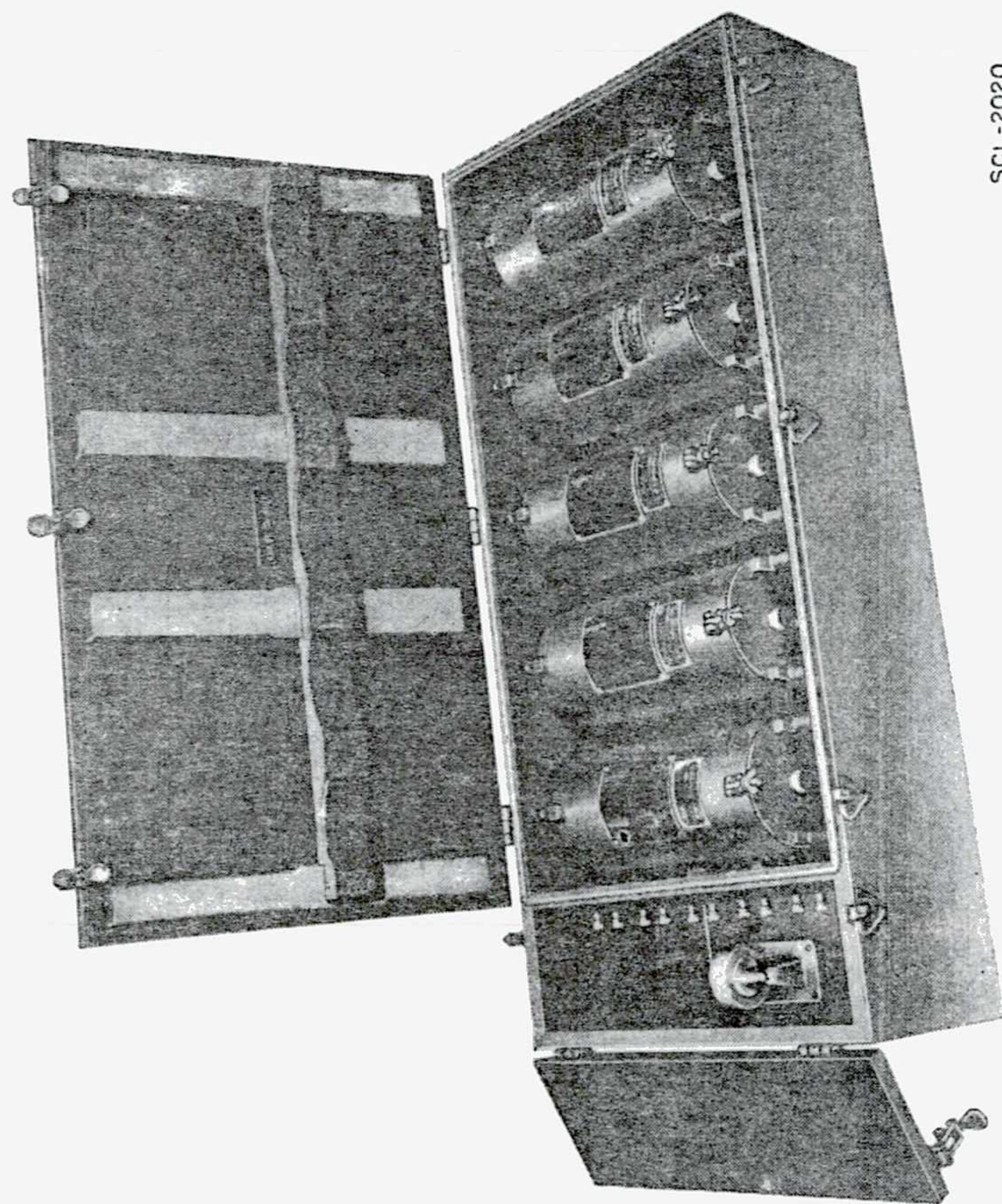


Figure 5.—Chest CH-40-(*), showing pistonphone and five Microphones T-21-(*).

b. Recording Equipment Assembly.

The recording equipment (fig. 1) consists of the following major components:

Oscillograph Equipment IE-14-(*), with Oscillograph Units M-166-A

Control Board BD-85-(*)

Switchboard BD-62-(*)

Relay Unit BK-9-(*)

(1) Oscillograph Equipment IE-14-(*), includes the framework and equipment mounted on its upper portion (figs. 2 and 3). This equipment consists of the timing unit, the galvanometer magnet, the identification panel, suitable lamps and optical system, the automatic camera with magazine, the fixing tray, and covers to prevent entrance of stray light. An operating panel is located on the lower front part of the equipment.

(2) Oscillograph Units M-166-A (fig. 4) are designed to fit into the galvanometer magnet of Oscillograph Equipment IE-14-(*). Eight are in use and eight are stored in a box mounted on the left end of the table top. Electrical connection to Oscillograph Equipment IE-14-(*), is made with Cords CD-475.

(3) Control Board BD-85-(*), (figs. 1 and 14) is housed in a metal case with the control panel forming the front. This unit is mounted in the middle part of the oscillograph assembly.

(4) Switchboard BD-62-(*), (figs. 1 and 12) is housed in a metal case with the operating panel forming the front. This unit is mounted below Control Board BD-85-(*), in the assembly.

(5) Connection is made between Control Board BD-85-(*), and Oscillograph Equipment IE-4-(*), with one Cord CD-443 and two Cords CD-444. These consist of multiple conductor cordage terminated with suitable plugs. Connection is made between Control Board BD-85-(*), and Switchboard BD-62-(*), with jumper wires connecting corresponding binding post terminals for the power circuits, and with Cords CD-428 for the microphone and outpost lines. These cords consist of two-conductor cordage terminated with suitable plugs to permit an easy reversal of polarity. Binding posts paralleling the plug sockets in Control Board BD-85-(*), and Switchboard BD-62-(*), are for emergency use.

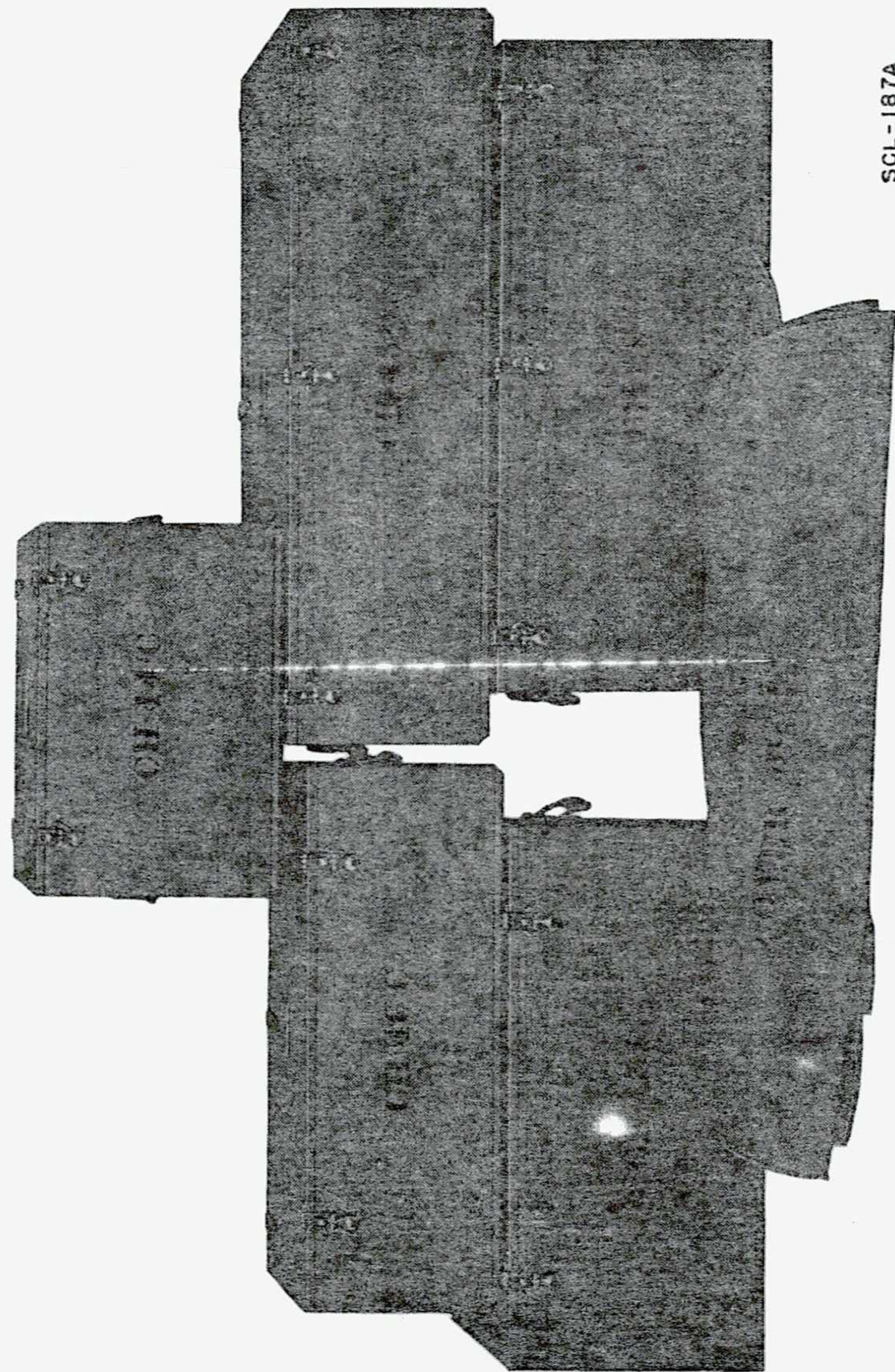


Figure 6.—Chests CH-44-(*), CH-45-(*), CH-46-(*), CH-47-(*), CH-48-(*), and Cover BG-74

(6) Relay Unit BK-9-(*) (fig. 14) fits into the left end of Control Board BD-85-(*), and is accessible through an opening in the control-box housing.

c. Testing Equipment.

The testing equipment consists of the following:

(1) Test Set EE-65-(*) is designed for testing and locating trouble on magneto telephone lines and equipment. (This test set is covered in TM11-361.)

(2) Test Set 1-56-C is a universal radio servicing set consisting of a radio set analyzer, output meter, voltohmmeter, and tube checker. Power supply for the tube checker is obtained from a 110-120-volt, 60-cycle, a-c line. A pamphlet of instructions is supplied with this test set.

(3) Photographer's Thermometer PH-28 is used to check the temperature of photographic chemical solutions.

(4) Chest CH-40-(*) (fig. 5) is a combined carrying chest for Microphones T-21-(*) and a testing chamber to check the operation of the complete sound recording channels. The microphone compartment is air-tight. At one end of the chest and connected to the microphone compartment is a pistonphone which provides a uniform sinusoidal variation in pressure over the frequency range necessary to determine the over-all response characteristic of each channel.

(5) The battery tester permits the reading of the voltage of each storage battery cell under load, and gives an indication of the internal condition of the battery.

d. Tools.

The tools consist of Clamp MM-7 (for use in replacing microphone diaphragms), a Soldering Iron TL-139, Tool Set TE-6, and Tool Equipment TE-37. See list of Replaceable Parts (par. 38).

e. Photographic Supplies.

The photographic supplies are given in the parts list, paragraph 39.

f. Batteries.

The batteries in use, the spare batteries, and spare parts are given in the list of components (par. 39).

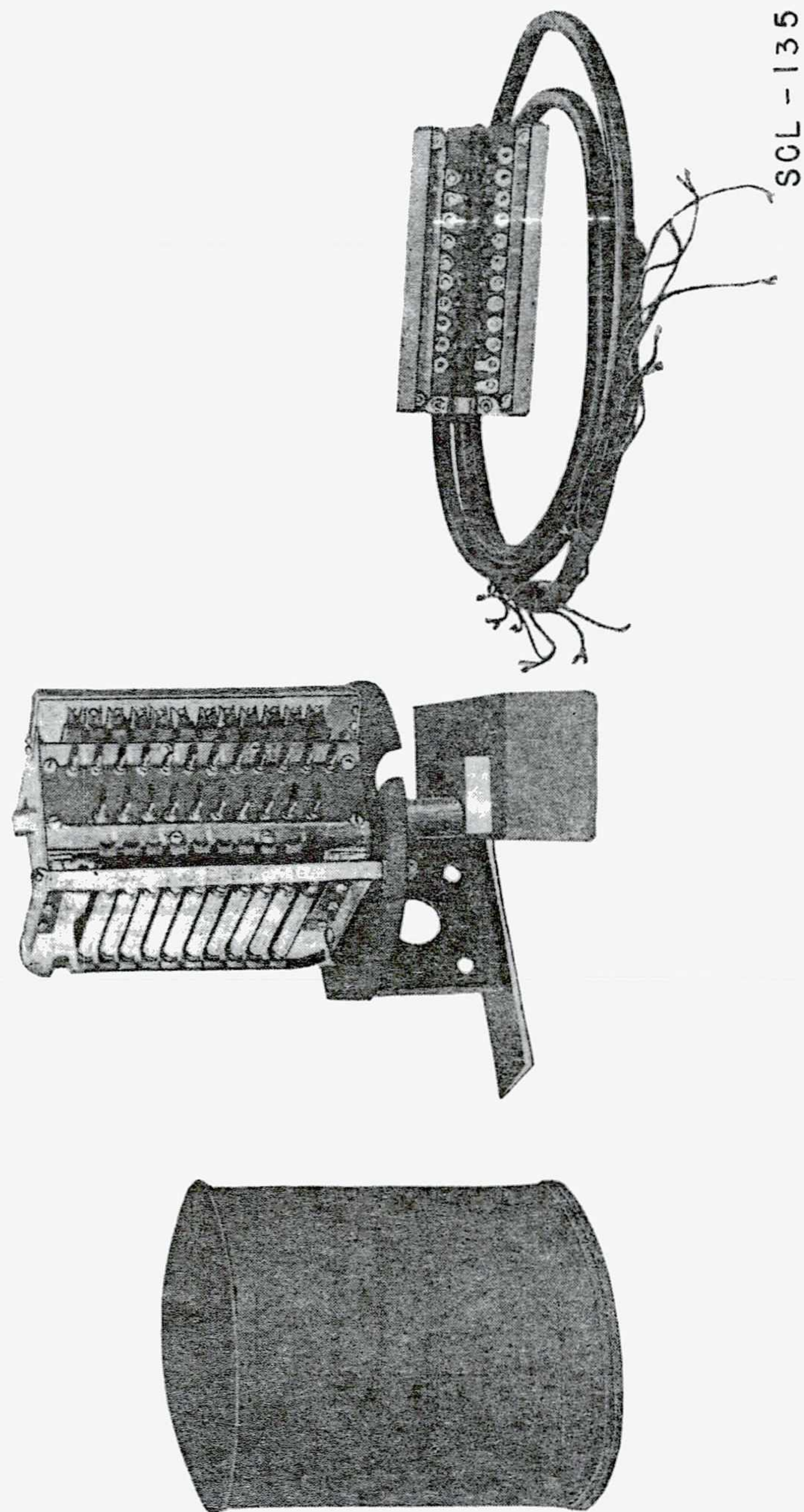


Figure 7.—Protector AR-8 (disassembled) and Cord CD-250-A.

g. Packing Equipment.

The packing equipment consists of the chests given in the list of components and shown in figures 5 and 6. They are made of wood and have hinged covers secured by rugged clamps. Each chest is provided with carrying handles.

h. Protector.

Protector AR-8 (fig. 7), normally installed at the line terminal, is an assembly of fuses and spark-gap blocks mounted in a round galvanized iron case.

i. Cord CD-250-A.

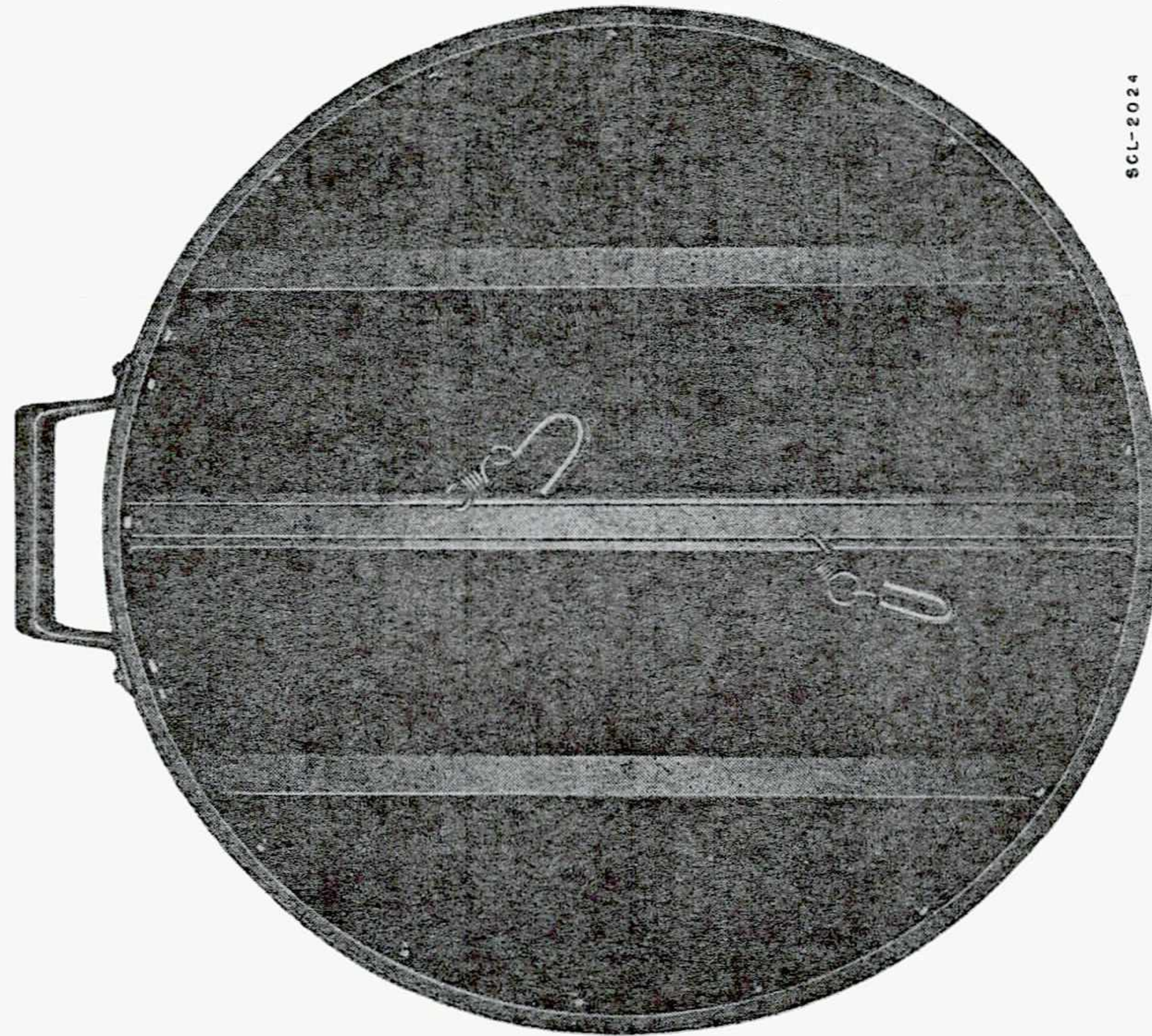
Cord CD-250-A (fig. 7) is used to connect the incoming terminals of Switchboard BD-62-(*) to Protector AR-8. The bakelite plug at one end of Cord CD-250-A fits into Protector AR-8. This permits quick connection of the incoming lines to the recording equipment assembly (fig. 1).

5. DESCRIPTION OF MICROPHONE EQUIPMENT.

Each microphone equipment consists of one Microphone T-21-(*), one Insulating Bag BG-97 (fig. 8), one Microphone Shelter BE-66-A (fig. 9), and one Protector AR-4. The microphone is of the condenser type. A cylindrical metal case about 14 inches long and 6 inches in diameter, with a carrying handle, is part of this microphone. The microphone is inclosed in Bag BG-97 to prevent earth grounding of the microphone case. The microphone shelter is made of metal and canvas, and is about 20 inches in diameter. It has two insulating spring hooks on which to hang the microphone. Protector AR-4 has two fuses mounted in a small metal container.

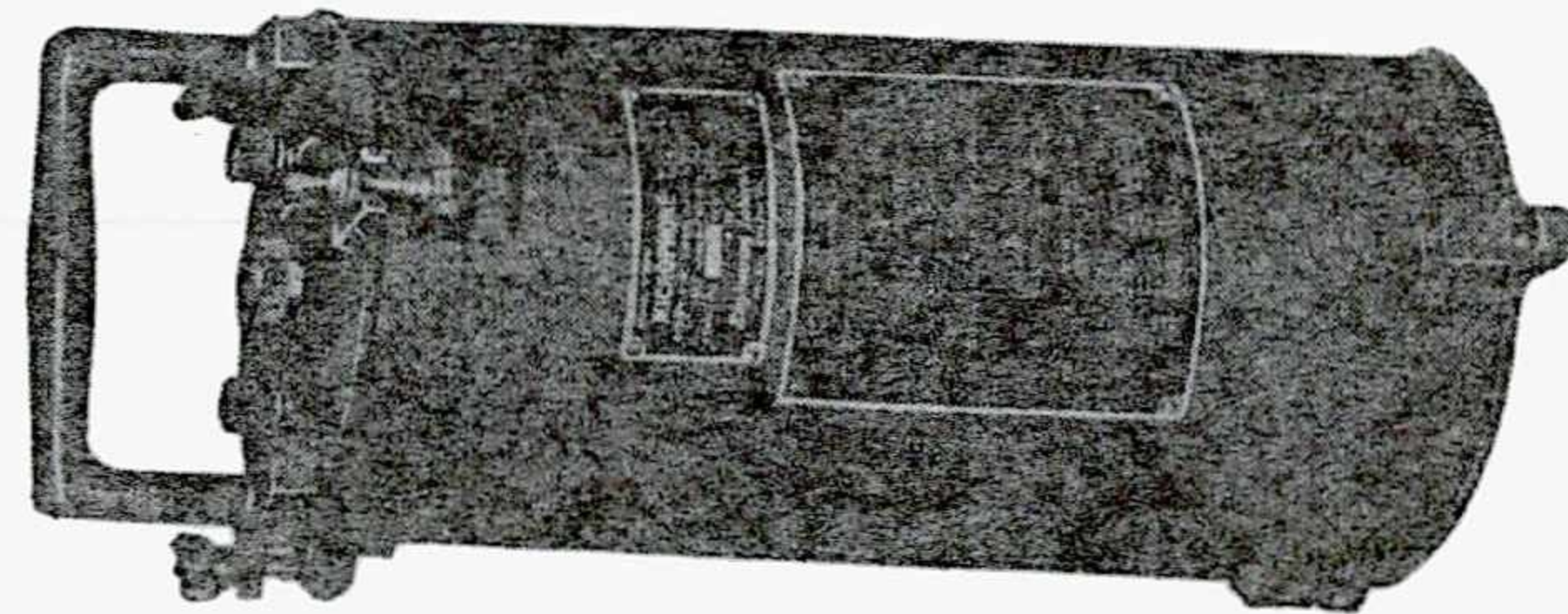
6. DESCRIPTION OF OUTPOST EQUIPMENT.

Each outpost equipment consists of one Outpost Unit BE-51, one Outpost Connecting Box BE-71, and normally, one Telephone EE-8-(*). These items are shown in figure 10. The outpost unit consists of a milliammeter and push switch mounted in a leather case with a carrying strap. The outpost connecting box is a small unit that can be snapped on the telephone carrying strap. It connects the outpost unit and telephone to the line.



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Figure 9.—Microphone Shelter BE-66-A.



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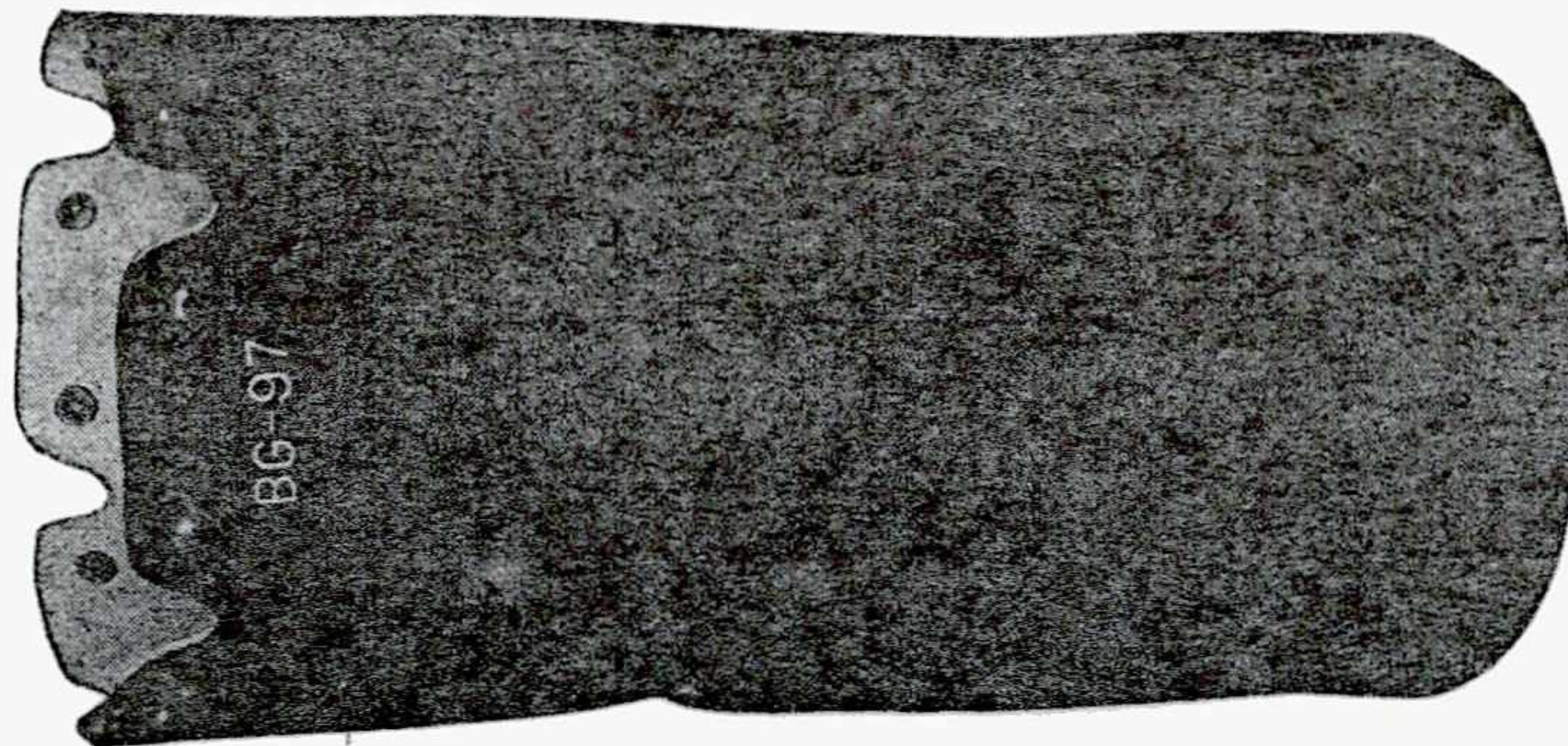


Figure 8.—Microphone T-21-(*) and Insulating Bag BG-97

Section II

INSTALLATION AND OPERATION

	Paragraph
Initial procedure	7
Installation	8
Cords	9
Batteries	10
Fuses, vacuum tubes, and lamps	11
Switchboard BD-62-(*)	12
Control Board BD-85-(*)	13
Oscillograph Equipment IE-14-(*)	14
Relay Unit BK-9-(*)	15
Protector AR-8	16
Microphone equipment	17
Outpost equipment	18
Preliminary over-all tests	19
Operation	20

7. INITIAL PROCEDURE.

Take care in unpacking and handling this equipment. Check the items given in the parts list, (paragraph 39).

8. INSTALLATION.

Assemble the recording equipment as illustrated in figure 1, using the wing nuts provided for the purpose. If the central station is a truck or a trailer, bolt the oscillograph assembly to the floor of the vehicle. If the central station is to be a casemate, a dugout, or a laboratory, bolt the recording equipment assembly to a planking. This planking either should be sufficiently wide, or should be secured to the flooring, to prevent the assembly from tipping over. Protect the recording equipment assembly from dust by Cover BG-74 (fig. 6), when not in use.

9. CORDS.

Test all cords for shorts or breaks before installation. Cords CC-66 and CC-67 are used to switch or patch connections on Switch-

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Batteries BA-30 must be installed upside down in the cylindrical holders of Microphone T-21-(*).

11. FUSES, VACUUM TUBES, AND LAMPS

a. Fuses.

Insert the fuses in Control Board BD-85-(*) and in Switchboard BD-62-(*) as indicated in the circuit diagrams, figures 13 and 15.

b. Vacuum Tubes.

Check the vacuum tubes for filament *open* and for plate or grid short circuits, before inserting them in Microphones T-21-(*).

c. Lamps.

(1) Inspect the lamps before insertion in Oscillograph Equipment IE-14-(*). The recording lamp, Lamp LM-40, is a straight-filament, 4.2-volt lamp. The identification lamps and the time lamp are Lamps LM-30.

(2) Make connection to the stud of the time lamp by means of a short jumper wire, soldered in place.

12. SWITCHBOARD BD-62-(*).

a. Drops.

Adjust the tension of the drop-retaining springs so that the drops are easily operated by the ringing of Telephone EE-8-(*) through a 10,000-ohm resistance. The drops of the microphone and auxiliary circuits should also operate when the 0.5- μ f capacitor is introduced in the drop circuit by placing the corresponding keys in the upward position. Check to see that the operation of all drops places a ground on the alarm circuit.

b. Ringing Circuit.

The ringing is effected by means of two mutually interrupting relays which operate from the 24-volt battery at the rate of 16 to 22 interruptions per second. This rate should be maintained. Regulate it by varying the tension of the relay spring with the tools furnished in Tool Equipment TE-37. Also, take care that the ringing relay (that is, the relay which connects two taps of the ringing transformer alternately to the 24-volt supply) is in the operated position

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about the same length of time that it is in the non-operated position. This can be checked visually, when the relays are operating, by observing the relative brightness of the movable springs as they appear stationary in both positions at once.

13. CONTROL BOARD BD-85-(*).

See paragraphs 9a, 9b, and 9c for cord connections, batteries, and fuses, respectively, for Control Board BD-85-(*).

14. OSCILLOGRAPH EQUIPMENT IE-14-(*).

a. Optical System.

The optical system for Oscillograph Unit M-166-A consists of the recording lamp, the lens on the face of the oscillograph unit, the mirror on the suspension, and the cylindrical lens on the camera. The length of the optical path between the recording lamp and the photographic paper is fixed. Adjust the position of the cylindrical lens by turning the lens mounting screws at the front of the camera. This position, however, is critical, has been accurately set, and should not require readjustment. To gain access to the lens for cleaning, loosen the front plate locking screw and drop the plate forward.

b. Recording Lamp.

The recording lamp has a base of the pre-focus type to insure that the lamp will remain firmly in position and that a new filament will occupy, within very close limits, the same position as the old filament when a recording lamp is replaced. To insure good photographic records of the filament trace, make these three adjustments on the recording lamp mount:

(1) First loosen the locking nut and rotate the lamp socket. Rotation is on a longitudinal axis passing through the filament, so that the position of the filament is not changed. Rotation selects that position of the lamp which eliminates secondary light sources, and thus prevents the formation of ghost images on the photographic paper.

(2) The lamp may be rotated on an axis at right angles to and passing through the center of the filament. This makes it possible to adjust the filament accurately to the vertical position necessary to

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obtain thin sharp traces on the record. Check the adjustment by viewing the points of light on the photographic paper through the peep-hole provided in front of the camera. The best adjustment is attained when these points are as small as possible.

(3) The vertical translation of the lamp is done by operating a rack and pinion arrangement at the left of the recording lamp housing. This provides for rapid vertical adjustment of the group of light images with respect to the camera lens and the viewing mirror, by changing the angles of incidence and reflection of the light beam at the mirror of the oscillograph unit.

c. Oscillograph Unit M-166-A.

(1) Eight of these units are assembled in a common galvanometer magnet (fig. 4), and each is connected to a sound channel by a Cord CD-475. The assembly is permanently mounted on Oscillograph Equipment IE-14-(*). Do not remove the individual elements except for replacement of mirror adjustment. Keep the lens, mounted at the front of each oscillograph unit, free from dust.

(2) The position of the galvanometer assembly is permanently fixed to give properly focused images at the photographic paper. All images should be equally spaced, sharp, in the proper order, and of approximately the same length. The vertical positions should be the same within $\frac{1}{8}$ inch. About one-third of each image should fall on the viewing screen, the other two-thirds should be projected on the recording lens of the camera. The positions of the viewing screen and the elongated mirror are so adjusted that when sharp and properly spaced images are formed on the viewing screen, sharp and properly spaced lines will also be made on the record. However, if this is not the case, readjust the elongated mirror and the viewing screen to their normally correct positions.

(3) Routine adjustment has been provided only for the spacing of the images by rotation of the suspension. To do this turn the slotted pin at the top of the element with a screw driver. Adjustment of the vertical position should ordinarily not be necessary because the oscillograph units, as supplied, are properly aged and adjusted. However, should readjustment be necessary, as when a unit requires replacement, carefully bend the mirror support so that the vertical tilt of the mirror is changed. Proceed as follows:

(a). Disconnect Cord CD-475.

(b). Loosen the three thumbscrews holding together the galvanometer assembly.

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(c). Insert the tip of a screw driver in the space between the unit and the magnet at the rear of the assembly and pry that end of the unit loose from the magnet. With this end free from contact with the magnet, pry the front end loose with the screw driver. The unit may then be removed from the assembly.

NOTE.—When making adjustment for vertical position, it is advisable to remove only one oscillograph unit at a time from the assembly. Replace each adjusted unit before another is removed. As many as four units may be removed at any one time. Should it become necessary to remove more than four units, first place a soft iron keeper across the magnet to prevent partial demagnetization.

(d). Remove the dust cover, and place the unit on the pins at the side of the magnet. The unit is now in line with the other units in the assembly.

(e). Rotate the recording lamp housing until light falls upon the mirror of the unit. Rotate the suspension until the image is very close to the other images. The unit is now ready for adjustment. With a pair of brass tweezers, grasp the mirror support carefully, and bend until the tilt of the mirror is such that the reflected image is vertically in line with the others. Remove the unit from the pins, replace the dust cover, and install the unit in the galvanometer assembly. Reset the recording lamp cover to its normal position, and rotate the suspension of the unit until its image is properly spaced with respect to the others.

(f). Adjust the tension on the suspension with the small screw at the bottom of the unit. Turning the screw to the right increases the tension by stretching the small coil spring to which the lower suspension of the moving system is attached. Tension should be the minimum required for stability, i.e., just enough to keep the moving system from "swaying" when the oscillograph assembly is gently rocked.

d. Timing Unit.

(1). *Tuning Fork*.—Adjust the tuning fork driving contact so that the unit is self-starting when the circuit is closed after the tuning fork comes to a complete rest. The time motor driving contact must be barely open when the tuning fork is at rest. With these adjustments the frequency of the tuning fork will be 100 cycles per second, to within 1 part in 2,000.

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(2). *Time Lamp*.—Adjust the position of the time lamp and reflecting mirror so that the light from the time lamp passing through the largest slot of the time wheel falls squarely on the recording lens of the camera.

(3). *Time Wheel*.—Adjust the time wheel and the two-spoke wheel so that once in every 10 revolutions of the time wheel the large spoke of the two-spoke wheel obliterates all light that otherwise would pass through the largest slot of the time wheel, without obliterating the light that passes through the two adjacent small slots. Adjust the length of the small spoke of the two-spoke wheel so that once every 10 revolutions of the time wheel one-half of the largest slot in the time wheel is in shadow, and the light that otherwise would pass through this part of the slot is obliterated. The time wheel is not self-starting and should be started by turning the starting knob to the right.

e. Identification Panel.

(1). *General*.—The identification panel consists of the counter and the clock. The clock is of the 8-day type stem-wind and stem-set. The face has a 24-hour dial. Close the cover during non-operating periods to prevent the entrance of dust. Illumination for photographing is provided by four Lamps LM-30.

(2). *Identification mirror and lens*.—Clean the identification mirror and lens with ether and soft cotton. They should be so adjusted that a complete, sharp image of the identification panel is projected on the recording paper. In making this adjustment, the image of the identification panel may be observed on a short strip of recording paper inserted in the top part of the camera.

f. Camera.

(1). *Motor*.—The camera motor is of the governed type. The governor is mounted at one end of the motor shaft and the speed of the motor is controlled by rotating the governor head. Rotating to the right *decreases* the motor speed. Adjust the motor speed so that the linear speed of the film is approximately 6 inches per second.

(2). *Feed rollers and cutter*.—Make certain that the cutter is free of any paper that may have accumulated in the knurling of the roller. When the cutter is in the released position, the fixed feed roller should take a firm grip on the recording paper. In the oper-

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ated position of the cutter, the idle roller should clear the recording paper, and, on release of the cutter, should not engage the paper before the movable slot with the movable cutting blade has cleared the fixed cutting blade. The cutter should operate cleanly and crisply. If failure occurs, install a complete new cutter assembly. A spare feed roller is furnished with each Sound Ranging Set GR-3-C. The backstop of the cutter and the position of the solenoid relative to its plunger may be adjusted. These adjustments may be made by removing the protecting cover on the front side of the camera.

(3). *Developing roller*.—The recording paper should be firmly and symmetrically held by both edges of the developing roller. If the developing roller appears to be unsymmetrically located with respect to the feed mechanism, its position on the shaft may be shifted. To do this, remove the side wall of the camera and loosen the set screw.

(4). *Pick-up mechanism*.—The ends of the two teeth of the pick-up scoop should be well below the surface of the developing roller, and should clear all sides of the grooves of the developing roller in which they are located.

(5). *Light shield*.—The light shield that fits over the exit of the camera and the fixing tray, should be in place during recording to prevent fogging of the record by stray light.

(6). *Developing tray*.—Insert the rubber stopper, with the rubber tubing connected to the funnel securely in the drain hole of the developing tray, before filling the tray with the developing solution. The maximum which the tray can hold safely is 12 ounces. The level of the developing solution should always be kept between $\frac{1}{2}$ and 1 inch from the top of the tray.

(7). *Developing solution and heaters*.—(a) The developing solution is made up of three parts of "A" solution and one part of "B" solution (Table I). The "A" and "B" solutions may be prepared in advance, but should not be mixed until just before using.

(b) This developer works best at temperatures of 65°F. and higher. The solution should not be allowed to go below 60°F. A heater is provided under the developing tray to keep the developer at a favorable working temperature in cold weather. Another heater is provided near the camera lens to prevent fogging of the lens when the developing solution is heated.

DEVELOPING SOLUTIONS

"A" SOLUTION

Component	Parts by weight	Suggested mix**
* "Elon" (paramethylamino-phenol sulfate)	1	38 grams (or 1 1/3 oz.)
Sodium sulfite	20	756 grams (or 1 lb. 10 2/3 oz.)
Hydroquinone	3	114 grams (or 4 oz.)
Water	300	3 gal.

* Put up under trade names of "Metol," "Pictol," and "Photol."

** 1 oz.—437.5 grains—28.4 grams.
1 gal. of water—8 1/3 lb. avoirdupois.

"B" SOLUTION

Component	Parts by weight	Suggested mix
Sodium hydroxide	5	189 grams (or 6 2/3 oz.)
Water, cold	100	1 gal.

CAUTION.—Sodium hydroxide and its solution is a strong caustic. Do not allow it to touch the skin or eyes, as it will cause severe burns. It will also destroy clothing. When preparing the solution, use cold water, add the sodium hydroxide slowly, and stir the solution continuously, as heat is evolved.

(c). The formula given has been proved satisfactory, but departures from it may be made by experienced personnel, if other formulas are found more advantageous. Use of other formulas will depend upon such considerations as: temperature, appearance of the finished records, preservation of the records, etc.

(8) *Fixing solution.*—The formula in Table II is recommended for the fixing solution. This solution should be used in the fixing tray with a dash of acetic acid to stop development immediately and prevent fogging of the record when it becomes exposed to light as it emerges from the fixing tray. The paper is then only partially fixed and should be allowed to stay for a few more seconds in the

hypo tank attached to the table top behind the camera. Have a bucket of water available for washing the completed records. The film drier is used to squeeze excess water from the record. If time is a consideration, some alcohol may be used to rinse the finished records in order to hasten drying. If records are to be kept for some time, re-immerses them in a fixing solution for approximately 10 minutes, then immerse in water for approximately 20 minutes.

FIXING SOLUTION

Component	Parts by weight	Suggested mix*
Sodium thiosulfate (hypo)	8	4536 grams (or 10 lb.)
Ammonium chloride	1	557 grams (or 1 lb. 3 2/3 oz.)
Water	20	3 gal.

* 1 oz.—437.5 grains—28.4 grams.

* 1 oz.—437.5 grains—28.4 grams.

1 gal. of water—8 1/3 lb. avoirdupois.

15. RELAY UNIT BK-9-(*).

a. After it has been ascertained that the recording system functions properly, test Relay Unit BK-9-(*) either by closing the outpost circuit or by placing the test key of Control Board BD-85-(*) on OVER-ALL TEST. When the outpost circuit is used, first check the outpost relay.

b. The proper sequence of operations controlled by Relay Unit BK-9-(*) between the closing and opening of the outpost circuit, is as follows: (check these operations against the wiring diagrams of Relay Unit BK-9-(*) (fig. 16), Control Board BD-85-(*) (fig. 19), and Oscillograph Equipment IE-14-(*) (fig. 17)).

- (1) Outpost Relay AQA-1 operates quickly.
- (2) A ground is placed on the control-board alarm circuit.
- (3) The counter of the identification panel operates.
- (4) Starting relay AQA-2 operates quickly.
- (5) The cutter solenoid circuit is broken. (It is already open at the "make" springs of relay ASO-6.)
- (6) The identification lamps are turned on, and the exposure of the identification photographs begins.

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- (7) Voltage is supplied to the microphone circuits.
- (8) Vibrating reed relay AVR-3 is energized and operates quickly.
- (9) Motor relay ASO-4 is energized and operates after a delay of .1 to .3 second.
- (10) The identification lamps are turned off, thereby terminating the exposure of the identification photograph.
- (11) The camera motor starts.
- (12) Weighted spring relay AWS-5 is energized and its armature pulls up quickly.
- (13) After the vibrations of the weighted spring of relay AWS-5 have died down, in about 1 second, lamp relay ASO-6 operates.
- (14) The cutter solenoid circuit closes at this point, but is still open at relay AQA-2.
- (15) The time lamp (24 volts) and the recording lamp (6 volts) are turned on.
- (16) From this time on, the recording operation takes place until the outpost circuit is opened.
 - c. When the outpost circuit is opened, the following sequence of operations takes place:
 - (1) Outpost relay AQA-1 is de-energized and releases quickly.
 - (2) The control board alarm circuit is opened.
 - (3) The counter relay is de-energized and releases.
 - (4) Starting relay AQA-2 is de-energized and releases quickly.
 - (5) The cutter solenoid circuit is closed and the cutter operates.
 - (6) The microphone circuits are switched from the 90-volt battery to ground.
 - (7) Vibrating reed relay AVR-3 is de-energized and its released vibrating reed keeps motor relay ASO-4 operating for a few seconds.
 - (8) Motor relay ASO-4 is de-energized and releases.
 - (9) The camera motor stops.
 - (10) Weighted spring relay AWS-5 is de-energized and releases quickly.
 - (11) Lamp relay ASO-6 is de-energized and releases.
 - (12) The cutter solenoid circuit is opened and the cutter releases.
 - (13) The time and recording lamps are turned off.
 - d. If Relay Unit BK-9-(*) does not function properly because of relays' operating or releasing too quickly or too slowly, or because of damaged contacts, use the tools of Tool Equipment TE-37 to adjust the relay spring tension or to clean the contacts. Take care

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to adjust the tension of the movable relay springs. To do this, bend the springs near the base and follow through with the tool up to the spring contact to give the spring a distributed tensioning. The quality of the work done can always be gauged from the straightness of the adjusted spring, along its edge. This work should normally be performed by someone who has received proper training in relay adjustment and care.

e. When motor relay ASO-4 is adjusted, the relay should be energized strongly enough to operate the two break contact springs and the three make contact springs. The time delay of motor relay ASO-4 may also be adjusted by means of the 200-ohm rheostat mounted on the relay mounting base. This adjustment may be changed from time to time to take care of variations in the 24-volt supply or in the effectiveness of the developing solution in developing the identification photograph.

f. The time delay of lamp relay ASO-6 in combination with weighted spring relay AWS-5 should be just sufficient to allow the identification photograph to pass by the recording lens of the camera. The extent of the delay is related to the position of the outpost with respect to the first microphone reached by the gun report.

g. Adjust vibrating reed relay AVR-3 to allow sufficient time for the record to leave the camera before the camera motor stops.

b. Make all these adjustments with Relay Unit BK-9-(*) in an upright position—its normal position when properly mounted in Control Board BD-85-(*)).

16. PROTECTOR AR-8.

Protector AR-8 constitutes the terminal part of the line installation and should be located on a pole or on a tree, if possible. Make certain that its fuses and spark-gap blocks are in good order. Each fuse should show a closed circuit and each spark-gap an open circuit when tested with an ohmmeter.

17. MICROPHONE EQUIPMENT.

a. Microphone T-21-(*).

Test each Microphone T-21-(*) before and after it is installed on the field array. To test before installation, proceed as follows:

- (1) Connect the microphone, equipped with tubes and batteries,

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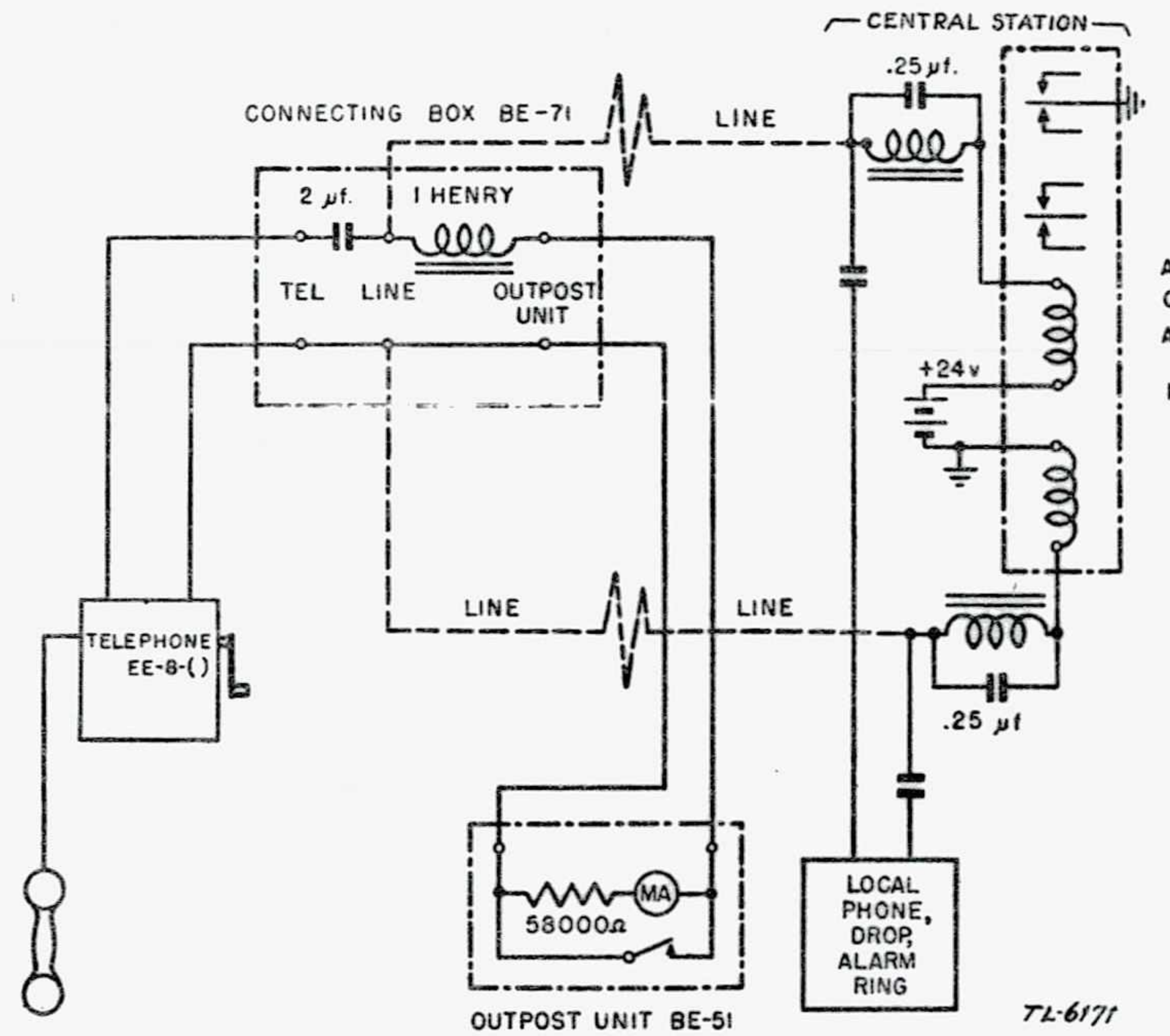


Figure 11.—Outpost wiring diagram.

to the oscillograph assembly through the switchboard and control board, in place of one of the incoming lines.

(2) With the test key of Control Board BD-85-(*) placed on CIRCUIT TEST, the milliammeters should each read approximately 4 milliamperes. If the polarity of the connection between microphone and control board is incorrect, the milliammeter will read approximately 2 milliamperes.

(3) The polarity is corrected by reversing the hammer-head plug of Cord CD-428.

(4) When a gust of air is produced near the outside plug of the microphone, the control board milliammeter of the circuit used oscillates over 1 or 2 milliamperes while the corresponding recording light image oscillates more or less violently (depending upon the potentiometer setting). Both milliammeter and light image should be very quiet whenever the holes in the outside plug of the microphone are kept closed.

(5) Repeat the test outlined above after the microphone has been installed.

(6) Co-ordination between the oscillograph operator and the installation crew is made by telephone communication over the

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microphone line. If the recording equipment assembly is not available for this test, the 5-milliamper scale of the voltohmmeter may be used in place of the milliammeter of Control Board BD-85-(*) to indicate oscillations of current. In this case a 90-volt dry cell battery will be required to supply plate voltage to the microphone amplifier.

b. Protector AR-4.

The protector should be connected between Microphone T-21-(*) and the line.

c. Microphone Shelter BE-66-A.

The assembly of Microphone T-21-(*) and Bag BG-97 should be installed in a round hole dug in the ground, sufficiently wide and deep to prevent any contact between the assembly and the earth. Microphone T-21-(*) must be suspended from the two springs of Microphone Shelter BE-66-A, and the shelter merely laid over the opening of the hole. Pile some earth smoothly around the shelter to eliminate openings under the edge and to eliminate obstructions in the path of the wind that might cause pressure gusts.

CAUTION:—Do not place the microphone within 100 yards of a gun as the blast from the gun may damage the microphone.

18. OUTPOST EQUIPMENT.

Connect the line, the telephone, and Outpost Unit BE-51 to Outpost Connecting Box BE-71, as indicated in figure 11. This figure is also shown on the top plate of the outpost connecting box.

19. PRELIMINARY OVER-ALL TESTS.

a. Over-All Response Test.

An overall frequency response test of a complete channel may be made with the use of Chest CH-40-(*).

(1) Place the microphones, equipped with tubes and batteries, in the chest.

(2) Connect the lead wires in the chest to the proper microphone terminals and clamp the lid of the chest shut.

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(3) Connections are made from the terminal board of the chest to the recording equipment assembly.

(4) Check and correct polarity as in paragraph 17a.

(5) Set the attenuators at 6.

(6) Set the pistonphone in motion by quickly pulling up a string which has previously been wound around the fly-wheel shaft. Make a photographic record for the full frequency range provided by the pistonphone. With the attenuators of all the channels adjusted to equal settings, the excursions of the traces should be approximately the same at any frequency.

b. Circuit Test.

When all microphones have been installed, test the proper functioning of the microphones, the control-board equipment, and the oscillograph unit by placing the test key of the control board on CIRCUIT TEST. The microphones are thereby energized, and the recording lamp is turned on. If all these parts function properly, a characteristic behavior of the microphone milliammeters will be observed on the control board, and the light images on the viewing screen will indicate wind-pressure gusts at the various microphone positions.

c. Over-All Test.

Place the test key on OVER-ALL TEST. The set should operate and produce a record, just as though the outpost circuit had been closed, except that the counter of the identification panel will not advance and the alarm circuit will not be closed.

d. Outpost Test.

Make sure that telephone communication with the outpost operator is available. The outpost operator should also operate Outpost Unit B-51 at the request of the oscillograph operator to ascertain whether the outpost circuit is functioning properly. It should be possible to maintain telephone communication with the outpost operator whether the outpost circuit is closed or not.

20. OPERATION.

a. Oscillograph.

Control Board BD-85-(*) and Oscillograph Equipment IE-14-(*) are turned on by means of the STATION BATTERY switch.

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As soon as the tuning fork is vibrating, start the time wheel by hand by rotating the starting knob to the right.

b. Switchboard BD-62-(*).

Switchboard BD-62-(*) has been designed for use either with Handset TS-9-(*) , or with the combination of Head Set HS-30-(*) and Chest Set TD-1. Both of these can be used by connecting one set to Plug PL-58 and the other to terminals T, C, and R on the switchboard. Telephone communication with the outpost operator or operators should be maintained at all times. Personnel assigned to the microphone stations or to the maintenance of the lines can establish telephone communication with the oscillograph if they are equipped with a Telephone EE-8-(*) .

c. Outpost.

With the sound ranging set properly installed and adjusted, the taking of records can be controlled entirely from the outpost by the operation of Outpost Unit BE-51. A record is started when the outpost operator presses the button switch of Outpost Unit BE-51. At the same time the alarm buzzer in the switchboard operates to warn the oscillograph operator that recording has started. Also, the outpost operator can transmit a verbal "on the way" signal over the telephone. The outpost operator can control the duration of recording by keeping the button switch on Outpost Unit BE-51 pressed until he judges the sound report has reached all the microphones. With the button switch on Outpost Unit BE-51 closed and the test key on Control Board BD-85-(*) , (in the neutral position), the alarm buzzer will continue to operate. As soon as a record has been started, the recording can be taken over by the oscillograph operator. He does this by switching the test key to OVER-ALL TEST. This operation opens the circuit of the alarm buzzer and also permits the outpost operator to release the switch on Outpost Unit BE-51. The oscillograph operator will observe the behavior of the light images on the viewing screen, and stop the recording by switching the test key to NEUTRAL when his observation indicates that the sound has reached all microphones. If, in the meantime, the switch on Outpost Unit BE-51 has again been placed in the pressed position, the recording will continue and the alarm buzzer will again begin to operate as a signal to the oscillograph operator that another sound report is "on the way." Any characteristic features of the sound heard by the outpost operator can be telephoned to the oscillograph operator.

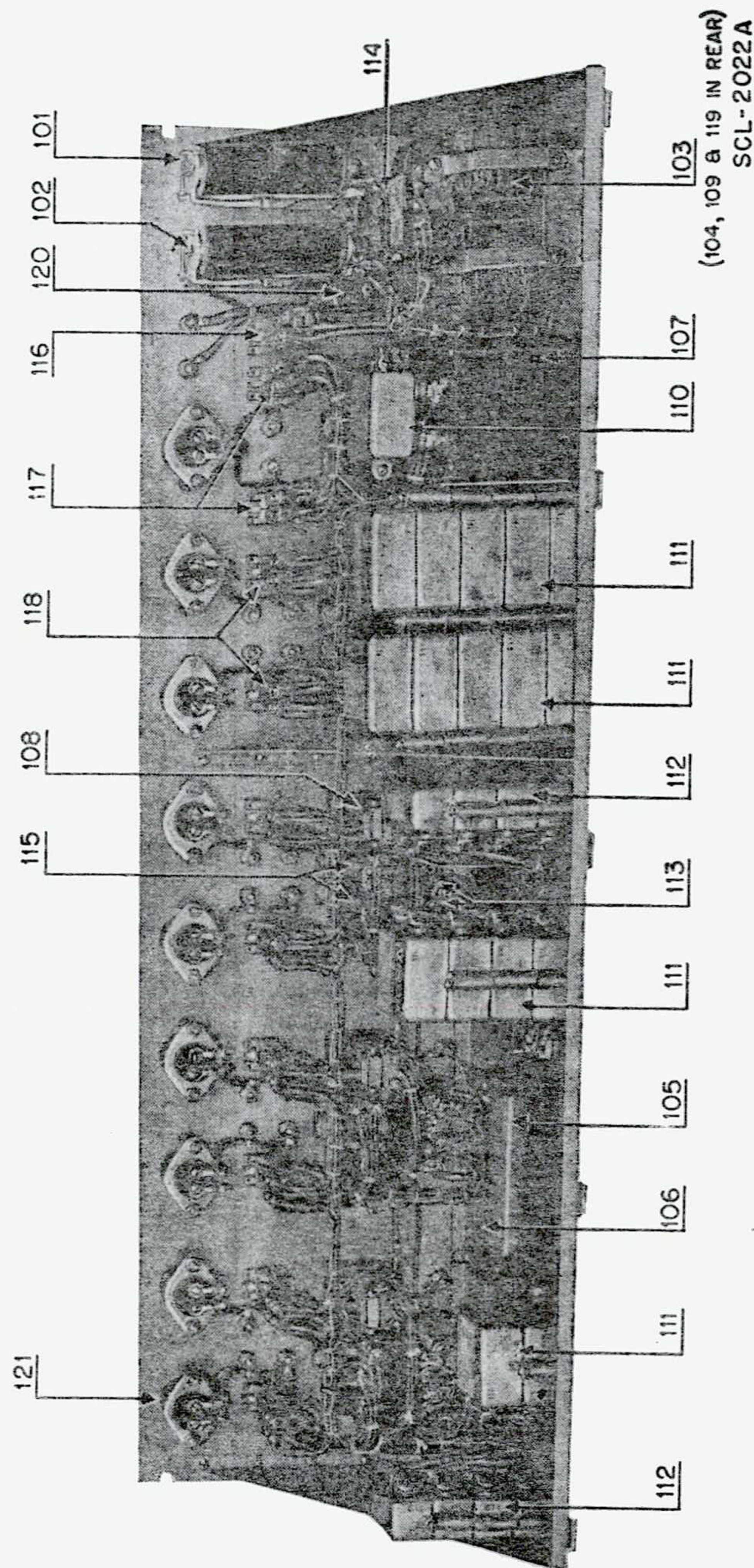


Figure 12.—Switchboard BD-62-(*), rear view.

Section III FUNCTIONING OF PARTS

	Paragraph
Switchboard BD-62-(*)	21
Control Board BD-85-(*)	22
Relay Unit BK-9-(*)	23
Oscillograph Equipment IE-14-(*)	24
Oscillograph Unit M-166-A	25
Microphone T-21-(*)	26
Protector AR-8	27
Cord CD-250-A	28
Outpost equipment	29

21. SWITCHBOARD BD-62-(*).

a. Switchboard BD-62-(*) (figs. 1, 12, and 13) provides means for conveniently switching or patching the various incoming outpost or microphone lines for communication and testing purposes. The switchboard has 1 telephone circuit and 10 other circuits as follows: 2 outpost circuits and 8 microphone circuits.

b. The input connections to the 10 switchboard circuits are made by means of 10 pairs of binding post terminals located along the bottom of the operating panel. Each circuit has two jacks, a telephone drop, and a key. A pair of binding posts and a socket for Cord CD-428 are provided at the output end of each microphone circuit. The two outpost circuits have a common output which is terminated in a pair of binding posts and a socket for Cord CD-428. The circuits in Switchboard BD-62-(*) are normally connected to the corresponding circuits in Control Board BD-85-(*) by means of Cords CD-428, but the connection can also be made by jumper wires between the corresponding binding posts on the switchboard and control board. To change the polarity of connection to the microphone line, reverse the hammer-head plug on Cord CD-428 in the socket at the switchboard. Plugs on Cords CC-66 or CC-67 fit into the switchboard jacks. Plugging into the upper jack connects across the circuit established with the incoming line, and plugging into the lower jack connects to the incoming line, cutting out the local circuit. The telephone drops indicate the ringing of the corresponding line, and operation of any one of the drops places a ground connection on the alarm circuit, thereby operating the

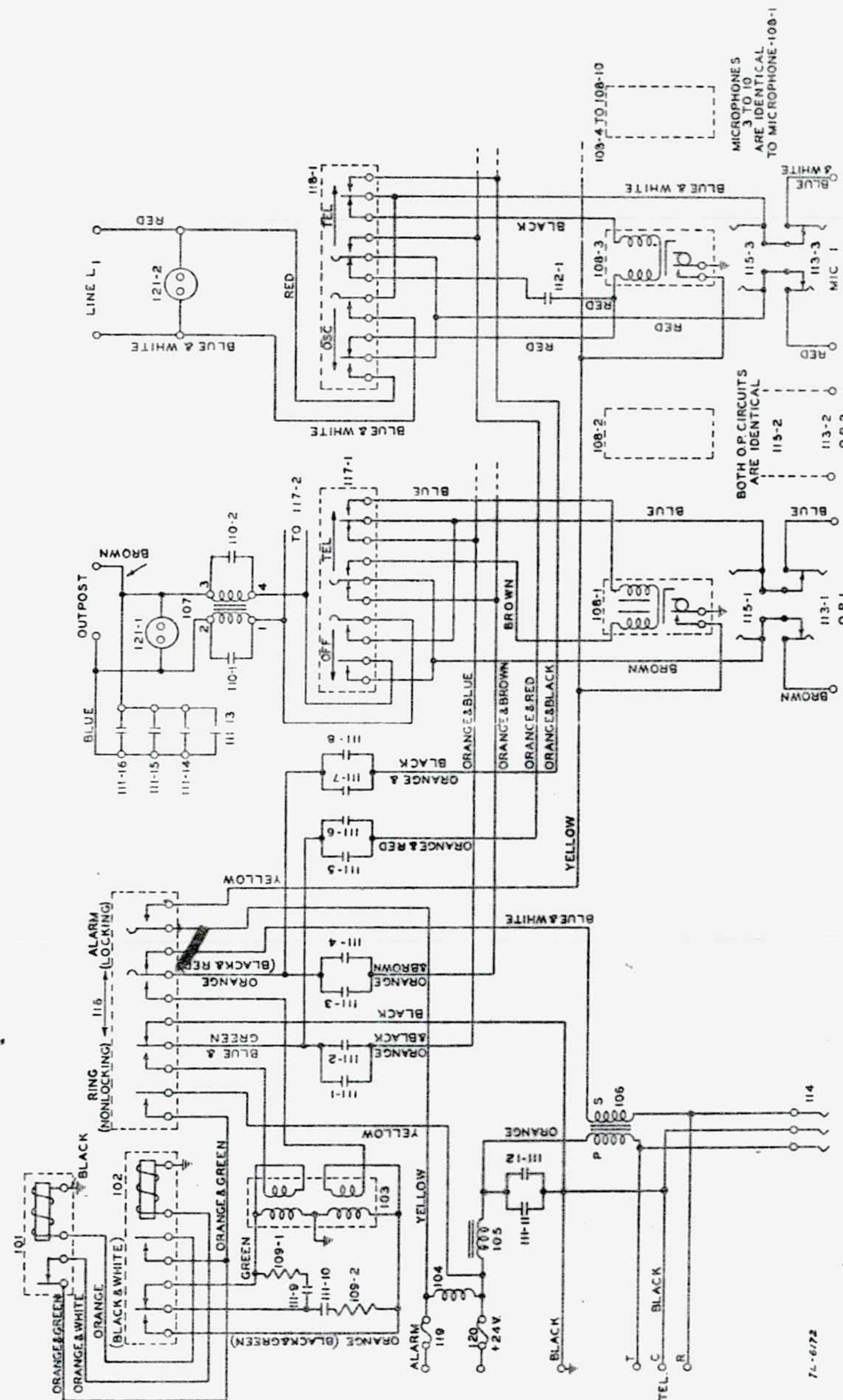


Figure 13—Switchboard BD-62(*)—circuit diagram.

buzzer in the switchboard. The night alarm can be installed between the +24V binding post and alarm binding post.

c. The keys permit three connections for the *outpost circuit*:

- (1) Key down—outpost line to indicator drop.
- (2) Key normal—outpost line to telephone circuit.
- (3) Key up—outpost line to telephone and control board outpost circuits.

d. The keys permit three connections for the *microphone circuits*:

- (1) Key down—microphone line to telephone circuit.
- (2) Key normal—microphone line to indicator drop.
- (3) Key up—microphone line to control board microphone circuit and to indicator drop through a 0.5μf capacitor.

e. The 0.5μf. capacitors with the indicator drops in series have a high impedance, at sound-ranging frequencies (5 to 25 cycles per second), compared with the microphone circuits and do not alter the characteristics of these circuits. These capacitors permit passage of sufficient current to operate the indicator drops when properly adjusted. The outgoing or incoming ringing current on the outpost circuit is prevented from reaching the control-board outpost circuit by a choke coil. Two 0.25-μf. capacitors connected across the two windings of this choke coil increase the impedance of the coil at ringing frequency.

f. The telephone circuit consists of a talking circuit of conventional design, and a ringing circuit. The two relays of the ringing circuit are connected so as to be mutually connecting and interrupting when energized from the 24-volt supply. As the 24-volt supply is alternately connected to two taps of the ringing autotransformer, a ringing alternating voltage of approximately square wave form and 96-volt peak value on open circuit is generated at the terminals of the autotransformer.

22. CONTROL BOARD BD-85-A.

a. Control Board BD-85-A (figs. 1, 14, and 15) contains eight identical control circuits, one for each of the eight microphone circuits. Meters are provided for indicating the following currents and voltages:

- (1) Plate current of each microphone circuit.
- (2) Plate supply voltage for the microphone circuits.

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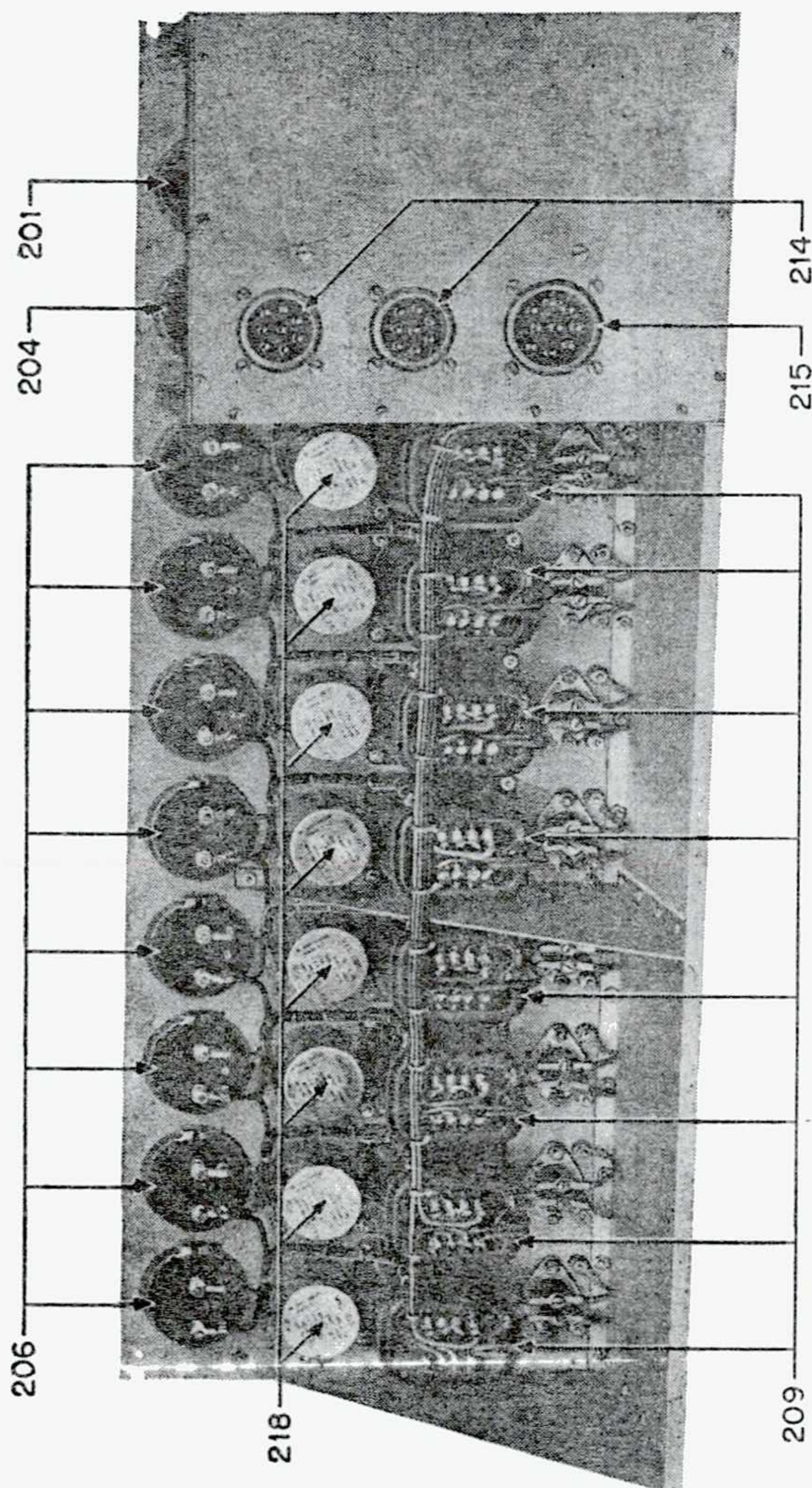
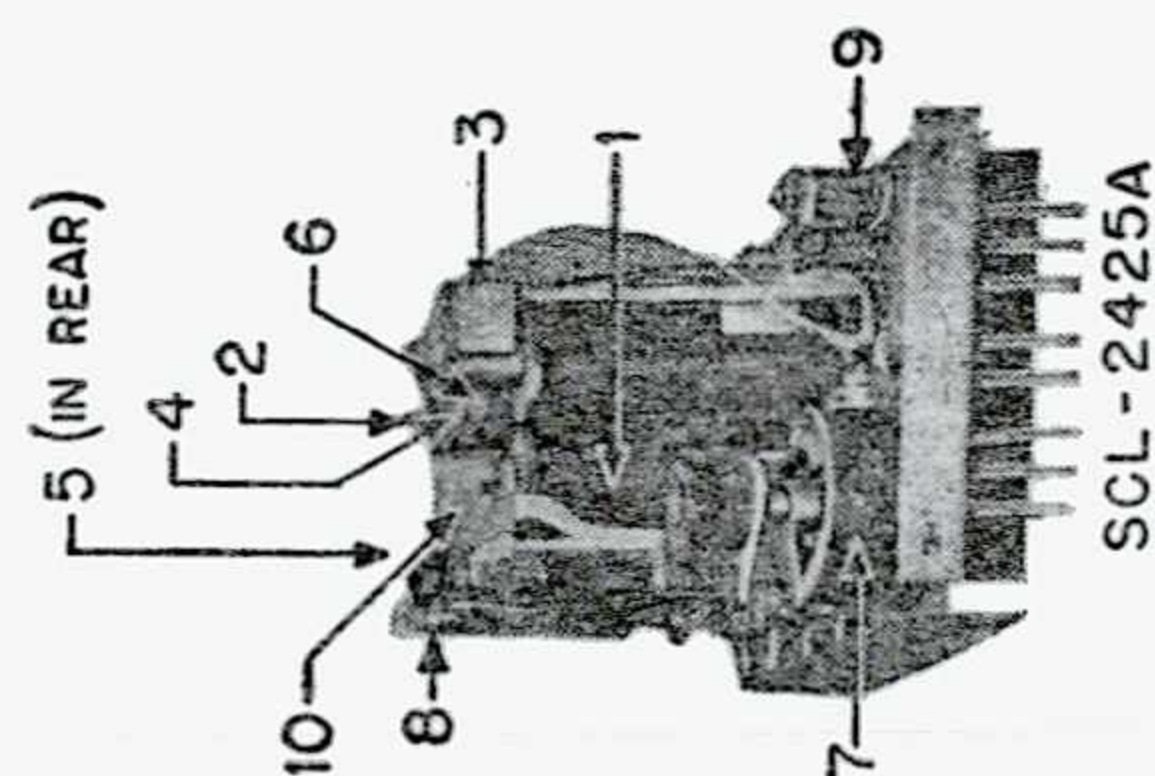


Figure 14.—Control Board BD-85-(*) (rear view) and Relay Unit BK-9-(*)

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- (3) Recording lamp current.
- (4) Station battery voltage.
- (5) Total station battery current.
- (6) Outpost circuit current.

Control Board BD-85-A also houses Relay Unit BK-9. This unit is connected to the circuits of the control board through a 16-point base plug that engages a 16-point frame jack mounted in the control board. Relay Unit BK-9 is readily removable through a door located at the left end of the control board.

b. Each of the eight control circuits of Control Board BD-85-A consists of a transformer and a ladder-type attenuator which couple the microphone to Oscillograph Units M-166-A. The transformer has a 31.6:1 turns ratio, and an input inductance of 200 henries, with 5 milliamperes flowing through the primary winding.

c. Each ladder attenuator has an approximately constant impedance of 10 ohms and is graduated in 16 steps of 3 db per step, the gain increasing clockwise. For a given input, an increase of two steps on the control setting will approximately double the amplitude of oscillation of the moving system of Oscillograph Unit M-166-A.

d. The meters are shown in figure 15, the schematic wiring diagram of Control Board BD-85-(*) . The numbers encircled in the diagram refer to the connections of the three sockets at the rear of the control board. A wiring diagram similar to that of figure 15 will be found inside of the control board cover, mounted on the back plate.

23. RELAY UNIT BK-9-(*)

Relay Unit BK-9-(*) consists of six interconnected relays arranged to close and open various electrical circuits in a definite time sequence, thereby making possible the automatic operation of Sound Ranging Set GR-3 C. The operation of Relay Unit BK-9-(*) is outlined in section II, paragraph 15. One spare Relay Unit BK-9-(*) , together with spare parts for servicing, is supplied with each Sound Ranging Set GR-3-C. A wiring diagram, similar to that of figure 16, will be found on the inside of the door at the left end of Control Board BD-85-(*) .

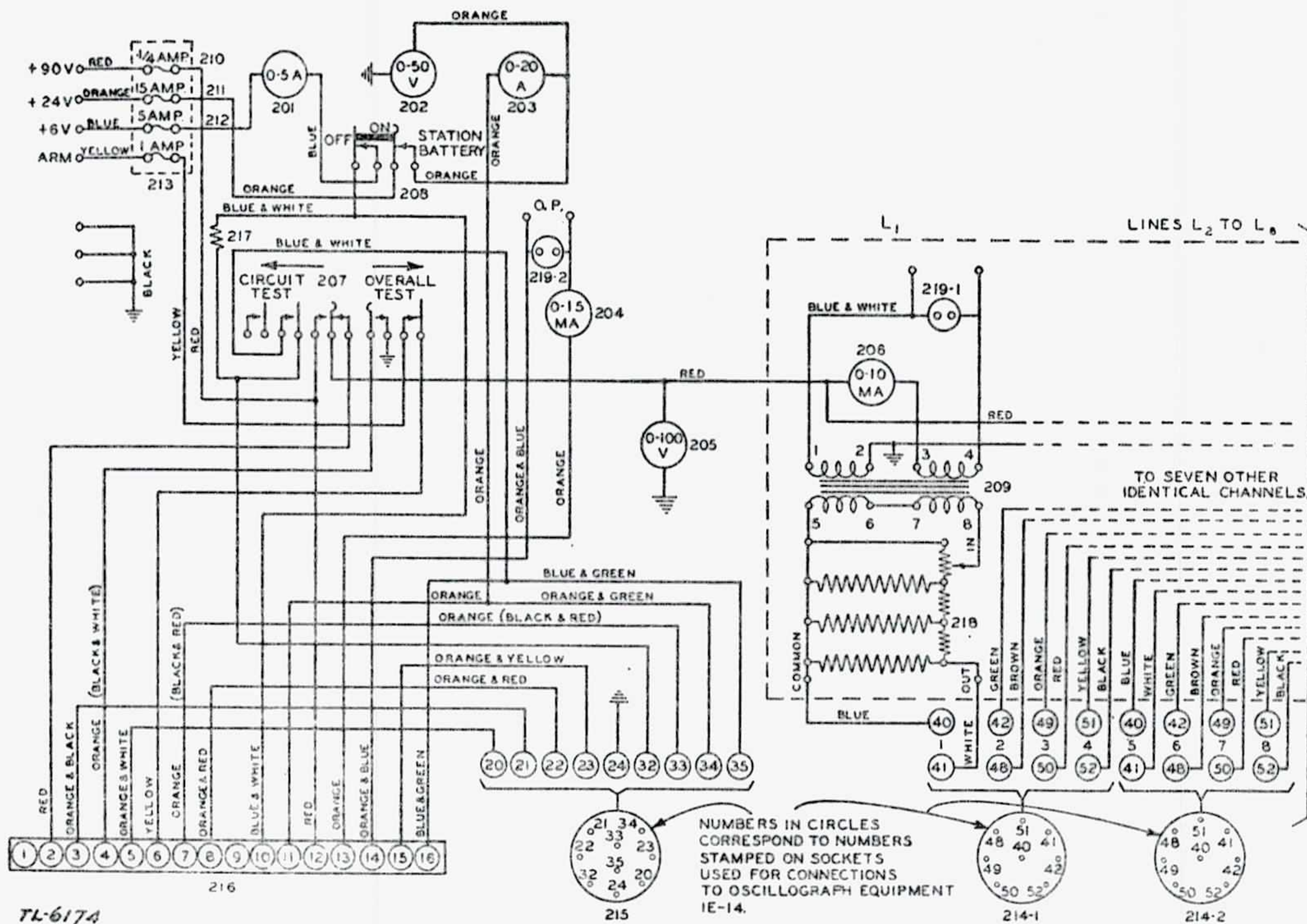


Figure 15.—Control Board BD-85-(*), circuit diagram.

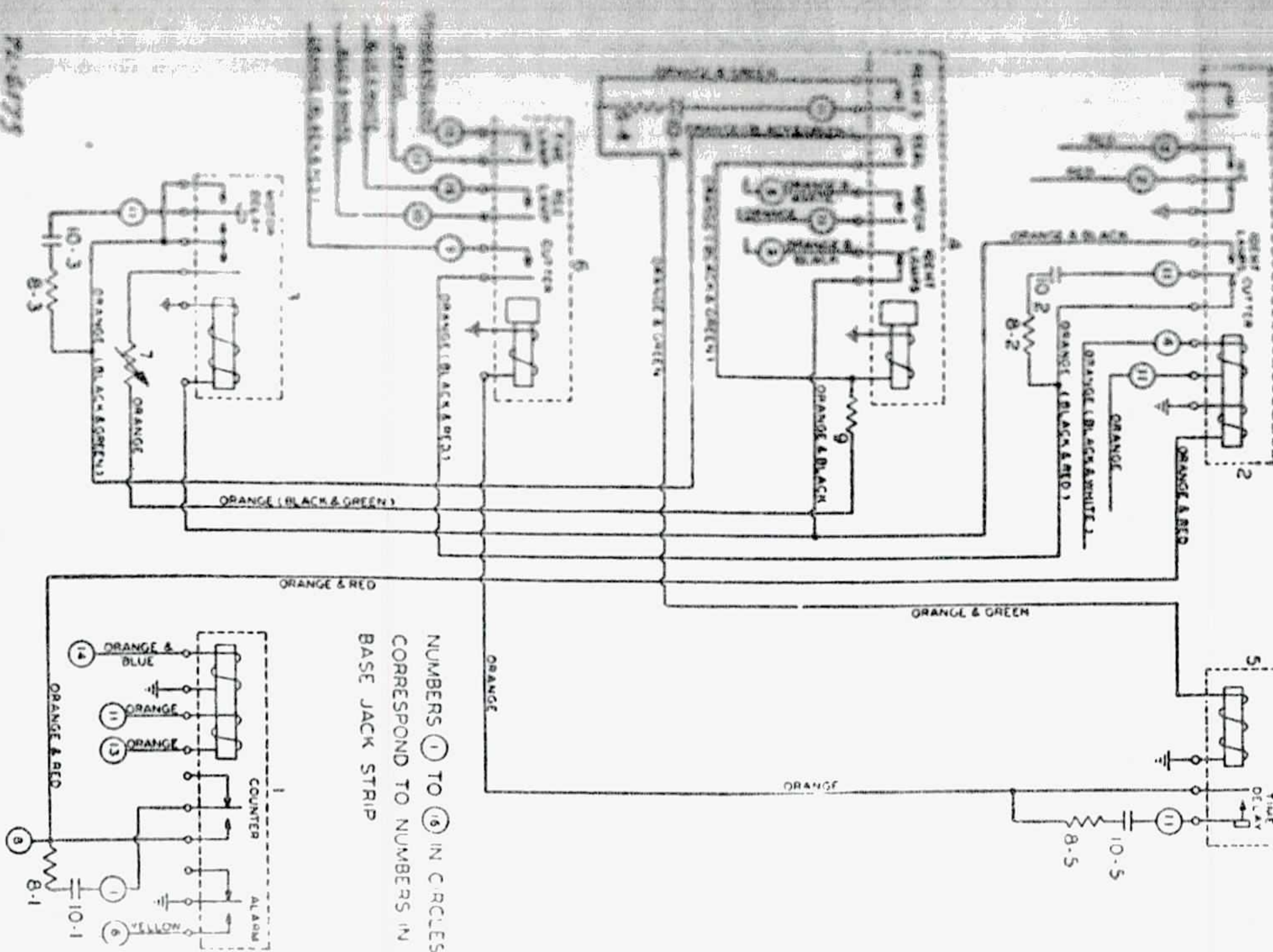


Figure 16.—Relay Unit BK-9-(*), circuit diagram.

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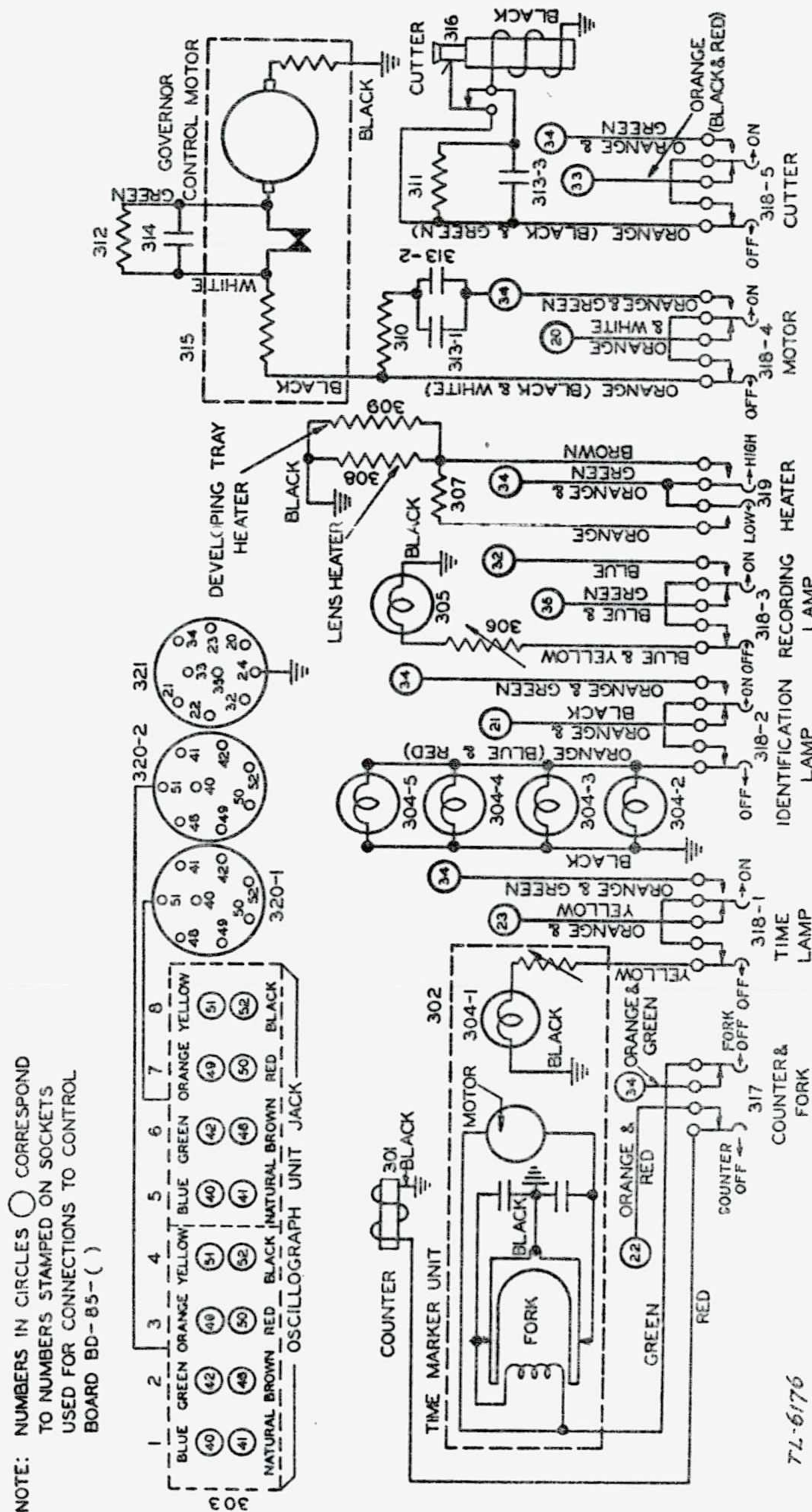


Figure 17.—Oscillograph Equipment IE-14-(*), circuit diagram.

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24. OSCILLOGRAPH EQUIPMENT IE-14-(*).

A wiring diagram is shown in figure 17. The circuit connections of this equipment are located under the table top, and access to them is obtained by removing Control Board BD-85-(*) and removing the bottom cover of the oscillograph equipment. A circuit diagram, similar to that of figure 17, will be found fastened to the removable panel on the large light hood of Oscillograph Equipment IE-14-(*). The various keys on the narrow front panel operate individually the components of the oscillograph equipment. See also section II, paragraph 14.

25. OSCILLOGRAPH UNIT M-166-A.

A photograph of this unit is shown in figure 4. It is of the moving coil type. A coil of fine copper wire is suspended in the air gap between two pole pieces built integral with the housing. A small mirror is mounted on a support that is fastened rigidly to the coil so that coil and mirror move together. This combination forms the moving system of the unit. The upper and lower suspensions are similar fine gold strips. One end of the upper suspension is fastened to the moving system, the other end to an insulated rotatable pin at the top of the housing. One end of the lower suspension is fastened to the moving system, the other end to a fine coiled spring, the tension of which can be adjusted by turning the screw in the bottom of the housing. The insulated terminals of the unit are connected to the output transformer of Control Board BD-85-(*) by means of Cords CD-475. When the unit is placed in position in the galvanometer magnet, a magnetic field is produced in the gap between the pole pieces. When current from the output transformer flows through the coil, a force is set up which causes the coil and its attached mirror to deflect in accordance with the magnitude and direction of the coil current, thereby causing a corresponding deflection of the light spot on the recording paper.

26. MICROPHONE T-21-(*). (Figs. 8, 18, and 19).

Microphone T-21-(*) is a combination condenser microphone and amplifier and a double Helmholtz resonator. The condenser head of the unit is mounted at the top of the inner resonat-

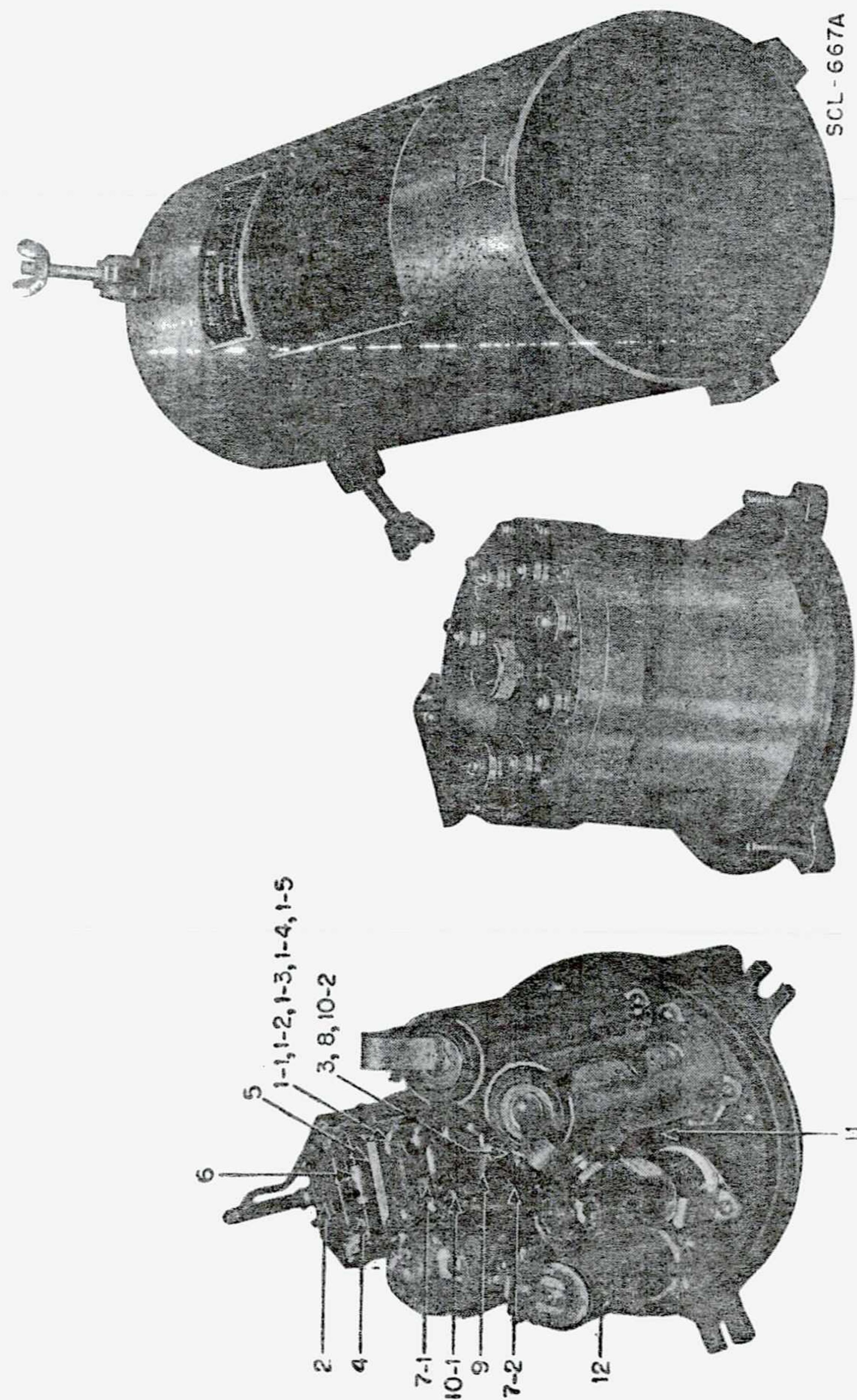


Figure 18.—Microphone T-21-(*)—disassembled.

ing chamber, and consists of a thin stretched metallic diaphragm mounted symmetrically .004 inch from an insulated metal plate. Air pressure from the main chamber of the microphone reaches this inner chamber through the holes of a removable plug. Access of air pressure from the outside to the main chamber is through the holes of another removable plug. The combination of the two plugs and of the inner and outer chambers forms a two-section acoustical low-pass filter. The dimensions of the plug holes have been calculated to obtain a 25-cycle-per-second cut-off frequency for this filter.

b. The power supplied from the line to the microphone serves as plate voltage for the two amplifying tubes and as polarizing voltage for the condenser head, and also serves to energize the relay which turns on the local filament batteries. The plate of the output Tube VT-27 is placed directly across the line; the plate supply of the first Tube VT-44 is fed through a two-section resistance-capacitance filter. This voltage is further filtered to serve as polarizing voltage for the condenser head. The voltage amplification yielded by the first tube is between 40 and 50. A further voltage amplification of about 9 is yielded by the second tube.

c. Insulating Bag BG-97 is used to prevent earth grounds on the microphone case. The microphone line is ungrounded and since the case is connected to one side of this line, an earth ground of the case will unbalance the system and produce erratic excursions of the recorded traces. Bag BG-97 will protect the case even if the hole in which the microphone is suspended should become partially filled with water.

d. Protector AR-4 is connected to the microphone at its field position to protect the microphone from the effects of the discharge of static electrical charges accumulated by the line, or in the event that lightning strikes the line.

27. PROTECTOR AR-8.—(See par. 16).

28. CORD CD-250-A.

Cord CD-250-A is used to connect Protector AR-8 with Switchboard BD-62-(*). The cordage contains 15 pairs of conductors,

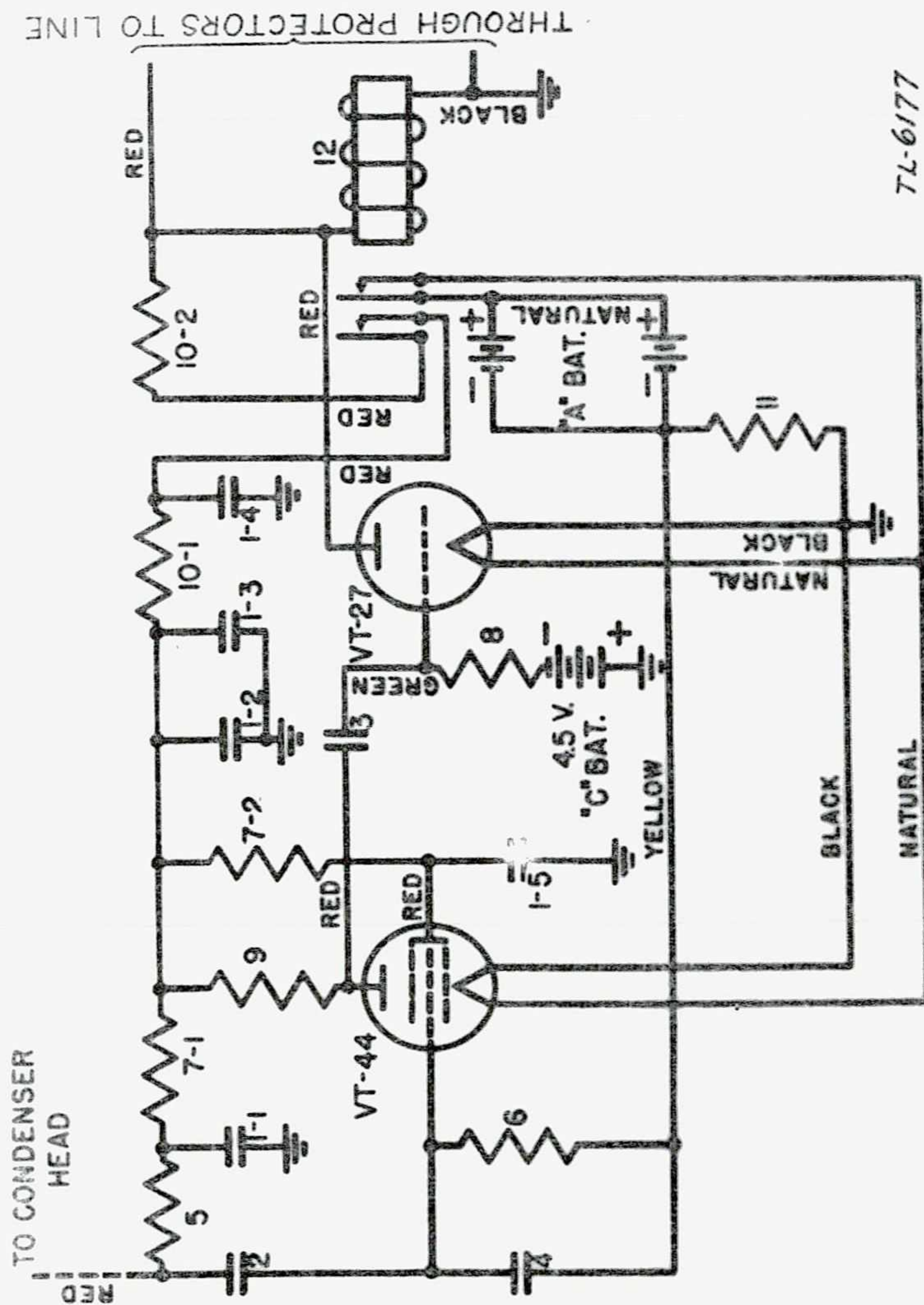


Figure 19.—Microphone T-21-(*), circuit diagram.

of which only 11 pairs are normally used. One end of the cord is terminated in an 11-pair phenolic plug for quick connection to Protector AR-8. The eight microphone terminals are labeled MIC 1 to MIC 8; the two outpost terminals, O. P. 1 and O. P. 2; and the auxiliary, AUX 1. The four pairs of spare conductors are taped to the phenolic plug. At the switchboard end, the cordage is fanned out for connection to Switchboard BD-62-(*) (O. P. 1 and O. P. 2, and MIC 1 to MIC 8). The pair of conductors corresponding to auxiliary (AUX 1) on the phenolic plug is terminated in spade terminals and is 29 inches in length. This pair is wrapped and rubber-taped about the cordage for a distance of approximately 2 inches in the direction away from the switchboard. The four spare pairs of conductors, which are carried to the extreme end of the cord, looped back, and enclosed in rubber tape, are for repair of the cord, when necessary.

29. OUTPOST EQUIPMENT (figs. 10 and 11).

- a. Telephone EE-8-(*).—See TM 11-333.
- b. Outpost Connecting Box BE-71.

This component comprises three pairs of binding posts, a 2.0- μ f. capacitor, and a 1-henry choke coil (C-158), and connects the outpost line to one Telephone EE-8-(*) and to one Outpost Unit BE-51. The capacitor is connected in the telephone circuit and the choke coil in the outpost unit circuit, thereby permitting simultaneous operation of the telephone and of the outpost unit.

c. Outpost Unit BE-51.

Outpost Unit BE-51 comprises a milliammeter in series with a 58,000-ohm resistor, and a switch. The ammeter with the series resistor is normally placed across the line, and the ammeter deflection serves as an indication to the outpost operator that the line is energized. The operation of the switch places a short across the line, thereby operating the outpost relay in the central station. The unit is housed in a leather carrying case with a celluloid window for observing the milliammeter. The switch, a push-button type, can be operated without removing the unit from its carrying case.

Section IV
MAINTENANCE

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Microphone T-21-(*)	34
Control Board BD-85-(*)	35
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30. GENERAL.

All repairs should be made by thoroughly competent personnel. *Don't use acid-core solder or soldering flux. Always use rosin-core solder.*

31. CARE AND CLEANING.

a. Batteries.

(1) *Storage batteries.*—For maintenance of the storage batteries, see TM 11-430.

(2) *Dry batteries.*—Inspect all dry batteries at least twice a month. This inspection should include testing for voltage and examining for mechanical defects, such as swelling, in order to prevent damage caused by leakage of electrolyte.

b. Vacuum Tubes.

Check all vacuum tubes at least once every 2 months by comparing their performance with the performance of fresh tubes.

c. Photographic Equipment.

(1) Clean all photographic equipment thoroughly at the end of each "day" of operation.

(2) Drain the developer tray and fill it with 12 ounces of clean water.

(3) Run the camera for about 1/2 minute.

(4) Drain the tray again. This is done to clean the developer roller and developer tray of all chemicals. During the cleaning operation remove the recording paper magazine, or place the cutter switch at ON, so that recording paper is not wasted.

(5) Repeat the above operation until the drained solution is fairly clean.

(6) Disassemble and clean the camera thoroughly at regular intervals; otherwise, the accumulation of dirt and bits of paper will seriously affect its operation.

(7) Lubricate the camera periodically by placing a few drops of light oil in the oil holes located directly beneath the recording paper magazine. A small amount of oil should also be placed on the exposed shafts of the gear box and on the bearings of the fixing tray roller.

32. CIRCUITS.

If a circuit becomes defective, first inspect the wiring for loose connections. Check moving parts, capacitors, and coils. If no defect can be found in the individual parts, check the circuit step by step by means of Test Set I-56-C until the defect is found.

33. RELAYS.

Inspect the relays at least once a month. The adjustment or replacement of springs should be performed by personnel specially trained in relay adjustment and care. Standard adjustments are given in the paragraphs following.

34. MICROPHONE T-21-(*).

The condition of the amplifier and the condenser head of a microphone can be checked by substituting parts of a microphone known to be in good condition, and comparing results. If a condenser head is faulty, the defect may be caused by a direct short in the condenser head, or by a faulty diaphragm. If it becomes necessary to change the diaphragm of the condenser head, clamp a square sheet of new diaphragm material securely in Clamp MM-7, and place it over the opened condenser-head chamber, the rim of which should be slightly oiled and free of grit or any other foreign particles. Place weights aggregating 30 to 40 pounds on the periphery of the clamp, or suspend them from the holes at the corners of the clamp. Two microphones with their amplifiers removed may be used for weights; suspend them from two opposite corners of the clamp. Dust the top face of the diaphragm carefully to remove any dust or other particles, locate the dowel pinholes by gently rubbing the rim of the chamber with an eraser. Place the head over the diaphragm and screw it down, taking care to tighten every fifth screw in turn, starting from any given screw. If the amplifier is at fault, check battery voltages under load, and install new batteries if necessary. Tubes known to be in good condition should be installed. The relay contacts may be cleaned and adjusted with Tool Equipment TE-37. With the microphone in operating position (handle up), adjust the amplifier relay as follows:

- a. The armature should move freely on its bearing surface but must not be loose.
- b. Set the residual adjustment screw to give not more than .001-inch clearance between armature and pole piece, when the armature is held firmly against the pole piece.
- c. Turn the adjusting screw on top of the relay to obtain a clearance of .012-inch between the residual screw and the pole piece, when the relay is in normal position.
- d. Place a .006-inch feeler gauge between the residual screw and the pole piece, holding the armature firmly against the gauge. Adjust the heavy contact spring so the contact is barely touching. This allows the armature to travel .006-inch while the contact makes after the feeler gauge is removed.
- e. With the amplifier in normal position (handle on top), the tension on the thin contact spring should be increased, so the relay

will not operate on 40 volts, but will operate on 50 volts. Be sure to maintain the above clearances.

f. When the relay is properly adjusted, the contacts will remain open for all possible positions of the microphone when it is not energized.

g. If the faulty operation is not corrected by the above procedure, make a complete check of the circuit with Test Set I-56-C.

35. CONTROL BOARD BD-85-(*).

Normal readings on the meters of Control Board BD-85-(*), with the test key on CIRCUIT TEST, are as follows:

Plate voltage—90 volts.

Station battery voltage—24 volts.

Station battery current—0 ampere (current drawn by timing fork is too small to register).

Recording lamp current—3.0 amperes approximate (dependent on rheostat setting).

Outpost current—up to 15 milliamperes (varies with length of line).

Microphone channel plate current—4.0 milliamperes.

Observe the station battery voltage and current during operation of the recording motor and cutter. If the station battery is discharged, or if one or more cells have high internal resistance, the battery voltage under load will drop to considerably less than 24 volts. This will cause improper functioning of Relay Unit BK-9-(*) and other equipment operating from the 24-volt source. A similar reduction of voltage may be caused by poor contact at the battery connections, binding posts, or plug and socket connections. In case of failure, check all battery voltages and connections, and replace fuses where necessary. If the fault is not located by the above procedure, check the circuits with Test Set I-56-C.

36. RELAY UNIT BK-9-(*).

a. Inspect the relays periodically. Clean all dirty contacts, using Tool Equipment TE-37, and if contacts are badly pitted or burned,

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install new springs. If failure of contacts is due to faults in other parts of the equipment, correct these faults before Relay Unit BK-9-(*) is replaced on the control board.

b. The adjustments of relays 1, 2, 4, and 6 are similar in that the clearance between the armature and the top of the support should be .002 to .003-inch. This is attained by moving the armature which is held by one screw in back of the support.

c. Adjust the residual screw until it extends .002 to .003-inch below the armature. This is measured by placing a gauge between the armature and the pole piece.

d. With a .013-inch gauge between the residual screw and the pole piece, and the armature pressed against the pole piece, bend the armature arm so it just touches the contact spring.

e. With a .006-inch gauge between the residual screw and the pole piece, and the armature pressed against the pole piece, bend the heavy contact springs so that they just touch. This allows approximately .010-inch of travel for the contacts when the gauge is removed.

f. Adjust the tension of the contact springs on the relay so that the relay will operate when a resistance of 2,000 ohms is in series with the outpost.

g. On relay 3, the two adjusting screws should have a gap of approximately .025-inch on each side of the vibrating reed contact. This adjustment will cause the motor to operate for approximately 4 seconds after the film is cut. If the motor runs more than 4 seconds, turn each screw inward an equal amount until the desired 4-second run is attained.

h. Now adjust the inner spring contact so that there is a .010-inch clearance between the contacts when they are in normal position.

i. Adjust relay 5 for a .002 to .003-inch clearance between the armature and the top of the support.

j. Adjust the residual screw to extend .002 to .003-inch below the armature.

k. The tension of the vibrating reed spring should be great enough to hold the stop against the back of the support.

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l. The tension of the inner spring should hold the armature firmly against the stationary stop.

m. Bend the stop spring so that there is a .025-inch gap between the contacts.

n. The gap between the residual screw and the pole piece should be .020 to .030-inch, depending on the tension of the vibrating reed spring, and is attained by bending the armature.

o. If the space on the film between the identification and recording lines exceeds 3 inches, the residual screw should be turned in slightly.

p. On relay 6, the recording and timing lamp contacts should make simultaneously. If they do not, adjust them by bending until they do.

q. For sufficient exposure of identification, adjust the tension of the thin contact springs on relay 4 with the rheostat turned fully clockwise.

CAUTION.—IF THE TENSION OF THE SPRINGS ON THE RELAY IS TOO GREAT, THE IDENTIFICATION LAMPS WILL STAY LIGHTED, AND THE RELAY UNIT WILL CEASE OPERATION.

37. SWITCHBOARD BD-62-(*).

a. Keep the switchboard free from dirt and chemicals to prevent corrosion and short-circuiting of the drops, keys, and relays. Inspect all components periodically, and make necessary repairs with Tool Equipment TE-37.

b. Adjust the bracket in back of the relays so there is a .002 to .004-inch clearance between the armature and the top of the support. This will keep the armature from binding when the coil is energized.

c. Adjust the residual screws in both relays so there is .002 to .003-inch clearance between the armature and the pole piece when the residual screw is held firmly against the pole piece.

d. With the armature in its normal position (the arm insulation resting against the contact spring) there should be a clearance of .013-inch between the residual screw and the pole piece. This is obtained by bending the relay arm.

Section V
SUPPLEMENTARY DATA

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38. LIST OF REPLACEABLE PARTS.

a. Amplifier of Microphone T-21-(*).

<i>Ref.</i>	<i>Stock No.</i>	<i>Name of part</i>	<i>Description</i>	<i>Function</i>
No.				
1-1	3D177A	Capacitor CA-177-A	0.5- <i>uf.</i>	Filter
1-2	3D177A	Capacitor CA-177-A	0.5- <i>uf.</i>	"
1-3	3D177A	Capacitor CA-177-A	0.5- <i>uf.</i>	"
1-4	3D177A	Capacitor CA-177-A	0.5- <i>uf.</i>	"
1-5	3D177A	Capacitor CA-177-A	0.5- <i>uf.</i>	"
2	3D155A	Capacitor CA-155-A	0.01- <i>uf.</i>	Coupling
3	3D157	Capacitor CA-157	0.02- <i>uf.</i>	"
4	3D156A	Capacitor CA-156-A	0.002- <i>uf.</i>	Shunt, condenser head
5	3Z6850	Resistor	50-megohm, 1-watt	Load condenser head
6	3Z6829	Resistor	20-megohm, 1/2 watt	Grid, 1st stage
7-1	3Z6810-5	Resistor	10-megohm, 1/2 watt	Filter
7-2	3Z6810-5	Resistor	10-megohm, 1/2 watt	Screen grid

8	3Z6805-6	Resistor	5-megohm, 1/2 watt	Grid, 2nd stage
9	3Z4534	Resistor RS-134	1-megohm	Plate, 1st stage
10-1	3Z4562	Resistor RS-162	0.25-megohm	Filter
10-2	3Z4562	Resistor RS-162	0.25-megohm	"
11	3Z5998	Resistor	8.0 - 8.3 ohms, 1/2 watt	Voltage dropping
12	2Z7649-6	Relay (see note 1)	2 pairs make contacts	Switch

b. Control Board BD-85-(*).

201	3F1005-21	Ammeter	0-5 amp	Recording lamp current
202	3F8050-10	Voltmeter	0-50 volts	Station battery voltage
203	3F1020-11	Ammeter	0-20 amp	Relays and IE-14 current
204	3F3470-Z	Milliammeter	0-15 Milliamp	Outpost current
205	3F8100-2	Voltmeter	0-100 volts	Microphone voltage
206	3F3470-1	Milliammeter	0-10 milliamp	Microphone current
207	4C5208DA	Key (see note 2)	Lever, 2 way	Test key
208	4C5208DA	Key (see note 2)	"	Station battery key
209	4G385A/T1	Transformer	Output	Output coupling
210	3Z2587	Fuse	1/4-amp	Circuit protector
211	3Z2015-1	Fuse	15-amp	"
212	3Z1925	Fuse FU-25	5-amp	"
213	3Z1926	Fuse FU-26	1-amp	"
214	2Z8778	Socket SO-78	8 contacts	Oscillograph connections
215	2Z8799-25	Socket SO-125	9 contacts	Power connections

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LIST OF REPLACEABLE PARTS (Continued)

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b. Control Board BD-85-(*). (Continued)

Ref. No.	Stock No.	Name of part	Description	Function
216	4C4365	Frame jack strip	16 contacts	Relay unit connections
217	3Z5983	Resistor	0.3 ohm, 20-watt	Voltage dropping resistor
218	2Z392	Attenuator	10/10 ohms	Output control
219	4G385A/S1	Socket	2 contacts	Input connection

c. Relay Unit BK-9-(*).

1	2Z7645	Relay (see note 1)	Double winding	Switch, counter and alarm
2	2Z7645	Relay (see note 1)	"	Switch, microphone, cutter, identification lamps
3	2Z7649-7	Relay (see note 1)	Single winding	Switch, motor delay
4	2Z7649-4	Relay (see note 1)	"	Switch, seal, motor, identification lamps
5	2Z7649-8	Relay (see note 1)	"	Switch, time delay
6	2Z7649-4	Relay (see note 1)	"	Switch, cutter, lamps
7	3Z7200-3	Rheostat	200-ohm, 6-watt	Time delay adjustment
8	3Z6030-23	Resistor	300-ohm, 1-watt	Filter
9	3Z6045-9	Resistor	450-ohm	Time delay
10	3D177A	Capacitor CA-177-A	0.5- μ f, 400-volt, d-c	Filter

d. Switchboard BD-62-(*).

101	2Z7645	Relay (see note 1)	Single winding	Ringling relay
102	2Z7645	Relay (see note 1)	"	"
103	4F2544	Ringling transformer		Ringling current
104	4C1527AW	Buzzer		Alarm
105	3C1712A	Retardation coil	24-volt, d-c	Filter choke
106	3C44	Induction coil	24-volt, d-c	Audio transformer
107	3C323-2A	Choke coil	4 terminals	Filter choke
108	4C3503	Drop M-203 (modified)		Call indicator
109	3Z6015-9	Resistor	150-ohm, 1-watt	Filter
110	3DA250-6.1	Capacitor	0.25- μ f., 200 volt, d-c	"
111-1 to 8	3DB1.763	Capacitor	1.0- μ f., 200-volt, d-c	Coupling condenser
111-9 to 16	3DB1.763	Capacitor	1.0- μ f., 200-volt, d-c	Filter
112	3D177A	Capacitor CA-177-A	0.5- μ f., 400-volt, d-c	Coupling Condenser
113	4C4319	Jack	Tip and ring	Circuit patching
114	4C4277	Jack JK-37	Telephone jack	Connection to handset
115	4C4314	Jack	Tip and ring	Circuit patching
116	4C5208DA	Key (see note 2)	Lever, 2-way	Ringling and alarm circuit key
117	4C5208DA	Key (see note 2)	"	Outpost circuit key
118	4C5208DA	Key (see note 2)	"	Microphone circuit key
119	3Z1926	Fuse FU-26	1-amp	Circuit protector

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LIST OF REPLACEABLE PARTS (Continued)

d. Switchboard BD-62-(*). (Continued)

Ref. No.	Stock No.	Name of part	Description	Function
120	3Z1925	Fuse FU-25	5-amp	Circuit protector
121	4G4762B/S7	Socket	2 contacts	Output connection

e. Oscillograph Equipment IE-14-(*).

301	4G435	Counter	Single winding	Record Counter
302	4G5132	Time marker unit	Motor, tuning fork, etc.	Timing lines
303	4G820	Oscillograph unit rack	16 jacks	
304-1	6Z6827	Lamp LM-30	27-volt	Time lamp
304-2 to 5	6Z6827	Lamp LM-30	27-volt	Identification lamp
305	4G1240	Lamp LM-40	4.2-volt	Recording lamp
306	3Z7000E5	Rheostat	1/2-ohm, 25-watt	Recording lamp control
307	3Z5996-1	Resistor	6.0-ohm, 20-watt	Heater current limiter
308	3Z6008-1	Resistor	80-ohm	Lens heater
309	3Z6001F6	Resistor	16-ohm	Developer heater
310	3Z6004A5-3	Resistor	45-ohm, 20-watt	Filter
311	3Z6010-30	Resistor	100-ohm, 20 watt	Cutter holding current limiter
312	3Z6001-11	Resistor	10-ohm, 50-watt	Motor speed control
313-1 to 3	3DB1.763	Capacitor	1.0- μ f., 200-volt, d-c	Filter
314	3D177A	Capacitor CA-177-A	0.5- μ f., 400-volt, d-c	Filter

315	3H3111	Motor		Camera drive motor
316	2Z7686	Relay		Cutter operation
317	4C5208DA	Key (see note 2)	Lever, 2-way	Counter & fork control
318	4C5208DA	Key (see note 2)	"	Lamp & motor control
319	4C5208DA	Key (see note 2)	"	Heater control
320	2Z8778	Socket SO-78	8 contacts	Oscillograph connection
321	2Z8799-25	Socket SO-125	9 contacts	Power connections
Fig. 4	4G1666A	Oscillograph unit M-166-A	Moving-coil type	Sound record
Fig. 4	3E1475	Cord CD-475	Plug-ended each end	Galvanometer connection

f. Headset HS-30 (*).

Stock No.	Name of part	Description
2B730	Headband HB-30	
2B2030(*)	Receivers R-30-(*)	
3E1620(*)	Cord CD-620-(*)	2-conductor
2B1300	Inserts M-300	

g. Chest Set TD-1.

4B418	Chest Unit T-26	
3E333	Cord CC-333	6-ft., 3-conductor
4B2358	Plug PL-58	
4Z6924	Strap ST-24	
4Z6925	Strap ST-25	
3Z8118	Switch SW-118	

LIST OF REPLACEABLE PARTS (Continued)

h. Tool Equipment TE-37.

Quantity	Name and Description	Manufacturer's Stock No. (Automatic Electric Co.)
1	Gauge, thickness	H-46755-1
1	Pliers, duck-bill	H-50620
1	Tool, spring bender	20777
1	Tool, spring bender	42873
1	Tool, spring bender	7066
1	Tool, armature stop bender	14769
1	Tool, armature bender	14768
1	Tool, contact cleaner	H-42962-1
1	Tool roll, canvas, No. 10 hard-texture, olive drab duck, with individual compartments for tools listed, side flaps, and webbing strap with buckle.	

i. Tool Set TE-6.

Stock No.	Quantity	Name	Description
6Q8112-18	24	Blade, hacksaw	12-in., 18 teeth per inch
6Q19077	1	Chest BC-77	Oak
6Q19808-6	1	Chisel, cold	1/2 by 6 in.
6Q27502	1	Cleaner, file	
6Q34530	1	Drill, hand	Ratchet
6Q36160	1 set	Drill, twist	Steel, Nos. 1 to 60
6Q38503-4	4	File, round	Second cut, 4-in.
6Q38503-6	6	File, round	Second cut, 6-in.
6Q38603-4	4	File, square	Second cut, 4-in.
6Q38030-8	6	File, flat	Bastard, 8-in.
6Q41000	1	Frame, hacksaw	Adjustable, 8 in. to 12 in.
6Q46315	1	Grinder, tool	Hand, bench, 1 by 5 in. wheel
6Q50004	1	Hammer, riveting	4-oz., cast steel
6Q51185-5	2	Handle, soldering iron	Wood, 5-in.
6Q51131-5	1	Handle, file	Malleable iron
6Z7300-75	1	Oiler	3/4-oz., coppered steel, 4-in. bent spout
6R2082M	1	Oilstone, soft	Mounted, 8 by 2 by 1 in.
6Z7492	1	Padlock MC-92	For Chest BC-77
6R4513	1	Pliers TL-13	Side-cutting, 6-in.
6R4603	1	Pliers TL-103	Diagonal-cutting, 5-in.
6R4626	1	Pliers TL-126	Long-nose, 6-in.
6R7508	2	Punch, center	1/2-in. diam. by 4 in.
6R19100	1	Screwdriver Set TL-128	Includes ratchet screwdrivers, drill points, chuck, countersink, etc.
6R14970	1	Screwdriver TL-25	Jewelers', swivel-head
6R19507	1	Screwplate set	Taps and dies, NC 4-36 to 14-20, in wood case

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LIST OF REPLACEABLE PARTS (Continued)

i. Tool Set TE-6. (Continued)

Stock No.	Quantity	Name	Description
6R24011	1	Shears, tinner's hand	Snips, 11 in. over-all, 2½-in. cut
6R24508	1	Soldering iron	Size 1, ½-lb.
6R24524	1	Soldering iron	Size 3, 1½ lb.
6N7531	1 lb.	Solder M-31	Resin core
6R25506	1	Square, combination	6-in.
6R42100	1	Torch, blow	Gasoline, 1-qt.
6R47020	1	Vise, bench	2-in., solid back jaw, swivel base

NOTE 1.—When ordering, specify contact arrangement, number of coils, reference number, and function.

NOTE 2.—When ordering, specify contact arrangement, reference number, and function.

39. LIST OF COMPONENTS

Quantity	Stock No.	Article	Dimensions (inches)			Unit Weight (pounds)
			Height	Width	Depth	
5 gal.	8A802-2	Alcohol, ethyl, denatured				
10	4G197	Bag BG-97	18	5	2	1
8	3A26	Battery BA-26	4½	8¼	7¾	14.5
20	3A28	Battery BA-28	11/16	2	2¼	0.12
120	3A30	Battery BA-30		1¼ diam.	2¼	0.25
16	3B29	Battery BB-29; includes 8 spare	8-9/16	9¾	8	35
1	3B4295	Battery tester, heavy discharge type	3	5	8	2
1	4C310D	Bell, switchboard, 24 volt, d-c.	6	3	1½	1.5
10 feet	6Z922LR	Belting, leather, round ¼ in.				
18	4E681	Block, protector, carbon	¾	¾	¾	0.03
18	4E682	Block, protector, bakelite	¾	¾	¾	0.03
8	4G290	Bucket, enameled steel, 10-qt.	12	10 diam.		2
6	3D157	Capacitor CA-157, (Spares)				
6	3D155A	Capacitor CA-155-A, (Spares)				
6	3D156A	Capacitor CA-156-A, (Spares)				
12	3D177A	Capacitor CA-177-A, (Spares)				
2	3DA250-6.1	Capacitor, .25µf., 200 volt, d-c (Spares)				
6	3DB1.763	Capacitor, 1.0 µf., 200 volt, d-c (Spares)				
1 tube	6G199	Cement, household, waterproof				
10 lb.	8A802-1	Chemical, acid, acetic, glacial, C.P. 99 per cent				
30 lb.	8A802-5	Chemical, ammonium chloride, grade A				
4 lb.	8A802-10	Chemical, metol				
2 lb.	8A802-12	Chemical, hydroquinone				
20 lb.	6G1910-1	Chemical, sodium hydroxide, U.S.P.				

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Quantity	Stock No.	Article	Dimensions (inches)			Unit Weight (pounds)
			Height	Width	Depth	
200 lb.	8A802-27	Chemical, sodium thiosulfate (hypo) photographic, pea-crystals				
50 lb.	8A802-30	Chemical, sodium sulfate, anhydrous, photographic				
1	6F705	Chest BC-5	28 ⁷ / ₈	18 ¹ / ₈	12	35
2	4G340B	Chest CH-40-(*)	11	25 ¹ / ₄	47 ¹ / ₂	84 ¹ / ₂
1	4G344A	Chest CH-44-(*)	15 ³ / ₄	14 ¹ / ₂	25 ¹ / ₂	46
1	4G345A	Chest CH-45-(*)	13 ¹ / ₄	15 ¹ / ₂	48 ¹ / ₂	57
1	4G346A	Chest CH-46-(*)	13 ¹ / ₈	12 ¹ / ₂	36 ¹ / ₂	34
1	4G347A	Chest CH-47-(*)	16 ⁵ / ₈	12 ¹ / ₄	38 ¹ / ₄	37
1	4G348A	Chest CH-48-(*)	17 ³ / ₈	14 ³ / ₄	43 ¹ / ₄	53
1	4B417	Chest Set TD-1 (Note 3)				
2	4G355	Clamp MM-7	8	8	3/4	6
50 yards	6N1619	Cloth, birdseye				
1	4G385	Control Board BD-85-(*)	12 ¹ / ₂	8 ³ / ₄	32 ³ / ₈	36
10	3E66	Cord CC-66, length 18 inches				
2	3E67	Cord CC-67, length 36 inches				
1	3E1250A	Cord CD-250-A, length 50 feet				

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15	3E1428	Cord CD-428, length 5 inches includes 6 spares				
2	3E1438	Cord CD-438, length 20 feet				
1	3E1439	Cord CD-439, length 20 feet				
1	3E1443	Cord CD-443, length 17 ¹ / ₄ inches				
2	3E1444	Cord CD-444, length 14 inches				
8	3E1475	Cord CD-475, length 8 inches				
10	3E2038	Cord CO-38, length 12 inches				
4	3E2050A	Cord CO-50-A, length 72 inches				
1 oz.	6B400	Cotton, absorbent				
1	4G394	Cover BG-74	18	18	4	8.5
24	4G1321B/D1	Diaphragm, aluminum, 7 x 7 x .001 inches thick				
2	8A980	Drier, film				
4 oz.	8A802-38	Ether				
1	6Z4002A.1	Flashlight TL-122-A				
4	8A1174	Funnel PH-174				
18	3Z1910	Fuse FU-10, 3-amp, tubular				
24	3Z1925	Fuse FU-25, 5-amp.				
24	3Z1926	Fuse FU-26, 1-amp.				
24	3Z2015-1	Fuse, 15-amp.				

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LIST OF COMPONENTS (Continued)

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Quantity	Stock No.	Article	Dimensions (inches)			Unit Weight (pounds)
			Height	Width	Depth	
18	3Z2427	Fuse, 5-amp., tubular				
24	3Z2587	Fuse, 1/4-amp.				
20	4G1321B/G1	Gasket, 1/16-inch, neoprene, large				
20	4G1321B/G2	Gasket, 1/16-inch, neoprene, small				
2	4G632	Graduate, enameled steel, white 32-ounce	7	4 diam.		0.75
10	5B4416	Ground Rod GP-16	24	1/2 diam.		1.5
1	3Z3329	Ground Rod GP-29	36	2 1/4 diam.		8
1	4B1109-(*)	Handset TS-9-(*)	9	3	3	1.1
		Handset TS-9A (4B1109A) through TS-9-Q (4B1109Q) may be issued.				3
1	2B830-(*)	Headset HS-30-(*). If Headset HS-30-(*) and Chest Set TD-1 are not available, Head and Chest Set HS-19-A (4B-1279A) may be issued.				
2	3B2202	Hydrometer HY-2	12 3/4	2	2-7/16	0.25
3	3B2600	Jug, gallon, glass, clear				
3	3B2600.1	Jug, gallon, glass, brown				
10	6Z6827	Lamp LM-30, 27 volt				

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10	6Z6761A	Lamp LM-35-A				
10	4G1240	Lamp LM-40, 3.7-amp., 4.2-volt				
2 cans	6G1315	Lubricant, household				
10	4G1406A	Microphone Shelter BE-66-A		21 diam.	1	4
10	4G1321B	Microphone T-21-(*), includes 2 spares	16	6 diam.		24
8	4G166A/C1	Moving coil system for Oscillograph Unit M-166-A. Not issued with GR-3-C. To be stored at depot for repair of Oscillograph Unit M-166-A.				
2 cans	6G1350	Oil, Gargoyle Velocite, grade E				
1	4G1614C	Oscillograph Equipment IE-14-(*) Includes 8 spare Oscillograph Units M-166-A.	19	11	36 1/2	90
2	4G1741	Outpost Connecting Box BE-71	4 1/2	2	1 1/2	1
2	4G1751	Outpost Unit BE-51	2 1/2	3 1/4	7	6
2	6M1220.3	Pad, stamping, black				
140 rolls	8A2852	Paper, recording, roll 250-feet long, 35-mm wide	3	6 diam.		2.5
12	6M1030	Pencil, red, china marking				
2	6R3000	Pick, railroad type, with handle				

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Quantity	Stock No.	Article	Dimensions (inches)			Unit Weight (pounds)
			Height	Width	Depth	
2	4B2358	Plug PL-58	2¼	2	2	0.12
10	4E4004	Protector AR-4	7⅞	3½	3	1
1	4E4008	Protector AR-8	16	12 diam.		13
1	2Z7649-6	Relay, (Spare)	3½	1¼	2¼	0.75
2	4G1909	Relay Unit BK-9-(*), includes 1 spare	4½	8	4½	6
6	3Z4534	Resistor RS-134, 1-megohm, ½-watt (Spares)				
6	3Z4562	Resistor RS-162, 0.25-megohm, ½-watt (Spares)				
6	3Z5998	Resistor, 8.0-ohms, ½-watt (spares)				
6	3Z6805-6	Resistor, 5-megohms, ½-watt (spares)				
6	3Z6810-5	Resistor, 10-megohms, ½-watt (spares)				
6	3Z6820	Resistor, 20-megohms, ½-watt (spares)				
6	3Z6850	Resistor, 50-megohms, 1-watt (spares)				
3	8A3430	Rod PH-230, stirring				
1	8A3614A	Scale PH-14-A	5	8	5	1
1	8A3624	Scale PH-114, 4-16	5	12	5	4
2	6R22019	Shovel LC-19	37-overall			5

1	6R24639	Soldering Iron TL-139				
1	6Z8369	Sponge, cellulose, fine pore				
1	4G1909/S1	Spring assembly for relay AQA-1 (spare)				
1	4G1909/S2	Spring assembly for relay AQA-2 (spare)				
1	4G1909/S3	Spring assembly for relay AVR-3 (spare)				
1	4G1909/S4	Spring assembly for relay ASO-4 (spare)				
1	4G1909/S5	Spring assembly for relay AWS-5 (spare)				
1	4G1909/S6	Spring assembly for relay ASO-6 (spare)				
1	4G1614C/S1	Spring assembly for cutter relay (spare)				
2	6M1201	Stamp, identification, rubber				
½ lb.	6Z8420	Stopper, cork, No. 5				
6	6Z8421	Stopper, rubber, No. 5, one-hole				
½-lb.	6Z8422	Stopper, rubber No. 6				
1	4G4762 (*)	Switchboard BD-62-(*)	8½	8¾	32⅞	27.4
3	4B5008 (*)	Telephone EE-8-(*)	3½	7-7/16	9½	4
1	3F4065 (*)	Test Set EE-65-(*). Test Sets EE-65-A (3F4065A) through EE-65-D (3F- 4065D) may be issued.	8	10	6	14
1	3F4056C	Test Set I-56-C	11	13½	9½	26
2	8A3828	Thermometer PH-28				

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LIST OF COMPONENTS (Continued)

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Quantity	Stock No.	Article	Dimensions (inches)			Unit Weight (pounds)
			Height	Width	Depth	
1	6R38037	Tool Equipment TE-37	4	2 diam.		0.75
1	6R38006	Tool Set TE-6	6 cu. ft.			108
28	2T27	Tube VT-27 (includes 18 spares)				
24	2T44	Tube VT-44 (includes 14 spares)				
3	4G5600	Tubing, pyrex, right-angle (includes 2 spares)				
24 feet	7A1930	Tubing, rubber, grade B, 3/16-inch bore				
2	6R4600	Tweezers, brass				
3 lb.	6Z8813	Twine RP-13				
1,000 feet	1B520	Wire, No. 20, rubber-covered, hook-up				
50 feet	1B816.4	Wire, No. 16, rubber-covered, 2-conductor, lamp cord				

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40. INDEX TO MANUFACTURERS.

Name	Address
American Automatic Electric Sales Co.	1033 W. Van Buren St., Chicago, Ill.
Engineering Laboratories, Inc.	624 E. Fourth Street, Tulsa, Okla.
Wallace & Tiernan Products, Inc.	Belleville, N. J.

(A.G. 062.11 (4-26-43).)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL

J. A. UJIO,
Major General,
The Adjutant General.

DISTRIBUTION:
IBa 6 (2); IC 6 (3), 11 (2).
(For explanation of symbols see FM 21-6.)

15 OCT 1943

TM 11-444

SUPPLEMENT
to
TECHNICAL MANUAL NO. 11-444
for
Sound Ranging Set GR-3-C

The following supplementary information covering Sound Ranging Set GR-3-C is published for the information and guidance of all concerned. The paragraph and figure numbers used are a continuation of the sequence established in TM 11-444, 12 June 1943.

Personnel using this equipment will enter suitable notations beside each changed paragraph of the TM to indicate the presence of supplementary information contained in the supplement.

RESTRICTED

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Par. 14. f. (2) Add after 5th line:- (SEE PARAGRAPHS #41)

Page 1	Add at bottom of page;- <i>Replacement of Relay Unit BK-9-(*)</i>	41
	<i>Ordering a replacement of Cut-off mechanism</i>	42
	<i>Removing the Cut-off mechanism</i>	43
	<i>Installing replacement cut-off mechanism</i>	44
Page 2	Add Figures 20 to 25 inclusive	

R E S T R I C T E D

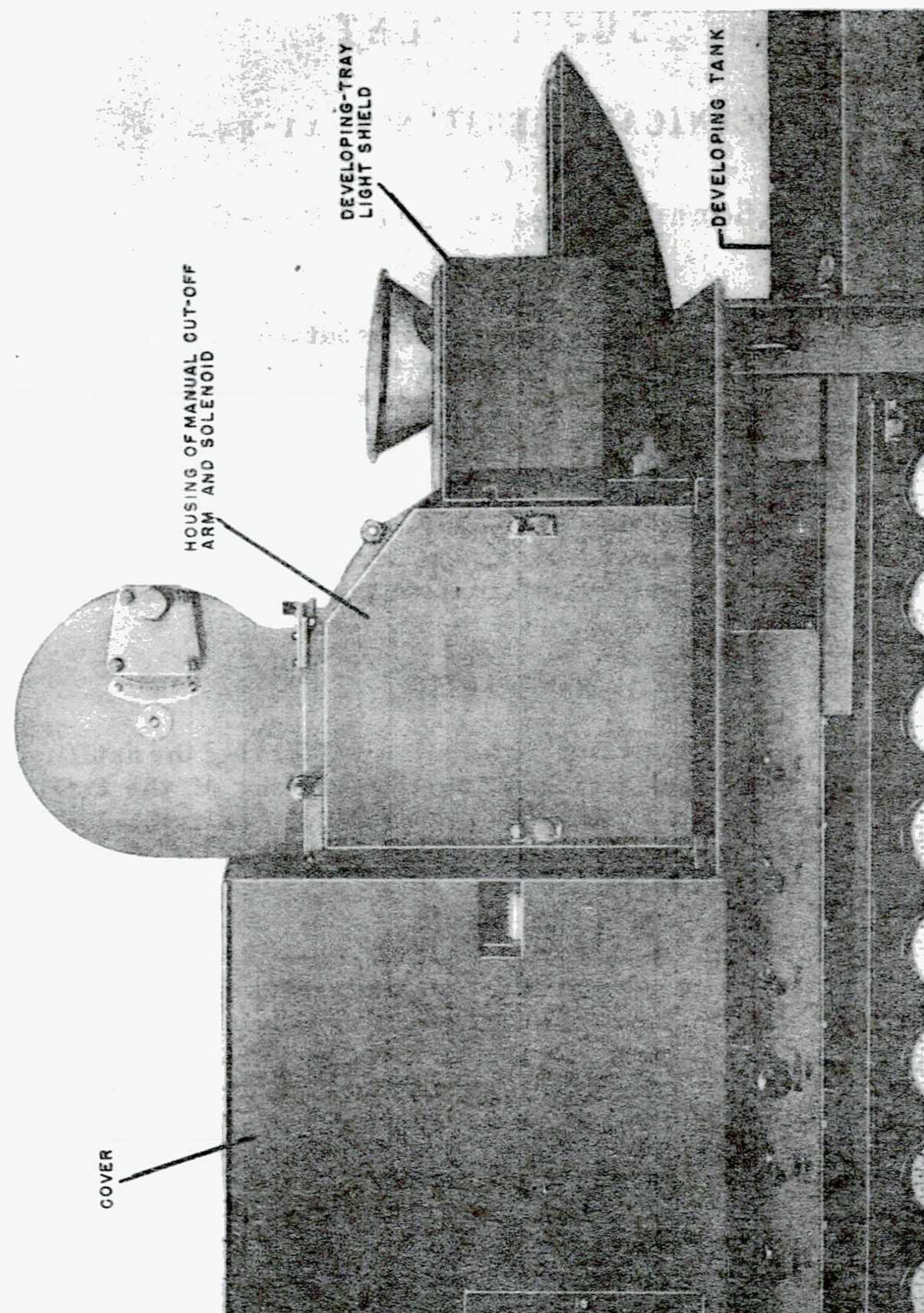


FIG. 20 OSCILLOGRAPH EQUIPMENT IE-14-(*) , FRONT VIEW SHOWING CAMERA

41. REPLACEMENT OF RELAY UNIT BK-9- (*)

When it is necessary to replace Relay Unit BK-9- (*) be sure you have the right one. They are not all the same. They are not all interchangeable. Order by Stock Number. With sets on Orders number 4538-SCL-42 and 3378-SCGDL-43, only unit with Signal Corps. Stock No. 4G1909C can be used. They have sides painted red. For all other sets use unit Signal Corps Stock No. 4G1909.

IN OSCILLOGRAPH EQUIPMENT IE-14- (*)

42. REPLACEMENT OF CUT-OFF MECHANISM IN SOUND RANGING SET GR-3-C.

CAUTION: Be sure you have the right cut-off mechanism. They are not all the same. They are not all interchangeable. Order by Stock number. With sets on Orders number 4538-SCL-42 and 3378-SCGDL-43 only mechanisms with Signal Corps Stock No. 4G3003C/C2 can be used. They have sides painted red and are marked SR22530 on the casting of the swinging cutter assembly which is beneath the knurled drive roller. For all other sets use mechanism Signal Corps Stock No. 4G3003C/C1. They are painted black.

43. REMOVING CUT-OFF MECHANISM.

Remove the cut-off mechanism as follows: (For this purpose that side of the camera housing from which the screen is viewed is the front).

a. First, remove the protective covers: (See Fig. 20)

- (1) The large one covering the entire left side of the set.
- (2) The housing covering the manual cut-off arm and the solenoid.
- (3) The developing-tray light-shield.
- (4) The light shield to the left of the galvanometer unit.

b. Then, remove film magazine and holder:

- (1) Remove the two small screws nearest the front on the top of the magazine guide. (Fig. 21)

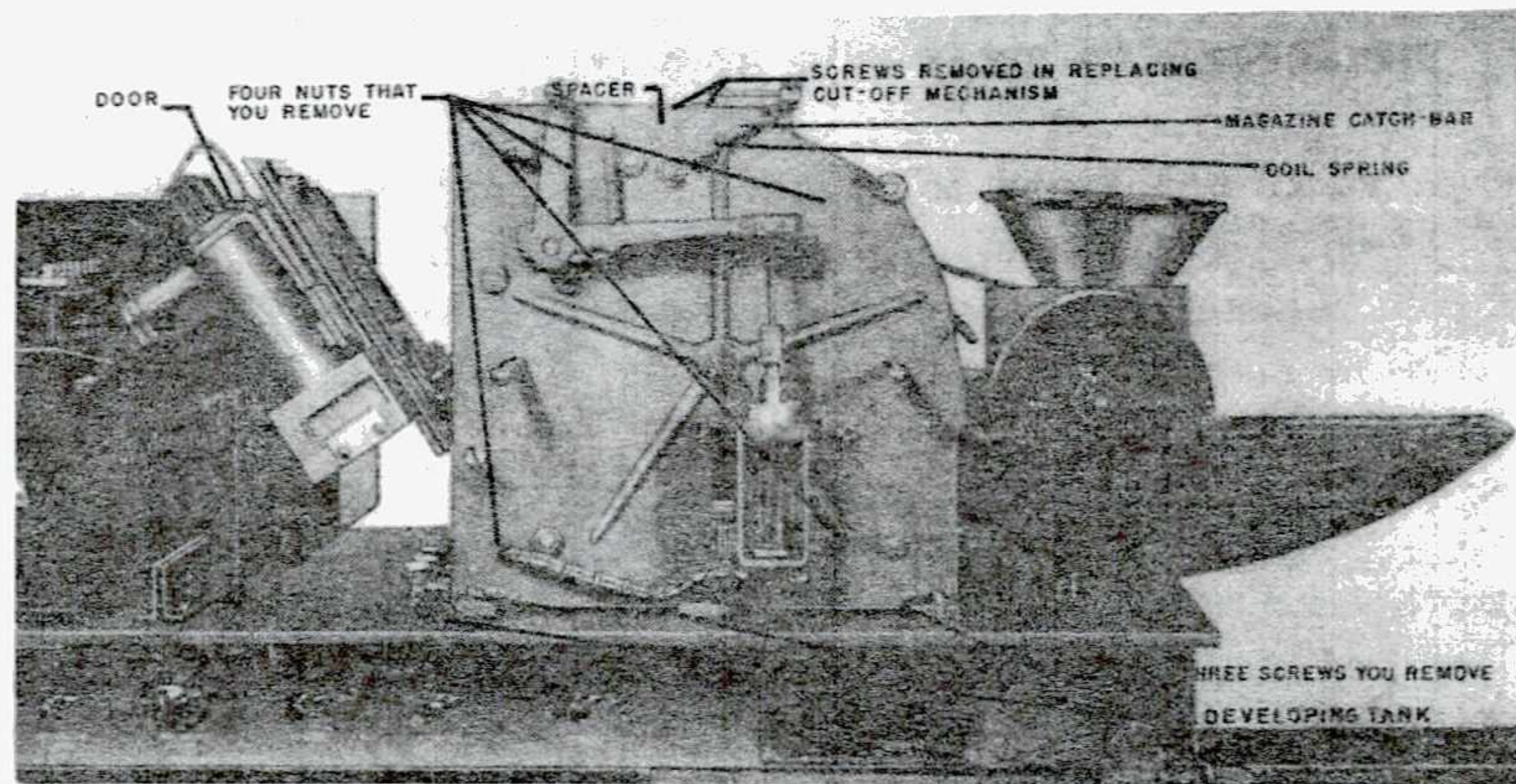


FIG. 21 OSCILLOGRAPH EQUIPMENT IE-14-(*), WITH HOUSING REMOVED TO SHOW SOLENOID AND MANUAL CUT-OFF ARM.

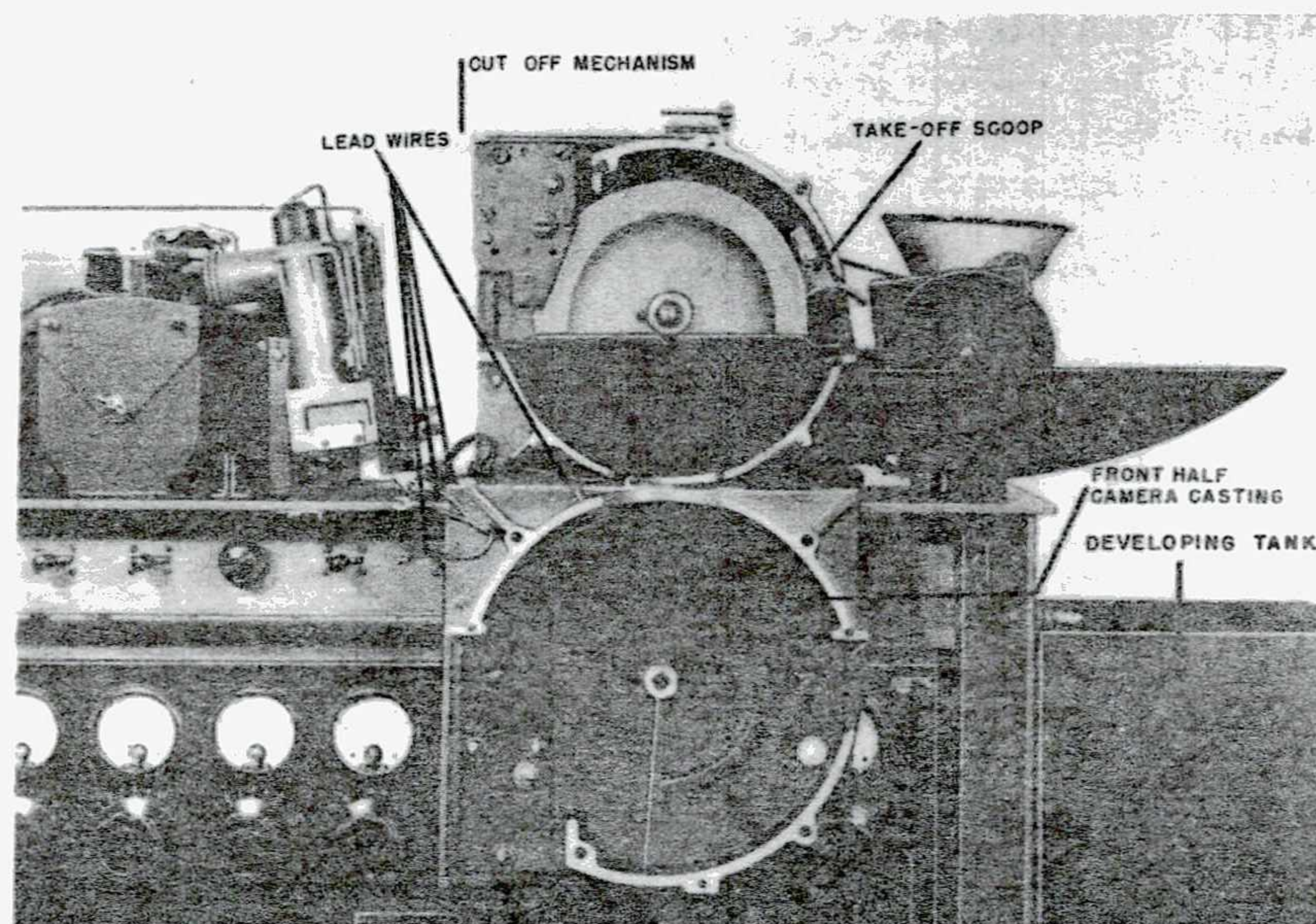


FIG. 22 OSCILLOGRAPH EQUIPMENT IE-14-(*), FRONT VIEW WITH COVERS AND FRONT HALF OF CAMERA CASTING REMOVED

(2) Remove the small spacer from between the magazine guide and the camera casting.

(3) Unhook both coil springs from ends of the magazine catch-bar.

(4) Remove the magazine catch-bar by raising the restraining pin and pulling the bar to the right.

c. Next, remove front half of camera casting: (Fig. 21)

(1) Remove the door holding the lenses, recording lamp etc., from the left side of the camera housing by unscrewing the knurled knob and removing both hinge screws. Tilt door to the left and allow barrel of identification lens to rest lightly on top of galvanometer magnet. Wires may be left connected to binding posts.

(2) Remove three screws holding front half of camera casting to the table top.

(3) Remove four nuts from front of camera casting.

(4) Very carefully pull the front half of the camera casting toward you exposing the cut-off mechanism, the developing tray and the large rubber-covered roller. Be sure that the take-off scoop on the right end of the casting remains attached to the rear half of the casting during this operation, (otherwise the springs of the scoop may be bent or may injure the rubber-covered roller).

(5) Detach the three solenoid lead wires from the binding posts, and the heater ground wire from the casting.

d. Now, remove the cut-off mechanism:

(1) Remove the three screws holding the cut-off mechanism to the rear half of the camera housing. The screws will be found on the back of the rear casting: one in the flat of the gear housing directly over the extension one to the right of the housing; the third near the top edge of the camera casting. (Fig. 23)

(2) Loosen the two screws in the hub of the knurled roller of the cut-off mechanism. (Fig. 24)

(3) The cut-off mechanism can now be removed by raising the small roller (running in the groove of the rubber-covered wheel) so as to clear the edge of the rubber and at the same time, drawing the mechanism towards you. (Fig. 25)

(4) Take care not to lose, or leave in the camera, the knurled roller and the two spacers which are normally on the shaft of the cut-off mechanism and which are completely detached when the mechanism is removed. (Fig. 24)

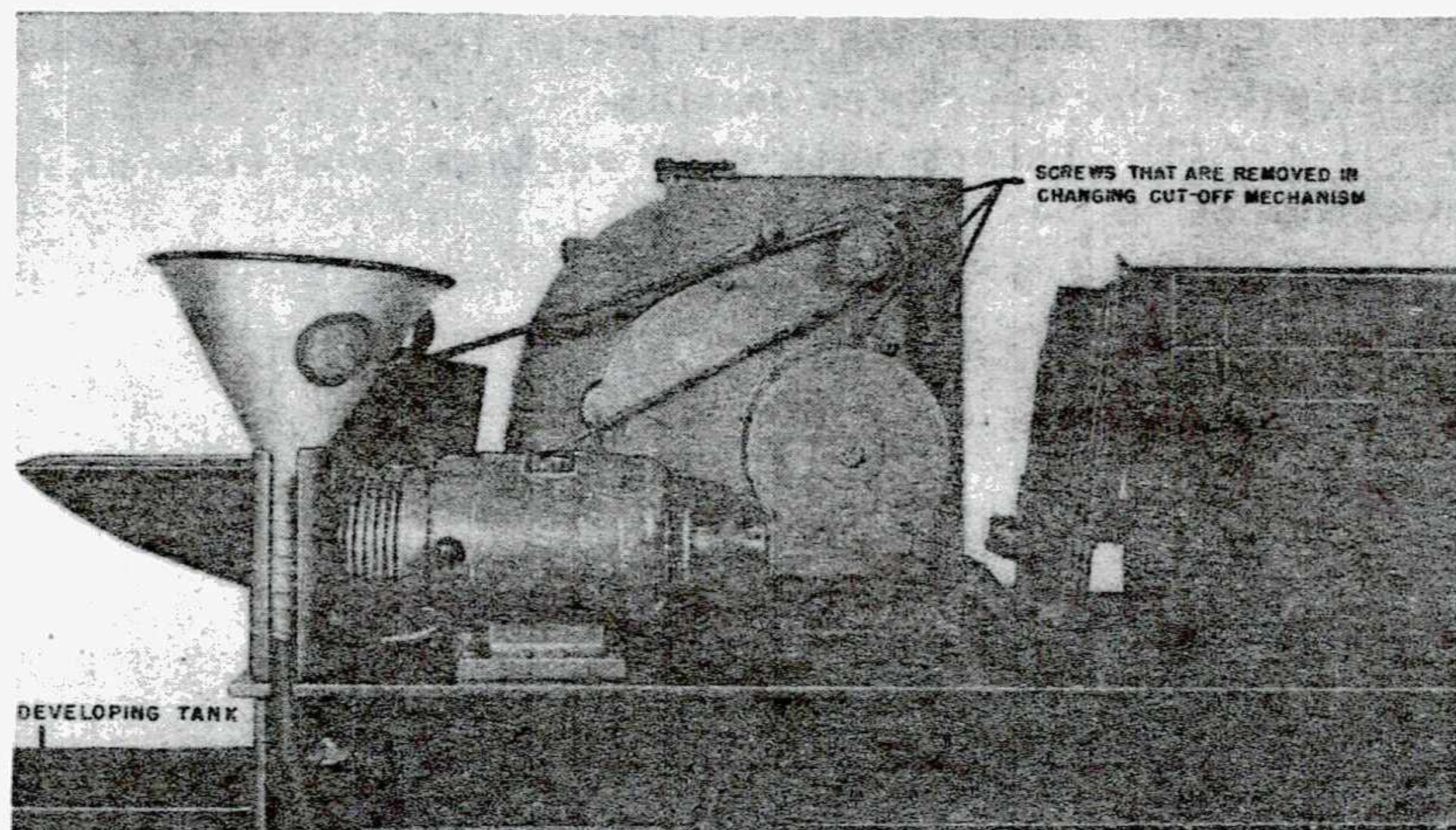


FIG. 23 OSCILLOGRAPH EQUIPMENT IE-14-(*) REAR VIEW OF CAMERA INDICATING SCREWS TO BE REMOVED TO RELEASE CUT-OFF MECHANISM.

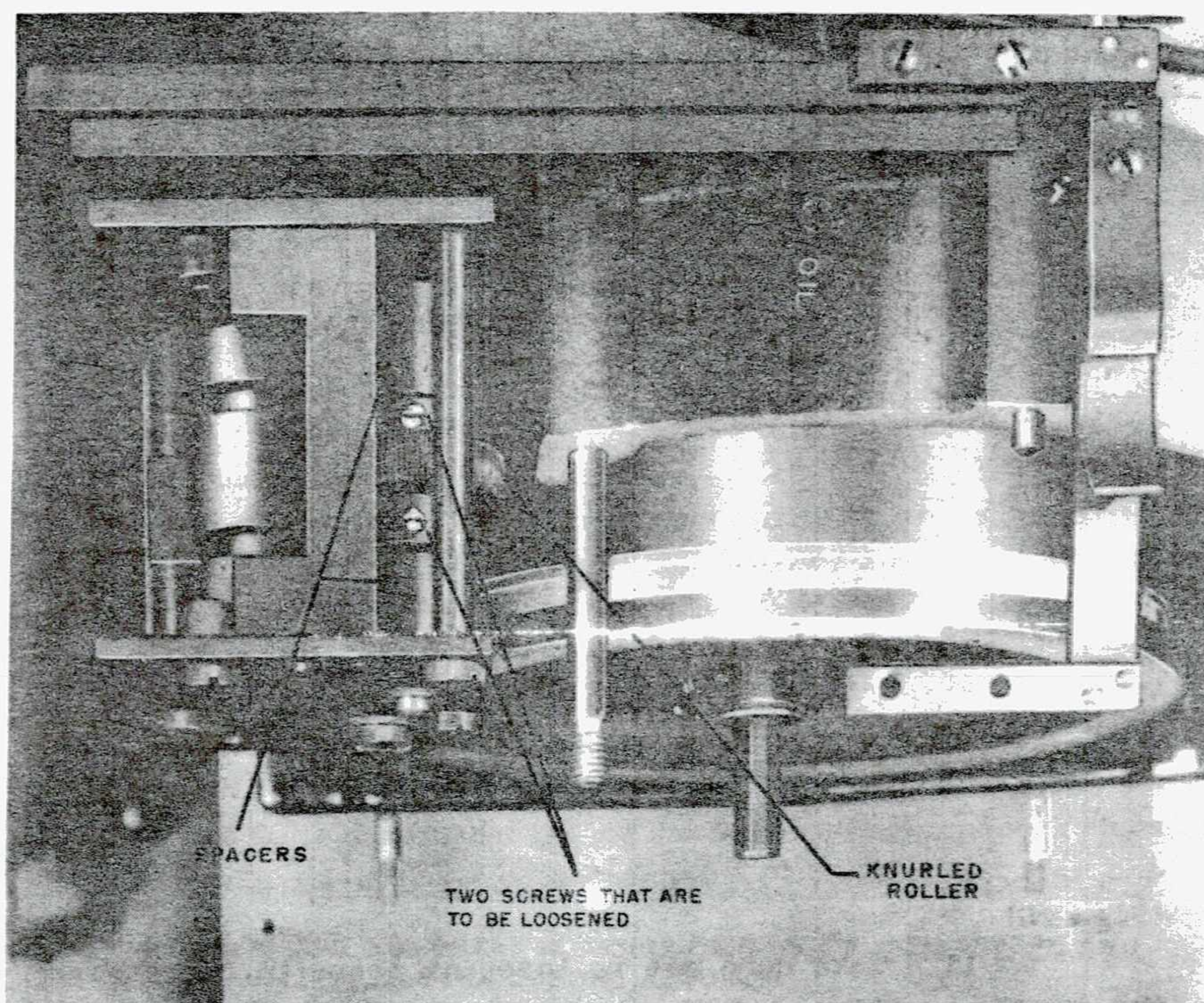


FIG. 24 OSCILLOGRAPH EQUIPMENT IE-14-(*) TOP VIEW OF CAMERA, FRONT CASTING REMOVED SHOWING SCREWS IN THE HUB OF THE KNURLED ROLLER.

44. INSTALLING THE REPLACEMENT CUT-OFF MECHANISM.

a. Hold the cut-off mechanism as shown in Fig. 25.

(1) Pull the small roller on the bottom of the cut-off mechanism to the left as far as it will go to clear the edge of the rubber wheel so you can put the mechanism in its place. Don't forget to put the knurled roller and the two spacers in place before putting the cut-off mechanism on the shaft. THE SHAFT MUST PASS THROUGH THE ROLLER WITH SPACER ON EACH SIDE BEFORE IT GOES IN TO THE FRONT BEARING OF THE MECHANISM. (Fig. 24)

(2) Tighten the two screws in the hub of the knurled roller of the cut-off mechanism. (Fig. 24) Be sure the screws seat on the flat places on the shaft.

b. Tighten the three screws which hold the cut-off mechanism to the rear half of the camera housing. The screws go in the back of the rear casting:

One in the flat of the gear housing right over the extension;-

One to the right of the housing;

The third near the top edge of the camera casting

(Fig. 23)

c. Attach the heater ground wire to the front casting and fasten the three solenoid wires to their binding posts:

The black wire to the middle post.

The orange and green wire to the front post.

The orange, green, and black wire to the post between the front and middle posts. (Fig. 22)

d. Put back the front half of the camera casting.

(Fig. 22) While bringing the front casting towards the rear stationary half, the take-off scoop shaft must be put in the opening provided for it in the front casting, and the scoop spring must be depressed so that it does not interfere with the two castings coming together.

(1) Replace the four nuts on the front of the camera casting.

(2) Put in the three screws and lock washers which hold the front half of the camera casting to the table top.

e. Replace the door holding the lenses, recording lamp, etc. Put in both its hinge screws and tighten the knurled knob.

f. (1) Replace the magazine catch-bar by raising the restraining pin and pushing the bar to the left. Make sure that the flat side of the "V" slot in the bar is down towards the camera casting so that the "V" points upward.

(2) Hook a coil spring over each end of magazine catch-bar.

(3) Replace the small spacer in between the magazine guide and the camera casting, (Fig. 21) so that the holes line up and the lip of the spacer is on the front of the casting.

(4) Replace the two small screws on the top of the magazine guide. (Fig. 21)

g. (1) Replace the light shield, to the right of the galvanometer unit. (Fig. 21)

(2) Put on the developing-tray light-shield.

(3) Put on the housing that covers the manual cut-off arm and the solenoid.

(4) Put on the cover that goes over the entire left side of the set.

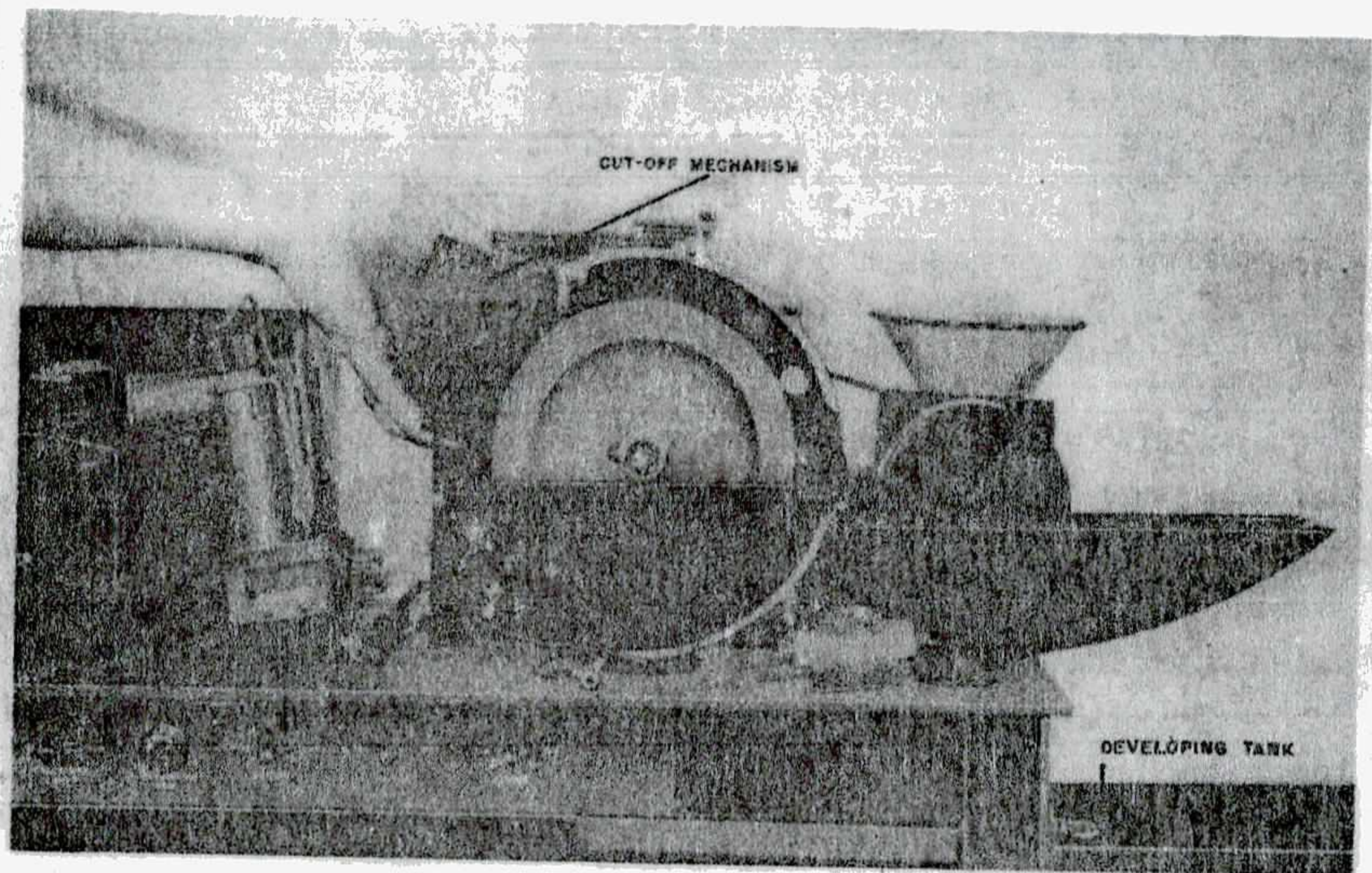
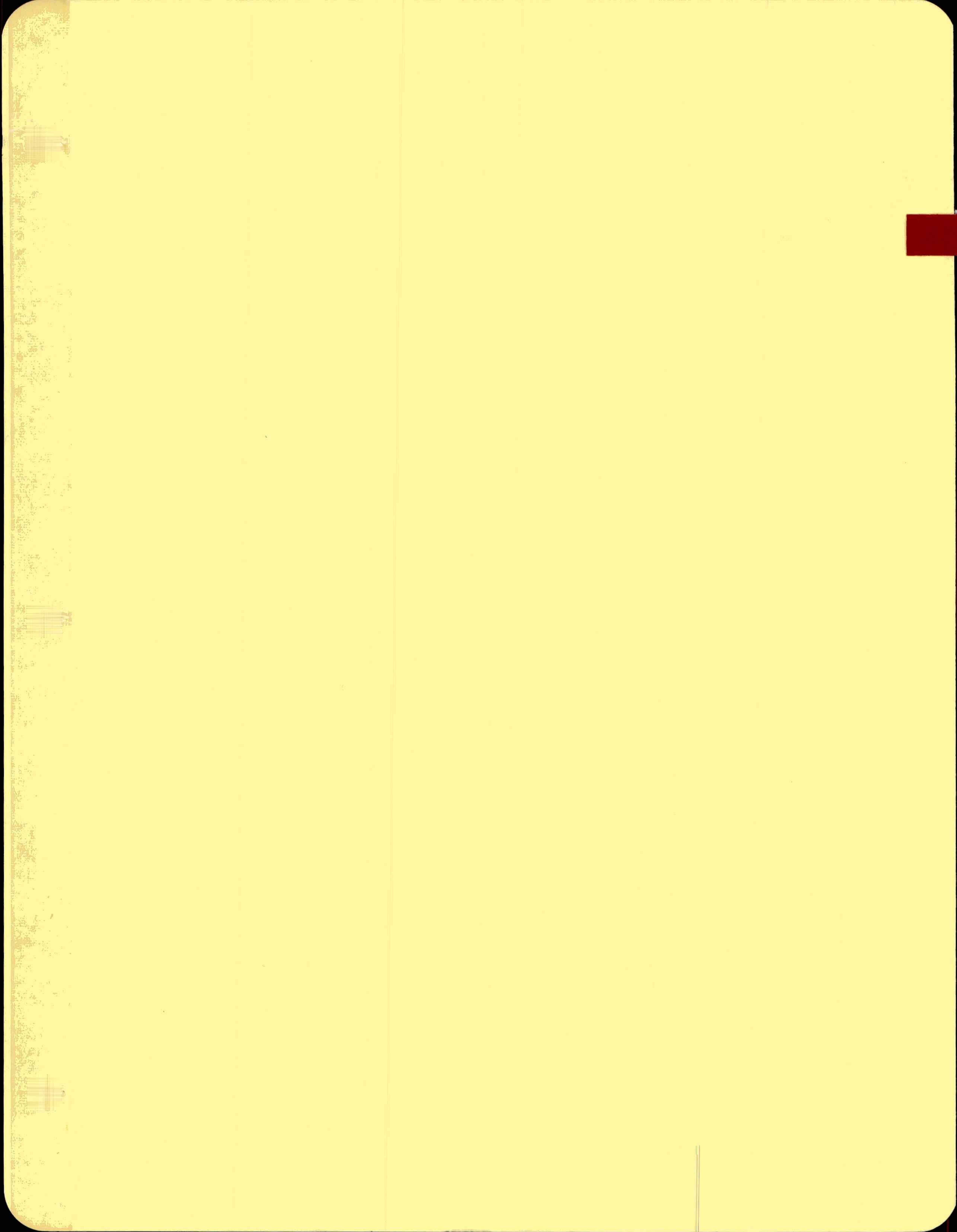


FIG. 25 OSCILLOGRAPH EQUIPMENT IE-14-(*), FRONT VIEW OF CAMERA, FRONT CASTING REMOVED SHOWING THE CUT-OFF MECHANISM BEING REMOVED.

Acc 577
Capt James E. Halley
24 March 1961



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TM 11-2405

WAR DEPARTMENT TECHNICAL MANUAL

METEOROLOGICAL

BALLOONS

WAR DEPARTMENT • 24 APRIL 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-2405

METEOROLOGICAL

BALLOONS



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SECTION. I

DESCRIPTION

1. General

Meteorological balloons are used to determine the direction and speed of winds aloft, to determine the height of clouds, and to carry aloft equipment which will take soundings of the temperature, humidity, and pressure of the upper air. The symbol (&), found in paragraph 5b, refers to all models of procurements of the Generator ML-185 series.

2. Types

Three types of balloons are used in meteorological work; ceiling balloons, pilot balloons, and sounding balloons. When in use, all three types are inflated with hydrogen gas.

a. CEILING BALLOONS. Ceiling balloons are small balloons which ascend at an average rate of 360 feet per minute after the first 1½ minutes (par. 16a). They are used in the daytime to determine the cloud heights whenever the ceiling is approximately 2,500 feet or less. Ceiling balloons are supplied in two colors, in red and in a dark color (black, dark blue, or purple to contrast with the color of the sky at the time of observation (par. 4). Ceiling balloons, before inflation, are approximately 3½ inches in diameter and weigh about 10 grams (0.35 ounce). The balloon neck is about 2 inches long and approximately 1 inch in diameter.

b. PILOT BALLOONS. Pilot balloons are used to determine the direction and speed of the wind in the upper air and to determine cloud heights at night if a ceiling light projector is not available. Pilot balloons are supplied in two sizes.

(1) The smaller pilot balloons (fig. 1) are approximately 6 inches in diameter before inflation and weigh about 30 grams (1.06 ounces). The balloon neck is about 2½ inches long and 1½ inches in diameter. The balloon is of one-piece seamless construction. Thirty-gram pilot balloons are inflated to ascend at a constant rate of about 200 yards per minute (par. 16b) and are used for low-level observation (up to 30,000 feet). They are supplied in the following colors: white or uncolored, a dark color (black, dark blue, or purple), red, orange, and yellow to contrast with the condition of the sky at the time of observation (par. 4).

(2) The larger pilot balloons are approximately 16 inches in diameter before inflation and weigh about 100 grams (3.53 ounces). The balloon neck is made of relatively thick rubber, is about 2½ inches long, and is 7/16 inch to 1½ inches in diameter. Pilot balloons

are of one piece seamless construction. Some 100-gram balloons have a mold mark near the center, but this does *not* weaken the balloon. All balloons are designed to ascend at a rate of approximately 400 feet per minute. Since they ascend faster than the smaller balloons, the 100-gram balloons are used when observations are of short duration or whenever an observation of the higher level is desired without increasing the time of observation. They are supplied in three colors; white, black, and red (par. 4).

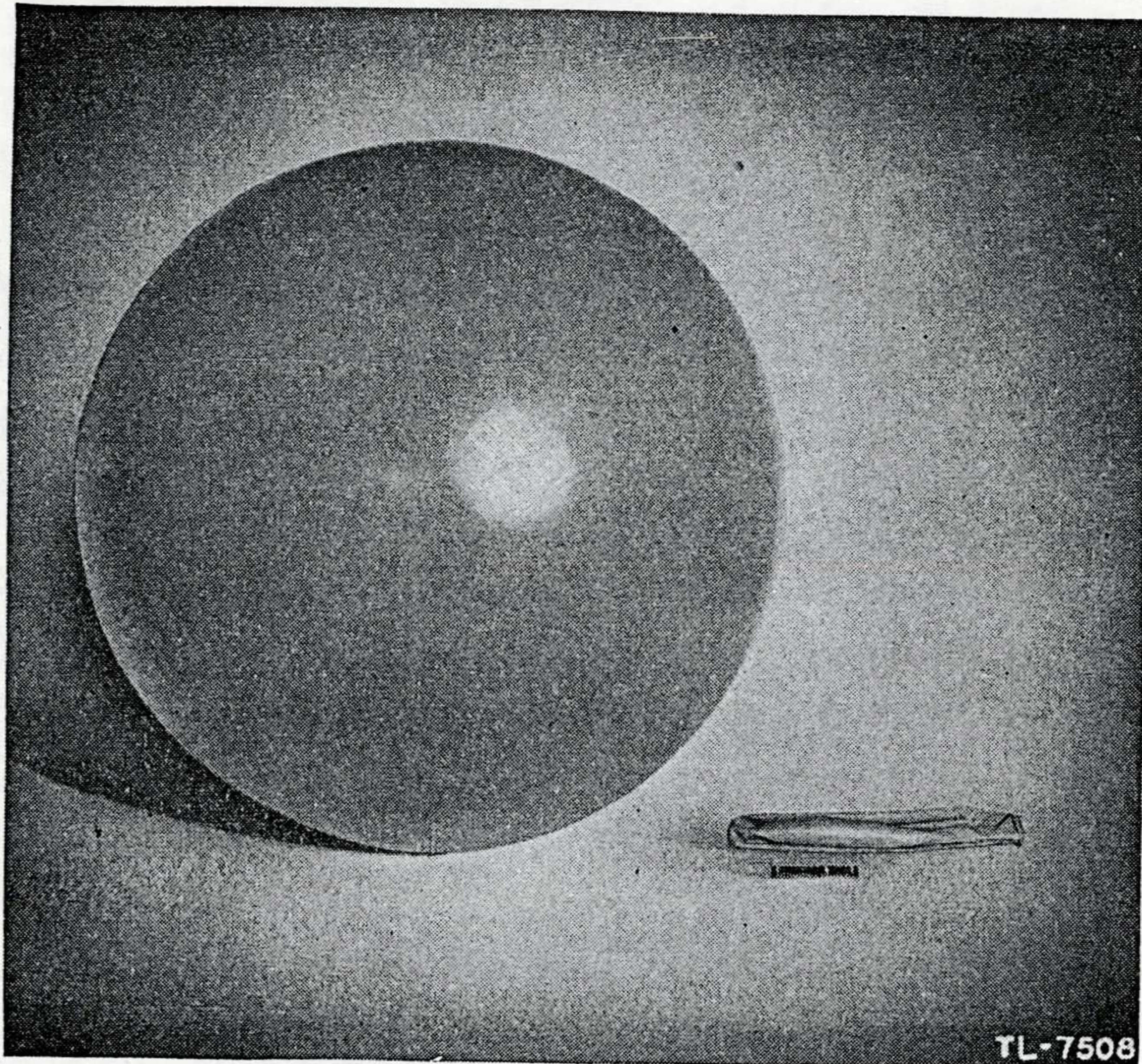


FIGURE 1. Thirty-gram pilot balloon, inflated and deflated.

c. SOUNDING BALLOONS. Sounding balloons are larger than ceiling and pilot balloons because they are designed to carry aloft sounding equipment. The average sounding balloon is 2 to 3 feet in diameter before inflation, weighs approximately 350 grams ($\frac{3}{4}$ pound), and has a neck about $4\frac{1}{2}$ inches long and 1 inch in diameter. Sounding balloons are always white* since their visibility in the sky is not important. Usually, sounding balloons carrying meteorological instruments are inflated to ascend at a rate of about 450 to 600 feet per minute and will reach altitudes in excess of 50,000 feet before they burst (par. 16d).

* unpigmented

3. Definitions

a. BALANCE. When a balloon is inflated just enough to float in the air at release, without rising or falling, it is balanced.

b. FREE LIFT. Free lift is the force required to raise the balloon and its equipment over and above the point of balance and is measured in pounds, ounces, or grams. When a balloon has reached the point of balance, any additional gas will cause it to rise at a definite rate. As gas is added, the rate of ascent will increase.

c. TOTAL LIFT. Total lift is free lift plus the weight of the balloon and any equipment it will carry in flight.

The best sounding balloons during the 1940's were made by Dewey + Almy in Cambridge, Mass. under the trademark "DAREX". These balloons were made by dipping fluted forms into a latex solution suspension which produced an "ivory" colored film with good stretch properties.

The competing balloon was made by the KAYSAN Company in Passaic, N.J. with a casting process that produced a thick-walled, ^{brownish-tan} spherical gel which was then stretched by inflation with air then cured in an oven. These did not stretch as well as the DAREX balloons and would not go as high.

We used both types. Both films turned smoky gray after prolonged exposure to sunlight. They initially developed a brown-rust color with shorter exposures to light.

(5) Attach the balloon to the radiosonde by threading one end of the cord through the ring on top of the radiosonde and tying the two ends together with a square knot. *The ballast balloon must hang far enough below the radiosonde so that the lower end of the antenna does not touch it.*

12. Use of Parachutes

The use of parachutes with meteorological equipment sent aloft prevents damage to persons or property by falling equipment. When used with the radiosonde, a parachute also diminishes the shock the equipment receives when it falls to the ground. A recovered radiosonde *can be repaired* and recalibrated for further use. Do not use a parachute when the equipment is expected to land in enemy territory. A parachute is not used with a battery lighting unit when there is no danger that the equipment will strike anything of value.

13. Releasing Procedure

a. GENERAL. Release a meteorological balloon as soon after inflation as possible because hydrogen gas gradually escapes through the rubber even of a perfectly tied balloon. At normal inflation, a 30-gram balloon loses about 1 gram of lift every 8 minutes, and a 100-gram balloon loses about 1 gram every 2 minutes. Consequently, if release of an inflated balloon is delayed for any length of time, the balloon becomes underinflated and must be reweighed before release (par. 20*b*).

b. CEILING BALLOONS. To release a ceiling balloon, hold it by the neck, and let it go at the proper moment. Release it on the even minute, and use a stop watch to time the release and the flight observations (par. 16*a*).

c. PILOT BALLOONS. To release a pilot balloon, hold it by the neck, and let it go at the proper moment. Stand in the open, as near the theodolite¹ as possible. The exact moment of release is determined by Time Interval Unit ML-138, which gives an audible signal every minute. The signal lasts 5 seconds. The beginning of the signal serves as a warning to get ready. The balloon must be released the moment the signal ends.

d. SOUNDING BALLOONS. (1) *Release by one operator (in calm or very light winds).* (a) Hold the balloon by the cord that fastens the radiosonde to it, and gradually pay out this cord as far as the radiosonde.

(b) Lift the radiosonde and let the balloon take it away.

(2) *Release by two operators (during moderate or high winds).*

(a) Operator 1 holds the balloon neck in one hand, and the radiosonde, raised in flight position, in the other hand (fig. 8).

(b) Operator 2 connects the two black leads at the side of the radiosonde, and then tunes the ground station to the radiosonde signal.

(c) Ground-station operator 2 takes the radiosonde, holding it upright by the bottom of the case.

(d) Operator 1 releases the balloon, maintaining a sliding grip on the line between the balloon and parachute and transferring this grip to the line leading to the radiosonde as the parachute rises into the air.

¹ Instruction in the use of the theodolite may be found in the following Technical Manuals: TM 1-235, TM 4-240, and TM 11-423.

(e) The operator holding the radiosonde approaches the position of the release of the balloon and follows the balloon as the line shortens, running if necessary, until the radiosonde is lifted gently from his hands by the ascending balloon (fig. 8).

(3) *Release in very high wind.* In a very high wind, the line from the parachute to the radiosonde should be shortened to about 20 feet. Heavy rubber bands are tied in this line (called "spanning a bight," as shown in fig. 9) to absorb the shock when the balloon lifts the radiosonde.

(4) *Release in downdraft.* Occasionally a balloon may not rise in a downdraft. Do not release the radiosonde if the balloon has not risen sufficiently; in this way all danger that the radiosonde will strike

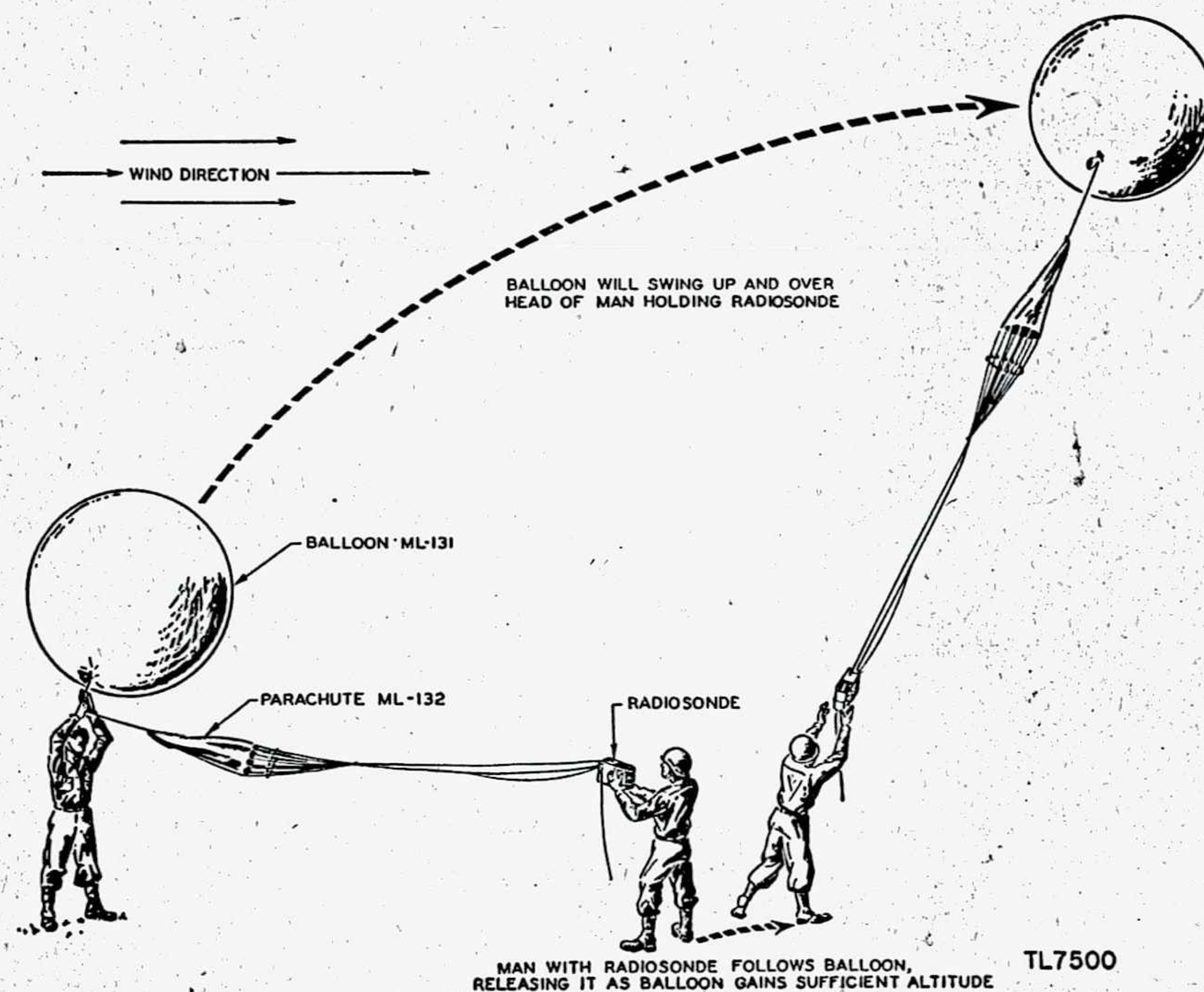


FIGURE 8. Method of releasing sounding balloons.

the ground will be eliminated. *The radiosonde must be saved, even if the balloon itself breaks away and is lost.*

14. Night Use of Pilot Balloons

a. GENERAL. Thirty-gram pilot balloons, fitted with a lighting unit, are used for night observation of wind direction and velocity. If no ceiling light projector is available, lighted pilot balloons may also be used for the determination of ceiling height at night, since they have a known rate of rise and can be timed by the same method used for daylight observation of ceiling balloons (par. 16*a*).

b. LIGHTING UNITS. Two types of lighting units, battery light and candle lantern, are available for 30-gram pilot balloons.

neoprene balloon out for use. All haste should be made to release a neoprene balloon in flight as soon after inflation as possible.

c. **WARMING NEOPRENE BALLOONS.** If a neoprene balloon is subjected to cold or becomes cold in transit, it must be conditioned, that is, it must be warmed before it is used. Remove the neoprene balloon from its container, and heat the balloon near a stove to a temperature of about 80° F. Make sure that the heat is distributed evenly over the entire surface of the balloon. Inflate in the usual manner in an inflation shelter.

21. Moistureproofing and Fungiproofing

Moistureproofing and fungiproofing will not be required for this equipment.

SECTION IV SUPPLEMENTARY DATA

22. List of Balloons and Associated Equipment

The symbol (*) is used in this table to refer to the original model of a series (as ML-157) and the model designated by suffix letter A.

Signal Corps stock No.	Item	Function	Color	Weight		Dimensions and remarks
				Grams	Ounces	
7A177	Balloon ML-157-(*).	Ceiling	Black, dark blue, or purple.*	10	0.35	Spherical, 3½-in. diameter; neck 2 in. long, 1-in. diameter.
7A178	Balloon ML-158-(*).	Ceiling	Red.*	10	.35	Spherical, 3½-in. diameter; neck 2 in. long, 1-in. diameter.
7A150	Balloon ML-50-(*).	Pilot	White or uncolored.	30	1.06	Spherical, 6-in. diameter; neck 2½ in. long, 1½-in. diameter.
7A151	Balloon ML-51-(*).	Pilot	Black, dark blue, or purple.	30	1.06	Spherical, 6-in. diameter; neck 2½ in. long, 1½-in. diameter.
7A164	Balloon ML-64-(*).	Pilot	Red	30	1.06	Spherical, 6-in. diameter; neck 2½ in. long, 1½-in. diameter.
7A175	Balloon ML-155-(*).	Pilot	Orange*	30	1.06	Spherical, 6-in. diameter; neck 2½ in. long, 1½-in. diameter.
7A176	Balloon ML-156-(*).	Pilot	Yellow*	30	1.06	Spherical, 6-in. diameter; neck 2½ in. long, 1½-in. diameter.
7A179	Balloon ML-159-(*).	Pilot	White*	100	3.53	Spherical, 16-in. diameter; neck 2½-3 in. long, 7/16-in. to 1½ in. diameter.
7A180	Balloon ML-160-(*).	Pilot	Black*	100	3.53	Spherical, 16-in. diameter; neck 2½-3 in. long, 7/16-1½-in. diameter.
7A181	Balloon ML-161-(*).	Pilot	Red.*	100	3.53	Spherical, 16-in. diameter; neck 2½-3 in. long, 7/16-1½-in. diameter.

* Colored with pigment in the neoprene latex.

Signal Corps stock No.	Item	Function	Color	Weight		Dimensions and remarks
				Grams	Ounces	
7A171	Balloon ML-131-(*).	Sounding	White <i>(actually the natural color of unpigmented latex)</i>	350	12.34	Spherical, 3-ft. diameter; neck 4½ in. long, (or 3 in. long if alternate provision for attachment of load is made 1-in. diameter).
7A849	Coupling ML-49.	Connects Hose ML-81 to hydrogen gas cylinder.				
7A850-187	Coupling ML-187.	Connects Tubing ML-188 to Hose ML-81.				
7A981	Hose ML-81.	Used as connection in inflation of all balloons.				5 feet long, rubber.
7A981-10	Hose ML-81.	Used as connection in inflation of sounding balloons.				10 feet long, rubber.
7A656	Cock ML-56.	Used in inflation of 30-gram balloons.		132	4.66	Gas hosecock with enlarged end for fastening balloon and attachment for rubber hose.
7A700-201A	Cock ML-201-A.	Used in inflation of 100-gram balloons.		575	20.28	Gas hosecock with end for fastening balloon and attachment for rubber hose.
7A1199A-186	Nozzle ML-186.	Used in inflation of 10-gram ceiling balloons.		39	1.38	Consists of wooden nozzle with end for fastening balloon and attachment for rubber tubing.
7A1199A-196	Nozzle ML-196.	Used in inflation of sounding balloons.		1,500 (basic)	52.91	Consists of metal nozzle with end for fastening balloon.
7A401	Candle ML-90.	Used in Lantern ML-91.		7	0.25	Stearic acid and paraffin; melting point about 128° F.
7A1105	Lantern ML-91.	Used in making night flights with pilot balloon.		6	0.21	Paper.
7A1119	Lighting Unit ML-179.	Used in making night flights with pilot balloon.		35	1.23	Consists of battery and bulb.
7A1207-100	Parachute (miniature).	Used with lighting unit.		4	0.11	Paper, approximately 16-in. diameter.
7A1207-132	Parachute ML-132.	Used with radiosonde.			5	Paper or cloth, approximately 44-in. diameter.
	Pins	Used to hold candle in lantern.				Straight.
7A1334-193	Hydrogen Regulator ML-193.	Used on hydrogen cylinder to indicate pressure and to provide a means of controlling rate of flow of gas. (Cannot be used with hydrogen generator.)				Consists of two gauges with a diaphragm type reducing valve.

Signal Corps stock No.	Item	Function	Color	Weight		Dimensions and remarks
				Grams	Ounces	
6M18	Rubber bands No. 16 or 18.	Used for tying off ceiling and 30-gram pilot balloons after inflation and as an aid in releasing lantern unit and radiosonde.				
7A1928	Tubing ML-188.	Used with Nozzle ML-186 for inflation of ceiling balloon.				
6Z8820.1	Twine †	Used with lighting unit and lantern, and for tying off sounding balloons and 100-gram pilot balloons.				8-ply cotton.
6Z8822	Twine †	Used for suspending radiosonde from sounding balloon.				16-ply cotton.
	Wrench	Used to attach Coupling ML-49 to hydrogen cylinder.				Jaw opening at least 1¼ in.

† Any cord of the same weight and about 50 pounds test strength can be used.