OPERATIONS MANUAL

FOR

BENDIX WIRELESS SYSTEM INSTALLATION

IN

Hudson Airplane

The instruction books comprising this manual describe the wireless installation in the "HUDSON" aircraft. Detailed information concerning the various items is contained in the instruction book for each major component, as follows:

—Coordinating Components—

Operator's Manual for Bendix Wireless and Interphone Equipment
System Schematic Diagram, Revised Hudson No. 4964

—Transmitting Components—

Instruction book for Model TA-2J-24 Aircraft Transmitting Equipment
Instructions for Installation and Operation of MT-5E Antenna Reel

—Receiving Components—

Instruction Manual for Type RA-1B, (RA-11 and RA-1J) Aircraft Receiver Equipment

—Direction Finding Components—

Instruction Book for (Model MN-26A and) Model MN-26C Aircraft Radio Compass Equipment
Operation and Maintenance of MN-22A Azimuth Control and Attachment

—Intercommunication Components—

Instruction Manual for Aircraft Interphone Equipment

ISSUE No. 2—Omits Drawing No. 4965 because 3617A and 3619A Station Boxes were only used in early production.

OPERATOR'S MANUAL

for

Bendix Wireless

and

Interphone Equipment

used in

Hudson Airplane

BENDIX

Bendix Aviation, Ltd.

Subsidiary of Bendix Aviation Corporation

NORTH HOLLYWOOD, CALIFORNIA

U. S. A.

OM 2 — Issue No. 2

OPERATING PROCEDURE FOR BENDIX WIRELESS AND INTERPHONE EQUIPMENT IN HUDSON AIRPLANES EFFECTIVE BEGINNING WITH SERIAL NO. AM703

I. Technical instructions covering circuit description, complete functions of all units and all initial adjustments are to be found in the instruction manuals included with the Hudson airplane. The brief instructions following are intended as a guide to permit operators to become familiar with the mode of operation of the wireless equipment installed in this airplane.

II. The following facilities and equipment are available in this installation:

2.1 TA-2J-24 Transmitter, crystal controlled, fitted with the following frequencies in this aircraft:

Channel 1	314 Kc	955.41	Metres
Channel 2	330 Kc	909.09	Metres
Channel 3	356 Kc	842.69	Metres
Channel 4	500 Kc	600.00	Metres
Channel 5	6580 Kc	45.59	Metres
Channel 6	6666 Kc	45.00	Metres
Channel 7	8544 Kc	35.11	Metres
Channel 8	3925 Kc	76.4	Metres

This transmitter is designed to operate over the following ranges (suitable crystals and coils for the frequencies selected being fitted):

Channels 1, 2, 3, and 4
300 - 600 Kc   1000 - 500 Metres
Channels 5, 6, 7, and 8
2900 - 15,000 Kc   103.5 - 20 Metres

The associated equipment is as follows:

MT-36C-24	Aerial Loading Unit
MT-34D	Transmitter Control Unit
MP-10G-24	Power Unit
MT-5E	Aerial Reel
Model 3939	Aerial Selector Panel
Model 3926B	Vacuum Relay
MT-11B	Key

2.2 RA-1B Receiver, capable of covering frequencies as follows:

Band 1	.150 - .315 Mc	2000 - 953	Metres
Band 2	.315 - .680 Mc	953 - 442	Metres
Band 3	.680 - 1.500 Mc	442 - 200	Metres
Band 4	1.8 - 3.7 Mc	163 - 81.2	Metres
Band 5	3.7 - 7.5 Mc	81.2- 40	Metres
Band 6	7.5 -15. Mc	40 - 20	Metres

2.3 MN-26C Radio Compass, covering frequencies as follows:

Band 1	.150 - .325 Mc	2000 - 924 Metres
Band 2	.325 - .695 Mc	924 - 432 Metres
Band 3	.695 - 1.5 Mc	432 - 200 Metres

Equipment associated with this unit is:

MN-24 Loop
MN-28C Compass Control Unit
(2) IN-4A Left-Right Indicator
MR-15A Crank Drive Assembly
MN-22A Azimuth Indicator

2.4 AERIAL

This ship is equipped with a "V" flat top aerial which is used as a communications, i. e. transmitting, receiving, and sense for the radio compass, aerial. The Model 3926B Antenna Relay is so arranged in the aerial circuit that break-in operation is provided when the aerial is used in conjunction with the transmitter and RA-1 Receiver. This relay also protects the input circuit to the RA-1 Receiver in case the aerial should become energized by the accidental operation of the transmitter.

The Model 3727 Receiver Aerial Transfer Switch, located on the right side of the equipment rack, provides either the RA-1B Receiver or the MN-26C Radio Compass with aerial input and should be positioned accordingly.

The Loop Aerial (Type MN-24A) is part of the radio compass equipment.

III. SYSTEM CONTROLS

3.1 In the wireless operator's position are located all the master controls for the radio equipment involved.
These controls are :

Model 3618A Station Box
Type MT-34D Transmitter Control Unit
Model 3939 Aerial Switch
RA-1B Receiver (controls on the face of receiver)
MN-28C Compass Control Unit
MN-22A Azimuth Control
MR-15A Loop Control Crank
Model 3727 Receiver Aerial Transfer Switch

IV. OPERATIONS

4.1 Inter-Communication

To place the interphone system in operation turn the "I/C AMP" switch, located on the Model 3618A Station Box, to the "ON" position. (NOTE: Be sure the ship's master electrical switch, located on the rear edge of the main switch and fuse box on the right of the pilot's seat, is "ON". A battery cart may be plugged in under the left motor nacelle.) All station boxes have headphone volume controls which may be adjusted to suit the requirements of any individual's hearing. It is advantageous to keep the master gain control on the panel of the 3611 Interphone Amplifier at a low level and advance the individual headphone volume controls until the desired volume is obtained.

4.2 Transmission

The transmission can be controlled from the operator's position only. To do so, the following manipulations are involved:

a. Make sure the interphone amplifier is "ON"

b. Turn the lever switch, located on the MT-34D Control Unit to the "ON" position.

c. Select the desired channel with the "FREQUENCY SELECTOR" switch on the MT-34D, Channels 1, 2, 3 and 4 may be used on either fixed or trailing aerials; 5, 6, 7, 8 on fixed only.

d. Select the type of emission desired with the switch marked "TRANSMISSION" on the MT-34D.

e. Select the aerial, i. e. either trailing or fixed, by use of the plugs provided with the Model 3939 aerial switch. If the trailing aerial is to be used, reel out the full amount of wire.

f. Turn the small selector switch, located on the upper left corner of the RA-1B Receiver, to the "FA" position and the 3727 aerial transfer switch to "REC." position.

g. On the Model 3618A Station Box, turn the selector switch to position "R1". If "R/T" communication is desired, turn the switch on the right side of the Model 3618A to the "R/T" position. If telegraph communication is desired, turn this switch to the "OFF" position. All transmitter controls are now properly adjusted to accomplish transmission. Audio sidetone or keying sidetone will be heard when using the transmitter accordingly.

h. As soon as any transmission is completed, the lever switch on the MT-34D should be turned "OFF".

i. All controls for the "RA-1B" Receiver are located on the face of the Receiver. It should be noted that the "REMOTE-LOCAL" switch must be in the "LOCAL" position. All other controls are marked such that their purpose is self-explanatory. If Automatic Volume Control (A. V. C.) is used, then the Continuous Wave ("C. W.") Switch must be off. When receiving C. W. the "A. V. C." should be "OFF".

j. The selector switch on the Model 3618A Station Box is marked "R1, R2, I/C" and "CALL". In the "R1" position, the headphones are connected to the RA-1B Receiver output; in the "R2" position, they are connected to the compass receiver output; and in the "I/C" position, to the amplifier. When the switch is turned to the "CALL' position, all receiver outputs and the 3611 Interphone Amplifier output are paralleled at all stations and a signal light lights at all stations. (NOTE: When the transmitter is in use, it is impossible for other stations to carry on any interphone communication.)

4.3 To use the radio compass, the following control manipulations should be accomplished:

a. On the MN-28C Compass Control Unit at the upper right hand corner is a switch marked "OFF - COMP - REC-ANT. REC-LOOP." When this switch is in the "COMPASS" position, the compass receiver functions as a visual radio compass. When in the "REC-ANT" position, it functions as a receiver operating on the sense aerial. When in the "REC-LOOP" position it functions as a receiver connected to the loop and as an aural-null direction finder. This switch should be placed in the position to accomplish the desired type of reception. Just below this switch on the MN-28C are two knobs, one marked "AUDIO" and one marked "COMPASS". The one marked "AUDIO" serves as an audio level control. The one marked "COMPASS" regulates the amount of left-right indicator sensitivity. The remainder of the controls on the MN-28C unit are marked such that their function is self-explanatory.

b. The selector switch on the Model 3618A Station Box must be set to the "R2" position and the 3727 Aerial Transfer Switch to "COMP" position.

c. Assuming the use of the compass receiver as a visual radio compass (with the selector switch in the "COMP" position) and the desired station upon which bearings are to be taken "tuned in," and considering first the use of the compass as a "homing" device, turn the loop such that the azimuth control pointer reads "zero". Maneuver the airplane until its direction of flight is such that the IN-4A Left-Right Indicator pointer, located in the V of the cockpit windshield, is centered. If the plane is approaching the station, a turn in either direction will cause the pointer to shift in the opposite direction. When the plane is receding from the station, a turn in either direction will cause the pointer to shift in the same direction. A full discussion of the direction finding procedure is contained in the instruction book for the MN-26C Compass Receiver contained in the Master Instruction Manual for the Hudson Airplane. The second

IN-4A Left-Right Indicator is located in the nose of the aircraft and its indication duplicates that of the one in the pilot's compartment.

d. If it is desired to use the compass receiver as a conventional receiver, the selector switch at the upper right corner of the MN-28C is turned to the "REC-ANT" position. The loop aerial is disconnected and the receiver operates from the sense aerial.

e. Assuming it is desired to use the compass receiver as an aural-null direction finder, the selector switch is rotated to the "REC-LOOP" position whereby the sense aerial is disconnected and the receiver operates as a conventional receiver from the loop aerial. Under these conditions, when the loop is rotated through 360°, two null points will be observed. There is no way to determine at which of these null points the azimuth scale should be read except by navigational means.

f. The MN-22A Azimuth Indicator, rotated by the MR-15A Crank, indicates bearings in the following manner:

  1. Bearings relative to the ship's heading are read on the outer fixed dial.
  2. Magnetic bearings are read under the pointer on the inner movable dial after the number of this dial, which corresponds to the airplane's magnetic course, has been set at the zero mark on the fixed dials.
  3. True bearings are read under the pointer on the inner movable dial after the number of this dial which corresponds to the airplane's magnetic course, has been set opposite the East or West compass variation shown on the inner fixed dial.

4.4 In the navigator's station, Model 3619A Station Box, the facilities available are:

a. Communications Receiver (RA-1B) output, Compass Receiver (MN-26C) output, Interphone and a means of calling all other stations. When the plane leaves the factory, no equipment controls for the transmitter or receivers are available; however, provision is made to move the compass receiver controls to this station. (See supplementary notes.) The microphone in this station is connected permanently to the 3611 Interphone Amplifier. Headphone level is adjusted by means of the knob marked "VOLUME". The selector switch on the Model 3619A Station Box is marked "R1, R2, COMP," and "CALL". "R1" and "R2" positions are paralleled in this installation and with the switch in either position, the headphones are connected to the RA-1B Receiver output. The audio output of the RA-1 and 3611 are paralleled in this installation. In the "COMP" position, the headphones are connected to the compass receiver. In "I/C" position, they are connected to the interphone amplifier output. When the switch is in "CALL" position, all receiver outputs and interphone amplifier output are parallelel at all stations and a signal light is lighted at all stations.

4.5 Pilot, tunnel gunner and astra hatch stations are provided with the Model 3617A Station Box which provides facilities for interphone, a means of calling all other stations and a headphone level control. Turning the selector switch to the "CALL" position lights a signal light at all stations and parallels the outputs of the RA-1B Receiver, the MN-26C Compass Receiver and the Interphone Amplifier. The microphones at these stations are connected permanently to the interphone amplifier.

V. SUPPLEMENTARY INFORMATION

5.1 Transmission

The low frequency channels of the TA-2J Transmitter, channels 1, 2, 3, and 4, are designed to operate with the "V" fixed aerial or trailing wire aerial, either of which may be selected by means of the patching plugs on the 3939 aerial Selector Panel. It must be borne in mind that both aerials require different settings of the flexible clip leads on the loading coil in the MT-36C-24 Aerial Tuning Unit. Also, slight re-adjustment of the corresponding tuning screws on the face of this unit may be required. The high frequency channels of the transmitter, Nos. 5, 6, 7, and 8, are designed to be used with the "V" fixed antenna. The microphone at any interphone position will modulate the transmitter on radio-telephone setting

5.2 Radio Compass

When using the radio compass, do not attempt to take accurate bearings utilizing the trailing wire aerial as the compass sense aerial. The trailing wire antenna should be reeled in when taking bearings, and the "V" aerial used for sense.

5.2.1 Provisions are incorporated in this aircraft for controlling the radio compass and rotating the loop aerial from the navigator's station and the following instructions should be strictly adhered to when the change is desired.

5.3 Re-locating the MN-28 Remote Control Unit.

5.3.1 Rotate the tuning crank counter-clockwise until a stop is reached. This should occur at the position of the alignment mark under the dial index on Band 3.

5.3.2 Disconnect the tach shaft and Cannon

Plug. Remove the unit and mounting plate and remount on the wall in the navigator's station just to the left of his seat. Mounting holes are provided and a tach shaft and electrical cable with a Cannon plug connector will be found in the proper position to be connected to this unit.

5.3.3 On the front of the MN-26 Radio Compass will be found a tach shaft fastened alongside the one now engaged in the tuning gear box. Exchange the two shafts.

5.3.4 Alongside the rear edge of the main junction box under the operator's table will be found an electrical cable with a Cannon plug fitting that is to replace that which was the original MN-28C Remote Control position.

5.4 Re-locating the MN-22A Azimuth Indicator and MR-15A Crank Drive Assembly.

5.4.1 Rotate the loop until the Azimuth indicates "zero" degrees and disconnect the tach shaft.

5.4.2 Remove from the wall by means of screws along rectangular mounting assembly.

5.4.3 Disconnect the flexible dial light conduit by means of the plug assembly on the bottom edge of the MN-22A and tape up to prevent shorting against the aircraft.

5.4.4 Remove Crank Drive Assembly and Azimuth Indicator from rectangular mounting plate by means of the mounting screws on the face. (A Bristo wrench to loosen the set screws of crank handle may be found on the bottom end of the MN-28C Compass Remote Control Unit, or on the side of the 3926B Vacuum Relay Box.)

5.4.5 Secured near the base of the MN-24A Loop aerial will be found a tach shaft that leads to the navigator's station, this is to replace the original fastened to the loop.

5.4.6 In the navigator's station, mount the MR-15A Crank Drive Assembly under the left edge of the table.

5.4.7 The MN-22A Azimuth Indicator is to be mounted on the floor in the corresponding position with the tach shaft fitting side parallel to the outer edge of the aircraft. Before this is mounted, it is necessary to first rotate the inner and outer fixed scales 180° and then the correction cam 180°. To rotate the scales 180° remove the snap ring, glass and the eight scale holding screws. Position at desired place and re-assemble. Care must be used so that neither scale binds on the movable dial. Next, to rotate the correction cam 180° ,it is first necessary to remove the rear mounting plate secured by the six binder head screws and lockwashers. Loosen the cam hex nut and rotate cam blank 180° so that the cam follower pin is lined up with the "zero" degree radial when the azimuth needle indicates zero degrees on the outer fixed scale. This must be very carefully done. When this position is found, make the cam hex nut secure and replace the rear mounting plate.

5.4.8 Mount the azimuth in the afore-mentioned floor position by means of the three mounting holes in the azimuth rear mounting plate and insert the flexible dial light conduit plug coming from the 3619A Station Box.

5.4.9 Connect the two tach shafts provided in that position making sure the azimuth needle is at zero degrees before engaging the tach shaft running to the loop.

5.4.10 To check the procedure heretofore mentioned regarding RADIO COMPASS, the following checks should be made and corrected if not coinciding.

5.4.11 If the tach shaft of the compass receiver is connected properly, the alignment mark on the dial scale near the low frequency end of Band 3 will be under the index line when the tuning stop of the receiver is reached. This will afford correct dial calibration.

5.4.12 To check the loop position against the azimuth reading, it is necessary to carefully tune in a signal on Band 1, the exact direction of approach of which must be known; head the aircraft in that direction and rotate the loop until an "on course" indication is obtained in the left-right indicators. The azimuth needle should indicate "zero" degrees even though the loop is not exactly perpendicular to the wave approach. In other words. a "zero" azimuth reading will be an exact homing indication.

SPECIFIC INSTRUCTIONS APPLYING ONLY TO THE REVISED HUDSON INSTALLATION

This revised installation provides facilities for the installation of British radio equipment, the addition of a Turret Gunner's Interphone Station and substitutions for the previous station boxes.

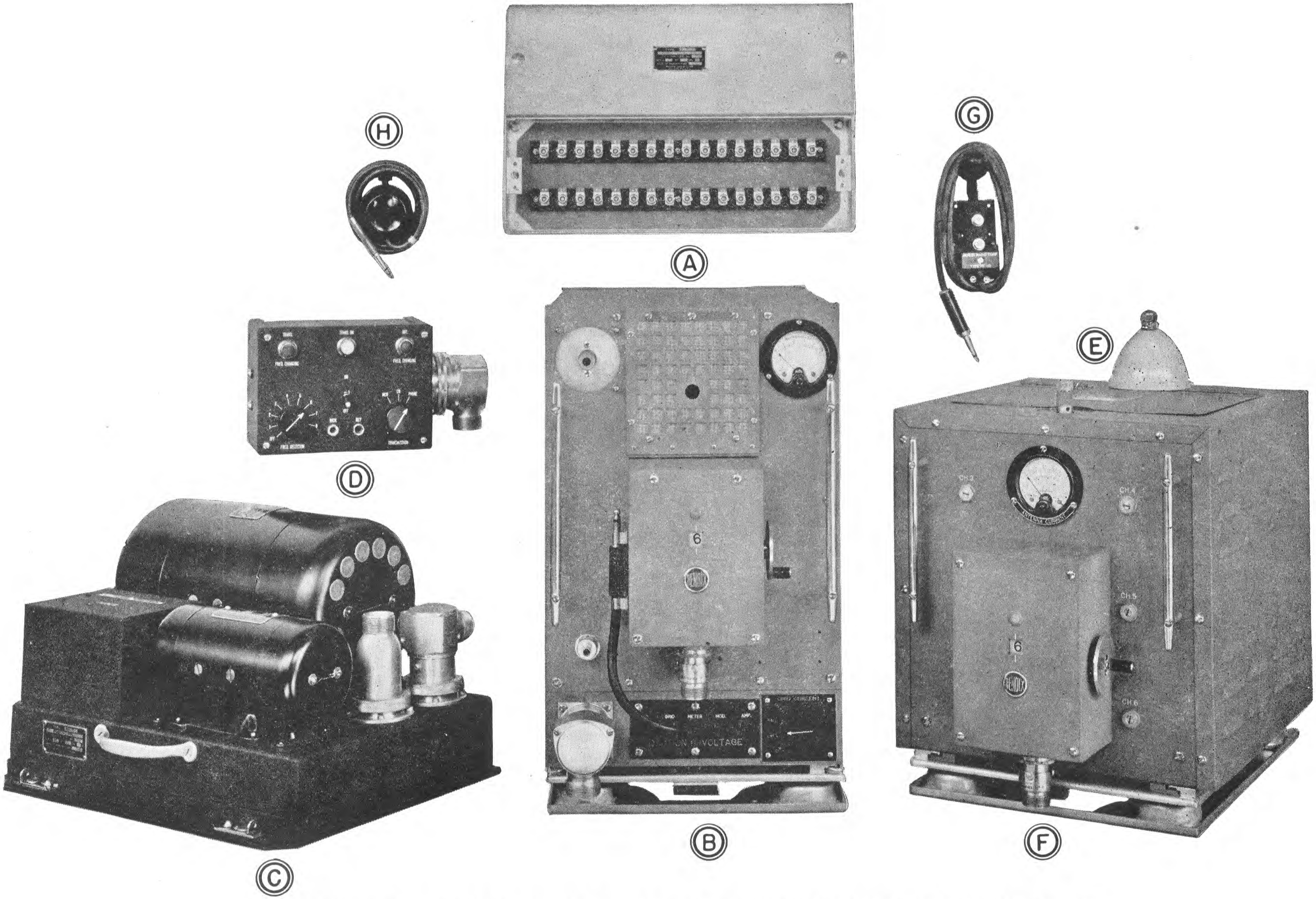
The new station boxes, Model 3620, are used only in the following stations: Navigator, Pilot, Astra Hatch, Turret Gunner and Tunnel Gunner. This station box provides microphone and telephone circuit switching to either the Bendix or British system, a call switch and attention light, a headphone volume control, and a send-receive transmitter control switch with its indicating light. This is intended for remote control operation where such a facility is required, but it should be known that this function is not available in this installation as this circuit is unwired.

In the navigator's station is incorporated a Model 3726 Receiver Selector Unit which gives him a choice of either the RA-1B Communication Receiver, or MN-26 Radio Compass Receiver telephone output when his 3620 Selector Switch is on "Bendix".

In the Wireless Operator's station is incorporated a Model 3964 "TR-9-Bendix" Transfer Unit which will switch his microphone and telephone circuits to either of the mentioned systems. This is used in conjunction with his 3618A Station Box.

The remainder of the equipment remains the same and the previous instructions apply as to their operations.

ALTERNATE POSITION MN22A AZIMUTH
MODEL 3620 NAVIGATOR'S STATION
*76877 NAVIGATOR'S JUNCTION BOX
MODEL 3726 RECEIVER SELECTOR SW
MODEL 3620 PILOT'S STATION
ALTERNATE POSITION MN-28C COMPASS REMOTE
PILOT'S IN-4A INDICATOR
NAVIGATOR'S IN-4A INDICATOR
IN-4A JUNCTION BOX #76396
MODEL 3618A W/O STATION
W/O MN-22A AZIMUTH
MT11-B KEY
MODEL 3611 INTERPHONE AMPLIFIER
MN-28C COMPASS REMOTE
MT-34D TRANSMITTER CONTROL
MODEL 3727 AERIAL TRANSFER SW.
RA-1 RECEIVER
B-7545 ULMER CONNECTOR
LEACH 1077 GROUNDING RELAY
MN-24A
LOOP
MN-26C COMPASS RECEIVER
MODEL 3964 TR-9 TRANSFER UNIT
BRITISH SOCKETS
W/O PENDANT JACK
MODEL 3926C AERIAL VACUUM RELAY
*76857 INTERPHONE JUNCTION BOX
*74593 MAIN JUNCTION BOX
— NOTE — CONNECT AS SHOWN WHEN ONE IN-4A INDICATOR IS USED
AA-18824-1 ASSEMBLY
BENDIX AERIAL
TR-9 AERIAL
MODEL 3939 AERIAL PANEL
MT-5E REEL
TRAILING WIRE
MT-36C TUNING UNIT
TA-2J TRANSMITTER
TR-9 JUNCTION BOX
FUSE PANEL
MODEL 3620 ASTRA HATCH STATION
*76820 ASTRA HATCH JUNCTION BOX
TURRET GUNNER'S SLIP RINGS
PENDANT SW. SPARES
8118A1-SM SLIP RINGS
MODEL 3620 TURRET GUNNER'S STATION
*76875 TURRET GUNNER'S JUNCTION BOX
BENDIX #97089 TWO PAIR TWISTED SHIELDED WIRE
SHIP'S BATTERY
MASTER SWITCH
MP-10G POWER SUPPLY
MODEL 3620 TUNNEL GUNNER'S STATION
— NOTE —
SINGLE SHIELDED PAIR – BENDIX #97097
DOUBLE SHIELDED PAIRS – BENDIX #97089
L INDICATES LENCIL WIRE
P INDICATES PACKARD WIRE
REVISED & REDRAWN 7-18-41
APP WALLACE 7-18-41
ENG W. JONES 7-18-41
CHK W. JONES 7-18-41
DRN ENGMAN 7-18-41
BENDIX AVIATION LIMITED BURBANK, CALIF.
SCHEMATIC REVISED HUDSON V B.A.M.
4964



MODEL TA-2J-24 AIRCRAFT TRANSMITTING EQUIPMENT

FOR DESCRIPTION OF ITEMS SEE SECTION 1-2-1

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A—PHOTOGRAPHS

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INSTRUCTION BOOK

for

MODEL TA-2J-24
AIRCRAFT TRANSMITTING EQUIPMENT

1. INTRODUCTION

1-1. FUNCTION

The Model TA-2J-24 Aircraft Transmitting Equipment is designed to provide reliable long range CW, MCW, or radio telephone communication between aircraft and ground stations or other aircraft while in actual flight. Complete remote control of the eight available frequency channels is provided over two ranges from 300 to 600 Kcs and from 2900 to 15,000 Kcs.

1-2. COMPOSITION

1-2-1. Major Units

The Model TA-2J-24 Aircraft Transmitting Equipment consists of the following major units:

Item	*Quantity*	*Description*	**Lbs.*	*Oz.*	*Ref. No.*
A	1	Type TA-2J-24 Transmitter Unit complete with vacuum tubes, crystals, and inductors for eight channels	47	2	110D/103
B	1	Type MT-56B Shockmount, for transmitter unit	3	4	110A/1
C	1	Type MP-10E-24 or MP-10G Power Supply Unit	52	2	110K/1
D	1	Type MT-34C-24 or MT-34D Remote Control	3	12	110J/1
E	1	Type MT-36C-24 Antenna Coupling and Loading Unit	28	.	110B/1
F	1	Type MR-44A Shockmount, for antenna coupling and loading unit	3	4	110A/2
G	1	Type MT-11B Flameproof Key	.	14	110F/101
H	1	Type MT-42A Microphone	.	9	110A/17
I	1	Instruction Book	.	.	.

* All weights subject to 5% variation due to manufacturers' tolerances.

1-2-2. Additional Equipment

The following additional equipment is required for a complete installation:

Item	*Quantity*	*Description*
J	.	Interconnecting cables, vary with type of aircraft
K	.	Antenna strain insulators, Type MT48A, per Bendix No. AB9988, quantity required depends on installation
L	2	Wall or roof bushings, Bendix No. B7943
M	1	Type MS-14C Junction Box, Bendix No. AL71095-3 can be used with equipment, but junction boxes will vary with different installations
N	1	Radiation Meter, Model 606 (optional) with static shield, Bendix No. C55602-2 without static shield, Bendix No. C55602-1
O	1	Antenna system
P	1	24-28V power source
Q	1	Plane master switch

1-2-3. RF INDUCTORS

Although the tank inductors are integral parts of the transmitter unit, their electrical characteristics are varied to suit individual customers' requirements and, therefore, necessitate separate and explanatory listings:

CRYSTAL OSCILLATOR TANK INDUCTORS—CIRCUIT SYMBOLS L1-L8

Bendix Type	*Frequency Range, Kcs**	*Trimming Information*	*Bendix Number*
MT-16H	300-400	None Required	AB11153
MT-16J	400-500	None Required	AB11152-1
MT-16K	500-600	None Required	AB11152-2
MT-16D1	1250-2500	Figure 27	AB12639
MT-16D2	2500-4000	Figure 27	AB12640
MT-16D3	4000-9000	Figure 28	AB12641

*Oscillator Frequency { ½ Output frequency from 2900 to 12,000 Kcs; Output frequency from 300 to 600 Kcs; ⅓ Output frequency from 12,000 to 15,000 Kcs }

IPA TANK INDUCTORS—CIRCUIT SYMBOLS L9-L16

Bendix Type	*Frequency Range, Kcs**	*Trimming Information*	*Bendix Number*
MT-16H	300-400	None Required	AB11153
MT-16J	400-500	None Required	AB11152-1
MT-16K	500-600	None Required	AB11152-2
MT-16D2	2500-4000	Figure 27	AB12640
MT-16D3	4000-9000	Figure 28	AB12641
MT-16D4	9000-15,000	Figure 28	AB12642

*IPA Frequency = Output frequency.

PA TANK INDUCTORS (VARIABLE)—CIRCUIT SYMBOLS L18-L25

Bendix Type	*Frequency Range, Kcs*	*Description*	*Bendix Number*
MT-19A	2900-10,000	30T, No. 16 spaced 3″, 2″ OD	AC55471-1
MT-19B	10,000-15,000	12T, No. 16 spaced 3″, 2″ OD	AC55471-2
*MT-21A	2900-10,000	2 Sections, 2″ OD: 22T, No. 16 spaced 3″; 6T, No. 16 spaced 3/5″	AC55385-1
*MT-21B	10,000-15,000	2 Sections, 2″ OD: 11T, No. 16 spaced 3″; 3T, No. 16 spaced 3/5″	AC55385-2
MT-23A	300-600	Blank coil frame with shorting strip	AC55685-1

*Supplied for ¼ wave antenna.

1-2-4. QUARTZ CRYSTALS

Frequency controlling quartz crystals are supplied ground for frequencies to suit individual customers' requirements.

1-3. ANTENNA REQUIREMENTS

The Type TA-2J-24 Aircraft Transmitter, in conjunction with the Type MT-36C-24 Antenna Loading and Coupling Unit, may be used with either a fixed antenna or variable trailing wire. The trailing wire antenna is the more efficient of the two types.

1-4. PRIMARY POWER REQUIREMENTS

Operating Condition	*Primary Voltage*	*Current Drain (Amperes)*
Filaments On	27	6.0
CW Operation	27	36.0
100% Modulation	27	39.0

1-5. PERFORMANCE

1-5-1. Power Rating

The transmitter delivers 30 watts CW, 20 watts MCW, and 20 watts phone into a 10-ohm 450 Mmf load in the frequency range from 300 to 600 kilocycles. The rating for the same equipment is 100 watts CW, 75 watts MCW, and 75 watts phone into a 10-ohm 200 Mmf load in the 2900 to 15,000 kilocycle frequency range.

1-5-2. Audio Characteristics

A high level, Class B modulator and associated driver stage effect 100% modulation of the carrier when one volt at 1000 cycles a second is applied across the 125-ohm impedance of the microphone input transformer.

RMS distortion is less than 10% at 85% modulation of the rated carrier output, using a standard 400-cycle modulating tone.

The audio response is within 4 DB between 400 and 3000 cycles at 90% modulation, using a reference level of 1000 cycles. The response to low frequencies has been intentionally attenuated to reduce reproduction of cabin rumbles and motor noises.

1-5-3. Normal Service Durability

The Model TA-2J-24 Transmitting Equipment is suitable for transoceanic and foreign service and also meets all requirements stipulated by the C.A.A. for Airline Aircraft Radio Equipment. The C.A.A. tests include humidity, temperature, and barometric pressure runs as well as vibration, orientation, and drop tests to determine mechanical durability. The ceiling of the transmitter is 31,000 feet, except that on frequencies between 300-600 Kcs it is restricted to 25,000 feet, unless the antenna capacity is not less than 200 Mmf at 300 Kcs.

2. DESCRIPTION

2-1. MECHANICAL CONSTRUCTION

2-1-1. General

The frame, chassis, and auxiliary parts forming the major units of the transmitting equipment are fabricated of the best materials obtainable for aircraft use. The frames are accurately assembled and securely riveted or spot welded. The interior surfaces are suitably protected from corrosion by sand blast and lacquer or etching treatments. Exterior surfaces such as shields, front panels, etc., are finished with a baked wrinkle finish. Each component part is protected from corrosion by suitable plating. Contact between dissimilar metals has been reduced to a minimum. No materials have been used which are combustible.

Consult the illustrations at the rear of this book for a pictorial description of the equipment.

2-1-2. Transmitter Unit

The top and side panels of the transmitter unit are formed in one piece which slides on to the frame and forward under the lip of the front panel. The rear panel is secured to the frame with Dzus fasteners, and its lip acts as a retainer for the rear edge of the top and side panel. A ventilating fan in the rear of the unit provides circulation of air for carrying off excess heat.

Two vertically mounted handles are provided on the front of the unit to facilitate removing it from the Type MT-56B Shockmount, used with the transmitter unit. The front panel is shown in Figure 1, whereon all controls are properly designated. Figures 1 through 5 show all views, inside and outside, necessary for identifying and locating the various component parts of the transmitter unit.

2-1-3. Power Supplies

The Type MP-10E-24 and Type MP-10G Power Supplies are identical in design, construction, and appearance except that the Type MP-10G has a smaller receiver dynamotor. Figures 6, 7, and 8 identify and locate the component parts of the Type MP-10E-24 Power Supply. All fuses are housed under the fuse cover and may be reached by releasing the snapslide fastener and sliding the fuse cover forward and upward. Relays and all other small electrical components may be reached in the following manner:

Remove the power supply from its mounting base by releasing the two snapslide fasteners and then remove the cover plate by unscrewing the four screws. Consult Figure 8 for identification of the component parts.

Dynamotor brushes and commutators may be reached by removing the covers at the high and low voltage ends; as shown in Figures 6 and 7. Snip the safety wire and remove the two screws which secure each cover to the main body of the dynamotors. Plug connectors and their associated receptacles are shown in Figure 7. A handle is provided on the power supply to facilitate its removal.

2-1-4. Remote Controls

Figure 9 identifies all controls located on the front panel of the Type MT-34C-24 Remote Control; the same controls and front panel are used on the MT-34D. Figure 10 identifies and locates the component electrical parts within both units. Access to the interior may be had by removing the screws located at the four corners of the front panel and sliding the U-shaped chassis from its back cover.

2-1-5. Type MT-36C-24 Antenna Coupling and Loading Unit

The top and side panels of the antenna coupling and loading unit are in one piece which slides on the frame from the top and is secured front and rear by machine screws. A hinged door in the top panel provides access for tuning adjustments. Six slotted controls are provided on the front panel designated CH. 1 to CH. 6 to permit adjustment of switches S15 to S20 respectively; Figure

11 shows the front panel arrangement. Figures 12 and 13 identify and show the location of the various electrical components. Louvers on the side panels provide ventilation.

2-2. ELECTRICAL CIRCUITS

2-2-1. RADIO FREQUENCY

2-2-1-1. General

The RF circuit of the transmitter unit employs a type 807 (V1) beam power tube as the crystal-controlled oscillator, the output of which is capacitively coupled to the grid of a second type 807 tube (V2) used as a buffer or doubler amplifier. The output of this stage is capacitively coupled to the grid of a type 803 (V3) power pentode which operates as a Class C amplifier on all frequencies. A feedback coil L17 (Figure 14) is used in the crystal oscillator circuit for frequencies of 300-475 Kcs, to compensate for the inherent lower activity common to crystals of this range.

2-2-1-2. Output Circuit

The output circuit of the transmitter is shunt-fed and is inductively reactive, because it is designed for capacitively reactive antennas. The output circuit is tuned by rotating the tank coil (screw driver operated control on front panel), thus changing the position of two variable clips with respect to ground. The relative position of these clips, which are respectively connected to the antenna and plate, (Figure 14) determines coupling. Note, Figure 5, that the antenna clip is on the right hand side, and the plate clip is on the left hand side, of the center coil, looking at the top of the transmitter, from the rear. By opening the small front door (unscrew the top center screw) the position of the clips relative to each other may be changed by hand.

For both high and low frequency operation, the output of the transmitter is fed to the Type MT-36C-24 Antenna Coupling and Loading Unit. For low frequency operation, a blank coil frame with a shorting strip, Type MT-23A, replaces the tank inductor and connects the plate of the amplifier (V3) through blocking capacitor C13 to the antenna relay S7 and the output terminal. The output terminal is connected to the input terminal on the antenna coupling and loading unit. C101 acts as a shunt tank capacity for the output stage on frequencies between 2900 Kcs, and 4000 Kcs. This capacitor helps reduce harmonics and will allow the final tank circuit to be resonated without any additional antenna capacitance. C101 may also be used as part of the coupling capacitance on any channel between 300 and 600 Kcs.

2-2-1-3. Type MT-36C-24 Antenna Coupling and Loading Unit

The Type MT-36C-24 Antenna Coupling and Loading Unit serves as amplifier tank and loading circuit for the frequency range 300-600 Kcs. Since an aircraft antenna is characteristically capacitively reactive at low frequencies, the load circuit is designed to provide an equivalent value of inductive reactance. Note, Figure 17, that capacitors C22, C23, C25, and C26 combine individually or in pairs, in series or in parallel, to form the input capacity of a pi-network. The other members consist of two load inductors and an output capacitance furnished by the antenna. Coarse variation in tuning is accomplished by changing the position of the taps on the large inductor L35. Vernier adjustments are made by changing taps on the smaller inductors by means of appropriate eleven-position rotary switches, S15 to S20, controlled from the front panel.

The following table lists the circuit connection and net capacitance for properly loading most antennas in the frequency range 300-600 Kcs. Proper channel and coupling capacitance connections for each customer's frequency requirements are made at the factory before the equipment is shipped.

Frequency Range (Kilocycles)	*Net Loading Capacitance (Mfd)*	*Capacitors Involved*	*Circuit Connection*
300-340	.0015	C23	.
340-425	.0011	C22, C25	Parallel
425-525	.0008	C26	.
525-600	.0006	C22, C23	Series

C101, in the transmitter may also be used as an added capacitance for frequencies between 300 and 600 Kcs. For high frequency operation, the low frequency pi-network, in the Type MT-36C-24 Antenna Coupling and Loading Unit is disconnected, permitting the RF to feed either directly to the antenna terminal or through capacitors C21 and C24. Correct tuning into inductive antennas at high frequencies is obtained through the proper circuit combination of capacitors C21 and C24.

2-2-2. AUDIO FREQUENCY

The audio frequency circuits consist basically of three major circuits: speech input, Class A speech amplifier, and Class B modulator.

The speech input circuit is designed for a single carbon button microphone, similar to the recommended Bendix Type MT-42A, equipped with press-to-talk switch, cord, and plug. The circuit consists of a microphone jack J4, carrying both the speech and press-to-talk circuits, a retard coil L28, carrying microphone voltage and suppressing generator ripple; and a capacitor C17 functioning as a blocking condenser and, combined with L28, as a high pass filter for the suppression of all audio frequencies below 400 cycles. This low frequency suppression does not preclude intelligibility of speech, but does reduce such undesirable interference as cabin rumbles, motor roar, and similar noises.

The speech amplifier employs a type 801 triode V4 in a typical Class A circuit. A voltage divider circuit across the input transformer T1 furnishes sidetone voltage for the audio stage of a receiver. The output of the speech amplifier is fed through coupling transformer T2 to the grids of a pair of 830B's (V5 and V6) in a typical Class B modulator circuit. Two windings are provided on the secondary of the output transformer T3 for simultaneously modulating the plate and screen of the Class C power amplifier tube.

2-2-3. CHANNEL SELECTOR CIRCUITS

2-2-3-1. General

For simplicity, all previous electrical description has covered the operation of only one channel. However, eight separate channels are available for local manual or remote electrical selection. Refer to Figure 14.

Any one of eight crystals (Y1 to Y8), the corresponding oscillator tank inductor (selected from L1 to L8), the corresponding IPA tank inductor (selected from L9 to L16), and the corresponding PA tank inductor (selected from L18 to L25) are simultaneously placed into position by their respective rotating turrets and a single-pole eight-throw switch. A motor driven selector unit containing a small reversing DC motor M1, is connected to a shaft common to the rotating turrets and switch by means of a gear assembly. A contact ring disc assembly, divided into three segments (outer contact ring, middle contact ring, and inner contact ring) is mounted on a worm gear shaft and functions as a positioning device. This worm gear shaft is fastened directly to the main turret shaft. Eight positioning contacts, corresponding to the eight channels, are located at 45-degree intervals around the periphery of a contact plate opposite the contact ring disc assembly. Seven of the positioning contacts make mechanical and electrical connection with either the outer or mid ring; the eighth contact corresponds to the operating channel and rests on an insulated gap between the two rings. Operating voltage for the motor is applied to one of the positioning contacts by the frequency selector switch (S1A) on the remote control unit. From the positioning contact, this voltage reaches the motor through one of the contact rings, causing the motor, turret, and switching mechanism to rotate in a clockwise or counterclockwise direction, until one of the two insulated gaps coincides with the positioning contact in use, thus opening the motor energizing circuit and stopping rotation. The motor is equipped with two field windings, one for clockwise rotation and one for counterclockwise rotation. Thus, from no starting position will the motor be required to rotate more than 180 degrees.

An indicator light on the remote control unit is shunted across the motor armature and glows while the channel selector is in motion. This indicator is appropriately marked TRANS. FREQ. CHANGING as may be seen on Figure 9.

A crank, which protrudes through the small separable box housing the channel selecting mechanism, is provided for local manual operation. In order to use the local control, it is necessary to turn the frequency selector switch on the remote control unit to OFF, or to disconnect the primary power source.

2-2-3-2. MT-36C-24 Antenna Coupling and Loading Unit

The antenna coupling and loading unit is equipped with a channel selecting device similar to the selector on the transmitter unit. The unit is provided with six low frequency and two high frequency coupling circuits. These are selected by three single-pole, eight-position rotary switches mounted on a shaft common to a motor driven selector unit similar to the one contained in the transmitter unit. Refer to Figure 17. The rear section of the frequency selector switch (S1B) in the remote control unit controls application of energizing voltage to the antenna loading and coupling unit motor. Thus, the two units operate simultaneously insofar as channel selection is concerned. Note that an indicating light on the remote control unit, designated ANT. FREQ. CHANGING serves the same purpose as its companion light, similarly marked, for the transmitter. Any number of low frequency circuits in the Type MT-36C-24 Antenna Unit may be connected so as to make the circuits available for high frequency operation.

2-2-4. CONTROL CIRCUITS

2-2-4-1. General

All circuits are normally controlled from the remote control unit. These controls include the frequency selector, the transmitter on-off switch with its associated indicator light, the transmission (PHONE, CW, and MCW) selector, and receptacles for the microphone and telegraph key. An auxiliary microphone receptacle is located on the front panel of the transmitter unit. Consult Figures 14, 15, 16, and 26.

2-2-4-2. Phone Operation

When in the phone position, the transmission selector S3 on the remote control panel, connects the negative side of keying relay S9 (S9 functions to apply plate and screen voltage to the oscillator, IPA, and speech amplifier stages) to the negative side of control relay S7A in the transmitter, and to the open side of a microphone press-to-talk switch. The positive sides of relays S7A and S9 in the transmitter are permanently connected to the +24V circuit ahead of the transmitter on-off switch S2 in the remote control unit. Thus, closing the microphone press-to-talk switch energizes S7A and S9. Contacts on S7A close the antenna changeover relay S7 in the transmitter and the starting relays S1 and S2 in the power unit, providing the transmitter on-off switch on the remote control panel is closed. Closing S2 on the remote control panel also starts the ventilating fan and applies filament voltage to V3, V4, V5, and V6. The heaters of V1, V2, and V7 are connected direct to +24V, ahead of S2, and consequently light as soon as the master switch in the aircraft is closed.

2-2-4-3. CW Operation

The transmission selector S3, in the remote control unit, when in the CW position, energizes control relay S7A in the transmitter by closing the negative side of its winding. Contacts on S7A in turn close the antenna changeover relay S7 in the transmitter, and dynamotor starting relays

S1 and S2 in the power supply, providing the transmitter on-off switch S2 on the remote control panel has been closed. In addition, S3 in the remote control unit closes the +24V circuit to the MCW hummer Y1 in the remote control unit, and grounds the MCW input circuit. The telegraph key will then operate both the keying relay S9 in the transmitter and the MCW hummer Y1 in the remote control unit. The output of the hummer feeds an audio sidetone circuit. Vacuum tube filaments and the ventilating fan receive their operating potential as described in Section 2-2-4-2.

2-2-4-4. MCW Operation

The transmission selector S3 in the remote control unit, when in the MCW position, energizes control relay S7A in the transmitter which in turn closes the antenna changeover relay S7 in the transmitter, and dynamotor starting relays S1 and S2 in the power unit, providing the transmitter on-off switch S2 in the remote control unit, also connects the output of the MCW hummer Y1 in the remote control unit to the MCW input circuit in the transmitter and closes the +24V circuit to the hummer. The telegraph key operates the keying relay S9 in the transmitter unit and MCW hummer Y1 in the remote control unit, which modulates the transmitter from the L tap on its output transformer and feeds a sidetone circuit from its H tap. Vacuum tube filaments and the ventilating fan receive their operating potential as described in Section 2-2-4-2.

2-2-5. DC Metering Circuits

All DC circuits in the transmitter are metered and controlled from the transmitter front panel. Grid current for the oscillator, IPA, and PA stages is indicated on the DC milliammeter MA by inserting the meter plug P10 into grid current receptacle, J3, and rotating switch S8 to the circuit desired. Appropriate shunts are placed in the meter circuit by switch S8. A fourth position is provided for rectified RF current indication in the event an RF indicator is included with the transmitter (see Section 2-2-8). Meter plug P10 is to be inserted into receptacle J2 for PA plate current indication and similarly inserted into receptacle J1 for modulator plate current indication. Various combinations of shunt and series resistors are connected across these two receptacles and function as meter multipliers.

2-2-6. Power Supplies MP-10E-24 and MP-10G

Refer to Figure 15 for details of circuit design. The circuit is identical for the two units.

Both power supply units are designed to furnish all operating power for the transmitting equipment and companion receiving equipment. The transmitter dynamotor is the same in each type of power supply, but the receiver dynamotor in the MP-10G is smaller and has a lower current rating than the receiver dynamotor supplied with the MP-10E-24. All other equipment for the two power supplies is identical and both supplies are interchangeable.

Continuous duty power and load ratings for the three different types of dynamotors are listed below:

DYNAMOTOR	TRANSMITTER	RECEIVER	
Unit	MP-10E-24 and MP-10G	MP-10E-24	MP-10G
Temp. Rise	40°C	40°C	40°C
RPM	3600	4300	4600
Input V	26.5	28	28
Input A	27	1.9	1.6
Output V	1100	250	230
Output A	.40	.15	.10

The transmitter dynamotor starting circuit is described in Section 2-2-4. The dynamotor input circuit is filtered to prevent arcing contactors and consequent receiver interference. The output circuit is filtered to reduce commutator ripple as well as receiver interference. Protective fuses are provided in both input and output circuits.

The input and output circuits of the receiver dynamotor are also filtered to suppress commutator ripple and receiver interference. Both circuits are fused.

2-2-7. Junction Box and Cables

All inter-unit connections are made with shielded cables which run from their respective receptacles to a common junction box, wherein the conductors are distributed to their proper circuits. A junction box with provision for radio equipment is normally a part of the standard electrical wiring system of most aircraft. Cables are generally made up at the time of installation to fit existing conditions. The primary power cable should be as short as possible. All other cables should not be more than fifteen feet in length. A typical installation wiring diagram showing cable connections between transmitter units and junction box is given in Figure 26. In common with standard practice, all insulation must be flame proof.

2-2-8. Radiation Indicator (Optional)

The radiation indicator for the transmitter unit functions as a voltage device, so that rectified radio frequency from the plate of the PA tube operates a 0-2 DC milliammeter (Item N, Section 1-2-2), located on the airplane control panel.

See Figure 14 for circuit connections. Resistors R24, R25, R26, and R27 are connected in series across the PA tank and ground. RF voltage built up across R27 feeds the plate of the diode rectifier tube V7. The cathode of V7 is connected to ground through the meter shunt resistor R19 and the RF indicating meter on the control panel.

When switch S8 on the front of the transmitter is in the diode position and the meter plug placed in the grid jack, the RF indicator current can be read at the transmitter as well as on the regular radiation indicating meter.

3. INSTALLATION

3-1. LOCATION OF UNITS

Because of the unit construction of the equipment, and the complete remote control facilities, considerable latitude in the physical layout of the major units can be allowed to meet the requirements of individual installations. However, the following restrictions are important and should be observed:

A. The power supply unit should be located as close as possible to the primary power source, limiting the length of the primary power cable to eight feet. The lead wire should never have a smaller diameter than No. 6. Likewise, all other major units should be located within fifteen feet of the junction box.

B. The junction box, if not already installed, should be located at a central point with respect to the major units.

C. The transmitter should be located to the right viewed from the front of the antenna loading and coupling unit, thus keeping the transmitter output lead to a minimum length.

D. The remote control unit should be located within easy view and reach of the operator with the major axis horizontal to allow the MCW hummer to operate properly.

3-2. MOUNTING DETAILS

3-2-1. Transmitter Unit

The Type MT-56B Shockmount is designed to hold the transmitter unit securely and serve as a protection against severe shocks and constant vibration. Select a suitable flat surface complying with the restrictions given in Section 3-1 and the accessibility clearances shown on Figure 21. Drill the mounting holes in accordance with Figure 21 and secure the shockmount with eight No. 10 round head machine screws, using lock washers under each screw. Finally, slide the transmitter unit onto the shockmount, and make sure that the lock tooth catch secures the transmitter in place.

3-2-2. Type MT-36C-24 Antenna Coupling and Loading Unit

The Type MR-44A Shockmount performs the same functions for this unit as does the MT-56B for the transmitter. Select a suitable flat surface complying with the restrictions given in Section 3-1 and the accessibility shown on Figure 24. Drill the mounting holes in accordance with the dimensions on Figure 24, and secure the shockmount with eight No. 10 round head machine screws, using lockwashers under each screw. Finally, slide the antenna coupling and loading unit on the shockmount and lock it into place.

3-2-3. Power Supply Unit

Select a suitable flat surface complying with the restrictions given in Section 3-1 and the accessibility clearances shown on Figure 22. If possible, the orientation should be such that the dynamotor shafts are parallel to the fore and aft center line of the plane. This position will cause the least wear to the dynamotor bearings from the gyroscopic action of the armatures. Drill at least four holes for No. 10 screws at suitable points in the power supply base plate. Use either flat head or binder head screws for securing the base plate to the mounting surface. Having firmly fastened the plate, seat the power supply thereon, close the snapslides, and secure them with safety wire.

3-2-4. Remote Control Unit

Select a flat surface complying with the restrictions given in Section 3-1 and Figure 23. Remove the chassis from the back and side cover by loosening the four front panel screws. Drill at least four holes in the back cover and secure it with No. 8 round head screws to the selected mounting surface. Slide the chassis back into place and tighten the four screws.

3-2-5. Radiation Indicator (Optional)

The radiation indicator should be located on the instrument panel near remote control unit. Cut and drill all mounting holes in accordance with dimensions shown at A or B, Figure 25, for the type of meter used.

3-3. ELECTRICAL CONNECTIONS

3-3-1. Junction Box and Cables

As stated in Section 2-2-7, all inter-unit wiring is accomplished by running shielded cables from each major unit to a common junction box serving as a distribution panel. It should be noted that where 90° plugs are supplied, they may be oriented to lead the cables away at any one of four angles 90° apart. The angle which best suits existing conditions should be utilized. This should be done before the wires are soldered to the plug terminals. To change the plug angle, remove the four screws next to the connector ring, rotate the elbow to the position desired, and replace the screws. All leads at the opposite end of the cable should be left free for individual connection at the junction box terminal block. Consult Figure 26 for typical cable and junction box installation information. Leave sufficient slack in the cables numbered 5, 6, and 7 to permit the major units to vibrate freely. *Important: The cables should not be made up from wire sizes smaller than those specified in Figure 26. Excessive voltage drop in filament wiring seriously interferes with the satisfactory operation of the equipment.*

3-3-2. Antennas

3-3-2-1. Fixed

If a fixed antenna is used, it should be as large as possible and should not fold back on itself. Several wires in parallel will prove satisfactory; the average installation requiring not less than two wires, at least 20 feet long, i. e., an antenna capacity of 175 Mmf is preferable for satisfactory operation at 2900 Kcs. An antenna capacity of not less than 200 Mmf for 300 to 600 Kcs operation should be used if operation at an altitude of 31,000 feet is desired. An antenna of smaller capacity will develop potentials high enough to cause breakdown at altitudes greater than 25,000 feet. Antenna insulators will be required to withstand potentials approaching 15,000 volts at 100% modulation. No. 14 A.W.G. braided phospher bronze wire or larger is recommended for the antenna proper and all connections must be well soldered. Insert a suitable weatherproof spring in each span to compensate for expansion and contraction resulting from changes in temperature, and also to allow a little give for slip stream pressure. Strain insulators used with the antenna should have metal ends tightly sealed to the insulating material. Bendix Type MT-48A Strain Insulators are recommended. All rod and stud ends should be fitted with cap nuts and care should be taken to remove all sharp points or burrs. Connector rods through lead-in bushings should be at least ½″ in diameter and should have smooth surfaces.

It is beyond the scope of this book to give dimensional details of the antenna installation since these will vary with each type of installation.

3-3-2-2. Trailing Wire

If a trailing wire antenna is used, the reel and associated insulating material should be capable of withstanding 20,000 volts at an altitude of 31,000 feet at 300 kilocycles.

3-3-2-3. Lead-In

The antenna lead-in connects to the input terminal located on the top front of the Type MT-36C-24 Antenna Loading and Coupling Unit. Connect the transmitter antenna lead-in to the output terminal of the MT-36C-24. This output terminal protrudes through the bowl insulator at the top rear of the MT-36C-24. Allow only enough slack to permit the transmitter and antenna tuning units to vibrate freely in their shockmounts. Do not use wire with inflammable insulation for antenna connections between the transmitter and tuning unit, or between the tuning unit and the antenna lead-in. Use either tinned copper braid or stranded wire with flexible, flame proof insulation.

3-3-3. Receiver

The power supply also provides plate and filament potentials for receiving equipment. The transmitter is designed to include a receiver sidetone circuit. The sidetone connections for phone or MCW will depend on the receiver circuits.

When using a common antenna for receiving and transmitting, connect the receiver antenna terminal to J8 on the transmitter, since the antenna is connected directly to the Type MT-36C-24 output terminal. Thus, by reason of antenna changeover relay S7 and associated control circuits, break-in operation for phone is feasible, Two separate antennas, one for the receiver and one for the transmitter, are necessary for break-in telegraph operation.

It is beyond the scope of this book to outline the receiver connections in detail since they depend entirely on the type of receiver and junction box employed.

3-4. VACUUM TUBES AND CRYSTALS

The transmitter unit is shipped with vacuum tubes and crystals. These should be checked to determine that they are firmly seated in their respective sockets, that all tube clamps are tight, and that all plate clips are properly secured to their respective tube caps.

To do this, remove the transmitter rear cover after loosening the Dzus fasteners and removing the fan motor plug P9 from its receptacle J9. Slide the one-piece top and side cover back and up. Check the tubes and crystals, using Figures 14 and 15 as an installation guide.

4. INITIAL ADJUSTMENTS

4-1. OSCILLATOR AND BUFFER

No front panel tuning adjustments are provided for the oscillator and buffer stages, as the tank inductors, supplied with the equipment for each channel, are adjusted to resonate at the exact frequency specified by the customer.

However, two adjusting capacitors, C1 for the oscillator and C12 for the buffer, are provided inside the transmitter unit (see Figure 5). These capacitors should not be touched unless the operating frequency of one or more channels is to be changed, or in the event faulty operation can be traced to a detuned oscillator or buffer tank circuit.

If the operating frequency of one or more channels is changed, the major portion of the tuning must be done by adjusting the new inductors, with C1 and C2 set to the values which resonate the unchanged channels. Finally, a value of capacity must be found which is optimum for the eight channels.

If it has been determined that one or both stages are detuned, it will be necessary to rotate the capacitor associated with that stage (after first loosening its locknut) until an optimum position is found which satisfactorily resonates all channels. It is well to remember that the condenser C1 should be turned out for a capacity setting that is less than that required for maximum IPA grid current on each channel. The locknuts on C1 and C12 should be tightened after final adjustments have been made.

4-2. TUNING PROCEDURE

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS.

DO NOT APPLY PLATE VOLTAGE TO THE TRANSMITTER FOR MORE THAN FIVE SECONDS AT A TIME UNTIL ALL TUNING OPERATIONS HAVE BEEN COMPLETED. NEVER SHIFT FREQUENCY WITHOUT RELEASING THE MICROPHONE PRESS-TO-TALK SWITCH OR THE TELEGRAPH KEY.

4-2-1. Switching Sequence

With the equipment completely installed, close the ship's primary power switch, thus supplying heater voltage to the oscillator, buffer, and RF indicator tubes. Allow these tubes to warm up for at least 30 seconds. Turn the TRANSMISSION selector (remote control) to the PHONE position, following which, close the transmitter ON-OFF switch located on the remote control front panel. This last operation closes the remaining vacuum tube filament circuits and starts the ventilating fan. Insert the plug of the MT-42A Microphone into the MICRophone jack on either the transmitter or remote control front panel. Close the microphone press-to-talk switch, thus energizing the dynamotor starting relays, the antenna changeover relay, and the keying relay. The keying relay applies plate and screen voltage to the speech amplifier, oscillator, and IPA tubes.

4-2-2. High Frequency Channels

For a fixed antenna, preliminary tuning adjustments should preferably be made on the ground, using an auxiliary service battery as the primary source of power.

Turn the FREQuency SELECTOR (remote control) to OFF and rotate the mechanical channel selector on both the transmitter and the MT-36C-24 Tuning Unit to the first high frequency channel. Open the door which provides access to the PA tank inductors by loosening the captive screw associated therewith. For frequencies higher than 5000 Kcs, remove the antenna lead from the transmitter. Insert the meter plug P10 into the AMPlifier receptacle. Depress the microphone press-to-talk switch and rotate the PA tank inductor by means of a small screw driver to the point of maximum plate current dip, indicating resonance. The plate current at resonance, with the antenna disconnected, should be approximately 50 milliamperes (multiply the meter reading by 100). A dip, to the order of 100 miliamperes, is an indication that the tank circuit has been resonated to a harmonic of the grid driving voltage. Having thus resonated the tank circuit, replace the antenna lead and proceed to load the amplifier as follows:

The antenna contact on the output coil described in Section 2-2-1-2 should be placed about one turn from the ground end of the coil (end of coil next to the front of the unit). The coil should be again rotated by means of a screw driver until resonance is indicated by a dip in PA plate current. If the PA plate current at resonance is less than 150 MA, the antenna contact should be moved forward one or two more turns and resonance again obtained by rotating the coil with a screw driver. A 0-5 RF ammeter placed temporarily in the antenna lead is very helpful in obtaining correct tuning adjustments. Continue this procedure until a plate current of 150 MA is obtained at resonance. If resonance cannot be obtained, capacitors C21 and/or C24 should be connected in series with the antenna for this particular channel in the Type MT-36C-24 Antenna Loading and Coupling Unit.

For tuning frequencies lower than 5000 Kcs, capacitor C101 should be connected between plate and ground by means of a small jumper between the plate contact and upper center contact on the output coil. Tuning can then be done in the same manner as that described for frequencies higher than 5000 Kcs.

It may be desirable to leave capacitor C101 out of the circuit for frequencies between 4000 and 5000 Kcs. The tank circuit cannot be resonated at these frequencies unless some added capacity from the antenna is used. If the antenna is not capacitive enough it will be necessary to add capacitor C21 or C24 in series (as previously mentioned) in the antenna coupling and loading unit.

In rare cases various combinations of capacitors C21, C24, and C101 may not allow satisfactory tuning in the output circuit because the antenna may either be inductive or very nearly resistive at various combinations of capacitors. It is always possible to get a condition where the antenna will at least be nearly resistive. For frequencies between 2900 and 10,000 Kcs, a Type MT-21A coil will allow much more critical adjustment than that allowed by the Type MT-19A coil. The corresponding coil for frequencies higher than 10,000 Kcs is designated as the Type MT-21B coil. The Type MT-21A and B coils are similar to the Type MT-19A and B coils except that the rotors of the Type MT-21A and B coils are split into two sections. This allows that portion of the coil carrying the antenna tap to be rotated independently and thus allows very close adjustment of coupling.

If a trailing wire antenna is used, reel out from 30 to 250 feet and use the same procedure described for a fixed antenna. This must be done in flight. The number of turns of the reel should be noted and this same amount always reeled out whenever high frequencies are used.

4-2-3. Low Frequency Channels

DO NOT MAKE ADJUSTMENTS INSIDE THE ANTENNA TUNING UNIT WHEN THE POWER IS ON. LET THE DOOR FALL BACK AGAINST THE ANTENNA POST WHEN THE DOOR IS OPEN, AS AN EXTRA PRECAUTION.

For low frequency operation (300 to 600 kilocycles) the antenna and coupling unit supplies both the PA tank coil and the antenna coupling network. As described in Section 2-2-1-2, a shorting strip is substituted for the tank inductor in the transmitter unit.

Set the transmitter up for operation and open the coil access door at the top of the antenna loading and coupling unit. Rotate the mechanical channel selector to correcpond with the channel selected at the transmitter. When more than one low frequency channel is incorporated in the transmitter the lowest frequency channel should be selected and tuned first. If a trailing wire antenna is used, reel out between 200 and 250 feet of antenna, noting the amount reeled out. In either case proceed as follows:

Close the microphone press-to-talk switch. Observing the PA plate current, rotate the proper channel switch with a small screw driver. A decided decrease in PA plate current is an indication of resonance. If no such drop occurs, release the press-to-talk switch and change the position of the flexible lead that corresponds to the channel being tuned, which is connected to the main loading inductor L35 (see Figure 13), and then repeat the entire operation. Continue this procedure until maximum antenna current is obtained with a PA plate current of between 150 and 160 milliamperes. If the PA plate current exceeds 160 MA at resonance, the coupling capacity for that channel should be reduced (see Section 2-2-1-3). Sometimes a capacity less than those listed is required. Repeat this process for all channels involving operating frequencies between 300 and 600 Kcs. After tuning the last low frequency channel in the manner described above, it is good practice to recheck the tuning of all channels previously tuned to insure maximum performance.

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5. ROUTINE OPERATING PROCEDURE

NEVER SHIFT FREQUENCY WITHOUT RELEASING THE MICROPHONE PRESS-TO-TALK SWITCH OR THE TELEGRAPH KEY.

ALWAYS CHECK THE CHARACTER OF EMISSION BY TUNING THE COMPANION RECEIVER TO THE FUNDAMENTAL FREQUENCY OF THE TRANSMITTER, DISCONNECTING THE RECEIVER ANTENNA AND GROUNDING ITS ANTENNA TERMINAL.

5-1. RADIOPHONE COMMUNICATION

The procedure for operating the Model TA-2J-24 Transmitting Equipment in radiophone communication is as follows

A. Close the airplane's master switch.

B. Turn the remote control unit FREQuency SELECTOR to the desired channel. Note that both the TRANS. FREQ. CHANGING indicator lights glow until the transmitter and antenna unit frequency selecting mechanisms stop.

C. Turn the remote control unit TRANSMISSION selector to the PHONE position.

D. Snap the remote control unit transmitter switch to ON. Note that the indicator lamp directly above lights.

E. For operation on the high frequency channels, reel out the trailing wire antenna to the length determined during initial adjustments. This length can be the same for all channels between 2900 and 15,000 Kcs. For operation on the low frequency channels (300 to 600 Kcs), reel out the trailing wire antenna to a length between 200 and 250 feet. For fixed antenna, neglect trailing wire instructions.

F. Press the microphone press-to-talk switch and modulate the transmitter by speaking into the microphone. Note the character of transmission by listening with the headphones of the receiving equipment.

G. For reception, release the microphone press-to-talk switch.

H. To decommission the equipment temporarily, snap the transmitter switch to OFF, thus opening all circuits except the 24-volt supply to V1, V2, and V7 heaters.

I. To decommission the equipment permanently, open the airplane's master switch.

5-2. CW TELEGRAPH

The procedure for placing the Model TA-2J-24 Transmitting Equipment into operation for CW telegraph communication is as follows:

A. Close the airplane's master switch.

B. Turn the remote control unit FREQuency SELECTOR to the desired channel. Note that both the TRANS. FREQ. CHANGING and ANT. FREQ. CHANGING indicator lights glow until the transmitter and antenna unit frequency selecting mechanisms stop.

C. Turn the remote control unit TRANSMISSION selector to the CW position.

D. *Snap the remote control unit transmitter switch to ON. Note that the indicator lamp, directly above, lights and the dynamotor starts.

E. For operation on the high frequency channels, reel out the trailing wire antenna to the length determined during initial adjustments. This length can be the same for all channels between 2900 and 15,000 Kcs. For operation on the low frequency channels, (300 to 600 Kcs), reel out the trailing wire antenna to a length between 200 and 250 feet as previously determined during initial adjustments. Neglect trailing wire instructions if a fixed antenna is used.

F. To transmit, operate the telegraph key. This also keys the hummer, so that the coding of signals can be heard in the receiver sidetone output, of the receiver is so equipped.

G. For reception, turn the TRANSMISSION selector to the PHONE position, thus de-energizing the antenna changeover relay.

H. To decommission the equipment, temporarily, snap the transmitter switch to OFF, thus opening all circuits except the 24-volt supply to V1, V2, and V7 heaters.

I. To decommission the equipment permanently, open the airplane's master switch.

5-3. MCW TELEGRAPH

The procedure for operating the Model TA-2J-24 Transmitting Equipment for tone modulated telegraphy is as follows:

A. Close the airplane's master switch.

B. Turn the remote control unit FREQuency SELECTOR to the desired channel. Note that both the TRANS. FREQ. CHANGING and ANT. FREQ. CHANGING indicator lights glow until the transmitter and antenna unit frequency selecting mechanisms stop.

C. Turn the remote control unit TRANSMISSION selector to the MCW position.

D. *Snap the remote control unit transmitter switch to ON. Note that the indicator lamp, directly above, lights and the dynamotor starts.

E. For operation on the high frequency channels, reel out the trailing wire antenna to the length determined during initial adjustments. This length can be the same for all channels between 2900 and 15,000 Kcs. For operation on the low frequency channels (300 to 600 Kcs), reel out the trailing wire antenna to a length between 200 and 250 feet as previously determined during initial adjustments. Neglect trailing wire instructions if a fixed antenna is used.

F. To transmit, operate the telegraph key. This also keys the hummer which modulates the transmitter and supplies sidetone to the receiver if the receiver is so equipped.

G. For reception, turn the TRANSMISSION selector to the PHONE position, thus deenergizing the antenna changeover relay.

H. To decommission the equipment temporarily, snap the transmitter switch to OFF, thus opening all circuits except the 24-volt supply to V1, V2, and V7 heaters.

I. To decommission the equipment permanently, open the airplane's master switch.

* For maximum tube life, turn the TRANSMISSION selector knob to the PHONE position before turning the transmitter switch to ON. Then turn the TRANSMISSION selector knob to CW or MCW, depending on the type of transmission being used.

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6. MAINTENANCE

6-1. LUBRICATION

6-1-1. Transmitter Unit

6-1-1-1. Fan Motor

The transmitter unit fan motor should be lubricated after 1000 hours of active service, or once every six months for semi-active service.

The fan motor must be removed from its mounting before dismantling it for lubrication. Remove the transmitter rear cover shield, withdraw the four screws which secure the motor to the case, and remove the fan from its driving shaft. Disassemble the brushes by removing the retainer screws. Remove the two flat head screws holding the end bell and brush holders. Slip the end bell off, exposing the brush leads, commutator, and ball bearing race. Remove the armature assembly by pulling it forward, and blow out all foreign matter with clean filtered compressed air. Clean the bearings with carbon tetrachloride, exercising care to prevent damaging the armature winding. Cover the ball bearing races with Andok C grease.

Reassemble the motor, taking care to replace the brushes in the correct holders. Insert the brushes so that their + and − marks coincide with those on the holders, thus insuring that their curvatures will fit that of the commutator. Replace the end bell so that its slot coincides with the small dowl pin on the case. The brush leads should be carefully placed so that they will not rub on the armature or commutator after assembly.

Drop from two to four drops of Pflueger Speede Reel Oil No. 379 into each oilhole.

6-1-1-2. Frequency Selecting Mechanism

The frequency selecting mechanism and its driving motor require the same attention as that recommended for the fan motor.

Remove the frequency selecting mechanism from the transmitter front panel in the following manner:

A. Remove the motor drive unit protective cover by removing the securing screws.

B. Remove the taper pin securing the drive shaft to the turret using a light hammer and a suitable drift pin.

C. Remove the four cover plate pillars with a screw driver, then the mechanism will come free.

Dismantle and lubricate the motor, following the procedure outlined in Section 6-1-1-1 for the fan motor. Lubricate the gear teeth sparingly with Royco No. 6A grease. The shaft bearings should be lubricated with one or two drops of Pflueger Speede Reel Oil at the same time.

6-1-1-3. Transmitter Turret Assemblies

The turret shaft bearings are so lubricated that they should not require any attention throughout the life of the equipment, but the coil contacts should be very sparingly greased with Andok C grease.

6-1-2. Antenna Loading and Coupling Unit

Dismantle and lubricate the frequency selecting mechanism and its driving motor in exactly the same sequence as described for the similar units in the transmitter (see Section 6-1-1). Switch contacts should be very sparingly greased with Andok C grease.

6-1-3. POWER SUPPLIES

All dynamotor bearings should be lubricated after 1000 hours of active service, or once every six months for semi-active service. Use Andok C grease in small amounts.

Remove bearing plates and apply enough Andok C grease to cover the bearings. Do not pack bearings. Keep grease off commutators.

6-2. DYNAMOTOR BRUSH REPLACEMENT

The brushes for both the transmitter and receiver dynamotors should be checked after every 100 hours of service. If they show signs of excessive wear, they should be replaced. To remove the brushes, proceed as follows:

A. Remove the dynamotor end bells.

B. Remove the brush retainer screws located on both sides of the bearing yoke assemblies.

C. Slide the brushes out.

6-3. AIR FILTERS

The front and rear filters in the end bells of the high voltage dynamotor, used with the power supply unit, should be blown clean with compressed air after every 100 hours of service. Remove the bells from the units before taking this action.

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7. SERVICE INFORMATION

7-1. TEST BENCH EQUIPMENT

During periods in which the ship is being overhauled, the radio equipment should be dismantled and inspected mechanically and electrically also. Satisfactory test bench equipment will include the following:

A. Primary power source, consisting of a 24-volt 200-ampere-hour storage battery, complete with 28-volt, 40-ampere charging system.

B. Complete set of cables and a junction box.

C. A reliable ohmmeter, a 100-ampere DC ammeter equipped with a shorting switch, a multi-scale 0-1500 DC voltmeter, and a 0-5 RF ammeter.

D. A high frequency dummy antenna consisting of a 10-ohm, 100-watt non-inductive resistor and a 250 Mmf, 5000-volt variable capacitor.

E. A low frequency dummy antenna consisting of a 225 Mmf, 15,000-volt capacitor.

7-2. VACUUM TUBE VOLTAGE AND CURRENT ANALYSIS (27-VOLT INPUT)

Tube	*Heater Voltage*	*Plate Voltage*	*Screen Voltage*	*Grid Voltage*	*Suppressor Voltage*	*Plate Current*	*Grid Current*
V1	6.0-7.0	200-300	75-150	.	.	.	.6 MA
V2	6.0-7.0	375-500	200-300	.	.	.	2.5 MA
V3	10.0-11.0	1050-1150	325-450	.	40-75	160 MA	35 MA
V4	7.25-8.3	375-500	.	.	.	.	.
V5	10.0-11.0	1050-1150	.	30-40	.	*160 MA	.
V6	10.0-11.0	1050-1150	.	30-40	.	*160 MA	.

*Maximum signal plate current at 100% modulation.

Make all voltage measurements to ground with an external voltmeter of appropriate range. All grid current readings may be made with the milliammeter on the transmitter front panel in the following manner:

Insert the meter plug P10 into the jack marked GRID and rotate the GRID CURRENT switch to OSC. for V1 (read directly), to AMP 1 for V2 (read directly), and to AMP 2 for V3 (multiply reading by 10).

Plate current for the final amplifier V3, and the modulators V5 and V6 may also be read from the milliammeter on the transmitter front panel by inserting the meter plug in the jacks AMP. and MOD. respectively. Multiply the meter readings by 100 for both measurements.

7-3. LOCATION OF FAULTS

In general, faults can best be located by isolating any irregular operation through a series of logical steps and eliminating possible causes, one by one, until the difficulty or series of difficulties become apparent. Such a procedure is outlined below, arranged in a sequence which should aid materially in locating any difficulties.

A. If the transmitter fails to operate properly on all channels:

1. Check the voltage of the primary power source and see that all cables are properly connected.
2. See that tube heaters and filaments are lighted and ascertain that the dynamotor is delivering the proper voltage to the transmitter.
3. Check antenna lead for opens and grounds.
4. Be sure all relay and switch contacts are clean and making contact.

5. Check microphone and key contacts and ascertain that their plugs are well seated in their jacks.
6. Remove tubes one at a time, replace with spare tubes, and check operation by observing grid and plate currents.
7. Check tuning adjustments.
8. Measure all tube, plate, and screen voltages.

B. If the transmitter fails to operate properly on any one channel:

1. Check tuning adjustments.
2. Clean coil turret and selector switch contacts associated with that channel and ascertain that they are making contact.
3. Be sure crystal holder contacts are clean and making contact.
4. Check crystal holder assembly in an external oscillator (do not attempt to open crystal holders). If defective, return to factory.
5. Check the crystal by replacing it with a spare.

C. If motor-driven channel selector mechanisms fail to operate:

1. Check to see that motor-driven switches are clean and make good contact.
2. Check frequency selector switch in remote control unit to be sure it is making contact properly.
3. Ascertain that proper voltage is being delivered at the drive switch contacts.
4. Check for frozen bearings.
5. Check turrets for freedom of operation.

D. If the carrier is not modulated on telephone or MCW transmissions:

1. Check and clean keying relay S9 contacts.
2. Check microphone press-to-talk key and contacts of S3 in the remote control unit.
3. Remove and test audio frequency tubes by replacing them one by one with spare tubes.
4. Check audio transformers for opens or shorts.
5. Check audio bypass condensers for shorts.

8. ELECTRICAL PARTS LIST

8-1. TYPE TA-2J-24 TRANSMITTER UNIT

CAPACITORS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
C1	Osc. plate trimmer	25 Mmf, midget variable	17	ZR-25-AS	110C/125	A14676-1
C2	Osc. cathode bypass	.01 Mfd, 600V DCW, mica	11	4L-11010	110C/126	A13752-14
C3	Osc. plate bypass	Same as C2	.	.	.	.
C4	IPA grid blocking	25 Mmf, 600V DCW, mica	11	4L-14050	110C/127	A13752-20
C5	IPA cathode bypass	Same as C2	.	.	.	.
C6	IPA screen bypass	Same as C2	.	.	.	.
C7	IPA plate bypass	.01 Mfd, 1200V DCW, mica	11	4L-21010	110C/59	A13756-14
C8	PA grid blocking	200 Mmf, 1200V DCW, mica	11	4L-23020	110C/128	A13756-3
C9	PA screen bypass, RF	Same as C7	.	.	.	.
C10	PA suppressor bypass	Same as C2	.	.	.	.
C11	PA plate bypass	.004 Mfd, 2500V DCW, mica	29	A-50	110C/969	A100671-4
C12	IPA plate trimmer	Same as C1	.	.	.	.
C13	PA plate blocking	.004 Mfd, 2500V DCW, mica	29	A-50	110C/864	A100671-3
C14	Osc. feedback	1 Mmf, 500V DCW	18	1468	110C/130	A4524-9
C15	PA screen bypass, AF	1 Mfd, 1000V DCW, paper	11	TJ10010	110C/131	C55556-6
C16	Sidetone blocking	.01 Mfd, 300V DCW, mica	11	3L-11010	110C/132	A12883-1
C17	Mic. input blocking	2 Mfd, 100V DCW, paper	11	VC1071	110C/133	A12503-3
C18	Grid bias bypass	Same as C17	.	.	.	.
C19	Meter bypass	Same as C16	.	.	.	.
C20	SA plate bypass	Same as C15	.	.	.	.
C22	Osc. screen bypass	Same as C2	.	.	.	.
C23	RF indicator cathode bypass	.02 Mfd, 600V DCW, mica	11	4L-11020	110C/134	A13752-16
C25	Filament bypass	Same as C23	.	.	.	.
C101	Antenna Series	100 Mmf, 3000V DCW mica	11	PL-583-15L	110C/67	A12282-2

JACKS AND RECEPTACLES

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
J1	Mod. plate current	Single-circuit, closed	4	218A	110H/49	A14540-2
J2	PA plate current	Same as J1	.	.	.	.
J3	Grid current	Same as J1	.	.	.	.
J4	Microphone	3-circuit, microphone type	4	246A	110H/42	A3547-1
J5	Trans. power	Circular, 14-contact	5	FK-B14-32S	110H/50	A13779
J6	Channel selector	Circular, 12-contact	5	GK-12-32S	110H/44	A14458
J7	Antenna	Single-circuit jack	1	.	110H/51	AB9542
J8	Trans. to receiver	Single-circuit jack	27	101	110H/34	B7380-1
J9	Fan motor	Same as J8	.	.	.	.

RF AND AF INDUCTORS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
L1-L8	Osc. tank	See Section 1-2-3	1	.	.	.
L9-L16	IPA tank	See Section 1-2-3	1	.	.	.
L17	Osc. low freq. feedback	Universal wound, ½″ form	1	.	110C/907	AA13577-1
L18-L25	PA tank	See Section 1-2-3	1	.	.	.
L26	PA low freq.	Universal pi-wound	1	.	110C/205	AA15216-1
L28	Mic. input	1.4H at .25A, 100Ω DC	1	.	110C/206	A14805
L29	PA grid	5-section, No. 30SSE	1	.	110C/207	AB11026

METER

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
MA	Transmitter milliammeter	0-5 MA, DC, aircraft movement humidity proof case	23	506	110A/51	C8806-13

MOTORS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
M1	Frequency selector	24V, 1.25A (no load)	12	.	110K/7	C55628
M2	Fan	24V, .25A (no load)	12	.	110K/8	B10271-1

8-1. *Continued*

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		PLUGS				
P5	Trans. power	14-contact, ¾″ ID, 90°	5	FK-B14-23 ¾B	110H/79	A14461
P6	Channel selector	12-contact, ½″ ID, straight	5	GK-21-21 ½B	110H/74	A14460
P7	Antenna	Self-locking, single-contact	1	.	110H/80	AE11085
P8	Trans. to receiver	Single-contact	27	101	110H/67	B7380-2
P9	Fan motor	Same as P8	.	.	.	.
P10	Meter multi-circuit	Single-circuit	28	.	110H/81	AC55321-1
		RESISTORS				
R1	Osc. grid leak	50,000Ω, 1W, ceramic	19	Y2	110C/308	A14687-31
R2	Osc. grid meter bypass	500Ω, ½W, ceramic	19	Y3	110C/309	A14683-8
R3	Osc. screen dropping	20,000Ω, 10W, vitreous	20	Brown Devil	110C/310	A1669-3
R4	IPA grid leak	Same as R1	.	.	.	.
R5	IPA grid meter	Same as R2	.	.	.	.
R6	IPA cathode	500Ω, 10W, vitreous	20	Brown Devil	110C/311	A1669-17
R7	PA grid meter	1500Ω, 10W, vitreous	20	Brown Devil	110C/312	A1669-16
R8	Filament dropping	.75Ω, 50W	20	.	110C/313	A14799
R9	Sidetone voltage divider	200,000Ω, ½W, ceramic	19	Y3	110C/314	A14683-39
R10	Sidetone voltage divider	200,000Ω, ½W, ceramic	19	Y3	110C/315	A14683-27
R11	SA filament dropping	2Ω, 10W, vitreous	20	Brown Devil	110C/316	A1669-15
R12	High voltage divider	1000Ω, 100W, tapped	20	.	110C/317	QB7348
R13	High voltage divider	1000Ω, 100W, vitreous	20	0609	110C/318	A14737-11
R14	High voltage divider	Same as R13	.	.	.	.
R15	High voltage divider	15,000Ω, 100W, 2 taps	20	.	110C/319	QB7349
R16	Osc. parasitic	50Ω, ½W, ceramic	19	Y3	110C/320	A14683-1
R17	Osc. cathode	500Ω, 1W, ceramic	19	Y2	110C/321	A14687-7
R18	Bias	100Ω, 50W, vitreous	20	.	110C/682	A14537-6
R19	Meter bypass for RF indicator	Same as R2	.	.	.	.
R20	IPA screen	25,000Ω, 10W, vitreous	20	Brown Devil	110C/357	A1669-10
R21	PA grid meter	15,000Ω, ½W, ceramic	19	Y3	110C/323	A14683-26
R22	Mod. plate meter	90Ω, ± 1%, .04W	21	181	110C/324	QB9424-9
R23	Mod. plate meter shunt	1Ω, ±1%, .04W,	21	181	110C/325	QB9424-8
R24	RF indicator series	250,000Ω, 2W, ceramic	7	F-2	110C/326	A14228-12
R25	RF indicator series	Same as R24	.	.	.	.
R26	RF indicator series	150,000Ω, 1W, ceramic	7	F-1	110C/327	A13570-2
R27	RF indicator diode plate	50,000Ω, 1W, ceramic	7	F-1	110C/328	A13570-1
R28	RF indicator diode heater	20Ω, 10W, vitreous	20	Brown Devil	110C/329	A18136-2
R30	PA plate meter	Same as R22	.	.	.	.
R31	PA plate meter shunt	Same as R23	.	.	.	.
R34	Filament shunt	40Ω, 10W	20	.	110C/330	A13945-15
R35	Heater dropping	9.7Ω, 25W	20	.	110C/331	A18138-2
		SWITCHES AND RELAYS				
S1	Channel selector, Xtal sec.	SP8T rotary	8	H	110F/58	A14462
S2	Channel selector, osc. sec.	3 DPST rotary sections	1	.	110F/57	AE10787
S3	Channel selector, IPA sec.	Same as S2	.	.	.	.
S4	Channel selector, PA sec.	Same as S2	.	.	.	.
S5	Channel selector motor	Double-section 8 positions:	1	.	110F/45	AB11411
	Positioning sec.	7 make and 1 break	1	.	110F/60	AA14452-1
S7	Antenna transfer relay	1 SPDT and 2 SPST	4	243A	110F/12	A13583-1
S7A	Mic. press-to-talk relay	DPDT, 24V, 265Ω coil	16	1204	110F/13	A9487-3
S8	Grid current selector switch	DP5T	8	H	110F/61	A13786
S9	Keying relay	Same as S7A	.	.	.	.

8-1. *Continued*

TRANSFORMERS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
T1	Microphone to speech amp.	Ratio, 40-1	1	.	110K/82	A14804
T2	Speech amp. to modulator	Pri 8000Ω, sec 6000Ω	1	.	110K/83	A14802
T3	Modulator	830 B's PP to single 803	1	.	110K/84	A14803

VACUUM TUBES

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
V1	Oscillator	Tetrode, beam power	22	807	110E/8	.
V2	IPA	Same as V1	.	.	.	.
V3	PA	Pentode	22	803	110E/31	.
V4	Speech amplifier	Triode	22	801A	110E/26	.
V5	Modulator	Triode	22	830B	110E/27	.
V6	Modulator	Same as V5	.	.	.	.
V7	RF indicator	Duplex-diode	22	6H6	110E/13	.

SOCKETS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
X1	Osc. tube	5-prong, ceramic	25	.	110H/98	AA12335-1
X2	IPA tube	Same as X1	.	.	.	.
X3	PA tube	5-prong, phenolic	1	.	110H/99	AA12887-1
X4	Speech amp. tube	4-prong. ceramic	25	.	110H/100	AA12334-1
X5	Modulator tube	Same as X4	.	.	.	.
X6	Modulator tube	Same as X4	.	.	.	.
X7	RF indicator tube	Octal base, ceramic	25	.	110H/101	A7763
X8	Crystal holder	3-pin	26	.	110H/276	A13213
X9	Crystal holder	Same as X8	.	.	.	.
X10	Crystal holder	Same as X8	.	.	.	.
X11	Crystal holder	Same as X8	.	.	.	.
X12	Crystal holder	Same as X8	.	.	.	.
X13	Crystal holder	Same as X8	.	.	.	.
X14	Crystal holder	Same as X8	.	.	.	.
X15	Crystal holder	Same as X8	.	.	.	.

8-2. TYPE MP-10E-24 AND MP-10G POWER SUPPLY UNITS

CAPACITORS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
C1	LV dyn. primary filter	1 Mfd, 100V, DCW, paper	11	VC-1541-1	110C/54	A204-5
C2	LV dyn. secondary filter	.5 Mfd, 400V, DCW, paper	11	DHR-4050	110C/55	A12503-4
C3	Trans. dyn. primary filter	Same as C2	.	.	.	.
C4	Trans. dyn. secondary filter	1 Mfd, 1500V, DCW, oil-filled	11	VC-1069	110C/56	A12931-1
C5	LV dyn. secondary filter	.8-.8-3 Mfd, 600V, DCW, paper	11	VC-674-D	110C/57	A6157-1
C6	Relay spark suppressor	Same as C2	.	.	.	.
C7	HV dyn. primary filter	Same as C1	.	.	.	.
C8	HV dyn. secondary filter	.01 Mfd, 1200V, DCW, mica	11	9-21010	110C/58	C55563-47
C9	Trans. dyn. secondary filter	Same as C8	.	.	.	.
C10	HF filter, primary	.01 Mfd, 1200V, DCW, mica	11	4L-21010	110C/59	A13756-14
C11	Ripple filter, secondary	Same as C4	.	.	.	.

DYNAMOTORS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
	*Receiver	28V, 1.6A pri; 230V, .10A sec	.	.	110K/18	C56728-2
	†Receiver	28V pri; 250V, .15A sec	.	.	.	C55629
	Trans.	26.5V, 27A; 1100V, .4A louvered	.	.	110K/19	N90292

* Used only on MP-10G † Used only on MP-10E-24

8-2. *Continued*

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
		FUSES				
F1	HV dynamotor secondary	1A, 1000V	2	2104	110H/19	A8944-4
F2	HV dynamotor secondary	Same as F1	.	.	.	.
F3	Primary input	75A, 24V	13	.	110H/262	A14201-11
F4	Filament and relay supply	40A, 24V	2	4AG special	110H/21	A12247-10
F5	LV dynamotor primary	10A, 24V	2	4AG 1095C	110H/22	A12247-5
F6	LV dynamotor secondary	.25A, 250V	2	4AG special	110H/23	A12247-11
		RECEPTACLES				
J1	Power output	Circular, 8-contact	5	RF-W8-538	110H/37	A12935
J2	Power input	Circular, 4-contact	1	.	110H/38	AB11803
		CHOKES				
L1	LV dynamotor primary	50T, No. 12DCC, ¾″ OD	1	.	110C/176	AB2889-2
L2	HV dynamotor secondary	375T, No. 22DCC, ¾″ OD	1	.	110C/177	AB2889-1
L3	HV dynamotor secondary	Same as L2	.	.	.	.
L4	LV dynamotor secondary	8H at 60 MA, iron core	15	21103	110C/178	A6156
L5	LV dynamotor secondary	460T, No. 28 DCC, 15/16″ OD	1	.	110C/179	AB10055-3
		PLUGS				
P1	Power output	8-cont, ¾″ ID, straight	5	RF-W8-22 ¾B	110H/69	A12938
P2	Power input	4-cont, ¾″ ID, 90°	5	RF-WE4-58 ¾B	110H/70	A12937
		RELAYS				
S1	HV dynamotor starting	SPST, 12V solenoid, 8Ω coil	14	.	110F/4	AA14951-1
S2	HV dynamotor starting	Same as S1	.	.	.	.
S3	LV dynamotor starting	DPST, 24V, 380Ω coil	16	1204	110F/5	A9487-2

8-3. TYPE MT-34C-24 AND MT-34D REMOTE CONTROL UNITS

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
		INDICATOR LAMPS				
I1	Trans. freq. change indicator	12-16V, bayonet base lamp	3	T-3¼	105L/21	A13244
I2	Trans. on indicator	Same as I1	.	.	.	.
I3	Ant. freq. change indicator	Same as I1	.	.	.	.
		RECEPTACLES				
J1	Telegraph key	Open-circuit	4	223A	110H/41	A14021-1
J2	Microphone	2 circuits	4	246A	110H/42	A3547-1
J3	Control cable	26 contacts for ¾″ plug	5	IK-26-32S	110H/43	A13919
		PLUG				
P3	Remote control	26 contacts, ¾″ ID, 90°	5	IK-26-23 ¾B	110H/73	A13920
		RELAY				
*D1	Selector relay	24V, 400Ω DC resistance	.	.	110F/17	C56935-2

* Use only on MT-34D

8-3. *Continued*

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		RESISTORS				
R1	Hummer primary	150Ω, 10W	6	1¾ Z3	110C/186	A13892-11
R2	Hummer secondary	1000Ω, ½W	7	BT-½	110C/287	A11207-14
R3	Indicator lamp dropping	Same as R1	.	.	.	.
R4	Indicator lamp dropping	Same as R1	.	.	.	.
R5	Indicator lamp dropping	Same as R1	.	.	.	.
		SWITCHES				
S1A, S1B	Frequency selector	DP9T rotary, 2-section	8	.	110F/40	A13247
S2	Filament on-off	SPST toggle	9	.	110F/41	A13250
S3	Transmission selector	3P3T rotary	8	.	110F/42	A13248
		MECHANICAL OSCILLATOR				
Y1	MCW tone generator	15MW output, 1000 cycles	10	572B	110V/1	A13252

8-4. TYPE MT-36C-24 ANTENNA LOADING AND COUPLING UNIT

Symbol	Function	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		METER				
A	Antenna ammeter	0-3A RF, thermocouple, humidity proof case	23	507	110A/50	B11445
		CAPACITORS				
C21	Antenna series	100 Mmf, 3000V DCW, mica	11	583-15L	110C/67	A12282-2
C22	LF coupling	.001 Mfd, 5000V DCW, mica	11	246-6LL	110C/68	A12283-5
C23	LF coupling	.0015 Mfd, 5000V DCW, mica	11	234-6LL	110C/69	A12283-6
C24	HF ant. series	Same as C21	.	.	.	.
C25	LF coupling	Same as C21	.	.	.	.
C26	LF coupling	800 Mmf, 5000V DCW, mica	11	599-6LL	110C/70	A12283-11
		RECEPTACLE				
J11	Channel selector	Circular, 12-contact	5	GK-12-32S	110H/44	A14458
		INDUCTORS				
L29-L34	LF trimmer	70T, No. 20DCC, 11 taps, 2″ OD	1	.	110C/180	AB9291
L35	LF antenna loading	176T, No. 20SSC, 22 taps, 4″ OD	1	.	110C/181	AF9192
		MOTOR				
M3	Freq. selector	24V, 1A	12	BX100-55931	110K/7	C55628
		PLUGS				
P11	Channel selector	12-contact, straight	5	GK-12-21-½B	110H/74	A14460
P107	Trans. input	Self-locking, single-contract	1	.	110M/88	AE11085
		SWITCHES AND RELAYS				
S10	Ant. coupling impedance selector	SP8T, shaft common with S11	1	.	110F/43	AF9384
S11	Ant. coupling impedance selector	Same as S10	.	.	.	.
S12	S14 selector	SP8T, common with S10 and S11	1	.	110F/44	AB9555
S13	Motor positioning switch	Double-section, 8 positions, 7-make and 1-break	1	.	110F/45	AB11411
S14	Antenna transfer relay	DPDT, plunger type	24	.	110F/9	C55501-2
S15-S20	Channel trimmer selector	11-contact, rotary switch	21	536	110F/46	A15657

9. RECOMMENDED SPARE ELECTRICAL PARTS

9-1. TYPE TA-2J-24 TRANSMITTER UNIT

(Recommended quantities of spare electrical parts for each lots of ten transmitters)

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		CAPACITORS				
2	C1, 12	25 Mmf, midget variable	17	ZR-25-AS	110C/125	A14676-1
7	C2, 3, 5, 6, 10, 22	.01 Mfd, ±10%, 600V DCW, mica	11	4L-11010	110C/126	A13752-14
3	C4	25 Mmf, ±10%, 600V DCW, mica	11	4L-14050	110C/127	A13752-20
4	C7, 9	.01 Mfd, ±10%, 1200V DCW, mica	11	4L-21010	110C/59	A13756-14
3	C8	200 Mmf, ±10%, 1200V DCW, mica	11	4L-23020	110C/128	A13756-3
3	C11	.004 Mfd, ±10%, 2500V DCW, mica	11	A-50	110C/969	A100671-4
3	C13	.004 Mfd, ±10%, 2500V DCW, mica	11	A-50	110C/864	A100671-3
3	C14	1 Mmf, +½−0 Mmf, 500V DCW, mica	18	1468	110C/130	A4524-9
4	C15, 20	1 Mfd, 1000V DCW, paper	11	TJ10010	110C/131	C55556-6
4	C16, 19	.01 Mfd, ±10%, 300V DCW, mica	11	3LL-11010	110C/132	A12883-1
4	C17, 18	2 Mfd, ±20%, 100V DCW, paper	11	VC1071	110C/133	A12503-3
4	C23, 25	.02 Mfd, ±10%, 600V DCW, mica	11	4L-11020	110C/134	A13752-16
3	C101	100 Mmf, ±5%, 3000V DCW, mica	11	PL-583-15L	110C/67	A12282-2
		JACKS AND RECEPTACLES				
2	J1, 2, 3	Single-circuit, closed	4	218A	110H/49	A14540-2
1	J4	3-circuit, microphone	4	246A	110H/42	A3547-1
1	J5	14-contact, circular	5	FK-B14-32S	110H/50	A13779
1	J6	12-contact, circular	5	GK-12-32S	110H/44	A14458
1	J7	Antenna lead-in fastener	1	.	110H/51	AB9542
1	J8, 9	Single-circuit jack	27	101	110H/34	B7380-1
		RF AND AF INDUCTORS				
1	L17	Universal wound, ½″ OD form	1	.	110C/907	AA13577-1
1	L26	Universal pi-wound, 5 layers, 235T, No. 28SSE each layer	1	.	110C/205	AA15216-1
1	L28	1.4H at .025A, 100Ω, DC	1	.	110C/206	A14805
1	L29	Choke, 5 section, No. 30 SSE	1	.	110C/207	AB11026
		METER				
1	MA	0-5 MA DC, aircraft movement, humidity proof case	23	506	110A/51	C8806-13
		MOTORS				
1	M1	24V, 1¼A, (no load)	12	.	110K/7	C55628
4	.	+Brush	12	.	110K/5	A30212-1
4	.	−Brush	12	.	110K/6	A30212-2
1	M2	24V, ¼A (no load)	12	BX100SS 932	110K/8	B10271-1
4	.	+Brush	12	.	110K/5	A30212-1
4	.	−Brush	12	.	110K/6	A30212-2
		PLUGS				
1	P5	14-contact, ¾″ ID, 90°	5	FK-B14-23-¾B	110H/79	A14461
1	P6	12-contact, ½″ ID, straight	5	GK-12-21-½B	110H/74	A14460
1	P7	Single-contact, self locking	1	.	110H/80	AE11085
1	P8, 9	Single-contact	27	101	110H/67	B7380-2
1	P10	Single-circuit	28	.	110H/81	AC55321-1

9-1. *Continued*

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
		RESISTORS				
4	R1, 4	50,000Ω, ±20%, 1W, ceramic	19	Y2	110C/308	A14687-31
4	R2, 5, 19	500Ω, ±20%, ½W, ceramic	19	Y3	110C/309	A14683-8
3	R3	20,000Ω, ±10%, 10W, vitreous	20	Brown Devil	110C/310	A1669-3
3	R6	500Ω, ±10%, 10W, vitreous	20	Brown Devil	110C/311	A1669-17
3	R7	1500Ω, ±10%, 10W, vitreous	20	Brown Devil	110C/312	A1669-16
3	R8	.75Ω, 50W, special	20	.	110C/313	A14799
3	R9	200,000Ω, ±20%, ½W, ceramic	19	Y3	110C/314	A14683-39
3	R10	20,000Ω, ±20%, ½W, ceramic	19	Y3	110C/315	A14683-27
3	R11	2Ω, ±10%, 10W, vitreous	20	Brown Devil	110C/316	A1669-15
3	R12	1000Ω, 100W, tapped	20	.	110C/317	QB7348
		Section 1, 600Ω				
		Section 2, 400Ω				
4	R13, 14	1000Ω, ±10%, 100W, vitreous	20	0609	110C/318	A14737-11
3	R15	15,000Ω, 100W, 2 taps	20	.	110C/319	QB7349
		Section 1, 4500Ω				
		Section 2, 7000Ω				
		Section 3, 3500Ω				
3	R16	50Ω, ±20%, ½W, ceramic	19	.	110C/320	A14683-1
3	R17	500Ω, ±20%, 1W, ceramic	19	Y2	110C/321	A14687-7
3	R18	100Ω, ±10%, 50W, vitreous	20	.	110C/682	A14537-6
3	R20	25,000Ω, ±10%, 10W, vitreous	20	Brown Devil	110C/357	A1669-10
3	R21	15,000Ω, ±20%, ½W, ceramic	19	Y3	110C/323	A14683-26
4	R22, 30	90Ω, ±1%, .04W	21	181	110C/324	QB9424-9
4	R23, 31	1Ω, ±1%, .04W	21	181	110C/325	QB9424-8
4	R24, 25	250,000Ω, ±10%, 2W, ceramic	7	F-2	110C/326	A14228-12
3	R26	150,000Ω, ±10%, 1W, ceramic	7	F-1	110C/327	A13570-2
3	R27	50,000Ω, ±10%, 1W, ceramic	7	F-1	110C/328	A13570-1
3	R28	20Ω, ±5%, 10W, vitreous	20	Brown Devil	110C/329	A18136-2
3	R34	40Ω, ±10%, 10W	20	.	110C/330	A13945-15
3	R35	9.7Ω, ±5%, 25W	20	.	110C/331	A18137-2
		SWITCHES AND RELAYS				
1	S1	SP8T, rotary	8	H	110F/58	A14462
1	S2, 3, 4	DP8T, 3 rotary sections	1	.	110F/59	AE10787
1	S5	Double-section, 8-position	1	.	110F/45	AB11411
1	.	7 Make and 1 break	1	.	110F/60	AA14452-1
1	S8	DP5T, rotary	8	H	110F/61	A13786
2	S7	1 SPDT and 2 SPST contacts, 24V	4	243A	110F/12	A13583-1
2	S7A, 9	DPDT, 265Ω coil, 24V	16	1204	110F/13	A9487-3
		TRANSFORMERS				
2	T1	Microphone, ratio 40:1	1	.	110K/82	A14804
2	T2	Driver, pri 8000Ω, sec 6000Ω	1	.	110K/83	A14802
2	T3	Modulator, 830B's PP to single 803	1	.	110K/84	A14803
		VACUUM TUBES				
7	V1, 2	Tetrode, beam power	22	807	110E/8	.
5	V3	Pentode	22	803	110E/31	.
5	V4	Triode	22	801A	110E/26	.
7	V5, 6	Triode	22	830B	110E/27	.
5	V7	Duplex-diode	22	6H6	110E/13	.

9-1. *Continued*

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
		SOCKETS				
2	X1, 2	5-prong, ceramic	25	.	110H/98	AA12335-1
1	X3	5-prong, phenolic	1	.	110H/99	AA12887-1
3	X4, 5, 6	4-prong, ceramic	25	.	110H/100	AA12334-1
2	X7	Octal base, ceramic	25	.	110H/101	A7763
4	X8, 9, 10, 11, 12, 13, 14, 15	3-pin	26	.	110H/276	A13213

9-2. TYPE MP-10E-24 AND MP-10G POWER SUPPLY UNITS

(Recommended quantities of spare electrical parts for each lot of ten power supply units)

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No.
		CAPACITORS				
4	C1, 7	1 Mfd, 100V DCW, paper	11	VC1541-1	110C/54	A204-5
5	C2, 3, 6	.5 Mfd, ±20%, 400V DCW, paper	11	DHR-4050	110C/55	A12503-4
4	C4, 11	1 Mfd, 1500V DCW, oil filled	11	VC1069	110C/56	A12931-1
3	C5	.8-.8-3 Mfd, 400V DCW, paper	11	VC674D	110C/57	A6157-1
4	C8, 9	.01 Mfd, ±10%, 1200V DCW, mica	11	9-21010	110C/58	C55563-47
3	C10	.01 Mfd, ±10%, 1200V DCW, mica	11	4L-21010	110C/59	A13756-14
		DYNAMOTORS				
†1	.	28V, 1.9A, pri: 250V, .150A sec	.	.	.	C55629
*1	.	28V, 1.6A, pri: 230V, .100A sec	.	.	110K/13	C56728-2
6 sets	.	Rec. Dyn: Pri positive and negative brushes	.	.	.	‡
		Rec. Dyn: Sec positive and negative brushes	.	.	.	‡
1	.	26.5, 27A pri 1100V, .4A sec	.	.	110K/19	N90292
6 sets	.	Trans. Dyn: Pri positive and negative brushes	.	.	.	‡
		Trans. Dyn: Sec positive and negative brushes				
6 sets	.	Brush holders, high and low voltage	.	.	.	‡
		FUSES				
14	F1, 2	1000V, 1A	2	2104	110H/19	A8944-4
10	F3	24V, 75A	13	.	110H/262	A14201-11
10	F4	24V, 40A	2	4AG-special	110H/21	A12247-10
10	F5	24V, 10A	2	4AG-1095C	110H/22	A12247-5
100	F6	250V, 0.25A	2	4AG-special	110H/23	A12247-11
		RECEPTACLES				
1	J1	8-contact, circular	5	RF-W8-53S	110H/37	A12935
1	J2	4-contact, circular	1	.	110H/38	AB11803
		INDUCTORS				
1	L1	50T, No. 12 DCC, ¾″ OD form	1	.	110C/176	AB2889-2
1	L2, 3	375T, No. 22 DCC, ¾″ OD form	1	.	110C/177	AB2889-1
2	L4	8H, .060A, iron-core	15	21103	110C/178	A6156
1	L5	460T, No. 28 DCC, 15/16″ OD form	1	.	110C/179	AB10055-3

* Used only on MP-10G

† Used only on MP-10E-24

‡ When ordering dynamotor brushes, or other dynamotor parts, submit complete nameplate data on the particular dynamotor for which replacements are intended.

9-2. *Continued*

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		PLUGS				
1	P1	8-contact, straight, ¾″ ID	5	RF-W8-22-¾B	110H/69	A12938
1	P2	4-contact, 90°, ¾″ ID	5	RF-WE4-58-¾B	110H/70	A12937
		RELAYS				
3	S1, 2	SPST, 12V 8Ω, coil (S1 and S2 in series)	14	.	110F/4	AA14951-1
2	S3	DPST, 24V, 380Ω coil	16	1204	110F/5	A9487-2

9-3. TYPE MT-34C-24 AND MT-34D REMOTE CONTROL

(Recommended quantities of spare electrical parts for each lot of ten remote controls)

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		INDICATOR LAMP				
7	I1, 2, 3	12-16V bayonet base	3	T-3¼	105L/21	A13244
		RECEPTACLES				
1	J1	Open-circuit phone	4	223A	110H/41	A14021-1
1	J2	2-circuit	4	246A	110H/42	A3547-1
1	J3	26 contacts for ¾″ plug	5	IK-26-32S	110H/43	A13919
		PLUG				
1	P3	26-contact ¾″ ID 90°	1	IK-26-23-¾B	110H/73	A13920
		RELAY				
*2	D1	24V, 400Ω DC resistance	.	.	110F/17	C56935-2
		RESISTORS				
6	R1, 3, 4, 5	150Ω, ±5%, 10W	6	1¾Z3	110C/286	A13892-11
3	R2	1000Ω, ±10%, ½W	7	BT-½	110C/287	A11207-14
		SWITCHES				
1	S1A, 1B	DP9T, rotary, 2-section	8	.	110F/40	A13247
1	S2	SPST, toggle	8	.	110F/41	A13250
1	S3	3P3T, rotary, 1-section	8	.	110F/42	A13248
		MECHANICAL OSCILLATOR				
2	Y1	15 MW output, 1000-cycle	10	572B	110V/1	A13252
		SOCKET				
3	.	Lamp assembly, blue	30	.	110H/192	A13245-5

* Used only on MT-34D

9-4. TYPE MT-36C-24 LOADING AND COUPLING UNIT

(Recommended quantities of spare electrical parts for each list of ten antenna loading and coupling units)

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
		METER				
2	A	0-3A RF, thermocouple	23	507	110A/50	B11445
		CAPACITORS				
5	C21, 24, 25	100 Mmf, ±5%, 3000V DCW, mica	11	583-15L	110C/67	A12282-2
3	C22	.001 Mfd, ±5%, 5000V DCW, mica	11	246-6LL	110C/68	A12283-5
3	C23	.0015 Mfd, ±5%, 5000V DCW, mica	11	234-6LL	110C/69	A12283-6
3	C26	800 Mmf, ±5%, 5000V DCW, mica	11	599-6LL	110C/70	A12283-11
		RECEPTACLE				
1	J11	12 contact, circular	5	GK-12-32S	110H/44	A14458
		INDUCTORS				
3	L29 to L34	Trimmer, 70T No. 20 DCC, 11 taps, 2″ OD	1	.	110C/180	AB9291
1	L35	Antenna, 176T No. 20 SSC, 22 taps, 4″ OD	1	.	110C/181	AF9192
		MOTORS				
1	M3	24V, 1¼A, (no load)	12	BX100-55931	110K/7	C55628
6	.	Positive brush	12	.	110K/5	A30212-1
6	.	Negative brush	12	.	110K/6	A30212-2
		PLUGS				
1	P11	12-contact, straight cord	5	GK-12-21-½B	110H/74	A14460
1	P107	Self-locking, single-contact	1	.	110M/88	AE11085
		SWITCHES				
1	S10, 11	SP8T, common shaft	1	.	110F/43	AF9384
1	S12	SP8T, shaft common with S10 and S11	1	.	110F/44	AB9555
1	S13	Double-section, 8-position	1	.	110F/45	AB11411
3	S15 to S20	11-contact, rotary, shorting	21	536	110F/46	A15657
		RELAY				
2	S14	DPDT, plunger type operates from 19 to 28V	24	.	110F/9	C55501-2

10. RECOMMENDED SPARE MECHANICAL PARTS

Rec. Quantity	Symbols	Description	Mfr.	Mfr.'s Desig.	Ref. No.	Bendix No
2	.	Spun glass air filter for rear panel	1	.	110M/99	QB7828
50	.	Coil support screws; 4 14/16″ long, 6-32 x 3/8″ thread, steel	1	.	110M/251	B9180
6	.	Captive screw, 11/16″ long, 6-32 x 3/8″ thread for front cover	1	.	110M/252	B9675
2	.	Spun glass air filter for front panel	1	.	110M/100	B10048
2	.	Spur gear for motor	1	.	110M/101	B10826
2	.	Worm gear	1	.	110M/102	B10828
2	.	Worm	1	.	110M/103	B10829
2	.	Switch gears	1	.	110M/104	QB10830
2	.	Tube clamp assembly (large)	1	.	110M/105	AB11084
2	.	Tube clamp assembly (small)	1	.	110M/106	AB11442
6	.	U-shaped spring contact assembly for variable inductors	1	.	110M/107	AB11161
4	.	U-shaped spring, spring temper phosphor bronze	1	.	110M/108	B11160
2	.	Spur gear	1	.	110M/86	B11200
2	.	Intermediate gear assembly	1	.	110M/85	AB11205
12	.	Coil mounting screw; dual thread 6-32 x 5/16″ and 4-40 x 1/2″	1	.	110M/253	B11315
1	.	Four blade ventilating fan	31	.	110M/109	A13783
2	.	Ceramic bushing (support for C11, 13)	32	1173	110M/110	A18124-2
2	.	Ball bearings	33	K6A	110M/111	A14682-4
1	.	Drive unit assembly	1	.	110M/82	AL70999-2
1	.	Coupling assembly	1	.	110M/83	AB9257
1	.	Crank assembly	1	.	110M/84	AB11269
1	.	Worm block assembly (drive unit)	1	.	110M/87	AB9691
4	.	Alsimag post 3/4″ long	32	.	110M/89	A9262-13
10		Alsimag post 1 1/4″ long	32	.	110M/90	A9262-15
2		Dial (drive unit)	1	.	110M/91	B10069

11. LIST OF MANUFACTURERS

1	Bendix Radio Division of Bendix Aviation Corporation	Baltimore, Md.
2	Littelfuse Laboratories	4557 Ravenswood Ave., Chicago, Ill.
3	General Electric Corporation	Nela Park, Cleveland, Ohio
4	Western Electric Company	195 Broadway, New York, N. Y.
5	Cannon Electric Development Co.	420 West Ave., 33, Los Angeles, Calif.
6	Hardwick-Hindle, Incorporated	40 Hermon St., Newark, N. J.
7	International Resistance Co.	401 N. Broad St., Philadelphia, Pa.
8	Oak Manufacturing Co.	1260 Clybourn Ave., Chicago, Ill.
9	Cutler-Hammer, Inc.	324 N. St. Paul Ave., Milwaukee, Wis.
10	General Radio Company	30 State St., Cambridge, Mass.
11	Cornell-Dubilier Elec. Corp.	1000 Hamilton Blvd., S. Plainfield, N. J.
12	Pioneer Gen-E-Motor Corp.	466 W. Superior St., Chicago, Ill.
13	Bussman Manufacturing Co.	University at Jefferson St., St. Louis, Mo.
14	Electric Auto-Lite Co.	4900 Chrysler Bldg., New York, N. Y.
15	Continental Electric Co., Inc.	323 Ferry St., Newark, N. J.
16	Leach Relay Company	5915 Avalon Blvd., Los Angeles, Calif.
17	Allen D. Cardwell Mfg. Corp.	81 Prospect St., Brooklyn, N. Y.
18	Aerovox Corp.	New Bedford, Mass.
19	Erie Resistor Corp.	644 W. 12th St., Erie, Pa.
20	Ohmite Mfg. Co.	4835 W. Flournoy St., Chicago, Ill.
21	Shallcross Manufacturing Co.	Collingdale, Pa.
22	RCA Radiotron Division RCA Manufacturing Co.	401 Bergen St., Harrison, N. J.
23	Weston Electrical Instrument Corp.	Newark, N. J.
24	Price Brothers	Frederick, Md.
25	National Company, Inc.	Malden, Mass.
26	Cinch Manufacturing Co.	2335 W. Van Buren St., Chicago, Ill.
27	Jones, Howard B.	2300 Wabansia Ave., Chicago, Ill.
28	Kellogg Switchboard & Supply Co.	6650 S. Cicero Ave., Chicago, Ill.
29	Sangamo Electric Co.	Springfield, Ill.
30	Drake Manufacturing Co.	1713 W. Hubbard St., Chicago, Ill.
31	Torrington Manufacturing Co.	Torrington, Conn.
32	American Lava Corp.	Chattanooga, Tenn.
33	Fafnir Bearing Co.	New Britain, Conn.

ADDENDA

MODEL TA-2J AIRCRAFT TRANSMITTING EQUIPMENT FOR 12.5V OPERATION

The Model TA-2J Aircraft Transmitting Equipment is identical with the Model TA-2J-24 Aircraft Transmitting Equipment except that the former is designed for a 12/14-volt power source. The primary power requirements are 12.5 volts DC at 72 amperes for CW operation, and 12.5 volts at 78 amperes for telephone and MCW at 100% modulation.

High frequency crystals on the Type TA-2J are provided with heaters for frequency stability.

The Model TA-2J has the following changes in the parts list:

TYPE TA-2J TRANSMITTER UNIT

NOT USED

C25, R34, and R35

SUBSTITUTE ITEMS

Symbol	*Function*	*Description*	*Bendix No.*
M1	Freq. selector motor	12V, 2.5A	C55502
M2	Fan motor	12V, .5A	B10271
R8	Filament dropping resistor	.135 to .152 special	AE11102
R18	Bias resistor	75Ω, 50W	A14537-5
S7	Antenna transfer relay	12V, coil	A13583
S7A	Mic. press-to-talk relay	12V, coil	A9487-1
S9	Keying relay	Same as S7A	.

TYPE MP-10E POWER SUPPLY

SUBSTITUTE ITEMS

.	Receiver dynamotor	14V primary	QE12336
.	Transmitter dynamotor	11.5 primary	N90260
F3	Pri. input fuse	125A, 12V	A14201-13
F5	LV dynamotor pri. fuse	20A, 25V	A12247-7

TYPE MT-34C REMOTE CONTROL UNIT

NOT USED

R3, R4, and R5

SUBSTITUTE ITEM

R1	Hummer primary resistor	60Ω, 10W	A13892-9

TYPE MT-36C ANTENNA COUPLING AND LOADING UNIT

SUBSTITUTE ITEMS

M3	Frequency selector motor	12V, 2.5A	C55502
S14	Antenna transfer relay	12V solenoid	C55501

See Figure A for connections of filament circuits.

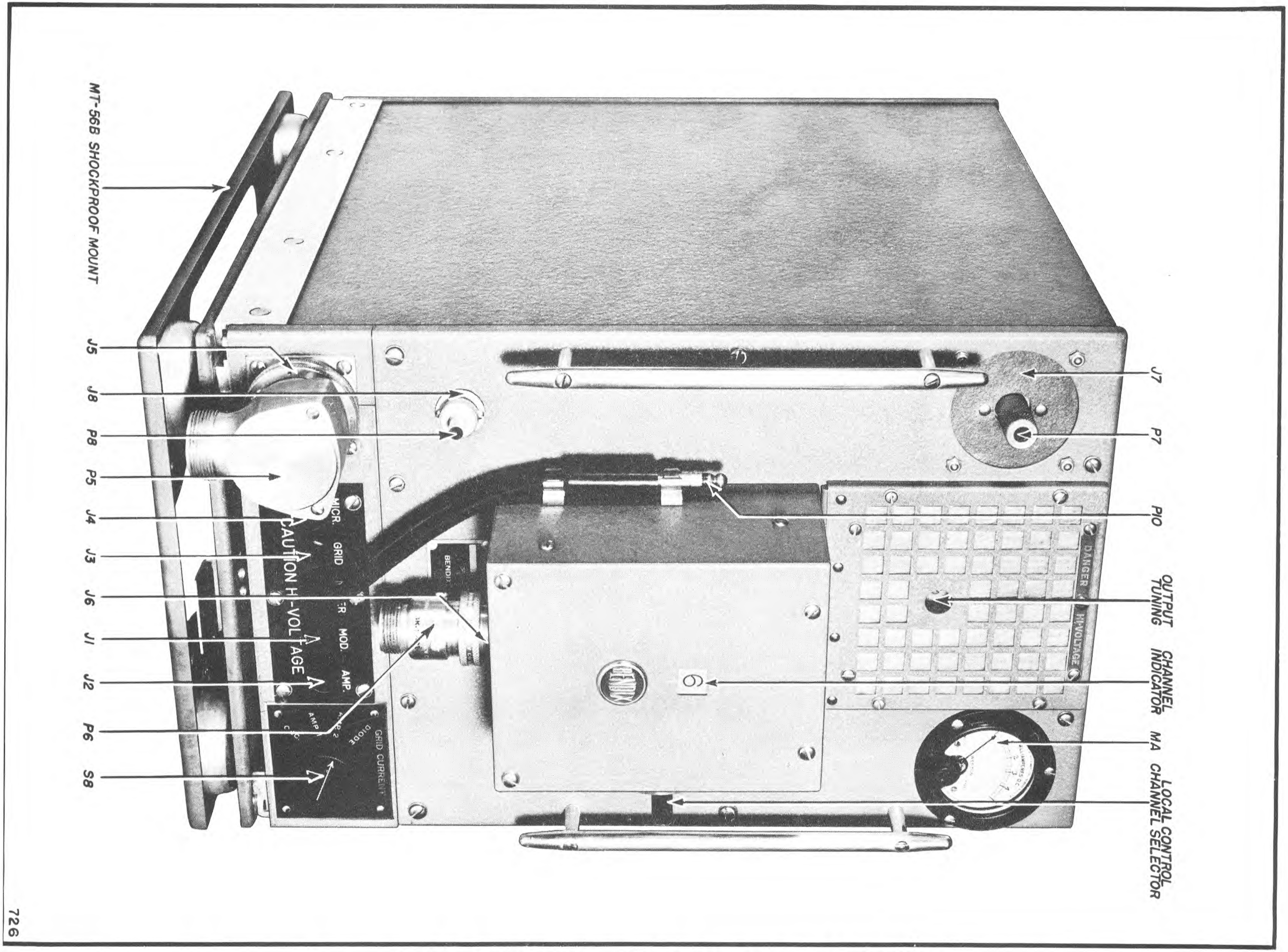


FIG. 1—FRONT OBLIQUE VIEW TRANSMITTER UNIT

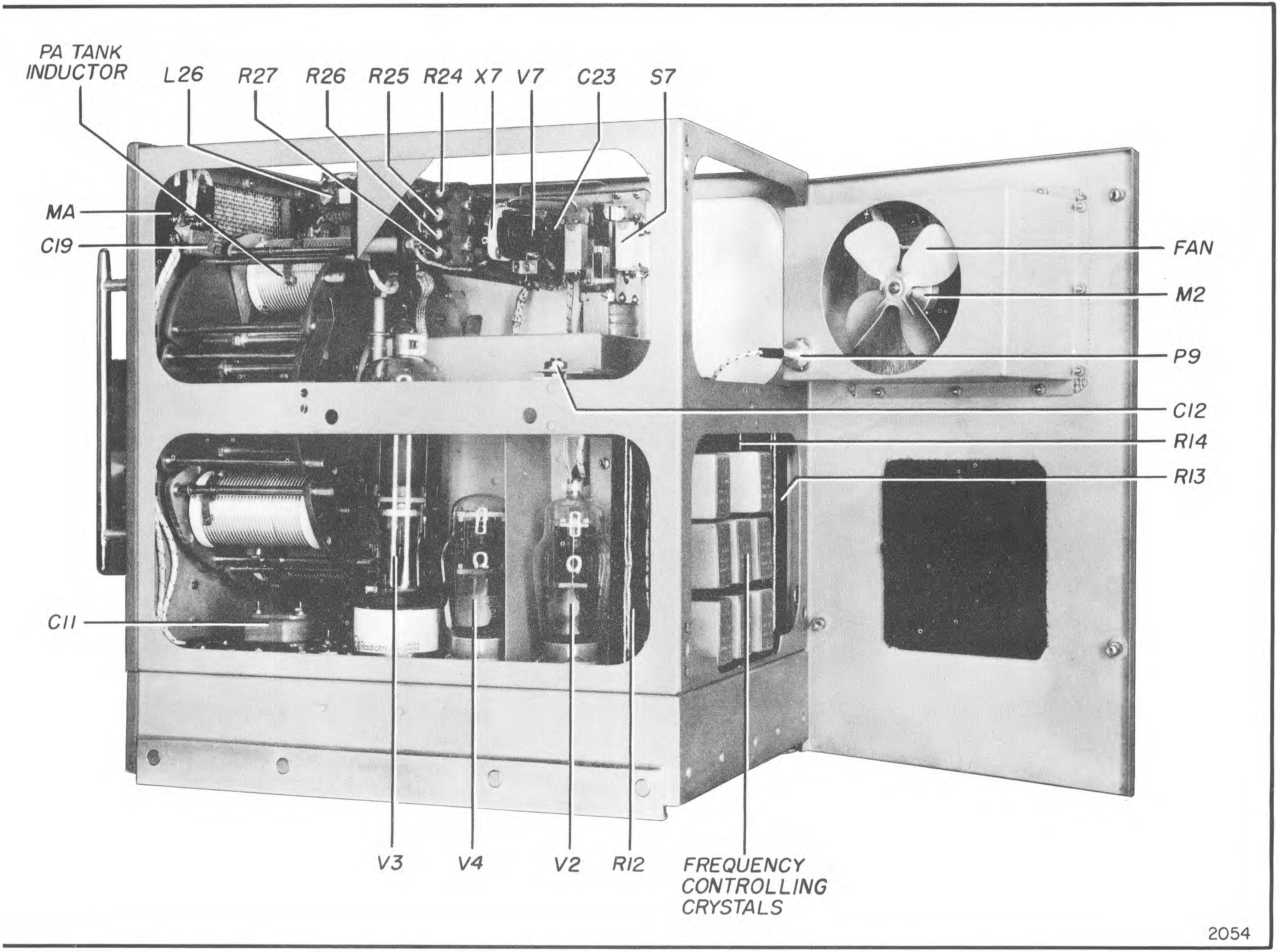


FIG. 2—LEFT REAR VIEW TRANSMITTER UNIT

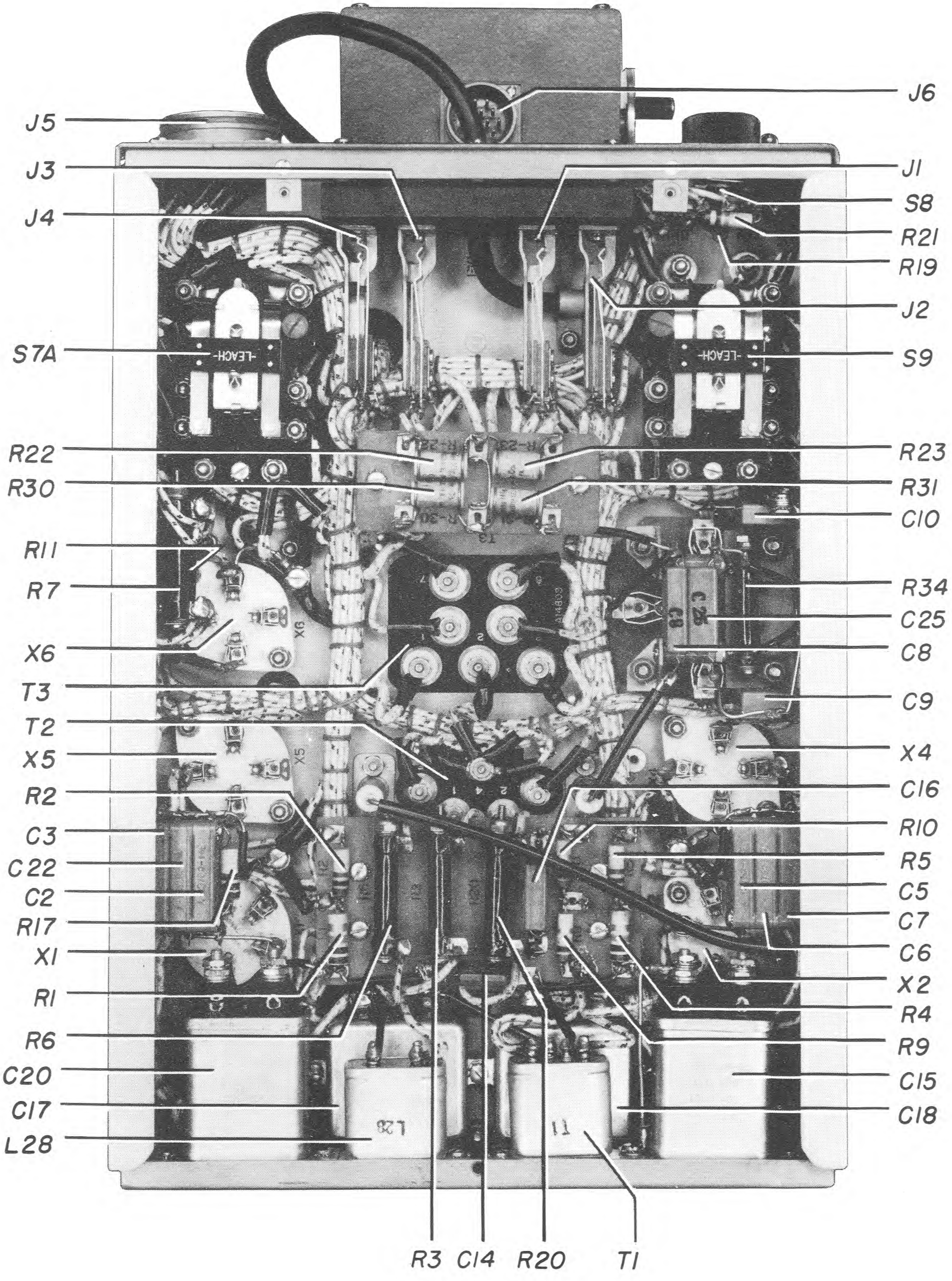


FIG. 3—BOTTOM VIEW TRANSMITTER UNIT

2055

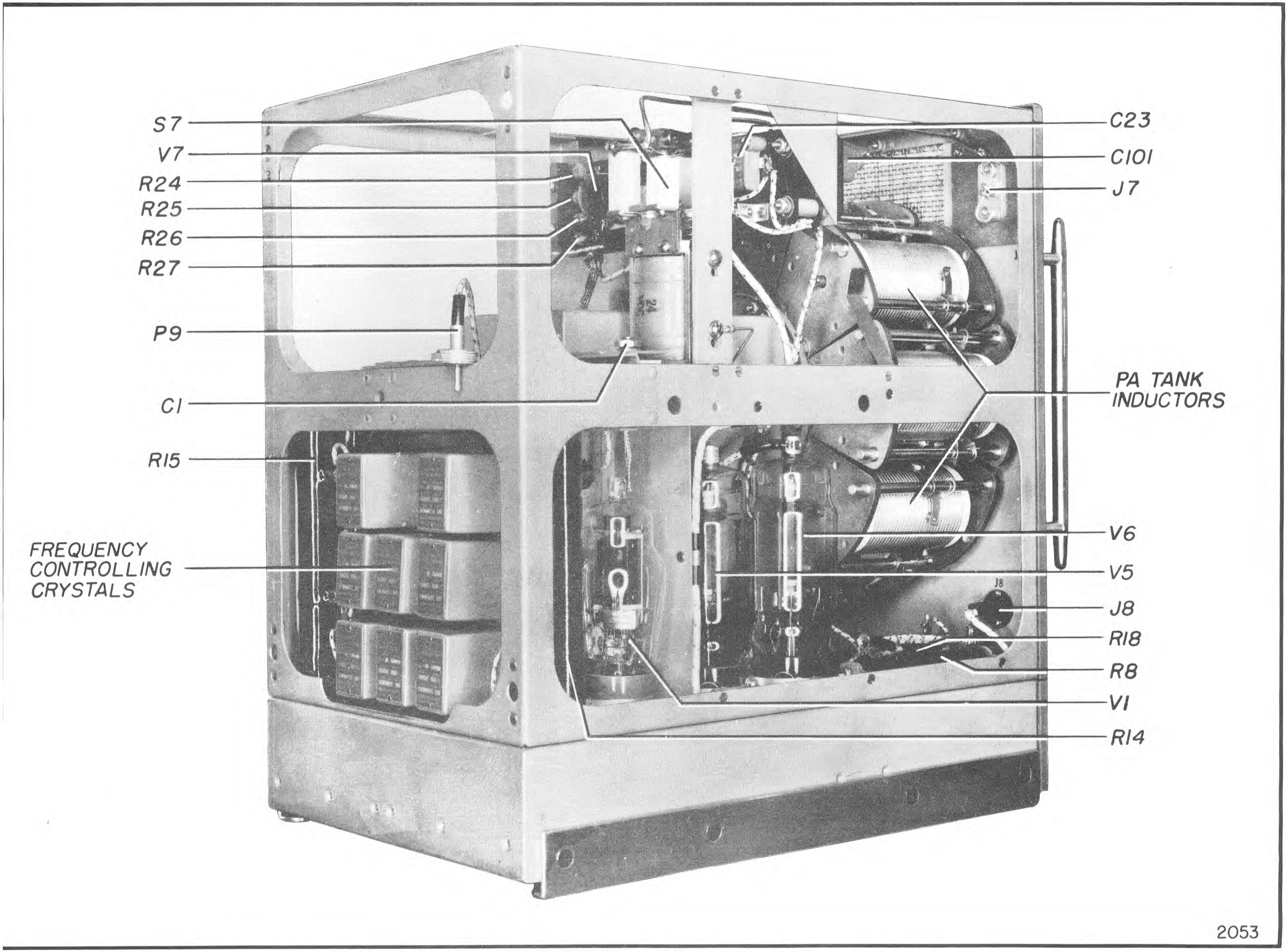


FIG. 4—RIGHT REAR VIEW TRANSMITTER UNIT

2064

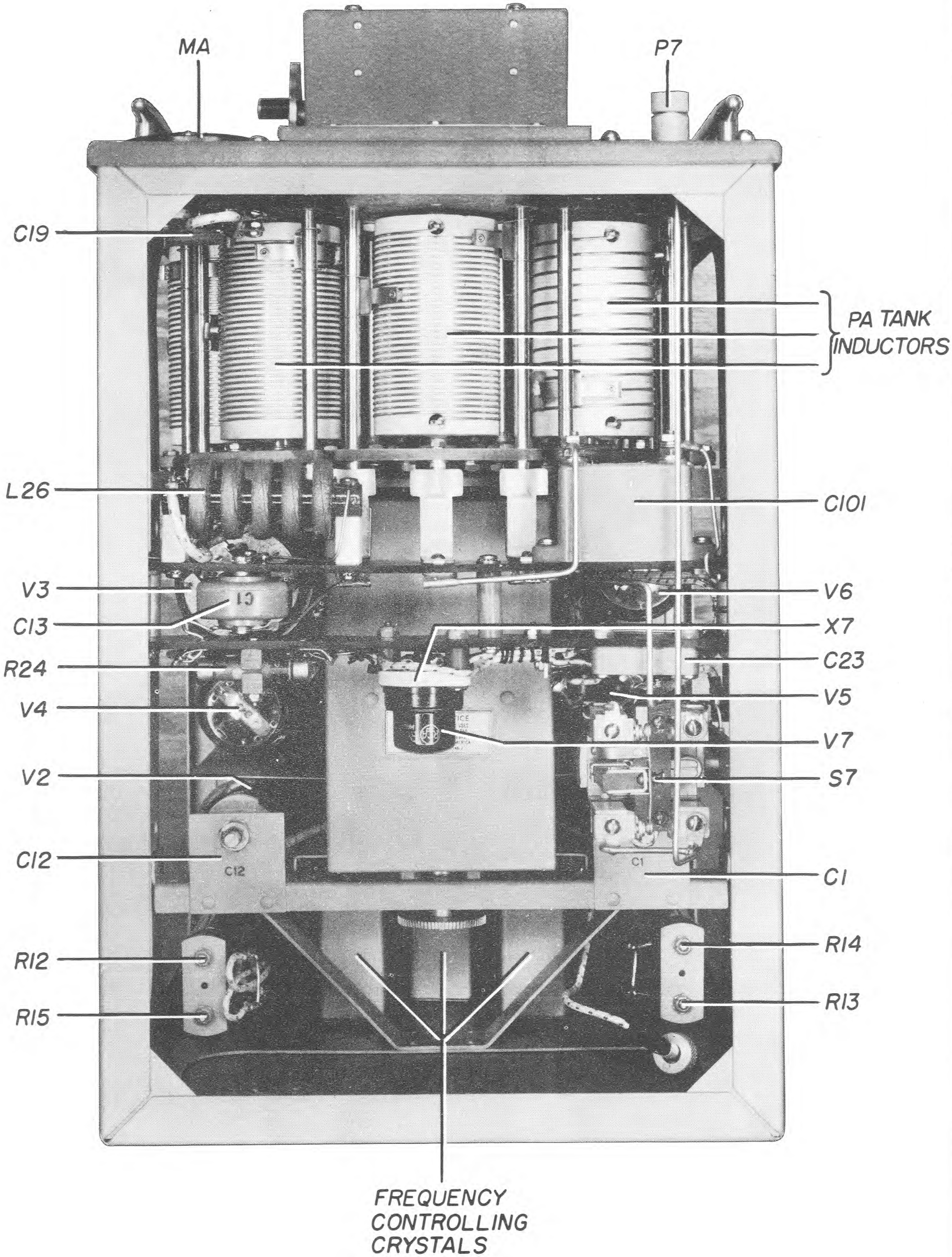


FIG. 5—TOP VIEW TRANSMITTER UNIT

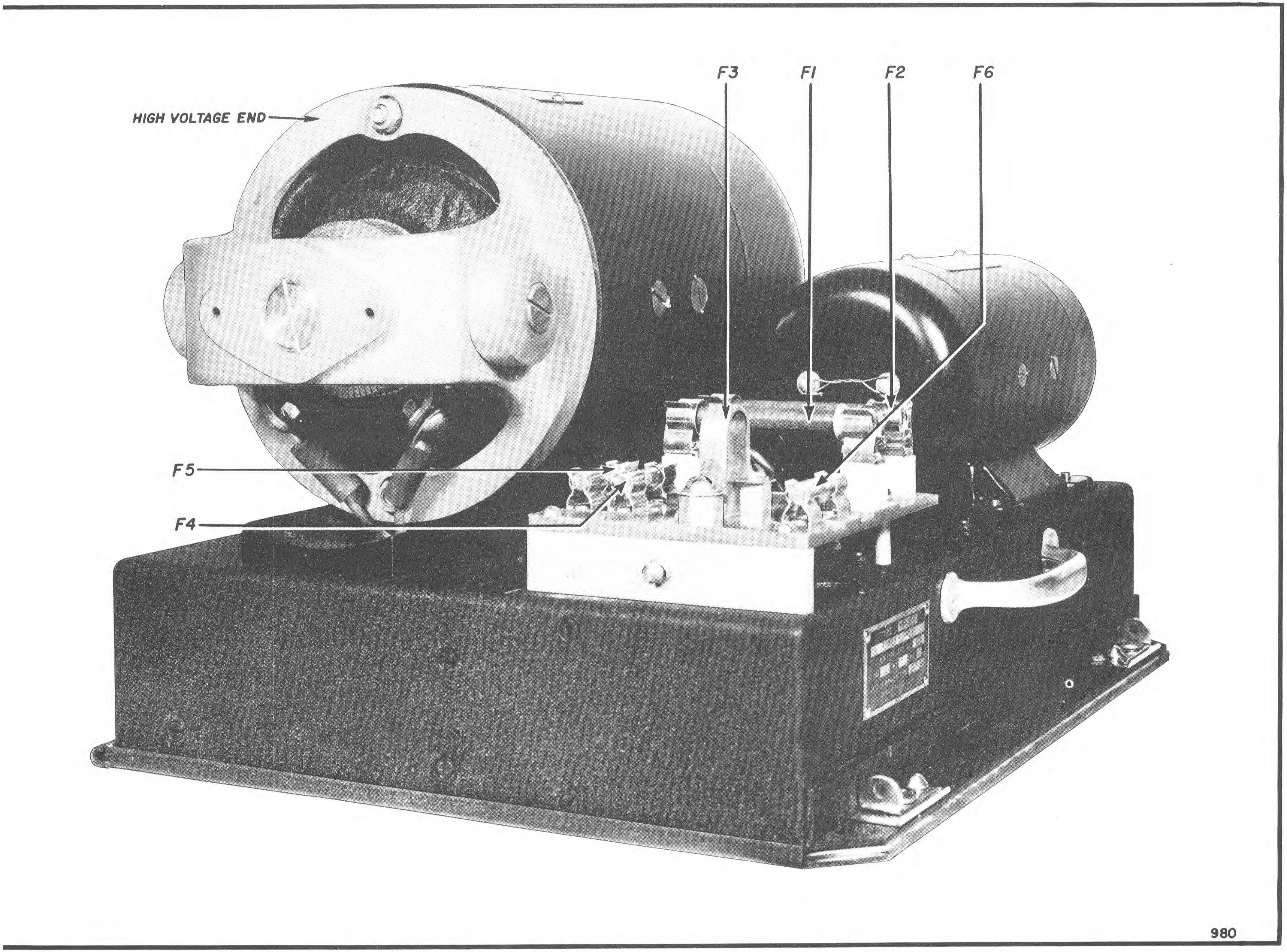


FIG. 6—FRONT OBLIQUE VIEW POWER SUPPLY

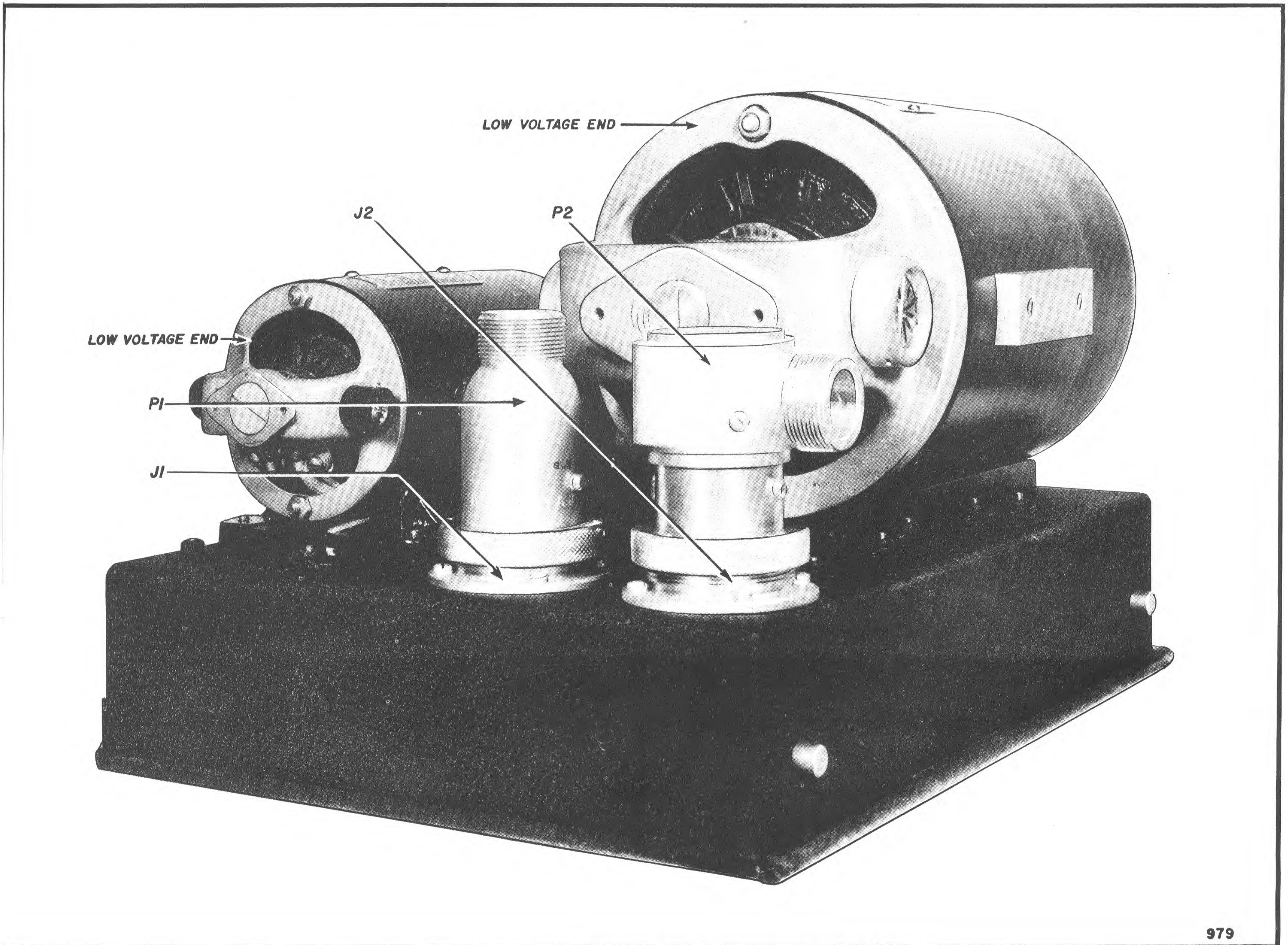


FIG. 7—REAR OBLIQUE VIEW POWER SUPPLY

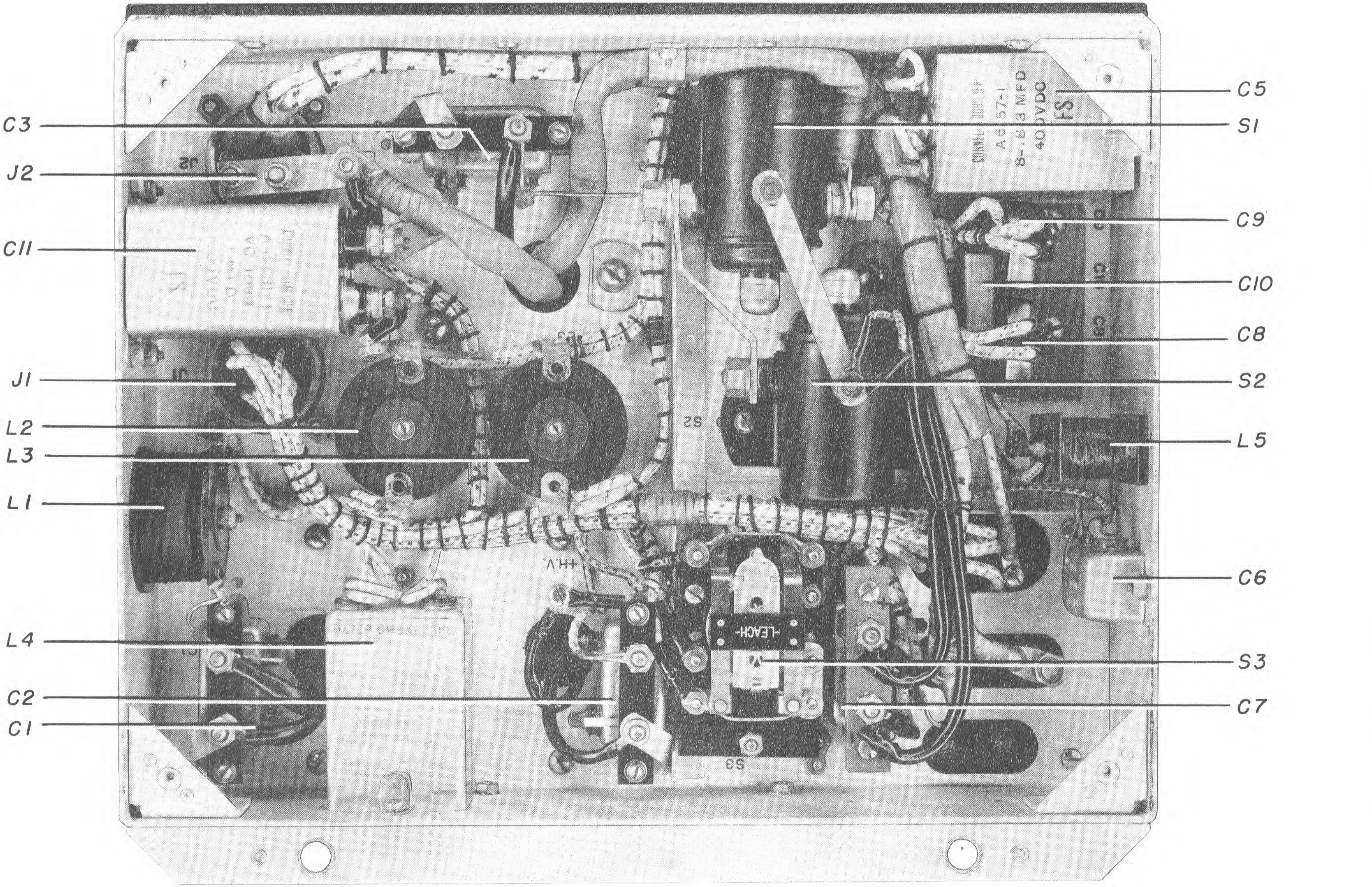


FIG. 8—BOTTOM VIEW POWER SUPPLY

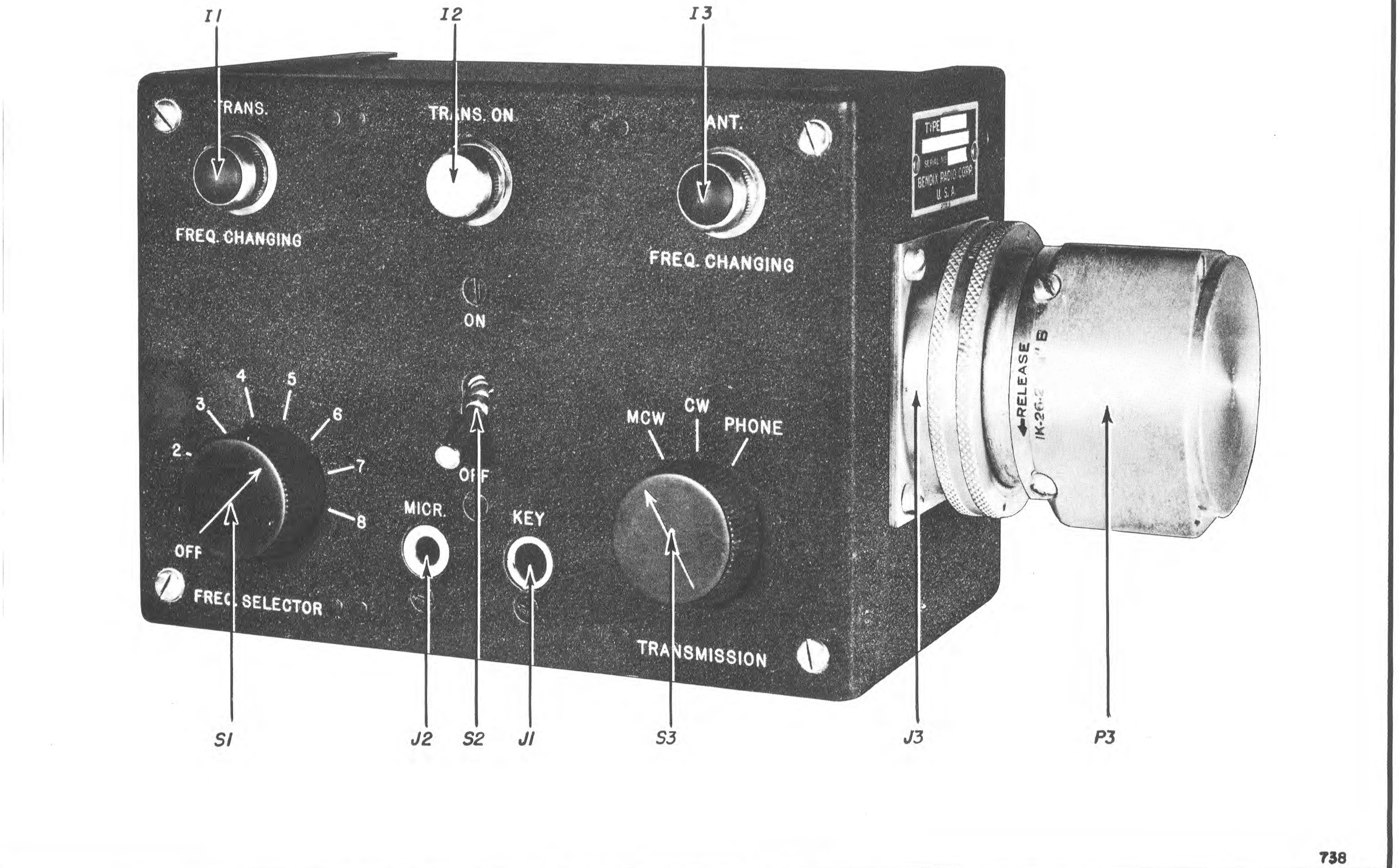


FIG. 9—FRONT OBLIQUE VIEW REMOTE CONTROL UNIT

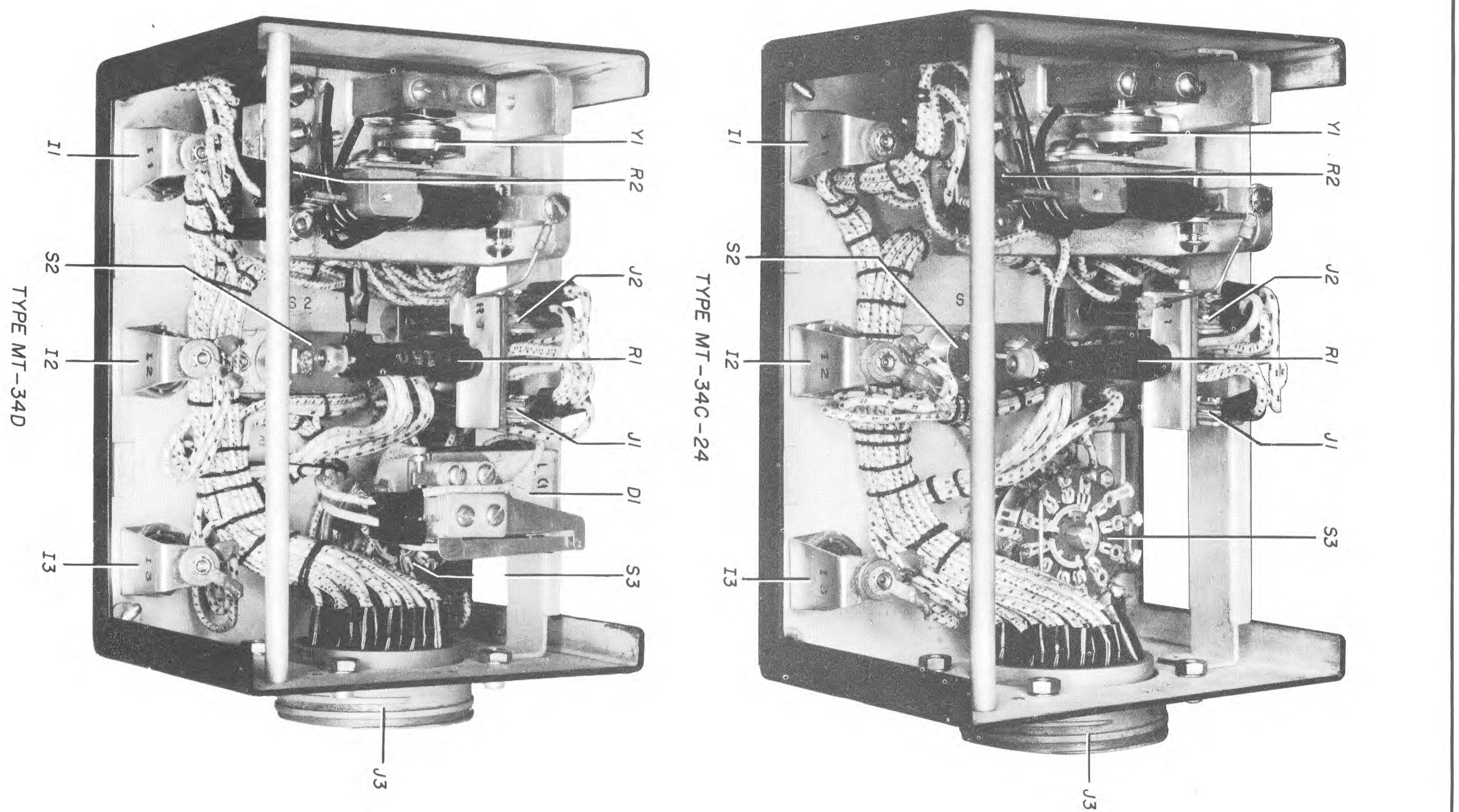


FIG. 10—INTERIOR VIEWS REMOTE CONTROL UNITS

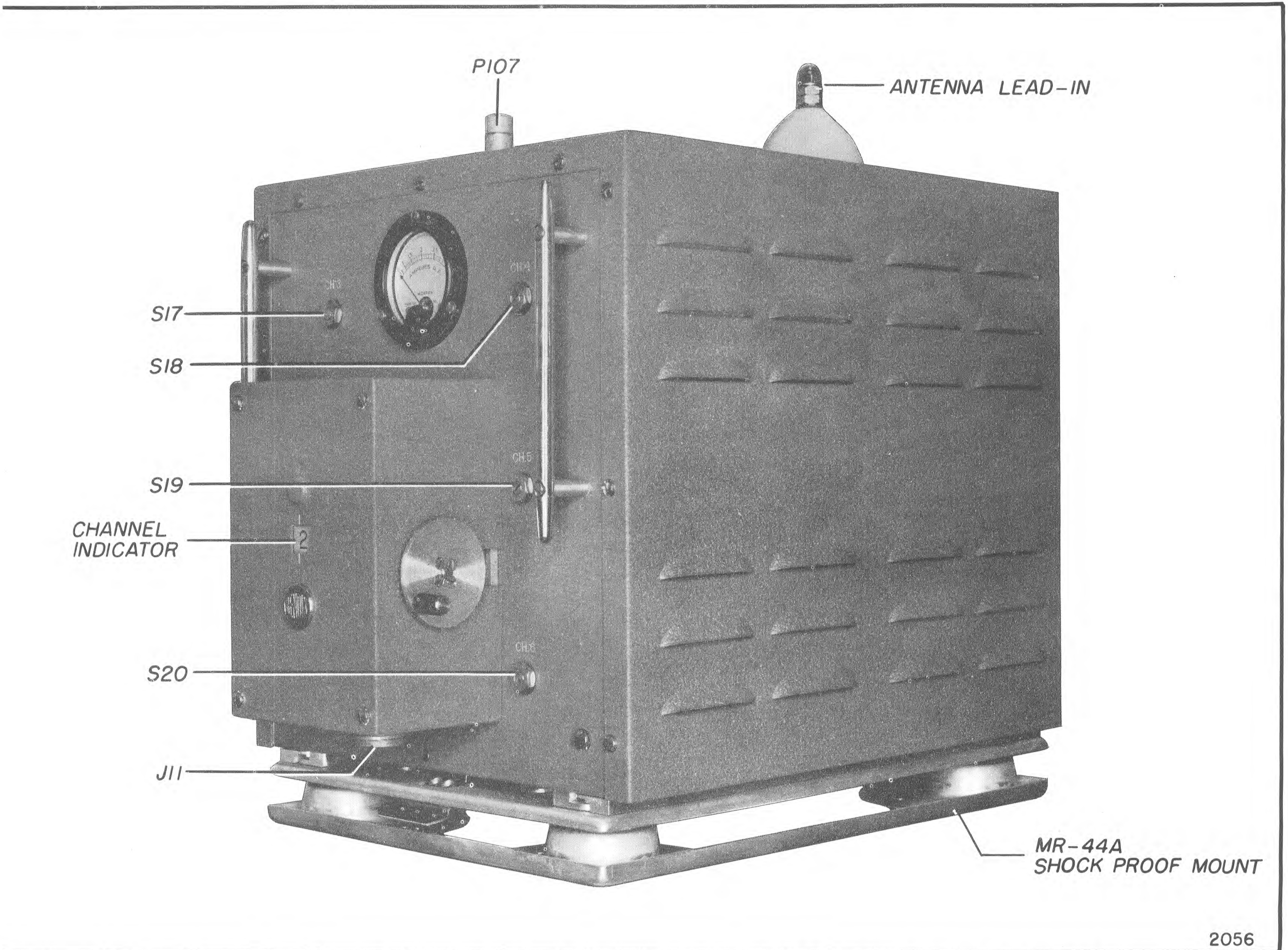


FIG. 11—FRONT OBLIQUE VIEW ANTENNA LOADING AND COUPLING UNIT

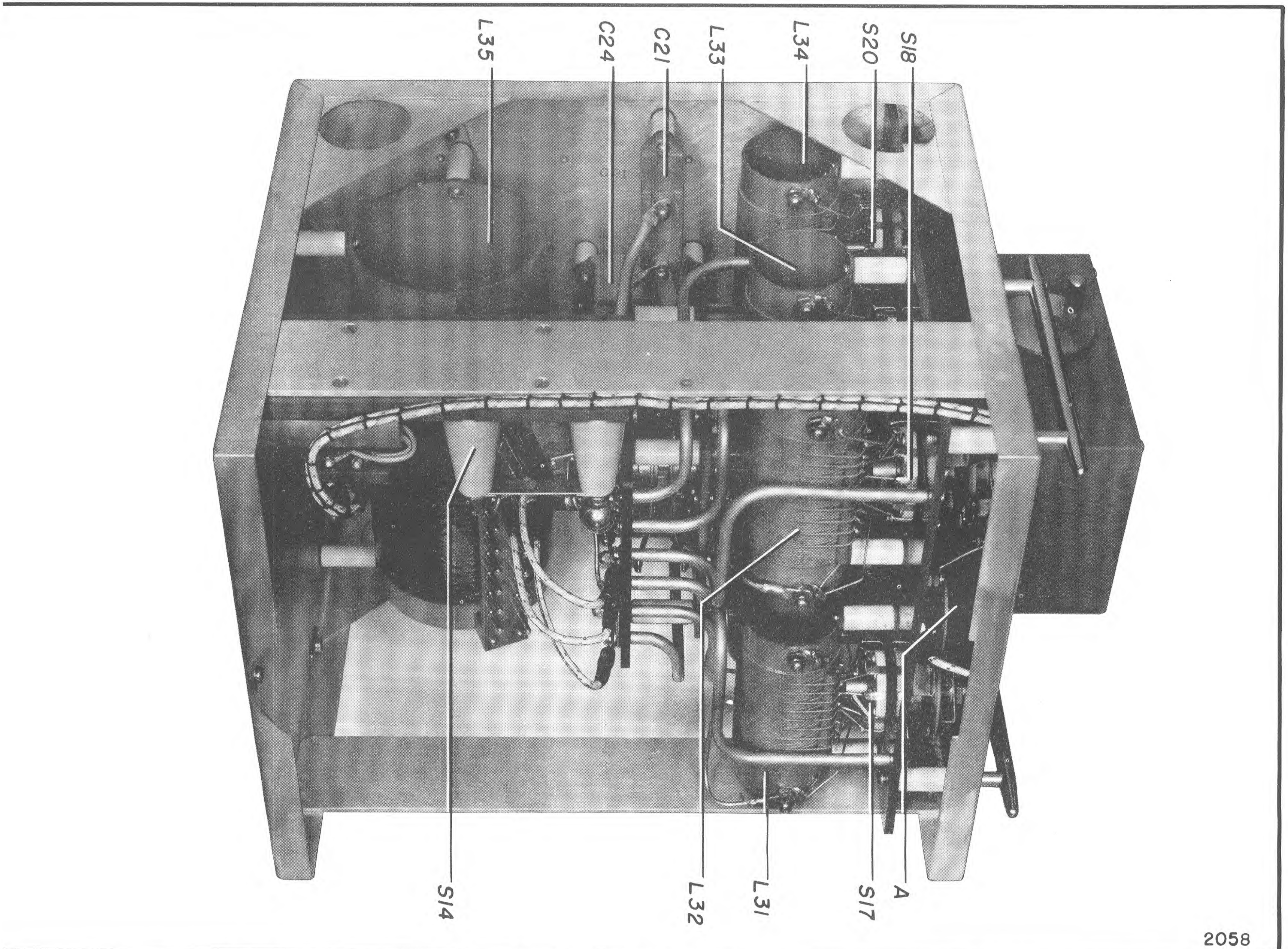


FIG. 12—LEFT VIEW ANTENNA LOADING AND COUPLING UNIT

2057

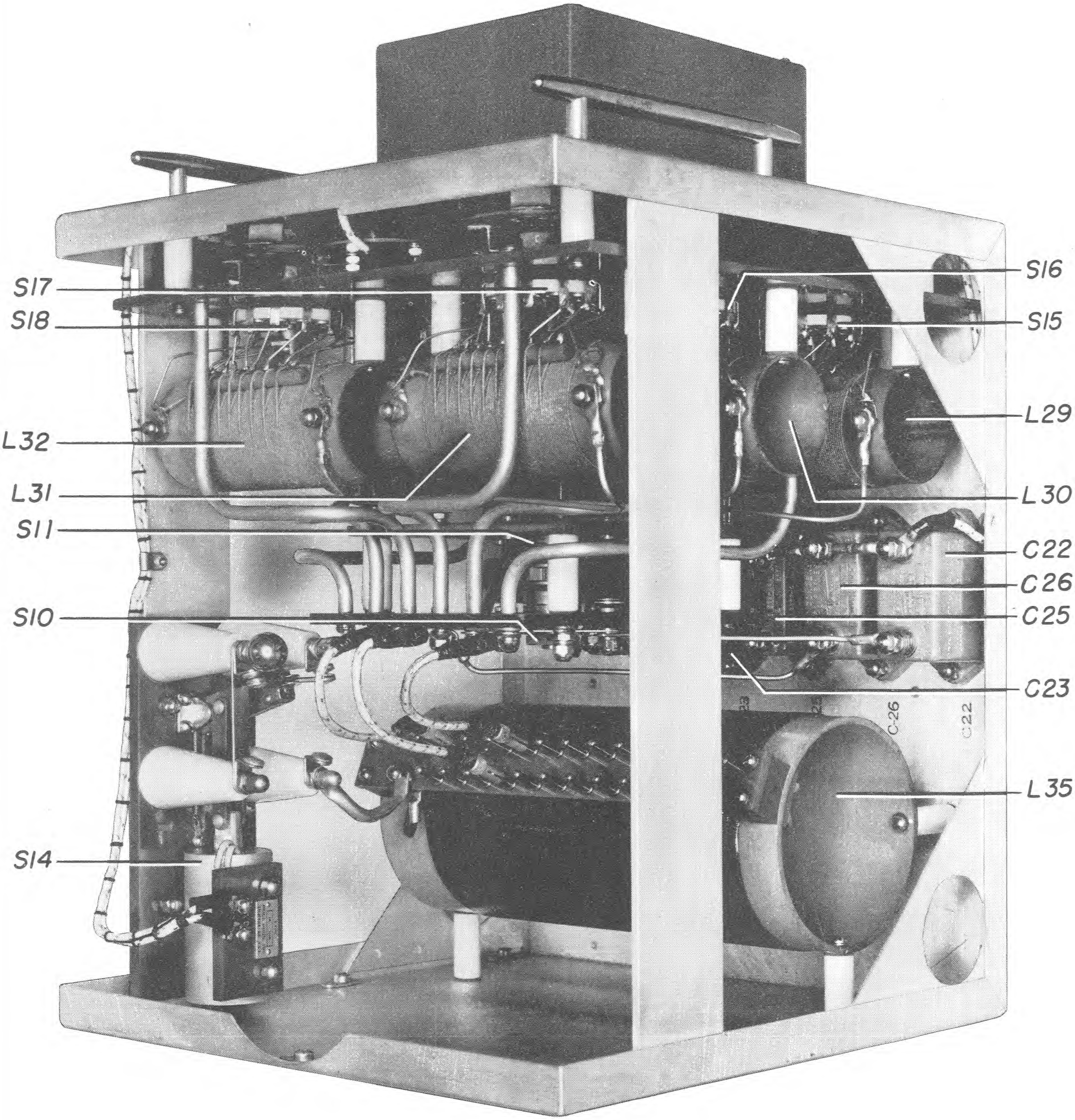


FIG 13—RIGHT VIEW ANTENNA LOADING AND COUPLING UNIT

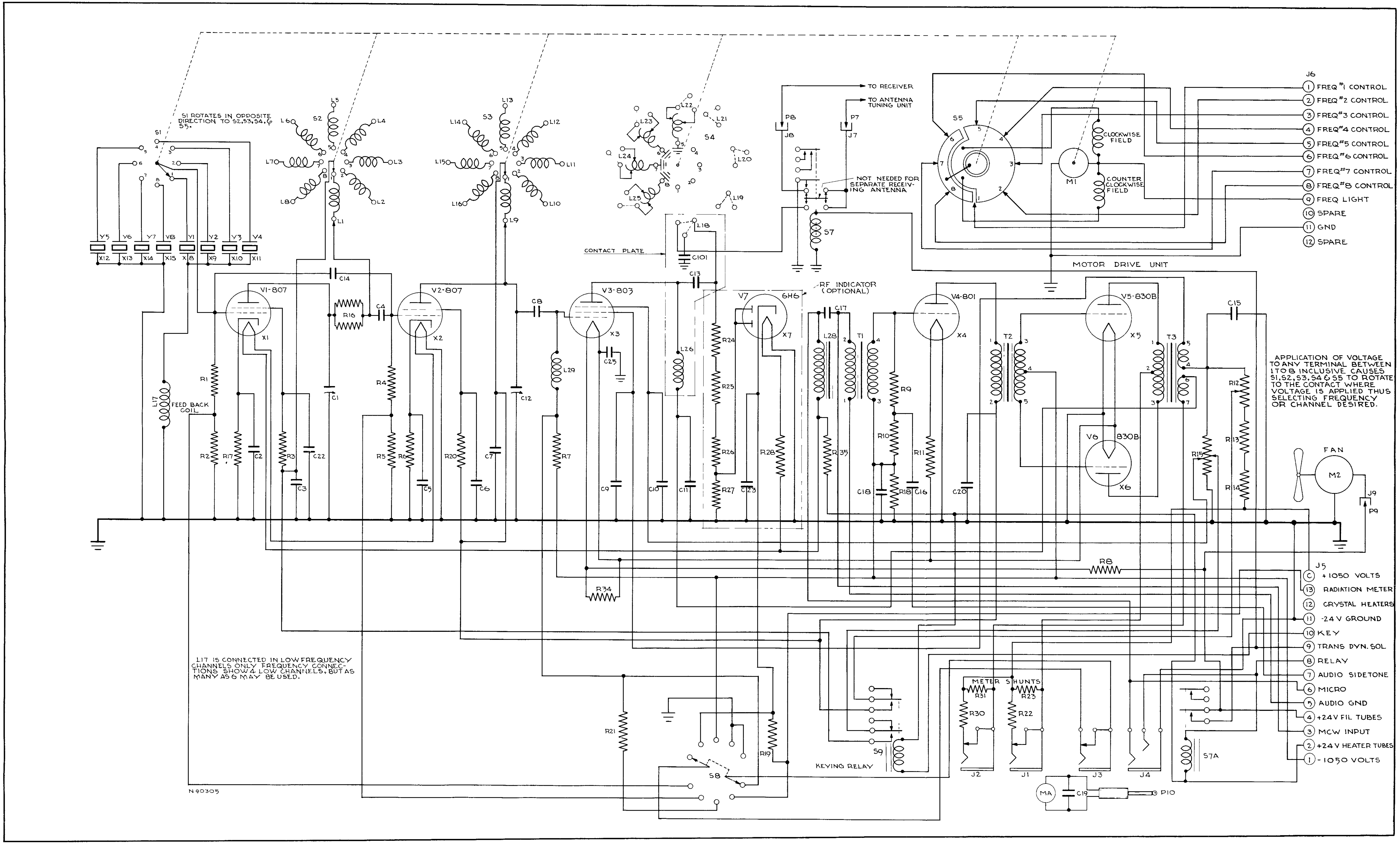


FIG. 14—SCHEMATIC DIAGRAM TRANSMITTER UNIT

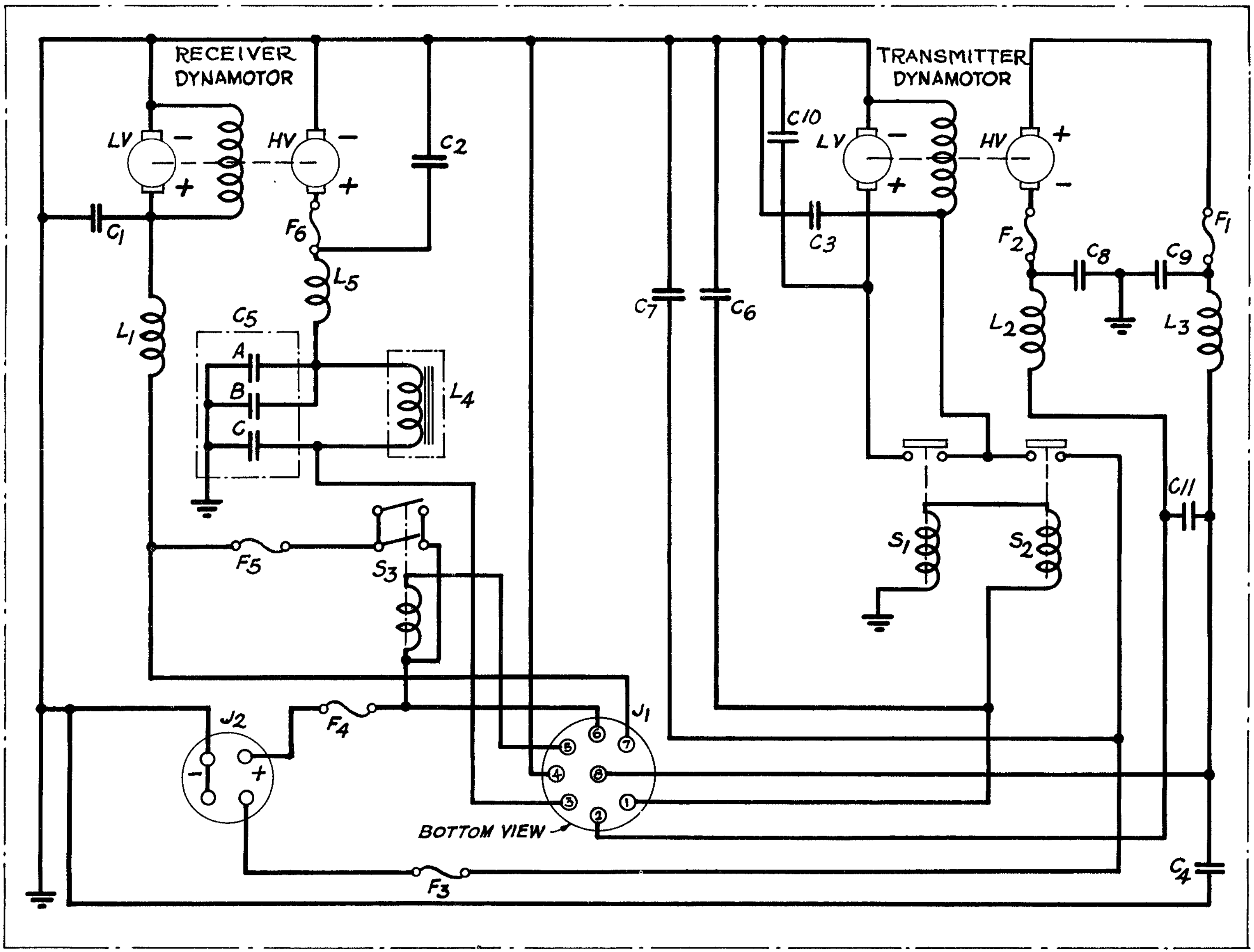
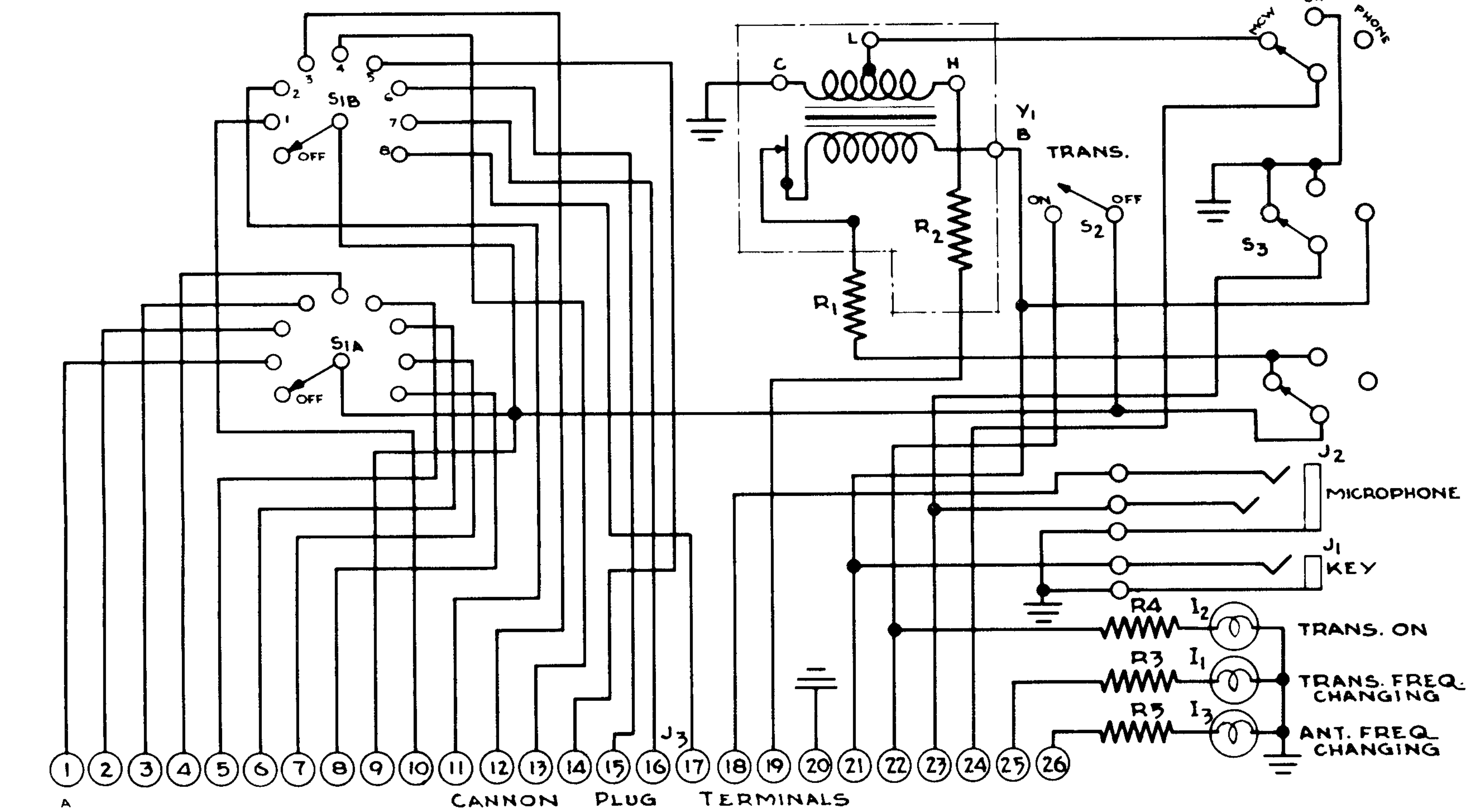
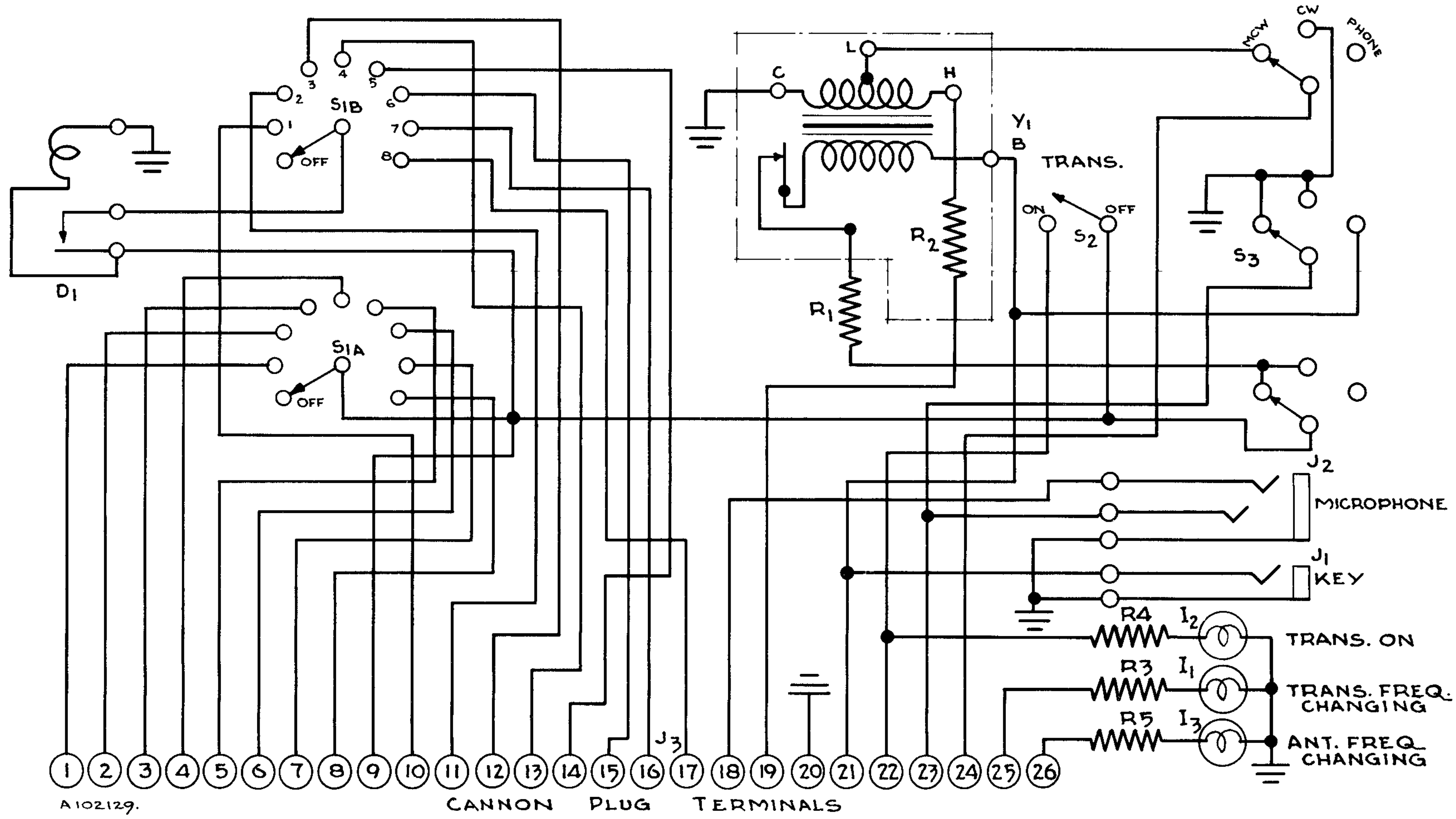


FIG. 15—SCHEMATIC DIAGRAM POWER SUPPLY



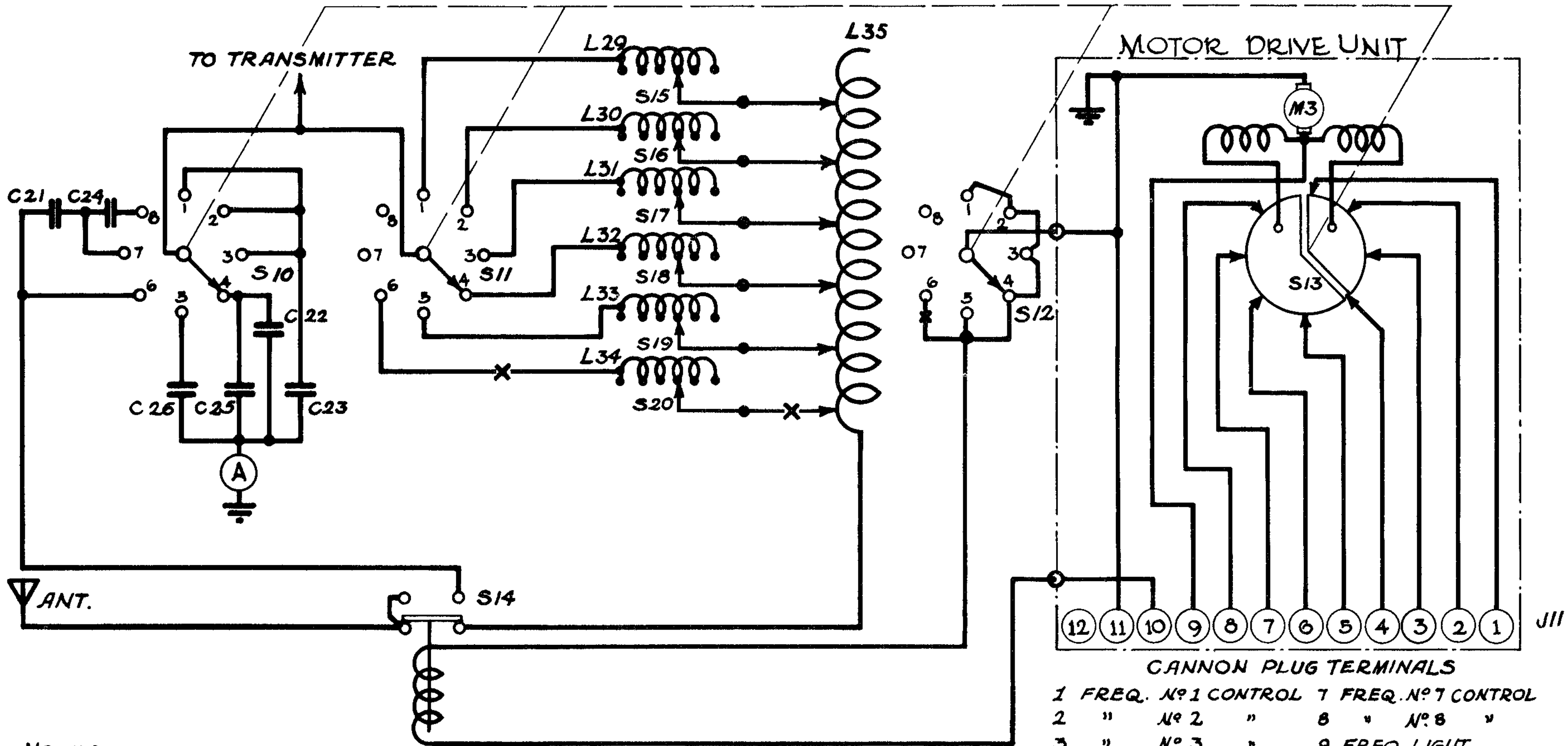
TYPE MT-34C-24



TYPE MT-34D

FIG. 16—SCHEMATIC DIAGRAMS REMOTE CONTROL UNITS

TYPICAL CIRCUIT DIAGRAM



CANNON PLUG TERMINALS

1	FREQ.	№ 1	CONTROL	7	FREQ. № 7	CONTROL
2	"	№ 2	"	8	" № 8	"
3	"	№ 3	"	9	FREQ. LIGHT	
4	"	№ 4	"	10	ANT. RELAY	
5	"	№ 5	"	11	GROUND	
6	"	№ 6	"	12	SPARE	

NOTE:
X = LEAD LEFT OPEN FOR HIGH FREQ. OPERATION ON THIS CHANNEL.
C 21 & 24 MAY BE CONNECTED IN SERIES WITH ANY HIGH FREQ. CHANNEL
CHANNEL 6, 7 & 8 ARE SHOWN FOR 2900 TO 15000 KCS. OPERATION
C22, C23, C25, C26 MAY BE CONNECTED IN SEVERAL COMBINATIONS ON AS MANY AS SIX OF THE FIRST SIX CHANNELS. THE ABOVE COMBINATION WILL ALLOW 300 TO 340 KC. OPERATION ON CHANNELS 1 TO 3 INC. 340 KCS. TO 425 KCS., ON CHANNEL NO. 4, 425 KCS TO 525 KCS. ON CHANNEL NO. 5.

FIG. 17—SCHEMATIC DIAGRAM ANTENNA COUPLING UNIT

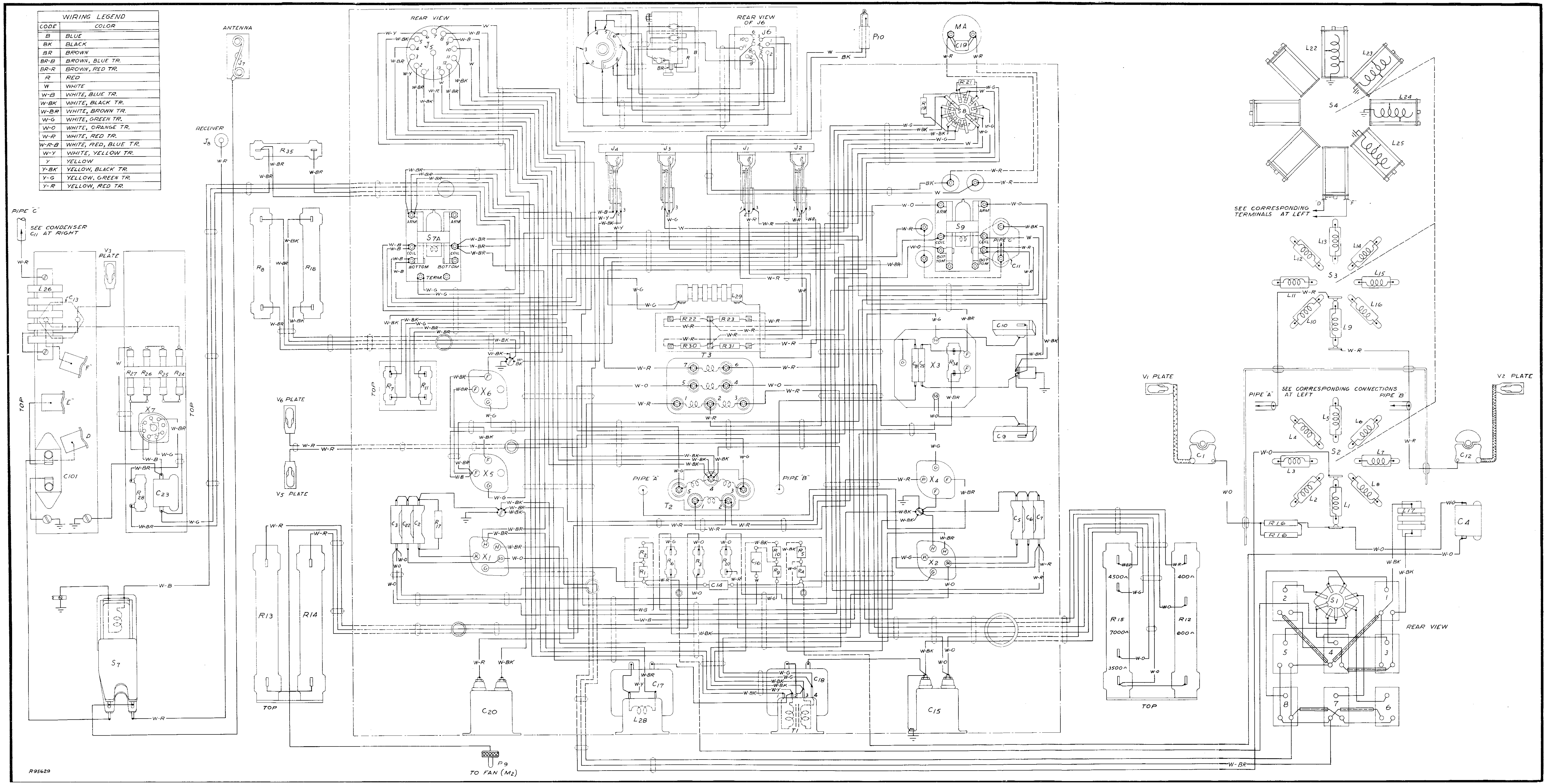
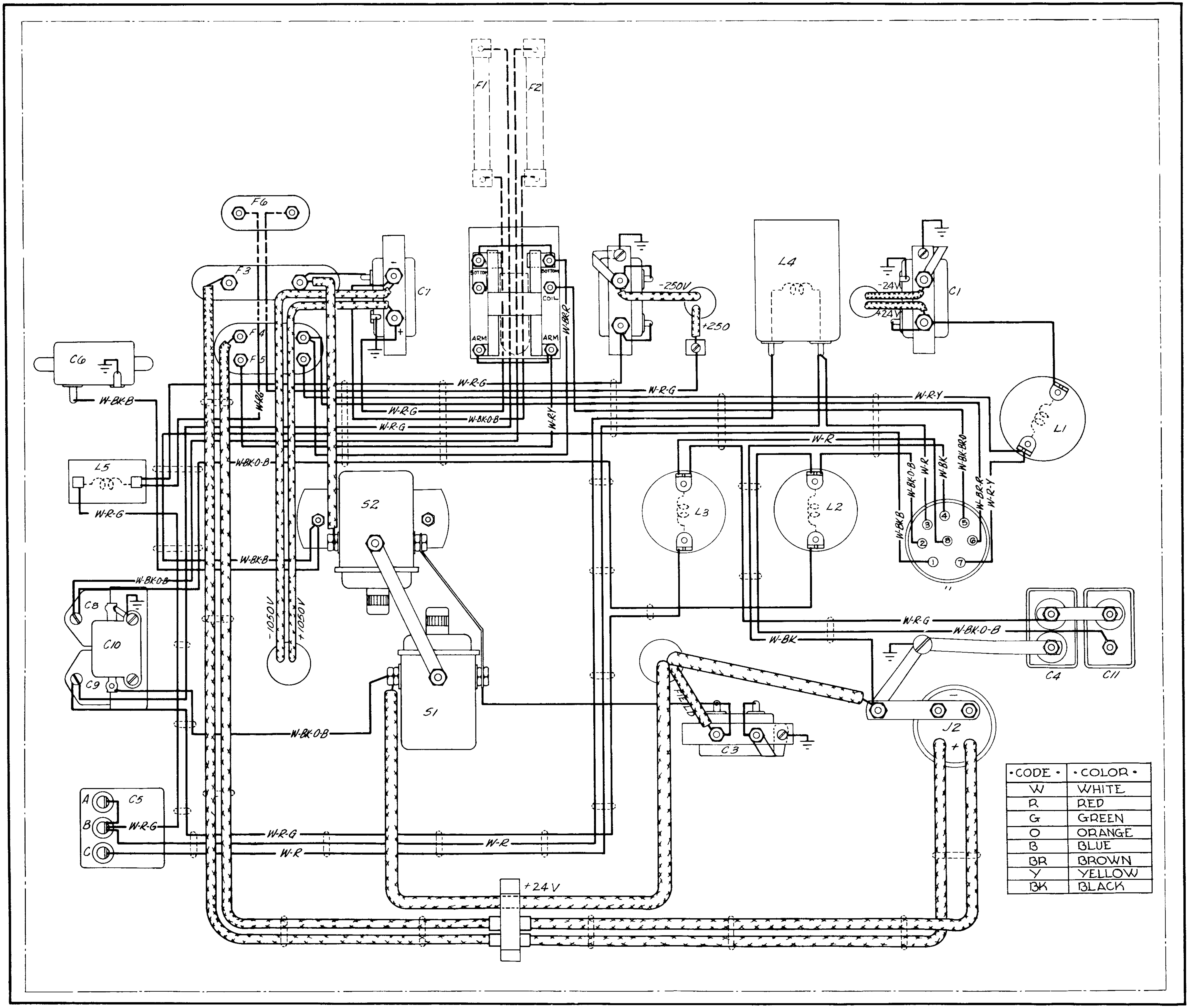


FIG. 18—WIRING DIAGRAM TRANSMITTER UNIT



•CODE•	•COLOR•
W	WHITE
R	RED
G	GREEN
O	ORANGE
B	BLUE
BR	BROWN
Y	YELLOW
BK	BLACK

FIG. 19—WIRING DIAGRAM POWER SUPPLY

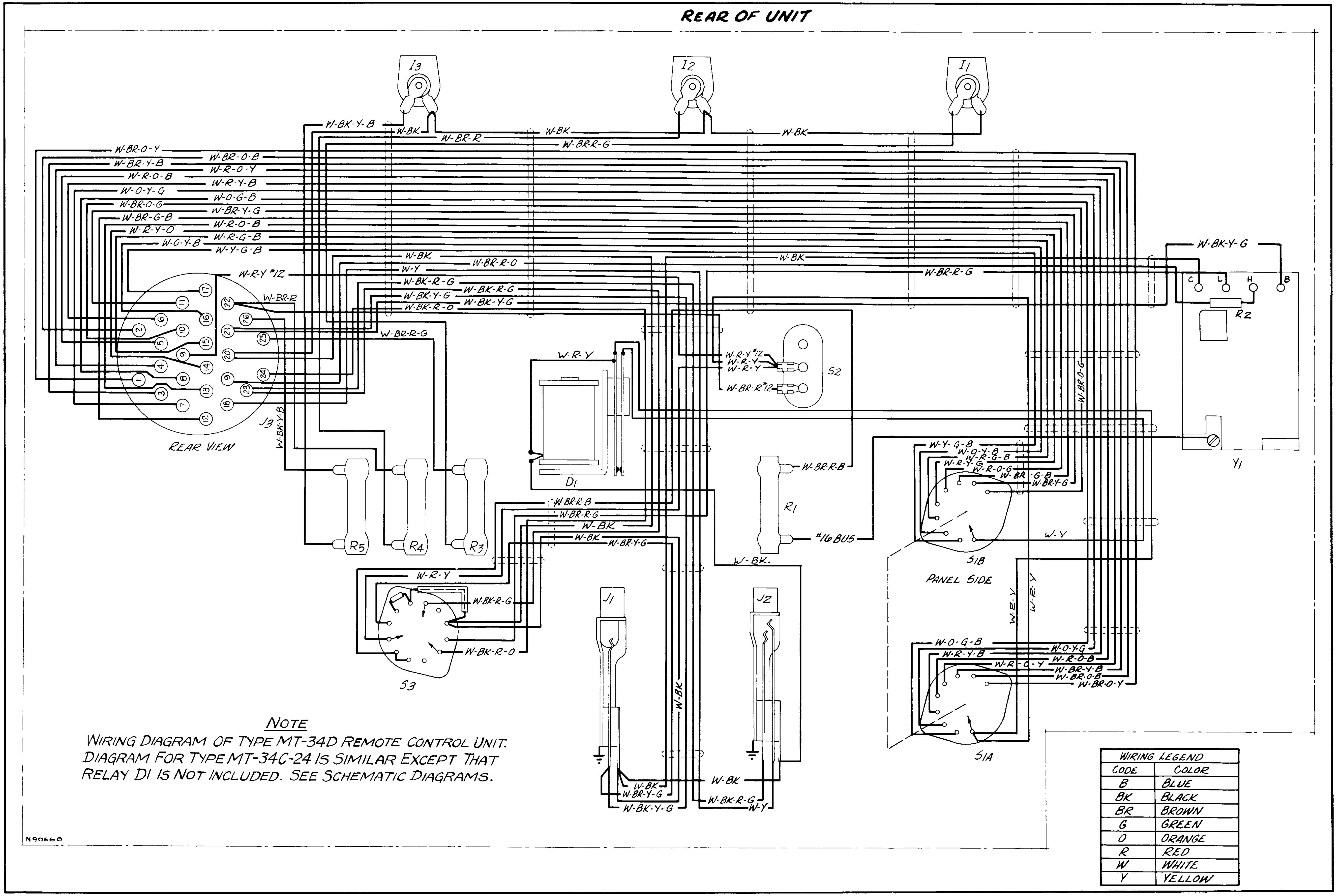


FIG. 20—WIRING DIAGRAM REMOTE CONTROL UNIT

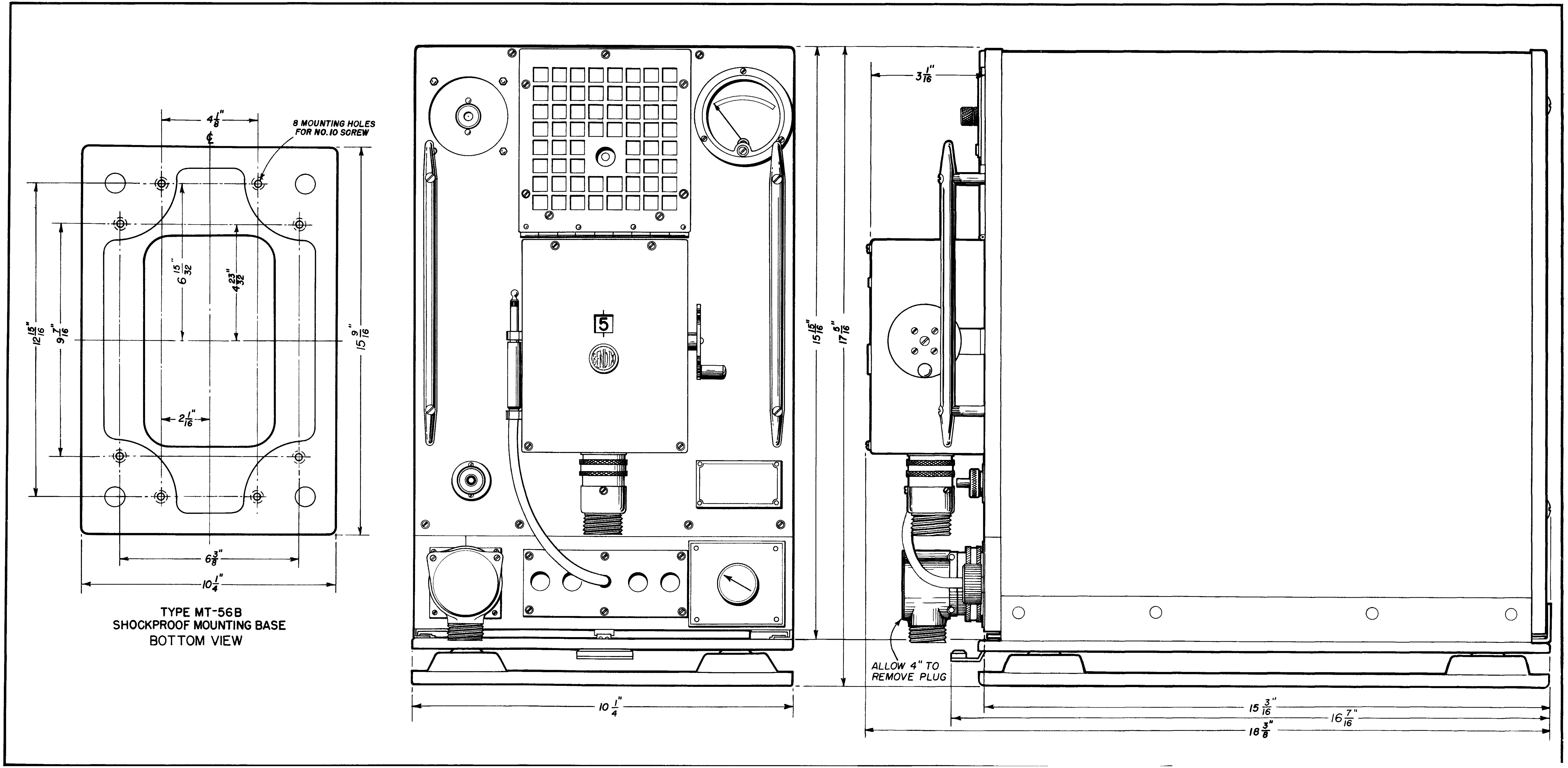


FIG. 21—OUTLINE AND MOUNTING DETAILS TRANSMITTER UNIT

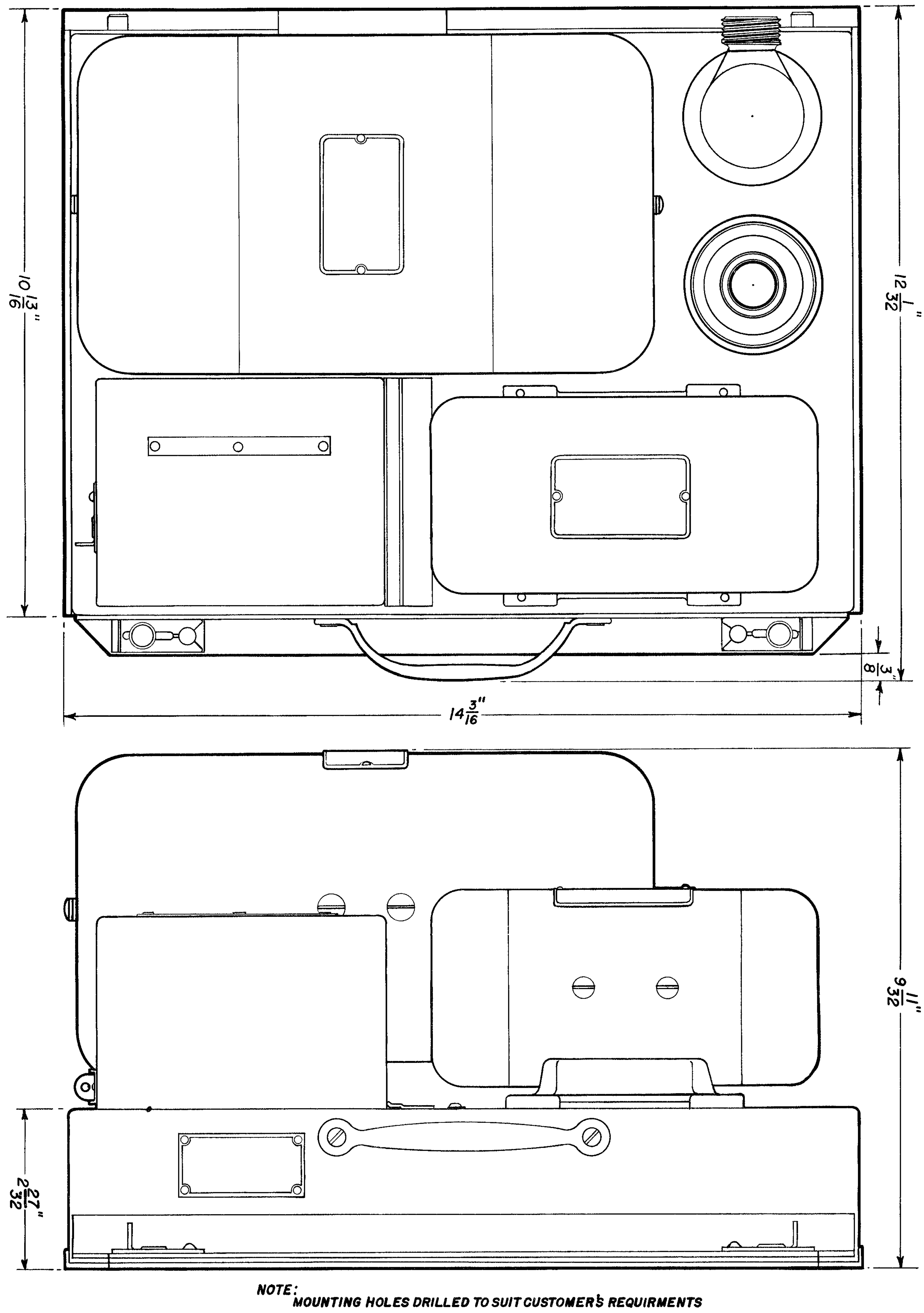


FIG. 22—OUTLINE AND MOUNTING DETAILS POWER SUPPLY

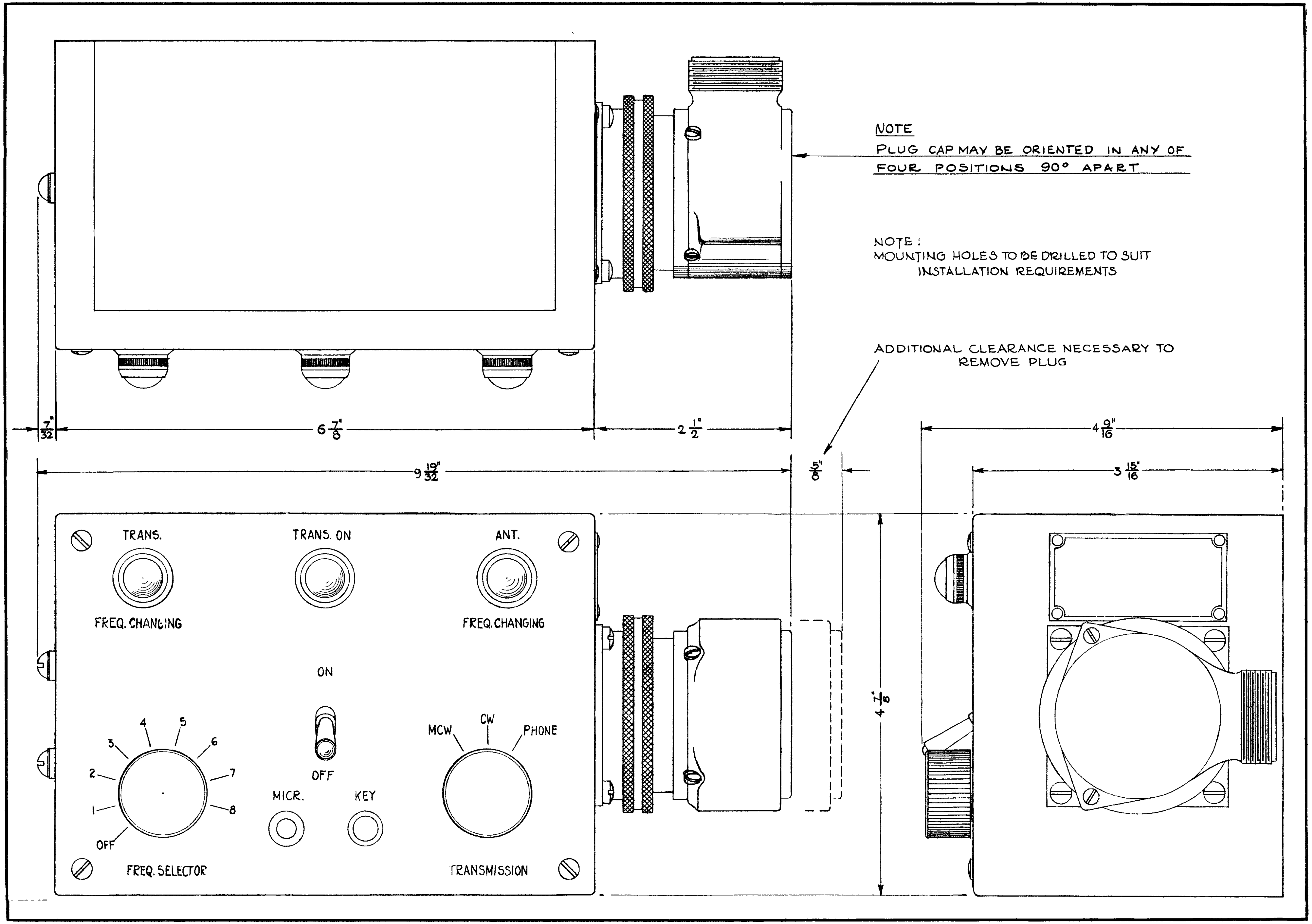


FIG. 23—OUTLINE AND MOUNTING DETAILS REMOTE CONTROL UNIT

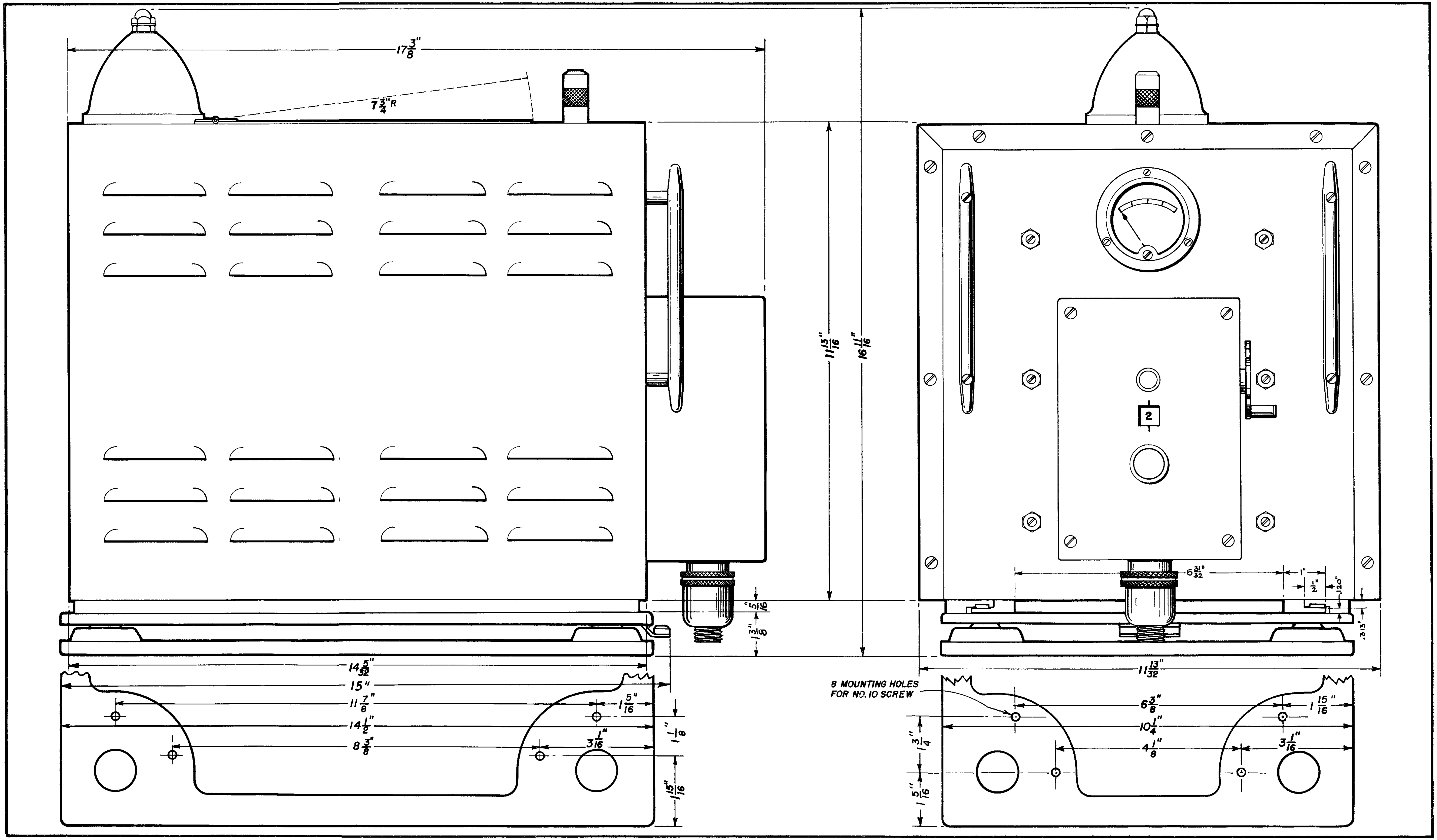
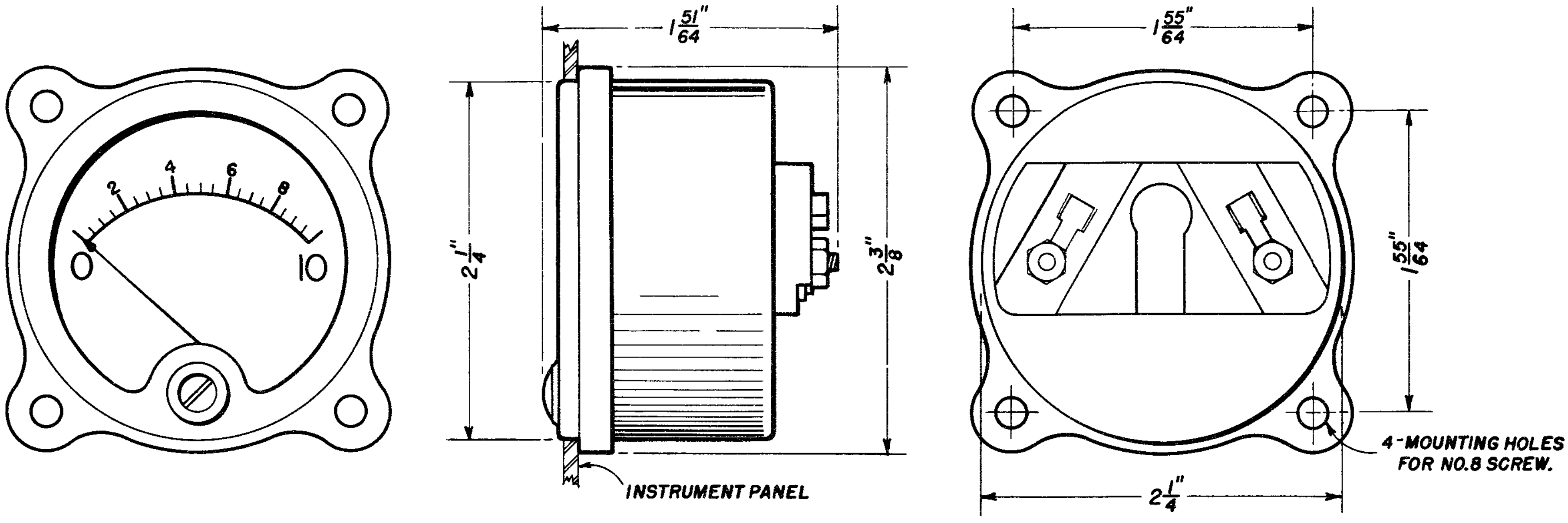
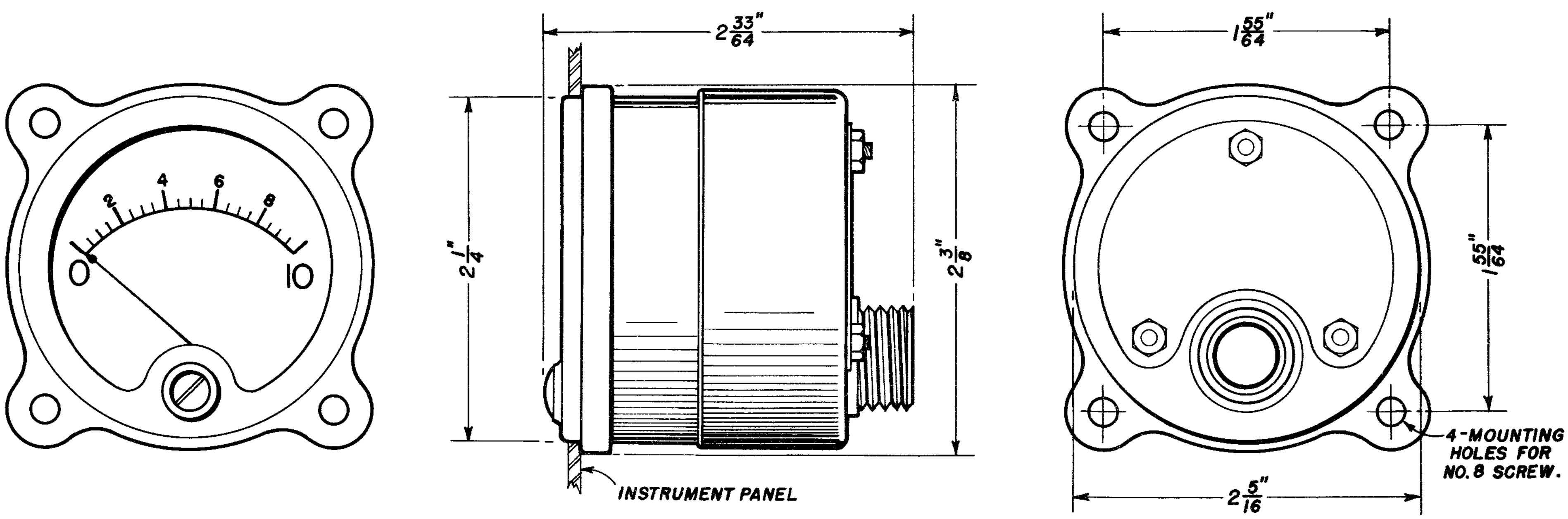


FIG. 24—OUTLINE AND MOUNTING DETAILS ANTENNA COUPLING UNIT



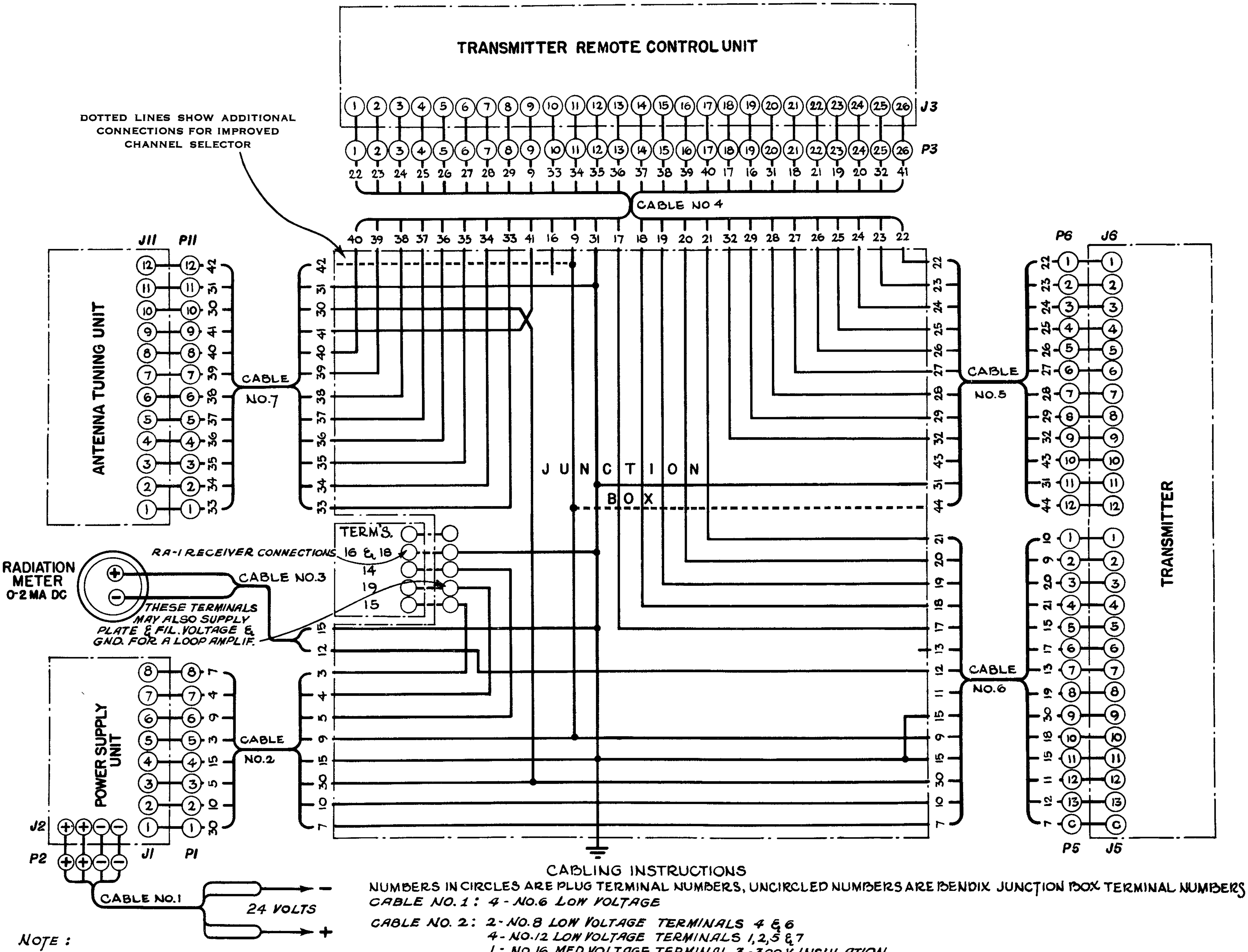
(A)
MODEL 606 METER WITHOUT STATIC SHIELD
(TYPE 92)



(B)
MODEL 606 METER WITH STATIC SHIELD
(TYPE 92)

136-36

FIG. 25—OUTLINE AND MOUNTING DETAILS RADIATION METERS



CABLING INSTRUCTIONS

NUMBERS IN CIRCLES ARE PLUG TERMINAL NUMBERS, UNCIRCLED NUMBERS ARE BENDIX JUNCTION BOX TERMINAL NUMBERS

CABLE NO. 1:	4 - NO.6 LOW VOLTAGE	
CABLE NO. 2:	2 - NO.8 LOW VOLTAGE	TERMINALS 4 & 6
	4 - NO.12 LOW VOLTAGE	TERMINALS 1, 2, 5 & 7
	1 - NO.16 MED. VOLTAGE	TERMINAL 3 - 300 V. INSULATION
	1 - NO.16 HIGH VOLTAGE	TERMINAL 8 - 1200V. INSULATION
CABLE NO. 3:	2 - NO.16 LOW VOLTAGE	
CABLE NO. 4:	2 - NO. 8 LOW VOLTAGE	TERMINALS 9 & 22
	24 - NO.16 LOW VOLTAGE	TERMINALS 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,23,24,25 & 26.
CABLE NO. 5:	12 - NO.16 LOW VOLTAGE	TERMINALS 1,2,3,4,5,6,7,8,9,10,11,12.
CABLE NO. 6:	2 - NO. 8 LOW VOLTAGE	TERMINALS 4 & 11
	2 - NO. 12 LOW VOLTAGE	TERMINALS 2 & 9
	9 - NO. 16 LOW VOLTAGE	TERMINALS 1,3,5,6,7,8,10,12 & 13
	1 - NO.16 HIGH VOLTAGE	TERMINAL C - 1200 V INSULATION
CABLE NO. 7	12 - NO.16 LOW VOLTAGE	TERMINALS 1,2,3,4,5,6,7,8,9,10,11,12.

NOTE:

BENDIX JUNCTION BOX TERMS. 6 & 8 LEFT BLANK FOR HIGH VOLTAGE INSULATION.

NOS. REFERRED TO IN CABLING INSTRUCTIONS ARE PLUG NOS., NOT JUNCTION BOX NOS.

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FIG. 26—TYPICAL INSTALLATION WIRING DIAGRAM

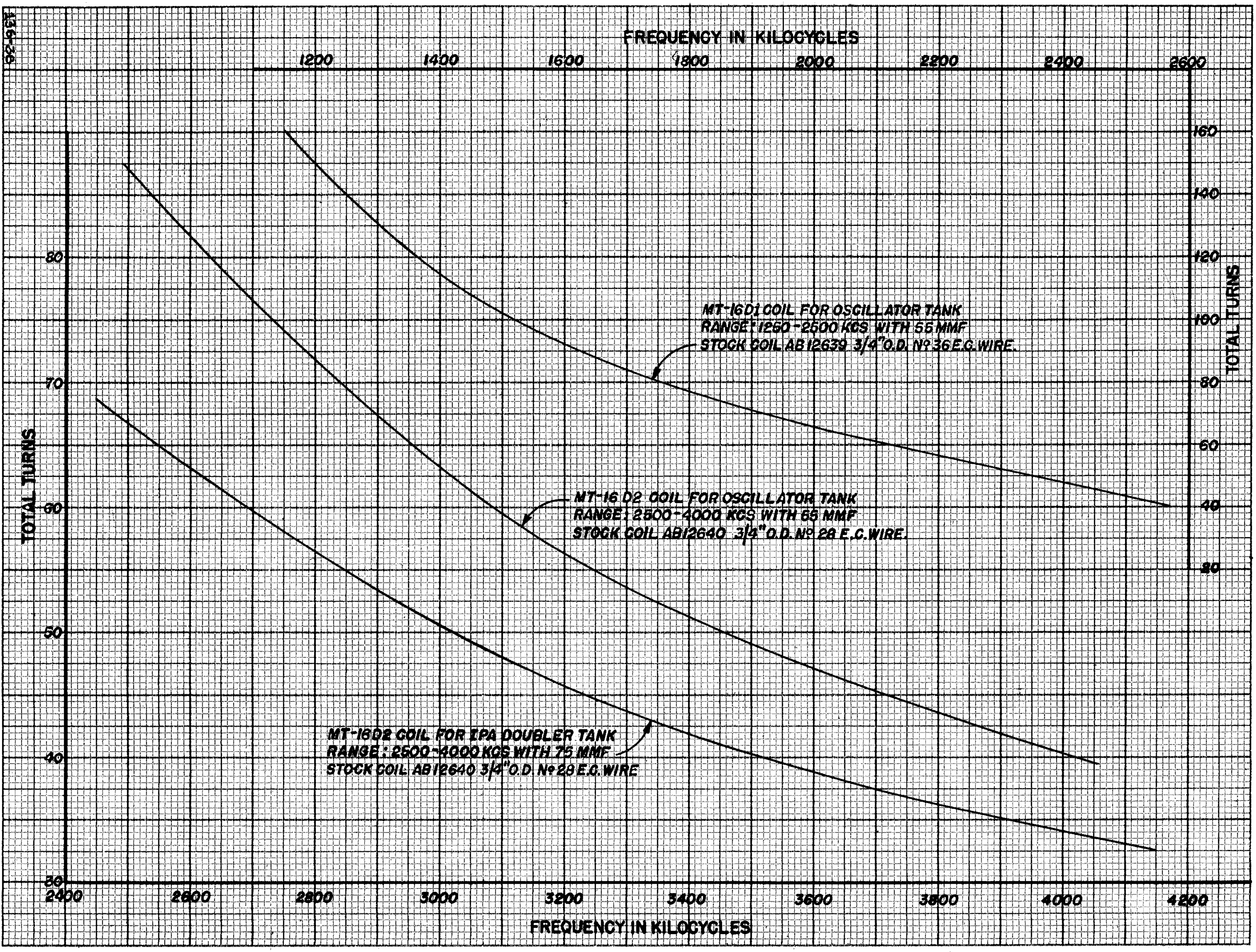


FIG. 27—FREQUENCY VS TURNS MT-16D1 & MT-16D2 OSCILLATOR & IPA TANK COILS

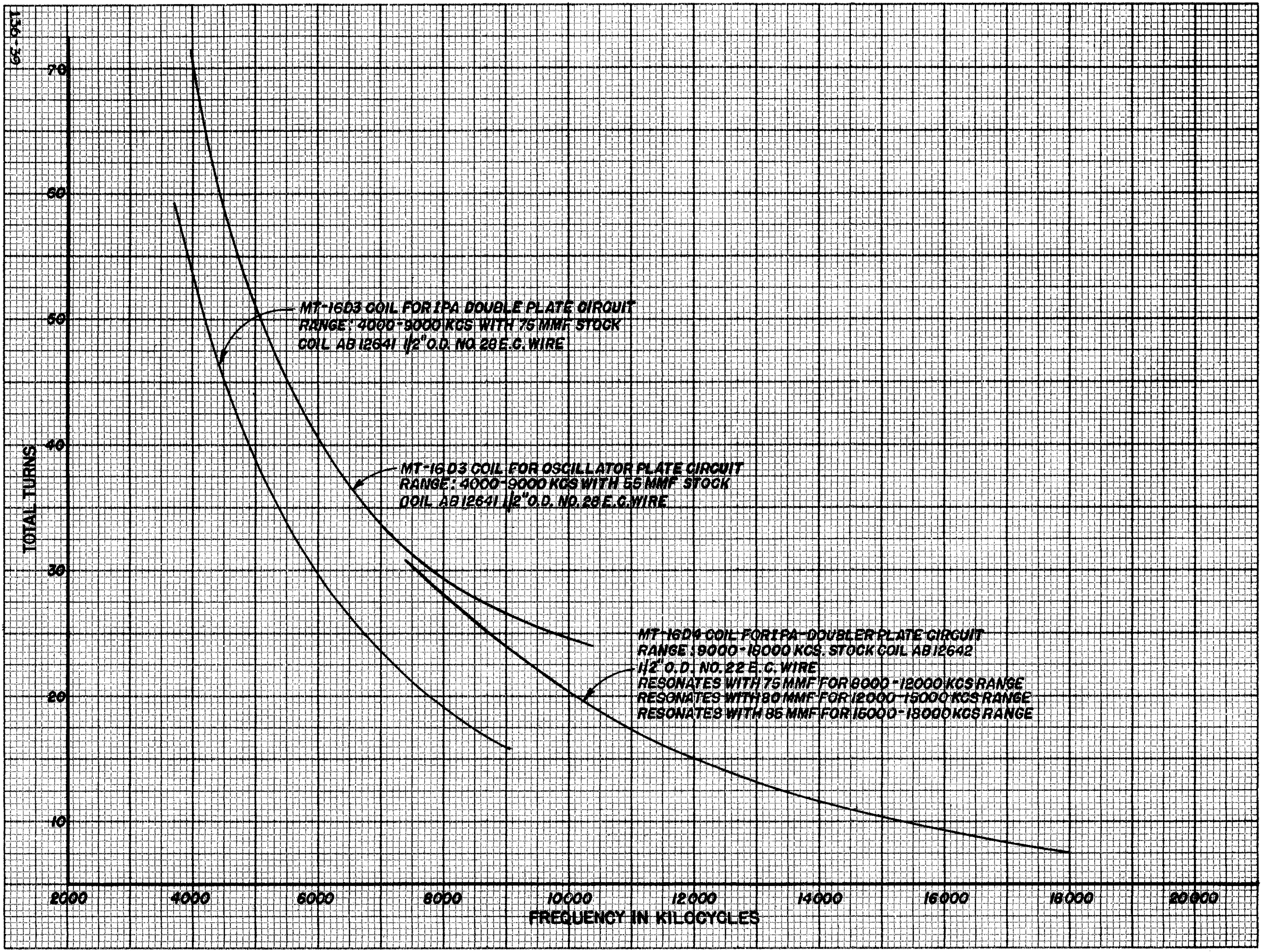


FIG. 28—FREQUENCY VS TURNS MT-16D3 & MT-16D4 OSCILLATOR & IPA TANK COILS

ADDENDA

CONNECTIONS FOR INTERLOCK RELAY S101

(BENDIX DWG. QB7856)

Relay S101 will be included in all new Type TA-2 Transmitter Units. For installations where S101 is not part of the original equipment, it may be installed in the transmitter unit or in the junction box associated with the equipment. Relay S101 is energized by motor M1 and breaks the keying relay circuit whenever the operator changes frequency. This system prevents the application of RF voltage to the power amplifier while frequency shifting is taking place.

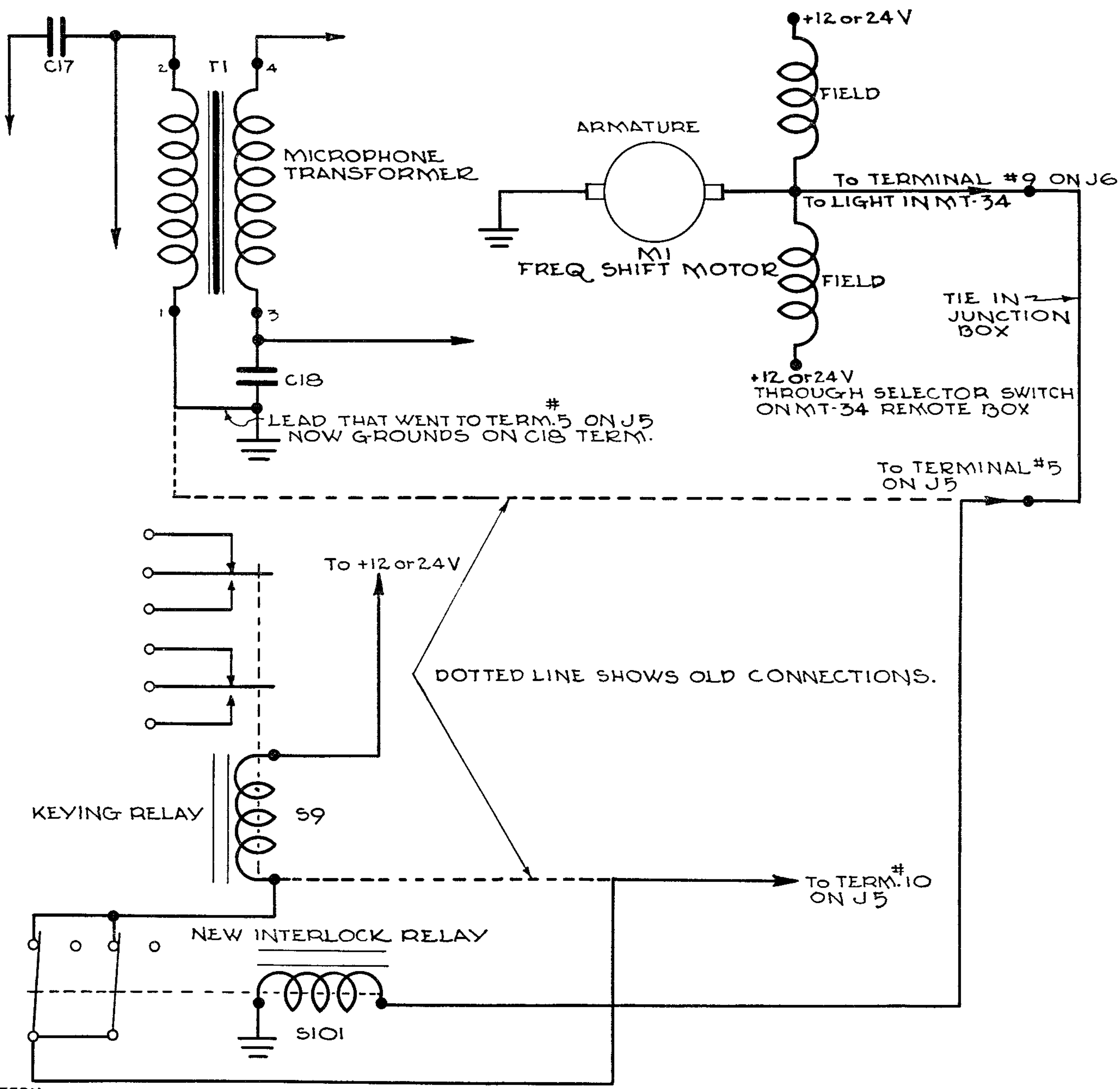


FIG. B—CONNECTIONS FOR INTERLOCK RELAY S101

ADDENDA

CONNECTIONS FOR IMPROVED CHANNEL SELECTOR

The improved channel selector unit, shown in the wiring diagram below, will be supplied with all new TA-2 Transmitter Units and MT-36C Antenna Loading and Coupling Units. The new channel selector is designed to eliminate excess sparking at the switch contacts when switching to a new channel. A connection from the positive side of the power supply must be made to terminal 12 on P6 of the transmitter unit and P11 of the antenna loading and coupling unit. Refer to Figure 26 for connections in the junction box.

The following electrical parts are used in the new channel selector:

Used On TA-2	Used On MT-36			
Symbol		*Function*	*Description*	*Bendix No.*
B201	B301	Motor Assembly	12V	AC58201-1
			24V	AC58201-2
C402	C402	Spark Damping Capacitor	50 Mfd, 50V	A102395-3
C403	C403	Spark Damping Capacitor	Same as C402	.
J6	J11	Channel Selector Receptacle	12-contact	A14458
R201	R301	Armature Shunt Resistor	10 Ohms 20W	A4433-12
R202	R302	Spark Damping Resistor	5 Ohms 1/2W	A16428-7
S201	S301	Motor Positioning Switch	Disc	AC57916-1
		2 Sections	Plate	AC57933-1

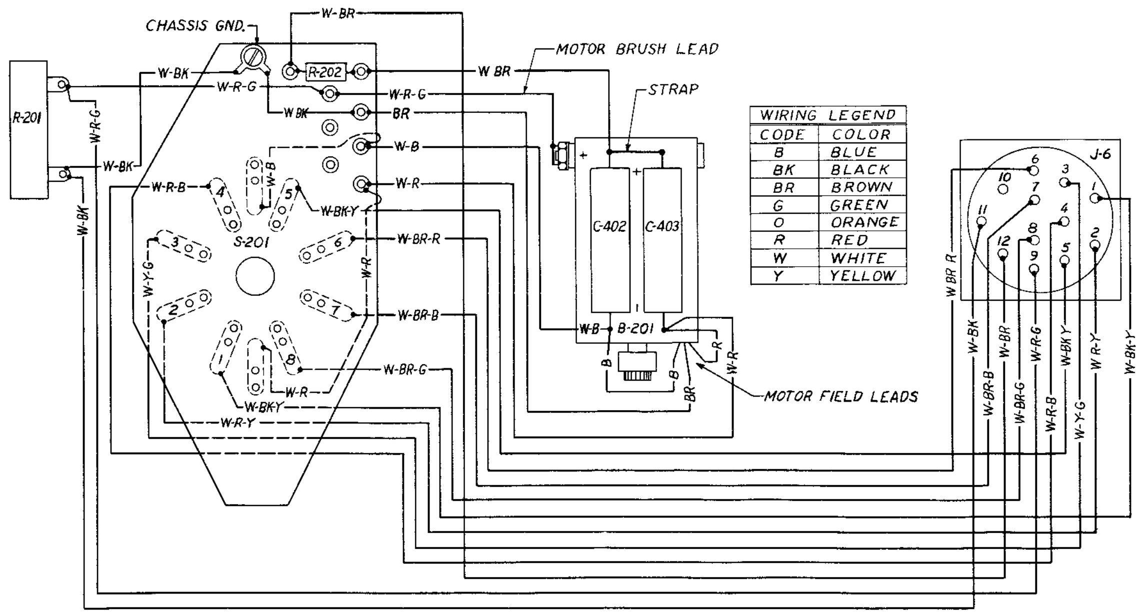


FIG. C—CONNECTIONS FOR IMPROVED CHANNEL SELECTOR

INSTRUCTIONS
for
INSTALLATION AND OPERATION
of
Type MT-5C, Type MT-5D, and Type MT-5E ANTENNA REELS

The Type MT-5C, Type MT-5D, and Type MT-5E Antenna Reels are designed to provide storage for a trailing antenna when it is not in use.

The Antenna Reel consists of a reel, upon which the antenna wire is wound, mounted on a base plate that is drilled for mounting as shown in the outline drawing. The reel is equipped with a crank to facilitate the winding in of the antenna and a friction brake to limit the speed at which the antenna wire is unwound. A ratchet with a removable pawl is also provided. This pawl may be engaged with the ratchet wheel to lock the reel in any desired position. The Type MT-5C Antenna reel has a revolution counter which may be used to measure the length of the trailing wire.

When the installation is made, the Antenna Reel should be substantially mounted in such a position that sufficient space is available to operate the reel crank.

IMPORTANT: The antenna wire must never be allowed to unwind completely from the reel with no braking, as the sudden take-up when the wire is completely unwound may snap the wire loose from the reel.

The Type MT-5C and the Type MT-5D Antenna Reels are identical except for the fact that the Type MT-5D is not equipped with the revolution counter and its associated driving gear.

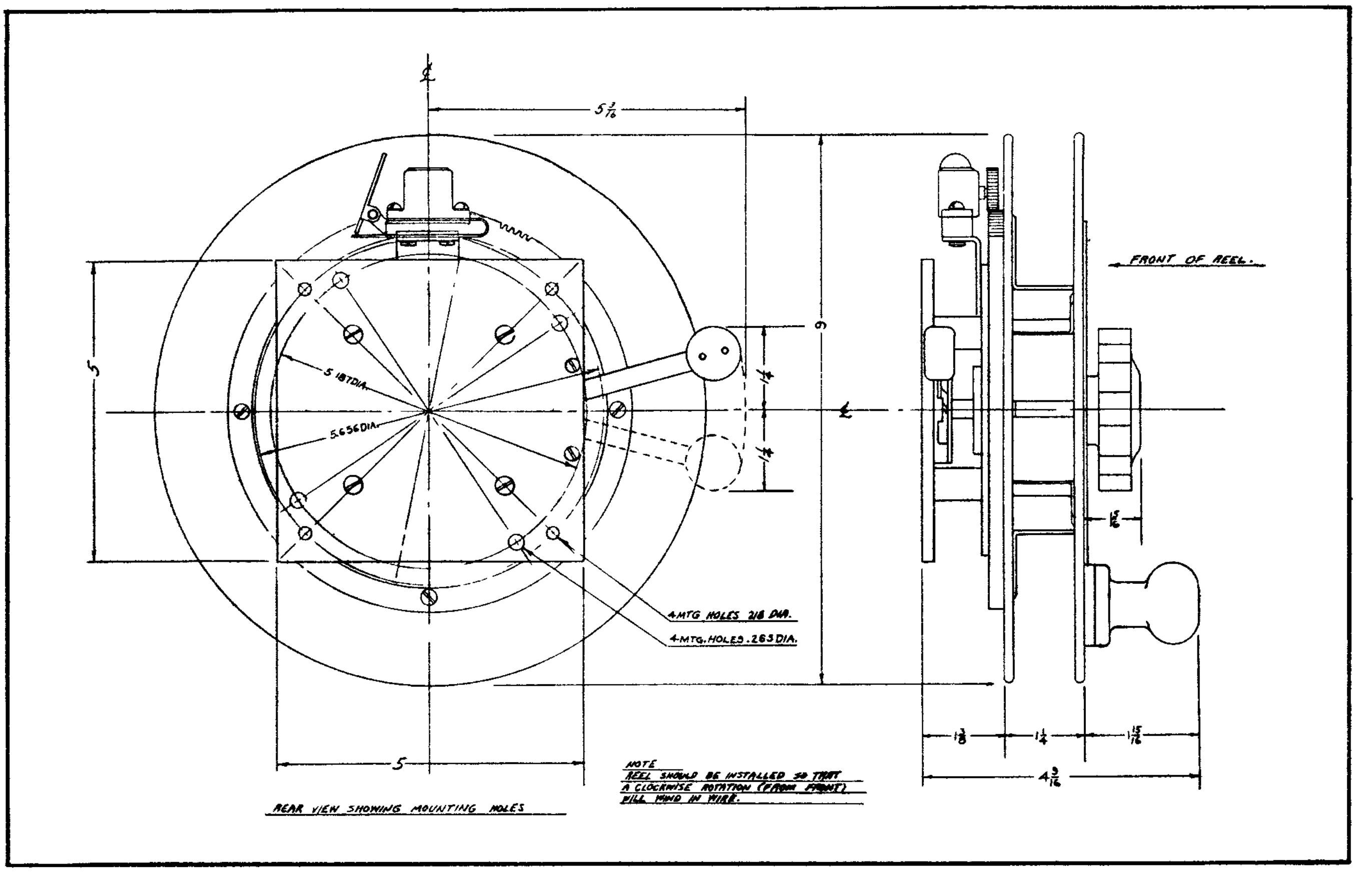
The Type MT-5E Antenna Reel is identical with the Type MT-5D but it is supplied with 200 feet of antenna wire and a lead weight adaptable for attachment to the trailing end of the antenna.

Manufactured by

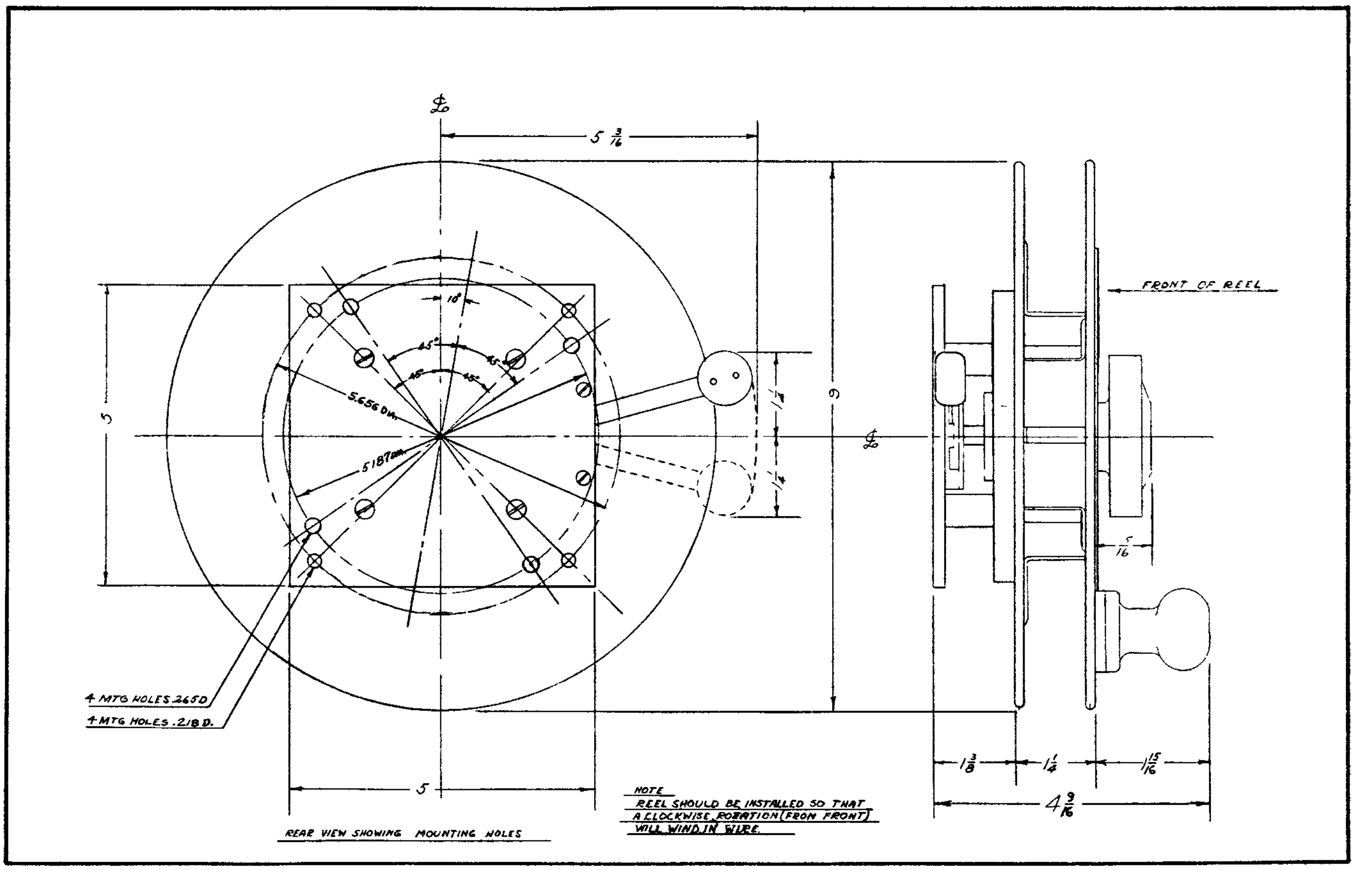
BENDIX RADIO CORPORATION

BALTIMORE, MARYLAND

I. B. 318 February, 1941



TYPE MT-5C ANTENNA REEL OUTLINE DRAWING



TYPE MT-5D ANTENNA REEL OUTLINE DRAWING

INSTRUCTION BOOK

for

MODELS RA-1B, RA-1I AND RA-1J
AIRCRAFT RECEIVER EQUIPMENT

WARRANTY

The Bendix Radio Corporation warrants each equipment manufactured by it to be free of defects in material and workmanship under the normal use and service for which the equipments are intended. The obligation of the Corporation is limited to making good at its factory any part or parts thereof, which shall, within ninety (90) days after delivery to the original purchaser, be returned to the Corporation with transportation charges prepaid, and which its examination shall disclose, to its satisfaction, to have been thus defective. The Corporation makes no warranty of vacuum tubes or their operation; further, this warranty does not apply to any defect in materials that cannot be discovered by ordinary factory inspection. This warranty is in lieu of all other warranties expressed or implied, and does not apply to any products of the Corporation which have been repaired or altered, or have been subject to misuse or abuse. The Corporation is not liable for any damage or personal injury resulting directly or indirectly from the design, material, workmanship, or installation of any of its products, and neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of its equipments.

I. B. 300 January, 1941

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INSTRUCTION BOOK

for

MODEL RA-1B, RA-1I AND RA-1J AIRCRAFT RECEIVER EQUIPMENT

I. INTRODUCTION

1-1. FUNCTION

The Bendix Type RA-1B Receiver is a communication receiver designed for use in aircraft. It may be employed for the reception of continuous wave telegraph or radio telephone signals within frequency ranges of 0.15 to 1.5 megacycles (2000 to 200 meters) and 1.8 to 15.0 megacycles (166 to 20 meters). Three bands are used to give full coverage in each frequency range.

Aural direction finding and loop antenna reception may be obtained over a frequency range from 0.2 to 1.5 megacycles by using the receivers in conjunction with the Bendix Direction Finding Equipment.

The receiver is designed to be operated locally, using the controls mounted on its front panel, or from any remote point within the airplane through the use of Bendix Type MR-1B Remote Control Unit which includes duplicate operating controls.

The receiver may be operated from either a 12- or 24-volt storage battery supply, jumper connections being provided at a terminal board in the receiver chassis to permit arranging the circuit for 12- or 24-volt operation. The receiver will be supplied with the circuit arranged for 12-volt operation unless otherwise specified. As the power supply unit cannot be converted it is necessary to use the 12-volt (MP-5B) or 24-volt (MP-5A24) Dynamotor-Filter unit as required.

1-2. COMPOSITION

A Type RA-1B Receiver installation includes the following equipment:

Item	*Quantity*	*Description*	*Weight-lbs.*
A	1	Type RA-1B Receiver with cable plugs, with tubes (1-6K6G; 5-6K7G; 1-6R7G; 1-6L7G)	25.1
B	1	Type MR-38A Shockproof Mounting Base	1.4
C	1	Type MR-1B Remote Control Unit with Cable Plug	4.25
D	1	Type MP-5B Power Supply for 12/14-volt operation or	
	1	Type MP-5A24 Power Supply for 24/28-volt operation, with cable plugs.	8.9
E	1	Type AF6372 Shielded cable assembly, 2-conductor, 5 ft. long, not wired to plug. (Power Supply to ship's master switch.) Part number of the cable only is QB7633.	
F	1	Type AF9355 Shielded cable assembly, 8-conductor, 15 ft. long, not wired to plugs, (Receiver to Remote Control Unit.) Part number of cable only is B7553.	

Item	Quantity	Description	Weight-lbs.
G	1	Type AF9353 Shielded cable assembly, 6-conductor, 15 ft. long, not wired to plugs. (Power Supply Unit to Receiver.) Part number of cable only is B7544.	
H	2	Type QB15460 Flexible Tuning Shafts, 15 ft. long, all fittings are supplied but are attached to one end only.	
I	1	Instruction Book	

NOTE: Unless otherwise specified by customer, the tuning shafts and cables will be supplied in the above mentioned lengths.

The dimensions of the equipment are:

	Width	Height	Depth
Receiver with shockmount	9 13/16"	8 7/8"	16 1/8"
Remote Control Unit	9 3/4"	7 1/8"	3 1/4"
Power Supply	4 3/8"	7 1/2"	7 3/8"

1-3. ELECTRICAL CHARACTERISTICS

1-3-1. FREQUENCY BANDS

The frequency ranges covered by the receiver are divided into six operating bands, the end limits of which are as follows:

Band 1	.15	to	.315	mc.
Band 2	.315	to	.680	mc.
Band 3	.680	to	1.5	mc.
Band 4	1.8	to	3.7	mc.
Band 5	3.7	to	7.5	mc.
Band 6	7.5	to	15.0	mc.

Extension of each tuning range beyond the nominal band limit provides an overlap of approximately 2%.

1-3-2. SENSITIVITY

The CW sensitivity of the receiver is 2 micrcvolts for a 50-milliwatt output when the volume control is adjusted to give a noise output of 5 milliwatts with no carrier input.

The MCW sensitivity of the receiver is 4 microvolts on Bands 4, 5 or 6 and is 5 microvolts or better on Bands 1, 2 or 3 for the standard output of 50 milliwatts into a 300-ohm load, with a signal to noise ratio of at least 4 to 1, and an input signal 30% modulated at 400 CPS.

1-3-3. SELECTIVITY

The selectivity of the receiver is indicated by the ratio of the input voltage off resonance to the input voltage at resonance, at given band width; and is observed by varying the input voltage to maintain a constant output level for frequencies off resonance. The selectivity of the Type RA-1B Receiver at representative frequencies follows:

Input Voltage	*Total Band Width For Reference Frequencies* 150 kc.	700 kc.	3000 kc.
10 times	7 kc.	15 kc.	18 kc.
100 times	13 kc.	24 kc.	28 kc.
1000 times	20 kc.	32 kc.	40 kc.

1-3-4. IMAGE REJECTION

The discrimination against image frequencies over the various ranges of the receiver is given in the following table:

Band	*Frequency*	*Minimum Ratio*
1	.315 mc.	200,000
2	.680 mc.	90,000
3	1.50 mc.	35,000
4	3.70 mc.	7,000
5	7.50 mc.	2,000
6	15.00 mc.	1,000

NOTE: As the frequency specified in each band is that at which the image rejection is poorest, considerably better minimum ratios will be assured for all other frequencies.

1-3-5. RESONANCE STABILITY

The resonance stability of the Type RA-1B Receiver is such that the signal variation through the 1.8 to 15.0 megacycle range will not exceed 1/4 of 1% of the signal frequency in kilocycles, and it will not exceed 1/2 of 1% of the signal frequency in kilocycles through the .15 to 1.5 megacycle range. These ratings will be obtained under the following conditions:

A. Any 20^{o}C temperature variations between the limits of -20^{o} and $+50^{o}$C.

B. Humidity variation between zero and 100%.

C. Battery voltage variation of 15%.

D. Normal vibration as encountered in aircraft.

E. Manipulation of the sensitivity control from maximum to minimum.

1-3-6. OVERALL FIDELITY

The overall fidelity characteristic of the Type RA-1B Receiver as measured from the antenna to the output terminals varies, on the different bands, due to the selectivity requirements in the range of 150 to 500 kilocycles.

On Band 1, .150 to .315 megacycles the output varies plus or minus 6 DB over the range of 200 to 1500 cycles per second, 2000 cycles per second is attenuated approximately 15 DB below the level at 1000 cycles per second.

On Bands 2 and 3, .315 to 1.500 megacycles the output varies plus or minus 8 DB over the range of 200 to 2000 cycles per second.

On Bands 4, 5 and 6, 1.800 to 15.00 megacycles the output varies plus or minus 6 DB over the range of 200 to 3000 cycles per second.

1-3-7. POWER OUTPUT

The output circuit of the Type RA-1B Receiver is designed for a 300-ohm load and will deliver over 500 milliwatts output at not over ten percent distortion when properly loaded. The maximum possible output is 1.5 watts.

1-4. ADDITIONAL EQUIPMENT REQUIRED

The following additional equipment will be required to effect satisfactory operation of the equipment.

Item	*Quantity*	*Description*
A	2	Type MR-8A Headphone Receiver or equivalent 500 ohm, head band type
B	1	Antenna-ground system (see Section 1-5)
C	1	Primary power source (see Section 1-6)

1-5. ANTENNA REQUIREMENTS

The Type RA-1B Receiver may be operated with a seperate receiving antenna, or it may be operated with the transmitting antenna through the break-in relay contained in the transmitter. Provisions are included in the receiver for the use of a fixed or trailing antenna and the applicable Bendix Direction Finder Amplifier. Convenient selection by means of a three-position antenna switch (S15) marked DF, TA, and FA (Direction Finder Amplifier, Trailing Antenna, Fixed Antenna) facilitates rapid selection of whichever antenna connection is desired. The knob marked ANTENNA SWITCH selects the source of signal input to the receiver. When the airplane's fixed antenna is connected to binding post A, the antenna switch is set at FA, and the antenna is then connected directly to the receiver input. When the trailing wire antenna is connected to A, the antenna switch S15 is set at TA, and the trailing wire is connected to the receiver input through a fixed series condenser which serves to compensate for the varying characteristics of the trailing wire antenna. With the antenna switch set at DF, the input of the receiver is connected to the output of the Direction Finder Amplifier and terminal A is grounded by the antenna selector switch. In series with the antenna and the primary of the antenna coil assembly, through the band switch S1, is a small variable antenna trimmer condenser C81 which compensates for antennas of differing capacities.

When using a separate antenna for the receiver, the choice of location is governed by proximity to a suitable location for the receiving antenna lead-in. The best results cannot be obtained at any frequency if the lead to the receiving antenna is run around the interior of the fuselage for several feet before connecting to the antenna binding post. This is particularly harmful at high frequencies where dielectric losses are greater. A receiving antenna suitable for the entire frequency range of the receiver will not have a large capacity. Additional capacity to the fuselage between the lead-in insulator and the antenna binding post shunts the receiver and may seriously reduce the signal energy reaching it. The ideal installation would have the receiver connected to the antenna lead-in by means of a single insulated conductor suspended in air throughout its length. Conductors of #16 and #18 B & S gauge are suitable for radio receiving antenna connection inside the airplane. This lead should not be located so that it is likely to be struck or subjected to stress involving the tensile strength of the wire. If it is necessary that this lead be longer than one foot or support is required along its length, every effort should be made to space it away from metal structural members by at least one-half inch. Glass or porcelain stand-off insulators are ideal for this purpose, however, if they are not available, it is preferable to use dry wooden blocks impregnated with paraffin wax as spacers rather than to secure this conductor directly to metal members.

When the transmitting antenna is used in conjunction with the break-in relay for receiving, the wire connecting binding post A on the receiver and the RECEIVER binding post on the transmitter should be made as short and as direct as circumstances permit; care should be taken to prevent its coming into proximity with metallic bodies wherever possible.

In all cases the antenna leads must have slack, this eliminates any possibility of vibration being transferred to the receiver through the leads.

The ground binding post G should be connected by a heavy flexible wire to the nearest metal member of the fuselage using a firm clean joint, preferably soldered. This ground lead must be short, not exceeding a foot in length.

1-6. POWER REQUIREMENTS

For 12-volt operation the receiver filament current is 1.5 amperes and the type MP-5B power supply requires approximately 3 amperes. Receiver filament current of 0.8 amperes and approximately 1.5 amperes current for the type MP-5A24 power supply will be required for 24-volt operation. The total plate current for the receiver is approximately 70 milliamperes at 225 volts.

1-7. SIMILAR RECEIVER EQUIPMENT

1-7-1. TYPE RA-1I RECEIVER

When it is desirable to have a high-impedance output receiver, the Bendix Type RA-1I Receiver may be obtained. This unit is identical to the Type RA-1B Receiver except for the local dual volume sensitivity control (R39, R40) and the audio output transformer T1.

The Bendix Type MR-1I Remote Control Unit used in conjunction with the Type RA-1I Receiver differs only in the remote dual volume sensitivity control (R41, R42) used.

A 4000-ohm high impedance headset such as the Bendix Type MR-48A is required when using this equipment.

An additional parts list (Section 6-5) has been added to give information necessary when referring to the Type RA-1I Receiver Equipment.

1-7-2. TYPE RA-1J RECEIVER

The Bendix Type RA-1J Receiver is similar to the Type RA-1B Receiver except for the frequency ranges of the bands 4, 5, 6, and the values of the tuning components.

The calibrated end limits of each band are given below:

Band 1	.150	to	.315	mc.
Band 2	.315	to	.680	mc.
Band 3	.680	to	1.500	mc.
Band 4	2.500	to	5.000	mc.
Band 5	5.000	to	10.000	mc.
Band 6	10.000	to	20.000	mc.

The Bendix Type MR-1J Remote Control Unit used in conjunction with the Type RA-1J Receiver has its dials and dial mask marked to correspond with the receiver markings. An additional parts list (see Section 6-6) has been added to give information necessary when referring to the Type RA-1J Receiver.

2. DESCRIPTION

2-1. ELECTRICAL THEORY

The Type RA-1B Receiver follows conventional superheterodyne design. The basic principle involves the use of a fixed frequency amplifier, usually tuned to some intermediate radio frequency, hence the term IF amplifier. In the case of the Type RA-1B Receiver, this frequency is 1630 Kcs. All desired signals are tuned by means of a variable tuning control and are subsequently heterodyned or converted to the fixed amplifier frequency. After passing through the IF amplifier, the converted signal is detected or rectified in the second detector, and the audio components, which carry the desired intelligence or message, are amplified and fed into head telephones.

The three main tuning condensers (antenna coupling transformers, RF amplifier transformer, and heterodyne oscillator) are ganged together for uni-control tuning, and their associated inductances and capacities are so chosen as to automatically maintain a constant difference of 1630 Kcs between the signal and heterodyne oscillator frequencies. Thus, for a 1000 Kcs signal, the RF amplifier and 1st detector are tuned to 1000 Kcs and the heterodyne oscillator is automatically set to 1000 plus 1630, or 2630 Kcs.

To illustrate the complete operation, assume, for example, that the receiver is tuned to an incoming signal of 1000 Kcs. In passing from the antenna to the grid of the first detector, the incoming signal will then be amplified through the RF amplifier tube and its associated tuned input and output transformers; whereas, signals of other frequencies will be amplified only slightly or not at all. The first detector will also have injected into it a second voltage originating in the heterodyne oscillator, which will have a frequency of 2630 Kcs, and the resultant of these two frequencies will appear in the output of the first detector. There will be two new frequencies in addition to the initial frequencies, namely: 1630 and 3630 Kcs, the difference between, and the sum of the original frequencies. The appearance of these new frequencies is a phenomenon of heterodyning which is similar to the beat obtained at audio frequencies when two tones of different pitch are sounded simultaneously.

The four frequencies (1000, 2630, 1630 and 3630 Kcs) are fed to the input of the 1st IF amplifier, which is tuned by a filter network to a band comprised of 1630 Kcs, plus and minus a few kilocycles. Consequently, the 1630 Kcs component is selected and amplified, while the other three are rejected, i.e., not amplified. This selection and amplification process is carried on further in the 2nd IF amplifier with its associated IF filters.

Simultaneously with the 1630-Kcs IF signal voltage, a 1631-Kcs CW oscillator voltage may be applied to the control grid of the 2nd IF amplifier tube through a coupling capacitor. These two voltages are amplified, passed through the final IF filters, and fed into the signal diode section of the 2nd detector tube. The output of the signal diode will then contain two frequencies 3261 Kcs and 1 kilocycle. The higher component will be filtered out by the resistance-capacitance filter associated with the signal diode circuit and the IF filter which couples the 2nd IF amplifier tube with the signal diode, or 2nd detector. The signal feed to the AF amplifier will be at 1 kilocycle. This produces an audible beat frequency signal which passes through the audio amplifier circuits and is fed to the head telephones.

The description above is for typical reception of unmodulated (CW) signals. When modulated continuous waves are being received, the CW oscillator is shut off. In this case, the amplitude modulation of the carrier at an audible frequency produces the audio signal which is heard in the output.

Automatic volume control is obtained from the second diode section in the 2nd detector tube. A portion of the 1630-Kcs output from the 2nd IF amplifier is rectified by this diode, suitably filtered by a resistance-capacitance filter, and applied to the control grid circuits of the RF amplifier, 1st detector, and 1st IF amplifier tubes through decoupling filters. Variations of incoming signal intensity result in corresponding changes of rectified voltage in the AVC diode circuit. These variations are transmitted to the above named control grids and serve to reduce the overall gain or sensitivity of the receiver when the incoming signal increases in amplitude, and vice versa, thus maintaining the output at a substantially constant level. This level may be adjusted by the potentiometer section of the dual volume control which determines the AF voltage applied to the grid of the output power tube.

Manual volume control is obtained by setting the AVC switch in the off position, thus substantially grounding the control voltage from the AVC diode. Control of volume is then accomplished by replacing the AVC voltage variation with that from the IR drop across a manually operated control which varies the cathode bias on the RF amplifier, 1st detector and 1st IF amplifier tubes.

2-2. CIRCUIT DETAILS

2-2-1. PANEL AND CONTROLS

The front panel of the receiver bears all the controls required for its operation. Viewing it from the front, one may note, in the upper left hand corner, three binding posts for connecting the antenna to Post A, Direction Finder (if used) to post DF, and post G to ground. Immediately to the right of these is the rotary antenna switch S15 which permits changing the receiver input for use with a direction finder DF, trailing antenna TA or fixed antenna FA, depending upon which type of antenna is connected to the binding posts. The antenna compensating condenser C81, is located at the right of the antenna switch. By turning the spring dust cover to one side, the condenser can be adjusted with a screw driver. Below the antenna switch is a projecting gear case, having an external knob marked TUNING. It contains a bevel-gear arrangement that permits the mechanical linkage of a remote control unit to the receiver. The TUNING control drives a precision, spring-loaded, worm gear which in turn drives the gang tuning condenser (C1.1, C1.2 and C1.3). The BAND SELECTOR located to the right of the tuning control has a similarly arranged mechanism, this has the external knob marked BAND SELECTOR. Along the bottom of the front panel, in succession from left to right, are the telephone jack J1, marked PHONES, the automatic volume control switch S8, marked A.V.C. OFF-ON, the CW switch S10, marked C.W. OFF-ON, the power switch S11 marked POWER OFF-ON, that operates the starting relay H1, a six-contact plug receptacle PL3 that receives the power cable from the dynamotor-filter unit and an eight-contact plug receptacle PL1 which connects to the remote control unit. Below and to the right of the band selector gear case are four pin jack terminals used for testing, G is the common terminal, B+ connects to the plate voltage bus, A+ connects to the heater voltage bus and AUDIO connects to the secondary high side of the output transformer. In the upper right corner is the VOLUME control (R39-R40). To the left of the volume control is the LOCAL-REMOTE transfer switch (S9). At the top center of the panel is the port through which the dial and dial mask are observed. A pilot light DL1 is enclosed in a small reflector case to the right of the dial port. Pilot lights may be changed by unfastening two screws which hold the cover in place. The case and front panel of the receiver are finished in a black wrinkle-enamel and all markings on the panel are engraved.

2-2-2. RF AMPLIFIER CIRCUITS

The input energy is taken from a fixed antenna, a trailing antenna, or a direction finder amplifier; choice of any one source is had by operation of the ANTENNA SWITCH. This energy is fed into the tuned antenna circuit coils L1 to L6 and their associated trimmer condensers, located in the ANTenna shield can.

The energy from the tuned antenna circuit is then fed into the radio frequency amplifier tube V1, which is a 6K7G triple-grid RF amplifier. This amplifier voltage then goes to the tuned circuits in the RF shield can, L7 to L12 and their associated trimmer condensers. The signal is then introduced into the first detector tube V3 (mixer stage).

The output of the heterodyne oscillator circuit, tuned 1630 kilocycles higher in frequency than the frequency of the desired signal, is injected into the mixer stage. This heterodyne oscillator circuit consists of a 6K7G oscillator tube V2 and the tuned circuits mounted in the OSCillator shield can, coils L13 to L18 and their associated padder and trimmer condensers.

Frequency conversion is accomplished by the heterodyne process, the tuned and amplified signal and the output of the heterodyne oscillator are simultaneously detected in the first detector (mixer) tube V3 whose output circuit FL1 is tuned to the intermediate frequency of 1630 Kcs. The first detector tube V3 (6L7G) has two separate control grids which are shielded from each other; use of this tube reduces the undesirable coupling effects between the oscillator and signal circuits to a minimum. The tuned circuits FL1 comprise a conventional 1630 Kcs, double-tuned, IF transformer.

2-2-3. IF AMPLIFIER CIRCUITS

Output of the first detector (mixer) tube V3 is fed through the tuned IF transformer FL1 to the first intermediate frequency amplifier tube V4. The transformer FL1 being tuned to 1630 Kcs passes signal energy of this frequency and attenuates all other frequencies. After amplification in the tube V4 the signal is fed through another tuned IF transformer FL2, that further attenuates undesired frequencies, into the second IF amplifier tube V5.

Provision has been made in the IF transformer FL2 to couple the output of the continuous wave beat frequency oscillator (CW Osc.). The CW oscillator tube V8 is a 6K7G operating at very low voltage. This oscillator is tuned to 1631 Kcs by the coil L27 and its associated condensers located in the CW, BFO shield can.

The second intermediate frequency stage consists of the IF amplifier tube V5 (6K7G) and a tuned circuit FL3. The output of V4 is amplified in the second IF amplifier tube V5; whenever the beat frequency oscillator tube V8 is used, its output is also amplified in the tube V5; the signal is then fed through the tuned IF transformer FL3 to the second detector tube V6. Transformer FL3 further attenuates signals of any undesired frequencies.

2-2-4. AVC AND AUDIO CIRCUITS

The duplex-diode triode tube V6 (6R7G) is used as a combined detector, audio amplifier, and automatic volume control tube. The signal input from FL3 is rectified in the diode portion of the tube and because of the current flow in the diode circuit a voltage is developed across the resistors R23 and R24,(see the schematic diagram). The audio voltage developed across resistor R24 is bypassed to eliminate the radio frequency component and is then applied to the grid of the triode section of the tube. This triode section amplifies the audio frequency signal. The rectified voltage developed across the resistors R23 and R24 is filtered and used to vary the bias on the tubes V1, V3 and V4. Any change in signal strength at the detector will cause a change in the DC bias voltage of the RF and IF tubes thus limiting the gain and acting to hold the signal level at the detector to a constant value. The output of the detector V6 is amplified in the audio output amplifier tube V7 (6K6G), and the audio output for headphones is obtained from transformer T1 in the plate circuit of the tube V7.

2-2-5. SENSITIVITY CONTROL CIRCUITS

When using AVC the receiver sensitivity is fixed. The receiver output is varied by rotating the dual volume control (R39 and R40). The potentiometer R40 is shunted across the secondary of the output transformer T1 to provide a means of varying the voltage delivered to the headphone jacks.

When AVC is not used the variable resistor R39 changes the cathode bias thus lowering the receiver sensitivity.

2-3. POWER SUPPLY

2-3-1. GENERAL, 12- OR 24-VOLT OPERATION

The Type RA-1B Receiver can be operated from either a 12- or 24-volt storage battery supply.

A. 12-volt operation requires the use of a Type MP-5B (12-volt) Dynamotor-Filter Unit; also, on the numbered terminal board located under the chassis, terminals 1 and 2 must be connected, terminals 3, 4 and 5 must be connected, terminals 6, 7 and 8 must be connected.

B. 24-volt operation requires the use of a Type MP-5A24 (24-volt) Dynamotor-Filter Unit; also, on the numbered terminal board located under the chassis only the terminals 2 and 3 shall be connected.

It is not necessary to change pilot lights when changing from 12-volt to 24-volt operation as the dropping resistors R43.3 and R43.4 are in the circuit when the jumper is removed from connections 6, 7 and 8 of the terminal board.

The Schematic Diagram, Figure 15, shows the locations of the fuse. For 12/14-volt operation the fuse is a 10-ampere, 25-volt Littelfuse located in the primary lead of the power supply. For 24/28-volt operation the fuse is located in the high voltage lead of the dynamotor output. This fuse is a one-eighth ampere, 500-volt Littelfuse.

The Type MR-1B Remote Control Unit does not have to be changed when it is used with either 12- or 24-volt installations. The Type MP-5B and MP-5A24 Dynamotor-Filter Units are ruggedly constructed machines designed especially for aviation service. Each unit is mounted securely on top of a chassis that contains all of the necessary component parts required for its proper operation.

2-3-2. EXTERNAL CONNECTIONS

At one end of the filter box are four plug receptacles that provide for the convenient connection of the power cables incidental to the use of the dynamotor. The upper left plug receptacle PL7 receives the low voltage input from the airplane storage battery. The upper right plug receptacle PL4 receives the power cable from the receiver. The lower right plug receptacle PL5 supplies potentials suitable for use with Bendix Direction Finder Amplifiers. The lower left plug receptacle PL6 provides potentials for any of the various Bendix Interphone systems. These systems can be installed to provide as many positions as desired. The interphone ON-OFF switches operage independent of the receiver ON-OFF switch.

A PROTECTIVE FUSE (F1), is mounted in the dynamotor so that it is readily accessible from the terminal end of the dynamotor mounting box, and may be removed for inspection or replacement by removing the small knob provided for this purpose.

2-4. CONSTRUCTION

2-4-1. RECEIVER

2-4-1-1. GENERAL

The Type RA-1B Receiver is designed for dependable operation under severe and adverse service conditions, as all of its component parts are constructed to withstand any degree of vibration, temperature or humidity change encountered in the course of normal flight operation. The metal from which the equipment is fabricated is selected to withstand corrosion.

2-4-1-2. TYPE OF CONSTRUCTION

The chassis-case form of construction has been used. All controls are located on the front panel enabling the chassis to be withdrawn from its case for inspection or replacement of tubes without the inconvenience of disconnecting the cables or the flexible tuning shafts. The chassis is held in place in its case by three thumb screws, two of which are mounted along the top edge of the front panel, and the third is mounted at the center of the bottom edge. All tuning coils and their associated trimmer and padder condensers are mounted in aluminum shield cans, (See

Figure 3.) One can is used for each stage. The tuned circuits are connected to switch sections which are turned by the BAND SELECTOR knob. Whenever possible, resistors and bypass condensers are soldered to lugs mounted on bakelite boards; this practice facilitates replacement of parts and provides rigid support.

2-5. REMOTE CONTROL

2-5-1. TYPE MR-1B REMOTE CONTROL UNIT

The Type MR-1B Remote Control Unit, (Figure 1), is designed to work in conjunction with the Type RA-1B Aircraft Receiver, and is constructed to meet the same service requirements. All external connections are on the right end. All couplings for the flexible tuning shaft, and flexible band selector shaft are held in place by threaded fittings. Midway between the flexible shaft couplings is the eight-contact terminal receptacle (PL2) to which the receiver control cable connects.

2-5-2. DESCRIPTION OF CONTROLS

The Type MR-1B Remote Control (Figure 1) contains all of the operating controls found on the Type RA-1B Receiver panel except the antenna switch S15 and the local-remote transfer switch S9. In the upper left corner of the remote control panel is a telephone jack J2 marked PHONES, directly below is the VOLUME control (R41-R42); C.W. ON-OFF switch (S13), A.V.C. ON-OFF switch (S12), POWER ON-OFF switch (S14). To the right of the power switch is a second telephone jack J3, marked PHONES. In the top center of the MR-1B panel is the dial port marked FREQUENCY. The tuning dial and dial mask, seen through the dial port, have the same scales and band markings as the receiver. This dial port is illuminated by a dial light DL2 that is housed in a removable reflector. Near the right edge of the panel are the TUNING and BAND SELECTOR crank handles. These cranks connect through mechanical linkage to the corresponding receiver drives.

Operating control is transferred from the receiver to the remote control unit by turning the LOCAL-REMOTE switch located on the receiver. The circuits of the Type MR-1B Remote Control Unit are so arranged that the PHONE jacks J2 and J3 are connected to the output of the receiver regardless of the position of the LOCAL-REMOTE switch S9. Headphones may be used simultaneously at the receiver and remote locations; a listener at the location which does not have control may regulate the audio level in his phones by adjustment of the volume control, providing that the AVC switch at the location is in the ON position.

3. INSTALLATION

3-1. GENERAL INSTALLATION INSPECTION

Prior to the installation of any equipment a thorough visual and, if possible, electrical inspection of all parts should be made. A typical inspection procedure is given below:

3-1-1. MECHANICAL AND VISUAL INSPECTION

A. Receiver Unit. Remove the receiver from its case. Observe whether any wires have broken or become loose and check all ceramic parts for cracks or breakage. If the receiver appears dusty, dry compressed air may be used to blow out this dust. A hand bellows may be used for this purpose. The use of extreme high pressure is objectionable as it may impose undue strains on some of the more delicate parts. Carefully inspect all exposed connections for short-circuits that may be caused by foreign materials, or misplacement of parts. Feel all parts to determine if any have become loose, especially see if all tubes are properly seated and making good contacts in their respective sockets. Manipulate all controls through their entire range of motion, noting any irregularities requiring correction. The receiver must be locked in its case by the three knurled lock screws. The case must be locked and safety wired on its shockmount, after ascertaining that all the metallic pivots on the rubber shock absorbers have penetrated into their respective holes before trying to close the snap-slides.

B. Remote Control Unit. The general procedure of inspection of the remote control unit is similar to that outlined for the receiver unit.

C. Dynamotor-Filter Unit. The dynamotor relay should be checked for improper alignment of contacts, pitted or corroded contacts, and improper spring tension. The protective fuse should make good contacts in its holder, also, the fuse must be of the correct value. The dynamotor should not be taken apart by anyone not familiar with its mechanism. (See Sec. 5-1-1.) All cables must be firmly locked in their respective receptacles by the small spring tips on all electrical cable plugs, and by the threaded collars in the case of the mechanical cables.

3-1-2. ELECTRICAL PERFORMANCE

After all units have been inspected and are properly connected, the equipment should be tested for electrical performance. The following procedure is typical of installation performance checks.

A. Set the LOCAL-REMOTE switch to LOCAL.

B. Turn POWER switch on the receiver to ON.

C. Plug a telephone headset into PHONES jack on receiver.

D. Adjust VOLUME control to maximum.

E. Turn BAND SELECTOR control on receiver to any band.

F. Turn CW switch to OFF.

G. Operate TUNING control until a signal is heard, at which time the antenna compensating condenser C81 should be adjusted. Turn the small snap cover and, with an insulated screwdriver, adjust condenser until maximum signal output is obtained. The cover must be turned to close the adjustment opening.

H. Turn AVC switch to ON.

I. Vary the VOLUME control and note if smooth reduction of volume is obtained.

J. Turn the AVC switch to OFF and again vary the VOLUME control while noting if smooth reduction of volume is obtained.

K. Turn the CW switch to ON and note if beat is heard in the headphones.

L. Turn LOCAL-REMOTE switch to REMOTE and repeat all checks in this position.

M. Check remote dial against the receiver dial, making certain that they are properly aligned; all readings should be identical.

It will be noted that at either remote or receiver positions, with the AVC switch ON, the VOLUME control functions to control the headphone volume at its position regardless of the position of LOCAL-REMOTE switch. The circuits are arranged in this manner so that, if the local operator should have control of the receiver, the pilot at the remote position may control the volume in his headphones by turning the AVC switch to ON. This may be done without affecting any of the local operator's controls. The controls should be checked to see if they operate in this manner.

Tune in several stations on each band at both the local and remote positions while making the above checks to assure correct operation of the equipment.

The above checks will indicate proper connection and operation of the receiving equipment. To check overall performance of the installation, tune in a weak station in any band and turn airplane's motors up to at least 1200 RPM, noting in headphones if any interference is introduced. Repeat this check on each band. Operate the battery-charging generator-field switch with motors turning 1200 RPM to be sure that no interference originates in the generator. If any interference is caused by either motors or generators, bonding and shielding must be examined and corrected.

3-2. BONDING AND SHIELDING

Before the Type RA-1B Receiver Equipment is installed, the aircraft engine, charging generator, ignition system and all electrical accessories must be completely bonded and shielded, if satisfactory radio results are to be obtained.

As the ultimate sensitivity of any aircraft receiving installation is limited by the magnitude of the local interference caused by ignition noises, etc., rather than by the sensitivity of the receiver, it is necessary if reception of weak signals is desired that the interfering signal be reduced to the lowest possible value by proper bonding and shielding.

A test to determine the completeness of bonding and shielding would be: With the airplane in flight or with the engine turning up at least 1200 RPM on the ground in clear weather when atmospheric static is negligible and the receiver volume control set at maximum, negligible sound should be audible in the telephone receivers over that which is heard with the engine not running. If the airplane is maintained in a well bonded and shielded condition, extremely long distance ranges of reception will be obtained by the Type RA-1B Receiver.

3-3. LOCATION AND MOUNTING OF RECEIVING EQUIPMENT

The receiver shockproof mounting base (Figure 10) should be attached to a plane surface at a location in the airplane that has been chosen for both the shortest practicable lead to the receiver antenna binding post and convenient access to the main tuning controls on the front panel. When determining this location, care must be taken to choose one that permits the receiver to vibrate freely in all directions without striking any other equipment or portion of the airplane. After these requirements have been met, and the mounting base has been permanently secured, the receiver should be attached to it by means of snapslides associated with the mounting brackets on the under side of the case. The snapslides must all be firmly engaged on their respective studs and securely closed.

The Type MP-5B or MP-5A24 Dynamotor-Filter Unit (Figure 14) should be located in such a position that the battery leads are kept as short as possible, and the longitudinal plane of the dynamotor shaft be as near parallel to the airplane line of flight as possible; also, consideration should be given to the placement of the connecting cables and the necessity for occasional removal for inspection of the dynamotor-filter unit. The mounting plate (Figure 12) should be permanently fastened in the location selected and the dynamotor-filter unit attached to it by means of the four snapslides provided for this purpose.

The remote control unit (Figure 11) must be so located that all controls are readily available to the pilot. The dial must be easily seen by the pilot when in flight. Care should be used in locating the remote control and receiver units so that no sharp bends will be required in the mechanical cables used for tuning and band switching. The remote control mounting base (Figure 13) should be securely fastened at the chosen location and the remote control unit attached to it, using the snapslides to hold the unit in place.

3-4. CABLE CONNECTIONS

The electrical connections of the Type RA-1B Receiver Equipment (Figure 8) are made by selecting first the battery cable, from one end of which project two wires marked to indicate their polarity. These are connected to the terminals of the storage battery voltage supply line. The plug at the opposite end of the battery cable is inserted in the two-contact receptacle PL7 on the base of the dynamotor-filter unit. The Type RA-1B Receiver is connected to the dynamotor through the power cable, one end of which plugs into the six-contact receptacle PL4 on the dynamotor base; the other end is inserted into the six-contact receptacle PL3 on the front panel of the receiver. The Type MR-1B Remote Control Unit is connected to the receiver electrically by the control cable which runs from the eight-contact receptacle PL2 on the side of the remote control unit to a similar eight-contact receptacle PL1 on the front panel of the receiver.

The TUNING and BAND SELECTOR controls on the remote control unit are mechanically linked to the corresponding TUNING and BAND SELECTOR controls on the receiver by two flexible mechanical shafts. The ends of these shafts terminate with spline joints and are securely held in place by threaded collars.

Before connecting the flexible mechanical shafts to the TUNING and BAND SELECTOR controls, the remote and local controls must be set to corresponding positions. Set the TUNING controls of the receiver and remote controls to read zero. Set the BAND SELECTOR control of both units so that the index line of each is in the center of the port for Band 1. The flexible mechanical shafts may then be connected by engaging the female fittings at the ends of each shaft with the proper male couplings on the receiver and remote control unit and securing the coupling nuts.

4. OPERATION

4-1. INITIAL TESTS AND ADJUSTMENTS

Prior to each flight the Type RA-1B Receiver should be checked for performance. This check should include, from both local and remote control points, a listening test on each band to determine:

A. PHONE reception.

B. CW reception.

C. AVC action.

D. MVC action.

E. VOLUME control.

F. TUNING.

G. BAND SELECTION.

H. LOCAL-REMOTE operation.

Any other equipment used in connection with this receiver, such as, a direction finder, interphone system, etc., should also be checked at this time. It must be determined which position is to have control during flight so that LOCAL-REMOTE switch on the receiver may be set to the correct position.

4-2. PHONE RECEPTION FROM THE LOCAL POSITION

A. Turn ANTENNA SWITCH to TA for use of receiver with a trailing antenna, turn ANTENNA SWITCH to FA for use with fixed antenna.

B. Turn CW switch to OFF.

C. Turn LOCAL-REMOTE switch to LOCAL.

D. AVC switch may be ON or OFF as desired.

E. Turn POWER switch to ON and allow receiver about fifteen seconds to warm up.

F. Turn BAND SELECTOR knob until the desired band is selected. (The dial mask gives band number and frequency limits.)

G. Turn the TUNING knob until the desired frequency is obtained. (The scale, marked in frequency, is to be used when setting the receiver to a station whose frequency is known.) When stations have been previously logged on the linear scale, turn the tuning knob until the dial scale is on its logged number, then turn the TUNING knob in a clockwise direction until its scale (0-100) is on its logged number; this latter method allows exact resetting of the receiver.

H. With the AVC switch OFF, strong signals may cause overloading of the audio circuits; the VOLUME control should be reduced to give the desired output level in the headphones.

4-3. CW RECEPTION FROM THE LOCAL POSITION

The only changes to the above procedure are:

B. Turn CW switch to ON.

D. AVC switch must be OFF.

4-4. REMOTE FUNCTIONS WHEN CONTROL IS AT THE LOCAL POSITION

When the LOCAL-REMOTE switch is at LOCAL, a listener at the remote point can vary the TUNING and BAND selection. The listener is able to vary his headphone VOLUME, provided his AVC switch is ON.

4-5. PHONE AND CW RECEPTION FROM THE REMOTE POSITION

All controls at the REMOTE position are duplicates of those at the local position except the ANTENNA SWITCH and LOCAL-REMOTE switch. It is necessary to set the ANTENNA SWITCH to the proper type of antenna connection, and the LOCAL-REMOTE switch must be turned to REMOTE before operating from the remote position.

4-6. LOCAL FUNCTIONS WITH CONTROL AT REMOTE POSITION

The listener at the local position may change the type of antenna being used by turning the ANTENNA SWITCH, he may return full control of the receiver to his position by turning LOCAL-REMOTE switch to LOCAL, he may vary the TUNING and BAND SELECTOR controls, and he may control the headphone VOLUME at his position if his AVC switch is ON, even though control is at the REMOTE position.

5. MAINTENANCE

5-1. ROUTINE INSPECTIONS

Regular inspections should be made preceding each flight.

A. All interconnecting cables should be checked to see that they are securely locked in their receptacles. The snapslides fastening the receiver, dynamotor and the remote control units should be locked in place with safety wires.

B. Check the airplane battery with a hydrometer.

C. Check the operation of the voltage regulator of the charging generator, adjusting, if necessary, to insure consistent operation of the generators at 14 volts to 15 volts.

D. Clean the antenna insulators, especially any which may be exposed to the engine exhaust or propeller blast.

E. Check connections of lead-in wire, both at antenna and at receiver ends.

F. If the receiver is functioning properly with the dynamotor background noise at a suitably low level, do not disturb the dynamotor unit.

Each inspection should include a listening test made on at least one point in each band of the receiver. The operation of all controls should also be checked. (See Section 3-1.) Any major trouble should be apparent from these tests. After each 500 hours of use, the equipment should be completely overhauled.

The receiver should be checked as in Installation Inspection, Section 3-1, in addition the tubes should be tested, all voltages checked to the values given in Section 5-3-1, and the general performance compared to the figures given in Electrical Characteristics, Section 3-1. Any defective parts should be replaced.

If realignment is necessary, it should be done by competent personnel, using the equipment and methods listed in Section 5-3-2.

The remote control unit should be checked for tightness and performance.

5-1-1. LUBRICATION OF DYNAMOTOR

The dynamotor-filter unit consists of a mounting box and the dynamotor. The relay H1 in the mounting box should be checked to see if the points are misaligned or pitted, and the spring tension should also be checked. The dynamotor will require lubrication every 500 hours of operation. At this time, it should be cleaned and inspected for wear. If a major overhaul is required, the dynamotor should be sent to a shop equipped to service such units. A recommended lubricant is Royco No. 6A grease; supplied by Royal Engineering Company, East Hanover, New Jersey.

The following precautions should be observed during inspection and assembly of the dynamotor unit:

A. Bearings should be properly lubricated and free from grit.

B. Commutators must be smooth and free from dirt and grease.

C. All mica between commutator bars must be undercut.

D. Brushes must fit freely in their boxes without excessive side play.

E. Brushes and brush rigging must be clean.

F. Brushes should be installed in same position in box as before disassembly.

G. Brush leads should be shaped so that wire is parallel to brush travel.

H. Brush springs must have required spring tension.

I. Armature must be installed with low voltage commutator at the low voltage head.

J. Pole shoes, if removed, should be replaced in their exact former position.

K. All spacers and washers must be correctly located.

L. End cover felts must be in their proper position.

M. End covers should be tight.

N. All wiring must be connected as per schematic diagram.

O. Replace all locking devices and safety wire.

The dynamotor should then be "run in" unloaded using a fully charged 12-volt battery, a "run in" time of approximately two to four hours should be sufficient to obtain proper seating of brushes. After this, the dynamotor may be checked for output at full load.

5-2. LOCATION AND REMEDY OF FAULTS

5-2-1. GENERAL

The location of open and short circuit faults will be facilitated if, instead of testing at random points, an orderly procedure is followed. Using the schematic diagram for guidance, test one portion of a circuit at a time, and successively check each element contained in that portion for open circuits, short circuits, and grounds by measuring the resistance from point to point with an ohmmeter. If the measured values of resistance are normal, as compared with the resistance chart in Section 5-3-1, that particular portion of the circuit is probably not at fault and needs no further attention. The identifying symbols of all components are given on the diagrams and their normal values can be determined by reference to Section 6.

The following table lists the average signal input required at the grid of each of the amplifier tubes to produce a standard output of 50 milliwatts into a 300-ohm load. In making these comparison measurements, the signal generator output should be connected from grid to ground. In the case of RF and IF amplifier tubes, the grid clip is removed and a 0.5 megohm resistor is shunted from grid to ground. A 0.01 Mfd coupling condenser is used between the signal generator and grid. The grid of the heterodyne oscillator tube V2 should be shorted to ground while testing the IF amplifier. When checking AF amplifier operation, it is not necessary to break the normal grid connection to the tube. The connection to the grid of V6 may be made to the cap of the tube through a 0.1 Mfd coupling condenser with the clip in place. To introduce signal voltage to the grid of V7, it will be necessary to connect the signal generator output across R37 on the underside of the chassis. All measurements should be made with AVC OFF, and the volume control at its maximum clockwise position. For RF measurements, a signal of the specified frequency modulated 30% at 400 CPS should be used. A 400-cycle signal source is used in making AF measurements.

Tube	*Band*	*Frequency*	*Input Microvolts for Standard Output of 50 MW*
V1	1	.15 mc.	3.0
V1	2	.315 mc.	3.0
V1	3	.680 mc.	4.0
V1	4	1.80 mc.	3.0
V1	5	3.70 mc.	3.0
V1	6	7.50 mc.	5.0
V3	IF	1.630 mc.	75
V4	IF	1.630 mc.	1,500
V5	IF	1.630 mc.	75,000
V6	AF	400 CPS	.2 Volts
V7	AF	400 CPS	3.0 Volts

By comparing the receiver performance with these data, the location of operational faults will be greatly facilitated. It is recommended that the stages be checked in reverse order; i.e., V7 through V1.

Should it become necessary to remove either the tuning or band selector knobs, take out the 6-32 holding screw in the center of the knob and replace with an 8-32 brass screw. The knob is tapped for an 8-32 screw and the shaft is tapped for a 6-32 screw; therefore, the end of the 8-32 screw will press against the end of the shaft and force the knob off without any danger of springing the shaft.

CAUTION: *During the assembly of the condenser and drive mechanism to the receiver chassis and panel, all screws (including shaft-coupling set-screws) are tightened while the condenser is connected to a capacity measuring instrument. Any change in the condenser capacity due to torsional strains, etc., is noted and corrected while the assembly screws are being tightened. Do not loosen any screws involving the condenser drive assembly unless it becomes absolutely necessary, as the receiver will have to be recalibrated following any such changes.*

The heterodyne oscillator coil assembly has also been very carefully assembled and adjusted, and any work done on or in it will necessitate recalibrating the receiver.

5-2-2. NO SIGNAL OR WEAK SIGNAL

With no signal or very weak signal, in any position of the tuning dial or band selector switch, the following checks may be made to determine the trouble.

A. Turn the POWER switch to ON.

B. Plug phones in the receiver jack marked PHONES to eliminate the possibility of trouble in the remote unit.

C. Turn the LOCAL-REMOTE switch to LOCAL.

D. Turn the VOLUME control to maximum.

E. Check the PROTECTIVE FUSE in the dynamotor.

F. Try the ANTENNA switch on its three positions to check its operation.

G. Check antenna connections for an open or shorted condition.

H. Measure the filament and plate supply voltages at the panel jacks marked A+ and B+.

I. Listen for audio output through the pin jack marked AUDIO to eliminate the phone jacks and volume control. Be sure that all tubes are lighted, and that the grid clips are connected securely to the grid caps.

J. Removal of the grid clip on V6 will cause a click to be heard in the headphones, if the audio stages of the receiver are functioning. If this click is absent, check the audio tubes V6 and V7. If this does not expose the trouble, check the voltages in the tube sockets. (See Section 5-3-1-1.)

K. Tap the grid of the second IF amplifier V5. A sharp click should be heard if the receiver is functioning following that tube. If a click is not heard, check the tube and the voltages at that tube socket (see Section 5-3-1-1). This check may be repeated on tubes V4 and V3. Check the operation of the high frequency oscillator by connecting a voltmeter to the screen of the tube V2, and note if the voltage (approx. 85 volts) drops when your finger is placed on the grid cap. If the voltage does not vary, the high frequency oscillator coil can should be checked. Remove the antenna and connect a short piece of insulated wire to it. Wrap the insulated wire around the lug on the front of the antenna coil can and note any change in output. If the signal increases, the antenna switch assembly should be checked.

L. Wrap the insulated antenna wire around the grid clip of tube V1 and note any change in output. If the signal increases the antenna can assembly should be checked.

M. Wrap the insulated antenna wire around the grid clip of tube V3 and note any change in output. If the signal increases check vacuum tube V1.

N. Check the voltages at the tube socket of V1.

O. Check the RF can assembly.

5-2-3. INTERMITTENT OR NOISY OPERATION

A. Check all electrical plugs for good contact.

B. Check for loose or shorted antenna connection.

C. Check headphone cord for open circuit while being moved about.

D. Make sure all tubes are pushed all the way in their sockets.

E. Check all grid clips.

F. Check all tube shields.

G. Make certain that no section of the ganged tuning condenser is shorting.

H. Tap all tubes IF filters and RF can assemblies for intermittent contacts.

I. Inspect and tap all parts on the lower side of chassis for mechanical rigidity.

5-3. SERVICING DATA

5-3-1. RESISTANCE - VOLTAGE ANALYSIS

5-3-1-1. TUBE SOCKET VOLTAGES

All measurements are made to ground. The AVC is turned off and the volume control set to its maximum clockwise position. Variations ±10% are normal and do not affect the operation of the receiver. The measurements shown below were made with a 1000-ohm per volt meter, Weston Model 697, or equivalent. Inasmuch as it is impractical to use the same meter range for all measurement, the meter ranges have arbitrarily been designated for purposes of tabulation as follows:

A	0-7.5	C	0-150
B	0-15	D	0-750

In the table, all voltages are followed by the reference letter of the range used in making the measurement.

Tube	*Socket Terminal and Corresponding Tube Elements*						
	1	2 to 7	3	4	5	6	8
V1-RF Amp:	0	6.2 (A)	205 (D)	70 (C)	2.6 (A)	.	2.6 (A)
V2-HF Osc:	0	6.5 "	170 "	85 "	0	.	0
V3-1st Det:	0	6.2 "	210 "	98 "	0	.	5.55 "
V4-1st IF:	0	6.3 "	205 "	70 "	2.75 "	.	2.75 "
V5-2nd IF:	0	6.3 "	187 "	70 "	2.5 "	.	2.5 "
V6-2nd Det:	0	6.2 "	47 (C)	0	0	.	0
V7-2nd Audio:	0	6.3 "	205 "	213 (D)	0	.	15.0 (C)
V8-CW Osc:	0	6.1 "	2.7 (B)	2.7 (B)	0	.	1.8 (A)

Tip jacks; A+ to G: 14 (C), B+ to G: 220 (D)

5-3-1-2. RESISTOR VOLTAGE DROP MEASUREMENTS

The following tabulation lists the average voltage drop across the various resistors located on the underside of the chassis. The indicated voltage is the normal expected drop across the particular resistor with a battery potential of 14 volts, and with the volume control full on, AVC off and CW oscillator off. Variations of ±10% from the tabulated voltages may be considered normal.

The system of indicating the meter range used in taking the measurements is the same as that adopted in Section 5-3-1-1. Here as well, the various ranges are arbitrarily designated as follows:

A	0-7.5	C	0-150
B	0-15	D	0-750

The reference letter of the scale follows each indicated voltage.

Symbol	*Voltage*	*Symbol*	*Voltage*	*Symbol*	*Voltage*
R1	0	R7	0	R12	95. (C)
R2	2.25 (A)	R8	68. (C)	R13	1.25 (A)
R3	2.6 (A)	R9	41. (C)	R14	0
R4	3.85 (A)	R10	84. (C)	R15	2.4 (A)
R5	0	R11	5.5 (A)	R16	2.9 (A)
R17	3.5 (A)	R29	0	R39	0
R18	2.35 (A)	R30	0	R40	0
R19	2.95 (A)			R43.1	12.2 (B)
R20	19. (C)	R32	2.7 (B)	R43.2	6.1 (A)
R21	62. (C)	R33	1.15 (A)	R44.1	0
R22	115. (C)	R34	91. (C)	R44.2	11.5 (B)
R23	0	*R35	.15 Neg. (A)	R45	0
R24	0	R37	0		
R26	142. (C)	R38	15. (C)		

*C.W. Switch On

5-3-1-3. POINT-TO-POINT RESISTANCE MEASUREMENTS

The following table indicates the average resistance to be expected when measured from the terminals of the various tube sockets to ground with the Weston Model 697 Selective Set Servicer. The power cable should be connected between the receiver and receiver dynamotor but the filament power switch must be turned off. The AVC and CW switches should be off and the volume control turned to its maximum clockwise position.

Tube	*Socket Terminals*							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
V1	0	5.5 (A)	1,550 (B)	14,500 (B)	500 (B)	.	4.8 (A)	500 (B)
V2	0	0	5,300 (B)	18,000 (B)	0	.	3.9 (A)	0
V3	0	5.0 (A)	1,500 (B)	24,000 (B)	45,000 (B)	.	3.9 (A)	1,000 (B)
V4	0	1.3 (A)	1,400 (B)	14,200 (B)	500 (B)	.	4.8 (A)	500 (B)
V5	0	3.2 (A)	5,400 (B)	14,000 (B)	500 (B)	.	1.5 (A)	500 (B)
V6	0	2.0 (A)	45,000 (B)	500,000 (B)	500,000 (B)	.	4.0 (A)	0
V7	0	0	890 (B)	500 (B)	1 Meg (B)	.	2.0 (A)	750 (B)
V8	0	4.2 (A)	200,000 (B)	80,000 (B)	0	.	4.2 (A)	*

J4	Test jack - ground	0	
J5	Test jack -- audio	° 17 (A)	
J6	Test jack - A+	1.5 (A)	
J7	Test jack - B+	500 (A)	

*C.W. Switch Off. No Connection
C.W. Switch On. 0 Ohms

° No Load
(A) X10 Scale
(B) X100 Scale

5-3-2. TRIMMER ALIGNMENT

WARNING: DO NOT CHANGE THE SETTING OF ANY TRIMMER CAPACITOR UNLESS THE NEED OF SUCH ADJUSTMENT IS DEFINITELY ESTABLISHED. NO ADJUSTMENT SHOULD BE MADE, IN ANY CASE, UNTIL THE FOLLOWING INSTRUCTIONS ARE CAREFULLY READ AND THE PROPER PROCEDURE THOROUGHLY UNDERSTOOD.

5-3-2-1. GENERAL

Should it become necessary to realign the receiver, it should be permitted to warm up for fifteen minutes before any adjustments are made.

The shielding compartments of the antenna, RF and oscillator stages (Figure 3) are provided with cover slides which protect the coils and trimmer condensers from dust. Loosening the two screws in each cover plate permits sliding the plate along to expose the condenser shafts for adjustment.

A signal generator with a low-impedance output and a 300-ohm output meter are necessary to align the Type RA-1B Receiver. A high-impedance headset may be placed in parallel with the output meter for monitoring. The signal generator must be capable of delivering the following frequencies with precision:

.150 Mcs	1.800 Mcs
.315 Mcs	3.700 Mcs
.680 Mcs	7.500 Mcs
1.500 Mcs	15.00 Mcs
1.630 Mcs	

5-3-2-2. IF AMPLIFIER ALIGNMENT

Remove the RF grid clip from the converter tube V3. Connect an 0.5 megohm resistor from the grid of V3 to ground. Connect the shield of the signal generator output cable to the tube shield can and connect the high potential lead from the generator to the grid of V3 through a 0.01 Mfd condenser.

A. Short the grid of the oscillator V2 to ground.

B. Turn the VOLUME control to maximum.

C. Turn the LOCAL-REMOTE switch to LOCAL.

D. TURN THE A.V.C. switch to OFF.

E. Turn the C.W. switch to OFF.

F. Plug the output meter into the receiver jack marked PHONES.

G. Set the signal generator accurately at 1.630 Mcs with 30% modulation at 400 CPS.

H. Adjust the trimmer condensers C54, C58, C59, C60, C62, and C63 on intermediate frequency transformers FL1, FL2 and FL3 for maximum output as indicated by the output meter, (Figures 2 and 5.) Keep the signal from the generator as low as possible at all times. Vary the signal generator frequency and set for maximum on the output meter. Read the signal generator frequency, and, if it is not 1630

Kcs, repeat the previously described alignment of intermediate frequency transformers FL1, FL2, and FL3 with the generator accurately reset at 1630 Kcs.

I. The input at resonance should be approximately 50 microvolts for an output of 50 milliwatts into a 300-ohm load; the total IF band width at 1000 times the resonant input is 45 Kcs or less.

While the signal generator is at exactly 1.630 Mcs turn off the modulation and turn the C.W. switch to ON. Adjust C71 on the CW oscillator can (Figure 5) for zero beat in the phones. The CW oscillator tube will then oscillate at the exact IF frequency and the zero beat method of aligning the oscillator stage can be employed. After completion of alignment, the CW oscillator should be readjusted to 1.631 Mcs for the 1000 cycle per second difference frequency.

5-3-2-3. HF OSCILLATOR ALIGNMENT

Connect the low potential lead from the signal generator to the ground post G of the receiver.

Connect the high potential lead from the signal generator to a 100 Mmf condenser which in turn is connected to the antenna post A on the receiver.

A. Turn the ANTENNA SWITCH to FA.

B. Turn the A.V.C. switch to OFF.

C. Turn the C.W. switch to ON.

D. Turn the VOLUME control knob to maximum.

E. Turn the LOCAL-REMOTE switch to LOCAL.

F. Turn the BAND SELECTOR switch of the receiver to BAND 1.

G. Turn the TUNING knob of the receiver so that the MEGACYCLES dial reads .315 Mcs on the calibrated scale.

H. Log the setting of the linear scale and TUNING knob so that it can be reset with precision.

I. Turn the spring dust cover to one side and adjust the antenna compensating condenser C81 (Figure 2) for maximum capacity.

J. Set the signal generator to give approximately 50-microvolt unmodulated output at exactly .315 Mcs.

K. Adjust the oscillator trimmer condenser C35 on Band 1 for zero beat in the headphones.

L. Set the signal generator to exactly .150 Mcs.

M. Turn the TUNING knob of the receiver so that the MEGACYCLES dial reads .150 Mcs on the calibrated scale, and log the setting.

N. Adjust the oscillator padder condenser C41 for zero beat. (Use a non-metallic screw driver.)

O. Reset the signal generator to .315 Mcs.

P. Retune the receiver to .315 Mcs by means of the logged setting.

Q. Readjust trimmer condenser C35 for zero beat.

These adjustments at the ends of the band must be repeated until the last adjustment when checked does not have to be altered.

The above procedure has been described for aligning the oscillator on Band 1. The same procedure may be used on the other bands. The following tables lists the trimmer and padder condenser numbers to be used with the various bands at the end frequencies. (See Figures 3 and 5.)

	HIGH FREQ. END OF BAND		LOW FREQ. END OF BAND	
Band No.	Freq. Mcs	Trimmer Cond. No.	Freq. Mcs	Trimmer Cond. No.
1	.315	C35	.150	C41
2	.680	C36	.315	C42
3	1.500	C37	.680	C43
4	3.700	C38	1.800	C44
5	7.500	C39	3.700	C45
6	15.000	C40	7.500	C46

5-3-2-4. ANTENNA AND RF STAGE ALIGNMENT

Connect the signal generator to the receiver as in Section 5-2-1 and adjust the receiver controls as for alignment of the HF oscillator, except that the C.W. switch should be turned to OFF.

A. Adjust the signal generator to 30% modulation at 400 CPS.

B. Set the signal generator at exactly .315 Mcs.

C. Turn BAND SELECTOR switch to BAND 1.

D. Tune the receiver to .315 Mcs.

E. Adjust signal voltage to obtain a receiver output of approximately 50 milliwatts.

F. Adjust RF trimmer condenser C29 for maximum indication of output meter.

G. Adjust antenna trimmer condenser C16 for maximum indication of output meter.

H. Decrease the signal generator output voltage as trimmers are adjusted to keep output of receiver at 50 milliwatts or less.

I. Final adjustments should be made using a signal generator output of five microvolts. The receiver sensitivity control should be decreased as necessary to keep the receiver output at approximately 50 milliwatts.

The above procedure describes the adjustments necessary to align the antenna and RF stages on BAND 1.

Repeat the above procedure at the high frequency ends of the remaining bands, using the frequencies and adjusting the trimmer condensers listed in the table below: (See Figure 3).

Band No.	Freq. Mcs.	Antenna Trimmer	RF Trimmer
1	.315	C16	C29
2	.680	C17	C30
3	1.500	C18	C31
4	3.700	C19	C32
5	7.500	C20	C33
6	15.000	C21	C34

6. MATERIAL LISTS

6-1. TYPE RA-1B RECEIVING EQUIPMENT

Symbol	Function	Description	Mfr's Type No.	Mfr.	Bendix Number
		CAPACITORS			
C1.1	Antenna Tuning	3 Gang 1st Sec. 348 Mmf Max.			
C1.2	RF Tuning	3 Gang 2nd Sec. 241 Mmf Max.	.	2	QE15189
C1.3	Osc. Tuning	3 Gang 3rd Sec. 241 Mmf Max.			
C2.1	V4 Grid Return Bypass				
C2.2	V3 Plate Bypass	3 x .1 Mfd 400V DCW Oil-paper	A206-2	3	A206-2
C2.3	V1 Screen Bypass				
C3.1	V1 Cathode Bypass				
C3.2	V3 Screen Bypass	3 x .1 Mfd 400V DCW Oil-paper	A205-2	3	A205-2
C3.3	V3 Cathode Bypass				
C4.1	V3 Grid Return Bypass				
C4.2	V2 Screen Bypass	Same as C3	.	.	.
C4.3	V2 Plate Bypass				
C5.1	V4 Cathode Bypass				
C5.2	V4 Screen Bypass	Same as C2	.	.	.
C5.3	V8 Screen Bypass				
C6.1	V4 Plate Bypass				
C6.2	V5 Cathode Bypass	Same as C2	.	.	.
C6.3	V5 Screen Bypass				
C7	V1 Grid Return Bypass	.1 Mfd 400V DCW Oil-paper	A204-1	3	A204-1
C9.1	V1 Plate Bypass				
C9.2	B + Supply Bypass	Same as C3	.	.	.
C9.3	Screen Supply Bypass				
C10.1	V8 Plate Bypass				
C10.2	AVC Filter	Same as C3	.	.	.
C10.3	V5 Plate Bypass				
C11	V7 Cathode Bypass	1.0 Mfd 100V DCW, Paper	VC 1541	3	B4991
C12	Antenna Coupling Band 1	10 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-100
C13	Antenna Coupling Band 2	Same as C12	.	.	.
C14	Antenna Coupling Band 3	5 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-050
C15	Antenna Coupling Band 4	Same as C12	.	.	.
C16	Antenna Trimmer Band 1	50 Mmf Var. Spec. Invar.Silver Plated	APC	5	B7175-15
C17	Antenna Trimmer Band 2	Same as C16	.	.	.
C18	Antenna Trimmer Band 3	Same as C16	.	.	.
C19	Antenna Trimmer Band 4	75 Mmf Var. Spec. Invar.Silver Plated	APC	5	B7175-16
C20	Antenna Trimmer Band 5	Same as C19	.	.	.

Symbol	*Function*	*Description*	*Mfr's Type No.*	*Mfr.*	*Bendix Number*
		CAPACITORS (Cont'd)			
C21	Antenna Trimmer Band 6	100 Mmf Var. Spec. Invar. Silver Plated	APC	5	B7175-17
C22	RF Primary Shunting Band 1	500 Mmf ±10%, 500V DCW, Mica	1468 with XM262 Case	4	C56315-501
C23	RF Primary Shunting Band 2	70 Mmf ± 5% 500V DCW Mica	1468 with XM262 Case	4	C56314-700
C24	RF Primary Shunting Band 3	15 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-150
C25	RF Coupling Band 4	Same as C12	.	.	.
C26	RF Coupling Band 5	Same as C14	.	.	.
C27	RF Coupling Band 6	Same as C14	.	.	.
C28	Antenna Coupling Band 5	Same as C12	.	.	.
C29	RF Trimmer Band 1	25 Mmf Var. Invar. Silver Plated	APC	5	B7175-13
C30	RF Trimmer Band 2	Same as C29	.	.	.
C31	RF Trimmer Band 3	Same as C29	.	.	.
C32	RF Trimmer Band 4	Same as C16	.	.	.
C33	RF Trimmer Band 5	Same as C16	.	.	.
C34	RF Trimmer Band 6	Same as C16	.	.	.
C35	Osc. Trimmer Band 1	Same as C19	.	.	.
C36	Osc Trimmer Band 2	Same as C16	.	.	.
C37	Osc. Trimmer Band 3	Same as C16	.	.	.
C38	Osc. Trimmer Band 4	Same as C29	.	.	.
C39	Osc. Trimmer Band 5	Same as C29	.	.	.
C40	Osc. Trimmer Band 6	Same as C29	.	.	.
C41	Osc. Padder Band 1	Same as C19	.	.	.
C42	Osc. Padder Band 2	Same as C21	.	.	.
C43	Osc. Padder Band 3	Same as C19	.	.	.
C44	Osc. Padder Band 4	Same as C19	.	.	.
C45	Osc. Padder Band 5	Same as C21	.	.	.
C46	Osc. Padder Band 6	Same as C21	.	.	.
C47	Osc. Padder Band 3	110 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 Case	4	B15530-37P
C48	Osc. Padder Band 4	300 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 Case	4	B15530-16P
C49	Osc. Padder Band 5	580 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 Case	4	B15530-38P
C50	Osc. Padder Band 6	1110 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 Case	4	B15530-39P
C51	V2 Grid Coupling	100 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-101
C52	Osc. Coupling	25 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-250
C54 C58	1st IF Plate Trimmer 1st IF Grid Trimmer	110-150 Mmf Dual Var.	APC 2556	5	B7066

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		CAPACITORS (Cont'd)			
C59	2nd IF Plate Trimmer	Same as C54	.	.	.
C60	2nd IF Grid Trimmer				
C61	CW Osc. Coupling	1.5 Mmf ±50% Mica	P120K10	6	B7003-20M
C62	3rd IF Plate Trimmer	Same as C54	.	.	.
C63	3rd IF Grid Trimmer				
C64	3rd IF Coupling	Same as C61	.	.	.
C65	V6 Diode Load Bypass	150 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-151
C67	V6 Grid Bypass	Same as C65	.	.	.
C68	V6 Plate Bypass	230 Mmf ±10%, 500V DCW Mica	1468 with XM262 Case	4	C56315-251
C69	V7 Grid Coupling	.01 Mfd ±10%, 500V DCW Mica	1467 with XM262 Case	4	C56312-103
C70	CW Osc. Cathode Return Bypass	Same as C69	.	.	.
C71	CW Osc. Tuning	Same as C19	.	.	.
C72	CW Osc. Fixed Tuning	500 Mmf ±3% Mica	2R (red case)	3	B15310-10P
C73	CW Osc. Grid	100 Mmf ±10% Mica	.	6	B7003-7F
C80	Trailing Wire Antenna	Same as C65	.	.	.
C81	Antenna Series Trimmer	100 Mmf Var. Brass Plates	APC	5	A10620-1
C82	Antenna Series Coupling	Same as C65	.	.	.
C83	Shunt, Sec. T1	Same as C69	.	.	.
		INDICATOR LAMP			
DL1	Dial Light	14-16 V Bayonet Base	T-3 1/4	10	A13244
		INDUCTORS			
L1	Antenna Band 1	.	.	1	AB11864
L2	Antenna Band 2	.	.	1	AB11865
L3	Antenna Band 3	.	.	1	AB11866
L4	Antenna Band 4	.	.	1	AB6772
L5	Antenna Band 5	.	.	1	AB6773
L6	Antenna Band 6	.	.	1	AB6774
L7	RF Band 1	.	.	1	AB6776
L8	RF Band 2	.	.	1	AB6777
L9	RF Band 3	.	.	1	AB6778
L10	RF Band 4	.	.	1	AB6779
L11	RF Band 5	.	.	1	AB6780
L12	RF Band 6	.	.	1	AB6781
L13	Heterodyne Osc. Band 1	.	.	1	AB6783-1
L14	Heterodyne Osc. Band 2	.	.	1	AB6783-2
L15	Heterodyne Osc. Band 3	.	.	1	AB6783-3
L16	Heterodyne Osc. Band 4	.	.	1	AB11676
L17	Heterodyne Osc. Band 5	.	.	1	AB6784

Symbol	*Function*	*Description*	*Mfr's. Type No.*	*Mfr.*	*Bendix Number*
		INDUCTORS (Cont'd)			
L18	Heterodyne Osc. Band 6	.	.	1	AB6785
L19	IF Filter #FL1 Primary	.	.	1	A27818
L22	IF Filter #FL1 Secondary				
L23	IF Transformer #FL2 Pri.	Same as L19-22	.	.	.
L24	IF Transformer #FL2 Sec.				
L25	IF Transformer #FL3 Pri.	Same as L19-22	.	.	.
L26	IF Transformer #FL3 Sec.				
L27	CW Osc.	.	.	1	A27822-1
		PLUGS			
PL1	For Remote Control	8 Contact Plug Board	.	1	AA296-1
PL3	Power Cable, Dynamotor	6 Contact Plug Board	.	1	AA309-1
CCF1	For Remote Control	8 Prong, 90°Female.655 wire hole	.	1	AA12468-1
CCF3	Power Cable, Dynamotor	6 Prong,90°Female .550" wire hole	.	1	AA11845-1
		RECEPTACLES			
J1	Local Telephone Jack	Single Circuit	TC-60	16	A3098
J4	Test Jack - Ground	Tip Jack	419A	8	A4509
J5	Test Jack - Audio	Same as J4	.	.	.
J6	Test Jack - A+	Same as J4	.	.	.
J7	Test Jack - B+	Same as J4	.	.	.
		RESISTORS			
R1	V1 Grid Decoupling	50,000 ohms, 1/4W,±10%, Ceramic	.	6	A18151-503
R2	V1 Cathode Initial Bias	500 ohms, 1/4W,±10%, Ceramic	.	6	A18151-501
R3	V1 Screen Decoupling	5,000,ohms,1/4W,±10%, Ceramic	.	6	A18151-502
R4	V1 Plate Decoupling	1,000 ohms,1/4W,±10%, Ceramic	.	6	A18151-102
R5	V3 Grid Decoupling	Same as R1	.	.	.
R6	V2 Grid Leak	Same as R1	.	.	.
R7	V3 Grid Return	Same as R1	.	.	.
R8	V2 Screen Decoupling	25,000 ohms,1/4W,±10%,Ceramic	.	6	A18151-253
R9	V2 Plate Decoupling	Same as R3	.	.	.
R10	V2 Screen Decoupling	Same as R1	.	.	.
R11	V3 Cathode Initial Bias	Same as R4	.	.	.
R12	V3 Screen Decoupling	Same as R8	.	.	.
R13	V3 Plate Decoupling	Same as R4	.	.	.
R14	V4 Grid Decoupling	Same as R1	.	.	.
R15	V4 Cathode Initial Bias	Same as R2	.	.	.
R16	V4 Screen Decoupling	Same as R3	.	.	.
R17	V4 Plate Decoupling	Same as R4	.	.	.
R18	V5 Cathode Initial Bias	Same as R2	.	.	.

Symbol	*Function*	*Description*	*Mfr's. Type No.*	*Mfr.*	*Bendix Number*
		RESISTORS (Cont'd)			
R19	V5 Screen Decoupling	Same as R3	.	.	.
R20	V5 Plate Deccupling	Same as R4	.	.	.
R21 R22	V1,V4,V5 Screen Voltage Divider	20,000 ohms, 2W ±5%, Ceramic	.	7	A4516-1
R23	V6 Diode Load	700,000 ohms, 1/4W, ±10%, Ceramic	.	6	A18151-700
R24	V6 Diode Load	300,000 ohms, 1/4W, ±10%, Ceramic	.	6	A18151-304
R26	V6 Plate Load	Same as R1	.	.	.
R29	V6 Diode Filter	1 Megohm 1/4W, ±10%, Ceramic	.	6	A18151-105
R30	AVC Overload Limiting	Same as R1	.	.	.
R32	V8 Plate Bleeder	100,000 ohms, 1/4W, ±10%, Ceramic	.	6	A18151-104
R33	V8 Plate Bleeder	500,000 ohms, 1/4W, ±10%, Ceramic	.	6	A18151-504
R34	V8 Plate Bleeder	Same as R33	.	.	.
R35	V8 Grid Leak	Same as R32	.	.	.
R37	V7 Grid Return	Same as R29	.	.	.
R38	V7 Cathode Bias	750 ohms, 1/2W, ±10%, Ceramic	.	6	A18150-751
R39 R40	Dual Volume Sensitivity Control	10,000 ohms, maximum Curve E 2,000 ohms, maximum Curve B	.	7	A27811
R43.1 R43.2	Filament Current Compensating	126 ohms, ±5% 63 ohms, ±5%	MW-2	7	QB15190-3
R44.1 R44.2	Dial Light Dropping	120 ohms, ±5% 120 ohms, ±5%	MW-2	7	QB15190-1
R45	Audio Load	Same as R2	.	6	.
R47	Static Drain	Same as R33	.	6	.
		SWITCHES			
S1	Antenna Primary Selector	6 Position - 1 Pole	RN	8	A26020
S2	Antenna Grid Selector	Same as S1	.	.	.
S3	RF Primary Selector	Same as S1	.	.	.
S4	RF Grid Selector	Same as S1	.	.	.
S5	Osc. Tuning Condenser	Same as S1	.	.	.
S6	Osc. Coil Selector	Same as S1	.	.	.
S7	Osc. Cathode	Same as S1	.	.	.
S8	Local AVC On-Off	DPDT 7/8" Shank	.	14	A3142-1
S9	Local-remote	4 PDT	3100J	8	A4506
S10	Local CW On-Off	SPDT, 7/8" Shank	.	14	A3141-1

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		SWITCHES (Cont'd)			
S11	Local Power On-Off	Same as S10	.	.	.
S15	Antenna Selector	Two Pole Three Position	.	8	A3528
		TRANSFORMER			
T1	Audio Output	260 ohms, Impedance	.	11	QE15206-1
		VACUUM TUBES			
V1	RF Amplifier	Super-Control Pentode	6K7G	12	.
V2	Heterodyne Oscillator	Same as V1	.	.	.
V3	Converter	Pentagrid Mixer	6L7G	12	.
V4	1st IF Amplifier	Same as V1	.	.	.
V5	2nd IF Amplifier	Same as V1	.	.	.
V6	2nd Detector	Duplex-Diode Triode	6R7G	12	.
V7	Audio Output	Power Amplifier Pentode	6K6G	12	.
V8	CW Oscillator	Same as V1	.	.	.

6-2. TYPE RA-1I RECEIVER

The RA-1I Receiver uses the same parts as an RA-1B except for the following:

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		CAPACITOR			
C83	Shunt, Sec. T1	.001 Mfd ±10% 500V DCW Mica	1467	4	C56312-102
		RESISTORS			
R39	Local, dual volume	Rear, 10,000 ohms, Curve E	Dual Type CP	7	A2782
R40	Sensitivity control	Front, 25,000 ohms, Curve B			
R45	Audio load	4000 ohms, 1/4W ±10% Ceramic	.	6	A18151-402
		TRANSFORMER			
T1	Audio Output Transformer	3500 ohms, Impedance	Special	11	A27010

6-3. TYPE RA-1J RECEIVER

The RA-1J Receiver uses the same parts as an RA-1B except for the following:

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		CAPACITORS			
C15	Antenna Coupling Band 4	5 Mmf ±10%, 500V DCW Mica	1468 with XM262 case	4	C56315-050
C48	Heterodyne Osc Padder Band 4	420 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 case	4	B15530-47P
C49	Heterodyne Osc Padder Band 5	810 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 case	4	B15530-48P
C50	Heterodyne Osc Padder Band 6	1420 Mmf ±2 1/2%, 500V DCW Mica	1467 with XM262 case	4	B15530-49P
	Capacitors C25, C26, C27 and C28 not used.				
		INDUCTORS			
L4	Antenna Band 4	.	.	1	B13688
L5	Antenna Band 5	.	.	1	B13689

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		INDUCTORS (Cont'd)			
L6	Antenna Band 6	.	.	1	B13690
L10	RF Band 4	.	.	1	B13694
L11	RF Band 5	.	.	1	B13695
L12	RF Band 6	.	.	1	B13696
L16	Heterodyne Osc Band 4	.	.	1	B13700
L17	Heterodyne Osc Band 5	.	.	1	B13701
L18	Heterodyne Osc Band 6	.	.	1	B13702
		RESISTORS			
R2	V1 Cathode Initial Bias	300 ohms, 1/4W ±10% Ceramic	.	6	A18151-301
R8	V2 Screen Decoupling	20,000 ohms, 1/4W ±10% Ceramic	.	6	A18151-203
R9	V2 Plate Decoupling	Same as R4 in RA-1B	.	.	.
R11	V3 Cathode Initial Bias	Same as R2 in RA-1B	.	.	.
		VACUUM TUBE			
V2	Heterodyne Oscillator	Triple - Grid Pentode	6J7G	12	.

6-4. TYPE MR-1B REMOTE CONTROL UNIT

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		INDICATOR LAMP			
DL2	Dial Lamp	Same as DL1	.	.	.
		PLUGS			
PL2	Remote Control Cable	Same as PL1	.	.	.
CCF2	Remote Control Cable	8 Prong, Straight, Female .655 Wire Hole	.	1	AA12443
		RECEPTACLES			
J2	Telephone Jack	Same as J1	.	.	.
J3	Telephone Jack	Same as J1	.	.	.
		RESISTORS			
R41 R42	Dual Volume, Sensitivity Control	Same as R39-R40	.	.	.
R46	Audio Load	Same as R45	.	.	.
		SWITCHES			
S12	AVC On-Off	Same as S8	.	.	.
S13	CW On-Off	Same as S10	.	.	.
S14	Power On-Off	Same as S10	.	.	.

6-5. TYPE MR-1I REMOTE CONTROL UNIT

The Mr-1I Remote Control Unit uses the same parts as an MR-1B except for the following:

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		RESISTORS			
R41 R42	Dual Volume, Sensitivity Control	Same as R39-R40 in RA-1I	.	.	.
R46	Audio Load	Same as R45 in RA-1I	.	.	.

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number

6-6. TYPE MR-1J REMOTE CONTROL UNIT

The MR-1J Remote Control Unit uses the same electrical parts as the MR-1B.

6-7. TYPE MP-5B POWER SUPPLY

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		CAPACITORS			
C74	LV Filter				
C75	HV Filter	3 x .8 Mfd 500V DCW, Paper	VC-368	3	A4532
C76	HV Filter				
C77	LV Noise Filter	Same as C69	.	.	.
C78	LV Noise Filter	Same as C69	.	.	.
C79	Dynamotor Brush Input	Same as C69	.	.	.
		PLUGS			
CCF4	Power Supply Cable	6 Prong, Straight, Female	.	1	AA11846
CCF7	Battery Supply Cable	2 Prong, Straight	.	1	AA12467-1
		DYNAMOTORS			
DYN	Power Supply	14V, 3A Input; 230V, .1A output	PS150	18	QE10309
.	LV Positive Brush	.	.	18	B15512
.	LV Negative Brush	.	.	18	B15513
.	HV Positive Brush	.	.	18	B15514
.	HV Negative Brush	.	.	18	B15515
		FUSE			
F1	Dynamotor Input	10A,25V	3AG-1081	17	B3535-6
		RELAY			
H1	Dynamotor Control	2 Pole 8-16V DC, Normally Open	1204	15	B4894-1
		INDUCTORS			
L28	RF Input Choke	.	.	1	AB655
L29	HV Filter Choke	6 Henries .080A, 160 ohms DC Resistance	3236A	9	A13111-1
		RECEPTACLES			
PL4	Receiver Power Supply	Same as PL3	.	.	.
PL5	Direction Finder Supply	5 Contact Plug Board	.	1	AA306-1
PL6	Interphone Power Supply	Same as PL5	.	.	.
PL7	Battery Supply	2 Prong Plug Board	.	1	AA310-1

6-8. TYPE MP-5A24 POWER SUPPLY

The Type MP-5A24 Power Supply uses the same parts as an MP-5B except for the following:

Symbol	Function	Description	Mfr's. Type No.	Mfr.	Bendix Number
		DYNAMOTOR			
DYN	Power Supply	28V, 1.55A Input; 230V, .1A output	PS150	18	QE10309-1
		FUSE			
F1	Dynamotor Output	1/8A, 500V	3AG-1044	17	B3532-21
		RELAY			
H1	Dynamotor Control	16-30V DC, Normally Open	1204	15	B4894-1

7. ADDRESSES OF MANUFACTURERS

1. Bendix Radio Corp.,
920 E. Fort Avenue,
Baltimore, Maryland.

2. Radio Condenser Co.,
Camden, N. J.

3. Cornell-Dubilier Electric Corp.,
1006 Hamilton Blvd.,
South Plainfield, N. J.

4. Aerovox Corp.,
New Bedford, Mass.

5. Hammarlund Mfg. Co., Inc.,
424 West 33rd Street,
New York, N. Y.

6. Erie Resistor Co.,
644 W. 12th Street,
Erie, Pa.

7. International Resistor Corp.,
401 N. Broad Street,
Philadelphia, Pa.

8. Yaxley Mfg. Co.,
Div. of P. R. Mallory Co., Inc.,
3029 E. Washington Street,
Indianapolis, Indiana.

9. Chicago Transformer Co.,
3501 Addison Street,
Chicago, Illinois.

10. General Electric Co.,
Nela Park,
Cleveland, Ohio.

11. Raytheon Mfg. Co.,
190 Willow Street,
Waltham, Mass.

12. R.C.A. Radiotron Div.,
R.C.A. Mfg. Co., Inc.,
401 Bergen Street,
Harrison, N. J.

13. A. J. Ulmer,
90 West Broadway,
New York, N. Y.

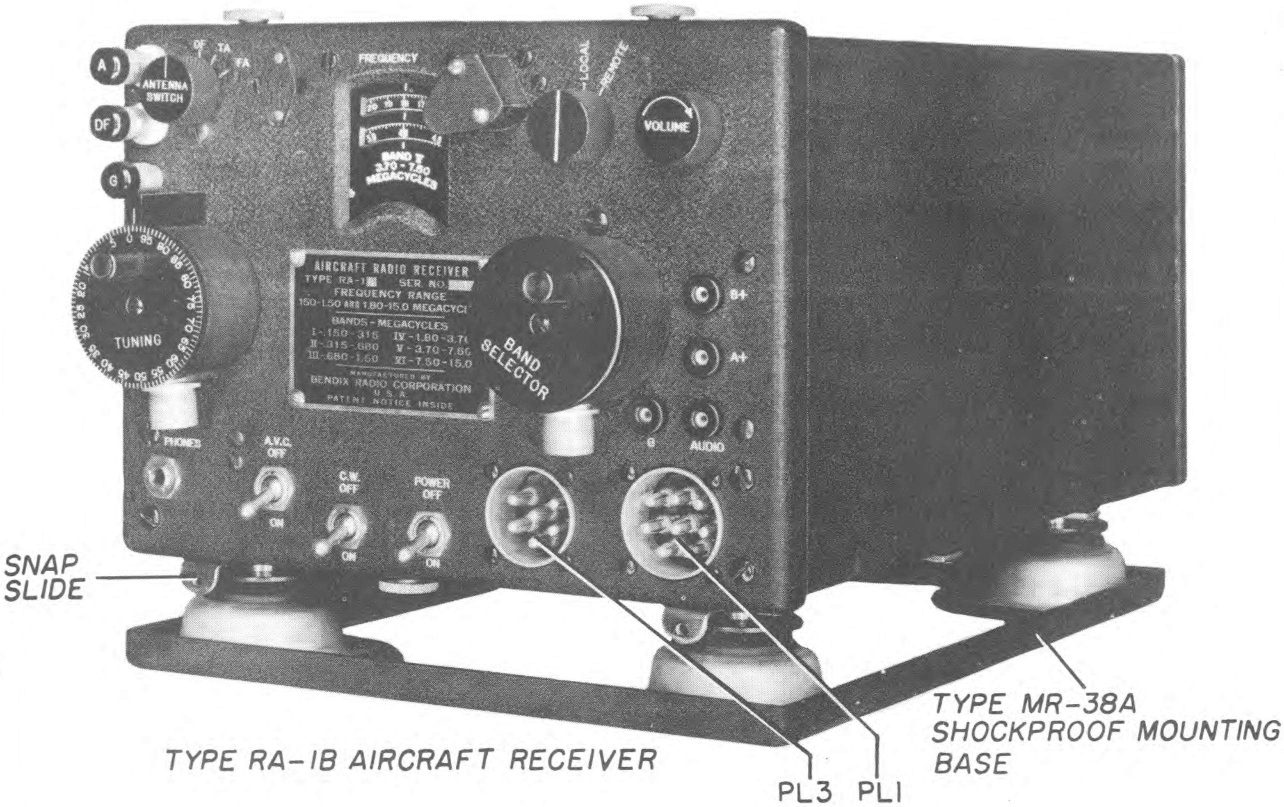
14. Hart & Hegeman Division,
Arrow-Hart & Hegeman Electric Co.
3201 Arch Street,
Philadelphia, Pa.

15. Leach Relay Co.,
5915 Avalon Blvd.,
Los Angeles, Calif.

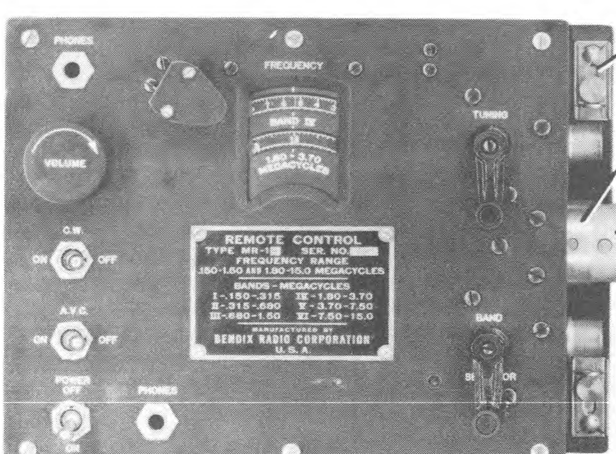
16. Telephonics Corp.,
350 W. 35th Street,
New York, N. Y.

17. Littelfuse, Inc.,
4757 Ravenswood Avenue,
Chicago, Illinois.

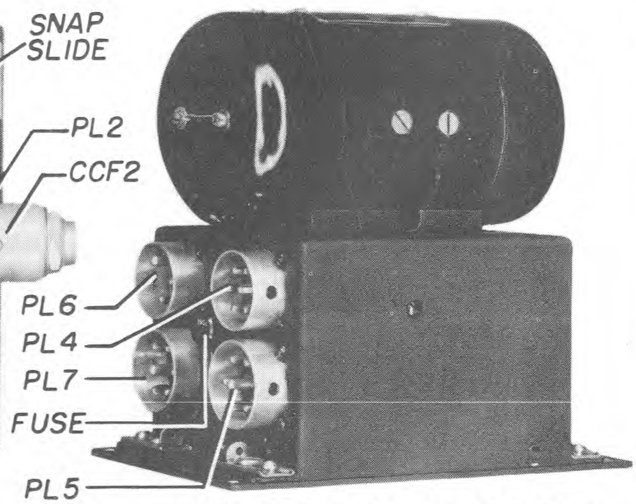
18. Pioneer Gen-E-Motor Corp.,
466 W. Superior Street,
Chicago, Illinois.



TYPE RA-1B AIRCRAFT RECEIVER



TYPE MR-1B REMOTE CONTROL



TYPE MP-5A24 DYNAMOTOR

FIG. 1-TYPE RA-1B AIRCRAFT RADIO RECEIVER EQUIPMENT

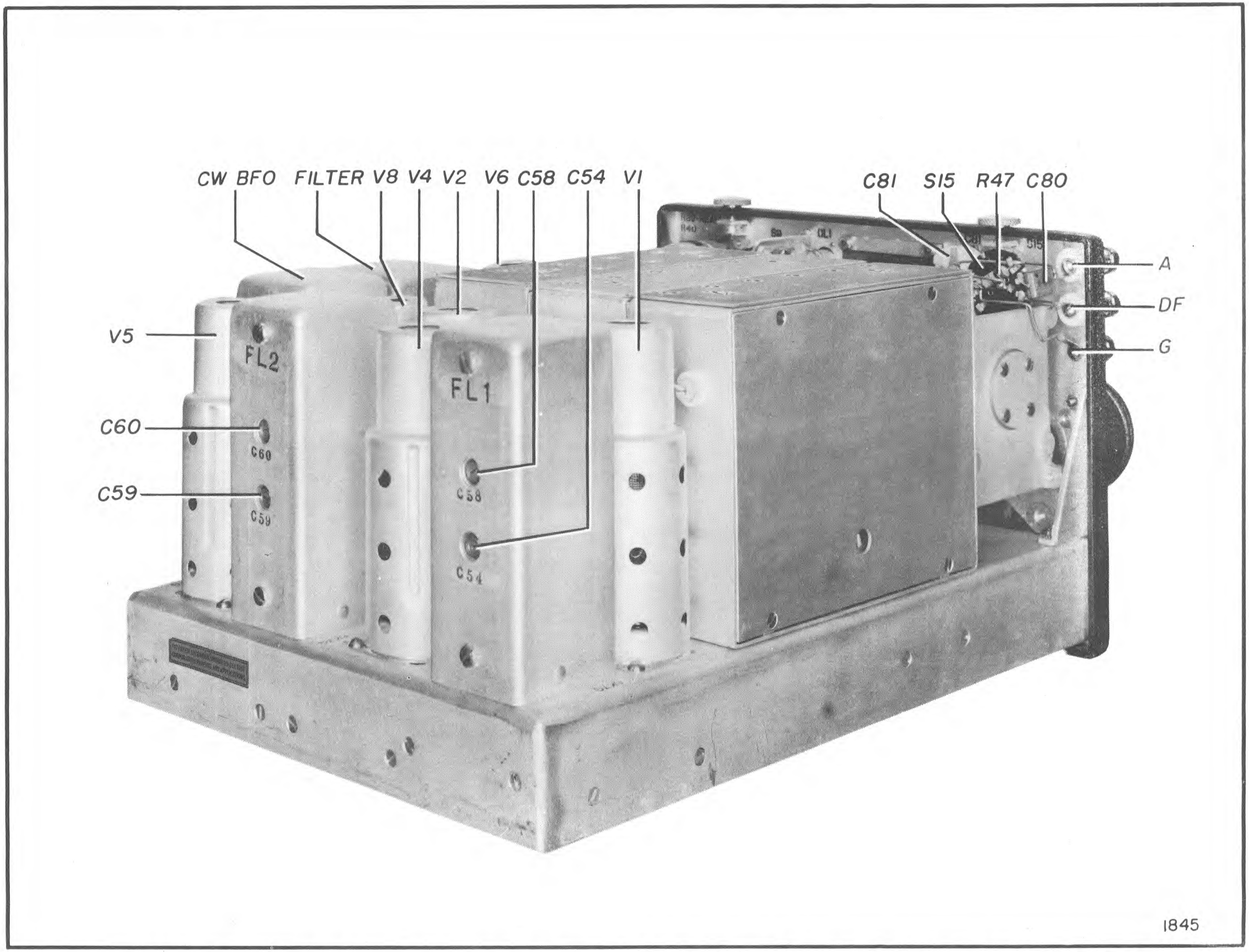


FIG. 2-TYPE RA-1B AIRCRAFT RECEIVER (REAR OBLIQUE VIEW)

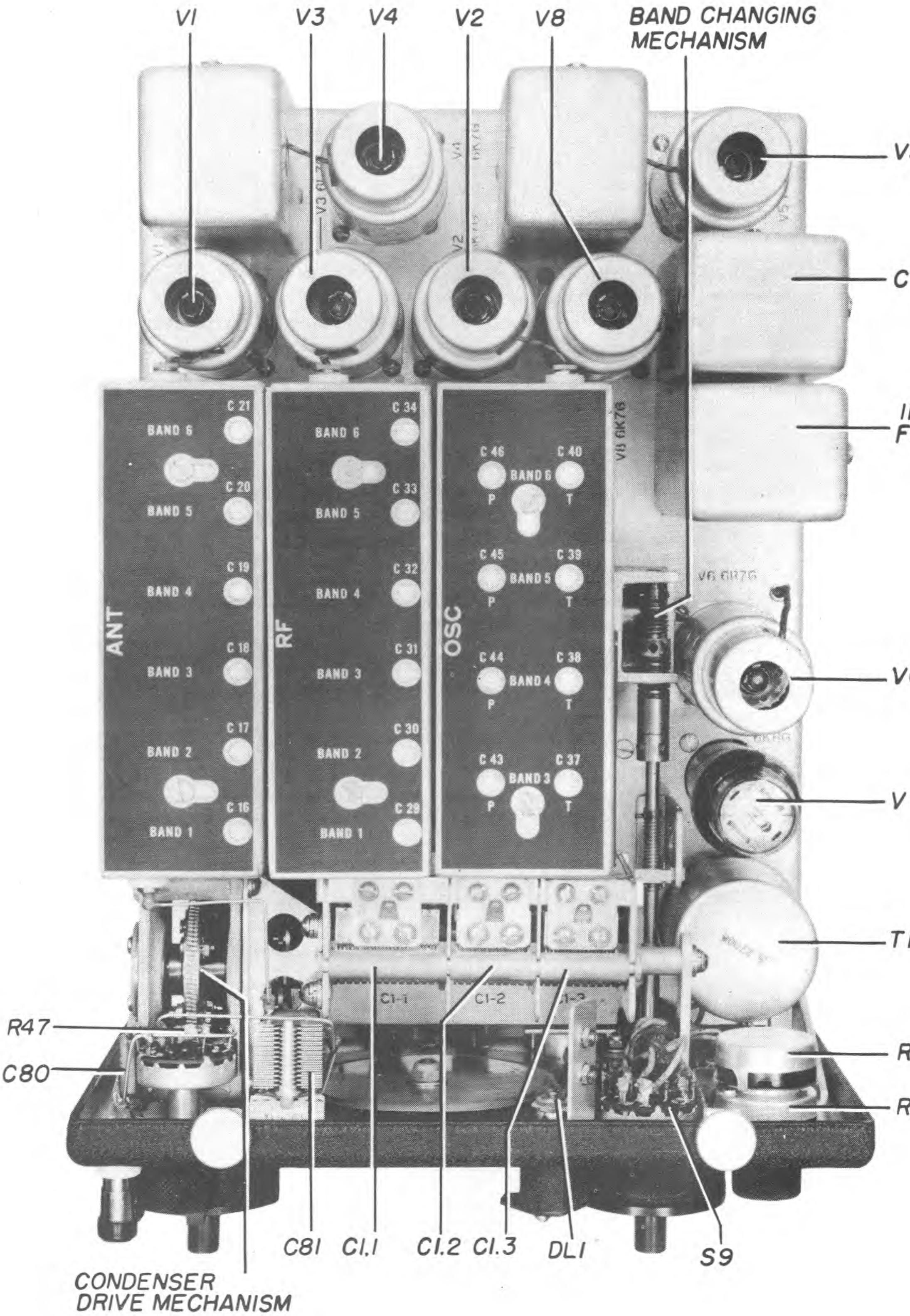


FIG.3– TYPE RA–1B AIRCRAFT RECEIVER (TOP VIEW)

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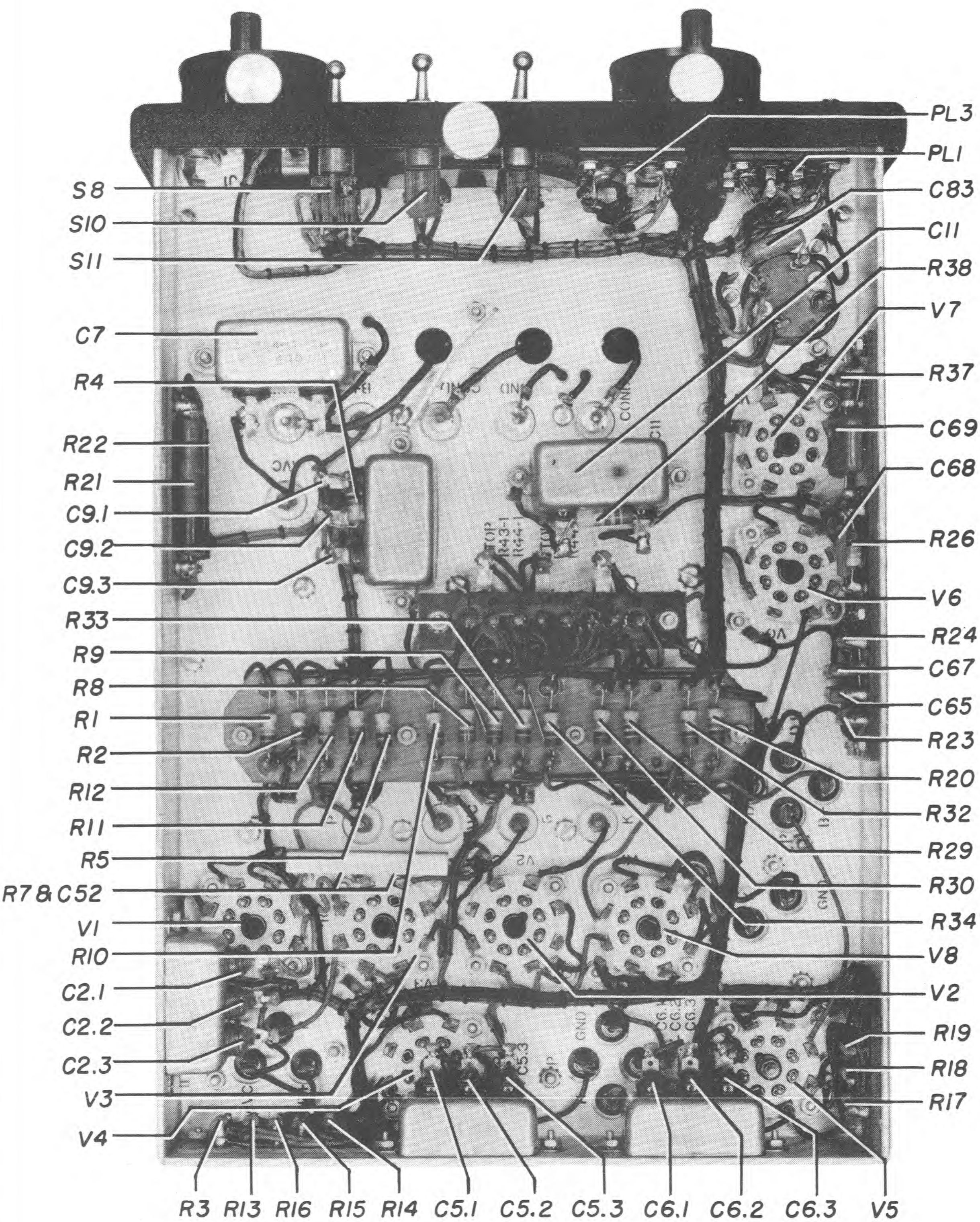


FIG. 4—TYPE RA-1B AIRCRAFT RECEIVER (BOTTOM VIEW)

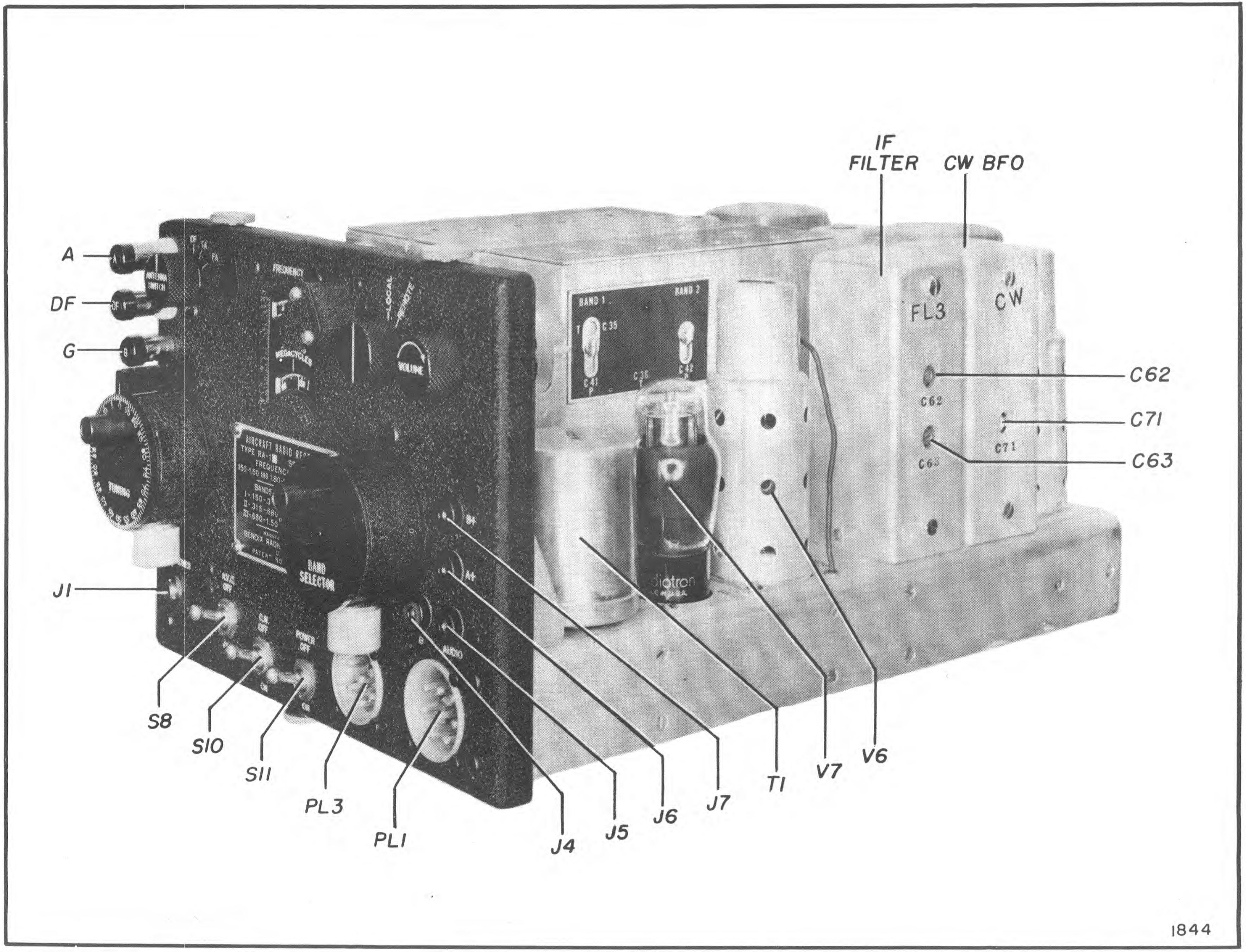


FIG.5–TYPE RA–1B AIRCRAFT RECEIVER (FRONT OBLIQUE VIEW)

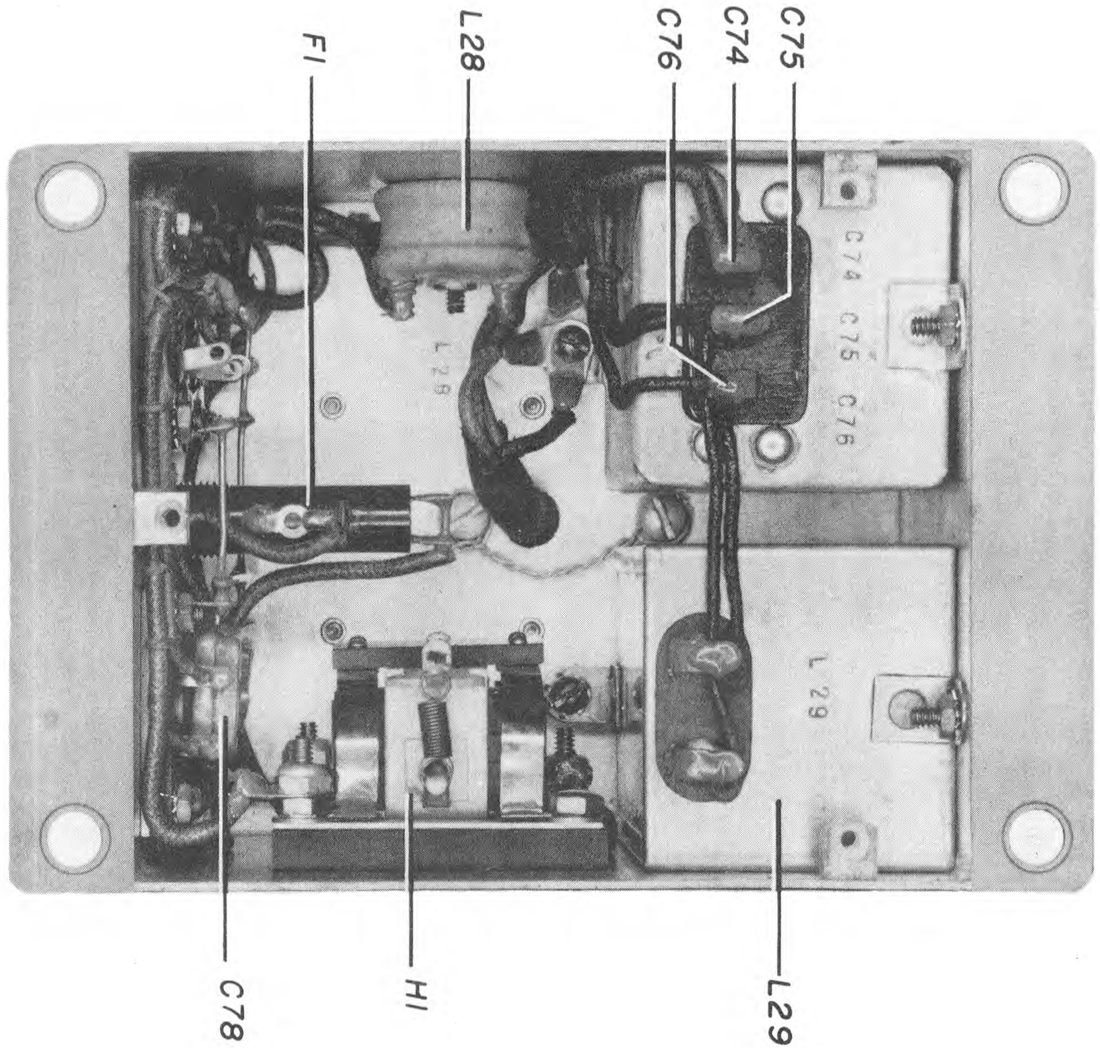


FIG. 6 – TYPE MP-5B OR MP-5A24 DYNAMOTOR FILTER UNIT

1848

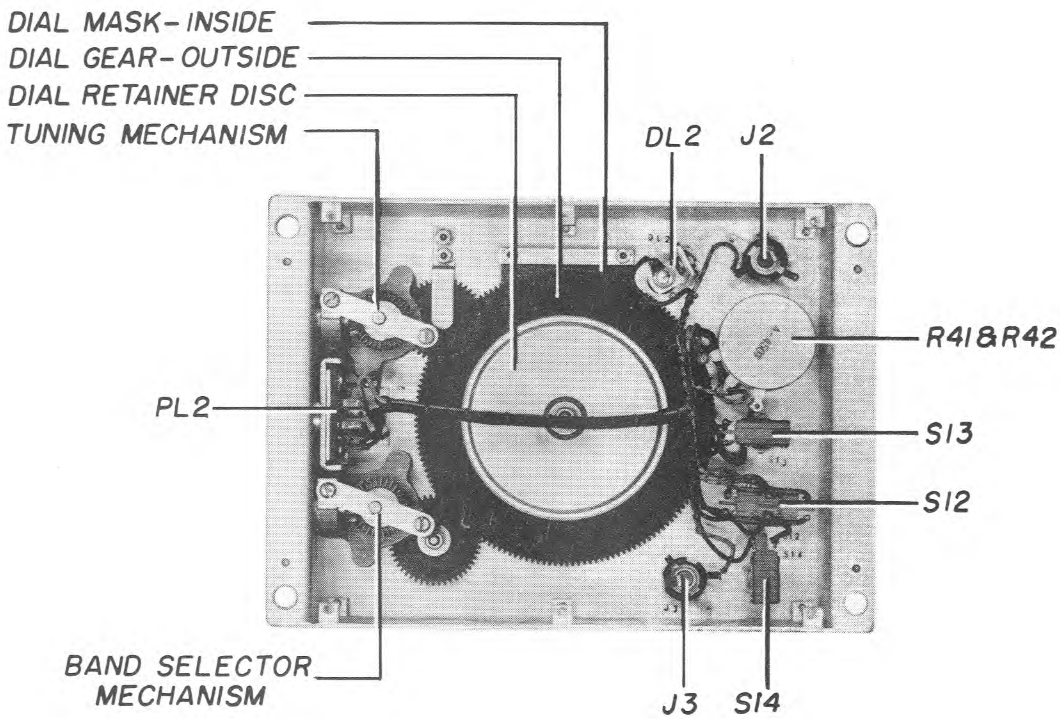


FIG.7- TYPE MR-1B REMOTE CONTROL UNIT

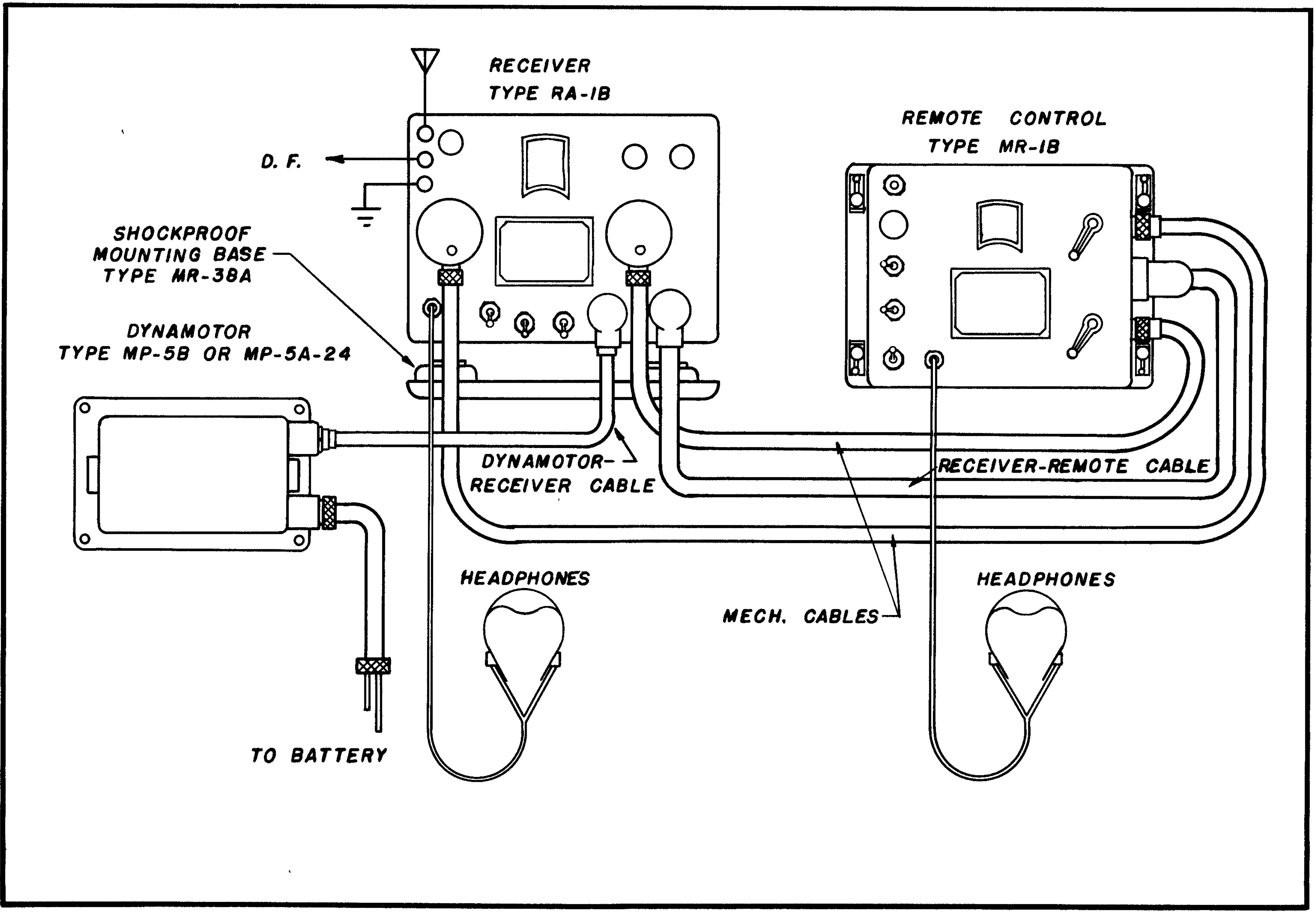


FIG. 8 DIAGRAM OF EXTERNAL CONNECTIONS

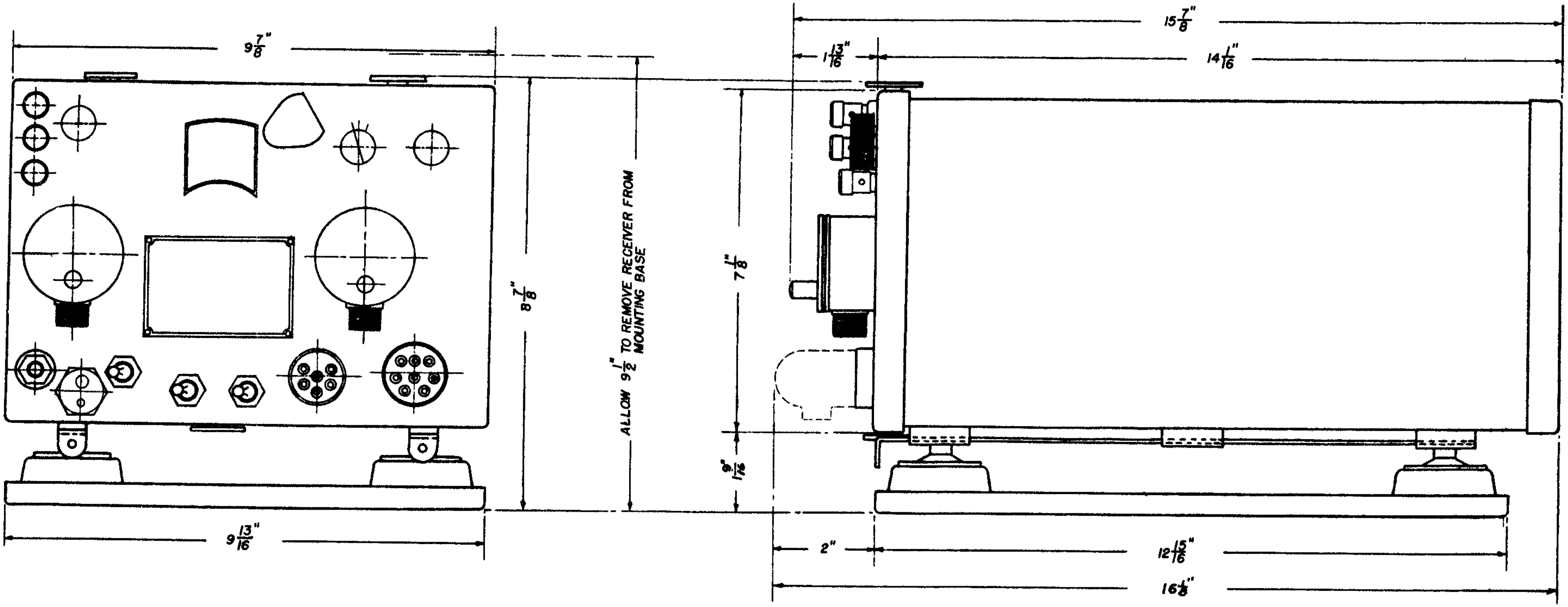


FIG. 9—TYPE RA-1B RECEIVER UNIT OUTLINE DRAWING

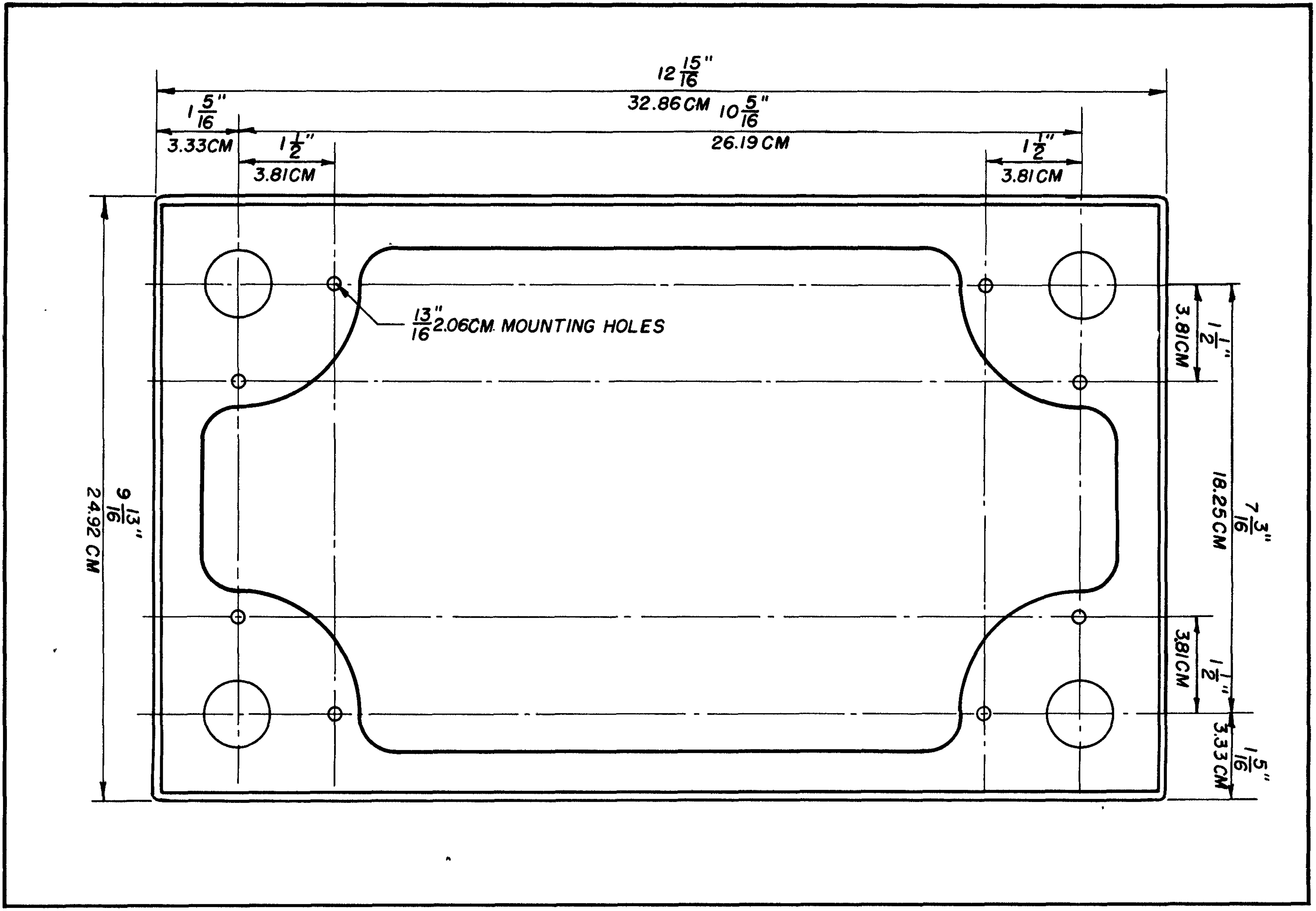


FIG. 10–TYPE MR-38A SHOCK MOUNTING OUTLINE DRAWING

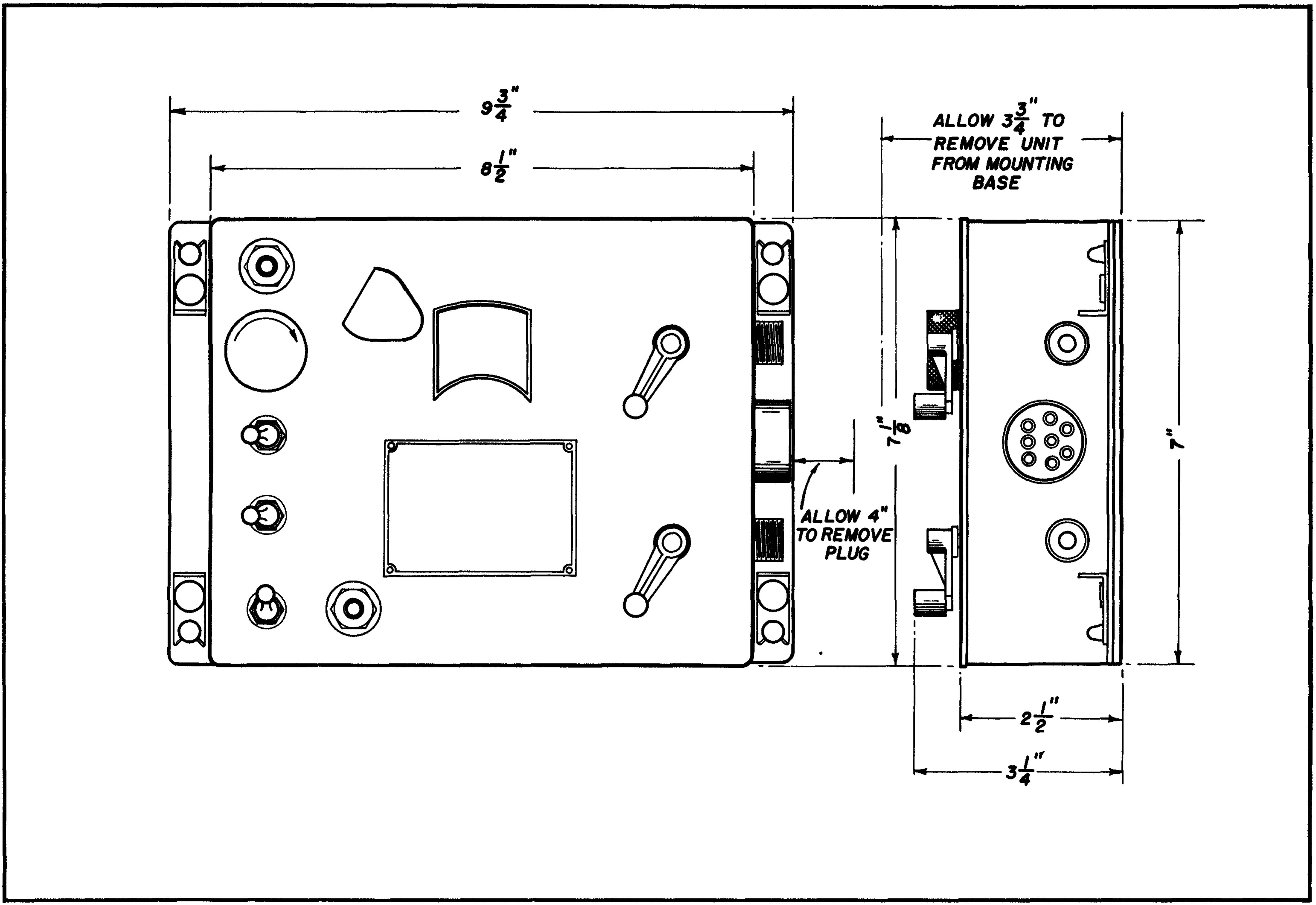


FIG.11-TYPE MR-1B REMOTE CONTROL UNIT OUTLINE DRAWING

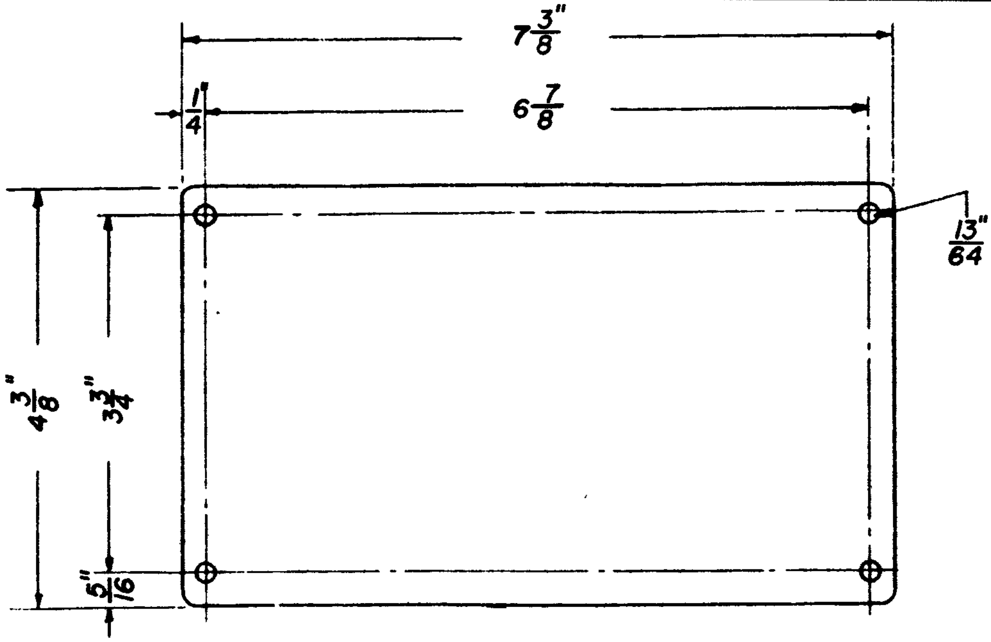


FIG.12 DYNAMOTOR BASE PLATE OUTLINE DIMENSIONS

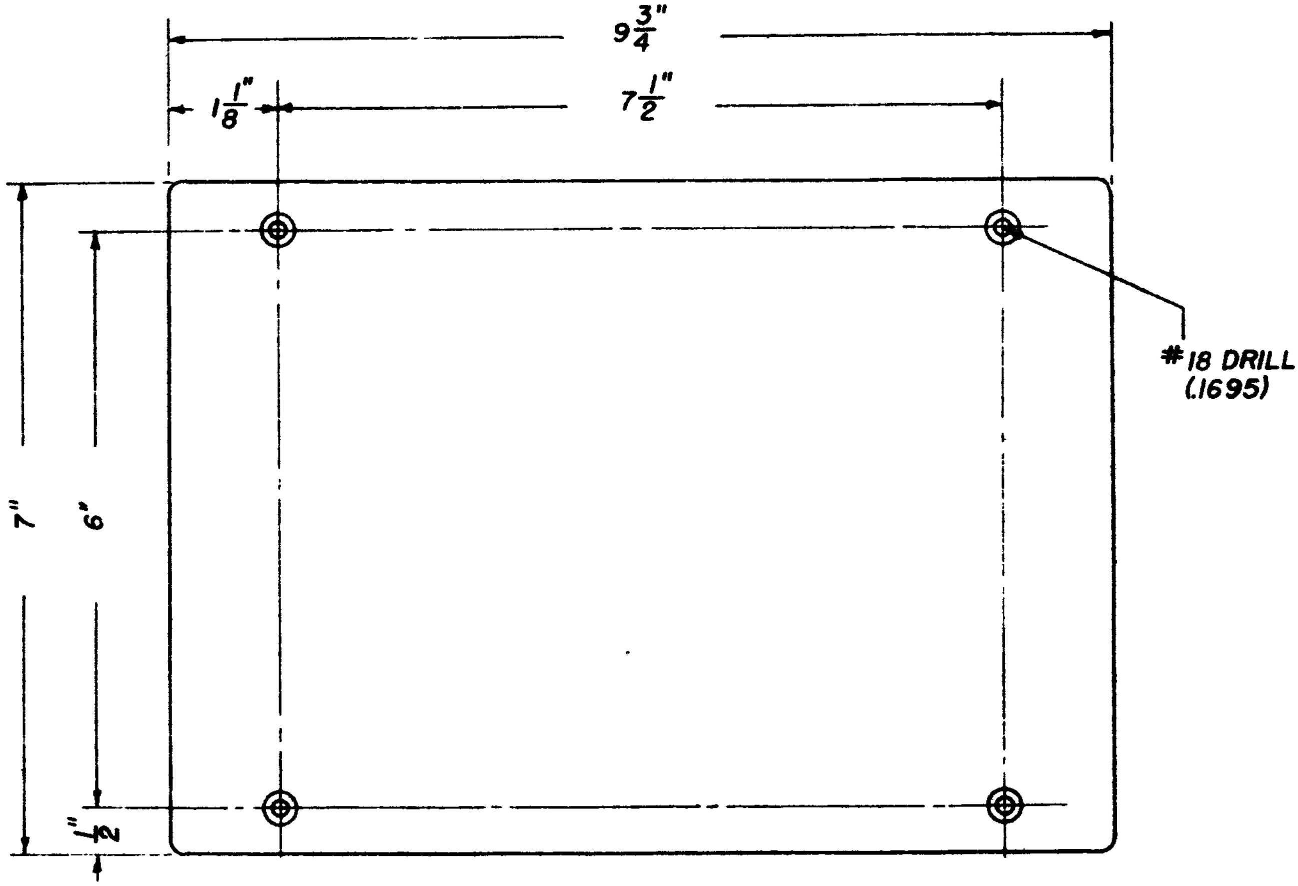


FIG.13 REMOTE CONTROL BASE PLATE OUTLINE DIMENSIONS

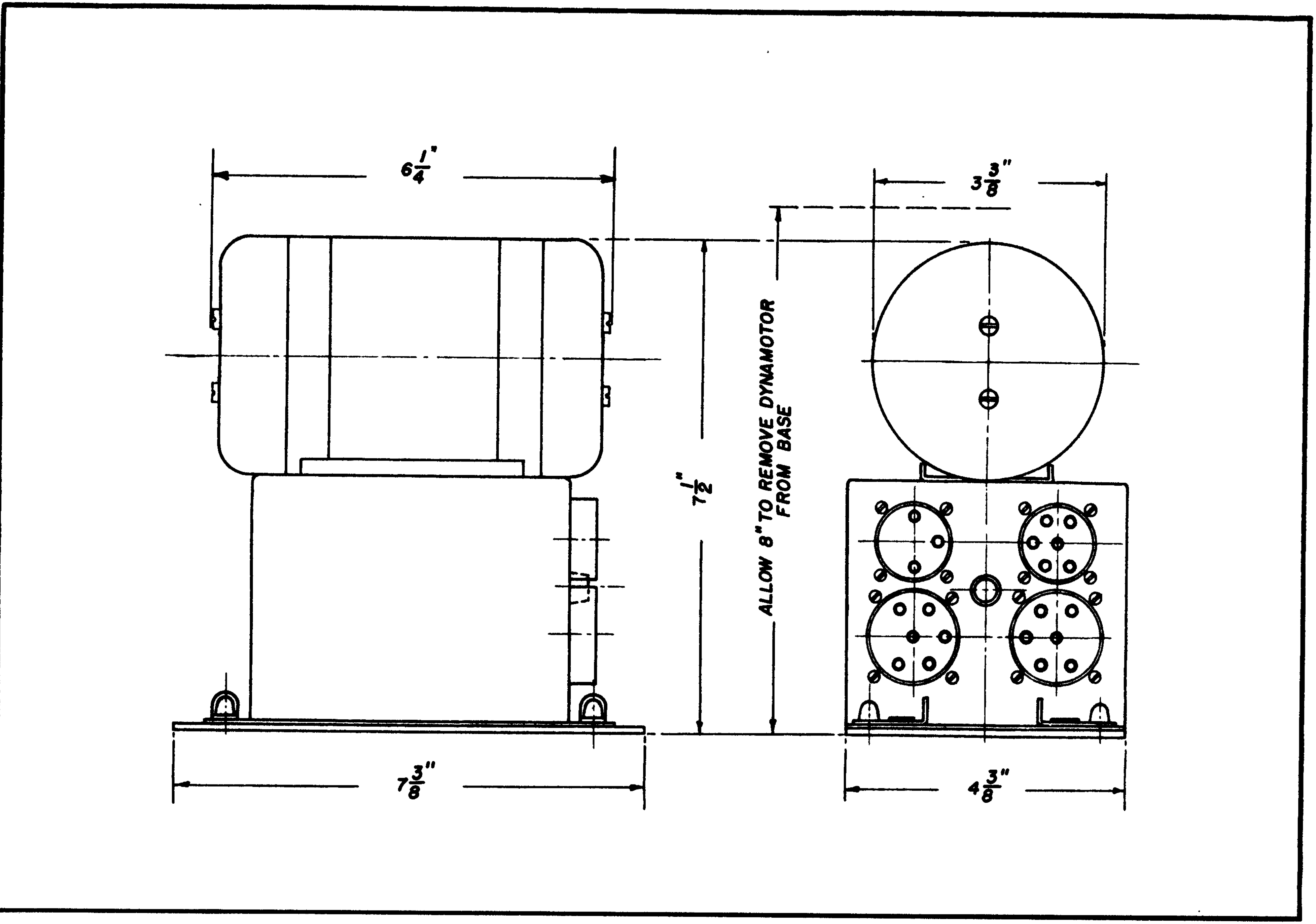


FIG. 14–TYPE MP–5B OR MP–5A24 OUTLINE DRAWING

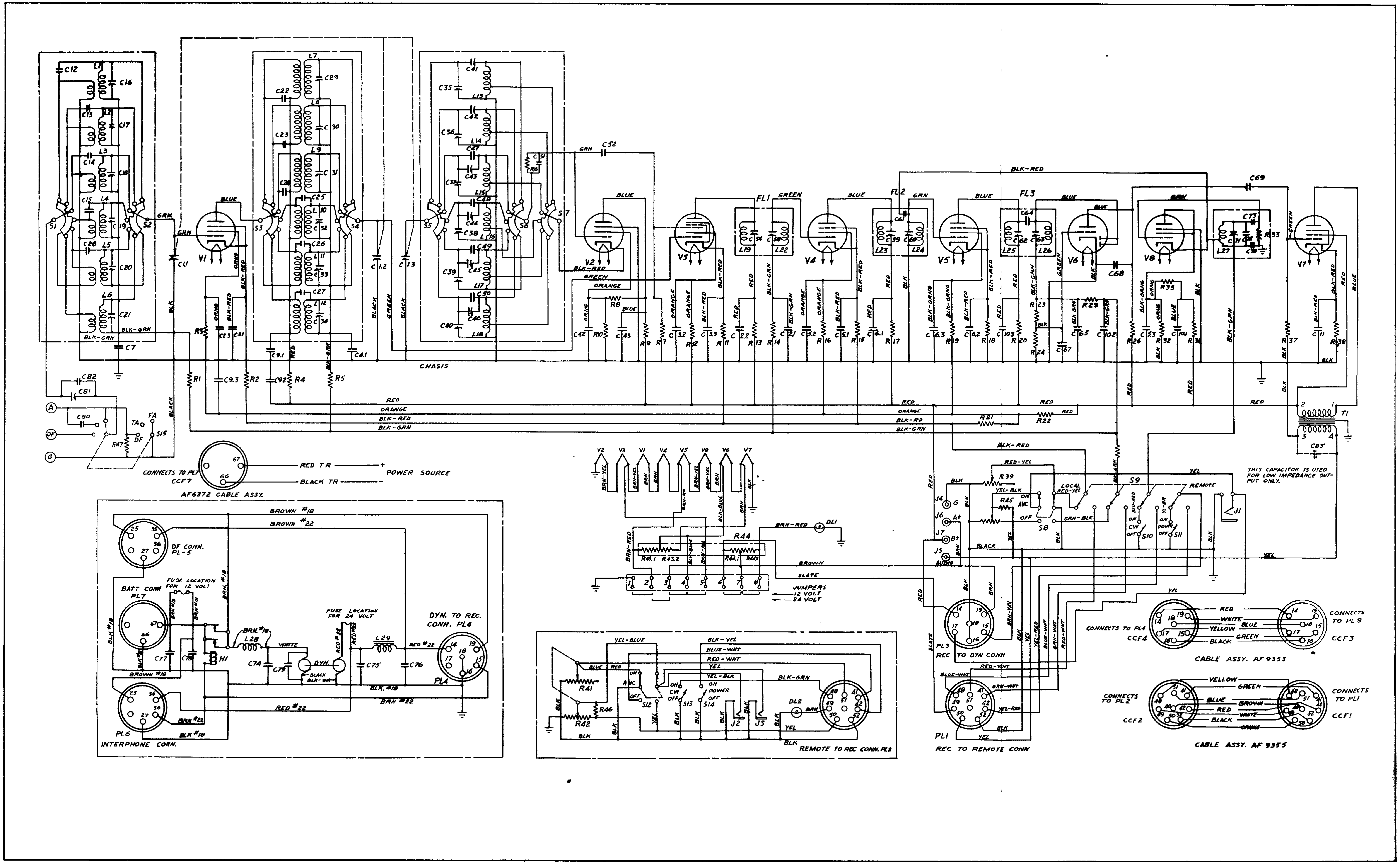


FIG. 15 - TYPE RA-1B RECEIVER UNIT SCHEMATIC DIAGRAM

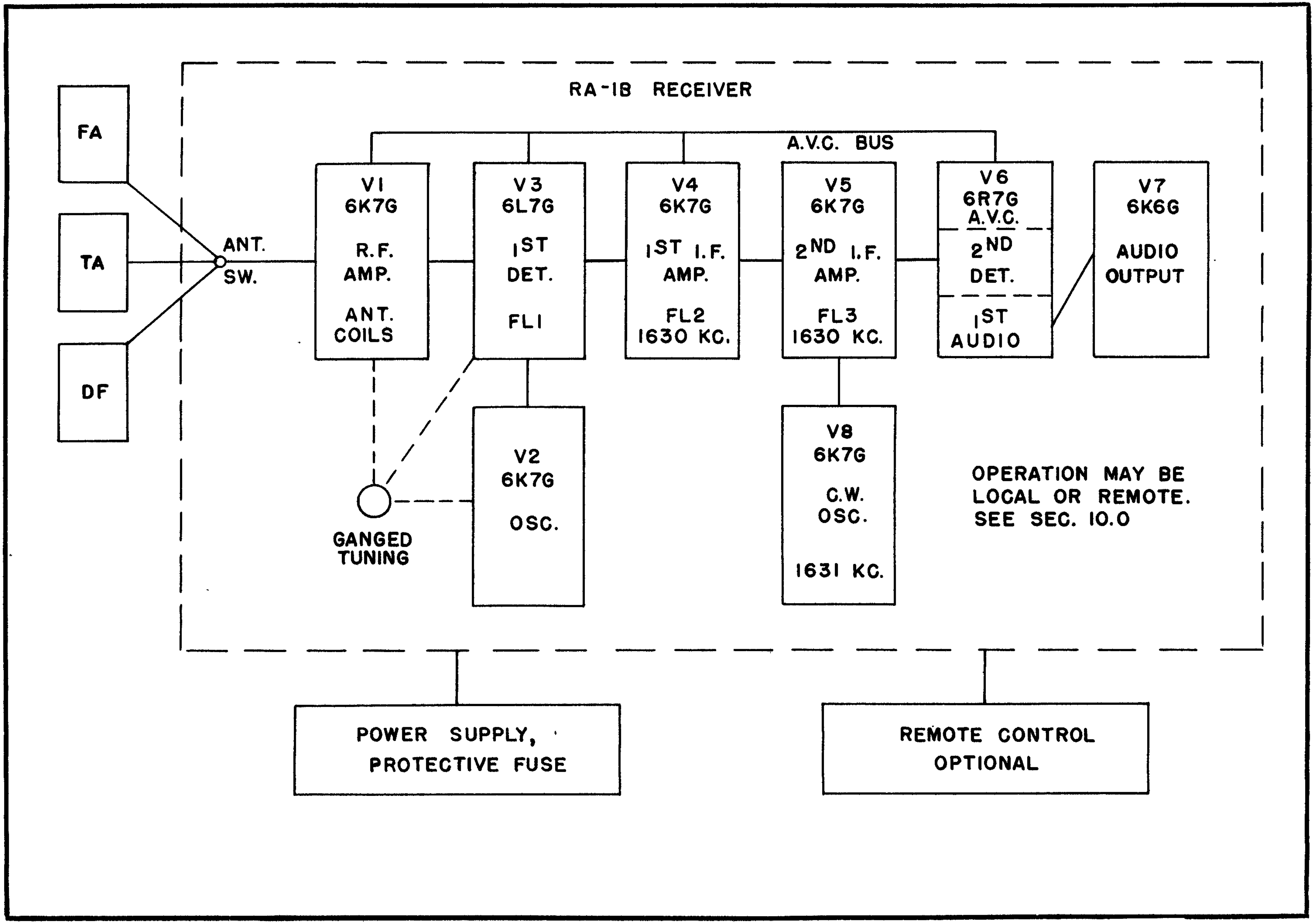
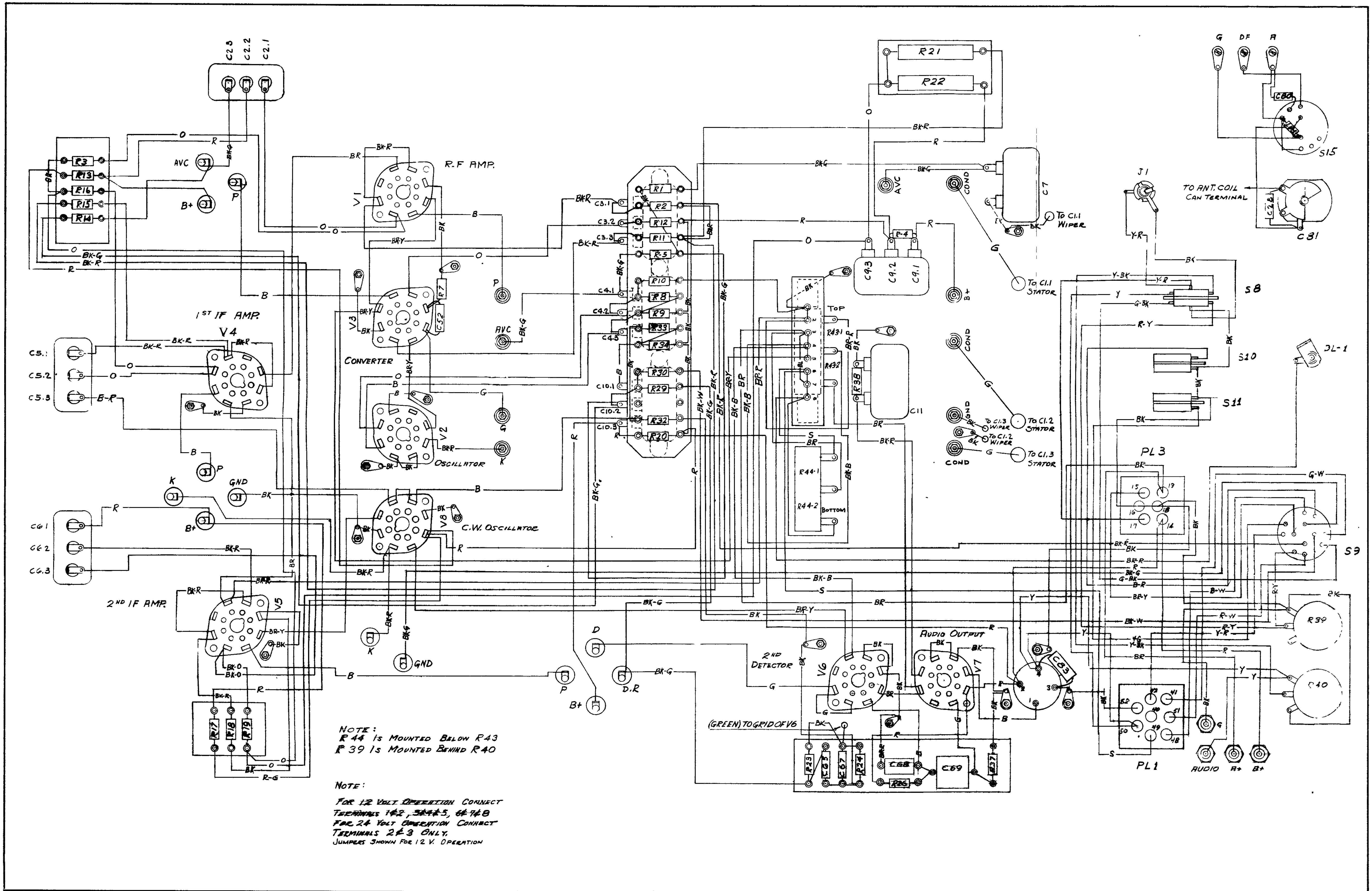


FIG. 16 BLOCK DIAGRAM OF RA-1B RECEIVER FUNCTIONS



TYPE RA-1B RECEIVER WIRING DIAGRAM

INSTRUCTION BOOK

FOR

MODEL MN-26A
MODEL MN-26C

AIRCRAFT RADIO COMPASS EQUIPMENT

BENDIX RADIO

DIVISION OF

BENDIX AVIATION CORPORATION

BALTIMORE, MD.

I.B.302C

OCTOBER 1941

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

FREQUENCY RANGE

MODEL MN-26A & MODEL MN-26C

BAND I	150 — 325 KCS
BAND II	325 — 695 KCS
BAND III	695 —1500 KCS

POWER REQUIREMENTS

	Volts	Amps.
MODEL MN-26A	14	5.5
MODEL MN-26C	28	3.0

The band switch motor draws approximately 2 amperes additional current in the 14-volt equipment and 1 ampere additional current in the 28-volt equipment when bands are being shifted.

INSTRUCTION BOOK

for

MODEL MN-26A & MODEL MN-26C AIRCRAFT RADIO COMPASS EQUIPMENT

1. INTRODUCTION

1-1. FUNCTION

The Model MN-26 Radio Compass Equipment, consisting of a radio compass receiver, remote control unit, azimuth control, loop and sense antennas, left-right and warning light indicators, interconnecting cables, and the necessary power source, comprises an aircraft navigational equipment which provides:

Visual unidirectional left-right indications of the arrival of radio frequency energy with respect to the plane of the loop; also, simultaneous aural reception of modulated or unmodulated radio frequency energy.

Aural reception of modulated or unmodulated radio frequency energy using a non-directional antenna.

Aural reception of modulated or unmodulated radio frequency energy using a loop antenna, especially desirable during periods of rain and snow static.

Aural null directional indications of the arrival of modulated or unmodulated radio frequency energy with respect to the plane of the loop antenna.

Visual warning indication of off-zero loop settings.

The radio compass receiver is a remotely controlled, 12-tube superheterodyne, with an intermediate frequency of 112.5 kilocycles. The frequency range of the equipment is from 150 to 1500 Kcs, which is covered in three bands calibrated in kilocycles as follows: Band I, 150 to 325 Kcs; Band II, 325 to 695 Kcs; Band III, 695 to 1500 Kcs.

The equipment is tuned manually from the remote control unit which may be mounted within easy reach of the operator. The bands are switched electrically by means of a selector switch on the control unit.

The Model MN-26A Equipment is used for operation from a 14-volt DC primary power source, and the Model MN-26C Equipment, which is similar except for the low voltage power source and associated circuits, is used for 28-volt DC installations.

1-2. COMPOSITION

Three arrangements of the Model MN-26A Aircraft Radio Compass Equipment are possible, depending upon the requirements of the user. Certain components are used in all of the arrangements, while others are used in only one arrangement. In Section 1-2-1 the components required in each case are listed briefly, while in Section 1-2-2 each component is described more fully.

1-2-1. Components Required for Each Arrangement

Item	*Quantity*	*Description*	*Wt. - Lbs.*
		SYSTEM 1	
A	1	Type MN-26A or MN-26C Radio Compass	37.37
B	1	Type MN-28A or MN-28C Remote Control	2.75
C	1	Type MN-52A Azimuth Control	.88
D	1	Type MN-20A Rotatable Loop; or	5.00
	1	Type MN-24A Rotatable Loop	6.80
E	1 or 2	Type IN-4A Left-Right Indicators	ea. 1.75
F	1	A30065 Loop Off-Zero Warning Light Assembly	.063
G	2	AA15410-1 Tuning Shafts	.265
H	1	AC55966-1 Loop Transmission Cable Assembly	.15
I	1	AL71095-2 Junction Box	2.44
J	1	*Power Cable	. .
K	1	*DC Input Cable	. .
L	1	*Remote Control Cable	. .
M	1	*Azimuth Control Cable	. .
N	1 or 2	*Left-Right Indicator Cable	. .
O	1	*Sidetone Cable	. .
P	1	*Warning Light Wire	. .
Q	1	Instruction Book	

Item	Quantity	Description	Wt. - Lbs.
		SYSTEM 2	
		All items the same as in System 1, except substitutions as follows:	
C	1	†Type MN-22A Azimuth Control, with	1.81
	1	†Type MR-21A Crank	.12
F		Not Used	
M	1	*†Azimuth Control Unit Dial Lamp Cable	. .
P		Not Used	
		SYSTEM 3	
		All items the same as in System 1, except substitutions as follows:	
C	1	†Type MN-22A Azimuth Control, with	1.81
	1	†Type MR-15A Crank Drive	.375
F		Not Used	
M	1	*†Azimuth Control Unit Dial Lamp Cable	. .
P		Not Used	

* Interconnecting cables supplied to customer's specifications.

† Instructions for the installation and operation of these items in conjunction with this or other direction finding equipment are contained in a separate instruction pamphlet supplied with these units.

1-2-2. Detailed Description of Components

Item	Description
A	Type MN-26A or MN-26C Radio Compass complete with mounting base; tubes as follows: 1-6L7, 2-6N7, 1-6B8, 2-6J5, 5-6K7, 1-6F6, and cable connectors as follows: 1-B7380-2 antenna plug. 1-A30095 cord plug.
B	Type MN-28A or MN-28C Remote Control complete with mounting base, fuse, and 1-A30090 cord plug. (MN-28A for 600 ohms output; MN-28C for 4000 ohms output.)
C	Type MN-52A Azimuth Control complete with 1-A30088 cord plug; or Type MN-22A Azimuth Indicator complete with Type MR-21A Crank and 1-AA25718-1 cord plug; or Type MN-22A Azimuth Indicator complete with Type MR-15A, 2 to 1, Crank Drive and 1-AA25718-1 cord plug.
D	†Type MN-20A Rotatable Loop Unit, 9″ diameter, complete with either 1-AA14695-1 90° or 1-AA14660-1 straight tuning shaft fitting; or Type MN-24A Rotatable Loop Unit, 18″ diameter, complete with either 1-AA14695-1 90° or 1-AA14660-1 straight tuning shaft fitting. The bases of both loops are the same, the loop diameters *only* are different. Electrical characteristics are identical.
E	Type IN-4A Left-Right indicator complete with A30088 cord plug, 1-AA18824-1 meter field load assembly.
F	A30065 Loop Off-Zero Warning Light assembly with A9320-2 12/16-volt bulb, 1-A30181 warning light dropping resistor (R41).
G	AA15410-1 Flexible tuning shaft, length as specified.
H	AC55966-1 Loop Transmission Cable; shielded 3-conductor, length as specified (168″ maximum, standard lengths 42″ and 168″). Completed assembly with one 90° and one straight cord plug.
I	AL71095-2 Junction Box (MS-14B) Location of cable entering holes as specified; larger sizes of junction boxes may be obtained when interconnections with other equipment are desired.

† Type MN-20A and MN-24A Rotatable Loops equipped with 90° mechanical control fittings. For 180° fittings, order Type MN-20C and MN-24B, respectively.

1-3. ADDITIONAL EQUIPMENT REQUIRED

The following additional items must be provided by the customer in order to operate this equipment:

Item	Quantity	Description
A.	1	14- or 28-volt DC primary power source as required for the equipment.
B.	1	Suitable antenna system.
C.	1 or 2	Pair of MR-8E 600-ohm headphones. High impedance, MR-48A, 4000-ohm headphones may be used if the equipment has been ordered with high impedance output circuits.

2. DETAILED DESCRIPTION OF PRINCIPAL COMPONENTS

2-1. TYPE MN-26A RADIO COMPASS

2-1-1. MECHANICAL

Each Type MN-26A Radio Compass Unit includes a cabinet, chassis, and mounting base. The radio compass unit contains the compass circuit elements, the superheterodyne receiver circuit elements, and the high voltage power supply. This unit also includes one set of vacuum tubes, one 6/32 socket type setscrew wrench, and 5 grid shield caps.

The radio compass receiver chassis is housed in a dust and spray proof cabinet formed of aluminum sheet and finished in grey wrinkle enamel. Slides in the base of the cabinet permit easy withdrawal of the chassis, which is held securely in place by a captive through-bolt running from the front panel of the chassis to a riveted nut in the back of the cabinet.

The mounting base consists of an aluminum base plate, with rubber shock absorbers mounted in the four corners. For outline dimensional drawing and drilling diagram see Figure 10.

The chassis of the radio compass receiver is formed of welded aluminum and is so constructed that when servicing the unit it may be placed on any of five sides without damage. A panel containing all of the cable terminations is attached to the front end of the chassis. All circuits are so shielded that after the equipment is aligned, the chassis may be placed in its cabinet without changing the alignments. The setscrew wrench is clipped to the middle chassis cross member. The sub-assemblies and other components on and under the chassis deck are arranged to provide the optimum in accessibility for maintenance. Refer to Figures 2, 3, and 4.

2-1-2. ELECTRICAL

2-1-2-1. General

The Type MN-26A Radio Compass Unit comprises a compass circuit and a receiver circuit. The receiver may be operated with a loop antenna or nondirectional antenna as desired. The frequency range (150-1500 Kcs) is covered in three bands (150-325, 325-695, and 695-1500 Kcs). Band selection is accomplished by a motor-driven band-change switch, the switch sections inserting into each circuit the coils for the desired band and shorting out all unused coils, thereby preventing any resonant absorption circuits. The schematic diagram, Figure 9, shows the equipment being operated as a compass on Band I. The following circuit description traces the circuit for Band I only. A corresponding description would apply to Bands II and III, should the band switch be set to either of these positions. The important elements of the circuit are illustrated in photographs, Figures 2, 3, and 4.

2-1-2-2. Compass Circuits

The theory of compass operation is explained in Section 2-8. The loop consists of a center-tapped coil. The outer ends of the winding and center tap are connected to a receptacle J8 at the base of the loop through which the loop output voltage is fed into the loop transmission cable to be conducted to the primary of the loop input transformer T1. Refer to Figure 9. The secondary of T1, tuned by the first section of the ganged tuning capacitor C2-1 is connected to the grid of the loop amplifier tube. The output of this tube is fed to the phaser, which consists of a shunt circuit L1 and C38 resonated to a frequency somewhat lower than that of the IF stages. This presents a capacitive reactance to signals of any frequency to which the compass may be tuned (150-1500 Kcs). Since the plate resistance of the loop amplifier tube is very high compared to the reactance of its load L1, C38, the voltage across the capacitive reactance C38 in the plate circuit is effectively changed in phase 90 degrees from the voltage on the grid of the tube.

RF voltage across C38 is fed through capacitors C19-1 and C19-2 to the grids of the modulator tube V3. The grids of the modulator tube are biased to cut-off, and are connected in push-pull through capacitors C3-18 and C3-19 and resistors R12-6 and R12-7 to the plates of the audio oscillator tube V2. These plates are connected in push-pull to the left-right indicator field which is resonated at 48 cycles by the internal capacitor. Grid excitation for the audio oscillator is supplied through capacitors C3-13 and C3-14 which are cross-connected to the opposite plates. The audio frequency oscillator output voltage renders the two triode sections of the modulator tube conductive in turn, by alternately overcoming the cut-off bias on each grid. The plates of this modulator tube are connected in push-pull to one primary winding of the antenna input transformer T4. The nondirectional vertical antenna voltage is applied to the second primary of T4. Both primaries are inductively coupled to the same secondary winding which is tuned by C2-2, the second section of the ganged tuning capacitor. This tuned secondary winding is connected to the grid of the first RF tube V4, applying voltages from the loop and nondirectional antenna to the grid of this tube. However, the voltage of the loop is alternately changed in phase 180 degrees at twice the audio oscillator frequency by action of the push-pull modulator tube V3 and, therefore, is alternately added to and subtracted from the antenna voltage at the grid of the first RF tube. Thus, a signal is applied to the grid of the first RF amplifier tube which is modulated at the audio oscillator frequency. The level of this signal depends on the effective height of the nondirectional antenna. The loop gain control R1 is provided to allow adjustment of the modulator tube gain so that the loop voltage at the grid of the first RF tube is at approximately the same level as the voltage obtained from the nondirectional antenna. The combined loop and antenna voltage is amplified and detected by the receiver circuits and the audio frequency component, containing the audio signal and meter signal frequencies, is fed to the grid of the audio output tube V11 through capacitor C16 and to the grid of the compass output tube V12 through capacitor C7. The level of the audio voltage applied to the compass output tube grid is determined by the compass sensitivity control R3 which is mounted on the remote control unit. The plate of the compass output tube is connected to the primary winding of the output transformer T16. The primary of this transformer is resonated to 48 cycles by capacitor C5-2 and so acts as a filter to pass only 48 cycles. The secondary of the transformer is connected to the moving coil of the left-right indicator and provides the power required to actuate the indicator pointer. When only one indicator is used, it is necessary to connect the meter field load assembly into the circuit as shown in Figure 9.

2-1-2-3. Receiver Circuit

The receiver circuit is of the superheterodyne type and consists of three stages of tuned radio frequency amplification (including first detector), a radio frequency oscillator, an intermediate frequency amplifier, a second detector and audio amplifier, an AVC circuit, an audio output amplifier, a compass output tube, and a CW beat frequency oscillator. A clearer idea of the following circuit description can be obtained by referring to Figure 9. While the description traces only the circuit for Band I, it is applicable to other bands by substituting the appropriate coils for those bands.

The nondirectional vertical antenna connects to a relay RE1, which performs two functions: When on COMP. or REC. ANT., the nondirectional antenna connects directly through the relay contacts to the primary of T4, the antenna input transformer; when on REC. LOOP, the relay connections are arranged to ground the nondirectional antenna and to substitute a capacitor C21-1 across the antenna primary winding of T4, the antenna input transformer. Resistor R18 connects directly to the antenna and permits electrostatic charges to leak off to ground when the antenna is ungrounded. The capacitor C15 prevents damage to the antenna transformer when a DC voltage is applied to the antenna. The primaries of T4 are inductively coupled to the secondary which is tuned by the second section of the ganged tuning capacitor C2-2. The grid of the 1st RF tube connects to the secondary of the transformer. A small neon tube between the grid and ground protects tube and circuit elements against high antenna voltages which may result from operation of the airplane's transmitter or from high electro-static charges on the antenna.

A coil L2 in the cathode lead is resonated at 110.5 Kcs by capacitor C14-1 and acts as a trap circuit to attenuate unwanted signals near the intermediate frequency.

The plate of the first RF tube couples through transformer T7-1 to the grid of the second RF tube, the secondary of transformer T7-1 being tuned by the third section of the ganged tuning capacitor C2-3. An IF trap circuit L3, C14-2, in the cathode lead of the second RF tube, is tuned to 114.5 Kcs. The plate of this tube connects to the primary of transformer T7-2 the secondary of which is tuned by the fourth section of the ganged tuning capacitor C2-4 and connects to the control grid of V6, the third RF or first detector tube.

The injector grid of the first detector is excited by the output of triode oscillator tube V7 which is tuned 112.5 Kcs above the desired signal by the fifth section of the ganged tuning capacitor C2-5. The plate circuit of this detector tube is tuned to 112.5 Kcs, and couples inductively to the control grid of IF tube V8.

The plate circuit of IF amplifier tube V8 is tuned to 112.5 Kcs and is coupled inductively to a second tuned circuit, which connects to one diode rectifier plate of the second detector tube.

Output from the CW beat frequency oscillator V9 is coupled to the above mentioned diode plate. Operation of the tube V9 is controlled by S10, a toggle switch (C.W. ON-OFF) located on the remote control unit.

The grid of the second detector tube V10 receives the audio component of the rectified radio frequency signal at the junction of the diode load resistors R14-5 and R28.

The second diode plate is fed from the plate circuit of the IF tube through capacitor C21-4, and supplies AVC bias for tubes V4, V5, V6, and V8. The greater the amplitude of the received signal, the greater will be the voltage built up across the AVC load resistor R22-4 by the rectified carrier. Since the control grids of the preceding tubes are connected to the negative end of the resistor, negative bias on them will be increased by a strong carrier, and because of their variable amplification characteristics, they will operate at reduced gain on such signals. Conversely, on weak signals the bias introduced by the AVC will be smaller and the tubes will operate at higher gain. This action tends, therefore, to maintain incoming signals at a constant level. The AVC circuit operates only when the master switch is set at COMP.

The plate of the second detector tube is resistance-capacity coupled to the grid of the audio output tube V11. The plate of this output tube is connected to the primary of output transformer T15. The secondary of this transformer is tapped for connection to 600-ohm or 4000-ohm output circuits. The output of transformer T15 is connected to the headset jacks J1 and J2. See Figure 9 for complete circuit.

2-1-2-4. Band Change Circuit

Band changing is effected by switching the tuned circuits in the loop, first RF, second RF, first detector, and RF oscillator stages by means of motor-driven switches. The motor armature drives a worm gear which is ganged on a common shaft with the crank arm and locking cam, the control cam, switches S5B, S5C, and the RF band change switches. When the remote control unit band selector switch S9 is operated to select a different band, band switch motor MO is energized by completing the circuit to ground through the contacts of S9 and S5B. The motor drives the crank arm through one or two complete revolutions which steps the Geneva disc until the motor is deenergized by the opening of S5B, which is on the same shaft as the Geneva disc and the switches that select the tuned circuits. Exact control of the positioning is obtained by the cam-operated switch S6. When the motor is at rest, the arm of switch S6 is on step 2 of the control cam, and all contacts are open. When the motor starts, the arm is first raised by step 3 of the cam, closing the upper contacts, which at this time perform no function since the corresponding contact of S9 will be open. As the motor continues operating, the arm of S6 will drop to step 1 of the cam, opening the upper contacts and closing the lower ones. The closing of the lower contacts provides an additional path to ground to keep the motor energized after the opening of S5B by the movement of the Geneva disc, and also grounds the audio output of the radio compass unit to prevent clicks while changing bands. When the crank arm has been driven past the Geneva disc, engaging the locking cam with the arc of the disc, the control cam raises the arm of S6 to step 2, opening all contacts, and the motor coasts to a stop. If it should coast past step 2, the upper contacts of S6 will be closed by the control cam and will now energize the reverse field of the motor through the contacts of S5C and S9 and the motor will reverse to the proper position until all contacts of S6 open.

2-1-2-5. Sidetone Circuits

A portion of the audio voltage from a transmitter may be fed to the audio input circuit of the MN-26 receiver for purposes of monitoring transmissions. Relay RE2 is connected into the grid circuit of the audio amplifier tube V11 to allow input from either the receiver circuits or the transmitter sidetone circuits. The unoperated or normal position of the relay provides continuity of the output circuits. The operated position of the relay grounds the receiver AVC buss and connects the externally applied (approximately 1.5 volts) voltage to audio amplifier tube V11. Voltage for operation of the relay solenoid is obtained from the radio compass primary voltage and is controlled by connecting the transmitter push-to-talk switch to the negative and positive sidetone leads. All connections to the sidetone relay circuit are to be made in the junction box as shown on Figure 9.

2-1-3. MN-26A and MN-26C Equipment Differences

The Type MN-26C Radio Compass (28-volt) is essentially the same as the MN-26A (14-volt) unit, the differences being necessitated by the change of primary voltage. The changes are as follows: (See MN-26C parts list and Figure 9 for details and part numbers.)

A 24/28-volt instead of 12/14-volt band switch motor is used.

A 24/28-volt instead of 12/14-volt dynamotor is used.

Resistor R36 has the jumper removed (see Figure 9).

Resistor R35-1 has the jumper removed.

Resistor R37-2 has the jumper removed.

The filament terminals numbered 2 and 3 must be connected. Terminals 1 and 4 will be disconnected.

Resistor R35-3, mounted in the remote control unit, must have its jumper removed.

Resistor R41, in the junction box, must have its jumper or jumpers removed.

2-2. TYPE MN-28A AND TYPE MN-28C REMOTE CONTROL UNITS

2-2-1. General

The remote control unit includes a lamp LM-1, 1 No. 6/32 socket stype setscrew wrench, and 1 base which may be drilled for mounting screws, as shown in Figure 11. The remote control unit contains all controls for operation of the radio compass unit. The differences between the two remote control units are discussed in paragraph 6, Section 2-2-2.

2-2-2. Controls (see figure 5)

The following controls appear on the remote control unit:

TUNING CRANK: The TUNING crank operates the remote control dial and is connected through a train of gears and the flexible tuning shaft to the ganged tuning capacitor in the radio compass unit. The gear ratio between the crank and the ganged capacitor is 120 to 1.

DIAL: A radial disc type dial is used which is calibrated every 5 Kcs from 150 to 325 Kcs and every 10 Kcs in the two bands from 325 to 1500 Kcs. The dial is illuminated by a lamp LM-1.

BAND SWITCH: The frequency band selector switch S9 located below the dial, energizes the band switching motor and thus is capable of selecting any of the three bands, 150-325, 325-695, and 695-1500 Kcs. A mask, attached to the switch shaft, permits viewing only that part of the tuning dial associated with the band selected. The band range in use is marked on the mask.

OFF-COMP.-REC.ANT.-REC.LOOP: A four-position switch S8 selects the desired operating function. In the OFF position, no current is drawn from the low voltage power supply. In the COMP. position, the circuit elements are arranged to provide compass operation. In the REC.ANT. position, the equipment functions as a communication receiver connected to the nondirective vertical antenna. In the REC.LOOP position, the equipment functions as a communication receiver connected to the directional loop antenna.

LIGHT: The control knob designated LIGHT regulates the brilliancy of the lamp LM-1 that illuminates the calibrated dial.

AUDIO: The control knob designated AUDIO regulates the level of the audio signal in the headsets. This control is a dual potentiometer connected in the headset and RF amplifier cathode circuits. When functioning as a compass, the equipment is operating on automatic volume control (AVC) and this knob, by varying the potentiometer section in the headset circuit R4A, determines the audio level in the headphones. When the equipment is functioning as a receiver, on either REC.ANT. or REC.LOOP positions, this control knob varies the gain of the radio frequency amplifiers, permitting radio range reception. The MN-28A remote control used with 600-ohm low impedance output systems is the same as the MN-28C remote control used with 4000-ohm high impedance systems except for the audio control potentiometer R4. See Section 7-3, parts list.

COMPASS: The control knob designated COMPASS operates a potentiometer R3 to regulate the extent of pointer deflection of the left-right indicator.

TEL JACKS: The two jacks J1 and J2 marked TEL receive standard two contact (barrel and tip) headphone plugs.

THRESHOLD SENSITIVITY: A control R2 is mounted inside the remote control unit case. This control is adjusted at the time of installation (COMPass operation only) to limit the gain of the radio frequency amplifiers to such an extent that erratic fluctuation of the left-right indicator due to noise is eliminated. Instructions for setting this control are given in Section 4-4.

2-3. TYPE MN-20A OR TYPE MN-24A ROTATABLE LOOP

The loop consists of a coil with center tap, enclosed in an electrostatic shield. At the top of the shield is a gap which is insulated, and waterproofed. The loop is permanently fastened into the mounting base. All connections from the loop coil are made through slip rings to brushes which are connected to the loop transmission cable receptacle. Rotation of the loop is accomplished by means of the associated azimuth control, flexible tuning shaft, and fittings which drive the loop gears that are located in the mounting base.

2-4. TYPE MN-22A AZIMUTH CONTROL

Essentially the Type MN-22A Azimuth Control consists of a double-ended tach-shaft drive to which is connected, through an appropriate gear and cam drive, a pointer that moves in the horizontal plane against the indicator dials. It is designed for use with standard aircraft tachometer shafts.

Connected to the internal gearing is a circular cam scribed with nine circles and twenty-four radial lines corresponding to degrees correction and degrees azimuth rotation respectively. The cam may be cut to any required shape to meet the particular installation and can accommodate a maximum error of plus or minus 20 degrees. As supplied the cam introduces no correction and can, if no error correction is required, be used without further adjustment.

Two instrument lamps provide ample illumination.

The Type MN-22A Azimuth Control provides means for obtaining loop rotation and bearings (indications of loop settings corrected for quadrantal error) as follows:

A. Bearings relative to ships heading are read on the outer fixed dial.

B. Magnetic bearings are read under the pointer on the inner movable dial, after the number on this dial, which corresponds to the airplane's magnetic course, has been set at the zero mark on the fixed dials.

C. True bearings are read under the pointer on the movable dial after the number on this dial, which corresponds to the airplane's magnetic course, has been set opposite the east or west compass variation shown on the inner fixed dial.

D. Reciprocal bearings can be read at the opposite end of the pointer.

2-5. TYPE MN-52A AZIMUTH CONTROL

The Type MN-52A Azimuth Control is designed for mounting on the instrument panel or alongside of the pilot, Figures 6 and 13. It has a dial calibrated to give direction readings to 2.5 degrees, readings to one degree being readily obtained by interpolation. The dial is illuminated by a pilot light LM-2 which is turned on or off by the LIGHT toggle switch S11.

A cam on the dial pointer shaft maintains contact through the cam operated switch S12 at all positions of the dial pointer except zero. This switch when connected to an appropriate warning light indicates off-zero loop settings.

2-6. TYPE IN-4A LEFT-RIGHT INDICATOR

The indicator is designed for instrument panel mounting, and must be *individually shock mounted if the instrument panel is not provided with shock absorbers*. The indicator dial is marked with a small conventionalized figure of an airplane to indicate on course flight. The dial markings and pointer are coated with luminous paint for visibility during night flying. The movement is of the iron-core dynamometer type. The field coil is center-tapped and serves as the plate inductance for the audio oscillator, being resonated by a capacitor which is mounted inside the case. This capacitor may be removed by taking off the meter case, unfastening the two mounting screws which hold it in place, and unsoldering the leads. Terminals 2 and 4 of the receptacle connect to the moving coil, and terminals 1, 3, and 5 to the field winding.

When one meter is used with the equipment, it is necessary to connect the field resonating meter load assembly supplied with the meter into the junction box as shown in the schematic diagram, Figure 9.

2-7. WARNING LIGHT

The warning light or lights provide visual warning indication of off-zero loop settings when a Type MN-52A Azimuth Control is used. The light is turned on or off by the cam operated switch located in the Type MN-52A Azimuth Control Unit. A voltage dropping resistor R41 is supplied complete with mounting hardware for installation in the junction box. This resistor should be wired as shown on Figure 9. It will be necessary to use this resistor on 28-volt installations.

2-8. JUNCTION BOX

All interconnections between the various units are made in the junction box. The junction box is provided with 8/32 screw size terminals upon which connections are made. See Figure 9 for interconnections. When one left-right indicator is used, it is necessary to connect the field resonating meter load assembly in the junction box as shown in Figure 9. All mounting hardware is supplied with the assembly; it is necessary that the mounting holes be drilled as required for the installation. Number 18 ga. wire will be sufficiently heavy for all leads except those marked, which should be 12 ga. The leads from plug P3 terminal 9 to plug P4 terminal 22 should have the best of insulation in order to minimize AVC leakage.

When no tuning meter is used with the equipment, the wire in the radio compass unit cable connecting to terminal 18 of plug P4 must be grounded. When a tuning meter is used, this wire must be connected to the positive meter lead. The negative meter lead must be returned to the junction box ground buss. A suitable meter for use in this circuit would be an aircraft type 0-5 milliampere meter with a suppressed zero movement arranged so that the pointer shall leave the right-hand (viewed from the front) zero stop with approximately 2 milliamperes and shall read full scale at the left stop with 5 milliamperes.

2-9. ELECTRICAL RADIO COMPASS THEORY

The radio compass equipment consists of a loop antenna, a loop input circuit and amplifier, a 90-degree phase shifter, a balanced modulator, an audio oscillator, a nondirectional antenna, a sensitive and selective receiver, a compass output circuit, a left-right indicator, and a telephone output circuit. The vertical antenna is nondirectional, that is, equally sensitive to radio signals from any direction. The voltage induced in a vertical antenna is in phase with the flux of the radio wave.

The loop antenna is directional in that the voltage induced in the loop is maximum when the plane of the loop is turned toward the transmitter and is zero when the plane of the loop is perpendicular to the direction of travel of the radio wave from the transmitter. The resultant of the voltage induced in the loop is 90 degrees out of phase with the voltage induced in the vertical antenna and changes abruptly 180 degrees as the loop is rotated through the position of zero pick-up.

The voltage from the loop is amplified and shifted through 90 degrees so that it is either in phase with or in phase opposition to the voltage induced in the vertical antenna, depending upon which edge of the loop is turned toward the transmitter.

The voltage from the loop amplifier is then impressed upon the grids of the modulator tube which are driven in phase opposition by the audio oscillator so that only one of the triode sections passes the loop signal at a time. Since the plates of the modulator tube are push-pull connected to the receiver circuits, they alternately add to and subtract from the voltage contributed by the vertical antenna. The addition of the loop signal to the signal from the nondirectional vertical antenna reverses in phase as the loop is rotated through a null position. The audio oscillator also provides alternating current for the field of a dynamometer type left-right indicator.

The receiver circuit amplifies the combined signal which is modulated at the audio oscillator frequency proportionally to the voltage contributed by the loop. Moreover, the phase of the modulation reverses as the loop is rotated through a null. The modulated signal is then detected, amplified, and impressed upon the moving coil of the left-right indicator.

The compass circuits are arranged so that, if the radio signal is coming from the ship's left, the modulation is such that the indicator pointer turns to the left, and if the radio signal is from the ship's right, the pointer of the indicator turns to the right. When the signal is on the axis of the loop, the loop voltage is zero, there is no modulation of the carrier at the frequency of the audio oscillator, and the indicator pointer remains at center.

The voltage induced in the loop by a radio wave from the transmitter is coupled to the loop amplifier tube V1, through transformer T1. The parallel combination of L1 and C38 in the plate circuit of V1 has a capacitive reactance at the signal frequency so that the phase of the signal voltage is shifted 90 degrees when impressed upon the grids of the modulator tube V3 through capacitors C19-1 and C19-2.

The fixed coils of the dynamometer type left-right indicator are tuned to resonance at 48 cycles per second and serve as the tuned circuit of the audio oscillator tube V2. Since the left-right indicator has an alternating magnetic field of 48 cycles per second, current in the moving coil at the same frequency, and leading in phase, will produce a deflection of the pointer toward one side of center. If the phase of the current in the moving coil is reversed, the deflection of the pointer will also reverse. Voltage from the audio oscillator is impressed upon the grids of the modulator tube sections in phase opposition through resistors R12-6, R12-7, and capacitors C3-18, C3-19. Due to its characteristics and because of the magnitude of the audio oscillator voltage impressed upon its grids, the modulator tube functions as an electronic switch, permitting the loop voltage to pass through first one section and then the other. Since the plates of the modulator tube are push-pull connected to transformer T4, the amplified loop voltage is added to the nondirectional vertical antenna voltage when one section of the modulator tube is functioning and subtracted when the other section is functioning. The received signal is thus locally modulated at the frequency of the audio oscillator proportionately to the voltage induced in the loop.

The signal is then amplified and the local modulation is detected and amplified to provide the 48-cycle per second energy for the moving coil of the left-right indicator. The phase of the voltage induced in the loop and the phase of the local modulation reverse as the loop is rotated through a null. This, in turn, reverses the phase of the current in the moving coil of the indicator and changes the deflection of the pointer from one side of center to the other.

When the transmitter is located on the perpendicular to the plane of the loop, there is no voltage induced in the loop consequently no local modulation of the received signal.

3. INSTALLATION

3-1. PRELIMINARY INSPECTION

Prior to the installation of any equipment, a thorough visual and, if possible, electrical inspection of all parts should be made in accordance with the procedure listed in Section 4-1.

3-2. BONDING AND SHIELDING

The ultimate sensitivity of any aircraft receiving installation is limited by the magnitude of the local electrical interference, rather than by the actual sensitivity of the receiver as measured in the laboratory. If reception of weak signals is desired, the aircraft engine, charging generator, ignition system, and all electrical accessories must be completely bonded and shielded prior to installation of the equipment.

3-3. LOCATION AND MOUNTING OF RADIO COMPASS EQUIPMENT

See Figures 10 to 14 and 17 for mounting dimensions.

The mounting base to support the radio compass should be firmly attached to a plane surface as close as possible to the vertical antenna lead-in, and near the associated equipment. When determining this location, care must be taken to permit the radio compass to vibrate freely in all directions. After these requirements have been met, and the lower mounting base has been permanently secured, the upper mounting base and dust cover should be attached to it by means of the Dzus fasteners. Mounting dimensions are given on Figure 10.

The Type MN-20A or Type MN-24A Rotatable Loop must be mounted within a 42- to 168-inch cable run of the receiver, and should be as far removed as possible from antennas and interfering metal structures. The preferred locations are on the fore-and-aft center line of the ship, either above or below the fuselage, about where the wings are attached. A mounting plate for the loop should be drilled as shown in Figure 12 and secured to the aircraft structure in such a manner that the loop base will be level during normal flight. Holes should be made in the skin of the aircraft to permit the passage of the rotator mechanism, the loop transmission cable, and the securing bolts. Sufficient clearance should be available inside the fuselage for the attachment and removal of the loop cable and tuning shaft. A velutex, or similar, gasket should be used between the loop mounting base and the skin of the aircraft to make a water tight seal.

The Type MN-22A Azimuth Control should be mounted so that the dials are easily readable from the operator's position. Four No. 6-32 screws are required for panel installations; three sets of No. 8-32 screws and nuts will be required for rear (bulkhead) mounting. To enable mounting the azimuth control in that position which facilitates the approach of the tach-shafts and still retain indications relative to ship's heading, the zero positions of the dials may be shifted to any of four 90-degree separated positions. This change of position may be done by removing the snap ring and glass, removing the eight dial holding screws and rotating the dial to the desired position. When replacing the screws, use a small amount of glyptal cement to hold them in place. Such a shift in the zero position of the dials will require resetting the cam. The shafting from the loop should be attached to that azimuth control shaft coupling which causes the pointer to rotate in the same direction as the loop. Zero indication on the outer dial should correspond with the zero bearing of the loop.

The two instrument lamps (Bendix No. A18881-1) have one side grounded so a single wire from the airplane's power source will provide illumination. Connection to the unit is made by means of a Breeze plug No. 1002-15-10 (Bendix No. AB9487). A resistor (A100199-1 for 14V; A10099-2 for 28V) is provided in the unit to reduce the current supplied to the lamps to the proper value.

The Type MN-52A Azimuth Control is arranged for mounting on a flat horizontal or vertical surface in front of, or alongside of the pilot. See Figure 13 for location of mounting holes.

The Type MN-28A Remote Control should be located where the panel will be easily visible and the controls accessible to the operator. Clearance for connection of the mechanical tuning shaft and the electrical cables should be provided. See Fig. 11 for location of mounting holes.

The Type IN-4A Left-Right Indicator is designed to fit standard 3¼-inch instrument panel mounting holes. Space is normally available for the indicator on the instrument panel near the other flight instruments. Mounting dimensions for the indicator are shown in Figure 14, Clearance must be allowed for the installation of the connecting cable. It will not be necessary to shock mount the left-right indicator if the panel on which it is mounted is provided with shock absorbers. For other installations, shock mounting must be provided.

The warning light may be mounted in any location that is constantly in the pilot's view. See Figure 14. No warning light is used with the MN-22A.

The junction box should be mounted in an accessible location. In the interest of weight reduction of interconnecting cabling, it is well to locate this box as near as possible to the component units. The junction box must be drilled for mounting. Whenever the resistor R41 or the meter field load assembly are used it will also be necessary to drill holes and mount them in the junction box.

3-4. CABLE CONNECTIONS

The equipment and cables must not interfere with the airplane controls or with other instruments or equipment.

The cable conduit and flexible tuning shafts should be securely fastened in place wherever necessary to prevent abrasion or vibration. Cables connecting to the radio compass should be unsupported for a distance of two feet from the unit and should have enough slack left so that they will not interfere with the action of the shock mounting. The loop cable should be insulated with friction tape wherever it touches another metallic surface. All connections are to be made as shown on Figure 9. See Section 2-8 for additional information concerning the cable interconnections. THE LOOP TRANSMISSION CABLE MUST NOT BE CUT, any excess length may be coiled wherever convenient.

The flexible tuning shafts should be bonded to the principal metallic structure of the aircraft at frequent intervals. The minimum bending radius of the tuning shafts is six inches and not more than two six-inch, 90-degree bends should be made in any one cable installation. Several bends of larger radius or greater angles may be permitted, however. The ends of the shafts terminate with spline joints which are securely held in place on the units by threaded collars.

A gear box mounted on the front panel provides means for obtaining the necessary reduction of rotation between the flexible tuning shaft and the tuning condenser. The flexible shaft connects through a spline and shaft to a worm which drives a split spring loaded worm gear provided with stops to limit the amount of rotation to 180 degrees. The hub of this worm gear is tapered to fit onto a similar taper on the gear shaft, pressure for locking the gear onto the shaft being provided by a knurled nut. When this knurled nut is loosened, the shaft may be turned to any setting without turning the gears. An arm that engages the tuning condenser is mounted on the end of worm gear shaft.

The gear box assembly may be mounted at any one of several positions on the front panel to enable the flexible tuning shaft to be run to the unit with a minimum of bending. Should it be desirable to change this gear box position:

A. Connect the tuning shaft and the remote control to the gear box and rotate the tuning crank in a *counterclockwise* direction until the gear box stops prohibit further rotation.

B. Disconnect the tuning shaft from the gear box and remove the six screws holding the gear box and its cover in place.

C. Loosen the knurled nut in the gear box.

D. Be sure that the condenser is set at maximum capacitance.

E. Rotate the gear box to the desired position and fasten it in place.

F. Tighten the knurled nut and replace the cover plate.

G. Turn the remote control tuning crank until the alignment dot is centered under the index (Band III).

H. Reconnect the flexible tuning shaft and check the adjustments by rotating the tuning crank throughout its range to see if minimum and maximum capacitance is obtained at the end points of the dial scale.

To connect the shaft used for receiver tuning:

A. Set the condenser plates at maximum capacitance (against the stop).

B. Turn the band selector switch to Band III (695-1500 Kcs).

C. Turn the remote control tuning dial to the dot designated ALIGN.

D. Connect the shaft to both the remote control and the radio compass.

E. Check the alignment by varying the tuning knob and resetting to maximum condenser setting. The dial should be reset on the alignment dot.

The flexible shaft which links the loop antenna and the azimuth control should be connected so that the plane of the loop is perpendicular to the airplane line of flight when the dial reading is zero. After setting the two units, tighten the shaft securely and check the installation by rotating the azimuth control knob several degrees each way, then resetting to zero. If the mechanical cable has been properly aligned, the dial scale will read zero when the plane of the loop is at right angles to the line of flight.

3-5. ANTENNA TYPES AND CONNECTIONS

The Type MN-26A and Type MN-26C Radio Compass units are designed and adjusted to operate in conjunction with a vertical antenna having an effective height of 0.3 to 0.6 meters, a capacitance between 50 and 100 Mmf, and a resistance of 1 to 10 ohms. While it is desirable to use an antenna whose characteristics fall within the above limits, satisfactory operation may be obtained with other antennas.

The type of antenna which will be used in any particular installation will be dictated by consideration of space and support structures available on the aircraft.

The portion of the lead-in inside the fuselage should be flexible insulated wire mounted so that the capacitance to ground is at a minimum. If a vertical "spike" antenna is used, the lead-in must have extremely low capacitance and be less than two feet long. A suitable amount of slack must be allowed at the receiver to permit free action of the shock mounting.

4. PREPARATION FOR USE

When a radio compass receiver is transferred from one type of airplane installation to another, and particularly if the change involves an alteration in the length of the loop transmission cable, it will be necessary to check the loop capacitor and inductance alignment as explained in Section 6-4-5.

4-1. TESTS BEFORE INSTALLATION IN AIRCRAFT

Considerable time and trouble will be saved if the components of radio compass equipment to be installed in aircraft are interconnected as shown in Figure 9, and tested before installation. If a standard transmission line test set-up is available, the performance of the equipment should be measured in accordance with Section 6-5. If the above test set-up is not available, the components should be properly interconnected and tested as follows: Tune in several radio stations in each band. On each station operate the equipment on the COMP., REC.ANT., and REC.LOOP positions. When operating the equipment on COMP., swing the loop to the right and left and note the degrees of loop rotation required to produce full scale indicator deflection with the COMPASS control set at maximum. This should be approximately 5 to 6 degrees, dependent on the input signal strength. Note the on course and reciprocal bearings. The on course bearings should check geographical bearings within one degree. From a knowledge of the distance, power, and direction of the station a rough check may be obtained of the performance of the equipment. These tests should be made in a frame test shack in an isolated spot free from electrical interference and at least 200 feet distant from large electrically conductive objects such as buildings, hills, power lines, railroads, etc. *Sensing or bearing accuracy checks can not be relied upon if made inside or close to buildings with metal structures or large electrically conductive objects unless radio compass bearings check actual geographical bearings.* The sensing of the radio compass should be such that the indicator pointer points to the station; that is, if the station is to the left of the perpendicular to the plane of the loop, the indicator should point left; if station is on the right, the indicator should point right. The following inspection should be made prior to installation:

A. Check list of parts and see that all parts are in good condition.

B. Insert all tubes in the radio compass unit, making sure that they are firmly seated in their respective sockets and that all grid clips and grid cap shields are pushed down tightly. The absence of grid caps will cause small errors of the left-right indicators.

C. Check safety wiring of dynamotor.

D. Check all lamps and fuses.

E. Check operation of tuning drives and all controls for freedom of operation.

F. Allow the equipment to operate for at least one-half hour. Check operation of headset. Vibrate or jar the equipment. Any clicks or increase in noise will require a thorough investigation and removal of the cause. Improper soldering of wires to the plugs and noisy vacuum tubes are the usual source of trouble.

G. If the equipment does not seem to be operating satisfactorily, the interconnecting leads and vacuum tubes should be rechecked and equipment known to be in operable condition substituted for the faulty component.

4-2. TESTS AFTER INSTALLATION

After the radio compass has been installed in the aircraft, the following tests should be made before placing the equipment into service:

A. Before turning on the radio compass, check the battery voltage and polarity at the remote control. The fuse terminals should be +11 to +15 volts (22 to 30 volts for 28-volt installations) with respect to ground, regardless of engine speed.

B. Check vacuum tubes to ascertain that they are securely seated in their sockets, and that the grid clips and grid shield caps are making positive contact and are not shorting.

C. Test operation of mechanical cables and connections at both local and remote positions. When properly connected, the ALIGN mark on the remote dial is centered with the ganged condenser at maximum.

D. Check radio compass mounting base screws.

E. Check remote control for tightness of mounting to aircraft structures, and check mounting screws on panel for tightness.

F. Check vertical antenna and see that connections are properly and securely made.

G. Be sure that the loop transmission cable is supported, taped, and bonded. Check tightness of ferrule couplings on the plugs.

H. Check for presence and operation of instrument lights. Also check lamp controls.

I. Using a headset, check receiver operation on all three bands, then check compass operation and indicator response. Jar the compass unit to check for possible sources of noise.

J. Switch compass on and off and note whether or not the airplane's magnetic compass is affected.

K. Check for effects of other radio equipment in the aircraft upon the communicational and navigational performance of the radio compass. Also determine the extent of any interference produced by the radio compass in other radio equipment.

L. Turn OFF-COMP.-REC.ANT.-REC.LOOP switch to COMP. and head the plane toward a transmitting station of known direction. The azimuth control should be set for a 0 azimuth dial reading to give on-course indications. Turn the azimuth control about 15 degrees to the right of the transmitting station and observe the indicator. The pointer should deflect toward the left of the dial. Repeat test, turning the azimuth control 15 degrees to the left of the transmitting station. The indicator pointer should deflect to the right of the dial. If the sense indication is wrong; disconnect the mechanical cable from the azimuth control, rotate the azimuth control 180 degrees, and connect the mechanical cable onto the control unit.

M. With AUDIO control at maximum, tune through each band with the engine stopped and note the noise level. Repeat test with the engines running at various speeds. If any appreciable increase in noise is noted with the engines running at any speed, the aircraft shielding and bonding and the battery circuit filtering should be improved.

4-3. LOOP GAIN ADJUSTMENT

The function of the loop gain control R1 is to provide the proper ratio of loop signal to vertical antenna signal. The control is located on the left side of the compass unit chassis. See Figure 3. The adjustment procedure is as follows:

A. Take the airplane to a place removed from buildings, power lines, fences, etc. If the vertical antenna used with the compass unit is installed underneath the fuselage of the aircraft, the adjustments should be made while the aircraft is in flight, as the pick-up of the vertical antenna will be affected by its proximity to ground.

B. Turn loop gain control fully counterclockwise and set the OFF-COMP.-REC.ANT.-REC. LOOP switch at the COMP. position.

C. Tune in a strong signal and rotate the loop until on-course indication is obtained on the left-right indicator.

D. Rotate loop 90 degrees and back off on the compass control until a less than full-scale deflection is obtained.

E. Turn loop gain control slowly in a clockwise manner until further clockwise adjustment no longer results in increased indicator deflection, readjusting the compass control if necessary to keep the indicator needle within scale limits.

4-4. THRESHOLD SENSITIVITY ADJUSTMENT

The threshold sensitivity control is mounted in the MN-28 remote control unit. After the loop gain control has been adjusted, with the threshold sensitivity control turned fully clockwise, tune the receiver to the point of maximum noise and meter deflection with no signal applied. This should occur in the low frequency band. (This test should be conducted in a location that is as free as possible from interference or static in order that the amount of externally generated noise be at a minimum.) Turn the threshold sensitivity control R2 counterclockwise until the indicator deflection is not over three quarters full scale.

4-5. QUADRANTAL OR AIRCRAFT ERROR CALIBRATION

4-5-1. General

Distortion of the radio frequency field pattern in the vicinity of the aircraft is due to wings, fuselage, engines, propellers, antennas, and other parts of the aircraft. This distortion makes it necessary to check the direction of radio bearings at intervals of 15 degrees or less with respect to the fore-and-aft axis of the aircraft. Errors determined by a calibration check may be compensated in the Type MN-22A Azimuth Control so that the readings correspond to the direction of the radio bearing, provided the errors do not exceed ±20 degrees.

Calibration may be made on the ground if the loop is mounted on top of the aircraft, but the accuracy of the calibration should be checked in the air. The accuracy of a ground calibration of an aircraft having the loop mounted on the bottom may be affected by the proximity of the loop and vertical antenna to the ground. Such a calibration should be considered only approximate until checked in the air.

Aircraft error increases with frequency so that the greatest errors will occur at the highest frequencies used for radio compass operation. Consequently, calibration should be made on at least one station in each band and on frequencies most generally used, where greatest accuracy is required. Accurate bearings may generally be obtained on stations in the frequency range from 200 to 1000 Kcs. The error caused by a change in frequency from 200 to 1000 Kcs. should not usually exceed 3 degrees. When calibration data obtained at the midpoint of this range is used for compensation of the loop, bearings read directly from the azimuth indicator at any other frequency between 200 and 1000 Kcs should not generally be in error by more than 2 degrees. Errors due to sharp discontinuities in the quadrantal error curve will be variable with frequency. These discontinuities are probably caused by resonant structures (usually antennas), and it is important that the loop be so located with respect to such structures that the quadrantal error curve is smooth and essentially sinusoidal.

4-5-2. Radio Compass Calibration On The Ground

4-5-2-1. General

The calibration may be made on the ground by one of two methods; either by moving a portable radio transmitter around the aircraft at a distance of at least 1000 feet in a clear and open field, or by using a fixed radio station and turning the aircraft on a compass rose.

Checks should be made at 15-degree intervals, or at 10-degree or 5-degree points if greater accuracy is required.

4-5-2-2. Portable Transmitter Method

The procedure to be followed when a portable radio transmitter is moved around the aircraft is as follows:

A. Locate the aircraft in the center of a clear and open field at least 2000 feet in diameter. The aircraft must be in flying position.

B. Locate a portable transmitter in line with the fore-and-aft axis of the aircraft so that the aircraft heads towards the transmitter. Use an accurate means of alignment such as an engineer's transit, or pelorus, located on top of the aircraft. The portable transmitter should have sufficient power (5 to 100 watts) to override any external interference and should use a vertical rod or mast 10 to 50 feet high for an antenna.

C. Set the transit or pelorus to zero degrees when the line of sight from the pelorus to the transmitter coincides with the center line of the aircraft.

D. Tune the radio compass in the aircraft to the frequency of the portable transmitter. Choose a transmitter frequency free of interfering signals, and preferably in the frequency range that will be used most of the time for radio bearings.

E. Rotate the loop until on-course indication is obtained. The bearing reading of the azimuth indicator should be zero if previous adjustments were made correctly. Record this reading for the zero heading of the aircraft on a form similar to that shown in Figure 19.

F. Move the portable transmitter, at a radius of at least 1000 feet, through an angle of 15 degrees with respect to the axis of the aircraft, as determined by the line of sight of the transit or pelorus mounted on the aircraft. Rotate the loop until on-course indication is obtained on the left-right indicator. Note and record the reading of the azimuth indicator for the 15-degree position of the transmitter.

G. Move the transmitter 15 degrees from its position in F above at a radius of at least 1000 feet so that the line of sight from the aircraft to the transmitter makes an angle of 30 degrees with the axis of the aircraft. Rotate the loop until on-course indication is obtained. Note and record the reading of the azimuth indicator for the 30-degree position of the transmitter.

H. Repeat the above procedure for transmitter positions at 15-degree (or less) intervals until the transmitter has been moved through 360 degrees around the aircraft.

I. Plot a correction curve of the results obtained on the graph sheet (Figure 22) or similar graph paper. Figure 21 is an example of a typical correction curve. The correction curve obtained may be used to compute the correction necessary when a Type MN-52A Azimuth Control is used. If a Type MN-22A Azimuth Control is used, the curve may be employed to plot cam correction points as described in Section 4-5-4.

J. Repeat the calibration for different frequencies. Be sure to indicate the calibrating frequency on each calibration curve obtained.

4-5-2-3. Fixed Transmitter Method

Calibration of the equipment on the ground from a fixed radio station may be made at the same time the magnetic compass is calibrated and may be accomplished as follows:

A. Locate the aircraft on a compass rose. The aircraft must be in flying position. The general location should be clear of all buildings or obstructions. If a compass rose is not available, one accurate heading toward the selected radio station must be determined and means provided for measuring the angle of aircraft heading with respect to the radio station heading. This angle may be measured by using a transit or pelorus set up on top of the aircraft and sighting on some fixed object at least 1000 feet distant from the aircraft.

B. Select a high-powered, clear-channel radio station from 10 to 100 miles distant, or use a suitable portable transmitter as described for the preceding method. The station should normally provide good bearings with practically no fluctuation of the left-right indicator needle.

C. Tune the radio compass receiver to the transmitter frequency used, and accurately head the aircraft toward the transmitter. Rotate the loop for an on-course indication on the left-right indicator needle. Set the azimuth scale zero mark on the MN-22A to the zero index mark. Note and record the pointer reading of the azimuth indicator for the zero-degree heading of the aircraft. The azimuth indicator reading should be zero degrees if the installation and all adjustments have been made correctly.

D. Swing the heading of the aircraft through an angle of 15 degrees (or less) from the original zero heading above. Rotate the loop for an on-course indication. Note and record the bearing reading of the azimuth indicator for this heading of the aircraft. If the aircraft is turned to the left (counterclockwise as seen from above), the azimuth indicator reading should increase.

E. Increase the heading of the aircraft by 15 degrees so that a heading of 30 degrees with respect to the original zero heading is established. Rotate the loop for an on-course indication. Note and record the pointer reading of the azimuth indicator.

F. Repeat the above procedure for every 15-degree increase in heading of the aircraft until the aircraft has been turned through 360 degrees.

G. Plot a correction curve of the results obtained on the graph sheet (Figure 22) or similar graph paper. Figure 21 is an example of a typical correction curve. The correction curve obtained may be used to compute the correction necessary when a Type MN-52A Azimuth Control is used. If a Type MN-22A Azimuth Control is used, the curve may be employed to plot cam correction points as described in Section 4-5-4.

H. Repeat the calibration for different frequencies. Be sure to indicate the calibrating frequency on each calibration curve obtained.

4-5-3. Radio Compass Calibration In The Air

The procedure for calibration in the air is similar to that previously outlined for ground calibration, since azimuth indicator readings are noted for definite headings of the aircraft with respect to a given transmitter. A high-powered, clear-channel radio station having a vertical radiator should be selected for use in calibrating. The station should provide good bearings with little or no fluctuation of the left-right indicator needle. Do not make the calibration within one hour of sunrise or sunset or when interference or wide fluctuations in bearings are noted. The calibration should be made over smooth terrain if possible in order to avoid reflected or distorted radio waves. A clear day with winds less than 8-10 miles per hour and when the air is smooth should be chosen for a calibration flight in order to eliminate errors due to drift, variations in the heading of the aircraft, and errors in reading the indicator and gyro. All turns made during the calibration procedure should be uniform and gradual so that the directional gyro is not disturbed more than absolutely necessary. Radio bearings should only be taken with the aircraft in level flight and not during a turn or in a bank. Practical use of the radio compass equipment for navigational purposes depends on the accuracy of the calibration, hence the necessity of accurate procedure in flight calibration cannot be overemphasized.

Calibration may be accomplished in the air as follows:

A. Select a series of landmarks that will provide a direct line toward a suitable radio station 25 to 100 miles distant. A road, railroad, power line, or section line makes a good reference line. Distortion of the radio field caused by structures on the reference line (a power line for example) should be checked by noting the action of the left-right indicator as the aircraft is flown on a steady heading across the reference line and as the loop is kept on course. If irregularities occur in the radio bearing indication as the line is approached, or crossed, distortion of the radio wave is present and should be eliminated by flying at a higher altitude or using a different location.

B. Head the aircraft toward the transmitter while flying directly over and along the reference line. Fly at an altitude low enough to avoid sighting error, and keep the aircraft in level flight. Set the directional gyro to zero and rotate the loop to obtain on-course indication of the left-right needle. Release the gyro caging knob so that the directional gyro reads zero when the heading of the aircraft coincides with the ground reference line. Note and record the reading of the azimuth indicator for this zero-degree heading of the aircraft. The indicator reading should be zero degrees if there is no drift and if all adjustments have been properly made.

C. Refer to Figure 18 for a diagram of the flight procedure to be used. After the reading for the zero heading is obtained, turn the aircraft to the left and fly far enough from the reference line so that the aircraft may be turned to the right and a gyro heading of 15 degrees established before the reference line is crossed. With the aircraft held in level flight on a steady gyro heading of 15 degrees, observe the azimuth indicator reading when the aircraft is exactly over the reference line, with the loop rotated for an on-course indication. Record this reading on a form similar to Figure 20.

D. Fly to the right of the reference line far enough so that a left turn may be made and a gyro heading of 345 degrees established before the reference line is recrossed. Note and record the azimuth indicator reading when the aircraft is exactly over the reference line in level flight and on a steady gyro heading of 345 degrees, with the loop held for an on-course reading.

E. Repeat C and D above for gyro headings of 30 and 330 degrees. After the azimuth indicator reading is obtained for the 330-degree gyro heading, execute a right turn so that the aircraft is heading away from the transmitter and flying directly over the reference line.

F. Check the directional gyro reading when the heading of the aircraft coincides with the reference line, flying away from the transmitter. The gyro should read within several degrees of 180 if all turns have been carefully made. If considerable precession of the directional gyro is noted when the 180-degree reference line course is checked, it is recommended that the procedure be repeated or the dirctional gyro checked, if necessary. Small differences due to normal creeping of the gyro (approximately 3 degrees or less over a period of 15 minutes) may be proportioned to each heading.

G. Recage the directional gyro to 180 degrees while the aircraft heading coincides with the reference line, release the caging knob and record the azimuth indicator reading for the 180-degree heading with the aircraft in level flight and on a steady course over the reference line, with the loop positioned for an on-course indication.

H. Following a procedure similar in general to that given above, obtain azimuth indicator readings for gyro headings of 195, 165, 210, and 150 degrees. Turn the aircraft to head toward the transmitter along the reference line, establish a zero-degree heading with respect to the reference line, check the gyro reading as in F above, and recage the gyro to zero degrees.

I. Continue to fly to and from the transmitter over the reference line, alternating the headings of the aircraft from left to right until azimuth indicator readings have been obtained for every 15-degree change in heading of the aircraft.

J. Record the data obtained on a form similar to Figure 20. Plot a correction curve on the graph sheet (Figure 22) or similar graph paper. Figure 21 is an example of a typical correction curve. The correction curve obtained may be used to compute the correction necessary when a Type MN-52A Azimuth Control is used. If a Type MN-22A Azimuth Control is used, the curve may be employed to plot cam correction points as described in Section 4-5-4.

K. Repeat the calibration for different frequencies. Be sure to indicate the calibration frequency on each calibration curve obtained.

L. If greater accuracy is required, use 5-degree or 10-degree increments for changes in heading instead of 15 degrees. Do not make more than four alternate bearing checks between any two zero-degree and 180-degree gyro checks, unless it can be proven that more than four checks can be made without introducing excessive errors. If the reference line is not long enough, or if difficulty is experienced in checking the zero-degree and 180-degree gyro headings of the aircraft against the reference line after a series of turns, reduce the number of alternate right and left headings of the aircraft from four to two or even one.

CAUTION: *Any metallic masses, structures, or conductors in which circulating RF currents may be induced, if later added, removed, or altered in the field of the loop may destroy the accuracy of the calibrations. This applies to the bonding of the airplane, relocation of wiring or of shielding, and spare parts or gear stowed near the loop. Check the calibration in flight at frequent intervals by taking bearings on stations of known direction. The corrected indicated radio bearing, added to the corrected magnetic heading, should give the actual magnetic bearing to the transmitting station.*

4-5-4. MN-22A Cam Shaping

If an MN-22A Azimuth Control is used, the cam must be cut so that corrected bearings may be read directly from the azimuth indicator. Since the cam is cut for one frequency only, it should provide correction at the most generally used frequency. In most instances, the errors will hold to within one or two degrees over the frequency range of 150 to 1500 Kcs.

Before cutting the cam prepare a correction curve as follows:

A. Determine the azimuth indicator corrections from the quadrantal error data. The correction will be the difference between the *True Radio Bearing* and the *Observed Radio Bearing.* If the *True Radio Bearing* is greater than the *Observed Radio Bearing,* the correction will be positive (negative error). If the *True Radio Bearing* is less than the *Observed Radio Bearing,* the correction will be negative (positive error). Use the blank calibration sheet (Figure 20) included in this book to record corrections. A typical set of quadrantal error data is shown as an example in Figures 19, 21.

B. Plot a correction curve similar to that shown in Figure 21. Plot corrections against the corresponding *Observed Radio Bearing* values. Do not plot the corrections against the *True Radio Bearings* or *Gyro Headings.* Be certain that the signs of the corrections are correct.

C. If this curve is essentially symmetrical and sinusoidal (corrections not exceeding ±20 degrees, and the change in correction from any 15-degree point to the adjacent 15-degree point not exceeding 10 degrees), the corrections can be compensated for on the compensator cam. If the errors exceed ±20 degrees and the curve is sinusoidal, corrections up to 20 degrees may be compensated for on the compensator, but it will be necessary to apply any corrections over 20 degrees by using a correction curve. If there are sharp discontinuities in the curve (rate of change of correction exceeding 10 degrees in 15 degrees of azimuth), it will be necessary to determine the cause of such errors and remove this cause. It will then be necessary to rerun the quadrantal error calibration. Should antennas or the aircraft structure be changed in any way after a calibration has been made, it will be necessary to rerun the calibration.

D. Determine the corrections to be applied at each 15-degree point on the cam scale by noting the reading of the curve at each 15-degree interval on the correction curve. Record these corrections on a form similar to Figure 20. *Note that the correction values to be applied to the compensator are not those determined from the flight calibration.*

Disassemble the cam assembly as follows:

NOTE: *Before uncoupling the loop tach-shaft, preparatory to removing the azimuth control, set the pointer on zero. Make sure that the shafting does not rotate from this position during the time in which the azimuth control is uncoupled.*

A. Remove the back cover by unfastening the six screws.

B. Remove the cam supporting bracket.

C. Unscrew the cam holding nut and remove the cam blank N5 from the cam bracket.

The azimuthal bearings of the loop are indicated on the cam blank by the radial lines spaced 15 degrees apart. The circles on the cam represent degrees of correction and the distance between each circle is equivalent to 5 degrees. It will be noted that the maximum plus correction of 20 degrees is the outside diameter of the cam (for correction of minus 20° quadrantal error). A plus correction, advances the indicator pointer relative to the loop.

With a sharp pointed scribe, lay out on the cam blank the contour indicated by the curve drawn on Figure 22. The correction to be applied on the 45-degree line is obtained by reading the intersection of the plotted calibration curve with the vertical 45-degree line on the *Observed Radio Bearing* scale. For example, if this is found to be plus 15 degrees a mark would be made on the cam at the point where the 45-degree radial line intersects the plus 15 degrees correction circle. A point should be marked at each radial line. Scratch a smooth connecting line through all the points. This line represents the contour of the cam. Sudden breaks in the contour usually indicate that a mistake has been made and the cam layout at these points should be checked. Using first a coarse and then a fine file, carefully file away the cam to the contour line. The edge of the cam should be smooth and free from file marks.

Reassemble the cam in the cam bracket with a lockwasher and nut. Do not fully tighten the nut. Assemble the cam bracket in the casting making certain that the cam follower pin is in contact with the edge of the cam. Keep the pointer at zero degrees on the dials and adjust the cam so that the zero-degree radial line is lined up with the mark on the cam follower pin. Tighten the nut.

To check the cam assembly and contour, refer to the calibration curve. Set up the loop azimuth bearings as indicated on the cam by the cam follower pin, by revolving the coupling shaft. The pointer should read the corresponding true bearings. Settings hidden from view by the cam holder can be checked by counting the revolutions of the coupling shaft, as one complete turn of this shaft rotates the cam follower pin 3 degrees. Reassemble the back cover.

If installation requirements have made it necessary to shift the zero position of the dials after the cam has been calibrated and filed, the cam will have to be set so that the cam follower pin is at zero on the cam when the pointer is at zero on the dials.

Before recoupling the indicator to the loop shaft, set the pointer on zero and make certain that the loop has not shifted from its zero-degree heading.

4-6. PERFORMANCE TESTS

4-6-1. Normal Radio Reception

To check normal radio reception:

A. Set master switch on the remote control box to REC.ANT.

B. Plug a telephone headset into TEL jack.

C. Turn AUDIO control to maximum.

D. Allow about forty seconds for the tube heaters to reach their operating temperature.

E. Turn band selector switch to 150-325.

F. Operate the TUNING control until a signal is heard.

G. Vary AUDIO control and note if smooth reduction of volume is obtained.

H. Tune in several stations and note if the selectivity is good.

I. Turn band selector switch to Bands II and III each time checking AUDIO control action and selectivity on several stations.

4-6-2. Anti-Static Radio Reception

To check anti-static reception:

A. Set master switch to REC.LOOP.

B. Repeat steps B, C, D, E, and F of Section 4-6-1.

C. Operate azimuth control until maximum signal is heard in the earphones.

D. Repeat steps G, H, and I of Section 4-6-1, each time operating the azimuth control until maximum signal is heard in the earphones.

4-6-3. Direction Finding

To test direction finding performance:

A. Set master switch to COMP.

B. Set plane in flying attitude headed accurately toward true north.

C. Tune in the signal from a weak station of known direction and rotate the azimuth control until on-course indication is obtained on the left-right indicator, noting whether the azimuth control reading as corrected for deviation corresponds with the known direction of the transmitting station.

D. Turn aircraft to any other known direction and repeat the procedure C, above. Sufficient checks from different positions must be taken to assure that the azimuth control reading and deviation calibration is correct.

5. OPERATION

5-1. GENERAL

The master control switch marked OFF, COMP., REC.ANT., and REC.LOOP controls all radio compass equipment functions other than tuning and adjustment of signal level.

The COMP. setting is used for obtaining communications reception, visual on-course indication of homing and bearings.

The REC.ANT. setting is used for communication and aural radio range reception.

The REC.LOOP setting is used for obtaining communications reception during conditions of severe rain and snow static, aural radio range reception, aural null bearings, and aural null homing from communication stations.

The OFF setting opens all current consuming circuits thus rendering the equipment inoperative.

The azimuth control warning light operates at all times when the equipment is in use except when the azimuth control is set at zero.

5-2. COMMUNICATIONS RECEPTION

5-2-1. General

The MN-26A or MN-26C Radio Compass Equipment may be used for normal reception of communications using a fixed antenna or, in times of extreme rain or snow static conditions, the loop antenna may be used in place of the vertical antenna for anti-static reception. Anti-static reception is not used at all times because of the lower over-all sensitivity when using the loop only.

5-2-2. Normal Reception (antenna)

A. Turn master switch to REC.ANT.

B. Select desired frequency range.

C. Snap C.W. switch ON or OFF as desired.

D. Tune in station.

E. Adjust AUDIO control for desired headset volume.

The COMPASS control and azimuth control are not used for reception of communications.

5-2-3. Anti-Rain-Static Reception (loop)

The operating procedure is as follows:

A. Turn master switch to REC.LOOP.

B. Select desired frequency range.

C. Snap C.W. switch ON or OFF as desired.

D. Tune in station.

E. Rotate azimuth control for maximum output in headset.

F. If the station is to the left or right of the airplane's course, it will occasionally be necessary to readjust the azimuth control setting for maximum signal.

G. Adjust AUDIO control for desired headset volume.

5-3. HOMING

5-3-1. Radio Range Reception

It is necessary either to have a map showing the radio range course and characteristics, or to know the location of the course and its characteristic A and N signal areas.

The operating procedure is as follows:

A. Turn master switch to REC.ANT.

B. Turn band switch to 150-325 Kcs.

C. Tune to desired frequency.

D. Adjust AUDIO control to desired signal level.

E. Obtain a fix of position, see Section 5-4-4, thus determining the direction to the course it is desired to follow.

F. Turn plane so as to intercept the radio range course.

G. The A and N signals will blend into a continuous dash interrupted by the station identification when on course.

H. The plane may then be flown on course to the location of the radio range station.

Arrival at destination is indicated by an abrupt decrease in headset volume known as the cone of silence.

A radio range course may also be flown with anti-rain-static reception in which case the master switch would be set on REC.LOOP and the azimuth control rotated for maximum signal strength at approximately 90-degree or 270-degree settings.

5-3-2. Visual Radio Compass Homing

The operating procedure is as follows:

A. Set azimuth control at zero. *The warning light must be off.*

B. Adjust COMPASS control to maximum.

C. Turn master switch to COMP.

D. Select desired frequency range and tune in station.

E. Listen carefully for station identification to be sure that the desired station is being received. AUDIO control may be set for any audio output level without affecting the deflection of the left-right indicator needle.

F. Alter the airplane's course to left or right as shown by the left-right indicator needle until reading is zero or on course.

G. Although on-course indications will be obtained both when approaching and when flying away from a transmitter no confusion as to location of the station need result. If a course correction, to the right for example, is accompanied by a deflection of the indicating needle in the same direction, the station is aft, while if the deflection is in the opposite direction, the station is ahead. The indicator needle points in the general direction of the transmitting station.

H. Reduce COMPASS control setting until an intermediate value has been found which permits following the course accurately without continuous hunting.

5-3-3. Aural Null Homing

Aural null homing may be used in place of visual radio compass homing should any of the compass circuits or indicator be inoperative or in case of severe rain static. This method is not so desirable as radio compass homing because of the possibility of 180 degrees ambiguity of direction.

The operating procedure is as follows:

A. Turn master switch to REC.LOOP.

B. Select desired frequency range and tune in station.

C. Listen carefully for station identification.

D. When homing on weak signals, turn C.W. switch ON.

E. Adjust AUDIO control for the desired audio level.

F. Rotate azimuth control of zero. *The warning light, if used, must be off.*

G. Turn airplane until headphone volume decreases to minimum.

H. Fly plane on this null course until desired position has been reached.

5-4. DIRECTION FINDING

5-4-1. Visual Bearings

The operating procedure for obtaining radio compass bearings is as follows:

A. Turn master switch to COMP.

B. Adjust COMPASS control for desired sensitivity.

C. Select frequency range and tune in desired station. Check station identification to be sure of having correct station.

D. Observe left-right indicator needle; if needle points toward the right, rotate loop for an increasing azimuth control dial reading, or if it points toward the left, rotate loop for a decreasing azimuth control reading, continuing rotation until an on-course indication is obtained.

E. Observe reading of the azimuth control dial which is relative to the airplane line of flight.

F. Observe actual magnetic heading from the corrected ship's compass reading.

G. Correct azimuth control reading for deviation and, if a Type MN-52A Azimuth Control is used, add corrected reading to actual magnetic heading. Subtract 360 if the sum permits. The final figure will give the true magnetic bearing of the transmitting station with respect to the position of the airplane. To correct this bearing to the magnetic bearing of the airplane with respect to the station, for plotting on a chart, add 180 degrees.

5-4-2. Aural-Null Bearings

Should the left-right indicator or radio compass circuits be inoperative, bearings may be obtained by aural null methods.

The operating procedure is as follows:

A. Turn master switch to REC.LOOP.

B. Select desired frequency range and tune in station. Check station identification.

C. When taking bearings of weak signals, it is helpful to use the CW oscillator beat note.

D. Adjust AUDIO control for desired audio level.

E. Rotate azimuth control until headset volume decreases to minimum.

F. Observe reading of azimuth control dial which is relative to the airplane line of flight. flight.

G. Observe actual magnetic heading from the corrected ship's compass reading.

H. If a Type MN-52A Azimuth Control is used, correct azimuth reading for deviation and add corrected reading to the actual magnetic heading. Subtract 360 if the sum permits. The final figure will give either the true magnetic bearing of the transmitting station or its reciprocal, with respect to the position of the airplane.

5-4-3. Direction Finding Precautions

When for any reason, broadcast station carriers are being used for obtaining bearings, care must be exercised in the selection of stations. Two stations operating on the same frequency may tend to indicate more than one direction, or may fail to give any indication of direction whatever. Stations operating on clear channels will always give the most satisfactory results. Note that broadcast transmitting stations are often situated a considerable distance outside of cities controlling them.

Night effect, or reflection of the radio wave from the sky, is always present. It may be recognized by a fluctuation in bearings.

Try the following to eliminate night effect:

A. Increase altitude thereby increasing the strength of the direct wave.

B. Take an average of the fluctuations.

C. Select a lower frequency station.

Night effect is worse at sunrise and sunset. Night effect is present on stations at 1500 Kcs at distances greater than 20 miles, and as the frequency decreases the distance increases until at 200 Kcs the distance will be about 200 miles. Satisfactory bearings, however, will often be obtained at much greater distances.

5-4-4. Position Fix

A fix of position may be obtained by plotting two or more bearings on a map observing the intersection of the bearings. An alternate method used when homing on a radio range beacon requires only one bearing and the known direction of the radio range course, the intersection of the two projected lines giving the location.

6. MAINTENANCE

6-1. LUBRICATION

The following parts require lubrication after the hours of service indicated below:

Part	*Time*	*Lubrication*
Dynamotor	1000 Hours	Royco Grease No. 6A
Loop mounting gears and bearings	1000 Hours	Royco Grease No. 6A
Radio compass and remote control tuning gears and bearings	1000 Hours	Royco Grease No. 6A
Mechanical tuning shafts	As required	Gargoyle Grease A No. O

Do not lubricate the variable tuning capacitor, potentiometers, or dynamotor commutator. Band switch motor MO is permanently lubricated and will not require attention, unless it is disassembled, in which case the bearings should be repacked with Royco No 6A low temperature grease. If the dial gear mechanism is disassembled, the ball bearings should be repacked with Royco No. 6A low temperature grease.

6-2. ROUTINE INSPECTIONS

6-2-1. Pre-Flight Inspections

Regular inspections should be made preceding each flight as follows:

A. All interconnecting cables should be checked to see that they are securely locked in their receptacles.

B. Check airplane battery with a hydrometer.

C. Check operation of the voltage regulator on the charging generator, adjusting same to insure consistent operation of the generators at 14 to 15 or 28 to 30 volts.

D. Clean antenna insulators, especially any which may be exposed to engine exhaust or propeller blast.

E. Check connections of lead-in wires, both at antenna and radio compass ends.

F. Check all instrument lamps.

If radio compass is functioning properly with power supply "background noise" at a suitable low level, do not disturb the power supply unit.

Each inspection should include a listening test made on at least one point in each band. Operation of all controls should also be checked. Any major trouble should be apparent from these tests.

6-2-2. Periodic Inspection

6-2-2-1. General—Applicable to all parts

Inspect all nuts, bolts, and screws for looseness. Do not tighten or loosen glyptalled screws or nuts unless it is evident they are loose. In the event they are loose, remove screws or nuts, glyptal, replace and tighten. Remove loose solder, dirt, and metallic chips. Clean equipment thoroughly and touch up scratched paint. Inspect soldered joints. Inspect wiring. Inspect all plug connectors and clean if necessary.

6-2-2-2. Radio Compass Unit

A. Inspect unit as described in Section 6-2-2-1 but do not disturb alignment adjustment. Do not disturb wiring unless necessary.

B. Check all tubes. If the tube plate current is less than 80% of normal plate current with 6.3 volts on heater, replace the tubes. Replace all tubes used over 500 hours.

C. Dynamotor DYN. The dynamotor should be inspected after 500 hours of service or once a year, whichever period is shorter. Examine the brushes to see if they have worn properly and are free of hard spots. If such spots are apparent, renew the brush. Spotted brushes can be located by inspecting the commutator for grooves. Remove bearings from armature, clean with penetrating oil and carbon tetrachloride. Check bearings for tolerances and broken or chipped balls. Clean away all old grease and relubricate. Wipe off dirt from commutator, end bells, armature, and housing. If commutator does not have a smooth, even surface, place the armature in a lathe and rotate it. Polish the faulty commutator with a piece of soapstone or take a very thin (.003 inch) cut on a lathe. Do not use sandpaper as this causes deformation of the commutator bars. *Do not use emery cloth.* Remove all dust and dirt particles after polishing. A commutator should have a smooth, polished surface free of dirt, grease, or ridges. *A commutator having a smooth or polished surface should not be turned down simply because it is discolored.* Under normal conditions, the commutators should not require turning down before the expiration of 5000 hours of service. After turning down, the commutators should be carefully examined to see if undercutting of mica is necessary. A small brush, such as a toothbrush, should be used to remove any foreign particles that remain between the commutator bars.

D. Tuning Mechanism. Remove all dirt and old grease. Lubricate gear and tuning shaft coupling as specified in Section 6-1.

E. Tuning Capacitors. Inspect for dirt between plates. *Carefully* clean with a pipe cleaner. *Do not bend plates. Do not lubricate.* Do not blow out as air hose may contain water and sufficient pressure to bend the plates.

6-2-2-3. Remote Control

Inspect as indicated in Section 6-2-2-1. Clean and lubricate dial tuning mechanism and tuning shaft coupling as in Section 6-1.

6-2-2-4. Loop

Clean off all grease and dirt. Relubricate if necessary as specified in Section 6-1.

6-2-2-5. Left-Right Indicator

Inspect visually. Replace faulty indicators. Do not open inner case. A faulty capacitor can be replaced by removing outer case only. Repairs of indicators should only be done by competent personnel at authorized instrument repair shops.

6-2-2-6. Test Performance

Reassemble equipment and measure performance as described in Section 6-5. Vibrate equipment and note any increase in noise or clicks with and without RF input. If equipment is noisy or fails to meet performance requirements, re-examine the equipment until the trouble is discovered.

6-2-2-7. Wiring

Inspect bonding in aircraft. Inspect dynamotor safety wiring. Reassemble equipment and safety wire. Inspect antenna lead-in. Make replacements wherever necessary. Inspect the loop mounting for proper bracing.

Repeat operational inspection of Section 6-2-1.

6-3. SERVICING DATA

6-3-1. TROUBLE LOCATION AND REMEDY

When one trouble has been found and remedied, check the equipment for proper operation. If unsatisfactory results are obtained, follow from the beginning the procedure outlined below to locate further sources of trouble.

Before removing the equipment from the aircraft, make the following checks:

A. Ascertain that the fuse in the remote control is not burned out, and that battery voltage is normal.

B. See that all cables are connected.

C. Make sure that the nondirectional vertical antenna and lead-in are not grounded or open.

6-3-1-1. Low Compass Output—All Bands

A. Test Receiver Output. Operate the radio compass with the OFF-COMP.-REC.ANT.-REC. LOOP switch in REC.ANT. position. Tune to stations in each band and note whether trouble is experienced on only one or two bands. If so, proceed as outlined in Section 6-3-1-2. If the equipment operates satisfactorily as a receiver on all bands, check REC.LOOP operation of the equipment. If the equipment operates satisfactorily under both conditions, the trouble must be associated with the compass circuits. Proceed as outlined in the following paragraphs. If, however, the REC.LOOP operation of the equipment is unsatisfactory, proceed as outlined in Section 6-3-1-4. If trouble is encountered on all bands, proceed as outlined in Section 6-3-1-3.

B. Normal Receiver Output (antenna or loop). When normal, REC.ANT. and REC.LOOP operation is obtained on all bands, the trouble must lie in the compass circuits and tests outlined in the following paragraphs should be made in sequence.

C. Audio Oscillator Test. With a vacuum tube voltmeter, measure AC voltage between ground and terminals 3 and 5 of the indicator. A .1 Mfd, 400-volt capacitor should be connected in series with the voltmeter. If the AF oscillator stage and the indicator are functioning properly, there will be an AC voltage of from 18 to 22 volts between ground and terminals 3 and 5.

D. Compass Output Amplifier Test. Test the tube V12 for emission and characteristics. Set the OFF-COMP.-REC.ANT.-REC.LOOP switch in COMP. position. Measure the socket voltages on the above tube and compare the readings obtained with the values given in the table in Section 6-3-2. If considerable variation is noted from the typical values, check wiring and components of the circuits associated with the tube elements. Disconnect the compass indicator. Turn COMPASS control full on and apply a 1.5-volt, 48-cycle signal from an audio oscillator between ground and the junction of C7 and R32. Connect an output meter between terminals 3 and 4 of compass output transformer can T16. If this stage is functioning properly, it should be possible to obtain an output of at least 5 milliwatts. If the transformer is defective, the entire transformer can assembly must be replaced. Check C7 for open or short circuit.

E. Left-Right Indicator Test. Check indicator and its associated cables for opens, shorts, and poor contacts. If the tests outlined above show no voltage across the indicator field with indicator connected, check the meter and its resonating condenser for shorts. When one indicator is being used, check the meter field load assembly for shorted or open conditions. If two left-right indicators are used, check one at a time by disconnecting the other and inserting the meter field load assembly supplied with the indicator in its place. If the moving coil of the indicator is intact, check between indicator terminal 4 and compass output transformer terminal 4 for open circuit. Proceed with tests outlined in Section 6-5.

6-3-1-2. Low REC.ANT. Output—1 or 2 Bands

If operation of the receiver is obtained on one or two bands, the necessity of checking operation of IF, 2nd Detector, Audio, etc., circuits is unnecessary as it is obvious that these stages must be functioning to permit operation of at least one band. Proceed to the tests outlined in Section 6-3-1-3.

6-3-1-3. Low REC.ANT. Output—All Bands

A. Miscellaneous. When both signal and noise output are low or absent, first check all external cable connections, including antenna connections, power supply connections, fuses, and headphone connections. Also, remove the cover of the antenna switching relay assembly and check operation of the relay R18, C21-1, and the relay contacts.

B. Remote Control Unit. Remove the remote control from its base and check the wiring, components, and switch contacts for opens, shorts, and grounds. Continuity tests should be made back through the cable and junction box to the plug at the radio compass.

C. Power Supply. Failure of the primary power source may normally be detected by failure of the instrument lamps. The supply voltage (approximately 14 or 28 volts) should appear across the yellow and black leads under the hash filter cover. If no supply voltage appears at this point, check the continuity of the wiring and the contacts of S8.

If supply voltage is normal, approximately 200 volts should appear across the red and black leads under the hash filter cover. If this voltage is unreasonably low, check for short circuits in wiring or components associated with or connected to the high voltage supply. Lack of dynamotor output voltage, if the primary supply voltage is normal, indicates a defective dynamotor.

D. Tubes. Test all tubes for emission and other characteristics. Any tubes not having characteristics within standard limits should be replaced.

E. Voltage Measurements. Socket voltages should be measured with the OFF-COMP.-REC.ANT.-REC.LOOP switch in REC.ANT. position and compared to the values given in the table in Section 6-3-2. If any considerable variation from typical values is noted, check all resistors, capacitors, and wiring in circuits associated with the tube elements.

F. Audio Output Amplifier Test. Plug a headset into the TEL jack on the remote control unit and while listening, touch the grid cap of the second detector tube. A loud click or whistle should be heard. If no sound is heard, measure the socket voltages of the audio output tube V11, and the second detector tube V10, and compare readings obtained with the values given in the table in Section 6-3-2. If any considerable variation from the typical values is noted, check wiring and components in the circuits associated with the tube elements. Apply a 400-cycle signal from an audio oscillator to the grid of the audio output tube (socket terminal 5); plug an output meter into TEL jack J1 and measure the audio oscillator voltage required for an output of 50 milliwatts. If the stage is functioning properly, it will be possible to obtain this output with an audio oscillator voltage of less than 1.5 volts. Likewise, an audio oscillator voltage of approximately .025 volts applied to the grid of the second detector tube V10, should give an output of 50 milliwatts. If the output is low when feeding the audio oscillator into the grid of the second detector, but normal when feeding into the grid of the audio output tube, connect the audio oscillator through a .1 Mfd capacitor to the plate of the second detector tube (socket terminal 3). If satisfactory output is obtained when the audio oscillator is connected to the grid of the audio output tube, but not when connected to the plate of the second detector tube, capacitor C16 or the relay RE2 contacts are defective.

G. AVC Circuit Tests. Extreme insensitivity of the radio compass unit may be caused by failure of C4-8, C4-9, or C4-10. One of these capacitors opening up removes the RF ground from the grid return of the associated stage. If the AVC is inoperative, check C6-1 for short circuit. A defective tube in the second detector stage may also cause ineffective AVC operation.

H. IF Amplifier Tests. Apply a 112.5 Kcs signal, 30% modulated at 400 cycles, to the grid of the IF tube and plug an output meter into the TEL jack. Measure the signal generator voltage required to produce an output of 50 milliwatts. If this stage is functioning properly, a signal generator input of less than 50,000 microvolts will be required. If more than 50,000 microvolts is necessary, adjust L12 and L13 to determine whether or not the sensitivity is due to misalignment of T14. If satisfactory alignment cannot be obtained, remove T14 and check all wiring and components. If function of this stage is normal, ground the grid of the RF oscillator tube V7, and apply a 112.5 Kcs signal, 30% modulated at 400 cycles from the signal generator to the grid of the first detector tube through a 0.5 Mfd capacitor, removing the regular grid clip, and shunt the grid of the first detector tube with a 500,000-ohm resistor. If this stage is functioning properly, an input of less than 900 microvolts will be necessary to produce an output of 50 milliwatts. If more than 900 microvolts is necessary, carefully check alignment of T13, alignment procedure for which will be found in Section 6-4-1. If satisfactory alignment and sensitivity of this stage cannot be obtained, remove T13 and check all wiring and components.

I. RF System Tests. Set the band switch on one of the bands on which trouble is encountered and set the tuning dial to the alignment frequency for that band as given in Section 6-4-3. Beginning at the grid of the first detector tube, apply a 30% modulated (400 cycles) signal from the signal generator. 900 microvolts input to this stage from the signal generator should give approximately 50 milliwatts output from the audio output amplifier. As the signal is fed successively into the grids of the second RF, first RF stages, etc., considerably less input from the signal generator should result in the same 50 milliwatts output. If a stage is reached where the signal necessary to produce 50 milliwatts output is greater than or only slightly less than it was for the preceding stage, that stage is faulty and tests outlined in the next two paragraphs should be applied, as the case might be.

J. RF Oscillator Tests. If socket voltage measurements on the first detector tube fail to reveal the source of trouble, set the band switch to one of the inoperative bands and rotate the tuning dial to the alignment frequency for that band, as given in Section 6-4 and apply a signal generator voltage of that frequency, 30% modulated at 400 cycles to the grid of the first detector tube as described in H, above. Turn AUDIO control fully clockwise. It should be possible to obtain an output of 50 milliwatts at the TEL jack for an input of less than 900 microvolts from signal generator. If these conditions can be met, the trouble is in one of the RF stages and the procedure outlined in the next paragraph should be followed. If the conditions cannot be met, check the alignment of the RF oscillator, following the procedure given in Section 6-4-2. If satisfactory alignment is not obtainable, remove the RF oscillator assembly, and check all wiring, contacts of S4, capacitors, resistors, and inductors.

K. RF Amplifier Tests. If socket voltage measurements on the first and second RF tubes fail to reveal the source of trouble, set band switch to one of the inoperative bands and rotate tuning dial to alignment frequency for that band, as given in Section 6-4, and apply a signal generator voltage of that frequency, 30% modulated at 400 cycles, to the grid cap of the second RF tube. It should be possible to obtain an output at the TEL jack of 50 milliwatts for an input of less than 120 microvolts from the signal generator. If these conditions cannot be met, check the alignment of the second RF circuit, following procedure given in Section 6-4-2. If satisfactory alignment is not obtainable, remove the second RF assembly, and check wiring, switch contacts, capacitors, and resistors. If satisfactory output is obtainable from the second RF stage, the procedure outlined above should be repeated for the first RF stage. It should be possible to obtain an output of 50 milliwatts with an input of 20 microvolts to the grid of the first RF tube. If the first RF stage is functioning properly, apply a 5-microvolt signal to the antenna pin on the panel of the compass unit, and if 50 milliwatts or more output, with no more than 12.5 MW noise, is not obtainable, check antenna relay contacts R18, C21-1, and operation of the relay. If normal operation is still unobtainable, remove the antenna shield can assembly, and check wiring, switch contacts, capacitors and antenna coils located in T4, T5, and T6.

6-3-1-4. Low REC.LOOP Output

Operate the radio compass with the OFF-COMP.-REC.ANT.-REC.LOOP switch in REC. LOOP position. Tune to stations in each band, observing whether trouble is encountered on all bands or only on one or two bands. If equipment is inoperative on all bands, proceed as outlined in paragraph A. If, however, trouble is encountered on only one or two bands, remove the compass unit from the cabinet and set up on the test bench. Measure voltage on the plates of modulator tube V3 for each setting of the band switch. If any considerable variation is noted from values given in Section 6-3-2, remove the antenna shield can assembly, and check contacts of S1-2 and plate windings of T4, T5, and T6 for open or short circuits. If the nature of the trouble encountered on only one or two bands is not apparent from the foregoing tests, proceed as outlined in paragraph B below.

A. Modulator Test. Measure socket voltages of the modulator tube and compare with values given in voltage table. If any considerable variation from typical values is noted, check wiring and components of the circuits associated with the tube elements. With the OFF-COMP.-REC.ANT.-REC.LOOP switch in COMP. position and the compass unit tuned to the aligning frequency (as given in Section 6-4) on any one of the faulty bands, set the loop gain, COMPASS, and threshold sensitivity controls at maximum and ground grid 1 (socket terminal 4) of the modulator tube. Apply a 7-microvolt signal generator voltage of the aligning frequency to grid 2 (socket terminal 5) of the modulator tube and observe the left-right compass indicator. If the modulator stage is functioning properly, the indicator pointer will deflect full scale to right. Repeat test, grounding grid 2 and applying signal to grid 1. The indicator pointer should deflect full scale to left.

B. Loop Amplifier Test. Measure the socket voltages of tube V1 and compare readings obtained with values given in the voltage table. If any considerable variations from typical values are noted, check wiring and components of circuits associated with the tube elements. If all bands are inoperative, remove the phasing can assembly and check all wiring and components for open or short circuits. If only one or two bands are inoperative, roughly check alignment of loop stage trimmers of the bands at fault. If proper alignment appears impossible, remove the loop shield can assembly and check all components, switch contacts, and wiring.

C. Loop Test. Test loop, mounting (brushes and rings on rotatable mounting), and loop cable for open or short circuits or grounds. Also check for poor contact at plugs.

D. Loop Stage Alignment. If it has been necessary to make any alteration in the settings of the loop stage trimmers, it will be necessary to realign this stage completely. The procedure outlined in Section 6-4-5 should be followed.

6-3-1-5. Noisy Compass or Receiver Operation

To locate the cause of noisy operation, check the following components:

Check	*For*
Vacuum tubes	Microphonic or defective tubes.
Dynamotor	Worn or arcing brushes.
Loop	Dirty or flattened pins.
Loop mounting	Corroded sockets, dirty brushes or rings.
Cable plugs	Poor contacts.
Bonding	Loose connections. Chassis not grounded.
Switches	Dirty contacts.
Variable capacitors	Dirt between plates.
Power source	Loose or corroded connections.
Circuits	Loose wires, defective capacitors or resistors.

6-3-2. TYPICAL MN-26A AND MN-26C VACUUM TUBE SOCKET VOLTAGES

Battery voltage, 14 volts (28-volt operation will give similar typical voltages). Equipment operating on COMP. Threshold sensitivity, COMPASS, loop gain, and AUDIO controls all fully clockwise. Band switch on Band III. All voltages are measured to the chassis unless otherwise stated. Allowable tolerance of voltage variation ±10%. Measurements made with a 5000 ohms per volt DC voltmeter. Plate and screen voltages measured on 250-volt scale. Heater, suppressor, and cathode voltages measured on 10-volt scale unless otherwise specified.

Tube	*Socket Terminal*	*Element*	*Voltage*
V1,6K7	2 to 7	Heater	6.4
Loop Amp.	3	Plate	192.
	4	Screen	97.
	5	Suppressor	2.8
	8	Cathode	2.8
V2,6N7	2 to 7	Heater	6.5
Audio Osc.	3	Plate (P_2)	200.
	6	Plate (P_1)	200.
	8	Cathode	1.0
V3,6N7	2 to 7	Heater	6.4
Mod.	3	Plate (P_2)	170.
	6	Plate (P_1)	170.
	8	Cathode	10.
V4,6K7	2 to 7	Heater	6.6
1st RF	3	Plate	170.
	4	Screen	77.
	5	Suppressor	0.
	8	Cathode	3.0
V5,6K7	2 to 7	Heater	6.4
2nd RF	3	Plate	175.
	4	Screen	75.
	5	Suppressor	0.
	8	Cathode	3.0
V6,6L7	2 to 7	Heater	65
1st Det.	3	Plate	1900
	4	Screen	85.0
	5	Grid #3	2.8
	8	Cathode	3.8
V7,6J5	2 to 7	Heater	6.5
Het. Osc.	3	Plate	62.
	8	Cathode	0.
V8,6K7	2 to 7	Heater	6.3
IF Amp.	3	Plate	167.
	4	Screen	125.
	5	Suppressor	0.
	8	Cathode	4.7
V9,6J5	2 to 7	Heater	6.5
CW Osc.	3	Plate	*23.
V10,6B8	2 to 7	Heater	6.6
2nd Det.	3	Plate	75.
	6	Screen	75.
	8	Cathode	**15.
V11,6F6	2 to 7	Heater	6.6
Audio Amp.	3	Plate	195.
	4	Screen	210.
	8	Cathode	**13.
V12,6K7	2 to 7	Heater	6.4
Comp. Amp.	3	Plate	195.
	4	Screen	65.
	5	Suppressor	0.
	8	Cathode	1.4

NOTES: * CW On
** 50V Scale

When vacuum tube socket voltages are found to vary appreciably from the typical values given in the above table, the trouble can usually be located as described below:

A. Heater Voltage High: Heater burned out in one of the tubes in the same parallel connected group. See Figure 9.

B. Heater Voltage Low: Dirty contacts on S8. Heater burned out in one of the tubes in the other parallel connected group.

C. Plate Voltage High: Shorted plate resistor. Open screen or cathode circuit.

D. Plate Voltage Low: Ground on plate lead. Defective screen or cathode bypass capacitor. Defective plate coupling capacitor.

E. Screen Voltage Low: Defective screen or cathode bypass capacitor.

F. Cathode Voltage High: Open cathode resistor. R2 open. L2 or L3 open.

G. Cathode Voltage Low: Defective cathode bypass capacitor or resistor.

6-4. RADIO COMPASS UNIT ALIGNMENT

This equipment has been carefully adjusted and aligned by the manufacturer and thoroughly inspected before shipment. The circuits are designed so that their alignment will be maintained over long periods of time. Before changing any adjustments it must be ascertained that the difficulty is not the result of normal deteriorating influences such as worn out vacuum tubes, blown fuses, improper operating voltages, broken cords, external RF interference, etc. FACTORY ADJUSTMENTS ARE SEALED WITH PURPLE GLYPTAL AND ARE NOT TO BE ALTERED UNLESS ABSOLUTELY NECESSARY. Any questionable performance characteristics should be measured in accordance with Section 6-5 before and after adjustment. All aligning adjustments are accessible from the top of chassis (see Figure 2) and are:

Band	*Aligning Freq.*	*Loop*	*Antenna*	*Radio Freq-1*	*Radio Freq-2*	*RF Osc*
I—(150- 325 Kcs)	325 Kcs	C1-1	C1-4	C1-7	C1-10	C1-13
II—(325- 695 Kcs)	695 Kcs	C1-2	C1-5	C1-8	C1-11	C1-14
III—(695-1500 Kcs)	1500 Kcs	C1-3	C1-6	C1-9	C1-12	C1-15

6-4-1. Intermediate Frequency Amplifier Alignment

6-4-1-1. Second IF Stage Alignment

Operate on REC.ANT. and plug a 600- or 4000-ohm output meter, as needed, in J1 with other jack open. Set AUDIO on maximum. Set tuning dial to 695 Kcs on Band II.

Apply a 112.5 Kcs signal, 30% modulated at 400 cycles, directly to the grid of the IF tube, leaving the regular grid clip in place. The signal generator output should be adjusted to about 100,000 microvolts.

Adjust L12 and L13 of T14 for maximum output, reducing the signal generator voltage as necessary to keep the output of the radio compass unit at approximately 50 milliwatts. The input to V8 when T14 is properly aligned should be between 25,000 and 40,000 microvolts.

While the signal generator is at exactly 112.5 Kcs, turn off modulation and turn CW switch ON. Adjust coil L6 for zero beat. The CW oscillator will then oscillate at the IF frequency and the zero beat method of aligning the RF oscillator stage may be employed. After completion of alignment, the CW oscillator should be readjusted to 113.5 Kcs for the 1000-cycle per second difference frequency.

6-4-1-2. First IF Stage Alignment

With the dial still turned to 695 Kcs on Band II, AUDIO control turned fully clockwise, and OFF-COMP.-REC.ANT.-REC.LOOP switch on REC.ANT. position, attach the lead from the signal generator to the grid of the first detector tube through a 0.5 Mfd capacitor, removing the regular grid clip, and shunt the grid of the first detector tube with a 500,000-ohm resistor. Ground the grid of the heterodyne oscillator V7. Adjust the signal generator to 114.5 Kcs, 30% modulated at 400 cycles and an output of 1000 microvolts. Adjust L10 and L11 for maximum output. Reset the signal generator to a frequency of 110.5 Kcs and readjust L10 and L11 for maximum output. Reset the signal generator to 114.5 Kcs and readjust L10 and L11 for maximum output. This completes the alignment of this stage.

Set the signal generator at 112.5 Kcs and check the input to V6 required for a 50-milliwatt output. This input should be approximately 900 microvolts. See Section 6-4-6 for CW oscillator alignment.

6-4-2. RF Oscillator Alignment

Operate radio compass unit on REC.ANT. switch position; AUDIO control at maximum clockwise position, plug headset into J1, and couple the signal generator to the control grid of the first detector tube.

Turn on CW oscillator, which has previously been adjusted to 112.5 Kcs.

Set the signal generator to 1500 Kcs 1000 microvolts output, unmodulated. Rotate the tuning dial to 1500 Kcs on Band III and rotate trimmer C1-15 for zero beat in headphones.

Set the generator to 695 Kcs and the tuning dial to 695 Kcs on Band II. Adjust trimmer C1-14 for zero beat.

Set the generator to 325 Kcs and the tuning dial to 325 Kcs on Band I. Adjust trimmer C1-13 for zero beat.

NOTE: If subsequent sensitivity measurements indicate poor tracking at the low frequency ends of any of the bands, adjustment of the oscillator coil inductance on one or more bands will be necessary. The same equipment setup and procedure used at the high frequency ends of the bands is used for this alignment which is accomplished by adjusting the settings of the iron core screws (glyptalled factory adjustments) in T10, T11, or T12 (Bands I, II, and III oscillator transformers, respectively) as the case may be. If any alteration of the oscillator coil inductance is made, it is necessary to repeat the oscillator alignment procedure at the high frequency ends of the band or bands in question, as outlined above.

6-4-3. First and Second RF Amplifier and Antenna Stage Alignment

Operate the compass unit on REC.ANT. switch position, AUDIO control at maximum clockwise position, plug an output meter into J1 and connect a signal generator to the antenna plug through a 100 Mmf, dummy antenna. Set the signal generator for 30% modulation at 400 cycles.

Band III Alignment. Set tuning dial to 1500 Kcs on Band III, and adjust signal generator to 1500 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmers C1-12, C1-9, and C1-6 for maximum output, reducing the input from the signal generator as much as is necessary to keep output at approximately 50 milliwatts. Set signal generator output at 10 microvolts and reduce AUDIO control setting to the point at which slightly less than 50 milliwatts output is obtained and touch up trimmers C1-12, C1-9, and C1-6 for maximum output.

Band II Alignment. Set tuning dial to 695 Kcs on Band II, reset AUDIO control to maximum clockwise setting, and adjust signal generator to 695 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmers C1-11, C1-8, and C1-5 for maximum output. Set signal generator output at 10 microvolts and reduce AUDIO control setting to the point at which slightly less than 50 milliwatts output is obtained and touch up trimmers C1-11, C1-8 and C1-5 for maximum output.

Band I Alignment. Set tuning dial to 325 Kcs on Band I, reset AUDIO control to maximum clockwise setting, and adjust signal generator to 325 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmers C1-10, C1-7, and C1-4 for maximum output. Set signal generator output at 10 microvolts and reduce AUDIO control setting to the point at which slightly less than 50 milliwatts output is obtained and touch up trimmers C1-10, C1-7, and C1-4 for maximum output.

6-4-4. Adjustment of the IF Rejection Traps

Connect signal generator to the compass unit antenna plug through a 100 Mmf capacitor, set tuning dial to 150 Kcs on Band I, and adjust the signal generator to 4 microvolts output at 150 Kcs 30% modulation at 400 cycles. Adjust AUDIO control to the point at which 50 milliwatts output is obtained.

Set the signal generator to 114.5 Kcs and adjust the input to one volt. Leaving the generators set, adjust the iron core of L3 until minimum output is obtained. Readjust the signal generator frequency to 110.5 Kcs and adjust the iron core of L2 for minimum output. With these adjustments made as described, there should not be over 30 milliwatts of power output with one volt of input.

6-4-5. Loop Alignment

Set the equipment as for a standard radio compass test setup. Turn the loop parallel to the transmission line and set the OFF-COMP.-REC. ANT.-REC.LOOP switch to REC.LOOP position.

Tune compass unit to 1500 Kcs on Band III and adjust signal generator to the same frequency and for an input to the loop of approximately 100 microvolts per meter, 30% modulated at 400 cycles. Adjust C1-3 for maximum indication on the output meter, adjusting AUDIO control knob to maintain output meter reading below 50 milliwatts.

Switch to Band II and set tuning dial at 695 Kcs. Adjust the signal generator to the same frequency and an input to the loop of approximately 100 microvolts per meter. Adjust C1-2 for maximum indication on output meter, adjusting AUDIO control knob to maintain output meter reading below 50 milliwatts.

Switch to Band I and set tuning dial to 325 Kcs. Adjust signal generator to the same frequency and an input to the loop of approximately 100 microvolts per meter. Adjust C1-1 for maximum indication on the output meter, adjusting AUDIO control knob to maintain output meter reading below 50 milliwatts.

If loop sensitivity is unsatisfactory at the low frequency end of any band or bands, it will be necessary to readjust the inductance of loop coils, T1, T2, and T3. This may be accomplished by repeating the procedure outlined in the three above paragraphs, adjusting the iron cores, which have been glyptalled in place at the factory, for maximum indication on an output meter. These adjustments should be made at the low frequency ends of the three bands (695 Kcs, 325 Kcs, and 150 Kcs). If it is necessary to change the settings of any of these core adjustments, it will be very important to readjust the loop trimmers C1-1, C1-2, and C1-3 as outlined above.

6-4-6. CW Oscillator Alignment

Operate on REC.ANT., plug a headset into the TEL jack J1. Set tuning dial to 695 Kcs on Band II. Attach the lead from signal generator to grid of the first detector tube through a 0.5 Mfd capacitor, removing the regular grid clip, and shunt the grid of the first detector tube with a 500,000-ohm resistor.

Apply a 113.5 Kcs signal unmodulated. The signal generator output should be approximately 1500 microvolts.

Adjust CW oscillator coil L6 for zero beat as heard in the headphones.

6-5. OVERALL PERFORMANCE CHARACTERISTICS

6-5-1. General

If at any time operation of the equipment is questionable, the performance of the equipment should be measured in accordance with the following typical procedures and values. After making any major repairs or adjustments, performance should be measured to insure that the adjustments have been properly made.

6-5-2. STANDARD TEST CONDITIONS

For these tests the following conditions should be maintained unless otherwise stated:

Signal-to-noise ratio of 4 to 1 in power, 2 to 1 in voltage. The noise output is 12.5 milliwatts when standard output is 50 milliwatts or 7 volts when standard output is 14.1 volts.

Standard Output. 50 milliwatts or 14.1 volts (signal and noise). This output may be obtained from either of the remote control unit jacks with plug out of the other jack. On receiver operation adjust AUDIO control for standard signal-to-noise ratio. On COMP. adjust AUDIO control for maximum output.

Artificial Antenna. Receiver 100 Mmf, compass 100 Mmf, and one-half meter effective height.

Standard Modulated Signal 30% 400 cycles per second.

Warm up period—20 minutes.

Low voltage supply +14 or +28 volts.

6-5-3. SENSITIVITY: REC.ANT.

Apply the standard modulated signal to the antenna terminal through an artificial antenna. Set generator output at approximately 5 microvolts. Carefully tune the radio compass unit to resonance. Cut off modulation, leaving the carrier on. Set AUDIO control to obtain 12.5 milliwatts average noise output. Turn modulation on and set generator output to the value which gives 50 milliwatts receiver output. Turn off modulation and reset AUDIO control to obtain 12.5 milliwatts average noise output. Repeat until 50 milliwatts output is obtained with modulation on and 12.5 milliwatts noise with modulation off. Repeat above procedure for each test frequency. Record receiver input on a form similar to that contained in Section 6-5-12.

6-5-4. MINIMUM NOISE LEVEL

Minimum noise level can be measured by operating on REC.ANT. and turning AUDIO control to minimum. Output levels greater than 0.050 milliwatts indicate trouble in dynamotor, filtering, or second detector and audio circuits.

6-5-5. INTERMEDIATE FREQUENCY REJECTION RATIO

Measure REC.ANT. sensitivity at test frequency (150 Kcs). Set signal generator at point of greatest response near 112.5 Kcs and increase its output until 50 milliwatts receiver output is obtained. The ratio of the attenuator setting at 112.5 Kcs and at the test frequency is the rejection ratio. Record this data on a form similar to that contained in Section 6-5-12. NOTE: The harmonics of the signal will appear in the frequency range of the equipment (i.e. 225, 337.5, etc.) To avoid response from harmonics select a test frequency half way between these harmonics.

6-5-6. IMAGE REJECTION RATIO

Measure REC.ANT. sensitivity of equipment first at test frequency (1500 Kcs) and again with signal generator set 225 Kcs above the test frequency. Do not disturb tuning of equipment but vary the signal generator frequency slightly until maximum response is obtained. The ratio of the signal generator output of the two settings is the image rejection ratio. Record this data on a form similar to that in Section 6-5-12.

6-5-7. AVC ACTION

Operate on REC.ANT., audio control maximum. Apply a standard modulated signal to the antenna terminal through a 100 Mmf artificial antenna. Record milliwatts output against microvolts input on a form similar to that of Section 6-5-12. The test frequency generally used is 655 Kcs.

6-5-8. SELECTIVITY: REC.ANT.

Measure REC.ANT. sensitivity of equipment at the high frequency end of each band. Increase the signal generator attenuator setting so that the output is 1000 times that of the measured sensitivity. Vary signal generator frequency above and below resonance until output equals original test output. Record the band width on a form similar to that of Section 6-5-12.

6-5-9. SENSITIVITY: REC.LOOP

Mount loop beneath the reference transmission line. Operate on REC.LOOP. Turn loop for maximum pick-up. Adjust AUDIO control for a signal to noise power ratio of 4 to 1 as done for REC.ANT. sensitivity measurement of Section 6-5-3. Record microvolts per meter field strength at the center of the loop for standard receiver output on a form similar to Section 6-5-12.

6-5-10. COMPASS SENSITIVITY UNIFORMITY AND ACCURACY

Mount the loop beneath the reference transmission line. Operate on COMP. Use a 100 Mmf, 0.5 meter artificial antenna. Adjust COMPASS control so that approximately 5 to 6 degrees rotation of the loop produces full scale indicator deflection, with an input of 1000-μV/M (800 Kcs) at the center of the loop. Without changing COMPASS control setting, record the degrees rotation of loop required to produce zero and full-scale right and left indicator pointer deflection, for 50, 100, and 100,000 microvolts per meter input at different test frequencies on a form similiar to that of Section 6-5-12.

6-5-11. INPUT FOR FULL SCALE INDICATOR DEFLECTION

This test requires a well shielded compass test room. Mount loop beneath the reference transmission line. COMPASS control on maximum. Apply an 800 Kcs signal of 1000 microvolts per meter field strength at the center of the loop.

Record number of degrees loop rotation required for left and right full scale indicator deflection. Typical loop settings are 5.5 degrees left for full scale left deflection, 0 for on-course setting, and 5.5 degrees right for full scale right deflection.

6-5-12. TYPICAL PERFORMANCE DATA

The following performance characteristics are the average of a number of production tests. Any equipment whose performance approximates that of the figures given below is considered satisfactory.

Para. No.	Test Point			1-L	1-M	1-H	2-L	2-M	2-H	3-L	3-M	3-H
	Test Freq (Kcs)			150	220	325	325	470	695	695	1100	1500
6–5–3	REC.ANT. Sens. μV			4.1	3.2	2.6	3.2	3.2	2.8	4.0	3.5	3.2
6–5–5	I F Rej. Ratio			300M/1	..	..	..	..	..	..	..	..
6–5–6	Image Rej. Ratio			..	..	..	..	..	..	..	..	22000/1
6–5–9	Loop Sens. μV/M			77.4	58.5	54.8	63.4	49.4	37.4	49.8	36.8	29.4
6–5–10	Compass Sensitivity Uniformity and Accuracy	50 μV/M	O	+.2	−.2	O	+.2	O	−.1	O	O	O
			R	14.	13.2	16.8	18.8	15.2	19.	20.2	15.9	17.
			L	13.5	13.7	16.7	17.5	15.2	19.3	20.2	15.8	17.
		100 μV/M	O	−.8	O	O	O	O	−.5	O	O	−.2
			R	10.4	12.	15.1	16.5	14.8	18.	15.9	15.	14.8
			L	12.	12.1	15.4	16.7	14.8	19.	15.8	15.	15.2
		100,000 μV/M	O	+.2	−.1	+.1	O	O	−.1	O	O	−.2
			R	11.5	11.2	14.8	16.4	15.	18.	16.1	15.	15.6
			L	11.	11.5	14.5	16.6	15.2	18.2	16.	15.2	16.
6–5–8	REC.ANT. Selectivity Res. Input Band Width X 1000			..	..	11.4	..	..	13.4	..	..	15.5
6–5–11	Loop Rotation for Full Scale Indicator Deflection at 800 Kcs					1000 μV/M			L=5.5°,			R=5.5°
6–5–7	AVC Action Mod. 30% Test Freq. 655 Kcs	Input				5 μV			100 μV			1V
		Mw Output				55			650			1550

7. PARTS LIST BY SYMBOL DESIGNATION FOR MODEL MN-26A AND MODEL MN-26C RADIO COMPASS EQUIPMENT

7-1. TYPE MN-26A RADIO COMPASS

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
		CAPACITORS			
C1-1	Loop Trimmer, Band 1				
C1-2	Loop Trimmer, Band 2				
C1-3	Loop Trimmer, Band 3				
C1-4	Ant. Trimmer, Band 1				
C1-5	Ant. Trimmer, Band 2				
C1-6	Ant. Trimmer, Band 3	Each, 6 to 25 Mmf, ±10%, 500V, Variable right-hand terminal	Special	3	B7751-25
C1-7	1st RF Trimmer, Band 1				
C1-8	1st RF Trimmer, Band 2				
C1-9	1st RF Trimmer, Band 3				
C1-10	2nd RF Trimmer, Band 1				
C1-11	2nd RF Trimmer, Band 2				
C1-12	2nd RF Trimmer, Band 3				
C1-13	HF Osc. Trimmer, Band 1				
C1-14	HF Osc. Trimmer, Band 2	Each, Same as C1-1, Except has left-hand terminal	Special	3	B7783-25
C1-15	HF Osc. Trimmer, Band 3				
C2-1	Loop Tuning				
C2-2	Ant. Tuning	5 Section Variable Capacitor, 400 Mmf per section max. cap., ±0.5%, 12.5 Mmf per section min. cap.	Special	3	L70943
C2-3	1st RF Tuning				
C2-4	2nd RF Tuning				
C2-5	HF Osc. Tuning				
C3-1	V1 Plate Bypass				
C3-2	V1 Screen Bypass				
C3-3	Not Used				
C3-4	Not Used				
C3-5	V4 Screen Bypass				
C3-6	V4 Plate Bypass				
C3-7	V5 Screen Bypass				
C3-8	V5 Plate Bypass				
C3-9	V6 Screen Bypass				
C3-10	V8 Plate Bypass				
C3-11	V8 Screen Bypass	Each, .05 Mfd, ±10%, 400V, DCW, Paper	345-8	4	A18015-503
C3-12	V6 Plate Bypass				
C3-13	V2 Grid Coupling				
C3-14	V2 Grid Coupling				
C3-15	V7 Plate Bypass				
C3-16	V3 Plate Bypass				
C3-18	V3 Grid Cplg., Low Freq.				
C3-19	V3 Grid Cplg., Low Freq.				
C3-20	V9 Grid Blocking				
C3-21	V9 Plate Bypass				
C4-1	V1 Cathode Bypass				
C4-2	V3 Cathode Bypass				
C4-3	V4 Cathode Bypass				
C4-4	V5 Cathode Bypass				
C4-5	V6 Cathode Bypass				
C4-6	V8 Cathode Bypass	Each, .05 Mfd, ±10%, 200V DCW, Paper	342-6	4	A18181-503
C4-7	V10 Cathode Bypass				
C4-8	V4 AVC Filter				
C4-9	V5 AVC Filter				
C4-10	V6 AVC Filter				
C4-11	V3 Cathode Filter				
C5-1	V12 Grid Bypass	0.1 Mfd, ±10%, 200V DCW, Paper	345-5	4	A18181-104
C5-2	V12 Plate Resonator	Same as C5-1	..	..	..
C6-1	AVC Filter	.02 Mfd, ±10%, 200V DCW, Paper	342-3	4	A18181-203
C6-2	V8 AVC Bypass	Same as C6-1	..	..	..
C7	V12 Grid Coupling	0.5 Mfd, ±10%, 400V DCW, Oil-paper	..	5	E11398
C8	V11 Cathode Bypass	5 Mfd, +100% −0% 50V, Oil-paper	..	5	E11402
C9-1	LV Filter Bypass	2 Sect, 0.5 Mfd, ±10%, 100V DCW, Oil-paper	Special	5	E11400
C9-2	LV Filter Bypass				
C10-1	HV Filter	2 Sect, Each, 6 Mfd, 400V DCW, Oil-filled	Special	5	A15066
C10-2	HV Filter				
C11-1	V1 Grid Parallel Padder				
C11-2	V5 Grid Parallel Padder	Each, 35 Mmf, ±10%, 500V DCW, Ceramic	N680K	6	A18207-350
C11-3	V6 Grid Parallel Padder				
C12-1	V10 RF Bypass	50 Mmf, ±5%, 500V DCW, Ceramic	N680K	6	A18182-7
C12-2	V10 Grid Bypass	Same as C12-1	..	..	..
C13	V10 RF Bypass	100 Mmf, ±10%, 500V DCW, Ceramic	N680L	6	A18205-101
C14-1	V4 Trap Resonator	.005 Mfd, ±2%, 300V DCW, Mica	1467	5	C56310-502
C14-2	V5 Trap Resonator	Same as C14-1	..	..	..
C15	Ant. Coupling	.001 Mfd, ±10%, 500V DCW, Mica	1468	5	C56315-102
C16	V11 Grid Coupling	.01 Mfd, ±10%, 300V DCW, Mica	1467	5	C56312-103
C17	V7 Grid Compensating	25 Mmf, ±10%, 500V DCW, Mica	1468	5	C56315-250

CAPACITORS (Cont'd)

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
C19-1	V3 Grid RF Coupling	250 Mmf, ±5%, 500V DCW, Mica	1468	5	C56314-251
C19-2	V3 Grid RF Coupling	Same as C19-1	..	..	..
C20-1	V4 Ant. Coupling	10 Mmf, ±10%, 500V DCW, Ceramic	N680L	6	A18205-100
C20-2	Trimmer Compensating	Same as C20-1	..	..	..
C21-1	Ant. Compensating				
C21-2	V4 Plate Resonator, Band 3				
C21-3	V5 Plate Resonator, Band 3	Each, 100 Mmf, ±5%, 500V DCW, Mica	1468	5	C56314-101
C21-4	V10 AVC Diode Coupling				
C21-5	V9 Grid Coupling				
C22-1	V4 Plate Resonator, Band 1	300 Mmf, ±5%, 500V DCW, Mica	1468	5	C56314-301
C22-2	V5 Plate Resonator, Band 1	Same as C22-1	..	..	..
C23-1	V5 Plate Resonator, Band 2	75 Mmf, ±5%, 500V DCW, Mica	1468	5	C56314-750
C23-2	V5 Plate Resonator, Band 2	Same as C23-1	..	..	..
C24-1	T9-1 Coupling				
C24-2	T9-2 Coupling	Each, 5 Mmf, ±10%, 500V DCW, Ceramic	P120K	6	A18182-2
C24-3	V9 Grid Coupling				
C25	V6 Injector Grid Coupling	15 Mmf, ±10%, 500V DCW, Mica	1468	5	C56315-150
C29	V4 Grid Parallel Padder	25 Mmf, ±10%, 500V DCW, Ceramic	N680K	6	A18205-250
C30	V7 Series Padder, Band 1	625 Mmf, ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-2
C31	V7 Series Padder, Band 2	1286 Mmf, ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-3
C32	V7 Series Padder, Band 3	2514 Mmf, ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-4
C34-1	V6 Plate Resonator				
C34-2	V8 Grid Resonator				
C34-3	V8 Plate Resonator	Each, 500 Mmf, ±2%, 500V DCW, Mica	1468	5	C56313-501
C34-4	V10 Diode Resonator				
C34-5	V9 Grid Resonator				
C35	V10 Plate Bypass	500 Mmf, ±10%, 500V DCW, Mica	1468	5	C56315-501
C37-1	LV Dynamotor RF Filter				
C37-2	HV Dynamotor RF Filter	3 Sect. each, 0.1 Mfd, 400V DCW, Paper	Special	5	E11347-1
C37-3	HV Dynamotor RF Filter				
C38	V1 Plate Resonator	100 Mmf, ±2%, 500V DCW, Mica	1468	5	C56313-101
C39-1	V2 Plate #1 Bypass				
C39-2	V2 Plate #2 Bypass	Each, 0.1 Mfd, ±10%, 400V DCW, Paper	345	4	A18015-104
C39-3	V12 Screen Bypass				
C40	V7 Grid Parallel Padder	30 Mmf, ±10%, 500V DCW, Ceramic	N680K	6	A18207-300

DYNAMOTOR AND BRUSHES

DYN	Dynamotor	14V, 3.3A input; 230V, 100MA output	BM15	..	*
	Low Voltage + Dyn. Brush				
	Low Voltage − Dyn. Brush	..	..	..	*
	High Voltage + Dyn. Brush				
	High Voltage − Dyn. Brush				

* When ordering dynamotor brushes, or other dynamotor parts, submit complete nameplate data on the particular dynamotor for which replacements are intended.

RECEPTACLES

J4	Wall Mtg. Recep. for P4	23-contact	NK-C23-32S	15	A30094
J7	Wall Mtg. Recep. for P7	6-contact	WK-6-32S	15	A30084
J10	Antenna Lead-in Receptacle	1-contact	#101	19	B7380-1

INDUCTORS

L1	Loop Phaser	1 coil, Sealed, 85Ω	Special	1	AL71791-16
L2, L3	IF Trap	2 coils, Sealed	Special	1	AC56703-1
L6	BFO Coil Assembly	1 coil, Sealed, Tapped	Special	1	AL71791-17
L7-1	LV RF Choke Assembly	45 turns, #18SSE	Special	1	AB6859-1
L7-2	LV RF Choke Assembly	Same as L7-1	..	..	..
L8	HV RF Choke	1200 turns, #33SSE, 40Ω	Special	1	AB6859-2
L9-1	V11 Filter Choke	6H, 50 MA, 340Ω, Part of T15 Ass'y	..	..	..
L9-2	HV Filter Choke	Same as L9-1, Part of T16 Ass'y	..	..	..
L10	V6 Plate	Part of T13 Ass'y	..	..	..
L11	V8 Grid	Part of T13 Ass'y	..	..	..
L12	V8 Plate	Part of T14 Ass'y	..	..	..
L13	V10 Audio Diode	Part of T14 Ass'y	..	..	..

MOTOR

MO	Band Switch Motor Ass'y	12-14V DC, 2.5A no load	Special	7	E11500-2
	Band Switch Motor Brushes	+ Brush	Special	7	A30212-1
		− Brush	Special	7	A30212-2

PLUGS

P4	Radio Compass to Junction Box	23-contact, Straight, Female	NK-C23-21-5/8B	15	A30095
P10	Antenna Lead-in	1-contact, Straight, Male	#101	19	B7380-2

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.

NEON TUBES

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
NE1	Overload discharge	1/25 W, 60V AC, Unbased neon tube	T2	18	QB15347
NE2	Overload discharge	Same as NE1	..	..	..

RESISTORS

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
R1	Loop Gain Control	15,000Ω, Pot, D taper	C	16	QB15353
R7	V1 Cathode Bias	300Ω, ±10%, ¼W, Ceramic	..	6	A18151-301
R9-1	V1 RF Compensator, Band 3				
R9-2	V5 RF Compensator, Band 3	Each, 3Ω, ±10%, ½W, WW	BW-½	16	A16428-3
R9-3	V6 RF Compensator, Band 3				
R10-1	V5 RF Compensator, Band 2	10Ω, ±5%, ½W, WW	BW-½	16	A16428-2
R10-2	V6 RF Compensator Band 2	Same as R10-1	..	..	..
R11-1	V5 RF Compensator Band 1	20Ω, ±5%, ½W, WW	BW-½	16	A16428-4
R11-2	V6 RF Compensator, Band 1	Same as R11-1	..	..	..
R12-2	V4 Screen Voltage Dropping				
R12-3	V5 Screen Voltage Dropping				
R12-4	V10 Grid				
R12-5	V8 AVC Filter				
R12-6	V3 Audio Voltage Supply				
R12-7	V3 Audio Voltage Supply				
R12-8	AVC Filter	Each, 100,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-104
R12-9	Sidetone Filter				
R12-10	V2 Audio Voltage Filter				
R12-11	V2 Audio Voltage Filter				
R12-12	V3 Cathode Bias				
R12-13	V3 Plate Dropping				
R12-14	V9 Grid Leak				
R12-15	V9 Plate Voltage Dropping				
R13-1	V6 Screen Voltage Bleeder	150,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-154
R13-2	V12 Screen Voltage Dropping	Same as R13-1	..	..	..
R14-1	V2 Grid Leak				
R14-2	V2 Grid Leak				
R14-3	V6 Injector Grid Leak				
R14-4	V7 Grid Leak				
R14-5	V10 RF Filter				
R14-6	V3 Cathode Bias				
R14-7	V4 AVC Filter	Each, 50,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-503
R14-8	V5 AVC Filter				
R14-9	V6 AVC Filter				
R14-10	V8 Screen Voltage Dropping				
R14-11	V7 Plate Voltage Dropping				
R14-12	V9 Grid Return				
R14-13	V1 Screen Voltage Dropping				
R15-1	V2 Plate Load	2000Ω, ±10%, ¼W, Ceramic	..	6	A18151-202
R15-2	V2 Plate Load	Same as R15-1	..	..	..
R18	Ant. Static Leak	1,000,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-105
R19-1	V12 Grid Resistor	1000Ω, ±10%, ¼W, Ceramic	..	6	A18151-102
R19-2	V1 Plate Voltage Dropping	Same as R19-1	..	..	..
R20-2	V4 Plate Voltage Dropping				
R20-3	V5 Plate Voltage Dropping	Each, 5,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-502
R20-4	V6 Plate Voltage Dropping				
R20-5	V8 Plate Voltage Dropping				
R21	V3 Cathode Bleeder	200,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-204
R22-1	V3 Grid Load				
R22-2	V3 Grid Load				
R22-3	V12 Grid	Each, 500,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-504
R22-4	V10 AVC Diode Load				
R22-5	V11 Grid				
R23	V3 Cathode Bias	10,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-103
R24-1	V4 Cathode Bias				
R24-2	V5 Cathode Bias				
R24-3	V6 Cathode Bias	Each, 600Ω, ±10%, ¼W, Ceramic	..	6	A18151-601
R24-4	V8 Cathode Bias				
R24-5	V12 Cathode Bias				
R27	V2 Cathode Bias	100Ω, ±10%, ¼W, Ceramic	..	6	A18151-101
R28	V10 Grid Load	250,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-254
R29	V11 Cathode Bias	500Ω, ±10%, ½W, Ceramic	..	6	A18150-501
R31	V10 Cathode Bias	3,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-302
R32	V12 Grid Isolating	300,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-304
R35-1	Azimuth Dial Light Dropping	117Ω Total, Sect A 50Ω, Sect B 67Ω	MW-2	16	A14739
R36	Ant. Relay Voltage Dropping	195Ω Total, Sect A 120Ω, Sect B 75Ω	MW-2	16	A30031
R37-1	Fil. Current Compensating	75.6Ω Total, Sect A 12.6Ω, Sect B 63Ω	MW-2	16	A15273
R37-2	Sidetone Relay Dropping	Same as R37-1	..	..	..
R38	V10 Plate Voltage Dropping	25,000Ω, ±10%, ¼W, Ceramic	..	6	A18151-253
R39	V6 Screen Voltage Supply	25,000Ω, ±10%, ½W, Ceramic	..	6	A18150-253

RELAYS

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
RE1	Antenna	DPDT, 8-16 Volts	15P32	8	QB7856
RE2	Sidetone	Same as RE1	..	..	..

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.

SWITCHES

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
S1-1	Loop, Band Selector, Pri.	Each, Bakelite, Wafer	H	9	QB9589-2
S1-2	Antenna, Band Selector, Pri. 1				
S1-3	1st RF, Band Selector, Pri. Sec.				
S1-4	2nd RF, Band Selector, Pri. Sec.				
S2	Loop, Band Selector, Sec.	Bakelite, Wafer	H	9	QB9589-1
S3	Antenna, Band Selector Pri. and Sec.	Bakelite, Wafer	H	9	QB9589-4
S4	HF Osc, Band Selector	Bakelite, Wafer	H	9	QB9589-3
S5	Motor Positioning	Bakelite, Wafer	H	9	QB9589-5
S6	Motor Control	1 make and 2 break, Non-locking	..	10	E10355

TRANSFORMERS

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
T1	Loop, Band 1	2 coils, Sealed	..	1	AL71791-1
T2	Loop, Band 2	2 coils, Sealed	..	1	AL71791-2
T3	Loop, Band 3	2 coils, Sealed	..	1	AL71791-3
T4	Antenna, Band 1	3 coils, Sealed	..	1	AL71791-13
T5	Antenna, Band 2	3 coils, Sealed	..	1	AL71791-14
T6	Antenna, Band 3	3 coils, Sealed	..	1	AL71791-15
T7-1	1st RF, Band 1	2 coils, Sealed	..	1	AL71791-7
T7-2	2nd RF, Band 1	Same as T7-1	..	..	..
T8-1	1st RF, Band 2	2 coils, Sealed	..	1	AL71791-8
T8-2	2nd RF, Band 2	Same as T8-1	..	..	..
T9-1	1st RF, Band 3	2 coils, Sealed	..	1	AL71791-9
T9-2	2nd RF, Band 3	Same as T9-1	..	..	..
T10	HF Osc, Band 1	2 coils, Sealed	..	1	AL71791-4
T11	HF Osc, Band 2	2 coils, Sealed	..	1	AL71791-5
T12	HF Osc, Band 3	2 coils, Sealed	..	1	AL71791-6
T13	1st IF Trans.	Complete assembly	..	1	AL71798-1
T14	2nd IF Trans.	Complete assembly	..	1	AL71908-1
T15	Audio Output, Ass'y contains L9-1 and T15	Pri: 645Ω, Sec: 310Ω	..	1	A14987
T16	Compass Output, Ass'y L9-2 and T16	Pri: 2400Ω, Sec: 14.5Ω	..	1	A15064

VACUUM TUBES

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
V1	Loop Amplifier	Triple grid	6K7	11	..
V2	Audio Oscillator	Twin triode	6N7	11	..
V3	Modulator	Same as V2	..	..	..
V4	1st RF	Same as V1	..	..	..
V5	2nd RF	Same as V1	..	..	..
V6	1st Detector	Pentagrid converter	6L7	11	..
V7	HF Oscilltaor	Triode	6J5	11	..
V8	IF	Same as V1	..	..	..
V9	CW Oscillator	Same as V7	..	..	..
V10	2nd Det. and 1st Audio	Duplex diode pentode	6B8	11	..
V11	Audio Output	Pentode power amp.	6F6	11	..
V12	Compass Output	Same as V1	..	..	..

7-2. TYPE MN-26C RADIO COMPASS

The MN-26C Radio Compass uses the same parts as an MN-26A except for the following:

DYNAMOTOR

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
DYN	Dynamotor	28V, 1.6A input; 230V, 100MA output	BM15	7	C56728-2

MOTOR

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
MO	Band Switch Motor	24-28V DC, 1.25A no load	Special	8	E11500-1

7-3. TYPE MN-28A AND MN-28C REMOTE CONTROL

FUSE

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
FU1	Fuse for both 12-14V and 24-28V	10A, 25V, Littelfuse	3AG-1081C	12	A11302-28

JACKS AND RECEPTACLE

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
J1	Phone Jack	For headset, 1 break circuit	XG-315	13	A28960
J2	Phone Jack	Same as J1	..	..	..
J3	Wall Mtg. Recep. for P3	16-contact	SK-C16-32S	15	A30089

LAMP

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
LM-1	Dial Light	3V, 0.19 A	Special	14	A18881-1

PLUG

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
P3	Remote to Junction Box	16-contact, Straight, Female	SK-C16-21-½B	15	A30090

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RESISTORS			
R2	Threshold Sensitivity Control	2,000Ω, Pot., Rear, Taper D	Special	16	A14551
R3	Compass Sensitivity Control	50,000Ω, Pot., Front, Taper C			
R4A	Audio Volume Control	2,000Ω, Front, Taper Special (MN-28A)	JJ	22	L72704-1
R4B	Manual Sensitivity Control	25,000Ω, Rear, Taper Special (MN-28A)			
R4A	Audio Volume Control	25,000Ω, Front, Taper C (MN-28C)	Special	16	A14550
R4B	Manual Sensitivity Control	25,000Ω, Rear, Taper E (MN-28C)			
R6	Panel Lamp Rheostat	100Ω, Taper A	CP	16	A14549
R35-3	Panel Lamp Voltage Dropping	117Ω, Total; Sect A, 50Ω; Sect B, 67Ω	MW-2	16	A14739
		SWITCHES			
S8	Off-Comp.-Rec. Ant.-Rec. Loop	Bakelite, Wafer	H	9	A14657
S9	Band Selector	Bakelite, Wafer	H	9	QB6707
S10	CW	SPST, Toggle, 250V, 3A	..	17	A26947-1

7-4. TYPE MN-20A AND MN-24A ROTATABLE LOOPS

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RECEPTACLE			
J8	Receptacle for P8	6-contact, Wall mounting	..	15	A25200
		MISCELLANEOUS			
..	Brush Holder Assembly	..	Special	1	A14692-1

7-5. TYPE IN-4A LEFT-RIGHT INDICATOR

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RECEPTACLES			
J5	Receptacle for P5	6-contact	WK-6-32S	15	A30094
J6	Receptacle for P6	Same as J5	..	..	..
		PLUGS			
P5	Indicator to Junction Box	6-contact, Straight, Female	WK-6-21-3/8B	15	A30088
P6	Indicator to Junction Box	Same as P5	..	..	..
		MISCELLANEOUS			
..	Meter Field Load Ass'y	See Section 1-2	..	1	AA18824-1

7-6. TYPE MN-22A AZIMUTH CONTROL

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RECEPTACLE			
J1	Lamp Plug Socket	Single-contact	AS-586-1	23	A30273
		LAMP			
LM-3	Dial Light	3V, 0.19A	Special	14	A18881-1
LM-4	Dial Light	Same as LM-3	..	..	
		PLUG			
P1	Lamp Plug	Single-contact	..	24	AB9487
		RESISTOR			
..	Lamp Series	14V: 116Ω, CT	MW-2	16	A100199-1
		28V: 264Ω, CT	MW-2	16	A100199-2
		CAM BLANK			
N5	Quadrantal Corrector	..	AS-787-1	25	A30243

7-7. TYPE MN-52A AZIMUTH CONTROL

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RECEPTACLE			
J9	Receptacle for P9	6-contact	WK-6-32S	15	A30094
		LAMP			
LM-2	Pilot Lamp	3V, 0.19A	Special	14	A18881-1
		PLUG			
P9	Azimuth Control to Junction Box	6-contact, Straight, Female	WK-6-21-3/8B	15	A30088
..	Contact Plug Assembly	2-contact	..	1	AA14664-1
		SWITCHES			
S11	Pilot Lamp	SPST, Toggle—13/64″ Shank	..	17	B418-1
S12	Loop Off-Zero Warning	See Section 2-7	..	1	AA14661-1

7-8. MISCELLANEOUS PARTS

Symbol	Function	Description	Mfr's. Desig.	Mfr.	Bendix No.
P7	Loop Cable Plug	6-contact, Straight, Female	WK-6-21-3/8B	15	A30088
P8	Loop Cable Plug	6-contact, 90°, Female	WK-6-23-3/8B 90°	15	A30085
R41	Warning Light Resistor	240Ω, CT, WW	..	16	A30181

8. LIST OF RECOMMENDED SPARE PARTS

(Recommended quantities of spare parts for each lot of ten equipments)

8-1. TYPE MN-26A RADIO COMPASS

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		CAPACITORS			
6	C1-1 to C1-12, inc.	6-25 Mmf, 500V Variable right-hand terminal	Special	3	B7751-25
2	C1-13 to C1-15, inc.	Same as C1-1, except has left-hand terminal	Special	3	B7783-25
2	C2-1 to C2-5, inc.	5 Sect. Variable, 400 Mmf per sect max cap; 20 Mmf per sect min cap	Special	3	L70943
12	C3-1, 3-2, C3-5 to C3-21, inc	.05 Mfd, 400V DCW, Paper	345-8	4	A18015-503
8	C4-1 to C4-11, inc	.05 Mfd, 200V DCW, Paper	342-6	4	A18181-503
4	C5-1, 5-2	0.1 Mfd, 200V DCW, Paper	345-5	4	A18181-104
4	C6-1, 6-2	.02 Mfd, 200V DCW, Paper	342-3	4	A18181-203
3	C7	0.5 Mfd, 400V DCW, Oil-paper	..	5	E11398
3	C8	5 Mfd, 50V, Oil-paper	..	5	E11402
3	C9-1, 9-2	2 Sect, 0.5 Mfd, 100V DCW, Oil-paper	Special	5	E11400
3	C10-1, 10-2	2 Sect, Each 6 Mfd, 400V DCW	Special	5	A15066
4	C11-1 to C11-3, inc	35 Mmf, 500V DCW, Ceramic	N680K	6	A18207-350
4	C12-1, 12-2	50 Mmf, 500V DCW, Ceramic	N680K	6	A18182-7
3	C13	100 Mmf, 500V DCW, Ceramic	N680L	6	A18205-101
4	C14-1, 14-2	.005 Mfd, 300V DCW, Mica	1467	5	C56310-502
3	C15	.001 Mfd, 500V DCW, Mica	1468	5	C56315-102
3	C16	.01 Mfd, 300V DCW, Mica	1467	5	C56312-103
3	C17	25 Mmf, 500V DCW, Mica	1468	5	C56315-250
4	C19-1, 19-2	250 Mmf, 500V DCW, Mica	1468	5	C56314-251
4	C20-1, 20-2	10 Mmf, 500V DCW, Ceramic	N680L	6	A18205-100
6	C21-1 to C21-5, inc	100 Mmf, 500V DCW, Mica	1468	5	C56314-101
4	C22-1, 22-2	300 Mmf, 500V DCW, Mica	1468	5	C56314-301
4	C23-1, 23-2	75 Mmf, 500V DCW, Mica	1468	5	C56314-750
4	C24-1 to C24-3, inc	5 Mmf, 500V DCW, Ceramic	P120K	6	A18182-2
3	C25	15 Mmf, 500V DCW, Mica	1468	5	C56315-150
3	C29	25 Mmf, 500V DCW, Ceramic	N680K	6	A18205-250
3	C30	625 Mmf, 300V DCW, Mica, XM262	Special	5	E12140-2
3	C31	1286 Mmf, 300V DCW, Mica, XM262	Special	5	E12140-3
3	C32	2514 Mmf, 300V DCW, Mica, XM262	Special	5	E12140-4
6	C34-1 to C34-5, inc	500 Mmf, 500V DCW, Mica	1468	5	C56313-501
3	C35	500 Mmf, 500V DCW, Mica	1468	5	C56315-501
3	C37-1 to C37-3, inc	3 Sect, Each: 0.1 Mfd, 400V DCW	Special	5	E11347-1
3	C38	100 Mmf, 500V DCW, Mica	1468	5	C56313-101
4	C39-1, 39-2, 39-3	0.1 Mfd, 400V DCW, Paper	345	4	A18015-104
3	C40	30 Mmf, 500V DCW, Ceramic	..	6	A18207-300
		DYNAMOTOR AND BRUSHES			
1	DYN	14V, 3.3A input, 230V, 100 MA output, Dynamotor	BM15	7	C56728-1
6	..	Low voltage + dynamotor brushes	..	..	*
6	..	Low voltage − dynamotor brushes	..	..	*
6	..	High voltage + dynamotor brushes	..	..	*
6	..	High voltage − dynamotor brushes	..	..	*

* When ordering dynamotor brushes, or other dynamotor parts, submit complete name plate data on the particular dynamotor or which replacements are intended.

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RECEPTACLES			
1	J4	23-contact, Wall mounting	NK-C23-32S	15	A30094
1	J7	6-contact, Wall mounting	WK-6-32S	15	A30084
1	J10	1-contact, Antenna lead-in	101	19	B7380-1
		INDUCTORS			
1	L1	1 coil, Sealed, 85Ω	Special	1	AL71791-16
1	L2, 3	2 coils, Sealed	Special	1	AC56703-1
1	L6	1 coil, Sealed, Tapped	Special	1	AL71791-17
1	L7-1, 7-2	45 turns #18SSE	Special	1	AB6859-1
1	L8	1200 turns, #33SSE, 40Ω	Special	1	AB6859-2
		MOTOR AND BRUSHES			
1	MO	12-14V DC, 2.5A no load,	Special	7	E11500-2
6	..	+ Band switch motor brushes	Special	7	A30212-1
6	..	− Band switch motor brushes	Special	7	A30212-2

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.

PLUGS

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
1	P4	23-contact, Straight, Female	NK-C23-21-5/8B	15	A30095
1	P10	1-contact, Antenna lead-in	#101	19	B7380-2

NEON TUBE

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
7	NE1, 2	1/25W, 60V, Unbased	T2	18	QB15347

RESISTORS

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
2	R1	15,000Ω, pot	C	16	QB15353
3	R7	300Ω, 1/4W	..	6	A18151-301
5	R9-1 to R9-3, inc	3Ω, ½W	BW-½	16	A16428-3
4	R10-1, 10-2	10Ω, ½W	BW-½	16	A16428-2
4	R11-1, 11-2	20Ω, ½W	BW-½	16	A16428-4
14	R12-2 to R12-15, inc	100,000Ω, ¼W	..	6	A18151-104
4	R13-1, 13-2	150,000Ω, ¼W	..	6	A18151-154
13	R14-1 to R14-13, inc	50,000Ω, ¼W	..	6	A18151-503
4	R15-1, 15-2	2000Ω, ¼W	..	6	A18151-202
3	R18	1,000,000Ω, ¼W	..	6	A18151-105
4	R19-1, 19-2	1,000Ω, ¼W	..	6	A18151-102
6	R20-2 to R20-5, inc	5,000Ω, ¼W	..	6	A18151-502
3	R21	200,000Ω, ¼W	..	6	A18151-204
6	R22-1 to R22-6, inc	500,000Ω, ¼W	..	6	A18151-504
3	R23	10,000Ω, ¼W	..	6	A18151-103
6	R24-1 to R24-5, inc	600Ω, ¼W	..	6	A18151-601
3	R27	100Ω, ¼W	..	6	A18151-101
3	R28	250,000Ω, ¼W	..	6	A18151-254
3	R29	500Ω, ½W	..	6	A18150-501
3	R31	3,000Ω, ¼W	..	6	A18151-302
3	R32	300,000Ω, ¼W	..	6	A18151-304
3	R35-1	117Ω, Total, Sect A 50Ω, Sect B 67Ω	MW-2	16	A14739
3	R36	195Ω, Total, Sect A 120Ω, Sect B 75Ω	MW-2	16	A30031
4	R37-1,37-2	75.6Ω, Total, Sect A 12.6Ω, Sect B 63Ω	MW-2	16	A15273
3	R38	25,000Ω, ¼W	..	6	A18151-253
3	R39	25,000Ω, ½W	..	6	A18150-253

RELAY

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
2	RE1, 2	DPDT 8-16V	15P32	8	QB7856

SWITCHES

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
2	S1-1 to S1-4, inc	Bakelite, Wafer	H	9	QB9589-2
1	S2	Bakelite, Wafer	H	9	QB9589-1
1	S3	Bakelite, Wafer	H	9	QB9589-4
1	S4	Bakelite, Wafer	H	9	QB9589-3
1	S5	Bakelite, Wafer	H	9	QB9589-5
1	S6	1 make, 2 break, Non-locking	..	10	E10355

TRANSFORMERS

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
1	T1	2 coils, Sealed	..	1	AL71791-1
1	T2	2 coils, Sealed	..	1	AL71791-2
1	T3	2 coils, Sealed	..	1	AL71791-3
1	T4	3 coils, Sealed	..	1	AL71791-13
1	T5	3 coils, Sealed	..	1	AL71791-14
1	T6	3 coils, Sealed	..	1	AL71791-15
1	T7-1, 7-2	2 coils, Sealed	..	1	AL71791-7
1	T8-1, 8-2	2 coils, Sealed	..	1	AL71791-8
1	T9-1, 9-2	2 coils, Sealed	..	1	AL71791-9
1	T10	2 coils, Sealed	..	1	AL71791-4
1	T11	2 coils, Sealed	..	1	AL71791-5
1	T12	2 coils, Sealed	..	1	AL71791-6
1	T13	1st IF trans ass'y	..	1	AL71798-1
1	T14	2nd IF trans ass'y	..	1	AL71908-1
1	T15	Pri: 645Ω, Sec: 310Ω	..	1	A14987
1	T16	Pri: 2400Ω, Sec: 14.5Ω	..	1	A15064

VACUUM TUBES

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
10	V1, 4, 5, 8, 12	Triple grid	6K7	11	..
6	V2, 3	Twin triode	6N7	11	..
5	V6	Pentagrid converter	6L7	11	..
6	V7, 9	Triode	6J5	11	..
5	V10	Duplex-diode pentode	6B8	11	..
5	V11	Pentode	6F6	11	..

8-2. TYPE MN-26C RADIO COMPASS

The MN-26C Radio Compass requires the same spare parts as an MN-26A except for the following:

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		DYNAMOTOR			
1	DYN	28V, 1.6A input, 230V, 100MA output	BM15	7	C56728-2
		MOTOR			
1	MO	24-28V DC	Special	7	E11500-1

8-3. TYPE MN-28A & MN-28C REMOTE CONTROL

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		FUSES			
10	Fu1	10A, 25V	3AG-1081C	12	A11302-28
		JACKS AND RECEPTACLES			
1	J1, 2	For headset, 1 break circuit	XG-315	13	A28960
1	J3	16-contact, Wall mtg. recep.	SK-C16-32S	15	A30089
		LAMP			
5	LM-1	3V, 0.19 A	Special	14	A18881-1
		PLUG			
1	P3	16-contact, Straight, Female	SK-C16-21-½B	15	A30090
		RESISTORS			
2	R2, 3	2,000Ω, Rear, Taper D; 50,000Ω, Front, Taper C	Special	16	A14551
2	R4A, 4B	2,000Ω, Front, Taper Special; 25,000Ω, Rear, Taper Special } MN-28A	JJ	22	L72704-1
2	R4A, 4B	25,000Ω, Front, Taper C; 25,000Ω, Rear, Taper E } MN-28C	Special	16	A14550
2	R6	100Ω, Taper A	CP	16	A14549
3	R35-3	117Ω, Total, Sect A 50Ω, Sect B 67Ω	MW-2	16	A14739
		SWITCHES			
1	S8	Bakelite, Wafer	H	9	A14657
1	S9	Bakelite, Wafer	H	9	QB6707
1	S10	SPST, Toggle, 250V, 3A	Special	17	A26947-1

8-4. TYPE MN-20A AND MN-24A ROTATABLE LOOPS

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		PLUG			
1	P8	6-contact, Straight, Female	WK-6-21-3/8B	15	A30088
		RECEPTACLE			
1	J8	6-contact, Wall mounting	..	15	A25200
		MISCELLANEOUS			
1	..	Brush holder assembly	..	1	AA14692-1

8-5. TYPE IN-4A LEFT-RIGHT INDICATOR

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		PLUG			
1	P5, 6	6-contact, Straight, Female	WK-6-21-3/8B	15	A30088
		RECEPTACLE			
1	J5, 6	6-contact, Wall mounting	WK-6-32S	15	A30084
		MISCELLANEOUS			
1	..	Meter field load assembly	..	1	AA18824-1

8-6. TYPE MN-22A AZIMUTH CONTROL

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		RECEPTACLE			
1	J1	Single-contact	AS-586-1	23	A30273
		LAMP			
10	LM-3, 4	3V, 0.19A	Special	14	A18881-1
		PLUG			
1	P1	Single-contact	..	24	AB9487
		RESISTOR			
1	..	14V: 116Ω, CT	MW-2	16	A100199-1
		28V: 264Ω, CT	MW-2	16	A100199-2
		CAM BLANK			
1	N5	Quadrantal corrector	AS-787-1	25	A30243

8-7. TYPE MN-52A AZIMUTH CONTROL

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
		LAMP			
5	LM-2	3V, 0.19A	Special	14	A18881-1
		PLUG			
1	P9	6-contact, Straight, Female	WK-6-21-3/8B	15	A30088
		RECEPTACLE			
1	J9	6-contact, Wall mounting	WK-6-32S	15	A30084
		SWITCH			
1	S11	SPST, Toggle	..	17	B418-1

8-8. MISCELLANEOUS SPARE PARTS

Quan.	Symbol	Description	Mfr's. Desig.	Mfr.	Bendix No.
6	..	12-16V, Lamp for warning light	GE T 3 ¼	18	A9320-2
1	.	Condenser drive assembly	..	1	AC55589-1
1	..	Band switch drive with motor E11500-1	..	1	AC56566-2
4	..	Shock mount	150 PH8	20	C56354-8
4	..	Mounting screws for dynamotor	Special	1	B11636
5		Socket, Octal base	2178	21	A15252
12		Screw ¼″-20 x 1⅛″	..	..	A11605-34
12	.	Washer, flat	..	..	A17021-19
12		Lockwasher, ¼″	..	..	A18038-13

9. LIST OF MANUFACTURERS

1. Bendix Radio,
Division of Bendix Aviation Corp.,
Baltimore, Maryland.

2. Hammarlund Mfg. Co., Inc.,
424 W. 33rd Street,
New York, N. Y.

3. Radio Condenser Co.,
Camden, N. J.

4. Micamold Products Corp.,
1097 Flushing Ave.,
Brooklyn, N. Y.

5. Aerovox Corp.,
New Bedford, Mass.

6. Erie Resistor Co.,
Erie, Pa.

7. Eicor, Inc.,
515 S. Laflin St.,
Chicago, Ill.

8. Kurman Electric Co.,
239 Lafayette St.,
New York, N. Y.

9. Oak Mfg. Co.,
1260 Clybourn Ave.,
Chicago, Ill.

10. Kellogg Switchboard & Supply Co.
6650 S. Cicero Ave.,
Chicago, Ill.

11. RCA Radiotron Division,
RCA Manufacturing Co.,
Harrison, New Jersey

12. Littelfuse, Inc.,
4757 Ravenswood Ave.,
Chicago, Ill.

13. Carter Radio Co.,
Division of Utah Radio Products Co.,
812 Orleans Street,
Chicago, Ill.

14. Pioneer Instrument Co., Inc.,
Bendix, N. J.

15. Cannon Elec. Development Co.,
420 West Ave. 33,
Los Angeles, Calif.

16. International Resistor Corp.,
401 N. Broad Street,
Philadelphia, Pa.

17. Hart & Hegeman Division,
Arrow Hart & Hegeman Elec. Co.,
Hartford, Conn.

18. General Electric Co.,
Schenectady, N. Y.

19. Howard B. Jones,
2300 Wabansia Ave.,
Chicago, Ill.

20. Lord Manufacturing Co.,
Erie, Pa.

21. Cinch Manufacturing Co.,
2335 W. Van Buren Street,
Chicago, Ill.

22. Allen-Bradley Co.,
Milwaukee, Wisc.

23. Kollsman Instrument Co.,
80-08 45 Ave.,
Elmhurst, N. Y.

24. Breeze Manufacturing Co.,
18-38 South 6th St.,
Newark, N. J.

25. Kearfott Engineering Corp.,
117 Liberty St.,
New York, N. Y.

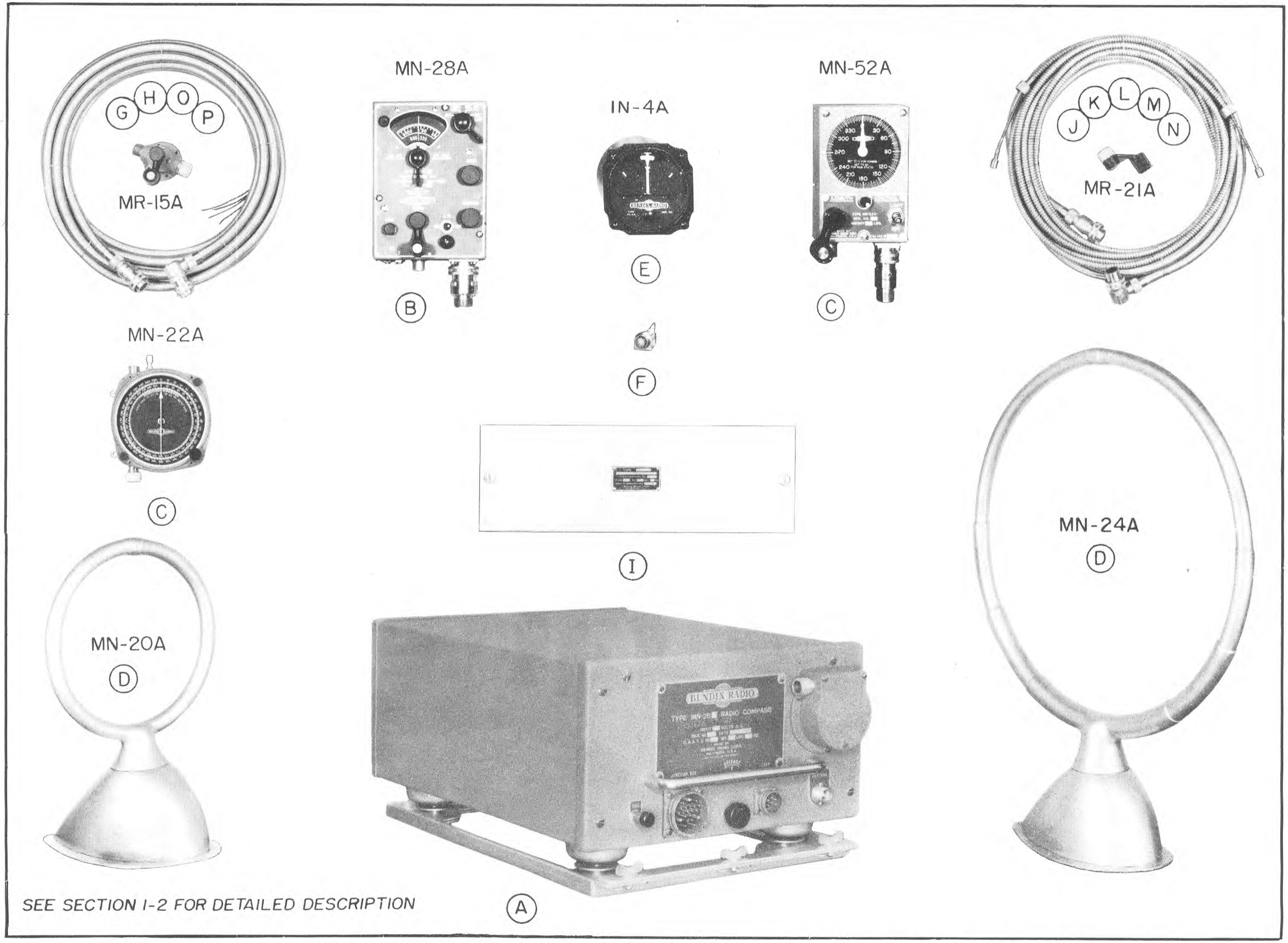


FIG. I - COMPOSITE VIEW, MN-26A OR MN-26C EQUIPMENT

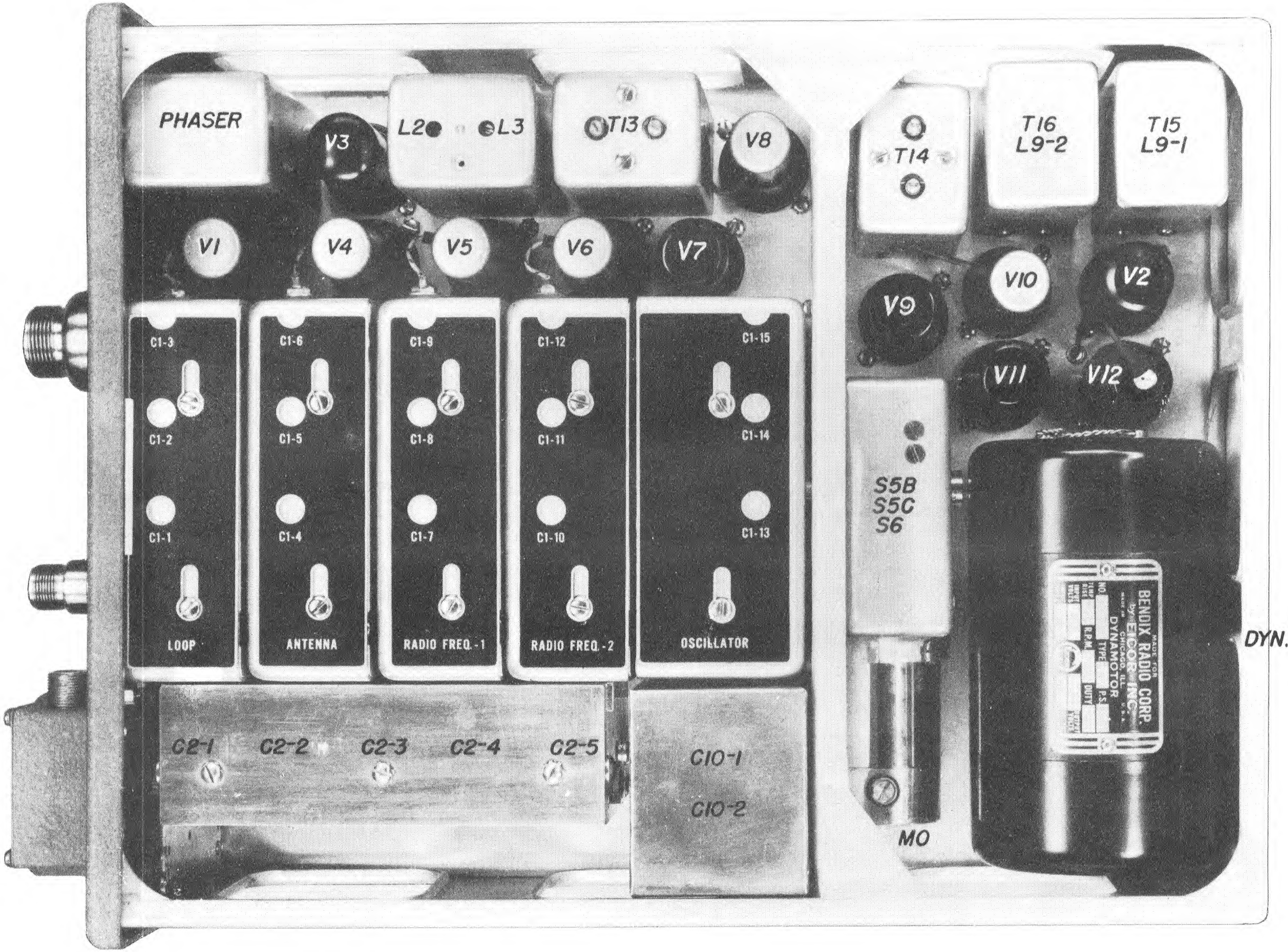


FIG. 2 - TOP VIEW, MN-26A RADIO COMPASS

2032

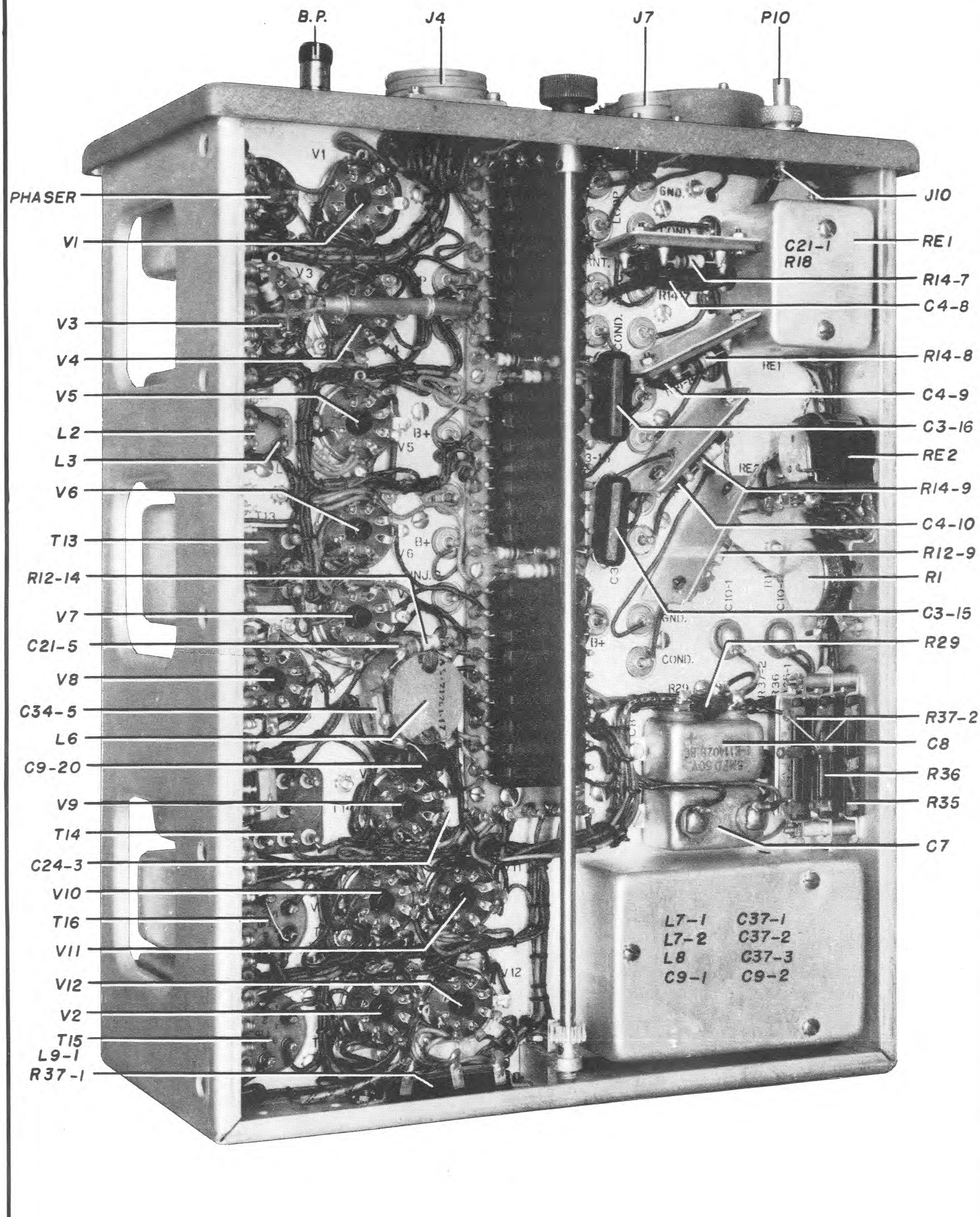


FIG.3-BOTTOM VIEW, MN-26A RADIO COMPASS

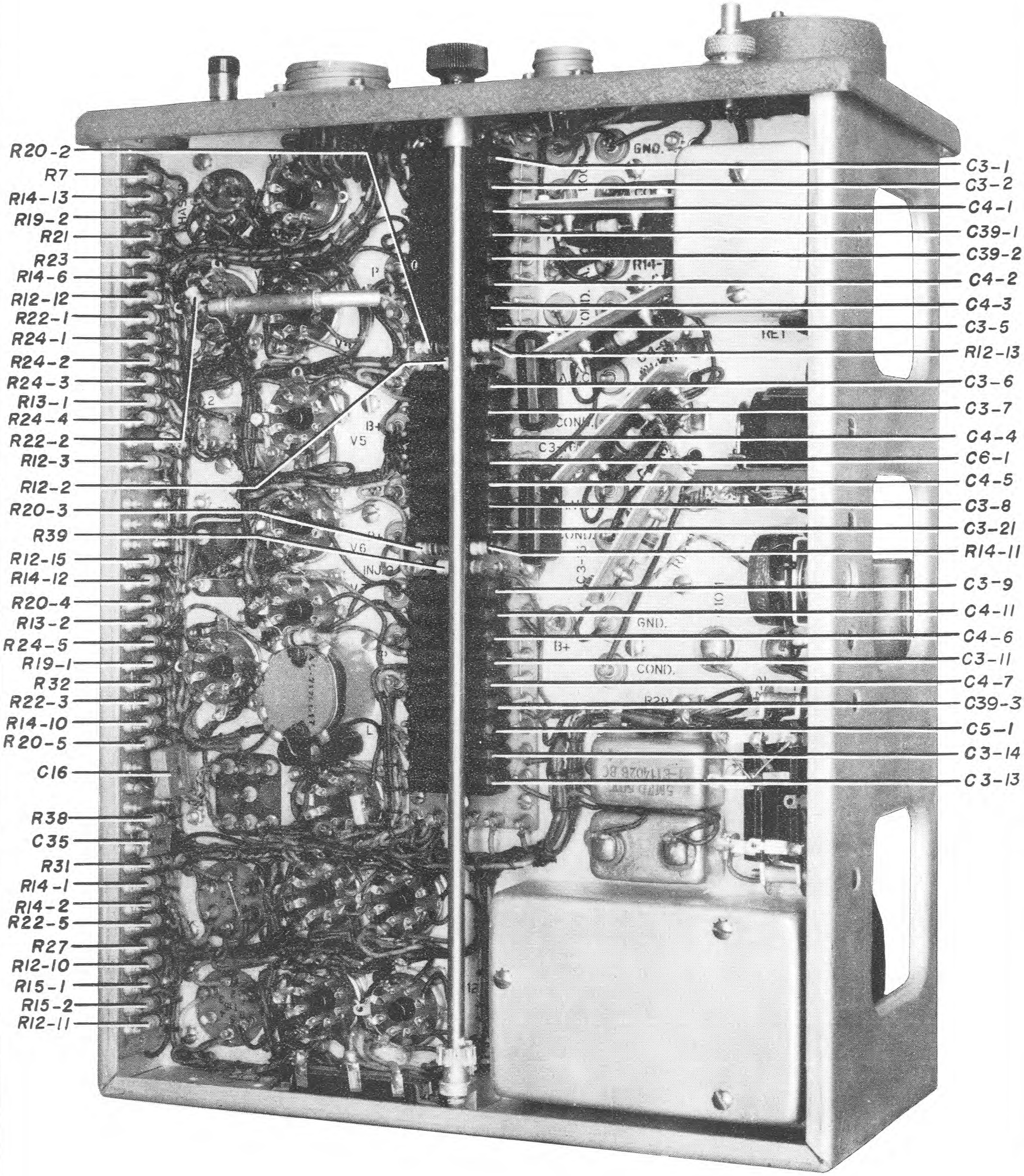


FIG. 4—BOTTOM VIEW. MN-26A RADIO COMPASS.

2033

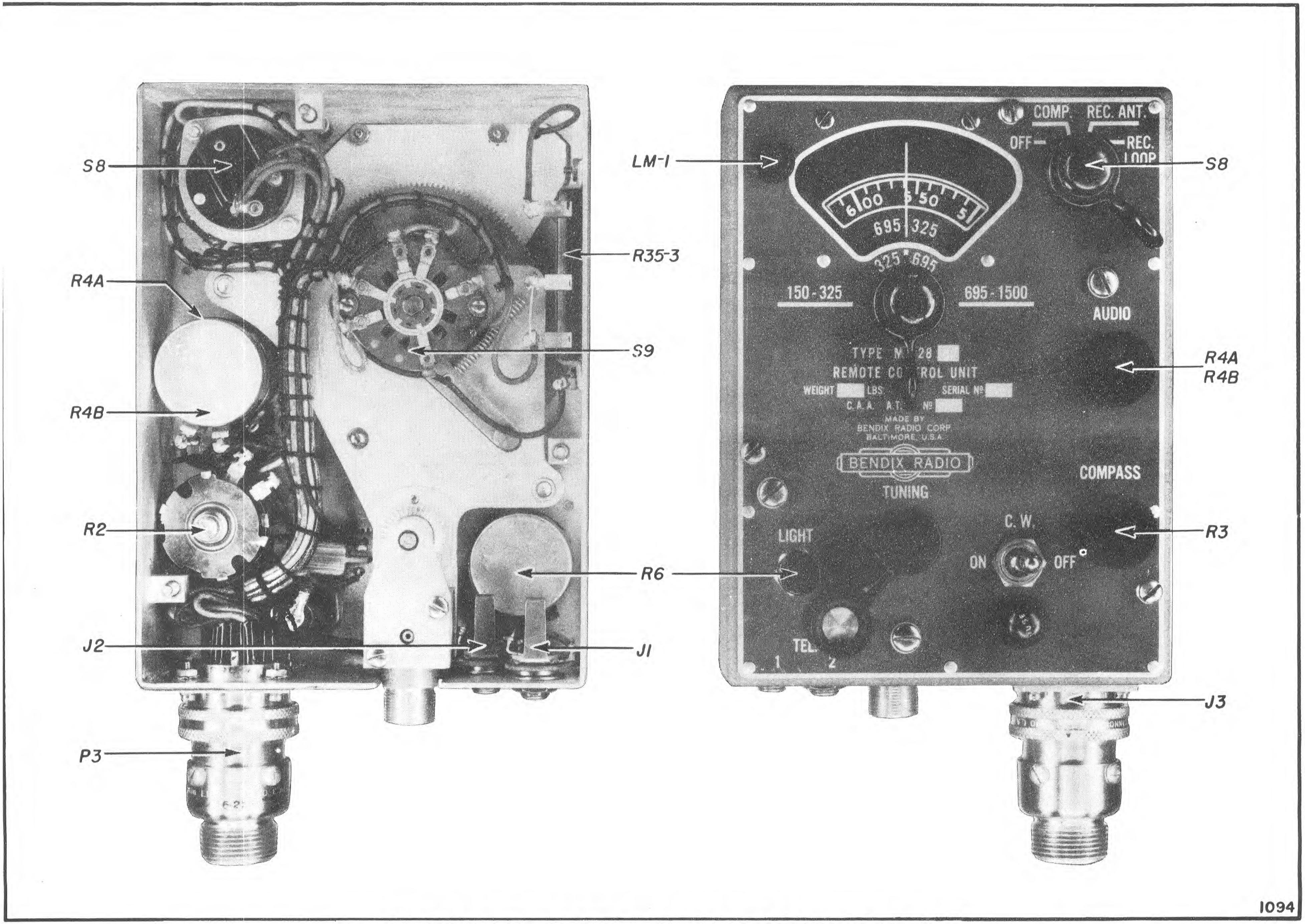
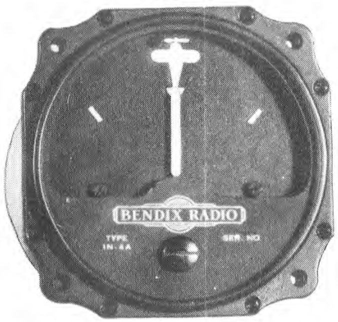


FIG. 5 - MN-28 REMOTE CONTROL UNIT

FIG. 7
MN-20 A
ROTATABLE LOOP

FIG 8



IN-4A LEFT-RIGHT
INDICATOR

FIG. 6

MN-52 A
AZIMUTH CONTROL

1083 & 1091

FIGS. 6,7,8 - DETAILED VIEWS

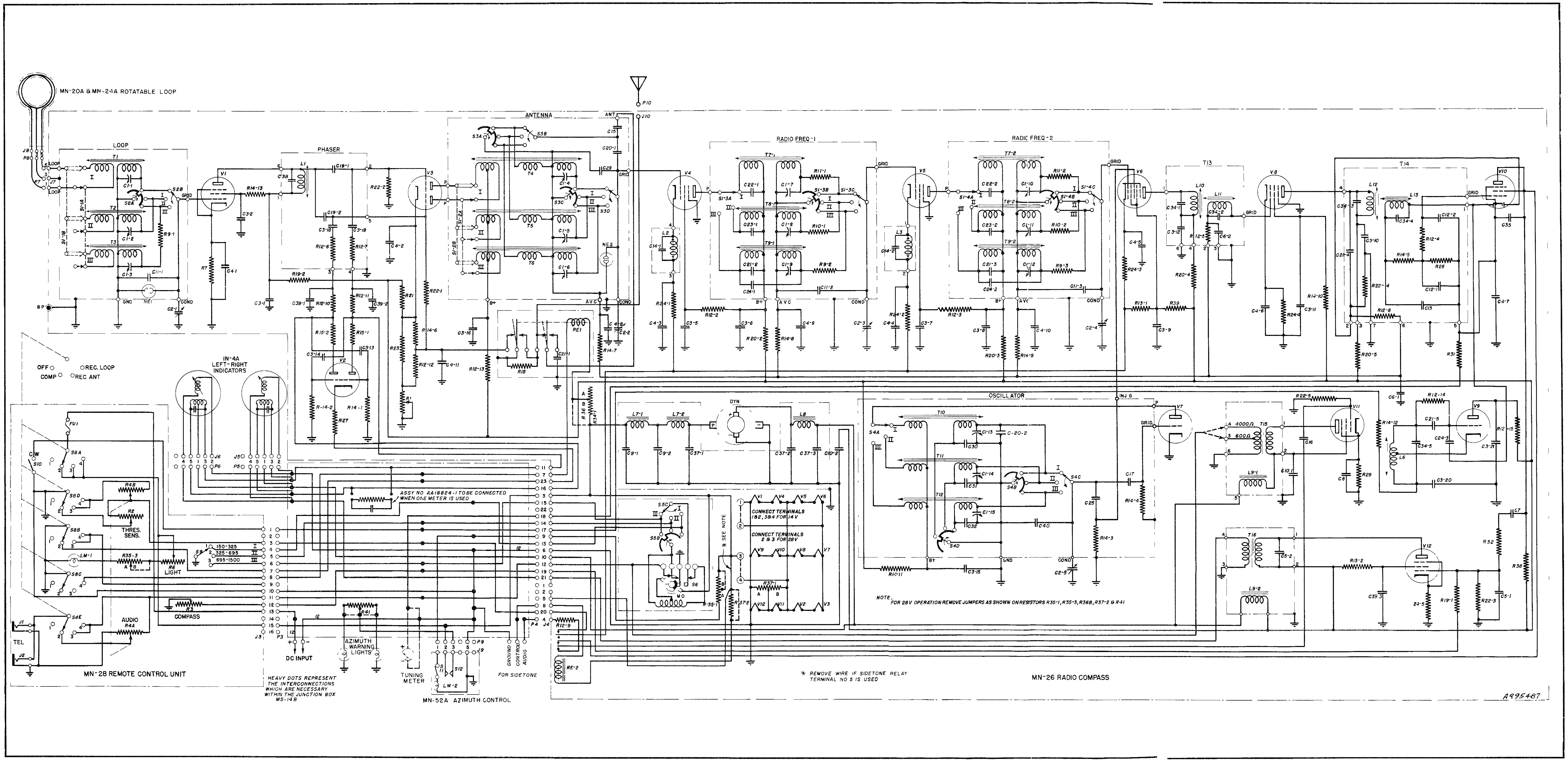


FIG. 9 - SCHEMATIC DIAGRAM RADIO COMPASS EQUIPMENT

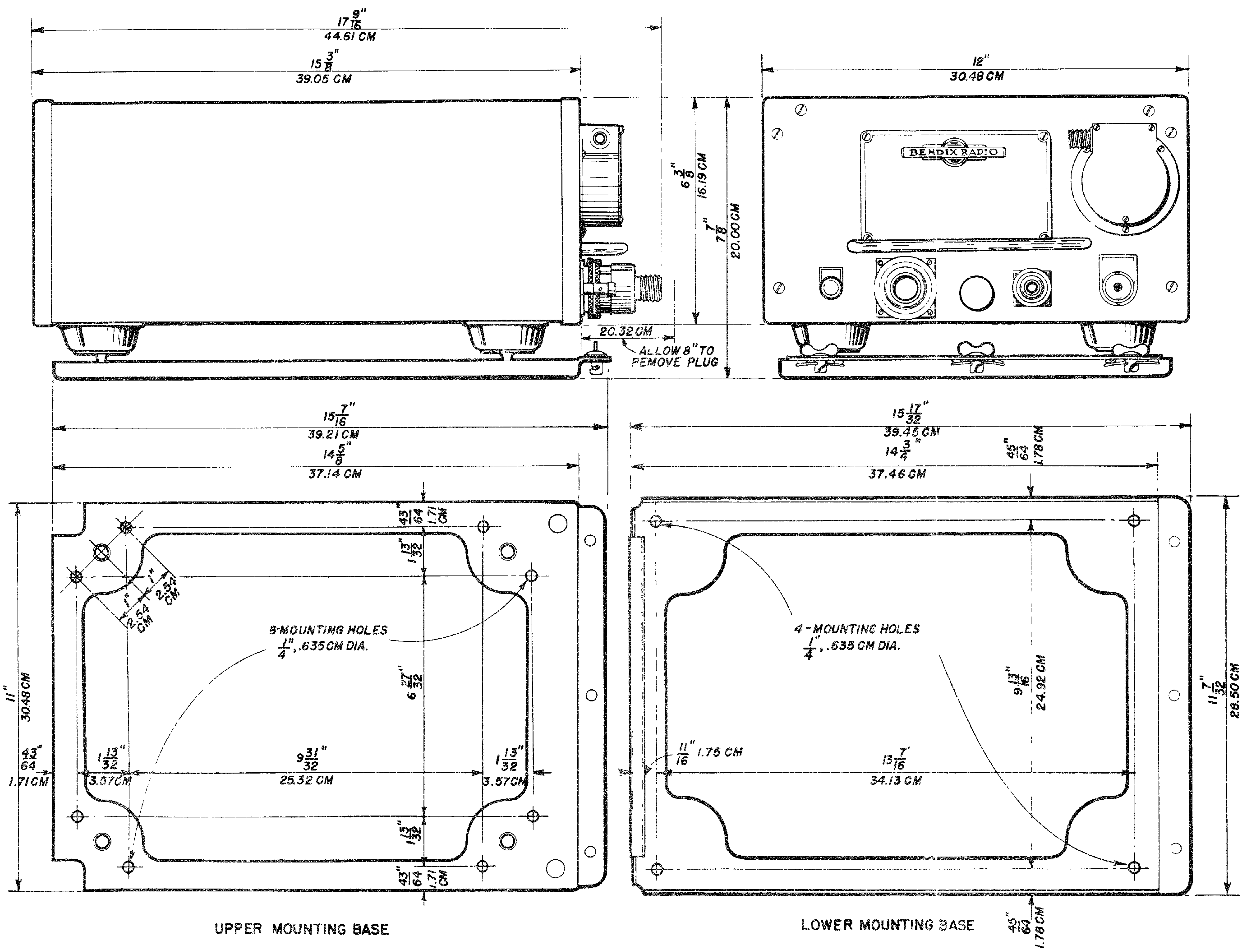


FIG. 10 - OUTLINE DIMENSIONS, MN-26 RADIO COMPASS UNITS

173-10

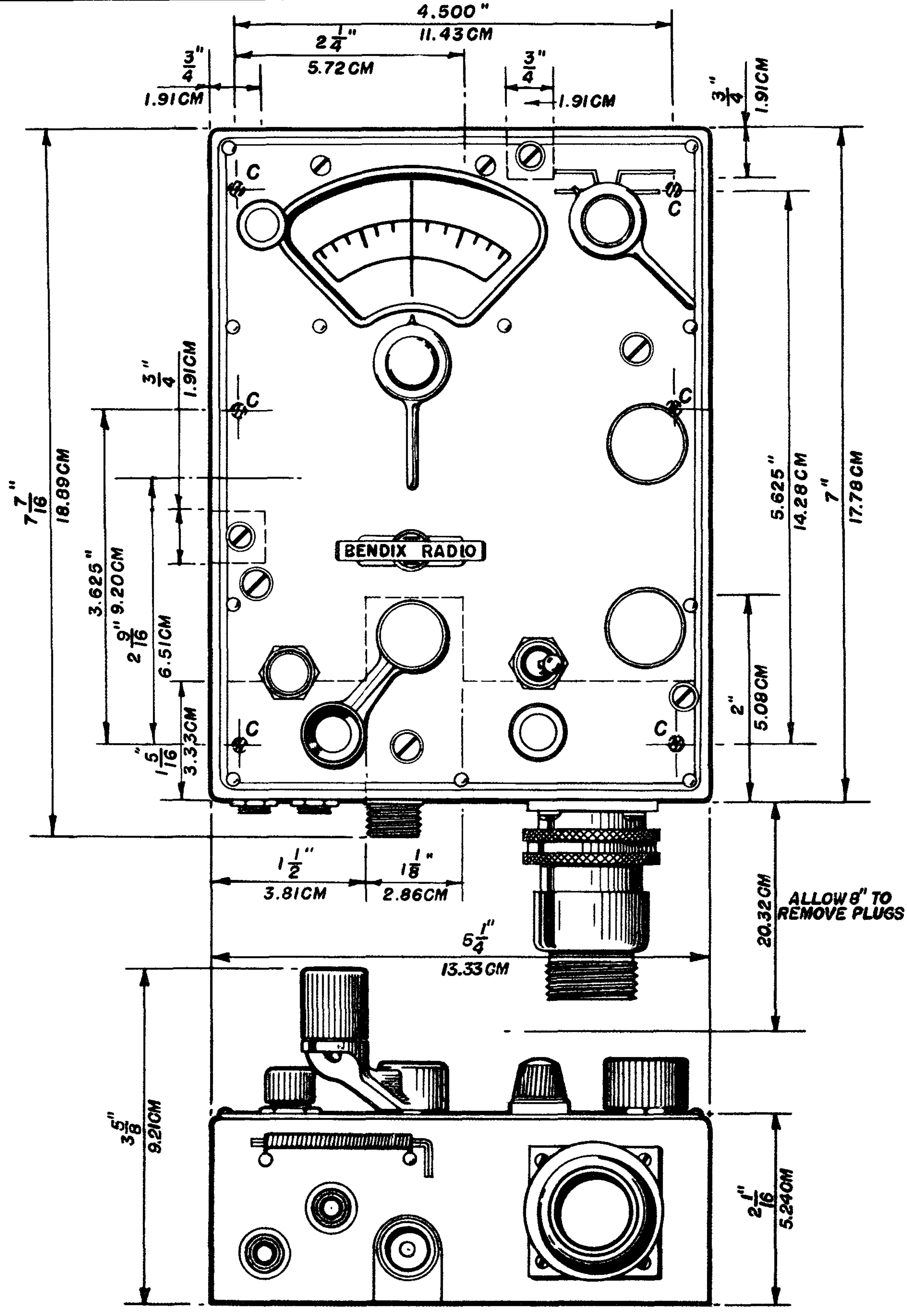


FIG. 11-OUTLINE DIMENSIONS. MN-28 REMOTE CONTROL UNITS

NOTE:
ADDITIONAL MOUNTING HOLES MAY BE DRILLED OUTSIDE OF DOTTED AREA ONLY.
MOUNTING HOLES "C" = NO. 12 DRILL (.189-.48 CM) DIA.

173-11

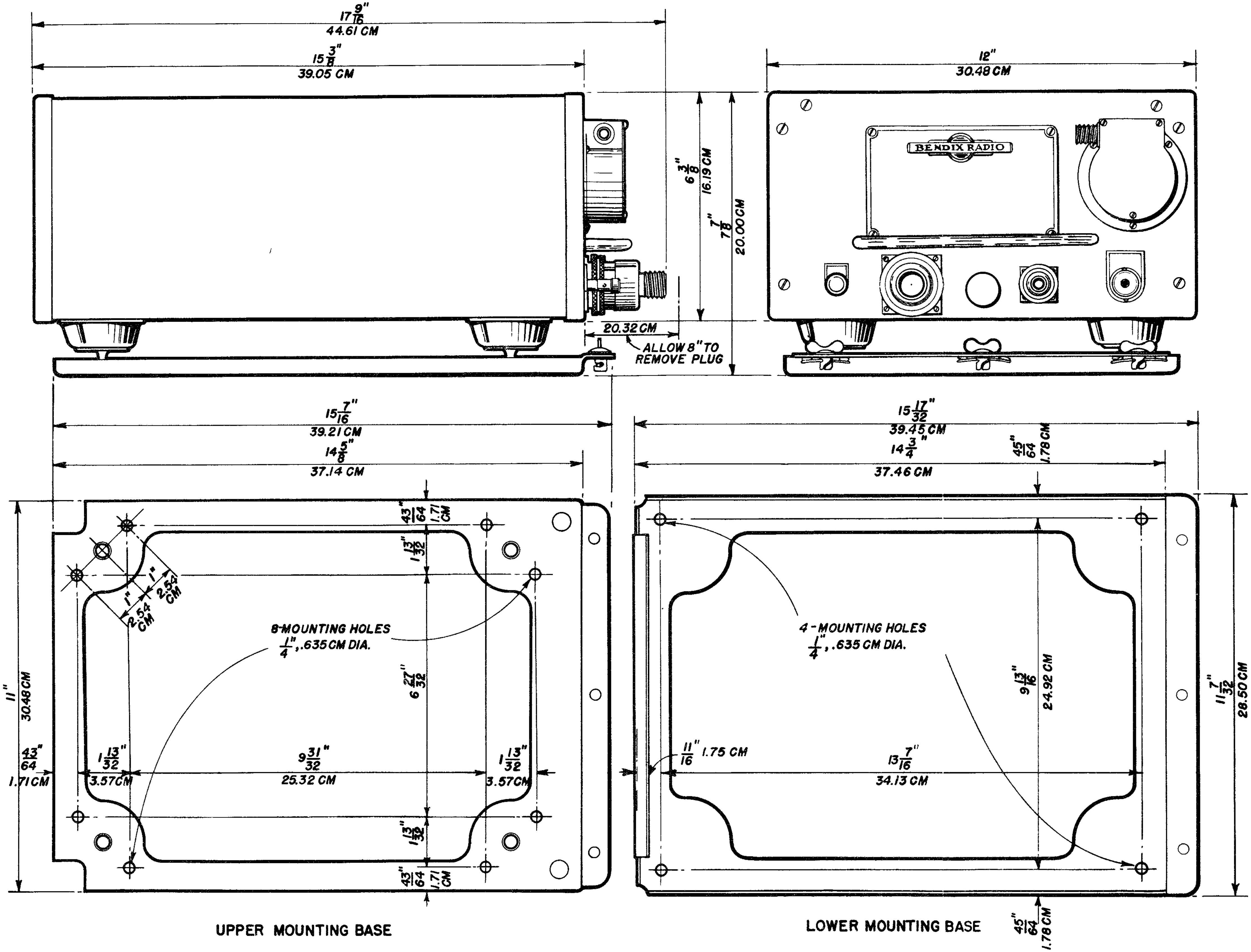


FIG.10-OUTLINE DIMENSIONS. MN-26 RADIO COMPASS UNITS

173-10

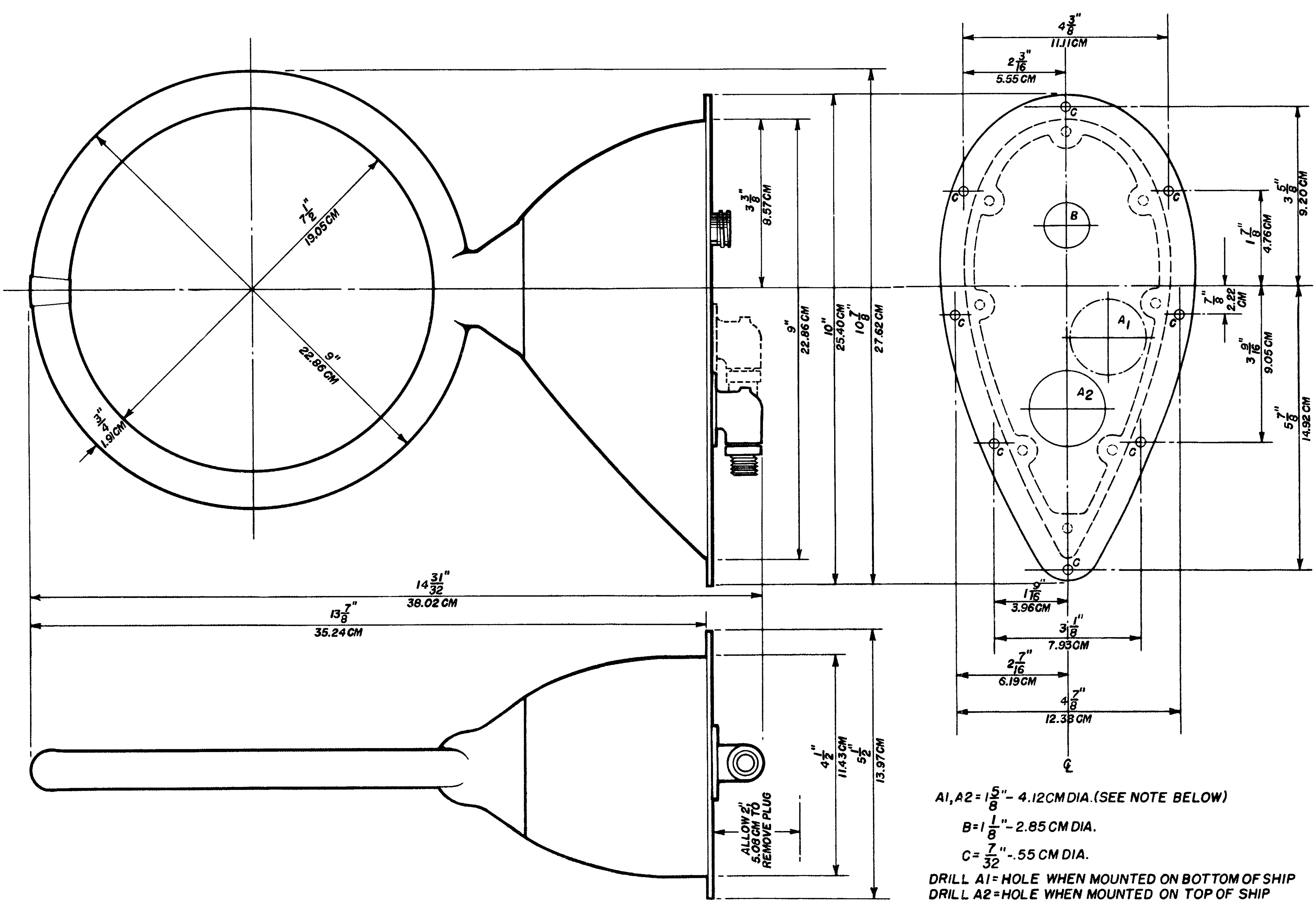


FIG. 12 - OUTLINE DIMENSIONS, MN-20A ROTATABLE LOOP

173-12

173-13

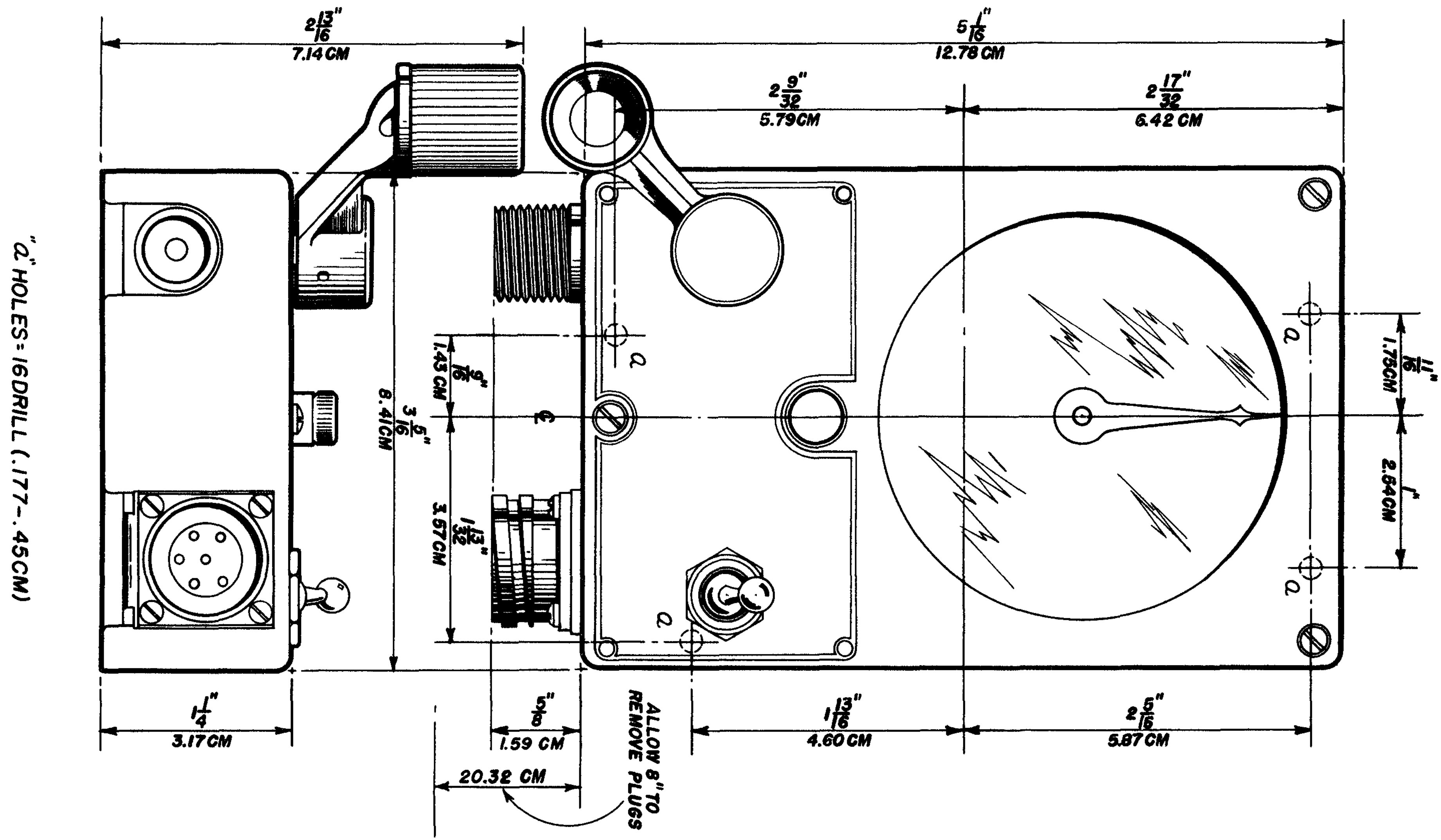


FIG. 13—OUTLINE DIMENSIONS, MN-52A AZIMUTH CONTROL UNIT

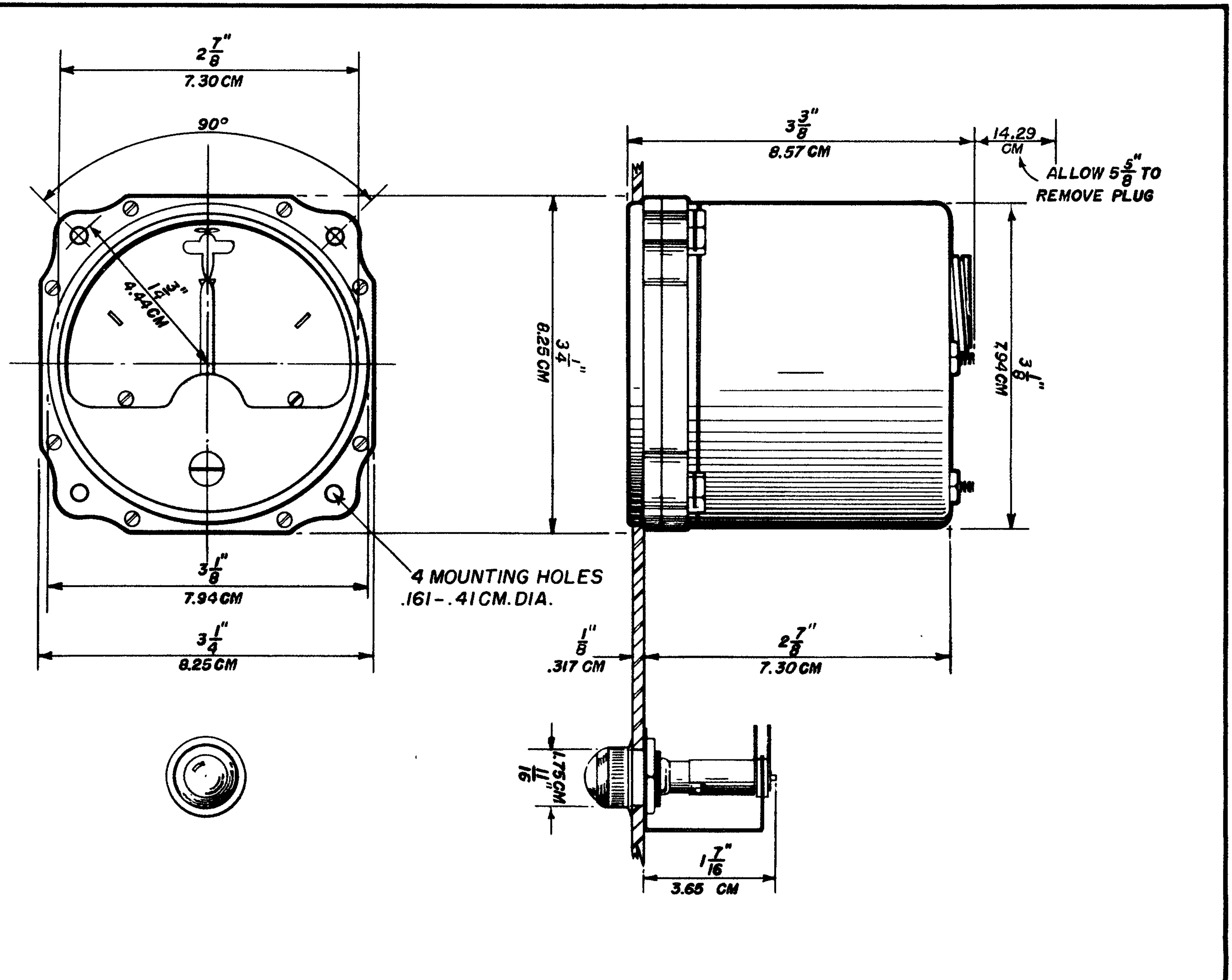


FIG. 14-OUTLINE DIMENSIONS, LEFT-RIGHT AND MARKER INDICATORS

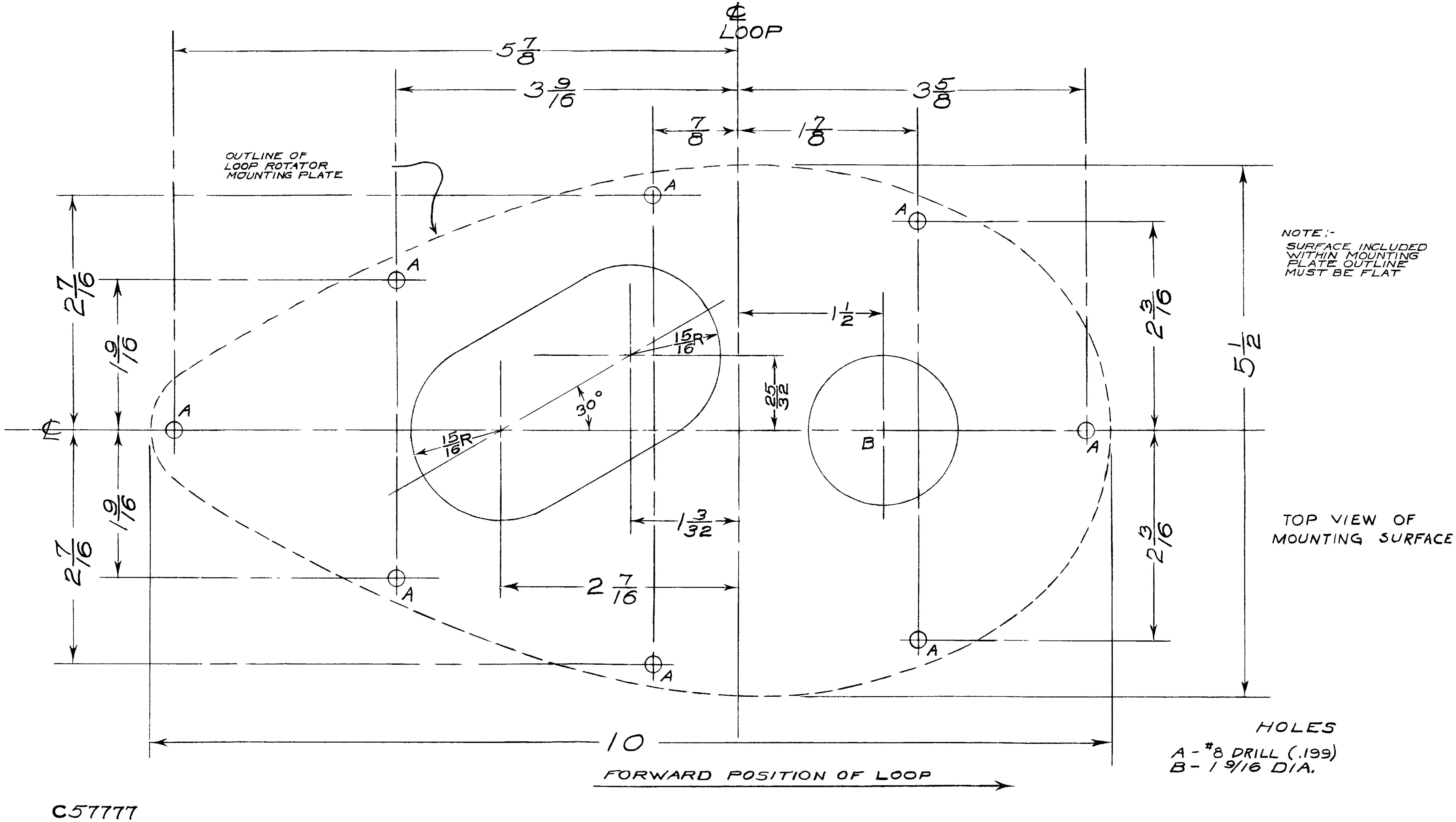
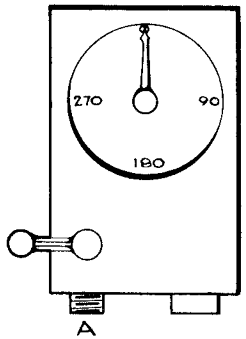
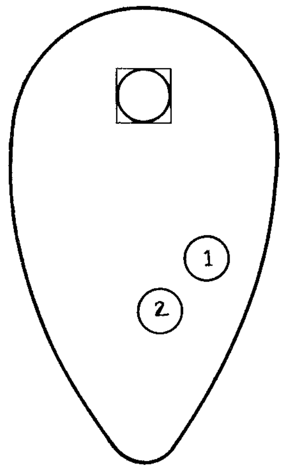


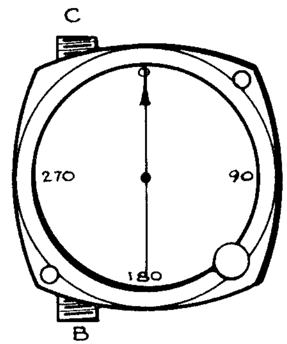
FIG.15– SHIP MOUNTING CUTOUT, MN-20 AND MN-24 LOOPS



AZIMUTH CONTROL
TYPE MN-52



TYPES MN-20 & MN-24
LOOPS
BOTTOM VIEW



AZIMUTH CONTROL
TYPE MN-22

• MOUNTING OF LOOP •	AZIMUTH CONTROL	TACH SHAFT CONNECTION, AZIMUTH CONT.	TACH SHAFT CONNECTION ON LOOP.
TOP OF SHIP	MN-52	A	2
BOTTOM OF SHIP	MN-52	A	1
TOP OF SHIP	MN-22	B	2
TOP OF SHIP	MN-22	C	1
BOTTOM OF SHIP	MN-22	B	1
BOTTOM OF SHIP	MN-22	C	2

A25177

FIG.16—POSITION OF TACH SHAFT. MN-20 AND MN-24 LOOPS

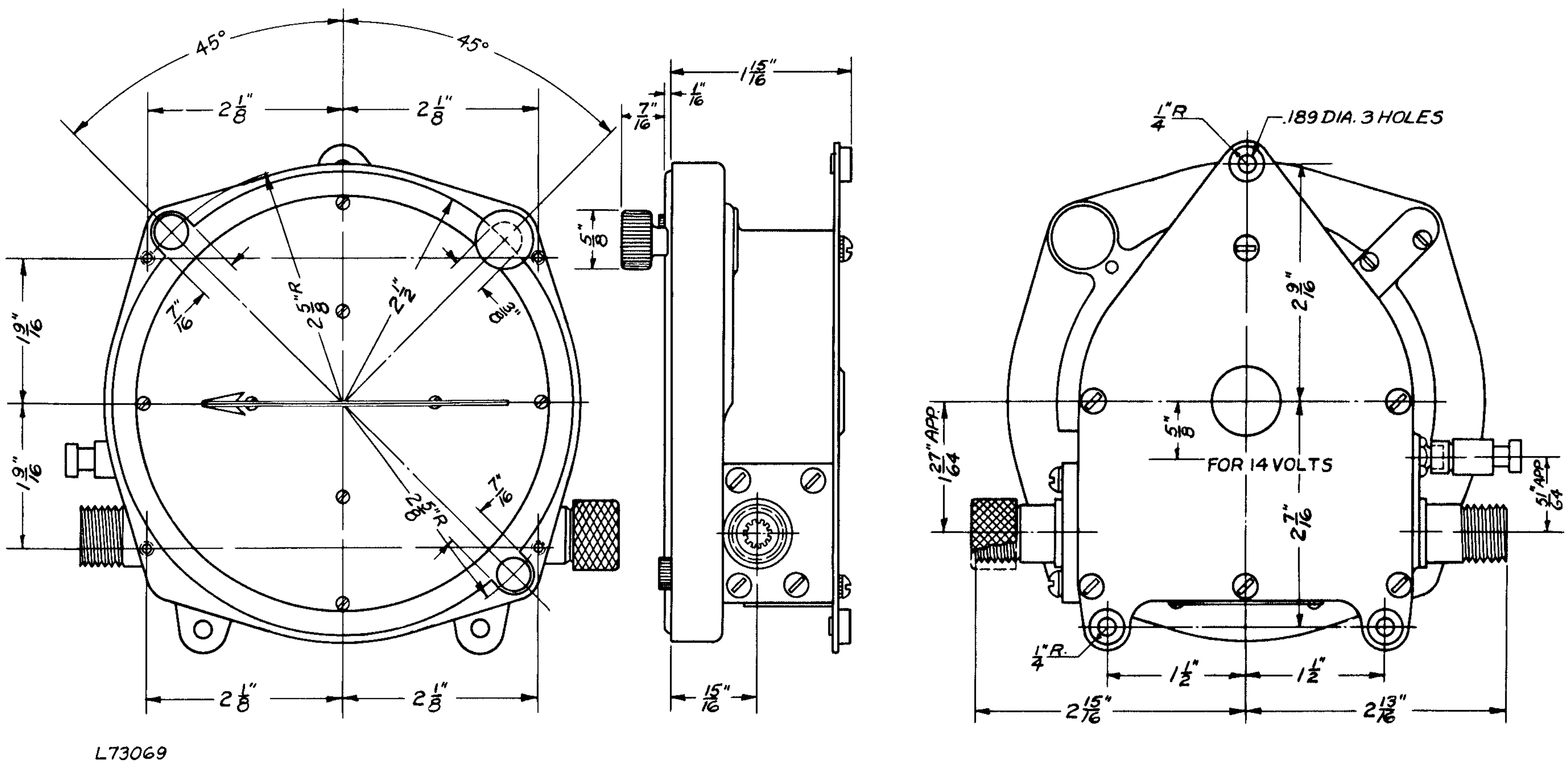


FIG 17-OUTLINE DIMENSIONS MN-22A AZIMUTH CONTROL UNIT

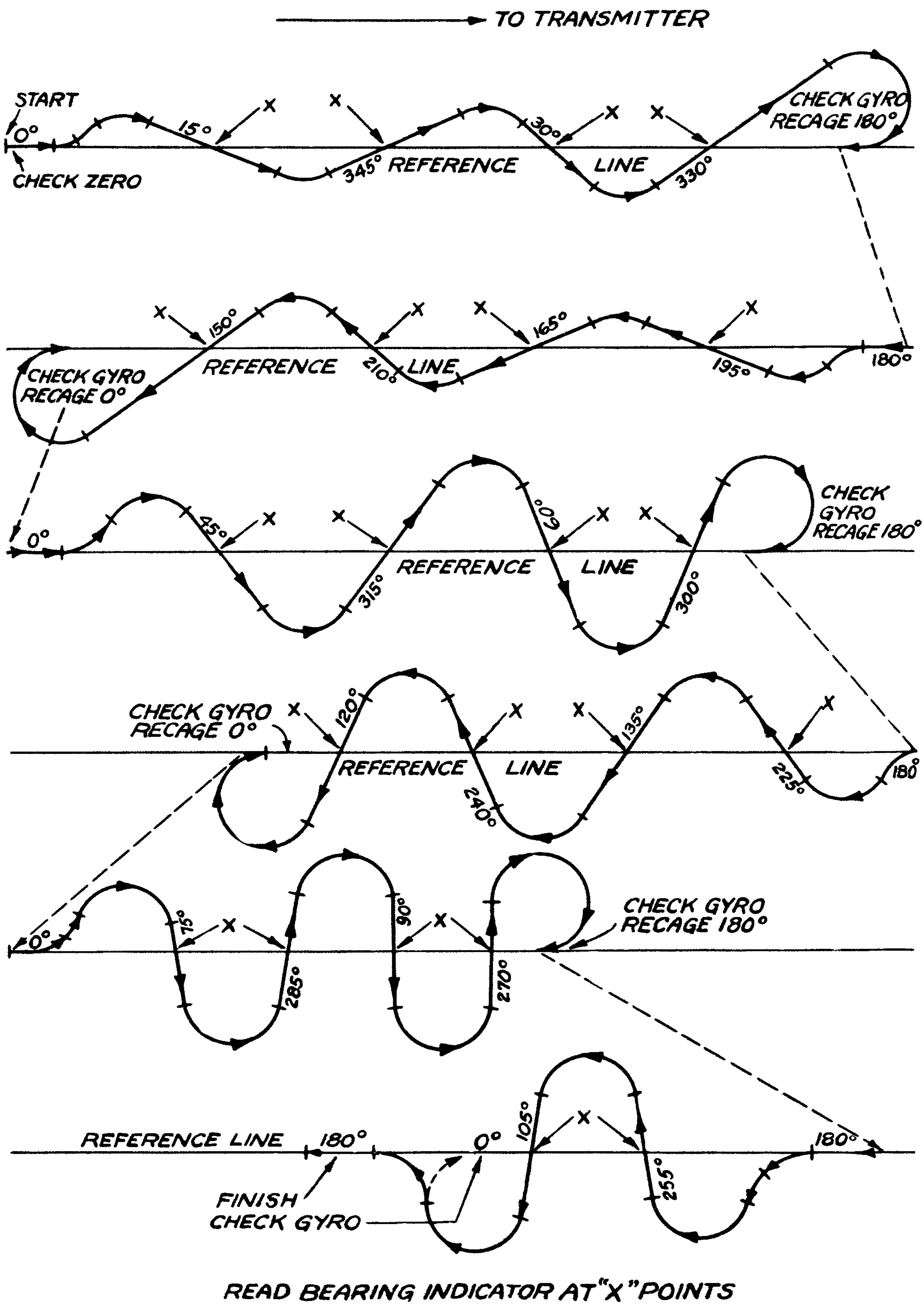


FIG. 18-PROCEDURE FOR OBTAINING QUADRANTAL ERROR DATA IN FLIGHT

NUMERICAL EXAMPLE ONLY - DO NOT USE THESE FIGURES

REMARKS: Reference line U.S. Highway #00 between X-town and Y-town Station XYZ - 410 K.C. Weather- clear & smooth	DATA SHEET RADIO COMPASS QUADRANTAL ERROR CALIBRATION	DATE: 8-4-41 LOCATION: See "Remarks" SHIP NO.: NCXXXX PILOT: J. Doe RECORDER: J. O. E.

GYRO HEADING	TRUE RADIO BEARING	OBSERVED RADIO BEARING	BEARING CORRECTION TRUE MINUS OBSERVED		CAM CORRECTIONS		
					CAM SCALE	CORRECTION	
0	0	0	0		0	0.0	
15	345	350	-5		15	+7.0	
345	15	10	+5		30	+9.5	
30	330	339	-9		45	+10.0	
330	30	21	+9		60	+7.5	
180	180	180	0		75	+4.0	
195	165	170	-5		90	0.0	
165	195	190	+5		105	-5.5	
210	150	159	-9		120	-10.0	
150	210	201	+9		135	-11.5	
0	0	0	0		150	-11.5	
45	315	326	-11		165	-8.0	
315	45	35	+10		180	0.0	
60	300	310	-10		195	+7.0	
300	60	50	+10		210	+11.0	
180	180	180	0		225	+11.5	
225	135	146	-11		240	+9.0	
135	225	214	+11		255	+5.5	
240	120	131	-11		270	+0.5	
120	240	229	+11		285	-4.0	
0	0	0	0		300	-8.0	
75	285	291	-6		315	-10.0	
285	75	69	+6		330	-10.5	
90	270	270	0		345	-7.5	
270	90	90	0		0	0.0	
180	180	180	0				
255	105	112	-7				
105	255	248	+7				
180	180	180	0				

NOTE: PLOT BEARING CORRECTIONS AGAINST OBSERVED RADIO BEARINGS. READ MN-22A CAM CORRECTIONS FROM CURVE AT 15-DEGREE INTERVALS.

FIG. 19-TYPICAL QUADRANTAL ERROR DATA SHEET

REMARKS:	DATA SHEET RADIO COMPASS QUADRANTAL ERROR CALIBRATION	DATE: LOCATION: SHIP NO.: PILOT: RECORDER:

GYRO HEADING	TRUE RADIO BEARING	OBSERVED RADIO BEARING	BEARING CORRECTION TRUE MINUS OBSERVED		CAM CORRECTIONS		
					CAM SCALE	CORRECTION	
0	0				0		
15	345				15		
345	15				30		
30	330				45		
330	30				60		
180	180				75		
195	165				90		
165	195				105		
210	150				120		
150	210				135		
0	0				150		
45	315				165		
315	45				180		
60	300				195		
300	60				210		
180	180				225		
225	135				240		
135	225				255		
240	120				270		
120	240				285		
0	0				300		
75	285				315		
285	75				330		
90	270				345		
270	90				0		
180	180						
255	105						
105	255						
180	180						

NOTE: PLOT BEARING CORRECTIONS AGAINST OBSERVED RADIO BEARINGS. READ MN-22A CAM CORRECTIONS FROM CURVE AT 15-DEGREE INTERVALS.

FIG. 20-QUADRANTAL ERROR DATA SHEET

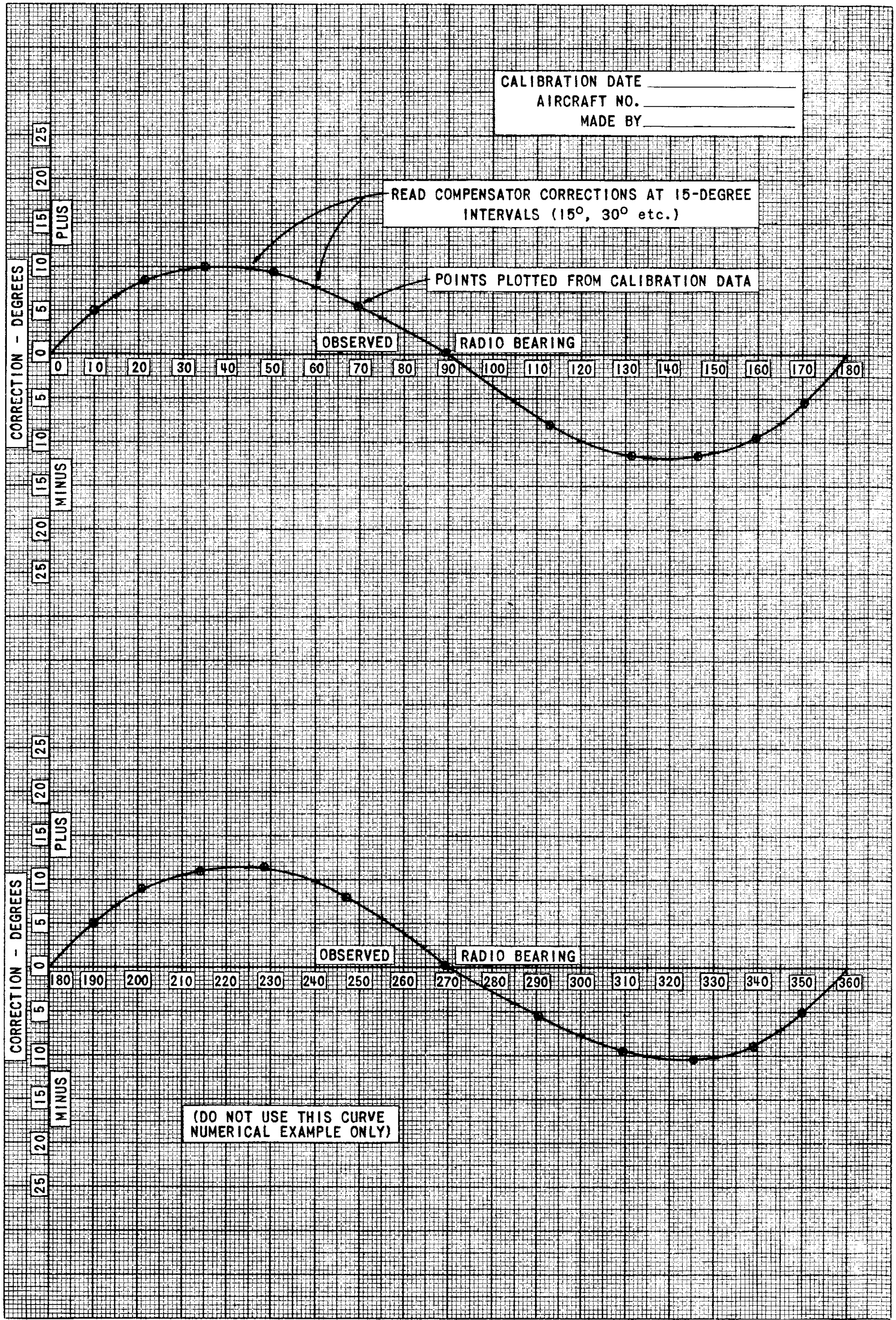


FIG.21-TYPICAL QUADRANTAL ERROR CALIBRATION CURVE

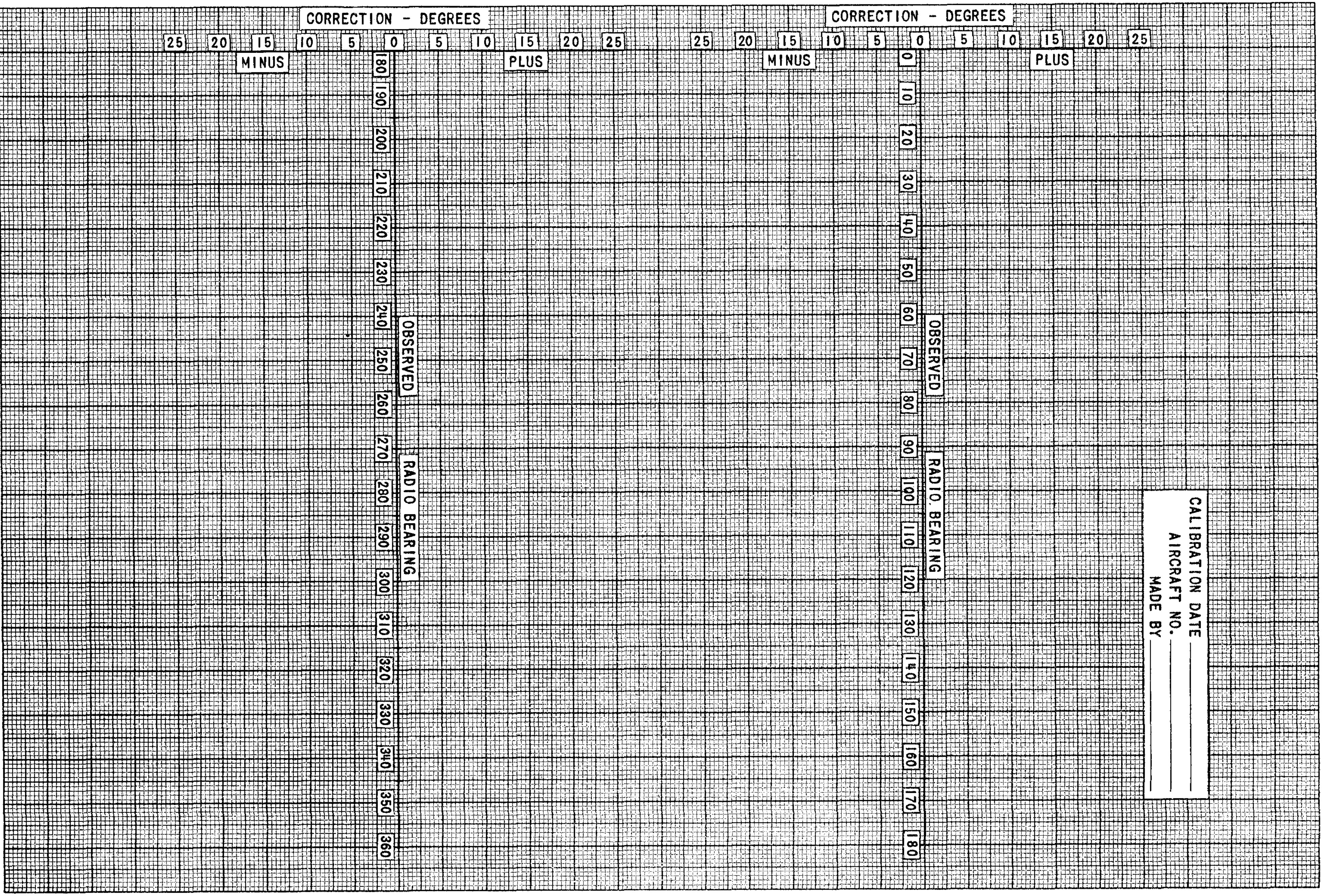


FIG.22-QUADRANTAL ERROR CALIBRATION CHART

FIG. A - MODEL MN-26M AIRCRAFT RADIO COMPASS EQUIPMENT

ADDENDA

for

MODEL MN-26M AIRCRAFT RADIO COMPASS EQUIPMENT

The Model MN-26M Radio Compass Equipment is similar to the Model MN-26C Equipment.

The equipment is designed for use with a 28-volt, direct-current power supply, and is normally wired for use with an output circuit of 4000 ohms impedance. The specific differences are tabulated below:

Frequency Range: 200-410, 410-850, and 3400-7000 Kcs.

Compass operation and loop reception is possible on the two lower frequency ranges only.

The following assemblies differ from those used in the Type MN-26C Radio Compass.

Item	*Bendix Drawing No.*
Can Assembly, Loop	AL72216
Can Assembly, Antenna	AL72217
Can Assembly, RF (two used)	AF11113-3
Can Assembly, Oscillator	AL72218

The Type MN-28N Remote Control Unit is provided to operate with the Type MN-26M Radio Compass. The frequency range is as follows:

200-410, 410-850, 3400-7000 Kcs.

The impedance of the output circuit is 4000 ohms.

The wiring of this unit is similar to other Type MN-28 series remote control units except for two additional connections to the Cannon connector as follows:

1. Pin No. 2 is connected to the arm of the frequency selector switch S9. This arm is grounded in other Type MN-28 control units.
2. Pin No. 16 is connected to the phone jack circuit, providing controlled audio for the junction box.

All RF aligning adjustments are as follows:

	Band	*Aligning Frequency*	*Loop*	*Antenna*	*Radio Freq. 1*	*Radio Freq. 2*	*RF Osc.*
I.	(210-410 Kcs)	410 Kcs	C1-1	C1-4	C1-7	C1-10	C1-13
II.	(410-850 Kcs)	850 Kcs	C1-2	C1-5	C1-8	C1-11	C1-14
III.	(3400-7000 Kcs)	7000 Kcs		C1-6	C1-9	C1-12	C1-15

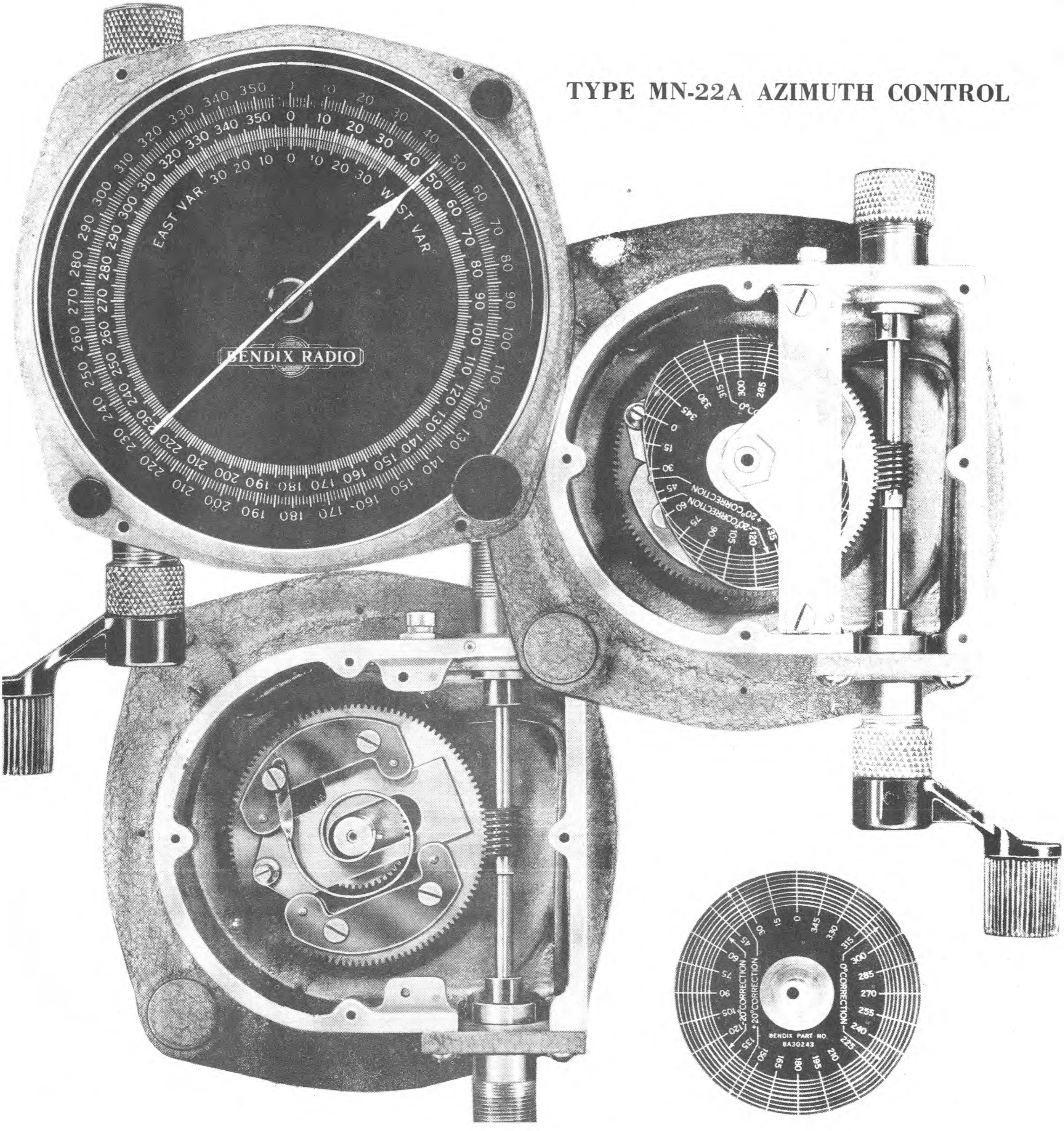
See Section 6-4 of the instruction book for intermediate frequency amplifier alignment.

The schematic diagram of the Type MN-26M Radio Compass and Type MN-28N Remote Control Unit is shown at left.

OPERATION AND MAINTENANCE
OF
TYPE MN-22A AZIMUTH CONTROL AND ATTACHMENTS

BENDIX RADIO CORPORATION
BALTIMORE, MARYLAND

TYPE MN-22A AZIMUTH CONTROL



FUNCTION

The Type MN-22A Azimuth Control provides means for obtaining loop rotation and bearings (indications of loop settings corrected for quadrantal error) as follows:

a. Bearings relative to ship's heading are read on the outer fixed dial.

b. Magnetic bearings are read under the pointer on the inner movable dial, after the number on this dial, which corresponds to the airplane's magnetic course, has been set at the zero mark on the fixed dials.

c. True bearings are read under the pointer on the movable dial after the number on this dial, which corresponds to the airplane's magnetic course, has been set opposite the east or west compass variation shown on the inner fixed dial.

d. Reciprocal bearings can be read at the opposite end of the pointer.

DESCRIPTION

Essentially the Type MN-22A Azimuth Control consists of a double ended tach-shaft drive to which is connected, through an appropriate gear and cam drive, a pointer that moves in the horizontal plane against the indicator dials. It is designed for use with standard aircraft tachometer shafts (Bendix No. AA15410) and any loop having a gear drive reduction of 120:1 between the loop and tach-shaft.

Connected to the internal gearing is a circular cam scribed with nine circles and twenty four radial lines corresponding to degrees correction and degrees azimuth rotation respectively. The cam may be cut to any required shape to meet the particular installation and can accommodate a maximum error of plus or minus 20 degrees. As supplied the cam introduces no correction and can, if no error correction is required, be used without further adjustment.

Two instrument lamps (Bendix No. QB15343-1) provide ample illumination. These lamps are connected in parallel with one side grounded, and require a 3 volt, 0.38 ± 0.040 ampere DC source which can be connected to the unit by means of a Breeze plug No. 1002-15-10 (Bendix No. AB9487).

Total weight of MN-22A is 1 lb., 13 oz. This unit has been assigned C.A.A. Type Certificate Number 99.

INSTALLATION

The azimuth control should be mounted so that the dials are easily readable from the operator's position. Four No. 6-32 screws are required for panel installations; three sets of No. 8-32 screws and nuts will be required for rear (bulkhead) mounting. To enable mounting the azimuth control in that position which facilitates the approach of the tach-shafts and still retain indications relative to ship's heading, the zero positions of the dials may be shifted to any of four 90° separated positions. This change of position may be done by removing the snap ring and glass, removing the eight dial holding screws and rotating the dial to the desired position. When replacing the screws, use a small amount of glyptal cement to hold them in place. Such a shift in the zero position of the dials will require resetting the cam. The shafting from the loop should be attached to that azimuth control shaft coupling which causes the pointer to rotate in the same direction as the loop. Zero indication on the outer dial should correspond with the zero bearing of the loop.

CORRECTION OF QUADRANTAL ERROR

General

The quadrantal errors of the particular loop installation with which the azimuth control is to be used will have to be determined before the cam contour can be shaped to give the desired correction. These quadrantal errors are caused by the distortion of the radio field pattern due to wings, engines, propellers, antennas and other parts of the aircraft. The quadrantal errors may be determined for the various headings (see list below) by "swinging the ship" on a compass rose, or conducting a series of test flights. In either case, noting the loop setting and the ship's heading with respect to the transmitting station for each 15° starting from 0°. The error being the difference between the loop setting (uncorrected dial indication) and the ship's heading with respect to the transmitting station. Errors are plus when the indicated heading is greater than the ship's heading (with respect to the transmitting station) and minus when the indicated heading is less than the ship's heading (with respect to the transmitting station).

It should be noted that errors apply for that frequency at which the data is obtained. In most instances, the errors will hold to within one or two degrees over the frequency range of 150 to 1500 Kcs.

Usually, the cam will be cut to supply correction of the quadrantal error at the most generally used frequency.

Cam Disassembly

NOTE: *Before uncoupling the loop tach-shaft, preparatory to removing the azimuth control, set the pointer on zero. Make sure that the shafting does not rotate from this position during the time in which the azimuth control is uncoupled.*

1. Remove the back cover by unfastening the six screws.
2. Remove the cam supporting bracket.
3. Unscrew the cam holding nut and remove the cam blank N5 from the cam bracket.

Cam Shaping

The azimuthal bearings of the loop are indicated on the cam blank by the radial lines spaced 15 degrees apart. The circles on the cam represent degrees of correction and the distance between each circle is equivalent to 5 degrees. It will be noted that the maximum plus correction of 20 degrees is the outside diameter of the cam (for correction of minus 20° quadrantal error), and the maximum minus correction of 20 degrees is the inner circle (for correction of plus 20° quadrantal error). A plus correction, advances the indicator pointer relative to the loop position. A minus correction retards the pointer relative to the loop.

With a sharp pointed scribe lay out on the cam blank, the contour indicated by the list of errors. Plus degrees of error are corrected by minus degrees of correction and vice versa. For example, if the loop setting error was *plus* 15 degrees at the third reading (45°), a mark would be made on the cam at the point where the 45 degree radial line intersects the *minus* 15 degrees correction circle. A point should be marked at each radial line. Scratch a smooth connecting line through all the points. This line represents the contour of the cam. Sudden breaks in the contour usually indicate that a mistake has been made and the cam layout at these points should be checked. Using first a coarse and then a fine file, carefully file away the cam to the contour line. The edge of the cam should be smooth and free from file marks.

Reassembly

Reassemble the cam in the cam bracket with a lockwasher and nut. Do not fully tighten the nut. Assemble the cam bracket in the casting making certain that the cam follower pin is in contact with the edge of the cam. Keep the pointer at 0° on the dials and adjust the cam so that the 0° radial line is lined up with the mark on the cam follower pin. Tighten the nut.

To check the cam assembly and contour refer to the calibration data. Set up the loop azimuth bearings as indicated on the cam by the cam follower pin, by revolving the coupling shaft. The pointer should read the corresponding *true* bearings. Settings hidden from view by the cam holder can be checked by counting the revolutions of the coupling shaft, as one complete turn of this shaft rotates the cam follower pin 3°. Reassemble the back cover.

If installation requirements have made it necessary to shift the zero position of the dials after the cam had been calibrated and filed the cam will have to be set so that the cam follower pin is at zero on the cam when the pointer is at zero on the dials.

Before recoupling the indicator to the loop shaft, set the pointer on zero and make certain that the loop has not shifted from its 0° heading.

MAINTENANCE

Lubrication

Lubrication at 1000 hour intervals is recommended as follows: Apply a small amount of light oil on the cross slide rollers, pointer shaft drive gear, pointer shaft, and the bearing for the worm gear. The ball bearings on the worm shaft should require no lubrication. Apply *Royco No. 6A* grease to the worm and to the edge of the cam.

Disassembly

Disassembly of certain parts may be accomplished as follows:

a. Remove the dial rotating knob from its shaft by loosening the two Bristo set screws. A Bristo wrench is provided on the inside of the rear cover plate.

b. To remove the pointer shaft drive gear, uncouple the spring and loosen the two Bristo set screws. This will permit disassembly of the pointer assembly and the worm gear to which the cross slide assembly is attached. Before the screws are loosened, set the pointer on zero and carefully scribe a line on the pointer shaft drive gear and on the cross slide, so that these three parts can be reassembled without changing their relative positions; otherwise, a shift in the error correction will occur. To check for proper assembly, set the cam follower pin at the 0° radial line on the cam blank; the pointer should read 0° on the dial when the distance between the center of the shaft and the inside edge of cam follower pin measures 1.062″. In making this check with an unfiled cam, the pointer should read 20° when the cam follower pin is set at the 0° radial line on the cam. In reassembling the pointer shaft drive gear, set the gear so that the pointer shaft has approximately .003″ end play.

c. Excessive back lash between the worm and worm gear can be remedied by loosening the four screws around the one tach shaft coupling and adjusting same for proper clearance.

d. Excessive play between the cross slide and its rollers can be corrected by loosening two of the screws securing the roller brackets and setting the rollers up against the cross slide.

ATTACHMENTS

The Type MR-15A Crank Drive provides means for rotation of standard tach-shafts. This unit may be connected between the azimuth control and the loop or at the end of a shaft connecting to the azimuth control. Weight is 6 ounces.

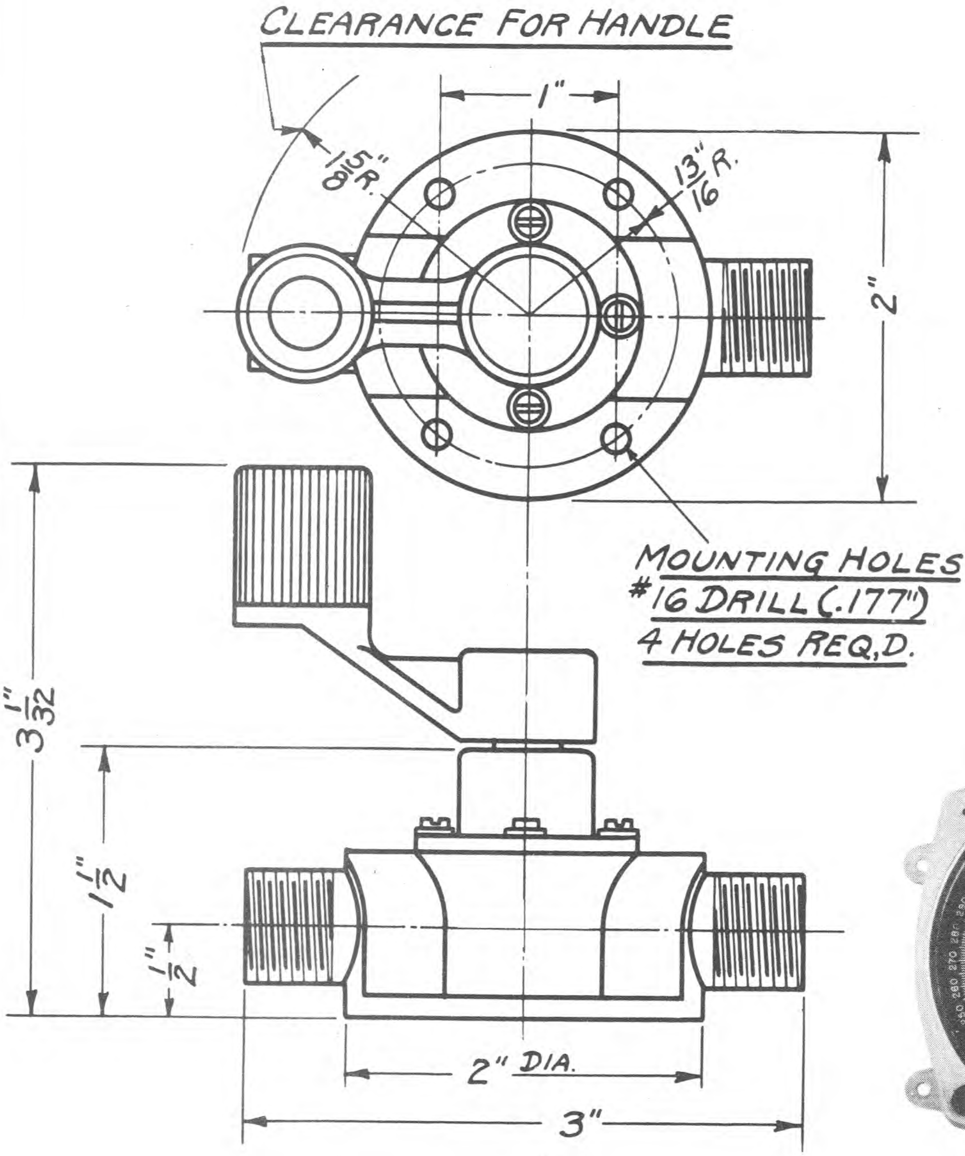
The Type MR-21A Crank Assembly fits standard ¼″ male tach-shaft connections and, where clearance is available, and remote control is no longer required, permits local operation of the MN-22A unit.

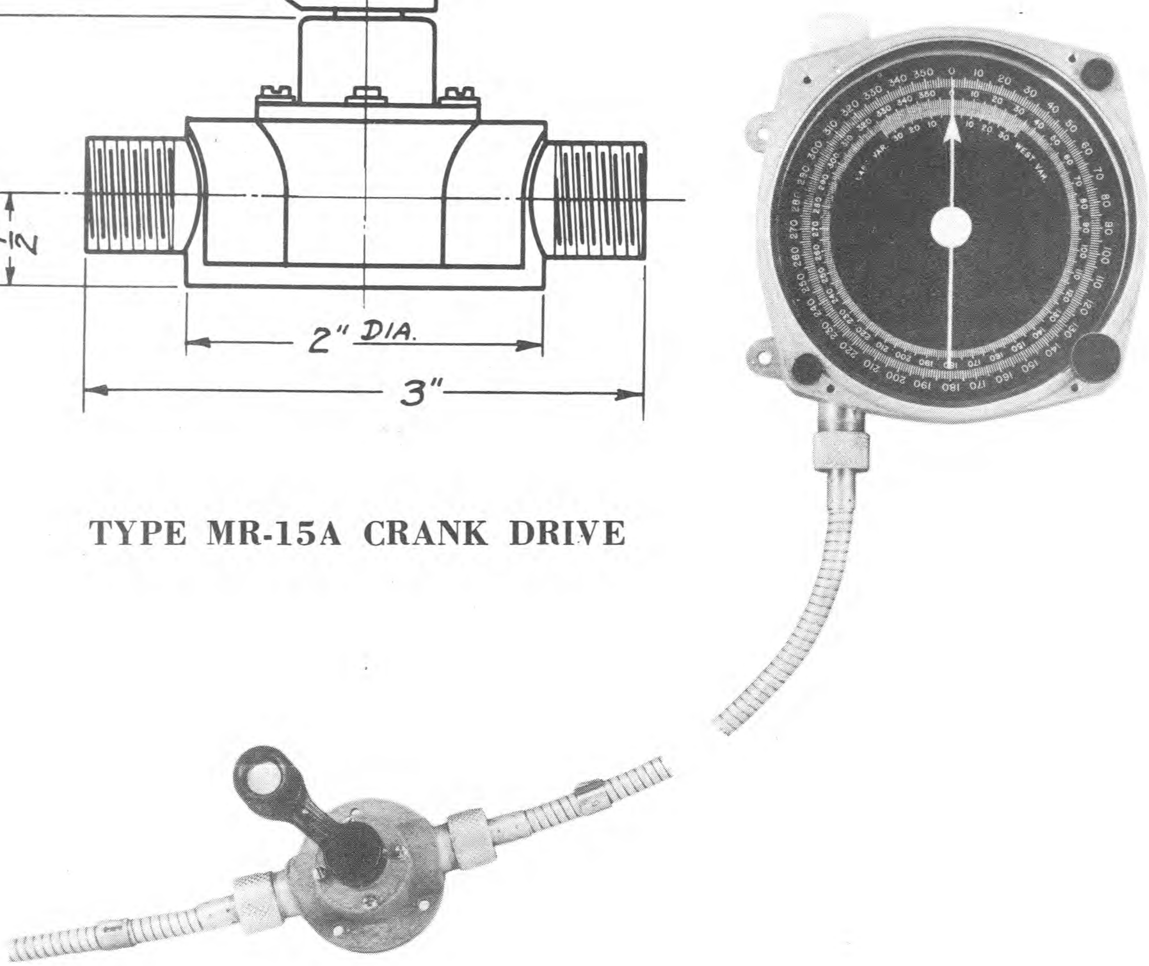
LIST OF REPLACEMENT PARTS

SYMBOL	DESCRIPTION	BENDIX NUMBER
E1	Knob	BA30266
H1	Glass	BA30267
H2	Snap Ring	BA30268
H3	Gasket	BA30269
H4	Cam Nut	BA30270
H5	Cam Bracket	BA30271
H6	Cover Plate	BA30272
I1	Instrument Lamp	QB15343-1
J1	Lamp Plug Socket	BA30273
N1	Pointer and Shaft Assembly	BA30274
N2	Outer Scale	BA30275
N3	Inner Scale	BA30276
N4	Variation Scale	BA30277
N5	Cam Blank	BA30243
O1	Compensator Spring	BA30278

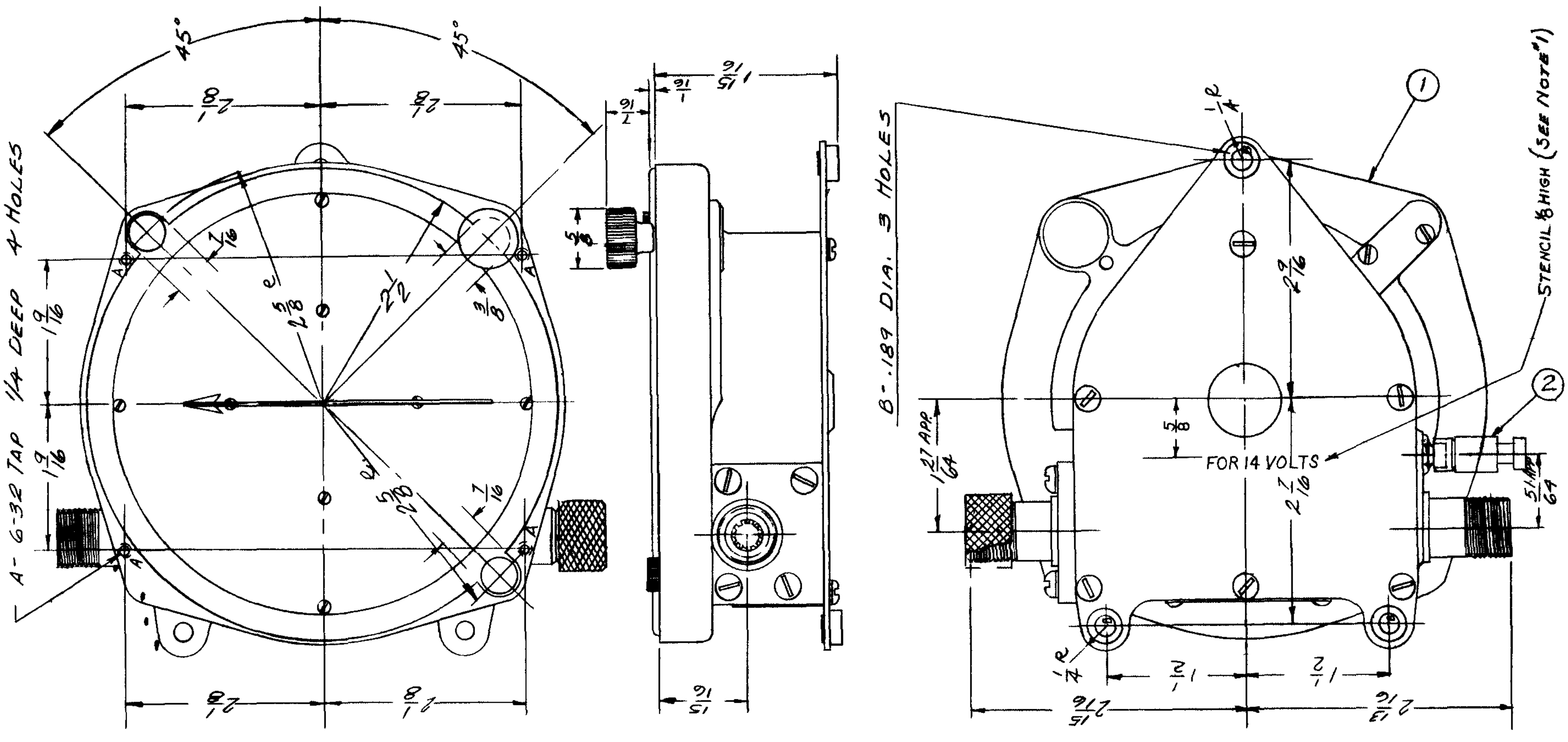
QUADRANTAL ERROR CALIBRATION

HEADING	LOOP SETTING	QUAD. ERROR
0		
15		
30		
45		
60		
75		
90		
105		
120		
135		
150		
165		
180		
195		
210		
225		
240		
255		
270		
285		
300		
315		
330		
345		
360		





TYPE MR-15A CRANK DRIVE



TYPE MN-22A AZIMUTH CONTROL

L71609

INSTRUCTION MANUAL

for

Aircraft Interphone Equipment

used in

Hudson Airplane

BENDIX

Model 3611
Model 3617A
Model 3618A
Model 3619A
Model 3620

Bendix Aviation, Ltd.

Subsidiary of Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIFORNIA
U. S. A.

IM 3 — Issue 3B

TABLE OF CONTENTS

Illustrations

Operations and Functions

General:

Operation is indicated under DESCRIPTION of the individual units. Discussion of Radio operation and functions follows this under OPERATION AND FUNCTIONS.

A. I/C Operation:

Inasmuch as Inter-Communication is a function common to each I/C unit covered in these instructions, this operation may be generalized as follows:

a. Insert microphone-telephone plugs fully into pendant jack receptacles at each I/C station, and turn microphone switches OFF, Station Box switches to I/C.
b. Adjust individual VOLUME controls at each station to approximately ¾ full on position. Adjust master VOLUME control on Amplifier to approximately ¾ full on position.
c. Turn amplifier ON and allow 20 to 30 seconds for filaments to heat. Refer to Model 3616, 3616-B, 3618 or 3618A for proper procedure.
d. Turn any microphone ON and, talking in a normal voice, adjust levels at all stations to requirements. Overall volume may be increased by master VOLUME control, as required.

B. I/C Circuit Functions:

In I/C position, the microphone circuits are across the input of the amplifier. An ON and OFF switch on the microphone opens or closes its individual circuit.

Similarly, in all cases, each pair of telephones is plugged in directly across the high impedance side of the Station Box matching transformer. A ground on the T minus side also provides a ground to the microphone cable shield through the microphone-telephone cable and plug. A volume control is connected in the low impedance primary side on all units excepting Model 3620, which see, and this primary is switched in the various functions of the Station Box Telephone circuits. In the I/C position the transformer with volume control is directly across the Interphone Amplifier Output.

The Model 3611 Interphone Amplifier is designed with a low impedance output transformer. Due to design characteristics, maximum undistorted power is developed when the Amplifier is loaded with sufficient headphones to effect a match (eleven or twelve high impedance telephones bridged through the Station Box matching transformers). This feature provides a partial self-equalizing of power output which is desirable to meet varying conditions of load. It permits individual station VOLUME control adjustment and an increase and decrease of number of telephones in use without wide fluctuations of volume.

MODEL 3611 INTERPHONE AMPLIFIER

Description

Weight complete with tubes: 9 pounds, 8 ounces.

Dimensions: Box 5$\frac{11}{16}$″ high, 7″ wide, 8$\frac{11}{16}$″ deep.

Overall: 6$\frac{5}{16}$″ high, 7½″ wide, 9⅝″ deep.

Primary Power: 24-28 Volts.

In the Instruction Manual the 3611 Interphone Amplifier is shown in photographs, Figures 1, 2 and 3, Dimensional Drawing Figure 8, and Schematic Drawing Figure 13. It is controlled by the master VOLUME control on its front panel, the ON-OFF switch and fuse being located in the Operator's Station Box. All external connections, consisting of Input and Output Transmission lines and Battery lines are completed through a single cable plug. The case, mounted on shock absorbers, is well grounded through two pigtails to the front shock mounting bolts. The chassis is easily removable from the case for service by loosening two bail type fasteners.

The Amplifier is a two stage, high gain, self-contained unit of rigid design to withstand mechanical stresses of vibration. All electrical parts were chosen to provide ample safety factor. The output of the unit may be worked into a widely varying load, limits approximately 60 ohms to 600 ohms, the power output increasing to over three watts at 100 ohms, with an overall gain of 80 db from an input of—55 db., 150 ohms. The frequency characteristic was chosen for maximum intelligibility with stability, and minimum extraneous noise pickup.

The unit is designed to take advantage of balanced transmission lines, but it is possible to ground either side of the output lines, without materially affecting performance. It is not permissible, however, to ground either side of the input.

The Power Supply, integral to the amplifier is of the Dynamotor type, shock mounted to avoid possible vibrational modulation in the amplifier. Battery lines feeding it are well filtered to prevent radio interference.

MODEL 3617-A STATION BOX

Description

Weight: 1 pound, 7 ounces.

Dimensions: Box 5 3/16" high, 3 11/16" wide 3 3/16" deep.

Overall: 5 3/16" high, 3 11/16" wide, 3 7/8" deep.

The Model 3617-A Station Box is shown in the Instruction Manual in photograph Figure 4, Dimensional Drawing Figure 9, and Schematic Drawing Figure 14.

This Model is designed for systems where only one Receiver is used. It has terminals for two Receivers, but these are strapped in parallel.

In addition to the Telephone matching transformer and individual station VOLUME control, this unit provides an ATTENTION jewel light, and a two position I/C-CALL rotary switch which is normally on I/C and held on CALL. In the I/C position the Telephones are connected to the Interphone Amplifier output only. When held on the CALL position the ATTENTION light comes on at this and all associated stations so equipped; in addition the Receiver's output is paralleled to the Interphone Amplifier Output and the station operator may call all stations regardless of their standby position. The Interphone Amplifier is adjusted to a greater output than the Radio Receiver in order to provide this audible attention signal.

External connections to this box are made to a solder-lug screw type terminal strip.

Operation and Functions

This unit is primarily an Interphone station. It may be used to transmit R/T through I/C channels by use of SW3 (OFF - R/T switch) on Station Box Model 3618-A. For normal I/C use, refer to I/C OPERATION. It is provided with a Call Switch (SW1) which, when operated, not only lights an attention signal light (VS1) but also parallels the Interphone Amplifier output with all stations regardless of their standby position. The unit operator should therefore:

1. Switch to CALL and listen to see if he is interrupting radio communication.
2. Make his call, and,
3. Return SW1 to I/C position to converse with called station or stations.

MODEL 3618-A STATION BOX

Description

Weight: 1 pound, 14½ ounces.

Dimensions: Box 6 5/32" high, 4 11/16" wide, 3 1/8" deep.

Overall: 6 5/32" high, 5½" wide, 3 7/8" deep.

The Model 3618-A Station Box is shown in the Instruction Manual in photograph Figure 5, Dimensional Drawing Figure 10, and Schematic Drawing Figure 15.

This Station Box permits its operator to listen to either of two Radio Receivers, or one Receiver and a Radio Compass, as well as the Interphone Channel. A four position rotary switch supplies these functions. This switch is designated R1 - R2 - I/C - CALL. In R1 and R2 positions the Telephones are connected to the respective Radio Receivers, and shunted by both Receivers and Interphone Amplifier when another position calls attention. In the I/C position, the Telephones are energized by the Interphone Amplifier. When the switch is held on CALL (a "hold" position for the switch) ATTENTION lights at all positons so supplied are turned on, all listening circuits are paralleled, and attention may be called verbally as well as by signal.

In addition to the individual VOLUME control and matching transformer, this Station Box contains the ON switch and accompanying indicator light for the Interphone Amplifier. The Amplifier's line fuse is also contained in this Box, and may be replaced from the front of the panel.

The 3618-A is provided with a toggle switch, conveniently mounted on the side of the Box and provided with a guard against accidental tripping, the purpose of which is to connect the Interphone Amplifier output to the Transmitter Modulator for Radio Telephone emission. This is accomplished through a variable leveling pad, mounted within the box and designed for screw driver adjustment, whereby the level to be fed the Modulator may be adjusted to other circuit features and is not thereafter readily available for misadjustment

All external connections are completed through a solder-lug screw type terminal strip.

Operation and Functions

This unit anticipates most transmitter adjustments being made at the transmitter or a separate control box. For I/C use, refer to I/C OPERATION.

SW2 provides Radio Receiver listening positions or Receiver and Compass Radio, an Interphone listening position and a CALL position. The function of the switch is to connect the telephone matching transformer (T1) to the desired unit and to parallel all units on CALL. The I/C volume level is normally held higher than the Receivers' so that a call will override. To use SW2, set it at desired function as indicated.

SW3 (OFF - R/T) provides a switch for modulating transmitter with I/C. Switch SW2 to I/C, depress SW3 to R/T and transmit message. Release SW3 at completion of message. The function of SW3 is to connect the Interphone Amplifier Output to the transmitter, also completing the Transmitter Control circuit so that it is on the air. If transmission originates at another station not equipped with R/T switch, use this switch as above while other station transmits.

NOTE: The Transmitter is connected to Amplifier through a leveling pad (R2) in the 3618-A. This pad should be adjusted for proper modulation when the transmitter is set up, and may thereafter be disregarded.

MODEL 3619-A STATION BOX

Description

Weight: 1 pound, 7½ ounces.

Dimensions: Box 5³⁄₁₆″ high, 3¹¹⁄₁₆″ wide, 3³⁄₁₆″ deep.

Overall: 5³⁄₁₆″ high, 3¹¹⁄₁₆″ wide, 3⅞″ deep.

The Model 3619-A Station Box is shown in the Instruction Manual Figure 6, Dimensional Drawing Figure 11, and Schematic Drawing 16.

The Model 3619-A is provided for those systems where one Receiver and a Compass are used. It includes terminal and switching provisions for two Receivers, but they are strapped in parallel to prevent the possibility of listening to a dead Receiver position.

This unit contains the Telephone matching transformer and individual VOLUME Control. A five position rotary switch, marked R1 (for Receiver No. 1), R2 (for Receiver No. 2), COMP. (for Radio Compass), I/C (for Inter-Communication), and CALL (for the Attention signal), governs the input into the Telephones. In the CALL position, which is a non-lock point on the switch, all units are paralleled so that all other stations may be called regardless of their standby position. An ATTENTION signal jewel is lighted at this, and all other stations so equipped, on CALL position.

All external connections are completed through a solder-lug screw type terminal strip.

Operation and Functions

In operating the 3619-A, SW1 is set to the function desired, eg., to listen to the Compass Receiver turn SW1 to COMP. Volume adjustments may be made with the VOLUME Control. Note from DESCRIPTION that R1 and R2 are internally paralleled. Primarily an I/C and listening station, it may be used to transmit R/T through I/C channels by use of SW3 (OFF-R/T Switch) on Station Box 3618-A. For normal I/C use, refer to I/C OPERATION.

MODEL 3620 STATION BOX

Description

Weight: 1 pound, 9½ ounces.

Dimensions: Box 6³⁄₁₆″ high, 4³⁄₁₆″ wide, 2¹¹⁄₁₆″ deep.

Overall: 6⁹⁄₁₆″ high, 4³⁄₁₆″ wide, 3½″ deep.

The Model 3620 Station Box is shown in the Instruction Manual in photograph Figure 7, Dimensional Drawing Figure 12, and Schematic Drawing Figure 17.

This unit is designed for an inter-communication station, with limited Transmitter control to permit R/T transmission to originate at this position.

A feature of the 3620 is a two position rotary switch by means of which Microphone and Telephone circuits are switched from one set of terminals to another, thus permitting their use on either of two systems. This unit incorporates a matching transformer between output of the 3611 Amplifier and headphones on the Bendix Channel but anticipates impedance match on the other. To provide individual station headphone volume control with one control for either Telephone circuit the volume control is provided in shunt with the Telephones, a fixed resistor limiting the attenuation available so that at no time may the headphone level be turned below audibility. This design is not common to other Station Boxes described in the Instruction Manual.

Other features of the Model 3620 include a CALL LIGHTS button and ATTENTION signal light by means of which all stations so equipped may be called visually. A second signal light, marked TRANSMITTER, comes on with the Transmitter's high tension circuit, indicating that it is in use.

External connections to ship's wiring are completed through a single cable plug. Local connection to Telephone, Microphone, etc., are completed to a screw type terminal strip and carried out of the Box through three grommeted holes. Provision is made for three lines from ship's wiring through the cable plug to the terminal strip, for circuits controlled or terminated at the 3620 Station, but whose functions do not necessarily relate to the functions of the 3620.

*

Operation and Functions

For normal I/C operation, procedure differs from general I/C OPERATION, to which reference is made, in that the selector switch on the 3620 is marked TR9—BENDIX, and carries no reference to I/C. It is suggested that this switch be set to BENDIX and procedure outlined in I/C OPERATION be followed for adjusting the headphone volume of this channel. This procedure may be modified when switching to TR9 to the extent indicated by the Manufacturers of that unit.

In I/C operation with selector switch (SW3) on BENDIX the Microphones are fed to the 3611 Amplifier through this switch. Similarly, the output of the Amplifier, after passing through the matching transformer (T1) is directed through this switch to Telephone shunt volume control and from it to the Telephones.

The Model 3620 provides remote voice only transmission from the Radio. Note that this is accomplished only when the LOCAL-REMOTE

* See page 10 of OPERATOR'S MANUAL for limitations to use of 3620 Station Box in HUDSON installation.

TRANS. CONTROL switch on the Operator's Station Box, Model 3616-B, is on REMOTE. Position of the EMISSION switch at the 3616-B Station does not affect emission originating at the 3620, because, when used on BENDIX Channel, R/T emission is automatically provided by the Bendix Transmitter.

To Transmit:

a. Listen for sidetone; if none is heard, use I/C channel to call Radio Operator. Ask for remote control on desired frequency channel.

b. Be sure Selector switch (SW3) is on BENDIX if transmission is to go through Bendix channel.

c. Put SEND-REC. switch (SW1) in SEND position, either holding it down or if more convenient, locking it up. The TRANSMITTER signal light will come on, indicating the Transmitter is on and the message may be given.

d. Upon completion of message return SEND key to REC. position. Upon completion of communication notify Radio Operator of such completion and turn microphone off.

e. Be sure selector switch (SW3) is restored to System (TR9 or BENDIX) normally used at this station.

Functional Operation of the SEND switch on this unit is to close the Dynamotor and Keying Relays on the Bendix Transmitter, which automatically puts the Transmitter on the air with R/T emission. The H. T. indicator lights are turned on by operation of these relays.

MAINTENANCE AND SERVICE

Interphone Amplifier

The Interphone Amplifier requires only routine inspection and service at regular intervals. The tubes should be removed and tested at these inspections and replaced when found weak or defective. The 6SJ7 (V1) must be quiet in operation because the high gain characteristics of the amplifier will cause microphonics to be greatly amplified.

Routine service of the Dynamotor should include a regular inspection at which time the brushes should be inspected and replaced if badly worn. The commutator should be lightly sanded with 0000 sandpaper as required. The bearings should be lubricated every 1000 hours of service. The unit is shipped with a supply of grease for approximately 1000 hours service. To relubricate, remove the bearing plates and cover bearings with grease. Do not pack the bearings, and avoid getting grease on commutators.

Recommended grease for bearing lubrication meets the following specifications:

1. The grease consists of a homogeneous mixture of petroleum oil and sodium soap or petroleum oil, sodium soap and calcium soap. It must be free from all fillers, such as rosin waxes, or mineral matter, or any other materials not naturally occuring in soaps or oils.
2. Water content shall not exceed 0.5 per cent.
3. Insolubles shall not exceed 0.2 per cent.
4. The ASTM penetration (worked), melting point, and oil content shall conform to the following:
   Penetration 340-380
   Melting Point (Deg. F.) .... Min. 270
   Per cent Mineral Oil Content (Min.) 84
5. Universal oil content shall conform to following requirements:
   Viscosity S.U.V. at 130 Deg. F. 90-130
   Pour Point ASTM Deg. F. Max. ... 20
   Spec. Gravity 60 Deg. F. Max. .... .895
   Color ASTM Max. 7
6. Free acid calculated as oleic acid shall not exceed 0.10 per cent.
7. Free alkali calculated as sodium hydroxide shall not exceed 0.10 per cent.

In the U. S., Royal Engineering Co's "Royco 6-A", Master Lubricants Co., "Lubrico M-6" and N. Y. and N. J. Lubricant Co. "F-927" comply with these specifications.

Voltage-Current Table

Supply Voltage	24V	28V
V1—		
Plate	35V	40V
Screen	20V	23V
Cathode	.6V	.75V
Filament	6.2V	6.8 V
V2—		
Plate	220V	250V
Screen	230V	265V
Cathode	12.5V	15V
Filament	6.2V	6.8V
Dynamotor Primary Current	1.2A	1.3A
Dynamotor Secondary Current	.036A	.045A
Total drain for amplifier	1.6A	1.75A

Voltage measurements based on readings from 1000 ohms per volt meter from socket terminal to ground, excepting across filament V2. For terminal placement refer to Schematic Drawing 13.

Station Boxes and Control Units

No maintenance service is necessary on Station Boxes except as required by electrical or mechanical breakdown.

As before mentioned, Amplifier line fuses may be replaced from the front of the Control Box Panel. Pilot lights are also available from the front of panel by unscrewing and removing the signal jewel. Rotary switches should be cleaned with a lintless cloth moistened with carbon-tetrachloride whenever they show a tendency to become dirty or noisy. Dirt or oxidization may be removed from relay contacts or switchboard type key contacts with a relay contact burnishing tool.

Interphone Systems Using Model 3611

Amplifier and Associated Station Boxes

Because of the high gain employed in I/C systems using this equipment, it is imperative, for stable operation, that all components and wiring of speech circuits be properly phased to prevent regeneration. The following instructions are designed to assist in the repair or replacement of wiring or speech circuit components, or the case of an installation in which oscillation and unstable operation is encountered.

Ship's Wiring

Ship's wiring diagram must be carefully adhered to with regard to phasing and pairing of amplifier In and Out lines, microphone and telephone lines. A visual check comparing color code of wiring at terminals of junction boxes and station boxes should reveal any wiring turnovers or split pairs. In addition, resistance checks may be made to clear shorts or grounds. Resistance measurements with components installed and with system in I/C condition are:

Amplifier In, High (+) to ground—250 ohms

Amplifier In, low (−) to ground—250 ohms

Amplifier In, High (+) to low (−)—4.5 ohms

M+ to ground—250 ohms.

M− to ground—250 ohms.

T+ to ground—600 ohms (600 - 9000 ohms in case of Models 3620 and 3621)

M+ to M− — 4.5 ohms

T− to ground—short.

The system uses a matching transformer in each Station Box so no continuity is found between amplifier output and headphone terminals unless one side of amplifier output is grounded. The resistance value of amplifier output or telephone input at station boxes is dependent upon the number of matching transformers shunted across this line as well as the position of the respective station box volume controls. Other equipment such as receiver outputs may be paralleled. It is suggested that ship's wiring diagram be consulted to ascertain if this line is grounded or floating. If a grounded installation, check for ground on proper telephone In (amplifier Out) terminal at station boxes. If floating, check for clear condition at junction box or a station box.

The d.c. resistance of the amplifier output winding is 5 ohms. The d.c. input resistance of a station box transformer, with volume full on, is 15 ohms.

With the amplifier disconnected, a resistance check should show infinity between microphone and telephone lines as leakage may cause feedback.

The input and output transformers used in this amplifier are carefully tested for phasing before assembly and a red dot on the base indicates passage of this test. An overall check is made of the amplifier in final inspection. In the event of the necessity arising to replace one of these transformers, it is suggested that reference be made to the accompanying drawing and the coding thereon be followed exactly. After completion of repairs, a phasing check, illustrated on the accompanying drawing, should be made as follows:

1. Connect low (−) side of output to low (−) side of input (Cannon plug terminals 3 to 4).
2. Connect high (+) side of output to high (+) side of input through a 4 mfd. condenser (Cannon plug terminals 2 to 5).
3. Connect test phones across output.
4. Turn on amplifier and with volume control about half on, a low pitched oscillation (approx. 200 to 250 cycles) will be heard if properly phased. If a high pitched oscillation (approx. 1500 cycles) is heard, a reversal has been made and must be corrected.

Note: If this test is made on a completed installation, be sure to remove all microphones and headphones at station boxes to avoid possibility of damage. If no definite phase relationship is established by this test, the amplifier should be removed for examination for defect.

Station Boxes

The headphone matching transformer used in these boxes is checked for proper phasing before assembly and a phasing test and ground check made from the box terminal strip after assembly. A phasing mark (red O on one end of the transformer mounting bracket) designates that the box is properly phased.

In the event that repair of the box or replacement of this transformer is required, refer to the accompanying drawing and follow the coding thereon. Due to the variety of boxes covered it is impossible to give a color code or terminal placement used on the individual transformer, but the drawing illustrates the following:

1. The primary, line, or low impedance side is indicated by the manufacturer's code (No. 9726 or No. 9946) marked on that side of the transformer.
2. The secondary, headphone, or high impedance side is the unmarked side.
3. Primary d.c. resistance is 15 ohms. Secondary d.c. resistance is 600 ohms.
4. The high (+) primary terminal is directly opposite the high (+) secondary terminal and the low (−) primary terminal is directly opposite the low (−) secondary terminal unless the internal connections of the individual transformer are reversed. These high and low terminal connections may be reversed

only when both sides are reversed similarly to maintain the same relative placement.

5. The low (−) secondary terminal (T−) is grounded and this connection is of great importance since it simultaneously provides a ground to the microphone cable shield and housing.

Care must be exercised in wiring repairs that the phasing relationship is not reversed through function switch operation.

Upon completion of repairs, a station box phasing test may be made as follows:

1. Connect station box normally to amplifier input and output.
2. Connect test phones to T+ and T− (If British or "Bendix-Substitute" microphone-telephone set is plugged into the box position, these phones may be used for this test. Check that the microphone is OFF before making test. If test is made on a completed installation, remove all microphones except at test position to prevent possibility of damage.)
3. Turn on amplifier with volume control on full.
4. Turn station box volume control on full.
5. Short between various microphone-telephone terminals of station box. Use an insulated jumper wire for shorting as voltages generated are high. A properly phased box and amplifier-to-box wiring will give these results.

Short T+ to M− —oscillations will occur.

Short T− to M+ —oscillations will occur.

Short T+ to M+ —click from contact but none or oscillation above audibility.

Short T− to M− —click from contact but none or oscillation above audibility.

Oscillation heard when like signs (T+ or M+ or T− to M−) are shorted indicates a reversal either within the box or in the amplifier to box wiring. This reversal may be in either the microphone or telephone circuits. If the amplifier proves properly phased by use of the method described under "3611 Amplifier" and no turnover is discovered in a continuity test made on the box and connecting wiring, reverse the primary leads on the station box transformer.

Checking Ship's I/C Installation

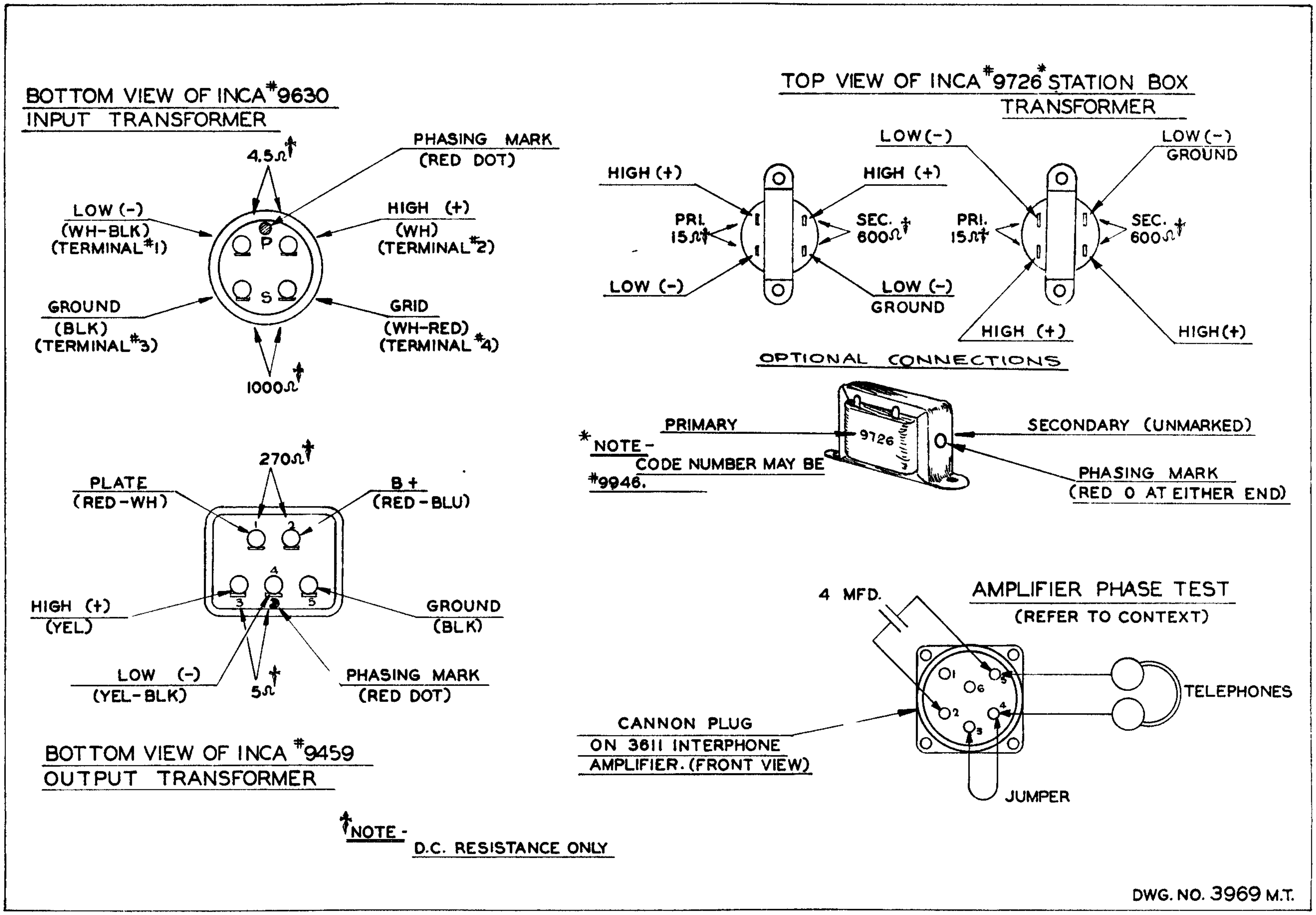
The interphone system should be stable under all functional conditions even when subjected to primary power voltages of 30 volts. In case of an installation failing to pass this test even when loaded with only one headphone, the following procedure is recommended:

1. Determine that oscillation is not due to acoustical feedback (headphone to microphone).
2. Continuity test microphone-telephone set for proper connections from spade lugs of pendant receptacle to the units. Check that microphone cable shield carries to T− (ground) and to microphone case without broken or loose connection.
3. Make visual check of connecting wiring suggested under "Ship's Wiring." A systematic check starting at junction box and including color code comparison with ship's wiring diagram at each station box will be most productive. If the junction box is readily available, considerable time may be saved by removing all interphone lines and restoring one unit at a time before making further tests. Alternatively before or while making visual check at the individual station boxes disconnect the microphone headset cord at the pendant jack. If stability in the balance of the system is accomplished the trouble will be found either in the box under examination or in the wiring to it.
4. Make resistance-continuity checks suggested under "Ship's Wiring," closely following ship's wiring diagram for possible mistakes, shorts or grounds. The T+ - T− check must be made at each individual box. In the case of systems using the Model 3620 Station Box the microphone lines tests should include one through the functional switch of each box, with the switch set on "Bendix".
5. Make station box phasing test at each box, using test suggested under "Station Boxes."
6. Make amplifier phasing test suggested under "Model 3611 Amplifier."

Inasmuch as instability may result from more than one source, corrections or repairs should be made whenever their necessity is exposed by above tests, before making additional checks.

Should none of the above tests reveal the cause of trouble, any associated equipment should be disconnected to see if source is external to I/C system.

In the event of the trouble persisting, it is possible to resort to temporary external wiring from amplifier to each individual unit to isolate the trouble. In such case use twisted shielded pairs for amplifier in and out lines to terminal strip of the individual station box, being careful that amplifier and station box under test are disconnected from all other ship's wiring.



PHASING INSTRUCTIONS (Pictorial)

PARTS LIST

(Recommended quantities are spare parts for each lot of 10 units. See list of manufacturers for key to "MFR.")

CIRCUIT SYMBOL	REC. QUAN.	FUNCTION	DESCRIPTION	MFR.	MFR. DESIG.	BENDIX NUMBER
			3611 INTERPHONE AMPLIFIER			
			CAPACITORS			
C1	3	Compensation	.0001 MFD. Mica	3	5W-5T1	BX37-1
C2	3	Compensation	.0015 MFD. Mica	3	1W-5D15	BX37-2
C3	3	Screen Bypass	.03 MFD. Mica	3	4-11030	BX37-3
C4	3	Coupling	.0025 MFD. Mica	3	1W-5D25	BX37-4
C5	3	Low Pass Filter	.0005 MFD. Mica	3	5W-5T5	BX37-5
C6 & C7	4	High Voltage Filter	10 MFD.—10MFD.—450V Electrolytic	3	UP 1145	BX38-2
C8 & C10	4	Bias Bypass	20 MFD.—150V Electrolytic	3	BRB 2015	BX38-4
C9	3	Low Voltage Filter	.5MFD—120V Paper	3	HC1900 B	BX40-1
			RESISTORS			
R1	3	Filament Dropping	30 ohm 25W	4	ACKER	BX26-30B
R2	3	Filament Shunt	40 ohm 10W	4	BROLO	BX24-40A
R3	3	Volume Control	250M ohm Potentiometer Curve 6	2	10101513	BX15-5
R4	3	Cathode Biasing	1000 ohm ½W	2	Type 710	BX21-14A
R5	3	Screen Dropping	1 Megohm ½W	2	Type 710	BX21-44A
R6	3	Plate Loading	250M ohm ½W	2	Type 710	BX21-38A
R7	3	Grid Leak	500 M ohm ½W	2	Type 710	BX21-41A
R8	3	Cathode Biasing	350 ohm 1W	2	Type 714	BX22-8A
R9 & R10	4	Line Balancing	500 ohm ½W	2	Type 710	BX21-11A
			CHOKES			
L1	1	Low Voltage Filter	8.5 M.H. .35 ohm d.c. Iron Core	9	9462	BX18-1
L2	1	High Voltage Filter	15H. 330 ohm d.c. Iron Core	9	9460	BX18-2
L3	1	Low Pass Filter	50 M.H. 180 ohm d.c. Air Core	10	693	BX18-3
L4	1	Low Voltage RF Filter	30 T No. 16 Enam.	10	5221	BX18-4
			TRANSFORMERS			
T1	2	Input	T. R. 1:37 Pri. 4.5 ohm, Sec. 1000 ohm d.c.	9	9630	BX17-2
T2	2	Output	T.R. 8.2:1 Pri. 270 ohm, Sec. 5 ohm d.c.	9	9459	BX17-3
			VACUUM TUBES			
V1	5	Voltage Amplifier	Triple Grid Amplifier	11	6SJ7	
V2	5	Power Amplifier	Beam Power Amplifier	11	6V6	
			PLUGS			
P1	1	Connector Plug	6 contact wall mtg.	12	WK-6-32S	BX34-5
P2	1	Cable Plug	6 contact right angle cable receptacle	12	WK-6-23-⅜"B	BX34-6

Parts List (Continued)

(Recommended quantities are spare parts for each lot of 10 units. See list of manufacturers for key to "MFR.")

CIRCUIT SYMBOL	REC. QUAN.	FUNCTION	DESCRIPTION	MFR.	MFR. DESIG.	BENDIX NUMBER
			DYNAMOTOR			
*D1	1	High Voltage Power Supply	24 Volt Input, 220 V. .06A Output	8	2712	BX42-1
	6	Pos. Brush L. V.		8		BX43-1
	6	Neg. Brush L. V.		8		BX43-2
	6	Pos. Brush H. V.		8		BX43-3
	6	Neg. Brush H. V.		8		BX43-4
*D1	1	High Voltage Power Supply	24 Volt Input, 220 V. .06A Output	25	DS-100	BX42-7
	6	Positive Brush L. V.		25		BX43-14
	6	Negative Brush L. V.		25		BX43-15
	6	Positive Brush H. V.		25		BX43-16
	6	Negative Brush H. V.		25		BX43-17
			MISCELLANEOUS			
	1	Knob	Volume Control Knob	1	1800	1800
	4	Cushions	Dyn. Mtg. Cushion	16	2184	BX44-1
	4	Cushions	Dyn Mtg. Cushion Grommets	16	1113G	BX44-5
	1	Octal Tube Socket	1½ Mtg. Centers	13	Series K-39	BX45-1
	1	Shock-mounts		14	100PH2	BX44-2
	1	Cabinet Catches	Bail Type	15	1809¾	BX56-1
TMS-1	1	Dynamotor Connector Block	Terminal Strip	16	1508	BX57-2
	1	Resistor Mtg. Card	Assembled	1	2963	2963
			Sub Assembly	1	2962	2962
			3617-A STATION BOX			
SW1	1	Function Selector Switch		7	2786-A	BX16-11
VS1	1	Attention Light	Call Light Assembly	5	810 BS	BX20-1R
V1	5		Pilot Light 24-28 V	6	T3¼ Bulb 651 Base	BX19-1
R1	2	Volume Control	10,000 ohms, Curve 4	2	NF 108	BX15-1
T1	2	Matching Transformer	T.R. 1:6.2 Pri. 15 ohm, Sec. 600 ohm d.c.	9	9726	BX17-1
TMS1	1	Connector Block	Terminal Strip Assem.	1	2878	2878
	1	Knob	Volume Control Knob	1	1800	1800
	1	Knob	Selector Knob	22	2150	2150

*Alternate High Voltage Power Supplies with associated brushes.

Parts List (Continued)

(Recommended quantities are spare parts for each lot of 10 units. See list of manufacturers for key to "MFR.")

3618-A STATION BOX

CIRCUIT SYMBOL	REC. QUAN.		DESCRIPTION	MFR.	MFR. DESIG.	BENDIX NUMBER
SW1	1	Amplifier Power Switch	DPST Pear Handle Switch	19	80600D	BX16-2
SW2	1	Function Selector Switch		7	2787	BX16-12
SW3	1	R/T Switch	DPST Pear Handle Switch	19	21189	BX16-28
VS1	1	Attention Light	Call Light Assembly	5	810 BS	BX20-1R
VS2	1	I/C Amp. Pilot	Pilot Light Assembly	5	810 BS	BX20-1G
V1-V2	7		Pilot Light 24-28V	6	T3¼ Bulb 651 Base	BX19-1
R1	2	Volume Control	10,000 ohms, Curve 4	2	NF 108	BX15-1
R2	1	Leveling Potentiometer	5,000 ohms, Curve 1	2	NF 106	BX15-6
T1	2	Matching Transformer	T.R. 1:6.2 Pri. 15 ohm, Sec. 600 ohm d.c.	9	9726	BX17-1
F1	10	Amplifier Line Fuse	4AG, 5 Amp.	20	1094	BX36-5
	1	Fuse Mounting	Aircraft Type	20	1212	BX35-1
TMS1	1	Connector Block	Terminal Strip Assembly	1	2878	2878
	1	Knob	Volume Control Knob	1	1800	1800
	1	Knob	Selector Knob	22	2150	BX53-1

3619-A STATION BOX

CIRCUIT SYMBOL	REC. QUAN.		DESCRIPTION	MFR.	MFR. DESIG.	BENDIX NUMBER
SW1	1	Function Selector Switch		7	2788	BX16-13
VS1	1	Attention Light	Call Light Assembly	6	810 BS	BX20-1R
V1	5		Pilot Light 24-28V	6	T3¼ Bulb 651 Base	BX19-1
R1	2	Volume Control	10,000 ohms, Curve 4	2	NF 108	BX15-1
T1	2	Matching Transformer	T.R. 1:6.2 Pri. 15 ohm, Sec. 600 ohm d.c.	9	9726	BX17-1
TMS1	1	Connector Block	Terminal Strip Assembly	1	2878	2878
	1	Knob	Volume Control Knob	1	1800	1800
	1	Knob	Selector Knob	22	2150	BX53-1

3620 STATION BOX

CIRCUIT SYMBOL	REC. QUAN.		DESCRIPTION	MFR.	MFR. DESIG.	BENDIX NUMBER
SW1	1	Send-Receive Switch	SPDT Luminous Tip	18	8108	BX16-1
SW2	1	Attention Switch	SPST Push-button	19	3391	BX16-38
SW3	1	Channel Selector Switch	4 PDT Selector	24	3242J	BX16-41
VS1	1	Transmitter "On" Pilot	Pilot Light Assembly	5	807BS	BX20-3G
VS2	1	Attention Light	Pilot Light Assembly	5	807BS	BX20-3R
V1-V2	7		Pilot Light 24-28 V	6	T3¼ Bulb 651 Base	BX19-1
R1	2	Volume Control	100,000 ohms, Curve 1	2	N-116	BX15-10
R2	2	Fixed Resistance	10,000 ohms, ½W	2	710	BX21-24A
T1	1	Matching Transformer	T.R. 1:6.2 Pri. 15 ohm, Sec. 600 ohm d.c.	9	9726	BX17-1
P1	1	Connector Plug	19 Contact Wall Mtg.	12	SK-19-32S	BX34-25
P2	1	Cable Connector	19 Contact Straight	12	SK-19-21 ⅝" B	BX34-39
			19 Contact Right Angle	12	SK-19-23 ⅝" B	BX34-38
TMS1	1	Connector Block	Terminal Strip Assembly	1	3294	3294
	1	Knob	Volume Control Knob	1	1757	1757
	1	Knob	Channel Selector Knob	22	2150	BX53-1

LIST OF MANUFACTURERS

Code No	*Name*	*Address*
1.	Bendix Aviation, Limited	11600 Sherman Way, North Hollywood, California
2.	Centralab, Inc.	900 East Keefe Avenue, Milwaukee, Wisconsin
3.	Cornell-Dubilier Electric Corp.	1000 Hamilton Boulevard, South Plainfield, New Jersey
4.	Ohmite Mfg. Co.	4835 West Flournoy Street, Chicago, Illinois
5.	Signal Indicator Corporation	140 Cedar Street, New York, New York
6.	Westinghouse Lamp Division Westinghouse Electric & Mfg. Co.	Bloomfield, New Jersey
7.	Oak Manufacturing Co.	1260 Claybourne Avenue, Chicago, Illinois
8.	Eicor, Inc.	1060 West Adams Street, Chicago, Illinois
9.	Phelps-Dodge Copper Products Corp.	2627 Santa Fe Avenue, Los Angeles, California
10.	J. W. Miller Coil Co.	5917 South Main Street, Los Angeles, California
11.	RCA Radiotron Division, RCA Manufacturing Co.	Camden, New Jersey
12.	Cannon Electric Development Co.	3209 Humboldt Street, Los Angeles, California
13.	Micarta Fabricators, Inc.	4619 Ravenswood Avenue, Chicago, Illinois
14.	Lord Manufacturing Co.	Erie, Pennsylvania
15.	Corbin Cabinet Lock Co.	New Britain, Connecticut
16.	American Radio Hardware Co.	476 Broadway, New York, New York
17.	C. P. Clare & Co.	Lawrence & Lamon Avenue, Chicago, Illinois
18.	Cutler-Hammer, Inc.	400 West Madison Street, Chicago Illinois
19.	Arrow-Hart & Hegeman Electric Co.	Hartford, Connecticut
20.	Littlefuse Laboratories	4507 Ravenswood Avenue, Chicago Illinois
21.	Leach Relay Co.	5915 Avalon Boulevard, Los Angeles, California
22.	Harry Davies Molding Co.	1428 North Wells Street, Chicago, Illinois
23.	Kellogg Switchboard & Supply Co.	6650 South Cicero Avenue, Chicago, Illinois
24.	P. R. Mallory & Co., Inc.	Indianapolis, Indiana
25.	Pioneer Gen-E-Motor Corp.	5844 West Dickens Street, Chicago, Illinois

FIG. 1 — MODEL 3611 INTERPHONE AMPLIFIER
(Front View)

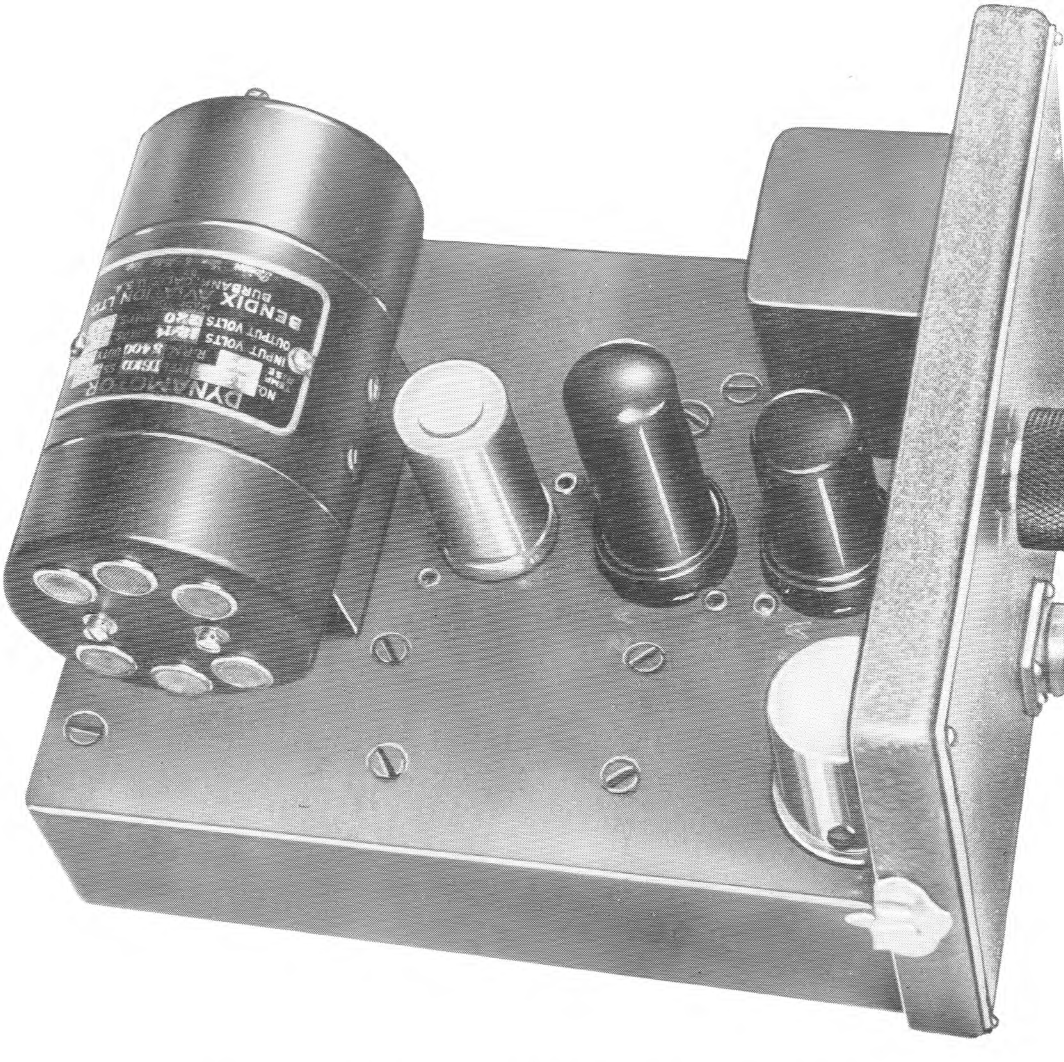


FIG. 2 — MODEL 3611 INTERPHONE AMPLIFIER
(Top View)

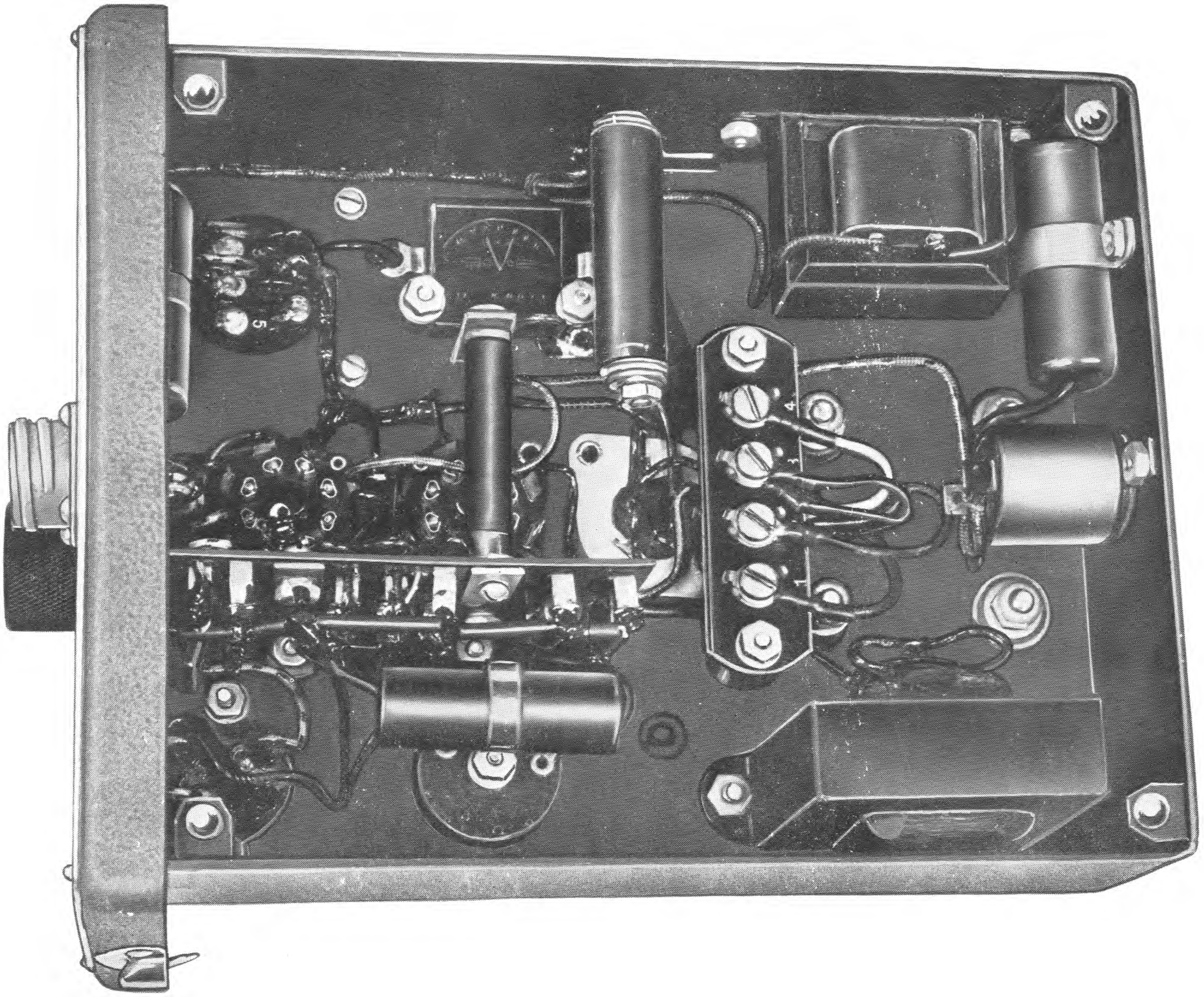


FIG. 3 — MODEL 3611 INTERPHONE AMPLIFIER
(Bottom View)

FIG. 4 — MODEL 3617-A STATION BOX

FIG. 5 — MODEL 3618-A STATION BOX

FIG. 6 — MODEL 3619-A STATION BOX

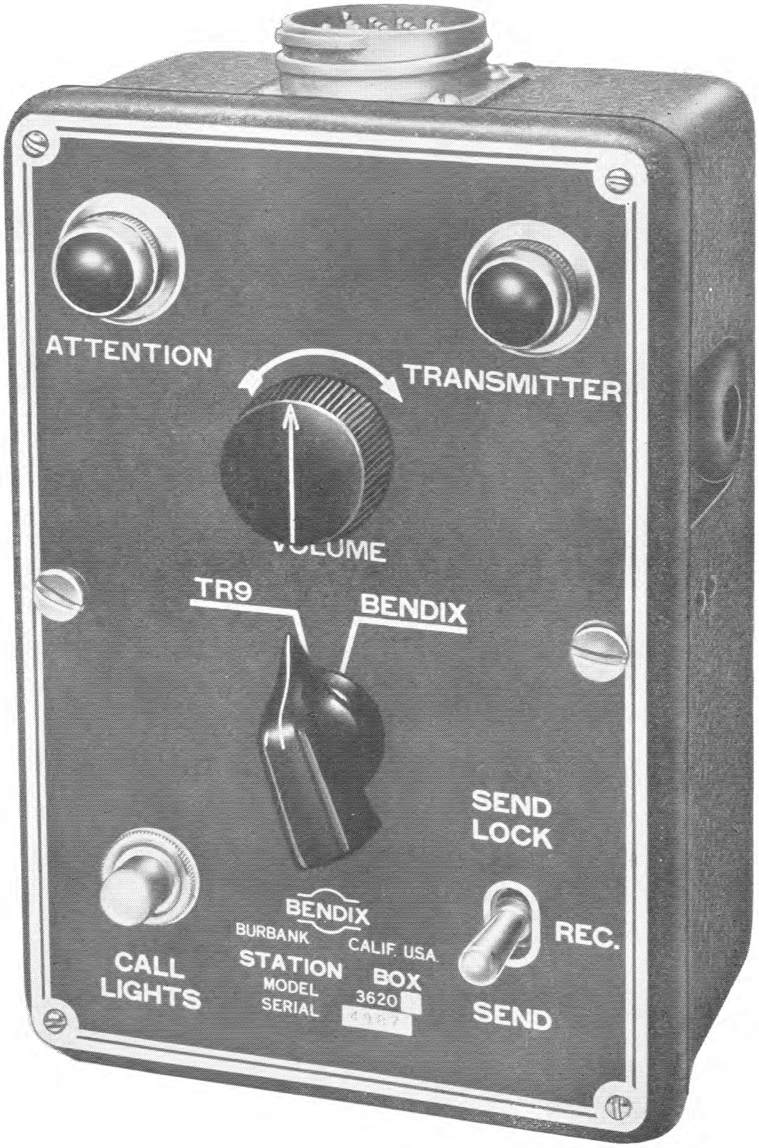


FIG. 7 — MODEL 3620 STATION BOX

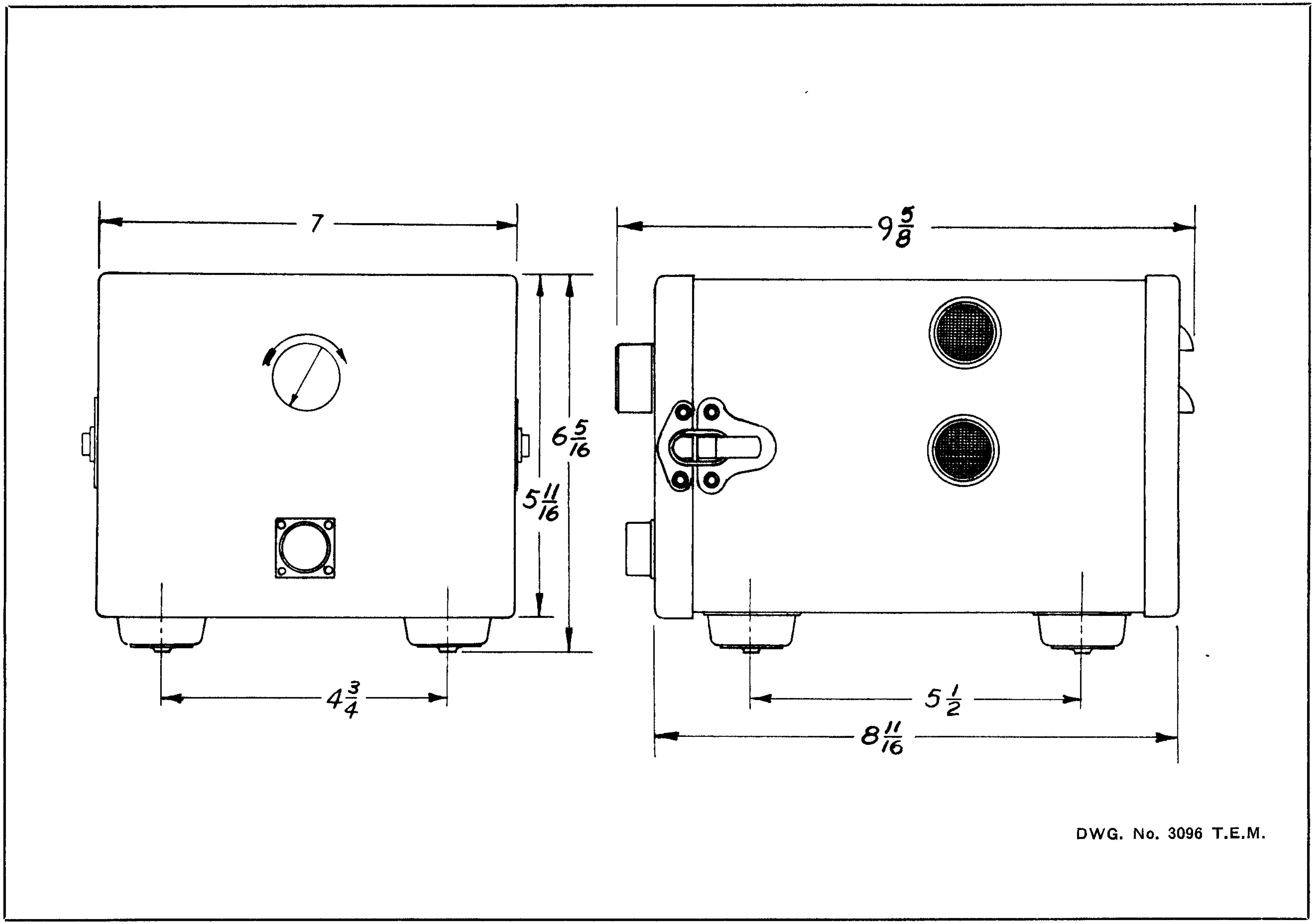


FIG. 8 — (Outline) MODEL 3611 INTERPHONE AMPLIFIER

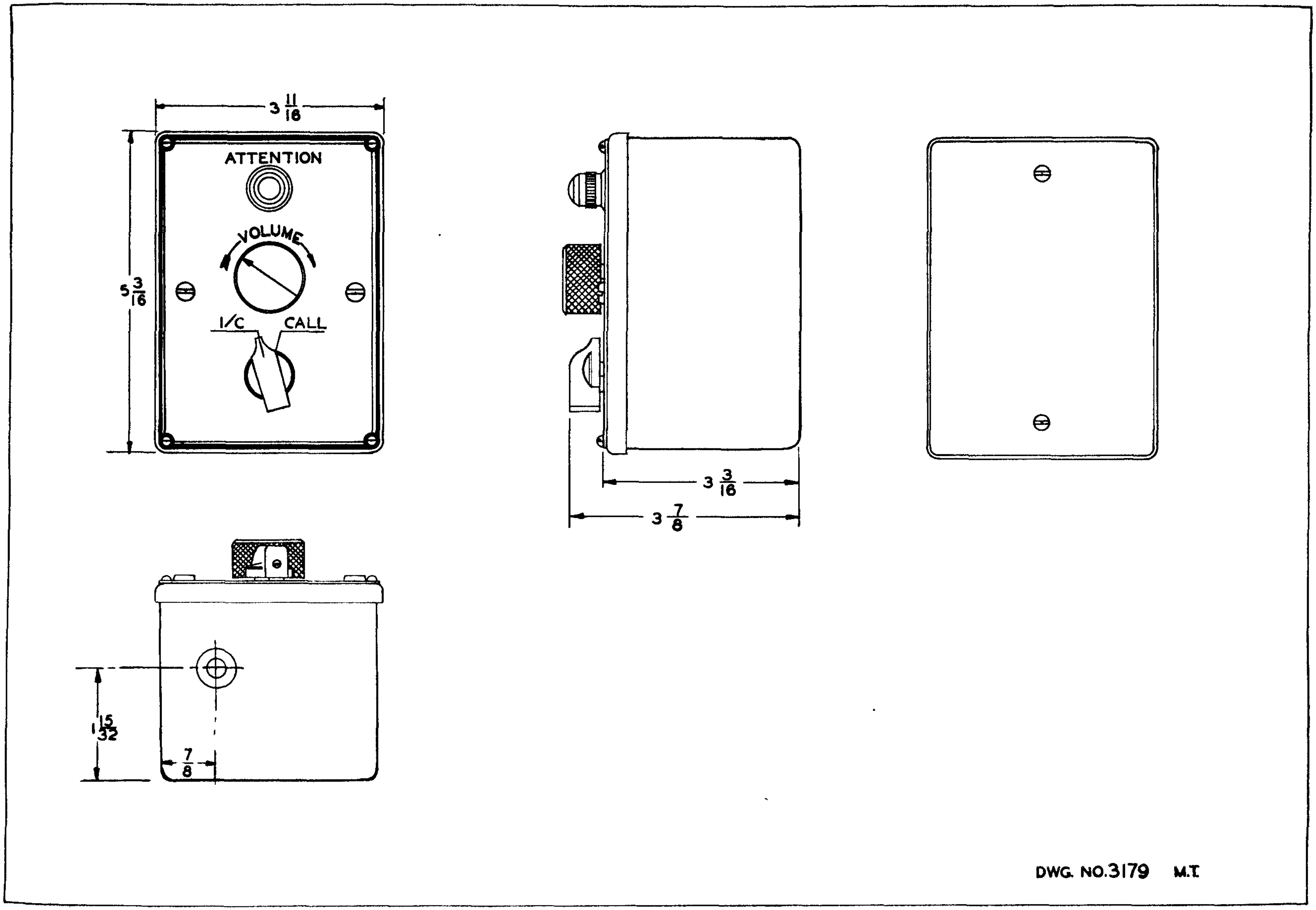


FIG. 9 — (Outline) MODEL 3617-A STATION BOX

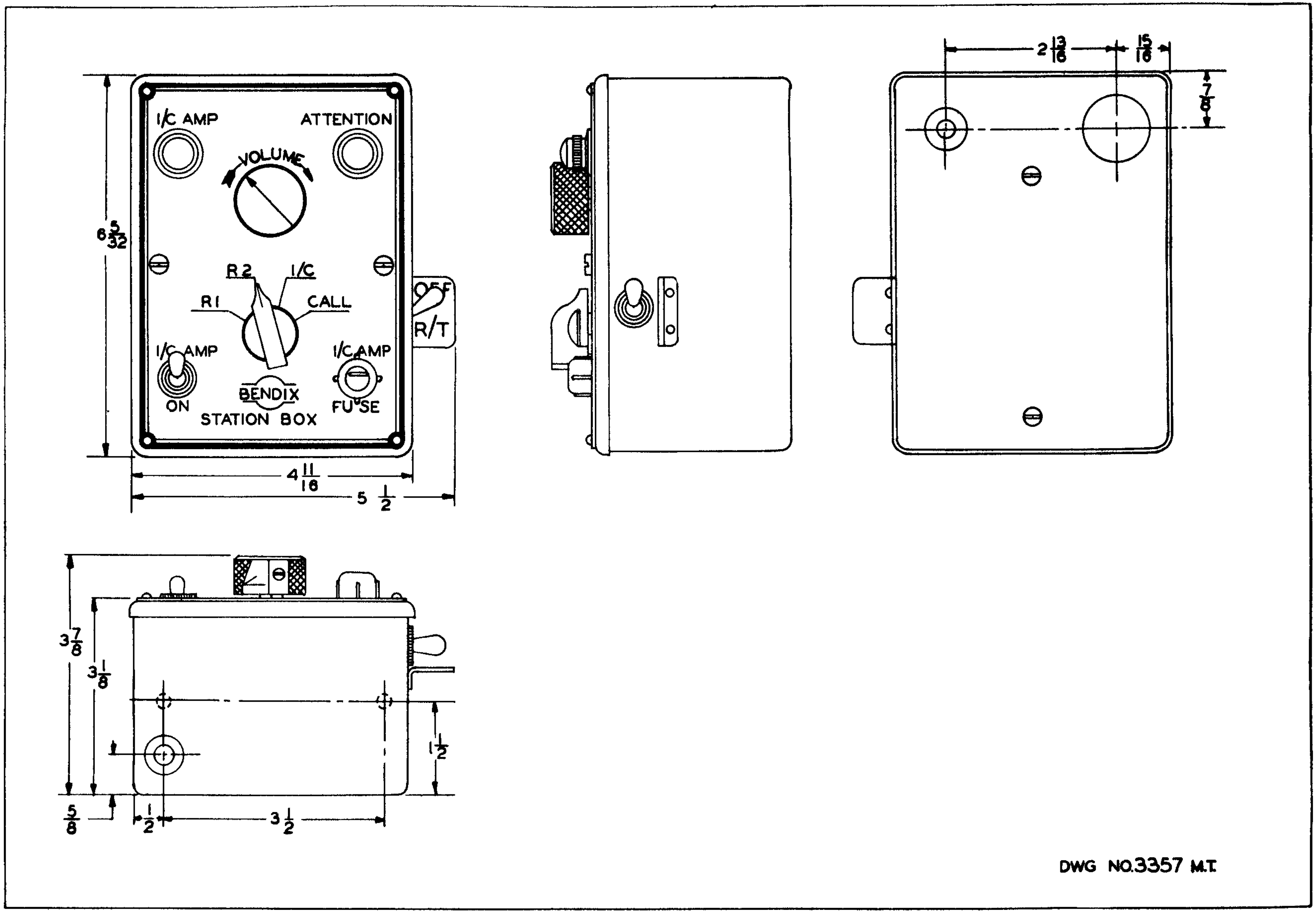


FIG. 10 — (Outline) MODEL 3618-A STATION BOX

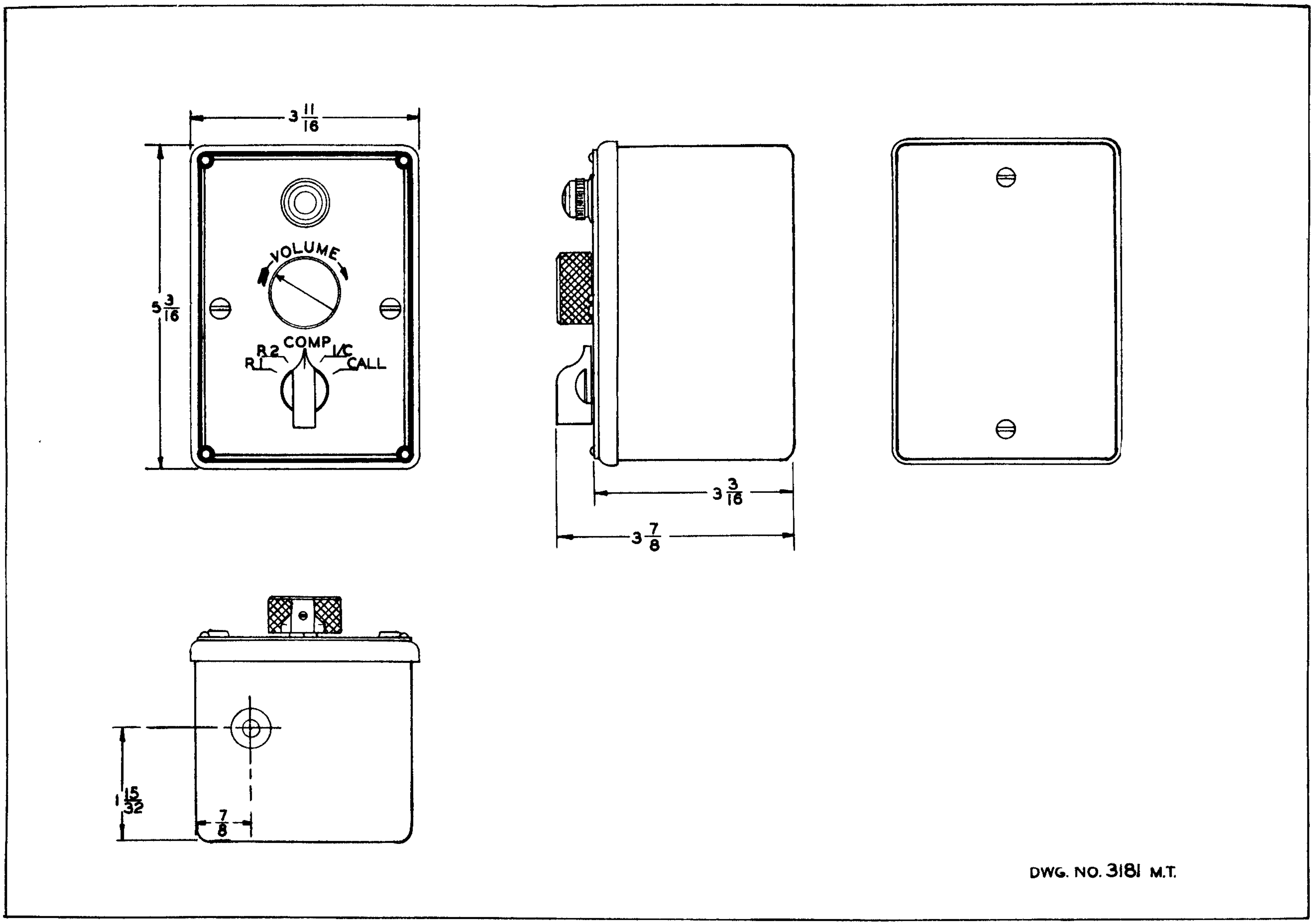


FIG. 11 — (Outline) MODEL 3619-A STATION BOX

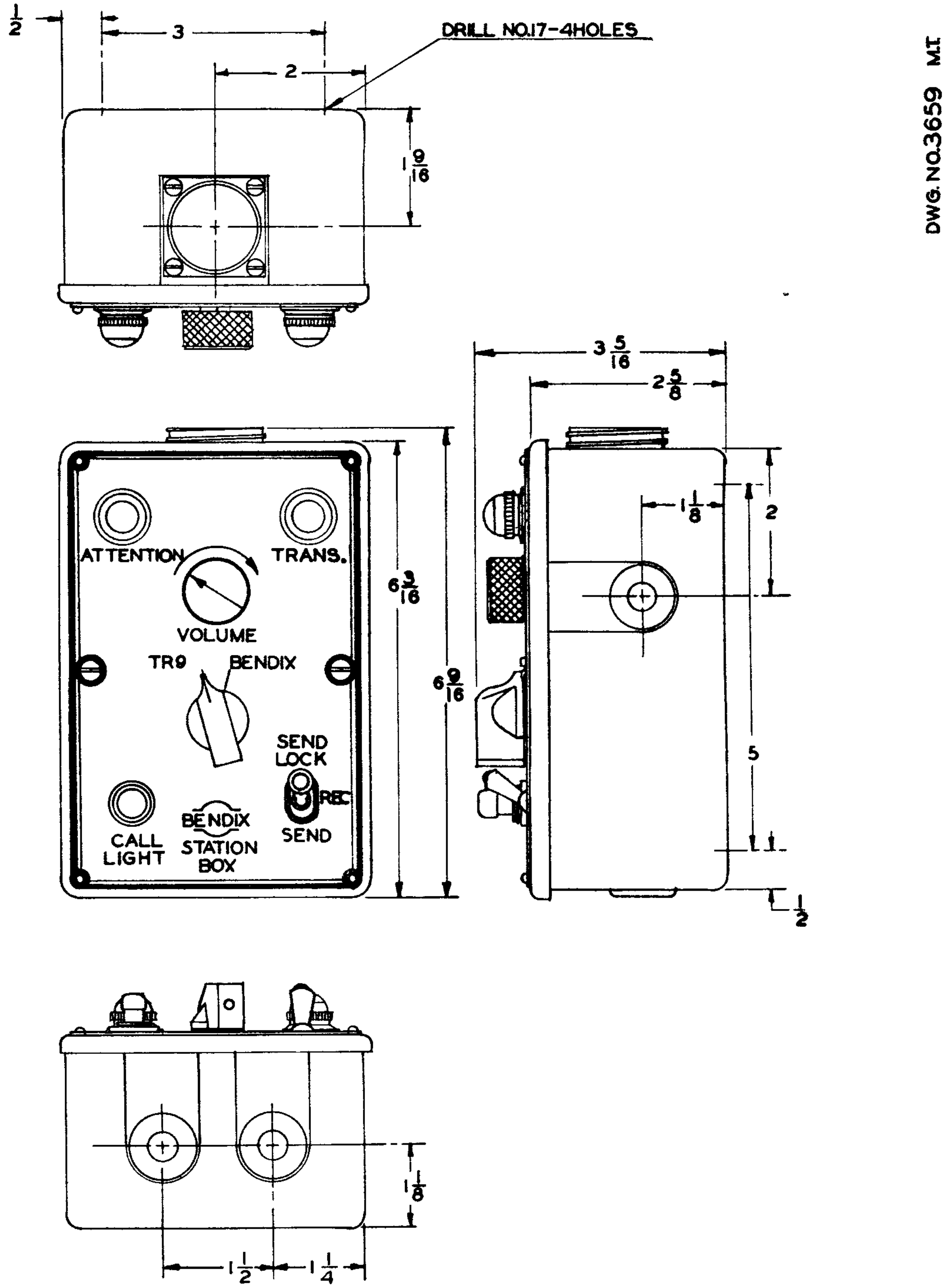


FIG. 12 — (Outline) MODEL 3620 STATION BOX

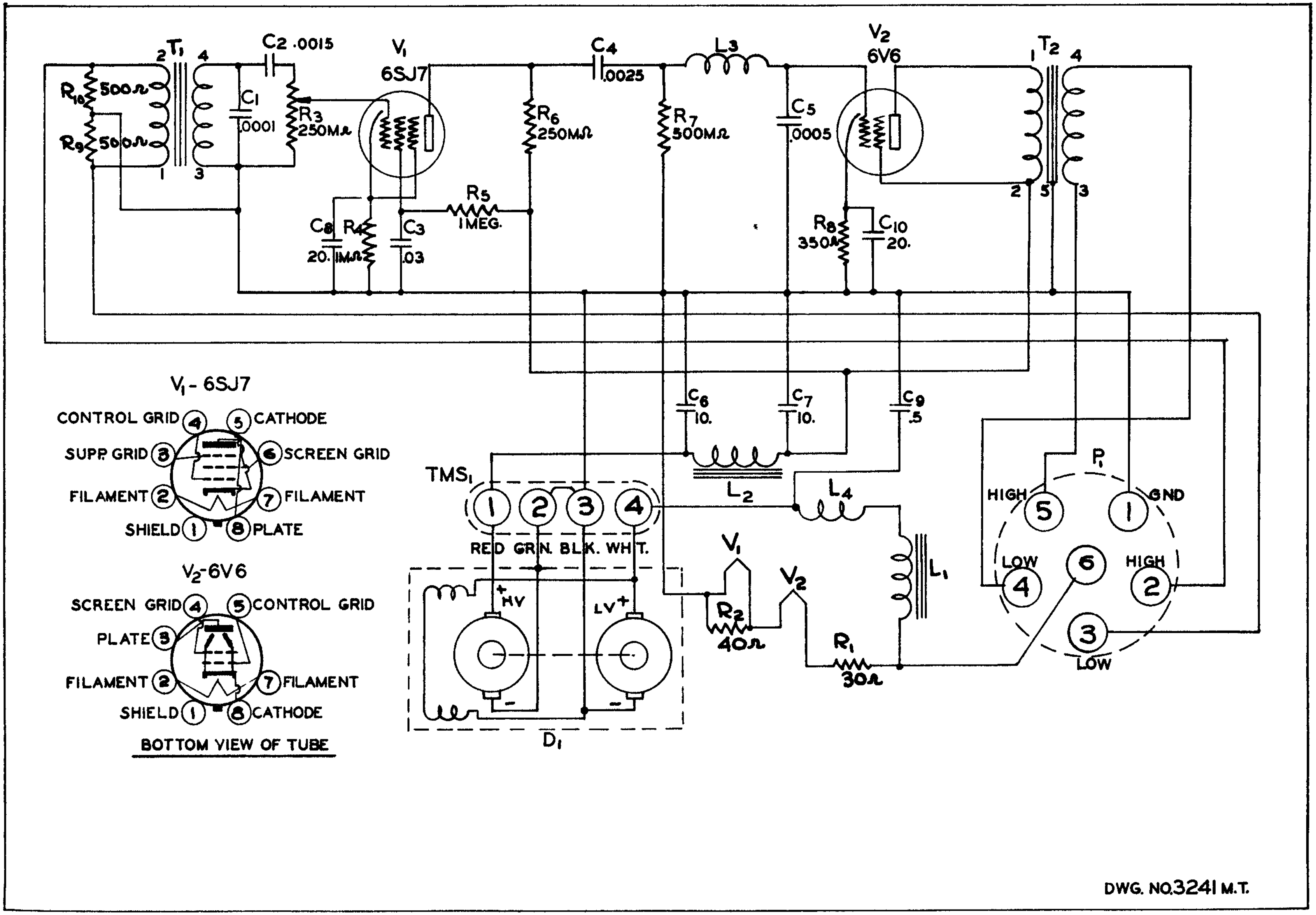


FIG. 13 — (Schematic) MODEL 3611 INTERPHONE AMPLIFIER

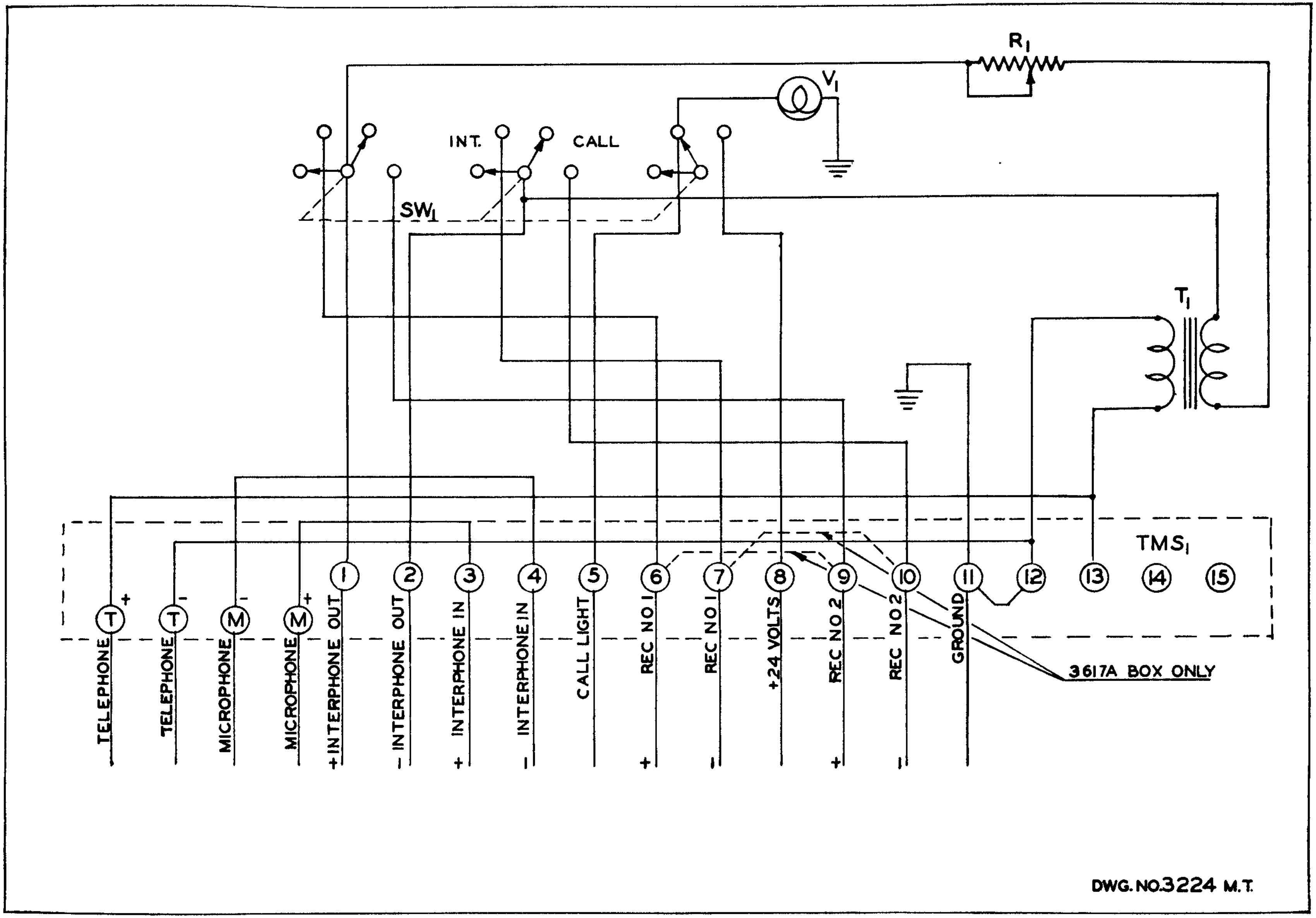


FIG. 14 — (Schematic) MODEL 3617-A STATION BOX

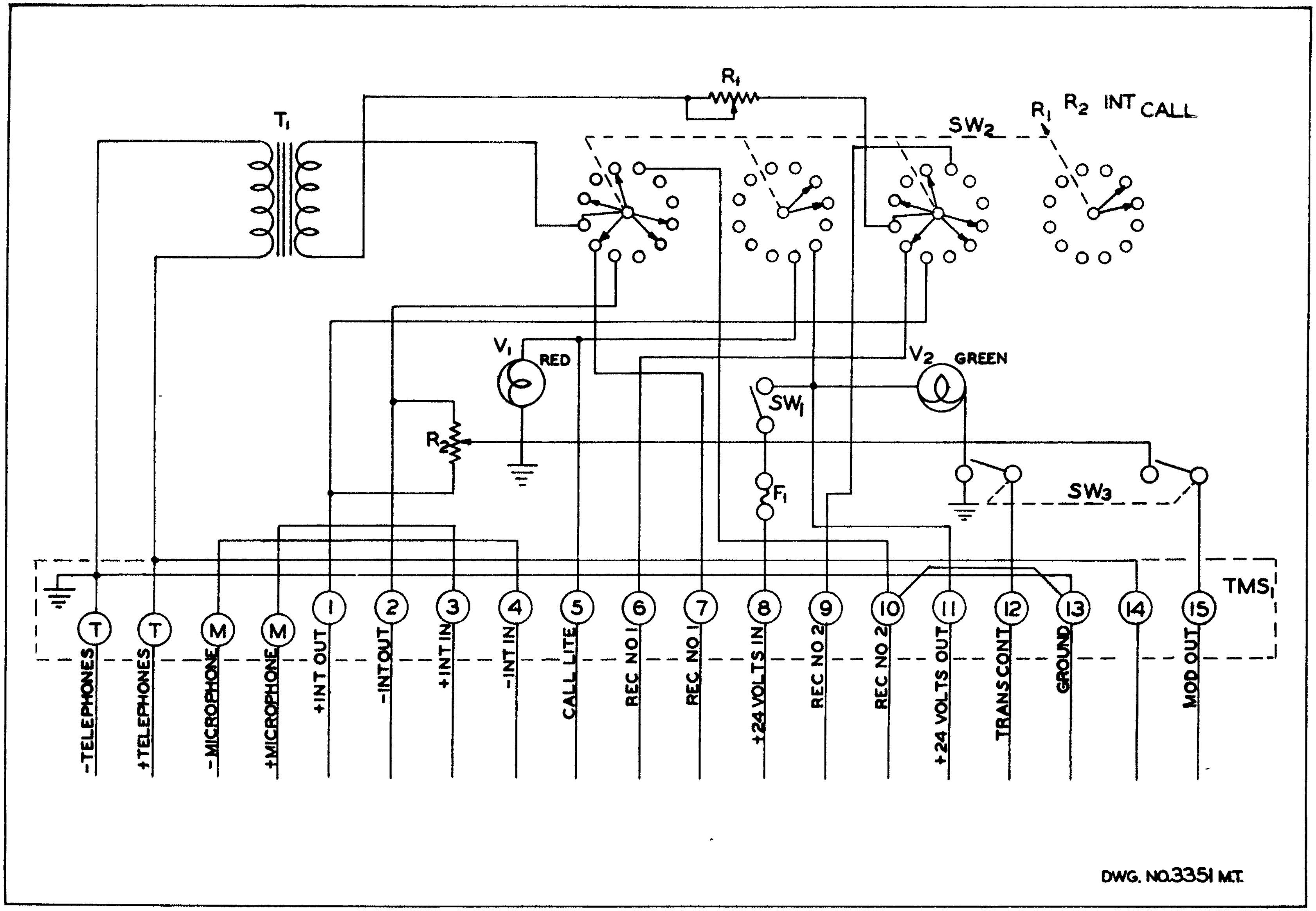


FIG. 15 — (Schematic) MODEL 3618-A STATION BOX

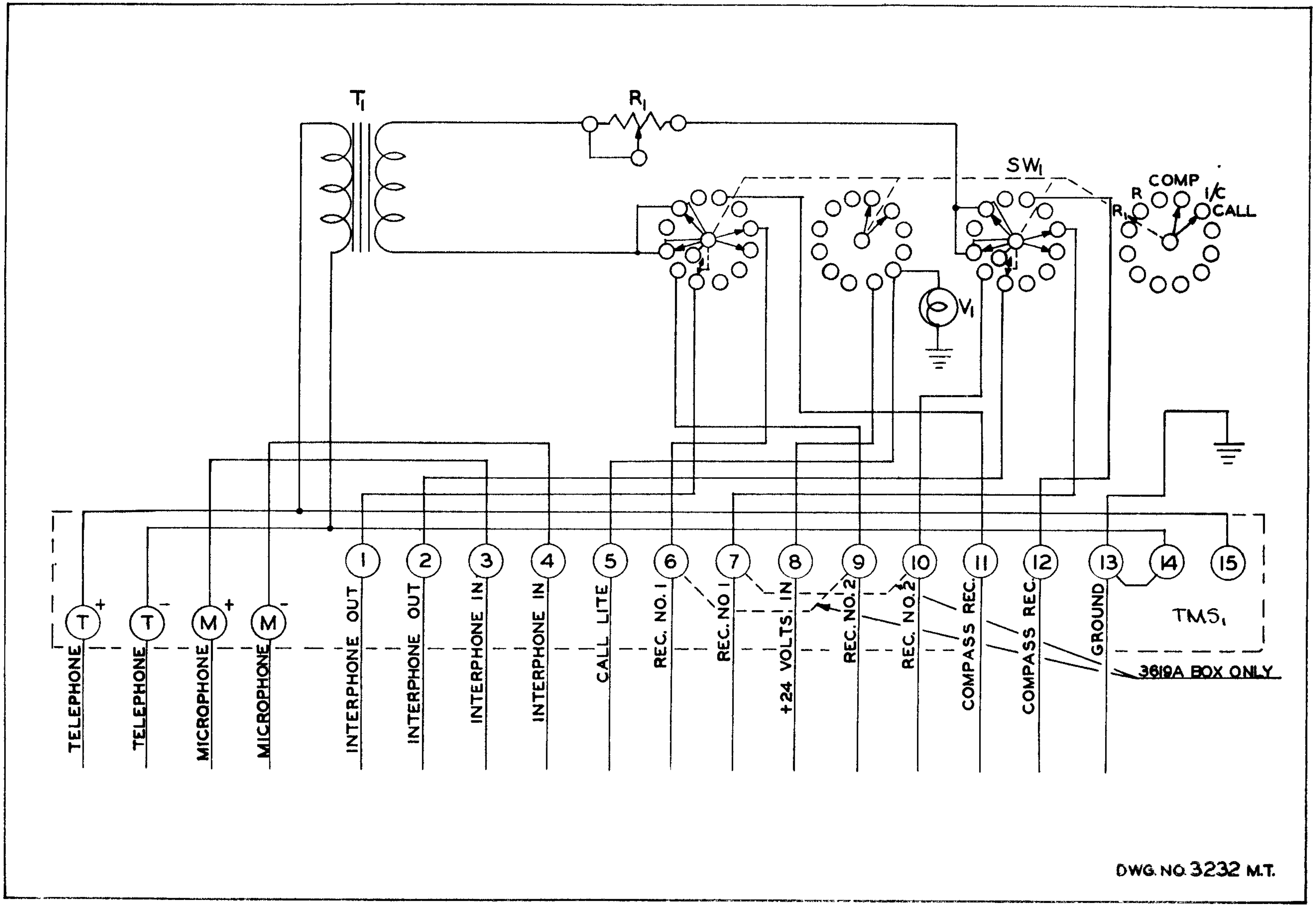


FIG. 16 — (Schematic) MODEL 3619-A STATION BOX

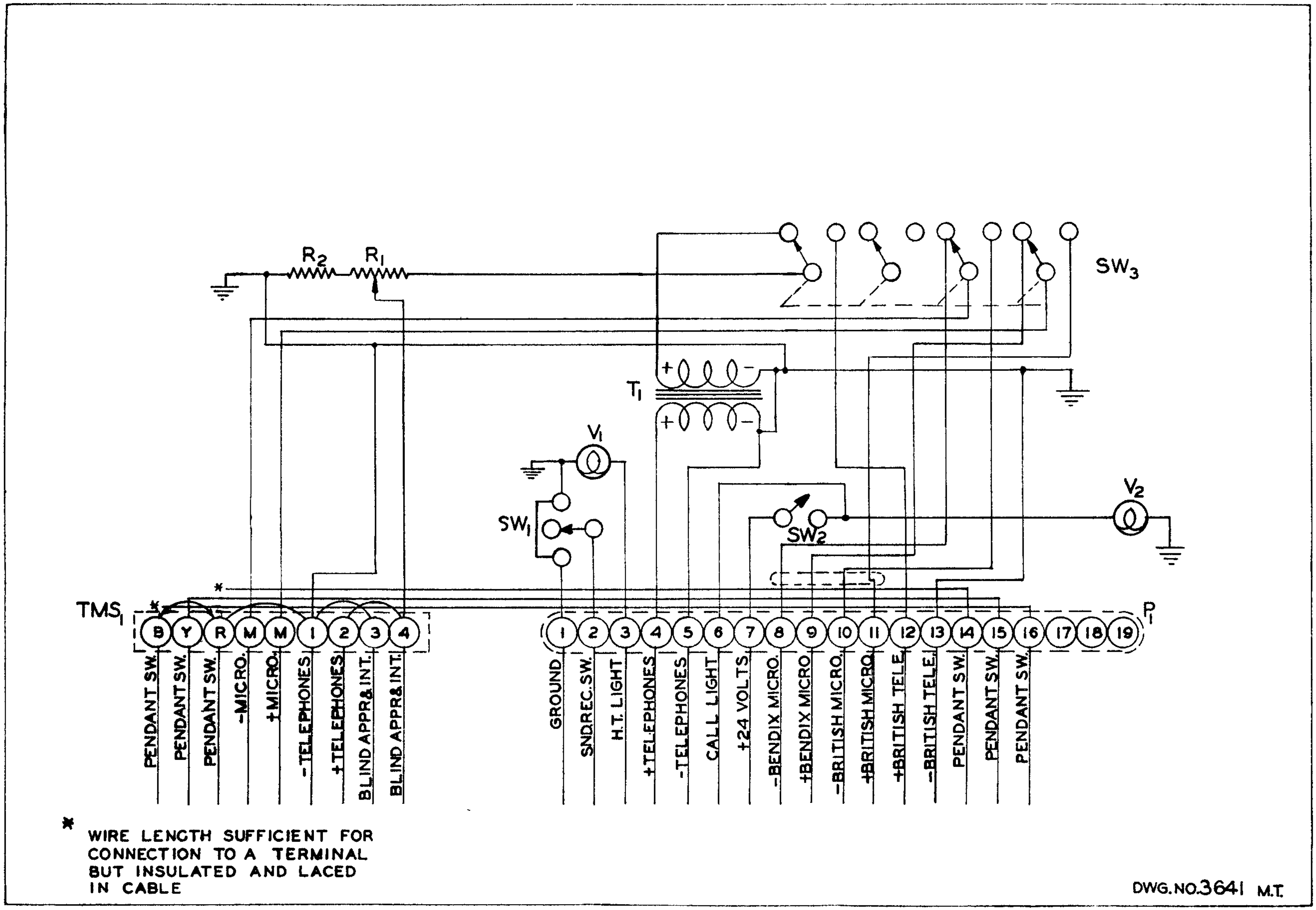


FIG. 17 — (Schematic) MODEL 3620 STATION BOX