RESTRICTED

TECHNICAL ORDER
No. 08-10-85

HANDBOOK OF INSTRUCTIONS

FOR

MODEL MN-31 SERIES
AUTOMATIC RADIO COMPASS EQUIPMENT

MANUFACTURED BY

BENDIX AVIATION CORP.

BALTIMORE, MARYLAND

NOTICE: This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act (U. S. C. 50:31:32). The transmission of this document or the revelation of its contents in any manner to an unauthorized person is prohibited.

PUBLISHED BY AUTHORITY

OF

THE COMMANDING GENERAL, ARMY AIR FORCES

BY

THE AIR SERVICE COMMAND

AIR FORCE SECTION
WRIGHT FIELD
DAYTON, OHIO

SEPTEMBER 5, 1942

MARSHALL-WHITE, CHICAGO
NOVEMBER, 1943— 6,000

INSTRUCTION BOOK

FOR

MODEL MN-31 SERIES

AUTOMATIC RADIO COMPASS EQUIPMENT FOR AIRCRAFT

W A R R A N T Y

The Bendix Radio Division of Bendix Aviation 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 Bendix Radio 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 Bendix Radio with transportation charges prepaid, and which its examination shall disclose, to its satisfaction, to have been thus defective. Bendix Radio 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 Bendix Radio which have been repaired or altered, or have been subject to misuse or abuse. Bendix Radio 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.

BENDIX RADIO

DIVISION OF

BENDIX AVIATION CORPORATION

BALTIMORE, MARYLAND

I.B. 202 DECEMBER 1941

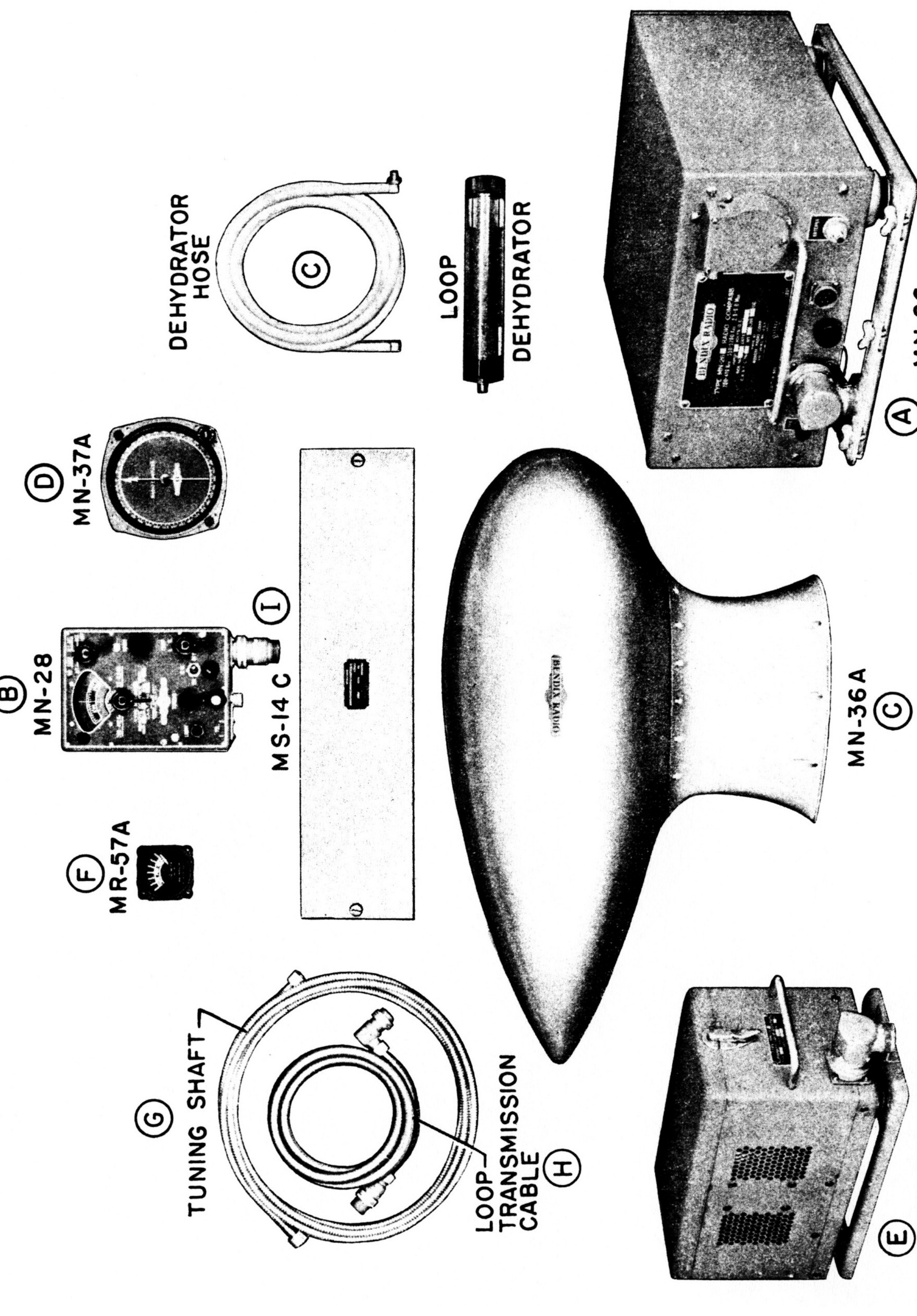


FIGURE 1—MODEL MN-31 AUTOMATIC RADIO COMPASS EQUIPMENT, COMPONENTS

TABLE OF CONTENTS

TABLE OF CONTENTS—*Continued*

LIST OF ILLUSTRATIONS

INSTRUCTION BOOK

for

MODEL MN-31 SERIES AUTOMATIC COMPASS EQUIPMENT FOR AIRCRAFT

1. INTRODUCTION

1-1. FUNCTION

The Model MN-31 Automatic Radio Compass Equipment, consisting of a Type MN-26 Radio Compass, Type MN-28 Remote Control Unit, Type MN-31 Automatic Loop Control, Type MN-36A Automatic Loop, Type MN-37A Bearing Indicator, sense antenna, interconnecting cables, and the necessary power source, comprises an aircraft navigational equipment which provides the following facilities:

Automatic visual indication of the direction of the arrival of radio frequency energy with respect to the heading of the aircraft and simultaneous aural reception of modulated or unmodulated signals;

Aural reception of modulated or unmodulated radio signals using a non-directional antenna;

Aural reception of modulated or unmodulated radio frequency signals using a loop antenna, especially desirable during occurrence of precipitation static, commonly known as rain or snow static;

Aural null indication of the direction of arrival of modulated or unmodulated radio signals with respect to the heading of the aircraft.

The operation of the Model MN-31 Automatic Radio Compass is entirely automatic and it is only necessary to tune to the frequency of the desired radio station and the bearing of that station, with respect to the plane's heading, will be directly indicated on the bearing indicator.

The Type MN-26 Radio Compass is a remotely controlled 12-tube superheterodyne receiver with an intermediate frequency of 112.5 Kcs. Type MN-26 Radio Compasses having the following characteristics are available. The associated remote control unit and automatic loop control for each Type MN-26 Radio Compass are also shown:

TABLE A

Primary Voltage	Headphone Impedance	Mounting	Frequency Ranges—Kilocycles 150- 325 325- 695 695-1500	200- 410 410- 850 850-1750	200- 410 550-1200 2900-6000	200- 410 550-1200 278	200- 410 580-1200 2200-4250
14 volts	600 ohm	Standard Shockmount	MN-26P MN-28P MN-31A	MN-26J MN-28J MN-31A	MN-26H MN-28E MN-31A	MN-26R MN-28T MN-31A	MN-26V MN-28V MN-31A
28 volts	600 ohm	Standard Shockmount	MN-26S MN-28P MN-31C	MN-26K MN-28J MN-31C	MN-26L MN-28E MN-31C	MN-26T MN-28T MN-31C	
14 volts	600 ohm	Modified A. T. R.			MN-26N MN-28E MN-31B		
28 volts	600 ohm	Modified A. T. R.			MN-26U MN-28E MN-31D		

The receiver is tuned manually from the Type MN-28 Remote Control Unit, which may be mounted within easy reach of the operator. The bands are switched electrically by means of a switch on the remote control unit. Only the frequency band in use is visible on the dial.

As shown by Table A, equipment is available for operation from either a 14-volt DC primary power source or a 28-volt DC primary power source.

The Type MN-26 Radio Compass and the Type MN-28 Remote Control Unit must be changed for the different frequency ranges. All other units will operate on any of the specified frequency ranges.

Radio compass operation is not available on the 2900—6000-Kcs or 2200—4250-Kcs ranges.

If a 4000-ohm output impedance is required, this information should be specified when ordering the equipment. A 4000-ohm output tap is provided on the output transformer in the Type MN-26 Radio Compass, but the audio volume control potentiometer must be changed in the Type MN-28 Remote Control Unit.

To change from a 14-volt to a 28-volt power supply, the Type MN-26 Radio Compass and the Type MN-31 Automatic Loop Control must be changed to 28-volt units. In addition, the lighting circuit to the Type MN-37A Bearing Indicator must be modified by adding a dropping resistor in the junction box, and the jumper across a portion of the dial light dropping resistor in the Type MN-28 Remote Control Unit should be removed.

The power supply voltage and the frequency range should be specified when ordering this equipment.

1-2. COMPONENTS PARTS

Item	Quantity	Description	Weight
A	1	†Type MN-26 Radio Compass complete with standard mounting base; tubes as follows: 1- 6L7, 2- 6N7, 2- 6B8, 2- 6J5, 4- 6K7, and 1- 6F6. and cable connectors as follows: 1 straight male 1-contact antenna plug B7380-2; 1 right angle 23-contact cable plug A30601. or With Modified A.T.R. mounting	38.2 lbs. 36.25 lbs.
B	1	†Type MN-28 Remote Control Unit complete with mounting base, and 1 straight cable plug A30852.	2.4 lbs.
C	1	Type MN-36A Automatic Loop, complete with 90-degree cable plug A30901. (Includes dehydrator unit with fittings.)	9.12 lbs.
D	1	Type MN-37A Bearing Indicator, complete with 90-degree plug A30085.	1.45 lbs.
E	1	Type MN-31 Loop Control Unit, complete with standard mounting base, 90-degree cable plug A30994, and tubes as follows: 2- 2051 and 3- 12A6. or With Modified A.T.R. mounting	17.0 lbs. 17.25 lbs.
F	1	Type MR-57A Tuning Meter (optional)	0.7 lb.
G	1	*Tuning shaft (flexible) A15410-1	0.27 lb./ft.
H	1	Loop transmission cable assembly AC55966-1, standard length 6 ft. (up to 20-ft. lengths special) complete with cable receptacles.	0.15 lb./ft.
I	1	**Type MS-14C Junction Box	3.5 lbs.
J	1	*Cable AC57465 (Type MN-26 Radio Compass to Junction Box), 5/8-inch I.D. flexible conduit.	0.3 lb./ft.
K	1	*Cable AC56647 (DC input to junction box), 3/8-inch I. D. flexible conduit.	0.16 lb./ft.
L	1	*Cable AC56795 (Type MN-28 Remote Control Unit to junction box), 5/8-inch I.D. flexible conduit.	0.27 lb./ft.

Item	Quantity	Description	Weight
M	1	*Cable AC57461 (Type MN-31 Automatic Loop Control to junction box), 5/8-inch I.D. flexible conduit.	0.25 lb./ft.
N	1	*Cable AC56760 (Type MN-36A Automatic Loop to junction box), 1/2-inch I.D. flexible conduit.	0.15 lb./ft.
O	1	*Cable AC56796 (Type MN-37A Bearing Indicator to junction box), 3/8-inch I.D. flexible conduit.	0.15 lb./ft.
P	1	*Cable A16832 (Sidetone to junction box—optional), 3/8-inch I.D. flexible conduit.	0.13 lb./ft.
Q	1	Miscellaneous Items	
R	1	Instruction Book	total 88.87 lbs.

NOTES: †Customer should select proper type for desired frequency range and supply voltage from Table A in paragraph 1-1.

*Lengths are to be specified by customer. Weights are specified per foot of length.

**Location of cable-entering holes is to be specified by customer. Larger sizes of junction boxes may be obtained when interconnection with other equipment is desired.

1-3. ADDITIONAL EQUIPMENT REQUIRED

The following additional items must be provided by the customer in order to effect satisfactory operation of 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 (See paragraph 3-3).
C	1 or 2	Pair of 500- or 600-ohm headphones. High-impedance, 4000-ohm headphones should be used if the equipment has been ordered with high-impedance output circuits.

1-4. CAA TYPE CERTIFICATE NUMBERS

This equipment has been tested, approved, and assigned the following approval numbers by the Civil Aeronautics Administration. The equipments listed without CAATC numbers in the table are available.

Type MN-26H Radio Compass Unit	#474	Type MN-28J Remote Control Unit	#478
Type MN-26J Radio Compass Unit	#477	Type MN-28P Remote Control Unit	#568
Type MN-26K Radio Compass Unit	#	Type MN-28T Remote Control Unit	#569
Type MN-26L Radio Compass Unit	#	Type MN-28V Remote Control Unit	#
Type MN-26N Radio Compass Unit	#558	Type MN-31A Automatic Loop Control	#471
Type MN-26P Radio Compass Unit	#567	Type MN-31B Automatic Loop Control	#551
Type MN-26R Radio Compass Unit	#559	Type MN-31C Automatic Loop Control	#
Type MN-26S Radio Compass Unit	#	Type MN-31D Automatic Loop Control	#
Type MN-26T Radio Compass Unit	#	Type MN-36A Automatic Loop	#472
Type MN-26U Radio Compass Unit	#	Type MN-37A Bearing Indicator	#473
Type MN-26V Radio Compass Unit	#	Type MR-57A Tuning Meter	#585
Type MN-28E Remote Control Unit	#475	Type MS-14C Junction Box	#385

2. DETAILED DESCRIPTION OF PRINCIPAL COMPONENTS

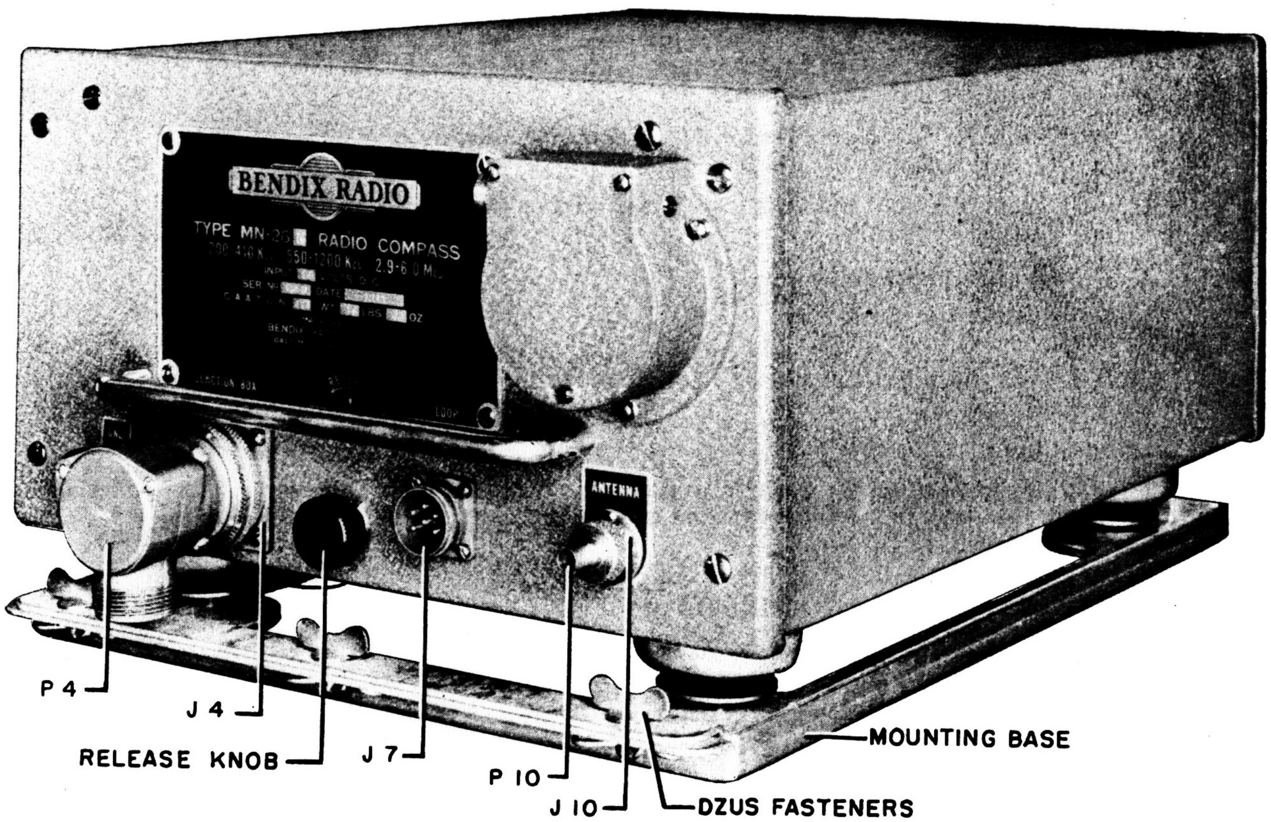


FIGURE 2—TYPE MN-26 RADIO COMPASS, FRONT OBLIQUE VIEW

2-1. TYPE MN-26 RADIO COMPASS

2-1-1 MECHANICAL

Each Type MN-26 Radio Compass includes a cabinet, chassis, and mounting base. The radio compass unit chassis 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 six grid shield caps.

The radio compass chassis is housed in a dust and spray-proof cabinet formed of aluminum sheet and finished in gray 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 cabinet is permanently attached to the shock-mounts with their mounting plate. This mounting plate engages the mounting base by means of a spring hold-down at the rear and three Dzus fasteners at the front. The mounting base is screwed to the structure of the aircraft. The radio compass unit is readily removable from the mounting base by releasing the Dzus fasteners.

The chassis of the radio compass is formed of welded aluminum alloy and is so constructed that, when servicing it, the unit 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, when the equipment is aligned on the bench, the chassis may be placed in its cabinet without changing the alignment. 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 maximum accessibility for maintenance. Refer to Figure 3.

2-1-2. ELECTRICAL

2-1-2-1. General

The Type MN-26 Radio Compass comprises a compass circuit and a receiver circuit. The receiver may be operated in conjunction with a loop antenna or a non-directional antenna as desired. Band selection is accomplished by a motor-driven band-change switch, the switch sections inserting into each circuit the tuned circuit for the desired band and shorting out all unused tuned circuits, thereby preventing

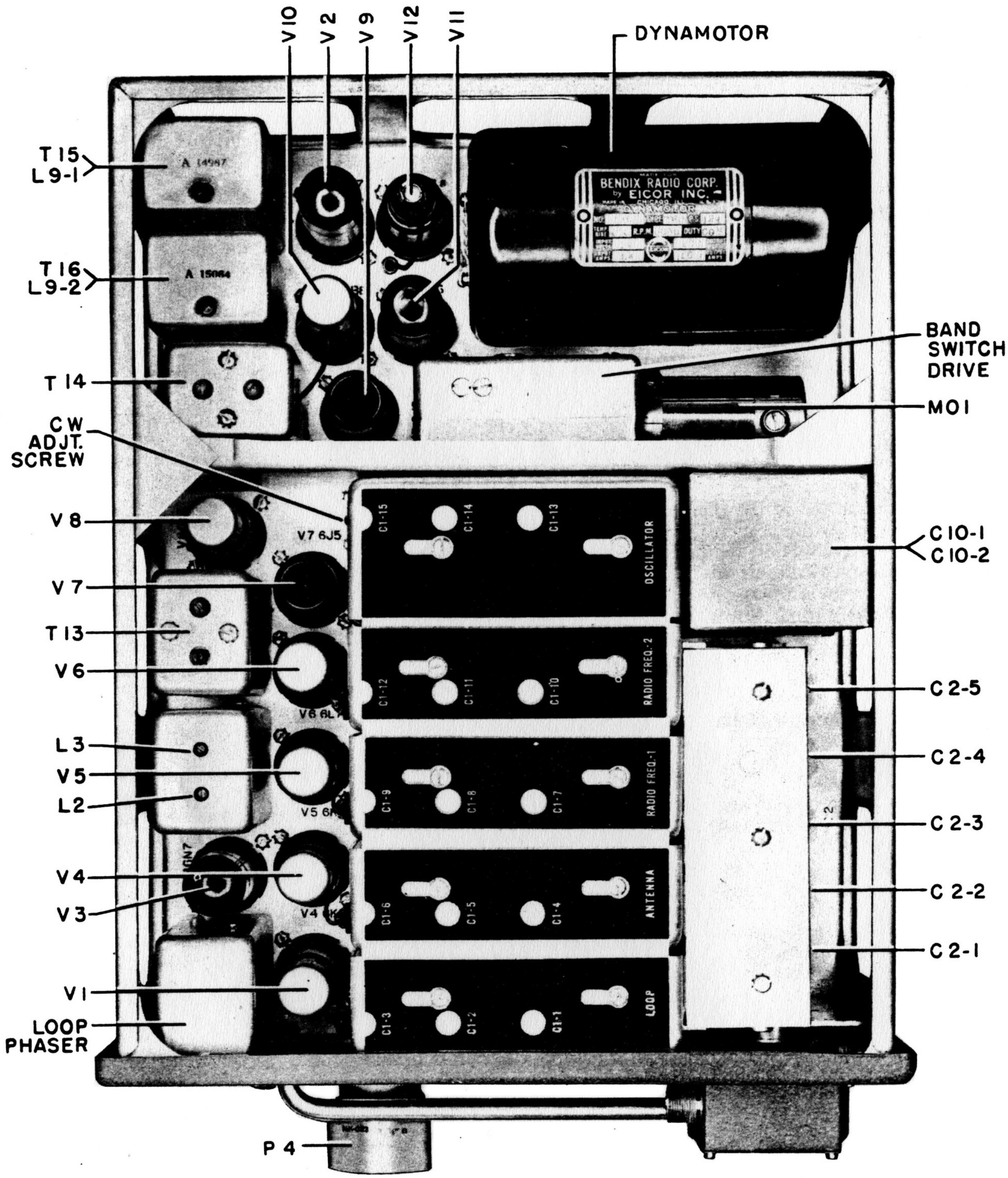


FIGURE 3—TYPE MN-26 RADIO COMPASS, INTERIOR TOP VIEW

any resonant absorption by unused circuits. The schematic diagram, Figure 25, 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 applies to Bands II and III if the band switch is set to either of these positions. The important elements of the circuit are pointed out in Figures 3, 4, and 5.

2-1-2-2. Compass Circuit (Refer to Figure 25)

The theory of compass operation is explained in paragraph 2-7. The loop consists of an eight-turn, center-tapped coil. The center tap and outer ends of the winding are connected to a receptacle J8 in the base of the loop, through which the loop output voltage is fed into the loop transmission cable to the primary of the loop input transformer T1. The secondary of transformer T1, tuned by the first section of the ganged tuning capacitor C2-1, is connected to the grid of the loop amplifier tube V1. A small neon tube NE1 is connected across the grid of the loop amplifier tube to protect the circuits during transmission on the same frequency to which the loop input is tuned. The output of the loop amplifier tube is fed to the phaser which consists of a shunt circuit, inductor L1 and capacitor C38, resonated to a frequency somewhat lower than that of the IF stages. This circuit presents a capacitive reactance to signals of any frequency to which the compass may be tuned. Since the plate resistance of the loop amplifier tube is very high compared to the reactance of its load, inductor L1 and capacitor C38, the voltage across the capacitor C38 in the plate circuit is effectively changed in phase 90 degrees from the voltage on the grid of the tube.

The RF voltage across capacitor 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 oscillation transformer T5 in the Type MN-31 Automatic Loop Control, which is resonated at 48 cycles. The 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, by alternately overcoming the cut-off bias on each grid, renders the two triode sections of the modulator tube conductive in turn. The plates of the modulator tube are connected in push-pull to one primary winding of the antenna input transformer T4. The non-directional vertical antenna voltage is applied to the second primary of transformer T4. Both primaries are inductively coupled to the same secondary winding which is tuned by capacitor C2-2, the second section of the ganged tuning capacitor. The tuned secondary winding of transformer T4 is connected to the grid of the first RF tube V4, applying voltages from the loop and non-directional 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 non-directional antenna. The combined loop and antenna voltage is amplified and detected by the receiver circuits. The 48-cycle compass voltage is fed to the grid of the compass output tube V12 through capacitor C7 and the phase-shifting and low-pass resistance-capacitance network R32 and C5-1, while signal frequencies are fed through capacitor C16 to the audio output tube V11. The plate of the compass output tube V12 is connected to the primary winding of the compass output transformer T16. The primary of this transformer is resonated to 48 cycles by condenser C5-2, and acts as a filter to pass only 48 cycles. The secondary of the transformer is connected through the cables and junction box to the thyratron grid input transformer T1 in the Type MN-31 Automatic Loop Control. The plate of the compass output tube V12 is also coupled to the diode sections in that tube through capacitor C39-4. The diode circuit is connected through a filter network comprising resistor R18-2 and capacitor C39-3 to the grid return circuit of the loop amplifier tube V1. The DC voltage obtained by rectification of the 48-cycle output voltage serves to bias the loop amplifier tube in proportion to the angle by which the loop is removed from its null position; accordingly, the 48-cycle compass output voltage is approximately constant, and the output circuits cannot become overloaded when the loop is 90 degrees from its null position.

Thus, the Type MN-26 Radio Compass, in conjunction with a non-directional antenna and the Type MN-36A Automatic Loop, supplies a 48-cycle output voltage that is in phase with the reference 48-cycle voltage from the audio oscillator when the loop is to the right of its signal null, and is 180 degrees out of phase with the reference 48-cycle voltage when the loop is to the left of its signal null. The 48-cycle output from the receiver is zero when the loop is in its null position.

2-1-2-3. Receiver Circuit

A clearer idea of the following circuit description can be obtained by referring to Figure 25. 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 receiver circuit is of the superheterodyne type and consists of three stages of tuned radio frequency amplification (including the first detector), a radio frequency oscillator, an intermediate frequency amplifier, a compass output tube, and a CW beat frequency oscillator.

The non-directional vertical antenna connects to a relay RE1 which performs two functions: When

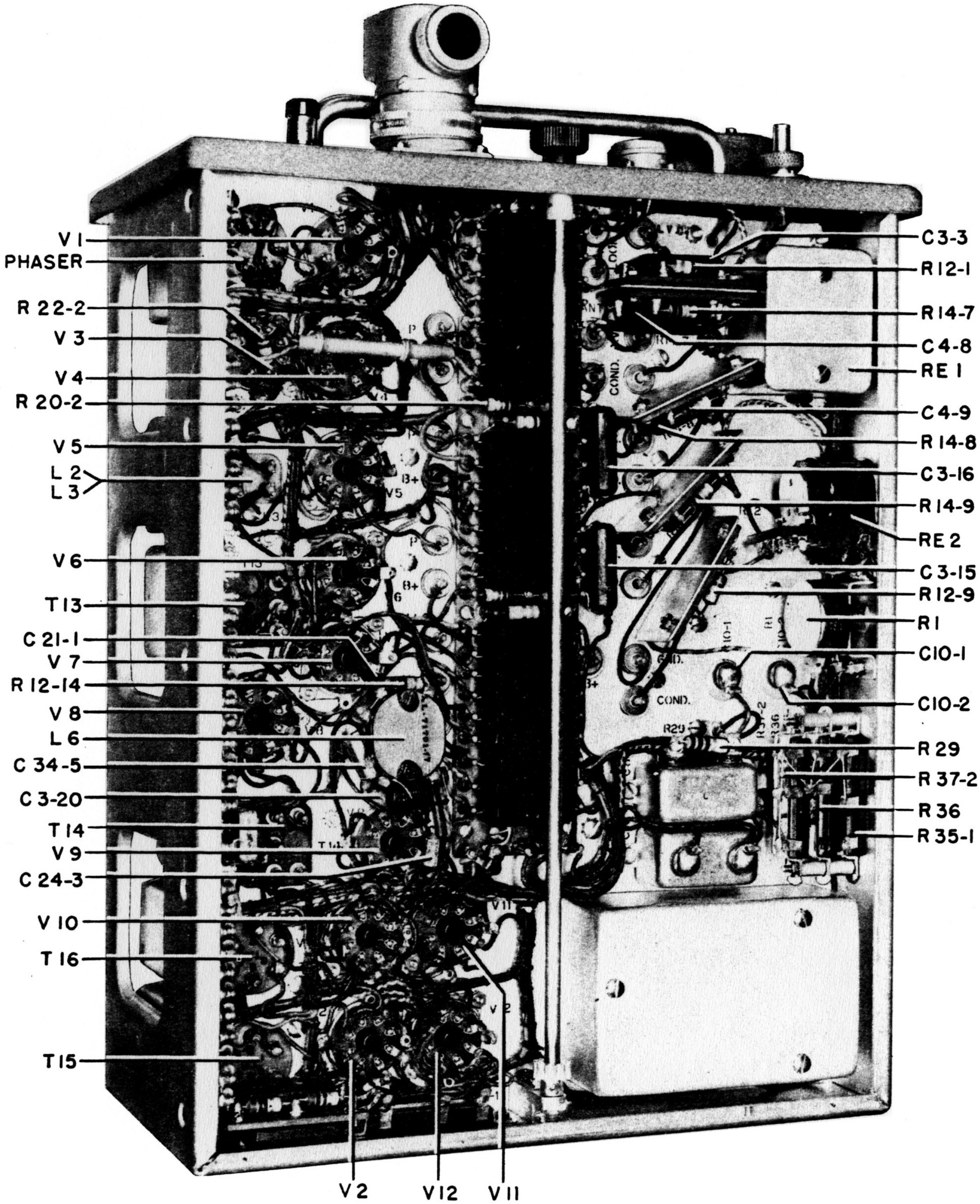


FIGURE 4—TYPE MN-26 RADIO COMPASS, LEFT BOTTOM VIEW

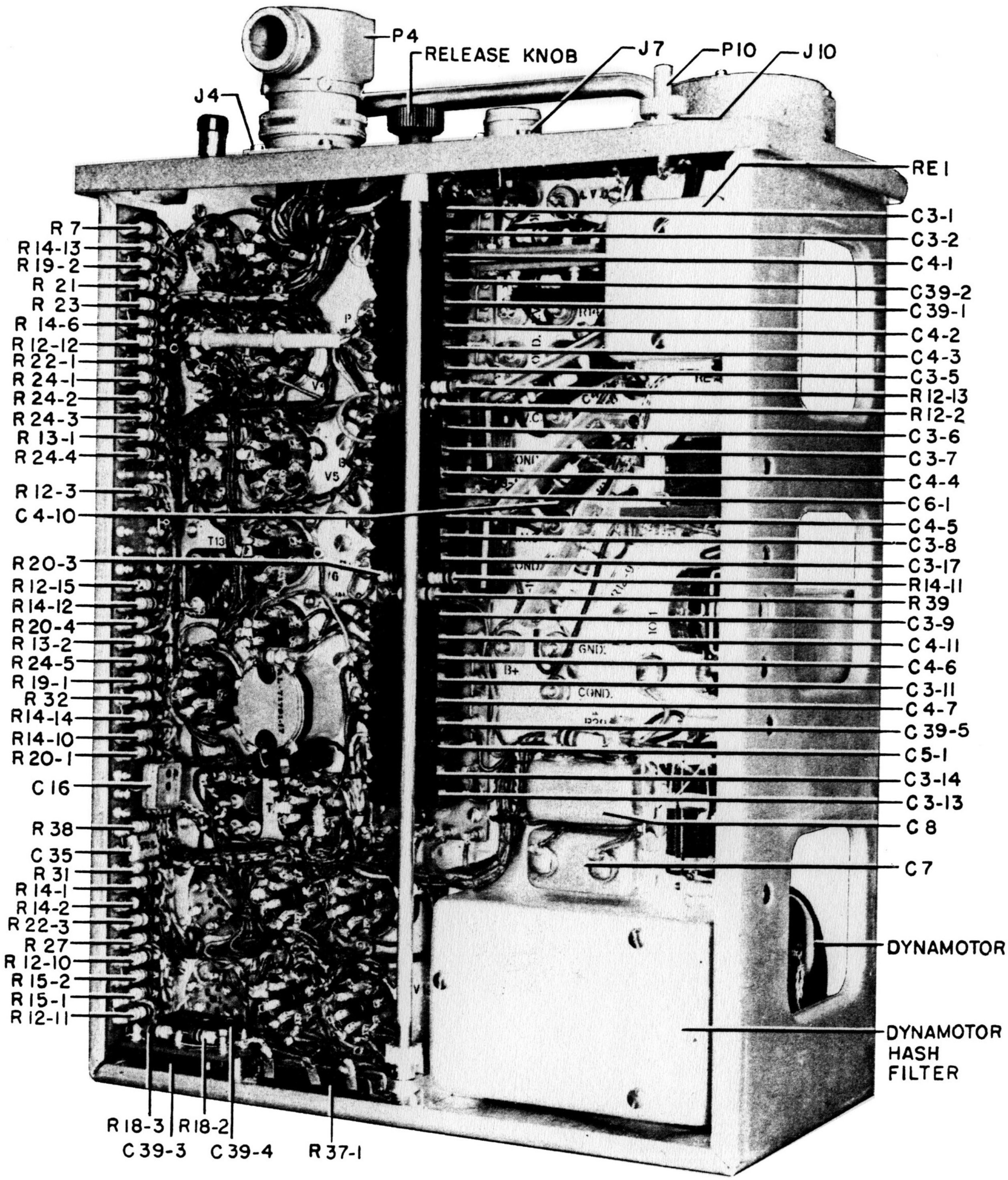


FIGURE 5—TYPE MN-26 RADIO COMPASS, RIGHT BOTTOM VIEW

the function switch on the remote control unit is set to COMP. or REC. ANT., the non-directional antenna connects directly through the relay contacts to the primary of the antenna input transformer T4; when set to REC. LOOP, the relay connections are arranged to ground the non-directional antenna and to substitute a capacitor C43-1 across the antenna primary winding of the antenna input transformer T4. A resistor R18-1 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 transformer T4 are inductively coupled to the secondary, which is tuned by the second section of the ganged tuning capacitor C2-2. The secondary of the transformer connects to the grid of the first RF tube V4. A small neon tube NE2 between the grid and ground protects the tube and circuit elements against high antenna voltages which may result from the operation of the airplane's transmitter or from high electrostatic charges on the antenna.

An inductor L2 in the cathode lead of the first RF tube V4 is resonated at 110.5 Kcs by capacitor C14-1 and acts as a trap circuit to attenuate undesirable signals near the intermediate frequency.

The plate of the first RF tube V4 couples through transformer T7-1 to the grid of the second RF tube V5, the secondary of the transformer T7-1 being tuned by the third section of the ganged tuning capacitor C2-3. An IF trap circuit consisting of inductor L3 and capacitor 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 the third RF or first detector tube V6.

The injector grid of the first detector tube is excited by the output of an RF 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 the first detector tube is tuned to 112.5 Kcs and couples inductively to the control grid of the IF amplifier tube V8.

The plate circuit of the IF amplifier tube 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 V10.

Output from the CW beat frequency oscillator tube V9, is coupled to the above-mentioned diode plate. Operation of the CW oscillator tube is controlled by a toggle switch S10 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 signal voltage to the second diode plate is fed from the plate circuit of the IF amplifier through capacitor C21-4 and supplies the 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, the negative bias on the grids will be increased by a strong carrier, and because of their variable amplification characteristic, the tubes will operate at reduced gain on such signals. Conversely, on weaker signals, the bias introduced by the AVC circuit will be smaller and the tubes will operate at higher gain. This action tends to maintain the audio output at a constant level.

AVC action is present for all positions of the function switch, but is delayed by the bias voltage developed across the second detector cathode bias resistor R31. This delay action is such that audio outputs up to approximately 300 milliwatts are proportional to the signal input voltage. Thus, the operation of the receiver is satisfactory for obtaining aural nulls using the loop antenna, and for radio range reception using the vertical antenna.

The plate of the second detector tube V10 is resistance-capacitance coupled to the grid of the audio output tube V11. The plate of the audio output tube is connected to the primary of the output transformer T15. The secondary of this transformer is tapped for connection to 600-ohm or 4000-ohm output circuits. The output of the transformer T15 is connected through the junction box to the headset jacks J1 and J2 in the remote control unit.

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 a crank arm, locking cam, and the control cam. Switches S5B, S5C, and the RF band change switches are ganged on a common shaft with a Geneva disc which is driven by the crank arm. When the remote control unit band selector switch S9 is operated to select a different band, the band switch motor MO1 is energized by completing the circuit to ground through the contacts of switches S9 and S5B. The motor drives the crank arm through one or two complete revolutions which operation steps the Geneva disc until the motor is de-energized by the opening of switch 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 the 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 switch 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 switch S6 to step 2, opening all contacts, and the motor coasts to a stop. If switch S6 should coast past step 2, its upper contacts will be closed by the control cam and thus energize the reverse field of the motor through the contacts of switches S5C and S9, and the motor will reverse to the proper position until all contacts of switch 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 Type MN-26 Radio Compass for the purpose 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 operative position of the relay opens the cathode circuits of tubes V4, V5, and V6 and connects the externally applied (approximately 1.5-volt) signal voltage to the audio amplifier tube V11. Voltage for operation of the relay solenoid may be obtained from the radio compass primary supply voltage and controlled by connecting the transmitter push-to-talk switch between the sidetone relay control lead (terminal 20 in the junction box) and ground.

Provision has also been made for an independent battery supply for the sidetone relay RE2. If this type of operation is desirable, remove the jumper between points A of resistor R37-2 and B of resistor R36 in the Type MN-26 Radio Compass. Connect the push-to-talk switch and an external 14-volt power supply in series between terminals 20 and 21 in the Type MS-14C Junction Box.

If the external supply is 28 volts, perform the above operation and also remove the jumper across resistor R37-2. (See Figure 25) All connections to the sidetone relay circuit are to be made in the junction box as shown on Figure 35.

2-1-3. Comparison Between 14- and 28-Volt Compass Units

The Type MN-26 Radio Compasses are essentially the same for 28-volt operation as for 14-volt operation. The following tabulation indicates the specific differences:

A 24/28-volt band switch motor is used.

A 24/28-volt dynamotor is used.

Resistor R36B has the jumper removed.

Resistor R35-1 has the jumper removed.

Resistor R37-2 has the jumper removed.

Jumpers are removed between terminals 1 and 2 and between terminals 3 and 4 of the heater circuit. These terminals are located on the terminal board on the right side wall of the chassis.

Jumpers are connected between terminals 2 and 3 of the heater circuit.

Refer to paragraph 7 and Figure 25 for details.

2-1-4. Comparison Between Automatic and Manual Radio Compass Units

The Type MN-26 Radio Compass used for automatic compass operation differs from the Type MN-26 Radio Compass used for manual radio compass operation only in very minor respects. As shown by Table A in paragraph 1-1, the frequency range may be different and, in addition, certain components have been added to improve the operation as an automatic radio compass. The compass output tube has been changed from a type 6K7 to a type 6B8 in order to provide a diode to furnish a rectified 48-cycle bias voltage to the loop amplifier tube and thus obtain constant 48-cycle compass output regardless of the number of degrees that the loop may be positioned from its null. The inductance of the loop coupling transformers has been changed to match a 25.6-microhenry loop instead of a 19.0-microhenry loop. A Type MN-26A Radio Compass for manual radio compass operation may be modified to a Type MN-26P Radio Compass for use as an automatic radio compass. Bendix Engineering Service Note BS-29 specifies the operations to accomplish this conversion and lists the additional components required.

2-2. TYPE MN-28 REMOTE CONTROL UNIT (See Figure 6)

2-2-1. General

The remote control unit contains all controls for operation of the radio compass unit. In addition, it includes a lamp LM1, one 6-32 socket-type setscrew wrench, and one mounting base which may be drilled for mounting screws as shown in Figure 38.

2-2-2. Controls

The following controls are located 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. The gear ratio between the tuning shaft and the ganged capacitor is 120 to 1.

DIAL: A disc-type dial radially calibrated in

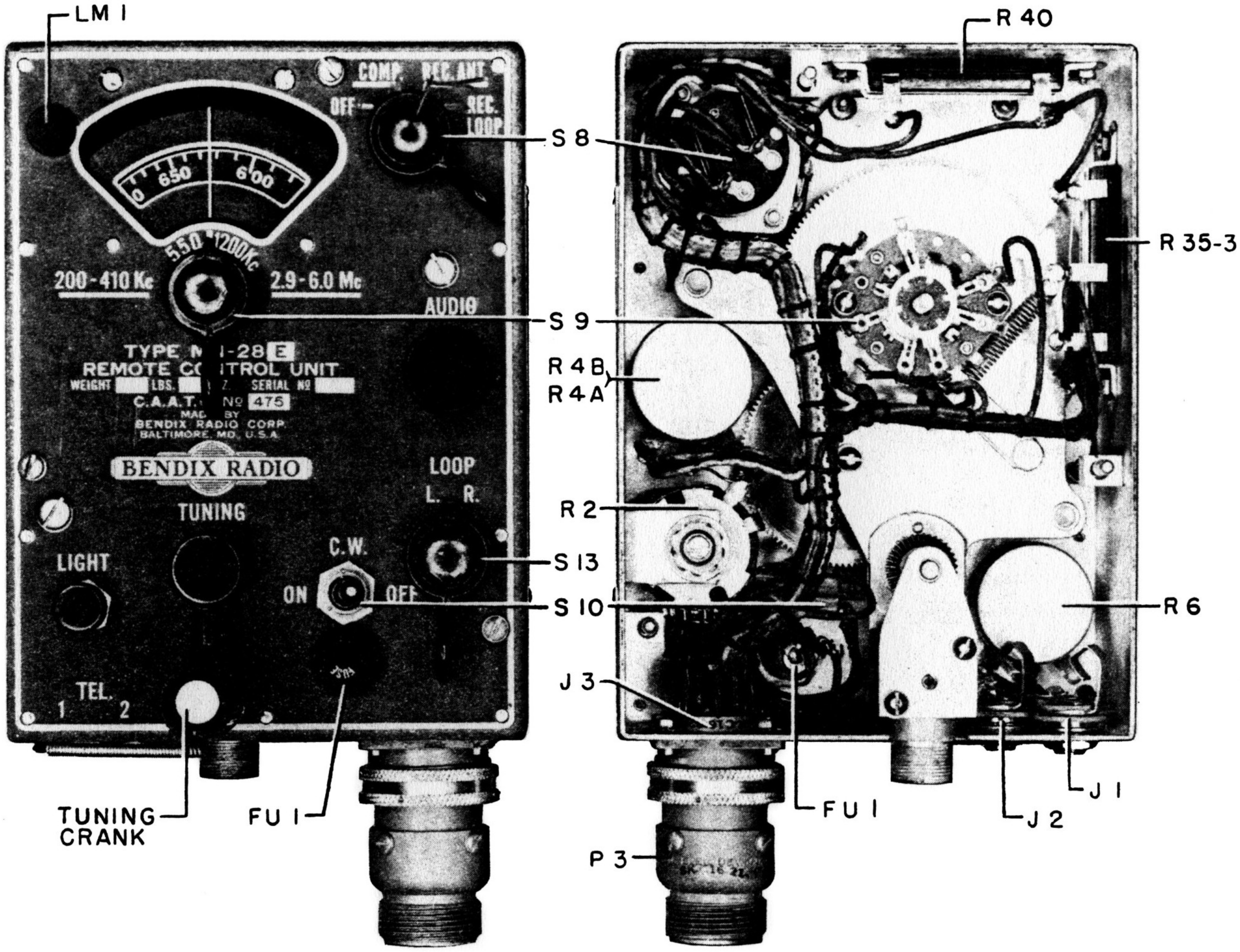


FIGURE 6—TYPE MN-28 REMOTE CONTROL UNIT, FRONT AND REAR VIEWS

kilocycles and megacycles is used. The dial is illuminated by a lamp LM1.

BAND SWITCH: The frequency band selector switch S9 located below the dial completes the circuit to the band switching motor and permits selection of each of the three bands. A mask attached to the switch shaft exposes only that part of the tuning dial associated with the band selected. The band range in use is indicated on the panel by the position of the selector switch knob.

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 automatic compass operation. In the REC. ANT. position, the equipment functions as a communication receiver connected to the non-directional 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 LM1 which 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 radio compass, the equipment is operating on automatic volume control (AVC) and this knob determines the audio level in the headphones by varying the potentiometer R4A in the headset circuit. 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 through potentiometer R4B, permitting radio range reception. The Type MN-28 Remote Control

Unit used with a 600-ohm low-impedance output system is the same as the Type MN-28 Remote Control Unit used with a 4000-ohm high-impedance system except for the audio control potentiometer R4. See paragraph 7.

LOOP L. R.: The control knob designated LOOP L.R. operates a switch to manually control the rotation of the loop when the function selector switch is set to REC. LOOP. Normally, a resistor R40 is connected in series with this switch for slow loop rotation. The switch may be depressed and turned to rotate the loop at full speed.

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 amplifier to such an extent that erratic fluctuation of the bearing indicator due to noise is reduced.

Instructions for setting this control are given in paragraph 4-1-2.

2-2-3. Comparison Between 14- and 28-Volt Remote Control Units

The panel-lamp dropping resistor R35-3 has the jumper removed for 28-volt operation. (See Figure 25)

2-3. TYPE MN-36A AUTOMATIC LOOP (See Figures 7 and 8)

The loop proper consists of a center-tapped, 8-turn coil enclosed in an electrostatic shield. At the top of the shield is a gap which is insulated and waterproof. The loop is permanently mounted on the mounting base. All connections from the loop coil are made through slip rings and brushes which are connected to the loop transmission cable plug. The loop is rotated by means of a low-inertia induction motor which is geared to the loop shaft at a ratio of 608 to 1. The motor is driven from the control circuit in the Type MN-31 Automatic Loop Control to obtain either automatic azimuth indication or manually-controlled rotation of the loop. The position of the loop is transmitted to a remote point by a self-synchronous or autosyn transmitter which is coupled directly to the loop shaft through an assembly containing the autosyn transmitter and a quadrantal error corrector of the adjustable screw type. (See Figure 15) The autosyn transmitter and the quadrantal error corrector are a complete assembly and may be removed from the loop as a single unit for adjustment of the quadrantal error. Two azimuth scales are provided for the compensator; one for use when the loop is mounted on top of the airplane, and the other for use when it is mounted on the belly of the airplane. A pointer on the compensator indicates the amount of correction applied. The entire loop assembly is contained in a streamlined cast aluminum base and a strong waterproof

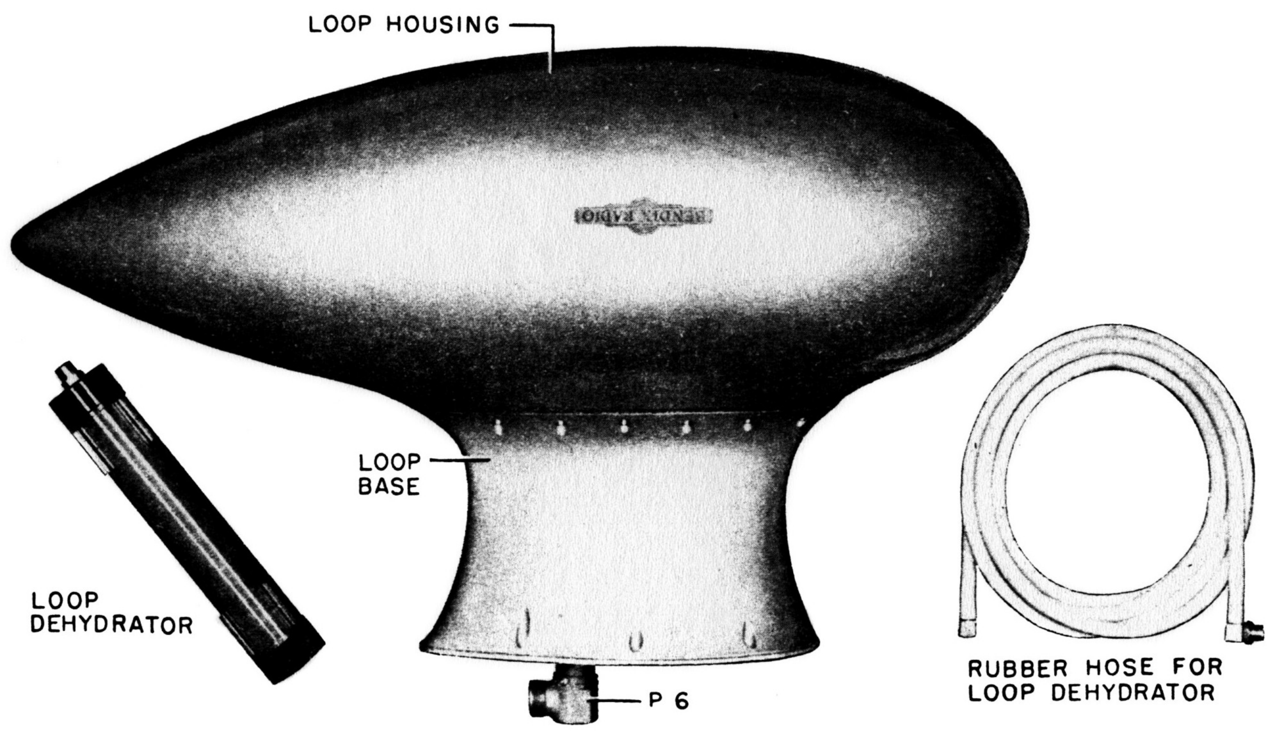


Figure 7—Type MN-36A Automatic Loop, Including Dehydrator

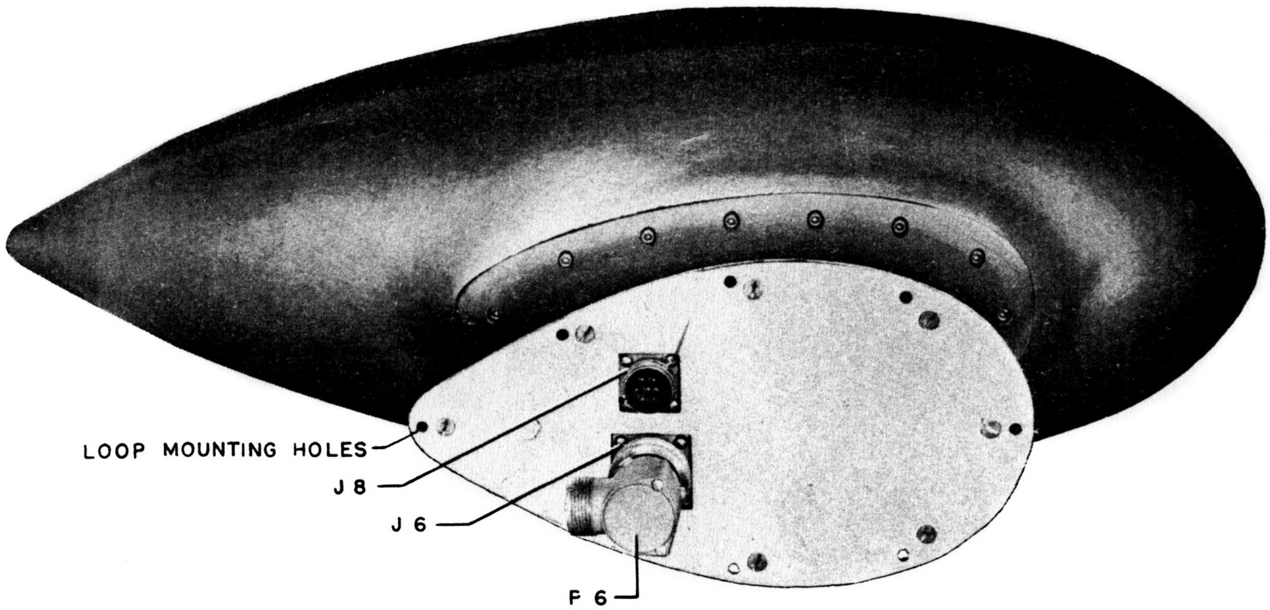


FIGURE 8—TYPE MN-36A AUTOMATIC LOOP, BOTTOM VIEW

streamlined housing. Two receptacles are provided on the base of the unit; one for connection to the loop transmission cable from the Type MN-26 Radio Compass, and the other for connection to the cable from the junction box which provides electrical connections for the driving motor and the autosyn transmitter.

The Type MN-36A Automatic Loop is equipped with a dehydrator unit to prevent the accumulation of condensed moisture inside the unit. The dehydrator consists of a transparent container filled with activated silica gel crystals. The container is connected to the loop unit by flexible tubing and suitable fittings so that the loop housing may breathe through the moisture absorbing material. The silica gel crystals are a bright blue color when dry but change to lighter shades as moisture is absorbed. The moist crystals may be easily removed from the container, dried in an oven (not over 350°F) until the original color is restored, and then replaced in the dehydrator for further use.

2-4. TYPE MN-37A BEARING INDICATOR (See Figure 9)

The bearing indicator is designed for flush mounting on the instrument panel, or it may be mounted on a flat surface from the rear. Refer to Figure 43 for outline dimensions. The indicator consists of an aluminum alloy casting containing a 4½-inch azimuth scale which may be rotated by means of a knob located on the front of the instrument. The pointer is controlled by a 400-cycle autosyn receiver which obtains its controlling energy from the autosyn transmitter of the Type MN-36A Automatic Loop. The pointer continuously indicates the bearing determined by the position of the loop as corrected by the compensator in the loop. Dropping resistors are provided in the unit to allow operation of two dial-illuminating instrument lamps from a 14-volt circuit. An external dropping resistor must be provided for operation of the lighting circuit from a 28-volt source. An adapter plate (Bendix Dwg. No. A29709) is available for mounting the indicator into a standard A-N instrument cut-out on the instrument panel of the aircraft. This adapter plate may be obtained as an accessory. All external connections are made through a 90° Cannon cable plug.

2-5. TYPE MN-31 AUTOMATIC LOOP CONTROL (See Figures 10, 11, 12, and 13)

2-5-1. GENERAL

The Type MN-31 Automatic Loop Control contains the 400-cycle rotary inverter, all automatic loop control circuits, and a dual output amplifier. The loop control is assembled on an aluminum alloy chassis which is spot-welded to an aluminum alloy case. The top may be easily removed to provide access to the tubes and other components. The bottom cover to which the shockmounts are secured is screwed to the case. The entire unit is held within the mounting base by means of a single Dzus fastener on the front of the base and a flange on the rear of the base. All external connections are made through a 19-contact receptacle to the cable running to the junction box. The automatic loop control circuit (See Figure 25) consists of a tuned 48-cycle input transformer T1, two thyratron

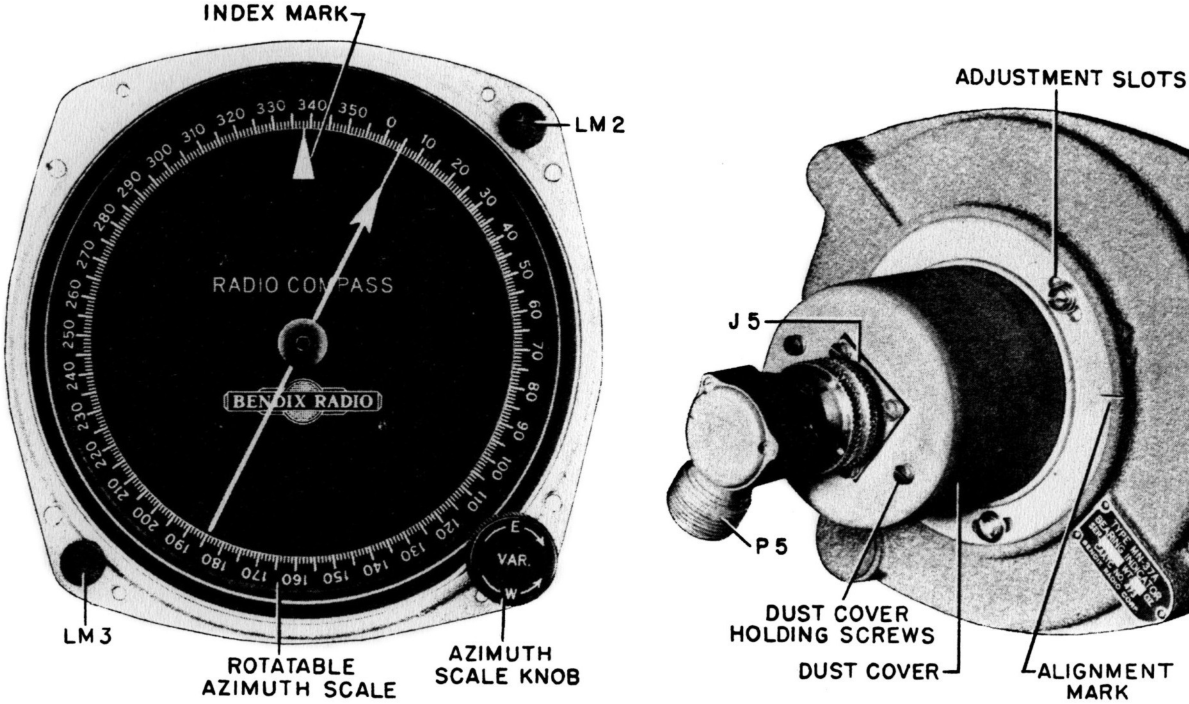


FIGURE 9—TYPE MN-37A BEARING INDICATOR, FRONT & REAR VIEWS

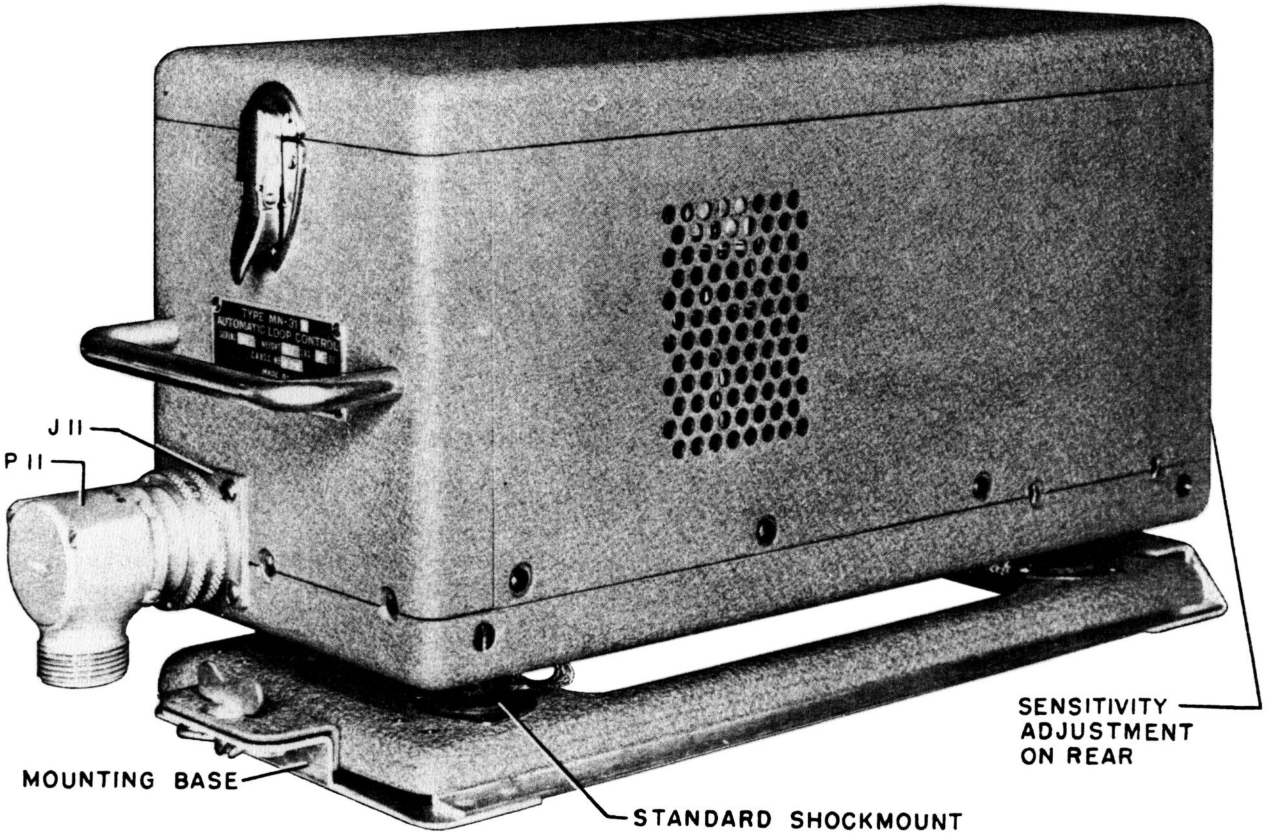


FIGURE 10—TYPE MN-31A AUTOMATIC LOOP CONTROL, FRONT OBLIQUE VIEW

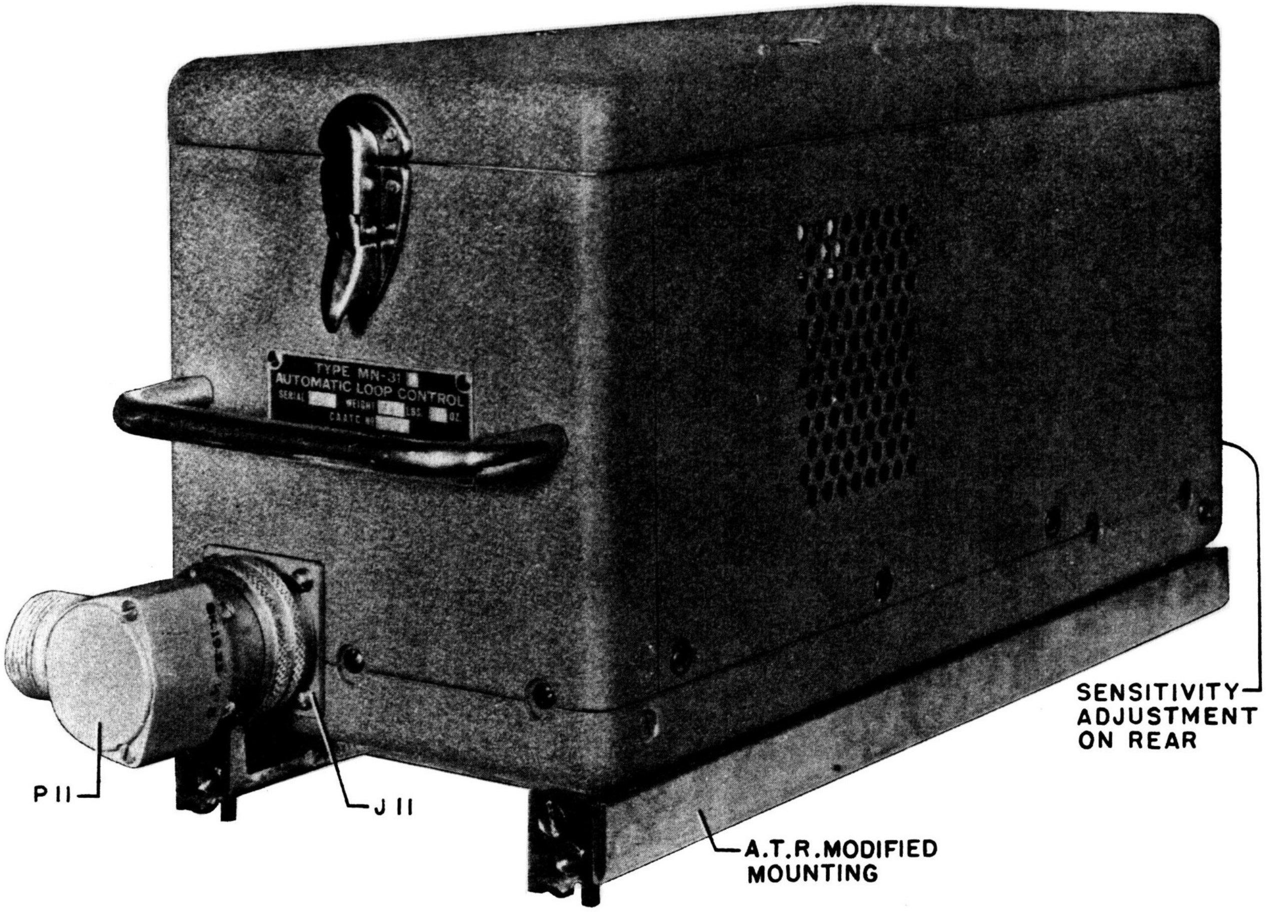


FIGURE 11—TYPE MN-31B AUTOMATIC LOOP CONTROL, FRONT OBLIQUE VIEW

control tubes V1 and V2, two saturable reactors T2 and T3, a 400-cycle power transformer T4, a 48-cycle oscillation transformer containing a choke coil, a plate control tube V3, and a 400-cycle rotary inverter. The thyratron input transformer T1 receives its voltage from the 48-cycle compass output transformer T16 in the Type MN-26 Radio Compass. The dual audio amplifier, which is so arranged that the audio phone output from the Type MN-26 Radio Compass may be fed to it, consists of two type 12A6 output tubes V4 and V5 and a dual audio output transformer T6. The output of the dual amplifier is connected to 4 terminals in the junction box so that the receiver output may be connected to separate pilot headset boxes.

2-5-2. COMPARISON BETWEEN 14- AND 28-VOLT AUTOMATIC LOOP CONTROL UNITS

The Type MN-31 Automatic Loop Controls are essentially the same for 28-volt operation as for 14-volt operation. The following tabulation indicates the specific differences:

A 24/28-volt inverter is used.

Jumpers are changed as shown on Figure 32.

See paragraph 7 and Figures 25 and 32 for details.

2-6. TYPE MS-14C JUNCTION BOX (See Figure 14)

All interconnections between the various units are made in the Type MS-14C Junction Box. The junction box is provided with 8-32 screw terminals to which the connections are made. The various cables may be brought into the junction box by cutting holes at the most convenient locations. (See Figures 25, 35, 44) No. 20 gauge (Brown & Sharpe) wire or larger will be satisfactory for all cables except those marked, which must be No. 12 B & S.

When no tuning meter is used with the equipment, the wire in the radio compass cable connecting to terminal 18 of receptacle J4 in the radio compass must be grounded in the junction box. 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 500-ohm resistor should be connected in shunt with the meter to prevent the receiver from becom-

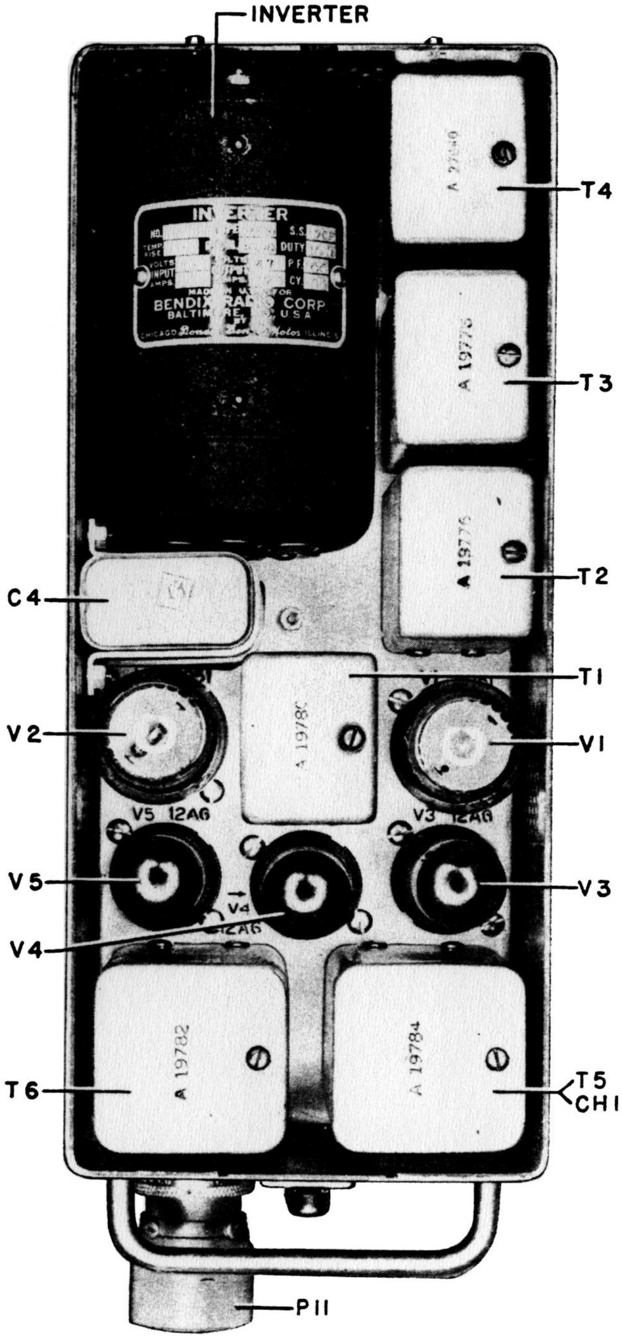


FIGURE 12—TYPE MN-31 AUTOMATIC LOOP CONTROL, TOP INTERIOR VIEW

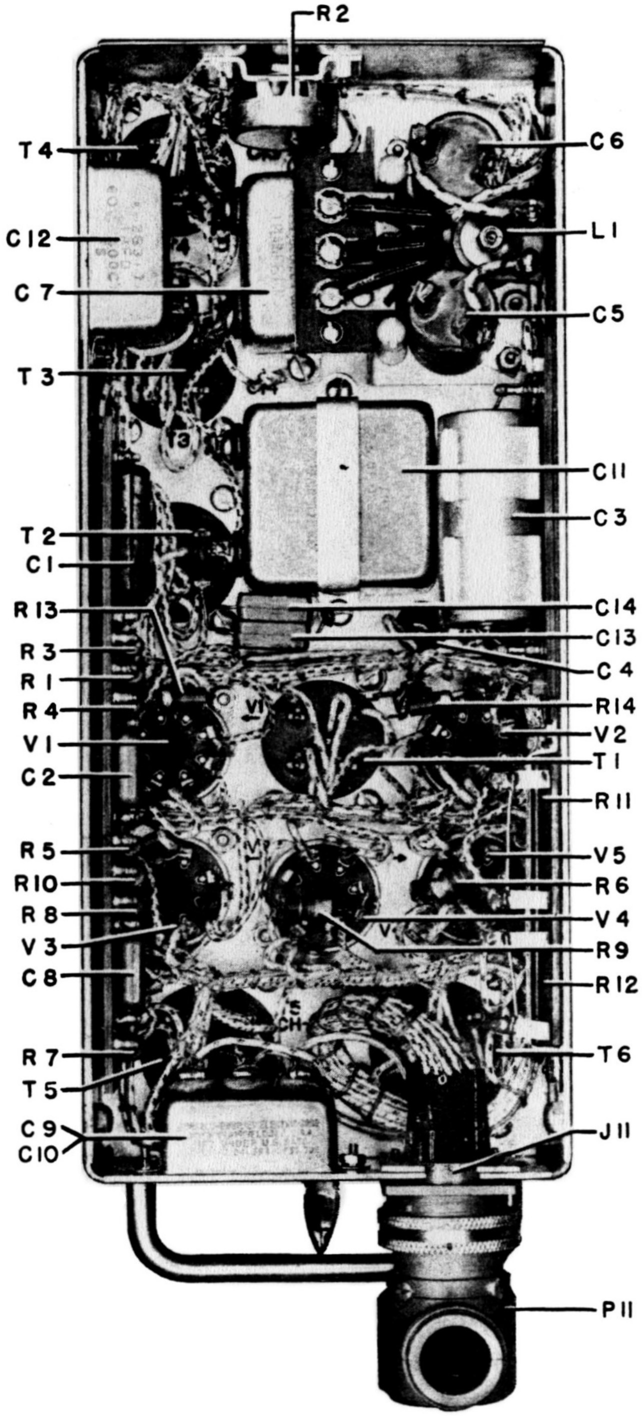


FIGURE 13—TYPE MN-31 AUTOMATIC LOOP CONTROL, BOTTOM INTERIOR VIEW

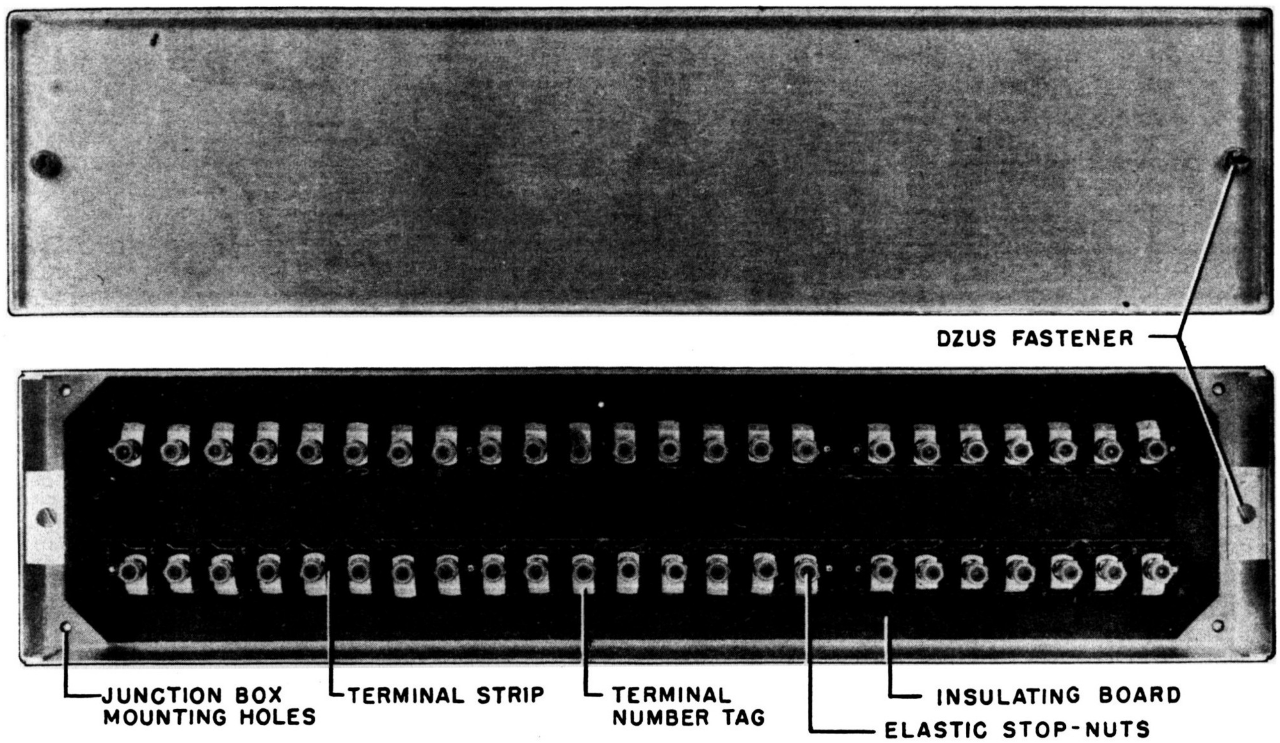


FIGURE 14—TYPE MS-14C JUNCTION BOX, INTERIOR VIEW

ing inoperative due to failure of the meter coil. A suitable meter for use in this circuit would be an aircraft type 0-5 milliampere meter with a suppressed-zero movement so arranged that the pointer will leave the right hand zero stop with approximately 2 milliamperes and will read full-scale at the left stop with 5 milliamperes. A Bendix Type MR-57A Tuning Meter may be purchased as an accessory. Outline dimensions of this tuning meter are shown in Figure 45.

2-7. ELECTRICAL RADIO COMPASS THEORY

The Type MN-26 Radio Compass contains the loop input circuit and amplifier, a 90-degree phase shifter, a balanced modulator, an audio oscillator, a non-directional antenna input, a sensitive and selective superheterodyne receiver, a compass output circuit, and an audio output circuit. The Type MN-36A Automatic Loop contains the loop antenna, the loop rotating motor and gear drive, the compensator, and the autosyn transmitter motor. The Type MN-31 Automatic Loop Control contains the loop rotating control circuits and the 400-cycle power supply. Reference to Figure 25 will assist in following the explanation below.

A vertical antenna is non-directional, and the voltage induced in a vertical antenna is in phase with the flux of the radio wave. A loop antenna is directional in that the voltage induced in the loop is maximum when the plane of the loop is in line with the direction of travel of the radio wave from the transmitter, and is zero when the plane of the loop is at right angles to the direction of travel of the radio wave from the transmitter. The voltage induced in the loop is 90 degrees out of phase with the flux of the radio wave and, therefore, is 90 degrees out of phase with the voltage induced in the vertical antenna. The loop voltage changes phase abruptly by 180 degrees as the loop is rotated through the position of zero signal pick-up, known as the null. In the radio compass, the voltage from the loop is fed to an amplifier tube through a resonant coupling circuit. The phase of the amplified loop voltage is shifted approximately 90 degrees in the plate circuit of the amplifier tube so that it is either in phase or 180 degrees out of phase with the voltage induced in the vertical antenna, depending upon which side of the loop is turned toward the transmitter.

The phase-shifted voltage from the loop amplifier is then impressed upon the grids of the modulator tubes which are driven in phase opposition by the audio oscillator so that only one of the triode sections will amplify the loop signal at one time. The voltage from the loop amplifier is coupled to the grids of the modulator tube in phase. Since the plates of the modulator tube are push-pull connected to the receiver circuit, it is evident that, for each half cycle of audio voltage, the loop output voltage will alternately add to and subtract from the voltage contributed by the vertical antenna. The relation of the loop signal to the signal from the non-directional vertical antenna will reverse in phase as the loop is rotated through a null position. Therefore, it is evident that the combined signal which is fed to the receiver circuit consists of a radio frequency signal modulated at the audio oscillator frequency. The modulation depth, or modulation percentage, is proportional to the voltage contributed by the loop and is therefore proportional to the sine of the angle by which the loop is rotated from the null. The modulation depth is, however, limited by the loop amplifier automatic gain control. Moreover, the phase of the loop voltage reverses as the loop is rotated through a null. This modulated signal is detected, amplified, and passed through a filter network to the compass output amplifier tube V12 and into a transformer T16, tuned to 48 cycles. The output voltage of this transformer is passed through a cable to the input transformer T1 in the Type MN-31 Automatic Loop Control and is in turn fed to the grids of the thyratron motor control tubes in phase opposition.

The compass circuits are arranged so that, if the radio signal is coming from the left, the modulation is such that the 48-cycle voltage on the grid of one thyratron is in phase with its plate voltage; and, if the radio signal is from the right, the 48-cycle voltage on the grid of the other thyratron tube is in phase with its plate voltage. When the loop is at its signal null, the loop voltage is zero, there is no modulation of the carrier at the frequency of the audio oscillator, and the thyratrons neither receive 48-cycle grid voltage nor draw plate current.

The audio oscillator tube V2 is located in the Type MN-26 Radio Compass, and the 48-cycle oscillation transformer T5 is located in the Type MN-31 Automatic Loop Control. The secondary of this oscillation transformer drives the grid of a plate control tube (V3 in the Type MN-31 Automatic Loop Control) in the proper phase relationship, which serves to furnish plate voltage to the thyratrons V1 and V2 in the form of half-wave, 48-cycle pulses. The phase relationship between the 48-cycle compass output voltage and the 48-cycle modulating output voltage determines which of the two thyratron tubes ionizes and draws plate current. As previously stated, the 48-cycle plate voltage of the thyratrons is so phased with the 48-cycle compass output voltage fed to the grids of the thyratrons that one tube will ionize and pass plate current when the loop is to the left of the signal, and the other tube will ionize and pass plate current when the loop is to the right of the signal. By inserting some means of motor control in the plate circuit of the thyratrons, a method of converting the relationship between the compass output voltage and the modulating oscillator voltage into bi-directional motor rotation is available.

The motor used to rotate the loop is a special low-inertia, 2-phase, 400-cycle induction motor which drives the loop through a gear ratio of 608 to 1 to give an angular loop velocity of 30-40 degrees per second. Assuming that a fixed amount of 400-cycle current is passed through one winding of the motor, the phase of the current through the second winding with respect to the current through the first winding determines the direction of rotation. Maximum torque is obtained when the current in the second winding either leads or lags that of the first winding by 90 degrees. The 90-degree phase relationship is obtained by a series capacitor in one winding. Special saturable reactors are inserted in the plate circuit of each of the two thyratron tubes. These reactors control the loop rotation in the following manner. When one thyratron passes plate current, direct current is passed through its reactor primary, the secondary impedance is reduced to a low value and current flows to the motor winding from one side of the power transformer secondary. When the other thyratron passes plate current, the secondary impedance of the other reactor is reduced to a low value and the motor winding is connected to the other side of the power transformer secondary. Thus, we have an electronic switch which operates to pass current to the motor winding which either leads or lags the current in the motor fixed winding by 90 degrees so that the motor will either rotate clockwise or counterclockwise, depending upon which thyratron tube is passing plate current. The circuits are so phased that, when the loop is off the null, the direction of rotation of the motor will be such as to return the loop to its null. Thus, an automatic circuit operates to rotate the loop to its null position whenever the radio compass is tuned to a signal. There is only one null on which the loop control circuits are stable because on one null only will the motor control circuit tend to rotate the loop toward the null. On the other null the motor control circuit will tend to rotate the loop away from the null and towards the opposite desired null.

In order that the system may be made as sensitive as possible around the loop null, a portion of the 48-cycle output voltage is rectified and fed to the grid bias return of the loop amplifier tube in such a manner that, as the loop is rotated further from the null, this voltage increases and biases the loop amplifier tube and therefore decreases its gain. This automatic loop gain control circuit tends to maintain the 48-cycle output voltage from the compass at a constant value regardless of the position of the loop with respect to its null.

In order to reduce the effect of noise and other modulation frequencies on the operation of the thyratron control tubes and the loop motor control circuit, the compass output circuits are sharply tuned to 48-cycles, and therefore only the 48-cycle output voltage will operate the thyratron and cause rotation of the loop.

The thyratron tubes are so biased that normally they cannot draw plate current, and, in order for the thyratrons to draw plate current, the loop must be a definite amount off its null. By adjustment of the thyratron sensitivity control resistor R2, this bias may be adjusted so that the sensitivity may be controlled as desired to obtain the required orienting sensitivity. This control may be adjusted so that the loop will hunt its null by any desired amount within ±0.2 degree to ±1 degree, or the thyratron sensitivity may be reduced to a point where there will be no hunting.

Although the loop motor has extremely low inertia and can be stopped almost immediately after removal of the power, there is a slight tendency of the loop to overshoot its null. This tendency to overshoot is reduced by means of a lag-circuit in the bias circuit of the thyratrons. When the thyratrons are passing plate current, the bias is built up to its maximum value across the large capacitor C3 in the cathode circuit of the thyratrons. When the loop approaches its null and the excitation voltage on the grid of one thyratron is reduced, that thyratron will cease to pass plate current an appreciable time before the loop reaches its null and the grid exciting voltage reaches zero. This is true because the thyratron bias is maintained at a higher value than normal as the null is approached but returns to normal a fraction of a second after the loop null is reached.

It is now evident that, in order to obtain automatic azimuth indication of the direction of a radio signal, it is only necessary to know the position of the loop with respect to the plane's heading, as the loop is always automatically held on its signal null for any given signal to which the radio compass is tuned. A motor of the self-synchronous (autosyn) type is coupled mechanically to the loop shaft. This autosyn motor is of such a nature that, when properly connected to a similar autosyn motor, the rotors in each of these motors will always maintain the same angular position with respect to their stators. Therefore, any angular position taken by the rotor of the autosyn coupled to the loop shaft will be assumed by the rotor of a similar autosyn coupled to the pointer on the bearing indicator. The pointer on the Type MN-37A Bearing Indicator is coupled to the shaft of this second autosyn motor and will therefore indicate the position of the loop with respect to any given reference axis. A quadrantal error compensator is interposed between the loop and the autosyn motor. This compensator serves to apply a correction to the position of the rotor of the autosyn transmitter to compensate for the quadrantal error introduced by the aircraft structure. This corrector consists of a circular steel tape upon whose inner surface a roller rides. The roller is coupled to a rack which operates a gear on the shaft of the autosyn transmitter. Screws are placed every 15 degrees around the periphery of the adjustable tape and are so arranged that, by turning them in or out, the tape can be moved radially in or out. Thus, by properly positioning the tape radially, the roller, which is geared to the autosyn, is made to change the position of the autosyn rotor by a predetermined amount with respect to the loop. The screws are adjusted at the factory for zero correction and the relationship between the loop and the autosyn rotor remains unchanged as the loop is rotated. An azimuth scale and a correction scale are mounted on top of the compensator assembly and indicate the angle by which the autosyn rotor is displaced from the position of the loop. (See Figure 15) After a quadrantal error curve is determined in accordance with paragraph 4-1-4, this assembly may be removed from the loop base and the screws adjusted at every 15-degree point to apply the proper correction. This correction is indicated directly by the correction pointer on the assembly. Inasmuch as the autosyn in the loop corrects the effect of the distortion produced by the aircraft structure, and since the autosyn in the bearing indicator is electrically coupled to the autosyn in the loop, the pointer on the bearing indicator will indicate the true direction of arrival of the radio signal. The distortion of the direction of arrival of the radio wave by the metal structure of the airplane is known as quadrantal error.

2-8. ACCURACY OF BEARING

There are a number of possible sources of bearing error in an automatic radio compass installation and in the radio compass equipment, disregarding the quadrantal error of the aircraft. The major sources are as follow:

A. Loop Base Alignment

Error in alignment of loop base with the fore-and-aft axis of the aircraft. This is an installation error.

B. Alignment of Loop Proper with Respect to Its Base

Misalignment of these two parts will cause the compensator scale pointer to be off the zero mark when the loop is at right angles to the loop base. (This is an equipment error.) This error is minimized by careful alignment at the factory by means of highly accurate jigs and should not exceed ±0.75 degree. The drive gear on the loop shaft (See Figure 16) is accurately pinned to the loop shaft to prevent incorrect assembly should the loop be disassembled. The slot in this gear which engages the driving pin on the compensator assembly (See Figure 16) is so located that a line drawn through the center of this slot and the center of the loop shaft coincides exactly with the fore-and-aft axis of the mounting base when the loop winding is at right angles to the fore-and-aft center line of the mounting base. The driving pin on the compensator assembly is so located that, for the above condition and with the compensator set for zero correction, the pointer will be at zero degrees on the compensator azimuth scale. (See Figure 15) This pointer is accurately clamped to the autosyn transmitter shaft. If removed, it must be reassembled with the pointer located at the electrical zero of the autosyn, as discussed in paragraph 6-5-4-2.

C. Misalignment between Loop Shaft and Autosyn Transmitter Shaft

This is an equipment error. The misalignment of these two shafts is held to less than .003 inch by accurate jig-drilling, at the factory, of the three mounting-screw holes for the compensator assembly with respect to the loop shaft. A misalignment of .015 inch will cause a maximum azimuth error of 0.8 degree. It is important that the correct mounting screws be used, and that the compensator mounting not be altered in any manner.

D. Error in Electrical Calibration of the Autosyn Transmitter Located in the Loop

In the manufacture of this autosyn, every effort is made to minimize these errors by very close tolerances on windings, laminations, ball bearings, etc. It is necessary that the electrical zero of this autosyn coincide with the loop azimuth zero so that any errors will be averaged each side of zero instead of accumulating on one side. For example, if the total spread of error in the autosyn is 2 degrees, the repeating error will be 0 ±1 degree if the autosyn is operated from a reference zero which coincides with the electrical zero, instead of a possible error of 0 +2/—0 degrees, which could occur if the zero should fall on a +1-degree error point. The autosyn is adjusted accurately at the factory so that the compensator assembly pointer is within ±0.2 degree of the azimuth zero on the compensator when the autosyn is at electrical zero. The pointer is securely clamped to the shaft to prevent changing this adjustment. (See Figure 15)

E. Error in Compensator Follow-Up Roller and Gear

It is important that the proper gear tooth on the roller rack engage the correct tooth on the pinion which is pinned to the autosyn transmitter shaft. This is located correctly at the factory and no error will occur if assembly is made in such a manner that, when the tape is adjusted for zero correction, the autosyn transmitter rotor will be at electrical zero when the correction pointer is at zero azimuth. Further, the compensator adjusting screws must be carefully set so that the correction pointer shows zero correction around the azimuth scale when no correction is applied. When correction has been applied, this pointer must follow the corrected azimuth curve.

F. Error in Electrical Repeating Ability of the Autosyn Motor in the Type MN-37A Bearing Indicator

The same type of error will occur in this motor as in the autosyn located in the loop. For this reason, the indicator pointer is so adjusted at the factory that the pointer is at zero azimuth when the autosyn rotor is at electrical zero. Errors will then be averaged each side of zero. Any pair of autosyns are guaranteed to be free from repeating errors exceeding ±2.0 degrees when the scale zero coincides with the electrical zero of both autosyns and when the proper excitation voltage is applied.

G. Error in Bearing Indicator caused by Scale Distortion

This error is held to less than ±0.25 degree by close control of the scale etching.

H. Eccentricity of Pointer Shaft on Type MN-37A Bearing Indicator

The pointer shaft is held concentric with the azimuth scale so that the error caused by eccentricity is negligible (less than 0.1 degree) when properly assembled.

I. Error caused by Loop and Receiver Input Circuits

By careful design and reduction of feedback, this error has been reduced in the Type MN-26 Radio Compass to less than 1 degree at any field strength from 100 to 100,000 microvolts per meter. In most cases this error will be less than 0.5 degree.

J. Orientation Accuracy of Automatic Loop Control Circuits

The automatic loop control circuits are so designed and adjusted that the loop will be held on its null to within less than ±0.5 degree when the orienting sensitivity is properly adjusted, at any signal field strength above 100 microvolts per meter free from interference.

K. Error in Ability of the Quadrantal Error Compensator to Repeat a Quadrantal Error Curve

The compensator will repeat a symmetrical quadrantal error curve (sinusoidal) to within ±0.5 degree at any point around the azimuth scale if carefully adjusted in accordance with instructions. Error curves having abrupt changes in error caused by resonant antennas cannot be corrected with the compensator.

The equipment is shipped from the factory so assembled and adjusted that the total bearing error does not exceed ±3.0 degrees for any azimuth heading, at any frequency in the tuning range of the compass, and at any field strength from 100 to 100,000 microvolts per meter. In general, the total error will be less than 1 degree, as the errors resulting from the sources outlined above tend to balance out rather than to accumulate.

The Type MN-37A Bearing Indicator has adjustment slots (See Figure 9) so arranged that the azimuth zero can be altered. Alignment marks on the rear of the indicator show the correct adjustment for electrical zero. These marks are correct only for the pointer location made at the factory. The adjustment slots should be used only as an emergency adjustment in the event of improper installation when it is desired to set the bearing indicator for exact zero-heading bearing, disregarding small errors (±1.5 degree) at other headings. However, should the adjustment slots be changed more than ±2 degrees, the quadrantal error cannot be accurately corrected by the compensator because the adjustments are referred to an incorrect zero on the compensator azimuth scale.

In all adjustments affecting the relation between the loop position and the bearing indicator pointer, precaution is taken to make all bearing indicators interchangeable in any installation and with any loop. All of the repeating errors on any one installation can be completely eliminated by adjustment of the quadrantal error compensator.

3. INSTALLATION

3-1. INSPECTION BEFORE INSTALLATION IN AIRCRAFT

A. Unpack the equipment carefully and check the components against the equipment list in paragraph 1-2 to be sure that all components are available.

B. Carefully inspect each component to be sure that it has not been damaged in shipment.

C. The Type MN-31 Automatic Loop Control and the Type MN-26 Radio Compass are shipped with all vacuum tubes in place as tested at the factory. Inspect all tubes to be sure that they are secure in their sockets and that all grid leads and grid shield caps are in place. If the dual audio channels of the Type MN-31 Automatic Loop Control are not used, the audio tubes V4 and V5 must be removed from their sockets.

D. Remove the mounting bases from the Type MN-31 Automatic Loop Control and the Type MN-26 Radio Compass so that they can be permanently mounted in the aircraft.

E. If proper laboratory facilities, as described in paragraph 6-7, are available, test the equipment for compass and receiver operation in accordance with the instructions in paragraph 6-8.

3-2. BONDING AND SHIELDING

Satisfactory operation of radio compass equipment in aircraft will depend upon the efficiency of the shielding and bonding of the ignition, generator, and other electrical systems. The ultimate sensitivity of any aircraft receiving installation is limited by the magnitude of the local electrical interference rather than by the 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 the installation of the equipment. This shielding must be complete enough so that no additional noise will be heard in the receiving equipment at any frequency when the airplane engines are started and the charging generator is charging at any rate.

3-3. ANTENNA REQUIREMENTS

The Type MN-26 Radio Compass is designed to provide optimum performance with a vertical antenna of approximately 0.25-meter effective height and 50/100-Mmf capacitance. However, the vertical antenna size is not critical and satisfactory operation is possible over a rather wide range of sizes.

On aircraft which will accommodate any one of several types of antenna installations, it is desirable that the type be used which most nearly meets the above requirements and which has the largest ratio of vertical to horizontal length. Vertical rod antennas and T-type wire antennas supported by stub-masts have been found satisfactory. No antenna or lead-in should be placed closer than 3 feet from the loop. Care should be taken in installing the lead-in to keep its capacitance as low as possible. In no case should the capacitance of the lead-in to ground exceed 15 Mmf.

3-4. INSTALLATION OF COMPONENTS

3-4-1. TYPE MN-26 RADIO COMPASS

The Type MN-26 Radio Compass should be so installed that sufficient clearance is allowed on all sides for free action of the shock absorbers and for removing the unit from the mounting. The separable mounting base should be secured to the principal structure of the aircraft by six #10 screws. Mounting dimensions are shown on Figures 36 and 37. The mounting should be bonded securely to the metal framework of the aircraft. The receiver must be located within the shortest practicable distance from the vertical antenna lead-in and should be located as close as possible to the other associated equipment, particularly the Type MN-28 Remote Control Unit in order that the tuning shaft may be as short as possible.

3-4-2. TYPE MN-28 REMOTE CONTROL UNIT

The remote control unit should be located where the panel will be easily visible and the controls accessible to the operator. Consideration must be given to providing clearance for connection of the tuning shaft and the flexible conduit from the junction box. See Figure 38 for outline dimensions.

No mounting holes are provided in the base of the remote control unit since the requirements will vary with individual installations. The control box is secured to its mounting base by means of the three stainless steel fillister-head mounting screws located on the front panel. These are captive-type screws and are loosened to remove the unit from its mounting base.

3-4-3. TYPE MN-31 AUTOMATIC LOOP CONTROL

The Type MN-31 Automatic Loop Control should be installed with sufficient clearance allowed on all sides for free action of the shock absorbers and for removal of the unit from its mounting base. The mounting base should be secured to the principal structure of the aircraft by four #10 screws. Outline dimensions are shown on Figures 39 and 40. Clearance must be allowed for connection of the junction box flexible conduit to the receptacle on the front of the unit. The unit may be removed from its mounting base by releasing the Dzus fastener located at the front of the unit, lifting the front end up, and sliding the unit forward a short distance. Access to the vacuum tubes and other internal components is provided by removal of the top cover. Access to the automatic sensitivity control located on the rear of the unit must be provided.

3-4-4. TYPE MN-36A AUTOMATIC LOOP

The Type MN-36A Automatic Loop should be located on the fore-and-aft center line of the fuselage in a position as far as practicable from sources of engine interference, metal masses, and conductors. In determining the actual location of the loop, consideration must be given to the space available for the loop base and housing, structural requirements, length of the loop transmisison cable, the location of the junction box, and other factors incident to the normal use of the aircraft. Areas affecting safety in flight, operation of the aircraft, and maintenance should not be obstructed by the loop and associated equipment.

The loop should be so mounted that it rotates on a vertical axis during normal flight. There are eight 7/32-inch holes provided in the mounting base for #10 screws for mounting the loop securely to the airplane. (See Figure 41) Holes must be provided in the skin of the aircraft to provide access to the two loop cable connections and the dehydrator connection on the base of the loop. Sufficient clearance should be available inside the fuselage for the attachment and removal of the loop cable, junction box cable, and dehydrator tubing. A velutex or similar gasket should be used between the loop mounting base and the aircraft to make a watertight seal. In locating the mounting holes, the fore-and-aft holes must be exactly in line with (within ±0.25 degree) the center line of the fuselage. Reference lines are scribed on the edge of the loop mounting base to assist in this alignment when mounting the loop. The broad nose of the loop housing must face forward. The assembly of the mounting of the support must be such as to prevent water, oil, dirt, etc. from entering the fuselage or the loop base. It is not necessary to remove the loop housing to install the loop because the autosyn is correctly adjusted with relation to the bearing indicator at the factory and the exact position of the loop inside the housing can be determined by the bearing indicator pointer after the compass has been electrically connected. However, it will be necessary to remove the entire loop assembly after the quadrantal error correction has been determined in order to remove the compensator assembly from the base of the loop to apply the necessary correction.

When ordering the equipment, the customer should specify whether the loop will be mounted on the belly or the top of the aircraft, in order that the proper azimuth scale may be installed on the compensator assembly at the factory. However, if such information is not specified at the time of ordering, the loop will be furnished with the scale for belly mounting in place, and the scale for top mounting furnished as an extra part which may be installed by the customer at the time that the compensator assembly is removed to apply the quadrantal error correction. The compensator azimuth scale used for belly mounting has red characters, the scale used for top mounting has black characters. See paragraph 4-1-4 for instructions on adjustment of the compensator.

The dehydrator unit should be mounted in a convenient location for inspection and servicing and may be mounted in any position. (See Figure 42) The spring mounting clips supplied with the dehydrator tube may be secured with #6 steel screws. Holes are provided in the ends of the clips for safety wire. Sufficient clearance should be allowed between the ends of the mounting clips and the nearest obstruction to facilitate replacement. Connection between the loop and dehydrator is made by a length of rubber tubing fitted to the hose connections provided on each unit. To permit free flow of air, the tubing should be without kinks. The loop unit should be reasonably air tight so that air entering or leaving the loop housing passes through the dehydrator unit.

The silica gel crystals contained in the dehydrator tube are normally blue but change color as moisture is absorbed. The crystals should be replaced as soon as a definite change in color is noted over half or three-quarters of the tube length. Moist silica gel crystals may be reactivated by heating at a temperature of not more than 350°F until the original dark blue color is restored. The dried crystals may be used in a normal manner.

Dehydrator units not in service and containing dry silica gel crystals should be stored with the openings in each end of the tube sealed to prevent absorption of moisture.

3-4-5. TYPE MN-37A BEARING INDICATOR

The bearing indicator should be so mounted that the entire bearing scale is visible to the operator. It should be mounted close enough to enable the operator to set up headings and magnetic variations by turning the variation knob located in one corner of the indicator. Provision is made for mounting the bearing indicator on a panel, either flush or from the rear of the indicator. (See Figure 43) If it is decided to mount the indicator behind a panel, a 5-inch hole will be necessary to expose the face of the instrument. Four holes tapped for 6-32 screws are provided for flush panel mounting. In addition, four clearance holes for a #6 machine screw are provided in the case for mounting the indicator from the rear. An adapter plate is available for mounting the indicator from the back in a standard A-N instrument cut-out on a panel. This adapter plate may be ordered separately by Bendix No. A29709. Space should be allowed for access to the cable receptacle on the rear of the indicator and also for the flexible conduit which connects to the junction box.

3-4-6. TUNING SHAFT

The tuning shaft should be run in a straight line, avoiding as many bends as is practicable. Where bends are absolutely necessary, the radius of the bend should be as large as possible and in no case less than 6 inches. The shaft must be held firmly in place to prevent movement and must be well bonded to the structure of the ship.

The flexible tuning shaft should be bonded to the principal metallic structure of the aircraft at frequent intervals. The minimum bending radius of the tuning shaft is 6 inches and not more than two 6-inch bends should be made in any one cable installation. However, several bends of larger radius or greater angles may be permitted. The ends of the flexible shaft engage with splined shafts on the Type MN-26 Radio Compass and Type MN-28 Remote Control Unit and are securely held in place on each unit by threaded coupling nuts.

3-4-7. TYPE MS-14C JUNCTION BOX

The junction box should be fastened securely to the principal structures of the aircraft at a location where it will be accessible for circuit checking and for making wiring connections. (See Figure 44) Access may be had to the terminals and the wiring by releasing the two Dzus fasteners and removing the cover. All conduit connections to the junction box should be made on the side that is most convenient for the particular installation involved. Proper holes must be cut in the sides of the box for conduit entrances. The cables required are shown in the cording diagram in Figure 24, and in the equipment list in paragraph 1-2. The wiring diagram of the junction box is shown in Figure 35. Filter capacitor C51 (Bendix No. A27988) must be mounted in the junction box. Terminals No. 27 and 29 may be used to clamp it in place. Connect the positive lead to terminal 25 and the negative lead to terminal 31.

3-4-8. CABLE CONNECTIONS

The equipment and cables must not interfere with the airplane controls nor with the other instruments or equipment. All connections are to be made as shown in the schematic diagram Figure 25, and in the cordage diagram Figure 24.

The flexible conduits and flexible tuning shaft should be securely fastened in place, where 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 so that they will not interfere with the action of the shockmounting. The loop cable should be protected with friction tape wherever it touches another metallic surface or should be securely bonded. *Do not alter the length of the loop transmission cable.* If it is too long, the excess length may be coiled wherever convenient. This cable may be furnished in any required length, but should never be altered in the field unless precautions are taken to adjust its capacitance to the correct value.

The gear box assembly may be mounted in any one of several positions on the front panel of the Type MN-26 Radio Compass to permit the flexible tuning shaft to be connected to the unit with a minimum of bending. Should it be desirable to change this gear box position, connect the tuning shaft to the remote control unit and to the gear box and rotate the tuning crank in a counterclockwise direction until the gear drive stop prevents further rotation. Disconnect the tuning shaft from the gear box and remove the screws holding the gear box and its cover in place. Loosen the knurled nut in the gear box. Be sure that the capacitor is set at maximum capacitance. Rotate the gear box to the desired position, and fasten it in place. Tighten the knurled nut, and replace the cover plate. Turn the remote control tuning crank until the ALIGN mark is centered under the index of Band III. Reconnect the flexible tuning shaft to the gear box. Check the adjustment by rotating the tuning crank throughout its range to see if its operation is smooth, that the stop on the gear drive is reached simultaneously with the maximum capacitance limit of the tuning capacitor, and that, at this stop, the ALIGN index on the dial is at the index. It is essential that the stop on this gear drive be exactly aligned with the maximum capacitance limit of the tuning capacitor. If the tuning capacitor limit is reached before the gear drive stop is reached, serious damage to the tuning capacitor will result. If the gear drive stop is reached before the tuning capacitor limit is reached, the dial calibration will be in error.

Several combinations of loop and antenna locations are possible. In order for the equipment to function properly, the following changes from the connections indicated in the schematic diagram Figure 25 must be made for each location condition.

A. If both the loop and antenna are mounted on the belly of the aircraft, make all interconnections as shown on Figure 25.

B. If the loop is mounted on the belly of the aircraft and the antenna on top, interchange the two leads from the Type MN-31 Automatic Loop Control to terminals 24 and 26 in the junction box. The reversal of connections reverses the sense of the loop to avoid a 180-degree error which would otherwise result.

C. If the loop and antenna are mounted on top of the aircraft, interchange the two leads from the bearing indicator terminals 43 and 44 in the junction box. This reverses the direction of rotation of the bearing indicator with respect to the loop. Also interchange the two leads from the loop control unit to terminals 45 and 46 in the junction box, thus reversing the direction of rotation of the loop with respect to the LOOP L.R. switch on the remote control.

D. If the loop is mounted on the top of the aircraft and the antenna on the belly, perform the operations described in paragraph C, above. In addition, the two leads from the loop control unit to terminals 24 and 26 in the junction box must be interchanged in order to reverse the sense of the loop.

The equipment is shipped from the factory with the audio headphone output so arranged that it is available at the jacks on the Type MN-28 Remote Control Unit with the volume controlled by the AUDIO knob on the remote control unit. If it is desired to use the dual channel audio output amplifier in the Type MN-31 Automatic Loop Control, the following modifications must be made in the circuit shown on the overall schematic circuit diagram, Figure 25.

A. Change resistor R29 in the Type MN-26 Radio Compass from 500 ohms to 2500 ohms, ½ watt.

B. Change output lead on transformer T15 from terminal 3 to terminal 4.

C. Remove jumper connecting terminals 2 and 7 in the junction box, and connect terminals 2 and 3. This connects terminal 4 of transformer T15 to the grids of tubes V4 and V5 in the Type MN-31 Automatic Loop Control.

D. Insert tubes V4 and V5 (Type 12A6 tubes) in their sockets in the Type MN-31 Automatic Loop Control.

E. Connect one output channel to terminals 36 and 38 in the junction box, and the second output channel to terminal 35 and 37 in the junction box. Connect a suitable headset volume control in the headset circuit. The dual-channel audio output amplifier is designed to work into 600-ohm loads.

The dial lights in the Type MN-37A Bearing Indicator are shown (See Figure 25) connected directly to the 14-volt supply voltage circuit (terminal 1 in the junction box). If it is desired to control the brilliancy of this lighting, it will be necessary to connect a 50-ohm, 25-watt rheostat between the lead from terminal 1 in the Type MN-37A Bearing Indicator and the 14-volt source. Connect the lead from terminal 1 of J7 in the bearing indicator to a spare terminal in the junction box instead of terminal 1. Then connect the rheostat from the spare terminal to terminal 1 in the junction box. An Ohmite, Model H, 50-ohm, 25-watt rheostat (Bendix No. A25647) is satisfactory for this purpose.

4. PREPARATION FOR USE

4-1. ADJUSTMENTS AFTER INSTALLATION

After the complete automatic radio compass equipment has been installed in the aircraft, the following tests and adjustments must be made before placing the equipment in service.

4-1-1. Initial Checks

A. Before turning on the radio compass, check the battery voltage and polarity at terminal 30 in the junction box. This terminal should be +12 to +14 volts with respect to ground for Types MN-26H, MN-26J, MN-26N, MN-26P, MN-26R, and MN-26V Radio Compass, and +24 to +28 volts for Types MN-26K, MN-26L, MN-26S, MN-26T, and MN-26U Radio Compass, regardless of engine speed. Check for installation of 20-ampere fuse FU1 in the Type MN-28 Remote Control Unit, be sure that it is securely in place.

B. Check the vacuum tubes in both the Type MN-26 Radio Compass and the Type MN-31 Automatic Loop Control to ascertain that they are securely seated in their sockets and that the grid clips and grid shields are making positive contact and are not shorting.

C. Inspect the loop to see that it is securely and properly mounted. The mounting screws must be properly locked and waterproofed with Permatex No. 1 sealing compound or equal. Check the loop housing and base casting for damage or cracks which may weaken it or admit moisture and thus impair compass operation. Check that the index lines on the fore-and-aft edges of the mounting plate are exactly in line with the fore-and-aft axis of the aircraft.

D. Test the operation of the remote control tuning shaft and the connections at the remote control unit. If the tuning shaft has been properly connected, the ALIGN mark on the control unit must coincide and be aligned with the dial index when the stop is reached.

E. Check the mounting base screws and the Dzus fasteners which hold the Type MN-26 Radio Compass and the Type MN-31 Automatic Loop Control to their mountings. Be sure the bases are securely bonded to the structure of the aircraft.

F. Check the Type MN-28 Remote Control Unit for tightness of mounting to the aircraft structure, and check the mounting screws on the panel for tightness.

G. Check the vertical antenna, and see that the connections are properly and securely made.

H. Be sure that the loop transmission cable is secured and that the conduit braid is bonded to the structure of the aircraft. Check the tightness of the plugs and ferrule couplings on all cable receptacles at all units.

I. Check for presence and operation of instrument lights on the Type MN-28 Remote Control Unit and the Type MN-37A Bearing Indicator. Also check the light control on the Type MN-28 Remote Control Unit.

J. Using a headset of proper impedance, set switch to REC. ANT., check receiver operation on all three bands for adequate sensitivity, dial calibration, and volume control action. Set C.W. switch to ON and check the reception of CW signals. Jar the radio compass to check for possible sources of noise. Operate AUDIO control to see that its operation is smooth and that it properly controls headset volume. For daylight reception at a location free from electrical disturbances, it should be possible to receive radio range signals clearly 100 to 200 miles distant and broadcast signals 100 to 500 miles distant, depending upon station power.

K. Switch the radio compass on and off, and note whether the magnetic compass is affected.

L. Check the effects of other radio equipment in the aircraft upon the performance of the radio compass. Also, determine the extent of any interference produced by the radio compass in the other radio equipment.

M. Switch to REC. LOOP and tune to several transmitting stations, with C.W. switch ON and OFF, to see that sensitivity is satisfactory. Operate AUDIO control to see that it properly controls the headset volume. Operate LOOP L.R. switch to see that when it is turned to R. the bearing indicator pointer rotates clockwise at a speed of 3-6 degrees per second, and when it is turned to L. the bearing indicator pointer rotates counterclockwise 3-6 degrees per second. Similarly, when this switch is first pushed inward toward the panel and then turned to R. and L. the bearing indicator pointer should rotate clockwise and counterclockwise respectively at a rate of 30-40 degrees per second. When checking reception of transmitting stations, rotate the loop by means of the LOOP L.R. switch for maximum headset volume. For daylight reception at a location free from electrical disturbances, it should be possible to receive radio range signals clearly 50 to 100 miles distant and broadcast signals 100 to 250 miles distant, depending upon station power.

N. Switch to COMP., and swing the heading of the aircraft so that it is exactly aligned toward a transmitting station. (Very accurate means should be used for determining this heading. See paragraph 4-1-3.) Tune the radio compass to this transmitting station. The bearing indicator pointer should immediately swing to the zero index within ±2 degrees. The accuracy of this zero-heading bearing will depend upon: (a) accuracy with which the fore-and-aft line of the aircraft was aligned with the line of direction of the transmitting station; (b) accuracy with which the loop mounting base was aligned with the fore-and-aft line of the aircraft; (c) amount of distortion in the direction of arrival of the radio waves, caused by unsymmetrical location of the loop with respect to the metal mass of the aircraft and location of other unsymmetrical antennas or masts; (d) error in radio compass equipment, which does not exceed ±1 degree under normal conditions at zero heading. An error in indicated zero heading of not over ±5 degrees will not be serious if this error can be definitely shown to be caused by (c) above, because this error is a function of the particular aircraft installation and can be corrected when the quadrantal error correction is applied to the compensator. (See paragraph 4-1-6) If the bearing indicator pointer should swing to 180 degrees instead of 0 degrees, the sensing is incorrect. This condition is a result of interconnection of the components not in accordance with the instructions in paragraph 3-4-8 and as shown on the complete schematic circuit diagram, Figure 25. The sensing may be reversed by interchanging the leads from the Type MN-31 Automatic Loop Control to terminals 24 and 26 in the junction box. These are the audio oscillator plate leads.

O. Swing the heading of the aircraft approximately 15 degrees to the right of the line of direction of the transmitting station. The bearing indicator pointer should immediately swing to an approximate azimuth reading of 345 degrees. If the pointer should swing to 15 degrees instead of 345 degrees, improper interconnection of the components for the location of the loop in this installation is indicated. Instructions for proper connections for top or belly mounting are given in paragraph 3-4-8. The direction of rotation of the bearing indicator pointer may be reversed by interchanging the leads from the Type MN-37A Bearing Indicator to terminals 43 and 44 in the junction box.

P. Swing the heading of the aircraft toward the transmitting station again. Switch to REC. LOOP, and rotate the loop for an azimuth reading of 175 degrees as indicated by the bearing indicator pointer. Switch to COMP. and the pointer should return to the zero reading at a rate of 30 to 40 degrees per second if the battery voltage is normal. When the pointer arrives at zero, the overshoot should not exceed 2 degrees under any condition and will usually be less than 1 degree. The amount of hunting at the bearing may be controlled by means of the screwdriver adjustment at the rear of the Type MN-31 Automatic Loop Control. Adjust this automatic sensitivity control to obtain the desired amount of hunting, but maintain sufficient sensitivity so that, if the loop is rotated one degree from its bearing position, the automatic control will return it to within 0.5 degree of its bearing position. This sensitivity can be checked as follows: (a) switch to COMP. with the radio compass still tuned to the radio transmitting station; (b) note azimuth reading of bearing indicator pointer; (c) switch to REC. LOOP, and rotate the loop so that the bearing indicator pointer is 1 degree from the reading taken in (b) above; (d) switch to COMP., and again note the azimuth reading of the bearing indicator pointer. The readings taken in (b) and (d) above must agree to within 0.5 degree.

4-1-2. THRESHOLD SENSITIVITY ADJUSTMENT

The purpose of the threshold sensitivity control is to reduce the noise output of the radio compass unit in order to reduce erratic movement of the bearing indicator pointer when the noise level is high. The control is located on the rear of the Type MN-28 Remote Control Unit. Adjustment is made by removing the control unit from its mounting. (See Figure 6) Adjustment should not be undertaken until the interference from the aircraft ignition, generating, and electrical systems has been reduced to the lowest possible level. The adjustment procedure is as follows:

A. Set the function switch to the COMP. position and the AUDIO control to maximum.

B. Turn the threshold sensitivity control to its maximum clockwise position.

C. Set the band selector switch on the center band, and tune the compass to a weak station near the middle of the band.

D. With the aircraft motors operating at normal cruising speed, reduce the threshold sensitivity control until the noise received in the headset is of appreciable, but not objectionable, loudness. Sufficient sensitivity must remain for the compass to indicate a bearing to within less than 1 degree.

E. Tune the radio compass throughout its frequency range to ascertain that the sensitivity is satisfactory at all points of the frequency spectrum. It may be necessary to tolerate a somewhat higher noise level on the lower frequencies in order to obtain proper sensitivity on the higher frequencies.

4-1-3. QUADRANTAL OR AIRCRAFT ERROR CALIBRATION

4-1-3-1. General

Distortion of the radio frequency field pattern in the vicinity of the aircraft is caused by wings, 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-36A Automatic Loop so that the Type MN-37A Bearing Indicator readings correspond to the direction of the radio bearing, provided the errors do not exceed ±25 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. The errors to be corrected in the loop compensator should be those occuring at a frequency where it is expected that the greatest bearing accuracy will be 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 does not usually exceed 3 degrees. When calibration data obtained at the midpoint of this range is used for compensation of the loop, generally, bearings read directly from the bearing indicator at any other frequency between 200 and 1000 Kcs should not 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.

4-1-3-2. Radio Compass Calibration on the Ground

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.

A. The procedure to be followed for the first method is as follows:

1. 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.
2. Locate a portable transmitter in line with the fore-and-aft axis of the aircraft so that the aircraft heads toward 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.
3. Set the transit or pelorus to 0 degrees when the line of sight from the pelorus to the transmitter coincides with the center line of the aircraft.
4. 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 most used for radio bearings.
5. Set the zero line of the azimuth scale to the zero index on the Type MN-37A Bearing Indicator, and note the reading of the bearing indicator pointer. Record this reading for the zero heading of the aircraft on a form similar to that shown in Figure 48. If the installation of the equipment and all adjustments have been correctly made, the bearing indicator should read 0 ± 2 degrees for a zero heading of the aircraft.
6. 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. Note and record the pointer reading of the Type MN-37A Bearing Indicator for the 15-degree position of the transmitter.
7. Move the transmitter 15 degrees from its position in (6) 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. Note and record the pointer reading of the Type MN-37A Bearing Indicator for the 30-degree position of the transmitter.
8. Repeat the above procedure for transmitter positions at 15-degree intervals (or less) until the transmitter has been moved through 360 degrees around the aircraft. Record the results for use in determining the corrections to be set up at the 15-degree points on the compensator contained in the Type MN-36A Automatic Loop.

B. Calibration of the equipment on the ground by the second method may be made at the same time the magnetic compass is calibrated, and may be accomplished as follows:

1. Locate the aircraft on a compass rose. The aircraft must be in flying position. The general location should be clear from 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.
2. 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 bearing indicator pointer.
3. Tune the radio compass receiver to the transmitter frequency used, and accurately head the aircraft toward the transmitter. Set the bearing indicator azimuth scale zero mark to the zero index mark. Note and record the

pointer reading of the bearing indicator for the 0-degree heading of the aircraft. The bearing indicator reading should be 0 ±2 degrees if the installation and all adjustments have been made correctly.

4. Swing the heading of the aircraft through an angle of 15 degrees (or less) from the original zero heading above. Note and record the pointer reading of the bearing indicator for this heading of the aircraft. If the aircraft is turned to the left (counterclockwise as seen from above), the bearing indicator reading should increase.

5. 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. Note and record the pointer reading of the bearing indicator.

6. Repeat the above procedure for every 15-degree increase in heading of the aircraft until the aircraft has been turned through 360 degrees. Record the data obtained for use in determining the corrections to be set up at 15-degree points on the compensator in the Type MN-36A Automatic Loop.

4-1-3-3. Radio Compass Calibration in the Air

A. General

The procedure for calibration in the air is similar to that previously outlined for ground calibration, in that bearing 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 bearing indicator pointer. Do not make the calibration within one hour of sunrise or sunset or when interference or wide fluctuations in bearings are noted. If possible, the calibration should be made over smooth terrain in order to avoid reflected or distorted radio waves. A clear day when the air is smooth and when the wind velocity is less than 8-10 miles per hour 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 be taken only 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 for accurate procedure in flight calibration cannot be overemphasized.

Two methods for flight calibration are given in detail below. The first method may be used when a suitable ground reference line can be found. The second method may be used at any suitable location and effects a considerable saving in time, but calls for close cooperation between pilot and observer.

B. Flight Calibration over a Ground Reference Line

1. 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 bearing indicator as the aircraft is flown on a steady heading across the reference line. 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.

2. 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. Set the zero mark of the bearing indicator azimuth scale to the zero index. 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 pointer reading of the bearing indicator for this 0-degree heading of the aircraft. The indicator reading should be 0 ±2 degrees if there is no drift and if all adjustments have been properly made.

3. Refer to Figure 46 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 bearing indicator reading when the aircraft is exactly over the reference line. Record this reading on a form similar to Figure 48.

4. Fly far enough to the right of the reference line 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 bearing indicator reading when the aircraft is exactly over the reference line in level flight and on a steady gyro heading of 345 degrees.

5. Repeat 3 and 4 above for gyro headings of 30 and 330 degrees. After the bearing 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.

6. While flying away from the transmitter, check the directional gyro reading when the heading of the aircraft coincides with the reference line. The gyro reading 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 directional 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.

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

8. Following a procedure similar in general to that given above, obtain bearing 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 0-degree heading with respect to the reference line, check the gyro reading as in 7 above, and recage the gyro to 0 degrees.

9. Continue to fly to and from the transmitter over the reference line, alternating the heading of the aircraft from left to right until bearing indicator readings have been obtained for every 15-degree change in heading of the aircraft. Record the data obtained on a form similar to Figure 48 for use in determining the corrections to be applied at the 15-degree points on the loop compensator. Refer to paragraph 4-1-4.

10. If greater accuracy is required, use 5- or 10-degree instead of 15-degree increments for changes in heading. Do not make more than four alternate bearing checks between any two 0- 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 0- and 180-degree gyro headings of the aircraft against 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.

11. The above procedure may be reduced to operation over a single point, such as a road intersection, provided that the bearing of the ground check point to the radio transmitter is accurately known. Fly a series of figure eights, always crossing the ground point on a 15-degree change in gyro heading from the previous course, and read the bearing indicator when the aircraft is exactly over the ground point.

4-1-3-4. Flight Calibration from Two Opposite 360-Degree Turns

A. Coincidence of the zero-degree radio bearing with the zero-degree heading of the aircraft must be checked prior to the use of this procedure. This may be checked on the ground in accordance with paragraph 4-1-3-2A or 4-1-3-2B and then checked in the air by the procedure given in the first two sections of paragraph 4-1-3-3B, or by the following method:

1. Head the aircraft toward a transmitter having a vertical radiator that is clearly visible from all angles of approach. Fly directly into or with the existing winds to eliminate drift if a location and period free from winds is not available.

2. Tune the radio compass to the transmitter, and set the zero mark of the bearing indicator azimuth scale to the zero index.

3. Align the fore-and-aft axis of the aircraft with a radial line from the transmitting antenna as accurately as possible. Do not rely on visual heading checks from the cockpit, since considerable error due to parallax may result. The use of a telescopic cross-hair sight mounted in the cockpit and accurately aligned with the axis of the aircraft is recommended. If such equipment is not available, the heading may be aligned by sighting along the aircraft center line from the rear center of the cabin through the center of the windshield. Direct the pilot to change the heading until the fore-and-aft axis of the aircraft coincides with a line from the transmitter. Alignment observation should be made along the center line of the aircraft as far aft as possible from the center of the windshield in order to increase the accuracy of alignment. A two-inch deviation to the right or left from the center of the aircraft at a distance of ten feet from the center vertical line of the windshield corresponds to an angle of one degree.

4. Note the bearing indicator pointer reading while the aircraft is held in level flight and headed directly toward the transmitting antenna. The bearing indicator should read 0 ±2 degrees if all adjustments have been correctly made.

5. Repeat the above procedure at least once, approaching the transmitter from the opposite direction, to check the first reading.

6. Record the bearing indicator reading obtained for the zero heading of the aircraft.

7. The 180-degree radio bearing may be checked by holding the above-established course and flying over and past the transmitting antenna far enough to obtain steady indications.

B. After the zero bearing has been checked, a calibration flight procedure similar to that shown in Figure 47 should be followed. Briefly, the procedure is to obtain bearing indicator readings for every 15-degree (or less) change in gyro heading of the aircraft during two 360-degree turns of equal diameter. The turns are made in opposite directions and started and finished over a given point on the ground. The lengths of all 15-degree courses should be equal so that a circle is approximated. Two bearing indicator readings will be obtained for a given gyro reading after the two turns have been completed (one for each turn). The average of these two indicator readings is used in determining the compensator corrections.

C. Locate a suitable ground check point, such as a road intersection or small town not less than 60 miles from the radio station to be used. The station should provide good bearings with little or no fluctuation of the bearing indicator in the vicinity of the ground check point. Approach the ground check point from the side opposite the transmitter so that the aircraft heads directly toward the transmitter. Use the radio bearing indicator to establish this heading by orienting the aircraft until a radio bearing of zero degrees is obtained. If results of the zero-heading check of paragraph A above indicate that the zero heading of the aircraft does not coincide with the zero radio bearing (within ±2 degrees), orient the aircraft so that the zero-heading radio bearing obtained in paragraph A above is indicated.

D. With the aircraft in steady, level flight and on a heading of zero degrees with respect to the transmitter, set the directional gyro to zero. Hold this course and release the gyro caging knob before the ground check point is reached. The radio bearing indicator reading must be zero or the same reading obtained in paragraph A above, when the aircraft is directly over the ground check point.

E. Change the heading of the aircraft by a smooth and even turn to establish a gyro heading of 345 degrees. After a steady 345-degree heading has been attained with the aircraft in level flight, note and record the radio bearing indicator reading on a chart similar to that shown in Figure 49. Not more than 20 to 25 seconds should be required for each heading after several trial headings have been made.

F. Decrease the gyro heading of the aircraft from 345 to 330 degrees by a smooth turn. Note and record the radio bearing indicator reading after a steady and level heading has been established and just before the turn is started for the next gyro heading of 315 degrees.

G. Continue in this manner to obtain bearing indicator readings for each 15-degree change in gyro heading of the aircraft, always establishing steady course and level flight conditions before the bearing indicator is read. Record the readings for each course on a form similar to Figure 49.

H. The finish of the 15-degree gyro course should bring the aircraft directly over the ground check point if the complete left turn has been properly executed. After the radio bearing has been obtained for a 15-degree gyro heading, turn the aircraft for a zero-degree radio bearing (or the radio bearing noted in paragraph A above). The aircraft should now be flying on the original starting line over the ground check point and headed directly toward the transmitter. Note and record the gyro reading for this heading of the aircraft. The gyro should check its original setting within 2 to 3 degrees if all turns have been carefully made.

I. If the gyro reading checks with its original zero setting when the aircraft is over the ground check point and headed directly toward the transmitter, as indicated by the radio bearing indicator, make a right turn to establish a gyro heading of 15 degrees, thus beginning the second half of the calibration procedure. If the gyro reading does not check its original setting, establish a zero reference course, as mentioned in paragraphs C and D above.

J. Obtain radio bearing indicator readings for every 15-degree change in gyro heading of the aircraft following the same procedure given above, making a series of right turns instead of left turns. Execute the complete 360-degree right turn so that the diameters of the two circles approximated during the left and right turns are as nearly equal as possible. Record the data obtained on a form similar to Figure 49.

K. Take the average of each pair of radio bearing indicator readings for a given gyro heading. These averages are to be used for obtaining the corrections to be applied at 15-degree intervals on the loop compensator unit.

L. The accuracy of this calibration procedure depends on the diameter of the two circles and the distance of the ground check point from the radio station if other errors due to flight conditions and observational errors are neglected. The ground check point should be as remote as possible from the radio station, consistent with good radio bearing indications, and the diameter of the two circles should be equal and as small as possible. For example, a maximum error of 0.5 degree is introduced on some courses if the ground check point is 90 miles from the radio station and the two circles are 8.5 miles in diameter. This error would be increased to approximately 2.0 degrees for a distance of 30 miles and circle diameters of 8.5 miles. Hence it is recommended that the ground check point be at least 60 miles from the radio station, and that the diameters of the circles be less than 9 miles.

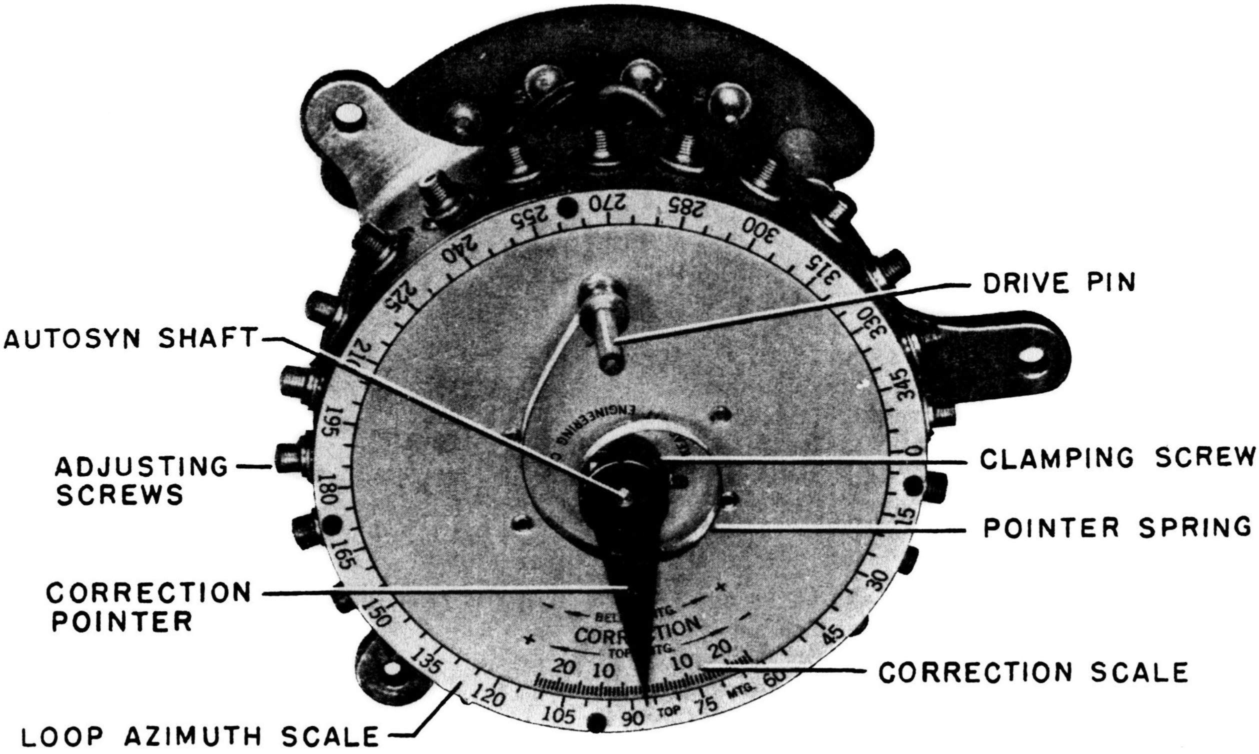


FIGURE 15—LOOP COMPENSATOR ASSEMBLY, FRONT VIEW

4-1-4. ADJUSTMENT OF QUADRANTAL ERROR COMPENSATOR (See Figure 15)

The quadrantal error determined in accordance with paragraph 4-1-3 may be so corrected by the compensator located in the Type MN-36A Automatic Loop that corrected bearings may be read directly from the bearing indicator pointer. This correction is accomplished as follows:

A. Determine the radio bearing 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 Radio Compass Quadrantal Error Calibration sheets included in this book to record corrections. Typical examples of quadrantal error data are shown in Figures 51 and 52. Figure 51 shows the quadrantal error data obtained by the ground reference-line method, and Figure 52 shows data obtained by the two-circle method. Referring to Figure 51, for a gyro heading of 15 degrees, the *True Radio Bearing* is 345 degrees and the *Observed Radio Bearing* is 350 degrees. Subtracting 350 from 345 gives a correction of -5.0 degrees. Plotting the -5.0 degree correction against an *Observed Radio Bearing* of 350 degrees gives one point on the correction curve. Similarly, the correction for a gyro heading of 135 degrees is 225 degrees minus 214 degrees or +11.0 degrees. Plot the +11.0 degree correction against an *Observed Radio Bearing* of 214 degrees for another point on the correction curve. Repeat the above procedure for each gyro heading and thus obtain the plot points for the correction curve shown in Figure 53. Referring to Figure 52, a gyro heading of 15 degrees gives an *Observed Radio Bearing* of 350 degrees for a left-turn circle and 350 degrees for a right-turn circle. The *Average Observed Radio Bearing* is therefore 350 degrees, and the *True Radio Bearing* is 345 degrees. Subtracting the *Average Observed Radio Bearing* from the *True Radio Bearing* gives a *Bearing Correction* of 345 degrees minus 350 degrees or -5.0 degrees. Similarly, the *Average Observed Radio Bearing* for a gyro heading of 135 degrees is 214 degrees, and the correction is 225 degrees minus 214 degrees or +11.0 degrees.

B. Plot a correction curve similar to that shown in Figure 53, using the data obtained in paragraph A above. 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 ±25 degrees, and the change in correction from any 15-degree point to the adjacent 15-degree point not exceeding 12 degrees), the corrections can be compensated for on the loop compensator. If the errors exceed ±25 degrees and yet the curve is sinusoidal, corrections up to 25 degrees may be compensated for on the compensator but it will be necessary to apply any corrections over 25 degrees by using a correction curve. If there are sharp discontinuities in the curve (rate of change of correction exceeding 12 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 re-run 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 re-run the calibration.

D. Determine the corrections to be applied at each 15-degree point on the loop compensator 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 48 or 49. For example, referring to Figure 53, the *Correction* for an *Azimuth Scale* reading of 15 degrees is +7.0 degrees. The correction values and azimuth scale readings are recorded in the last two columns of the data sheet and are arranged in the order in which the corrections are set up on the compensator adjusting screws. *Note that the correction values to be applied to the compensator are not those determined from the flight calibration.*

E. Remove the compensator assembly from the loop. To accomplish this, first remove the complete loop assembly from the aircraft. Remove the bottom cover plate by removing the 8 flat-head screws. Disconnect the four connector lugs from the terminal board on the compensator assembly by removing the four screws. Remove the 3 fillister-head mounting screws. (See Figure 18) Lift the compensator assembly from the loop base casting.

F. Lay the compensator assembly with the azimuth scale up and note if the proper azimuth scale is in place (red for belly mounting, black for top mounting). Remove the adjusting-screw wrench from its helical spring mounting on the side of the compensator assembly.

G. Set the zero-correction point on the correction scale opposite the loop azimuth-scale zero. The inner scale may be rotated by holding the assembly and rotating the inner scale with the drive pin, taking care not to place excessive axial pressure on the drive pin. Turn the adjustment screw opposite the zero azimuth point inward or outward until the proper plus or minus correction is indicated by the compensator pointer. The correction-scale zero is set opposite each 15-degree azimuth scale point, and the adjusting screw is turned until the compensator pointer indicates the proper correction as obtained from the Quadrantal Error Calibration described in paragraph 4-1-4A.

H. Rotate the correction scale until the zero is opposite the 15-degree point on the loop azimuth scale. Turn the adjusting screw opposite this point until the proper plus or minus correction is indicated by the compensator pointer.

I. The above procedure should be followed for each of the 24 compensating screw positions, taken in the order listed in the Compensator Correction column of Figure 48 or Figure 49 (i.e., working alternately clockwise and counterclockwise from the zero position).

J. Rotate the correction scale around the loop azimuth scale from 0 to 345 degrees. Check the corrections as indicated by the correction pointer at every 15-degree azimuth scale point. If there is any discrepancy, carefully readjust all screws, and recheck. The correction pointer should follow the quadrantal error correction curve to better than 1 degree when properly adjusted, provided that the curve is essentially sinusoidal (smooth and with no sharp discontinuities).

K. Replace the compensator in the loop assembly by carefully setting it in place, being sure that the drive pin is aligned with the slot in the loop shaft gear. Replace the three mounting screws. Reconnect the four terminals. Replace the bottom mounting plate, taking care that the neoprene gaskets are in place. Replace the 8 flat-head screws and securely tighten and stake them. Mount the loop on the aircraft, taking care to seal it to the structure and to see that the index lines on the edges of the mounting plate are exactly aligned with the fore-and-aft line.

L. Recheck in accordance with paragraph 4-1-3. The Observed Radio Bearing should be equal to the True Radio Bearing if all corrections have been properly made and data accurately taken.

NOTE:—Do not attempt to apply corrections greater than 25 degrees or to apply sharp changes in correction, or the compensator tape will be damaged beyond repair.

Do not attempt to apply a large correction (over 10 degrees) when no correction has been applied to the adjacent correction point.

To avoid kinking the tape, apply all corrections in each direction from the 0-degree point, as the ends of the tape overlap at the 180-degree point.

5. OPERATION

5-1. GENERAL

A. Set the function switch on the Type MN-28 Remote Control Unit to COMP. or REC. ANT. position, as desired.

B. Rotate the bandswitch to the frequency band in which operation is desired.

C. Turn the TUNING crank to the desired station frequency in kilocycles and rotate the crank back and forth through resonance to determine the exact setting of the dial for maximum clockwise deflection of the tuning meter or for maximum and clearest headset signal. Listen for station identification to be sure the correct station is being received.

5-2. HOMING

For homing operation, perform the operations of paragraph 5-1, and proceed as follows:

A. Turn the VAR. knob on the bearing indicator until the azimuth zero is at the zero index.

B. Switch to COMP.

C. Apply rudder in the direction shown by the bearing indicator pointer. When the bearing indicator needle is at the zero index, the aircraft is headed toward the radio station. The bearing indicator pointer always points toward the radio station. If the pointer is to the right of the zero index, the station is to the right of the aircraft's heading.

D. Adjust AUDIO control for satisfactory headset level.

E. Since in COMPass operation the equipment has an excellent automatic volume control action, it is not practical to home on a radio range course and fly it aurally at the same time.

F. In radio compass homing operation the aircraft will ultimately arrive over the radio station antenna regardless of drift due to the cross wind. However, the flight path will be a curved line and coordination with ground fixes or landing fields along the route will be either difficult or impossible. Consequently, it is often expedient to fly a straight line course by off-setting the aircraft's heading to compensate for wind drift. To do this determine the wind drift either with the drift sight or by noting the change in magnetic compass reading over a period of time, while homing with the radio compass. A *decreasing* magnetic bearing indicates a wind from the *left* while an *increasing* magnetic bearing indicates a wind from the *right*. By trial and error, find the correct up-wind radio compass angle, as shown by the bearing indicator pointer, which provides the minimum rate of change of magnetic compass reading. The scale on the bearing indicator shows the deviation of the aircraft's heading from the direction of the radio station directly in degrees.

5-3. DIRECTION FINDING

For operation as an automatic visual indicating direction finder, perform the operations of paragraph 5-1, and proceed as follows:

A. Switch to COMP.

B. Adjust AUDIO control for desired headset level.

C. Using the VAR. knob on the bearing indicator, set the bearing scale so that the numerical value of the aircraft's magnetic heading is at the index mark. Note that the magnetic compass reading must be corrected at some points to obtain the magnetic heading of the aircraft.

D. Determine the magnetic variation for the locality, and rotate the VAR. knob for the required correction in the direction indicated by the arrows. The knob is marked with arrows to show the proper direction of rotation to compensate for East or West variation.

E. Record the bearing shown by the tail end of the bearing indicator pointer. (This will be station-to-aircraft-bearing from north.)

F. To obtain a fix, take bearings on two or more stations, 30 degrees or more from the line of direction of any one station, and plot them on a map. The intersection of the plotted lines is the position of the aircraft at the time of observation.

G. For best accuracy, several bearings should be taken in rapid succession thereby eliminating error caused by the distance traveled between bearing observations. Bearings cannot be accurate unless the aircraft can be held on a steady heading.

H. Prior to making fix determinations, the stations to be used should be located on the map, tuned in, identified, and the dial reading logged. This avoids delay and error at the time of obtaining the fix.

I. In this equipment, the quadrantal error correction is accomplished automatically and need not be considered when taking bearings.

5-4. ANTENNA AND LOOP RECEIVER OPERATION

Perform the operation described in paragraph 5-1, and proceed as follows:

5-4-1. ANTENNA RECEPTION

A. Set function selector switch to REC.ANT. and adjust the AUDIO knob on the Type MN-28 Remote Control Unit for satisfactory headset volume.

B. For the best definition of radio range signals (between 200 and 400 Kcs), adjust the AUDIO knob for the lowest usable headset volume.

C. For reception of CW telegraphic signals, turn C.W. switch ON, and adjust tuning for the best CW beat note.

5-4-2. Loop Reception

A. If reception on antenna is noisy because of precipitation static, commonly known as rain or snow static, loop reception may be employed for better results. Turn function selector switch to REC. LOOP position and rotate the loop by means of the LOOP L.R. switch until maximum signal strength is obtained. Adjust AUDIO knob for desired headset volume. To rotate loop at high speed, depress LOOP L.R. knob and turn to L. or R.

B. For the best definition of radio range signals on REC. LOOP, it is necessary to maintain the loop near the 90- or 270-degree position and adjust the AUDIO knob for the lowest usable headset volume.

NOTE: Cone of silence indications with REC. LOOP operation depend on the particular type of range transmitting antenna and the mounting of the loop on the aircraft, and therefore are not always reliable. In some cases, an increase, instead of decrease, in signal strength will be noted.

5-4-3. Loop Direction Finding or Homing

A. Set switch to REC. LOOP, and adjust the AUDIO knob on the Type MN-28 Remote Control Box for satisfactory headset volume.

B. Rotate the loop for minimum headset volume, and read the bearing indicator. If the signal null exists over too wide an angle, greater accuracy may be obtained by placing the AUDIO knob on maximum and locating null by either listening for the disappearance of the audio signal or noting the dip in the tuning meter deflection. To obtain sharper nulls, turn the C.W. switch to ON, and adjust tuning for clearest headset beat note.

NOTE: A loop alone has two zero-signal positions 180 degrees removed from each other. Therefore it is necessary that bearings taken by the loop null method be resolved of their 180-degree ambiguity by comparing them with the magnetic heading.

5-5. PRECAUTIONS DURING OPERATION

A. For aural reception of A-N signals, operate the equipment on REC. ANT. or REC. LOOP instead of COMP., since the action of the AVC in the COMP. position will cause broad course indications.

B. For best definition of A-N signals on REC. ANT. or REC. LOOP, the AUDIO control must be set to the lowest usable audio level and must be reduced as A-N signals increase. When the signal in the headset is very loud, the AVC circuit operates to prevent overloading of the receiver, thereby preventing reversal of course (N instead of A or vice versa).

C. During periods of precipitation static, operate on REC. LOOP, and, for best reception, rotate the loop until a maximum signal is obtained.

D. When determining direction on REC. LOOP by the aural-null method, there is a 180-degree ambiguity, and the direction of the station may be 180 degrees from the null obtained. The broadness of the null with aural-null direction finding depends on the strength of the signal. Strong fields produce very sharp nulls, sometimes as small as one-tenth (0.1) degree. Vary the AUDIO control until the null is of satisfactory width. The tuning meter may be used as a visual null indicator if available in the particular installation.

E. If the loop should be in the null-position when flying on a radio range course, the signal may fade in and out and possibly be mistaken for a cone of silence.

Cone of silence indications are not reliable on loop-type radio range stations when the radio compass is operating on REC. LOOP. The signal may increase in volume to a strong surge instead of indicating a silent zone when directly over the station.

F. Select radio stations providing stable bearings. Tune the equipment carefully. If an interfering signal is heard in the headset, it is probably causing an error in bearing. To check, tune a few kilocycles either side of maximum. A change in bearing with tuning indicates an interfering signal. The direction of the interfering signal can be read on the bearing indicator. If station interference exists, select another station, or proceed by means of navigation until closer to the desired station. Care must be exercised when taking bearings on stations broadcasting the same program as they may be mistaken for each other. Avoid taking bearings on synchronized stations unless close to the desired station. If the radio station stops transmitting or fades, especially code stations operating in a network, bearings might be taken on other stations of the same frequency, thus causing errors. Do not use a station for bearings unless it can be identified by the headset signal on COMP. operation.

G. Check the dial calibration against actual station frequencies. If the calibration is wrong, report the defect.

H. Fly the aircraft with the bearing indicator pointer at the zero index or fluctuating equally slightly left and right.

I. Do not depend on the tuning meter as a distance meter.

J. Do not disturb any internal adjustments.

K. Night effect, or reflection of the radio wave from the sky, is always present. It may be recognized by a fluctuation in bearings. The remedy is: (1) increase altitude, thereby increasing the strength of the direct wave; (2) take an average of the fluctuations; or (3) select a lower frequency station. Night effect is worst at sunrise and sunset. Night effect may be present on stations operating at 1500 Kcs at distances greater than 20 miles. 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 than stated above, and, sometimes, unsatisfactory bearings may be obtained at shorter distances.

L. When close to a station, accurate bearings cannot be taken with the aircraft in a steep bank.

M. Do not depend on two stations for a fix of location. At least three station bearings, which will plot as a triangle to give an average should be used. In general, a set of stations with bearings spaced at approximately equal intervals throughout 360 degrees will give best results.

N. This equipment should provide compass bearings during conditions of moderate precipitation static which interrupt normal reception. On occasions where severe precipitation static is present, especially when discharges occur from parts of the aircraft surfaces, it will be necessary to operate on REC. LOOP position. In this position, satisfactory reception and aural-null direction finding will be possible most of the time. The type of precipitation static existing in air mass fronts at different temperatures can be avoided by crossing the air mass front at right angles and then proceeding on the desired course instead of flying along the air mass front.

6. MAINTENANCE

NOTE: Adjustments, repair, or disassembly of the equipment should not be attempted by personnel not trained to service this type of equipment. Trained personnel and suitable laboratory equipment must be available before the equipment can be properly tested for major faults. (See paragraph 6-5)

6-1. OPERATIONAL INSPECTION OF EQUIPMENT WHEN MOUNTED IN AIRCRAFT

The inspection of the Model MN-31 Automatic Radio Compass Equipment, when mounted in aircraft, should be sufficiently thorough to determine whether or not the equipment is in working order. This inspection should be made with the airplane at least 200 feet distant from hills, buildings, towers, telephone lines, power lines, and other large conductive objects which would be likely to distort the radio frequency field.

A. Check the mounting of all components.

B. Inspect all plugs and mechanical couplings, and make certain that they are securely seated and that the outer collar is tight enough to prevent movement of the flexible conduit or mechanical cable in the couplings. Check headset cords. Clean all headset plugs. (A three-inch pencil eraser provides a simple means for cleaning these plugs.)

C. Make sure that the loop is securely mounted and sealed.

D. Check the condition of the storage battery and the voltage regulator on the charging generator, adjusting the regulator to insure a stable voltage across the battery of 14 or 28 volts as required.

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

F. Check connection of lead-in wires at both the antenna and receiver.

G. Check all instrument lamps.

H. Operate equipment as a receiver. Tune in different stations in each band. Select stations providing weak signals, and check receiver sensitivity. Check the operation of all controls, both local and remote. Check noise level in equipment. Check frequency calibration on remote control unit dial.

I. Operate equipment as an automatic compass. Check bearings of stations in each band against known bearings. Select stations providing weak signals. Check bearing indicators for correct sensing. The indicator position should point in the direction of the station.

J. Start aircraft motors. Repeat procedure of paragraphs 6-1H and 6-1I, above. Check for any increase in noise and instability of indicator pointer.

6-2. ROUTINE INSPECTIONS AND OVERHAUL OF EQUIPMENT

NOTE: Remove Type MN-26 Radio Compass, Type MN-28 Remote Control Unit, Type MN-31 Automatic Loop Control, Type MN-37A Bearing Indicator, and Type MN-36A Automatic Loop from the aircraft, and take into a properly equipped radio inspection shop. It is recommended that this inspection and overhaul be done after 200 hours of flight or every 6 months, whichever period is shorter.

6-2-1. General — Applicable to All Parts

Inspect all nuts, bolts, and screws for tightness. Do not tighten glyptalled screws or nuts unless it is evident they are loose. In the event they are loose, remove the screws or nuts, apply glytal, replace, and tighten. Remove loose solder, dirt, and metallic chips. Clean equipment thoroughly, and touch up scratched paint. Remove all traces of corrosion. Inspect soldered joints. Inspect wiring. If more than two strands are broken at a soldered joint, resolder the connection. Inspect all plug connectors and clean if necessary.

6-2-2. Type MN-26 Radio Compass

A. Inspect unit as described in paragraph 6-2-1 but do not disturb alignment adjustments. Do not disturb wiring unless necesssary.

B. Check all tubes. If the tube plate current of any tube is less than 80% of normal plate current with 6.3 volts on the heater, replace the tubes. Replace all tubes used over 500 hours. See that all tubes are securely mounted in their sockets.

C. The dynamotor should be inspected after 1000 hours of service or once a year, whichever period is shorter. Disassemble the dynamotor as described in paragraph 6-4-1-4. 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 and clean with hot lubricating oil. Check bearings for tolerances and broken or chipped balls. Clean away all old grease. Relubricate as specified in paragraph 6-3. Wipe off dirt from commutator, end bells, armature, and housing. If commutators do not have a smooth, even surface, place the armature in a lathe and rotate it. Polish the faulty commutator with a piece of soap stone, or take a very thin (.003-inch) cut, using a lathe. Do not use sandpaper or deformation of the commutator bars may result. *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 sanded or turned down simply because it is discolored.* Under normal conditions, the commutators should not require turning down before the expiration of 5,000 hours of service. After turning down, the commutator should be carefully examined to see if under-cutting 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 gears and tuning shaft coupling as specified in paragraph 6-3.

E. Tuning Capacitor. Inspect for dirt between plates. Carefully clean with pipe cleaner. *Do not bend plates. Do not lubricate.* Do not blow out, as air hose may contain water or produce sufficient pressure to bend plates.

F. Band Switch. Remove the band switch drive assembly from the chassis in accordance with paragraph 6-4-1-5. Disassemble the band switch motor as described in paragraph 6-4-1-6 and make an inspection similar to that described for the dynamotor in paragraph 6-2-2C above. Inspect and clean the gears, bearings, cams, and switches contained in the cast housing. Relubricate as specified in paragraph 6-3.

G. Test in accordance with paragraph 6-8 if there is any reason to suspect that performance is not normal.

6-2-3. Type MN-31 Automatic Loop Control

Inspect as indicated in paragraph 6-2-1. Make same inspection and overhaul of the 400-cycle inverter as described in paragraph 6-2-2C for dynamotor. Test in accordance with paragraph 6-5-4-6B if there is any reason to suspect abnormal operation.

6-2-4. Type MN-28 Remote Control Unit

Inspect as indicated in paragraph 6-2-1. Clean and lubricate dial tuning mechanism and tuning shaft coupling as described in paragraph 6-3.

6-2-5. Type MN-36A Automatic Loop

Inspect as indicated in paragraph 6-2-1. Clean off all grease and dirt, and repaint outside of housing if necessary. Remove mounting base and inspect neoprene gaskets for proper sealing. Inspect all bearings and gears for evidence of corrosion. Relubricate in accordance with paragraph 6-3, if necessary. Make sure that the loop, gears, motor, and compensator assembly rotate freely. Inspect loop slip rings and brushes to see that they are making firm contact and are not corroded. Clean and relubricate if necessary. See paragraph 6-4-4 for disassembly instructions.

Inspect the dehydrator unit for proper hose connections and check condition of the silica gel crystals contained in the tube. When a definite color change in the crystals is noticed over more than half the length of the tube, remove the crystals and dry at a temperature of not over 350°F or replace with a fresh supply.

6-2-6. Type MN-37A Bearing Indicator

Inspect as indicated in paragraph 6-2-1. Check to see that bearing scale can be rotated but yet is not free enough to move as a result of vibration. Check for position of the electrical zero in accordance with paragraph 6-5-4-2. See that the alignment slot screws are tight and that alignment marks are aligned with each other. Be sure that the instrument lamps are tight in their sockets. Do not disassemble the autosyn motor unless competent instrument service personnel is available, and then, only after 1000 hours of operation for lubrication of bearings, in accordance with paragraph 6-3. Be sure that the glass face cover is not loose and that the retaining spring is in place.

6-2-7. Performance Tests of Compass Operation

Reassemble equipment and measure overall performance as described in paragraph 6-8, if a compass test setup is available; otherwise make performance tests in the aircraft in accordance with paragraph 6-1. Vibrate the equipment when operating, and note clicks or increase in noise when receiving a weak signal, or without any signal. If the equipment is noisy or fails to meet the specified performance, reexamine until the trouble is discovered and corrected.

6-2-8. Type MS-14C Junction Box and Interconnecting Cables

Do not remove from the aircraft. Inspect all terminals in the junction box for tightness or broken strands of wire. Inspect wiring and soldered connections at each cable plug receptacle for abrasion of insulation, broken strands, or possible sources of trouble in soldered connections. Inspect bonding in aircraft.

6-2-9. Inspection in Aircraft After Overhaul

Repeat operational inspection in aircraft in accordance with paragraph 6-1.

6-3. LUBRICATION

Do not lubricate the variable tuning capacitor, potentiometers, or dynamotor commutators. When packing ball bearings *do not* wash out the old grease with a solvent of any kind, but force the old grease out with the new grease. Use extreme care not to get excess grease on other parts or windings. When lubricating the autosyn motors or loop driving motor with Pioneer #2 Instrument Oil, use sparingly, and do not get excess oil on windings. Under no circumstances should these bearings be washed unless they should be extremely gummy and dirty, in which case they can be washed with hot Pioneer #2 Instrument Oil. Do not handle these bearings with bare hands, but use tweezers, as body acids will cause corrosion.

Royco #6A Grease is a grease specially selected and compounded for lubrication at temperatures from +60°C to −40°C and for non-corrosion of parts. This grease may be obtained from the Royal Engineering Corp., Hanover, N. J. An equivalent grease, Lubrico M6, is also satisfactory and may be obtained from New York and New Jersey Lubricant Co., Newark, N. J.

Pioneer #2 Instrument Oil is an oil having a special base to allow extremely free rotation of bearings at temperatures from +60°C to —40°C and may be obtained from Pioneer Instrument, Division of Bendix Aviation Corp., Bendix, N. J.

The following parts require lubrication after the operating service time indicated.

Part	Time	Lubricant
Ball Bearings in Dynamotor	1000 Hours	Royco #6A Grease
Ball Bearings in 400-cycle Inverter	1000 Hours	Royco #6A Grease
Ball Bearings in Automatic Loop	1000 Hours	Royco #6A Grease
Loop Gears	1000 Hours	Royco #6A Grease
Ball Bearings in Loop Driving Motor	1000 Hours	Pioneer #2 Instrument Oil
Ball Bearings in Loop Autosyn Motor	1000 Hours	Pioneer #2 Instrument Oil
Ball Bearings in Indicator Autosyn Motor	1000 Hours	Pioneer #2 Instrument Oil
Ball Bearings in Tuning Drive	1000 Hours	Royco #6A Grease
Tuning Dial Gears	1000 Hours	Royco #6A Grease
Motor Ball Bearings—Band Switch	1000 Hours	Royco #6A Grease
Gears and Bearings—Band Switch	1000 Hours	Royco #6A Grease
Ball Bearings and Gears in Tuning Drive	1000 Hours	Royco #6A Grease
Mechanical Tuning Shafts	1000 Hours	Royco #6A Grease
Cable Plug Threads	1000 Hours	Aluminum Anti-sieze Compound

6-4. DISASSEMBLY OF UNITS

6-4-1. Type MN-26 Radio Compass

6-4-1-1. Removal of Cabinet from Base

The radio compass, with its cabinet, is removed from the mounting base by turning the three Dzus fasteners on the front of the base counterclockwise ½ turn, lifting the front end up slightly, sliding forward one inch or more, and lifting from the base.

6-4-1-2. Removal of Chassis from Cabinet

The chassis is removed from the cabinet by unscrewing the thumb screw at the lower center of the front panel until the chassis is free and then withdrawing the chassis. It is not necessary to remove the cabinet from the mounting base in order to remove the chassis from the cabinet.

6-4-1-3. Removal of Dynamotor

A. Remove the three screws holding the cover of the hash filter. (See Figure 4) Lift off the cover.

B. Disconnect the three dynamotor leads from the terminal board.

C. Cut the safety wire securing the dynamotor mounting screws, and remove the screws. Do not let the dynamotor drop, but remove carefully from the chassis.

6-4-1-4. Dynamotor Disassembly

A. Cut the safety wire on the screws holding the dust covers, remove the screws, and slide off the dust covers.

B. Unscrew the brush retainers and remove the brushes.

C. Unscrew the frame bolts, and remove the end brackets. Slide out the armature.

D. Unscrew the field retaining screws, and remove the fields. Be careful not to damage the wiring or insulation.

E. In reassembling the dynamotor, make sure that the armature is replaced in the proper position. The commutator with the wide segments should be at the low voltage end-bracket. Clean out carefully any dust or other foreign matter which might interfere with the armature clearance. Replace the brushes in their proper location with the + or -- marking on the brush facing the corresponding marking on the end bracket. Apply glyptal cement to the frame bolts and field retaining screws. Replace the safety wire.

6-4-1-5. Removal of Band Switch Drive Assembly from Chassis

A. Remove the nameplate from the front panel. This exposes the switch shaft hole. Remove the phenolic retaining plug from the hole. With a pair of long-nose pliers pull the shaft outward and remove.

B. Unsolder the five wires attached to the rear end of the terminal board running along the center of the underside of the chassis. Remove the lead soldered to the ground lug of V9 which is contained in the cable that goes up through the chassis to the band switch drive assembly.

C. Remove the two #8 screws (located near the rear end of the above terminal board) that secure the band switch drive assembly casting to the chassis, and lift out the assembly.

D. To disassemble the band switch drive assembly after removal from the chassis, remove the three screws passing through the two halves of the casting and the four screws which secure the motor to the casting. The two halves of the casting will then come apart for inspection of bearings, switch, and gears. When reassembling, apply a small amount of glyptal to all screw threads.

6-4-1-6. Disassembly of Band Switch Motor MO1

The band switch motor MO1 is disassembled as follows:

A. Unsolder the red, brown, and blue wires from the motor to the switch wafer.

B. Loosen the setscrew, and remove the worm gear from the motor shaft.

C. Remove the brush retaining screws on the sides of the motor, and withdraw the brushes.

D. Remove the two screws from the brush-bell. Tap the rim of the front end-bell *lightly* with a wooden mallet or block until it separates enough from the housing to permit the insertion of a screwdriver blade. Pry the end-bell off the housing, being careful not to damage either.

E. The armature will probably be removed with the end-bell, and, if so, can be separated from it by tapping lightly on the motor shaft with a wooden mallet or block.

F. The rear end-bell is removed from the housing in the same way as the front end-bell. The brush holders are removed from the end-bell by removing the setscrews that secure them.

G. In reassembling the motor, the brush holders should first be mounted in the rear end-bell and the end-bell pressed onto the housing. Make sure that the notch in the rim of the end-bell registers with the positioning stud in the housing. Next, set the armature in place and tap lightly to seat the rear bearing. Press the front end-bell in place, with the notch in the rim in line with the positioning stud, and draw up tightly by means of the two frame screws. Reassemble the brushes, making sure that the brush marked + is mounted in the brush holder marked + and that both brushes are mounted with the markings on the brush facing the markings on the end-bell. Replace the brush retaining screws being careful not to twist the brush wires. Replace the worm gear. Resolder the wires to the proper terminals on the switch wafer. Apply glyptal cement to all screws.

H. When reassembling the band switch drive assembly to the chassis, make sure that the rotor of each switch wafer in the radio frequency can assemblies is in the same relative position before attempting to insert the band switch drive shaft. Take extreme care not to force this shaft through the switch wafers, but work it gently through each switch wafer. If the radio frequency cans have been removed from the chassis, leave their chassis mounting screws and top plate retaining screws loose until the switches are carefully aligned so that the shaft may be pushed through each can without undue force. The alignment of the switch wafers may be determined by placing a light at the rear of the band switch drive assembly, sighting through from the front panel, and noting that the locating notches in all switch rotors are aligned. After the band switch drive shaft has been inserted with ½ inch of its length still protruding from the front of the panel, rotate the shaft without undue force to see that it rotates without damage to any switch wafer.

6-4-1-7. Removal of Antenna, Loop, Radio Frequency, or Oscillator Assemblies from the Chassis

To remove the antenna, loop, RF, or oscillator assemblies from the chassis, withdraw the band switch drive shaft, unsolder the leads from the terminals which project through the chassis, remove the two screws which secure each can to the chassis, and remove the cover plate screws on each assembly. When replacing these assemblies on the chassis, make sure that the arms of all switch wafers are in the same relative position before attempting to re-insert the band switch drive shaft. Refer to paragraph 6-4-1-6H.

6-4-1-8. Removal of T13, T14, or the IF Trap Assembly L2 and L3

To remove T13, T14, or the IF trap assembly, unscrew the nuts on the spade lugs and withdraw the shield can. Unsolder the leads from the terminals and remove the two screws holding the assembly to the chassis. In reassembling, do not tighten the screws holding the assembly until the shield can has been mounted and the nuts on the spade lugs brought up tight.

6-4-2. TYPE MN-28 REMOTE CONTROL UNIT

The tuning drive and dial mechanism may be removed from the remote control unit panel as follows:

A. Loosen the setscrews, and remove the tuning crank, the band selector switch lever, the function selector switch lever, and the audio control knob.

B. Remove the screws holding the center tapped resistor R35-3 to the side of the unit, the resistor R40 to the top of the unit, and the band switch wafer to the dial plate.

C. Remove the nuts holding the function selector switch and audio control to the panel.

D. Remove the two screws which secure the lamp socket and reflector assembly above the dial and the three larger screws which hold the tuning drive and dial assembly to the panel.

E. Withdraw the assembly, being careful not to damage the wiring or the dial.

6-4-3. Type MN-31 Automatic Loop Control

A. Removal of the Cabinet from the Base (See Figure 10)

The automatic loop control is removed from the mounting base by turning the Dzus fastener located on the front of the base counterclockwise ½ turn, lifting the front end of the unit up slightly and sliding forward one inch or more, and lifting from the base.

B. Removal of the Top Cover (See Figure 10)

To remove the cover, release the fastener on the front of the cabinet, lift the front of the cover about one inch, slide the cover back to disengage the two pins at the rear of the cabinet, and lift from the cabinet.

C. Removal of the Bottom Cover (See Figure 10)

Remove the 4 flat-head screws (2 on each side of the unit) which go through the bottom cover and lift the cover off. It is *not* necessary to remove the screws in the Cannon receptacle located on the front of the unit.

D. Removal of Inverter (See Figure 13)

1. Disconnect the three inverter leads from the terminal board on the underside of the chassis.
2. Unscrew the two mounting screws. Do not let the inverter drop, but remove it carefully from the chassis.

E. Inverter Disassembly

1. Remove the two screws holding the dust cover, and slide off the dust cover.
2. Unscrew the brush retainers, and remove the brushes.
3. Unscrew the frame nuts from the end opposite the brushes, and remove the end castings.
4. The armature will probably be removed with the end casting and, if so, can easily be separated from it by pulling the two items apart.
5. Clean out carefully any dust or other foreign matter which might interfere with the armature clearance. Replace the brushes in their proper location with the + or — marking on the brush facing the corresponding marking on the bracket.

F. Removal of Saturable Reactors T2 and T3 (See Figure 13)

If either of these two units is defective, it will be necessary to replace both units. Each reactor is numbered on the side of its case in addition to the Bendix number appearing on top of the unit. The number on the side of each unit in a given Type MN-31 Automatic Loop Control must be the same for satisfactory operation of the compass equipment.

6-4-4. Type MN-36A Automatic Loop

A. Removal of Loop Housing from Base Casting

Remove the 14 Allen-head screws around the top base casting. The housing is cemented to the base and it may be necessary to use a sharp tool to separate the two items. Rotate the housing to line up the opening in the loop housing with the loop, and slip the housing over the loop.

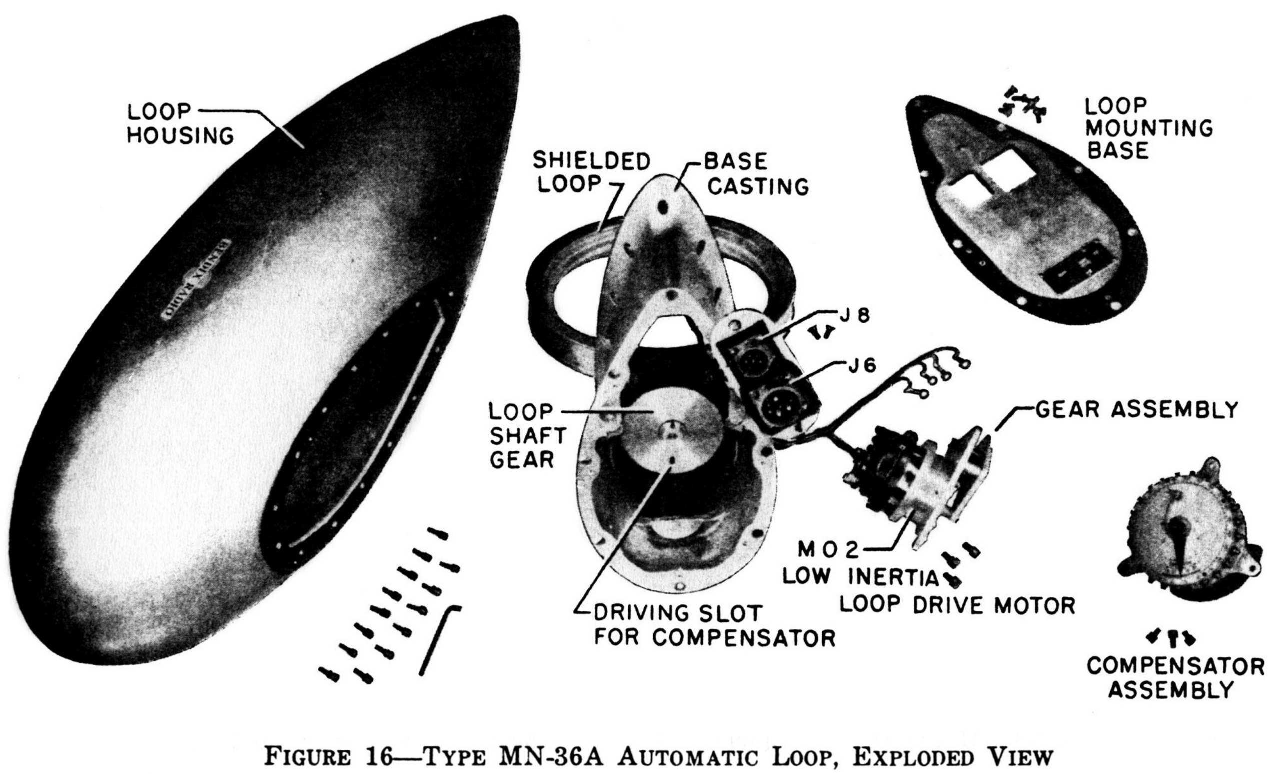


Figure 16—Type MN-36A Automatic Loop, Exploded View

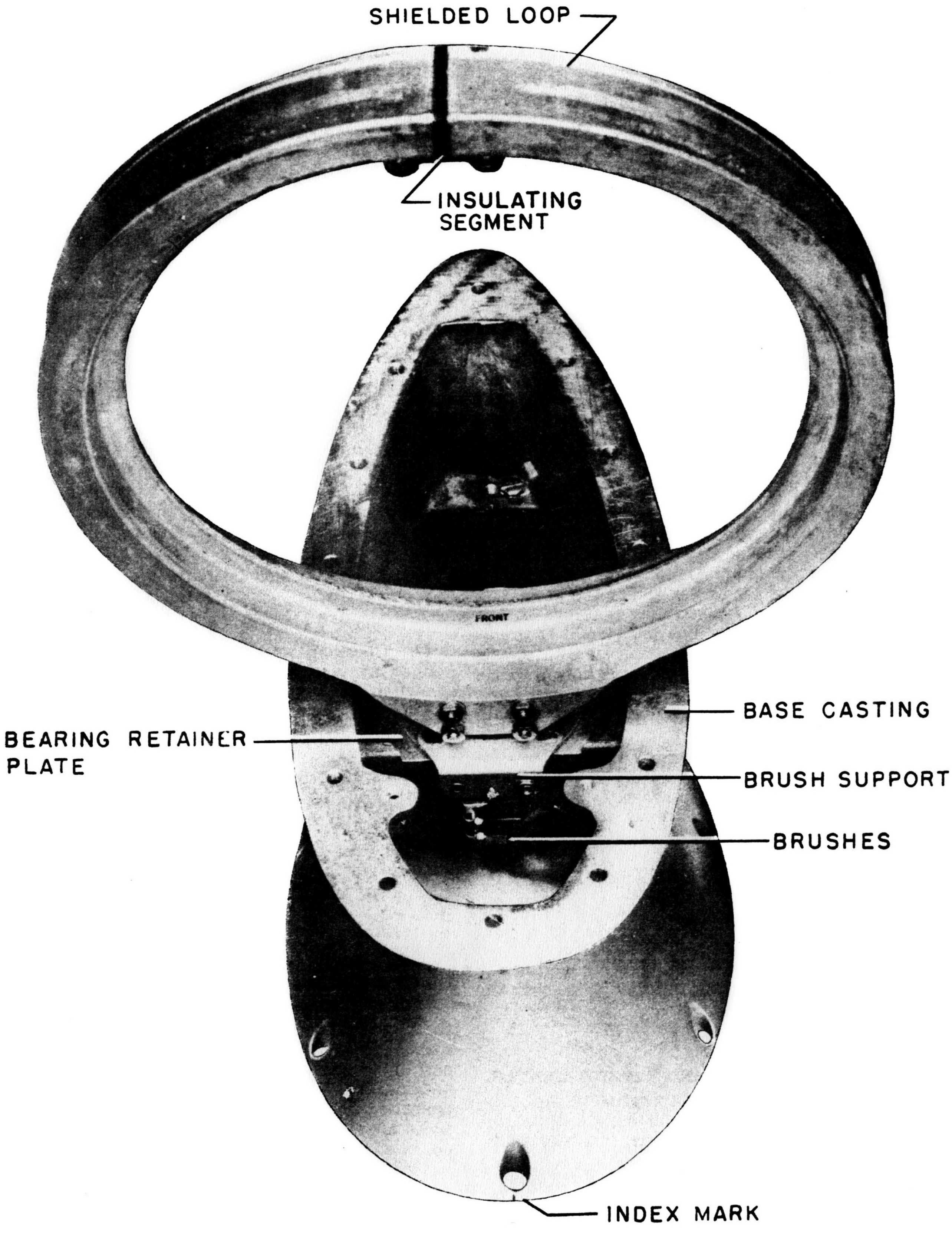


FIGURE 17—TYPE MN-36A AUTOMATIC LOOP, INTERNAL TOP VIEW

B. The loop base plate can be removed after the 8 flat-head screws are removed.

C. Removal of the Autosyn Transmitter and Compensator Assembly

1. Proceed as described in paragraph B above.
2. Remove the 4 leads connected to the unit.
3. Remove the 3 fillister-head screws, and lift the unit out of the casting.

D. Removal of the Loop Drive Motor

1. Proceed as described in paragraph B above.
2. Remove the 2 flat-head screws mounting the Cannon receptacle mounting plate assembly, and lift the assembly out of the base.
3. Remove the 3 leads connected to the motor.
4. Remove the 3 fillister-head screws holding the motor mounting plate to the casting.
5. Lift the motor and gear assembly out of the base casting.

E. Removal of Loop and Slip Ring Assembly

1. Proceed as described in paragraph C above.
2. Remove the taper pin holding the loop gear to shaft, and slide the gear off the shaft. *The taper pin must not be hammered loose.* If no suitable tool is available, one may be made by cutting a lengthwise slot in one jaw of a pair of gas pliers. In using these pliers, the slot is allowed to clear the larger end of the taper pin, and the opposite jaw applies pressure to the small end of the pin. The pin should snap out easily.
3. Proceed as described in paragraph A above.
4. Remove the 4 flat-head screws holding the brush assembly and bearing retaining plate to the casting.
5. The loop and slip ring assembly can now be released from the casting by tapping lightly on the shaft end of the loop assembly with a raw hide mallet. Pull the two items apart.

F. Removal of Dehydrator Unit

1. Remove the rubber tubing from the hose connection on one end of the dehydrator tube.
2. Cut the safety wires holding the tube in the mounting clips, and remove the tube from its clips.
3. Unscrew the knurled cap on the end of the tube opposite the hose connection to remove the silica gel crystals.

6-5. SERVICING DATA

6-5-1. Trouble Location and Remedy—General

The cause of unsatisfactory operation of the equipment should be traced to a particular component before any attempt is made to correct the difficulty. It is recommended that the procedure outlined below be followed unless the trouble is immediately apparent. Performance checks should be made after each trouble is located and corrected. If the trouble is located in any circuit that affects alignment of the receiver, all circuits involved should be realigned to insure optimum performance.

If extra equipment is available, the trouble may be localized to a particular unit by substitution of equipment known to be in operable condition. If the performance of any one unit is doubtful, make that substitution first, noting the performance of the system before further changes are made. This is usually the simplest and quickest method of localizing the difficulty to a particular unit.

All continuity measurements should be made with an ohmmeter and should be made through the cable and junction box unless the internal connections of a unit are being tested. Resistance and capacitance values are shown on the schematic diagram, as well as in the parts list. Tube socket voltage measurements should be made in accordance with paragraph 6-5-5.

If considerable variation from the values given is noted, the associated circuit element should be checked.

All vacuum tubes should be tested for emission and other characteristics. Defective tubes should be replaced.

If the equipment is totally inoperative, make the following checks before removing the units from the installation or proceeding with further tests:

A. Check for normal battery voltage.

B. Check fuse in remote control unit.

C. Check fuses in main fuse box.

D. Check operation of all switches and relays in the primary voltage supply system, including switch S8A in the Type MN-28 Remote Control Unit.

E. Test all cable and plug interconnections for continuity and possible short circuits.

F. Check operation of the dynamotor and inverter in the Type MN-26 Radio Compass and the Type MN-31 Automatic Loop Control, respectively.

If, after the above checks have been made, the equipment fails to operate on any band or any position of the remote control function switch, it is recommended that further tests be made with the equipment removed to a suitable test room.

6-5-2. Trouble Location—Procedure Outline

The following procedure is outlined for locating the source of trouble if the equipment operates below normal. Tests should be made in the order given, as certain troubles are eliminated if positive results are obtained for a specific test. Automatic compass operation should be tested first, since all component units are employed. Satisfactory results should be obtained for one test before making the next test. See paragraph 6-5-3 for test procedure.

A. Check Automatic COMPass Operation

1. Satisfactory operation in at least one band: proceed to test C.

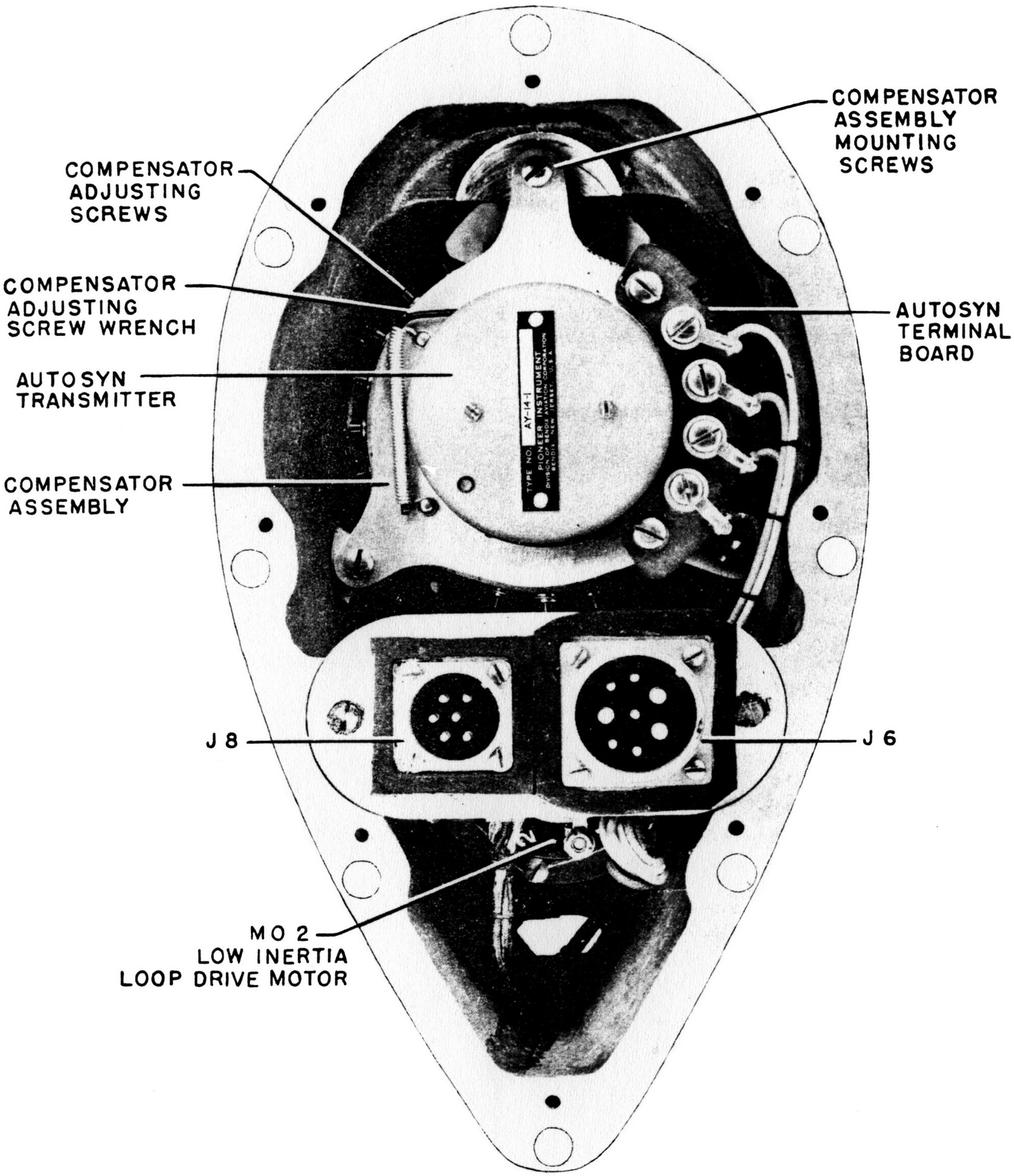


FIGURE 18—TYPE MN-36A AUTOMATIC LOOP, BOTTOM PLATE REMOVED

2. Unsatisfactory on all bands: proceed to test B.

B. Check REC. LOOP Operation

1. Satisfactory results: proceed to test C.

2. Unsatisfactory results: test Type MN-28, Type MN-36A, Type MN-37A, and Type MN-31 units.

C. Check REC. ANT. Operation

1. Satisfactory operation on all bands: proceed to test D.

2. Satisfactory operation on at least one band: test radio frequency and high frequency oscillator circuits on poor bands.

3. Unsatisfactory results on all bands: test audio, intermediate frequency, and radio frequency circuits.

D. Check REC. LOOP Operation

1. Satisfactory results on all bands: proceed to test E.

2. Satisfactory results on at least one band: test modulator and loop amplifier stages on poor bands.

3. Unsatisfactory operation on all bands: test modulator stages, loop amplifier stage, loop transmission cable, loop, and antenna relay.

E. Check COMPass Operation

1. Satisfactory results for manual loop control, REC. ANT. operation, REC. LOOP operation on all bands, but unsatisfactory operation for COMP. operation: test following compass circuits:

a. Audio oscillator (48-cycle)

b. Modulator stage

c. Compass output amplifier

d. Thyratron motor-control circuit

6-5-3. TROUBLE LOCATION—TEST PROCEDURE

These tests should be made with the aircraft clear of all metal hangars or buildings. If the equipment is tested with the aircraft inside a hangar, allowance must be made for the effects of the buildings on signal strength and bearing indications. Satisfactory bearings cannot be obtained when the equipment is located in or near a steel building.

A. Test Automatic COMPass Operation

1. Set function switch to COMP. position.

2. Tune in stations in each band.

3. Note operation of Type MN-37A Bearing Indicator for each signal.

4. If compass operation is unsatisfactory on all bands, proceed to tests B, C, D, and E.

5. If compass operation is satisfactory on at least one band,

a. Test the following operations on unsatisfactory bands:

(1) REC. ANT. operation

(2) REC. LOOP operation

b. The following sources of trouble are eliminated:

(1) Audio frequency amplifier, intermediate frequency amplifier, compass output amplifier, and dynamotor in Type MN-26 Radio Compass.

(2) Operation of the Type MN-31 Automatic Loop Control.

(3) Operation of the Type MN-36A Automatic Loop.

(4) Operation of the Type MN-37A Bearing Indicator.

B. Test REC. LOOP Operation

1. Set function switch to REC. LOOP position.

2. Operate LOOP L.R. switch in slow and fast positions.

3. Note action of Type MN-37A Bearing Indicator.

4. If test is satisfactory, troubles in items listed under paragraph 5 below are eliminated. Proceed to tests C, D, and E.

5. If test is unsatisfactory, check the following items by inspection or voltage and continuity tests:

a. 400-cycle inverter, transformer T4, capacitors C12, C4, and inductor CH-1 in the Type MN-31 Automatic Loop Control.

b. Low-inertia motor, gear train, and loop shaft bearings in Type MN-36A Automatic Loop.

c. Self-synchronous (or autosyn) motors in Type MN-36A Automatic Loop and Type MN-37A Bearing Indicator.

d. LOOP L.R. switch in Type MN-28 Remote Control Unit. The LOOP L.R. switch should not control the loop in any position of the function switch except the REC. LOOP position.

C. Test REC. ANT. Operation

1. Set function switch to REC. ANT. position.

2. Tune in stations in each band.

3. Note receiver output on each band, considering transmitter power and location. Also note general background noise level.

4. If test is satisfactory on all bands,

a. Proceed to tests D and E.

b. Sources of trouble listed in paragraph 6 below are eliminated.

5. If test is satisfactory on at least one band,

a. Trouble in items a, b, c, and g of paragraph 6 below, is eliminated.

b. Check items d, e, f, and h of paragraph 6 below, by inspection and voltage or continuity tests.

6. If test is unsatisfactory on all bands, check the following items by inspection and voltage or continuity tests:

a. Power supply
b. Audio frequency amplifier
c. Intermediate frequency amplifier
d. Radio frequency oscillator
e. Radio frequency amplifier
f. Antenna relay
g. Vertical antenna
h. Remote control unit

D. Test REC. LOOP Operation

1. Set function to REC. LOOP position.
2. Tune in station.
3. Orient loop for minimum receiver output, and note sharpness of the aural null.
4. Rotate loop 90 degrees from null, noting receiver output with loop in this position.
5. Switch to REC. ANT. position, noting comparison of receiver output with that of paragraph 4, above.
6. Repeat 1, 2, 3, 4, and 5 for stations in each band.
   a. Quality of nulls should in general be well defined in test 3, above.
   b. The outputs noted in paragraph 4 and 3 above should be approximately equal for the average installation.
7. If satisfactory results are obtained in each band,
   a. Trouble in loop and loop transmission cable, loop amplifier tubes, loop phaser, and antenna relay is eliminated.
   b. Test following on bands where poor REC. LOOP operation is noted:
      (1) Modulator plate circuit coil and switches in antenna can assembly.
      (2) Loop can assembly switches and components.
8. If test is unsatisfactory on all bands,
   a. Test following items by continuity and voltage measurements:
      (1) Modulator stage
      (2) Loop phaser assembly
      (3) Loop amplifier stage
      (4) Antenna relay operation
      (5) Loop transmission cable and loop

E. Test Operation of Compass Circuits

If unsatisfactory operation is obtained with the function switch in the COMP. position, after satisfactory results have been obtained for all tests described above, the trouble must be associated with the compass circuits. Make the following test in one of the bands where compass operation is provided:

1. Set function switch in REC. LOOP position.
2. Tune in station, and rotate loop for maximum receiver output.
3. Set function switch to COMP. position.
4. Note action of thyratron tubes in Type MN-31 Automatic Loop Control, and characteristic sound of output signal immediately after performing operation noted in paragraph 3 above.
5. Repeat paragraphs 2, 3, and 4 using the same signal but with the loop rotated 180 degrees from position used in paragraph 2 above.
6. If the headset output signal does not have the 48-cycle modulation present, and the thyratron tubes in the Type MN-31 Automatic Loop Control do not operate to rotate the loop, check operation of:
   a. 48-cycle audio oscillator tube V2 and associated components in the Type MN-26 Radio Compass and Type MN-31 Automatic Loop Control.
   b. Modulator stage and tube V3, in Type MN-26 Radio Compass Unit.
7. If the characteristic 48-cycle modulation is present in the headset output signal, but the thyratron tubes fail to operate, check the following:
   a. Compass output amplifier tube V12 in Type MN-26 Radio Compass.
   b. Thyratron motor control circuit in Type MN-31 Automatic Loop Control.
8. If the ignition of each thyratron is consistently controlled by the position of the loop with respect to the null, but no movement of the loop results when the function switch is placed in the COMP. position, check the continuity and connections of saturable reactors T2 and T3, transformer T4, and capacitor C11 in the Type MN-31 Automatic Loop Control.
9. If operation of the automatic compass is erratic and affected by variations in carrier modulation, such as speech or music, check the 24-Mfd, 350-volt capacitor C51 mounted in the Type MS-14C Junction Box.

6-5-4. TROUBLE REMEDY

The following tests, where applicable, should be made after the trouble has been traced to one of the units or particular circuits by the above test procedure. Tube socket voltages and circuit voltages are listed in paragraph 6-5-5.

6-5-4-1. Unsatisfactory Manual Loop Operation

A. Type MN-31 Automatic Loop Control

Operation of the 400-cycle inverter may be checked by noting the characteristic operating sound and by terminal voltage measurements. The 400-cycle output voltage may be measured between terminal 42 (Autosyn Armature) and ground in the junction box. If this voltage is considerably lower than average for normal input voltage, check for possible short circuits or grounds. Inspect all circuit connections, and make continuity measurements of all associated circuit components. Circuit voltages are given in paragraph 6-5-5-4.

The 400-cycle inverter may be load tested by connecting it to a 13.0-volt DC power source. The output voltage should be approximately 45 volts (RMS) at a frequency of approximately 400 cycles per second for a resistive load current of 0.420 ampere and terminal input voltage of 13.0 volts DC.

B. Type MN-36A Automatic Loop

If satisfactory results are not obtained after the 400-cycle supply in the Type MN-31 Automatic Loop Control has been found to be satisfactory, the loop control unit should be checked by operating the equipment with the function switch in the REC. LOOP position. Tune in a station on any band provided with loop reception, and operate the LOOP L.R. switch to obtain an aural null.
If an aural null is obtained as the switch is operated, but the Type MN-37A Bearing Indicator does not move or operate properly, the trouble must be in the self-synchronous motor in the Type MN-37A Bearing Indicator or in the compensator assembly located in the Type MN-36A Automatic Loop. These items should be inspected for mechanical condition and tested by resistance and continuity checks. Refer to paragraph 6-5-4-1D for further information on the self-synchronous motors.

If an aural null is not obtained, and the Type MN-37A Bearing Indicator does not move, the trouble may be associated with the LOOP L.R. control switch in the Type MN-28 Remote Control Unit or in the low-inertia loop-drive motor and gear train in the Type MN-36A Automatic Loop. Measure the 400-cycle voltage across the low-inertia motor control winding at terminal 40 in the junction box, with the function switch in the REC. LOOP position and the loop control switch in both the L. and R. positions for slow and high speed. If no control winding voltage is obtained at the junction box, check the operation and continuity of the LOOP L.R. switch circuits in the Type MN-28 Remote Control Unit. If this switch is satisfactory, and tests show that all cable connections are in good condition, the housing or base-plate should be removed from the Type MN-36A Automatic Loop for inspection of the low-inertia motor, gear train, and bearings.

C. Type MN-37A Bearing Indicator

If improper operation of this unit is suspected, the Type MN-37A Bearing Indicator should be examined to see that the pointer shaft rotates freely in its bearings. Continuity and resistance tests should be made to check the motor windings and brush contacts. Further information for checking this unit is given below.

D. Self-Synchronous Motor Indicating System

The self-synchronous motors contained in the Type MN-37A Bearing Indicator and in the compensator assembly in the Type MN-36A Automatic Loop may be checked by observing the action of the bearing indicator pointer in the manual loop control test described above. If the pointer follows the apparent rotation of the loop, but assumes a position of either 0° or 180° relative to the position of the loop, an open connection in either armature circuit is indicated. If the pointer follows the loop over only a part of the scale and then reverses as the loop continues to rotate in a given direction, an open field winding in either self-synchronous motor is indicated. The armature and field windings of each self-synchronous motor should be checked by resistance and continuity tests. NOTE: The field resistance between any two terminals of either self-synchronous motor should be twice the value shown on the schematic diagram for a single field. The resistance of the self-synchronous motor armature and brush contacts, as measured at the terminals, should be constant while the armature is slowly rotated. Abrupt changes in resistance indicate poor brush contacts.

6-5-4-2. Electrical Zero of Self-Synchronous Motors (Refer to Figure 19)

The electrical zero settings of the Type MN-37A Bearing Indicator and the compensator assembly in the Type MN-36A Automatic Loop must be checked if it is found necessary to disassemble either of these units. A test circuit in accordance with Figure 19 must be used for these checks to obtain the proper 400-cycle voltage relations. Procedure for making correct electrical zero settings is given below.

A. Adjustment of Type MN-37A Bearing Indicator Pointer to Electrical Zero

1. Remove snap ring and cover glass.
2. With switch in the ZERO position, connect the Type MN-37A Bearing Indicator in position I, as shown in the test circuit diagram.
3. Set the rear of the bearing indicator for coincidence of the engraved lines, and tighten the three clamping screws so that the autosyn motor frame cannot be rotated with respect to the main casting.
4. Turn on power, and note that autosyn motor shaft seeks a definite position.
5. Loosen setscrews on pointer hub, carefully set pointer to zero index, and tighten hub setscrews. The setscrews should be sealed with glyptal.
6. Check setting by tapping indicator lightly. Move pointer not more than 10 degrees from zero, and note if it always returns exactly to the zero index. Do not hold the pointer in a position more than 10 degrees from zero with the power on, or the slip rings and brushes may be injured.

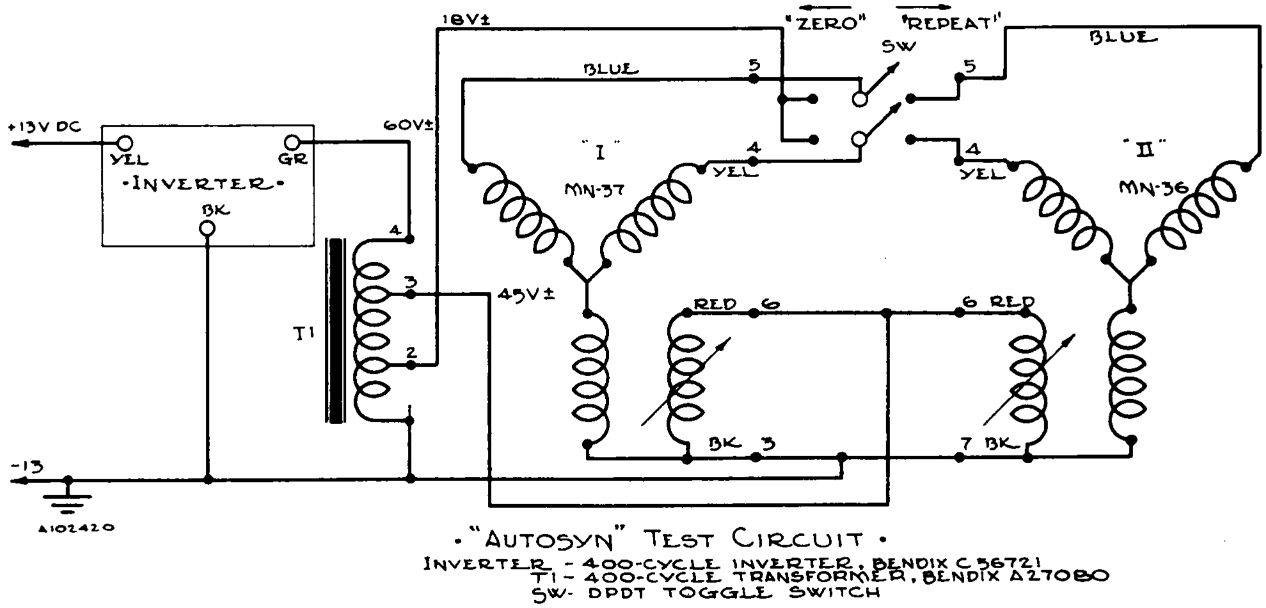


FIGURE 19—ELECTRICAL ZERO AND REPEATING CIRCUIT, SCHEMATIC DIAGRAM

If setting is not correct, reset the needle. Do not bend the needle.

7. Replace cover glass and snap ring.

B. Electrical Zero Adjustment of Compensator Unit in Type MN-36A Automatic Loop

1. Remove compensator assembly loop base.

2. Remove spring on face of compensator which holds pointer in proper position.

3. Be sure that the cam roller is not against the cam strip, in order that the correction scale plate may rotate freely.

4. Connect compensator unit in position I of the test circuit, Figure 19, with the switch in the ZERO position. Be sure that the connections are made in accordance with color of leads.

5. Loosen the pointer-hub clamping screw.

6. Turn power on, and note that autosyn shaft seeks a definite position.

7. Hold the compensator assembly so that the autosyn motor shaft is exactly vertical, and adjust the position of the pointer so that it is on the azimuth scale zero.

8. Tighten the hub clamping screw, being careful not to disturb the setting of the pointer on the autosyn motor shaft. Seal the setscrew with glyptal.

9. Move the pointer approximately 10 degrees each side of the azimuth scale zero and release, noting if pointer returns exactly to zero when assembly is lightly tapped. If not, reset position of pointer. Do not hold pointer in a position more than 10 degrees from zero with the power on, or the slip rings and brushes may be injured.

10. Replace pointer spring, so that the cam roller is held against the cam strip.

C. Repeating Accuracy of Both Autosyn Motors

After both autosyn motors have been set to electrical zero by performing the above operations, the repeating accuracy may be checked as follows:

1. Connect the Type MN-37A Bearing Indicator in position I, as shown in Figure 19.

2. Throw the DPDT switch to the REPEAT position.

3. Connect the compensator unit autosyn in position II, as shown in Figure 19.

4. Hold compensator pointer on zero reading of the azimuth scale (outer scale) and note the reading of the Type MN-37A Bearing Indicator, with the zero of the bearing indicator scale set to the zero index.

5. If the bearing indicator differs by more than ±0.5 degree, check the accuracy of the electrical zero settings made in the operations outlined above.

6. The repeating error at points other than zero may be checked by holding the compensator pointer at a given azimuth scale reading and noting the bearing indicator pointer reading.

7. The error should not exceed ±2.0 degrees for any setting of the compensator pointer. In actual use, this error is partially corrected by compensation for aircraft error.

6-5-4-3. REC. ANT. Operation—Unsatisfactory on all bands

The following tests should be made if the equipment is inoperative or low in output on all bands.

A. High Voltage Power Supply

Operation of the dynamotor may be checked by measuring the input and output voltages across the leads under the hash filter cover in the Type MN-26 Radio Compass. For normal input voltage across the yellow and black leads, the output voltage across the red and black leads should be approximately 200 volts under load. If the output voltage is lower than this value with normal input voltage, check all components associated with the dynamotor output circuit for short circuits. If the primary supply voltage is zero, check the operation of switch S8A and the fuse FU1 in the Type MN-28 Remote Control Unit.

B. Audio Frequency Amplifier

The audio frequency amplifier may be tested by listening to the headset output, while the grid cap of the second detector tube V10 is touched. If a loud click or hum is not heard when the grid cap is touched, check the tube socket voltages and circuit components associated with tubes V11 and V10 in the Type MN-26 Radio Compass for continuity and resistance. If the dual channel output amplifier in the Type MN-31 Automatic Loop Control is used, check the operation of tubes V4 and V5 in that unit and their associated components. Performance of the audio amplifier may be checked by the application of a 400-cycle signal to the successive audio amplifier grids and by noting the input voltage necessary to produce an output of 50 milliwatts into the rated load impedance.

C. Audio Frequency Amplifier—Radio Compass Output Only

If the dual channel amplifier of the automatic loop control unit is not used, plug an output meter having the proper load impedance into the audio output jack on the remote control unit, apply a 400-cycle signal to the grid (pin #5) of the audio output tube V11, and adjust the signal voltage for an output of 50 milliwatts. The function switch should be in the REC. ANT. position with the AUDIO control set for maximum output. The antenna should be disconnected or grounded. If this stage is functioning properly, an input voltage of less than 2.0 volts should produce a power output of 50 milliwatts. All circuit components associated with the audio output tube V11 should be checked by continuity and voltage tests if the operation of this stage is not satisfactory. If a headset is used in parallel with the output meter for monitoring purposes, the headset impedance should be high enough to have little effect on the output meter. A 400-cycle voltage of less than 0.4 volt applied to the second detector tube V10 through terminal 1 of transformer T14, should produce an output of 50 milliwatts. If the output is low when the audio voltage is fed to the input of tube V10, the circuit components associated with the grid circuit of the audio output tube V11, as well as the operation of the sidetone relay RE2, should be checked.

D. Audio Frequency Amplifier—Radio Compass with Dual Channel Output in Automatic Loop Control

If the dual channel output amplifier is used in the automatic loop control, connect the output meter to one pair of the audio output terminals of transformer T6 in the automatic loop control. The load impedance should be adjusted to a value of 600 ohms. The other output channel should be connected to a 600-ohm load during all tests, to prevent injury to that output transformer. A 400-cycle audio signal of less than 7.5 volts, applied across the common grid resistor R9 to the grids of audio output tubes V4 and V5 in the loop control, should produce an output of 50 milliwatts. Test the output of each channel for a given input voltage. If the output of one channel is considerably less than 50 milliwatts for the above input, check the circuit components and voltages associated with that channel. The complete audio amplifier may then be checked by following the procedure given above for the audio output tubes V10 and V11, with the output meter connected to one of the dual amplifier output channels. A 400-cycle audio input voltage of less than 0.1 volt applied to the grid of tube V11, or 0.3 volt applied to the input of audio amplifier tube V10, should produce a 50-milliwatt output. Note that the cathode resistor R29 of tube V11 in the radio compass unit is changed from 500 to 2500 ohms and that the output tap of transformer T15 is connected to terminal 4 when the dual channel output amplifier is used.

E. AVC Circuit

Extreme insensitivity of the receiver on all bands and all positions of the remote control unit function switch may be due to failure of one of the AVC circuit bypass capacitors. A defective tube in the second detector stage or a short circuit in capacitor C6-1 will cause the AVC circuit to be inoperative. Check the continuity and connections of all AVC circuit components. Operation of the AVC system may be checked by noting the increase in cathode bias of one of the controlled tubes V4, V5, or V6 when a strong signal is tuned with the function switch in the COMP. position.

F. IF Amplifier Tests

1. Second IF Stage

If trouble in the IF amplifier circuits cannot be located by voltage and continuity measurements, the performance of the amplifier should be checked with an ouput meter and RF signal generator. Disconnect the antenna and set the

AUDIO control for maximum sensitivity. Connect the output meter to the audio output terminals, and apply a 112.5-Kcs signal, modulated 30% at 400 cycles, to the grid of the IF tube V8. The grid cap may be left in place. With the function switch in the REC. ANT. position and the receiver tuned to the high frequency end of Band II, note the signal generator output voltage necessary for an audio output of 50 milliwatts. A signal input of approximately 40,000 microvolts or less should be required if this stage is functioning properly. If the signal generator output required is greater than the above value, adjust inductor L12 or inductor L13 slightly to check the alignment of the IF transformer T14. If transformer T14 cannot be aligned satisfactorily in accordance with paragraph 6-6-1-1, remove the transformer from the chassis (See paragraph 6-4-1-8), and check all components and connections.

2. First IF Stage

If the operation of the second IF stage is normal, apply the modulated 112.5-Kcs signal to the grid of the first detector tube V6 through a 0.5-Mfd capacitor after removing the regular grid clip. Shunt the grid to ground through a 500,000-ohm resistor. Stop the RF oscillator by grounding the oscillator gang tuning capacitor terminal on the oscillator can assembly with a short clip lead. An input of approximately 900 microvolts or less should produce an audio output of 50 milliwatts if this stage is operating properly. If the 112.5-Kcs input is considerably above 900 microvolts, make voltage and continuity tests, and check the alignment of IF transformer T13 in accordance with paragraph 6-6-1-2. If satisfactory results cannot be obtained, remove transformer T13 from the chassis (See paragraph 6-4-1-8), and check all components and connections.

6-5-4-4. REC. ANT. Operation—Satisfactory on at least one band

Make the following tests after satisfactory results have been obtained for the above checks.

A. RF Oscillator

Operation of the RF oscillator may be checked by tube socket voltage measurements and by noting the change in voltage measured from the B+ terminal of the RF oscillator can assembly to ground as the oscillator gang tuning capacitor is grounded. A decrease of approximately 25 volts should occur when the tuning capacitor terminal is shorted to ground as a result of the change in plate current when oscillation is stopped.

When the signal generator is connected to the first detector grid as above, apply a signal voltage at the frequency indicated on the tuning dial, modulated 30% at 400 cycles. A signal input of approximately 1500 microvolts or less should produce an audio output of 50 milliwatts with the AUDIO control set in the maximum clockwise position. If oscillator performance is not satisfactory, test tube socket voltages and circuit components. Check the alignment of the oscillator according to paragraph 6-6-2. If the oscillator cannot be aligned properly, remove the RF oscillator can assembly from the chassis (See paragraph 6-4-1-7), and check all wiring, switch contacts, and associated circuit components.

B. Radio Frequency Amplifier

If voltage measurements and continuity tests fail to locate the trouble in the first and second RF stages, their performance may be tested as follows:

1. Second RF Amplifier

Connect the signal generator to the grid cap of the second RF amplifier tube V5, and apply a signal voltage, modulated 30% at 400 cycles, at the frequency indicated on the tuning dial. Set the function switch to the REC. ANT. position and the AUDIO control to the maximum clockwise position. An output of 50 milliwatts should be obtained for an input signal voltage of approximately 150 microvolts or less. If satisfactory results cannot be obtained, check the alignment of the second RF stage according to paragraph 6-6-3. If satisfactory alignment still cannot be made, remove the second RF can assembly from the chassis (See paragraph 6-4-1-7), and check the circuit components.

2. First RF Stage

If satisfactory results are obtained for the second RF stage test, repeat the above procedure for the first RF stage. A modulated signal generator output of approximately 20 microvolts or less, applied to the grid cap of the 1st RF amplifier tube V4, should produce an audio output of 50 milliwatts.

3. Antenna Stage

If the first RF stage operates properly, connect the signal generator to the antenna terminal, located on the front panel, through a 50-Mmf capacitor. A signal generator output of less than 7 microvolts, 30% modulated, should produce an audio output of 50 milliwatts with better than a 4-to-1 signal-to-noise ratio for signal frequencies below 1750 Kcs. For frequencies above 1750 Kcs, an input of less than 12 microvolts should produce standard output. The signal-to-noise ratio is taken as the ratio of audio output with an input signal 30% modulated at 400 cycles, to the noise output with the same input signal unmodulated.

If these performance conditions cannot be met, check the operation and contacts of the antenna relay RE1, resistor R18-1, and capacitor C43-1. If the operation is still unsatisfactory, check the antenna stage alignment in accordance with paragraph 6-6-3. Remove the antenna can assembly from the chassis (See paragraph

6-4-1-7) and check all circuit wiring, switch contacts, and components if satisfactory alignment cannot be made.

6-5-4-5. REC. LOOP Operation—Unsatisfactory on any band

If voltage measurements and continuity tests fail to locate the trouble for REC. LOOP operation, after satisfactory performance for REC. ANT. operation has been obtained on all bands, the modulator stage, loop amplifier stage, and loop should be checked. The operation and contacts of antenna relay RE1 and capacitor C43-1 should be checked before making further tests. Note that the loop amplifier and modulator circuits are not used on the high frequency bands of some of the Type MN-26 Radio Compasses.

A. Modulator Stage

Check the tube socket voltages and continuity of circuit components associated with the modulator tube V3 when the function switch is in the REC. LOOP position.

To check the performance of modulator tube V3 for REC. LOOP operation, set the function switch in the REC. LOOP position and connect a signal generator to grid #2 (socket pin #4) of tube V3 through a .01-Mfd capacitor. At a 4-to-1 signal-to-noise ratio, a 30% modulated signal input of approximately 10 microvolts or less should produce an output of 50 milliwatts. If operation is not satisfactory, check the plate circuit connections of tube V3 and the continuity of all circuit components.

B. Loop Amplifier Stage

If the above test is satisfactory, check the operation of the loop amplifier stage and loop amplifier tube V1. If voltage and continuity measurements do not indicate the source of trouble, connect the signal generator directly to the grid of tube V1, and place the function switch in the REC. LOOP position. A 30% modulated signal input of approximately 6 microvolts or less should produce an audio output of 50 milliwatts for a 4-to-1 signal-to-noise ratio at an input frequency of 200 Kcs. The signal input required to produce standard output increases to approximately 10 microvolts at 1200 Kcs. If satisfactory results are not obtained, check the continuity of the loop phaser assembly and all components associated with the output circuit of the loop amplifier tube V1.

If the loop amplifier tube V1 operates satisfactorily in the test above, but poor results are obtained when the loop is connected, check the continuity of the loop transmission cable, loop winding, and all loop cable plug connections. If these are satisfactory, check the alignment of the loop stage circuits as described in paragraph 6-6-5. This stage cannot be aligned without having the loop transmission cable connected to the Type MN-26 Radio Compass. If proper alignment is not obtained when it is known that the loop and loop transmission cable are satisfactory, remove the loop stage assembly from the chassis (See paragraph 6-4-1-7) and check all switch contacts, connections, and circuit components.

C. Loop—Unsatisfactory operation all bands

The continuity of the loop winding, slip-ring contacts, and loop transmission cable may be checked before the Type MN-36A Automatic Loop is removed from the installation. Measure the resistance from pin #1 to pin #5 of the Cannon cable plug terminating the loop cable at the receiver. Note the resistance between these terminals as the loop is rotated by means of the LOOP L.R. switch for slow loop speed. The resistance should be approximately 1.5 ohms and should be constant as the loop rotates. Sudden changes in resistance as the loop rotates indicate poor connections between the slip rings and brushes in the Type MN-36A Automatic Loop.

6-5-4-6. Compass Circuit Operation

If unsatisfactory results are obtained in the COMP. position after satisfactory operation has been obtained for REC. ANT. and REC. LOOP positions, make the following tests:

A. Audio Oscillator

1. Operation of the audio oscillator should be checked with the function switch in the COMP. position. If tube socket voltage measurements on the audio oscillator tube V2 in the Type MN-26 Radio Compass differ considerably from those given in paragraph 6-5-5-1, check the associated circuit components in the radio compass and the automatic loop control. Check the continuity and operation of switch S8B in the remote control unit.

2. Performance of the audio oscillator may b checked by connecting a vacuum tube voltmeter from either terminal of capacitor C7 to ground in the automatic loop control. Under normal conditions, a 48-cycle voltage of 17 to 23 volts RMS should be indicated on either terminal of capacitor C7. The voltages from either terminal to ground should be equal within two volts.

3. Under normal conditions, the audio oscillator should operate at a frequency of 48 ±2 cycles per second. This frequency may be checked by the use of a cathode ray oscilloscope having one set of deflection plates connected from either grid of the modulator tube V3 in the radio compass to ground and a suitable audio oscillator connected to the other set of deflection plates.

4. If the audio frequency oscillator is not operating satisfactorily, check all circuit elements and connections associated with the oscillator tube V2 in the radio compass. Reactor CH-1 contained in transformer T5 in the automatic loop control is not associated with the audio oscillator.

B. Thyratron Motor Control Circuit

1. Operation of the thyratrons and loop motor control circuit in the automatic loop control may be checked when the audio oscillator is functioning properly. With the function switch in the COMP. position, temporarily connect the junction of resistors R7, R8 and capacitor C8 to the junction of resistor R4 and capacitor C2 in the automatic loop control by means of a 0.1-Mfd isolating capacitor. Thyratron tube V1 should ignite, and the loop should rotate in a counterclockwise direction at maximum speed of 30 to 40 degrees per second. Thyratron tube V2 should ignite and cause the loop to rotate at maximum speed in a clockwise direction when the junction of resistor R7, resistor R8, and capacitor C8 is connected to the junction of resistor R5 and capacitor C2 through a 0.1-Mfd capacitor. These connections may be easily made to the proper terminals on the resistor mounting board contained on the automatic loop control chassis. The thyratrons should cease operation when the above connections are removed.

2. If the thyratrons do not operate, check the tube socket voltages in accordance with paragraph 6-5-5-3. Check the continuity and resistance of all circuit elements associated with tubes V1, V2, and V3 in the automatic loop control, as well as the condition of the tubes. If no plate voltage is obtained for tube V3, check the operation of switch S8F in the Type MN-28 Remote Control Unit.

C. Compass Output Amplifier

1. The compass output amplifier in the Type MN-26 Radio Compass may be checked as follows if the audio oscillator and thyratron control circuits are operating satisfactorily. Temporarily connect the control grid of the compass output tube V12 directly to socket pin #4 (grid #2) of the modulator tube V3. The function switch should be in the COMP. position and the sensitivity control resistor R2 in the automatic loop control should be set for minimum sensitivity. One thyratron tube (V1 or V2) in the automatic loop control should ignite, and the loop should rotate at maximum speed in a given direction. If the grid of the compass output tube V12 is then connected to pin #5 (grid #1) of the modulator tube V3, the other thyratron tube (V2 or V1) should operate and cause the loop to rotate at maximum speed in the opposite direction. Operation of a given thyratron for the above connections will depend on the sense of the audio oscillator plate connections in the Type MS-14C Junction Box.

2. If the thyratrons fail to ignite in the above test, check the tube socket voltages of the compass output tube V12. Make continuity and resistance tests of all circuit components associated with compass output tube V12, including transformer T1 in the automatic loop control.

3. If satisfactory operation of tube V12 is obtained in the above test, temporarily connect pin #1 of transformer T14 directly to socket pin #4 (grid #2) of the modulator tube V3 in the radio compass unit. One thyratron should ignite and cause the loop to rotate in a given direction at maximum speed. If pin #1 of transformer T14 is connected directly to pin #5 (grid #1) of tube V3, the other thyratron should ignite causing the loop to rotate in the opposite direction at maximum speed. In this test, operation of the thyratrons and direction of rotation of the loop should be the reverse of results obtained for the connection of a given pin number of modulator tube V3 to the grid of the compass output amplifier tube V12.

4. If satisfactory results are not obtained from the preceding test, check all audio circuit components associated with audio amplifier tube V10. If it is known from previous tests that the audio amplifier is operating correctly, it will be necessary to check only the resistors and capacitors connected between the plate of tube V10 and the grid of the compass output tube V12.

D. Modulator Test—Compass Operation

1. If continuity tests and tube socket voltage measurements in accordance with paragraph 6-5-5-1 fail to locate the trouble in the modulator stage, check the 48-cycle voltage to ground from each grid of modulator tube V3 in the radio compass with a vacuum tube voltmeter for the COMP. position of the function switch. For normal operation, a 48-cycle voltage of 4.5 to 5.5 volts RMS should be indicated on each grid. Approximately equal voltages should appear on both grids. If proper 48-cycle voltages are not obtained on the modulator grids, check the circuit components connecting the modulator grids to the audio oscillator, and the operation of the audio oscillator.

2. Compass operation of the modulator stage may be checked with radio frequency signal voltages after it is known that all other compass circuits are operating properly. Place the function switch in the COMP. position, and connect the antenna terminal located on the panel of the radio compass unit through a 50-Mmf capacitor to ground. Connect the output of a signal generator through a .01-Mfd capacitor from pin #4 (grid #2) of modulator tube V3 to ground, and connect pin #5 (grid #1) of the modulator tube directly to ground. Set the loop control unit sensitivity control R2 for minimum sensitivity (extreme counterclockwise position). With the signal generator output adjusted for approximately 10 microvolts, vary the tuning

of either the generator or radio compass for maximum radio compass output. Increase the signal generator output from zero until one thyratron tube (V1 or V2) glows continuously and the loop rotates at maximum speed in a given direction. Note the output setting of the signal generator. Connect the signal generator through a .01-Mfd capacitor to pin #5 (grid #1) of modulator tube V3, and repeat the above procedure with pin #4 (grid #2) of tube V3 grounded. The opposite thyratron tube (V2 or V1) should glow continuously, and maximum loop rotation speed in the opposite direction should be obtained for an approximately equal signal input to that previously noted. Inputs of less than 15 microvolts should cause the thyratrons to ignite and extinguish intermittently. In the above tests, smooth thyratron operation and maximum loop rotation speed should be obtained for signal generator outputs of less than 30 microvolts to the grids of modulator tube V3. Only one thyratron should operate for a given signal generator connection.

3. Operation of the automatic loop gain control circuit associated with tubes V1 and V12 in the radio compass may be checked in the above tests by noting the change in cathode bias for loop amplifier tube V1 as the signal input to either modulator grid is increased from zero. The cathode bias voltage for the loop amplifier tube V1 should decrease from the value given in paragraph 6-5-5-1 for an increase in signal strength. If the bias does not change for an increased input to either modulator grid when the function switch is in the COMP. position, check the diode sections of the compass output tube V12 and all resistors and capacitors contained in the rectifier-filter circuit between the diodes of tube V12 and the grid return of tube V1.

4. If satisfactory results are not obtained on all bands where automatic compass operation is provided, check the continuity of the plate circuit connections and switch operation in the antenna can assembly. Check the alignment of the receiver in accordance with paragraph 6-6 if circuit alignment has not been made in previous tests.

6-5-4-7. Beat Frequency Oscillator

If an audio beat note is not obtained with the C.W. ON-OFF switch in the ON position as the receiver is tuned through a signal carrier, check the operation of the CW oscillator tube V9 in the radio compass. If tube socket voltage measurements and continuity tests give satisfactory results, check the adjustment of the oscillator inductor L6 and the alignment of the oscillator frequency in accordance with paragraph 6-6-6.

6-5-4-8. Noisy Compass or Receiver Operation

Check the following items to locate the cause of noisy receiver operation:

Vacuum Tubes	—Defective or microphonic.
Dynamotor	—Arcing brushes.
Inverter	—Loose internal connections.
Cable plugs	—Poor contacts.
Bonding	—Loose chassis grounding connections.
Switches	—Dirty contacts.
Variable capacitors	—Dirty contacts, shorted plates.
Primary power source	—Loose or corroded connections.
Circuits	—Loose connections, defective circuit elements.
Vertical antenna	—Loose or corroded connections.
Relays	—Poor contacts.
Loop	—Loose or corroded connections, dirty clip rings and brushes.

6-5-5. TYPICAL VACUUM TUBE SOCKET VOLTAGES AND CIRCUIT VOLTAGES

The following voltage measurements should be made with a primary input voltage of 14.0 volts for Type MN-26H, MN-26J, MN-26N, MN-26P, MN-26R, and MN-26V, and 28.0 volts for Types MN-26K, MN-26L, MN-26S, MN-26T, and MN-26U, measured between terminals 30 and 31 in the junction box.

All voltages should be measured to the chassis unless otherwise noted. The AUDIO and threshold sensitivity controls in the Type MN-28 Remote Control Unit should be set for maximum sensitivity (fully clockwise). The thyratron sensitivity control in the Type MN-31 Automatic Loop Control should be set for minimum sensitivity (fully counterclockwise). The band switch should be placed in the Band II position. The vertical and loop antennas should be disconnected from the Type MN-26 Radio Compass.

All values given below were obtained with a voltmeter having a resistance of 20,000 ohms per volt for the DC scales. Allowance must be made for the resistance of the voltmeter if a voltmeter having a different resistance is used. The values may vary slightly from one equipment to another but should vary proportionally with the dynamotor output voltage.

6-5-5-1. Type MN-26 Radio Compass—Tube Socket Voltages

Tube	Socket Terminal	Element	Voltage COMP.	Voltage REC. ANT.	Voltage REC. LOOP	Scale
V1	2 & 7	Heater	6.5	6.5	6.5	10V DC
6K7	3	Plate	178	182	181	250V DC
Loop Amp.	4	Screen	92	93	93	250V DC
	5	Suppressor	2.4	2.5	2.5	10V DC
	8	Cathode	2.4	2.5	2.5	10V DC
V2	2 & 7	Heater	6.2	6.2	6.2	10V DC
6N7	3	Plate (P_2)	207	225	225	250V DC
Audio Osc.	4	Grid (G_1)	−4.3	0	0	10V DC
	5	Grid (G_2)	−4.3	0	0	10V DC
	6	Plate (P_1)	207	225	225	250V DC
	8	Cathode	1.0	7.0	7.0	10V DC
V3	2 & 7	Heater	6.6	6.6	6.6	10V DC
6N7	3	Plate (P_2)	168	205	160	250V DC
Modulator	4	Grid (G_1)	0	0	+1.6	10V DC
	5	Grid (G_2)	0	0	0	10V DC
	6	Plate (P_1)	170	205	156	250V DC
	8	Cathode	10	8	12.5	50V DC
V4	2 & 7	Heater	6.3	6.3	6.3	10V DC
6K7	3	Plate	165	177	177	250V DC
1st RF Amp.	4	Screen	72	72	72	250V DC
	5	Suppressor	0	0	0	
	8	Cathode	2.7	2.7	2.7	10V DC
V5	2 & 7	Heater	6.5	6.5	6.5	10V DC
6K7	3	Plate	170	175	175	250V DC
2nd RF Amp.	4	Screen	70	70	70	250V DC
	5	Suppressor	0	0	0	
	8	Cathode	2.8	2.8	2.8	10V DC
V6	2 & 7	Heater	6.4	6.4	6.4	10V DC
6L7	3	Plate	188	193	192	250V DC
1st Det.	4	Screen	75	76	76	250V DC
	5	Injector Grid	.4	.4	.4	10V DC
	8	Cathode	3.3	3.3	3.3	10V DC
V7	2 & 7	Heater	6.4	6.4	6.4	10V DC
6J5	3	Plate	70	75	73	250V DC
RF Osc.	5	Grid	−7.0	−7.4	−7.2	10V DC
	8	Cathode	0	0	0	
V8	2 & 7	Heater	6.5	6.5	6.5	10V DC
6K7	3	Plate	165	170	170	250V DC
IF Amp.	4	Screen	110	112.5	112.5	250V DC
	5	Suppressor	0	0	0	
	8	Cathode	6.4	6.4	6.4	10V DC
V9	2 & 7	Heater	6.4	6.4	6.4	10V DC
6J5		(CW Switch ON)				
CW Osc.	3	Plate	80	85	85	250V DC
	5	Grid	40	42	42	250V DC
	8	Cathode	50	50	50	250V DC
V9	2 & 7	Heater	6.4	6.4	6.4	10V DC
6J5		(CW Switch OFF)				
CW Osc.	3	Plate	195	200	200	250V DC
	5	Grid	137	148	145	250V DC
	8	Cathode	180	187.5	185	250V DC

Type MN-26 Radio Compass *(Continued)*

Tube	Socket Terminal	Element	Voltage			Scale
			COMP.	REC. ANT.	REC. LOOP	
V10	2 & 7	Heater	6.4	6.4	6.4	10V DC
6B8	3	Plate	75	75	75	250V DC
2nd Det.	4	Diode	0	0	0	10V DC
	5	Diode	3.5	3.6	3.8	10V DC
	6	Screen	75	75	75	250V DC
	8	Cathode	12	13.5	13.5	50V DC
V11	2 & 7	Heater	6.5	6.5	6.5	10V DC
6F6		(With Dual Audio Output in MN-31)				
Audio Output	3	Plate	205	210	210	250V DC
	4	Screen	212	217	217	250V DC
	5	Grid	0	0	0	50V DC
	8	Cathode (2500-ohm bias)	18.5	19	19	50V DC
V11	2 & 7	Heater	6.5	6.5	6.5	10V DC
6F6		(Without Dual Audio Output in MN-31)				
Audio Output	3	Plate	180	182	182	250V DC
	4	Screen	107.5	192	195	250V DC
	5	Grid	0	0	0	
	8	Cathode (500-ohm bias)	11.5	12	12	50V DC
V12	2 & 7	Heater	6.3	6.3	6.3	10V DC
6B8	3	Plate	187	192	192	250V DC
Comp. Output	4	Diode	0	0	0	250V DC
	5	Diode	0	0	0	250V DC
	6	Screen	70	70	70	250V DC
	8	Cathode	0	0	0	250V DC

6-5-5-2. Type MN-31 Automatic Loop Control—Tube Socket Voltages

Tube	Socket Terminal	Element	COMP.	REC. ANT.	REC. LOOP	Scale
V1 (Idle)	2 & 7	Heater	6.3	6.3	6.3	10V DC
2051	3	Plate	215	0	0	250V DC
Thyratron	5	Grid	0	0	0	250V DC
	6	Shield	13	13	13	50V DC
	8	Cathode	13	13	13	50V DC
V2 (Idle)	2 & 7	Heater	6.3	6.3	6.3	10V DC
2051	3	Plate	210	0	0	250V DC
Thyratron	5	Grid	0	0	0	250V DC
	6	Shield	13	13	13	250V DC
	8	Cathode	13	13	13	250V DC
V3	2 & 7	Heater	13	13	13	50V DC
12A6	3	Plate	215	0	0	250V DC
Plate Control	4	Screen	215	0	0	250V DC
Tube	5	Grid	136	0	0	250V DC
	8	Cathode	210	0	0	250V DC
V4	2 & 7	Heater	13.1	13	13	50V DC
12A6	3	Plate	212.0	220	220	250V DC
Audio Output	4	Screen	222.0	230	230	250V DC
	5	Grid	0	0	0	
	8	Cathode	14	14	14	50V DC
V5	2 & 7	Heater	12.4	13	13	50V DC
12A6	3	Plate	207.0	215	215	250V DC
Audio Output	4	Screen	217.0	223	223	250V DC
	5	Grid	0	0	0	
	8	Cathode	15	15	15	50V DC

6-5-5-3. Thyratron Operating Voltages

Place the function switch in the COMP. position and set the automatic loop control sensitivity control for minimum sensitivity. The following tube socket voltage measurements for the Type MN-31 Automatic Loop Control should be made with either grid of the modulator tube V3 connected directy to terminal #1 of transformer T14 in the Type MN-26 Radio Compass. Refer to the compass output amplifier test in paragraph 6-5-4-6C.

Tube	Socket	Element	Voltage		Scale
			V1 Operating	V2 Idle	
V1, V2 2051	2 & 7	Heater	6.4	6.4	10V DC
	3	Plate	60	90	250V DC
	5	Grid	25	25	250V DC
	6	Shield	29	29	50V DC
	8	Cathode	29	29	50V DC
			V1 Idle	V2 Operating	Scale
V1, V2 2051	2 & 7	Heater	6.4	6.4	10V DC
	3	Plate	90	60	250V DC
	5	Grid	25	25	250V DC
	6	Shield	29	29	50V DC
	8	Cathode	29	29	50V DC
V3 12A6 Plate Control	2 & 7	Heater	12.4	12.4	50V DC
	3	Plate	192	192	250V DC
	4	Screen	192	192	250V DC
	5	Grid	100	100	250V DC
	8	Cathode	90	90	250V DC

Considerable variation of the tube socket voltages from the values given above is usually due to one of the following causes:

Heater Voltage High —Heater burned out in one of the tubes in the same parallel group.

Heater Voltage Low —Heater burned out in one of the tubes in the other parallel connected group.

Plate Voltage High —Shorted plate impedance. Open screen or cathode circuit.

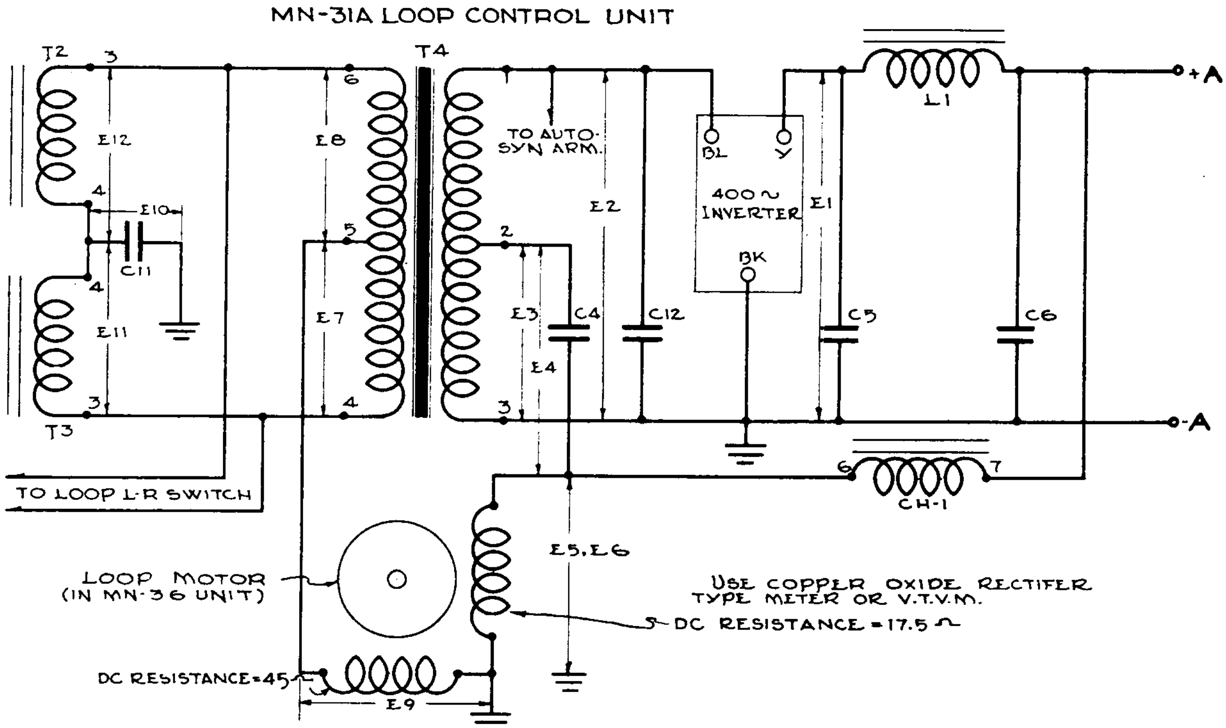
Plate Voltage Low —Plate grounded. Defective screen or cathode bypass capacitor. Defective plate coupling capacitor. Open plate impedance.

Screen Voltage Low —Defective screen or cathode bypass capacitor. Open screen circuit resistor.

Cathode Voltage High —Open cathode circuit.

Cathode Voltage Low —Defective cathode resistor or bypass capacitor.

6-5-5-4. Typical Loop Control Circuit Voltages



		LOOP STATION-ARY.	R-L SWITCH CONTROL		THYRATRON CONTR	
			"R" FAST	"L" FAST	V_1-ON	V_2-ON
DC	E1	12.3	12.2	12.2	12.4	12.4
	E2	52.5	31	32	37.5	38.5
	E3	27	16	16	18.5	19.5
	E4*	40.5	29	29.5	32.5	33.5
	E5*	25	20	20.5	23.5	24
DC	E6	6.6	6.5	6.5	6.6	6.6
	E7	74	36	40	50	50
	E8	74	40	36	45	52
	E9	0.6	36	36	32	29
	E10	0.7	6.2	5.7	42	38
	E11	74	6.2	80	54	58
	E12	73	80	5.7	52	53

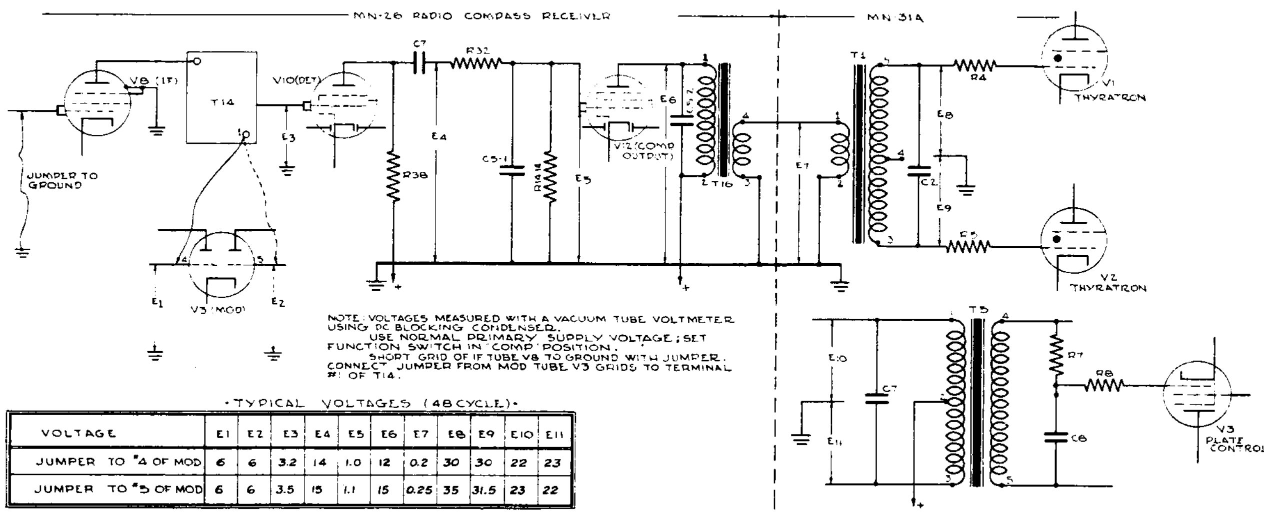
TYPICAL VOLTAGES (400 CYCLE).

* USE METER ISOLATED FROM DC FOR MEASUREMENT OF VOLTAGES E4 & E5.

NOTE:- ALL 400~ VOLTAGES ABOVE WILL VARY WITH THE INVERTER OUTPUT VOLTAGE AND INVERTER FREQUENCY.

FIGURE 20—MEASUREMENT POINTS, MOTOR CONTROL CIRCUIT VOLTAGES

6-5-5-5. Typical Compass Circuit Voltages



·TYPICAL VOLTAGES (48 CYCLE)·

VOLTAGE	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
JUMPER TO #4 OF MOD	6	6	3.2	14	1.0	12	0.2	30	30	22	23
JUMPER TO #5 OF MOD	6	6	3.5	15	1.1	15	0.25	35	31.5	23	22

FIGURE 21—MEASUREMENT POINTS, COMPASS CIRCUIT VOLTAGES

6-6. RADIO COMPASS UNIT ALIGNMENT

6-6-1. GENERAL

This equipment has been carefully aligned and inspected by the manufacturer before shipment. The circuits are designed so that their alignment will be maintained over long periods of time under normal use. Factory adjustments must not be changed until it is ascertained that the difficulty is not due to normal deteriorating influences such as worn out vacuum tubes, defective resistors or capacitors, improper operating voltages, broken leads, or external RF interferences. FACTORY CORE ADJUSTMENTS ARE SEALED WITH GLYPTAL AND ARE NOT TO BE ALTERED UNLESS ABSOLUTELY NECESSARY.

Questionable performance characteristics should be compared to the normal characteristics listed in paragraph 6-8-12 before and after alignment. All aligning capacitors are accessible from the top of the chassis and are listed below for the various frequency ranges.

Receiver Type	Band	Frequency Range Kcs	Alignment Freq. Kcs.	Trimmer Capacitors				
				Loop	Ant.	1st RF	2nd RF	Osc. RF
MN-26P-S	I	150- 325	325	C1-1	C1-4	C1-7	C1-10	C1-13
	II	325- 695	695	C1-2	C1-5	C1-8	C1-11	C1-14
	III	695-1500	1500	C1-3	C1-6	C1-9	C1-12	C1-15
MN-26J-K	I	200- 410	410	C1-1	C1-4	C1-7	C1-10	C1-13
	II	410- 850	850	C1-2	C1-5	C1-8	C1-11	C1-14
	III	850-1750	1750	C1-3	C1-6	C1-9	C1-12	C1-15
MN-26H-N	I	200- 410	410	C1-1	C1-4	C1-7	C1-10	C1-13
L-U	II	550-1200	1200	C1-2	C1-5	C1-8	C1-11	C1-14
	III	2900-6000	6000	*	C1-6	C1-9	C1-12	C1-15
MN-26R-T	I	278	278	C1-3	C1-6	C1-9	C1-12	C1-15
	II	200- 410	410	C1-1	C1-4	C1-7	C1-10	C1-13
	III	550-1200	1200	C1-2	C1-5	C1-8	C1-11	C1-14
MN-26V	I	200- 410	410	C1-1	C1-4	C1-7	C1-10	C1-13
	II	550-1200	1200	C1-2	C1-5	C1-8	C1-11	C1-14
	III	2200-4250	4250	*	C1-6	C1-9	C1-12	C1-15

* NOTE: No Loop Adjustments on Band III.

The use of a frequency-modulated signal source and a cathode ray oscilloscope having a synchronized sweep circuit for visual alignment of the receiver is not recommended since considerable variation in results may be obtained with different types of visual alignment equipment.

6-6-2. INTERMEDIATE FREQUENCY AMPLIFIER ALIGNMENT

6-6-2-1. Second IF Stage Alignment

Place the function switch in the REC. ANT. position, set the tuning dial to the high-frequency end of Band II, and the AUDIO control for maximum output. Connect an output meter whose impedance is equal to the rated load impedance to the audio output terminals. Connect the output of a modulated signal generator directly to the grid of the IF tube V8, leaving the regular grid cap in place. Set the signal generator for a frequency of 112.5 Kcs, and an output of approximately 100,000 microvolts, modulated 30% at 400 cycles. Adjust inductors L12 and L13 of transformer T14 for maximum output, holding the receiver audio output at approximately 50 milliwatts by reducing the signal generator output when necessary. The input to IF amplifier tube V8, when transformer T14 is properly aligned, should be between 25,000 and 40,000 microvolts for an output of 50 milliwatts.

The CW oscillator should be adjusted to oscillate exactly at the IF frequency so that the zero-beat method of aligning the RF oscillator and RF stages may be used. With the signal frequency set at 112.5 Kcs, turn the 400-cycle modulation off and the C.W. switch ON. Adjust inductor L6 for zero beat.

6-6-2-2. First IF Stage Alignment

Set all controls as above, with the C.W. switch OFF. Connect the signal generator output lead to the grid of the first detector tube V6 through a 0.5-Mfd capacitor. Remove the regular grid clip and shunt the grid to ground through a 500,000-ohm resistor. Ground the grid of the heterodyne oscillator tube V7. Set the signal generator to 114.5 Kcs, modulated 30% at 400 cycles, for an output of approximately 1000 microvolts. Adjust inductors L10 and L11 for maximum output. Set the signal generator frequency to 110.5 Kcs, and readjust inductors L10 and L11 for maximum audio output. Keep the audio output at approximately 50 milliwatts by adjustment of the signal generator output. Reset the signal generator frequency to 114.5 Kcs and readjust inductors L10 and L11 for maximum output. Set the signal generator frequency to 112.5 Kcs and check the input to the grid of the 1st detector tube V6 necessary to produce an output of 50 milliwatts. Approximately 900 microvolts input should be required.

6-6-3. RF OSCILLATOR ALIGNMENT

The CW oscillator should be adjusted to 112.5 Kcs, as described in paragraph 6-6-2-1, before the following operations are performed. Snap the C.W. switch ON.

Operate the equipment with the function switch in the REC. ANT. position, the AUDIO control set for maximum output, and headset connected to the audio output terminals. Connect the signal generator output lead to the grid of the first detector tube V6 as described in paragraph 6-6-2-2.

Set the signal generator frequency to the alignment frequency (high frequency end) for Band III as noted in the table in paragraph 6-6-1. Adjust the signal generator for an unmodulated output of 1000 microvolts. Rotate the tuning dial to the alignment frequency for Band III and adjust the proper RF oscillator trimmer slightly for a zero beat in the headset.

Set the generator and tuning dial to the alignment frequency for Band II. Adjust the proper RF oscillator trimmer for zero beat.

Repeat the above procedure for the alignment frequency of Band I.

If poor tracking at the low frequency end of any band is indicated in subsequent sensitivity measurements, adjustment of the oscillator coil inductance for that band will be necessary. Be certain that the poor tracking is not due to defective circuit components before the adjustment of the oscillator coil is disturbed. Use the same equipment set-up and procedure as above except that the signal generator should be set to the frequency determined by the end calibration of the tuning dial for the particular band. Coil adjustment is accomplished by changing the setting of the proper iron core screw in the RF oscillator can assembly. The band switch motor may have to be removed from the chassis to facilitate core screw adjustments. (See paragraph 6-4-1-5) If the core setting is changed on any band, it will be necessary to repeat the oscillator alignment procedure at the high frequency end of the band in question.

6-6-4. RF AMPLIFIER AND ANTENNA STAGE ALIGNMENT

A. Place the function switch in the REC. ANT. position, set the AUDIO control for maximum output, and connect an output meter to the audio output terminals. Connect a signal generator to the receiver antenna plug through a 50-Mmf capacitor. Set the signal generator to the alignment frequency for Band III. Refer to paragraph 6-6-1 for the proper trimmer capacitor numbers. Place the C.W. switch ON and adjust the tuning for zero beat. The CW oscillator must be set for 112.5 Kcs.

B. Turn the CW oscillator OFF and set the signal generator for 30% modulation at 400-cycles. Do not disturb the frequency setting of the signal generator. Adjust the signal generator output to produce less than 50 milliwatts audio output. Adjust the proper trimmer capacitor in each can assembly for maximum output, proceeding from the second RF stage trimmer to the antenna stage trimmer and reducing the signal generator output, when necessary, to maintain an audio output of 50 milliwatts. Set the signal generator output at 10 microvolts (15 microvolts for frequencies above 1750 Kcs), reduce the audio output to slightly less than 50 milliwatts by adjustment of the AUDIO control and readjust the trimmers slightly for maximum output.

C. Repeat the above procedure for Band II and Band I, always proceeding from the second RF amplifier stage to the antenna stage when adjusting the trimmer capacitors.

6-6-5. ADJUSTMENT OF IF REJECTION TRAP CIRCUITS

Connect the signal generator to the antenna terminal through a 50-Mmf capacitor, set the tuning dial to the lowest calibrated frequency (150 Kcs or 200 Kcs), and place the function switch in the REC. ANT. position. Set the signal generator to the tuning dial indication, and adjust the generator output for 4 microvolts, modulated 30% at 400 cycles. Adjust the AUDIO control for 50 milliwatts audio output.

Set the signal generator to 114.5 Kcs and adjust the generator output to 1 volt. Do not change the AUDIO control setting. Adjust the core of inductor L3 until minimum output is obtained. Set the signal generator frequency to 110.5 Kcs for 1-volt output and adjust the core of L2 minimum output.

6-6-6. LOOP STAGE ALIGNMENT

A. Set the equipment up for a standard radio compass test. Turn the loop parallel to the transmission line and place the function switch in the REC. LOOP position.

B. Set the signal generator to the alignment frequency for Band III as noted in paragraph 6-6-1. Adjust the tuning dial to the same frequency by tuning for zero beat with the CW oscillator set to 112.5 Kcs, and for an input to the loop of approximately 100 microvolts per meter. Set the signal generator for 30% modulation at 400 cycles, turn the C.W. oscillator OFF. Adjust the proper trimmer capacitor in the loop can assembly for maximum receiver output. Hold the audio output below 50 milliwatts by adjustment of the AUDIO control knob.

C. Repeat the above procedure for the alignment frequencies of Bands II and I.

D. If the loop sensitivity is unsatisfactory at the low frequency end of any band, it will be necessary to readjust the inductance of the coil used for that band in the loop stage. Be certain that unsatisfactory operation is not due to other causes before altering the core adjustment of the loop stage coil. The coil inductance may be adjusted by means of the core screw located behind the front panel of the receiver and which is accessible when the Bendix nameplate is removed. Follow the procedure given above except that the signal generator and tuning dial must be set to the low frequency end of the band in question. Adjust the core screw for maximum audio output. Reset the tuning dial and signal generator to the alignment frequency, and readjust the proper trimmer capacitor for maximum audio output.

E. The CW oscillator should be set to 113.5 Kcs after all RF stages have been aligned.

6-6-7. CW OSCILLATOR ALIGNMENT

A. Place the function switch in the REC. ANT. position, set the tuning dial to the high frequency end of Band II, and connect a headset to the audio output terminals. Attach the signal generator output lead to the grid of the first detector tube V6 as described in paragraph 6-5-4-3F.

B. Set the signal generator frequency to 113.5 Kcs for an unmodulated output of approximately 1500 microvolts.

C. Turn the C.W. switch ON, and adjust the CW oscillator inductor L6 for zero beat in the headset.

6-7. TEST FACILITIES AND EQUIPMENT

6-7-1. GENERAL

If proper facilities are provided, the automatic compass equipment may be tested in the laboratory under conditions similar to field use. A shielded test room as subsequently described should be used, especially if loop sensitivity and automatic compass performance measurements are to be compared with the figures given in paragraph 6-8-12. The test room should be equipped with adequate test instruments.

The following recommendations are made concerning the test room and equipment.

6-7-2. TEST EQUIPMENT

6-7-2-1. Signal Generator

The signal generator should have very low external leakage, accurate calibration of output in microvolts, and output impedance of less than 20 ohms, and must be capable of covering the required frequency range. The generator must provide 30% modulation of the carrier at a frequency of 400 cycles per second. Units equivalent to the Ferris Models 14C or 22A have been found to be satisfactory.

6-7-2-2. Output Meter

The meter used for audio power output measurements should be capable of indicating power outputs from a fraction of a milliwatt to several watts for various load impedances. The scale should preferably be calibrated in DB as well as milliwatts. A General Radio Type 583-A Output Meter, or equivalent, has been found to be satisfactory.

6-7-2-3. AC-DC Voltmeter and Ohmmeter

The AC-DC analyzer unit should be capable of measuring voltages up to at least 500 volts and should have a sensitivity of at least 5000 ohms per volt on the DC scales. The ohmmeter should be capable of indicating resistance values from 0 to at least one megohm.

6-7-2-4. Vacuum Tube Voltmeter

The vacuum tube voltmeter should have a high-impedance input circuit and several calibrated ranges so that voltages from 0 to 150 volts may be conveniently measured. Provision should be made in the input circuit so that only AC components are indicated in cases where an AC voltage is superimposed on a DC voltage.

6-7-2-5. Variable Frequency Audio Oscillator

The audio oscillator should have a continuous frequency range from aproximately 30 to 10,000 cycles per second and should be relatively stable with respect to frequency drift. Calibration should be such that frequencies between 40 and 60 cycles per second may be determined within one cycle if the unit is to be used to check the 48-cycle audio oscillator in the Type MN-26 Radio Compass. Measurements in the vicinity of 400 cycles per second should be accurate within 10 cycles.

6-7-2-6. Cathode Ray Oscilloscope

The cathode ray oscilloscope should preferably have a 3-inch screen for convenient observation and should be provided with vertical and horizontal amplifiers having high-impedance input circuits.

6-7-2-7. Miscellaneous Tools, Supplies, and Storage Batteries

The test rooms should be furnished with a 14-volt or 28-volt DC primary power source capable of supplying a load current of 10 amperes for test intervals of several hours. The power supply should have good regulation and be free from noise. The use of heavy duty storage batteries and a suitable battery charger has been found to be the most practical solution. The equipment should include the necessary assortment of tools and supplies that are ordinarily used in radio service work.

6-7-3. SHIELDED TEST ROOM (See Figure 22)

The shielded test room should be constructed in accordance with the following recommendations.

6-7-3-1. Inside Dimensions

Length—152 inches
Width—108 inches
Height—144 inches

6-7-3-2. Material and Construction

A. The frame and floor should be constructed of wood. Satisfactory spacing for the inner and outer shields may be obtained by the use of 2" x 4" lumber in construction of the frame.

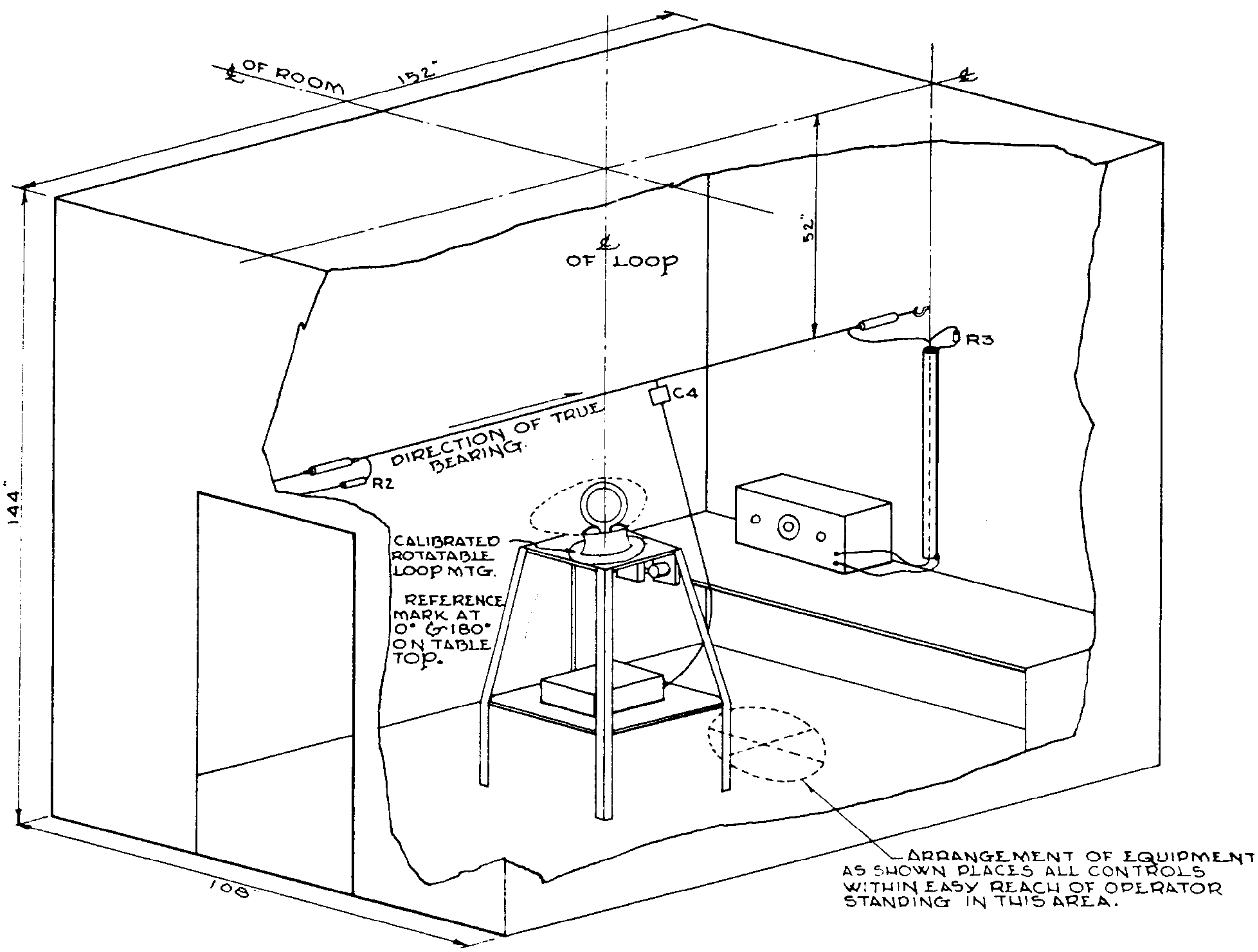


FIGURE 22—TYPICAL SCREEN ROOM AND COMPASS TEST SET-UP

B. The room should be shielded completely on the inside with copper sheet or copper screen. All joints in the shielding should be soldered and the shield should be grounded at only one point. If external interference is severe, add a second complete shield on the outside of the frame, connecting the two shields at only one point.

C. The door should be located at the center of one end of the room with spring contacts arranged to ground the screened door surfaces to the room shields.

6-7-3-3. External Power

All external power leads brought into the test room must be well filtered to prevent radio interference. Use an electrostatically-shielded power transformer or a three-section radio-frequency power-line filter.

6-7-3-4. Transmission Line

A. A transmission line is used in the test room to produce a signal at the loop whose intensity in microvolts per meter is a direct function of the output reading of the signal generator.

B. The line should be #12 copper-clad wire, 144 inches long, located along the longitudinal center-line of the shielded room, 52 inches from the ceiling. The line should be supported by insulators at each end and drawn taut. Each end of the line should be four inches from the room shield.

C. Termination: The end of the line opposite the signal generator must be terminated by a non-inductive resistor whose resistance is equal to the characteristic impedance of the line. A value of 455 ohms is correct for the dimensions given above.

D. Input to Transmission Line: A concentric line should be used to connect the signal generator to the transmission line. The concentric line should be made of one-inch copper tubing with a #16 wire supported in the center of the tube. The line should be long enough to connect the input end of the transmission line to the terminals of a signal generator located directly below the transmission line.

E. Connection: Connect the signal generator output terminal to the center conductor of the concentric line and the ground terminal of the generator to the outer shield of the concentric line. The outer shield of the concentric line should be connected to the room shield. Leads connecting the signal generator to the concentric line should be as short and direct as possible.

6-7-3-5. Loop Location

The loop assembly should be located on a rigid stand below the transmission line so that the vertical distance from the line to the center of the loop is 25 inches. The vertical axis of the loop should be in the center of the test room and directly below the transmission line. A calibrated rotatable mounting base should be provided on top of the stand so that the loop assembly may be rotated through a given angle. Index marks should be so located on the top of the stand that the loop assembly may be accurately aligned with respect to the transmission line. The rotatable loop-mounting base should be fitted with mounting screws to fit the base plate of the Type MN-36A Automatic Loop. The Type MN-36A Automatic Loop should be so located that the front and rear index marks on the base plate of the loop unit coincide with the 0—180-degree line of the rotatable base. The center of the loop shaft should coincide with the center of the rotatable base.

Locate the mounting stand with the center of the rotatable mounting base directly below the transmission line and in the center of the room. This location may be accomplished by suspending a plumb bob from the midpoint of the transmission line and moving the stand until the point of the plumb bob coincides with the center of the rotatable mounting base. Fasten the stand securely to the screen room floor so that this position will be permanently maintained.

The 0- and 180-degree marks on the rotatable loop mounting base must be referenced to the transmission line. This alignment may be made with two plumb bobs and a metal straight-edge at least 60 inches long. Clamp the straight-edge horizontally on top of the rotatable base so that the edge passes through the 0- and 180-degree marks. The longitudinal center of the straight-edge should be over the center of the mounting base so that the 0—180-degree line is extended 30 inches in either direction. Suspend two plumb bobs from the transmission line, slightly less than 30 inches in either direction from the center of the transmission line. Turn the rotatable mounting base and straight-edge so that the straight-edge aligns with the two plumb lines. Hold the mounting base in this position, and locate index marks on the top of the stand for the 0- and 180-degree marks on the rotatable loop mounting base. These marks are to be used for alignment purposes in future tests and should be located accurately.

If the test stand is not equipped with a rotatable loop-mounting base, the center of the stand should be located under the transmission line, as mentioned above. Establish a reference line on top of the stand by a procedure similar to that described in the above paragraph, except that the straight-edge should be oriented on top of the stand so that it is in alignment with the two vertical plumb lines. The Type MN-36A Automatic Loop should then be located on top of the stand so that the two index marks on the front and rear of the mounting plate coincide with the reference line on top of the stand.

6-7-3-6. Vertical Antenna

A vertical antenna of 0.25-meter effective height and 50-Mmf capacitance is used for testing Type MN-26 Radio Compasses. These conditions may be approximated by connecting the antenna input terminal of the receiver to the transmission line through a capacitance of 2.6 Mmf, with a capacitance of 50 Mmf connected from the antenna input terminal to ground. The small capacitor in the vertical antenna lead should be located at the transmission line 2 feet from the loop.

6-7-3-7. Attenuation Ratio

The ratio of signal generator output indication to field strength in microvolts per meter at the loop, will be 5.0 when all dimensions are as given in the above paragraph. Thus, if the signal generator attenuator is set for 5000 microvolts input to the transmission line, the field strength will be 1000 microvolts per meter at the loop whose center is 25 inches from the line.

6-7-3-8. Variation of Room Dimensions

A change in any of the dimensions given above will change the characteristic impedance of the line, effective height of the vertical antenna, and the attenuation ratio. If a room having dimensions different from those given above is used, these factors will have to be determined. See paragraph 6-7-4.

The shielded room may be larger than the dimensions given, but should not be smaller.

The loop may be spaced from 24 to 50 inches from the transmission line, but a change in either loop spacing or room dimensions will change the attenuation ratio given above.

6-7-4. Determination of Screen Room Constants

6-7-4-1. General

The following procedures may be used to establish the various constants if a screen room having dimensions different from those given above is used.

6-7-4-2. Procedure for Terminating Compass Room Line (See Figure 23)

A. Apparatus required:

2 General Radio vacuum tube voltmeters (VTV).

1 RF signal generator capable of supplying a 1-volt output over a frequency range from 28 Mcs to 150 Kcs.

1 DC resistance bridge.

Assortment of ½-watt resistors from 100 to 1000 ohms.

B. Termination at top of concentric feed line: Disconnect the line from the top of the concentric line feeder. Connect the vacuum tube voltmeters as shown in Detail A Figure 23, but omit the temporary termination resistor R_1 until a desirable test frequency has been found.

Adjust the signal generator frequency so that the line resonates as a ¼-wave system. This point will be indicated by a dip in the output calibrating meter on the signal generator or by maximum

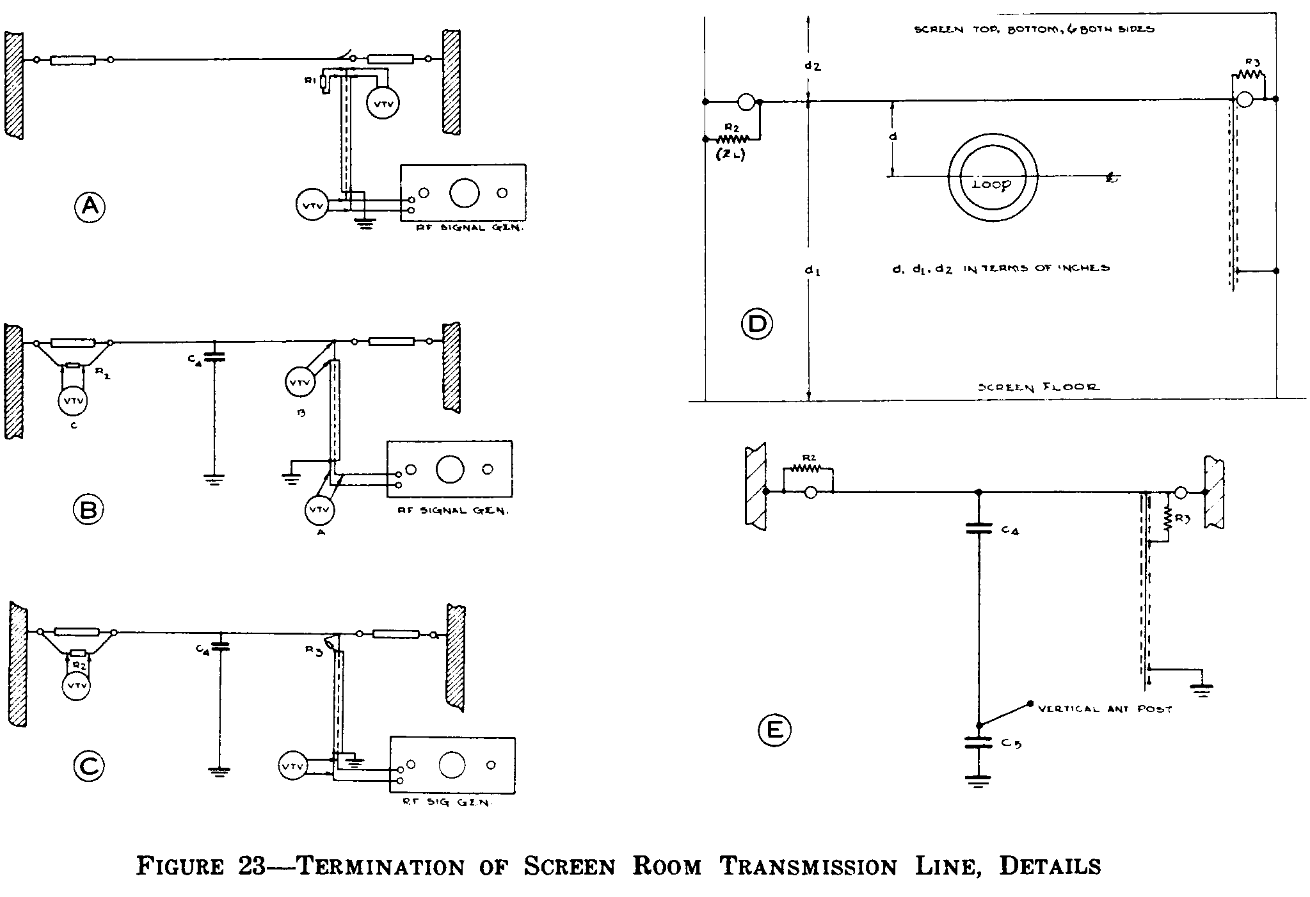


FIGURE 23—TERMINATION OF SCREEN ROOM TRANSMISSION LINE, DETAILS

voltage at the top of the tubing for constant input. This voltage may be read with the vacuum tube voltmeter connected as shown in the sketch. The frequency at which the concentric tube is electrically 1/4 wavelength long is the one at which the greatest step-up at the end of the line will occur and, therefore, will give the most sensitive indication of correct termination. A frequency near this resonant frequency may be used if the line absorbs too much energy from the generator. Temporarily connect resistor R_1 at the top end of the concentric line between the center wire and pipe. The final value of this resistor is to be determined by a cut-and-try method, but its approximate value may be obtained from the formula for determining the characteristic impedance of a concentric line:

$$Z = R_1 = 138 \log_{10} \frac{d_2}{d_1}$$

d_2 = inside diameter of pipe

d_1 = outside diameter of central conductor

With a specific case of a 1-inch tube and #14 wire the value is approximately 150 ohms.

Connect one of the vacuum tube voltmeters across this resistor R_1. Connect the other vacuum tube voltmeter at the input end of the tubing near the generator. (See Detail A, Figure 23) With the generator set at zero output, adjust the voltmeters for zero reading.

With the input voltage to the concentric tubing raised to one or two volts, the vacuum tube voltmeters should read the same if 150 ohms is the correct termination for the system. If the voltage at the top end of the tubing is higher than the lower one, the termination is too high. Conversely, if the voltage at the top is less than that at the bottom, the termination is too low. By successive trials, a value of resistance can be found which will terminate the line properly. Several resistors in parallel or series combinations may be used to get the required value if a single resistor of correct value cannot be found.

Successive lower frequencies should then be tried and should produce identical readings on the two vacuum tube voltmeters if the termination is correct.

This termination can now be disconnected and measured on the DC bridge, the value being recorded as R_1.

C. Termination of single (horizontal) line:

With the termination of the concentric line removed, connect the end of the horizontal line to the center wire of the tubing. (See Detail B, Figure 23) Connect capacitor C_4 from the center point of the line to ground. Its value is discussed in paragraph 6-7-4-2F. For a specific case of simulating an antenna of 50 Mmf capacitance and an effective height of 0.25 meters, capacitor C_4 is approximately 2.5 Mmf.

With the vacuum tube voltmeters in positions A and C and temporary termination R_2 removed, the frequency at which the system is 1/4 wave long is found as in paragraph 6-7-4-2B. This frequency is to be used in the following determination of R_2. Since a frequency near this 1/4-wave value can be used, a rough measurement will do.

For finding the value of resistor R_2, the voltmeters should connect in positions B and C. (See Detail B, Figure 23)

Since experience has shown the characteristic impedance of such lines to be in the neighborhood of 400 ohms, much time can be saved by omitting involved measurements on the line and, starting with this 400-ohm value for R_2, proceeding as per paragraph 6-7-4-2B to find the correct termination. Once the vacuum tube voltmeters read the same, or within 0.1 volt of one another, for several frequencies, the termination may then be removed, measured on the bridge, and replaced permanently as part of the system. Record termination value as $R_2=Z_L$, the characteristic impedance of the line, to be used later in calculation of concentric line feeder termination and attenuation constant.

D. Matching the horizontal line to the concentric tube feeder:

The termination found in paragraph 6-7-4-2C is correct termination for the single-wire horizontal line alone and will be the impedance seen when looking in the end opposite to that terminated. However, this resistance is not the correct value for proper termination of the top of the concentric line. Since we are interested only in the termination of the concentric line at this point, a resistor may be put in as a termination which, when connected in parallel with the impedance presented by the horizontal line, would give the value of resistance determined in paragraph 6-7-4-2B as the correct termination of the concentric line. The formula for finding this resistance is the usual one for finding values of parallel resistance combinations.

R_1 = Termination for concentric line alone from paragraph 6-7-4-2B.

R_2 = Termination for horizontal line from paragraph 6-7-4-2C.

R_3 = Termination which must be put across top end of concentric line to give correct termination.

$$R_1 = \frac{R_1 \times R_2}{R_2 - R_1}.$$

Typical values obtained at Bendix Radio.

R_1 = 138 ohms

R_2 = 413 ohms = Z_L (The characteristic impedance of line)

R_3 = 206 ohms

After both terminations have been connected (See Detail C, Figure 23), a final check should be made to see if the voltages at the bottom end of the concentric line and the far end of the horizontal line remain substantially the same over a frequency range from 150 Kcs to 14 Mcs.

E. Determination of attenuation constant:

1. To determine the field strength around a transmission line in terms of µV/m at a known distance from the line (Detail D, Figure 23):

a. $E_{\mu V/m} = E_{t.s.} + E_{fl.} - E_c$

$E_{\mu V/m}$ = field strength at known distance.

$E_{t.s.}$ = voltage due to current in line.

$E_{fl.}$ = voltage due to current in floor.

E_c = voltage due to current in ceiling.

E_L = µV into line at point A (Detail C, Figure 23) from a signal generator.

$$E_{t.s.} = \frac{2.36 \times 10^3 \frac{E_L}{Z_L}}{d}$$

$$E_{fl.} = \frac{2.36 \times 10^3 \frac{E_L}{Z_L}}{2d_1 - d}$$

$$E_c = \frac{2.36 \times 10^3 \frac{E_L}{Z_L}}{2d_2 + d}$$

NOTE: All values of d, d_1, and d_2 in inches.

2. To determine attenuation constant of transmission line:

a. $K_d = \frac{E_1}{E_{\mu V/m}}$

K_d = Attenuation constant (factor)

E_1 = µV into line from generator

$E_{\mu V/m}$ = Field strength at a known distance

This is a constant and, for a standard loop distance in a given room with a given line, can always be used to determine the field strength in microvolts per meter at the loop in terms of the generator input in microvolts.

For example: If this constant ratio K_d is found to be 5, then, to obtain a field strength at the loop of 1000 microvolts per meter, the signal generator input will be set at 5000 microvolts. If a field strength measuring set is available, the calculation should be checked by actual measurement of the field.

F. Determination of vertical antenna constants:

1. To determine the value of capacitor C_4 when the value of the dummy antenna capacitance and effective height of the vertical antenna is known (Detail D, Figure 23):

a. $C_4 = \frac{H_e \times C_5}{K_d - H_e}$ (This gives an approximate value.)

$K_d \times H_e$ = Ratio of line voltage applied at A to antenna voltage applied to receiver

C_4 = Coupling capacitance to line

C_5 = Dummy antenna load

H_e = Effective antenna height in meters

K_d = Attenuation constant of line

2. For a more accurate determination, the following procedure is recommended.

For example, assume an antenna with effective capacitance of 50 Mmf and an effective height of 0.25 meter is desired.

Adjust the radio compass to 500 Kcs with the selector switch on REC. ANT. (receiver operation), and connect the signal generator, modulated 30% at 400 cycles, directly to the radio compass antenna input through a 50-Mmf capacitor. Set the signal generator attenuator to 250 microvolts and adjust the compass volume control for an audio output of 50 milliwatts. Henceforth, do not disturb the volume adjustment of the radio compass.

Disconnect the signal generator from the radio compass, connect it to the concentric line, and adjust its output to produce a field strength of 1000 microvolts per meter at standard loop distance.

Connect one side of a small variable capacitor (2-20 Mmf) directly to the line about 24 inches from a point directly over the loop. Connect the other side of this capacitor to the radio compass antenna input by means of an insulated lead tied away from the compass stand and loop. Connect a capacitor (approximately 45 Mmf) from the antenna input terminal of the radio compass to ground. Adjust the 2—20-Mmf coupling capacitor to obtain exactly 50 milliwatts output from the compass receiver, being sure that its gain has not been changed since the measurement was made directly from the signal generator. Set the variable coupling capacitor permantly to the value thus obtained, or replace it with a fixed capacitor of the same capacitance. This arrangement of coupling can henceforth be used as a vertical antenna having an effective height of 0.25 meter and an effective capacitance of approximately 50 Mmf.

For other values of effective height or capacitance, use the applicable ratio between generator input and field strength in microvolts per meter.

6-8. OVERALL PERFORMANCE TESTS

6-8-1. General

Performance of the combined equipment should be measured in accordance with the following procedure if the operation of the equipment is questionable. Performance tests should be made after any major repairs or adjustments have been made to be certain that all changes are correct.

6-8-2. Standard Test Conditions

The following standard test conditions should be maintained unless otherwise mentioned.

A. Low voltage supply: +14 or +28 volts, measured at input to junction box.

B. Warm-up period: 20 minutes.

C. Artificial antenna: REC. ANT. operation, 50 Mmf; COMP. operation 50 Mmf; 0.25-meter effective height.

D. Standard signal modulation: 30% at 400 cycles per second.

E. Standard audio output (signal plus noise): 50 milliwatts or 5.5 volts across a 600-ohm load. This output may be obtained from either channel of the dual output amplifier contained in the Type MN-31 Automatic Loop Control. If the dual amplifier is not used, the output may be obtained from one of the jacks on the Type MN-28 Remote Control Unit with no connection to the other jack. For REC. ANT. or LOOP operation, adjust AUDIO control for standard signal-to-noise.

F. Standard signal-to-noise ratio: This is taken as the ratio of power output for a given input signal, modulated 30% at 400 cycles, to the power output for the same signal input, unmodulated. The ratio is 4 to 1 for power measurements and 2 to 1 for voltage measurements. For a standard power output of 50 milliwatts, the noise output is 1.5 milliwatts. For voltage measurements with a 600-ohm load, the noise output is 2.8 volts and the standard voltage output is 5.5 volts.

6-8-3. Sensitivity Rec. Ant.

Apply a standard modulated signal to the receiver antenna plug through a 50-Mmf artificial antenna. Set the signal generator output at approximately 5 microvolts. Tune the receiver to resonance. Switch the modulation off, leaving the carrier on. Set the average noise output to 12.5 milliwatts by adjusting the AUDIO control. Turn the modulation on, and adjust the signal generator output to obtain an audio output of 50 milliwatts. Turn the modulation off, and reset the AUDIO control for an average noise output of 12.5 milliwatts. Repeat this procedure until an output of 50 milliwatts is obtained with standard modulation, and 12.5 milliwatts noise output is obtained without modulation. Record the signal generator output reading for this test frequency on a form similar to that in paragraph 6-8-11-2.

Repeat the above procedure for each test frequency.

6-8-4. Minimum Noise Level

Minimum noise level may be measured by operating the equipment on REC. ANT. position of the function switch with the AUDIO control in the minimum output condition. Output levels in excess of .050 milliwatts indicate trouble in the dynamotor filtering or in second detector and audio circuits.

6-8-5. Intermediate Frequency Rejection Ratio

Measure the sensitivity for REC. ANT. operation at the lowest test frequency. (See paragraph 6-8-11-1) Note the signal generator output. With the signal generator connections and receiver tuning undisturbed, set the generator frequency near 112.5 Kcs for maximum receiver output. Adjust the generator output until a receiver output of 50 milliwatts is obtained. Note the signal generator output. The ratio of the generator output at 112.5 Kcs to the generator output at the lowest test frequency is the rejection ratio for that test frequency. Record this data on a form similar to that shown in paragraph 6-8-11-2.

NOTE: Harmonics of the 112.5-Kcs signal will appear in the frequency range of the equipment (i.e., 225, 337.5 etc.). If test frequencies other than those specified in paragraph 6-8-11-1 are used, always select a frequency half way between harmonic points in order to avoid harmonic responses.

6-8-6. Image Rejection Ratio

Measure sensitivity for REC. ANT. operation on the highest test frequency. (See paragraph 6-8-11-1) Note the signal generator output. Set the signal generator frequency 225 Kcs above the test frequency, but do not disturb any control settings of the receiver. Vary the signal generator frequency slightly until maximum receiver response is obtained. Adjust the signal generator output until a receiver output of 50 milliwatts is obtained with the AUDIO control undisturbed. Note the signal generator output. The ratio of the signal generator output for a generator frequency of twice the intermediate frequency above the test frequency, to the generator output for the test frequency, with adjustments made as above, is the image rejection ratio. Record this data on a form similar to that shown in paragraph 6-8-11-2.

6-8-7. AVC Action

Operate the equipment with the function switch in the REC. ANT. position and with the AUDIO control set for maximum output. Apply a standard modulated signal to the receiver antenna terminal through a 50-Mmf artificial antenna. Tune the receiver for maximum audio output with a modulated input signal of 10 microvolts at a frequency of 655 Kcs. Adjust the output to 100 milliwatts by varying the audio control. Increase the output of the signal generator by steps of ten times until an output of one volt has been reached. Note and record the receiver output in milliwatts for various input signals on a form similar to that shown in paragraph 6-8-11-2.

6-8-8. SELECTIVITY—REC. ANT. OPERATION

Operate the equipment with the function switch in the REC. ANT position. Measure the sensitivity at the high frequency end of Band III in accordance with paragraph 6-8-3. Note the signal generator output reading for standard receiver output. Increase this signal generator output 1000 times and vary the signal generator frequency above and below resonance until standard receiver output is obtained. Do not change the receiver tuning or AUDIO control during this test. Note the frequencies above and below resonance for standard output conditions. Record their difference as the 1000X bandwidth on a form similar to that shown in paragraph 6-8-11-2.

Repeat the above procedure for Bands II and I.

6-8-9. SENSITIVITY REC. LOOP OPERATION

Mount the loop under the screen room transmission line as shown in Figure 22. Operate the equipment with the function switch in the REC. LOOP position. Turn the loop parallel to the transmission line for maximum pick-up. Apply a standard modulated signal to the transmission line, adjusting the signal generator output so that a field strength of approximately 100 microvolts per meter will be obtained at the center of the loop. Tune the receiver for maximum output. Adjust the AUDIO control and signal generator output until a 4-to-1 signal-to-noise power output ratio is obtained, using a procedure similar to that used in the REC. ANT. sensitivity test of paragraph 6-8-3. Record the field strength in microvolts per meter at the center of the loop, for standard receiver output, on a form similar to that shown in paragraph 6-8-11-2.

Perform the operation for the various test frequencies listed in paragraph 6-8-11-1.

6-8-10. AUTOMATIC COMPASS TESTS

6-8-10-1. Equipment Set-up

The following tests must be made in a suitable screened test room equipped with a transmission line and loop mounting standard as described in paragraph 6-7-3. The use of a Type MN-36A Automatic Loop having zero compensator correction at all azimuth points is assumed. The zero calibration line on the rotatable azimuth scale of the Type MN-37A Bearing Indicator should be set to the zero index mark. Refer to paragraph 6-7-3-5 and 6-7-3-6 for loop alignment procedure and for the adjustment of the artificial vertical antenna in the screened test room.

Connect the component units in accordance with the overall schematic circuit diagram shown in Figure 25. Mount the loop under the transmission line and connect the receiver antenna terminal to the line through an artificial antenna having an effective height of 0.25 meter and a capacitance of 50-Mmf. Connect a signal generator to the transmission line. Adjust the signal generator so that a 300-Kcs signal, modulated 30% at 400 cycles and having a field strength of 1000 microvolts per meter, is obtained at the center of the loop. Place the function switch in the REC. ANT. position and carefully tune the receiver for maximum output. Orient the entire automatic loop so that the center-line of the loop mounting base aligns with the transmission line to within ±0.2 degree. The nose of the loop should face the signal generator end of the line.

6-8-10-2. Hunting and Sensitivity Adjustment

Place the function switch in the COMP. position. Adjust the thyratron sensitivity control on the Type MN-31 Automatic Loop Control so that the Type MN-37A Bearing Indicator responds to 1-degree rotation of the loop within less than ±0.5 degree but does not continually hunt more than ±0.5 degree. Note and record, on a form similar to that shown in paragraph 6-8-11-3, the bearing indicator reading with the automatic loop set to a zero azimuth heading.

6-8-10-3. Compass Performance

Make the following tests at three frequencies in each compass band (low end, middle, and high end) after the above adjustments have been made. (See paragraph 6-8-11-1).

Set the signal generator for a field strength of 50 microvolts per meter. Tune the receiver for maximum output with the function switch in the REC. ANT. position. Place the function switch in the REC. LOOP position, and rotate the loop to a reading of 175 degrees on the Type MN-37A Bearing Indicator by use of the LOOP L.R. switch. Note the time required for the loop to return automatically from the 175-degree position to the zero position, measuring time from the instant the function switch is placed in the COMP. position. (The use of a stop watch is recommended.) The indicator pointer should return in a counterclockwise direction. Note the indicated zero-bearing. Rotate the loop to a reading of 185 degrees by use of the LOOP L.R. switch and note the time required for the loop to return to the indicated zero-bearing for clockwise rotation of the indicator pointer. Record the time and indicated zero-bearing on a form similar to the one shown in paragraph 6-8-11-3. Increase the field strength to 1000 microvolts per meter and repeat the above measurements for 175-degree rotation of the loop in either direction from the zero heading. Place the function switch in the REC. LOOP position and rotate the loop slowly to an indicator reading of 2 degrees. Place the function switch in the COMP. position and note the indicated zero-bearing. Rotate the loop slowly to an indicated reading of 358 degrees and again note the indicated zero-bearing after the switch is placed in the COMP. position. Record the measured time for 175-degree rotation and 2-degree bearing indications.

Repeat the above procedure for a field strength of 100,000 microvolts per meter.

6-8-11. Performance Data

The data obtained in the tests outlined in paragraph 6-8-10 should be recorded on data sheets similar to those shown below. Use the test frequencies given in the table of paragraph 6-8-11-1 for the receiver under test.

6-8-11-1. Test Frequencies—MN-26 Radio Compass

Types	Band I			Band II			Band III		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
MN-26 P, S	150	250	325	325	500	695	695	1100	1500
MN-26 H, L, N, U	200	300	410	550	900	1200	2900	4500	6000
MN-26 J, K	200	300	410	410	600	850	850	1200	1750
MN-26 R, T	–	278	–	200	300	410	550	900	1200
MN-26V	200	300	410	550	900	1200	2200	3000	4250

OVERALL PERFORMANCE DATA SHEET

6-8-11-2. Receiver Tests

		Sensitivity		Selectivity	Rejection Ratio	
Test Point	Test Freq.	Rec. Ant. μV	Rec. Loop μV/m	Rec. Ant. 1000X	IF	Image
1L						
1M						
1H						
2L						
2M						
2H						
3L						
3M						
3H						

A. V. C. OPERATION (655 Kcs)

Input—μV	10	100	1000	10,000	100,000	1 Volt
Output—μW	100					

Tested by ____________________

Date ____________________

OVERALL PERFORMANCE DATA SHEET

6-8-11-3. Compass Operation

Adjustments made at 300 Kcs, 1000 μV/meter as described in paragraph 6-8-10-2.
Zero Bearing......degrees (0±1.5°) for above adjustment.

Field Strength		50 μV/meter				1000 μV/meter						100,000 μV/meter					
Test Point	Test Freq.	175°-0°		185°-0°		175°-0°		185°-0°		+2°-2°		175°-0°		185°-0°		+2°-2°	
		Time	Bear.	Time	Bear.	Time	Bear.	Time	Bear.	Bear.	Bear.	Time	Bear.	Time	Bear.	Bear.	Bear.
1L																	
1M																	
1H																	
2L																	
2M																	
2H																	
3L																	
3M																	
3H																	

Time = Time in seconds for 175° automatic loop rotation.
Bear. = Indicated zero azimuth scale reading.

Tested by____________________

Date____________________

6-8-12. TEST LIMITS

The following general limits are listed for the tests outlined in paragraphs 6-8-3 through 6-8-10. These limits are applicable for normal test conditions only.

REC. ANT. Sensitivity: (a) Better than 7 μV below 1750 Kcs.
(b) Better than 12 μV above 1750 Kcs.

IF Rejection Ratio: Better than 80,000 to 1.

Image Rejection Ratio: (a) Better than 10,000 to 1 for 1750 Kcs or lower frequencies.
(b) Better than 100 to 1 for 4250 Kcs.
(c) Better than 100 to 1 for 6000 Kcs.

AVC Operation: Output range 100 to 250 milliwatts for signal inputs to one volt with audio control set for 100 milliwatts output with a 30% modulated input signal of 10 microvolts.

REC. ANT. Selectivity: Maximum band width for 1000X resonance input at high frequency end of band.

BAND	FREQ. Kcs	REC. TYPE	BANDWIDTH Kcs
III	6000	MN-26H	25
III	4250	MN-26V	25
III	1750	MN-26J	23
III	1500	MN-26P	22
II	1200	MN-26H	21
II	1200	MN-26V	21
III	1200	MN-26R	21
II	850	MN-26J	19
II	695	MN-26P	17
I	410	MN-26H	16
I	410	MN-26J	16
I	410	MN-26V	16
II	410	MN-26R	16
I	325	MN-26P	14
Fixed I	278	MN-26R	11

REC. LOOP Sensitivity: Better than 120 μV/meter, all bands.

Compass Performance:

Accuracy of Zero Bearing: ±4° at 50 μV/meter, ±1.5° 1000 and 100,000 μV/meter.

Time for 175° Loop Rotation, either direction:
4.5 to 8 seconds, 50 μV/meter, 4.5 to 7 seconds, 1000 μV/meter and 100,000 μV/meter.

7. PARTS LIST BY SYMBOL DESIGNATION

7-1. TYPE MN-26 RADIO COMPASS SERIES

CAPACITORS

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
C1-1	Loop Trimmer, Band I	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-2	Loop Trimmer, Band II	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-3	Loop Trimmer, Band III	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25			X	X	X	X	X	X			
C1-4	Ant. Trimmer, Band I	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-5	Ant. Trimmer, Band II	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-6	Ant. Trimmer, Band III	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-7	RF Amp. Trimmer, Band I	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-8	RF Amp. Trimmer, Band II	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-9	RF Amp. Trimmer, Band III	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-10	RF Amp. Trimmer, Band I	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-11	RF Amp. Trimmer, Band II	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-12	RF Amp. Trimmer, Band III	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
C1-13	RF Osc. Trimmer, Band I	6-25 Mmf ±10%, 500V, Variable, Left-hand terminal	Special	26	QB7783-25	X	X	X	X	X	X	X	X	X	X	X
C1-14	RF Osc. Trimmer, Band II	6-25 Mmf ±10%, 500V, Variable, Left-hand terminal	Special	26	QB7783-25	X	X	X	X	X	X	X	X	X	X	X
C1-15	RF Osc. Trimmer, Band III	6-25 Mmf ±10%, 500V, Variable, Left-hand terminal	Special	26	QB7783-25	X	X	X	X	X	X	X	X	X	X	X
C2-1 C2-2 C2-3 C2-4 C2-5	Loop Tuning Ant. Tuning 1st RF Tuning 2nd RF Tuning RF Osc. Tuning	5-section, Variable, Max. cap. per section 400 Mmf ±0.5%, Min. cap. per section 12.5 Mmf	Special	3	L70943	X	X	X	X	X	X	X	X	X	X	X
C3-1	V1 Plate Bypass	.05 Mfd ±10%, 400V DCW Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-2	V1 Screen Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-3	V1 AVC Filter	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-5	V4 Screen Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-6	V4 Plate Bypass	.05 Mfd ±10%, 400V, DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-7	V5 Screen Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-8	V5 Plate Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-9	V6 Screen Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-10	V8 Plate Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-11	V8 Screen Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-12	V6 Plate Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-13	V2 Feedback	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-14	V2 Feedback	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-15	V7 Plate Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
C3-16	V3 Plate Bypass	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

CAPACITORS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
C3-17	V9 Plate Bypass.....	.05 Mfd ±10%, 400V DCW, Paper........	345-8..	4	A18015-503...	X	X	X	X	X	X	X	X	X	X	X
C3-18	V3 Grid Coupling Low Freq..........	.05 Mfd ±10%, 400V DCW, Paper........	345-8..	4	A18015-503...	X	X	X	X	X	X	X	X	X	X	X
C3-19	V3 Grid Coupling Low Freq..........	.05 Mfd ±10%, 400V DCW, Paper........	345-8..	4	A18015-503...	X	X	X	X	X	X	X	X	X	X	X
C3-20	V9 Grid Bypass.....	.05 Mfd ±10%, 400V DCW, Paper........	345-8..	4	A18015-503...	X	X	X	X	X	X	X	X	X	X	X
C4-1	V1 Cathode Bypass..	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-2	V3 Cathode Bypass..	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-3	V4 Cathode Bypass..	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-4	V5 Cathode Bypass..	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-5	V6 Cathode Bypass..	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-6	V8 Cathode Bypass..	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-7	V10 Cathode Bypass.	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-8	V4 AVC Filter......	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-9	V5 AVC Filter......	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-10	V6 AVC Filter......	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C4-11	V3 Cathode Filter...	.05 Mfd ±10%, 200V DCW, Paper........	342-6..	4	A18181-503...	X	X	X	X	X	X	X	X	X	X	X
C5-1	V12 Grid Bypass....	.01 Mfd ±10%, 200V DCW, Paper........	345-5..	4	A18181-104...	X	X	X	X	X	X	X	X	X	X	X
C5-2	V12 Plate Resonator.	.01 Mfd ±10%, 200V DCW, Paper........	345-5..	4	A18181-104...	X	X	X	X	X	X	X	X	X	X	X
C6-1	AVC Filter.........	.02 Mfd ±10%, 200V DCW, Paper........	342-3..	4	A18181-203...	X	X	X	X	X	X	X	X	X	X	X
C6-2	V8 AVC Filter......	.02 Mfd ±10%, 200V DCW, Paper........	342-3..	4	A18181-203...	X	X	X	X	X	X	X	X	X	X	X
C7	V12 Grid Coupling..	0.5 Mfd ±10%, 400V DCW, Paper........	Special	5	E11398.......	X	X	X	X	X	X	X	X	X	X	X
C8	V11 Cathode Bias...	5 Mfd +100% −0%, 50V, Electrolytic........	Special	5	E11402.......	X	X	X	X	X	X	X	X	X	X	X
C9-1 C9-2	LV Filter Bypass... LV Filter Bypass...	2-section, Each 0.5 Mfd ±10%, 100V DCW, Oil, Paper	Special	5	E11400.......	X	X	X	X	X	X	X	X	X	X	X
C10-1 C10-2	HV Filter Bypass... HV Filter Bypass...	2-section, Each 6 Mfd, 400V DCW, Oil-filled........	Special	5	A15066.......	X	X	X	X	X	X	X	X	X	X	X
C11-1	V1 Grid Parallel Padder............	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-350...					X	X					
C11-2	V5 Grid Parallel Padder............	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-350...					X	X					
C11-3	V6 Grid Parallel Padder............	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-350...					X	X					
C11-4	V4 Grid Parallel Padder............	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-350...			X	X							
C11-5	V7 RF Oscillator Tuning, Band I.....	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-350...	X	X					X	X	X	X	X
C11-6	V5 Grid Resonator...	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	5	A18207-350...											X
C11-7	V6 Grid Resonator...	35 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-350...											X
C12-1	V10 RF Bypass.....	50 Mmf ±5%, 500V DCW, Ceramic........	N680K	6	A18207-500...	X	X	X	X	X	X	X	X	X	X	X
C12-2	V10 Grid Bypass....	50 Mmf ±5%, 500V DCW, Ceramic........	N680K	6	A18207-500...	X	X	X	X	X	X	X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

CAPACITORS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
C12-3	V4 Grid Resonator	50 Mmf ±5%, 500V DCW, Ceramic	N680K	6	A18207-500											X
C13	V10 RF Bypass	100 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-101	X	X	X	X	X	X	X	X	X	X	X
C14-1	V4 Trap Resonator	.005 Mfd ±2%, 300V DCW, Mica	1467	5	C56310-502	X	X	X	X	X	X	X	X	X	X	X
C14-2	V5 Trap Resonator	.005 Mfd ±2%, 300V DCW, Mica	1467	5	C56310-502	X	X	X	X	X	X	X	X	X	X	X
C15	Ant. Coupling	.001 Mfd ±10%, 500V DCW, Mica	1468	5	C56315-102	X	X	X	X	X	X	X	X	X	X	X
C16	V11 Grid Coupling	.01 Mfd ±10%, 300V DCW, Mica	1467	5	C56312-103	X	X	X	X	X	X	X	X	X	X	X
C17	V7 Grid	25 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-250	X	X	X	X	X	X	X	X	X	X	X
C18	V1 Grid Parallel Padder	45 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-450			X	X							
C19-1	V3 Grid RF Coupling	250 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-251	X	X	X	X	X	X	X	X	X	X	X
C19-2	V3 Grid RF Coupling	250 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-251	X	X	X	X	X	X	X	X	X	X	X
C20-1	V4 Ant. Coupling	10 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-100	X	X			X	X	X	X	X	X	X
C20-2	V7 Grid Parallel Padder	10 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-100			X	X	X	X					
C21-1	V9 Grid	100 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-101	X	X	X	X	X	X	X	X	X	X	X
C21-2	V4 Plate Resonator, Band III	100 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-101					X	X					
C21-3	V5 Plate Resonator, Band III	100 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-101					X	X					
C21-4	V10 AVC Diode Coupling	100 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-101	X	X	X	X	X	X	X	X	X	X	X
C22-1	V4 Plate Resonator, Band I	300 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-301					X	X					
C22-2	V5 Plate Resonator, Band I	300 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-301					X	X					
C23-1	V4 Plate Resonator, Band II	75 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-750					X	X					
C23-2	V5 Plate Resonator, Band II	75 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-750					X	X					
C24-1	T9-1 Coupling	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050			X	X	X	X					
C24-2	T9-2 Coupling	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050			X	X	X	X					
C24-3	V9 Grid Coupling	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050	X	X	X	X	X	X	X	X	X	X	X
C24-4	Coupling, Antenna, Band III	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050											X
C25	V6 Injector Grid Coupling	15 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-150	X	X	X	X	X	X	X	X	X	X	X
C26-1	V1 Grid Resonator, Band I	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X					X	X	X	X	X
C26-2	V4 Grid Parallel Padder I	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X					X	X	X	X	X
C26-3	Ant. Coupling	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150			X	X							
C26-4	V4 Grid Resonator, Band I	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X					X	X	X	X	X
C26-5	V5 Grid Resonator, Band III	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X							X	X	
C26-6	V6 Grid Resonator, Band III	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X							X	X	
C26-7	V7 Grid Parallel Padder	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X					X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

CAPACITORS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
C27-1	V1 Grid Resonator, Band III	185 Mmf ±2%, 500V DCW, Ceramic	1469	5	C56316-1850							X	X			
C27-2	V4 Grid Resonator, Band III	185 Mmf ±2%, 500V DCW, Ceramic	1469	5	C56316-1850							X	X			
C27-3	V5 Grid Resonator, Band III	185 Mmf ±2%, 500V DCW, Ceramic	1469	5	C56316-1850							X	X			
C27-4	V6 Grid Resonator, Band III	185 Mmf ±2%, 500V DCW, Ceramic	1469	5	C56316-1850							X	X			
C28-1	V4 Plate Resonator, Band I	175 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-1750	X	X	X	X			X	X	X	X	X
C28-2	V4 Plate Resonator, Band III	175 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-1750							X	X			
C28-3	V5 Plate Resonator, Band I	175 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-1750	X	X	X	X			X	X	X	X	X
C28-4	V5 Plate Resonator, Band III	175 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-1750							X	X			
C29-1	V4 Grid Parallel Padder	25 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-250					X	X					
C29-2	V4 Grid Resonator, Band III	25 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-250	X	X							X	X	
C29-3	V5 Grid Parallel Padder 1	25 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-250	X	X					X	X	X	X	X
C29-4	V6 Grid Parallel Padder	25 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-250	X	X					X	X	X	X	X
C30	V7 Series Padder, Band I	625 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-2					X	X					
C31	V7 Series Padder, Band II	1286 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-3					X	X					
C32	V7 Series Padder, Band III	2514 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-4					X	X					
C33-1	V5 Grid Parallel Padder	40 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-400			X	X							
C33-2	V6 Grid Parallel Padder	40 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-400			X	X							
C33-3	V7 Grid Parallel Padder	40 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-400			X	X							
C33-4	V7 Grid Parallel Padder, Band III	40 Mmf ±10%, 500V DCW, Ceramic	N680K	1	A18207-400											X
C34-1	V6 Plate Resonator	500 Mmf ±2%, 400V DCW, Mica	1468	5	C56313-501	X	X	X	X	X	X	X	X	X	X	X
C34-2	V8 Grid Resonator	500 Mmf ±20%, 500V DCW, Mica	1468	5	C56313-501	X	X	X	X	X	X	X	X	X	X	X
C34-3	V8 Plate Resonator	500 Mmf ±2%, 500V DCW, Mica	1468	5	C56313-501	X	X	X	X	X	X	X	X	X	X	X
C34-4	V10 Diode Resonator	500 Mmf ±2%, 500V DCW, Mica	1468	5	C56313-501	X	X	X	X	X	X	X	X	X	X	X
C34-5	V9 CW Osc. Resonator	500 Mmf ±2%, 500V DCW, Mica	1468	5	C56313-501	X	X	X	X	X	X	X	X	X	X	X
C35	V10 Plate Bypass	500 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-501	X	X	X	X	X	X	X	X	X	X	X
C36-1	V5 Grid Resonator, Band I	20 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-200	X	X					X	X	X	X	X
C36-2	V6 Grid Resonator, Band I	20 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-200	X	X					X	X	X	X	X
C36-3	V7 Grid Parallel Padder, Band III	20 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-200	X	X							X	X	
C37-1 C37-2 C37-3	Hash Filter RF Filter RF Filter	3-section. Each, 0.1 Mfd, 400 V DCW, Paper	Special	5	E11347-1	X	X	X	X	X	X	X	X	X	X	X
C38	V1 Plate Resonator	100 Mmf ±2%, 500V DCW, Mica	1468	5	C56313-101	X	X	X	X	X	X	X	X	X	X	X
C39-1	V2 Plate #1 Bypass	0.1 Mfd ±10%, 400V DCW, Paper	345	4	A18015-104	X	X	X	X	X	X	X	X	X	X	X
C39-2	V2 Plate #2 Bypass	0.1 Mfd ±10%, 400V DCW, Paper	345	4	A18015-104	X	X	X	X	X	X	X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

CAPACITORS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
C39-3	V12 AVC Bypass....	0.1 Mfd ±10%, 400V DCW, Paper........	345....	4	A18015-104..	X	X	X	X	X	X	X	X	X	X	X
C39-4	V12 Plate Diode Coupling..........	0.1 Mfd ±10%, 400V DCW, Paper........	345....	4	A18015-104..	X	X	X	X	X	X	X	X	X	X	X
C39-5	V12 Screen Bypass...	0.1 Mfd ±10%, 400V DCW, Paper........	345....	4	A18015-104..	X	X	X	X	X	X	X	X	X	X	X
C40-1	V1 Grid Parallel Padder..........	30 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-300..	X	X					X	X	X	X	X
C40-2	V7 Grid Parallel Padder..........	30 Mmf ±10%, 500V DCW, Ceramic........	N680K	6	A18207-300..					X	X					
C41-1	V4 Plate Resonator, Band III..........	45 Mmf ±5%, 500V DCW, Mica........	1468...	5	C56314-450..			X	X							
C41-2	V5 Plate Resonator, Band III..........	45 Mmf ±5%, 500V DCW, Mica........	1468...	5	C56314-450..			X	X							
C42-1	T9-1 Coupling......	10 Mmf ±10%, 500V DCW, Ceramic........	P120K	6	A29857-100..	X	X							X	X	X
C42-2	T9-2 Coupling......	10 Mmf ±10%, 500V DCW, Ceramic........	P120K	6	A29857-100..	X	X							X	X	X
C43-1	Ant. Compensating..	50 Mmf ±5%, 500V DCW, Mica........	1468...	5	C56314-500..	X	X	X	X	X	X	X	X	X	X	X
C43-2	V4 Plate Resonator, Band II..........	50 Mmf ±5%, 500V DCW, Mica........	1468...	5	C56314-500..			X	X							
C43-3	V5 Plate Resonator, Band II..........	50 Mmf ±5%, 500V DCW, Mica........	1468...	5	C56314-500..			X	X							
C44	V7 Grid Parallel Band III	135 Mmf ±2%, 500V DCW, Mica........	1469...	5	C56316-1350							X	X			
C45	V7 Series, Padder, Band I..........	875 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-6...	X	X					X	X	X	X	X
C46	V7 Series Padder, Band II..........	1990 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-5...	X	X					X	X	X	X	X
C47	V7 Series Padder, Band III..........	5525 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-7...	X	X							X	X	
C48	V7 Series Padder, Band I..........	815 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-8...			X	X							
C49	V7 Series Padder, Band II..........	1625 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-9...			X	X							
C50	V7 Series Padder, Band III..........	2820 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-10..			X	X							
C51	HV Plate, Supply Filter..........	24 Mfd, 350V, Electrolytic, May be put in Junction Box MS-14C, (Necessary when MN-31 is used in system)....	Special	5	A27988.....	X	X	X	X	X	X	X	X	X	X	X
C52	V7 Series Padder, Band III..........	5000 Mmf ±0.5%, 300V DCW, Mica, XM262........	Special	5	E12140-12..											X
		DYNAMOTORS & BRUSHES														
Dyn	Dynamotor.........	14V, 3.3A, input; 230V, 100 MA, output..........	.	.	C56728-1...	X		X		X		X		X		X
Dyn	Dynamotor.........	28V, 1.5A, input; 230V, 100 MA, output..........	.	.	C56728-2...		X		X		X		X		X	
	LV + Dyn. Brush.. LV − Dyn. Brush..	Dyn. Input	*	*	*	X	X	X	X	X	X	X	X	X	X	X
	HV + Dyn. Brush.. HV − Dyn. Brush..	Dyn. Output														

*When ordering brushes submit complete nameplate data of dynamotor for which replacements are desired.

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

RECEPTACLES

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
J4	Wall Mounting Receptacle for Plug P4	23-contact	NK-C-23-32S	15	A30094	X	X	X	X	X	X	X	X	X	X	X
J7	Wall Mounting Receptacle for Plug P7	6-contact	WK-6-32S	15	A30084	X	X	X	X	X	X	X	X	X	X	X
J10	Antenna Lead-in	1-contact	101	19	B7380-1	X	X	X	X	X	X	X	X	X	X	X
		INDUCTORS														
L1	Loop Phaser	1 coil, Sealed 85Ω	Special	1	AL71791-16	X	X	X	X	X	X	X	X	X	X	X
L2, L3	IF Trap	2 coils, Sealed, 1.3Ω	Special	1	AC56703-1	X	X	X	X	X	X	X	X	X	X	X
L6	BFO Coil Assembly	1 coil, Sealed, Tapped	Special	1	AL71791-17	X	X	X	X	X	X	X	X	X	X	X
L7-1	LV RF Choke Assembly	45 turn, #18 paper, Enamel	Special	1	AB6859-1	X	X	X	X	X	X	X	X	X	X	X
L7-2	LV RF Choke Assembly	45 turn, #18 paper, Enamel	Special	1	AB6859-1	X	X	X	X	X	X	X	X	X	X	X
L8	HV RF Choke	1200 turns, #33 SSE, 40Ω	Special	1	AB6859-2	X	X	X	X	X	X	X	X	X	X	X
L9-1	V11 Filter Choke	6H, 50 MA, 340Ω, Part of T17 Assembly	.	.		X	X	X	X	X	X	X	X	X	X	X
L9-2	HV Filter	6H, 50 MA, 340Ω, Part of T16 Assembly	.	.		X	X	X	X	X	X	X	X	X	X	X
L10	V6 Plate	Part of T13 Assembly	.	1	AA26868-1	X	X	X	X	X	X	X	X	X	X	X
L11	V8 Grid	Part of T13 Assembly	.	1	AA26867-1	X	X	X	X	X	X	X	X	X	X	X
L12	V8 Plate	Part of T14 Assembly	.	1	AA26869-1	X	X	X	X	X	X	X	X	X	X	X
L13	V10 Audio Diode	Part of T14 Assembly	.	1	AA26868-1	X	X	X	X	X	X	X	X	X	X	X
		MOTORS														
MO1	Band Switch	12-14V, 2.5A no-load	Special	7 14	E11400-2	X		X		X		X		X		X
MO1	Band Switch	24-28V, 1.25A no-load	Special	7 14	E11500-1		X		X		X		X		X	
	+ Brush		.	7 14	A30212-1	X	X	X	X	X	X	X	X	X	X	X
	− Brush		.	7 14	A30212-2	X	X	X	X	X	X	X	X	X	X	X
		PLUGS														
P4	Radio Compass to Junction Box, Cable Plug	23-contact, Straight, Female	NK-C23-23-⅝B	15	A30601	X	X	X	X	X	X	X	X	X	X	X
P10	Antenna Lead-in	1-contact, Straight, Male	101	19	B7380-2	X	X	X	X	X	X	X	X	X	X	X
		NEON TUBES														
NE1	Overload Discharge, Loop	1/25W, 60V AC, Unbased	T2	18	B15347	X	X	X	X	X	X	X	X	X	X	X
NE2	Overload Discharge, Antenna	½W, 60V AC, Unbased	T2	18	B15347	X	X	X	X	X	X	X	X	X	X	X
		RESISTORS														
R1	Loop Gain Control	15,000Ω, Potentiometer, D Taper	C	16	QB15353	X	X	X	X	X	X	X	X	X	X	X
R2-1	V5 RF Compensator, Band I	25Ω ±5%, ½W, WW	BW-½	16	A16428-6			X	X							
R2-2	V6 RF Compensator, Band I	25Ω ±5%, ½W, WW	BW-½	16	A16428-6			X	X							

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

RESISTORS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
R7	V1 Cathode Bias	300Ω ±10%, ¼W, Ceramic		6	A18151-301	X	X	X	X	X	X	X	X	X	X	X
R9-1	V1 RF Compensator, BandIII	3Ω ±10%, ½W, WW	BW-½	16	A16428-3			X	X	X	X					
R9-2	V5 RF Compensator, Band III	3Ω ±10%, ½W, WW	BW-½	16	A16428-3			X	X	X	X					
R9-3	V6 RF Compensator, Band III	3Ω ±10%, ½W, WW	BW-½	16	A16428-3			X	X	X	X					
R9-4	V5 RF Compensator, Band II	3Ω ±10%, ½W, WW	BW-½	16	A16428-3	X	X					X	X	X	X	X
R9-5	V6 RF Compensator, Band II	3Ω ±10%, ½W, WW	BW-½	16	A16428-3	X	X					X	X	X	X	X
R10-1	V5 RF Compensator, Band II	10Ω ±5%, ½W, WW	BW-½	16	A16428-2			X	X	X	X					
R10-2	V6 RF Compensator, Band II	10Ω ±5%, ½W, WW	BW-½	16	A16428-2			X	X	X	X					
R10-3	V5 RF Compensator, Band I	10Ω ±5%, ½W, WW	BW-½	16	A16428-2	X	X					X	X	X	X	X
R10-4	V6 RF Compensator, Band I	10Ω ±6%, ½W, WW	BW-½	16	A16428-2	X	X					X	X	X	X	X
R10-5	V5 RF Compensator, Band III	10Ω ±5%, ½W, WW	BW-½	16	A16428-2							X	X			
R10-6	V6 RF Compensator, Band III	10Ω ±5%, ½W, WW	BW-½	16	A16428-2							X	X			
R11-1	V5 RF Compensator, Band I	20Ω ±5%, ½W, WW	BW-½	16	A16428-4					X	X					
R11-2	V6 RF Compensator, Band I	20Ω ±5%, ½W, WW	BW-½	16	A16428-4					X	X					
R12-1	V1 AVC Filter	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-2	V4 Screen Voltage Dropping	100,000Ω ±10%, ¼W Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-3	V5 Screen Voltage Dropping	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-4	V10 Grid	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-5	V8 AVC Filter	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-6	V3 Audio Voltage Supply	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-7	V3 Audio Voltage Supply	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-8	AVC Filter	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-9	Sidetone Filter	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-10	V2 Audio Voltage Filter	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-11	V2 Audio Voltage Filter	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-12	V3 Cathode Bias	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-13	V3 Plate Dropping	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-14	V9 Grid Leak	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R12-15	V9 Plate Voltage Dropping	100,000Ω ±10%, ¼W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
R13-1	V6 Screen Voltage Bleeder	150,000Ω ±10%, ¼W, Ceramic	.	6	A18151-154	X	X	X	X	X	X	X	X	X	X	X
R13-2	V12 Screen Voltage Dropping	150,000Ω ±10%, ¼W, Ceramic	.	6	A18151-154	X	X	X	X	X	X	X	X	X	X	X
R14-1	V2 Grid Leak	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-2	V2-Grid Leak	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-3	V6 Injector Grid	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-4	V7 Grid Leak	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

RESISTORS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
R14-5	V10 RF Filter	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-6	V3 Cathode Bias	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-7	V4 AVC Filter	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-8	V5 AVC Filter	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-9	V6 AVC Filter	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-10	V8 Screen Voltage Dropping	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-11	V7 Plate Voltage Dropping	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-12	V9 Isolating	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-13	V1 Screen Voltage Dropping	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R14-14	V12 Grid	50,000Ω ±10%, ¼W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
R15-1	V2 Plate Load	2000Ω ±10%, ¼W, Ceramic	.	6	A18151-202	X	X	X	X	X	X	X	X	X	X	X
R15-2	V2 Plate Load	2000Ω ±10%, ¼W, Ceramic	.	6	A18151-202	X	X	X	X	X	X	X	X	X	X	X
R18-1	Ant. Static Leak	1 megohm ±10%, ¼W, Ceramic	.	6	A18151-105	X	X	X	X	X	X	X	X	X	X	X
R18-2	Loop AVC Filter	1 megohm ±10%, ¼W, Ceramic	.	6	A18151-105	X	X	X	X	X	X	X	X	X	X	X
R18-3	V12 Diode Load	1 megohm ±10%, ¼W, Ceramic	.	6	A18151-105	X	X	X	X	X	X	X	X	X	X	X
R19-1	V12 Grid	1000Ω ±10%, ¼W, Ceramic	.	6	A18151-102	X	X	X	X	X	X	X	X	X	X	X
R19-2	V1 Plate Voltage Dropping	1000Ω ±10%, ¼W, Ceramic	.	6	A18151-102	X	X	X	X	X	X	X	X	X	X	X
R20-1	V8 Plate Voltage Dropping	5000Ω ±10%, ¼W, Ceramic	.	6	A18151-502	X	X	X	X	X	X	X	X	X	X	X
R20-2	V4 Plate Voltage Dropping	5000Ω ±10%, ¼W, Ceramic	.	6	A18151-502	X	X	X	X	X	X	X	X	X	X	X
R20-3	V5 Plate Voltage Dropping	5000Ω ±10%, ¼W, Ceramic	.	6	A18151-502	X	X	X	X	X	X	X	X	X	X	X
R20-4	V6 Plate Voltage Dropping	5000Ω ±10%, ¼W, Ceramic	.	6	A18151-502	X	X	X	X	X	X	X	X	X	X	X
R21	V3 Cathode Bleeder	200,000Ω ±10%, ¼W, Ceramic	.	6	A18151-204	X	X	X	X	X	X	X	X	X	X	X
R22-1	V3 Grid	500,000Ω ±10%, ¼W, Ceramic	.	6	A18151-504	X	X	X	X	X	X	X	X	X	X	X
R22-2	V3 Grid	500,000Ω ±10%, ¼W, Ceramic	.	6	A18151-504	X	X	X	X	X	X	X	X	X	X	X
R22-3	V11 Grid	500,000Ω ±10%, ¼W, Ceramic	.	6	A18151-504	X	X	X	X	X	X	X	X	X	X	X
R22-4	V10 AVC Diode Load	500,000Ω ±10%, ¼W, Ceramic	.	6	A18151-504	X	X	X	X	X	X	X	X	X	X	X
R23	V3 Cathode Bias	10,000Ω ±10%, ¼W, Ceramic	.	6	A18151-103	X	X	X	X	X	X	X	X	X	X	X
R24-1	V4 Cathode Bias	600Ω ±10%, ¼W, Ceramic	.	6	A18151-601	X	X	X	X	X	X	X	X	X	X	X
R24-2	V5 Cathode Bias	600Ω ±10%, ¼W, Ceramic	.	6	A18151-601	X	X	X	X	X	X	X	X	X	X	X
R24-3	V6 Cathode Bias	600Ω ±10%, ¼W, Ceramic	.	6	A18151-601	X	X	X	X	X	X	X	X	X	X	X
R24-4	V8 Cathode Bias	600Ω ±10%, ¼W, Ceramic	.	6	A18151-601	X	X	X	X	X	X	X	X	X	X	X
R24-5	V12 Cathode Bias	600Ω ±10%, ¼W, Ceramic	.	6	A18151-601	X	X	X	X	X	X	X	X	X	X	X
R27	V2 Cathode Bias	100Ω ±10%, ¼W, Ceramic	.	6	A18151-101	X	X	X	X	X	X	X	X	X	X	X
R28	V10 Grid Load	250,000Ω ±10%, ¼W, Ceramic	.	6	A18151-254	X	X	X	X	X	X	X	X	X	X	X
R29	V11 Cathode Bias	500Ω ±10%, ½W, Ceramic	.	6	A18150-501	X	X	X	X	X	X	X	X	X	X	X
R31	V10 Cathode Bias	3000Ω ±10%, ¼W, Ceramic	.	6	A18151-302	X	X	X	X	X	X	X	X	X	X	X
R32	V12 Grid Isolating	300,000Ω ±10%, ¼W, Ceramic	.	6	A18151-303	X	X	X	X	X	X	X	X	X	X	X
R35-1	Azimuth Dial-Light Dropping	117Ω total, Section A 50Ω, Section B 67Ω	MW-2	16	A14739	X	X	X	X	X	X	X	X	X	X	X
R36	Antenna Relay Voltage Dropping	195Ω total, Section A 120Ω, Section B 75Ω	MW-2	16	A30031	X	X	X	X	X	X	X	X	X	X	X
R37-1	Fil. Current Compensating	75.6Ω total, Section A 12.6Ω Section B 63Ω	MW-2	16	A15273	X	X	X	X	X	X	X	X	X	X	X
R37-2	Sidetone Relay Dropping	75.6Ω total, Section A 12.6Ω, Section B 63Ω	MW-2	16	A15273	X	X	X	X	X	X	X	X	X	X	X
R38	V10 Plate Voltage Dropping	25,000Ω ±10%, ¼W, Ceramic	.	6	A18151-253	X	X	X	X	X	X	X	X	X	X	X
R39	V6 Screen Voltage Supply	25,000Ω ±10%, ½W, Ceramic	.	6	A18150-253	X	X	X	X	X	X	X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
		RELAYS														
RE1	Antenna Switching	DPDT, 8-16V	15P32	8	QB7856	X	X	X	X	X	X	X	X	X	X	X
RE2	Sidetone	DPDT, 8-16V	15P32	8	QB7856	X	X	X	X	X	X	X	X	X	X	X
		SWITCHES														
S1-1	Loop Band Selector, Primary	Bakelite Wafer	H	9	QB9589-2	X	X	X	X	X	X	X	X	X	X	X
S1-2	Antenna Band Selector, Primary	Bakelite Wafer	H	9	QB9589-2	X	X	X	X	X	X			X	X	X
S1-3	1st RF Band Selector, Primary, Secondary	Bakelite Wafer	H	9	QB9589-2	X	X	X	X	X	X			X	X	X
S1-4	2nd RF Band Selector, Primary, Secondary	Bakelite Wafer	H	9	QB9589-2	X	X	X	X	X	X			X	X	X
S2	Loop Band Selector, Secondary	Bakelite Wafer	H	9	QB9589-1	X	X	X	X	X	X			X	X	X
S3	Antenna Band Selector, Primary, Secondary	Bakelite Wafer	H	9	QB9589-4	X	X	X	X	X	X	X	X	X	X	X
S4	RF Osc. Band Selector	Bakelite Wafer	H	9	QB9589-3	X	X	X	X	X	X	X	X	X	X	X
S5	Motor Positioning	Bakelite Wafer	H	9	QB9589-5	X	X	X	X	X	X	X	X	X	X	X
S6	Motor Control	1 make and 2 break, Non-locking	E	10	E10355	X	X	X	X	X	X	X	X	X	X	X
S11	Loop Band Selector, Secondary	Bakelite Wafer	H	9	A29302							X	X			
S12-1	Antenna Band Selector, Primary and Secondary Tuning	Bakelite Wafer	H	9	A29265							X	X			
S12-2	1st RF Band Selector, Primary, Secondary	Bakelite Wafer	H	9	A29265							X	X			
S12-3	2nd RF Band Selector, Primary, Secondary	Bakelite Wafer	H	9	A29265							X	X			
S14	RF Osc. Band Selector, For Tuning Capacitor	Bakelite Wafer	H	9	A29301							X	X			
		TRANSFORMERS														
T1	RF, Loop, Band I	2 coils, Sealed	.	1	AL72150-15			X	X							
T1	RF, Loop, Band I	2 coils, Sealed	.	1	AL72150-1	X	X					X	X	X	X	X
T1	RF, Loop, Band I	2 coils, Sealed	.	1	AL71687-20					X	X					
T2	RF, Loop, Band II	2 coils, Sealed	.	1	AL72150-16			X	X							
T2	RF, Loop, Band II	2 coils, Sealed	.	1	AL72150-2	X	X					X	X	X	X	X
T2	RF, Loop, Band II	2 coils, Sealed	.	1	AL71687-21					X	X					
T3	RF, Loop, Band III	2 coils, Sealed	.	1	AL72150-17			X	X							
T3	278 Kcs Fixed, Band III	2 coils, Sealed	.	1	AL72150-1							X	X			
T3	RF, Loop, Band III	2 coils, Sealed	.	1	AL71687-22					X	X					
T4	RF, Antenna, Band I	3 coils, Sealed	.	1	AL72150-18			X	X							
T4	RF, Antenna, Band I	3 coils, Sealed	.	1	AL72150-12	X	X					X	X	X	X	X
T4	RF, Antenna, Band I	3 coils, Sealed	.	1	AL71791-13					X	X					
T5	RF, Antenna, Band II	3 coils, Sealed	.	1	AL72150-19			X	X							
T5	RF, Antenna, Band II	3 coils, Sealed	.	1	AL72150-13	X	X					X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

TRANSFORMERS—*Continued*

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
T5	RF, Antenna, Band II	3 coils, Sealed	.	1	AL71791-14					X	X					
T6	RF, Antenna, Band III	3 coils, Sealed	.	1	AL72150-20			X	X							
T6	RF, Antenna, Band III	2 coils, Sealed	.	1	AL72150-14	X	X							X	X	
T6	RF, Antenna, Band III	2 coils, Sealed	Special	1	AL73016-1											X
T6	RF, Antenna, Band III	3 coils, Sealed	.	1	AL71791-15					X	X					
T6	278 Kcs Fixed, Band III	3 coils, Sealed	.	1	AL72150-12							X	X			
T7-1	1st RF, Band I	2 coils, Sealed	.	1	AL72150-21			X	X							
T7-1	1st RF, Band I	2 coils, Sealed	.	1	AL72150-6	X	X					X	X	X	X	X
T7-1	1st RF, Band I	2 coils, Sealed	.	1	AL71791-7					X	X					
T7-2	2nd RF, Band I	2 coils, Sealed	.	1	AL72150-21			X	X							
T7-2	2nd RF, Band I	2 coils, Sealed	.	1	AL72150-6	X	X					X	X	X	X	X
T7-2	2nd RF, Band I	2 coils, Sealed	.	1	AL71791-7					X	X					
T8-1	1st RF, Band II	2 coils, Sealed	.	1	AL72150-22			X	X							
T8-1	1st RF, Band II	2 coils, Sealed	.	1	AL72150-7	X	X					X	X	X	X	X
T8-1	1st RF, Band II	2 coils, Sealed	.	1	AL71791-8					X	X					
T8-2	2nd RF, Band II	2 coils, Sealed	.	1	AL72150-22			X	X							
T8-2	2nd RF, Band II	2 coils, Sealed	.	1	AL72150-7	X	X					X	X	X	X	X
T8-2	2nd RF, Band II	2 coils, Sealed	.	1	AL71791-8					X	X					
T9-1	1st RF, Band III	2 coils, Sealed	.	1	AL72150-23			X	X							
T9-1	1st RF, Band III	2 coils, Sealed	.	1	AL72150-8	X	X							X	X	
T9-1	1st RF, Band III	2 coils, Sealed	.	1	AL73016-2											X
T9-1	1st RF, Band III	2 coils, Sealed	.	1	AL71791-9					X	X					
T9-1	1st RF, 278 Kcs, Fixed, Band III	2 coils, Sealed	.	1	AL72150-29							X	X			
T9-2	2nd RF, Band III	2 coils, Sealed	.	1	AL72150-23			X	X							
T9-2	2nd RF, Band III	2 coils, Sealed	.	1	AL72150-8	X	X							X	X	
T9-2	2nd RF, Band III	2 coils, Sealed	.	1	AL73016-2											X
T9-2	2nd RF, Band III	2 coils, Sealed	.	1	AL71791-9					X	X					
T9-2	2nd RF, 278 Kcs, Fixed, Band III	2 coils, Sealed	.	1	AL72150-29							X	X			
T10	Oscillator, RF, Band I	2 coils, Sealed	.	1	AL72150-24			X	X							
T10	Oscillator, RF, Band I	2 coils, Sealed	.	1	AL72150-3	X	X					X	X	X	X	X
T10	Oscillator, RF, Band I	2 coils, Sealed	.	1	AL71791-4					X	X					
T11	Oscillator, RF, Band II	2 coils, Sealed	.	1	AL72150-25			X	X							
T11	Oscillator, RF, Band II	2 coils, Sealed	.	1	AL72150-4	X	X					X	X	X	X	X
T11	Oscillator, RF, Band II	2 coils, Sealed	.	1	AL71791-5					X	X					
T12	Oscillator, RF, Band III	2 coils, Sealed	.	1	AL72150-26			X	X							
T12	Oscillator, RF, Band III	2 coils, Sealed	.	1	AL72150-5	X	X							X	X	
T12	Oscillator, RF, Band III	2 coils, Sealed	.	1	AL73016-3											X
T12	Oscillator, RF, Band III	2 coils, Sealed	.	1	AL71791-6					X	X					
T12	Oscillator, RF, Band III, Fixed	2 coils, Sealed	.	1	AL72150-30							X	X			
T13	1st IF	Complete assembly	.	1	AL71798-1	X	X	X	X	X	X	X	X	X	X	X
T14	2nd IF	Complete assembly	.	1	AL71908-1	X	X	X	X	X	X	X	X	X	X	X
T15	Audio Output, Includes L9-1	Primary 645Ω, Secondary 310Ω	.	1	A14987	X	X	X	X	X	X	X	X	X	X	X
T16	Compass Output, Includes L9-2	Primary 2400Ω Secondary 14.5Ω	.	1	A15064	X	X	X	X	X	X	X	X	X	X	X

7-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

VACUUM TUBES

Symbol Designation	Function	Description	Manufacturers Designation	Manufacturer	Bendix Number	Used On										
						MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
V1	Loop Amplifier	Triple-grid Amplifier	6K7	11	.	X	X	X	X	X	X	X	X	X	X	X
V2	Audio Oscillator	Twin Triode	6N7	11	.	X	X	X	X	X	X	X	X	X	X	X
V3	Modulator	Twin Triode	6N7	11	.	X	X	X	X	X	X	X	X	X	X	X
V4	1st RF Amplifier	Triple-grid Amplifier	6K7	11	.	X	X	X	X	X	X	X	X	X	X	X
V5	2nd RF Amplifier	Triple-grid Amplifier	6K7	11	.	X	X	X	X	X	X	X	X	X	X	X
V6	1st Detector	Pentagrid Converter	6L7	11	.	X	X	X	X	X	X	X	X	X	X	X
V7	RF Oscillator	Triode Amplifier	6J5	11	.	X	X	X	X	X	X	X	X	X	X	X
V8	IF Amplifier	Triple-grid Amplifier	6K7	11	.	X	X	X	X	X	X	X	X	X	X	X
V9	CW Oscillator	Triode Amplifier	6J5	11	.	X	X	X	X	X	X	X	X	X	X	X
V10	2nd Detector and 1st Audio	Duplex-diode Pentode	6B8	11	.	X	X	X	X	X	X	X	X	X	X	X
V11	Audio Output	Pentode Power Amplifier	6F6	11	.	X	X	X	X	X	X	X	X	X	X	X
V12	Compass Output	Duplex-diode Pentode	6B8	11	.	X	X	X	X	X	X	X	X	X	X	X

7-2. TYPE MN-28E, J, P, T, AND V REMOTE CONTROL UNITS

Symbol	Name or Function	Description	Mfr.	Mfr's. Type	Bendix No.
		FUSE			
FU1	Fuse for both 12-14V and 24-28V, 20A	25V, 10A	12	3AG-1081C	A11302-28
		JACKS AND RECEPTACLE			
J1	Phone Jack	.	13		A26837
J2	Phone Jack	.		13	A26837
J3	Wall Mtg. Recep. for Plug P3	16-contact	15	SK-C16-32S	A30089
		LAMP			
LM1	Dial Light	3V, 0.19A	14	Special	A18881-1
		PLUG			
P3	Remote to Junction Box Cable Plug	16-contact, Straight, Female	15	SK-C16-21-⅝B	A30852
		RESISTORS			
R2	Threshold Sensitivity Control	2000Ω, Taper D	16	C	A28147
R4A	Manual Sensitivity Control	2000Ω, Front, Special taper	} 29	JJ	L72704
R4B	Manual Sensitivity Control	25,000Ω, Rear, Special taper			
R6	Panel Lamp Rheostat	100Ω, WW, Taper A	16	CP	A14549
R35-3	Panel Light Voltage Dropping	117Ω, total, Sect. A 50Ω, Sect. B 67Ω	16	MW-2	A14739
R40	Loop Motor Speed Limiter	2000Ω ±10%, WW	16	MW-2	A30995
		SWITCHES			
S8	Off-Comp.-Rec. Ant.-Rec. Loop Switch	Bakelite Wafer	9	H	A28146
S9	Band Selector Switch	Bakelite Wafer	9	H	A100473
S10	CW Switch	SPST, Toggle, 250V, 3A	17	Special	A26947-1
S13	Left-Right Motor Control Switch		1	Special	AC56949-1
		MISCELLANEOUS			
.	Final Assembly	For MN-28E	1		AN90646-1
		MN-28J	1		AN90646-2
		MN-28P	1		AN90646-3
		MN-28T	1		AN90646-4
		MN-28V	1		AN90646-7
.	Dial Assembly	For MN-28E, T	1		AB5626-2
		MN-28J	1		AB5626-4
		MN-28P	1		AB5626-1
		MN-28V	1		AB5626-5
	Mask, Dial Assembly	For MN-28E, J, T	1		A100733-3
		MN-28P	1		A100733-1
.	Mask, Etched	For MN-28E	1		C56855
		MN-28J	1		C57213
		MN-28P	1		C57238
		MN-28T	1		C57310
		MN-28V	1		C58233

7-3. TYPE MN-31A, B, C, D AUTOMATIC LOOP CONTROLS

Symbol	Name or Function	Description	Mfr.	Mfr's. Type	Bendix No.
		CAPACITOR			
C1	Thyraton Grid Return Bypass	0.1 Mfd ±10%, 400V DCW, Paper	4	345	A18015-104
C2	Thyratron Grid Filter	.002 Mfd ±5%, 500V DCW, Mica	5	1467	C56311-202
C3	Thyratron Cathode Bypass	50 Mfd, 50V DCW, Electrolytic	5	1467	A27875
C4	Phase Shifting	5 Mfd ±10%, 50V RMS, 400 cycles, Dykanol C	22	.	A28316
C5	Low Voltage Hash Filter	0.5 Mfd, 120V DCW, Paper	22	HC-1900B	A27888
C6	Low Voltage Hash Filter	0.5 Mfd, 120V DCW, Paper	22	HC-1900B	A27888
C7	Input	0.5 Mfd ±5%, 400V DCW, Dykanol C	22	.	A28319
C8	Phasing	.005 Mfd ±5%, 500V DCW, Mica	5	1467	C56311-502
C9	Thyratron Plate	} 2 x 0.5 Mfd ±10%, 100V DCW, Dykanol A	22	.	A28314
C10	Thyratron Plate				
C11	Phase Corrector	2 Mfd, 80V RMS, 400 CPS, Dykanol A	22	.	A27905
C12	Power Factor Corrector	1 Mfd ±10%, 60V RMS, 400 CPS, Oil, Paper	22	.	A28317
C13	RF Bypass	.01 Mfd ±10%, 300V DCW, Mica	5	1467	C56312-103
C14	RF Bypass	.01 Mfd ±10%, 300V DCW, Mica	5	1467	C56312-103

7-3. TYPE MN-31A, B, C, D AUTOMATIC LOOP CONTROLS—*Continued*

Symbol	Name or Function	Description	Mfr.	Mfr's. Type	Bendix No.
		INDUCTOR			
L1	RF Choke		1	.	AB6859-1
		RECEPTACLE			
J11	Loop Control to Junction Box	19-contact, Wall mounting	15	SK-19-32S	A30956
		PLUG			
P11	Plug for J11	19-contact, 90° angle	15	SK-19-23-5/8B	A30994
		RESISTORS			
R1	V1 Bias	0.5 megohm ±5%, 1/4W, Ceramic	6	.	A18001-504
R2	Potentiometer	5000Ω, Curve A taper	16	.	A28318
R3	Thyratron Cathode	2500Ω ±5%, 1/4W, Ceramic	6	.	A18001-252
R4	V1 Grid	.5 megohm ±5%, 1/4W, Ceramic	6	.	A18001-504
R5	V2 Grid	.5 megohm ±5%, 1/4W, Ceramic	6	.	A18001-504
R6	V5 Cathode Bias	1500Ω ±5%, 1/4W, Ceramic	6	.	A18001-152
R7	V3 Grid	.5 megohm ±5%, 1/4W, Ceramic	6	.	A18001-504
R8	V3 Grid	.5 megohm ±5%, 1/4W, Ceramic	6	.	A18001-504
R9	V4 Grid	5000Ω ±10%, 1/4W, Ceramic	6	.	A18002-502
R10	V4 Cathode	1500Ω ±5%, 1/4W, Ceramic	6	.	A18001-152
R11 R12	Filament Voltage Dropping Bias Voltage Dropping	28Ω section, 5.7W; 36Ω section, 4.4W	16	MW-3	A100219
R13	V1 Plate	250Ω ±10%, 1/4W, Ceramic	6	.	A18002-251
R14	V2 Plate	250Ω ±10%, 1/4W, Ceramic	6	.	A18002-251
		TRANSFORMERS			
T1	Input	Pri. 125Ω, Sec. 10 megohms	1	Special	A19780
T2, T3	Saturable Reactors	4000Ω, at 0 A, 120Ω at .010 A (pair to be matched)	1	Special	A19776
T4	Power Transformer	Pri. 45V, 15VA, 400 CPS, Sec. 120/60V, 10VA	1	Special	A27060
T5	Audio Pack	Includes transformer & reactor CH-1	1	Special	A19784
T6	Dual Output	600Ω, Dual channel	1	Special	A19782
		VACUUM TUBES			
V1	Thyratron	.	11	2051	.
V2	Thyratron	.	11	2051	.
V3	Plate Control	Beam amplifier	11	12A6	.
V4	Audio Output	Beam amplifier	11	12A6	.
V5	Audio Output	Beam amplifier	11	12A6	.
		MISCELLANEOUS			
.	Inverter with Mounting Bracket	For 14-volt operation of MN-31A, MN-31B	25	SS-1705	C56721
.	Inverter with Mounting Bracket	For 28-volt operation of MN-31C, MN-31D	25	SS-1974	C56721-1
.	Brush Assembly +	For inverter	25	.	A29731-1
.	Brush Assembly −	For inverter	25	.	A29731-2
.	Bottom Cover and Mounting Base Assembly	Standard shockmount for MN-31A, MN-31C	1	.	AL71941-1
.	Bottom Cover and Mounting Base Assembly	Modified A.T.R. mounting for MN-31B, MN-31D	1	.	AL72300-1

7-4. TYPE MN-36A AUTOMATIC LOOP

Symbol	Name or Function	Description	Mfr.	Mfr's. Type	Bendix No.
		RECEPTACLES			
J6	Receptacle	8-contact, Wall mtg.	15	GK-C8-32S	A31353
J8	Receptacle	6-contact, Wall mtg.	15	WK-6-32S	A30084
		PLUGS			
P6	Plug	8-contact, 90°	15	GK-C8-23-1/2B	A30901
P8	Plug	6-contact, 90°	15	WK-6-23-3/8B	A30085

7-4. TYPE MN-36A AUTOMATIC LOOP—*Continued*

Symbol	Name or Function	Description	Mfr.	Mfr's. Type	Bendix No.
		DEHYDRATOR			
.	Dehydrator Assembly	Complete with tubing and fixtures	27	.	AC57763-1
.	Hose	5/16″ ID x 1/16″ wall, Rubber		.	A100745
.	Clip	2 required	27	.	A100737
.	Silica Gel	6-16 mesh, 4 ounces	3	85966-160T	A100744
.	Right Angle Fitting	For dehydrator hose	27	Special	A100738
		MISCELLANEOUS			
MO2	Motor	Low-inertia for loop drive	14	.	C57343
MO3	Motor	Autosyn transmitter	14	PO-21984	C57225-1
	Housing	For loop	2	Y-360	A104060
	Loop	Loop & shaft assembly	2	W-94-A	AL72398-1
	Compensator	Includes autosyn MO3	2	W-97-E	L72397
	Cam Strip	Part of compensator	2	U-87	A102026

7-5. TYPE MN-37A BEARING INDICATOR

Symbol	Name or Function	Description	Mfr.	Mfr's. Type	Bendix No.
MN-37A	Bearing Indicator		14		AL72154-1
		RECEPTACLE			
J5	Receptacle for P5		15	WK-6-32S	A30084
		PLUG			
P5	Indicator to Junction Box Cables	6-contact, 90°	15	WK-6-23-3/8B	A30085
		MISCELLANEOUS			
MO4	Motor	Autosyn indicator	14		C57226
LM2	Pilot Lamp	3V, 0.19A	14	Special	A18881-1
LM3	Pilot Lamp	3V, 0.19A	14	Special	A18881-1
R3-1 R3-2	Voltage Dropping Resistor Voltage Dropping Resistor	Each section, 51Ω, 2W	14	Special	A31352-1
R41	Lamp Dropping Resistor	40Ω, Part of MS-14C Junction Box for 28-volt operation	16	MW-3	A100517

8. RECOMMENDED SPARE ELECTRICAL PARTS (Recommended Quantities per 10 Units)

8-1. TYPE MN-26 RADIO COMPASS SERIES

Quantity	Symbol Designation	Description	Manufacturers Designation	Manufacturer	Bendix Number	MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
			CAPACITORS													
6	C1-1 to C1-12	6-25 Mmf ±10%, 500V, Variable, Right-hand terminal	Special	26	B7751-25	X	X	X	X	X	X	X	X	X	X	X
2	C1-13 to C1-15	6-25 Mmf ±10%, 500V, Variable, Left-hand terminal	Special	26	B7783-25	X	X	X	X	X	X	X	X	X	X	X
2	C2-1 to C2-5	5-section, Variable, Max., 400 Mmf per section, Min., 12.5 Mmf per section	Special	3	L70943	X	X	X	X	X	X	X	X	X	X	X
12	C3-1 to C3-20	.05 Mfd ±10%, 400V DCW, Paper	345-8	4	A18015-503	X	X	X	X	X	X	X	X	X	X	X
8	C4-1 to C4-11	.05 Mfd ±10%, 200V DCW, Paper	342-6	4	A18181-503	X	X	X	X	X	X	X	X	X	X	X
4	C5-1, C5-2	0.1 Mfd ±10%, 200V DCW, Paper	345-5	4	A18181-104	X	X	X	X	X	X	X	X	X	X	X
4	C6-1, C6.2	.02 Mfd ±10%, 200V DCW, Paper	342-3	4	A18181-203	X	X	X	X	X	X	X	X	X	X	X
3	C7	0.5 Mfd ±10%, 400V DCW, Oil, Paper	Special	5	E11398	X	X	X	X	X	X	X	X	X	X	X
3	C8	5 Mfd +100 −0%, 50V, Electrolytic	Special	5	E11402	X	X	X	X	X	X	X	X	X	X	X
3	C9-1, C9-2	2-section, Each 0.5 Mfd, 100V DCW, Oil, Paper	Special	5	E11400	X	X	X	X	X	X	X	X	X	X	X
4	C10-1, C10-2	2-section, Each 6 Mfd, 400V DCW, Oil-filled	Special	5	A15066	X	X	X	X	X	X	X	X	X	X	X
4	C11-1 to C11-3	35 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-350					X	X					
3	C11-4	35 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-350			X	X							
3	C11-5	35 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-350	X	X					X	X	X	X	X
4	C-11-6, C11-7	35 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-350											X
4	C12-1, C12-2	50 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-500	X	X	X	X	X	X	X	X	X	X	X
3	C12-3	50 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-500											X
3	C13	100 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-101	X	X	X	X	X	X	X	X	X	X	X
4	C14-1, C14-2	.005 Mmf ±2%, 300V DCW, Mica	1467	5	C56310-502	X	X	X	X	X	X	X	X	X	X	X
3	C15	.001 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-102	X	X	X	X	X	X	X	X	X	X	X
3	C16	.01 Mfd ±10%, 300V DCW, Mica	1467	5	C56312-103	X	X	X	X	X	X	X	X	X	X	X
3	C17	25 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-250	X	X	X	X	X	X	X	X	X	X	X
3	C18-1	45 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-450			X	X							
4	C19-1, C19-2	250 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-251	X	X	X	X	X	X	X	X	X	X	X
3	C20-1	10 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-100	X	X			X	X	X	X	X	X	X
3	C20-2	10 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-100			X	X	X	X					
4	C21-2, C21-3	100 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-101					X	X					
4	C21-1, C21-4	100 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-101	X	X	X	X	X	X	X	X	X	X	X
4	C22-1, C22-2	300 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-301					X	X					
4	C23-1, C23-2	75 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-750					X	X					
4	C24-1, C24-2	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050			X	X	X	X					
3	C24-3	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050	X	X	X	X	X	X	X	X	X	X	
4	C24-3, C24-4	5 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-050											X
3	C25	15 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-150	X	X	X	X	X	X	X	X	X	X	X
3	C26-3	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150			X	X							
6	C26-1, C26-2, C26-4 to C26-7	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X					X	X	X	X	X
4	C26-5, C26-6	15 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-150	X	X							X	X	
5	C27-1 to C27-4	185 Mmf ±2%, 500V DCW, Mica	1469	5	C56316-1850							X	X			
5	C28-1 to C28-4	175 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-1750							X	X			
4	C28-1, C28-3	175 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-1750	X	X	X	X					X	X	X
3	C29-1	25 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-250					X	X					
4	C29-2 to C29-4	25 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-250	X	X							X	X	
4	C29-3, C29-4	25 Mmf ±10%, 500V DCW, Ceramic	N680L	6	A18205-250							X	X			X
3	C30	625 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-2					X	X					
3	C31	1286 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-3					X	X					
3	C32	2514 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-4					X	X					
4	C33-1 to C33-3	40 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-400			X	X							
3	C33-4	40 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-400											X
6	C34-1 to C34-5	500 Mmf ±2%, 500V DCW, Mica	1468	5	C56313-501	X	X	X	X	X	X	X	X	X	X	X
3	C35	500 Mmf ±10%, 500V DCW, Mica	1468	5	C56315-501	X	X	X	X	X	X	X	X	X	X	X
4	C36-1, C36-2	20 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-200							X	X			X
4	C36-1 to C36-3	20 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-200	X	X							X	X	
3	C37-1 to C37-3	3-section, Each 0.1 Mfd, 400V DCW, Oil, Paper	Special	5	E11347-1	X	X	X	X	X	X	X	X	X	X	X
3	C38	100 Mmf ±2%, 500V DCW, Mica	1468	5	C56313-101	X	X	X	X	X	X	X	X	X	X	X
6	C39-1 to C39-5	0.1 Mfd ±10%, 400V DCW, Paper	345	4	A18015-104	X	X	X	X	X	X	X	X	X	X	X

8-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

Quantity	Symbol Designation	Description	Manufacturers Designation	Manufacturer	Bendix Number	MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
			CAPACITORS (Continued)													
3	C40-1	30 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-300	X	X					X	X	X	X	X
3	C40-2	30 Mmf ±10%, 500V DCW, Ceramic	N680K	6	A18207-300					X	X					
4	C41-1, C41-2	45 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-450			X	X							
4	C42-1, C42-2	10 Mmf ±10%, 500V DCW, Ceramic	P120K	6	A29857-100	X	X							X	X	X
3	C43-1	50 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-500	X	X	X	X	X	X	X	X	X	X	X
4	C43-2, C43-3	50 Mmf ±5%, 500V DCW, Mica	1468	5	C56314-500			X	X							
3	C44	135 Mmf ±2%, 500V DCW, Mica	1469	5	C56316-1350							X	X			
3	C45	875 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-6	X	X					X	X	X	X	X
3	C46	1990 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-5	X	X					X	X	X	X	X
3	C47	5525 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-7	X	X							X	X	
3	C48	815 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-8			X	X							
3	C49	1625 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-9			X	X							
3	C50	2820 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-10			X	X							
2	C51	24 Mfd, 350V, Electrolytic, May be put in Junction Box MS-14C	Special	5	A27988	X	X	X	X	X	X	X	X	X	X	X
3	C52	5000 Mmf ±0.5%, 300V DCW, Mica, XM262	Special	5	E12140-12											X
			DYNAMOTORS AND BRUSHES													
1	Dyn	14V, Dynamotor	.	.	C56728-1	X		X		X		X		X		X
1	Dyn	28V, Dynamotor	.	.	C56728-2		X		X		X		X		X	
6	.	Low voltage + dynamotor brush	*	*	*	X	X	X	X	X	X	X	X	X	X	X
6	.	Low voltage − dynatotor brush	*	*	*	X	X	X	X	X	X	X	X	X	X	X
6	.	High voltage + dynamotor brush	*	*	*	X	X	X	X	X	X	X	X	X	X	X
6	.	High volatge − dynamotor brush	*	*	*	X	X	X	X	X	X	X	X	X	X	X
	* When ordering brushes submit complete nameplate data of dynamotors for which replacements are desired.															
			RECEPTACLES													
1	J4	23-contact, Wall mounting	WK-C23-32S	15	A30094	X	X	X	X	X	X	X	X	X	X	X
1	J7	6-contact, Wall mounting	WK-6-32S	15	A30084	X	X	X	X	X	X	X	X	X	X	X
1	J10	1-contact, Antenna lead-in	101	19	B7380-1	X	X	X	X	X	X	X	X	X	X	X
			INDUCTORS													
1	L1	1 coil, Sealed, 85Ω	Special	1	AL71791-16	X	X	X	X	X	X	X	X	X	X	X
1	L2, L3	2 coils, Sealed	Special	1	AC56703-1	X	X	X	X	X	X	X	X	X	X	X
1	L6	1 coil, Sealed, Tapped	Special	1	AL71791-17	X	X	X	X	X	X	X	X	X	X	X
1	L7-1, L7-2	45 turns, #18, Paper, Enamel	Special	1	AB6859-1	X	X	X	X	X	X	X	X	X	X	X
1	L8	1200 turns, #33 SSE, 40Ω	Special	1	AB6859-2	X	X	X	X	X	X	X	X	X	X	X
			MOTORS													
1	M01	Band switch motor, 12-14V DC input	Special	7 14	E11500-2	X		X		X		X		X		X
1	M01	Band switch motor, 24-28V DC input	Special	7 14	E11500-1		X		X		X		X		X	
6		Band switch motor + brush	Special	7 14	A30212-1	X	X	X	X	X	X	X	X	X	X	X
6		Band switch motor − brush	Special	7 14	A30212-2	X	X	X	X	X	X	X	X	X	X	X
			PLUGS													
1	P4	23-contact, Straight, Female	NK-C23-23-5/8B	15	A30601	X	X	X	X	X	X	X	X	X	X	X
1	P10	1-contact, Antenna lead-in	101	19	B7380-2	X	X	X	X	X	X	X	X	X	X	X
			NEON TUBE													
7	NE1, NE2	1/25 W, 60V, Unbased neon tube	T2	18	B15347	X	X	X	X	X	X	X	X	X	X	X

8-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

Quantity	Symbol Designation	Description	Manufacturers Designation	Manufacturer	Bendix Number	MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
			RESISTORS													
2	R1	15,000Ω, Potentiometer	C	16	QB15353	X	X	X	X	X	X	X	X	X	X	X
4	R2-1, R2-2	25Ω ±5%, 1/2W, WW	BW-1/2	16	A16428-6			X	X							
3	R7	300Ω ±10%, 1/4W, Cremaic	.	6	A18151-301	X	X	X	X	X	X	X	X	X	X	X
5	R9-1 to R9-3	3Ω ±10%, 1/2W, WW	BW-1/2	16	A16428-3			X	X	X	X					
4	R9-4, R9-5	3Ω ±10%, 1/2W, WW	BW-1/2	16	A16428-3	X	X					X	X	X	X	X
4	R10-1, R10-2	10Ω ±5%, 1/2W, WW	BW-1/2	16	A16428-2			X	X	X	X					
5	R10-3 to R10-6	10Ω ±5%, 1/2W, WW	BW-1/2	16	A16428-2							X	X			
4	R10-3, R10-4	10Ω ±5%, 1/2W, WW	BW-1/2	16	A16428-2	X	X							X	X	X
4	R11-1, R11-2	20Ω ±5%, 1/2W, WW	BW-1/2	16	A16428-4					X	X					
15	R12-1 to R12-15	100,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-104	X	X	X	X	X	X	X	X	X	X	X
4	R13-1, R13-2	150,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-154	X	X	X	X	X	X	X	X	X	X	X
14	R14-1 to R14-14	50,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-503	X	X	X	X	X	X	X	X	X	X	X
4	R15-1, R15-2	2000Ω ±10%, 1/4W, Ceramic	.	6	A18151-202	X	X	X	X	X	X	X	X	X	X	X
4	R18-1 to R18-3	1 megohm ±10%, 1/4W, Ceramic	.	6	A18151-105	X	X	X	X	X	X	X	X	X	X	X
3	R19-1, R19-2	1000Ω ±10%, 1/4W, Ceramic	.	6	A18151-102	X	X	X	X	X	X	X	X	X	X	X
8	R20-1 to R20-4	5000Ω ±10%, 1/4W, Ceramic	.	6	A18151-502	X	X	X	X	X	X	X	X	X	X	X
3	R21	200,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-204	X	X	X	X	X	X	X	X	X	X	X
5	R22-1 to R22-4	500,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-504	X	X	X	X	X	X	X	X	X	X	X
3	R23	10,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-103	X	X	X	X	X	X	X	X	X	X	X
9	R24-1 to R24-5	600Ω ±10%, 1/4W, Ceramic	.	6	A18151-601	X	X	X	X	X	X	X	X	X	X	X
3	R27	100Ω ±10%, 1/4W, Ceramic	.	6	A18151-101	X	X	X	X	X	X	X	X	X	X	X
3	R28	250,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-254	X	X	X	X	X	X	X	X	X	X	X
3	R29	500Ω ±10%, 1/2W, Ceramic	.	6	A18150-501	X	X	X	X	X	X	X	X	X	X	X
3	R31	3000Ω ±10%, 1/4W, Ceramic	.	6	A18151-302	X	X	X	X	X	X	X	X	X	X	X
3	R32	300,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-304	X	X	X	X	X	X	X	X	X	X	X
2	R35-1	Section A, 50Ω; Section B, 67Ω; Total, 117Ω	MW-2	16	A14739	X	X	X	X	X	X	X	X	X	X	X
3	R36	Section A, 120Ω; Section B, 75Ω; Total, 195Ω	MW-2	16	A30031	X	X	X	X	X	X	X	X	X	X	X
3	R37-1, R37-2	Section A, 12.6Ω; Section B, 63Ω; Total, 75.6Ω	MW-2	16	A15273	X	X	X	X	X	X	X	X	X	X	X
3	R38	25,000Ω ±10%, 1/4W, Ceramic	.	6	A18151-253	X	X	X	X	X	X	X	X	X	X	X
3	R39	25,000Ω ±10%, 1/2W, Ceramic	.	6	A18150-253	X	X	X	X	X	X	X	X	X	X	X
			RELAY													
2	RE1, RE2	DPDT, 8-16V, Relay	15P32	8	QB7856	X	X	X	X	X	X	X	X	X	X	X
			SWITCHES													
2	S1-1 to S1-4	Bakelite, Wafer	H	9	QB9589-2	X	X	X	X	X	X			X	X	X
1	S1-1	Bakelite, Wafer	H	9	QB9589-2							X	X			
1	S2	Bakelite, Wafer	H	9	QB9589-1	X	X	X	X	X	X			X	X	X
1	S3	Bakelite, Wafer	H	9	QB9589-4	X	X	X	X	X	X	X	X	X	X	X
1	S4	Bakelite, Wafer	H	9	QB9589-3	X	X	X	X	X	X	X	X	X	X	X
1	S5	Bakelite, Wafer	H	9	QB9589-5	X	X	X	X	X	X	X	X	X	X	X
1	S6	1 make, 2 break, Non-locking	E	10	E10355	X	X	X	X	X	X	X	X	X	X	X
1	S11	Bakelite, Wafer	H	9	A29302							X	X			
2	S12-1 to S12-3	Bakelite, Wafer	H	9	A29265							X	X			
1	S14	Bakelite, Wafer	H	9	A29301							X	X			
			TRANSFORMERS													
1	T1	Loop, Band I		1	AL72150-15			X	X							
1	T1	Loop, Band I		1	AL72150-1	X	X					X	X	X	X	X
1	T1	Loop, Band I		1	AL71687-20					X	X					
1	T2	Loop, Band II		1	AL72150-16			X	X							
1	T2	Loop, Band II		1	AL72150-2	X	X					X	X	X	X	X
1	T2	Loop, Band II		1	AL71687-21					X	X					
1	T3	Loop, Band III		1	AL72150-17			X	X							
1	T3	Loop, Band III		1	AL72150-1							X	X			
1	T3	Loop, Band III		1	AL71687-22					X	X					
1	T4	Antenna, Band I		1	AL72150-18			X	X							
1	T4	Antenna, Band I		1	AL72150-12	X	X					X	X	X	X	X
1	T4	Antenna, Band I		1	AL71791-13					X	X					
1	T5	Antenna, Band II		1	AL72150-19			X	X							
1	T5	Antenna, Band II		1	AL72150-13	X	X					X	X	X	X	X

8-1. TYPE MN-26 RADIO COMPASS SERIES—*Continued*

Quantity	Symbol Designation	Description	Manufacturers Designation	Manufacturer	Bendix Number	MN-26H	MN-26L	MN-26J	MN-26K	MN-26P	MN-26S	MN-26R	MN-26T	MN-26N	MN-26U	MN-26V
			TRANSFORMERS (Continued)													
1	T5	Antenna, Band II		1	AL71791-14					X	X					
1	T6	Antenna, Band III		1	AL72150-20			X	X							
1	T6	Antenna, Band III		1	AL72150-14	X	X							X	X	
1	T6	Antenna, Band III		1	AL73016-1											X
1	T6	Antenna, Band III		1	AL71791-15					X	X					
1	T6	Antenna, Band III		1	AL72150-12							X	X			
2	T7-1, T7-2	RF, Band I		1	AL72150-21			X	X							
2	T7-1, T7-2	RF, Band I		1	AL72150-6	X	X					X	X	X	X	X
2	T7-1, T7-2	RF, Band I		1	AL71791-7					X	X					
2	T8-1, T8-2	RF, Band II		1	AL72150-22			X	X							
2	T8-1, T8-2	RF, Band II		1	AL72150-7	X	X					X	X	X	X	X
2	T8-1, T8-2	RF, Band II		1	AL71791-8					X	X					
2	T9-1, T9-2	RF, Band III		1	AL72150-23			X	X							
2	T9-1, T9-2	RF, Band III		1	AL72150-8	X	X							X	X	
2	T9-1, T9-2	RF, Band III		1	AL73016-2											X
2	T9-1, T9-2	RF, Band III		1	AL71791-9					X	X					
2	T9-1, T9-2	RF, Band III		1	AL72150-29							X	X			
1	T10	Oscillator, Band I		1	AL72150-24			X	X							
1	T10	Oscillator, Band I		1	AL72150-3	X	X					X	X	X	X	X
1	T10	Oscillator, Band I		1	AL71791-4					X	X					
1	T11	Oscillator, Band II		1	AL72150-25			X	X							
1	T11	Oscillator, Band II		1	AL72150-4	X	X					X	X	X	X	X
1	T11	Oscillator, Band II		1	AL71791-5					X	X					
1	T12	Oscillator, Band III		1	AL72150-26			X	X							
1	T12	Oscillator, Band III		1	AL72150-5	X	X							X	X	
1	T12	Oscillator, Band III		1	AL73016-3											X
1	T12	Oscillator, Band III		1	AL71791-6					X	X					
1	T12	Oscillator, Band III		1	AL72150-30							X	X			
1	T13	1st IF transformer		1	AL71798-1	X	X	X	X	X	X	X	X	X	X	X
1	T14	2nd IF transformer		1	AL71908-1	X	X	X	X	X	X	X	X	X	X	X
1	T15	Audio output transformer		1	A14987	X	X	X	X	X	X	X	X	X	X	X
1	T16	Compass output transformer		1	A15064	X	X	X	X	X	X	X	X	X	X	X
			VACUUM TUBES													
9	V1, V4, V5m V8	Triple-grid Amplifier	6K7	11		X	X	X	X	X	X	X	X	X	X	X
6	V2, V3	Twin Triode	6N7	11		X	X	X	X	X	X	X	X	X	X	X
5	V6	Pentagrid Converter	6L7	11		X	X	X	X	X	X	X	X	X	X	X
6	V7, V9	Triode Amplifier	6J5	11		X	X	X	X	X	X	X	X	X	X	X
6	V10, V12	Duplex-Diode Pentode	6B8	11		X	X	X	X	X	X	X	X	X	X	X
5	V11	Pentode Power Amplifier	6F6	11		X	X	X	X	X	X	X	X	X	X	X

8-2. TYPE MN-28E, J, P, T, AND V REMOTE CONTROL UNITS

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
		FUSES			
10	FU1	20A, 25V, Littelfuse	3AG-1081C	12	A11302-28
		JACKS & PLUGS			
1	J1, J2	For headset, 1 break circuit	XG-315	13	A26837
1	J3	16-contact, Wall mounting	SK-C16-32S	15	A30089
		LAMP			
5	LM1	3V, 0.19A	Special	14	A18881-1
		PLUG			
1	P3	16-contact, Straight, Female	SK-C16-21-⅝B	15	A30852
		RESISTORS			
2	R2	Threshold 2000Ω, Taper D, Sensitivity control	C	16	A28147
2	{ R4A R4B	2000Ω, Front, Special taper 25,000Ω, Rear, Special taper }	JJ	29	L72704
2	R6	100Ω, Taper A, Rheostat	CP	16	A14549
3	R35-3	Sect. A 50Ω, Sect. B 67Ω, 117Ω total	MW-2	16	A14739
3	R40	2000Ω ±10%, WW	MW-2	16	A30995
		SWITCHES			
1	S8	Bakelite, Wafer	H	9	A28146
1	S9	Bakelite, Wafer	H	9	A100473
1	S10	SPST, Toggle, 250V, 3A	Special	17	A26947-1
1	S13	Left-right motor control	Special	1	AC56949-1

8-3. TYPE MN-31A, B, C, D AUTOMATIC LOOP CONTROLS

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
		CAPACITORS			
3	C1	0.1 Mfd ±10%, 400V DCW, Paper	345	4	A18015-104
3	C2	.002 Mfd ±5%, 500V DCW, Mica	1467	5	C56311-202
3	C3	50 Mfd, 50V DCW, Electrolytic	.	5	A27875
3	C4	5 Mfd ±10%, 50V RMS, 400 CPS, Dykanol C	.	22	A28316
4	C5, C6	0.5 Mfd, 120V DCW, Paper	HC-1900B	22	A27888
3	C7	0.5 Mfd ±5%, 400V DCW, Dykanol C	.	22	A28319
3	C8	.005 Mfd ±5%, 300V DCW, Mica	1467	5	C56311-502
3	C9, C10	0.5-0.5 Mfd ±10%. 100V DCW, Dykanol A	.	22	A28314
3	C11	2 Mfd, 80V RMS, 400 CPS, Dykanol A	.	22	A27905
3	C12	1 Mfd ±10%, 50V RMS, 400 CPS, Dykanol A	.	22	A28317
4	C13, C14	.01 Mfd ±10%, 300V DCW, Mica	1467	5	C56312-103
		INDUCTOR			
1	L1	RF choke	.	1	AB6859-1
		PLUG			
1	J11	19-contact, Wall mounting	SK-19-32S	15	A30956
		RECEPTACLE			
1	P11	19-contact, 90-degree angle	SK-19-23-⅝B	15	A30994
		RESISTORS			
7	{ R1, R4, R5, R7, R8 }	500,000Ω ±5%, ¼W, Ceramic	.	6	A18001-504
2	R2	5000Ω potentiometer, Curve A Taper	.	16	A28318
3	R3	2500Ω ±5%, ¼W, Ceramic	.	6	A18001-252
4	R6, R10	1500Ω ±5%, ¼W, Ceramic	.	6	A18001-152
3	R9	5000Ω ±10%, ¼W, Ceramic	.	6	A18002-502
3	R11, R12	28Ω, 5.7W; 36Ω, 4.4W, ±5%	MW-3	16	A100219
3	R13, R14	250Ω ±10%, ¼W, Ceramic	.	6	A18002-251

8-3. TYPE MN-31A, B, C, D AUTOMATIC LOOP CONTROLS—*Continued*

TRANSFORMERS

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
2	T1	Input; Pri. 125Ω, Sec. 10 megohms	Special	1	A19780
1 pr.	T2, T3	Saturable reactors; 4000Ω at 0A, 120Ω at .010A	Special	1	A19776
2	T4	Power; Pri. 45V, 15VA, 400 CPS; Sec. 120/60V, 10VA	Special	1	A27060
2	T5	Audio pack (Includes transformer and reactor CH-1); Transformer 1 to 6 ratio pri. to sec., Reactor 12H, .4A DC, 16Ω resistance	Special	1	A19784
2	T6	Dual output	Special	1	A19782

VACUUM TUBES

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
7	V1, V2	Thyratron	2051	11	
8	V3, V4, V5	Beam amplifier	12A6	11	

MISCELLANEOUS

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	.	Inverter with mounting bracket for MN-31A, B, 14-volt model	SS-1705	25	C56721
1	.	Inverter with mounting bracket for MN-31C, D, 28-volt model	SS-1974	25	C56721-1
2	.	Socket, Tube	2178	21	A30717
6	.	Brush assembly, Positive (Inverter)		25	A29731-1
6	.	Brush assembly, Negative (Inverter)		25	A29731-2
2	.	Ball bearing (Inverter)	7111	24	A29732

8-4. TYPE MN-36A AUTOMATIC LOOP

LOOP MOTOR

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	M02	Low inertia motor, Loop drive		14	C57343
1	.	Cup assembly	Special	14	A103294
4	.	Ball bearing	R-2-XS-1158	24	A100397

AUTOSYN MOTOR

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	M03	Autosyn transmitter	PO-21984	14	C57225
1	.	Rotor	Special	14	A100390
2	.	Brush assembly (For autosyn)	PB-21415	14	A100392
1	.	Brush holder (For autosyn)	PB-21408	14	A100710

LOOP

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	.	Loop and shaft assembly	W-94	14	AL72398-1
1	.	Slip ring assembly	AS-883-1	2	AA29711-1
1	.	Slip ring	AS-885-1	2	A29712
1	.	Gear plate assembly (Less motor)	Special	2	AA29710-1
1	.	Ball bearing (Loop shaft assembly)	B-1340	23	A31286
1	.	Ball bearing (Gear plate)	77R-2	24	A29975
1	.	Ball bearing (Loop shaft lower)	TR-771	23	A29977
1	.	Brush holder and support assembly	U-101	2	A31449

RECEPTACLE

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	J6	8-contact, Wall mounting	GK-C8-32S	15	A31353
1	J8	6-contact, Wall mounting	WK-6-32S	15	A30084

PLUG

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	P6	8-contact, 90°	GK-C8-23-½B	15	A30901

MISCELLANEOUS

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
1	.	Gasket, Mounting	V-336	2	C57921
1	.	Compensator	W-97	2	L72397
1	.	Housing for loop	Y-360	2	A104060
1	.	Gasket, Socket base	U-153	2	A102273
1	.	Scale, Fixed (Belly)	U-95-B	2	A26997
1	.	Gasket, Socket base	U-154	2	A102274
1	.	Scale, Fixed (Top)	U-090-B	2	A29976
1	.	Gasket, Base	V-105	2	C57900
1	.	Dehydrator assembly	Special	27	AC57763-1
1 gal.	.	6-16 Mesh silica gel	85966-160T	3	A100744
12	.	Allen cap screw 8-32 x 9/16 S.S., For attaching cloth type housing	.	28	A102406-16
12	.	Allen cap screw 8-32 x 7/16 S. S., For attaching celluloid housing	.	28	A102406-12
4	.	Allen wrench for #8 cap screw	.	28	A18190-14
4	.	Allen wrench for #10 cap screw	.	28	A18190-16

8-5. TYPE MN-37A BEARING INDICATOR

Quantity	Symbol Designation	Description	Mfr's. Designation	Mfr.	Bendix No.
		MISCELLANEOUS			
6	LM2	Instrument lamp	Special	14	A18881-1
1	M04	Autosyn motor		14	C57226
1	P5	6-contact, 90°, Plug	WK-6-23-3/8B	15	A30085
1	J5	6-contact, Receptacle	WK-6-32S	15	A30084
4	R3-1, R3-2	Each 51Ω	Special	14	A31352-1
2	.	Glass for dial window	AS-774-1	2	A30267
2	.	Gasket for glass	AS-776-1	2	A30269
1	.	Outline, Mounting plate	U-130	2	A29709
1	.	Rotor	Special	14	A100399
2	.	Bearing, Ball (For autosyn)	R-2-XS-1158	24	A100397
2	.	Brush assembly	PB-21415	14	A100392
1	.	Bruch holder	PB-21408	14	A100710
2	R41	40Ω, WW 2.5W, Part of Type MS-14C Junction Box, for 28-volt operation of Type MN-37A pilot lamp	MW-3	16	A100517

9. LIST OF MANUFACTURERS

1. Bendix Radio,
   Division of Bendix Aviation Corp.,
   Baltimore, Maryland
2. Kearfott Engineering Co.,
   117 Liberty Street,
   New York, N. Y.
3. Davison Chemical Corp.,
   Baltimore, Maryland
4. Micamold Radio Corp.,
   1085 Flushing Ave.,
   Brooklyn, N. Y.
5. Aerovox Corp.,
   New Bedford, Mass.
6. Erie Resistor Corp.,
   Erie, Pa.
7. Eicor, Inc.,
   515 S. Laflin Street,
   Chicago, Ill.
8. Kurman Electric Co.,
   239 Lafayette Street,
   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, N. J.
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 Resistance Co.,
    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.,
    2339 W. Van Buren Street,
    Chicago, Ill.
22. Cornell-Dubilier Electric Corp.,
    Hamilton Bldg.,
    South Plainfield, N. J.
23. Torrington Manufacturing Co.,
    Torrington, Conn.
24. New Departure,
    Division General Motors Sales,
    Bristol, Conn.
25. Pioneer Gen-E-Motor Corp.,
    466 W. Superior Street,
    Chicago, Ill.
26. Hammarlund Manufacturing Co.,
    424-438 West 33rd Street,
    New York, N. Y.
27. Multi Products Tool Co.,
    123 Sussex Avenue,
    Newark, N. J.
28. Allen Manufacturing Co.,
    133 Sheldon Street,
    Hartford, Conn.

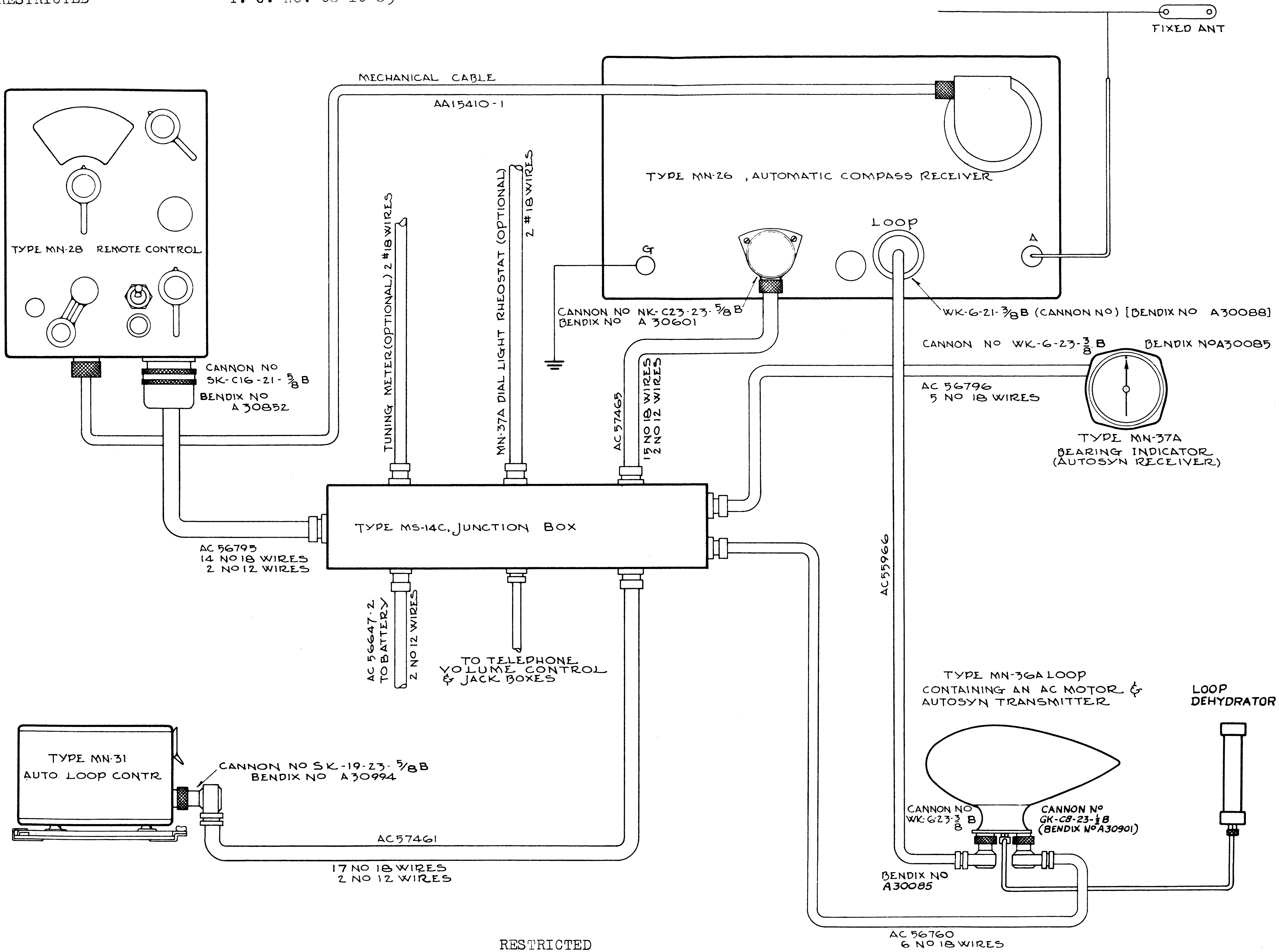


Figure 24—Model MN-31 Automatic Radio Compass, Typical Cording Diagram

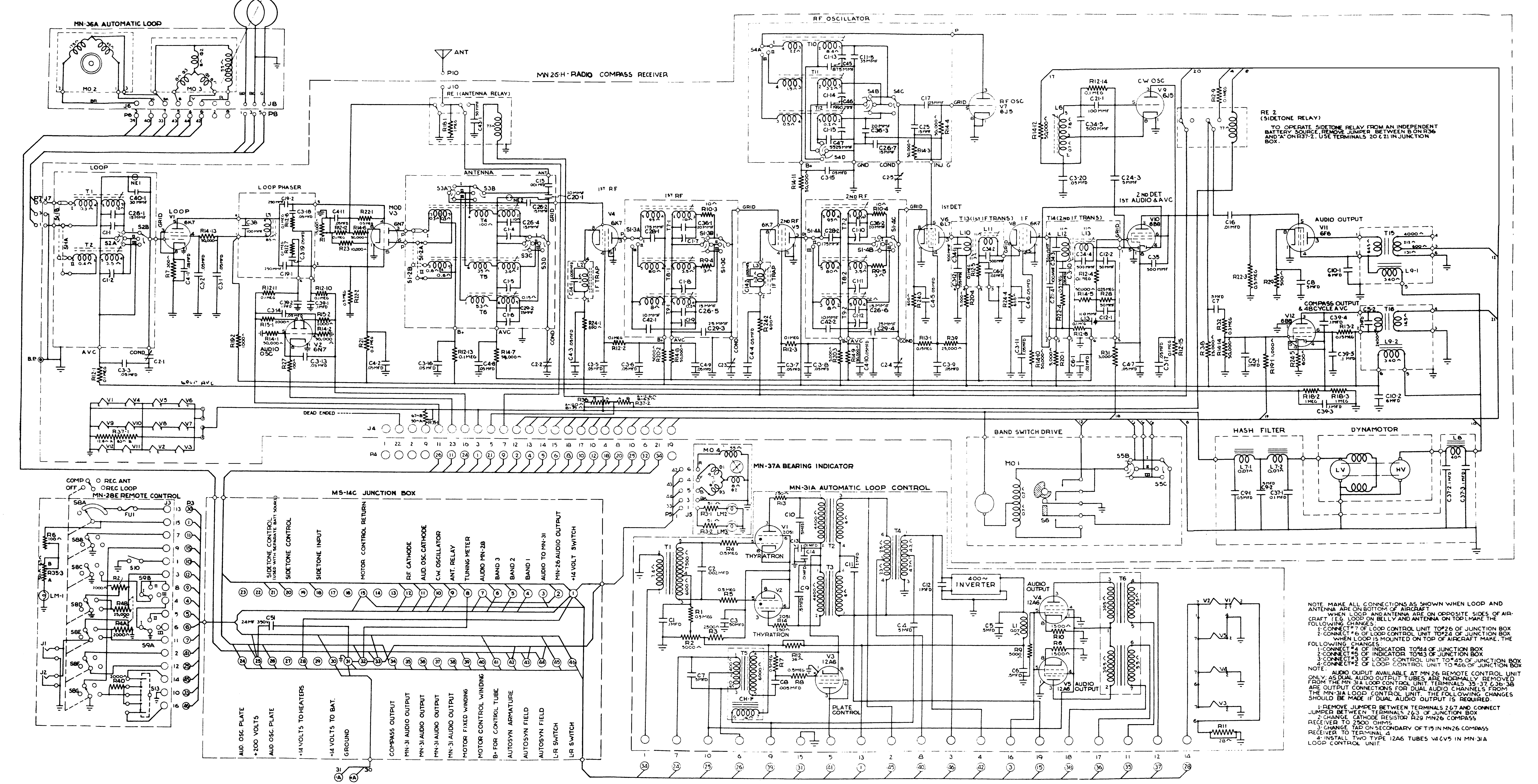
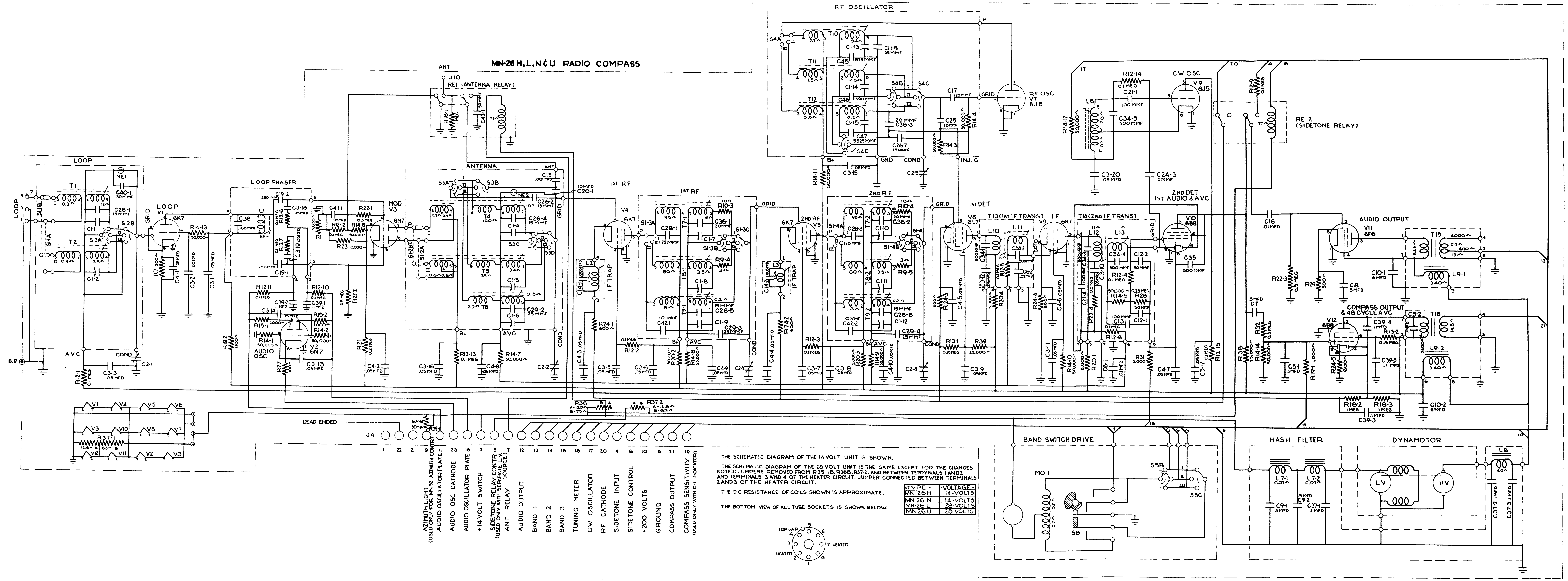


FIGURE 25—MODEL MN-31 AUTOMATIC RADIO COMPASS, COMPLETE SCHEMATIC CIRCUIT DIAGRAM



THE SCHEMATIC DIAGRAM OF THE 14 VOLT UNIT IS SHOWN.

THE SCHEMATIC DIAGRAM OF THE 28 VOLT UNIT IS THE SAME EXCEPT FOR THE CHANGES NOTED: JUMPERS REMOVED FROM R35-1B, R36B, R37-2, AND BETWEEN TERMINALS 1 AND 2 AND TERMINALS 3 AND 4 OF THE HEATER CIRCUIT. JUMPER CONNECTED BETWEEN TERMINALS 2 AND 3 OF THE HEATER CIRCUIT.

THE DC RESISTANCE OF COILS SHOWN IS APPROXIMATE.

THE BOTTOM VIEW OF ALL TUBE SOCKETS IS SHOWN BELOW.

TYPE	VOLTAGE
MN-26H	14-VOLTS
MN-26N	14-VOLTS
MN-26L	28-VOLTS
MN-26U	28-VOLTS

FIGURE 26—TYPE MN-26H, L, N, U RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM

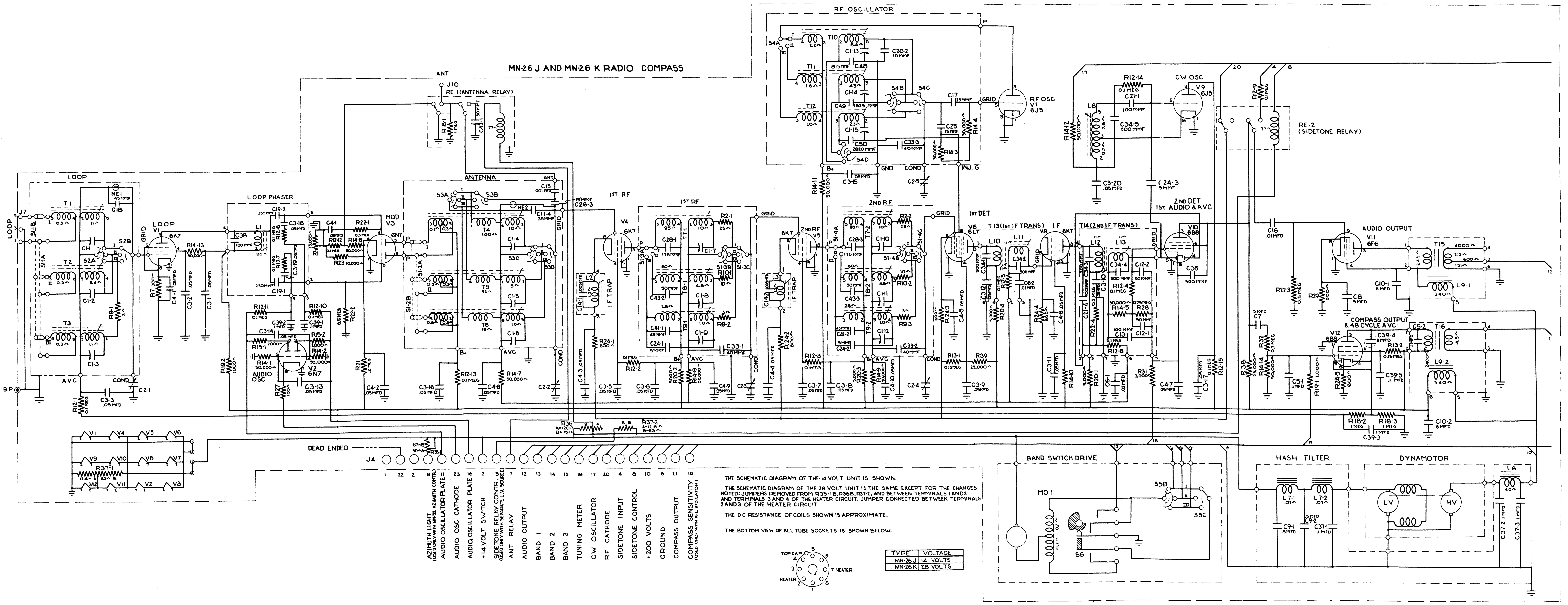


FIGURE 27—TYPE MN-26J, K RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM

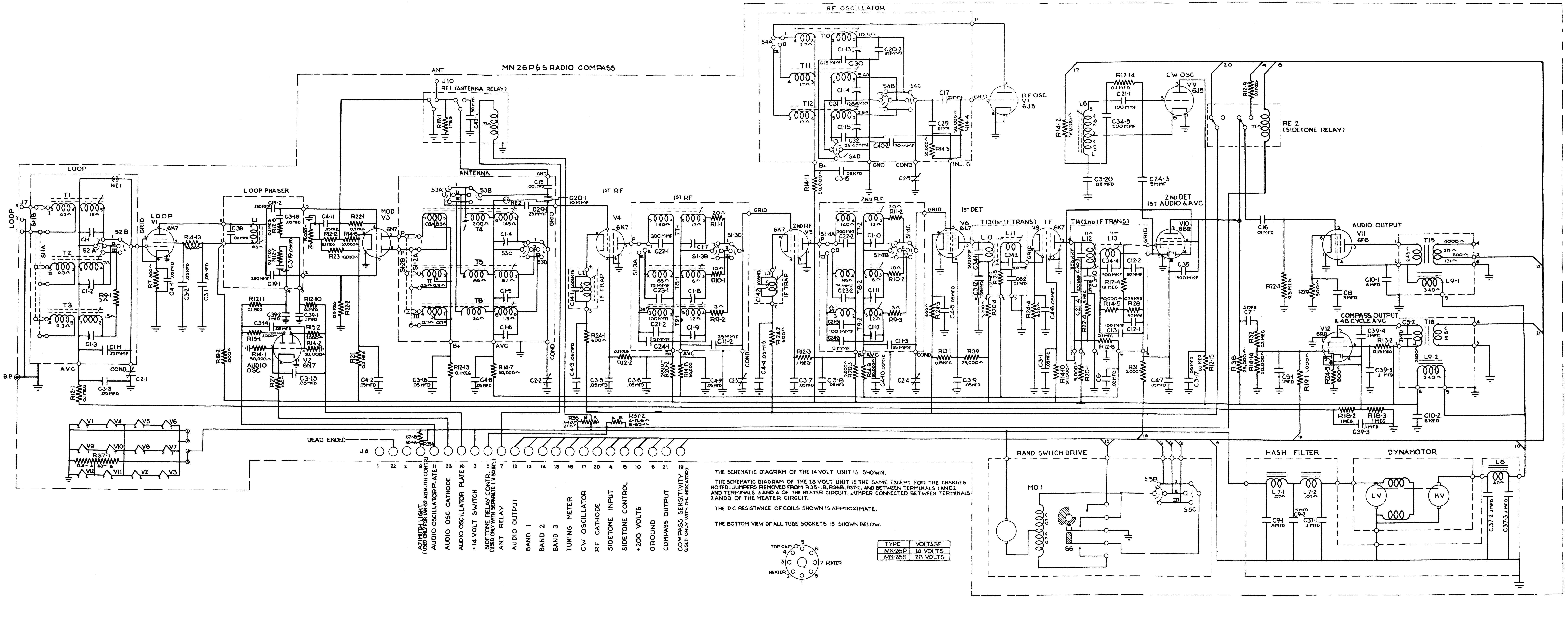


Figure 28—Type MN-26P, S Radio Compass, Schematic Circuit Diagram

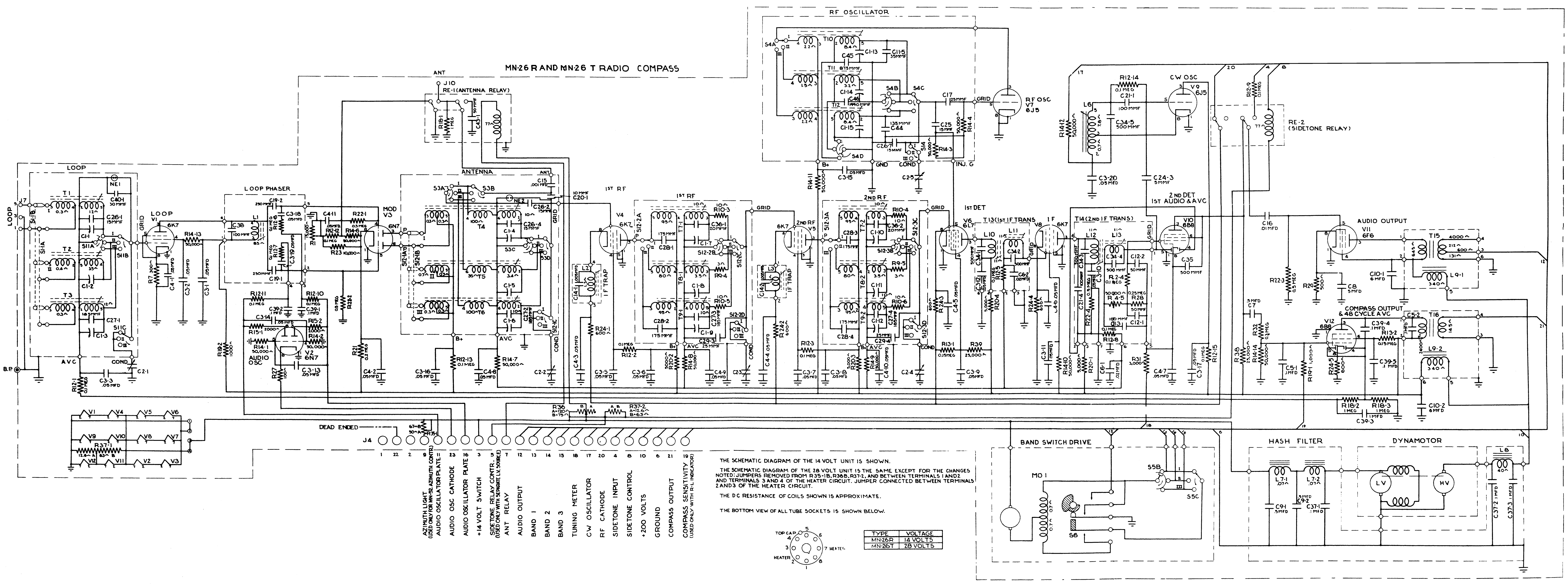


FIGURE 29—TYPE MN-26R, T RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM

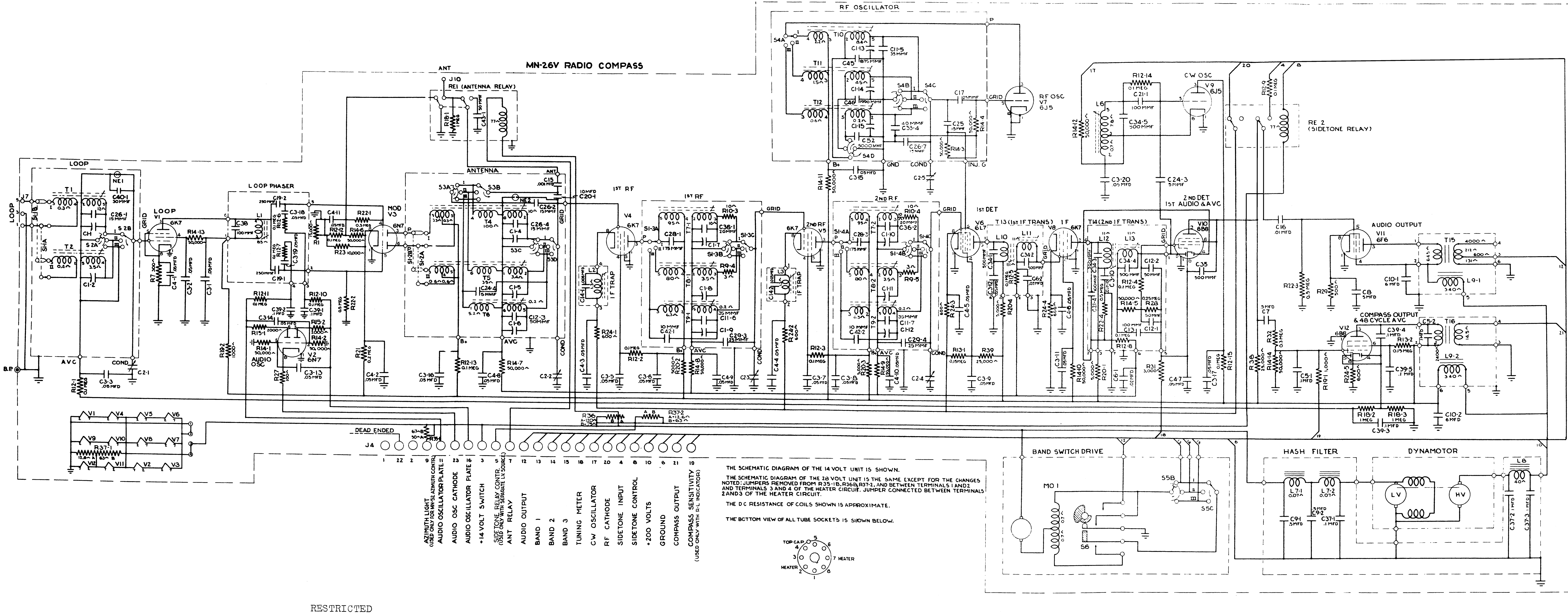


FIGURE 30—TYPE MN-26V RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM

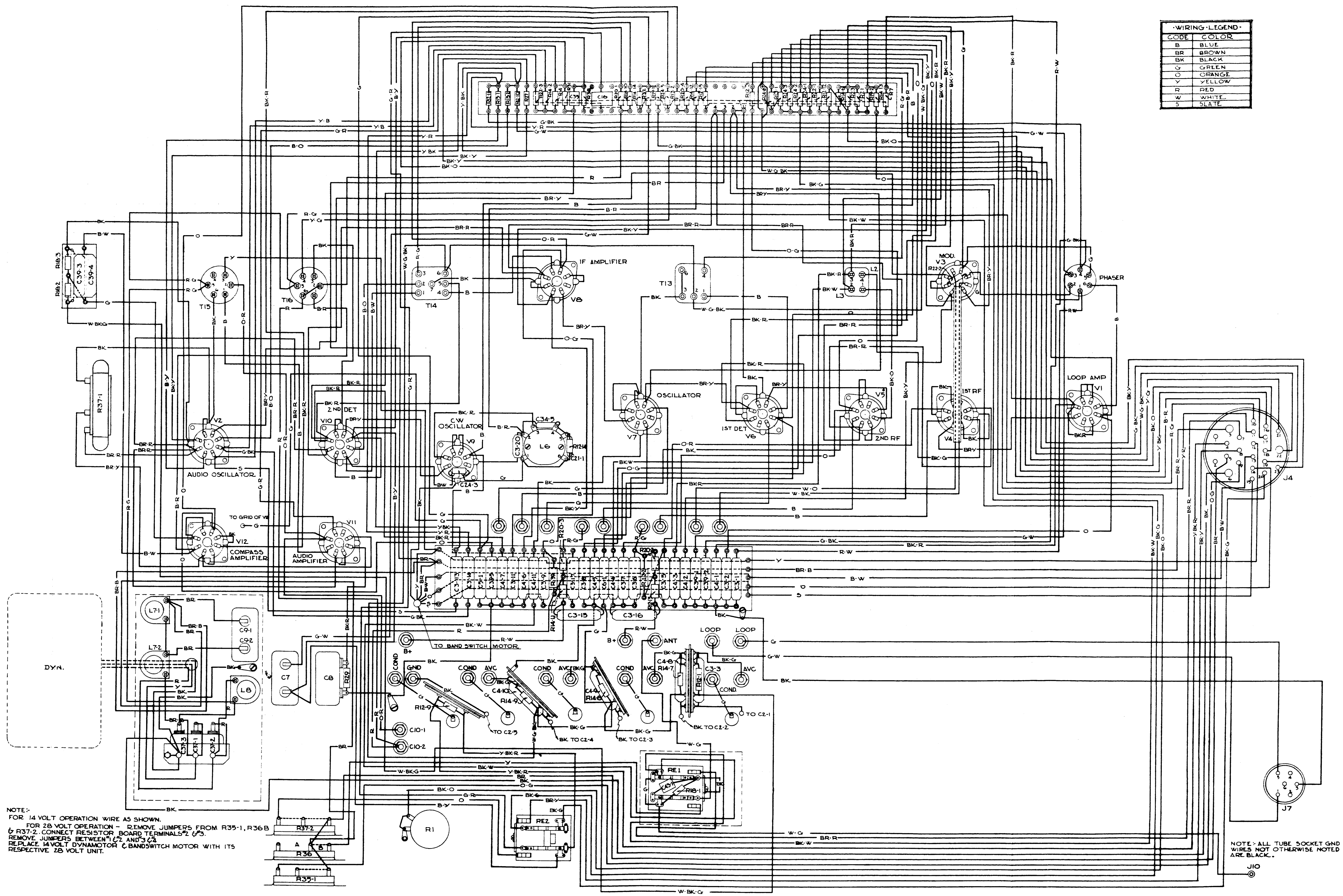


Figure 31—Type MN-26H Radio Compass, Wiring Diagram

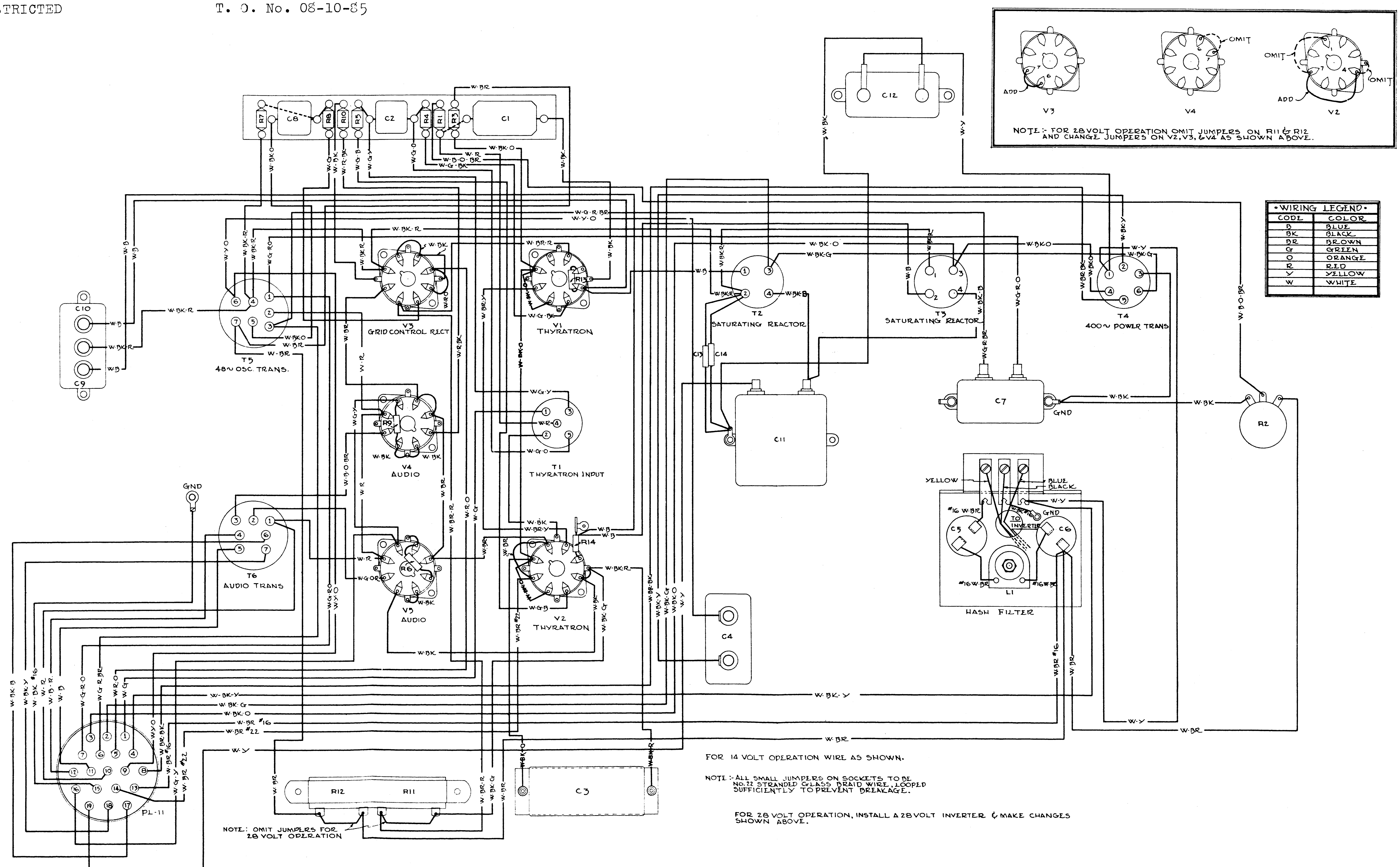


FIGURE 32—TYPE MN-31 AUTOMATIC LOOP CONTROL, WIRING DIAGRAM

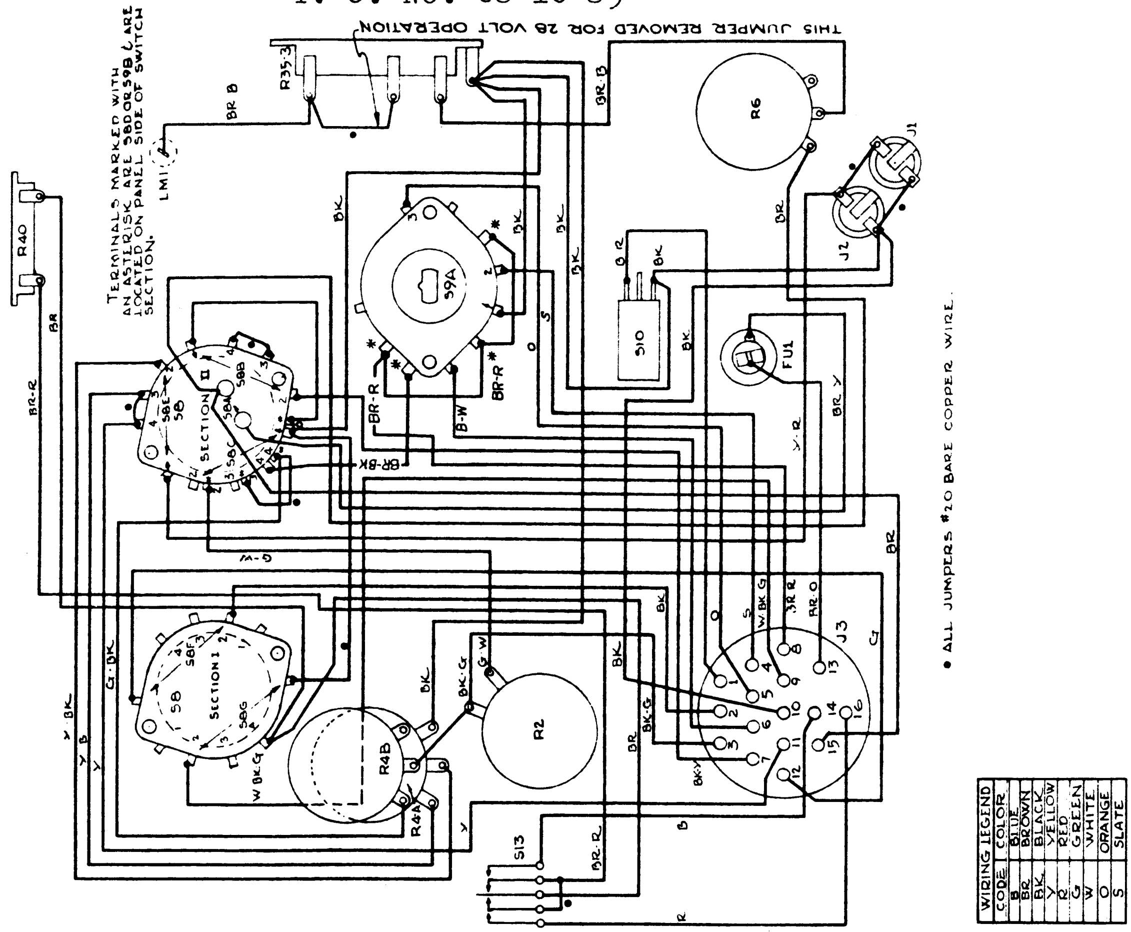


FIGURE 34—TYPE MN-28T REMOTE CONTROL UNIT, WIRING DIAGRAM

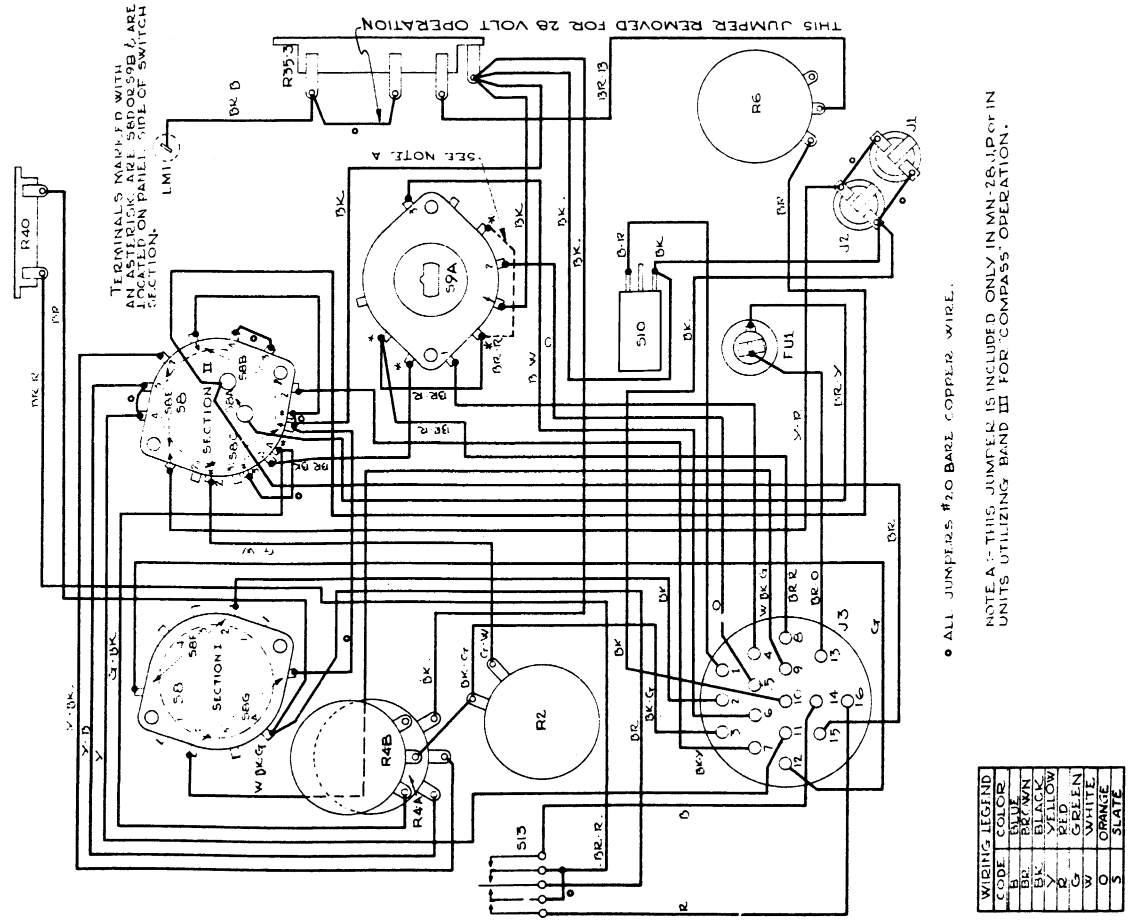
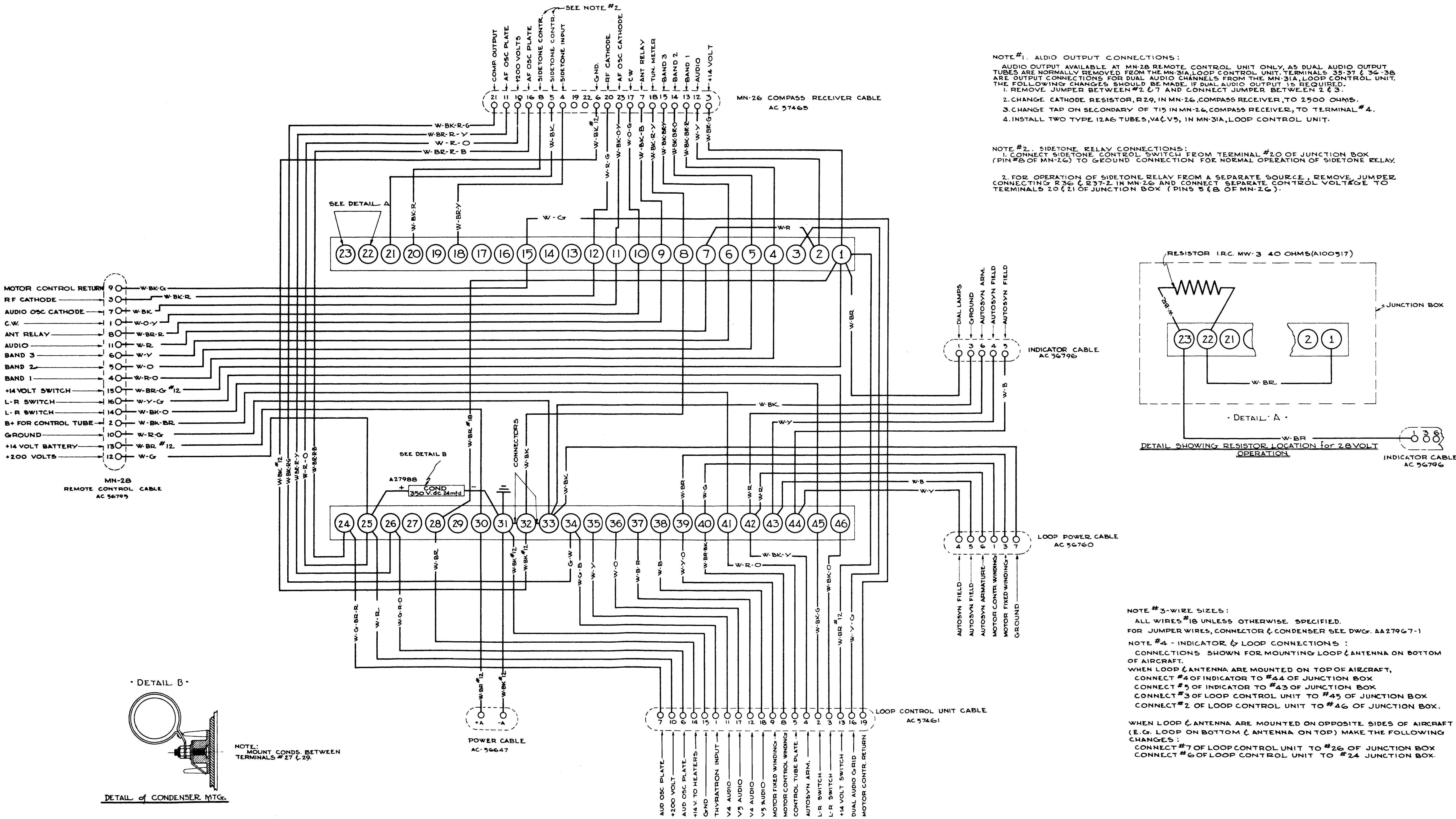


FIGURE 33—TYPE MN-28E, J, P, V REMOTE CONTROL UNIT, WIRING DIAGRAM



NOTE #1. AUDIO OUTPUT CONNECTIONS:

AUDIO OUTPUT AVAILABLE AT MN-28 REMOTE CONTROL UNIT ONLY, AS DUAL AUDIO OUTPUT TUBES ARE NORMALLY REMOVED FROM THE MN-31A, LOOP CONTROL UNIT. TERMINALS 35-37 & 36-38 ARE OUTPUT CONNECTIONS FOR DUAL AUDIO CHANNELS FROM THE MN-31A, LOOP CONTROL UNIT. THE FOLLOWING CHANGES SHOULD BE MADE IF DUAL AUDIO OUTPUT IS REQUIRED.

1. REMOVE JUMPER BETWEEN #2 & 7 AND CONNECT JUMPER BETWEEN 2 & 3.
2. CHANGE CATHODE RESISTOR, R29, IN MN-26, COMPASS RECEIVER, TO 2500 OHMS.
3. CHANGE TAP ON SECONDARY OF T15 IN MN-26, COMPASS RECEIVER, TO TERMINAL #4.
4. INSTALL TWO TYPE 12A6 TUBES, V4 & V5, IN MN-31A, LOOP CONTROL UNIT.

NOTE #2. SIDETONE RELAY CONNECTIONS:

1. CONNECT SIDETONE CONTROL SWITCH FROM TERMINAL #20 OF JUNCTION BOX (PIN #8 OF MN-26) TO GROUND CONNECTION FOR NORMAL OPERATION OF SIDETONE RELAY.

2. FOR OPERATION OF SIDETONE RELAY FROM A SEPARATE SOURCE, REMOVE JUMPER CONNECTING R36 & R37-2 IN MN-26 AND CONNECT SEPARATE CONTROL VOLTAGE TO TERMINALS 20 & 21 OF JUNCTION BOX (PINS 5 & 8 OF MN-26).

NOTE #3-WIRE SIZES:

ALL WIRES #18 UNLESS OTHERWISE SPECIFIED.

FOR JUMPER WIRES, CONNECTOR & CONDENSER SEE DWG. AA27967-1

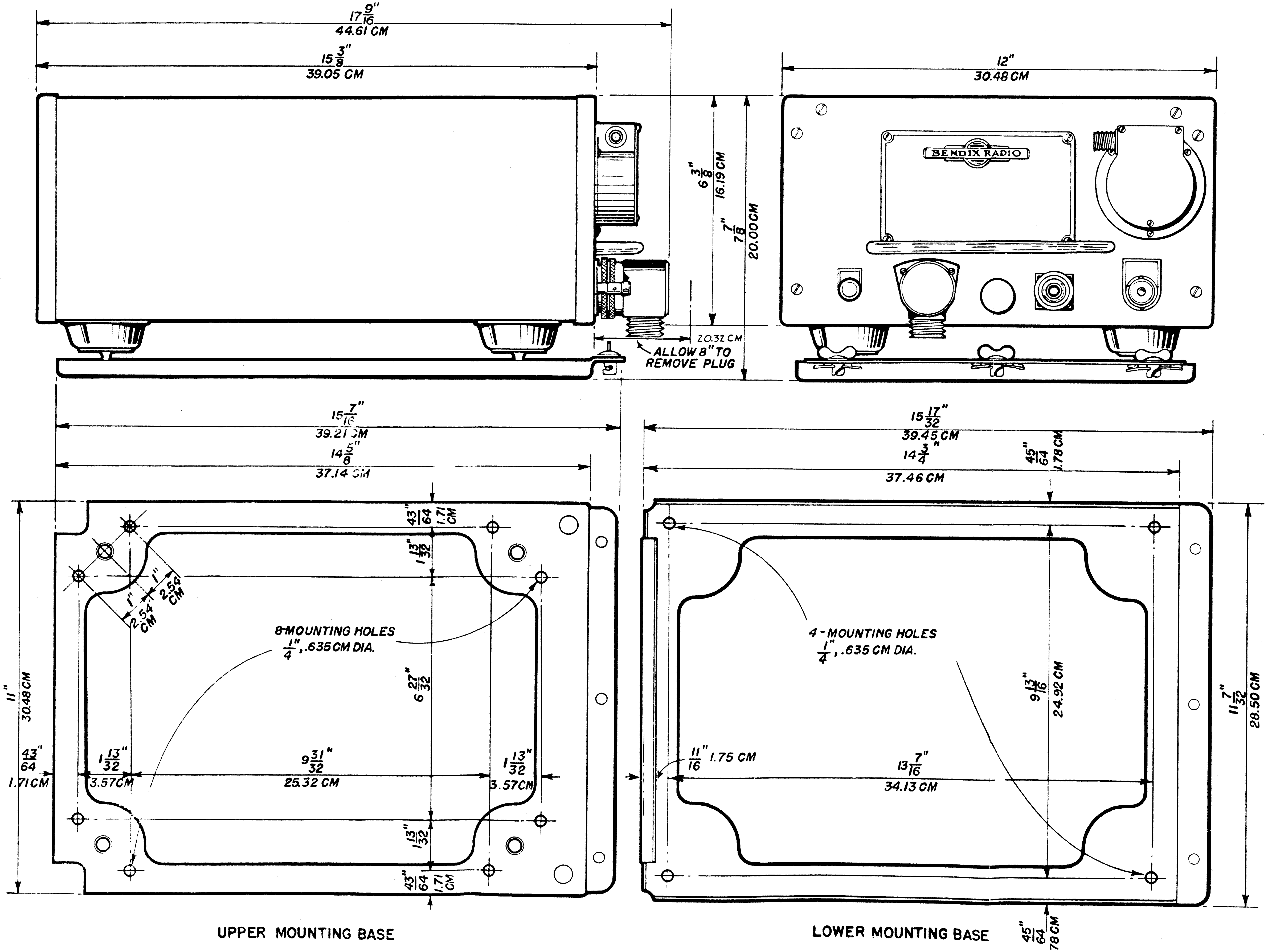
NOTE #4 - INDICATOR & LOOP CONNECTIONS:

CONNECTIONS SHOWN FOR MOUNTING LOOP & ANTENNA ON BOTTOM OF AIRCRAFT.

WHEN LOOP & ANTENNA ARE MOUNTED ON TOP OF AIRCRAFT,
CONNECT #4 OF INDICATOR TO #44 OF JUNCTION BOX
CONNECT #5 OF INDICATOR TO #43 OF JUNCTION BOX
CONNECT #3 OF LOOP CONTROL UNIT TO #45 OF JUNCTION BOX
CONNECT #2 OF LOOP CONTROL UNIT TO #46 OF JUNCTION BOX.

WHEN LOOP & ANTENNA ARE MOUNTED ON OPPOSITE SIDES OF AIRCRAFT (E.G. LOOP ON BOTTOM & ANTENNA ON TOP) MAKE THE FOLLOWING CHANGES:
CONNECT #7 OF LOOP CONTROL UNIT TO #26 OF JUNCTION BOX
CONNECT #6 OF LOOP CONTROL UNIT TO #24 JUNCTION BOX.

FIGURE 35—TYPE MS-14C JUNCTION BOX, WIRING DIAGRAM



WT. - 35.375 lbs or 16.04 kg

Figure 36—Type MN-26 Radio Compass (Standard Shockmount), Outline & Mtg. Dimensions

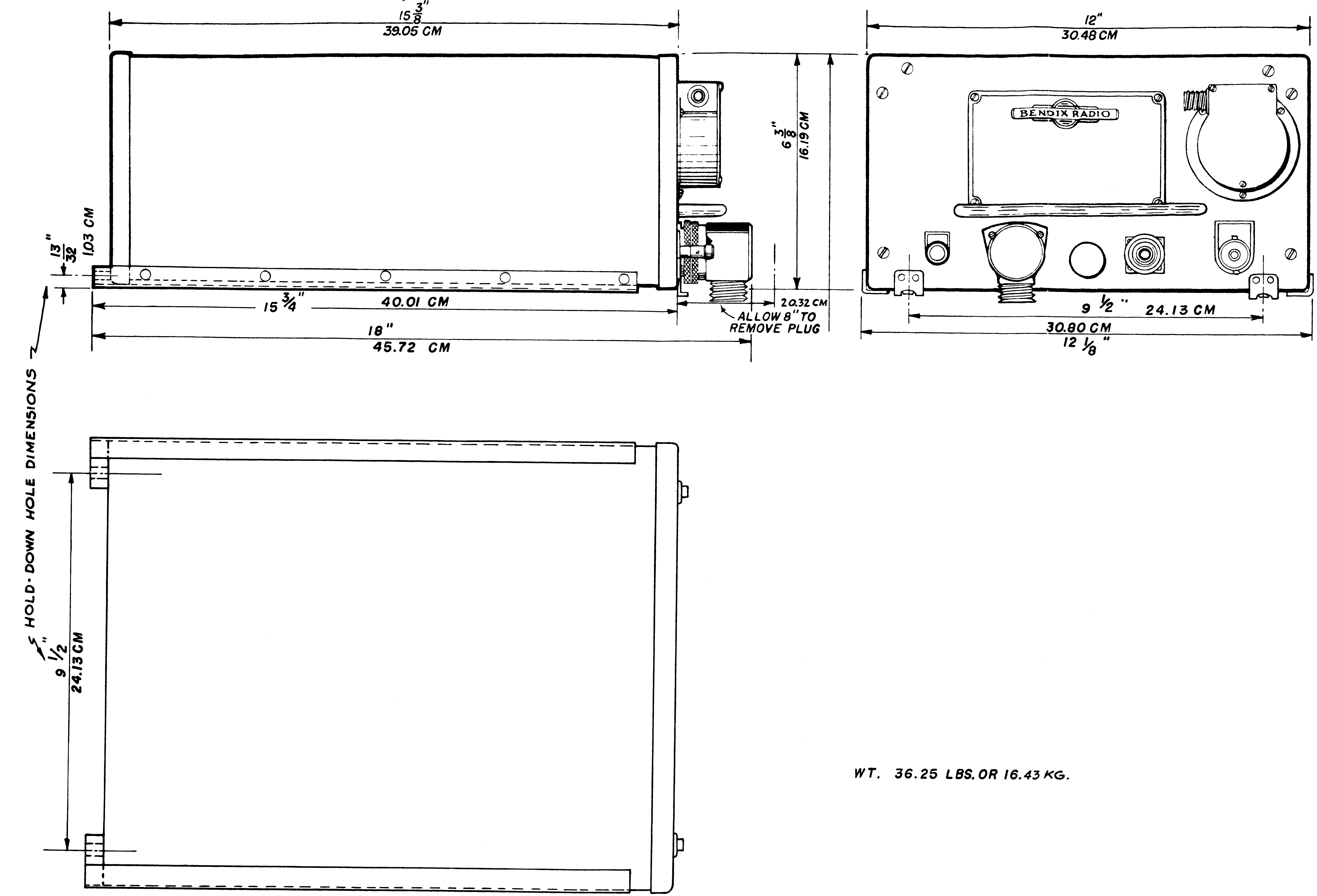
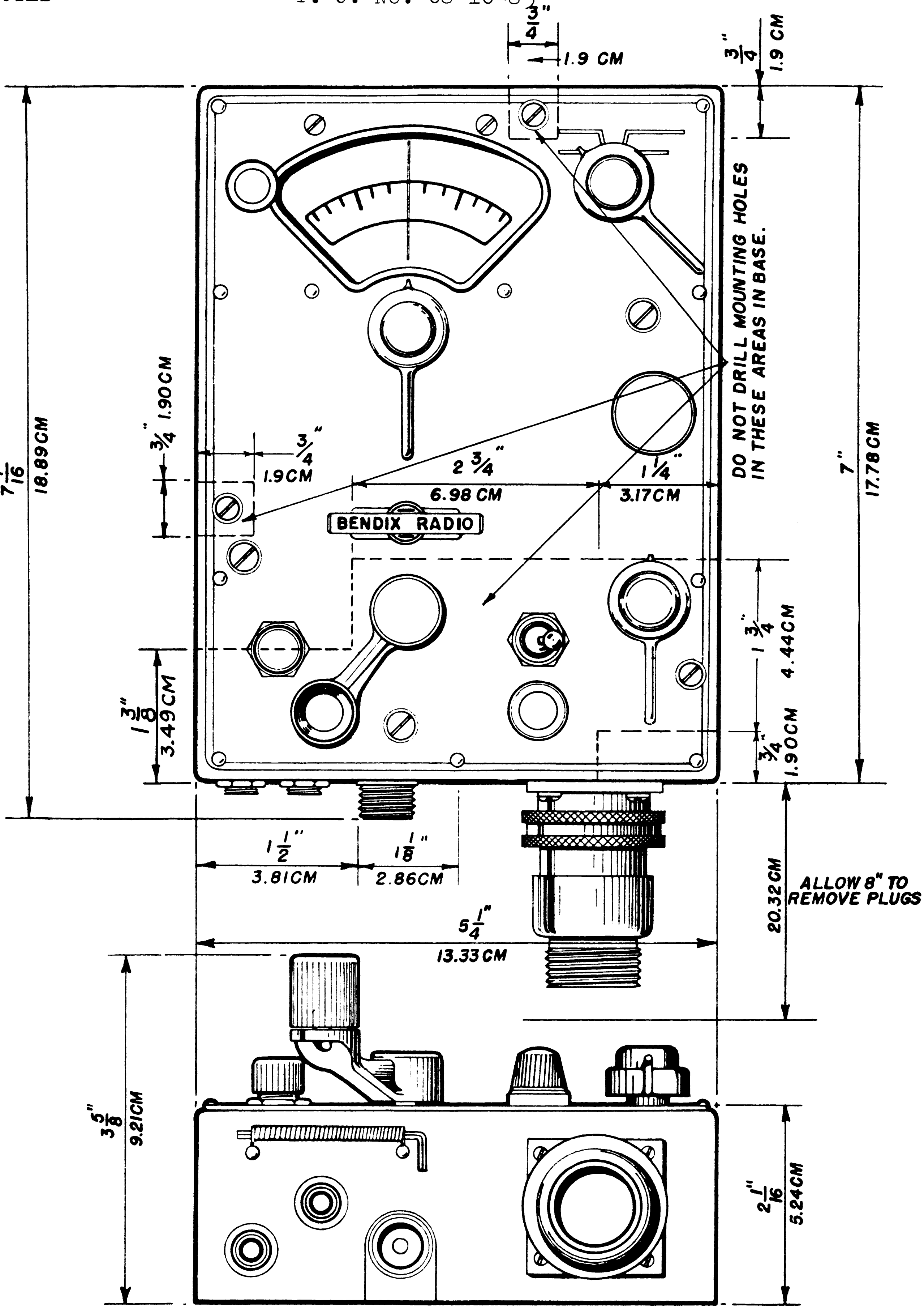


Figure 37—Type MN-26N, U Radio Compass (A.T.R. Shockmount), Outline & Mtg. Dimensions



WT. 2.75LBS; 1.24 KG.

FIGURE 38—TYPE MN-28 REMOTE CONTROL, OUTLINE & MTG. DIMENSIONS

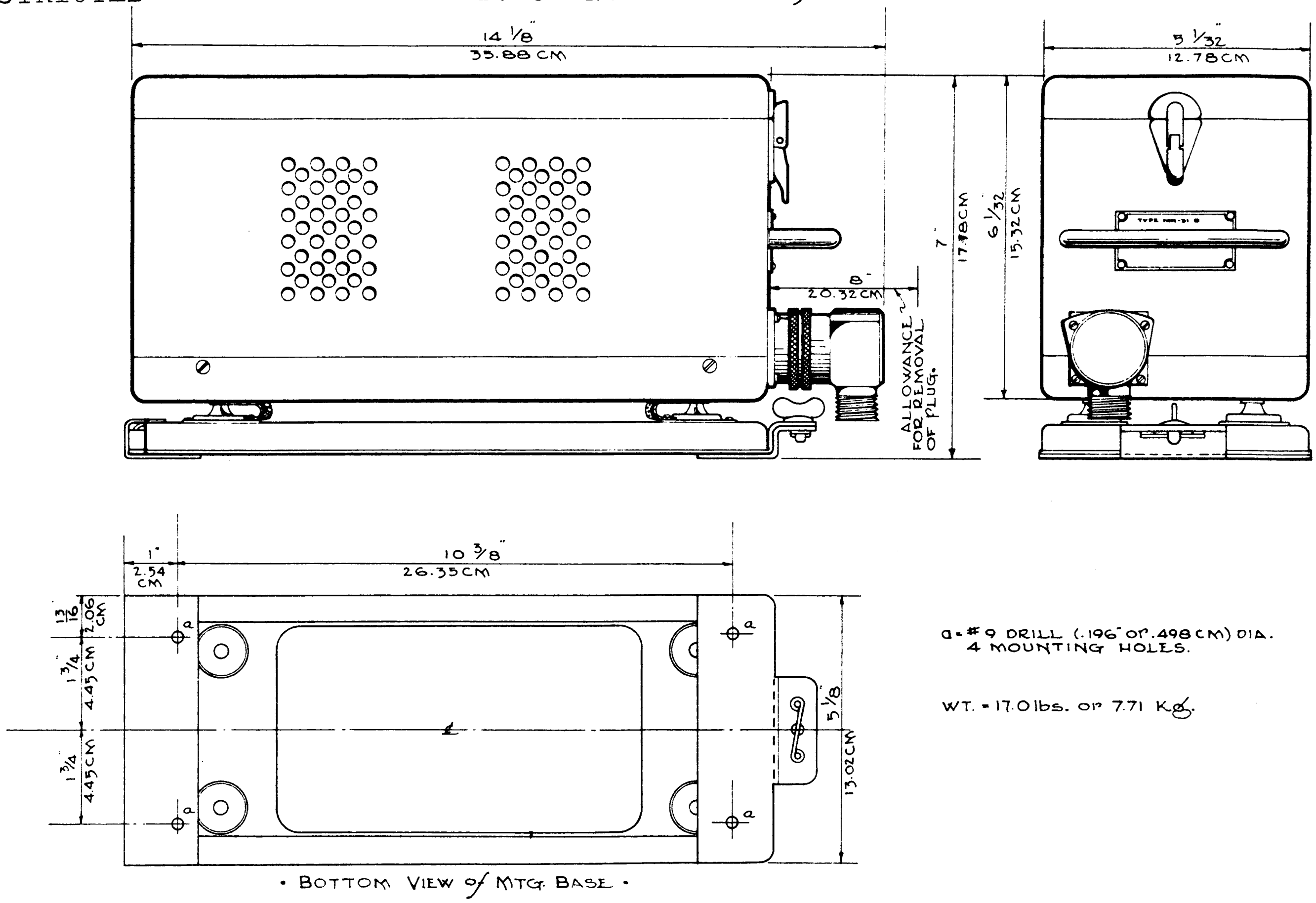


FIGURE 39—TYPE MN-31A, C AUTOMATIC LOOP CONTROL, OUTLINE & MTG. DIMENSIONS

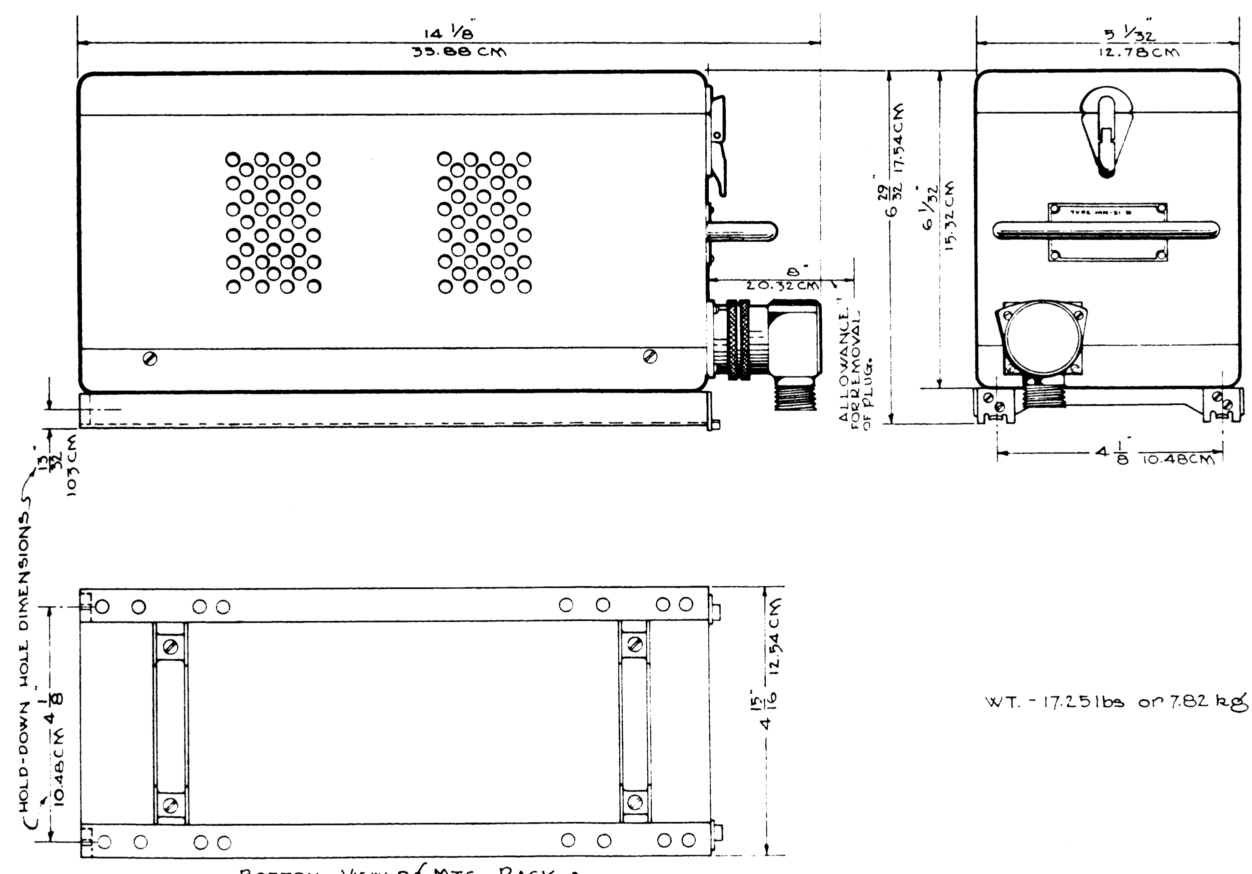


FIGURE 40—TYPE MN-31B, D AUTOMATIC LOOP CONTROL, OUTLINE & MTG. DIMENSIONS

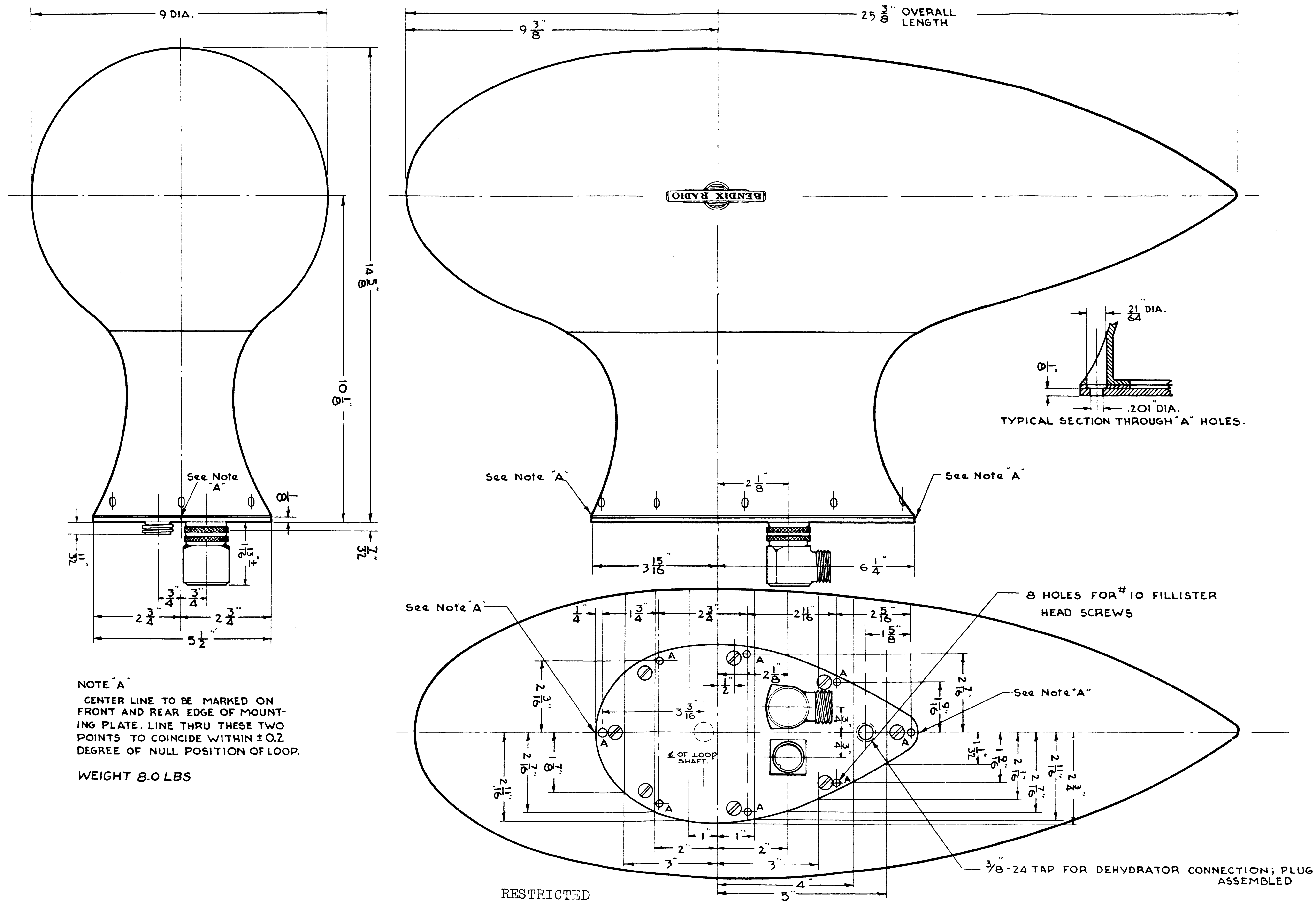


FIGURE 41—TYPE MN-36A AUTOMATIC LOOP, OUTLINE & MTG. DIMENSIONS

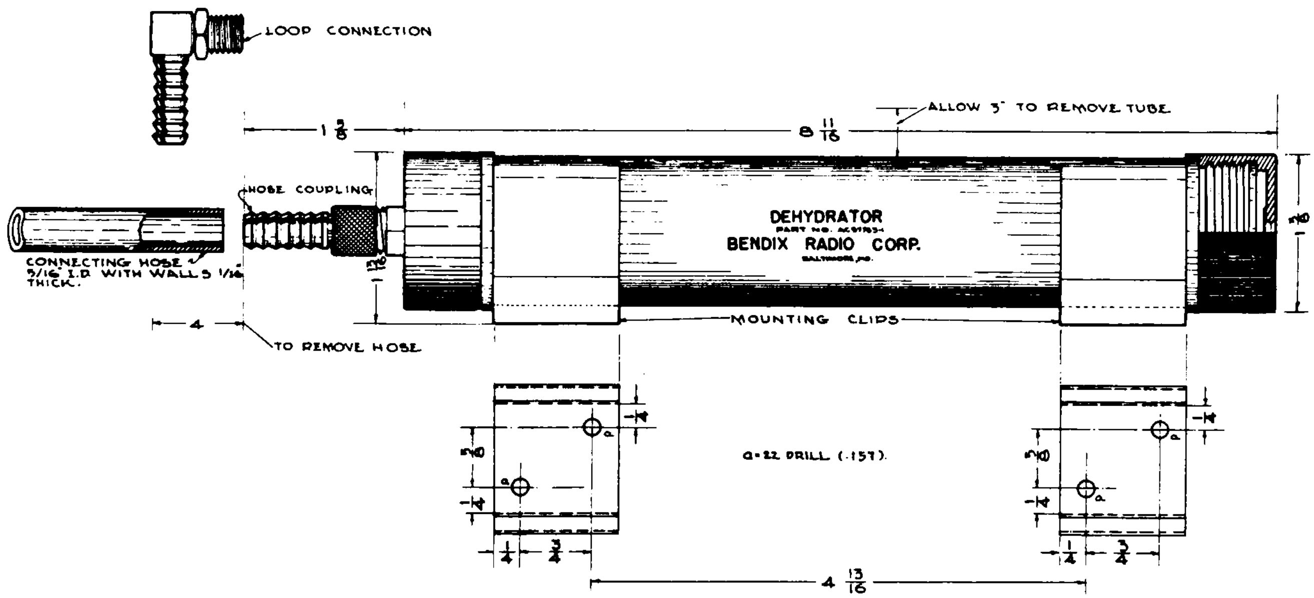


FIGURE 42—LOOP DEHYDRATOR UNIT, OUTLINE & MTG. DIMENSIONS

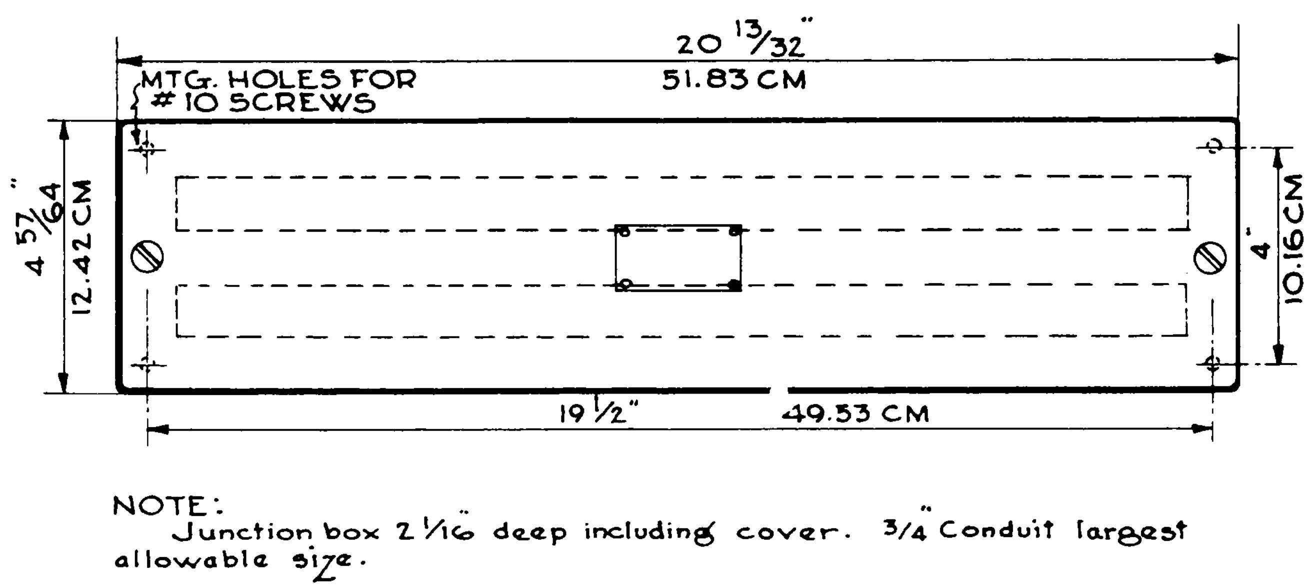


FIGURE 43—TYPE MS-14C JUNCTION BOX, OUTLINE & MTG. DIMENSIONS

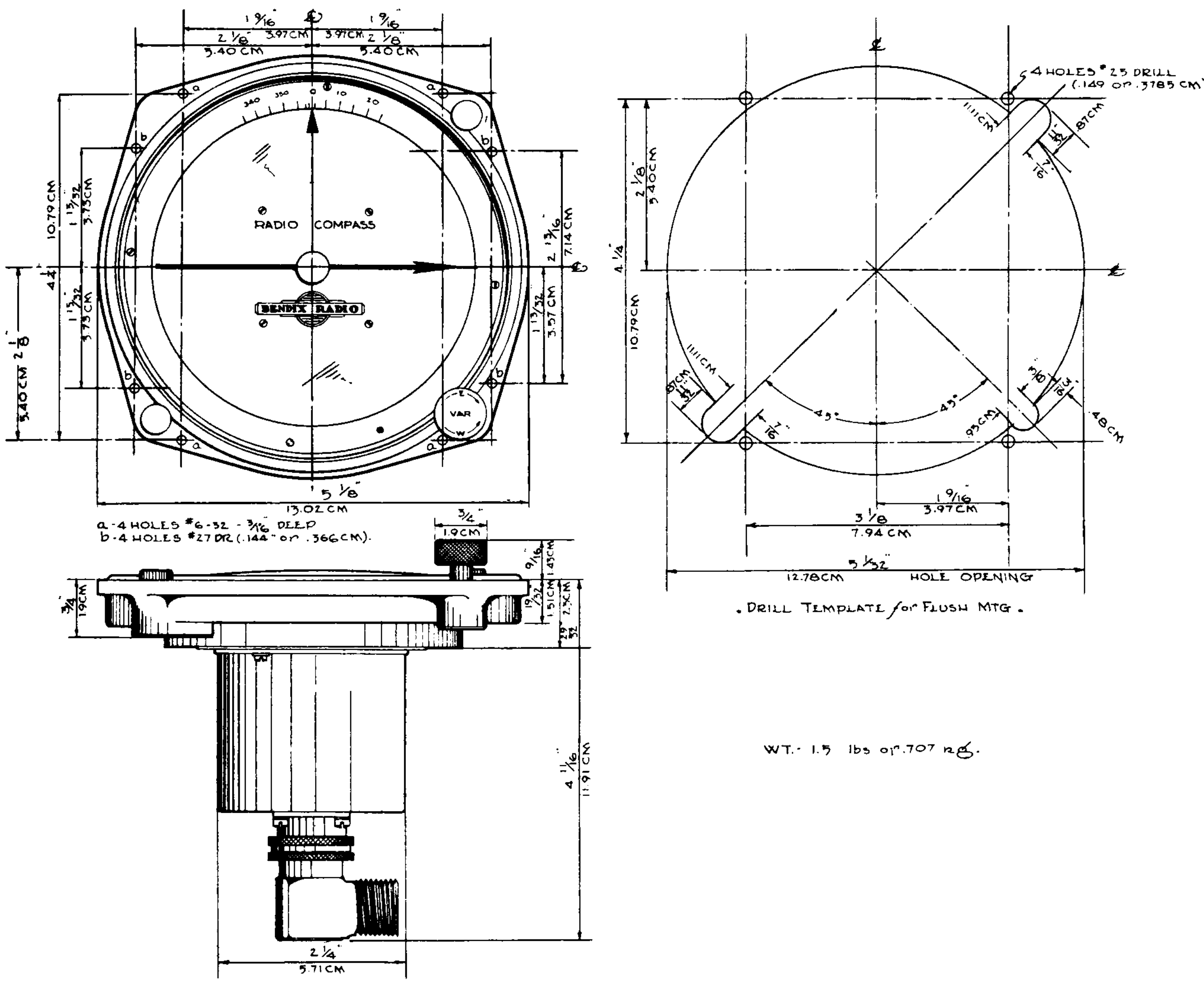


Figure 44—Type MN-37A Bearing Indicator, Outline & Mtg. Dimensions

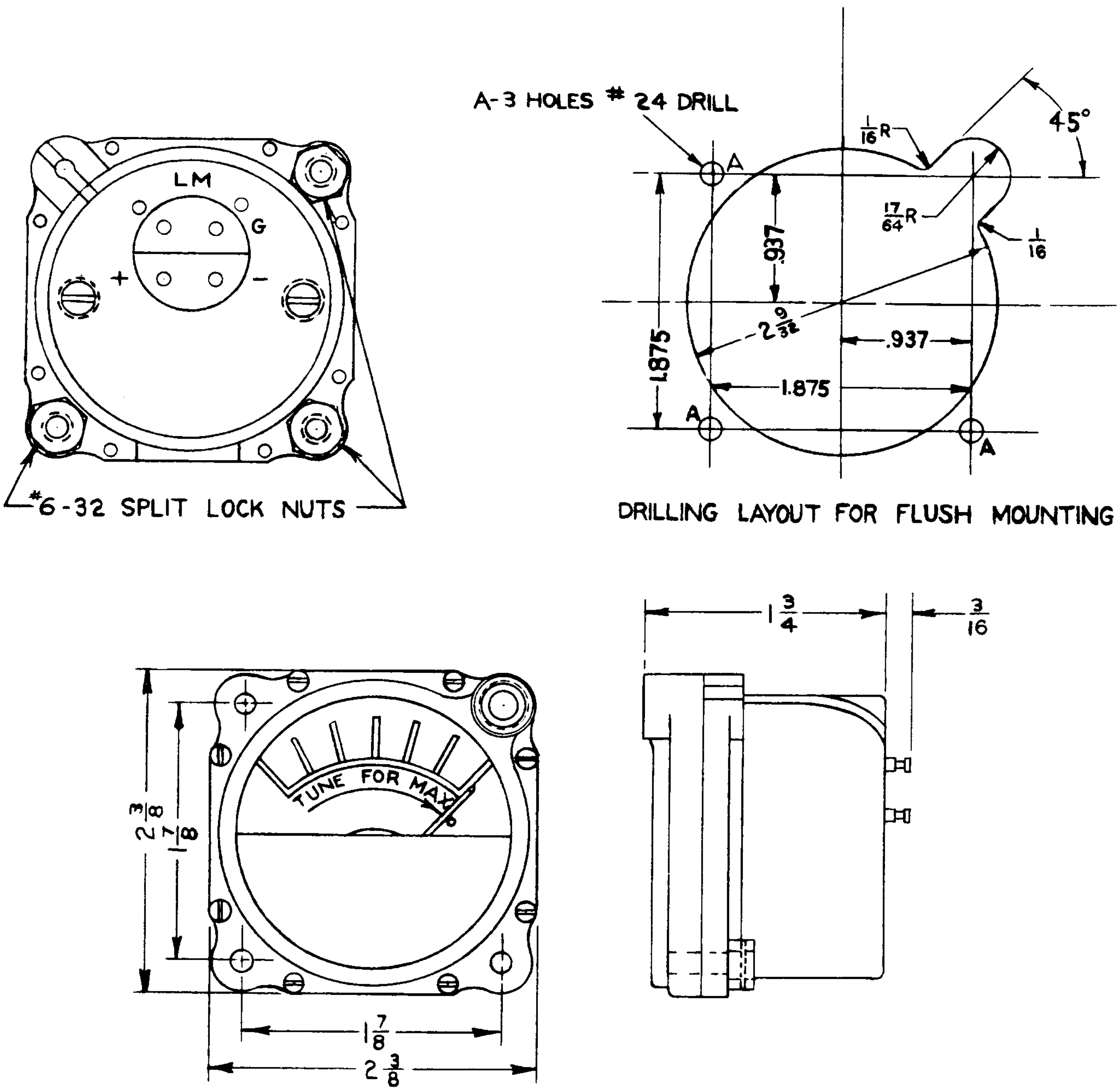


FIGURE 45—TYPE MR-57A TUNING METER, OUTLINE & MTG. DIMENSIONS

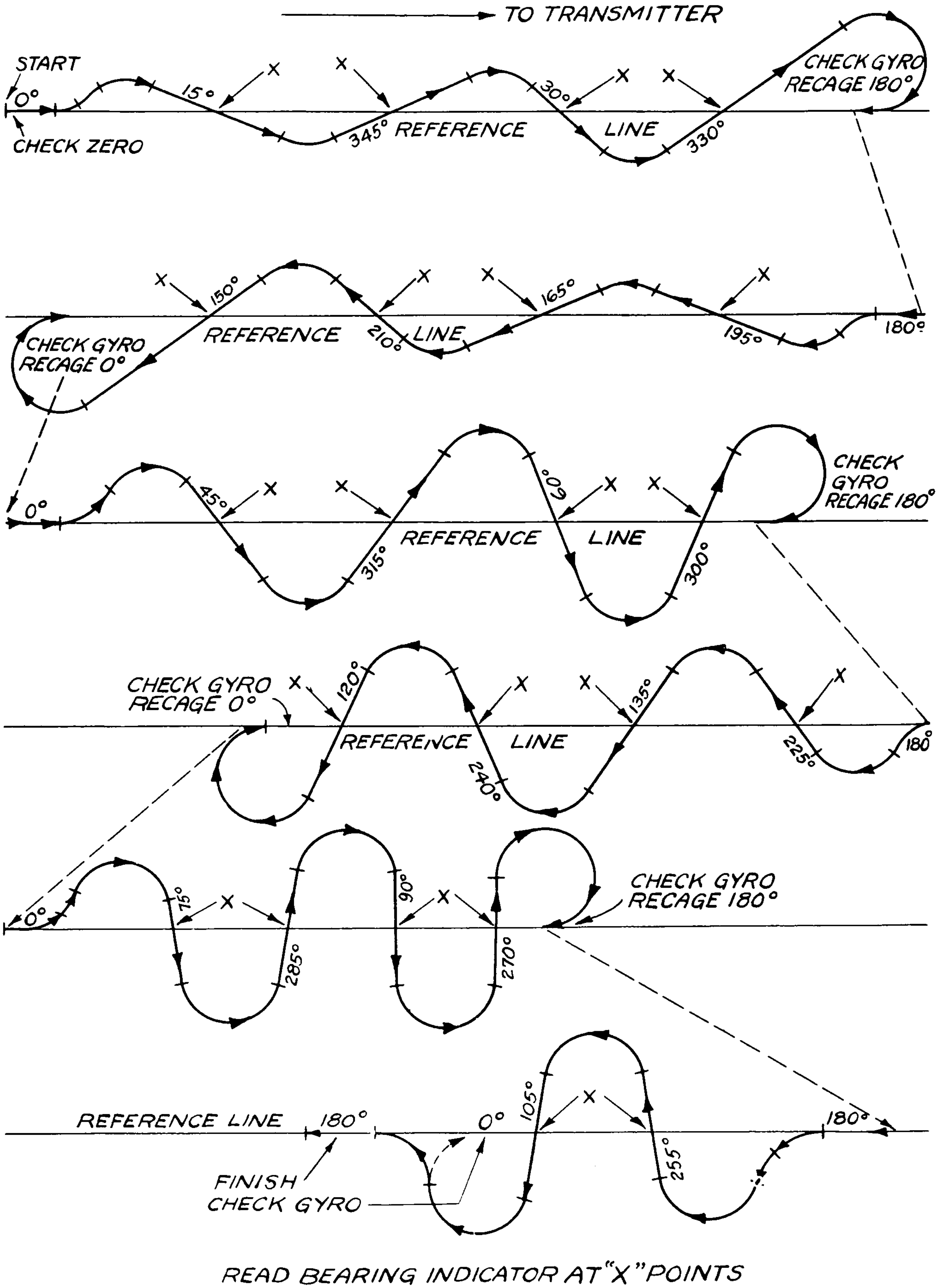


FIGURE 46—RADIO COMPASS QUADRANTAL ERROR FLIGHT PROCEDURE, (GROUND REFERENCE-LINE METHOD)

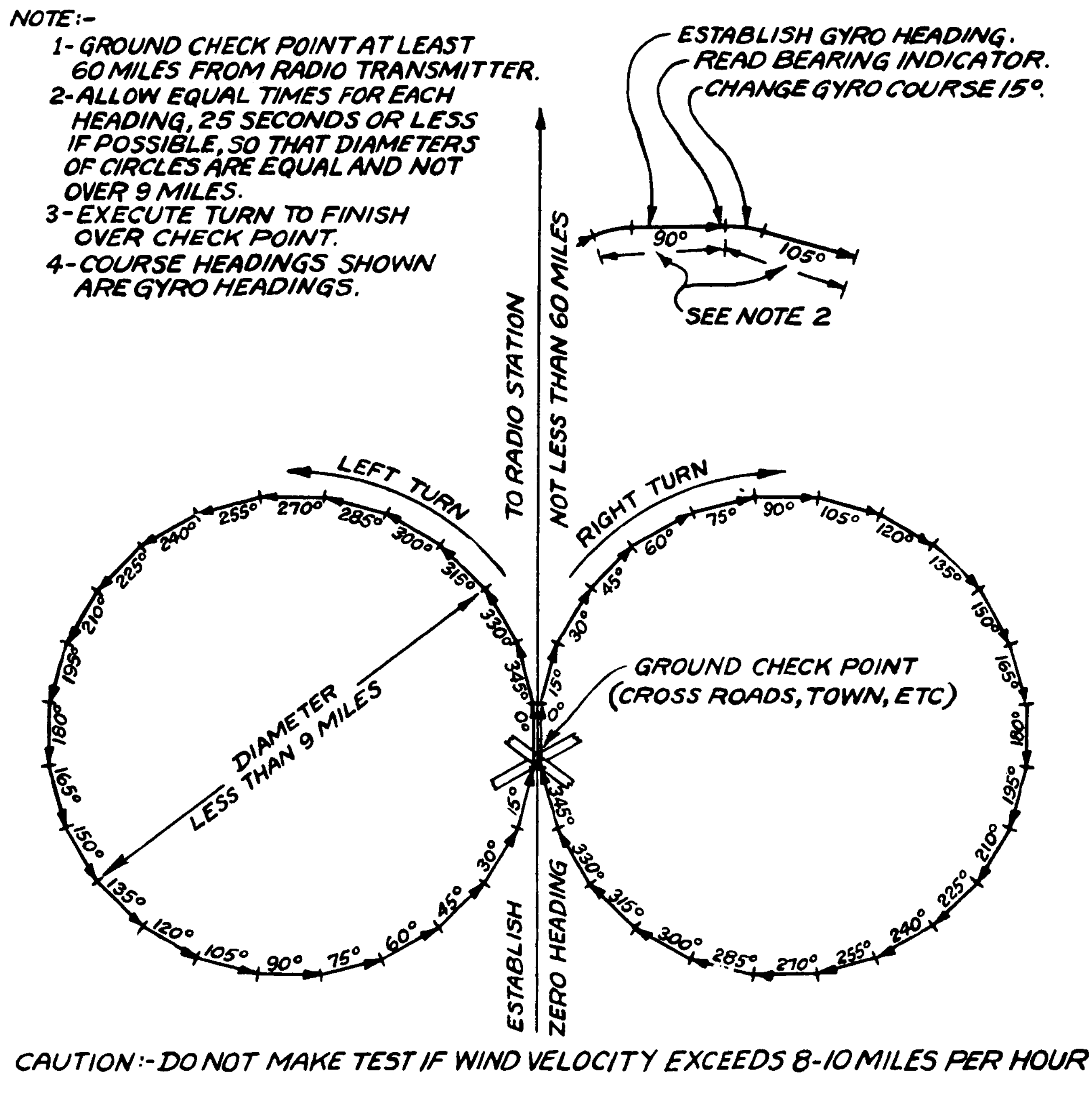


FIGURE 47—RADIO COMPASS QUADRANTAL ERROR FLIGHT PROCEDURE, (TWO-CIRCLE METHOD)

Remarks:

DATA SHEET

Radio Compass

Quadrantal Error Calibration

(Ground Reference-Line Method)

Date:

Location:

Ship No:

Pilot:

Recorder:

Gyro Head.	True Radio Bear.	Observed Radio Bear.	Bearing Correction
			True Minus Observed
0	0		
15	345		
345	15		
30	330		
330	30		
180	180		
195	165		
165	195		
210	150		
150	210		
0	0		
45	315		
315	45		
60	300		
300	60		
180	180		
225	135		
135	225		
240	120		
120	240		
0	0		
75	285		
285	75		
90	270		
270	90		
180	180		
255	105		
105	255		
180	180		

Compensator Corrections	
Azimuth Scale	Correction
0	
15	
345	
30	
330	
45	
315	
60	
300	
75	
285	
90	
270	
105	
255	
120	
240	
135	
225	
150	
210	
165	
195	
180	

NOTE: Apply corrections to compensator unit in order given above.

NOTE: Plot BEARING CORRECTIONS against OBSERVED RADIO BEARINGS to obtain COMPENSATOR CORRECTIONS used at 15 degree intervals on compensator azimuth scale. See Figure 50.

FIGURE 48—RADIO COMPASS QUADRANTAL ERROR CALIBRATION DATA, (GROUND REFERENCE-LINE METHOD)

Remarks:

DATA SHEET

Radio Compass
Quadrantal Error Calibration
(Two-Circle Method)

Date:__________
Location:__________
Ship No:__________
Pilot:__________
Recorder:__________

Left Turn			Right Turn			True Radio Bear.	Avg. Obs'vd Radio Bear.	Bearing Correction	Compensator Corrections	
Course No.	Gyro Head	Obs'vd Radio Bear.	Course No.	Gyro Head	Obs'vd Radio Bear.			True Minus Avg. Obs'vd	Azimuth Scale	Correction
Finish			Start							
Check	0		1	0		0			0	
24	15		2	15		345			15	
23	30		3	30		330			345	
22	45		4	45		315			30	
21	60		5	60		300			330	
20	75		6	75		285			45	
19	90		7	90		270			315	
18	105		8	105		255			60	
17	120		9	120		240			300	
16	135		10	135		225			75	
15	150		11	150		210			285	
14	165		12	165		195			90	
13	180		13	180		180			270	
12	195		14	195		165			105	
11	210		15	210		150			255	
10	225		16	225		135			120	
9	240		17	240		120			240	
8	255		18	255		105			135	
7	270		19	270		90			225	
6	285		20	285		75			150	
5	300		21	300		60			210	
4	315		22	315		45			165	
3	330		23	330		30			195	
2	345		24	345		15			180	
1	0		Check	0		0				
Start			Finish							

NOTE: Plot BEARING CORRECTIONS against AVERAGE OBSERVED RADIO BEARINGS to obtain COMPENSATOR CORRECTIONS used at 15-degree intervals on compensator azimuth scale. See Figure 50 (Quadrantal Error Calibration Curve).

NOTE: Apply corrections to compensator unit in order given above.

FIGURE 49—RADIO COMPASS QUADRANTAL ERROR CALIBRATION DATA, (TWO-CIRCLE METHOD)

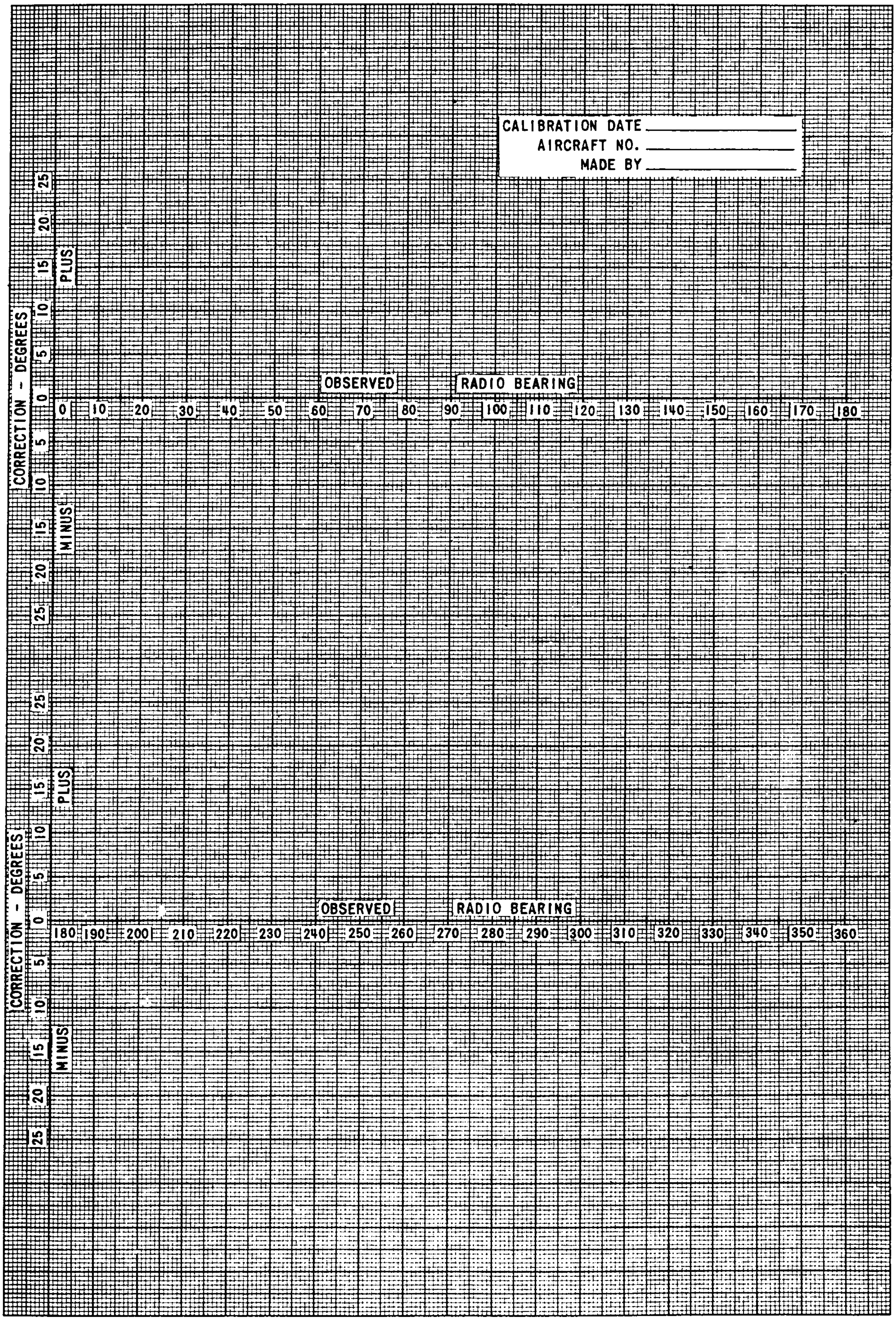


Figure 50—Radio Compass Quadrantal Error Calibration Curve

NUMERICAL EXAMPLE ONLY
DO NOT USE THESE FIGURES

Remarks: Reference line U. S. Highway #00 between X town and Y town. Station XYZ—410 Kc WX clear and smooth.

DATA SHEET

Radio Compass
Quadrantal Error Calibration
(Ground Reference-Line Method)

Date: 8-4-41
Location: See "Remarks"
Ship No: NCXXXX
Pilot: J. Doe
Recorder: G. O. E.

Gyro Head.	True Radio Bear.	Observed Radio Bear.	Bearing Correction
			True Minus Observed
0	0	0	0
15	345	350	−5
345	15	10	+5
30	330	339	−9
330	30	21	+9
180	180	180	0
195	165	170	−5
165	195	190	+5
210	150	159	−9
150	210	201	+9
0	0	0	0
45	315	326	−11
315	45	35	+10
60	300	310	−10
300	60	50	+10
180	180	180	0
225	135	146	−11
135	225	214	+11
240	120	131	−11
120	240	229	+11
0	0	0	0
75	285	291	−6
285	75	69	+6
90	270	270	0
270	90	90	0
180	180	180	0
255	105	112	−7
105	255	248	+7
180	180	180	0

Compensator Corrections	
Azimuth Scale	Correction
0	0.0
15	+7.0
345	−7.5
30	+9.5
330	−10.5
45	+10.0
315	−10.0
60	+7.5
300	−8.0
75	+4.0
285	−4.0
90	0.0
270	+0.5
105	−5.5
255	+5.5
120	−10.0
240	+9.5
135	−11.5
225	+11.5
150	−11.5
210	+11.0
165	−8.0
195	+7.0
180	0.0

NOTE: Apply corrections to compensator unit in order given above.

NOTE: Plot BEARING CORRECTIONS against OBSERVED RADIO BEARINGS to obtain COMPENSATOR CORRECTIONS used at 15 degree intervals on compensator azimuth scale. See Figure 53.

FIGURE 51—RADIO COMPASS QUADRANTAL ERROR CALIBRATION DATA (GROUND REFERENCE-LINE METHOD), NUMERICAL EXAMPLE

NUMERICAL EXAMPLE ONLY
DO NOT USE THESE FIGURES

Remarks: "X" Town approximately 90 miles S.E. Station XYZ—410 Kc. WX clear and smooth.

DATA SHEET

Radio Compass
Quadrantal Error Calibration
(Two-Circle Method)

Date: 8-4-41
Location: Over "X" Town
Ship No: NCXXXX
Pilot: J. Doe
Recorder: G. O. E.

Left Turn			Right Turn			True Radio Bear.	Avg. Obs'vd Radio Bear.	Bearing Correction
Course No.	Gyro Head	Obs'vd Radio Bear.	Course No.	Gyro Head	Obs'vd Radio Bear.			True Minus Avg. Obs'vd
Finish Check	0	0	Start	0	0	0	0.0	0.0
24	15	350	2	15	350	345	350.0	−5.0
23	30	339	3	30	339	330	339.0	-9.0
22	45	326	4	45	325	315	325.5	−10.5
21	60	311	5	60	308	300	309.5	−9.5
20	75	293	6	75	288	285	290-5	−5.5
19	90	274	7	90	265	270	269.5	+0.5
18	105	252	8	105	242	255	247.0	+8.0
17	120	233	9	120	224	240	228.5	+11.5
16	135	218	10	135	210	225	214.0	+11.0
15	150	205	11	150	197	210	201.0	+9.0
14	165	194	12	165	186	195	190.0	+5.0
13	180	183	13	180	177	180	180.0	0.0
12	195	174	14	195	167	165	170.5	−5.5
11	210	163	15	210	156	150	159.5	−9.5
10	225	151	16	225	142	135	146.5	−11.5
9	240	136	17	240	127	120	131.5	−11.5
8	255	118	18	255	108	105	113.0	−8.0
7	270	95	19	270	87	90	91.0	−1.0
6	285	72	20	285	67	75	69.5	+5.5
5	300	52	21	300	49	60	50.5	+9.5
4	315	36	22	315	34	45	35.0	+10.0
3	330	22	23	330	21	30	21.5	+8.5
2	345	10	24	345	10	15	10.0	+5.0
1 Start	0	0	Check Finish	0	0	0	0.0	0.0

Compensator Corrections	
Azimuth Scale	Correction
0	0.0
15	+7.0
345	−7.5
30	+9.5
330	−10.5
45	+10.0
315	−10.0
60	+7.5
300	−8.0
75	+4.0
285	−4.0
90	0.0
270	+0.5
105	−5.5
255	+5.5
120	−10.0
240	+9.5
135	−11.5
225	+11.5
150	−11.5
210	+11.0
165	−8.0
195	+7.0
180	0.0

NOTE: Plot BEARING CORRECTIONS against AVERAGE OBSERVED RADIO BEARINGS to obtain COMPENSATOR CORRECTIONS used at 15-degree intervals on compensator azimuth scale. See Figure 53 (Quadrantal Error Calibration Curve).

NOTE: Apply corrections to compensator unit in order given above.

FIGURE 52—RADIO COMPASS QUADRANTAL ERROR CALIBRATION DATA (TWO-CIRCLE METHOD). NUMERICAL EXAMPLE

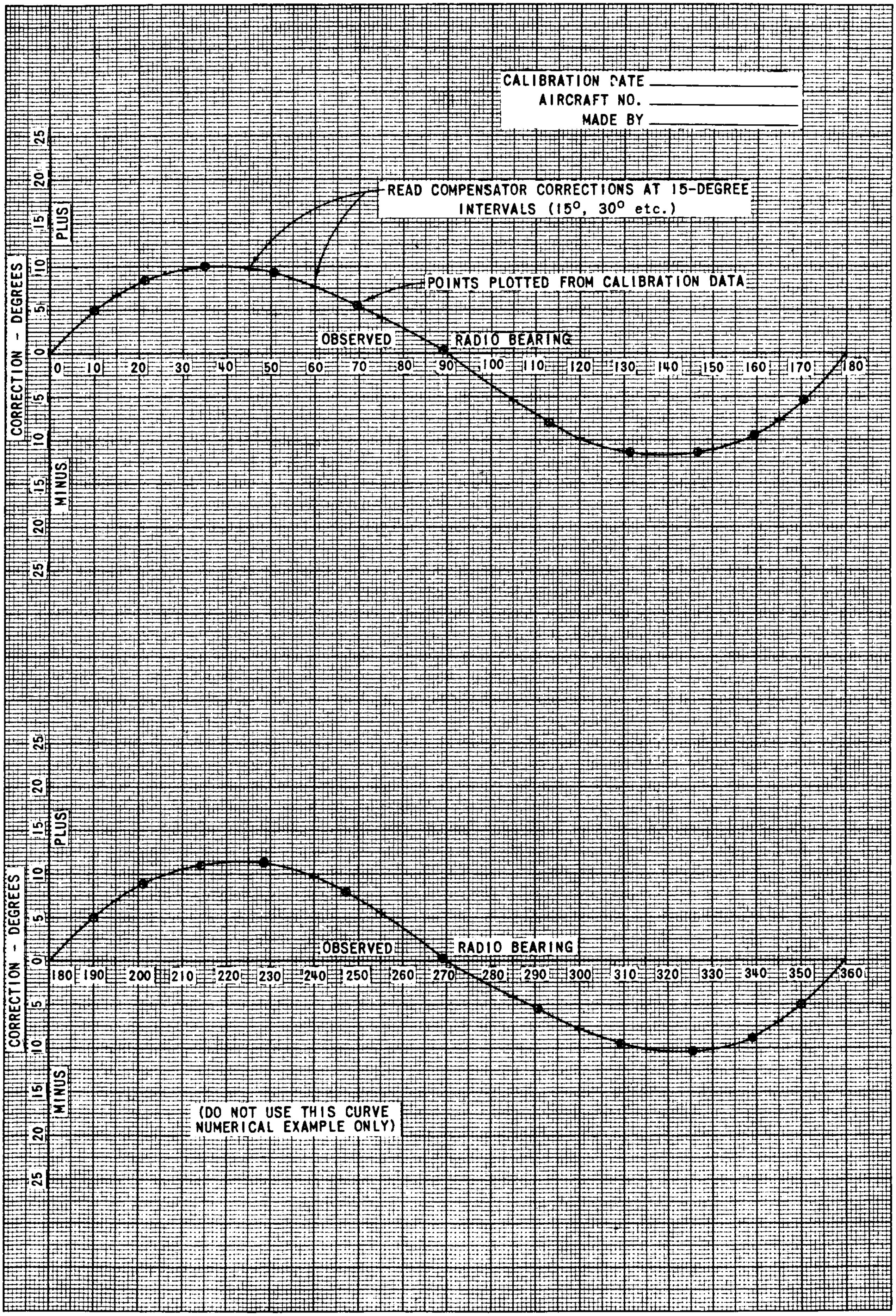


Figure 53—Radio Compass Quadrantal Error Calibration Curve, Numerical Example