RA-10DB RADIO RECEIVER

Northern Electric
COMPANY LIMITED
ELECTRONICS DIVISION

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LIST OF ILLUSTRATIONS

INSTRUCTION BOOK

for

MODELS RA-10CA, RA-10CB, RA-10DA, & RA-10DB
AIRCRAFT RADIO RECEIVING EQUIPMENTS

1. INTRODUCTION

1-1. FUNCTION

The Models RA-10CA, RA-10CB, RA-10DA and RA-10DB Aircraft Receiving Equipments are designed for aircraft and mobile service. These equipments may be employed for the reception of continuous wave, modulated continuous wave, or radio telephone signals in two frequency ranges, from 150 to 1100 kilocycles and from 2000 to 10,000 kilocycles. Two bands are used to give full coverage in each frequency range.

Provision has been made for two lock-in crystal controlled frequencies, one each in Bands 3 and 4. When specified on order, Bands 3 and 4 may be wired so that the crystal controlled fixed frequencies only are available, thereby eliminating the necessity of tuning the RF circuits to the approximate crystal frequency. When the receiver is wired for general coverage of Bands 3 and 4 and the crystal is in use, lock-in occurs over a band-width of at least 50 kilocycles.

Aural-null direction finding and loop reception may be obtained by using this equipment in conjunction with the components listed in Section 1-2-2.

The Models RA-10CA and RA-10CB Equipments are designed for operation from a 14-volt direct current source, while the Models RA-10DA and RA-10DB Equipments are used for operation from a 28-volt direct current power source. The equipments are designed for remote control operation only.

Those sections of the following descriptive matter and instructions applying to the use of the receiving equipment as an aural-null direction finder or anti-rain-static radio receiver apply specifically to the Models RA-10CB and RA-10DB Receiving Equipments. All others apply generally to the Models RA-10CA, RA-10CB, RA-10DA and RA-10DB Receiving Equipments.

1-2. COMPONENT UNITS

1-2-1. Models RA-10CA and RA-10DA Receiving Equipments

Item	*Quantity*	*Description*	*Weight, Lbs.*
A	1	Type RA-10CA or Type RA-10DA Aircraft Receiver, complete with shockproof mounting; one set of tubes (1 each of Types 6C5, 6K6G, 6K8, 6H6, 6R7, and 3 Type 6SK7), and one plug A30601 for Item D.	32.5
B	1	Type MR-9B or Type MR-9C Remote Control Unit, complete with one plug A30090 for Item E. See Section 2-4.	2.25
C	1	*Type MS-14B Junction Box.	2.44
D	1	**Receiver to Junction Box Cable.	
E	1	**Remote Control to Junction Box Cable.	
F	1	**Battery to Junction Box Cable.	
G	1	**Tuning Shaft (flexible).	

NOTES: Type MX-9E Crystal and Holder Assembly is furnished only on special order. The component crystals may be furnished ground to any frequency tuned by the oscillator on Bands 3 and 4: one crystal to be used in each band. See Section 2-1-2-11.

Ref. No. 10X Crystals are not available from Bendix Radio. However, the appropriate Type MR-56A Crystal Socket Adapter for two No. 10X Crystals, per Bendix Dwg. AA28709-1, is furnished on special order.

*Location of cable entering holes to be specified by customer; larger sizes of junction boxes may be obtained when interconnections with other equipments are desired. (See Fig. 13).

**Length to be specified by customer.

1-2-2. Models RA-10CB and RA-10DB Receiving and Direction Finding Equipments

If the radio receiving equipment is to be used for radio reception, aural-null direction finding and anti-rain-static radio reception, the following components will be required in addition to those listed in Section 1-2-1:

Item	*Quantity*	*Description*	*Weight, Lbs.*
H	1	Type MN-20A Rotatable Loop, complete with one AA28932-1 right angle tuning shaft fitting,	4.2
		or	
	1	Type MN-20C Rotatable Loop, complete with one AA28615-1 straight tuning shaft fitting.	4.2
I	1	Type MR-11C or Type MR-11D Loop Relay Unit, complete with mounting hardware.	1.0

Item	*Quantity*	*Description*	*Weight, Lbs.*
J	1	Type MN-52B Azimuth Control, complete with one A30088 straight female 6-contact plug for Item M,	.81
		or	
		†Type MN-22A Azimuth Control, complete with suitable crank drive.	
K	1	††A30065 Loop Off-Zero Warning Lamp Assembly, requires one A13244 12/16V lamp (G.E. T3-¼).	.063
L	1	Loop Transmission Cable Assembly.	
M	1	**Azimuth Control to Junction Box Cable.	
N	1	**Tuning Shaft (flexible).	

†Instructions for the installation and operation of the Type MN-22A Azimuth Control in conjunction with this or other direction finding equipment are contained in a separate instruction pamphlet supplied with that unit. The instructions contained in this book apply to the receiving equipments as used with the Type MN-52B Azimuth Control.

††For use with Type MN-52B Azimuth Control; cannot be used with Type MN-22A Azimuth Control.

**Length to be specified by customer.

1-3. ADDITIONAL EQUIPMENT

1-3-1. Required Equipment

The following additional items must be provided by the customer:

Item	*Quantity*	*Description*
A	1	14-volt direct current power source (For Model RA-10CA or RA-10CB),
		or
		28-volt direct current power source (For Model RA-10DA or RA-10DB).
B	1	Antenna; any standard fixed or trailing wire antenna usually installed on aircraft.
C		One or more pairs of 500-ohm low-impedance headphones, to be used with the Type MR-9B Remote Control Unit.
		or
		One or more pairs of 4000-ohm high impedance headphones, to be used with the Type MR-9C Remote Control Unit.

1-3-2. Optional Equipment

Item	*Quantity*	*Description*
D	1	Type MX-9E Crystal and Holder Assembly with 2 Crystals (available from Bendix Radio),
		or
	2	Reference No. 10X Crystals (not available from Bendix Radio).
E	1	Type MR-56A Crystal Socket Adapter, per Bendix Dwg. AA28709-1, for installations using two Reference No. 10X lock-in crystals.

1-4. PERFORMANCE CHARACTERISTICS

1-4-1. General

The Models RA-10CA, RA-10CB, RA-10DA, and RA-10DB Receiving Equipments are designed for aircraft use under any of the conditions which may occur in the course of normal flight operations.

The receiver is designed only for remote control, using the Type MR-9B or MR-9C Remote Control Unit. This remote control may be installed at any convenient point within the airplane.

Plate voltage for the receiver is obtained from the dynamotor D1, designed to operate from the airplane's storage battery. The filament voltage is supplied directly from the same battery.

1-4-2. Sensitivity

The modulated continuous wave (MCW) sensitivity, when measured at a signal-to-noise power ratio of 4:1, is better than 6.5 microvolts input for 50 milliwatts output with the proper load. If the signal-to-noise ratio is greater than 4:1, the sensitivity is measured with the receiver set for maximum gain.

The continuous wave (CW) sensitivity, when measured at a signal-to-noise power ratio of 10:1, is better than 3.5 microvolts input for 50 milliwatts output with the proper load.

1-4-3. Power Output

The Types RA-10CA, RA-10CB, RA-10DA, and RA-10DB Aircraft Receivers are designed for either a 500- or 4000-ohm load, as specified by customer, and will deliver over 500 milliwatts output at not over 15-percent distortion when properly loaded. The maximum output is approximately 1 watt.

1-4-4. Selectivity

Selectivity of the receiver is the measure of its ability to discriminate against undesired signals differing slightly in frequency from the desired signal. This is indicated by the range of frequencies over which a given signal input will result in audio output equal in power or greater than standard (50MW). This range of frequencies, called the band width, is measured in the following way. With the receiver and signal generator tuned to resonance, measure the M.C.W. sensitivity of the receiver as in Section 1-4-2. Detune the signal generator and increase the signal input 10 times. Retune the signal generator toward the original resonance point, noting the frequency at which the receiver output again reaches 50 milliwatts. Repeat this procedure, tuning from the other side of resonance. The difference between these two frequencies is the selectivity of band width.

Typical selectivity figures for the receiver at representative frequencies are tabulated below. (Input at resonance = 1).

Resonant Input Multiplied:	*Total Band Width for Reference Frequencies*					
	150 Kcs	*400 Kcs*	*1100 Kcs*	*2000 Kcs*	*5000 Kcs*	*10,000 Kcs*
X10	5.5 Kcs	10 Kcs	13 Kcs	15 Kcs	15 Kcs	15 Kcs
X100	11 Kcs	18 Kcs	22 Kcs	22 Kcs	25 Kcs	26 Kcs
X1000	18 Kcs	26 Kcs	33 Kcs	31 Kcs	39 Kcs	41 Kcs

1-4-5. IMAGE REJECTION

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

Band	*Frequency*	*Minimum Ratio*
1	400 Kcs	10,000:1
2	1100 Kcs	5,000:1
3	5000 Kcs	1400:1
4	10,000 Kcs	1000:1

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

1-4-6. AUTOMATIC VOLUME CONTROL ACTION

The automatic volume control (AVC) action will hold the output power constant within eight decibels for a 10,000 to 1 change of input signal voltage.

1-4-7. AUTOMATIC SIGNAL LIMITER ACTION

The automatic signal limiter action starts when a signal of approximately ¼ volt is applied to the antenna. It will allow AVC operation with signal inputs to 2.5 volts without blocking out.

1-4-8. CALIBRATION

The tuning dial of the Type MR-9B or Type MR-9C Remote Control Unit is directly calibrated in kilocycles on the two low frequency bands and in megacycles on the two high frequency bands. The calibration accuracy of this dial is better than 1%.

The calibrated end limits of each band are as follows:

Band 1	150.0– 400.0 Kcs
Band 2	400.0–1100.0 Kcs
Band 3	2.0– 5.0 Mcs
Band 4	5.0– 10.0 Mcs

1-4-9. POWER CONSUMPTION

The total current drain of the receiver, exclusive of relay current, will not exceed 3.0 amperes at 28 volts direct current, or 6.0 amperes at 14.0 volts.

2. DETAILED DESCRIPTION

2-1. TYPE RA-10CA OR TYPE RA-10DA RECEIVER

2-1-1. MECHANICAL

All major components of the receiver are mounted on an aluminum alloy chassis which is welded to the receiver case, thus producing a rigid unit. The receiver case assembly is provided with removable top and bottom covers made of heavy gauge aluminum alloy. The bottom cover is permanently attached to the upper mounting base, by means of four Lord shockmounts. The upper mounting base is held securely into a recessed lower mounting base by two thumb operated Dzus fasteners. The lower mounting base should be permanently attached to the airplane. The outer surfaces of the receiver are covered with grey-wrinkle enamel.

The variable capacitor is driven by a flexible shaft from the Type MR-9B or MR-9C Remote Control Unit, through a worm and spur gear assembly which is mounted to the front of the receiver in such a manner that it may be rotated in steps of 30°, thereby permitting the tuning shaft to leave the receiver at the most desirable angle for the particular installation. The spur gear is spring loaded to reduce back-lash to a minimum.

With the top and bottom removed, the receiver may be rested on any of five sides without possible injury to any of the component parts.

The receiver is so designed that the Type MR-11C or Type MR-11D Loop Relay Unit may be mounted on the front of the receiver should it later become desirable to operate the receiver as a Type RA-10CB or RA-10DB, respectively, in conjunction with a loop. See Section 3-3-6 for details concerning the mounting of this unit.

2-1-2. ELECTRICAL CIRCUITS (See Figure 14).

2-1-2-1. Voltage Supply Circuits

A. Input to the Power On-Off Control.
Connection is made from the positive terminal of the aircraft storage battery and charging system, through the battery cable to the junction box; thence through the remote control-junction box cable and protective fuse F101 to the power on-off switch S104. This switch is mounted integrally with the dual volume control R101A–R101B located in the remote control unit. Negative return circuits are made through the common ground leads between the equipments and the negative battery cable terminal 19 of the junction box. The two leads from sidetone relay K2 connect directly through the jumper across resistor R32 and the receiver-junction box cable to the positive battery terminal and to the external switch terminal 14 of the junction box. Relay K2 operates independently of the power on-off switch S102. In the Types RA-10DA and RA-10DB Receivers, dropping resistor R32 is inserted into the positive energizing lead of the relay.

B. Low Voltage Circuits.

When the power on-off switch S104 is turned on, voltage is applied through voltage dropping resistor R103 to the instrument lamp I101, and through the interconnecting cables and junction box to contact 22 of the receiver cable receptacle J1. This low voltage is then distributed to the band switch motor circuit, the filament circuit, the crystal on-off relay K1, the dynamotor-filter circuit, and, when direction finding equipment is used, through voltage dropping resistors R35, R36 and R37, the receiver-junction box cable and the azimuth control-junction box cable to the azimuth control instrument lamp and off-zero warning lamp switches. Proper vacuum tube heater voltage (6.3 volts) is obtained by wiring the heaters in a series-parallel arrangement. The unoperated, or normal, position of the sidetone relay K2 provides continuity of the receiver audio circuits. The unoperated, or normal, position of the crystal on-off relay K1 grounds the grid side of the crystals thereby allowing the heterodyne oscillator to function in the normal manner. When the crystal on-off switch S103 is turned on, the contacts of relay K1 move to the open position (crystal lock-in). With the relay in the energized position, a holding coil is inserted in series with the initial starting relay coil. The purpose of this holding coil is to reduce the amount of current required to hold the relay in the energized position to a minimum.

C. High Voltage Circuits.

When the power switch S104 is turned on, power is supplied through the line filter comprised of capacitor C79A, inductor L7, capacitor C79B, inductor L6, and capacitor C78A, to the low voltage side of the dynamotor D1. The secondary of the dynamotor feeds high voltage through a filter comprised of capacitor C78B, inductor L5, capacitors C78C, C77A, C77B, inductor L4 located in transformer assembly T16, and capacitor C77C to the cathode bias bleeder, and the vacuum tube plates and screens. When manual volume control (MVC) is used, the cathode bias is obtained from the voltage drop across the volume control R101B, which is variable to allow change of the receiver sensitivity. This volume control is connected in series with bleeder resistors R33 and R34 to the high voltage circuit. When automatic volume control (AVC) is used on Bands 2, 3, & 4, the switch S102 shunts the resistor R101B to the ground. Decoupling, RF filter, or dropping resistors are used in each of the high voltage leads to the tubes.

2-1-2-2. Antenna Connections

The ganged band selector switch S1 selects the proper primary coil to be used on each band.

When using the conventional straight wire antenna on Band 1, the loop primary coil of transformer T1 is provided with an artificial load (L1 and C1) representing the normal inductance and capacitance of the rotatable loop. This compensation is necessary to insure that the tracking curve remains normal.

2-1-2-3. RF Circuits

The proper secondary coil of antenna transformers T1 to T4 is selected by the band selector switch S2, and tuned by the ganged capacitor C12A. The signal is fed to the grid of the RF amplifier tube V1 where it is amplified. Switches S3 and S4 connect the corresponding coils of RF transformers T5 to T8 to the ganged tuning capacitor C12B, thus coupling the tuned and amplified signal to the control grid of the mixer-heterodyne oscillator tube V2. The heterodyne oscillator circuit is comprised of the triode section of tube V2, ganged tuning capacitor C12C and the oscillator can assembly. When the lock-in control is operated, the associated crystal is also placed into the circuit. The oscillator can assembly houses the oscillator coils, their trimmer and padder capacitors, the band selector switches S5 and S6, RF filter elements C43, C44 and R16, and grid condenser C25. See Section 2-1-2-11 for operation of the crystal controlled oscillator. The ganged tuning capacitor C12C tunes the oscillator circuit to a frequency 1630 Kcs above the frequency of the incoming signal, the output of the triode oscillator section being mixed with the incoming signal in the converter section of tube V2. The voltages resulting from the combined signals are fed to the intermediate frequency transformer T13, which attenuates all but the desired beat, or 1630-Kcs difference frequency.

2-1-2-4. Intermediate Frequency and Second-Detector Circuits

The voltage obtained from the IF transformer T13 is tuned and amplified by the 1st and 2nd IF stages comprised of tubes V3 and V4, and transformers T14 and T15, respectively. The output of the transformer T15 is rectified in one diode section of the tube V5 (socket terminal 5).

A portion of the audio frequency voltage developed across the series-connected diode resistors R20 and R22 is fed from their junction, through condenser C62 to the control grid of the triode section (1st audio amplifier) of V5.

2-1-2-5. CW Oscillator Circuit

Output from the continuous wave (CW) beat frequency oscillator tube V6 is coupled to the grid of 2nd IF amplifier tube V4 through capacitors C49 and C90. Operation of tube V6 is controlled by S102, the C.W.-M.V.C.-A.V.C. switch, located on the remote control unit.

2-1-2-6. Automatic Volume Control Circuits

The DC component of the rectified signal voltage appearing across the diode load resistor R24, is supplied through RF filter resistor R25 to the AVC buss, thence influencing the grid bias of the tubes V1, V2, and V3. Interaction between tubes is eliminated by using a filter in each grid return load. When the control switch S102, designated C.W.-M.V.C.-A.V.C., is in the AVC position, the AVC voltage is applied to the grids of the tubes V1, V2 and V3; the sensitivity control R101B and the cathode bias buss is shunted to ground, thereby providing fixed cathode bias and predetermined maximum sensitivity; and the headphone jacks J101 and J102 are shunted across the variable portion of the audio volume control R101A, permitting variable limitation of the audio signal. Since AVC is undesirable for aural-null direction finding or radio range operation, the above connections are not made on Band 1. When in the M.V.C. or C.W. positions, the switch S102 performs the following functions: the AVC buss is grounded through the 200,000-ohm resistor R41;

the variable resistor R101B controls the receiver sensitivity; and the phone jacks J101 and J102 are shunted across the resistor R101A, which has its variable arm disconnected. One contact of the band selector switch S101A automatically grounds the AVC buss through resistor R41 whenever Band 1 is used, thus preventing any possibility of having full or unlimited AVC action on the band used for radio range homing.

2-1-2-7. Automatic Signal Limiter Circuit

When a receiver is functioning with automatic volume control, very high signal input voltages to the antenna will cause overloading or blocking of the grid of the first RF tube. In the Types RA-10CA, RA-10CB, RA-10DA and RA-10DB receivers, a diode rectifier tube V9 (6H6) has been added in order to load the first RF tuned circuits, under conditions of high signal input, and retard blocking. The diode is so biased that it does not start to load the circuit until a signal of approximately ¼V is impressed at the antenna binding post. This loading in no way decreases the sensitivity of the receiver for signals below ¼V inputs. Because of the low impedance of the diode rectifier to the high impedance tuned circuit, especially at the lower frequencies, the rectifier tends to compress the modulation peaks on radio telephone signals. In effect, this condition reduces the percentage of modulation. However, this effect is noticeable only at the lower frequencies (below 2000 Kcs), and then only with signal input voltages between one-quarter and one volt. At such high signal input voltages, the signal-to-noise ratio is very great, and, in practice, the decrease in modulation is not objectionable. Such sacrifice in modulation capability is more than offset by the advantage gained in the ability of the receiver to handle signal input voltages to 2.5 volts with automatic volume control without overloading.

However for beacon reception on the beacon band (Band 1), it will be found undesirable to use the signal limiter due to the non-linearity between input and output at signal inputs above ¼V on the antenna, caused by the demodulating effect of the diode rectifier. If this high signal input is likely to be frequently encountered by the user, it is recommended that the diode tube V9 be removed from its socket. This may be done without disturbing any other part of the circuit although it will be necessary to retrim the high end of each band by adjusting trimmers C6, C7, C8 and C9, (Bands 1, 2, 3, and 4, respectively) in the antenna stage only. It will be unnecessary to change the inductance adjustments on the coils since the distributed circuit capacitance only has been changed by removing V9. Without the signal limiter, signal voltages to ¾V may be applied to the antenna without serious overloading when functioning on AVC. When the receiver is functioning on MVC higher signal inputs can be controlled by adjustment of the sensitivity control.

2-1-2-8. Audio Circuits

As previously stated, intermediate frequency voltage is detected in one diode section of the tube V5, and the audio component of the signal appears across the series-connected diode resistors R20 and R22. The audio voltage obtained at their junction is amplified by the triode (1st audio amplifier) section of V5, and fed through coupling capacitor C72 and the contacts of sidetone circuit relay K2 to the grid of the 2nd audio tube V7. The audio signal is amplified by this tube. The plate circuit of V7 connects to the primary winding of audio output transformer T16. The secondary winding is tapped at 500 ohms and 4,000 ohms for use with Types MR-9B or MR-9C Remote Control Units, respectively. The proper tap (on the ungrounded end of the secondary winding) connects through the receiver-junction box cable, the junction box-remote control cable and the connecting wires, across audio volume control R101A. The variable arm of R101A connects through switches S102 and S101A to the parallel phone jacks J101 and J102. This potentiometer R101A, however, is thus operative only when the circuits are selected by switch S102 for AVC operation.

When MVC or CW operation is selected, the full audio voltage available at the ungrounded terminal of R101A is connected through switches S102 and S101A to phone jacks J101 and J102. When Band 1 is used, the above circuit is effected directly through switch S101A, regardless of the setting of the AVC-MVC-CW switch S102. At the same time, as explained in Section 2-1-2-6, sensitivity control R101B is used to control signal gain manually. However, in order to isolate the output circuit from audio volume control R101A, limiting resistor R102 is automatically inserted in series with it.

In the commercial Type RA-10 Series Receivers, a dual audio-output channel is used. This second audio-output circuit may thus be wired to any remote point in the plane. In the Types RA-10CA, RA-10CB, RA-10DA and RA-10DB Receivers, the tube V8 and the output transformer T17, as shown dotted on schematic diagram Figure 14, have been eliminated. However, provision has been made for the addition of this audio channel by including the remainder of the necessary components required for such an addition; i.e., the tube socket (with a shunt resistor R42 across the socket to take the place of the tube filament), the hole in the chassis for mounting of the output transformer, plate filter capacitor C75 and the necessary additional wiring facilities (provided in the cable harness).

2-1-2-9. Sidetone Circuit

A portion of the audio voltage from a transmitter may be fed to the audio input circuit of the receiver for purposes of monitoring transmissions. Relay K2 is connected into the grid circuit of the 2nd audio amplifier tube V7 to allow input from either the receiver circuits or the transmitter sidetone circuits. The unoperated, or normal, position of the relay K2 provides continuity of the receiver audio circuits. The energized position of relay K2 connects the voltage applied from the external source (approximately 1 to 5 volts) to the amplifier tube V7. Voltage from the primary source for operation of the relay is obtained by connecting the transmitter push-to-talk switch to the sidetone relay leads 19 and 14 at the junction box. All connections to the sidetone relay circuits are to be made in the junction box as shown on Figure 14.

2-1-2-10. Band Change Circuit

Band changing is effected by switching the tuned circuits in the RF, mixer and heterodyne oscillator stages by means of motor-driven switches. The motor armature shaft terminates with a worm drive, and the worm gear which it turns is ganged on a common shaft with a crank arm and locking cam and a control cam. Motor control switch S8 rides on the control cam, while the crank arm and locking cam operate a Geneva disc. The hollow shaft of this

Geneva disc is slotted at one end, to engage the locking pin of a long drive shaft. This latter shaft passes through the Geneva disc shaft, drives the motor positioning switch S7 and runs through the RF coil and can assemblies. The band change switches S1 - S6 are operated simultaneously by this shaft, which is easily removable for replacement of any RF can. (See Note to Section 6-4-1-2). When the remote control unit band selector switch S101B is operated to select a different band, the band switch motor B1 is energized by completion of its return circuit to ground through the contacts of switch S101B and the shorting contact of switch S7. Motor B1 drives the crank arm through one or more complete revolutions depending upon the band selected, thus stepping the Geneva disc to the desired position. At this point the motor is automatically de-energized by an open slot in the shorting contact of switch S7. Exact control of the positioning is obtained by the cam-operated motor control switch S8. When the motor B1 is at rest, the arm of switch S8 is on step 2 of the control cam, and all contacts are open. When the motor B1 starts, the arm is first raised by step 3 of the cam, closing the upper contacts. These contacts connect from the reversing field of motor B1 to a selecting rotor on the positioning switch S7. At this time, however, the selected contact connects to a non-grounded position of the remote control switch S101B; thus the motor is allowed to continue operating. When the arm of switch S8 drops to step 1 of the control cam, the upper contacts are opened and the lower ones are closed. The closing of the lower contacts provides an additional path directly to ground to keep the motor B1 energized after the opening of the selector switch S7 by the movement of the Geneva disc. 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 motor control switch S8 to step 2, opening all contacts, and the motor coasts to a stop. If it should coast past step 2, the upper contacts of S8 will be closed, effecting a return to ground for the motor reversing field, through the contacts of switches S7 and S101B. The motor will therefore reverse, driving the cam back to the proper position, where all contacts of switch S8 remain open and the motor is at rest.

2-1-2-11. Crystal Oscillator Circuits

A. Lock-In Crystal-Controlled Circuits.
Provision is made for the addition of one lock-in crystal-controlled frequency in each of the two high frequency bands. The Types RA-10CA, RA-10CB, RA-10DA and RA-10DB Receivers are provided with a built-in crystal socket and the necessary wiring. A crystal socket adapter (Type MR-56A) is available on special order for using two Reference No. 10X Crystal and Holder Assemblies in the standard crystal socket. To use the crystal lock-in feature, it is necessary to obtain a crystal 1630 Kcs higher in frequency than the frequency of the desired signal (Type MX-9E Crystal and Holder Assembly if standard socket is used). With the switch S103 turned to XTAL ON, lock-in occurs over a band width of at least 40 Kcs. This lock-in is unsymmetrical; that is, when approaching the crystal controlled frequency from a lower frequency, lock-in occurs at a point 10 to 15 Kcs below the crystal-controlled frequency. When approaching from a higher frequency, lock-in occurs at a point 25 to 30 Kcs above the crystal-controlled frequency. With the switch S103 turned to XTAL OFF, normal reception (general coverage) is obtained.

B. Fixed-Frequency Crystal-Controlled Circuits.
When fixed-frequency operation is desired in Bands 3 and 4, the circuits must be altered. Briefly, the changes consist of substituting fixed tuning capacitors in all tuned RF circuits in place of the variable gang capacitors on Bands 3 and 4 and shunting XTAL ON-XTAL OFF Switch S103 with switch S101 in those bands. These capacitors must be selected to tune the coils to the frequency specified. This fact, and the fact that considerable wiring changes are necessary, make this conversion definitely a factory operation. The necessary changes for fixed frequency operation are indicated by dotted lines on Figure 14.

2-2. TYPE RA-10CB OR TYPE RA-10DB RECEIVER

As explained in Section 2-1-1, the Types RA-10CB and RA-10DB Receivers are identical with the Types RA-10CA and RA-10DA Receivers, except for the additions to the former of the Types MR-11C and MR-11D Loop Relay Units, respectively.

2-3. TYPE MR-9B REMOTE CONTROL UNIT

All normal tuning and operating adjustments are made from the remote control unit, no provision being made for local operation at the receiver. The base is designed to be fastened securely to the airplane at any location which is accessible to the operator. The case of the remote control unit is made of aluminum, and its exterior surfaces are finished with grey-wrinkle enamel. The case, which carries all parts, may be removed from the base by unfastening the 3 holding screws (see Figure 5).

The TUNING control, located to the operator's left in the lower portion of the unit, provides for the selection of the desired frequency on any of the four bands. This control is connected to the receiver variable capacitor by means of a flexible tuning shaft. A dial on this control is directly calibrated in kilocycles on the two low-frequency bands and in megacycles on the two high-frequency bands. The dial is illuminated by means of an aircraft instrument lamp I101 which is readily replaceable when in flight. A SPARE LAMP is mounted on the remote control unit.

The BAND SELECTOR switch S101, located below the tuning dial port, energizes the band selector motor, thus selecting any one of the four bands (see Section 2-1-2-10). A mask, attached to the switch shaft, permits viewing only that part of the tuning dial associated with the selected band. The frequency limits of each band are etched on the panel adjacent to the index marks.

The A.V.C.-M.V.C.-C.W. switch S102 selects the following functions: A.V.C. (automatic volume control action) M.V.C. (manual volume control) C.W. (for reception of continuous wave signals). A.V.C. action is available on all bands except Band 1. Since A.V.C. is not desirable when using the C.W. oscillator, the circuits are wired so as to remove AVC action when the switch is turned to C.W.

The OFF-VOLUME control, comprised of switch S104 and variable resistors R101A and R101B, adjusts the signal output or receiver sensitivity as determined by the setting of switch S102. Switch S104 connects the power input to the receiver low-voltage circuits at all settings of this control except OFF. With the switch S102 in the A.V.C. position, potentiometer R101A in the headphone circuit varies the audio signal output. With the switch S102 in the M.V.C. or C.W. positions, the signal output is determined indirectly by potentiometer R101B, which varies the receiver sensitivity. A 500-ohm output is provided.

The XTAL ON-XTAL OFF switch S103 connects the crystals into the receiver heterodyne oscillator circuit (see Section 2-1-2-11).

The protective FUSE is mounted on the remote control panel and is readily accessible for replacement. This fuse is connected in the positive primary power supply lead.

All external connections to the remote control unit are made to jacks or receptacles located on the lower surface of the control box. These connections, viewed from the operator's left to right, as in Fig. 5, are: coupling for the flexible shaft that controls receiver tuning; plug receptable J2 for connection of the electrical cable that joins the remote control to the junction box; and phone jacks J101 and J102 for connection of the headsets.

2-4. TYPE MR-9C REMOTE CONTROL UNIT

The Type MR-9C Remote Control Unit is similar to the Type MR-9B, except for the fact that the Type MR-9B provides a 500-ohm output circuit, while the Type MR-9C provides a 4000-ohm output circuit.

In the latter case the 4000-ohm tap of the audio output transformer T16 is used.

2-5. TYPE MS-14B JUNCTION BOX

All interconnections between the various units are made in the junction box. This box is supplied with 8-32 screw-type terminals. As the location and size of cable entering holes will be dictated by the requirements of the particular installation, these junction boxes are furnished undrilled except when the required information is specified. The schematic diagram, Figure 14 shows interconnections between the various units.

2-6. TYPE MN-20A OR MN-20C ROTATABLE LOOP

A rotatable loop is used when the components listed in Section 1-2-2 are operated as an aural-null direction finding or anti-rain-static radio receiving equipment.

The loop consists of a low-impedance coil enclosed in an electrostatic shield. At the top of the shield is a gap which is insulated and waterproofed. The loop is permanently fastened into its mounting base in which are located the necessary gears for turning the loop to any desired position. Rotation of the loop is accomplished by means of a tuning crank on the azimuth control which is coupled to the loop through a standard flexible tuning shaft. The loop may be supplied with either a right angle tuning shaft fitting in the case of the Type MN-20A, or a straight fitting as in the Type MN-20C. In the former case, the tuning shaft may leave the loop at various angles. See Figure 8 for details.

2-7. TYPE MN-52B AZIMUTH CONTROL

The azimuth control may be mounted in any convenient position near the pilot or radio operator. It is provided with an azimuth scale and pointer for the purpose of indicating the setting of the loop with regard to the heading of the aircraft. An instrument lamp I301 is provided for the purpose of illuminating the scale; switch S303 provides on-off control of this lamp. A switch S301 is provided for the purpose of selecting receiver input from either the antenna or from the rotatable loop. In order to perform these functions, this switch S301, in series with a section of band change motor switch S7, operates the loop selector relay K201 in the Types MR-11C and MR-11D Loop Relay Units. This section of switch S7 maintains the relay energizing circuit only so long as the receiver is set for Band 1 or Band 2 operation.

A cam on the dial pointer shaft closes the contacts of switch S302 at all positions of the dial pointer except zero. This switch, when connected to an appropriate warning lamp, indicates off-zero loop azimuth settings.

2-8. TYPE MR-11C OR MR-11D LOOP RELAY UNITS

The Types MR-11C and MR-11D Loop Relay Units are supplied with the Types RA-10CB and RA-10DB Receivers, respectively. This unit is mounted on the front of the receiver by means of three captive mounting studs. Its outer surfaces are covered with grey-wrinkle enamel. The loop relay unit contains a receptacle J3 for connecting the loop transmission cable into the unit, an antenna binding post for connecting the antenna, and a switch and relay assembly comprised of switch S201 and relay K201, for the purpose of selecting input from either the loop or the antenna. The relay K201 is controlled by switches S301 on the Type MN-52B Azimuth Control, and S7 in the receiver. The Types MR-11C and MR-11D Loop Relay Units differ only in operating voltage requirements; the former requires 12/14V, the latter 24/28V

See Section 3-3-6 for details of mounting and interconnection.

2-9. OFF-ZERO WARNING LAMP

The off-zero warning lamp operates in conjunction with the cam operated switch S302 mentioned in Section 2-7, and serves to indicate when the loop is set to any position except zero heading.

Do not operate the equipment as an aural-null homing device when the warning lamp is illuminated, as this indicates that the loop is not set to the zero position.

3. INSTALLATION

3-1. PRELIMINARY INSPECTION

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

3-2. BONDING AND SHIELDING

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

3-3. LOCATION AND MOUNTING OF RADIO RECEIVING AND DIRECTION FINDING EQUIPMENT

See Figures 7, 8, 9, 10, 12, and 13 for mounting dimensions.

3-3-1. TYPES RA-10CA, RA-10CB, RA-10DA, AND RA-10DB RECEIVERS

The mounting base that supports the radio receiver should be firmly attached to a plane surface at a point within the shortest practicable distance from the vertical antenna lead-in and in close proximity to the associated equipment. When determining this location, care must be taken to choose one that will permit the radio receiver to vibrate freely in all directions without striking any other equipment or portions of the airplane. After these requirements have been met and the lower mounting base has been permanently secured, the upper mounting base, which is permanently fastened to the bottom section of the receiver case, should be attached to it by means of the Dzus fasteners. (See Figure 7.)

3-3-2. TYPE MR-9B AND TYPE MR-9C REMOTE CONTROL UNITS

The Type MR-9B or MR-9C 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 mechanical tuning shaft and the electrical cables. (See Figure 10.)

3-3-3. TYPE MS-14B JUNCTION BOX

The junction box should be mounted in an accessible location. In the interest of weight reduction of interconnecting cabling, it is well to locate this box as near as possible to the component units. The junction box will require mounting and cable fitting holes suitable to the individual installation. (See Figure 13.)

3-3-4. TYPE MN-20A OR MN-20C ROTATABLE LOOP

The rotatable loop must be mounted within a 6- or 12-foot cable run of the receiver and should be as far removed as possible from antennas and interfering metal structures. The preferred locations are on the fore-and-aft center line of the ship, either above or below the fuselage, about where the wings are attached. The skin of the aircraft should be drilled as shown in Figure 9, and the rotatable loop secured to the aircraft structure in such a manner that the loop base will be level during normal flight. Sufficient clearance should be available inside the fuselage for the attachment and removal of the loop cable and tuning shaft. A velutex or similar gasket should be used between the loop mounting base and the skin of the aircraft to make a water-tight seal. Figure 11 shows the proper tach shaft connections for the various possible combinations of azimuth controls and loop mounting positions.

3-3-5. TYPE MN-52B AZIMUTH CONTROL

The Type MN-52B Azimuth Control is arranged for mounting on a flat horizontal or vertical surface in front of, or beside the pilot. (See Figure 12.)

3-3-6. TYPES MR-11C AND MR-11D LOOP RELAY UNITS

Types MR-11C and MR-11D Loop Relay Units are supplied as integral parts of the Types RA-10CB and RA-10DB Receivers, respectively. However, provision has been made for converting a Type RA-10CA Receiver to a Type RA-10CB Receiver by the addition of a Type MR-11C Loop Relay Unit. Similarly, the addition of a Type MR-11D Loop Relay Unit will convert a Type RA-10DA Receiver to a Type RA-10DB Receiver. Captive mounting nuts are included in the panel assembly of the receiver to accept the three mounting screws necessary to secure the loop relay unit to the receiver.

The procedure for mounting and wiring the loop relay unit is as follows:

A. Remove receiver antenna binding post.
B. Pull the seven leads from loop relay unit through hole formerly occupied by antenna binding post.
C. Fasten loop relay unit to receiver with the three mounting screws supplied with relay unit.
D. Remove the connection between dummy loop coil L1 and LOOP terminal on antenna can assembly.
E. Connect White-Blue-Black (RF-insulated) wire to LOOP terminal on antenna can assembly.
F. Connect White-Blue (RF-insulated) wire to ungrounded side of dummy loop coil L1.
G. Connect the Black and the White-Yellow (RF-insulated) wire to ground.
H. Connect White-Red-Green (RF-insulated) wire to ANTenna terminal on antenna can assembly.
I. Connect White-Blue (Glass-insulated) wire to +A end of resistor R39.
J. Connect Brown-Yellow wire to contact 3 of cable receptacle J1.

3-3-7. OFF-ZERO WARNING LAMP

The off-zero warning lamp may be mounted in any location that is constantly in the pilot's view. The lamp holder requires an 11/16-inch diameter mounting hole; and a 2-inch diameter, 1¾-inch depth behind the panel.

3-4. CABLE CONNECTIONS

The equipment and cables must not interfere with the airplane controls nor with other instruments or equipment.

The cable conduit and flexible tuning shaft should be securely fastened in place wherever necessary to prevent abrasion or vibration. Cables connecting to the receiver should be unsupported for a distance of two feet from the unit, and should have enough slack left so that they will not interfere with the action of the shock-mounting. The loop cable should be insulated with friction tape wherever it touches another metallic surface. Cables which are furnished without plugs should be cut to the desired length by the customer. All connections are to be made as shown on Figures 14 and 15. The loop transmission cable should not be cut; any excess length may be coiled wherever convenient.

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

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

The gear box assembly is designed for mounting in any one of 12 positions on the front panel, in order to permit the flexible tuning shaft to be run to the unit in the most desirable direction and in such a way that any sharp bends may be eliminated. If it should be desirable to change this gear box position, the following instructions should be followed:

A. Connect tuning shaft from remote control unit to gear box and rotate tuning crank in a counterclockwise direction until the gear box stops prevent further rotation. *Be sure that capacitor is not forced against its stops.*
B. Disconnect tuning shaft from gear box, remove the three screws holding gear box to receiver, and remove gear box cover.
C. Loosen knurled nut in gear box.
D. Be sure that capacitor is set at maximum capacitance.
E. Rotate gear box to desired position and fasten it in place on receiver.
F. Make certain that capacitor is turned to maximum setting, then tighten knurled nut, and replace cover plate.
G. Turn remote tuning crank until finish line at low-frequency end of any band on dial scale is centered under window index line.
H. Reconnect flexible tuning shaft and check adjustments by rotating tuning crank throughout its range, to determine that minimum and maximum capacitance is obtained at end points of the dial scale. When capacitor drive strikes the stops in the counterclockwise direction, capacitor should be fully meshed, and low frequency end marks should be under window index. However, in clockwise direction the stop may come slightly beyond end marks due to variations in stops.

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

3-5. ANTENNA TYPES AND CONNECTIONS

The Types RA-10CA, RA-10CB, RA-10DA and RA-10DB Receivers are designed and adjusted to operate in conjunction with a vertical antenna having an effective height of 0.1 to 0.6 meters, a capacitance of 50 to 150 Mmf, and a resistance of 1 to 10 ohms. While it is desirable to use an antenna whose characteristics fall within the above limits, satisfactory operation may be obtained with other antennas.

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

The portion of the lead-in inside the fuselage should be flexible insulated wire. A suitable amount of slack must be allowed at the receiver to permit free action of the shockmounting.

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4. PREPARATION FOR USE

4-1. TEST BEFORE INSTALLATION IN AIRCRAFT

Considerable time and trouble will be saved if the components of the radio receiving or direction finding equipment to be installed in an airplane are interconnected as shown in Figures 14 and 15, and tested before installation. The components should be properly interconnected and tested as follows: tune in several radio stations in each band; on each station in Bands 1 and 2 operate the equipment both as a receiver and as a direction finder; check operation of AVC, MVC, and CW; check operation of crystal lock-in oscillator. From a knowledge of the distance, power and direction of the station, a rough check may be obtained of the performance of the equipment.

These tests should be made in a frame test shack in an isolated spot free from electrical interference and at least 200 feet from large electrically conductive objects such as buildings, hills, power lines, railroads, etc. *Bearing accuracy checks cannot be relied upon if made inside or close to buildings with metal structures or large electrically conductive objects.*

The following inspection should be made prior to installation:

A. Check list of parts and see that all parts are in good condition.
B. Insert all tubes in radio receiver, determine that each tube is firmly seated in its socket and that all grid clips are pushed down tightly.
C. Check safety wiring of dynamotor.
D. Check all lamps and fuses.
E. Check operation of tuning drives and all controls for freedom of operation.
F. Allow equipment to operate for at least one-half hour. Check operation of headset. Vibrate or jar equipment. Any clicks or increase in noise will require a thorough investigation to ascertain the cause. Improper soldering of wires to plugs and noisy vacuum tubes are possible sources of trouble.
G. If equipment does not seem to be operating satisfactorily, interconnecting leads and vacuum tubes should be rechecked and equipment known to be operating satisfactorily substituted for faulty components.

4-2. TESTS AFTER INSTALLATION IN AIRCRAFT

After the components have been installed in the aircraft, the following tests should be made before placing the equipment in service:

A. Before turning on receiver, check battery voltage and polarity at remote control unit. Regardless of engine speed, fuse terminals should be +22 to +30 volts for Models RA-10DA and RA-10DB Equipments, and +11 to +15 volts for Models RA-10CA and RA-10CB Equipments, with respect to ground.

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

C. Test operation of mechanical cables and connections at both local and remote positions. When properly connected, low frequency end mark on remote control dial is centered with window index when ganged capacitor is at maximum.

D. Check receiver mounting base screws.

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

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

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

H. Check for presence and operation of instrument lamps.

I. Using a headset, check receiver and direction finder operation on all bands. Jar receiver to check for possible sources of noise.

J. Switch power on and off and note whether or not magnetic compass is affected.

K. Check for effects of other radio equipment in aircraft upon communicational and nagivational performance of receiving equipment. Also determine extent of any interference produced by this receiver in other radio equipment.

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

4-3. DIRECTION FINDING DEVIATION

Practically all aircraft direction finding installations give definite errors in relative bearings which vary in a regular pattern throughout the 360 degrees, and are known as quadrantal errors or quadrantal deviation. These errors are caused by the effect of the metallic fore-and-aft mass of the fuselage structure, the athwartship mass of the wing structure, and the effect of closed circuits such as represented by wing bays, in the case of biplanes, or braced monoplanes. If the loop is mounted on the exact centerline of the airplane and the connection to the azimuth control has been properly aligned, there is generally no appreciable error on bearings taken dead ahead (0°) or astern (180°). Advantage may be taken of this condition, when exact bearings are desired before it has been possible to calibrate the installation, or to determine the exact reference bearing on a station for calibration purposes. The poorest bearings are frequently obtained, in the case of biplanes, at angles of 60 to 70 and 290 to 300 degrees, where these bearings pass through the outer wing struts. Since the deviational errors in unfavorable directions are generally on the order of 10 to 20 degrees, and often still greater, it is highly desirable to measure such deviations by swinging the ship, preferably on a compass rose, in a suitable location. The calibration data thus obtained are used to calculate the various deviations, which may then be transposed and plotted against indicated bearings to form a correction curve. By correction, is meant the value which, algebraically added to the indicated radio bearing (relative to ship's heading), equals the actual relative bearing of the incoming signal. Hence, if the actual bearing is numerically less than the indicated bearing, the correction is negative and is preceded by a minus sign and is plotted on a calibration curve below the zero axis; but when the actual bearing exceeds the indicated bearing, the correction is positive, has a plus sign, and is plotted above the zero line. Correction is often confused with deviation; the former term applies to the indicated relative bearing, whereas the latter refers to the actual relative bearings. They are numerically equal, but opposite in sign.

To perform the deviation calibration for plotting the correction curve, proceed as follows:

A. Visually check loop, mechanical tuning shaft, and azimuth control alignment.

B. Select a suitable location for calibration, preferably a compass rose. This should be several hundred feet removed from high buildings.

C. Select a suitable transmitter upon which to calibrate. A local transmitter or broadcast station, preferably at a distance between one and ten miles, is satisfactory. Its direction should be exactly known, or may be determined with fair accuracy by turning the airplane to give a zero bearing directly over the nose. In absence of a suitable transmitting station, a fair calibration can often be made with a shielded radio-frequency driver provided with a vertical (metal rod or tube) radiator about ten feet high, and placed in the open at as great a distance as the location and receiver sensitivity permit (at least several hundred feet).

D. Tune in the calibrating signal as outlined in Section 5-4-1. Starting with a head-on bearing, swing the plane by five-, ten- or fifteen-degree steps until a complete revolution has been made. For greatest accuracy, it is desirable to elevate the tail to approximately normal flight position as a fifteen-degree fore-and-aft slope of the plane will result in one-degree bearing changes at certain loop positions.

E. For each 5- or 10-degree heading, record the following data:
   1. Actual magnetic heading, by compass rose or by corrected ship's compass.
   2. Indicated radio bearing, relative to ship's heading.

F. The deviation is calculated as follows:
   1. Add the plane's magnetic heading to the indicated radio bearing.
   2. Subtract 360 if the sum obtained in (1) permits.
   3. If the resultant of operations (1) and (2) is more than the magnetic bearing of the station, subtract the magnetic bearing. The difference is the plus deviation. For example, if a certain transmitter has a magnetic bearing of

184 degrees, and the plane heading is 225 degrees, the indicated radio bearing might be 340 degrees. The sum as obtained under (1) is therefore 565; and since this is more than 360, we subtract, as in operation (2), obtaining 205. This resultant is more than the magnetic bearing of the station so that the latter is subtracted from the former, as in (3), giving a deviation of +21 degrees.

4. If the result of operations (1) and (2) is less than the magnetic bearing of the station, subtract the result from the magnetic bearing. The difference is the minus deviation. Thus, using the same transmitting station (the magnetic bearing of which was 184 degrees), the indicated radio bearing might be 37.5 degrees when the plane heading is shifted to 135 degrees. The sum, as obtained for operation (1), is then 172.5; and since this is less than 360, operation (2) is omitted. However, the result is now less than the magnetic bearing of the station, so the former is subtracted from the latter, as in operation (4), and the deviation is −11.5 degrees.

G. In all cases, the desired corrections will be numerically equal to the deviations thus obtained, but opposite in sign. For example, a deviation of plus 10 degrees would require a correction of minus 10 degrees to the indicated radio bearing.

H. When all values for correction have thus been determined, plot the correction curve by showing plus corrections upward, minus corrections downward, starting with 0 degrees indicated radio bearing at the left, and ending with 360 degrees at the right side of the graph sheet. Connect the points by as smooth a curve as possible. If the calibration has been carefully performed, this curve will approximate a sine wave, having two peaks and two dips through the 360 degrees. If the peaks and dips are not approximately equal, or if the curve does not cross the zero axis at 0 degrees, 180 degrees and two intermediate points (approximately 90 degrees and 270 degrees), recheck the loop alignment and centering on the airplane, and verify the actual direction of the transmitting station used in the calculations.

I. Repeat the calibration for different frequencies, as described. Do not fail to indicate the calibrating frequency on the difference calibration curves thus obtained.

CAUTION: Any metallic masses, structures, or conductors in the field of the loop, in which circulating RF currents may be induced, if later added, removed, or altered, may destroy the accuracy of the calibrations. This applies to the bonding of the airplane, relocation of wiring or of shielding, and spare parts or gear stowed near the loop. Check the calibration in flight at frequency intervals by taking bearings on stations of known direction. The corrected indicated radio bearing, added to the corrected magnetic heading, should give the actual magnetic bearing to the transmitting station (subtract 360 degrees if necessary).

5. OPERATION

5-1. GENERAL

The switch located to the operator's right on the upper portion of the remote control unit, marked C.W.-M.V.C.-A.V.C., provides the following functions:

C.W. position operates the beat frequency oscillator for reception of continuous wave signals.

M.V.C. position permits control of receiver sensitivity.

A.V.C. position permits control of audio output and the receiver sensitivity varies with signal input voltage.

The switch located to the operator's left on the upper portion of the remote control unit, marked XTAL OFF-XTAL ON, connects the lock-in crystals into the heterodyne oscillator circuit (Bands 3 and 4 only).

The OFF-VOLUME control is a combined power on-off switch and volume control. When turned to the maximum counterclockwise position, all current consuming circuits are opened, thus rendering the equipment inoperative.

5-2. COMMUNICATIONS RECEPTION

5-2-1. General

The Models RA-10CA, RA-10CB, RA-10DA, and RA-10DB Receiving Equipments may be used for normal reception of communications using any suitable antenna. In times of extreme rain or snow static conditions, when provided with direction finding components, the loop may be used in place of the antenna for anti-rain-static reception. Over-all sensitivity when using the loop will, however, be comparatively lower.

5-2-2. Normal Reception (Antenna)

The operating procedure is as follows:

A. Turn OFF-VOLUME switch clockwise.

B. Select desired frequency range (Band 1, 2, 3, or 4).

C. Turn C.W.-M.V.C.-A.V.C. switch to desired position.

D. Tune in station.

E. Adjust VOLUME control for desired signal level. See Section 5-2-4 for operation of XTAL OFF-XTAL ON switch.

5-2-3. Anti-Rain-Static Reception (Loop)

The operating procedure is as follows:

A. Turn OFF-VOLUME switch clockwise.

B. Select desired frequency range (Band 1 or 2).

C. Operate on CW or MVC as desired.

D. Snap ANT.-LOOP switch on the azimuth control to LOOP.

E. Tune in station.

F. Rotate azimuth control for maximum output in headset.

G. If the station is to the left or right of the airplane's course, it will occasionally be necessary to readjust the azimuth control setting for maximum signal.

H. Adjust VOLUME control for desired signal level.

5-2-4. Reception on Crystal Controlled Frequencies

5-2-4-1. Reception With Lock-In Crystal Oscillator (Band 3 and 4).

The operating procedure is as follows:
A. Turn OFF-VOLUME control clockwise.
B. Select desired frequency range (Band 3 or 4).
C. Turn C.W.-M.V.C.-A.V.C. switch to desired position.
D. Turn crystal switch to XTAL ON.
E. Tune to within plus or minus 10 kilocycles of desired frequency.
F. Adjust VOLUME control for desired signal level.
G. General coverage of Bands 3 and 4 may be obtained by turning crystal switch to XTAL OFF.

5-2-4-2. Reception With Spot-Frequency Crystal Oscillator (Bands 3 and 4).

The operating procedure is as follows:
A. Turn the OFF-VOLUME control clockwise.
B. Select the desired frequency range (Band 3 or 4).
C. Turn the C.W.-M.V.C.-A.V.C. switch to the desired position.
D. The crystal switch is inoperative, for the proper crystal is automatically selected and inserted into the oscillator circuit through the wiring changes in switch S101.
E. Adjust VOLUME control for desired signal level.

5-3. HOMING

5-3-1. Radio-Range Reception

It is necessary either to have a map showing the radio-range course and characteristics, or to know the location of the course and its characteristic A- and N-signal areas.

The operating procedure is as follows:
A. Turn OFF-VOLUME switch clockwise.
B. Turn band switch to Band 1 (150–400 Kcs).
C. Tune to desired frequency.
D. Adjust VOLUME control to desired signal level.
E. Obtain a "fix" of position (see Section 5-4-3), thus determining the direction to the course it is desired to follow.
F. Turn plane so as to intercept radio range course. A and N signals will blend into a continuous dash interrupted by station identification, when on-course.
G. Plane may then be flown on-course to location of radio range station.
H. Arrival at destination is indicated by an abrupt decrease in headset volume which is due to entering cone of silence.

NOTE: A radio-range course may also be flown with anti-rain-static reception, in which case the equipment is operated as described in Section 5-2-3.

5-3-2. Aural-Null Homing

The operating procedure is as follows:
A. Turn OFF-VOLUME switch clockwise.
B. Select desired frequency range (Band 1 or 2).
C. Operate on C.W. or M.V.C. as desired.
D. Snap ANT.-LOOP switch on azimuth control to LOOP.
E. Tune in station.
F. Rotate azimuth control to zero. Warning light must be off.
G. Turn airplane until headphone volume decreases to minimum.
H. Fly plane on this null course until desired position has been reached.

5-4. DIRECTION FINDING

5-4-1. Aural-Null Bearings

The operating procedure is as follows:
A. Turn OFF-VOLUME switch clockwise.
B. Select desired frequency range (Band 1 or 2).
C. Tune in station.
NOTE: When taking bearings of weak signals, it is helpful to use the CW oscillator beat note.
D. Adjust VOLUME control to desired signal level.
E. Rotate azimuth control until headphone volume decreases to minimum.
F. Observe reading of azimuth control dial relative to airplane line of flight.
G. Observe actual magnetic heading from corrected ship's compass reading.

Correct the azimuth reading to the actual magnetic heading. Subtract 360 if the sum permits. The final figure will give either the true magnetic bearing of the transmitting station or its reciprocal, with respect to the position of the airplane.

5-4-2. Direction Finding Precautions

When, for any reason, broadcast station carriers are being used for obtaining bearings, care must be exercised in the selection of stations. Two stations operating on the same frequency may tend to indicate more than one direction, or may fail to give any indication of direction whatever. Stations operating on clear channels will always give the most satisfactory results. Note that broadcast transmitting stations are often situated a considerable distance outside of cities controlling them.

Night effect, or reflection of the radio wave from the sky is always present. It may be recognized by a fluctuation in bearings. 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 worse at sunrise and sunset, and is least bothersome at the lower frequencies. Night effect on stations of 1500 Kcs appears at distances greater than 20 miles. As the frequency decreases the unaffected operating range 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.

5-4-3. Position Fix

A fix of position may be obtained by plotting two or more bearings on a map and observing the intersection of the bearings. An alternate method used when homing on a radio-range beacon requires only one bearing and the known direction of the radio-range course, the intersection of the two projected lines giving the location.

6. MAINTENANCE

6-1. LUBRICATION

Do not lubricate the variable tuning capacitor, potentiometers, or dynamotor commutator. Band switch motor B1 is permanently lubricated and will not require attention, unless it is disassembled, in which case the bearings should be repacked with a low temperature grease. If the dial gear mechanism is disassembled, the ball bearings should be repacked with low temperature grease.

6-2. ROUTINE INSPECTIONS

6-2-1. Pre-Flight Inspections

Regular inspections should be made preceding each flight as follows:

A. All interconnecting cables should be checked to see that they are securely locked in their receptacles.

B. Check the operation of the voltage regulator on the charging generator, adjust to insure consistent operation of the generator at 28 to 30 volts for Models RA-10DA and RA-10DB Equipments or 14 to 15 volts for Models RA-10CA and RA-10CB Equipments.

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

D. Check connection of lead-in wires, both at antenna and receiver ends.

E. Check all instrument lamps.

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

G. Each inspection should include a listening test made on at least one point in each band. The operation of all controls should also be checked. Any major trouble should be apparent from these tests.

6-2-2. General Periodic Inspections

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

Inspect all nuts, bolts, and screws for looseness. *Do not tighten or loosen glyptal-coated screws or nuts* unless it is evident they are loose. In the event they are loose, remove screw or nuts, apply glyptal, replace and tighten. Remove loose solder, dirt, and metallic chips. Clean equipment thoroughly and touch up scratched paint. Inspect soldered joints. Inspect wiring. Inspect all plug connectors and clean if necessary.

6-2-2-2. Receiver

A. Inspect the unit as described in Section 6-2-2-1 but do not disturb the alignment adjustment. Do not disturb wiring unless necessary.

B. Check all tubes. If the 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.

C. The dynamotor D1 should be inspected after 500 hours of service, or once a year, whichever period is shorter. Examine the brushes to see if they have worn properly and are free of hard spots. If such spots are apparent, replace the brush. Spotted brushes can be located by inspecting the commutator for grooves. Remove the bearings from the armature, clean with penetrating oil and carbon tetrachloride. Check bearings for tolerances and broken or chipped balls. Clean away all old grease and relubricate. Wipe off dirt from the commutator, end bells, armature, and housing. If the commutator does not have a smooth, even surface, place the armature in a lathe and rotate it. Polish the faulty commutator with a piece of soapstone or take a very thin (.003-inch) *cut using a lathe. Do not use sandpaper* as this causes deformation of the commutator bars. *Do not use emery cloth.* Remove all dust and dirt particles after polishing. A commutator should have a smooth polished surface free of dirt, grease, or ridges. *A commutator having a smooth or polished surface should not be sanded or turned down simply because it is discolored.* Under normal conditions, the commutator 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 the gears and tuning shaft coupling as specified in Section 6-1.

E. Tuning Capacitors. Inspect for dirt between plates. Carefully clean with an ordinary smoking-pipe cleaner. Do not bend plates. Do not lubricate. Do not blow out with an air hose as the hose may contain water, or the air pressure may bend the plates.

6-2-2-3. Remote Control Unit

Inspect as indicated in Section 6-2-2-1. Clean and lubricate the dial tuning mechanism and tuning shaft coupling as in Section 6-1.

6-2-2-4. Loop

Clean off all grease and dirt. Relubricate if necessary as specified in Section 6-1.

6-2-2-5. Test Performance

Reassemble the equipment and check its performance as described in Section 4-1. Vibrate the equipment and note any increase in noise or clicks with and without RF input. If the equipment is noisy or fails to meet performance requirements, re-examine the equipment until the trouble is discovered.

6-2-2-6. Wiring

Inspect all bonding in the aircraft. Inspect the dynamotor safety wiring. Reassemble the equipment and safety wire it where necessary. Inspect the antenna lead-in. Inspect the loop mounting for proper bracing. Repeat the tests outlined in Section 4-2.

6-3. LOCATION AND REMEDY OF FAULTS

6-3-1. General

The locating of open and short circuit faults will be facilitated if, instead of testing at random points, an orderly procedure is followed. Using the schematic diagram Fig. 14 for guidance, test one portion of a circuit at a time, and successively check each element contained in that portion for open circuits, short circuits, and grounds by measuring the resistance from point to point with an ohmmeter. If the measured values of resistance are normal, as compared with the resistance chart in Section 6-4-1-1, that particular portion of the circuit is probably not at fault and needs no further attention. The identifying symbols of all components are given on the schematic diagram Fig. 14 and their normal values can be determined by reference to Section 7.

The following table lists the average signal input required at the grid of each of the amplifier tubes to produce a standard output of 50 milliwatts into a proper load. In making these comparison measurements, the signal generator output should be connected from grid to ground. All measurements should be made on MVC, volume control at its maximum clockwise position, and the crystal switch turned off. For RF measurements, a signal of the specified frequency modulated 30% at 400 CPS should be used with the receiver adjusted to a signal-to-noise power ratio of 4:1. If the signal-to-noise ratio is greater than 4:1, the receiver is operated at maximum sensitivity. A 400-cycle signal source is used in making AF measurements.

Tubes	*Band*	*Frequency*	*Input V for 50-MW Output*
V1	1	150 Kcs	4–13 μV
V1	2	400 Kcs	4–13 μV
V1	3	2000 Kcs	4–13 μV
V1	4	5000 Kcs	8–22 μV
V2	IF	1630 Kcs	25–85 μV
V3	IF	1630 Kcs	1200–1700 μV
V4	IF	1630 Kcs	40,000–60,000 μV
V5	AF	400 CPS	150 MV
V7	AF	400 CPS	1.8 V

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

6-3-2. No Signals

A. Test all tubes, using a tube checker. If a tube checker is not available, replace the tubes one at a time, allowing a sufficient period for each tube to reach the proper operating temperature.

B. If tapping the 2nd detector V5 introduces a ringing sound in the headset, the audio system is probably operating satisfactorily. If no sound is heard, check the primary and secondary of the output transformer for open circuits and grounds; also the associated circuit resistors and capacitors for open circuits and short circuits respectively.

C. Measure the plate, screen, and bias voltage at the tube sockets, referring to the table in Section 6-4-1-2 as a check on the measured value. If an abnormal voltage is found at any point, examine the associated resistors, capacitors, and coils for short circuits, grounds, and open circuits.

6-3-3. Weak Signals

A. Examine the antenna system for poor connections.

B. Follow the procedure outlined under Section 6-3-1.

6-3-4. Noisy Reception

First determine whether the noise originates in the receiver or in some external source. To do this, disconnect the antenna from the receiver. If the noise is eliminated, examine the antenna system for loose connections and for points where rubbing against metal objects, etc. may occur. If shorting the antenna terminal to the ground does not reduce the noise, check all cable bonding and look for loose connections throughout the installation. Check for noisy tubes, following the procedure outlined in Section 6-3-2A.

6-4. SERVICING DATA

6-4-1. Resistance-Voltage Analysis

6-4-1-1. Point-To-Point Resistance Measurements

The table below indicates the average resistance to ground from the terminals of the various tube sockets and points indicated when measured with a sensitive ohmmeter with receiver on Band 1. The receiver to junction box cable should be removed from its receptacle. Tubes should be left in their respective sockets.

POINT-TO-POINT RESISTANCE MEASUREMENT TABLE

Tube	*Socket Terminals**										
	1	*2*†	*2*††	*3*	*4*	*5*	*6*	*7*†	*7*††	*8*	*9*
V1-RF Amp:	0	0	0	45,000	7 Meg	45,000	100,000	2	3	1500	—
V2-Osc. Mixer:	0	1	1	1500	15,000	50,000	36,000	2	5	1250	7 Meg
V3-1st IF:	0	1	5	45,000	2 Meg	45,000	100,000	2.5	5	1500	—
V4-2nd IF:	0	0	2	300	2	300	100,000	2.5	5	1500	—
V5-2nd Det:	0	0	0	30,000	1 Meg	1 Meg	2 Meg	2.5	3.5	3000	500,000
V6-CW Osc:	0	1	5	60,000	∞	50,000	∞	2.5	5	∞	—
V7-2nd Aud:	0	2	5	1000	200	500,000	∞	0	3	500	—
V9-Limiter:	0	0	0	16	250	∞	450	5	5	∞	—

* Numbered clockwise, looking into bottom of chassis, starting from the aligning key.
† RA-10CA, RA-10CB
†† RA-10DA, RA-10DB

6-4-1-2. Tube Socket Voltages

All the typical measurements tabulated below were made with a 1000-ohms per volt DC voltmeter. The terminal voltage measured at the input of the battery cable was 14 volts or 28 volts, with Models RA-10CA and RA-10CB, or Models RA-10DA and RA-10DB Equipments, respectively. All measurements were made to ground except where noted with equipment operating on MVC, crystal off, and the volume control turned to its maximum clockwise position. Variations up to ±15% are permissable.

Tube	*Socket Terminals* 1	*2 to 7*	*3*	*4*	*5*	*6*	*8*
V1-RF Amp:	0	6.3V	2.4V	—	2.4V	60V	200V
V2-Osc. Mixer:	0	6.3V	205V	105V	—	100V	2.8V
V3-1st IF:	0	6.3V	2.0V	—	2.0V	60V	200V
V4-2nd IF:	0	6.3V	2.0V	—	2.0V	60V	205V
V5-2nd Det:	0	6.3V	135V	—	—	—	5.8V
V6-CW Osc:	0	6.3V	*6V	—	—	—	*0V
V7-2nd Aud:	0	6.3V	195V	225V	—	—	14V
V9-Limiter:	0	6.3V	—	1.0V	—	205V	—

* CW Osc. Operating.

NOTE: IF for any reason, Ant., RF or Osc. cans are removed, be certain that before being replaced, the switch sections S1 to S7 are all turned to the same position. When inserting the coupling shaft, be certain that the flats of the shaft are in the same position as the switch sections. Failure to observe this precaution may cause damage to the wafer sections of the band switch.

6-5. RECEIVER ALIGNMENT

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

6-5-1. General

The following equipment is necessary:

A. Signal generator (low output impedance), capable of 30% modulation at 400 CPS, accurately calibrated at the following frequencies:

150 Kcs	1100 Kcs	3500 Kcs
270 Kcs	1630 Kcs	5000 Kcs
400 Kcs	1631 Kcs	7500 Kcs
700 Kcs	2000 Kcs	10,000 Kcs

B. Output meter, 500 ohm low-impedance type if the receiver has a low-impedance output (using Type MR-9B Remote Control Unit). A receiver with high-impedance output (using Type MR-9C Remote Control Unit), should be adjusted using a 4000 ohm high-impedance meter. This meter may be bridged by a high impedance telephone headset for monitoring.

C. Insulated aligning tool.

6-5-2. IF Amplifier Alignment

Remove the signal grid lead from the grid cap of the converter tube V2 and connect the signal generator output to the grid through a 0.1-Mfd capacitor. Connect a 0.5-megohm resistor from the grid of V2 to ground, to furnish a bias return. Set the controls as follows:

A. Turn OFF-VOLUME control fully clockwise.
B. Turn function switch to M.V.C.
C. Turn crystal switch to XTAL OFF.
D. Plug output meter into one of the remote control phone jacks. Accurately set signal generator to 1630 Kcs, and modulate carrier 30% at 400 cycles.
E. Adjust iron cores in the IF transformers T13, T14, and T15 for maximum deflection of output meter.
F. Reset the signal generator frequency for a maximum deflection on the output meter and check the generator frequency. If it is other than 1630 Kcs, reset thereto and repeat the previously described alignment of the IF transformer iron cores. The input should be between 25 and 85 microvolts for an output of 50 milliwatts. The oscillator grid, pin number 5 of tube V2, should be shorted to ground during these adjustments.
G. While the signal generator is at exactly 1630 Kcs, turn off the modulation and turn the function switch to C.W. Adjust coil L3 for zero beat. The CW oscillator will then oscillate at the IF frequency, and the zero beat method of aligning the RF oscillator stage may be employed.

6-5-3. Heterodyne Oscillator Alignment

6-5-3-1. Trimmer Adjustment (High Frequency End of Bands)

Operate the receiver with the VOLUME control fully clockwise and with the crystal switch off. Plug a headset into one of the remote control phone jacks and couple the signal generator to the control grid of the mixer-oscillator tube.

A. Turn on the CW oscillator, which has previously been adjusted to 1630 Kcs.
B. Set the signal generator to 400-Kcs output, unmodulated. Rotate the tuning dial to 400 Kcs on Band 1 and adjust capacitor C30 for zero beat.
C. Set the signal generator to 1100-Kcs output, unmodulated. Rotate the tuning dial to 1100 Kcs on Band 2 and adjust capacitor C31 for zero beat.
D. Set the signal generator to 5000-Kcs output, unmodulated. Rotate the tuning dial to 5000 Kcs on Band 3 and adjust capacitor C32 for zero beat.
E. Set the signal generator to 10,000-Kcs output, unmodulated. Rotate the tuning dial to 10,000 Kcs on Band 4 and adjust capacitor C33 for zero beat.

6-5-3-2. Padder and Core Adjustment (Low Frequency End of Bands)

With the equipment set-up as described in Section 6-5-3-1, padder and core adjustments are made as follows:

A. Set the signal generator to 150-Kcs output, unmodulated. Rotate the tuning dial to 150 Kcs on Band 1 and adjust capacitor C35 for zero beat.
B. Set the signal generator to 400-Kcs output, unmodulated. Rotate the tuning dial to 400 Kcs on Band 2 and adjust capacitor C36 for zero beat.
C. Set the signal generator to 2000-Kcs output, unmodulated. Rotate the tuning dial to 2000 Kcs on Band 3 and adjust capacitor C37 for zero beat.
D. Set the signal generator to 5000-Kcs output, unmodulated. Rotate the tuning dial to 5000 Kcs on Band 4 and adjust capacitor C38 for zero beat.

Should the above procedure be unsatisfactory, that is, should it be impossible to obtain zero beat by the adjustments of the padding capacitors on any bands or band, it will be necessary to adjust the inductance by varying the iron core settings; final alignment may then be made by repeating the procedure above.

6-5-3-3. Scale and Tracking Adjustments.

With the equipment set-up as described in Sections 6-5-3-1 and 6-5-3-2, check the midband frequencies, 270 Kcs, 700 Kcs, 3500 Kcs, and 7500 Kcs, against the dial scale. If off calibration, readjust as follows:

A. Set the heterodyne oscillator frequency to the correct 1630-Kcs difference frequency from the dial setting by adjusting the iron core inductance of T9, T10, T11 and T12 on Bands 1, 2, 3, and 4, respectively.

B. Readjust the high- and low-frequency alignment of the bands as described in Sections 6-5-3-1 and 6-5-3-2.

C. Keep repeating the adjustments as outlined in Sections 6-5-3-1, 6-5-3-2, and 6-5-3-3A until proper alignment is obtained.

When using a crystal in conjunction with the oscillator tuned circuits, no change in the oscillator alignment will be necessary.

6-5-4. RF Amplifier and Antenna Stage Alignment

6-5-4-1. Trimmer Adjustment (High Frequency End of Bands)

Operate the receiver on M.V.C., crystal switch off, VOLUME control at maximum clockwise position, plug an output meter into J101, and connect a signal generator to the antenna terminal through a 100-Mmf condenser used as a dummy antenna. Set the generator for 30% modulation at 400 cycles.

A. Band 1 Alignment: Set the tuning dial to 400 Kcs on Band 1, and adjust the signal generator to 400 Kcs with sufficient output voltage to produce somewhat less than 50 milliwatts output. Adjust trimmer capacitors C6 and C21 for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C6 and C21 for maximum output.

B. Band 2 Alignment: Set the tuning dial to 1100 Kcs on Band 2, reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 1100 Kcs with sufficient output voltage to produce less than 50 milliwatts output. Adjust trimmer capacitors C7 and C22 for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C7 and C22 for maximum output.

C. Band 3 Alignment: Set the tuning dial to 5000 Kcs on Band 3, reset the VOLUME control to maximum clockwise setting and adjust the signal generator to 5000 Kcs with sufficient output voltage to produce less than 50 milliwatts output. Adjust trimmer capacitors C8 and C23 for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C8 and C23 for maximum output.

D. Band 4 Alignment: Set the tuning dial to 10,000 Kcs on Band 4, reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 10,000 Kcs with sufficient output voltage to produce less than 50 milliwatts output. Adjust trimmer capacitors C9 and C24 for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C9 and C24 for maximum output.

6-5-4-2. Core Adjustment (Low Frequency Ends of Bands)

With the equipment set-up as described in Section 6-5-4-1, core adjustments are made as follows:

A. Band 1 Alignment: Set the tuning dial to 150 Kcs on Band 1, set volume control to maximum clockwise setting, and adjust the signal generator to 150 Kcs and to the output voltage necessary to produce somewhat less than 50 milliwatts output. Adjust cores marked 1 on both antenna and RF cans for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 1 on the antenna and RF cans for maximum output.

B. Band 2 Alignment: Set the tuning dial to 400 Kcs on Band 2. Reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 400 Kcs with sufficient output voltage to produce less than 50 milliwatts output. Adjust cores marked 2 on both the antenna and RF cans for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 2 on antenna and RF cans, for maximum output.

C. Band 3 Alignment: Set the tuning dial to 2000 Kcs, on Band 3. Reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 2000 Kcs with sufficient output voltage to produce less than 50 milliwatts output. Adjust cores marked 3 on both antenna and RF cans for maximum output, reducing the input from the signal generator as much as necessary to keep the output approximately 50 milliwatts. Set the signal generator output at

5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 3 on both antenna and RF cans for maximum output.

D. Band 4 Alignment: Set the tuning dial to 5000 Kcs on Band 4. Reset the VOLUME control to maximum clockwise setting and adjust the signal generator to 5000 Kcs with sufficient output voltage to produce less than 50 milliwatts output. Adjust cores marked 4 on both antenna and RF cans for maximum output, reducing the input from the signal generator as much as necessary to keep the output at approximately 50 milliwatts. Set the signal generator output at 5 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 4 on both antenna and RF cans for maximum output.

Repeat successive high- and low-frequency adjustments several times as described in Sections 6-5-4-1 and 6-5-4-2 until successive adjustments show no additional sensitivity.

6-5-5. Adjustments of the IF Rejection Trap

Connect the signal generator to the antenna plug through a 100-Mmf capacitor. Set the tuning dial to 1100 Kcs on Band 2, and adjust the signal generator to 25,000 microvolts output at 1630 Kcs, 30% modulation at 400 cycles. Adjust the VOLUME control to the point at which 50 milliwatts output is obtained.

Adjust the iron core of L2 until minimum output is obtained.

6-5-6. CW Oscillator Alignment

Operate on CW, plug a headset into one of the remote control phone jacks. Attach the lead from the signal generator to the control grid of the detector-oscillator tube V2, leaving the regular grid clip in place.

Apply a 1631-Kcs signal, unmodulated. The signal generator output should be approximately 100 microvolts. Adjust the iron core of L3 for zero beat.

7. PARTS BY SYMBOL DESIGNATIONS

7-1. TYPE RA-10DA, REF. NO. 110D/302 AND TYPE RA-10DB, REF. NO. 110D/301 AIRCRAFT RECEIVERS

Symbol Number	Function	Description	Ref. No.	Bendix Number
		MOTOR		
B1	Band Switch Drive & Worm Assembly	28V DC, 1.25A—no load	110K/4	E11500-1
.	+ Motor Brush		110K/5	A30212-1
.	− Motor Brush		110K/6	A30212-2
	Band Switch Drive & Worm Assembly, including Motor B1		110M/95	AC56696-2
		CAPACITORS		
C1	Dummy Loop Padder	140 Mmf ±5%, 500V DCW, Mica	110C/95	C56314-141
C2	Antenna Coupling	10 Mmf ±10%, 500V DCW, Mica	110C/76	C56315-100
C3	Ant. Padder, Band 4	100 Mmf ±5%, 500V DCW, Mica	110C/30	C56314-101
C4	Grid Blocking	.001 Mfd ±10%, 500V DCW, Mica	110C/25	C56315-102
C5	IF Trap Coil Padder	.001 Mfd ±2%, 500V DCW, Mica	110C/96	C56313-102
C6	Ant. Trimmer, Band 1	25 Mmf, Variable	110C/97	A26829-3
C7	Ant. Trimmer, Band 2	25 Mmf, Variable	110C/98	A26829-1
C8	Ant. Trimmer, Band 3	Same as C6	.	.
C9	Ant. Trimmer, Band 4	50 Mmf, Variable	110C/99	A26829-2
C10	V1 Cathode Bypass	0.1 Mfd ±10%, 400V DCW, Paper	110C/43	A18015-104
C11	RF Padder, Band 4	50 Mmf ±10%, 500V DCW, Mica	110C/100	C56315-500
C12A	Antenna Tuning	3 Section, Variable, Assembly	110C/101	AC56827-1
C12B	RF Tuning	Same as C12A	.	.
C12C	Het. Osc. Tuning	Same as C12A	.	.
C13	RF Primary Shunt, Band 2	25 Mmf ±5%, 500V DCW, Mica	110C/102	C56314-250
C14	RF Primary Shunt, Band 1	500 Mmf ±5%, 500V DCW, Mica	110C/103	C56314-501
C15	RF Coupling	5 Mmf ±10%, 500V DCW, Mica	110C/77	C56315-050
C16	Grid Blocking	Same as C4	.	.
C17	V1 Screen Bypass	Same as C10	.	.
C18	V1 Plate Return Bypass	Same as C10	.	.
C19	V2 Screen Bypass	Same as C10	.	.
C20	V2 Cathode Bypass	Same as C10	.	.
C21	RF Trimmer, Band 1	Same as C6	.	.
C22	RF Trimmer, Band 2	Same as C7	.	.
C23	RF Trimmer, Band 3	Same as C6	.	.
C24	RF Trimmer, Band 4	Same as C9	.	.
C25	Osc. Grid Blocking	250 Mmf ±10%, 500V DCW, Mica	110C/90	C56315-251
C26	Osc. Fixed Padder, Band 1	45 Mmf ±2%, 500V DCW, Ceramic	110C/1225	A102055-450
C27	Osc. Fixed Padder, Band 2	85 Mmf ±2%, 500V DCW, Silver Mica	110C/1381	C56316-850

Symbol Number	Function	Description	Ref. No.	Bendix Number
C28	Osc. Fixed Padder, Band 3	500 Mmf ±2%, 500V DCW, Silver Mica	110C/106	C56316-501
C29	Osc. Fixed Padder, Band 4	1450 Mmf ±1%, 500V DCW, Silver Mica	110C/107	A31274
C30	Osc. Trimmer, Band 1	25 Mmf, Variable	110C/108	A26829-7
C31	Osc. Trimmer, Band 2	25 Mmf, Variable	110C/109	A26829-8
C32	Osc. Trimmer, Band 3	Same as C30	.	.
C33	Osc. Trimmer, Band 4	Same as C31	.	.
C34	Osc. Fixed Trimmer, Band 1	35 Mmf ±10%, 500V DCW, Ceramic	110C/110	A18207-350
C35	Osc. Padder, Band 1	Same as C30	.	.
C36	Osc. Padder, Band 2	Same as C30	.	.
C37	Osc. Padder, Band 3	50 Mmf, Variable	110C/111	A26829-6
C38	Osc. Padder, Band 4	Same as C37	.	.
C39	Osc. Fixed Trimmer, Band 2	10 Mmf ±10%, 500V DCW, Ceramic	110C/29	A18205-100
C40	Osc. Fixed Trimmer, Band 3	20 Mmf ±10%, 500V DCW, Ceramic	110C/112	A18207-200
C41	Osc. Fixed Trimmer, Band 4	30 Mmf ±5%, 500V DCW, Ceramic ramic	110C/1227	A102055-300
C43	Osc. Plate Return Bypass	.01 Mfd ±2%, 500V DCW, Mica	110C/114	C56310-103
C44	Osc. Plate Return Bypass	Same as C43	.	.
C45	1st IF Pri. Trimmer	115 Mmf ±2%, 500V DCW, Silver Mica	110C/105	C56316-1150
C46	1st IF Sec. Trimmer	Same as C45	.	.
C47	2nd IF Pri. Trimmer	Same as C45	.	.
C48	2nd IF Sec. Trimmer	Same as C45	.	.
C49	CW Osc. Coupling	1.0 Mmf ±50%, 500V DCW, Ceramic	110C/116	A30763
C50	V2 Plate Return Bypass	Same as C10	.	.
C51	V3 Grid Return Bypass	.02 Mfd ±10%, 400V DCW, Paper	110C/117	A18015-203
C52	V3 Cathode Bypass	Same as C10	.	.
C53	V3 Screen Bypass	Same as C10	.	.
C54	V3 Plate Return Bypass	Same as C10	.	.
C55	V4 Cathode Bypass	Same as C10	.	.
C56	V4 Screen Bypass	Same as C10	.	.
C57	V4 Plate Return Bypass	Same as C10	.	.
C58	AVC Buss Bypass	Same as C10	.	.
C59	3rd IF Pri. Trimmer	Same as C45	.	.
C60	3rd IF Sec. Trimmer	Same as C45	.	.
C61	V5 Diode Return Filter	150 Mmf ±10%, 500V DCW, Mica	110C/89	C56315-151
C62	V5 Grid Blocking	.01 Mfd ±10%, 300V DCW, Mica	110C/26	C56312-103
C63	V5 Diode Return Filter	Same as C11	.	.
C64	AVC Diode Coupling	Same as C11		
C65	V5 Cathode Bypass	1.0 Mfd, 100V DCW, Paper	110C/54	A204-5
C66	Xtal Bypass	75 Mmf ±10%, 500V DCW, Mica	110C/118	C56315-750
C67	Xtal Bypass	35 Mmf ±10%, 500V DCW, Mica	110C/119	C56315-350
C68	CW Osc. Grid	Same as C61	.	.
C69	CW Osc. Trimmer	450 Mmf ±2%, 500V DCW, Silver-mica	110C/1224	C56316-451
C70	CW Osc. Plate Bypass	Same as C10	.	.
C71	CW Osc. Bypass	Same as C10	.	.
C72	V5 to V7 Grid Blocking	.01 Mfd ±5%, 300V DCW, Mica	110C/121	A292-10
C73	1st Audio Plate Bypass	.0005 Mfd ±5%, 500V DCW, Mica	110C/103	A293-17 (interchangeable with C56314-501)
C74	V7 Cathode Bypass	5.0 Mfd +100 −0%, 50V, Electrolytic	110C/18 2	QE11402
C75	V8 Plate Filter	.002 Mfd ±5%, 500V DCW, Mica	110C/122	A292-17
C76	V7 Plate Filter	Same as C75	.	.
C77A	High Voltage Supply Filter	30-30-30 Mfd, 350V DCW, Electrolytic	110C/123	A30189
C77B	High Voltage Supply Filter	Same as C77A	.	.
C77C	High Voltage Supply Filter	Same as C77A	.	.
C78A	Low Voltage Supply Filter	0.1-0.1-0.1 Mfd ±10%, 400V DCW, Paper	110C/41	QE11347-1
C78B	High Voltage Supply Filter	Same as C78A	.	.
C78C	High Voltage Supply Filter	Same as C78A	.	.
C79A	Low Voltage Input Filter	0.5-0.5 Mfd ±10%, 100V DCW, Paper	110C/19	QE11400
C79B	Low Voltage Input Filter-	Same as C79A	.	.
C80	Ant. Fixed Padder, Band 3	20 Mmf ±10%, 500V DCW, Mica	110C/124	C56315-200
C81	Osc. Fixed Trimmer, Band 4	Same as C41	.	.
C82	CW Osc, Trimmer	50 Mmf ±5%, 500V DCW, Ceramic	110C/1229	A18206-500
C83	1st IF Pri. Trimmer	Same as C39		

Symbol Number	Function	Description	Ref. No.	Bendix Number
C84	1st IF Sec. Trimmer	Same as C39	.	.
C85	2nd IF Pri. Trimmer	Same as C39	.	.
C86	2nd IF Sec. Trimmer	Same as C39	.	.
C87	3rd IF Pri. Trimmer	Same as C39	.	.
C88	3rd IF Sec. Trimmer	Same as C39	.	.
C89	Osc. Fixed Padder, Band 2	Same as C41	.	.
C90	CW Osc. Coupling	Same as C80	.	.

DYNAMOTOR AND BRUSHES

Symbol Number	Function	Description	Ref. No.	Bendix Number
D1	Dynamotor	28V, 1.6A, input; 230V, 0.1A output	110K/13	~~6, 15 or 18~~ C56728-2
.	Low Voltage + Brush			
.	Low Voltage − Brush			
.	High Voltage + Brush	NOTE: When ordering dynamotor brushes, give complete nameplate data on the dynamotor on which they are to be used.		
.	High Voltage − Brush			

JACKS

Symbol Number	Function	Description	Ref. No.	Bendix Number
J1	Recep. for Plug P1	23-contact, Wall mounting	110H/33	A30094
J6	Crystal Socket	3-prong, for MX-9E Crystal and Holder Assembly	110H/48	A15202
.	Crystal Socket Adapter	4-prong to 3-prong, for two Ref. No. 10X crystals	110A/278	AA28709-1

RELAYS

Symbol Number	Function	Description	Ref. No.	Bendix Number
K1	Crystal On-Off	28-volt, Rotary	110F/10	AC56864-2
K2	Sidetone	150 Ω coil, SPDT	110F/11	A28758

INDUCTORS

Symbol Number	Function	Description	Ref. No.	Bendix Number
L1	Dummy Loop Coil	Each coil part of IF trap and dummy loop assembly	110C/203	AC55706-1
L2	IF Trap Coil		.	.
L3	BFO Coil	Assembly	110C/204	AC56852-1
L4	Filter Choke	Part of T16, Assembly	.	.
L5	HV Hash Filter	1200T #33 SSE, 40 Ω	110C/175	AB6859-2
L6	LV Hash Filter	#18, Paper enamel	110C/174	AB6859-1
L7	LV Hash Filter	Same as L6	.	.

PLUG

Symbol Number	Function	Description	Ref. No.	Bendix Number
P1	Junction Box to Receiver Cable	23-contact, 90°, Female	110H/78	A30601

RESISTORS

Symbol Number	Function	Description	Ref. No.	Bendix Number
R1	V1 Cathode Initial Bias	300 Ω, ±10%, ¼W	110C/245	A18151-301
R2	V1 Control Grid Return	5 Megohms, ±10% ¼W	110C/296	A18151-505
R3	V1 Screen Dropping	100,000 Ω, ±10%, ¼W	110C/249	A18151-104
R4	V9 Bias	250 Ω ±10%, ¼W	110C/297	A18151-251
R5	V9 Bleeder	50,000 Ω ±10%, ½W	110C/298	A18150-503
R6	V1 Plate Decoupling	1000 Ω ±10%, ¼W	110C/254	A18151-102
R7	V2 Screen Dropping	15,000 Ω ±10%, 1W	110C/299	A18009-153
R8	V2 Control Grid Return	Same as R2	.	.
R9	V2 Cathode Initial Bias	Same as R4	.	.
R10	V2 Injection Grid Leak	50,000 Ω ±10%, ¼W	110C/251	A18151-503
R11	V2 Plate Decoupling	Same as R6	.	.
R12	V3 Control Grid Decoupling	Same as R10	.	.
R13	V3 Cathode Initial Bias	Same as R1	.	.
R14	V3 Screen Dropping	Same as R3	.	.
R15	V3 Plate Decoupling	Same as R6	.	.
R16	V2 Osc. Plate Decoupling	35,000 Ω ±10%, ¼W	110C/300	A18151-353
R17	V4 Cathode Initial Bias	Same as R1	.	.
R18	V4 Screen Dropping	Same as R3	.	.
R19	V4 Plate Decoupling	Same as R6	.	.
R20	V5 Diode Return Filter	500,000 Ω ±5%, ¼W	110C/301	A18001-504
R21	V5 Control Grid Leak	Same as R20	.	.
R22	V5 Diode Return Filter	Same as R20	.	.
R23	V5 Cathode Bias	3000 Ω ±10%, ¼W	110C/262	A18151-302
R24	V5 AVC Diode Load	1 Megohm ±10%, ¼W	110C/253	A18151-105
R25	V5 AVC Buss Filter	Same as R24	.	.
R26	V5 Plate Load	25,000 Ω ±10%, ¼W	110C/268	A18151-253
R27	V7 Grid Return	500,000 Ω ±10%, ¼W	110C/257	A18151-504
R28	CW Osc. Grid Leak	Same as R10	.	.
R29	V6 Plate Voltage Bleeder	Same as R27	.	.
R30	V6 Plate Voltage Bleeder	75,000 Ω ±10%, ¼W	110C/302	A18151-753
R31	V7 Cathode Bias	500 Ω ±10%, 1W	110C/235	A18009-501
R32	K2 Dropping	150 Ω ±5%, 5W	110C/303	A18133-151
R33	B+ to Cathode, Bleeder	20,000 Ω ±10%, 1W	110C/304	A18009-203
R34	B+ to Cathode, Bleeder	Same as R33		.
R35	Voltage Dropping	Section D; 120 Ω 1.50W		
R36	Voltage Dropping	Section F; 61 Ω 2W		
R37	Voltage Dropping	Section E; 71 Ω 2.68W		
R39	Voltage Dropping	Section B; 25 Ω 2.25W	110C/305	A27941
R40	Voltage Dropping	Section A; 50 Ω 4.5W		
		Section C; link		

Symbol Number	Function	Description	Ref. No.	Bendix Number
R38	Filament Equalizing	125 Ω ±5%, 5W	110C/306	A18133-1250
R41	AVC Limiting	200,000 Ω ±10%, ¼W	110C/256	A18151-204
R42	Dummy Filament	15 Ω ±5%, 5W	110C/307	A18133-150

SOCKET

Symbol Number	Function	Description	Ref. No.	Bendix Number
.	Tube Socket	Octal Base	110H/97	A30717

SWITCHES

Symbol Number	Function	Description	Ref. No.	Bendix Number
S1	Ant. Pri. Band Selector	Bakelite wafer, 4-position	110F/52	A28004
S2	Ant. Sec. Band Selector	Bakelite wafer, 4-position	110F/53	A28002
S3	RF Pri. Band Selector	Bakelite wafer, 4-position	110F/54	A28003
S4	RF Sec. Band Selector	Same as S2	.	.
S5	Osc. Pri. Band Selector	Ceramic wafer, 4-position	110F/227	A102006
S6	Osc. Sec. Band Selector	Ceramic wafer, 4-position	110F/228	A102007
S7	Motor Positioning	Bakelite wafer	110F/57	A16301
S8	Motor Control	1 make, 2 break, Non-locking	110F/127	C57496
S9	Crystal Control	Bakelite wafer	110F/240	A15280

TRANSFORMERS

Symbol Number	Function	Description	Ref. No.	Bendix Number
T1	Antenna, Band 1	Complete assembly	110K/66	AA26609-1
T2	Antenna, Band 2	Complete assembly	110K/67	AA26614-1
T3	Antenna, Band 3	Complete assembly	110K/68	AL71765-9
T4	Antenna, Band 4	Complete assembly	110K/69	AL71765-10
T5	RF Band 1	Complete assembly	110K/70	AL71765-5
T6	RF Band 2	Complete assembly	110K/71	AL71765-6
T7	RF Band 3	Complete assembly	110K/72	AL71765-7
T8	RF Band 4	Complete assembly	110K/73	AL71765-8
T9	Osc., Band 1	Complete assembly	110K/74	AL71765-1
T10	Osc., Band 2	Complete assembly	110K/75	AL71765-2
T11	Osc., Band 3	Complete assembly	110K/76	AL71765-3
T12	Osc., Band 4	Complete assembly	110K/77	AL71765-4
T13	1st IF Assembly	Complete assembly	110K/78	AC56773-1
T14	2nd IF Assembly	Complete assembly	110K/79	AC56854-1
T15	3rd IF Assembly	Complete assembly	110K/80	AC56772-1
T16	Audio Output, V7	Includes L4	110K/81	A16901
T17	Audio Output, V8	Optional equipment, Not included	.	A14814

TUBES

Symbol Number	Function	Description		Ref. No.	Bendix Number
V1	RF Amplifier	Triple-grid, Super-control	6SK7	110E/11	.
V2	Combination Het. Osc.-Mixer	Triode-hexode converter	6K8	110E/12	.
V3	1st IF Amplifier	Same as V1	6SK7	.	.
V4	2nd IF Amplifier	Same as V1	6SK7	.	.
V5	2nd Det-AVC-1st Audio	Duplex-diode triode	6R7	110E/7	.
V6	CW BFO	Detector-amplifier triode	6C5	110E/29	.
V7	2nd Audio	Power amplifier pentode	6K6	110E/32	.
V9	Signal Limiter	Diode, Dual	6H6	110E/13	.

CRYSTALS

Symbol Number	Function	Description	Ref. No.	Bendix Number
X3	Lock-In Crystal	Complete assembly (See Section 2-1-2-11)	110X	AL71157-1
X4	Lock-In Crystal	Part of X3	.	.

7-2. TYPE MR-9B REMOTE CONTROL UNIT, REF. NO. 110J/4

Symbol Number	Function	Description	Ref. No.	Bendix Number
		FUSE		
F101	Protective	25V, 10A, 3AG	110C/568	A11302-28
		LAMP		
I101	Instrument	3V, 0.19 ±.020A	105L/20	A18881-1
		RECEPTACLES		
J2	Wall Mounting for P2	16-contact	110H/29	A30089
J101	Phone Jack	Open circuit	110H/166	A28960
J102	Phone Jack	Same as J101	.	
.	Fuse Holder	.	110M/51	A30003
		PLUG		
P2	Remote to Junction Box Cable	16-contact, Straight, Female	110H/62	A30090
		RESISTORS		
R101A	Dual Volume Control, Section A	1500 Ω ±20%	110C/971	L72639
R101B	Dual Volume Control, Section B	25,000 Ω ±20%		
R102	Audio Limiting	500 Ω ±10%, ½W	110C/261	A18150-501
R103	Inst. Lamp Voltage Dropping	61 Ω, 71 Ω, Total 132 Ω	110C/292	A31356
R104	Interphone Minimum Output Loading	250 Ω ±10%, ½W	110C/1223	A18150-251
		SWITCHES		
S101A	Band Selector	2-pole, 4-position	110F/36	A15248
S101B	Band Selector	2-pole, 4-position	110F/37	A15247
S102	AVC, MVC and CW Selector	4-pole, 3-position	110F/38	A15405
S103	Crystal On-off	SPST, Toggle	110F/39	A15404
S104	Power On-off	Part of R101; Single pole, Single throw, 10A., 125 V.	.	.
		SOCKET		
.	Lamp Socket	For Lamp I101	110H/92	B8184

7-3. TYPE MR-11D LOOP RELAY UNIT, PART OF REF. NO. 110D/301

Symbol Number	Function	Description	Ref. No.	Bendix Number
		CAPACITOR		
C201	Dummy Antenna Resonator	100 Mmf ±10%, 500V DCW, Mica	110C/60	C56315-101
		RECEPTACLE		
J3	Recep. for P3	6-contact, Wall-mounting	110H/28	A30084
		PLUG		
P3	Loop Cable to Relay Unit	6-contact, Straight, Female	110H/60	A30088
		RELAY		
K201	Loop-Antenna Control	28-volt	110F/10	AC56864-10
		SWITCH		
S201	Loop-Antenna Selector	4-pole, 2-position, Shorting	110F/103	A15462

7-4. TYPE MN-20A. REF. NO. 110B/3 OR TYPE MN-20C, REF. NO. 110B/21 ROTATABLE LOOP

		RECEPTACLE		
J5	Recep. for P5	6-contact, Wall-mounting	110H/35	A25200
		PLUG		
P5	Loop to Loop Trans. Cable	6-contact, Straight, Female	110H/60	A30088
		MISCELLANEOUS		
	Brush Holder Assembly		110M/29	AA14692-1

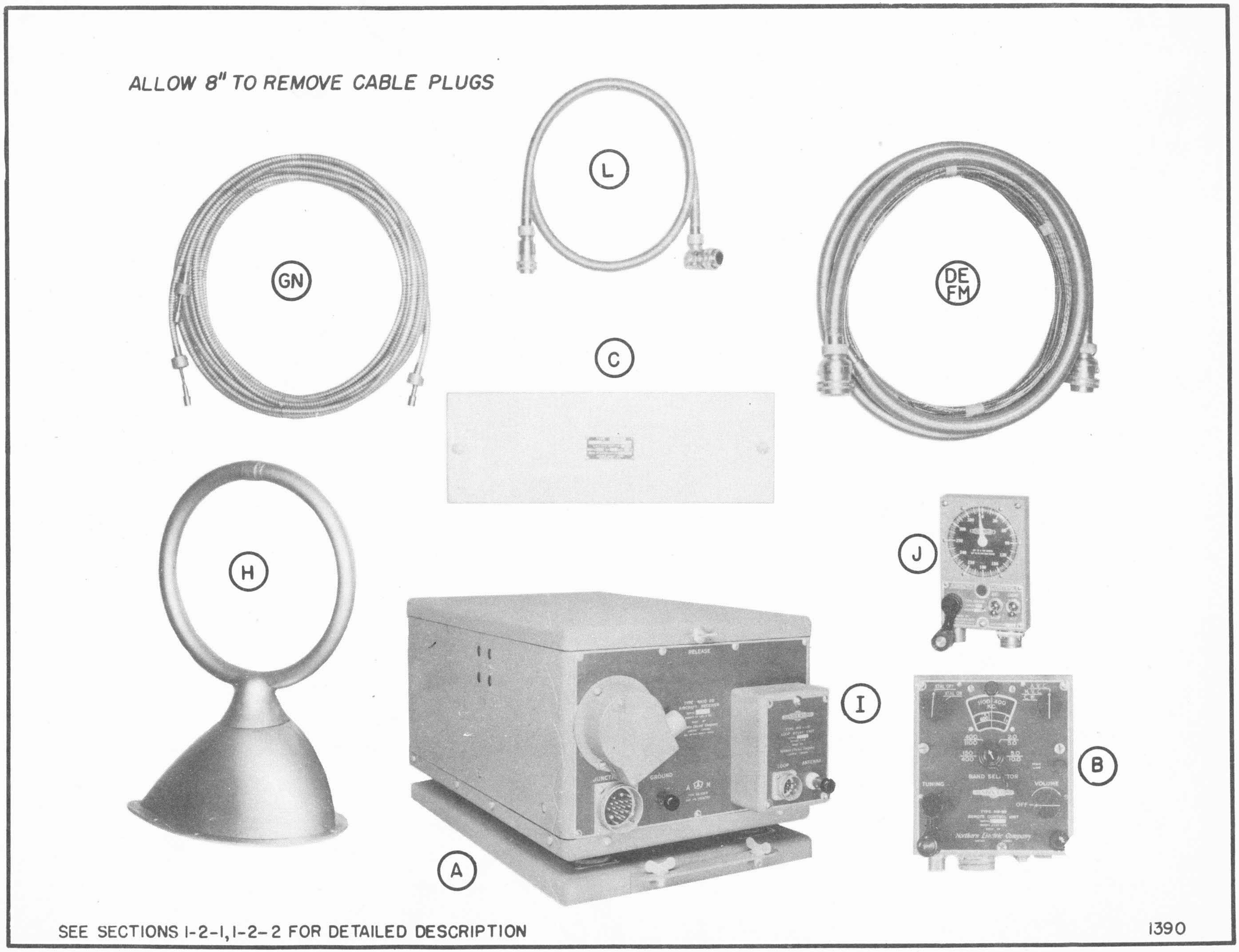

FIG.1-COMPOSITE VIEW RECEIVING & DIRECTION FINDING COMPONENTS

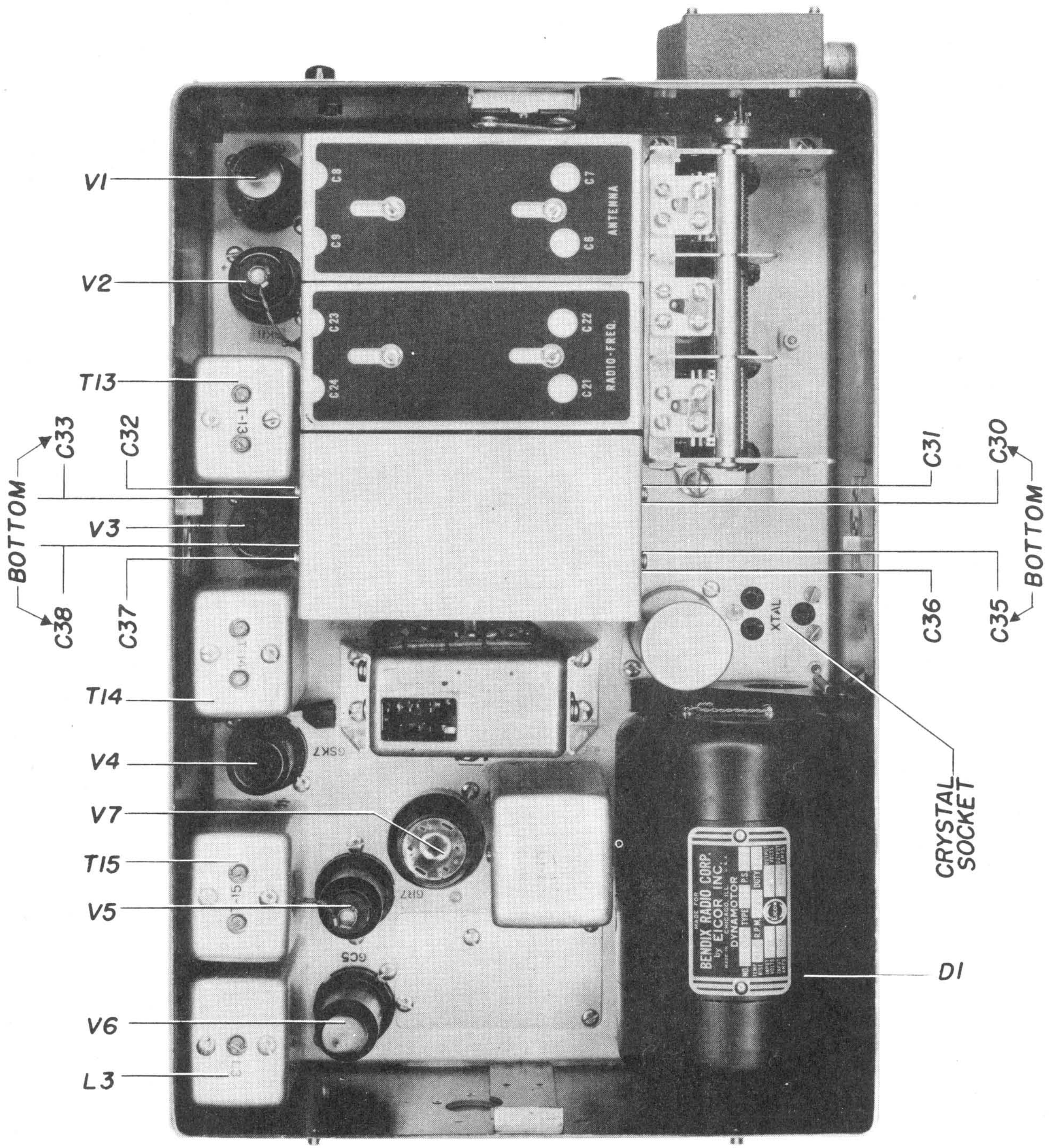

FIG. 2—TOP VIEW, RECEIVER CHASSIS

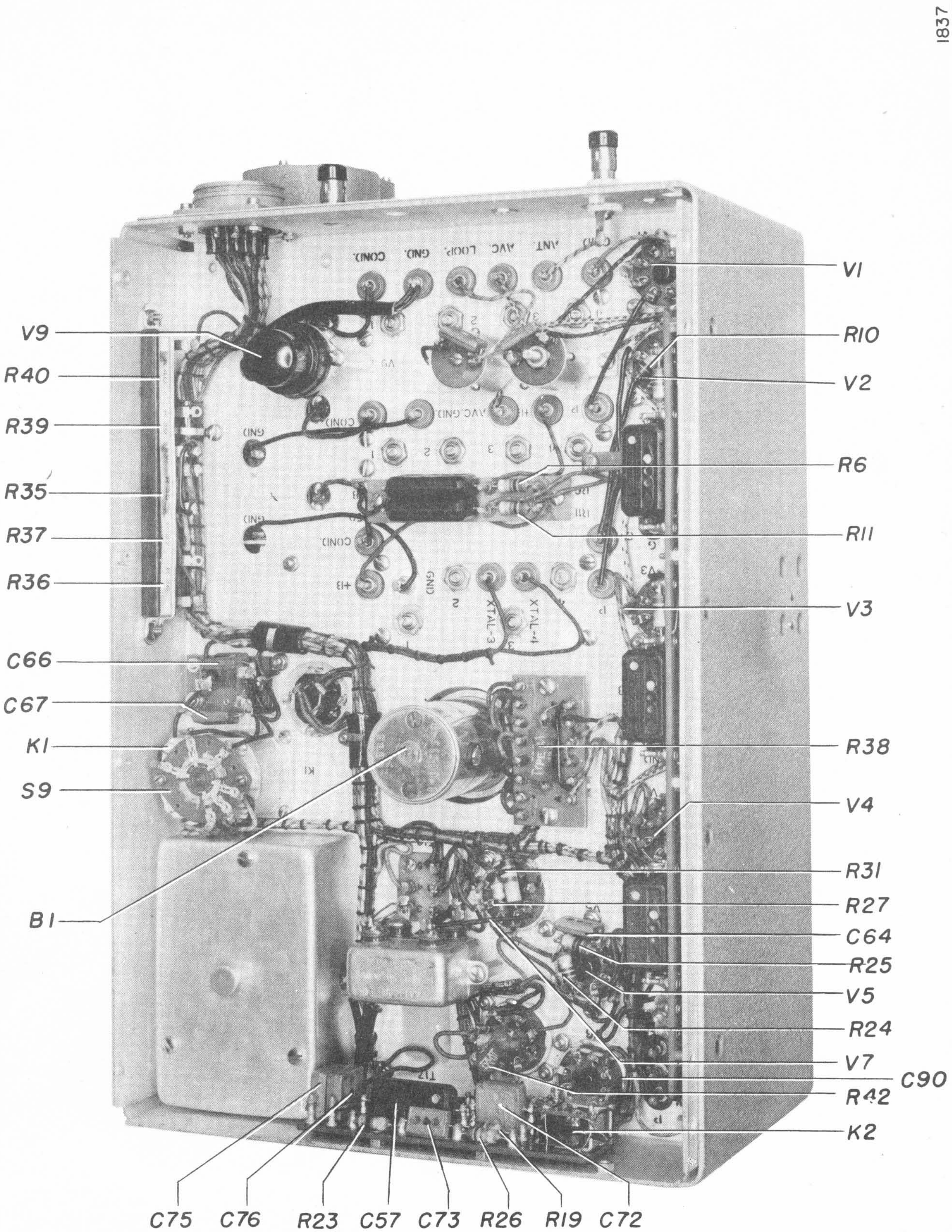

FIG. 3- RIGHT BOTTOM OBLIQUE, RECEIVER CHASSIS

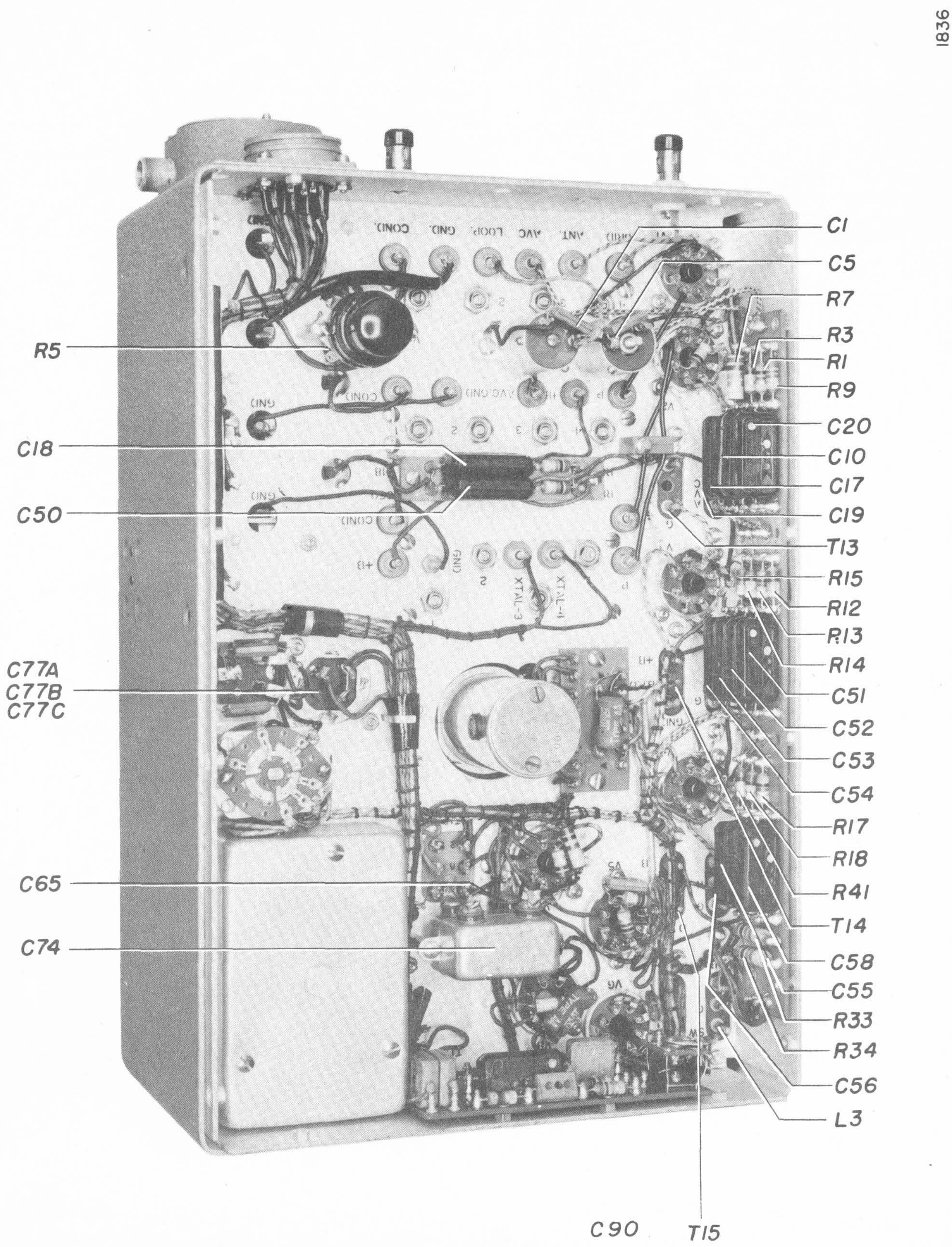

FIG.4-LEFT BOTTOM OBLIQUE, RECEIVER CHASSIS

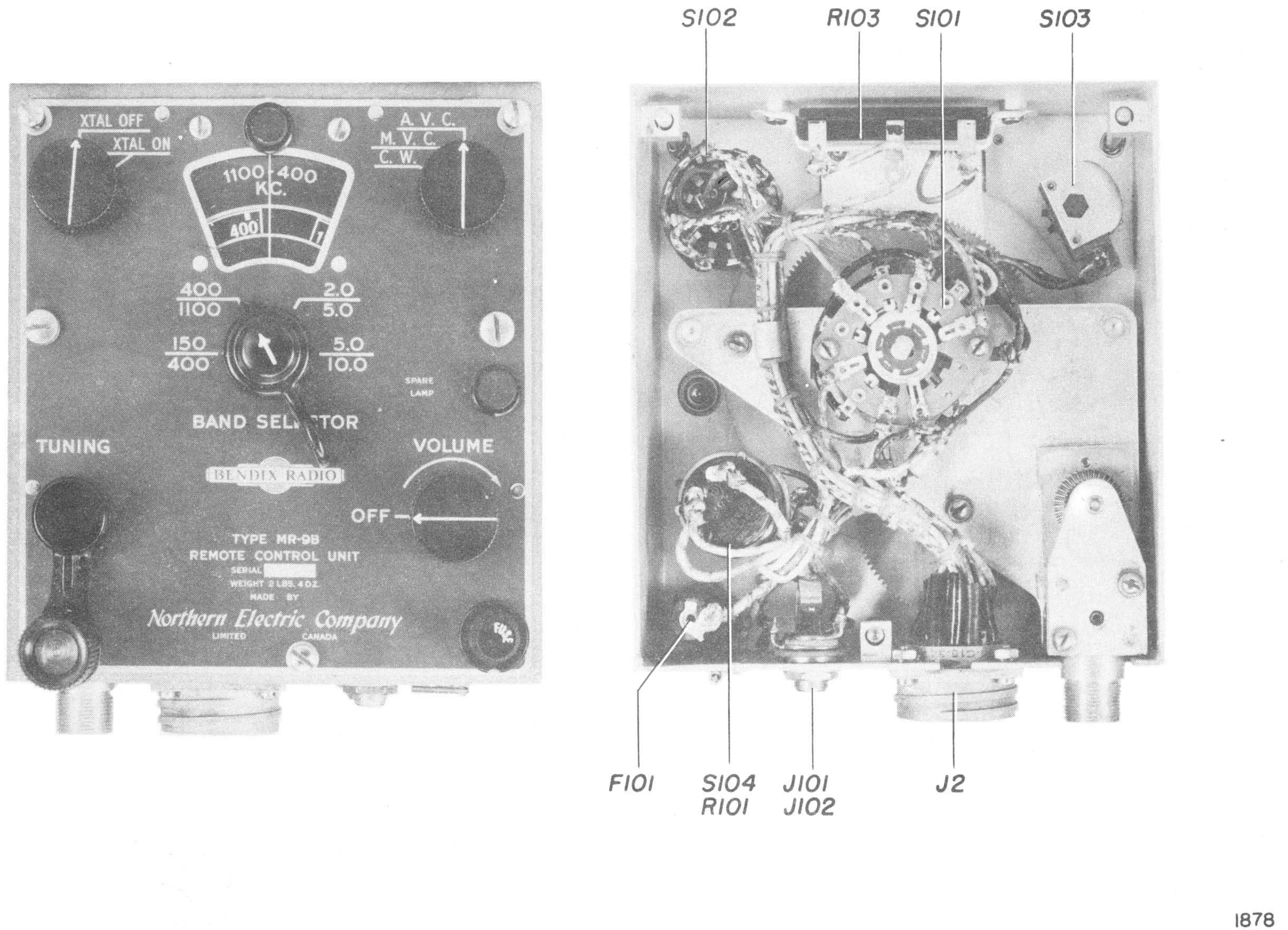

FIG.5-TYPE MR-9B OR MR-9C REMOTE CONTROL UNIT

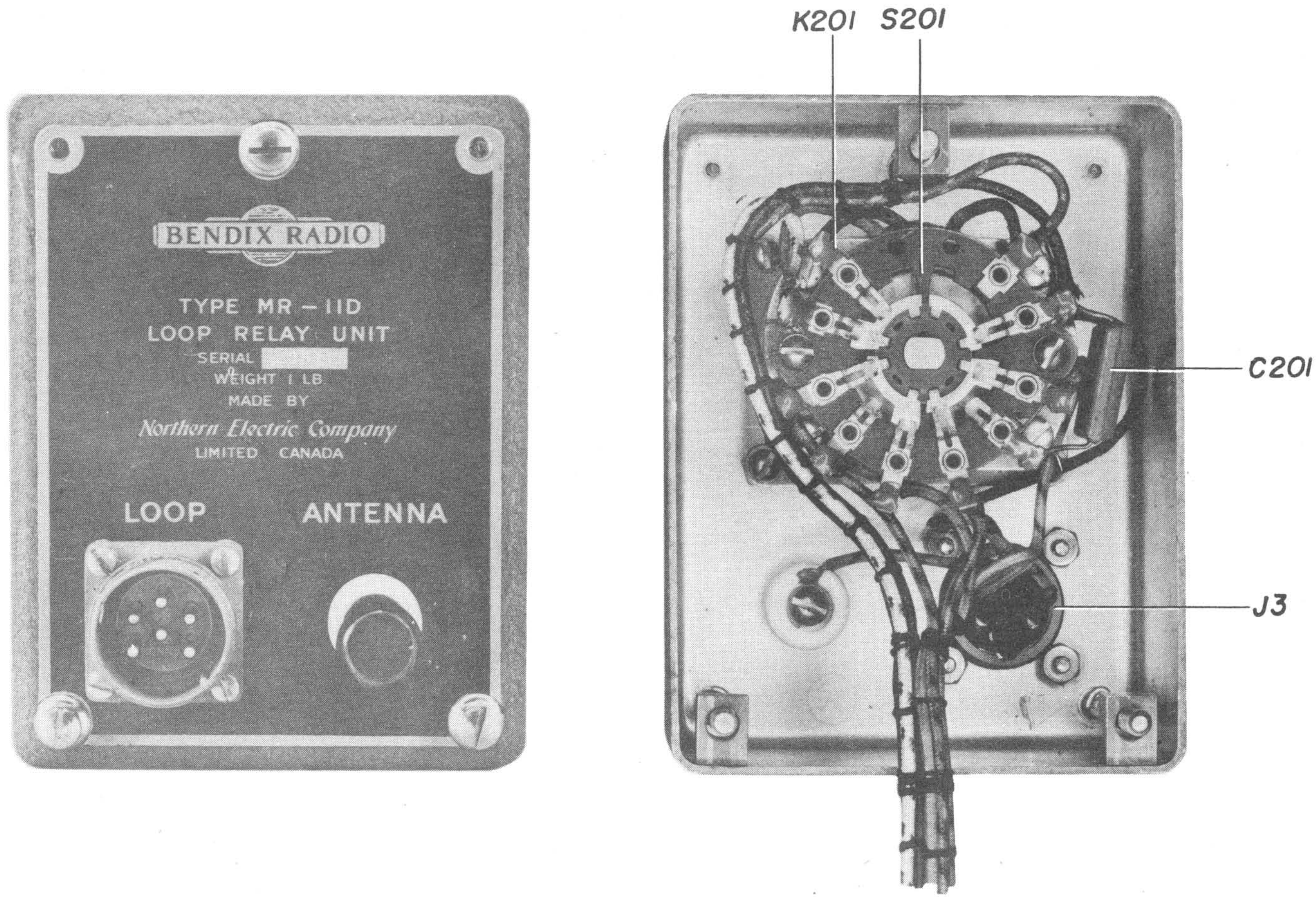

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FIG. 6 – TYPE MR-11C OR MR-11D LOOP RELAY UNIT

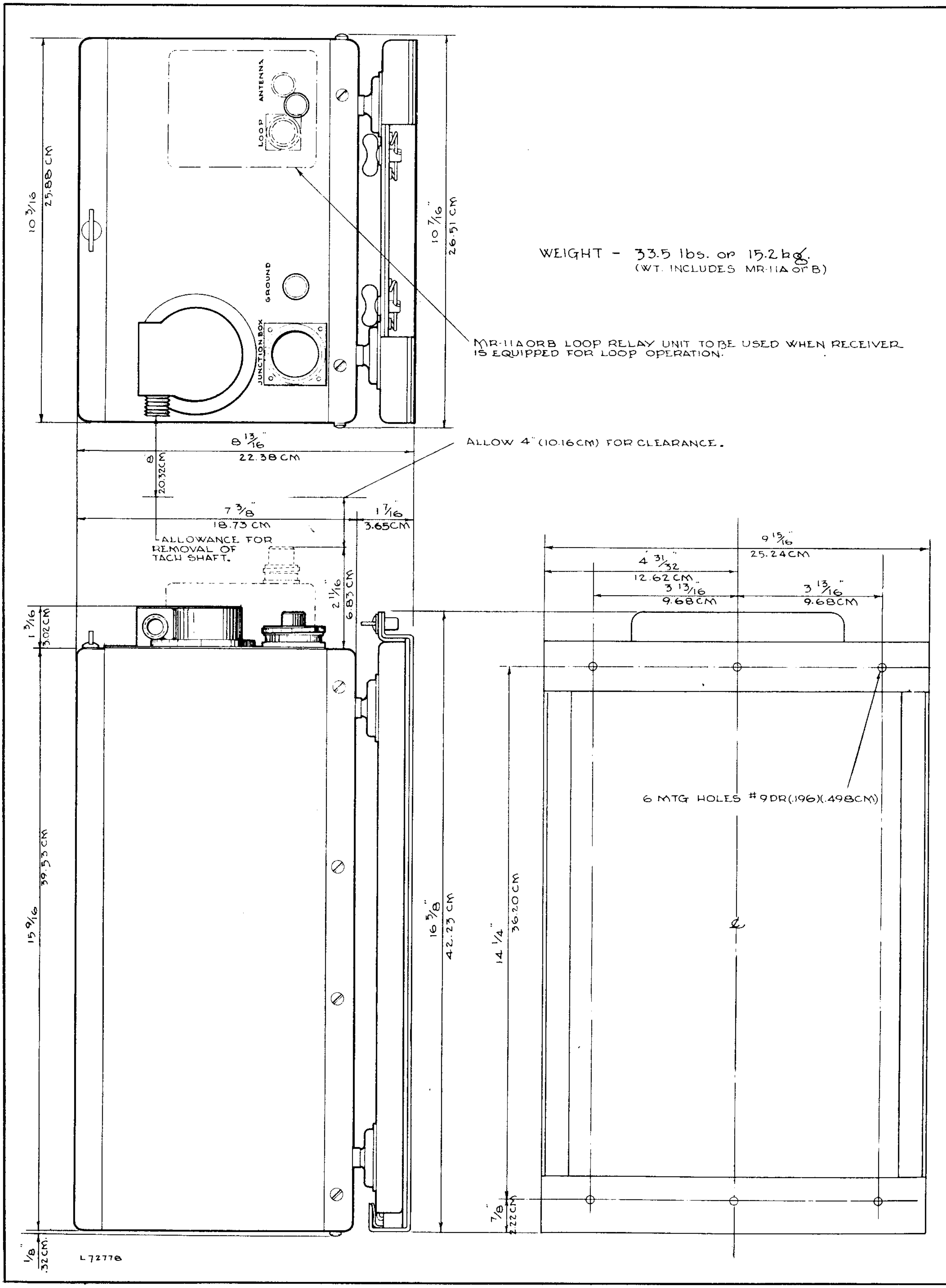


FIG. 7-OUTLINE AND MOUNTING DIMENSIONS, TYPE RA-10 SERIES RECEIVER

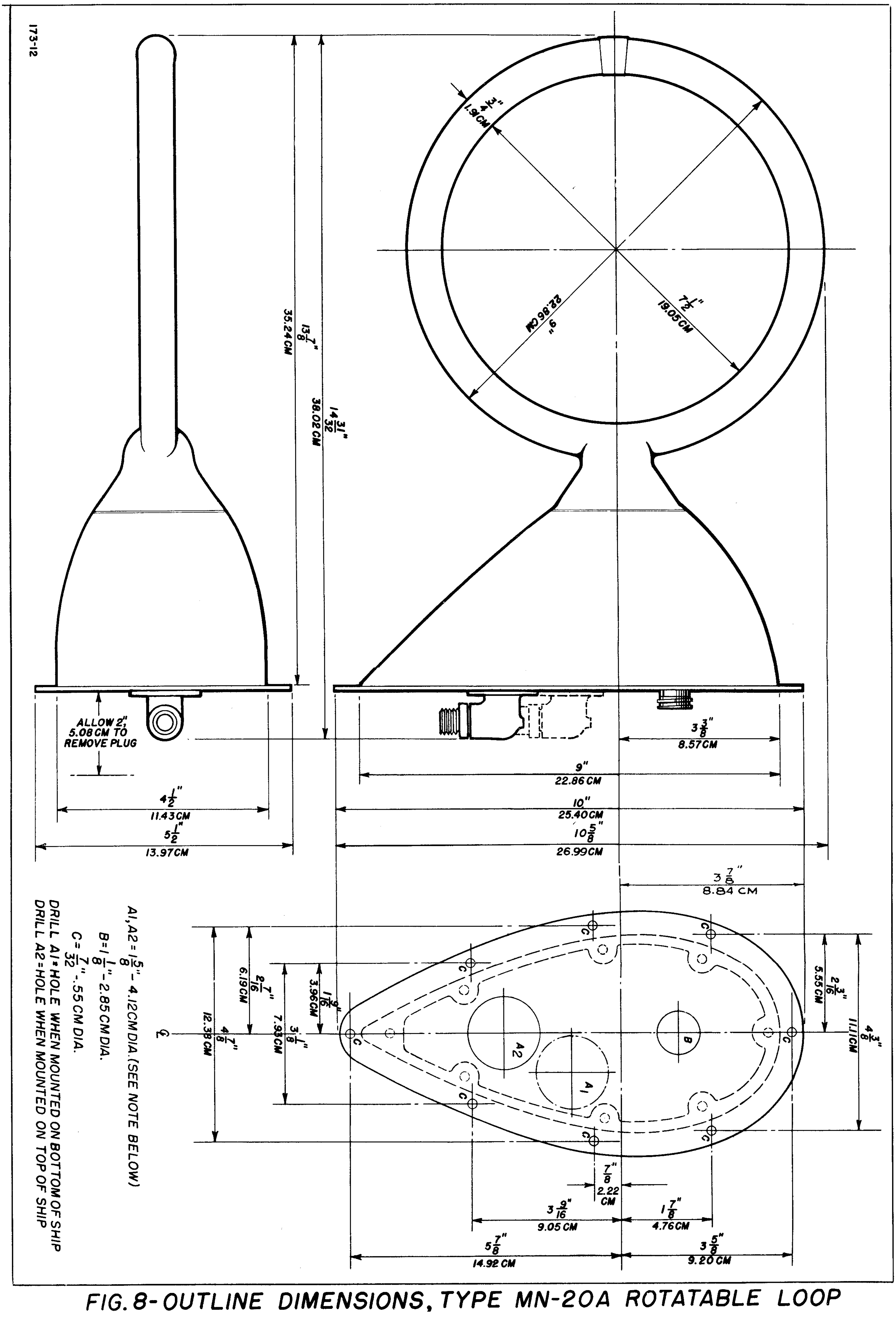


FIG. 8 - OUTLINE DIMENSIONS, TYPE MN-20A ROTATABLE LOOP

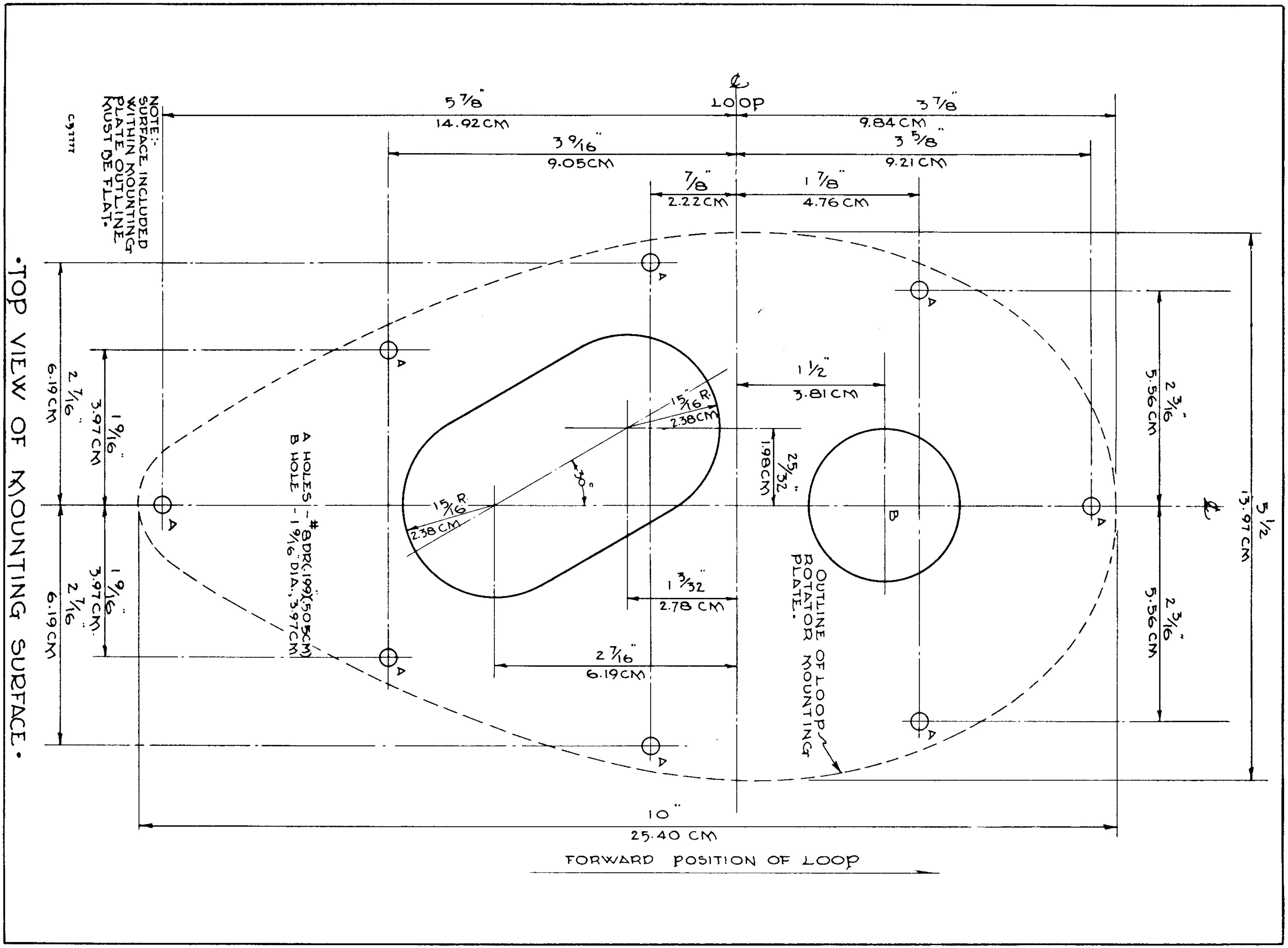


FIG. 9-LOCATION OF MOUNTING HOLES FOR TYPE MN-20 ROTATABLE LOOP

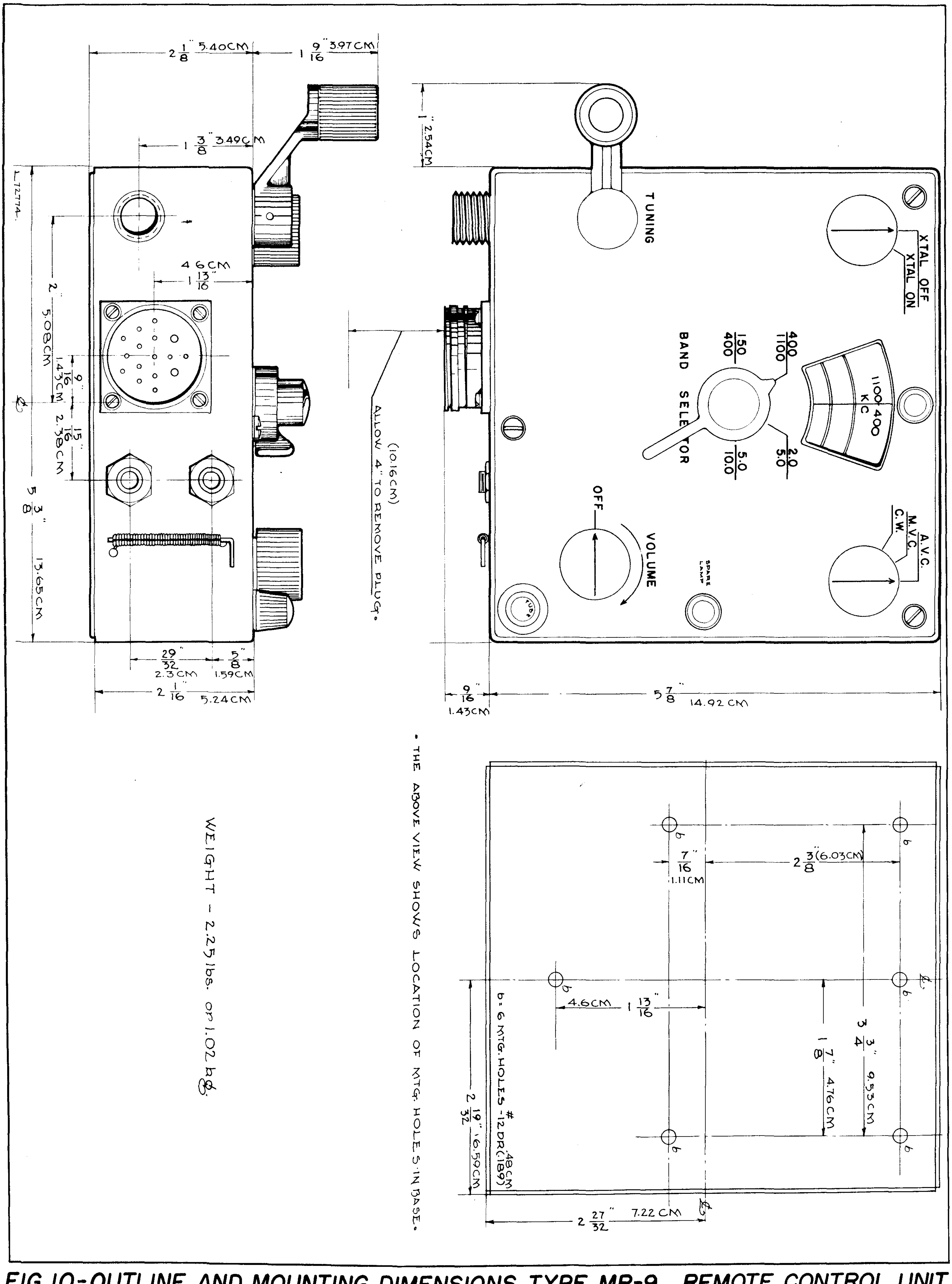
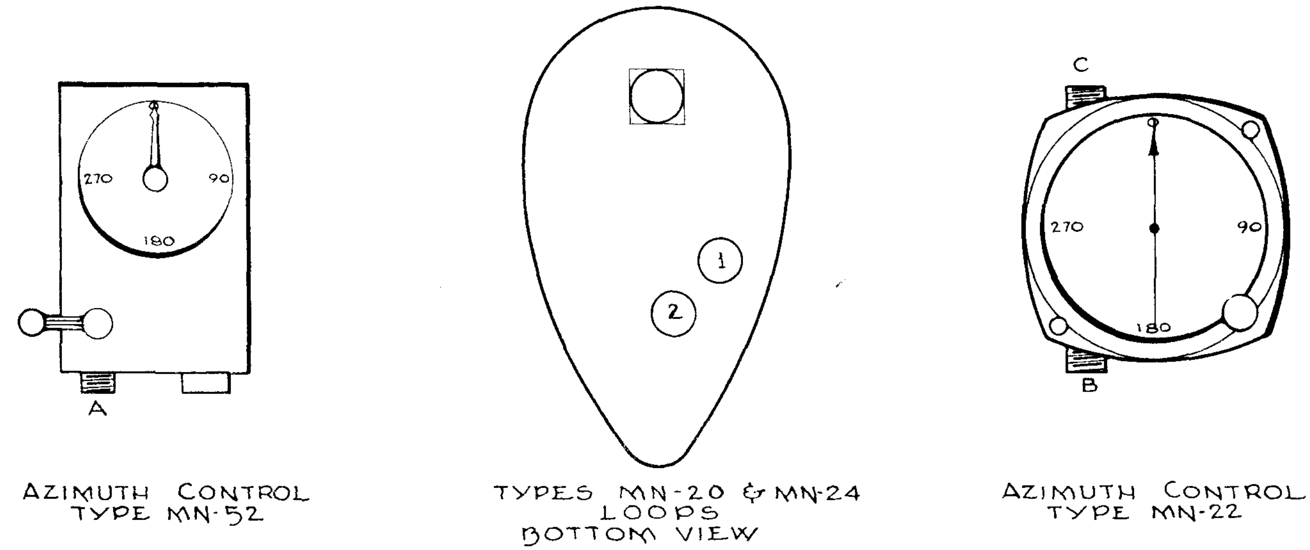


FIG. 10 - OUTLINE AND MOUNTING DIMENSIONS, TYPE MR-9 REMOTE CONTROL UNIT



• MOUNTING OF LOOP •	AZIMUTH CONTROL	TACH SHAFT CONNECTION, AZIMUTH CONT.	TACH SHAFT CONNECTION ON LOOP.
TOP OF SHIP	MN-52	A	2
BOTTOM OF SHIP	MN-52	A	1
TOP OF SHIP	MN-22	B	2
TOP OF SHIP	MN-22	C	1
BOTTOM OF SHIP	MN-22	B	1
BOTTOM OF SHIP	MN-22	C	2

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FIG. 11-TACH SHAFT CONNECTIONS FOR VARIOUS INSTALLATIONS

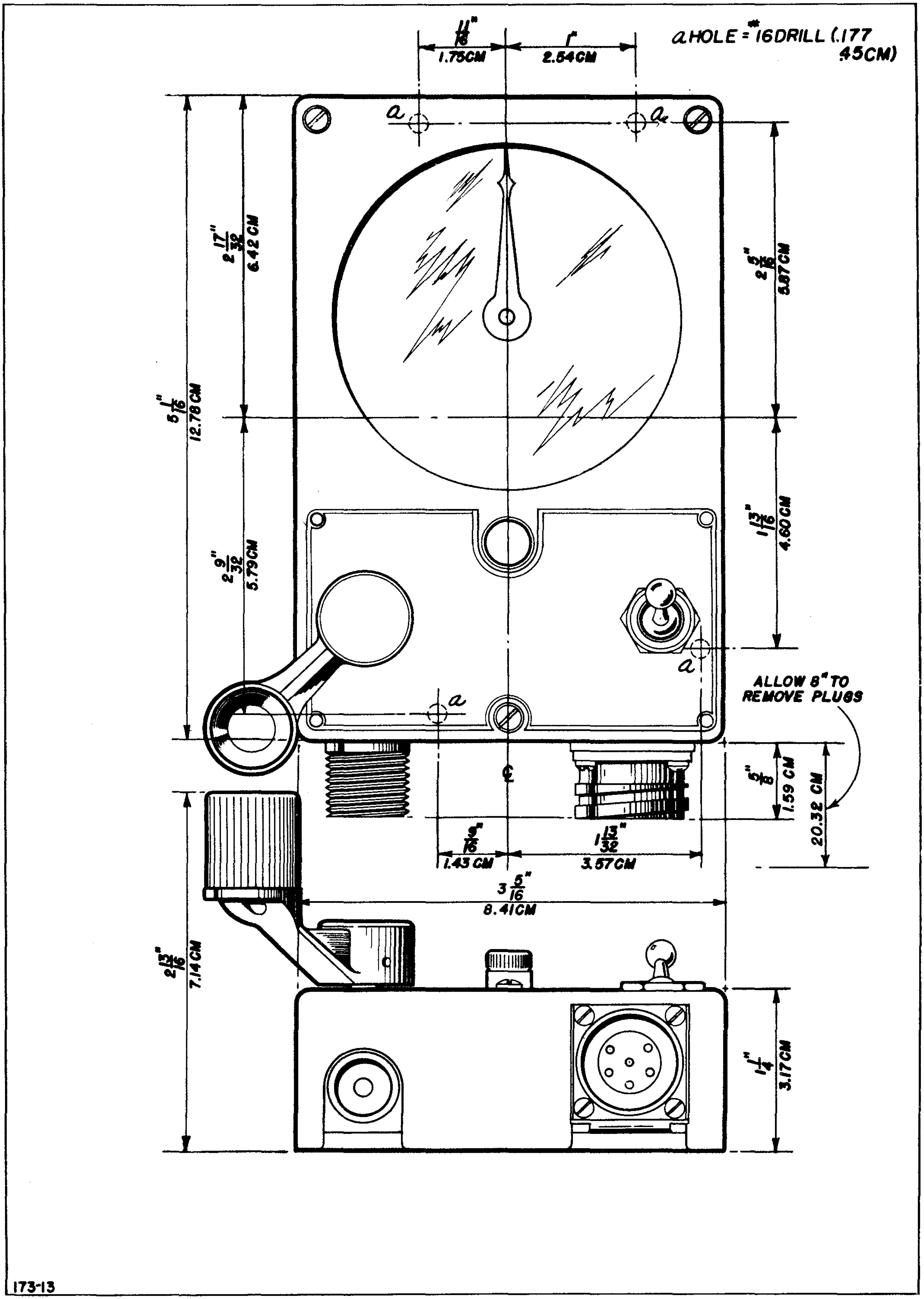

FIG.12-OUTLINE AND MOUNTING DIMENSIONS, TYPE MN-52B AZIMUTH CONTROL UNIT

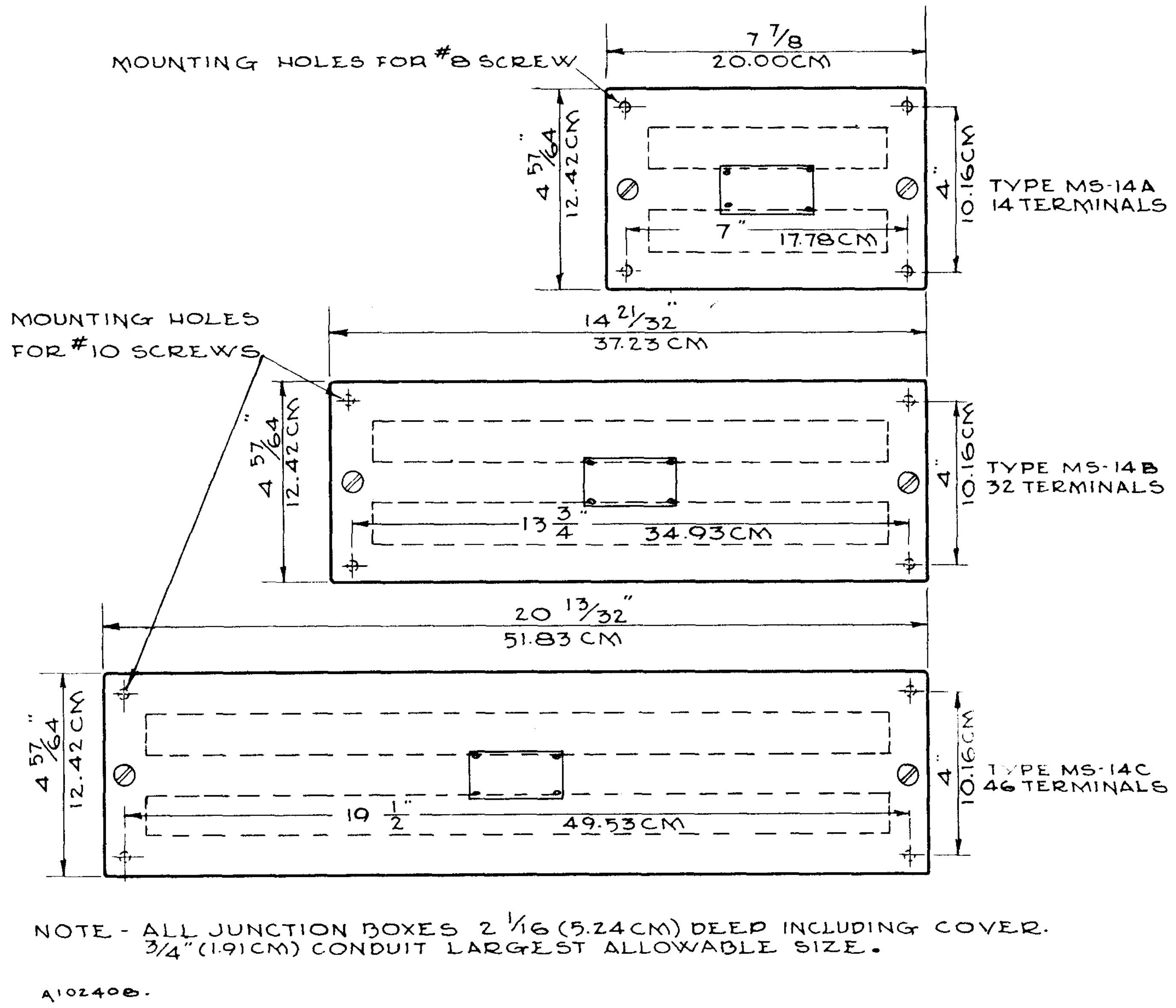

FIG.13-OUTLINE AND MOUNTING DIMENSIONS, TYPE MS-14 JUNCTION BOX

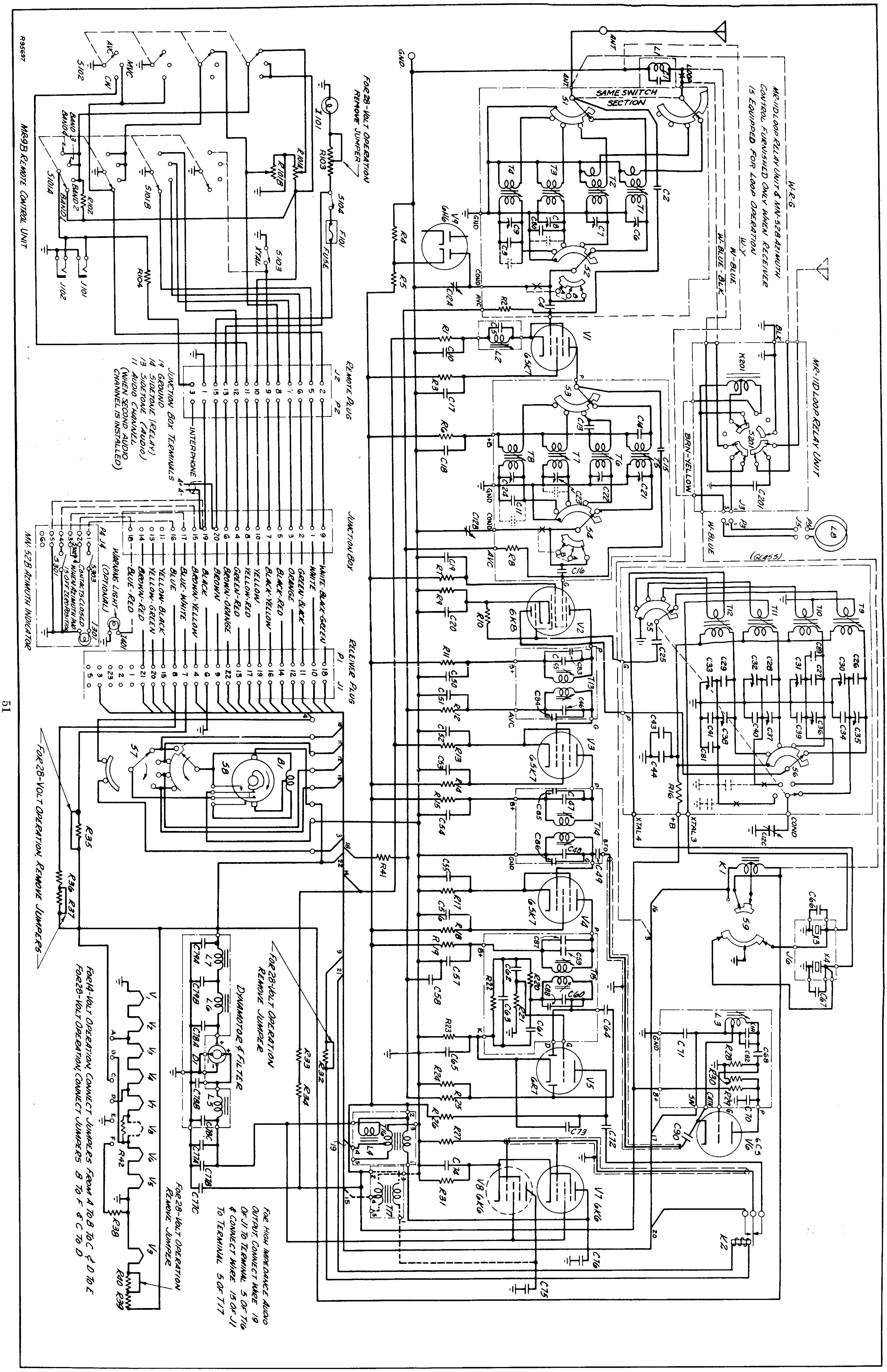

FIG. 14-SCHEMATIC DIAGRAM, RECEIVING AND DIRECTION FINDING COMPONENTS

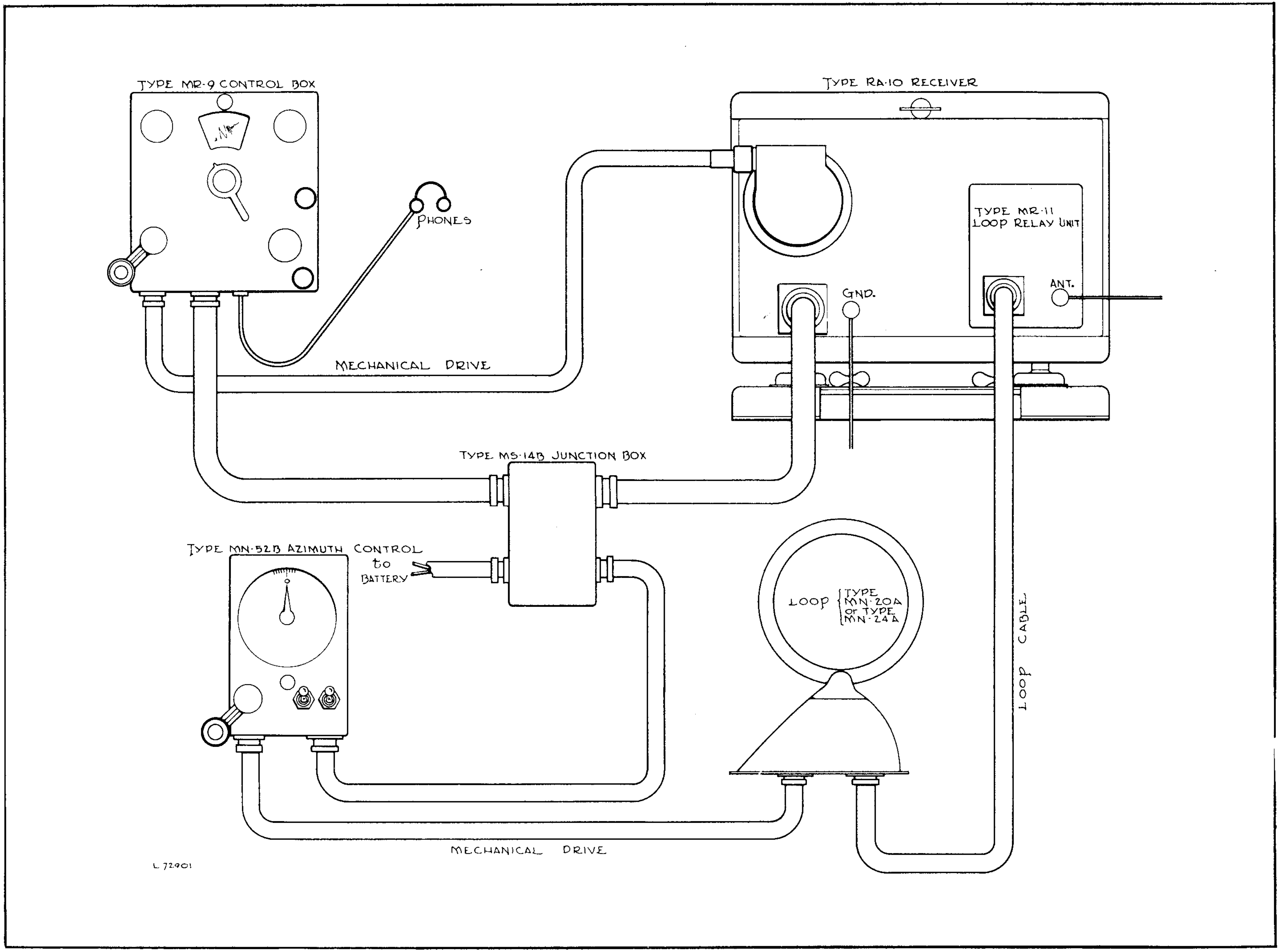

FIG.15-CORDAGE DIAGRAM, RECEIVING AND DIRECTION FINDING COMPONENTS

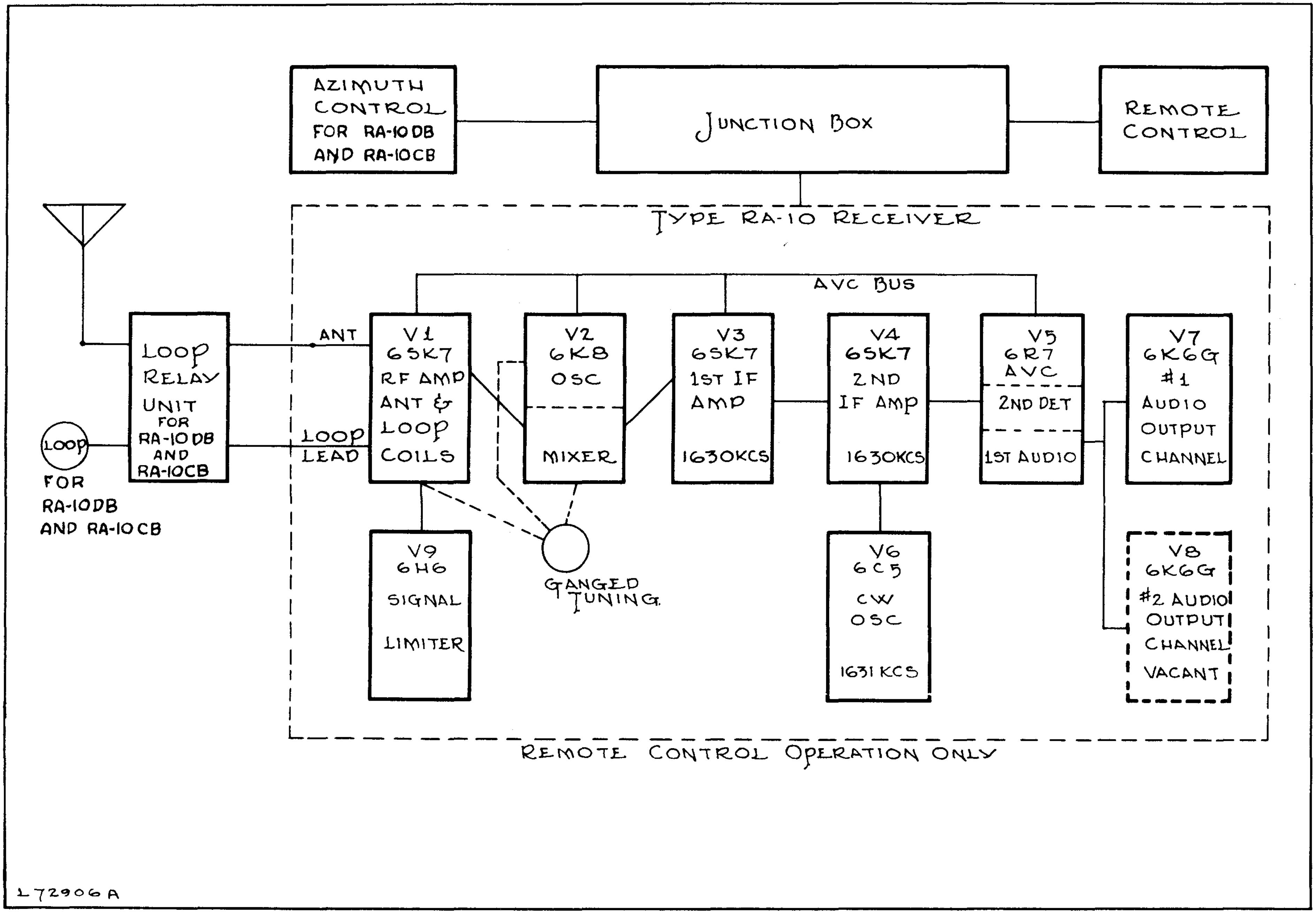

FIG. 16 BLOCK DIAGRAM, TYPE RA-10CA, RA-10DA OR RA-10DB REC.