(200)

Restricted **Serial Nº 1138**

This instruction book is furnished for the information of commissioned, warranted, enlisted and civilian personnel of the Navy whose duties involve design, instruction, operation and installation of radio and sound equipment. The word "RESTRICTED" as applied to this instruction book, signifies that this instruction book is to be read only by the above personnel, and that the contents of it should not be made known to persons not connected with the Navy.

MODELS DP-12 and DP-13
RADIO DIRECTION FINDER EQUIPMENT

Frequency Range; 100—1500 KC

Alternating Current Operation

INSTRUCTIONS

Manufactured for

NAVY DEPARTMENT—BUREAU OF SHIPS

by

RCA VICTOR DIVISION

of

RADIO CORPORATION OF AMERICA

Camden, New Jersey, U. S. A.

CONTRACT NOs-70837 CONTRACT DATE: 9 January, 1940

CONTRACT NOs-70837 (Sup) CONTRACT DATE: 12 April, 1941

105

ERRATA
IN IB-38114

MODELS DP-12 and 13 DIRECTION FINDER EQUIPMENT

To be inserted in: Final Instruction Book
Equipment Spare Parts List

(This errata supplements errata 'b')

TABLE IV

Item 18 - Add § before symbol designation

Add footnote at bottom of page iii -
§ This item to be packed with spares

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RCA VICTOR DIVISION OF RADIO CORPORATION OF AMERICA
Camden, New Jersey, U.S.A.

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GUARANTEE

All parts and spare parts, except vacuum tubes, of this equipment shall be guaranteed for a service period of one year with the understanding that, as a condition of the contract, all items found to be defective as to design, material, workmanship or manufacture shall be replaced without delay and at no expense to the Government, provided: that such guarantee and agreement shall not obligate the contractor to make replacement of defective material unless the failure occurs within a period of two years from the date of delivery of the equipment to and acceptance by the Government, and provided further, that: if any part or parts (except vacuum tubes) fail in service or are found defective in ten per cent or more of the equipments furnished under contract such part or parts shall be conclusively presumed to be of defective design, and as a condition of contract subject to one hundred per cent replacement of all similar units supplied on subject contract. Re-designed replacements which will assure proper operation of the equipment shall be supplied promptly, transportation paid, to the Naval activities using such equipment, upon receipt of proper notice and without cost to the Government. All defective parts originally furnished under contract shall be held subject to rejection and return to the contractor.

THIS PERIOD OF TWO YEARS AND THE SERVICE PERIOD OF ONE YEAR SHALL NOT INCLUDE ANY PORTION OF THE TIME THAT THE EQUIPMENT FAILS TO GIVE SATISFACTORY PERFORMANCE DUE TO DEFECTIVE ITEMS AND THE NECESSITY FOR REPLACEMENT THEREOF, AND PROVIDED FURTHER THAT ANY REPLACEMENT PART SHALL BE GUARANTEED TO GIVE ONE YEAR OF SERVICE.

Manufactured for

NAVY DEPARTMENT—BUREAU OF SHIPS

by

RCA VICTOR DIVISION

of

RADIO CORPORATION OF AMERICA

Camden, New Jersey, U. S. A.

CONTRACT NOs–70837 CONTRACT DATE: 9 JANUARY, 1940
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RADIO DIRECTION FINDER EQUIPMENT

MODELS DP-12 AND DP-13

INSTALLATION AND OPERATION INSTRUCTIONS

FREQUENCY RANGE: 100-1500 KC

ALTERNATING CURRENT OPERATION

I

INTRODUCTION

In order to obtain optimum performance from this equipment, the following instructions should be carefully studied before installation or operation is attempted.

1.1 These instructions cover the installation, operation and servicing of the Direction Finder Equipment specified above. This equipment is designed to operate from 115 volt, 60 cycle, single phase service. The receiver is of the superheterodyne type and covers the frequency range of 100 to 1500 kc. When properly installed and calibrated the equipment will accurately indicate the direction of propagation of pure or modulated continuous wave signals, either keyed or unkeyed, at any frequency within this band.

1.2 The receivers for these equipments have an antenna input protective relay and neon protective device. The relay is equipped with back contacts which ground the antenna input circuit when the receiver is not in use. The neon protective device bypasses high voltages which may be induced from nearby transmitting antennas when the receiver is in operation. An electronic output indicator also has been added, which aids in taking bearings on C-W signals. Other minor mechanical features have been improved.

1.3 A shielded transmission line, loop output junction box, and receiver input transformer are supplied for connection between the loop and the receiver. The transmission line must be cut to a suitable length when it is installed.

1.4 For all equipments, the incidental mounting hardware, drive shaft extensions, and tools required for making the installation are to be furnished by the Navy.

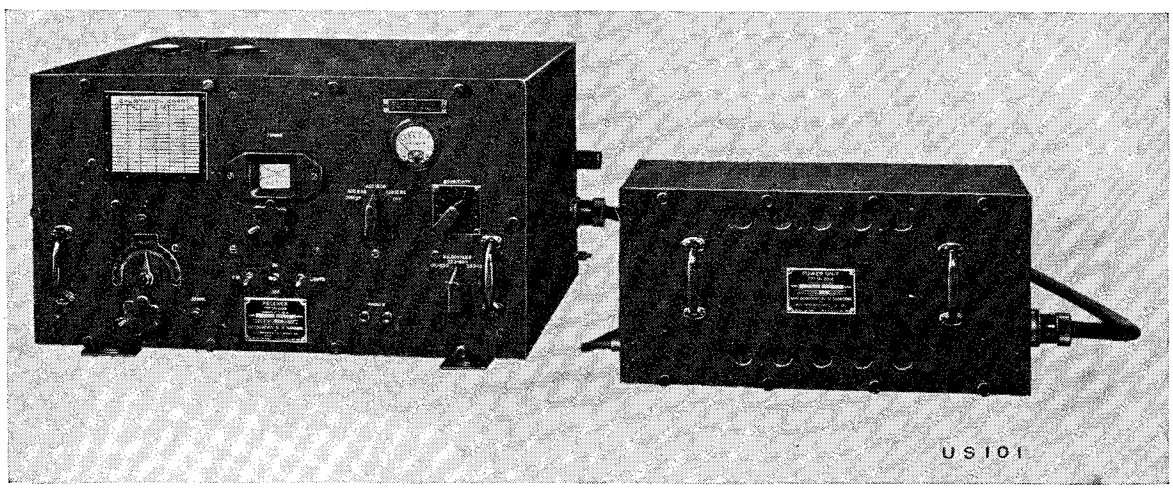

Figure 1—Direction Finder, Receiver and Power Unit

II
EQUIPMENT

2.1 The following table lists all units and accessories furnished with each equipment.

Item	Quantity DP-12	DP-13	Description	CRV No.	Drawing Reference	Weight Lbs.
a	1	1	Loop	69046	T-620135-501	18
b	1	1	Loop Pedestal	69047	T-620045-502	41
c	1	1	Operating Pedestal	69011	T-601377-501	30
d	2	1	Deck Bearing	69008	P-701471-501	9
e	2	2	Cable Drum	69009	P-701479-501	13
f	1	1	Handwheel	69012A	M-421331-501	4¼
g	1	1	Azimuth Scale	69013	P-701459-501	3
h	1	1	Loop Output Junction Box	62029	P-701912-501	4½
i	1	1	Receiver Input Transformer	47180	P-701912-502	6
j	1	1	Transmission Line and Conduit	62030	M-421592-502	4
k	1	1	Radio Receiver	46136	W-302223-503	93
l	1	1	Power Unit	20049	T-601584-503	35
m	1	1	Power Cable		M-413378-501	3
n	1	1	Spare Parts and Box		See Table III	19
o	4	3	Deck Crib		P-7755062-11	2
p	4	3	Deck Crib		P-7755062-12	2
q	2	2	Deck Plate		K-815007-2	1
r	1	1	Drill Jig		K-806427-1	
s	3	3	Pin		K-815493-3	
t	1	1	Taper Reamer		K-806429-1	
u	1	1	Can of Neoprene Cement			
v	2	2	Set of Vacuum Tubes (including one set of spare tubes)			
w	2	2	Instruction Book			

Items r, s, t, and u are included in a cloth bag.

The following accessories are contained in a second cloth bag, and are required for the installation of the transmission line conduit:

Item	Quantity DP-12	DP-13	Description	Drawing Reference
(A)	2	2	Connector, Bulkhead	K-866286-1
(B)	2	2	Gaskets, for item (A)	K-815581-5
(C)	2	2	Gaskets, for item j	K-815581-6
(D)	2	2	Washers, for item (A)	K-866292-1
(E)	2	2	Locknuts, for item (A)	K-866283-3
(F)	2	2	Nut	K-875014-1
(G)	2	2	Ferrule	K-875013-1

III
INSTALLATION

3.1 CHOICE OF LOCATION—In choosing the location aboard ship for the mounting of the Direction Finder apparatus, consideration should be given to the following requirements: Mount the loop on the keel line of the ship if possible. This will simplify correcting adjustments. The deviation curve generally becomes sinusoidal if the loop is mounted exactly on the keel line.

3.2 Select a location where the loop will be removed as far as possible from all conducting objects, such as bulkheads, masts, stacks, and stays. Particularly should it be kept from objects which have considerable height or which form closed loops, such as handrails, rigging, etc.

3.3 Locate the loop drive handwheel and indicator scale in a position convenient to the operator and within easy reading distance. If otherwise practical, locate the equipment so that the operator faces the bow or the stern of the ship, with the handwheel and azimuth scale to the left of the receiver.

3.4 Mount the receiver in such a manner that the panel will face the operator within easy reading distance, so that the controls may be adjusted without requiring the operator to change his normal position.

3.5 The equipment is designed only for Direction Finder installations where remote control operation is a necessity. A transmission line loop output junction box and receiver input transformer are used to connect the loop winding and the receiver input. The loop and its pedestal assembly must be so located, with respect to the operating pedestal and receiver, that the required shielded transmission line between the loop output junction box and receiver input transformer, Types CRV-62029 and CRV-47180 respectively, will not be in excess of 35 feet in length. See paragraph 3.69.

3.6 The loop and its supporting pedestal may be located in different positions with respect to the operating pedestal, as follows:

(1) Both pedestals on the same deck with cable drums and drive cables beneath the deck.

(2) The loop pedestal may be remotely located either on the deck overhead or on a platform elevated above the deck on which the operating pedestal is located. Note that the deck bearing supplied is always required on the upper or lower end of the drive shaft of the operating pedestal when an installation is made under one of the above conditions.

3.7 Variations of the above installations are possible; the loop and its pedestal are constructed for either upright or inverted operation. See Figure 17 for normal mounting.

3.8 It is preferable so to arrange the installation that the operating pedestal and deck bearing are mounted on opposite sides of the same deck. This precludes all relative movement between these items during vibration and shock, permits alignment of the units and allows closer clearance to be maintained between the azimuth scale and the fiducial mark. After the type of installation has been determined for the selected location from those given in paragraph 3.6, see that the location decided upon provides sufficient clearance on the overhead below or above the deck on which the pedestals are mounted, for the respective deck bearings, cable drums and runway for the drive cables.

3.9 Should structural difficulties prohibit a straight runway for the drive cables between the cable drums, which must be in the same horizontal plane, it is suggested that reliable adjustable idler pulleys be employed to provide for any

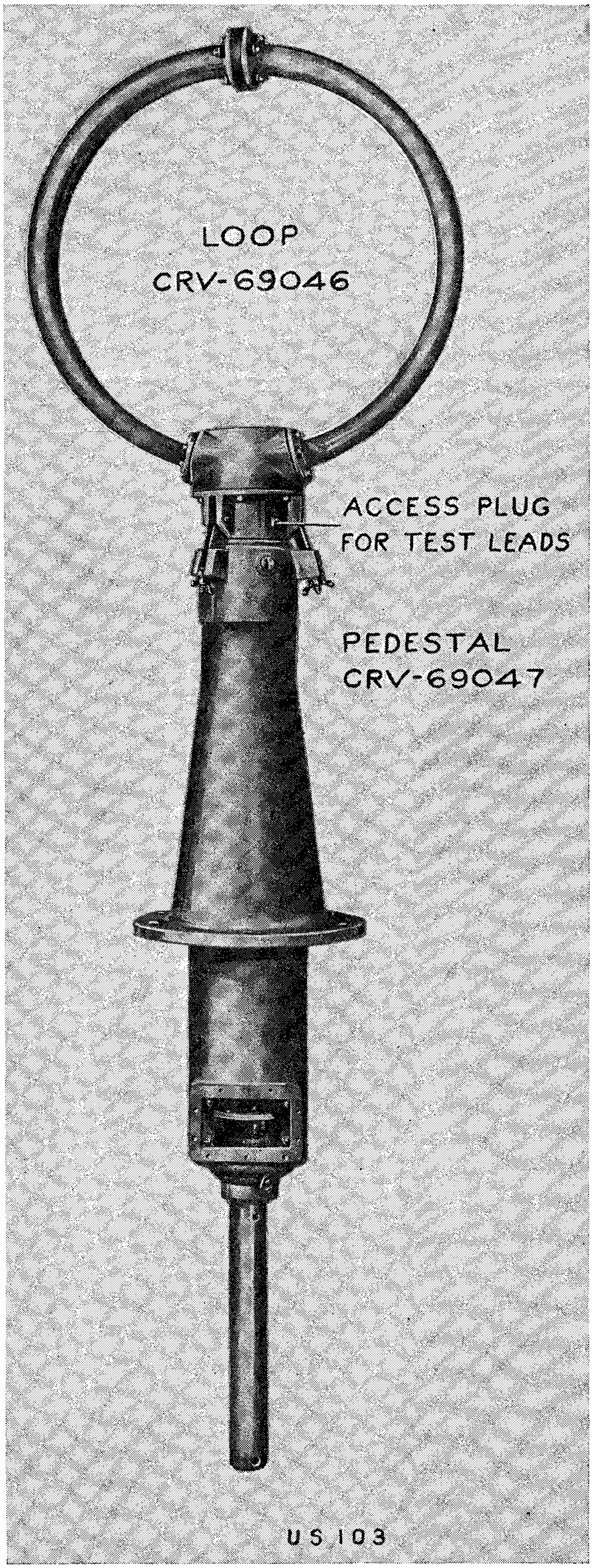

Figure 2—Loop and Pedestal Assembly

required offset in the cables. Idler pulleys are also desirable on long cable runs to reduce the sag of the cables and to minimize backlash. It is important that as much cable weight as possible be supported by idler pulleys to minimize backlash and remove strain from the pedestal bearings.

3.10 Except for ballbearings, transformer laminations and a few miscellaneous small parts, the Direction Finder is made of non-magnetic materials. If it is not placed closer than six feet to the ship' s magnetic compass, it will have no effect upon its function. If located less than this distance, the magnetic compass should be rechecked after the installation has been completed.

3.11 TREATMENT OF SHIP'S RIGGING— Deviations due to the influence of nearby metallic objects can be reduced to a minimum by locating the loop as far as possible from the object which may produce displacement errors. In any case, make certain that any object causing error will not be moved. Such metallic objects should be **permanently** grounded and, if necessary, bonded. In a great majority of cases it may be necessary to erect "Corrector" loops around or "jumpers" over the coil in order to reduce the maximum deviation. The arrangement of such devices must be considered for each individual type of vessel with respect to the location of the loop and the surrounding structure and in most cases must be determined by trial and error methods. In addition, the ends of all "Corrector" jumpers, wherever practicable, should be welded or brazed to the ship's structure. Bolted lugs will usually not maintain sufficient constancy of resistance. The resistance of the "Correctors" themselves is and must be extremely low; any small variation in the resistance of the end contacts will produce serious changes in deviation.

3.12 Wires not used as electrical conductors should have their conductivity interrupted at five to eight-foot intervals by inserting strain insulators. This practice will prevent the re-radiation of energy at frequencies to which the Direction Finder will be tuned. This applies to whistle cords, signal halyard triatics, standing rigging, etc. In cases where the rigging cannot be properly insulated, it should be bonded in such a way as to make a permanent grounded connection.

3.13. The use of copper ground clamps and wire for bonding stays is unsatisfactory, because of chemical and electrolytic action. Therefore, wherever possible, use steel or galvanized clamps and steel wire. Wherever possible, it is recommended that 7/18 or 7/22 steel wire be inserted into the twist of the stay and either electrically welded or clamped, the other end to be welded to the thimble of the stay or run down and welded or bolted to the eye in the deck. The breaking or corrosion of these bonds will, in most cases, cause a constant or varying error in calibration, the cause of which is hard to locate. Particular attention should be given to the periodic inspection of bonds.

3.14 The use of electrical "correcting jumpers" with this equipment is desirable. They should be used to reduce deviation as much as possible before the final calibration.

3.15 UNPACKING THE EQUIPMENT—When unpacking the equipment, a careful check should be made to ascertain that all small parts listed under "Equipment" in paragraph 2.1 have been received. Care should be exercised in handling the aluminum alloy castings, and particularly the bottom portion of the loop, to make certain no injury occurs to the hanger bolts or to the contact plugs located in the upper end of the pedestal casting.

After the equipment has been unpacked, it should not be left exposed to the weather. Although the loop and loop pedestal are watertight when installed, they will be damaged if exposed to the weather prior to installation.

3.16 LOCATING THE OPERATING PEDESTAL—Determine the exact location for the operating pedestal assembly, ascertaining if there is sufficient clearance for mounting the cable drum and deck bearing either on the overhead, the overhead of the deck above, or below the deck on which the operating pedestal is located. See paragraph 3.6. Make certain that there is ample room inside the operating compartment for the operator to turn the handwheel. See Figure 27.

3.17 LOCATING LOOP AND DRIVE ASSEMBLY—In choosing the location for the loop and drive assembly, ascertain if the deck above is clear for mounting the loop and pedestal. See that there is sufficient clearance for the loop to rotate within a circle of approximately 24 inches in diameter. See Figure 24.

3.18 LOCATING RECEIVER AND POWER UNIT—When the loop and drive assembly has been properly located, determine the position for the receiver and power unit which will provide maximum accessibility for the operator.

3.19 LOCATING PEDESTALS—Spot or drill a small hole through each of the decks at the point which will be the center of each of the pedestals. Spotting or drilling this hole will give the proper location for placing the deck cribs. If the operating pedestal does not have its cable drum on the opposite side of the deck from the pedestal, it will not be necessary to drill any hole for this unit. However, the exact center of this pedestal should be marked, in order to locate the center of the deck bearing mounting on the overhead or the deck above.

3.20 CUTTING OPENINGS FOR PEDESTALS—Using the above holes as centers, scribe circles 7 inches in diameter. These circles are used as outlines for locating the operating pedestal cribs and the deck bearings and for cutting a hole of this size through the deck for the loop pedestal. This may be done in any suitable manner provided no burrs are left around the edges. If the cable drum is on the opposite side of the deck from the operating pedestal, it will also be necessary to provide a clearance hole for the drive shaft in the deck using the hole previously made as a center.

Figure 3—Operating Pedestal, Azimuth Scale and Handwheel

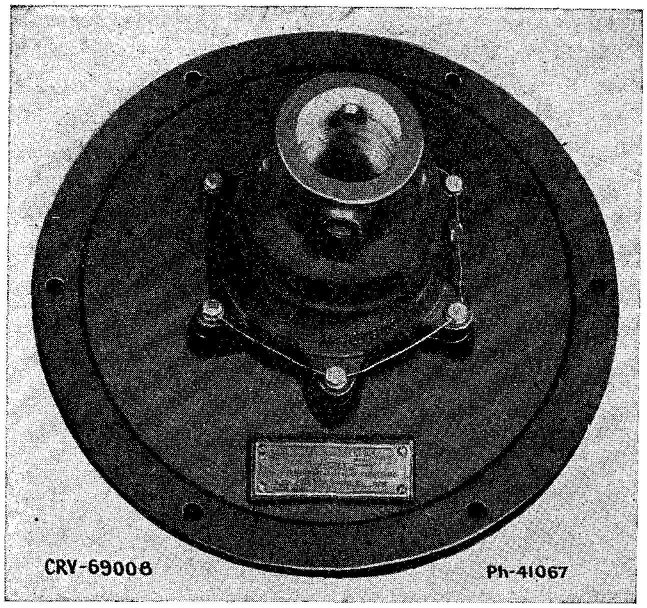

Figure 4—Deck Bearing

3.21 LOCATION OF DECK BEARING—The deck bearings usually take up the thrust in the shafts extending from the operating or loop pedestals, although one may act as a guide bearing, and are located directly above or below these pedestals. In case the bearing for the operating pedestal is on the underside of the deck from the operating pedestal, it can be secured in place by means of through bolts and nuts, extending through the pedestal flange, pedestal cribs, deck, deck bearing cribs and deck bearing flange. When mounted on the overhead above the pedestal or on the deck above, it may be secured by bolts or lag screws into that deck, or overhead, cribs being used between the deck and the deck bearing for perpendicular alignment purposes. The deck bearing for the loop pedestal shaft may ordinarily be located on the deck below that on which the loop pedestal is located, secured by bolts or lag screws into that deck overhead. If the deck is perfectly flat, it may not be necessary to use cribs when installing the bearing. This can best be determined at the time of installation. Note that it will be necessary to provide a hole in the deck beneath this bearing to pass the drive shaft extension when the cable drum is used below this bearing.

3.22 The use of a dummy shaft, secured to the deck bearing by use of the teat screws as set screws, will facilitate the location and installation of the deck bearings and cribs. After installation remove cap screw and fill with grease, Alemite "Temprite Sub-Zero," or equivalent.

3.23 ADJUSTING CRIBS FOR PROPER AXIS OF ROTATION—If a rake and camber of the deck is present, the wooden cribs must be adjusted to make the center line of the loop-pedestal perpendicular to the beam of the ship, or plumb in the case of shore installation. This may be accomplished as follows: Place the two halves on the deck, centered over the 7 inch hole, with the rounded edge of the upper crib facing upward. Remove the brush opening casting from the loop pedestal, leaving the Neoprene gasket cemented in place on the pedestal. Set the pedestal loosely in the position it is to occupy on the crib. The two halves of the crib must be adjusted to make the center line of the pedestal perpendicular to the beam of the ship and parallel to a thwartship bulkhead. Rotating one crib with respect to the other will take care of the rake of the deck. Rotating both cribs together will take care of the camber of the deck. Be sure that the two halves coincide. When the correct position of the cribs has been established, mark a heavy chalk line across the edges of both cribs and out on the adjacent deck. Also mark a line around the cribs. This is done so that the cribs may be easily replaced in the same position.

3.24 In installations where the operating pedestal is mounted on the overhead, the rake and camber of the overhead will usually be the same as the deck above, on which the deck bearing is mounted. In such cases, it will usually be advantageous to adjust the pedestal cribs in an inverted position with rounded edge against the deck and under the deck bearing. When properly adjusted and marked, transfer them to their final location under the operating pedestal and in their proper relative position. The cribs to be permanently associated with the deck bearings may then be adjusted.

3.25 In adjusting the cribs under the deck bearing, a length of drive shaft—the actual operating pedestal shaft will do—should be temporarily secured in the bearing near one end. The other end will project into the operating room. Adjustment of the cribs should then be made as described in paragraph 3.23, using the shaft for alignment purposes.

3.26 In the preliminary adjustment of the units, necessitating the securing of the drive shafts to couplings or bearings, it is recommended that the teat screws be removed temporarily and replaced by 7/16-20 x 1⅛" brass machine screws to preclude scoring or denting of the shafts. The teat screws should be carefully retained for final installation. To gain access to the teat screws in the operating pedestal bearing, remove the large plug screw with the flat slotted head located in the skirt about half way up the pedestal. Rotate the bearing until each teat screw lines up with the hole and remove each screw in turn.

3.27 CUTTING DRIVE SHAFT—The length of drive shaft necessary is dependent on the arrangement and location of pedestals, as follows:

3.28 If the operating pedestal and the loop pedestal are on the same deck, with the cable drums located directly beneath the deck, it will be necessary to provide a drive shaft extending from the operating handwheel down through the pedestal and deck bearing and terminating at the cable drum, which must be in the same horizontal plane with the cable drum on the loop pedestal. The cable drums and drive cable runway should be located as near to the overhead as possible to provide as great a clearance above deck as is consistent with good practice and at the same time reduce the difficulty of housing the cable drum, drive cable runway, etc., external to the operating compartment, and out over open deck in order to maintain the gastight integrity of the vessel.

3.29 If the loop pedestal is mounted on the deck or on a platform above the elevation of the operating pedestal, it will be necessary to provide a shaft extending upward from the operating pedestal to a deck bearing located on the underside of the deck above.

3.30 From actual measured dimensions of the installation and from the dimensions given on the outline drawings of the deck bearing cable drums and pedestals (Figures 24, 25, 26, 27), determine the length of operating or drive shafting required. For the condition given in paragraph 3.28, it is suggested that the shaft be made long enough to allow for the installation of a nickel plated pipe cap or end fitting to cover the open end of the drive shaft above the handwheel, and that the lower end of the shaft extends below the deck the same distance as the loop pedestal shaft.

3.31 Both ends of the shaft should be cut square and all burrs removed.

3.32 The drive shaft must be of full hard, heavy wall, seamless aluminum alloy tubing, perfectly straight over the length used and with an outside diameter of 1.9 inches $+ .000 - .010$ inch.

3.33 CHECKING DRIVE SHAFT—After the drive shaft has been cut to length, insert it in its approximate position in the deck bearing and operating pedestal to check the length. This may be done by tilting the pedestal, inserting the drive shaft through the handwheel, azimuth scale and pedestal coupling, leaving it loosely in position. Make certain that the locking brake is entirely released before attempting to insert the shaft in the pedestal.

3.34 Finally adjust the cribs of the deck bearings and pedestals to make the shafts perpendicular and in alignment. Rotate the shafting from time to time during the operation to make certain that it is free running and without eccentricity.

3.35 Mark a heavy chalk line across the edges of both cribs and out across the deck as well as around the edge of the cribs on the deck. This will assist in replacing the cribs in the same position.

3.36 FASTENING PEDESTALS TEMPORARILY INTO POSITION—With deck bearings and both pedestals in position on their cribs, drill holes through the cribs and decks using the mounting flanges as templates, and bolt temporarily into position. Recheck the alignment by making certain that the entire shaft is perpendicular and rotates freely with an absence of eccentricity.

3.37 If the alignment is satisfactory, release the extension shafts and remove the units, being certain to mark the relative positions of the pedestal flanges, and both cribs with respect to the deck.

3.38 WATERPROOFING THE LOOP PEDESTAL CRIBS—Put a heavy coating of deck cement or white lead on the portion of the deck covered by the crib, also on both sides of the lower half of the crib, and on the under side of the loop pedestal flange. Place the crib on the deck with a felt or canvas gasket under it.

3.39—BOLTING THE LOOP PEDESTAL IN POSITION—Bolt the pedestal in position wherever possible using through bolts with the heads located on the pedestal side and the nuts, washers and lock washers on the under side of the deck. Use white lead to seal the joint. Tighten the bolts evenly in order to equalize the strain. In cases where the bolt holes of the pedestal fall on a wooden beam of the overhead, ½-inch lag screws may be used in place of the bolts. Bore a hole into the wooden deck smaller than that used for the bolts. If the bolts fall on a steel beam, the beam should be drilled and tapped for the bolts.

3.40 CLOSING SEAMS—In all cases where joints are packed with white lead or cement, pull the joints together until the white lead or cement squeezes out freely. The cement will continue to squeeze out and it will be necessary later to retighten the bolts. The residual surface cement should be removed.

3.41 ASSEMBLING THE BRUSH HOUSING CASTING TO THE PEDESTAL—Replace the brush opening casting in position on the pedestal. Note that the casting carries a locating pin to prevent mounting in the reverse position. The Neoprene gasket and casting must be liberally coated with Neoprene cement, supplied in the small can, before finally clamping in place. This will insure a watertight seam between the pedestal and casting.

3.42 Attach the brush plate and cable assembly to the pedestal opening. The arrangement of the screws prevents attachment in any but one position. **Do not use cement** on this gasket; the brushes will be subject to an occasional inspection during which the plate will have to be removed. When connecting the brush and cable assemblies to the loop pedestal or to the receiver, care should be exercised that the cable is partially supported and is not permitted to hang by its full weight at an angle to the ferrule. A sharp bend near the ferrule will exert considerable tension at the outer curvature by application of a relatively small force in the bending motion. Sharp bends near either ferrule after connection should be avoided. Support should be provided to allow the cable to leave the nut in a reasonably straight line. Bends should not be made closer than two inches from ends. When it is necessary to tighten the cable nut, the cable should be held loosely. As the nut starts to tighten the ferrule against the conduit box conductor, the ferrule cable may turn with the nut. This turning of the cable, if permitted, will seldom exceed a quarter of a turn. The conduit should be turned in the reverse direction by this amount prior to final tightening of the nut. The cable should not be held against the nut nor should it be used as an aid in tightening the nut by application of a twisting force. All unnecessary strains at the ferrules should be avoided. In handling the short cables attached to the loop output junction box and receiver input transformers, care should be taken to avoid using the cables as handles. Transformer installations should be planned to avoid tight bends as this cable has slightly less flexibility than the longer loop cables.

3.43 FASTENING THE LOOP PEDESTAL OVERHEAD COVER PLATE IN POSITION— The overhead cover plate, supplied in two halves, is designed to fit around the lower loop pedestal casting, to cover up the hole in the overhead. Place the two halves in position and secure them to the overhead with six screws. The edges of the holes should be covered with white lead or cement before the plate is fastened. In cases where the loop is mounted in an inverted position this plate may not be necessary.

3.44 PLACING THE LOOP—Place the loop on its pedestal, exercising care not to damage the plugs and receptacles carrying the loop lead connections. The unsymmetrical arrangement of hanger bolts insures proper location of the loop on the pedestal. Slip the hanger bolts into the slots in the upper pedestal casting and tighten them securely. Wire the wing nuts in place through the holes provided for this purpose, to prevent loosening.

3.45 GROUNDING THE LOOP PEDESTAL —If the loop pedestal is not well grounded by the securing bolts, provide a good ground connection by means of a heavy brass strip of approximately 1 x 1/16 inches or an equivalent flexible braided copper ribbon. In either case the strip should be nickelplated to prevent corrosion. This strip should have a 9/16-inch hole in one end to clamp under a pedestal mounting bolt and should have the other end attached to some well grounded metal portion of the ship or station. Contact surfaces must be scraped free from paint. Pipes should be avoided as their resistance is not always constant. Where practicable, the grounds for all units should be brought to a common point.

3.46 Although the operating pedestal is not in any portion of the electrical circuit, it should be grounded to preclude the possibility of noises developed by static discharge from objects touching the isolated metal.

3.47 DRILLING OPERATING PEDESTAL SHAFT—It will be necessary to drill and ream holes in the drive shaft for securing each of the units permanently to the shaft. These units consist of the handwheel, azimuth scale, deck bearing, cable drum, and operating pedestal bearing. The location of these units with respect to each other is shown on Figure 17, and their individual details on Figures 25, 26, 27, 28 and 29. These drawings also show the location of and access to the holes with respect to each other. With the various units mounted temporarily on the drive shaft—using the teat screws as set screws—drill holes for the securing screws in the following order: (1) Operating pedestal bearing, (2) deck bearing, (3) azimuth scale, (4) handwheel. Leave the cable drum temporarily in its approximate position until definitely located. See paragraph 3.21.

3.48 Use the drill jig supplied in the cloth bag for drilling all teat screw holes.

3.49 Teat screws in all remaining units of each drive assembly must be made secure by drilling and reaming holes in the shafts associated with them. When the position of each unit is definitely determined on drive shafts and temporarily secured in place, remove one teat screw at a time and screw in the drill jig in the tapped hole until it presses against the drive shaft. Drill the shaft with a 5/16 inch (.312″) drill. Remove the drill jig and ream the hole with the special 14 degree reamer furnished in the cloth bag. Do not ream too deeply. Several trials should be made until the teat screws, when tight, are flush with the surface. Such drilling and reaming will be necessary in all shaft couplings, deck bearings and cable drums, as well as those in the units of the operating pedestal mentioned in paragraph 3.47.

3.50 See Figure 17. Before replacing the azimuth scale assembly in position, insert a two-conductor #14 A.W.G. lead covered cable, Navy Type TRLL, through the hole in the rear of scale pointer casting, passing it around the inner flange, under the cable clamp, and solder it to the two connections provided on the pilot lamp socket. Care should be taken not to break or damage the lead sheathing. The length of this cable depends on the particular installation. Pull the leads for azimuth scale indicator lamp taut and clamp them to the rear of the pedestal with clamps, screws and lockwashers. It is necessary to drill and tap the pedestal for the screws as required in each particular installation. Care must be taken to prevent chips from falling into the bearing at the pedestal coupling.

3.51 See Figure 27. Slide the azimuth scale down the shaft to its approximate correct position. In the final permanent setting of the azimuth scale, two important items must be considered: (1) The clearance between the graduations and the fiducial (reading) mark on the pedestal must be kept as small as mechanically practicable with respect to the various installations in order to reduce parallax reading errors; (2) The scale should rotate as true as possible in order to maintain a uniform clearance between the scale and the fiducial mark at all degrees of rotation. Figure 27 shows this clearance as 1/32 inch, which is an average clearance. For ship installations where sufficient stiffening between decks exists to permit the securing of the extension shaft in the deck bearing without appreciable play between the azimuth scale and the pedestal, the clearance should be as small as possible.

3.52 On vessels where the operating pedestal and deck bearing are secured to different decks and where the stiffening is not sufficiently close to the units or sufficiently rigid to preclude all relative movement of these decks, the drive shaft should be secured to the pedestal bearing only, and **not** secured to the deck bearing sleeve. Leave the shaft undrilled at this point, removing the four teat screws completely and plugging the holes with round-head machine screws 7/16″ x 20, cut sufficiently short to prevent touching the shaft. The deck bearing then acts as a transverse guide and permits longitudinal movement of the shafting when the two decks are displaced.

3.53 Set the azimuth scale with the proper clearance with respect to the fiducial mark and clamp in position, using the four teat screws. Rotate the scale during the clamping process to assure uniform clearance. Remove one of the teat screws and drill and ream as described in paragraph 3.49. Replace the teat screw permanently and proceed similarly and progressively with the three remaining screws, setting each one permanently before another is loosened so that the scale is at all times clamped with at least three screws.

3.54. Place centerpunch marks on the azimuth scale boss and on the shaft adjacent thereto, in order to permit realignment in event of disassembly. The engraved periphery of the azimuth scale is on a movable ring designed to be rotated on its cast spindle for accurate azimuth setting, so that in locating the spindle, the azimuth setting can be neglected and clearance with the fiducial mark only, considered.

3.55 The handwheel should next be secured in place. The handwheel should be located convenient to the operator when taking bearings and tuning the receiver.

3.56 After the operating pedestal has been permanently installed, the azimuth scale pointer and brake assembly should be located conveniently to the operator, preferably facing the operator's chair. Loosen the three set screws securing the casting to the pedestal skirt casting, and slide the assembly around to the desired position. Tighten the screws. A hole is drilled through the center of each of these screws. Drill a small hole in the pedestal skirt casting, using the hole in the center of each of the screws as a guide. Tapered pins will be found, packed in the cloth bag accompanying the equipment, and should be inserted into these holes and driven in until they engage with the skirt casting, locking the pointer assembly in position. Do not cut off the ends of the pins; it will be easier to remove them if it becomes necessary.

3.57 INSTALL CABLE DRUMS—Determine the location of the cable drums with respect to the distance below the deck. (See paragraph 3.28.) Remove the coupling from the lower end of the loop pedestal shaft. (Coupling is only required when shaft extension is necessary.) Place the cable drums symmetrically and temporarily in position. Cut off the excess length of shaft or shafts, as the case may be. **Dress and plug the open end of the shafts to prevent the entrance of moisture.**

3.58 Since the half-scale method of calibration (see Section V) is used the end stops should be centered from the 90-degree azimuth position. This places the center of the calibrated scale at the mid-position of the usable arc. Rotate the loop so that its plane is parallel to the lubber line, with the loop nameplate facing starboard. Lock the operating pedestal drive shaft, which is capable of approximately 450 degrees rotation, midway between the stops with respect to the indicator mark on the pointer assembly. Loosen the six screws securing the azimuth scale to the supporting casting, slide the scale around until the zero comes directly over the indicator mark, then tighten the screws. The cable drums should now be loosened and rotated so that the associated cable clamps are in the relative positions shown on Figure 17. Tighten teat screws of the cable drums, then drill and ream one hole at a time as was done for the drive shaft units.

3.59 ASSEMBLE REMOTE CONTROL DRIVE CABLE—The remote control drive cable, all necessary sheaves, spring takeups, and installation hardware are furnished by the Navy Department or installing activity. Therefore, no installation information on this portion of the equipment is included in this book.

3.60 The operating pedestal is capable of approximately 450 degrees rotation. The two drive drums are identical, having right-hand threads suitable for ⅜-inch flexible steel drive cable. Provision is made to clamp the cable securely to the drums at the center point. When placing the cable in position the drums should be in the relative positions with respect to the cable clamps as shown in Figure 17, and both loop and operating pedestal drive shaft positioned as in paragraph 3.58. One and one-quarter turns of cable should be wrapped around each drum each side of the center clamp. Thus there will always be 2½ turns of cable on each drum at all times. When the cable is placed in this manner, the drums will rotate in the same direction with the cable unwinding from the upper half of one drum onto the upper half of the other drum and vice versa. No crossing of the cable is required. The drive drum **must** be halfway between the stops when placing the cable in position.

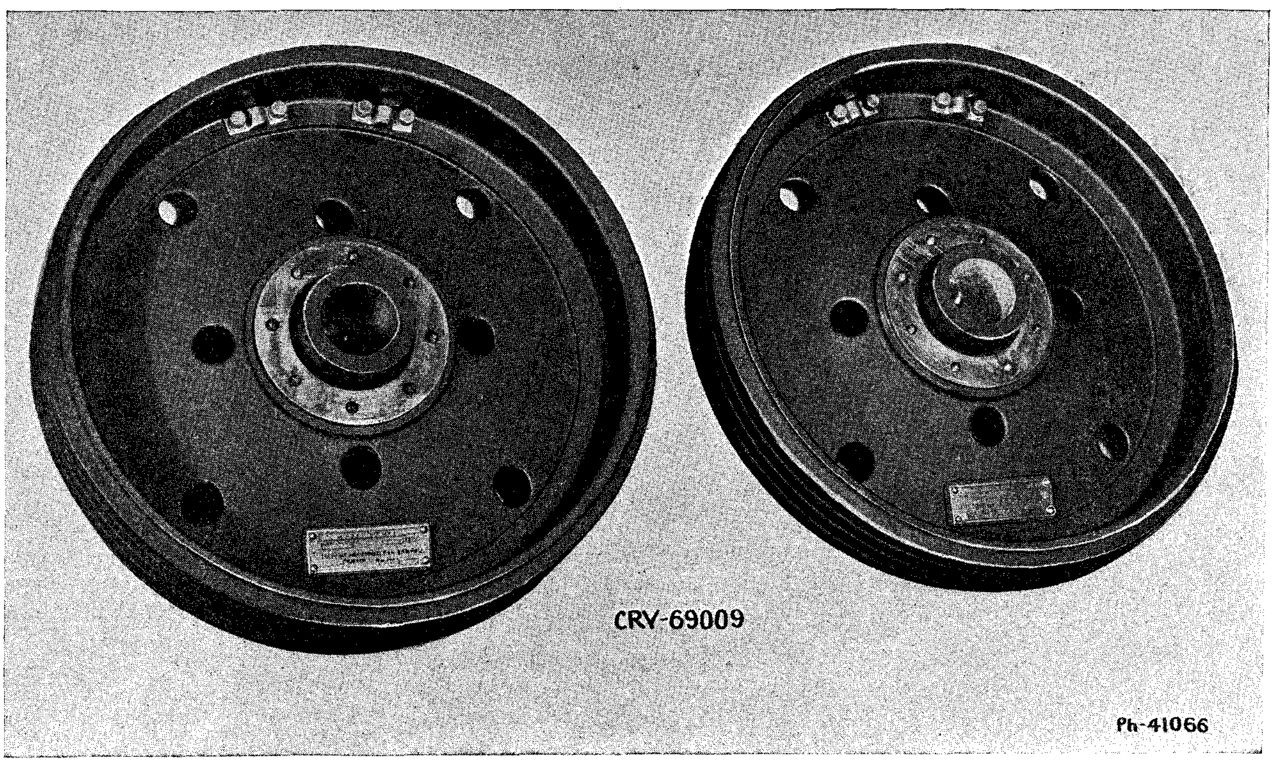

Figure 5—Cable Drums

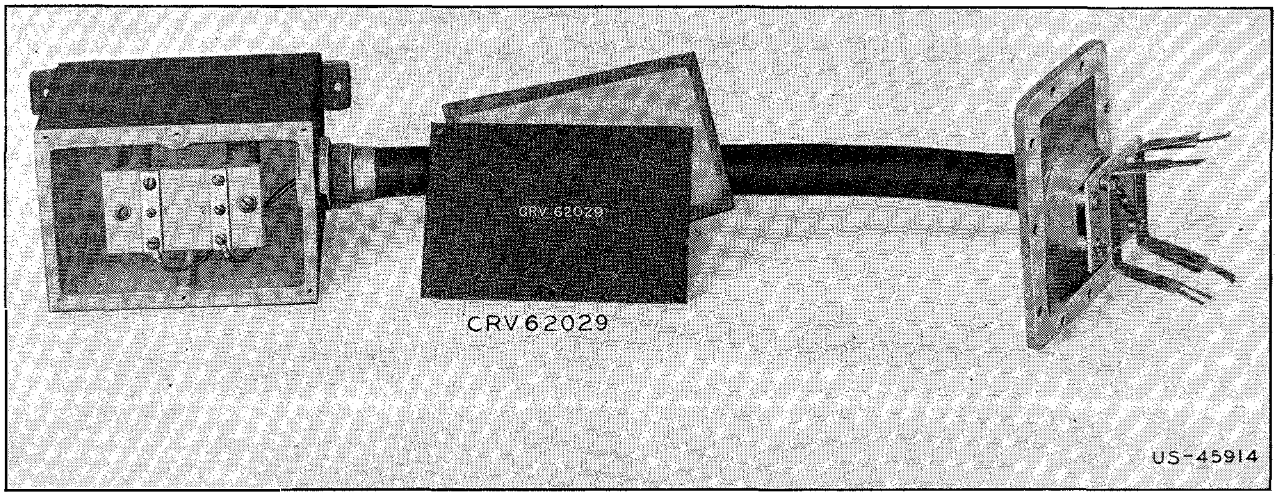

Figure 6—Loop Output Junction Box

3.61 INSTALLING THE LOOP OUTPUT JUNCTION BOX AND RECEIVER INPUT TRANSFORMER—A sixteen-inch flexible cable is provided between the collector ring brushes and the loop output junction box (CRV-62029). The same length of flexible cable is provided between the receiver input transformer (CRV-47180) and the loop plug terminals on the receiver unit.

3.62 The outline dimensions of these transformers are shown on Figure 30.

3.63 The loop junction box (CRV-62029) should be bolted temporarily in place below the deck adjacent to the loop pedestal. Four 9/32-inch diameter holes are provided in the transformer case for mounting.

3.64 The receiver input transformer (CRV-47180) should be bolted temporarily in place adjacent to the receiver unit. Four 9/32-inch diameter holes are provided in the transformer case for mounting.

3.65 The transformer cases should be bonded to ground to eliminate all possibility of high-resistance ground connection through the flexible conduit connection.

3.66 At the time of installation it will be necessary to drill the proper size opening in the loop output junction box case and the receiver input transformer case to accommodate the bulkhead connectors having an outside diameter of 1-25/32 inches.

3.67 It may be found necessary to cut the 35-foot length of transmission line and conduit supplied by the RCA Victor Division of Radio Corporation of America, to suit the particular installation in which it is to be used; therefore, only one of the end fittings is provided as a part of the conduit, and the other one is furnished separately for attachment by the installing personnel.

The nut, shown on Fig. 31 at 7 should be slipped over the ferrule. When the synthetic outer covering has been cut back ¾ inch from the end of the conduit, the ferrule should be soldered to the end thus exposed. Rubber tape should be wound about the ferrule and outer covering of the conduit as shown on Fig. 31. The exposed leads in the conduit should be permitted to extend 8 inches beyond the cut end.

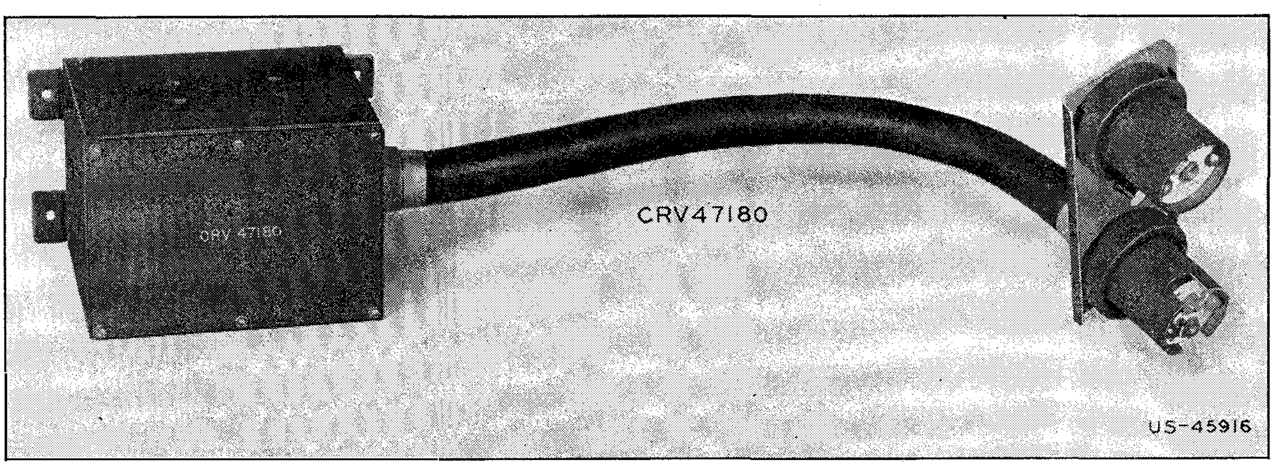

Figure 7—Receiver Input Transformer

Note: The ceramic spacers of the transmission line are placed approximately 4 inches apart. When cutting the line it is necessary to tie the leads to the end spacer in the same manner as on the uncut end.

3.68 In connection with the installation of the loop output junction box, receiver input transformer and interconnecting transmission line, attention should be given to the relative rigidity of the ship structure to which they are secured.

Care must be taken that no metal parts are permitted to rub on metal and that the cases have a short flexible ground connection to the immediately adjacent metal structure of the vessel.

3.69 TRANSMISSION LINE INSTALLATION—In order to make installations where a transmission line length of more than 10 feet but less than 35 feet between the loop output junction box CRV-62029 and the receiver input transformer CRV-47180 is required, the transformer must be suitably adjusted. A length less than 10 feet may be used without the transformer by employing the ¼-inch spacing within the transmission line supplied with the equipment.

3.70 LINE CONSTRUCTION—All joints of the tubing at the boxes should be electrically of low resistance. The continuity of the shielding from the flexible cable at the loop brush assembly to the receiver plug assembly should be tested and should be less than 0.25 ohms resistance.

3.71. Normally the ground, if made at the loop and at the receiver, will continue through the shield of the transmission line, but it is advisable to make ground connections to the boxes as a precautionary measure.

3.72 PRELIMINARY ADJUSTMENT OF THE TRANSFORMER—The spacing of the auto transformer coils is determined by the length of the line as shown in the following table:

RECEIVER INPUT TRANSFORMER CRV-47180

Line Length (feet)	Connect Loop Line to Taps	Connect Receiver Line to Taps	Approximate coil spacing (inches)
10-20	1 and 2	5 and 6	3/16
20-30	1 and 2	5 and 6	7/32

3.73 The spacings may vary from those given in the table above because of variations in coil inductance and installation set-up. The spacing actually obtained is not important, provided that alignment is secured over the 500-1500 kc band. When the spacing is adjusted to provide alignment over this range, it will be found that the two lower frequency bands are also in alignment.

3.74 The final settings should be made as described in paragraphs 4.9 to 4.14.

3.75 For line lengths less than 10 feet the transformer should be omitted, and the loop directly connected to the receiver. In this case the transformer winding may be disconnected and the terminal board of the receiver input transformer used as a junction box.

3.76 For line lengths between 10 and 20 feet an increase in signal-to-noise ratio may be obtained by means of the following connection:

Line Length (feet)	Connect Loop Line to Taps	Connect Receiver Line to Taps	Approximate coil spacing (inches)
10-20	3 and 4	7 and 8	1/8 to 3/16

3.77 ADJUSTING THE AZIMUTH SCALE—Set the loop by sighting across the sides and lock it so that its plane is exactly fore and aft, with the nameplate facing the starboard side. Free the azimuth scale ring by releasing the six set screws on the top of the casting and rotate it until the scale reads exactly **90 degrees;** lock in this position by tightening the set screws. An alternative shipboard method is to select a suitable distant object, approximately on the beam, and simultaneously sight across the edges of the loop diameter using the pelorus. The loop nameplate should face aft. Lock the loop in position at the time of simultaneous observation and note the relative bearing of the distant object as observed with the pelorus. With the loop locked in position, set the azimuth scale to read zero plus or minus the difference in degrees between the observed relative bearing of the object and 90 or 270, depending upon whether the observed object was on the starboard or port hand. As the case may require, observe the following rules: (a) if the bearing of the distant object is **less** than 90 or 270 degrees, relative, set azimuth scale to read 0 (360) minus the difference in degrees between the object and 90 or 270, or, (b) if the bearing of the distant object is **greater** than 90 or 270 degrees, relative, set the azimuth scale to read 0 plus the difference in degrees between the object and 90 or 270. Optimum adjustment of the azimuth scale can only be made after a calibration, but the above procedure will provide an approximate setting.

3.78 LUBRICATING AND PAINTING THE LOOP AND PEDESTAL—If the loop is mounted in an inverted position, it is important that the bearing cavities be carefully checked to be sure they are entirely filled with grease to insure watertightness. Use Alemite "Temprite Sub-Zero" or its equivalent. Figure 24 shows the location of lubricating points and relief plug which must be removed during packing to insure complete filling of cavities. Removal of the cap screw opposite the lubrication plug in the pedestal head provides pressure relief during lubrication when this bearing is being filled.

3.79 Carefully clean the exposed portion of the loop drive shaft with a suitable cleaning agent, to remove all grease. Apply one coat of zinc chromate primer. Paint all metal parts above the overhead and the cribs with a heavy coat of paint of the same color as the vessel. **The insulated spacer at the top of the loop frame must not be painted,** but should be given a coat of clear insulating varnish.

3.80 ERECTING THE SENSE BALANCE ANTENNA—Erect a single wire sense balance antenna as nearly vertical as possible, using 7/18 antenna wire. Space this antenna at least four feet from the loop and as far as practicable from any parallel stay, mast or stack. The upper end must be well insulated. As initially installed this antenna should be as long as possible, provided its capacity to ground, including the lead-in wire, is between 140 and 500 mmfd. If the capacity exceeds this value, it may be impossible to properly line up the "Sense" circuit. In the DF room, the lead-in should be supported on pedestal insulators and **must not,** under any circumstance, be run in shielded wire or conduit, between the lead-in insulator and the receiver unit. Avoid long runs between the lead-in insulator and the receiver. Should tests indicate that the exposed section of lead in the DF room is coupling to a noise source, thereby introducing noise into the receiver, shielding of this section may be permissible, but should not be attempted until the adequacy of the Sense Balance antenna with an unshielded lead is demonstrated by actual test. The shielded section of antenna lead should be kept small in diameter and well spaced from the shielding so as to keep its capacitance to ground very low, i.e., not in excess of a total of 15 mmfds. How to determine the correct length of the "Sense" antenna is treated in paragraph 4.16 under "Electrical Tests." Note that for the frequency range of this equipment a substantially vertical antenna may be used, the extreme end of which when projected on the operating pedestal supporting desk, is not more than 25 feet from the center of the pedestal center line.

3.81 INSTALLING THE RECEIVER AND POWER UNITS—See Figures 22 and 23. The receiver is designed for installation on top of a table or desk. The power unit may be located on a shelf or suspended beneath the top of the table or desk. A clearance of about 6 inches should be left at the right-hand end of the unit for convenience in removing the power cord and plug.

3.82 The receiver should be located so that the operator, when seated, may comfortably reach and operate the handwheel and the lower left knob or "BALANCER" control on the receiver. He should be able to read the azimuth scale without parallax and without changing his position. All receiver controls must be accessible.

3.83 When the proper position has been chosen, proceed with the installation as follows: Loosen the panel thumbscrews securing the receiver chassis to the case and withdraw the chassis from the case. Figure 22 shows the receiver mounting dimensions. Remove the screw in the center of each shock absorber mounting and using the bottom of the cabinet as a template, mark the location of each mounting on the table top. Drill a ¾-inch hole through the table at the exact center of each shock absorber. Secure these mountings to the table top using sixteen ¼-inch wood screws, not supplied. If the table or desk top is of steel, through-bolts must be used for this mounting. Replace the receiver cabinet on the shock-absorbing mountings.

3.84 The power unit cabinet must be mounted in the approximate vicinity of the receiver so that the receiver power cable supplied with the equipment can be used. The power unit chassis must likewise be removed from its cabinet before mounting. No shock absorber mountings are required on this unit and no mounting holes are provided in the case. Due to the peculiarities of each installation, mounting holes must be drilled in the case at the time of installation. If suspension type mounting is used, at least four ¼-inch bolts should be used with large washers located within the case in order to distribute the strain more evenly. It is suggested that ½-inch spacers be used to separate the case from the mounting surface in order to facilitate removal of the panel thumbscrews. For suspension mounting, the holes should be drilled near the corners of the case and after completing the mounting, the bolts should be cut so that they do not project into the case more than ½ inch. This is necessary to provide clearance for removing the chassis from the case. If mounted on the case of the cabinet, the heads of the bolts should be on the inside of the cabinet. See Figure 23.

3.85 INTERCONNECTIONS—With the receiver chassis withdrawn from its case, make the connection to the azimuth scale lamp as shown on Figure 17. The cable should be drawn in through the gland fitting at the right side of the receiver and connected to the terminals associated with the plug mounting board in the rear of the receiver cable. The cable shield should be connected to the ground terminal on the outside of the case.

3.86 Connect the ground terminal located on the right end of the receiver case to a low-resistance electrical ground, i.e., the metallic structure of the ship or the station ground system. Nickel-plated flexible copper braid, 1 inch x 1/16 inch, is recommended for this purpose.

3.87 Place the vacuum tubes in their proper sockets in the receiver chassis. Tube designations are marked adjacent to each tube socket. The chassis may now be replaced in its case and secured in place by means of the panel thumbscrews.

3.88 With the power unit chassis removed from its case, draw the 115-volt 60-cycle power supply cable through the bushing at the left side of the unit and connect it to the two terminals provided for the purpose. The power supply cable should consist of a flexible shielded twisted pair of #16 wires or larger. They may consist of a pair of approved electric light wires run in grounded conduit to some point adjacent to the power unit, and terminated in a junction box. In the case of the flexible cable the shielding must be grounded to the chassis by connecting it to a lug under the terminal board mounting screw.

3.89 Check the line fuses located in the clips mounted on the left end of the panel. Clips are provided on the same clip mounting for a spare fuse.

3.90 Place a Type 5Z3 vacuum tube in the power unit socket and replace the chassis in its case, securing it by the panel thumbscrews.

3.91 CAUTION: THE POWER SUPPLY VOLTAGE MUST BE DISCONNECTED WHEN MAKING OR REMOVING ANY CABLE CONNECTIONS—Connect the receiver and power units together by means of the five-foot cable equipped at both ends with connecting plugs. The full length of this cable should be used. Any excess may be coiled and/or clipped to some convenient supporting point. The plugs and sockets at the end of the cable are held together by means of a bayonet type locking device. To remove a plug it is necessary to turn it slightly to the left and pull out.

3.92 CONNECTING THE ANTENNA TO THE RECEIVER—The vertical antenna should be connected to the terminal stud on the connector plug located on top of the receiver, through a flexible wire from the last insulator.

IV

ALIGNMENT AND PERFORMANCE TESTS

4.1 GENERAL INSTRUCTIONS—Make certain that all connections have been properly made in accordance with Figure 17 and that vacuum tubes are inserted in the tube sockets in accordance with the markings adjacent to each socket. Plug in a 600-ohm headset and turn the power switch, which is the center switch located above the nameplate on the receiver panel, to the "ON" position. Allow sufficient time for the tube heaters to reach their operating temperature. Advance the "SENSITIVITY" control to the maximum position with the "C-W" switch "ON" and the output meter range switch "OFF." A high steady noise level should be heard in the phones at any setting of the "TUNING" control. With all controls set as indicated, reduce the "SENSITIVITY" control to the minimum position. A barely noticeable hum, previously inaudible above the tube noise, should now be heard. These tests indicate whether the receiver is functioning properly. Read **Section VII before attempting to operate or make any adjustments on the equipment.**

4.2 EQUIPMENT—In making the alignment and performance tests and adjustments indicated here and in Section IX, wherever "signals" are required, they can be provided by the use of a Model LN Alignment Oscillator which will permit of their frequency and intensity control at will. Certain precautions are necessary, however, in the use and application of this instrument in order that the characteristics of the loop and antenna may not be affected. The various methods of application are covered in succeeding paragraphs.

4.3 DIRECT APPLICATION TO THE LOOP—In introducing a signal from the Model LN oscillator directly into the midpoint of the loop circuit, it is necessary that the oscillator output impedance be reduced from its 10-ohm value to not over 0.1 ohm in order not to destroy the effectiveness, or "Q," of the loop. To accomplish this, a capacitative voltage divider should be assembled, consisting of a 1.0 mfd capacitor in series with one of 0.01 mfd. The two capacitors should be kept as close together as possible so that the lead between them is extremely short. A 1-meg-ohm resistor is necessary to bypass any bias voltage that might be present. It is important that these units be connected and applied exactly as shown on Figure 16. In connecting the Model LN Equipment to the loop, this divider should be located as close to the loop as possible so that the leads between the 1.0 mfd capacitor and the mid-point of the loop are not over 6 inches in length and are connected directly to the terminals of the 1.0 mfd capacity unit. The plug which is provided on the loop base may be removed to admit the generator leads (see Figure 2). The leads to the LN Equipment may be longer than those regularly supplied, provided a twisted pair not in excess of 30 feet in length is used, care being taken to make certain that the "HIGH" side of the oscillator is properly connected as shown in Figure 16. In this way, the oscillator may be conveniently located near to the receiver.

4.4 OTHER APPLICATIONS—In order to obtain a controllable "dummy" signal with which to adjust the sense antenna circuits, the Model LN alignment oscillator should be used as follows: With full output (100,000 microvolts), ground the low-potential lead and couple the high-potential lead to the sense antenna through the smallest capacitance that will give a usable signal. This can best be accomplished by connecting a length of insulated wire to the high side of the oscillator and twisting a turn or two around the antenna lead. It should be noted that all final sense antenna circuit adjustments must be made with the antenna with which the equipment will be operated, connected to the receiver antenna stud.

4.5 For certain adjustments, such as loop alignment, coupling transformer adjustments on remotely controlled installations, and relative sensitivity measurements throughout the various frequency ranges, an actual signal is desirable. This may be obtained to a limited extent from the LN signal generator by using a length of heavy wire formed in the shape of a loop approximately 16 inches in diameter, connected across the output leads of the signal generator.

4.6 This loop attached to the signal generator should be placed approximately 3 to 5 feet from the direction finder loop, with its plane parallel to it. The center of the circle formed by the loop

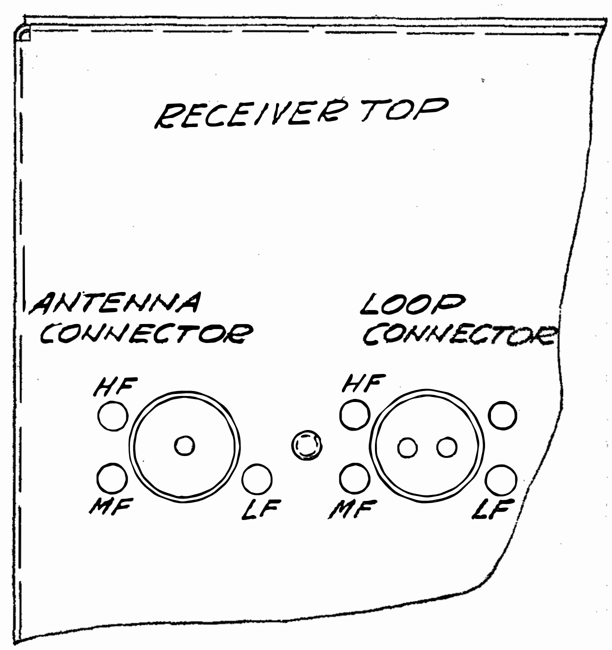

Figure 8—Antenna and Loop Trimmer Locations

which is connected to the generator should also be located on the same level as the center of the direction finder loop.

4.7 With the LN signal generator adjusted to the same frequency as the direction finder receiver and with the direction finder in operation, it should be possible to rotate the direction finder loop and obtain a sharp minimum signal when the two loops lie at right angles to each other. If the LN generator is perfectly shielded, the true and reciprocal bearings should agree within 0.5 of a degree. If there is leakage from the generator, the reciprocal bearings may not agree. For this reason, the LN generator should be kept as far removed from the DF loop as possible.

4.8 LOOP TUNING ALIGNMENT—The equipment is unicontrolled, i.e., the tuning of the loop circuit, antenna circuit, r-f amplifier and r-f oscillator are all adjusted and tracked so as to tune simultaneously by means of one panel control. With the exception of the loop circuit and the sense antenna circuit, the receiver is accurately adjusted at the factory for maximum performance. In order to properly adjust and align the loop circuit proceed as follows: Disconnect the loop receiver cable from the receiver by loosening the thumbscrew and lifting the plug assembly out of its sockets at the top of the receiver case. Pry the three snapbuttons out of the adjustment holes near the loop plug opening, see Figure 8. Replace the plug assembly and secure it with the thumbscrew to insure good ground connection between the cable and the receiver case. Place the band switch in the highest frequency (h-f) position, 550-1500 kc. Rotate the tuning control until a signal is heard in the headphones, choosing a strong local signal of approximately 1450 to 1500 kc, a setting between 900 and 950 on the dial. A signal produced by an LN alignment oscillator described in paragraph 4.3 may be used. Turn the "C-W" switch to "ON" position and tune the signal to a 1000 cycle beat note, reducing the sensitivity control if the signal is too loud. Turn the output meter switch to "DIRECT" position and readjust the sensitivity control until the needle stands at approximately mid-scale position. Using the special fibre alignment wrench furnished in the spare-parts box, adjust the h-f loop aligning capacitor for maximum signal strength as indicated by the output meter needle. The position of the alignment capacitors is shown on Figure 8. Turn the band switch to the medium frequency position, 250-550 kc. Select a signal between 550 and 575 kc, 900-950 on the dial, and proceed to adjust the medium frequency (m-f) aligning capacitor in the same manner as the h-f band, using "C-W" and the meter to determine maximum signal strength. The low frequency (l-f) band is adjusted in like manner, using a signal frequency between 245 and 255 kc with the band switch set at the lowest frequency position, 100-250 kc. The loop adjustment will require no further attention. The buttons previously removed should be replaced by springing them into the holes in the case, thus precluding accidental misadjustment when aligning the antenna circuits. If readjustment of the loop circuit becomes necessary at a later date, it is important that all three bands be checked as outlined above and always in the same order, i.e., h-f, m-f and then l-f.

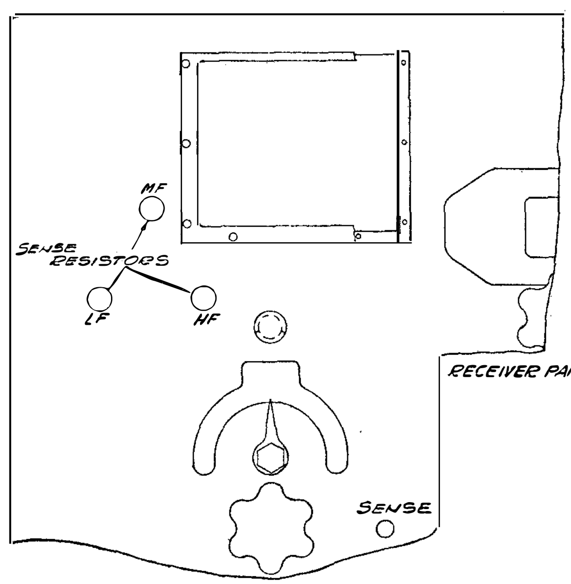

Figure 9—Sense Adjustment Resistor Locations

4.9 If a transmission line is used it is **essential** that the loop tuning accurately track the receiver tuning throughout the entire frequency range, otherwise inherent errors of 4 or more degrees in indicated bearing may exist, as manifested by a deviation from the true 180° difference between direct and reciprocal bearings obtained on a fixed station. This necessitates that the inductance of the receiver input transformer be accurately and carefully adjusted. To accomplish this and at the same time trim the receiver input circuit, proceed as follows:

4.10 After the coils have been spaced approximately as described in paragraphs 3.72 to 3.76, set the band switch to the h-f position. Tune in a signal on a frequency between 1400 and 1500 kc. A broadcast station may be used as the source. Set the loop in the maximum signal position and reduce the sensitivity control so that the output is about 6 milliwatts or +5 db level with the output meter switch on "ADD 15DB." Observing the output meter, tune the h-f loop trimmer, see Figure 8, through the hole in the top of the case, until maximum output has been obtained. Next, tune to a station between 560 and 600 kc and readjust the trimmer to see whether more or less capacity will increase the output. If more capacity is required, the receiver transformer coils require more inductance, which is obtained by moving the coils closer together. When this has been done and the loop tuned on this end of the band to resonance by moving the coils, go back to the previous station at the 1400-1500 kc end and readjust the trimmer to resonance. If an adjustment is required, it will be necessary to retune to the low frequency signal and observe whether more or less capacity improves the alignment. If less, the coils have too great an inductance and require greater spacing. When the adjustment has been found where no change is required in the trimmer at either end of the band, the transformer is properly adjusted and should be placed in the case. If the adjustment as described is made outside of the case, care should be taken to ground the terminal marked G to the case. Points in the middle of the range such as 800 kc may be checked and should be found to require no trimmer adjustment. If actual signals are not available, a signal generator such as the LN may be used as covered by paragraph 4.5.

4.11 Should the transformer be improperly adjusted, an error (displacement of the two bilateral minimums from 180°) of substantially 2° between the direct and reciprocal bearings may be observed. Under this condition, it is assumed that the trimming adjustment is correct only at one frequency. If the procedure described for adjustment at 2 frequencies is followed, an error of less than ½ of 1° should be observed between the direct and reciprocal bearings taken on any fixed transmitting station.

4.12 Set the band switch on 250-550 kc and tune in a signal near 550 kc which is close to the high frequency end of this band. Turn the loop in the maximum position and adjust the m-f loop trimmer for greatest output.

4.13 Turn the band switch to l-f and make the same adjustment with the l-f loop trimmer at a frequency of approximately 245 kc.

4.14 If practicable, it is advantageous to make the final adjustments after all electrical correctors are in place, inasmuch as these correctors, if close to the loop, may reduce its inductance.

4.15 SENSE CIRCUIT ALIGNMENT — The sense and balancer circuits are so arranged that when the sense antenna circuit is properly aligned, the balancer circuit is automatically adjusted to have the proper phase relation to the loop circuit with which it is normally coupled. This feature makes necessary only one adjustment on each of the three frequency bands. The procedure for aligning the sense circuit is as follows: Remove the loop receiver cable plug from the top of the receiver case. Pry the three plug buttons out of the three adjusting holes near the antenna plug opening. See Figure 8. Replace the cable plug in its double socket and secure it with the thumbscrew to insure a good ground connection between the plug assembly and the receiver case. Remove the three plug buttons from the antenna adjustable resistor holes in the front panel of the receiver. See Figure 9. With a small screwdriver, not necessarily insulated, turn all three resistor shafts to their extreme counterclockwise position, minimum resistance. Place the band switch to the highest frequency position, 550-1500 kc, and tune in a strong signal of approximately 1450 to 1500 kc, 900 to 950 on the dial. This signal may be produced by an LN alignment oscillator as described in paragraph 4.4. Turn the "C-W" switch "ON" and tune the signal to a beat frequency of approximately 1000 cycles. Swing the loop into position of minimum signal response and depress the sense button. If the signal is too strong, it may be reduced by adjustment of the sensitivity control. Turn the output meter switch to the "DIRECT" position and adjust the sensitivity control until the meter needle registers about midscale while holding the sense button depressed. Using a special alignment wrench, the fibre tube with a hexagonal hole, furnished in the spare parts box, adjust the h-f antenna alignment capacitor through the hole in the top of the receiver case for maximum output as indicated by the output meter reading. The sense button may now be released. The band switch is next turned to the medium frequency position, 250-550 kc, and using a strong signal between 550 and 560 kc, the procedure for adjusting the m-f sense antenna circuit is exactly the same as for the h-f band except that the m-f alignment capacitor is adjusted. Likewise, the low frequency band sense antenna circuit is aligned to a frequency between 245 and 255 kc. Replace all plug buttons covering the adjusting holes in the receiver case and panel.

Note: In certain cases, where the sense antenna does not lie within the recommended values of capacity and inductance and the alignment of the capacity circuit given above does not permit satisfactory operation on low frequency ends of bands, the low frequency tuning should be adjusted as follows:

Use the antenna with which the equipment is to operate.

Couple the LN generator to the antenna by wrapping one or two turns around the lead going to the receiver. This will form a coupling capacitor. Tune the receiver to the h-f end of Band 3. Depress sense button and tune the LN generator to the same frequency. Follow the procedure in the above paragraph and adjust the sense tuning capacitor for maximum output.

Tune to the low end of Band 3 and loosen the locking nut on the inductance adjustment plug of L-101 (see photo figure 11). With the sense button depressed, turn the inductance adjusting screw to obtain maximum output. If the position of the adjustment is changed, it will be necessary to repeat the capacitor adjustment at the h-f end of the band. It should be possible to align both the inductance and the capacitor with only one or two rechecks at either end.

L-102 and L-102A are adjusted in the same manner on their respective MF and LF Bands.

4.16 ADJUSTMENT OF THE SENSE BALANCE ANTENNA—One of the most important considerations in the proper operation of a direction finder, particularly aboard ship, is the selection of the correct size of the sense balance antenna. It is not possible to prescribe any definite size or arrangement for this antenna, but its dimensions must be chosen and adjusted for each installation by "cut" and "try" methods. In determining the size, a compromise may be necessary between the sense and balance requirements. In such a case, **always subordinate sense performance to balance performance.** Balance performance is of prime importance in obtaining accurate and well-defined bearings. For ship installations, the size of the antenna for balance purposes is a function of:

(a) The size of the vessel
(b) The location of the Direction Finder
(c) The proximity and size of nearby metallic objects
(d) The amount of electrical correction applied
(e) The frequency
(f) The direction of the received signals (bearings)
(g) The criticalness of the balancer control operation.

4.17 For sense purposes, the size of the antenna is relatively independent of the factors described in the previous paragraph. Therefore, in adjusting the size of the antenna, choose and arrange it to permit satisfactory operation of the direction finder, under conditions requiring a maximum balance voltage, provided its static capacity is between 140 and 500 mmfds.

4.18 For ship installations in general, the maximum size of the antenna used with this equipment for balance purposes should be such as to provide best results at the highest frequency to which the direction finder will be tuned, which is 1500 kc, with signals intercepted at right angles to the course of the vessel, i.e., on the beams. Perfect minimum readings of less than half degree in width should be obtained on strong signals with a balancer scale reading between 30 and 50 in either direction, depending upon which side of the loop faces in the direction of the intercepted signal. When a satisfactory adjustment has been made, a re-check should be made at some frequency between 100 and 150 kc in order to make certain that sufficient balance voltage is obtained at the low frequency end of the band.

4.19 The procedure for adjusting the size of the sense balance antenna is as follows: Align the sense circuit with the trial antenna as outlined in paragraph 4.15, choosing a signal between 1450 and 1500 kc. With a strong signal from a broadcast station having a frequency between 1000 and 1500 kc arriving from a beam direction, take an accurate bearing, see Section VII, noting the balance control setting at which a perfect null or minimum is obtained. The azimuth reading is unimportant for this test. Be sure that the balancer setting is critical and less than full scale, 50, i.e., that an increase or decrease of setting destroys the null condition. If such a condition cannot be found, a more effective antenna is required. If the setting is less than 20, the antenna is too long and its length should be reduced until the balancer setting is between 20 and 30 for critical bearings. In each case, the sense circuit must be realigned when a new antenna is tried. See paragraph 4.15.

4.20 In general, the tendency is to erect balance antennas of insufficient height or effectiveness, a condition which precludes proper operation of the equipment in certain sectors, usually off the beams. In case of doubt, an overly effective antenna is to be preferred to an ineffective one, as its only drawback is to render the adjustment of the balancer critical on bow and stern bearings, whereas an insufficient antenna will render the entire equipment ineffective over a large sector on either beam; and may adversely affect sense performance in the sectors of satisfactory balance.

4.21 An insufficient balance antenna, one with an effective height less than 1.5 meters, may also affect the sense performance. If the sense button is depressed when the plane of the loop is pointing toward the signal, a slight reduction in output may result instead of the increase in output which would be expected in the method of determining sense given in paragraph 7.9. Rotating the loop 180 degrees from this position will give a decided decrease in output. The preferred method of determining sense with short antennas is that described in paragraph 7.9, except that the angle of swing from the null should be restricted to $\pm$ approximately 30 degrees. With this restricted angle of swing, there should be no ambiguity since the anticipated rise in output should be encountered. In general, the characteristics discussed above are exhibited only on Band 3 at frequencies around 550 kc. The sense resistor should be properly adjusted as described in paragraph 4.26 before attempting to make these observations.

4.22 In many cases, it will not be practicable to adjust the antenna at the time of installation. It is recommended that as large an antenna as practicable be erected, using a halyard or gantline for temporary support. Prior to calibration, the calibrating signal should be brought abeam on a suitable frequency and the antenna adjusted as described in paragraph 4.19. After calibration has been completed the antenna may be permanently secured.

4.23 In extreme cases, it may be necessary to use a small flat-top section of antenna, in order to obtain sufficient antenna voltage. It should be of the "T" rather than the "L" type, with the flat-top section as symmetrically located over the loop as possible.

4.24. Shore installations obey no definitely known law with respect to balance antenna requirements, either as to the shape or magnitude of the balance curves, but require relatively small antennæ, compared with most ship installations. In general, a height of 50 feet might be considered representative for a trial, although facilities may be required to support an 80-foot antenna to cover extreme cases. The final adjustment of the antenna length must be made by trial and error. Prior to calibration, the calibration vessel should transmit from the position requiring maximum balance setting. Adjust the antenna length until perfect bearings (nulls) are obtained with a setting between 20 and 30 on the balancer dial.

4.25 ADJUSTMENT FOR SENSE INDICATION—Three adjustable resistors, one for each frequency band, are provided and each must be adjusted for best sense indication in its respective band, after all other antenna adjustments have been made.

4.26 Pry the three plug buttons from the receiver panel, located above the balance control. See Figure 9. The resistors are adjustable with a small screwdriver that need not necessarily be insulated. The resistor associated with each band is indicated in the figure.

4.27 Provide a moderately strong signal whose general bearing is known, having a frequency of about 1000 kc. Tune the signal with the "C-W" switch turned "ON." Swing the loop to the null position indicating the correct bearing on the azimuth scale, not its reciprocal. Note the bearing and swing the loop counterclockwise, decreasing the scale reading 90 degrees. Depress the sense push button and, if necessary, adjust the signal strength by means of the sensitivity control. Turn the "OUTPUT METER" switch to "DIRECT" position and further adjust the sensitivity until the needle registers "O" level, about midscale. By means of a screwdriver, adjust the h-f sense resistor to the value producing the maximum dip of the "OUTPUT METER" needle. **The sense button must be depressed at all times during this adjustment.** If the sense button is alternately depressed and released, there should be a marked decrease of signal strength when the button is depressed. If the loop is swung 180 degrees from this adjusting position, and the button again depressed, the signal should increase in intensity.

4.28 If it is found that the sense indication is reversed, i.e., that signals decrease when the loop is turned clockwise and increase when the loop is turned counterclockwise, it is probable that the loop or cable leads have been reversed at some point during installation. This condition may be corrected by turning the azimuth scale 180 degrees relative to the loop. To do this, lock the loop on "O" degree azimuth. Release the six screws on top of the azimuth scale retaining ring and turn the azimuth scale until it reads 180 degrees. Reclamp the six screws and proceed to readjust the resistor as described in paragraph 4.27.

Note: If a relatively small **decrease** in output occurs on 90 degrees clockwise loop rotation from the null and a normal **decrease** on 90 degrees counterclockwise rotation (with sense button depressed in both cases), the frequency band in which this condition is noted requires realignment of the sense circuit. See note to paragraph 9.39. The above condition will only be encountered in equipments to which a sense balance antenna less than 1.5 meters in effective height is connected, and then only on the lower frequencies of the 550-1500 kc band.

4.29 Adjust the medium and low frequency bands in a manner similar to that described for the high frequency band adjustment, using signal frequencies located in about the middle of each band, i.e., 400 and 175 kc respectively. Check the performance of sense at each end of each band as well as near the middle. Replace the snapbuttons in the holes in the panel.

4.30 Where signals are required for making these adjustments, the source of such signals should be at least one-half mile distant from the direction finder and should be of sufficient power to permit bearings to be obtained with a minimum width not in excess of 1 degree.

4.31 For ship installations, it is preferable to make the final adjustments with the vessel removed from all disturbing influences such as may originate in navy yards, shipyards and nearby vessels. All super-structure gear should be secured for sea service and all electrical correcting jumpers should be in place, in order to simulate actual operating conditions.

4.32 ADJUSTMENT OF THE ELECTRONIC OUTPUT INDICATOR—Turn the "Output Meter Range Switch" to "OFF." Turn the "Output Indicator Bias" control to the extreme counterclockwise position. Pry the plug button directly below the output meter loose with a screwdriver (not necessarily insulated), and adjust the slotted shaft behind the hole until the bright sectors of the electronic output indicator just come together, but do not overlap. Replace the plug button.

V
CALIBRATION

5.1 The procedure for calibrating the equipment described here is similar to that used in calibrating all direction finders. Calibration should be conducted in the manner prescribed in Chapter 30 of the Manual of Engineering Instructions. The frequencies at which calibrations should be conducted in order to permit the determination of the deviation at any frequency within the range of the equipment, by interpolation between the calibrations thus obtained, cannot be predicted, but must be determined after the initial calibrations. The change in deviation with frequency is a function of the type of vessel, the location of the DF and the amount of "correction" applied. In all cases the increase in maximum deviation with frequency is more nearly logarithmic than linear, i.e., at the lower frequencies very little difference will be noted, while as the frequency increases the deviation increases with much greater rapidity, and calibration at closer separation will be necessary. For an initial calibration on a new vessel or in a new location on an older vessel, it is suggested that calibration be made for one frequency in the L.F. and M.F. bands and at least three (or more if time permits) in the H.F. band. From these curves any additional frequencies requiring calibration at a later date may be noted.

5.2 After the azimuth scale has been adjusted in the final calibration it is advisable to make a permanent mark across the lower edge of the azimuth scale and the azimuth supporting plate, in order that any displacement of the scale may be readily discerned and corrected.

5.3 Wire is provided through the heads of two of the azimuth scale clamping screws to seal the final adjustment.

5.4 FINAL ADJUSTMENT OF THE AZIMUTH SCALE—It will be noted that the zero setting of the azimuth scale, although intended to be correct for ship's head, or true north for shore installation, is only arbitrary and cannot be set accurately by mechanical observation. See paragraph 3.77.

5.5 After completion of all calibrations and plotting of the deviation curves, examine these curves to ascertain whether or not the average electrical axis, zero deviation, is approximately centered, i.e., whether the maximum plus and minus deviations are of the same order of magnitude.

5.6 From the most representative or most frequently used calibration curve, ascertain the maximum plus and minus deviations; subtract them, neglecting the sign, and divide by two. Pick the nearest whole number to this, which is the number of degrees the scale must be moved with respect to its previous setting.

5.7 Set the loop so that the scale reads an even number of degrees and lock the loop securely by means of the loop locking clamp. Note the reading for reference. Loosen the six azimuth clamping screws and move the scale the number of degrees necessary for realignment. The direction of movement is determined as follows: If the positive deviation is greater than the negative deviation, the scale should be moved so as to increase the scale reading. If the negative deviation is greater than the positive, the scale reading should be decreased. Secure the scale by the six clamping screws.

5.8 After the realignment of the loop and scale, it will be necessary to alter the numbering of the coordinates of all the calibration curves in order to make them applicable to the new scale setting. This is accomplished in the following manner, and by the application of the following rules: Redraw the zero deviation axis, (abscissa) displacing it the same number of degrees the azimuth scale was moved, and renumber the other deviation axes accordingly. The displacement should be in the same direction the scale was moved, i.e., if the scale was moved from zero to five degrees, the zero axis should be moved to the five degree line, plus. Redraw and re-number the azimuth scale reading (ordinates) displaced the same number of degrees the scale was moved. The displacement should be in the same direction the scale was moved, i.e., if the scale was moved from zero to five degrees, the zero line should be moved to the five degree line, etc.

5.9 After the azimuth scale is set in its final position lock the operating pedestal with the azimuth scale at zero and place a scribe mark across the rotating head of the loop pedestal and the pedestal itself. This will permit the ready determination of any displacement between the loop and azimuth scale due to cable stretch, etc., and permit the loop to be reset without recalibration in the event of such displacement.

5.10 Should, as a result of calibration, the maximum deviation be found to be in excess of fifteen (15) degrees, an effort should be made to effect its reduction by the erection of suitable "Corrector" loops or "jumpers" surrounding the loop. Their use, in general, will not only reduce the deviation, but will also reduce the amount of "balance" voltage necessary for satisfactory operation of the direction finder. (See paragraph 3.11.)

VI
THEORETICAL DISCUSSION

6.1 The action of a loop antenna as a direction finder can be explained by considering the loop signal voltage pattern as the loop is rotated about its vertical axis. The electro-magnetic flux lines of the incoming signal wave flow at right angles to the direction of signal travel. Consequently when the loop is linked by the greatest number of lines of the magnetic component of the flux, its plane is at right angles to this flux component and hence lies in the direction of signal travel. This is the condition for maximum received loop voltage. When the loop is at right angles to the direction of signal travel, it is linked with minimum flux, and this produces a minimum signal in the receiver connected to the loop. The loop voltage thus varies with loop rotation as tabulated below, maximum loop voltage being taken as unity:

RELATIVE LOOP ANGLE

With Signal Direction	With Flux Lines	Loop Voltages
0°	90°	1.000
30°	120°	0.866
60°	150°	0.500
90°	180°	0
120°	210°	−0.500
150°	240°	−0.866
180°	270°	−1.000
210°	300°	−0.866
240°	330°	−0.500
270°	0°	0
300°	30°	0.500
330°	60°	0.866
0°	90°	1.000

6.2 The values in the table may be plotted as illustrated in Figure 14, where the loop voltage is laid out on polar co-ordinates for relative angles of the loop plane to the direction of signal. This is known as a "figure eight" diagram.

6.3 It will be seen from the "figure eight" diagram that there are two maxima and two minima of signal voltage induced in the loop as the angle between its plane and the direction of signal travel changes through a complete 360 degrees. The minima are used for direction finding, because the signal output varies more rapidly per degree of rotation at a minimum point than at a maximum and hence a much sharper indication is obtained. Such a minimum is found, of course, when the plane of the loop is at right angles to the direction of signal.

6.4 It should be remembered that an ordinary vertical wire antenna has no directive effect, but instead has a merely constant signal voltage induced in it regardless of the direction from which the signal is intercepted; in other words, its signal voltage pattern is approximately a circle. Any loop has some of the characteristics of an ordinary untuned vertical antenna, which introduces voltages in quadrature, or 90 degrees out of phase, in the loop circuit and so affects the loop directive properties by broadening the minimum points, thus rendering accurate observations difficult. Neighboring objects such as masts and stacks induce similar effects into the loop, and further complicate matters by producing in phase voltages, which in turn cause deviations in the indicated direction of the incoming signal. To overcome the antenna effect, a separate vertical antenna is used, producing a signal voltage which is fed into the receiver through an inductive type of coupling, in such a manner as to balance out the quadrature voltage in the loop. The deviation produced by these objects must be determined by calibration and applied to the observed bearings.

6.5 "ANTENNA EFFECT" may be used in another way; namely, to determine the "sense" or absolute direction of the received signal. When the loop is properly balanced, the two minima of signal voltage indicate the "line" of signal direction; but it is not evident which of the two minima indicates the true direction toward the transmitting station. That is to say, for any minimum found by turning the loop, there are two possible directions from which the signal may be coming. Often the operator knows from other evidence, which of the two minima indicates true direction or "sense." When that other evidence is not present, the "sense" of the signal may be found by the method described in paragraph 6.6.

6.6 If a signal voltage of proper magnitude and phase relation be introduced into the loop circuit from a vertical wire antenna, it will change the "figure eight" into the heart shaped diagram or cardioid of Figure 15. E_L represents the voltage produced in the loop, E_A the voltage from a resonant antenna, and $E_A + E_L$ the sum of the two voltages. Minimum voltage in the cardioid figure occurs at only one point throughout a revolution of the loop, as also does the maximum voltage. These minimum and maximum points are displaced 90 degrees from the minima of the "figure eight" diagram. Therefore, it is necessary to rotate the loop 90 degrees in one direction or the other to find the "sense" of the received signal. As has been explained, the minimum signal is more accurate for obtaining bilateral bearings, while the maximum of the cardioid, being less critical is best suited for obtaining "sense" indications. To determine "sense," the indication need not be sharp, therefore, the voltage E_A need not be of the exact value and phase required to produce a true cardioid diagram.

6.7 A distinction should be drawn between the two uses of the "balance" or "sense" antenna. In the first case, it is used to balance out the quadrature voltages induced in the loop, so that only loop signal voltage remains, with a sharp indication of the signal direction. Then after this indication has been obtained, the balance antenna voltage can be changed 90 degrees in phase by tuning, and combined with the loop voltage in order to determine the "sense" of the signal. This change of phase is accomplished by depressing the sense button. For a more complete study of this subject, the reader is referred to "Wireless Direction Finding" by R. Keen.

VII
OPERATION

7.1 LOOP—The loop is arranged for 450 degree orientation by means of the handwheel. See paragraph 3.60. It may be locked in any position by tightening the brake adjustment screw located on the azimuth scale pointer assembly.

7.2 RECEIVER—The following panel controls are provided:

(1) **TUNING CONTROL**—This is a vernier control which is used to vary the capacity of the ganged tuning capacitors. Loop, r-f, antenna and oscillator tuning capacitors are thus uni-controlled. The vernier reduction ratio is 20:1.

(2) **FREQUENCY BAND SWITCH** — This switch performs all the functions necessary to change from one frequency band to another. Three positions are provided: 100-250 kc (l-f), 250-550 kc (m. f.) and 550-1500 kc (h-f).

(3) **SENSITIVITY CONTROL**—The sensitivity control serves to control the volume by variation of the bias on the r-f and i-f amplifier tubes.

(4) **ON-OFF SWITCHES**—The center switch, of this group of three, turns "ON" and "OFF" the line voltage applied to the power unit. The switch at the right turns "ON" or "OFF" simultaneously the three panel lamps and the azimuth scale indicator lamp. The left switch opens and closes the +B feed to the i-f oscillator tube which is used for C-W reception.

(5) **BALANCE CONTROL**—The purpose of the balancer is to give sharp distinct null points which are necessary for accurate determination of bearings. Before taking any bearings, set the "balance" pointer to the "O" position. Assuming that a signal is being intercepted, carefully rotate the loop to the position of minimum signal strength. The "balance" pointer should then be rotated slowly clockwise or counterclockwise until a point is found at which the signal is reduced to a null. It will then be necessary to slightly readjust both the loop and the balancer to obtain the most accurate readings.

(6) **SENSE PUSH SWITCH** — When this switch is depressed, the balancer is removed from the circuit and the antenna tuning is connected through a resistor to the "SENSE" coil. The "SENSE" coil is fixed coupled to the grid side of the loop circuit. The phase relation of the antenna circuit is such that its energy coupled into the loop circuit either adds to, or subtracts from the loop energy, depending upon the position of the loop with respect to the magnetic field of the incoming signal. The purpose of the resistor is to control the amount of energy from the antenna and to broaden the resonance of the antenna circuit.

(7) **PHONE JACKS**—Jacks are connected in parallel across the secondary of the receiver output transformer, to provide for aural signal reception by plugging in 600-ohm headphones.

(8) **OUTPUT METER**—This meter provides visual indication of the reception of signals, thus permitting the maintenance of a fixed signal level. A standard output of 6 mw delivered into a 600-ohm load is indicated by a full scale meter reading with the meter range switch set to "ADD 15 DB" position. **A meter reading of "0," mid-scale, with the range switch set to "DIRECT" position, indicates an output of 60 microwatts delivered into a 600-ohm load instead of 6 milliwatts, as was the case in meters formerly supplied with Navy equipment.** The unmarked line at the extreme counterclockwise end of the meter scale indicates the position the pointer should occupy when the range switch is "OFF." An adjusting screw is provided on the front of the meter to adjust the pointer to this position.

(9) **OUTPUT METER RANGE SWITCH**—This switch provides a means of algebraically adding 5, 10 or 15 db to the normal range of the output meter. Example: A scale reading of – 10 db with the switch in the "ADD 5 DB" position indicates an output level of –5 db. The switch also disconnects the meter entirely when in the "OFF" position.

(10) **ELECTRONIC OUTPUT INDICATOR**—The electronic output indicator provides visual indication of the signal level, and since the indication response is instantaneous, it can follow rapid variations in signal intensity. It is, therefore, useful in taking bearings on C-W signals. The eye is closed, when there is no audio output from the receiver, and opens when a signal is present. The sensitivity of the eye is controlled by the "Output Meter Range Switch."

(11) **ELECTRONIC INDICATOR SENSITIVITY CONTROL**—The electronic output indicator should open, if noise is present in the receiver output. By turning the electronic output indicator sensitivity control in a clockwise direction, until the eye just closes again, the full sensitivity of the electronic output indicator may be retained even in the presence of considerable noise.

7.3 TAKING BEARINGS—Assuming the set has been properly installed and calibrated, the following operations are necessary to obtain a bearing: Notify the radio room to open all transmitting antennas that may affect the accuracy of bearings. The equipment should be used only under operating conditions identical with those of calibration.

7.4 Assume that a bearing is required of a beacon operating on 295 kc. Set the "FREQUENCY BAND" switch to the position "250-550 kc." Turn the sensitivity control until a perceptible noise, not in excess of zero db, is heard. Rotate the "TUNING" control until the desired station is tuned in.

7.5 Set the "BALANCER" pointer at "0" and turn the handwheel of the loop until a point of minimum signal intensity is obtained with the azimuth scale reading on the **black** figures, 0-190 degrees. Adjust the setting of the "BALANCER" control until the signal strength is still further decreased. By varying the loop position and balance setting alternately, one point will be found where no signal is heard in the earphones. Note the azimuth scale reading and the gyro compass reading simultaneously. Apply to the azimuth scale reading the two corrections at the closest frequency for the station's calibration in order to obtain the corrected direct and reciprocal bearings. Where signals are so weak that the "minimum" or zero signal region embraces several or many degrees of loop rotation, accurate bearings may often be obtained by employing the output meter as a reference indicator rather than depending on an aural match of the signal strength on either side of the minimum region. To use this method, bring the signal into the "minimum" region with the receiver gain set so that the noise level is not in excess of 0 db on the direct range. Then swing the coil slowly to one side of this region until a readily readable and easily remembered output, such as 5 db is obtained. Note the exact reading of the azimuth scale. Swing again slowly through "minimum" until the output signal level matches that previously obtained and again note the exact azimuth scale reading. The "mean" of these two scale readings will usually give accurate bearing indications, far greater than can be obtained by ear if the minimum is broad due to **weak signals.** Do not use this procedure if the minimum is broad due to a residual signal. This almost always indicates improper "balance" adjustment. The minimum signal should always be reduced to zero by proper "balance" before proceeding to take a bearing.
When taking bearings on C-W signals, the electronic indicator should provide a more convenient indication of the receiver output than the meter. When taking bearings in the presence of noise, detune the receiver approximately 20 kc from the signal, and using the electronic indicator sensitivity control, adjust the electronic output indicator for closure on the noise alone. Retune to the signal. The eye will close when a null is obtained in spite of the presence of noise.

7.6 For shore stations, bearings taken according to paragraph 7.5 are TRUE, or TRUE + 180 degrees, according to whether the direct or reciprocal bearing is used.

7.7 For ship stations, bearings taken according to paragraph 7.5 are only directly or reciprocally relative to the ship's head and must have a true compass reading added for true bearings, subtracting 360 degrees if necessary.

7.8 To determine which of the two bearings is correct and should be used, proceed to obtain a uni-lateral sense indication as described in paragraph 7.9.

7.9 UNI-LATERAL OR SENSE BEARING— Starting with the loop set on the bilateral bearing, black scale, swing the loop approximately 90 degree clockwise (increasing the scale reading) when looking down on the azimuth scale. Depress the sense button, noting the effect on the signal intensity as indicated by the output meter. An INCREASE in signal intensity denotes a direct bearing, between 0-180 degrees. Swinging the loop 90 degrees counterclockwise should give a decreased signal intensity. See "note" to paragraph 4.28.

7.10 If the "SENSE" operation INCREASES the signal intensity when the loop is swung clockwise, towards increased azimuth scale divisions, and **decreases** the intensity when the loop is swung counterclockwise, towards decreasing azimuth scale divisions, the DIRECT bearing is correct.

7.11 If the opposite effect to that described in paragraph 7.10 is noted, the RECIPROCAL bearing should be used.

7.12 To make accurate "Sense" observations it is necessary that the "RECEIVER TUNING" control be accurately adjusted. Do not tune this control when the loop is near a null point. Tune only when the loop is at least 10 degrees from the null, and with the sensitivity reduced to prevent overloading.

7.13 When making "Sense" observations it is necessary to reduce the volume by means of the sensitivity control to give standard output or less, with the loop in the position for maximum signal intensity. This will provide good "Sense" indications.

7.14 It may be helpful at times to swing the loop one way only and push the "SENSE" switch, noting whether the signal strength increases or decreases. The same rule of clockwise and counterclockwise observation of minimum readings described in paragraphs 7.10 and 7.11 holds in this case.

7.15 When through using the direction finder notify the radio room so that the transmitting antenna switches may be closed.

7.16 Turn the power switch "OFF" and lock the loop in a fore and aft position by means of the brake so that the loop will not be rotated by the wind.

7.17 With the exception of the power switches, all switches, particularly the band-change switches, require extremely clean, unoxidized and highly polished contact surfaces. To insure satisfactory operation, they should be periodically "worked" throughout their entire range. (See paragraph **9.43.**)

VIII

CIRCUIT DESCRIPTION

8.1 RECEIVER UNIT CRV-46136—(Reference:—Schematic Diagram Figure 18.) This receiver utilizes the superheterodyne circuit in order to obtain high voltage gain with maximum stability.

8.2 One stage of tuned radio frequency amplification precedes the first detector, providing two tuned circuits so essential in the reduction of image frequency response and the prevention of radiation from the local r-f oscillator.

8.3 A separate r-f "first oscillator" tube is employed in an electron-coupled oscillator circuit to provide the greatest frequency stability.

8.4 Two high gain i-f stages of amplification tuned to a frequency of 81.5 kc, provide good selectivity and will remain constant, as to the band width frequency, for all bands.

8.5 A separate i-f "second oscillator" tube employed in an electron-coupled oscillator circuit provides a beat frequency for c-w reception. This circuit is well shielded and bypassed so that practically all coupling to the grid and plate of the diode second detector tube is obtained through the coupling capacitor. This allows proper c-w reception on strong signals with the receiver sensitivity control turned low.

8.7 Type —6D6 tubes are used in the r-f, i-f and first detector stages, while Type —6C6 tubes are used for the two electron-coupled oscillator circuits and first audio stage. Two Type —76 tubes are used, one as a second detector, connected as a diode, and one in the output audio stage. The output circuit is designed for use with either one or two pair of 600-ohm telephone receivers.

8.8 The following table lists the measured operating voltages and currents of each vacuum tube. Voltage readings will vary for different types of voltmeters used. All d-c voltages given were taken with a Type OE Set Analyzer having a resistance of 20,000 ohms per volt. The following conditions are to be observed in making measurements: (1) all switches should be set to the "ON" position; (2) the "SENSITIVITY" control should be set for maximum sensitivity; (3) the electronic output indicator sensitivity control should be in the extreme counterclockwise position; (4) the "Output Meter Range Switch" should be in the "OFF" position; (5) be sure the power supply is 110 volts, 60 cycles; (6) see that all tubes are in their respective sockets; (7) measure voltages from socket prongs to chassis ground. See Figure 32.

Function	Type Tube	Plate Volts°	Grid Bias Volts*	Screen Volts°	Heater Volts	Plate Current M. A.
R-F Ampl.	—6D6	95	3.5	99.	5.8	6.
1st Det.	—6D6	95	7.8	75.	5.8	1.2
R-F Osc.	—6C6	75	2.5	75.	5.8	2.0
I-F Ampl. 1	—6D6	95	3.6	99.	5.8	6.0
I-F Ampl. 2	—6D6	110	3.6	99.	5.8	6.0
2nd Det.	—76	0	0	—	5.8	—
I-F Osc.	—6C6	60	5.0	32.	5.8	.3
1st A-F Ampl.	—6C6	25	.8	20	5.8	.2
2nd A-F Ampl.	—76	95	2.0	—	5.8	2.5
Rectifier	—5Z3	300 volts plate to plate (no load)				
Electronic Indicator Ampl.	—6C6	60	6.5	38	5.8	.016
Electronic Indicator	—6AF6-G	110	9.5	—	5.8	.63

°Use 250 volt scale. *Use 25 volt scale.

Bus wire at DC potentials above ground is marked by colored dots. The color code used is as follows:

B+ and plates	RED	Band #1 LF	1 dot
Screens	GREEN	Band #2 MF	2 dots
Cathodes	BLACK	Band #3 HF	3 dots

In cases where bus lead is common to all bands one dot is used.

8.6 Two stages of audio amplification having low power output are used. As bearings are taken on minimum strength signals with high receiver gain and it is desirable to limit the output arising from external disturbances and off-minimum signals, greater audio amplification is not desirable when using headphones.

8.9 POWER SUPPLY UNIT CRV-20049—(Reference:—Schematic Diagram Figure 20.) This unit is designed to operate from a 110-volt, 60-cycle service and supplies all operating voltages required by the receiver. It will function satisfactorily over a range of 99 to 120 volts at a frequency of 55 to 65 cycles.

8.10 A Type —5Z3 tube is used as a full-wave rectifier. A radio frequency filter is located in the a-c supply line and an electrostatic shield between the primary and secondary windings of the power transformer, in order to prevent the transfer of disturbances and radio frequency pickup in the supply line, to the receiver.

8.11 A bleeder resistor is connected across the power supply output and serves to improve the regulation of the output voltage. It also serves to protect the capacitor pack from damage in case the power unit is operated while the cable to the receiver is disconnected. A hum control potentiometer is connected across the filament supply winding to reduce a-c hum in the receiver, arising from this circuit. It is provided with a slotted shaft for screwdriver adjustment.

8.12 Power is applied to the power supply unit by turning the power switch, located on the receiver panel, to the "ON" position. Cartridge fuses are provided in each side of the supply line for the protection of the equipment. The fuse block is readily accessible for inspection or replacement of fuses, and is equipped with a spare replacement fuse.

IX
MAINTENANCE

9.1 The Type CRV-46136 receiver differs from most other Naval receivers with which the Service is familiar in that practically all the radio and intermediate frequency inductances and transformers employ **iron cores** and "trimming" is accomplished by varying the circuit inductance by changing the core position instead of by variation of trimmer capacitances. The receiver is carefully adjusted and aligned by the manufacturer before shipment, and should maintain the correct characteristics over reasonably long periods. When required, major adjustments and repairs should be made in a laboratory well equipped with the necessary tools and equipment.

9.2 EQUIPMENT REQUIRED—The following equipment should be available for the accurate diagnosis of trouble, and its remedy.

(1) A test oscillator having a frequency range of 80-1500 kc with provision for accurate frequency calibration; or a Model LN Alignment Oscillator.

(2) A continuity tester consisting of an ohmmeter, or a voltmeter and battery, or phones and battery.

(3) A multi-range a-c voltmeter with a maximum reading of 300 volts.

(4) A d-c milliammeter with a range of 0-10 milliamperes.

(5) A high resistance multi-range d-c voltmeter having a 150-volt maximum scale and a resistance of 1000 ohms per volt; or a Model OE Radio Receiver Analyzing Equipment with a resistance of 20,000 ohms per volt.

(6) A microammeter with a range of 0-250 microamperes.

The Model OE Radio Receiver Analyzing Equipment contains all of the above items with the exception of the test oscillator and the microammeter.

9.3 WEAK SIGNALS ON ALL BANDS is the usual symptom of worn-out vacuum tubes. Due to the gradual development of this condition, it is difficult to recognize, except by the fact that with signals of nearly constant intensity, it is found necessary to advance the "SENSITIVITY" control from time to time. In general, it is a good policy to change all vacuum tubes at the end of every thousand hours of operation. Where possible a log should be kept of the hours of operation.

9.4 Tubes should be tested either by a measurement of the "transconductance," or the "emission current" with normal working voltages. If the "transconductance" measures less than the minimum values given in the table of tube characteristics, the tube should be destroyed. It is a good practice to paste stickers on the glass noting the date of test and the "transconductance," in the case of tubes replaced in service. Certain tubes may deteriorate in less than a thousand hours of operation so that it should not be arbitrarily assumed that all tubes are good because they are relatively new.

9.5 As an operating test of the general condition of the tubes and equipment, the following procedure should be followed: With the loop and balance antennas disconnected and the c-w (i-f) oscillator turned "ON," advance the "SENSITIVITY" control to the maximum or extreme clockwise position. A steady high noise level should be heard in the phones at any setting of the tuning controls. Reduce the "SENSITIVITY" control to the minimum or extreme counterclockwise position. A barely noticeable hum, previously inaudible over the tube noise, should be heard. Failure of this test indicates that the receiver is inoperative and the tubes should be changed before looking for trouble elsewhere.

9.6 When checking tubes, the Type —5Z3 rectifier tube in the power unit should not be overlooked. The operating switch should be turned "OFF" and the power cord disconnected, after which the chassis should be removed from the case. The power cord may again be attached and the power turned "ON." The voltages can be checked at the terminals of the connecting socket. With a line voltage of 105-115 and the receiver volume control set for maximum volume, the voltage readings at the cable connector should be as follows:

(1) Terminals 5 and 6—Heater—5.5-7.0 volts (a-c)

(2) Terminals 1 and 2—Plate—85-110 volts (d-c)

The current drain from the supply line is 0.5 ampere.

9.7 In case no voltage readings result from a check of the power unit, test the power unit fuse and wiring connections from the a-c line. See Figure 20.

9.8 In case voltage readings are obtained during the voltage check of the power unit, but are not of the correct value, the component parts of the power unit should be carefully checked.

9.9 If all voltage readings of the power unit are correct, the receiver unit should be checked for trouble.

9.10 For checking the voltages at the receiver, it will be necessary to turn "OFF" the operating switch, disconnect the power cord from the receiver and remove the receiver from its case. After the chassis has been removed from its case the power cord should be reconnected and the power turned "ON." Voltages and plate current should be checked with the tabulation in paragraph 8.8, referring to Figures 18, 19 and 32 for locations.

9.11 In case no voltage readings are obtained while checking the receiver, the fuses located in the rear of the receiver should be tested.

9.12 If the receiver voltages check correctly the individual circuits should be checked for trouble. This should be started with a simple test of the audio amplifier. Tap the Type —76 detector tube V-105, with the finger. If noise is picked up in the phones, the audio amplifier is operative. If no noise is obtained, check the tube and replace it if necessary. If, with a new Type —76 tube in place, no sound can be detected when the tube is tapped, check the other audio tubes and wiring for short or open circuits, poor contacts, open transformer, etc.

9.13 POOR SENSITIVITY—The sensitivity of a receiver is gauged by the number of microvolts input required to produce an output of 6 milli-

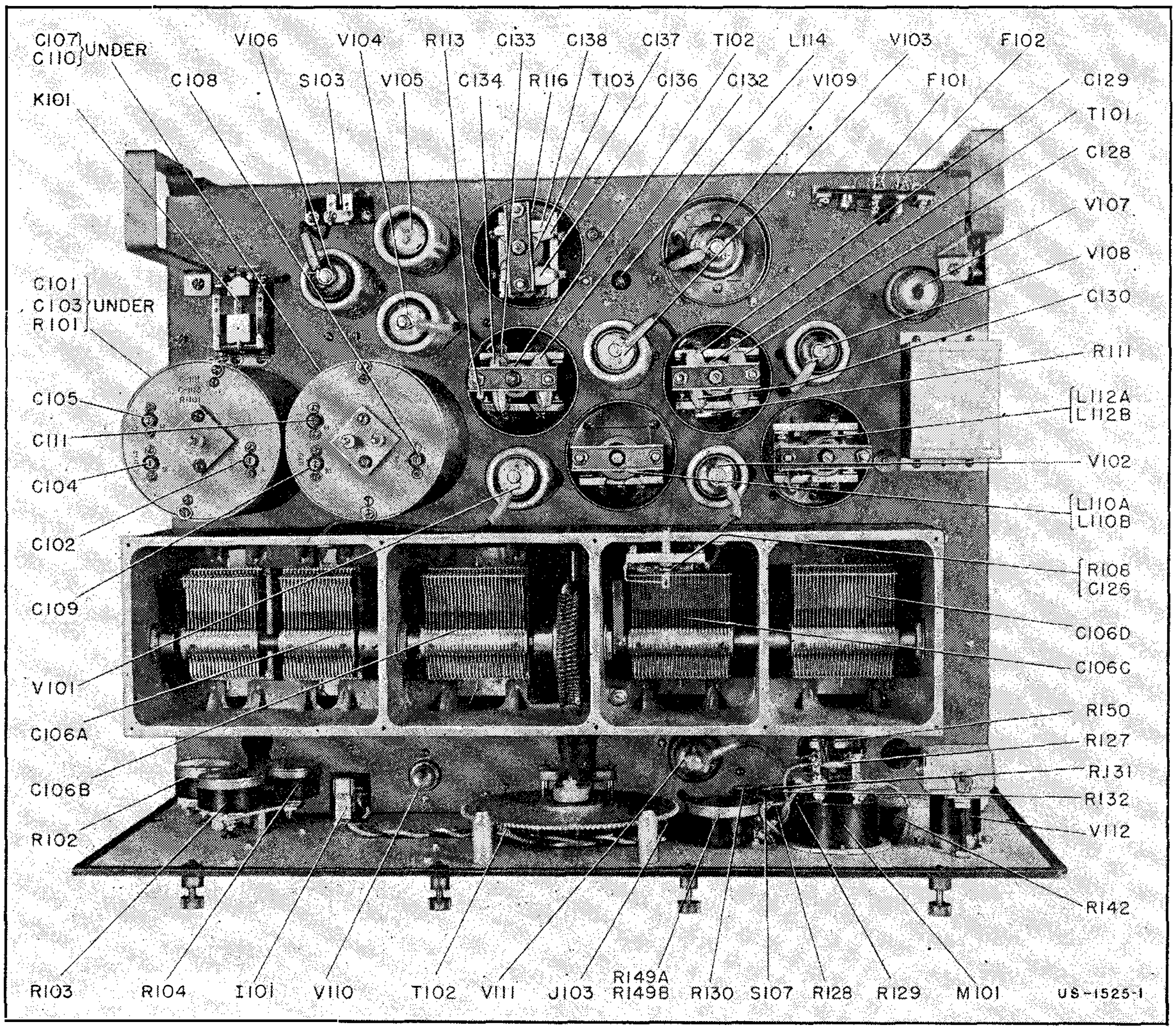

Figure 10—Receiver Unit (Top View)

watts in a non-inductive circuit having a resistance of 600 ohms. This means that the more microvolts required to produce a 6 milliwatt output under these conditions, the lower will be the sensitivity of the receiver. Although the sensitivity may vary between receivers, it should be approximately 1 microvolt on all bands. It is not however advisable to realign the equipment unless the sensitivity decreases below 2 microvolts.

9.14 In a direction finder receiver it is essential that the loop circuit be exactly resonated to the received signal, otherwise phase relations are distorted and variable deviations, not amenable to calibration, are produced. In a unicontrolled receiver such as this, mistracking of the loop circuit cannot usually be detected by tuning. Fortunately the deviation "errors" are in opposite directions for bilateral bearings taken on opposite sides of the loop. Therefore the test for this condition, as well as other forms of trouble, is to take two uncorrected bearings on a fixed station, using opposite sides of the loop. **They should always be 180 degrees displaced, within ± ½ degree.** If the ½ degree value is exceeded, the loop tuning should be retracted. It is recommended that a practice be made of occasionally taking reversed, red scale, bearings to check the operation of the equipment.

9.15 In the following instructions for test and realignment of the radio and intermediate frequency circuits, all reference to test oscillator voltages predicates their application with respect to ground or chassis. The degree of coupling, i.e., "loosely," "tightly," etc., predicates the relative applied radio frequency voltages and may be obtained by the method of coupling, small capacities, etc., or by means of an adjustable attenuator on the test oscillator or signal generator. A 0.5 mfd, 200 V. capacitor should be used in series with the high lead from the oscillator to protect its attenuator. In all cases the test oscillator voltages should be held to such a point that the audio output does not exceed 6 milliwatts, +5 output meter reading with output meter range switch set to "ADD 15 DB" position, in order to prevent overloading of any of the vacuum tubes.

9.16 In case the audio amplifier is found to be operative, proceed to test the i-f amplifier stages as follows: Ground the grid of the r-f oscillator tube, V-108. Couple the test oscillator, unmodulated and tuned to 81.5 kc, to the grid of the second detector tube, V-105, with the c-w oscillator "ON." A 1000 cycle beat-note should be heard. If it is not heard, it is an indication that either the second detector diode or the c-w oscillator is at fault. Check the tubes and then the wiring.

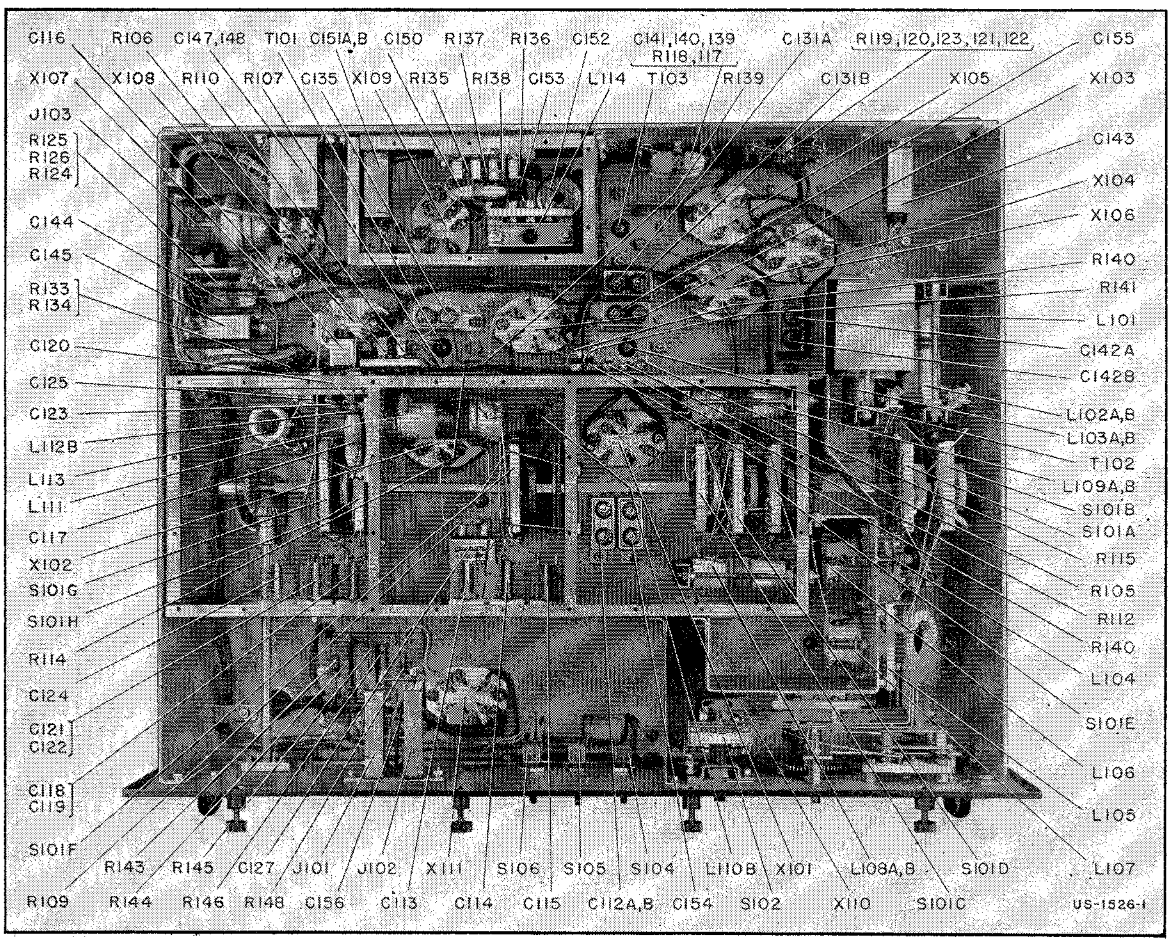

Figure 11—Receiver Unit (Bottom View)

9.17 Set the test oscillator at a frequency of approximately 81.5 kc. Couple the output of the oscillator, modulated, to the grid of the first i-f tube, V-103, and with the "C-W" switch in the "OFF" position, listen for a response while the test oscillator is carefully tuned. If a single, sharply tuned response is heard with loose coupling of the test oscillator, the i-f amplifier stages are operating correctly. If a weak signal or no response is obtained, the two i-f amplifier and second detector tubes should be checked and replaced if found defective. If the tubes are satisfactory and the receiver still does not function properly, use a "set checker" or Model OE Analyzer to measure the voltages at the terminals of each tube socket. See Figures 18, 19, and 32.

9.18 The voltages read at the tube sockets should conform to within ±25 per cent of those given in the tabulation in paragraph 8.8. These are not the actual operating electrode potentials, being merely representative voltmeter readings. They will vary considerably with the type and scale of voltmeter employed. If the tube socket voltages do not conform to those given in the table, check the particular tube circuits for open or short circuits, poor contacts, etc. If the tube voltages check and there is no response, with the "C-W" switch "OFF," couple the modulated test oscillator, adjusted to the proper frequency, to the grid of each stage progressively, beginning with the second detector and working toward the r-f stage.

9.19 FAILURE OF "C-W" RECEPTION ON ALL BANDS would result from a defective c-w (i-f) oscillator tube or defect in the oscillator circuit. Check the Type —6C6 tube voltages, V-109, and circuit components. The tube is enclosed in a can shield similar to the coil shields.

9.20 If any band is operative, it is an indication that the tubes and circuits pertaining to that band are functioning and the trouble must therefore be localized in the coils or switching contacts directly associated with the faulty band.

9.21 ALIGNMENT OF I-F STAGES AND C-W OSCILLATOR — The intermediate frequency amplifier is designed for a frequency of 81.5 kc and the c-w (i-f) oscillator for a frequency of 80.5 kc. Both the primary and secondary of all three intermediate frequency transformers are tuned by varying the magnetic flux within the core. The adjusting screws for varying the iron cores are accessible without removing the cover of the transformer units and are located as shown in Figures 10 and 11. The frequency adjusting screw for the c-w oscillator is accessible from the top of the chassis.

9.22 For accurate alignment of the equipment, the frequency of the test signal should be accurate to 0.1%. Set the receiver "SENSITIVITY" control at maximum position, extreme clockwise, and the c-w switch to the "OFF" position. Open the test link in the output of the second detector circuit, S-103, Figure 10, and connect in a 250 microampere meter (negative side to the ground). The Type CRV-22193 volt/milliammeter/ohm meter, part of the Model OE equipment, may be used on the 1 volt range as a microammeter reading 50 microamperes full scale (its resistance of 20,000 ohms on this range will not be harmful for this purpose). Read the center voltage scale times 10 as microamperes. Connect the high side of an unmodulated test oscillator output through a 0.5 mfd capacitor to the grid of the second i-f amplifier tube, Type —6D6, V-104. Connect the other output terminal of the test oscillator to ground. Set the frequency of the test oscillator to 81.5 kc. and adjust its output to obtain a reading of about 20 microamperes on the meter.

9.23 Insert the special alignment tool into the secondary adjusting screw of the third i-f transformer, T-103, Figure 10, and after unlocking the check nut, adjust the iron core for maximum deflection of the meter. Keep the test oscillator input so adjusted that the meter reading does not exceed 30 microamperes. Next adjust the primary core, T-103, Figure 11, in the same manner. It is advisable to recheck the secondary again if the primaryadjustment has been changed. Tighten the locknuts of both primary and secondary adjustments, being careful not to disturb the core adjustments. The combination screwdriver and wrench aligning tool is arranged to hold the adjusting screw from turning while tightening the locknut.

9.24 Change the test oscillator connection from the grid of the second i-f tube to the grid of the first i-f tube, V-103, and proceed to line up the second i-f transformer, T-102, in the same manner as specified for the third i-f transformer. Do not change the frequency of the test oscillator when shifting from stage to stage, although the output should be reduced to keep the meter reading below 30 microamperes.

9.25 Change the test oscillator connection from the grid of the first i-f tube to the grid of the first detector tube, V-102, and proceed to align the first i-f transformer, T-101, in the same manner as specified for the second and third transformers. Disconnect the microammeter and close the test link.

9.26 Turn the "C-W" switch to the "ON" position. Proceed to align the c-w (i-f) oscillator, L-114, Figure 10, for 1000 cycle response in the headphones, which should be plugged into the receiver output jacks. It is possible to obtain two different 1000 cycle beat-notes, one above, and one below the intermediate frequency. The one above is produced when the adjusting core is unscrewed, while the one below is produced when the adjusting core is screwed in. The beat-note 1000 cycles **below the intermediate frequency must be used.** Secure the adjustment by the locknut when completed. As a final **performance check** of the I.F./A.F. amplifier, the following approximate sensitivities should be obtained with the Model LN signal generator coupled to the grids of the respective tubes, under the conditions noted below:

Conditions

Output . . . . .6 milliwatts (+ 20 decibels).
C-W switch . . . . .OFF
Sensitivity control. Full on—clockwise.
LN frequency . . . .81.5 kc
LN output modulated 30 per cent.

Sensitivities

2nd I.F	12,000	microvolts
1st I.F.	550	"
1st Detector	140	"

9.27 ALIGNMENT OF LOOP, R-F AND FIRST OSCILLATOR STAGE—The loop loading inductance units are located in a shielded compartment with their associated band switches. See Figure 11. These units are equipped with adjustable iron cores which are carefully adjusted at the factory for correct inductance. It is essential that each pair of loading coils be properly matched. If it becomes necessary to readjust the load coils they must be removed from the chassis and carefully paired by means of an inductance standard using a frequency of 1000 cycles. Following are the correct inductance values for the various frequency bands:

(1) Medium frequency loading coils, L-108A and L-109A, 0-151 millihenries each.

(2) Low frequency loading coils, L-108B and L-109B, 950 millihenries each.

(3) No loop loading is used in the high frequency band.

9.28 Trimming capacitors for the loop circuit are located within the cylindrical cover of the loop connecting plug board and may be adjusted without removing the chassis from its case. The location of each trimmer is shown on Figure 8. The adjustment of these capacitors is made by means of the fibre tube portion of the alignment tool. There is sufficient friction in the capacitor bearing to prevent displacement of the adjustment when the adjusting tool is removed.

9.29 The high frequency band coils for the r-f amplifier and the r-f oscillator are contained in their respective switch compartments as shown on Figure 11. The r-f amplifier coil, L-111, has a fixed iron core to improve its "Q" factor, but the r-f oscillator coil, L-113, is of the air-core type. Adjustment of the inductance in these two coils is accomplished by moving or "slipping" turns of wire at one end of the winding, thereby reducing or increasing the mutual inductance of the end turns with respect to the main winding.

9.30 Coil windings for the medium and low frequency bands of the r-f amplifier and r-f oscillator are contained in can shields and are equipped with adjustable iron cores. The location of these coils on the chassis is shown on Figures 10 and 11. Adjustment of the cores for the medium frequency band, L-110B and L-112B, is made from beneath the chassis and for the low frequency band, L-110A and L-112A, at the top of the can shield, using the special aligning tool.

9.31 Trimming capacitors for the r-f amplifier, C-113 and C-114, and for the r-f oscillator C-121 and C-118, are located in the shielded switch compartments as shown on Figure 11, and are all adjustable from the outside of the shield by means of the special fibre aligning tool. It is essential that the frequencies and dial settings shown below be used when aligning the r-f circuits.

R-F AMPLIFIER AND OSCILLATOR ALIGNMENT

Frequency Band	Test Signal Frequency	Dial Setting	Adjust R-F Osc.
550-1500 KC	1450 KC	900	Air Trimmer
	578	50	None
250-550 KC	376	400	Iron Core
	270	100	Series Air Trimmer
100-250 KC	245.5	900	Air Trimmer
	178	500	Iron Core
	105	50	Series Air Trimmer

9.32 Connect a test oscillator (Model LN if available) between the mid-points of the loop winding as explained in paragraph 4.3. If the receiver chassis is out of its case it is essential that it be grounded by means of a connector to the loop cable. Operate the receiver with the c-w oscillator "ON" and the sensitivity control advanced to the point where the noise output does not exceed 0 level (direct). If any appreciable noise is picked up on the loop it is advantageous to rotate the loop to and lock it in the position of least noise. Make all adjustments with an approximate 1000 cycle beat-note from the signal. As the alignment operation progresses it may be necessary to reduce the sensitivity to prevent overloading and consequent broadening of the best alignment points.

9.33 Set the "FREQUENCY BAND" switch on the band to be aligned and adjust the receiver tuning control to indicate the exact setting for the desired frequency. Set the test oscillator accurately on the specified frequency, repeating this procedure for each setting given in Par. 9.31.

9.34 Starting at the high frequency alignment point, adjust the r-f oscillator h-f trimmer, see Figure 11, to a 1000 cycle beat-note. Reduce the "SENSITIVITY" control, if necessary, to insure against overloading the tubes. Proceed to align the r-f coil by means of C-115, and then the loop circuit in the same manner. For loop trimmer location, see Figure 8.

9.35 Set the signal generator at the next lower test frequency and turn the receiver tuning dial to the setting given in Paragraph 9.31. If no signal is heard, adjust the m-f oscillator core, L-112B, Figure 11, until a 1000-cycle note is heard. Adjust the r-f coil core, L-110B, for maximum output as indicated by the db meter. Set the signal generator to the lowest frequency of the particular band, and turn the receiver dial to the value shown in Paragraph 9.31. If no signal is heard, adjust the r-f oscillator series pad trimmer, C-122, for a 1000-cycle note. Repeat this entire procedure several times, rocking the tuning condenser on the final adjustments to produce the maximum output on the db meter. For alignment of the low-frequency band, use the same procedure. Refer to Figure 10, and adjust the l-f oscillator coil core, L-112A, and the r-f coil core, L-110A, and the oscillator series pad trimmer, C-119, Figure 11. Replacement coils for the r-f amplifier and the r-f oscillator are adjusted to the correct inductance at the factory. Their adjustment should not be changed unless necessary.

9.36 VERTICAL ANTENNA CIRCUIT ALIGNMENT—The vertical antenna circuit is capacity tuned and ganged with all the other tuned r-f circuits. Normally, this circuit is and must be kept tuned about 15-20 per cent lower in frequency than the loop circuit, in order to maintain the proper phase relations for "balancer" operation. When the "sense" button is operated by pressing, the antenna inductance circuit is changed to a value producing resonance at loop circuit frequency.

9.37 For antenna circuit alignment, the receiver chassis must be removed from its case. Connect the aligning oscillator through a 200 mmfd capacitor to the antenna post of the receiver, using the chassis as ground. Use the same alignment frequencies as shown in paragraph 9.31. Use the "C-W" 1000 cycle note. Remove the three plug buttons on the panel covering the adjustable "sense" resistors, see Figure 9. With a screwdriver, turn the resistor associated with the band to be aligned to the extreme counterclockwise position.

9.38 Set the oscillator at the highest frequency for any particular band and tune the signal in on the receiver. The "balance" setting should be in either the −50 or +50 position. Depress the "sense" button and reduce the sensitivity to a point where the db output meter needle is about midscale. Using the special alignment tool, adjust the antenna trimmer, associated with the band under test, for maximum receiver output. See Figure 8. The "sense" button must be depressed during this adjustment. Set the alignment oscillator to the lowest frequency of the band under consideration and tune the receiver to the 1000 cycle note. Depress the "sense" button and adjust the iron core of the antenna coil associated with the circuit. See Figure 11, L-101, L-102A and L-103A. Note holes in rear chassis wall. This procedure should be repeated two or three times at the two frequencies to assure correct tracking. Each of the three band circuits is entirely independent of the other two so that adjustment of one band has no effect upon the other bands.

9.39 After alignment of antenna circuits, the receiver may be connected to any antenna within the capacity limits of 150 to 500 mmfd and realigned only at the high frequency end of each band, see paragraph 4.15.

Note: For optimum performance the sense circuit alignment (paragraph 9.38) and sense resistor adjustments (paragraphs 4.25, 4.26, 4.27, 4.29, and 9.37) should be made with the antenna to be used with the equipment connected to the receiver, and the aligning oscillator should be coupled as outlined in paragraph 4.4.

9.40 TUBE CHARACTERISTICS—The following tabulation shows the average characteristics of the vacuum tubes employed in the direction finding equipment. As shown in section VIII, these ratings are not exceeded in the application of the equipment. The column at the right gives minimum usable values of mutual conductance. If the tubes test less than these values, they should be replaced.

TUBE DATA

Tube Type	Heater Volts Ef	Heater Cur. If	Plate Volts Ep	Grid Bias Volts Eg	Plate Cur. M.A.	Screen Grid Volts Ea	A. C. Plate Res. Ohms Rp	Transcond. Micromhos Gm	Ampl. Factor Mu	Minimum Usable Values Gm
—6C6	6.3	.3	250.	3.	2.	100	500,000	1225	1500	820
—6D6	6.3	.3	250.	3.	8.2	100	800,000			1070
—76	6.3	.3	250.	13.5	5.		9,500	1450	13.8	970
—5Z3	5.0	3.0	AC voltage per plate (RMS) 500							
			DC output—250 ma maximum							
—6AF6-G	6.3	.15	135 (target)		1.5					

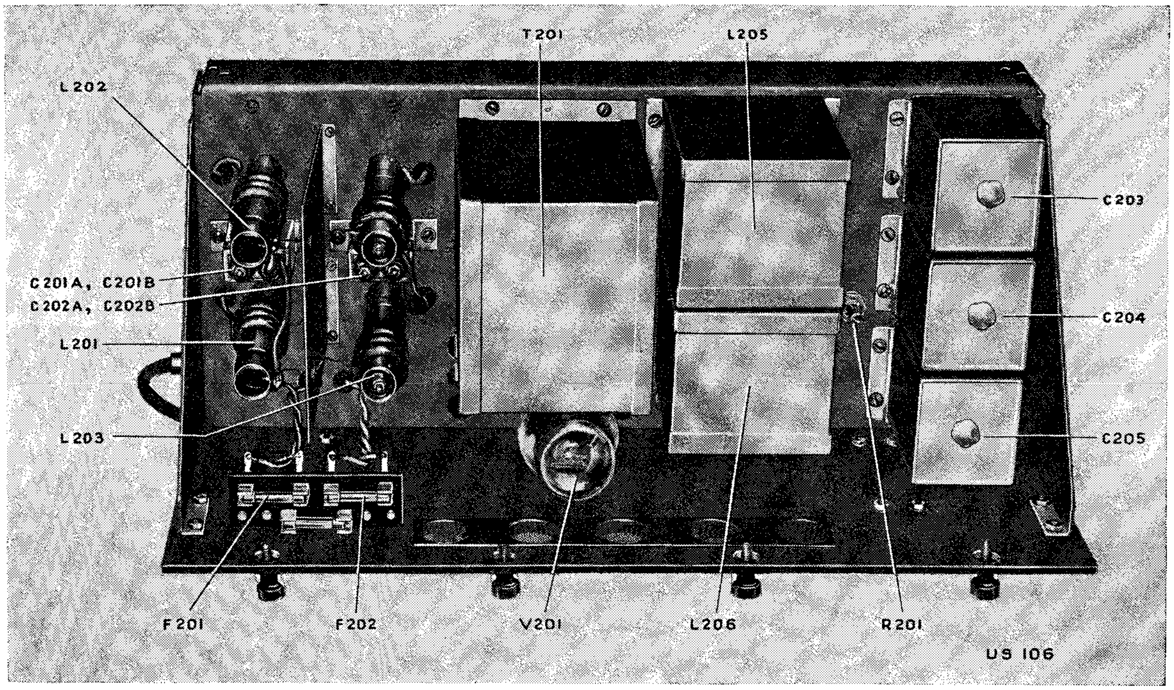

Figure 12—Power Unit (Top View)

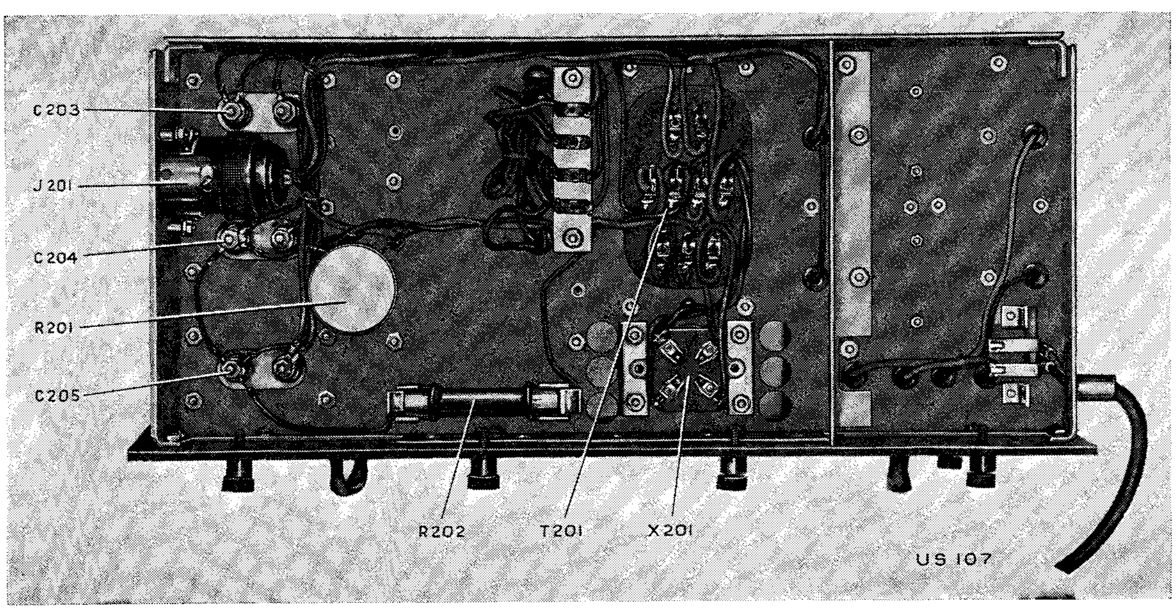

Figure 13—Power Unit (Bottom View)

9.41 CLEANING RECEIVER SWITCH CONTACTS—All rotary switches in the receiver employ silver surfaces for both the movable and fixed contacts. While this combination provides the best electrical performance, the use of "similar" metals as wiping contacts is conducive to "galling" unless proper lubrication is used. Similarly for satisfactory and quiet operation, absolutely clean and highly polished surfaces are essential. Accordingly, the following maintenance procedure should be followed with the rotary switches:

1. Rotate the switches through their entire range several times, at least weekly, to prevent the accumulation of dirt on the contacts not so frequently used and to maintain their polish.
2. Inspect the contacts at least once every six months, cleaning them with carbon tetrachloride applied with a small brush. After cleaning, the contacts should be lubricated with a **very thin** film of petrolatum (vaseline). The amount of lubrication should be kept to a minimum. This may be more easily accomplished if the petrolatum is thinned by heating prior to application by a fine brush.

   Caution: Do not use an abrasive such as sandpaper for cleaning the contacts.

9.42 CLEANING LOOP CONTACTS—The loop contact plugs should be occasionally wiped clean with a rag and inspected to see that springs are expanded sufficiently to insure good contact.

9.43 If noise results when rotating the loop, remove the brush plate and clean the brushes and rings with alcohol or carbon tetrachloride (do not use emery cloth or sandpaper). A third brush below the collector rings provides a good ground connection between the loop shaft and pedestal. This must also be cleaned occasionally. Be sure that there is a continuous electrical ground connection from the loop housing to the receiver case.

9.44 LUBRICATING BRAKE—If at any time a squeak or chatter is noticed when the loop is being rotated, application of Neatsfoot oil, Navy Specification 14-O-3b, to the brake lining on the operating pedestal will remedy the condition.

9.45 Make periodic tests for any backlash in the slightest degree between the handwheel, azimuth scale and loop. If any is found, go over all teat screws and retighten. If "play" is allowed to persist in any of the teat screws, the shaft holes will be elongated and it will be impossible ever to keep them tight. Likewise, check periodically to insure that the loop center tap is properly grounded. (Screw "A," Figure 16.) A loose connection at this point will result in poor and non-reciprocal bearings.

9.46 LOOP INSPECTION AND MAINTENANCE—One of the most insidious troubles that may develop results from moisture entering the loop or associated structures, bridging the spacers and causing sufficient leakage to greatly reduce the effectiveness, "Q," of the loop circuit. Bridging of the insulated joint at the top of the loop housing by moisture has an equally bad effect. "Megger" or "ohmmeter" test will not always disclose these conditions. It is extremely important that the "Q" of the loop circuit be kept as high as possible as the sensitivity of the equipment is largely dependent upon it.

9.47 If the loop is installed in an inverted position, the two drain plugs in the loop housing, see Figure 24, near the insulated joint, should be removed to drain off any moisture that may have accumulated. If there is no indication of water, the plugs may be replaced.

9.48 To test for moisture or other leakage conditions in the loop, proceed as follows: Remove the loop from the pedestal and connect a Model LN oscillator to the center of the loop as described in paragraph 4.3, using the 100-1 ratio capacitative attenuator. Replace the loop on the pedestal.

9.49 With the equipment set to approximately 1500 kc, carefully trim the loop circuit as described in paragraph 4.8.

9.50 With the receiver set for M-C-W reception and the "SENSITIVITY" control set to produce a low noise output, not in excess of 0 db with meter switch in "direct" position, adjust the Model LN Equipment to exact resonance and adjust the LN Attenuator for a scale deflection of +5 db with the db meter switch set to "ADD 15 DB" position. Note the output reading of the LN Attenuator and designate it E_L.

9.51 LEAVE THE RECEIVER ADJUSTMENTS INTACT and transfer the LN Oscillator with its added capacitative attenuator from the loop to the receiver. Remove the flexible connection assembly from the top of the receiver case and connect the "high" side of the capacitative attenuator to the right hand male terminal of the loop connector, and the "low" side to the case. Readjust the LN Attenuator until +5 db is again registered on the db meter with the switch set to "ADD 15 DB" position. Note the output reading of the LN Attenuator and designate it Eg.

9.52 Designating the loop circuit gain for the frequency in question as Q, then $Q = \frac{E_g \times 2}{E_L}$

For directly connected loops, this figure should not be less than 50 or for transformer coupled loops less than 30.

Should the loop gain value be less than that stated above, the loop and associated wiring must be thoroughly dried out. This may be done by blowing warm dry air into one of the drain holes, see Figure 24, allowing it to escape through the plug receptacle of the loop base.

9.53 If it is known that salt water has entered the loop housing, it should be thoroughly washed out by entirely filling the loop housing with warm fresh water and draining, twice. This must be followed by a thorough drying as outlined in paragraph 9.52. Such a drying process will require several hours.

9.54 In freezing weather when spray or rain causes an accumulation of ice on the loop structure, it is advisable to rotate the loop frequently to keep it free at the junction of rotation.

9.55 The tuning capacitor (C106 A, B, C, and D) has been carefully adjusted for correct capacity by slightly bending the outside rotor plates. **The position of such plates must not be changed under any condition.**

9.56 Dial panel lamps may be replaced after removing the window frame covering the panel opening. Balancer panel lamp may be replaced by sliding the lamp socket off its supporting lug. Azimuth scale lamp may be replaced by removal of the adjustable shade.

TABLE I
LIST OF MAJOR UNITS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

QUANTITY DP-12	QUANTITY DP-13	SYMBOL GROUP	NAVY TYPE DESIGNATION	NAME OF MAJOR UNIT	ASSEMBLY DRAWING NUMBER
1	1	101-199	CRV-46136	Receiver	W-302223-503
1	1	201-299	CRV-20049	Power Unit	T-601584-503
1	1	301-399	CRV-69011	Operating Pedestal	T-601377-501
1	1	401-499	CRV-69046	Loop Assembly	T-620135-501
		501-599		Unassigned	
1	1	601-699	CRV-47180	Receiver Input Transformer	P-701912-502
1	1		CRV-62029	Loop Output Junction Box	P-701912-501
1	1		CRV-62030	Transmission Line & Conduit	M-421592-502
2	1		CRV-69008	Deck Bearing	P-701471-501
2	2		CRV-69009	Cable Drum	P-701479-501
1	1		CRV-69012A	Hand Wheel	M-421331-501
1	1		CRV-69013	Azimuth Scale	P-701459-501
1	1		CRV-69047	Loop Pedestal	T-620045-502

For IB-38114
Series AB

TABLE II

PARTS LIST BY SYMBOL DESIGNATION

FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		CAPACITORS						
*C101	L-F Antenna Padding Capacitor	Fixed, mica, 33 mmfd ±10%, 500 v d.c. working	-48759-10	RE 48A 238A RE 48A 154F	1			K-850253-12
*C102	L-F Antenna Trimmer Capacitor	Air trimmer, 5 to 100 mmfd	-48758		2	APC-100		M-413394-10
*C103	M-F Antenna Padding Capacitor	Fixed, mica, 39 mmfd ±10%, 500 v d.c. working	-48760-10	RE 48A 238A RE 48A 154F	1			K-850253-13
*C104	M-F Antenna Trimmer Capacitor	Same as C102	-48758					
*C105	H-F Antenna Trimmer Capacitor	Same as C102	-48758					
C106A B C D	Loop Tuning Capacitor Antenna Tuning Capacitor R-F Tuning Capacitor R-F Oscillator Tuning Capacitor	Loop section, 1050 mmfd ±1% Antenna section, 734 mmfd ±1% R-F section, 734 mmfd ±1% Osc. section, 734 mmfd ±1%			1			T-601626-501
*C107	L-F Loop Padding Capacitor	Fixed, mica, 47 mmfd ±10%, 500 v d.c. working	-48801-10	RE 48A 238A RE 48A 154F	1			K-850253-11
*C108	L-F Loop Trimmer Capacitor	Same as C102	-48758					
*C109	M-F Loop Trimmer Capacitor	Same as C102	-48758					
*C110	M-F Loop Padding Capacitor	Fixed, mica, 100 mmfd ±10%, 500 v d.c. working	-48761-10	RE 48A 238A RE 48A 154F	1			K-850253-14
*C111	H-F Loop Trimmer Capacitor	Same as C102	-48758					
*C112A B	Cathode By-pass Capacitor Plate Supply Capacitor	Oil, paper foil, 0.5/0.5 mfd +10% -3%, 250 v d.c. working	-48554	RE 13A 488D RE 48A 160D	1		For Replacement Use Navy Type -48554-A	P-721074-3
*C113	R-F Trimmer Capacitor, Low	Same as C102	-48758					
*C114	R-F Trimmer Capacitor, Medium	Same as C102	-48758					
*C115	R-F Trimmer Capacitor, High	Same as C102	-48758					
*C116	R-F Oscillator Screen Capacitor	Oil, paper foil, 0.0075 mfd +10% -3%, 500 v d.c. working	-48796	RE 13A 488D RE 48A 110P	1			P-720555-15
*C117	R-F Oscillator Grid Coupling Capacitor	Fixed, mica, 560 mmfd ±10%, 500 v d.c. working	-48797-10	RE 48A 248A RE 48A 154F				K-850253-1

** EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		CAPACITORS (Continued)						
*C118	R-F Oscillator Trimmer Capacitor, Low	Same as C102	-48758					
*C119	R-F Oscillator Series Trimmer Capacitor, Low	Same as C102	-48758					
*C120	R-F Oscillator Series Padding Capacitor, Low	Fixed, mica, 854 mmfd ±3%, 500 v d.c. working	-48820-3	RE 48A 248A RE 48A 154F	1			K-850253-7
*C121	R-F Oscillator Trimmer Capacitor, Medium	Same as C102	-48758					
*C122	R-F Oscillator Series Trimmer Capacitor, Medium	Same as C102	-48758					
*C123	R-F Oscillator Series Padding Capacitor, Medium	Fixed, mica, 2030 mmfd ±1.5%, 500 v d.c. working	-48819-1.5	RE 48A 248A RE 48A 154F	1			K-850253-6
*C124	R-F Oscillator Trimmer Capacitor, High	Same as C102	-48758					
*C125	R-F Oscillator Series Padding Capacitor, High	Fixed, mica, 4375 mmfd ±1.5%, 500 v d.c. working	-48818-1.5	RE 48A 248A RE 48A 154F	1			K-850253-5
*C126	R-F 1st Detector Coupling Capacitor	Fixed, mica, 1000 mmfd ±5%, 500 v d.c. working	-48798-5	RE 48A 248A RE 48A 154F	1			K-850253-2
*C127	Cathode By-pass Capacitor	Oil, paper foil, 0.25 mfd +10% -3%, 800 v d.c. working	-48794	RE 13A 488D RE 48A 160D	1		For Replacement Use Navy Type -48802	P-721074-10
*C128	I-F Tuning Capacitor	Fixed, mica, 1800 mmfd ±5%, 500 v d.c. working	-48799-5	RE 48A 248A RE 48A 154F	1			K-850253-3
*C129	I-F Tuning Capacitor	Same as C128	-48799-5					
*C130	Grid Bias By-pass Capacitor	Fixed, mica, 2700 mmfd ±10%, 500 v d.c. working	-48800-10	RE 48A 248A RE 48A 154F	1			K-850253-4
*C131A B	Cathode By-pass Capacitor Cathode By-pass Capacitor	Same as C112A,B	-48554					
*C132	I-F Tuning Capacitor	Same as C128	-48799-5					
*C133	I-F Tuning Capacitor	Same as C128	-48799-5					

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		CAPACITORS (Continued)						
*C134	Grid Bias By-pass Capacitor	Same as C130	-48800-10					
*C135	Plate Supply Capacitor	Oil, paper foil, 1 mfd +10% -3%, 250 v d.c. working	-48553	RE 13A 488D RE 48A 160D	1		For Replacement Use Navy Type -48829	P-721074-2
*C136	I-F Tuning Capacitor	Same as C128	-48799-5					
*C137	I-F Tuning Capacitor	Same as C128	-48799-5					
*C138	R-F By-pass Capacitor	Same as C117	-48797-10					
*C139	R-F By-pass Capacitor	Same as C130	-48800-10					
*C140	Audio Coupling Capacitor	Same as C130	-48800-10					
*C141	R-F By-pass Capacitor	Same as C117	-48797-10					
*C142A B	Cathode By-pass Capacitor 1st A-F Plate Capacitor	Same as C112A,B	-48554					
*C143	1st A-F Screen Capacitor	Oil, paper foil, 0.5 mfd +10% -3%, 600 v d.c. working	-48793	RE 13A 488D RE 48A 160D	1			P-721074-9
*C144	Audio Coupling Capacitor	Same as C130	-48800-10					
*C145	Cathode By-pass Capacitor	Same as C135	-48553					
*C146	Plate Supply Capacitor	Same as C135	-48553					
*C147	Audio Filter Capacitor	Same as C135	-48553					
*C148	Audio Filter Capacitor	Same as C135	-48553					
*C149	I-F Oscillator Tuning Capacitor	Same as C126	-48798-5					
*C150	I-F Oscillator Grid Coupling Capacitor	Same as C126	-48798-5					
*C151A B	I-F Oscillator Heater Capacitor I-F Oscillator Heater Capacitor	Same as C112A,B	-48554					
*C152	I-F Oscillator 2nd Detector Coupling Capacitor	Air trimmer, 2 to 10 mmfd	-48757		2	APC-10		M-413394-1

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENT

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		CAPACITORS (Continued)						
*C153	I-F Oscillator Screen Capacitor	Same as C116	-48796					
*C154	Screen By-pass Capacitor	Same as C135	-48553					
*C155	Volume Control By-pass Capacitor	Same as C135	-48553					
*C156	Electronic Indicator Audio By-pass Capacitor	Oil, paper foil, 0.05 mfd +10% -3%, 600 v d.c. working	-481349	RE 48A 110P	1			P-720555-17
*C201A B	Line Filter Capacitor Line Filter Capacitor	Oil, paper foil, 0.125/0.125 mfd +10% -3%, 500 v d.c. working	-48795	RE 13A 488D RE 48A 110P	1			M-420071-4
*C202A B	Line Filter Capacitor Line Filter Capacitor	Same as C201A,B	-48795					
*C203	D-C Filter Capacitor	Oil, paper foil, 4 mfd +10% -3%, 300 v d.c. working	-48792	RE 13A 488D RE 48A 137E	1		For Replacement Use Navy Type -48792-A	M-420071-1
*C204	D-C Filter Capacitor	Same as C203	-48792					
*C205	D-C Filter Capacitor	Same as C203	-48792					
		FUSES						
*F101	Heater Supply Fuse	6 amps., cartridge type, 1-1/4" long, 1/4" dia. ferrules		17-F-2e	3	Type 3AG		K-811485-5
*F102	Plate Supply Fuse	0.1 amp., cartridge type, 1-1/4" long, 1/4" dia. ferrules		17-F-2e	3	Type 3AG		K-811485-16
*F201	Line Fuse	3 amps., cartridge type, 1-1/4" long, 1/4" dia. ferrules		17-F-2e	3	Type 3AG Cat. #1043		K-811485-12
*F202	Line Fuse	Same as F201						

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)

PARTS LIST BY SYMBOL DESIGNATION

FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
PILOT LAMPS								
*I101	Balancer Scale Panel Lamp	6.3 v, 0.25 amp., miniature screw base	TB-6	RE 38F 149B	4	Mazda 46		K-61114-18
*I102	Tuning Dial, L.H. Side, Panel Lamp	Same as I101	TB-6					
*I103	Tuning Dial, R.H. Side, Panel Lamp	Same as I101	TB-6					
*I301	Azimuth Scale Lamp	Same as I101	TB-6					
JACKS & RECEPTACLES								
J101	Phone Output Jack	Four spring, two circuit	-49021-A	RE 13A 481D	5			K-833982-1
J102	Phone Output Jack	Same as J101	-49021-A					
J103	Power Cable Receptacle	Six pole, male			6	F-3584		WW-302223-112
J104	Balancer Scale Lamp Receptacle	Miniature base, screw socket			1			K-67842-503
J105	Tuning Dial, L.H. Side, Panel Lamp Receptacle	Miniature base, screw socket			1			K-829808-501
J106	Tuning Dial, R.H. Side, Panel Lamp Receptacle	Miniature base, screw socket			1			K-829808-502
J201	Power Cable Receptacle	Same as J103						
J301	Azimuth Scale Lamp Receptacle	Miniature base screw socket			1			K-81550-501
CONTACTORS								
*K101	Antenna Grounding Relay	D.P.S.T., 6 v a.c., 50-60 cycles, min. operating voltage 5.4 v, d-c resistance of coil 1.5 ohms, 280 turns #23 E wire, contact rating: 2 amps. at 110 v a.c. or d.c. non-inductive load	-29057		12	L-131 Coil 367		K-854724-1

** EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		INDUCTANCES						
L101	Antenna Tuning Coil, H.F.	5 strand #40 litz wire, universal wound 4 crosses per turn in two sections, on wax impregnated isolantite form, O.D. 9/16", I.D. 3/8", 2-3/4" long, each section 31 turns, 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 1-9/16" from end of form and finishes 7/8" from opposite end, 56.3 microhenries ±3%, after adjustment of iron core - 71.5 microhenries			1			M-413251-501
L102A B	Antenna Tuning Coil, M.F. Antenna Load Coil, M.F.	5 strand #40 litz wire, universal wound 4 crosses per turn in two parts, on wax impregnated isolantite form, O.D. 9/16", I.D. 3/8", 2-3/4" long, part A in two sections, one section 91 turns, one section 81 turns, 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 1-1/2" from end of form and finishes 15/16" from opposite end, 468 microhenries ±3%, after adjustment of iron core - 505 microhenries, part B, single section 95 turns, 1/8" wire traverse, winding starts 1-1/8" from end of form and finishes 1/4" from start of part A, 196 microhenries ±3%			1			M-413253-501
L103A B	Antenna Tuning Coil, L.F. Antenna Load Coil, L.F.	5 strand #40 litz wire, universal wound 4 crosses per turn in two parts, on wax impregnated isolantite form, O.D. 9/16", I.D. 3/8", 2-3/4" long, part A in two sections, each section 217 turns, 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 1-1/2" from end of form and finishes 15/16" from opposite end 2950 microhenries ±3%, after adjustment of iron core - 3213 microhenries, part B, single section,			1			M-413254-501

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		INDUCTANCES (Continued)						
L103	(Continued)	260 turns, 5/16" wire traverse, winding starts 13/16" from end of form and finishes 3/8" from start of part A, 1050 microhenries ±3%						
L104	Sense Coupling Coil	#28 DS copper wire, 112" long, 25-1/2 turns right hand wound on impregnated isolantite spool 1-5/16" dia. at coil base, O.D. 1-1/2", spool thickness 5/16", wire traverse 1/8", 40.1 microhenries ±1%			1			K-829369-501
L105	Balancer Coupling Coil	10 strand #40 DS litz wire, 40 turns, left hand wound on impregnated isolantite spool 1-3/16" dia. at coil base, O.D. 1.594", 1" center hole, spool thickness 5/16", wire traverse 3/16", 88 microhenries +5% -3%			1			K-829312-501
L106	Loop Sense Coupling Coil	10 strand #40 DS litz wire, 11 turns bank wound in two layers on impregnated isolantite form, O.D. 1-1/2", I.D. 1-1/4", 1" +1/32" -0" long, 10.1 microhenries ±5%			1			K-829365-502
L107	Loop Balance Coupling Coil	10 strand #40 DS litz wire, 12 turns bank wound in two layers on impregnated isolantite form, O.D. 1-1/2", I.D. 1-1/4", 1" +1/32" -0" long, 11.3 microhenries ±5%			1			K-829365-503
L108A B	Loop Load Coil, M.F. Loop Load Coil, L.F.	10 strand #40 DS litz wire, universal wound, four crosses per turn, in two parts on wax impregnated isolantite form, O.D. 3/4", I.D. 0.500" +0.015" -0", 2-1/2" long, part A in four sections, each section 21 turns, 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 29/32" from end of form and finishes 29/32" from			1			M-413203-501

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		INDUCTANCES (Continued)						
L108	(Continued)	opposite end, 106.5 microhenries ±5%, after adjustment of iron core 151.1 microhenries ±0.1%, part B in four sections, each section 52 turns 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 29/32" from end of form and finishes 29/32" from opposite end, 653.2 microhenries ±5%, after adjustment of iron core - 1115 microhenries ±1%						
L109A B	Loop Load Coil, M.F. Loop Load Coil, L.F.	Same as L108A&B						
L110A B	R-F Tuning Coil, M.F. R-F Tuning Coil, L.F.	10 strand #41 DS litz wire, universal wound, four crosses per turn, in two parts on wax impregnated isolantite form, O.D. 3/4", I.D. 1/2", 4-5/8" long. Part A in four sections, each section 95 turns, 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 3-1/8" from end of form, and finishes 1-13/16" from opposite end, 2310 microhenries ±3%, after adjustment of iron core - 3441 microhenries. Part B, in four sections, 1st section 45 turns, remaining 3 sections 35 turns each, 1/8" wire traverse, spaced 1/16" apart and connected in series, winding starts 7/8" from end of form and finishes 1-9/16" from start of part A, 335 microhenries ±3%, after adjustment of iron core - 565 microhenries			1			M-413258-501
L111	R-F Tuning, H.F.	10 strand #40 DS litz wire, right hand wound in two sections on wax impregnated isolantite form O.D. 1", I.D. 0.750", 3-1/8" long, first section 53 turns, 7/8" wire traverse, spaced 1/8" apart and connected in series			1			M-413209-501

TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		INDUCTANCES (Continued)						
L111	(Continued)	with second section of 3 turns, winding starts 1-1/2" from end of form and finishes 5/8" from opposite end, 119 microhenries ±0.1%						
L112A B	R-F Oscillator Tuning Coil, L.F. R-F Oscillator Tuning Coil, M.F.	10 strand #41 DS litz wire, universal wound, four crosses per turn, in two parts on wax impregnated isolantite form, O.D. 3/4", I.D. 1/2", 4-5/8" long, part A in five sections, each section 65 turns, 1/8" wire traverse, spaced 1/16" apart, four sections connected in series and leads brought out, remaining section with separate leads, winding starts 2-7/8" from end of form and finishes 7/8" from opposite end, 1390 microhenries ±3%, after adjustment of iron core - 1821 microhenries, part B in three sections of 34 turns each and two sections of 29 turns each, 1/8" wire traverse spaced 1/16" apart and two sections of 29 turns and two of 34 turns connected in series with leads brought out, remaining section of 34 turns with separate leads, winding starts 7/8" from end of coil and finishes 1-1/8" from start of part A, 320 microhenries ±3%, after adjustment of iron core, 426 microhenries			1			M-413237-501
L113	R-F Oscillator Tuning Coil, H.F.	#30 ES wire, right hand wound in two sections on wax impregnated isolantite form, O.D. 1", I.D. 0.750" 3-1/8" long, first section 74 turns, approx. 1-1/8" wire traverse spaced 1/8" apart and connected in series with second section of 2 turns, winding starts 1-5/16" from end of form and finishes 9/16" from opposite end, 101.1 microhenries ±0.1%			1			M-413205-501

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		INDUCTANCES (Continued)						
L114	I-F Oscillator Tuning Coil	ES wire, 0.01" dia. (bare wire), universal wound one cross per turn in three sections, wax impregnated isolantite form, O.D. 9/16", I.D. 3/8", 2-3/4" long, two sections of 255 turns each, 5/16" wire traverse spaced 1/16" apart and connected in series, winding starts 1-1/8" from end of form and finishes 15/16" from opposite end, third section of 150 turns, 1/8" wire traverse, winding starts 7/8" from end of form and finishes 1/8" from start of other sections			1			M-413249-501
L201	Line Filter Coil	Filter coil with core adjustment, #22 ES wire, O.D. 3/4", I.D. 5/8", four sections wound in series, 1st section 40 turns single layer, wire traverse 1-1/4", other three sections each section 50 turns, universal wound, two crosses per turn, wire traverse 1/4", 1/8" apart, 0.85 ohms ±5%, 600 microhenries ±5% at zero current			1			K-829371-501
L202	Line Filter Coil	Same as L201						
L203	Line Filter Coil	Same as L201						
L204	Line Filter Coil	Same as L201						
L205	D-C Filter Coil	Filter reactor, #31 E wire, 6050 turns, 40 layers, wire traverse 1.625", tap at 5965 turns, layer insulation 1 turn 0.0015" kraft paper, insulation over coil 2 turns gummed kraft paper core stacked all one way with air gap spacer, 25 h, 0.055 amp., d-c resistance 375 ohms ±7-1/2% at 25°C., full winding, ratio: 70.2 to 1 ±2% between start and tap, to tap and finish hipot test: 1500 v, 60 cycles for 5 seconds from coil to ground	-30331		1	RT-518		M-80885-502

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		INDUCTANCES (Continued)						
L206	D-C Filter Coil	Same as L205	-30331					
L401	Signal Pickup Coil	Loop antenna			1			T-620135-501
L402	Compensating Coil	In two sections, 1/4" apart, each section: 20 turns 19/#41 S litz wire, single layer wound over steatite ceramic tube, I.D. 0.378", O.D. 1/2", 2-3/8" long, wire traverse 3/8"			1			K-855314-501
		METERS						
*M101	Output Indicator Meter	D-B meter, rectifier type, scale -10 to +5 db, responsiveness 0.6 second or less, damping factor between 16 and 200, sensitivity zero level = 72 microwatts (0.6 v), impedance 5000 ohms -6 +10% at 0.6 v, 1000 cycles, 2-1/2" flush bakelite case	-22257-A	17-I-12(INT)	7			K-837019-1
		FUSE MOUNTINGS						
O101	Fuse Mounting	Jack and fuse board for F101 and F102			1			K-829539-501
O201	Fuse Mounting	Mounting for F201 and F202			1			K-829388-501
		RESISTORS						
*R101	Antenna Static Leak Resistor	Composition, pigtail, 1 megohm ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-98
*R102	Sense Resistor, L.F.	Potentiometer, wire wound, 1000 ohms ±10%, linear, 2 watts, screwdriver shaft 1/2" long	-63529	RE 13A 492C	9			K-806807-5
*R103	Sense Resistor, M.F.	Same as R102	-63529					

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		RESISTORS (Continued)						
*R104	Sense Resistor, H.F.	Same as R102	-63529					
*R105	R-F Cathode Resistor	Composition, pigtail, 470 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-58
*R106	R-F Oscillator Grid Resistor	Composition, pigtail, 0.27 megohm ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-91
*R107	R-F Oscillator Screen Resistor	Composition, pigtail, 0.1 megohm ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-86
*R108	1st Detector Grid Resistor	Same as R101	-63360					
*R109	1st Detector Cathode Resistor	Composition, pigtail, 4700 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-70
*R110	R-F Oscillator Detector Coupling Resistor	Composition, pigtail, 10,000 ohms ±5%, 1/2 watt	-63355	RE 13A 372G	8	BT-1/2		K-850981-74
*R111	1st I-F Grid Bias Resistor	Same as R107	-63360					
*R112	1st I-F Cathode Resistor	Same as R105	-63360					
*R113	2nd I-F Grid Bias Resistor	Same as R107	-63360					
*R114	Plate Supply R-F Filter Resistor	Composition, pigtail, 1000 ohms ±5%, 1/2 watt	-63355	RE 13A 372G	8	BT-1/2		K-850981-159
*R115	2nd I-F Cathode Resistor	Same as R105	-63360					
*R116	Diode Coupling Resistor	Composition, pigtail, 0.68 megohm ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-96
*R117	1st A-F Grid Resistor	Same as R106	-63360					
*R118	1st A-F Grid Resistor	Same as R101	-63360					
*R119	1st A-F Cathode Resistor	Composition, pigtail, 2200 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-66
*R120	1st A-F Screen Resistor	Composition, pigtail, 0.47 megohm ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-94

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		RESISTORS (Continued)						
*R121	1st A-F Screen Resistor	Composition, pigtail, 0.22 megohm ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-90
*R122	1st A-F Plate Resistor	Composition, pigtail, 47,000 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-82
*R123	1st A-F Plate Resistor	Same as R121	-63360					
*R124	2nd A-F Grid Resistor	Same as R101	-63360					
*R125	2nd A-F Cathode Resistor	Composition, pigtail, 1500 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-64
*R126	Audio Filter Resistor	Composition, pigtail, 5600 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-71
*R127	DB Meter Net Resistor	Composition, pigtail, 5100 ohms ±5%, 1/2 watt	-63355	RE 13A 372G	8	BT-1/2		K-850981-176
*R128	DB Meter Net Resistor	Same as R114	-63355					
*R129	DB Meter Net Resistor	Same as R114	-63355					
*R130	DB Meter Net Resistor	Composition, pigtail, 20,000 ohms ±5%, 1/2 watt	-63355	RE 13A 372G	8	BT-1/2		K-850981-190
*R131	DB Meter Net Resistor	Same as R110	-63355					
*R132	DB Meter Net Resistor	Composition, pigtail, 3900 ohms ±5%, 1/2 watt	-63355	RE 13A 372G	8	BT-1/2		K-850981-173
*R133	Phone Output Resistor	Composition, pigtail, 200 ohms ±5%, 1/2 watt	-63355	RE 13A 372G	14	MB-1/2		K-837141-18
*R134	Phone Output Resistor	Same as R133	-63355					
*R135	I-F Oscillator Grid Resistor	Same as R101	-63360					
*R136	I-F Oscillator Coupling Resistor	Same as R105	-63360					
*R137	I-F Oscillator Screen Resistor	Same as R106	-63360					
*R138	I-F Oscillator Plate Resistor	Same as R107	-63360					

* ***EQUIPMENT SPARE PARTS FURNISHED****, refer to* ***TABLE IV. EQUIPMENT SPARES****, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		RESISTORS (Continued)						
*R139	R-F and I-F Screen Resistor	Same as R119	-63360					
*R140	Sensitivity Control Resistor	Composition, pigtail, 6800 ohms ±10%, 2 watts	-63474	RE 13A 372G	8	BT-2		K-844302-72
*R141	Sensitivity Control Resistor	Same as R140	-63474					
*R142	Sensitivity Control Potentiometer	5150 ohms ±5%, 4 watts, wire wound, first 160° counter-clockwise linear 1350 ohms, remainder 3800 ohms	-63528-A	RE 13A 492B	10	M		K-854763-1
*R143	Indicator Amplifier Plate Resistor	Same as R101	-63360					
*R144	Electronic Indicator Ray Control Resistor	Composition, pigtail, 2.7 megohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-103
*R145	Indicator Amplifier Screen Grid Voltage Divider Resistor	Composition, pigtail, 22,000 ohms ±10%, 1 watt	-63288	RE 13A 372G	8	BT-1		K-844314-78
*R146	Indicator Amplifier Screen Grid Voltage Divider Resistor	Composition, pigtail, 10,000 ohms ±10%, 1 watt	-63288	RE 13A 372G	8	BT-1		K-844314-74
*R147	Electronic Indicator Cathode Bias Resistor	Composition, pigtail, 15,000 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-76
*R148	Indicator Amplifier Fixed Cathode Resistor	Composition, pigtail, 560 ohms ±10%, 1/2 watt	-63360	RE 13A 372G	8	BT-1/2		K-850981-59
*R149A B	Output Indicator Bias Control Potentiometer Output Indicator Bias Control Potentiometer	Dual, 1500 ohms ±10%, each section, 2 watts, linear taper, wire wound, round shaft	-631087	RE 13A 372G	9			P-720471-18
*R150	Output Indicator Cathode Bias Potentiometer	400 ohms ±10%, wire wound, 2 watts, linear taper screwdriver shaft 1"long	-631086	RE 13A 492B	9			P-720471-19
*R201	Hum Adjustment Potentiometer	Linear, 100 ohms, 4 watts, wire wound screwdriver shaft 1" long	-63324	RE 13A 492C	9			K-806807-1
*R202	Bleeder Resistor	Fixed, wire wound, 5000 ohms, 4 watts, grade 1, class 2	-63015E	RE 13A 372J	13			M-418350-51

** EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		SWITCHES						
S101A	Antenna Circuit Switch	Band switch, eight sections, each section, two pole, three position			1			M-421580-1
B	Antenna Circuit Switch							
C	Loop Circuit Switch							
D	Loop Circuit Switch							
E	Loop Circuit Switch							
F	R-F Amplifier Switch							
G	R-F Oscillator Switch							
H	R-F Oscillator Switch							
S102	Balance-Sense Switch	D.P.D.T.	24028		1			M-413229-501
S103	Diode Output Switch	Test link 2nd detector			1			K-829571-501
*S104	CW Oscillator Switch	Toggle, S.P.S.T., 1 amp. at 250 v	-24000	RE 24AA 118A (Fig.2)	11			K-30066-11
*S105	Off-On Switch	Same as S104	-24000					
*S106	Panel Lamp Switch	Same as S104	-24000					
S107	DB Meter Range Switch	Rotary tap, one section, 2 pole, 5 position, 3/4" shaft	-24027		10	#B-110008		M-80871-1
		TRANSFORMERS						
* T101	1st I-F Transformer	Assembly, 81.5 kc i.f., includes i-f coil, capacitors C128,129,130, and resistor R111, Coil assembly: 2 coils spaced 1" apart on form, O.D. 9/16", I.D. 3/8", 3-1/8" long, wax impregnated isolantite, each coil has 300 turns of 7 strands #42 S copper litz wire, universal wound, 2 crosses per turn, wire traverse 1/4"			1			M-413246-501
* T102	2nd I-F Transformer	Assembly, 81.5 kc i.f., includes i-f coil, capacitors C132,133,134, and resistor R113, Coil assembly same as T101			1			M-420062-501

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENT

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		TRANSFORMERS (Continued)						
*T103	3rd I-F Transformer	Assembly, 81.5 kc i.f., includes i-f coil, capacitors C136,137,138 and resistor R116 Coil assembly same as T101			1			M-420062-502
*T104	Output Transformer	Comprised of primary, secondary with mid-tap, and tertiary shielded windings; ratio: primary to secondary 5.24 to 1 ±3%; primary to tertiary 2.82 to 1 ±3%; secondary mid-tap to be within 2% of electrical neutral, Primary: 3300 turns, 26 layers, wire traverse 0.981", #36 E wire wound on tertiary winding, insulation between layers 1 turn 0.001" kraft paper, insulation over coil 2 turns 0.007" gummed kraft paper, Secondary: made of two sections for mid-tap connection, each section 315 turns, 10 layers, wire traverse 0.313", #32 E wire wound on false spool, insulation between layers 1 turn 0.003" kraft paper, insulation over coil 2 turns of 0.007" gummed kraft paper, both sections wound alike, one reversed in assembly, start leads connected for mid-tap Tertiary: 1170 turns, 10 layers, wire traverse 0.781", #36 E wire wound on kraft spool 0.025" thick, cross section inside of spool 39/64" x 41/64" insulation between layers 1 turn 0.001" kraft paper, insulation over coil 4 turns 0.003" kraft paper Resistance: primary 450 ohms, secondary 52 ohms, tertiary 122 ohms Hipot test: 1000 v, 60 cycles between windings and from windings to shield and core or case, iron core stacked alternately in groups of 5, transformer impregnated and sealed in can	-30330		1	RT 426		M-81127-501

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		TRANSFORMERS (Continued)						
T201	Power Transformer	Comprising four windings: one primary and three secondaries: plate (tapped within ±1% of electrical neutral), amplifier filament, and rectifier filament Ratio test: with 112 v, 60 cycles applied to the primary, the secondary no load voltages shall be - plate 347 v ±3%, amplifier filament 7.37 v ±3%, rectifier filament 5.75 v ±3%, Hipot test: the transformer shall withstand for five seconds 1500 v, 60 cycles between primary and amplifier filament and from these windings to shield and ground; 2500 v, 60 cycles between plate and rectifier filament and from the latter windings to shield or ground; max. core loss 3.25 watts measured on the primary at max. exciting current 0.4 amp., 112 v, 60 cycles, Induced voltage test: 450 v, 500 cycles for 30 seconds to primary, Primary: 760 turns, 10 layers of #24 E wire, wire traverse 1.8125", wound on fuller board spool 2-1/16" long, 1/8" thick, I.D. 1-1/32" x 1-1/16", insulation between layers 1 turn 0.003" kraft paper and over coil 1 turn 0.003" and 2 turns 0.007" gummed kraft paper continued with 3 turns 0.007" gummed kraft paper over shield; shield, 1 turn of sheet copper 1-13/16" x 7-1/2", 0.004" thick; coil build 0.3165", d-c resistance 8.74 ohms, Plate: 2350 turns, 11 layers of #33 E wire tapped at 1175 turns, wire traverse 1.825" wound over false spool, insulation between layers 1 turn 0.0015" kraft paper, insulation over coil 2 turns 0.010" gummed fiber coil build 0.141"	-30069		1	RT-424		M-80876-501

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		TRANSFORMERS (Continued)						
T201	(Continued)	Amplifier filament: 50 turns, 2 layers of #16 E wire, wire traverse 1.463" wound over plate coil, insulation between layers 1 turn 0.010" kraft paper, insulation over coil 2 turns 0.010" gummed fiber, coil build 0.142", d-c resistance 0.156 ohms, Rectifier filament: 39 turns, 1 layer of #18 E wire, wire traverse 1.79" wound over amplifier filament, insulation over coil 2 turns 0.010" gummed fiber, coil build 0.065", d-c resistance 0.203 ohms, Iron core stacked 7/8" alternately in groups of 3, transformer impregnated and sealed in can						
		VACUUM TUBES (FOR COMPLETE ELECTRICAL CHARACTERISTICS SEE PAGE 32)						
*V101	Tube, R-F Amplifier	Triple-grid, super-control amplifier	-6D6	RE 13A 600C	1a	RCA-6D6		
*V102	Tube, 1st Detector	Same as V101	-6D6					
*V103	Tube, 1st I-F Amplifier	Same as V101	-6D6					
*V104	Tube, 2nd I-F Amplifier	Same as V101	-6D6					
*V105	Tube, 2nd Detector	Super-triode amplifier, detector	-76	RE 13A 600C	1a	RCA-76		
*V106	Tube, 1st A-F Amplifier	Triple-grid amplifier, detector	-6C6	RE 13A 600C	1a	RCA-6C6		
*V107	Tube, 2nd A-F Amplifier	Same as V105	-76					
*V108	Tube, R-F Oscillator	Same as V106	-6C6					
*V109	Tube, I-F Oscillator	Same as V106	-6C6					
*V110	Antenna Protective Device	Lamp, neon				RCA-991		
*V111	Tube, Indicator Amplifier	Same as V106	-6C6					

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE II (Continued)
PARTS LIST BY SYMBOL DESIGNATION
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
		VACUUM TUBES (Continued)						
*V112	Tube, Electronic Indicator	Electron-ray			1a	RCA-6AF6-G		
*V201	Rectifier	Full wave high-vacuum rectifier	-5Z3	RE 13A 600C	1a	RCA-5Z3		
		VACUUM TUBE SOCKETS						
*X101	Tube Socket for V101	6 prong, wafer type, ceramic base	-49318	RE 49AA 307A	2	S-6		K-856996-3
*X102	Tube Socket for V102	Same as X101	-49318					
*X103	Tube Socket for V103	Same as X101	-49318					
*X104	Tube Socket for V104	Same as X101	-49318					
*X105	Tube Socket for V105	5 prong, wafer type, ceramic base	-49314	RE 49AA 307A	2	S-5		K-856996-2
*X106	Tube Socket for V106	Same as X101	-49318					
*X107	Tube Socket for V107	Same as X105	-49314					
*X108	Tube Socket for V108	Same as X101	-49318					
*X109	Tube Socket for V109	Same as X101	-49318					
*X110	Socket for V110	Neon lamp socket			1			K-855531-501
*X111	Tube Socket for V111	Same as X101	-49318					
*X112	Tube Socket for V112	Ceramic steatite, with mounting ring, octal, 8 contacts	-49373	RE 49AA 313A	15	SS-8		K-856955-6
*X201	Rectifier Tube Socket	4 prong, tube socket, phenolic base and support assembly	-49311A	RE 49AA 308A	1			M-401485-502

* *EQUIPMENT SPARE PARTS FURNISHED, refer to TABLE IV, EQUIPMENT SPARES, for quantities.*

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TABLE III
PARTS LIST BY NAVY TYPE NUMBERS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
MISCELLANEOUS (CLASS 10)		
4	TB-6	I101,102,103,301
2		J103,201
1		J104
1		J105
1		J106
1		J301
METERS (CLASS 22)		
1	-22257-A	M101
SWITCHES (CLASS 24)		
3	-24000	S104,105,106
1	-24027	S107
1	-24028	S102
1		S101A,B,C,D,E,F,G&H
1		S103
FUSES (CLASS 28)		
1		F101
1		F102
2		F201,202
1		O101
1		O201
CONTACTORS (CLASS 29)		
1	-29057	K101
TRANSFORMERS (CLASS 30)		
1	-30069	T201
1	-30330	T104
2	-30331	L205,206
1		L101
1		L102A&B
1		L103A&B
2		L108A&B,109A&B
1		L110A&B
1		L112A&B
4		L201,202,203,204
VACUUM TUBES (CLASS 38)		
1	-5Z3	V201
4	-6C6	V106,108,109,111
4	-6D6	V101,102,103,104
2	-76	V105,107
1		V110
1		V112
INDUCTANCES (CLASS 47)		
1		L104
1		L105
1		L106
1		L107
INDUCTANCES (CLASS 47) (Continued)		
1		L111
1		L113
1		L114
1		L401
1		L402
CAPACITORS (CLASS 48)		
7	-48553	C135,145,146,147,148,154,155
4	-48554	C112A&B,131A&B,142A&B,151A&B
1	-48757	C152
14	-48758	C102,104,105,108,109,111,113, 114,115,118,119,121,122,124
1	-48759-10	C101
1	-48760-10	C103
1	-48761-10	C110
3	-48792	C203,204,205
1	-48793	C143
1	-48794	C127
2	-48795	C201A&B,202A&B
2	-48796	C116,153
3	-48797-10	C117,138,141
3	-48798-5	C126,149,150
6	-48799-5	C128,129,132,133,136,137
5	-48800-10	C130,134,139,140,144

For IB-38114
Series ABC

TABLE III (Continued)
PARTS LIST BY NAVY TYPE NUMBERS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
CAPACITORS (CLASS 48) (Continued)		
1	-48801-10	C107
1	-48819-1.5	C123
1	-48818-1.5	C125
1	-48820-3	C120
1	-481349	C156
1		C106A,B,C&D
JACKS & VACUUM TUBE SOCKETS (CLASS 49)		
2	-49021A	J101,102
1	-49311A	X201
2	-49314	X105,107
8	-49318	X101,102,103,104,106,108,109,111
1	-49373	X112
1	-	X110
FILTERS (CLASS 53)		
1		T101
1		T102
1		T103
RESISTORS (CLASS 63)		
1	-63015E	R202
1	-63288	R146
1	-63288	R145
1	-63324	R201
RESISTORS (CLASS 63) (Continued)		
2	-63355	R110,131
3	-63355	R114,128,129
1	-63355	R127
1	-63355	R130
1	-63355	R132
2	-63355	R133,134
6	-63360	R101,108,118,124,135,149
4	-63360	R105,112,115,136
3	-63360	R106,117,137
4	-63360	R107,111,113,138
1	-63360	R109
1	-63360	R116
2	-63360	R119,139
1	-63360	R120
2	-63360	R121,123
1	-63360	R122
1	-63360	R125
1	-63360	R126
1	-63360	R144
1	-63360	R147
1	-63360	R148
2	-63474	R140,141
RESISTORS (CLASS 63) (Continued)		
1	-63528-A	R142
3	-63529	R102,103,104
1	-631086	R150
1	-631087	R149A&B

BC

TABLE IV
SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

CONTRACT NOs-70837 — DATED 9 JAN. 1940
SUPPLEMENTARY CONTRACT NOs-70837 — DATED 12 APRIL 1941

EQUIPMENT SPARES

ITEM	BOX NO.	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
					MISCELLANEOUS (CLASS 10)					
1	1	1	-10012		Wrench, for shield can		1			K-815970-501
2	1	3	TB-6	I101,102,103,301	Lamps, 6.3 v, 0.25 amp., miniature screw base	RE 38F 149B	4	Mazda 46		K-61114-18
3	1	1			Wrench, for Allen set screws		1			K-828505-2
4	1	1			Wrench, for aligning		1			K-837018-1
5	1	1			Screw driver, for aligning		1			K-837017-501
6	1	1			Spare parts box		1			T-620059-504
					ELECTRICAL MEASURING INSTRUMENTS (CLASS 22)					
7	1	1	-22257A	M101	Output d-b meter, rectifier type, scale -10 to +5% db; responsiveness 0.6 second or less, damping factor between 16 and 200, sensitivity zero level =72 microwatts (0.6 v), impedance 5000 ohms -6 +10% at 0.6 v, 1000 cycles, 2-1/2" flush bakelite case	17-I-12(INT.)	7			K-837019-1
					SWITCHES (CLASS 24)					
8	1	2	-24000	S104,105,106	Switches, toggle, S.P.S.T., 1 amp. at 250 v	RE 24AA 118A	11			K-30066-11
					FUSES (CLASS 28)					
9	1	1		F101	Fuse, 6 amp., cartridge type, 1-1/4" long, 1/4" dia. ferrules	17-F-2e	3	Type 3AG		K-811485-5
10	1	1		F102	Fuse, 0.1 amp., cartridge type, 1-1/4" long 1/4" dia., ferrules	17-F-2e	3	Type 3AG		K-811485-16
11	1	2		F201,202	Fuses, 3 amp., cartridge type, 1-1/4" long, 1/4" dia. ferrules	17-F-2e	3	Type 3AG		K-811485-12

For IB-38114
Series ABCDE

TABLE IV (Continued)

SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS

FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

EQUIPMENT SPARES

ITEM	BOX NO.	QUAN-TITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
					RELAYS, RELAY COILS, CONTACTS (CLASS 29)					
12	1	1	-29057	K101	Antenna grounding relay, D.P.S.T., 6 v a.c., 50-60 cycles, min. operating voltage 5.4 v, d-c resistance of coil 1.5 ohms, 280 turns #23 E wire, contact rating: 2 amps. at 110 v a.c. or d.c. non-inductive load		12	L-131 Coil 367		K-854724-1
					A-F TRANSFORMERS (CLASS 30)					
13	1	1	-30330	T104	Comprised of primary, secondary with mid-tap, and tertiary shielded windings; ratio: primary to secondary 5.24 to 1 ±3%; primary to tertiary 2.82 to 1 ±3%; secondary mid-tap to be within 2% of electrical neutral Primary: 3300 turns, 26 layers, wire traverse 0.781", #36 E wire wound on tertiary winding, insulation between layers 1 turn 0.001" kraft paper, insulation over coil 2 turns 0.007" gummed kraft paper Secondary: made of two sections for mid-tap connection, each section 315 turns, 10 layers, wire traverse 0.313", #32 E wire wound on false spool, insulation between layers 1 turn 0.003" kraft paper, insulation over coil 2 turns of 0.007" gummed kraft paper, both sections wound alike, one reversed in assembly, start leads connected for mid-tap Tertiary: 1170 turns, 10 layers, wire traverse 0.781", #36 E wire wound on kraft spool 0.025" thick, cross section inside of spool 39/64" x 41/64" insulation between layers 1 turn 0.001" kraft paper, insulation over coil 4 turns 0.003" kraft paper Resistance: primary 450 ohms, secondary 52 ohms, tertiary 122 ohms Hi-pot test: 1000 v, 60 cycles between windings and from windings to shield and core or case, iron core stacked alternately in groups of 5, transformer impregnated and sealed in can		1	RT 426		M-81127-501

TABLE IV (Continued)
SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS
EQUIPMENT SPARES

ITEM	BOX NO.	QUAN-TITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLER-ANCE, RATING OR MODIFICATION	RCA DRAWING NO.
* VACUUM TUBES (CLASS 38) (FOR COMPLETE ELECTRICAL CHARACTERISTICS SEE PAGE 32)										
14	1	1	-5Z3	V201	Tube, full-wave, high-vacuum rectifier	RE 13A 600C	1a	RCA-5Z3		
15	1	4	-6C6	V106, 108, 109, 111	Tube, triple-grid amplifier, detector	RE 13A 600C	1a	RCA-6C6		
16	1	4	-6D6	V101, 102, 103, 104	Tube, triple-grid, super-control amplifier	RE 13A 600C	1a	RCA-6D6		
17	1	2	-76	V105, 107	Tube, super-triode amplifier, detector	RE 13A 600C	1a	RCA-76		
18	1	1		V110	Lamp, neon		1a	RCA-991		
19	1	1		V112	Tube, electronic indicator		1a	RCA-6AF6-G		
CAPACITORS (CLASS 48)										
20	1	4	-48553	C135, 145, 146, 147, 148, 154, 155	Capacitor, oil, paper foil, 1 mfd +10% -3%, 250 v d.c. working	RE 48A 160D RE 13A 488D	1		For Replacement Use Navy Type 48829	P-721074-2
21	1	2	-48554	C112A&B, 131A&B, 142A&B, 151A&B	Capacitor, oil, paper foil, 0.5/0.5 mfd +10% -3% 250 v d.c. working	RE 48A 160D RE 13A 488D	1		For Replacement Use Navy Type -48554-A	P-721074-3
22	1	1	-48757	C152	Capacitor, air trimmer, 2 to 10 mmfd		2	APC-10		M-413394-1
23	1	3	-48758	C102, 104, 105, 108, 109, 111, 113, 114, 115, 118, 119, 121, 122, 124	Capacitor, air trimmer, 5 to 100 mmfd		2	APC-100		M-413394-10
24	1	1	-48759-10	C101	Capacitor, fixed, mica, 33 mmfd ±10%, 500 v d.c. working	RE 48A 238A RE 48A 154F	1			K-850253-12
25	1	1	-48760-10	C103	Capacitor, fixed, mica, 39 mmfd ±10%, 500 v d.c. working	RE 48A 238A RE 48A 154F	1			K-850253-13
26	1	1	-48761-10	C110	Capacitor, fixed, mica, 100 mmfd ±10%, 500 v d.c. working	RE 48A 238A RE. 48A 154F	1			K-850253-14
27	1	2	-48792	C203, 204, 205	Capacitor, oil paper foil, 4 mfd +10%, -3%, 300 v d.c. working	RE 48A 137E RE 13A 488D	1		For Replacement Use Navy Type -48792-A	M-420071-1
28	1	1	-48793	C143	Capacitor, oil paper foil, 0.5 mfd +10%, -3%, 600 v d.c. working	RE 48A 160D RE 13A 488D	1			P-721074-9

** To be packed separately.*

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TABLE IV (Continued)
SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS
EQUIPMENT SPARES

ITEM	BOX NO.	QUAN-TITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLER-ANCE, RATING OR MODIFICATION	RCA DRAWING NO.
					CAPACITORS (CLASS 48) (Continued)					
29	1	1	-48794	C127	Capacitor, oil, paper foil, 0.25 mfd +10% -3%, 800 v d.c. working	RE 48A 160D RE 13A 488D	1		For Replacement Use Navy Type #48802	P-721074-10
30	1	1	-48795	C201A&B, 202A&B	Capacitor, oil, paper foil, 0.125/0.125 mfd +10% -3%, 500 v d.c. working	RE 48A 110P RE 13A 488D	1			M-420071-4
31	1	1	-48796	C116, 153	Capacitor, oil, paper foil, 0.0075 mfd +10% -3%, 500 v d.c. working	RE 48A 110P RE 13A 488D	1			M-720555-15
32	1	2	-48797-10	C117, 138, 141	Capacitor, fixed, mica, 560 mmfd ±10%, 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-1
33	1	2	-48798-5	C126, 149, 150	Capacitor, fixed, mica, 1000 mmfd ±5%, 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-2
34	1	3	-48799-5	C128, 129, 132, 133, 136, 137	Capacitor, fixed, mica, 1800 mmfd ±5%, 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-3
35	1	3	-48800-10	C130, 134, 139, 140, 144	Capacitor, fixed, mica, 2700 mmfd ±10%, 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-4
36	1	1	-48801-10	C107	Capacitor, fixed, mica, 47 mmfd ±10%, 500 v d.c. working	RE 48A 238A RE 48A 154F	1			K-850253-11
37	1	1	-48818-1.5	C125	Capacitor, fixed, mica, 4375 mmfd ±1.5% 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-5
38	1	1	-48819-1.5	C123	Capacitor, fixed, mica, 2030 mmfd ±1.5% 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-6
39	1	1	-48820-3	C120	Capacitor, fixed, mica, 854 mmfd ±3%, 500 v d.c. working	RE 48A 248A RE 48A 154F	1			K-850253-7
40	1	1	-481349	C156	Capacitor, oil, paper foil, 0.05 mfd +10% -3%, 600 v d.c. working	RE 48A 110P	1			P-720555-17
					SOCKETS (CLASS 49)					
41	1	1	-49311A	X201	Tube socket, 4 prong, phenolic base and support assembly	RE 49AA 308A	1			M-401485-502
42	1	1	-49314	X105, 107	Tube socket, 5 prong, wafer type, ceramic base	RE 49AA 307A	2	S-5		K-856996-2

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TABLE IV (Continued)

SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS

FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

EQUIPMENT SPARES

ITEM	BOX NO.	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
					SOCKETS (CLASS 49) (Continued)					
43	1	4	-49318	X101,102,103,104,106 108,109,111	Tube socket, 6 prong, wafer type ceramic base	RE 49AA 307A	2	S-6		K-856996-3
44	1	1	-49373	X112	Socket, ceramic, steatite base, with mounting ring, octal, 8 contacts	RE 49AA 313A	15	SS-8		K-856956-6
45	1	1		X110	Socket, neon lamp		1			K-855531-501
					TRANSFORMERS (CLASS 53)					
46	1	2		T101,102,103	I-F transformer coils, 2 coils spaced 1" apart on coil form O.D. 9/16", I.D. 3/8" and 3-1/8" long, wax impregnated isolantite, each coil has 300 turns of 7 strands#42 litz copper wire, S covering, universal wound 2 crosses per turn, wire traverse 1/4"		1			K-850223-501
					RESISTORS (CLASS 63)					
47	1	1	-63015E	R202	Resistor, wire wound, fixed, 5000 ohms, 4 watts, grade 1, class 2	RE 13A 372J	13			M-418350-51
48	1	1	-63288	R146	Resistor, composition, 10,000 ohms ±10%, 1 watt, pigtail type	RE 13A 372G	8	BT-1		K-844314-74
49	1	1	-63288	R145	Resistor, composition, 22,000 ohms ±10%, 1 watt, pigtail type	RE 13A 372G	8	BT-1		K-844314-78
50	1	1	-63324	R201	Potentiometer, wire wound, 100 ohms, linear, 4 watts, screwdriver shaft 1" long	RE 13A 492C	9			K-806807-1
51	1	1	-63355	R133,134	Resistor, composition, 200 ohms ±5%, 1/2 watt, pigtail type	RE 13A 372G	14	MB-1/2		K-837141-18
52	1	2	-63355	R114,128,129	Resistor, composition, 1000 ohms ±5%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-159
53	1	1	-63355	R132	Resistor, composition, 3900 ohms ±5%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-173
54	1	1	-63355	R127	Resistor, composition, 5100 ohms ±5%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-176
55	1	1	-63355	R110,131	Resistor, composition, 10,000 ohms ±5%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-74
56	1	1	-63355	R130	Resistor, composition, 20,000 ohms ±5%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-190
57	1	2	-63360	R105,112,115,136	Resistor, composition, 470 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-58

TABLE IV (Continued)
SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS
EQUIPMENT SPARES

ITEM	BOX NO.	QUAN-TITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
RESISTORS (CLASS 63) (Continued)										
58	1	1	-63360	R148	Resistor, composition, 560 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-59
59	1	1	-63360	R125	Resistor, composition, 1500 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-64
60	1	1	-63360	R119,139	Resistor, composition, 2200 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-66
61	1	1	-63360	R109	Resistor, composition, 4700 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-70
62	1	1	-63360	R126	Resistor, composition, 5600 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-71
63	1	1	-63360	R147	Resistor, composition, 15,000 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-76
64	1	1	-63360	R122	Resistor, composition, 47,000 ohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-82
65	1	2	-63360	R107,111,113,138	Resistor, composition, 0.1 megohm ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-86
66	1	1	-63360	R121,123	Resistor, composition, 0.22 megohm ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-90
67	1	2	-63360	R106,117,137	Resistor, composition, 0.27 megohm ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-91
68	1	1	-63360	R120	Resistor, composition, 0.47 megohm ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-94
69	1	1	-63360	R116	Resistor, composition, 0.68 megohm ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-96
70	1	3	-63360	R101,108,118,124,135, 143	Resistor, composition, 1 megohm ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-98
71	1	1	-63360	R144	Resistor, composition, 2.7 megohms ±10%, 1/2 watt, pigtail type	RE 13A 372G	8	BT-1/2		K-850981-103

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TABLE IV (Continued)

SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS

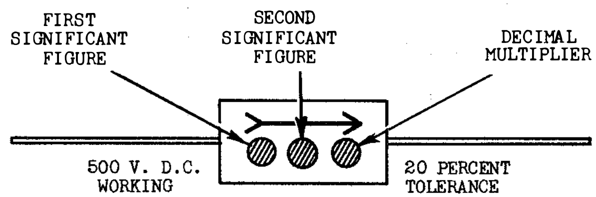
FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

EQUIPMENT SPARES

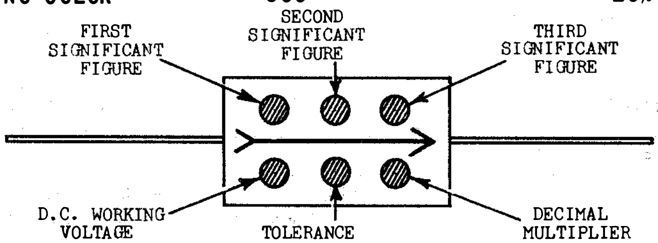
ITEM	BOX NO.	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE, RATING OR MODIFICATION	RCA DRAWING NO.
					RESISTORS (CLASS 63) (Continued)					
72	1	1	-63474	R140,141	Resistor, composition, 6800 ohms ±10%, 2 watts, pigtail type	RE 13A 372G	8	BT-2		K-844302-72
73	1	1	-63528-A	R142	Potentiometer, wire wound, 5150 ohms ±5%, 2 watts, first 160° counter-clock-wise, linear, 1350 ohms, remainder 3800 ohms	RE 13A 492B	10	M		K-854763-1
74	1	2	-63529	R102,103,104	Potentiometer, wire wound, 1000 ohms ±10%, linear, 2 watts, screwdriver shaft 1/2" long	RE 13A 492C	9			K-806807-5
75	1	1	-631086	R150	Potentiometer, wire wound, 400 ohms ±10%, linear, 2 watts, screwdriver shaft 1" long	RE 13A 492B	9			P-720471-19
76	1	1	-631087	R149A&B	Potentiometer, dual, each section 1500 ohms ±10%, linear, 2 watts, wire wound, round shaft	RE 13A 492B				P-720471-18

TABLE V
APPLICABLE COLOR CODES AND MISCELLANEOUS DATA FOR MODELS DP-12 & 13 DIRECTION FINDER EQUIPMENTS

RMA COLOR CODES FOR CAPACITORS (MMFD)



COLOR	NUMERAL	VOLTS	MULTIPLIER	TOLERANCE
BLACK	0		1	
BROWN	1	100	10	1%
RED	2	200	100	2%
ORANGE	3	300	1,000	3%
YELLOW	4	400	10,000	4%
GREEN	5	500	100,000	5%
BLUE	6	600	1,000,000	6%
VIOLET	7	700	10,000,000	7%
GRAY	8	800	100,000,000	8%
WHITE	9	900	1,000,000,000	9%
GOLD		1000	0.1	5%
SILVER		2000	0.01	10%
NO COLOR		500		20%



RADIO CORP. OF AMERICA COLOR CODE FOR CAPACITORS

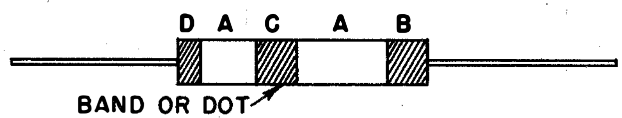
CAPACITY VALUES IN MMFD. ARE MARKED IN COLORS DESIGNATING TOLERANCE, THUS: YELLOW = 20%
BLUE = 10% BLACK = 5% GREEN = 2.5%

RMA COLOR CODE FOR RESISTORS (OHMS)

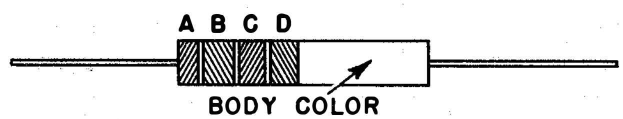
COLOR	A 1ST DIGIT	B 2ND DIGIT	C MULTIPLIER
SILVER			0.01
GOLD			0.1
BLACK		0	1.0
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
PURPLE	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	

D - TOLERANCE CODE:

GOLD = 5% SILVER = 10% NO COLOR = 20%



OLD COLOR ARRANGEMENT



NEW COLOR ARRANGEMENT

BODY COLOR (NEW COLOR ARRANGEMENT ONLY) INDICATES TYPE OF RESISTOR, AS FOLLOWS:-
- BLACK - COMPOSITION, NON-INSULATED
- TAN, OLIVE OR WHITE - COMPOSITION, INSULATED
- DARK BROWN - WIRE-WOUND, INSULATED

TABLE VI
LIST OF MANUFACTURERS
FOR MODEL DP-12 & 13 DIRECTION FINDER EQUIPMENTS

CODE NUMBER	MFR. PREFIX	NAME	ADDRESS
1	CRV	RCA Manufacturing Co., Inc.	Camden, N.J.
1a	CRC	RCA Manufacturing Co., Inc. (Harrison Division)	Harrison, N.J.
2	CHC	Hammarlund Mfg. Co., Inc.	424-438 W. 33rd Street, New York, N.Y.
3	CLF	Littlefuse Laboratories	4242 Lincoln Ave., Chicago, Ill.
4	CG	General Electric Co.	Bridgeport, Conn.
5	CMS	Federal Stamping & Engineering Co.	25 Lafayette Street, Brooklyn, N.Y.
6	CSR	Russell & Stoll Co., Inc.	125 Barclay Street, New York, N.Y.
7	CAY	Westinghouse Electric & Mfg. Co.	3001 Walnut Street, Philadelphia, Pa.
8	CIR	International Resistance Co.	401 N. Broad Street, Philadelphia, Pa.
9	CWC	Wirt Co.	5221-27 Greene Street, Philadelphia, Pa.
10	CMA	P.R. Mallory & Co., Inc. (Yaxley Division)	3029 E. Washington Street, Indianapolis, Ind.
11	CHH	Arrow-Hart & Hegeman Co.	Hartford, Conn.
12	CLR	Leach Relay Co.	5915 Avalon Blvd., Los Angeles, Calif.
13	CHD	Hardwick Hindle, Inc.	40 Hermon Street, Newark, N.J.
14	CSA	Stackpole Carbon Co.	St. Mary's, Pa.
15	CPH	American Phenolic Corp.	1250 W. Van Buren Street, Chicago, Ill.

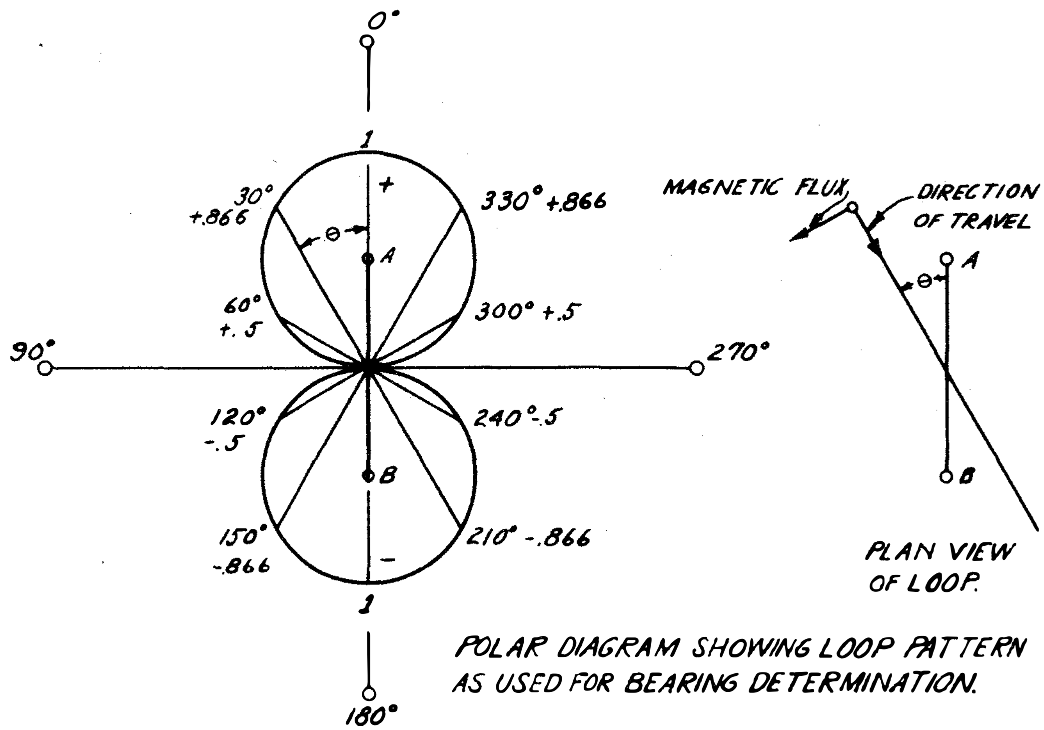


Figure 14—*Polar Diagram for Determining Bearings*
(*M*-406574—*Sub* 0)

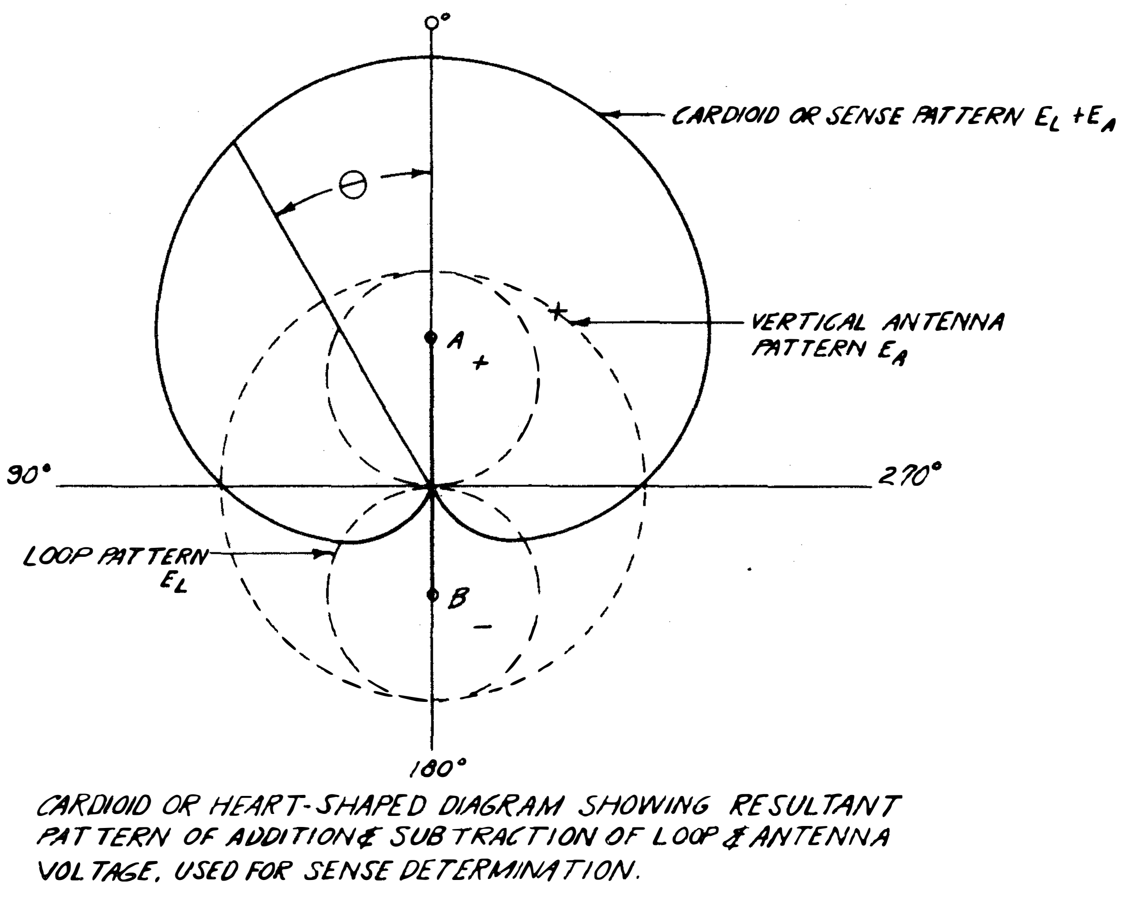


Figure 15—*Cardioid Diagram for Sense Determination*
(*M*-406574—*Sub* 0)

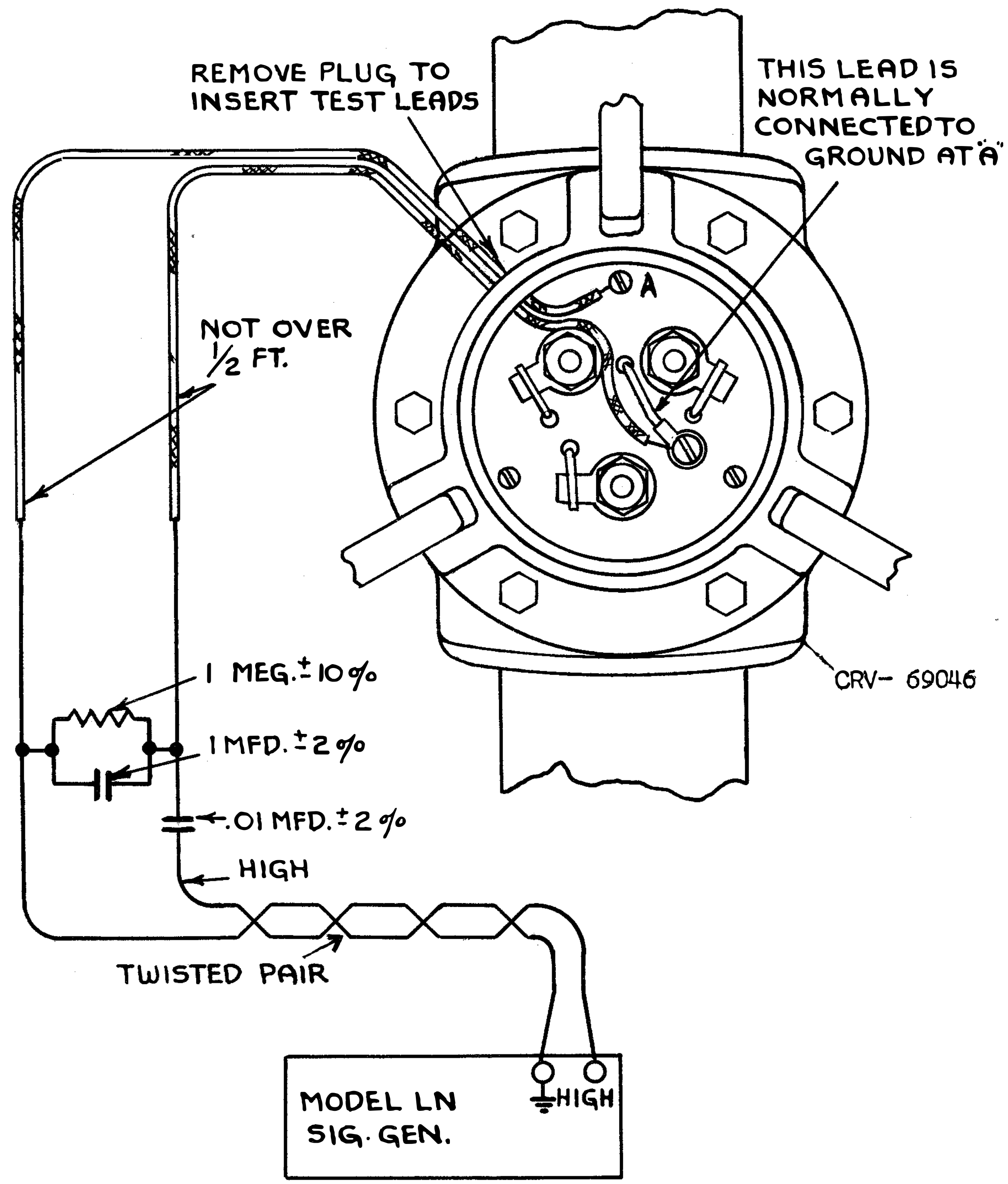


Figure 16—*Loop Base Terminals (Signal Generator Connections K*-856543 —*Sub* 1)

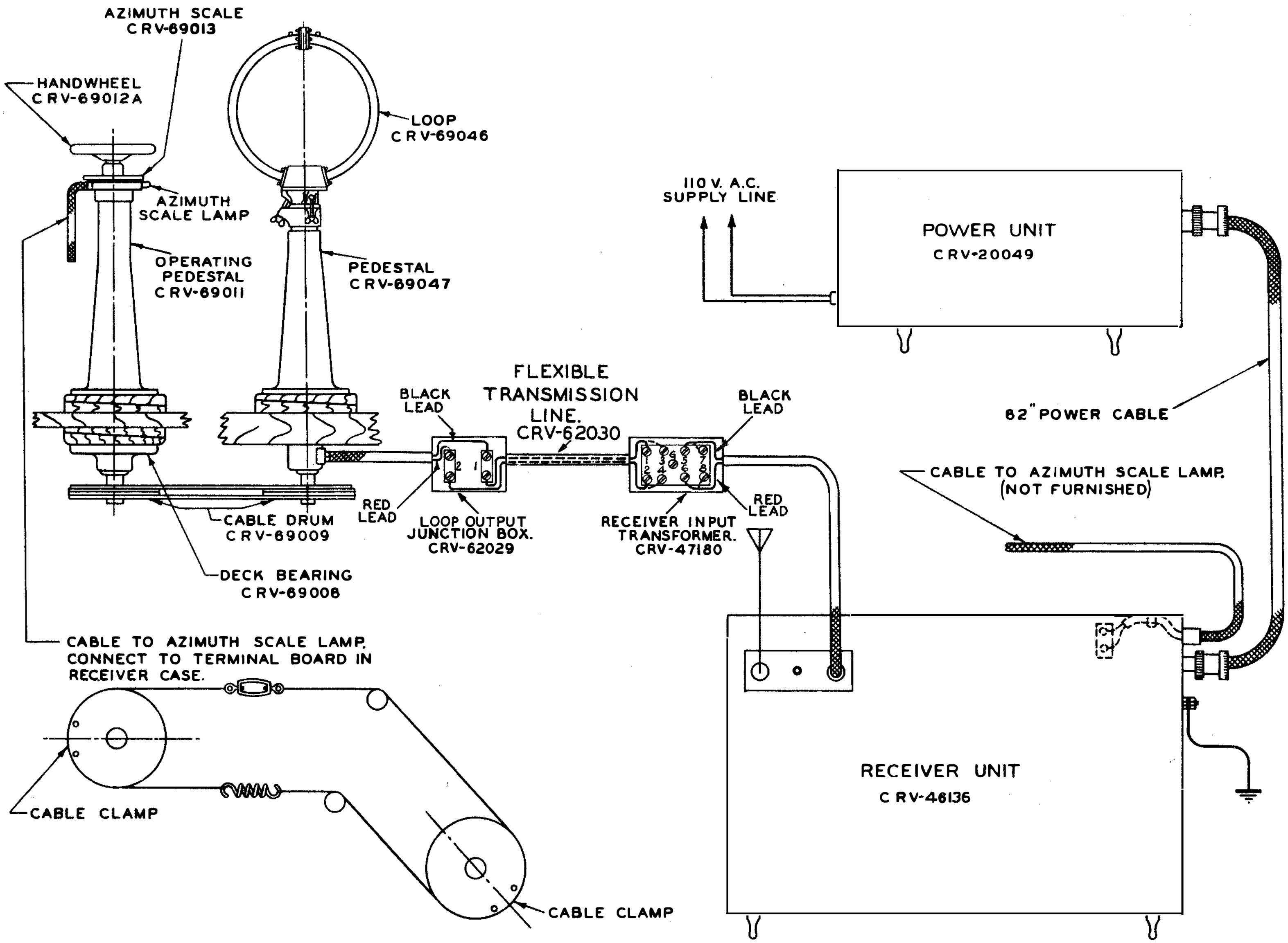


Figure 17—Direction Finder Equipment
(Interconnection Diagram P-714989—Sub 0)

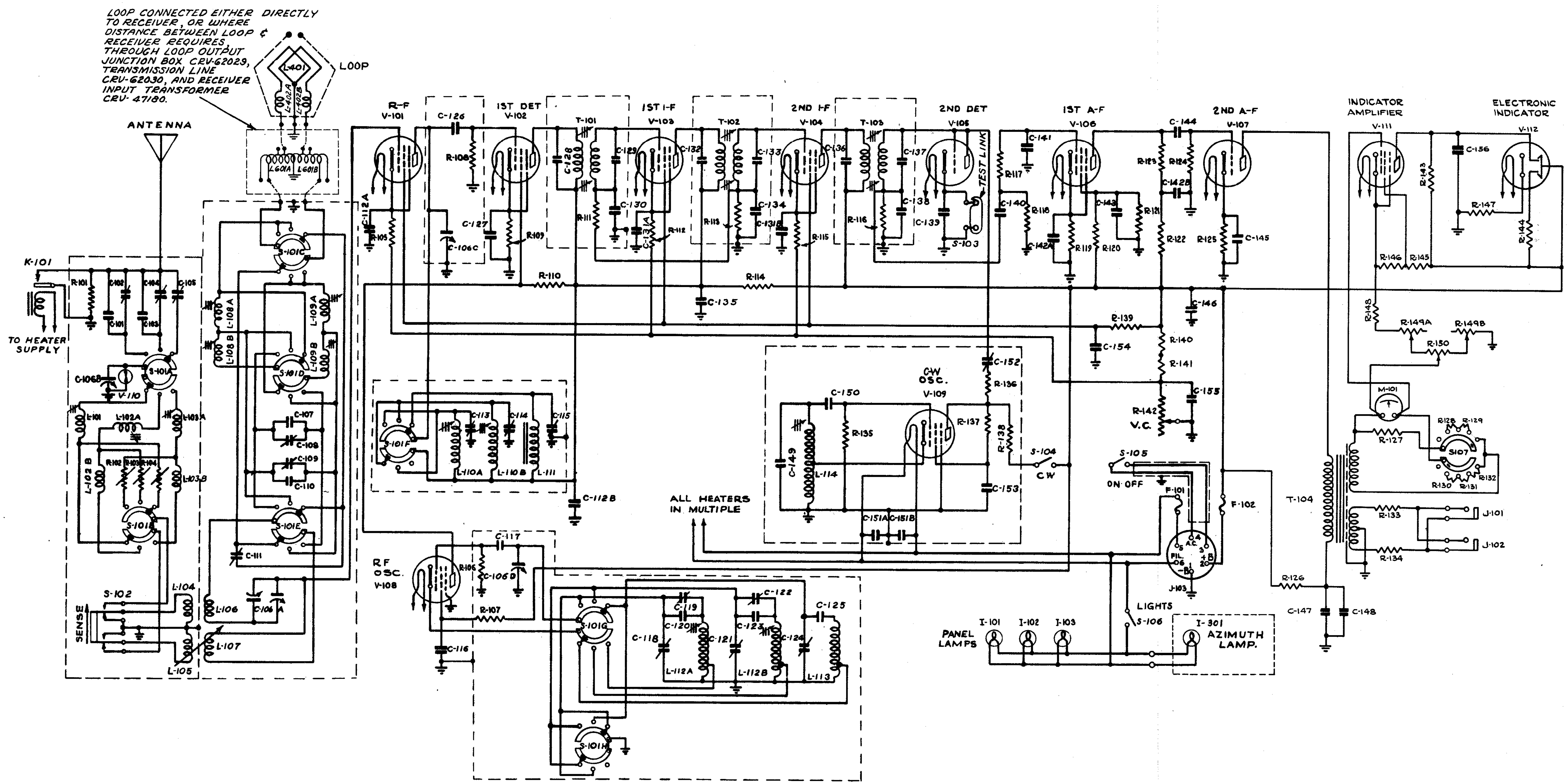


Figure 18—Receiver Unit
(Schematic Diagram T-620486—Sub. 2)

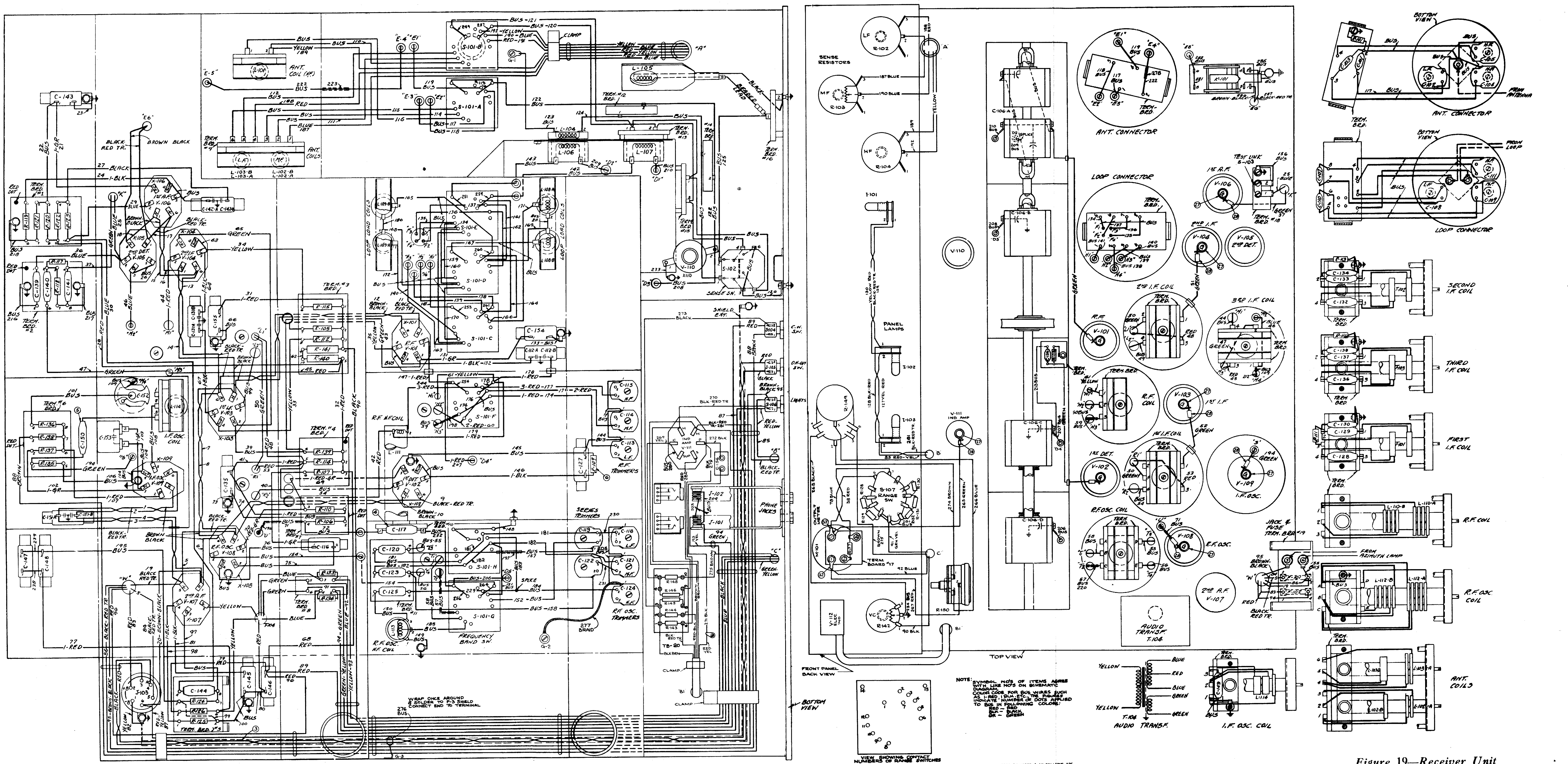


Figure 19—Receiver Unit
(Connection Diagram W-305225—Sub 2)

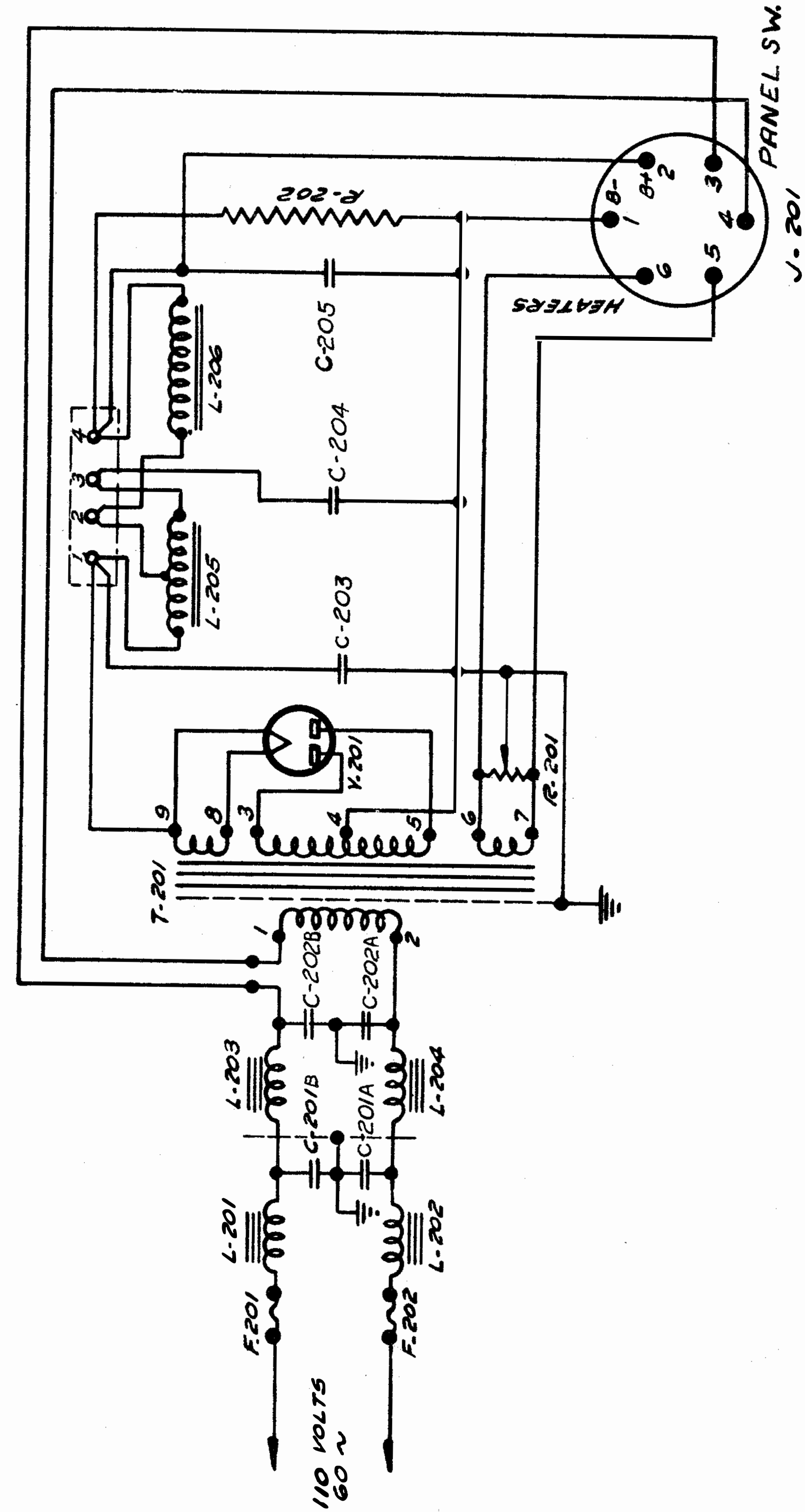
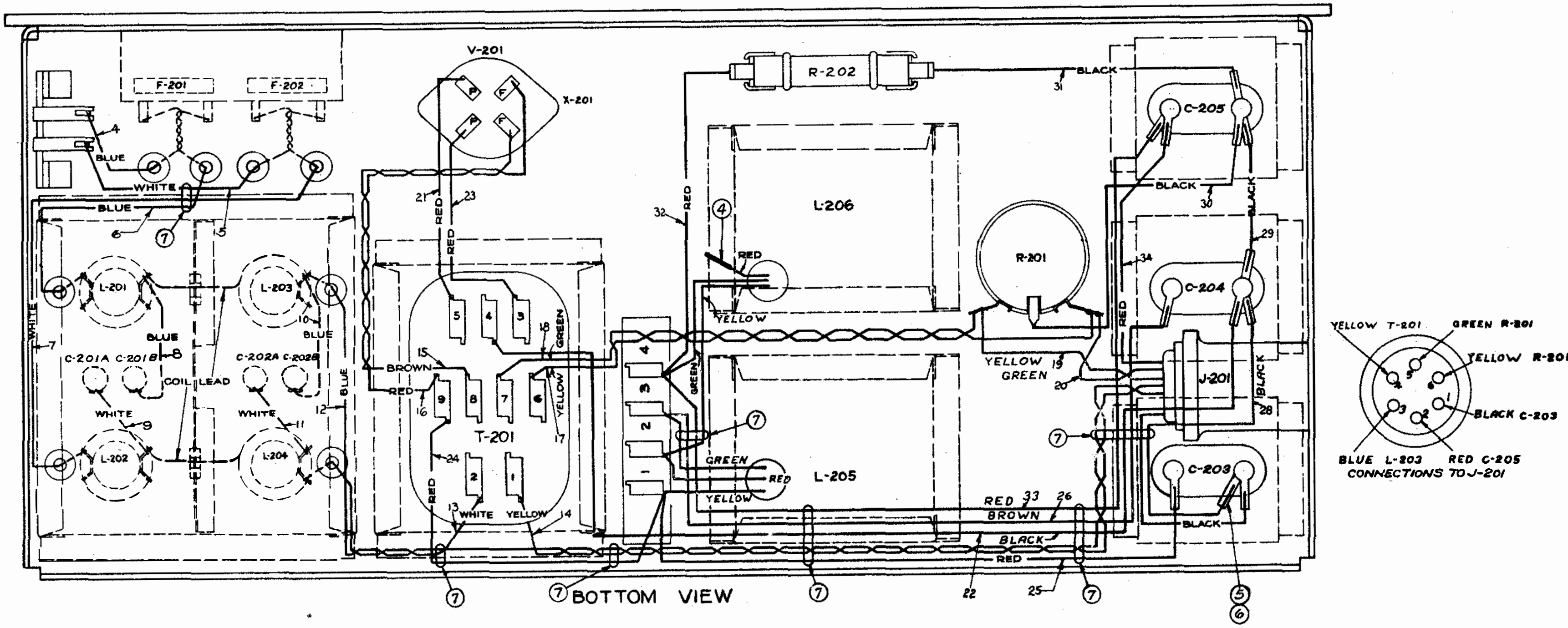
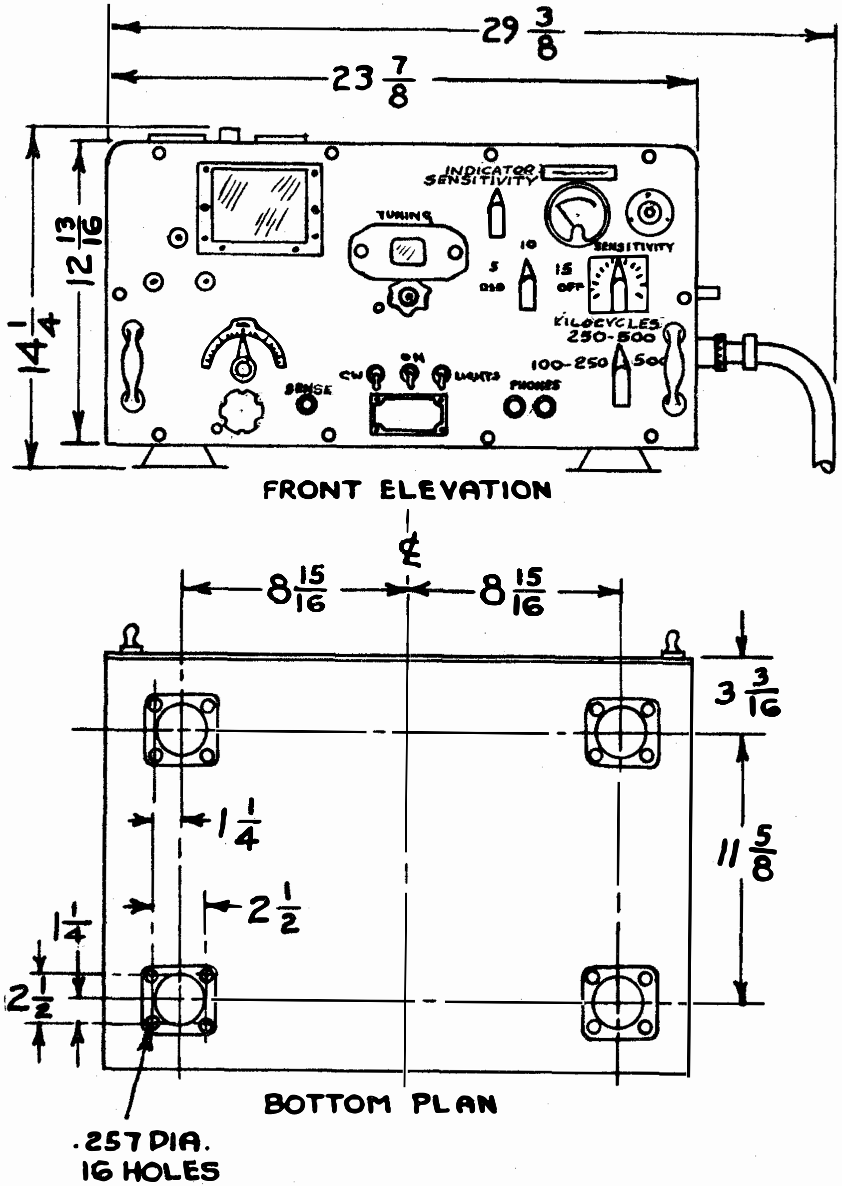


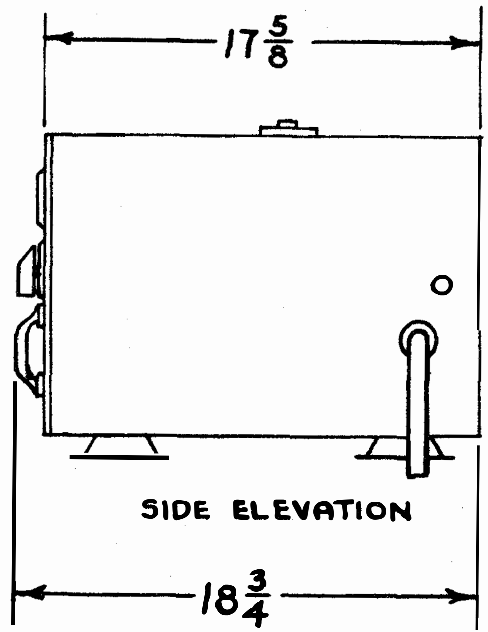
Figure 20—Power Unit
(*Schematic Diagram* K-855598—*Sub* 1)



NUMBERS ON WIRES & IN BALLOONS ARE
FOR MANUFACTURING PURPOSES ONLY

Figure 21—Power Unit
(Connection Diagram T-620155—Sub 0)

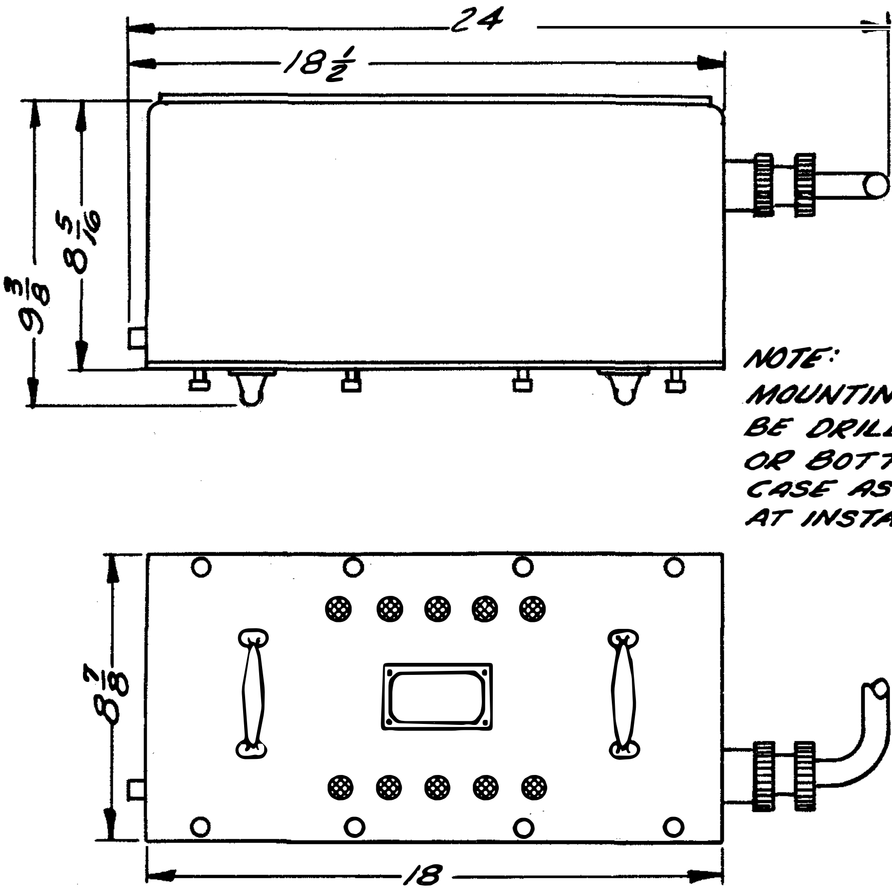




MODEL NO.	NAVY TYPE NO.	WEIGHT	MFR'S. DESIGNATION
DP-12	CRV-46136	93 LBS.	W-302223-503
DP-13	CRV-46136	93 LBS.	W-302223-503
DP-14	CRV-46137	93 LBS.	W-302223-505
DP-15	CRV-46136	93 LBS.	W-302223-503
DP-16	CRV-46138	93 LBS.	W-302223-503
DP-17	CRV-46141	93 LBS.	W-302223-503
DQ-5	CRV-46093	94 LBS.	W-302223-502 *
DQ-6 {	CRV-46146	94 LBS.	W-302223-506 *
	CRV-46146-A	94 LBS.	W-302223-504

* THESE UNITS DO NOT INCLUDE ELECTRONIC INDICATOR.

Figure 22—Receiver Unit
(Outline Diagram K-868585—Sub 1)



NOTE:
MOUNTING HOLES TO
BE DRILLED IN TOP
OR BOTTOM OF
CASE AS REQUIRED
AT INSTALLATION.

MODEL NO.	POWER SUPPLY	NAVY TYPE NO.	MANUFACTURER'S DESIGNATION	WEIGHT
DP-12	115V, 60 CYCLES	CRV-20049	T-601584-503	35 LBS.
DP-13	115V, 60 CYCLES	CRV-20049	T-601584-503	35 LBS.
DP-15	115V-60 CYCLES	CRV-20049	T-601584-503	35 LBS.
DP-16	115V-25 CYCLES	CRV-20129	T-601584-503	37 LBS.
DP-17	115V-50 CYCLES	CRV-20049	T-601584-503	35 LBS.
DQ-5	115V-60 CYCLES	CRV-20049	T-601584-503	35 LBS.
DQ-6	115V-60 CYCLES	CRV-20049	T-601584-503	35 LBS.

INPUT CURRENT 0.6 AMP.

OUTPUT { 100 V., 0.03 AMP.
6.1 V., 3.3 AMP.

Figure 23—Power Unit
(Outline Diagram K-868586—Sub 3)

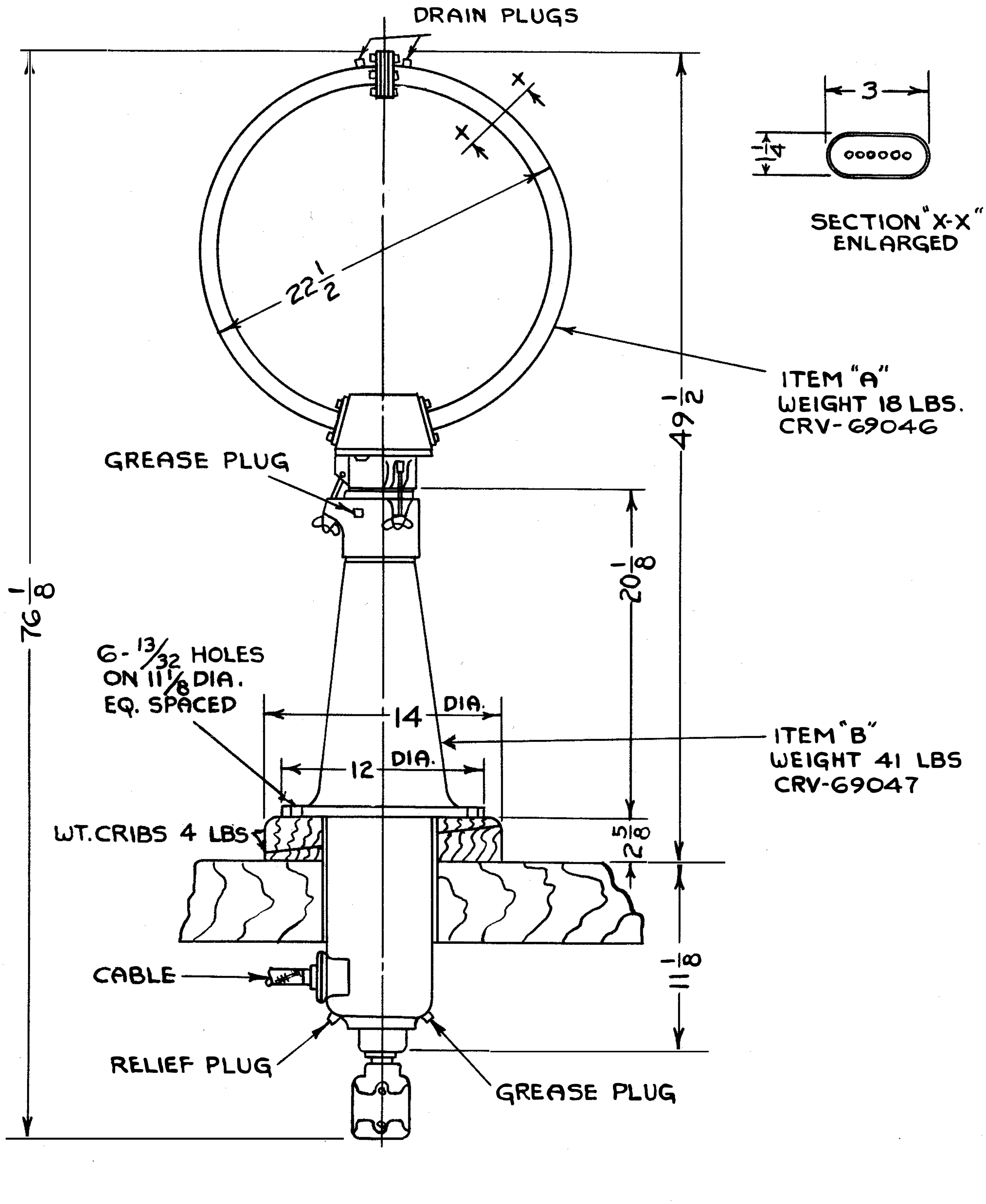


Figure 24—Loop and Pedestal Assembly
(Outline K-854491—Sub 2)

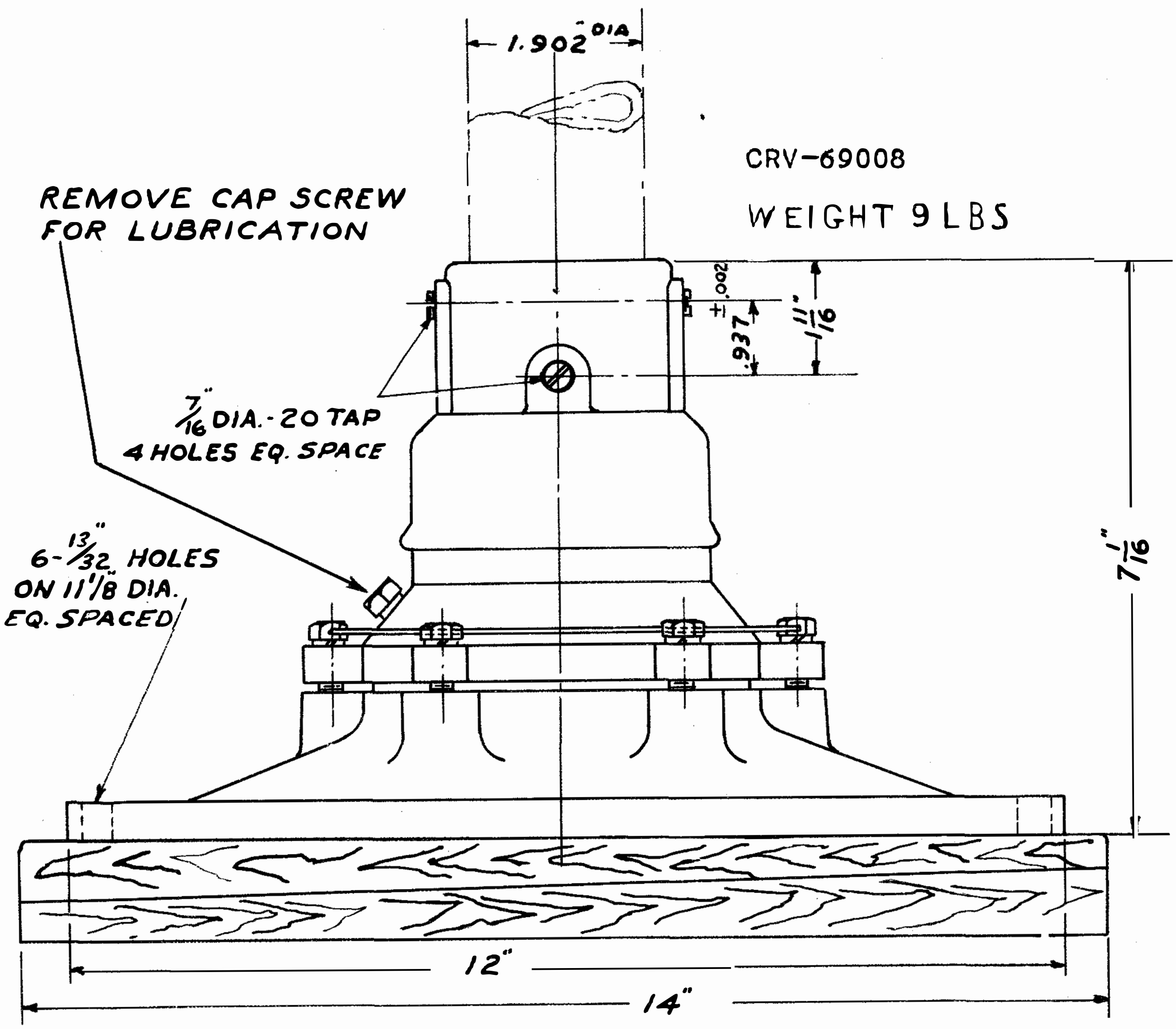


Figure 25—Deck Bearing
(Outline Diagram KX-280906—Sub 3)

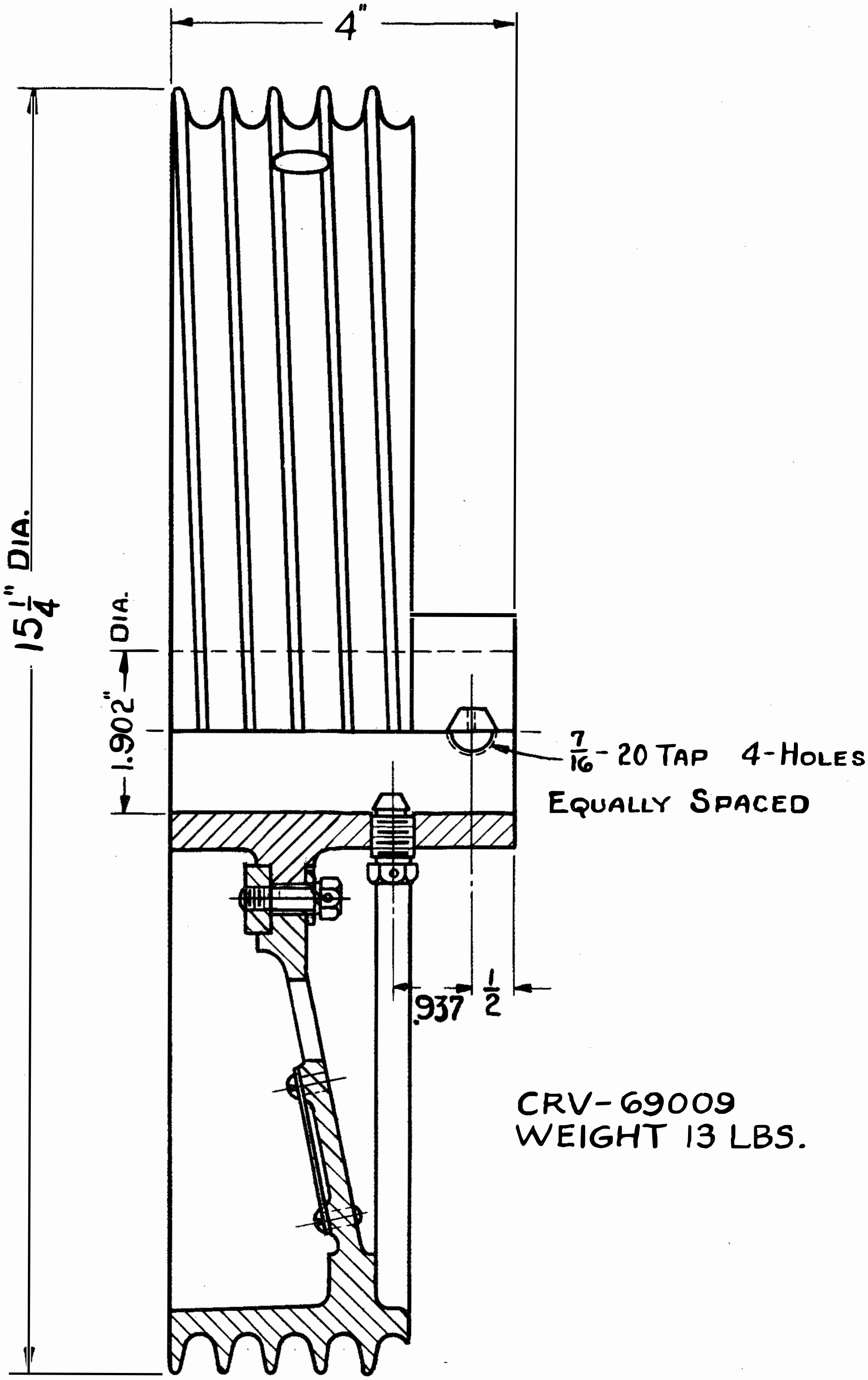


Figure 26—*Cable Drum*
(*Outline Diagram KX*-280907—*Sub* 5)

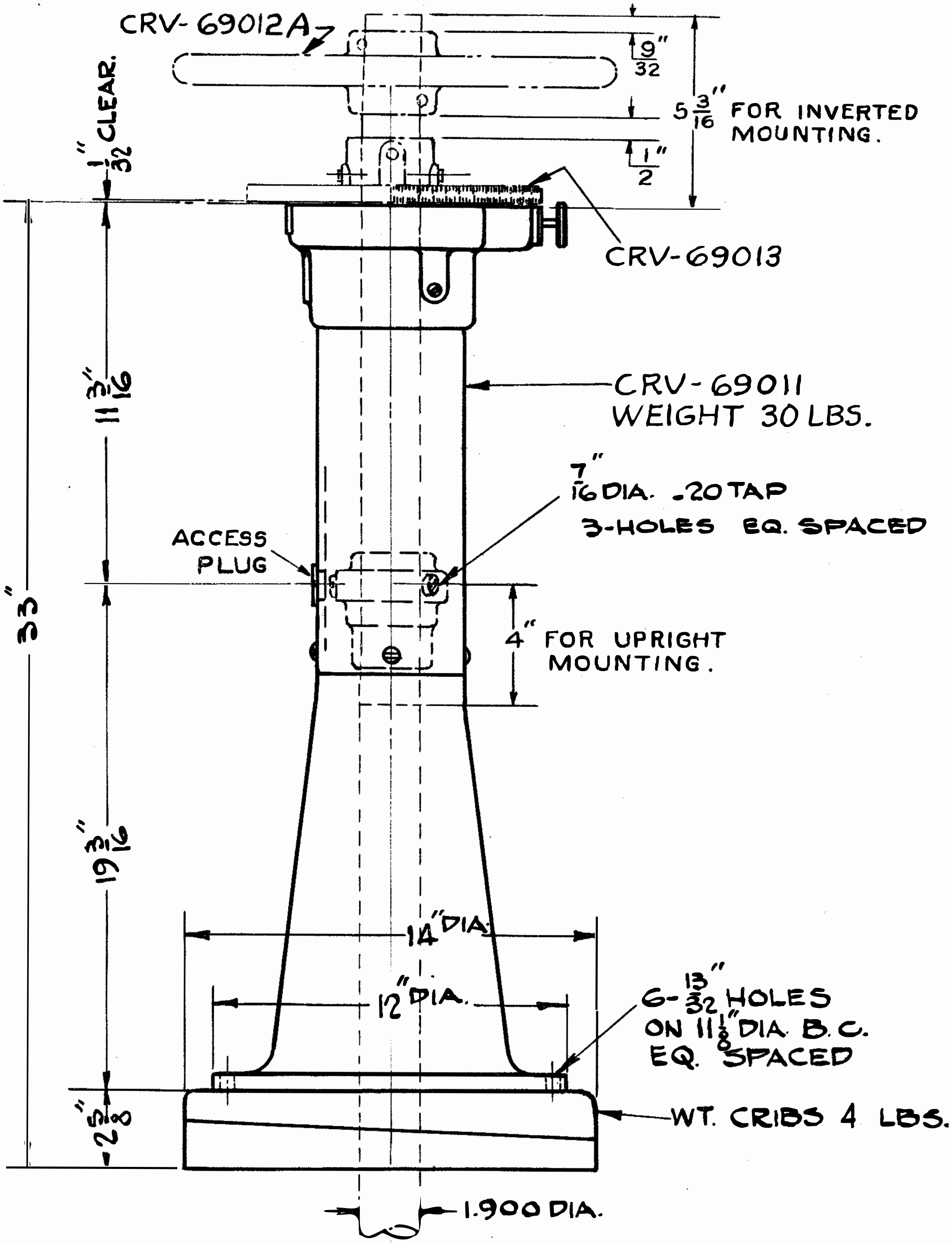


Figure 27—Operating Pedestal
(*Outline Dimensions KX*-280909—*Sub* 3)

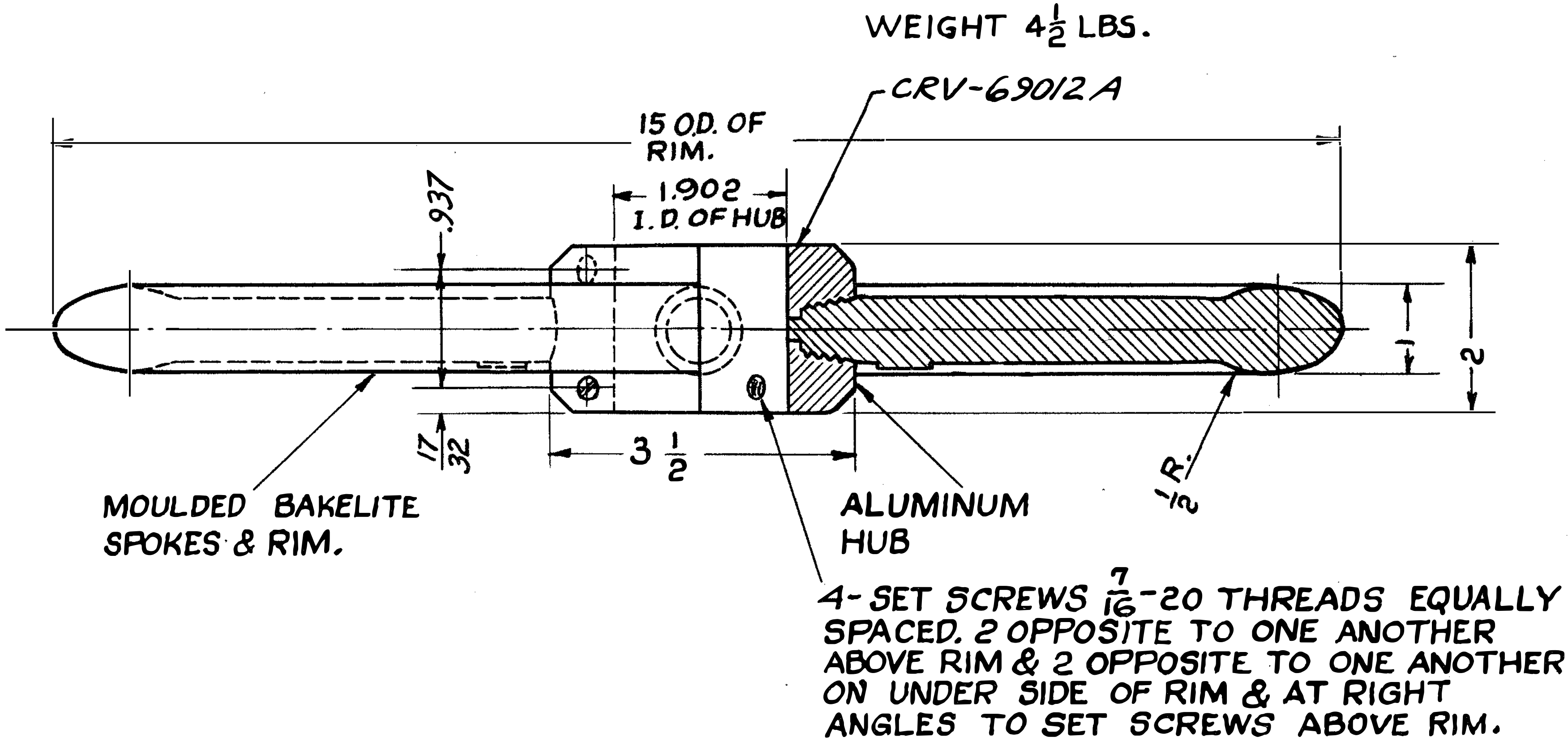


Figure 28—Handwheel
(*Outline Dimensions* K-866351—*Sub* 1)

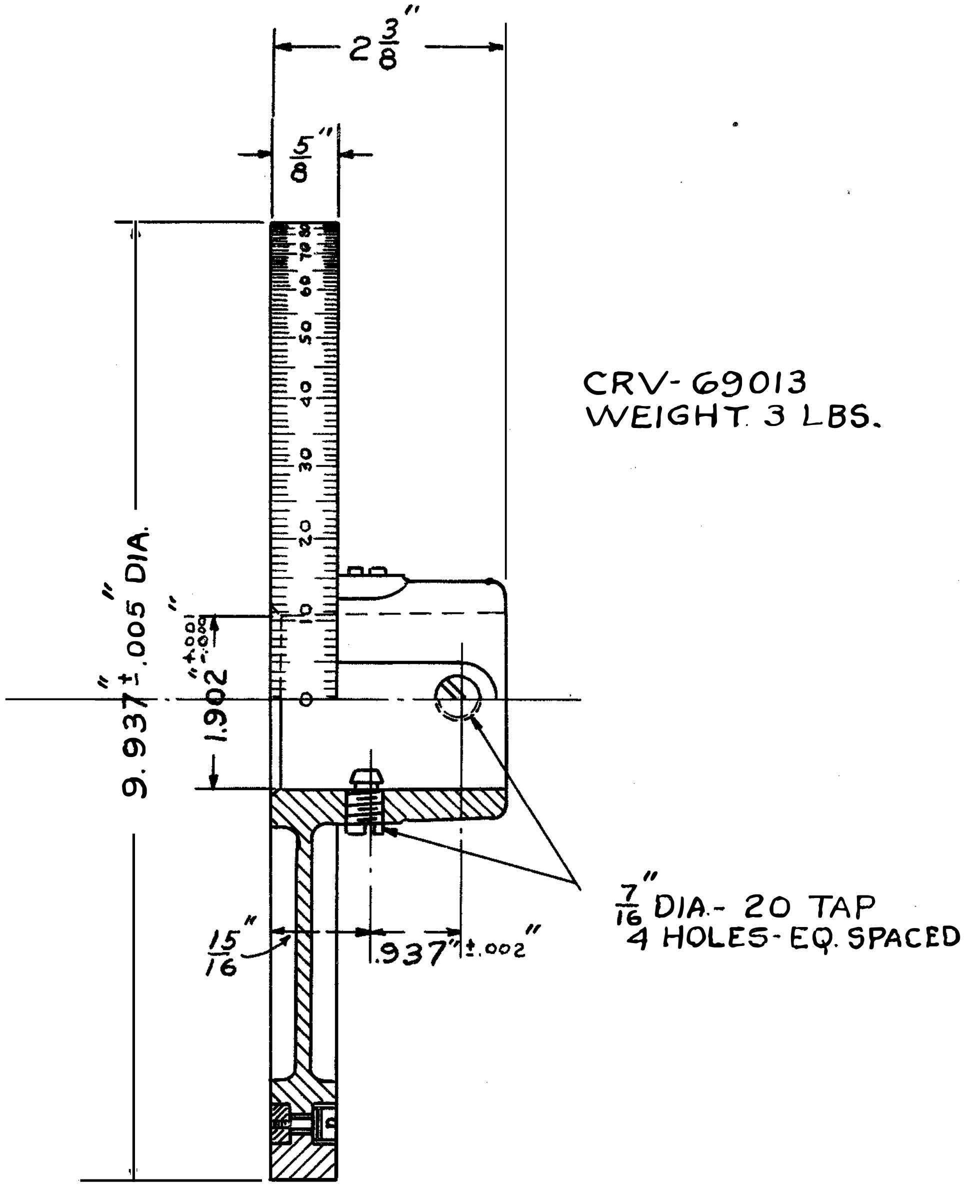
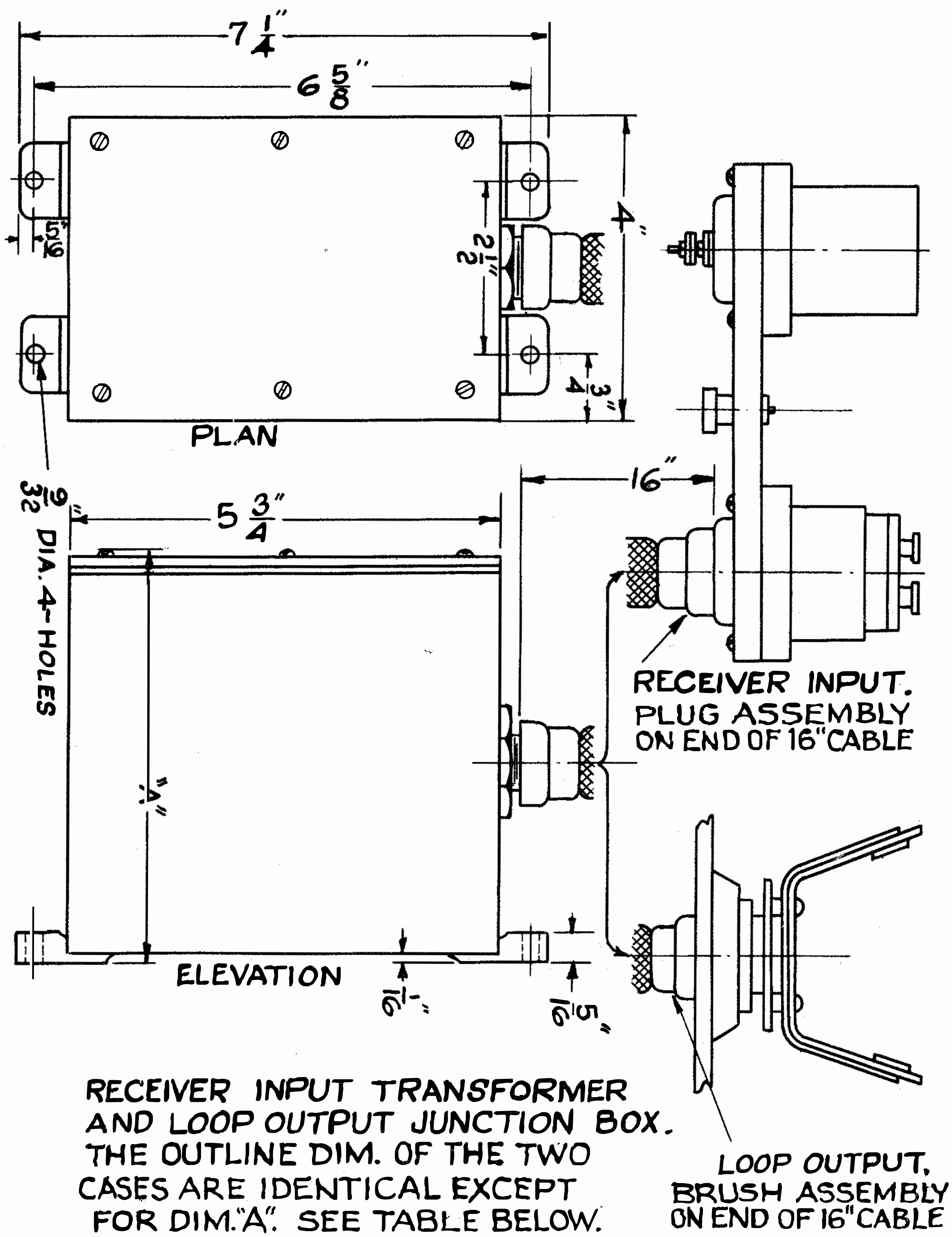
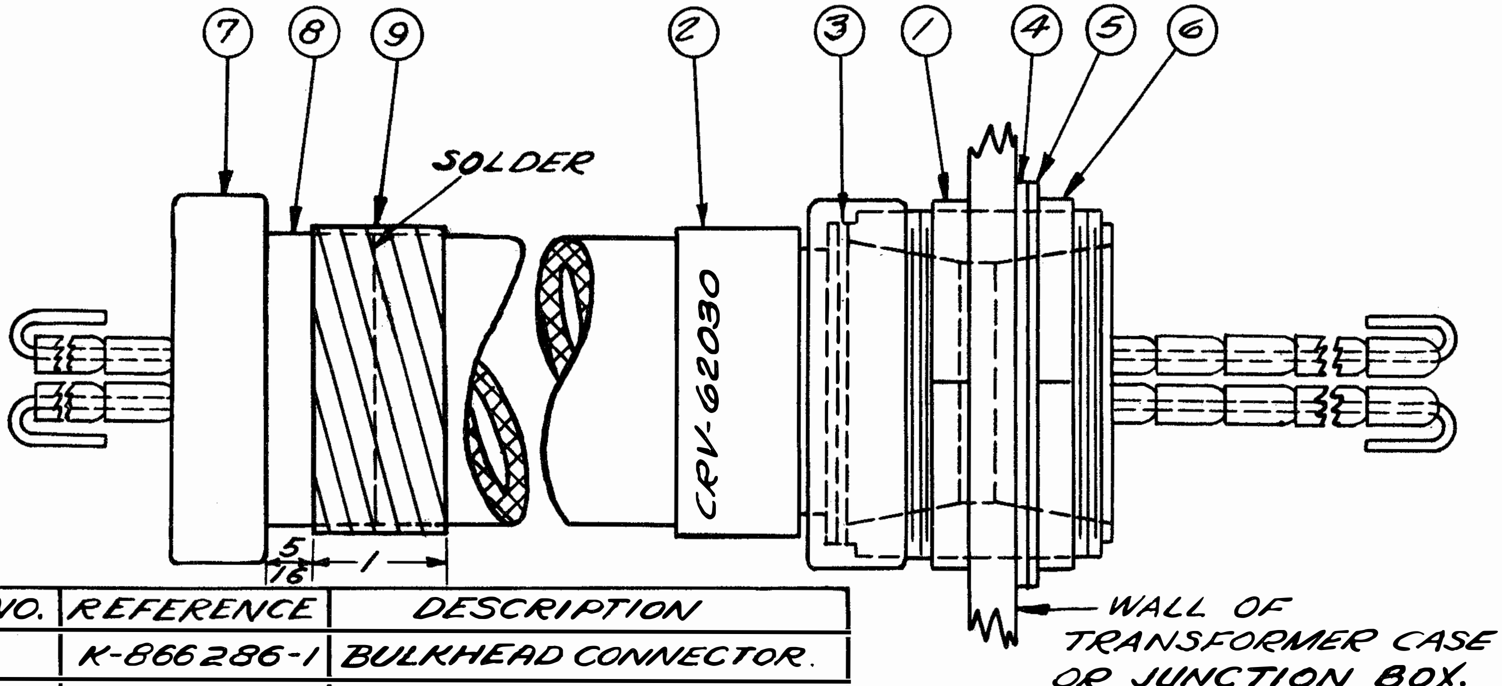


Figure 29—Azimuth Scale
(Outline Dimensions KX-280911—Sub 3)



NAME	CRV-NO.	DIM. "A"	WEIGHT LBS.
RECEIVER INPUT TRANSFORMER	47180	5 1/2"	6
LOOP OUTPUT JUNCTION BOX	62029	3 7/8"	4 1/2

Figure 30—Loop Output Junction Box and Receiver Input Transformer (K-866352—Sub 2)



PT.NO.	REFERENCE	DESCRIPTION
1	K-866286-1	BULKHEAD CONNECTOR.
2	M-421592-502	TRANSMISSION LINE
3	K-815581-6	WASHER (GASKET)
4	K-815581-5	WASHER (GASKET)
5	K-866292-1	WASHER
6	K-866283-3	LOCKNUT
7	K-875014-1	NUT
8	K-875013-1	FERRULE
9		RUBBER TAPE (SUPPLIED BY NAVY.)

Figure 31—Transmission Line and Connectors
(K-871602—Sub 1)

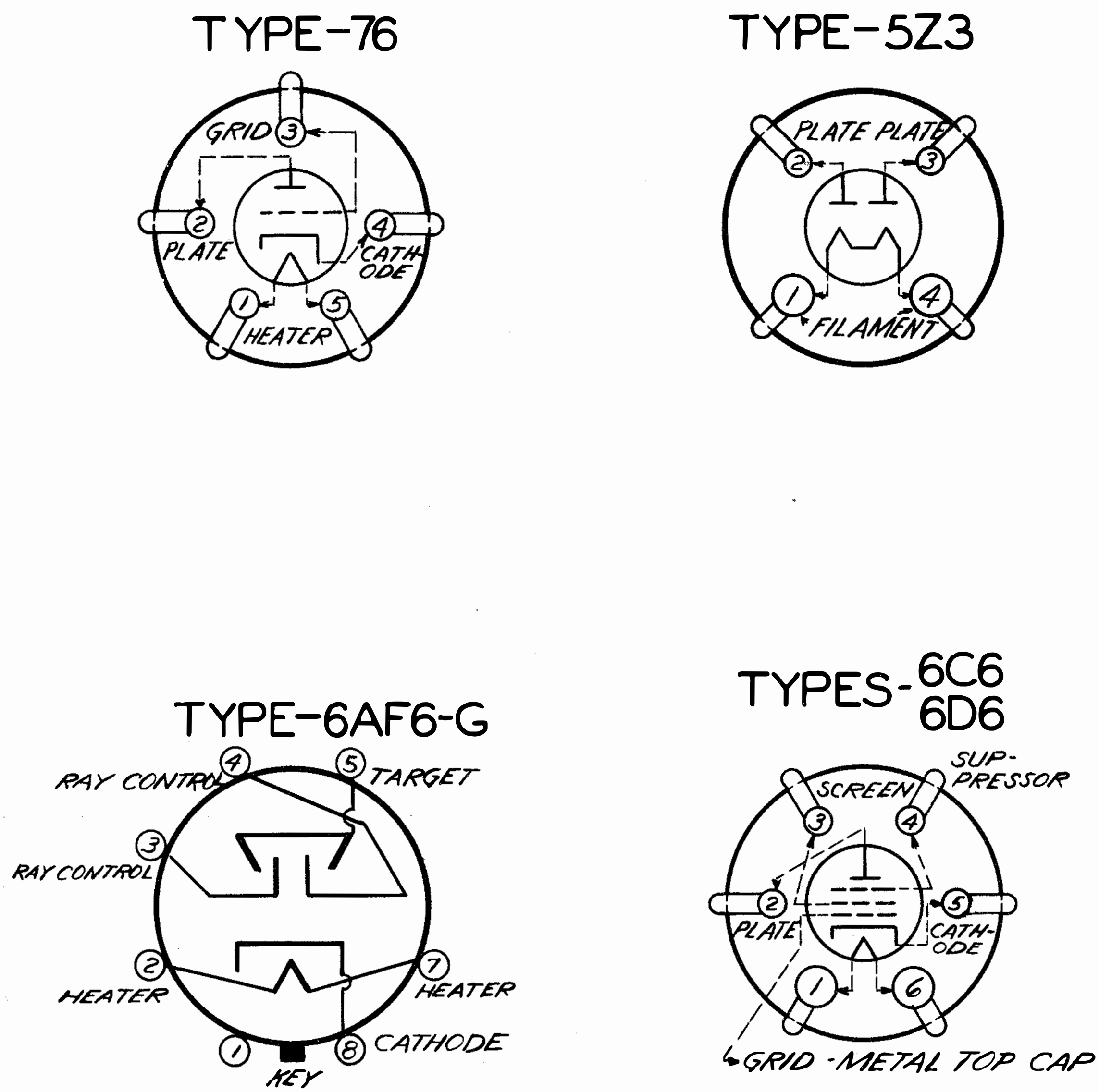


Figure 32—Tube Socket Terminal Location
(K-850379—Sub 1)

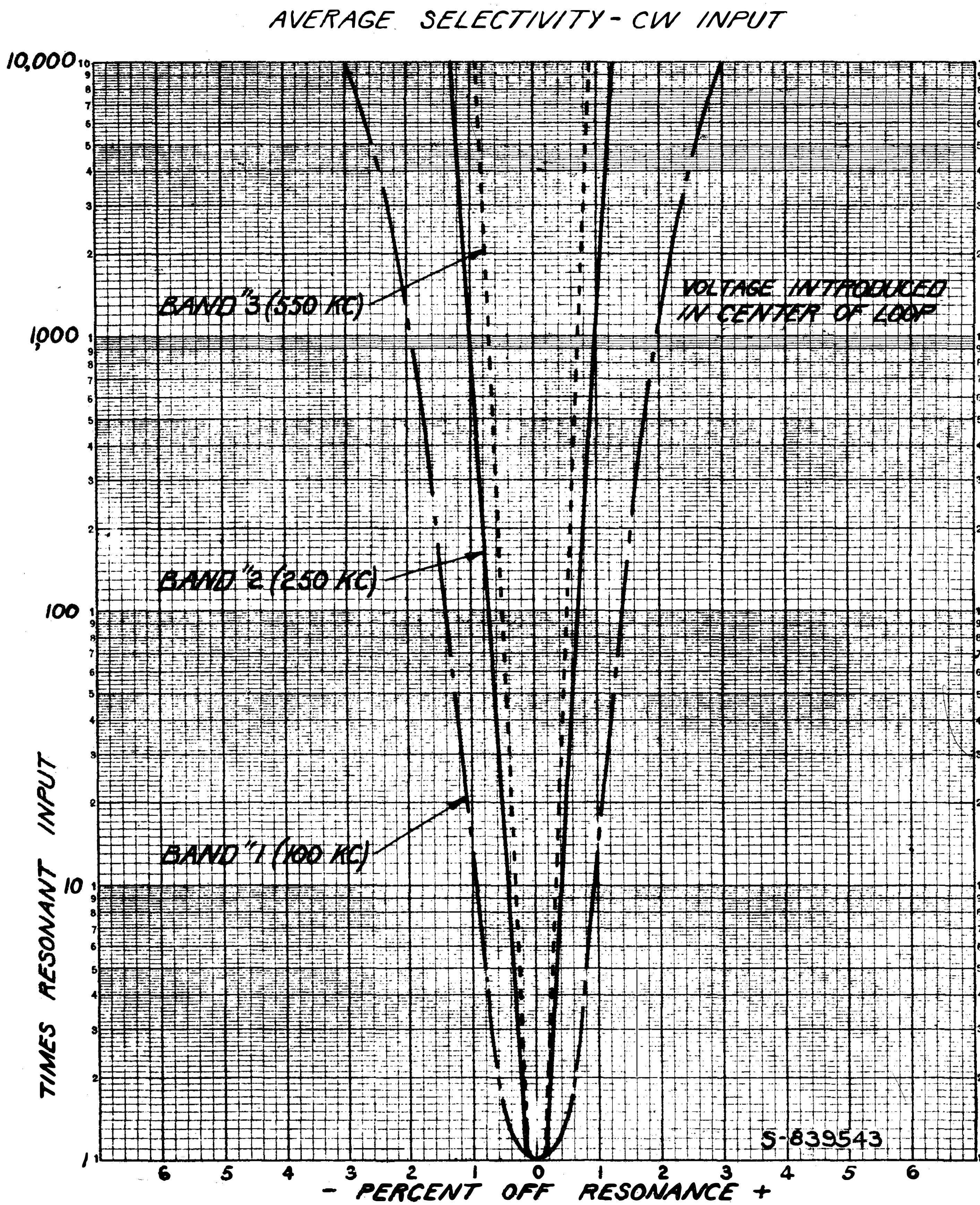


Figure 33—Average Selectivity Curve (S-839543)

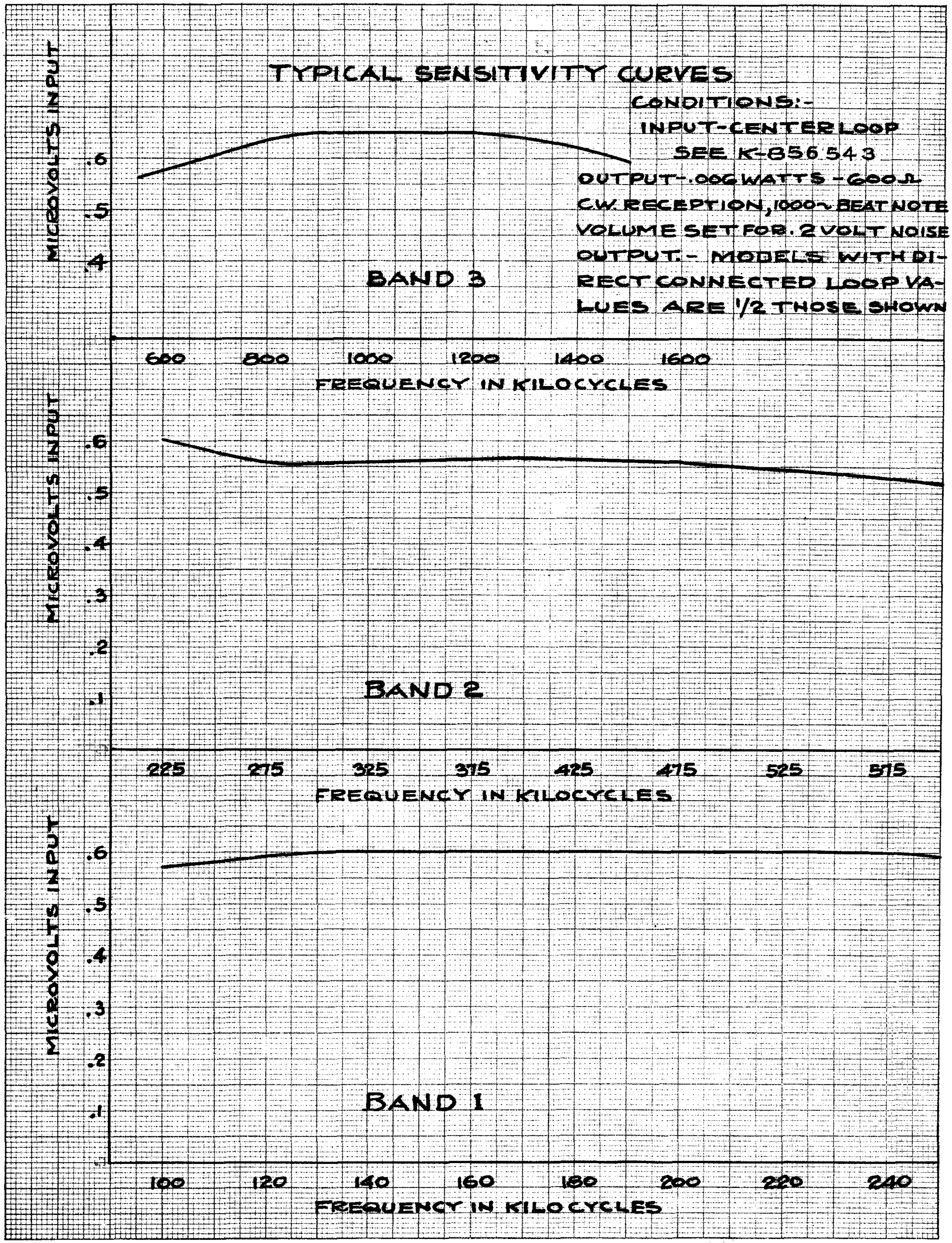


Figure 34—Typical Sensitivity Curve
(*S*-839544—*Sub* 0)

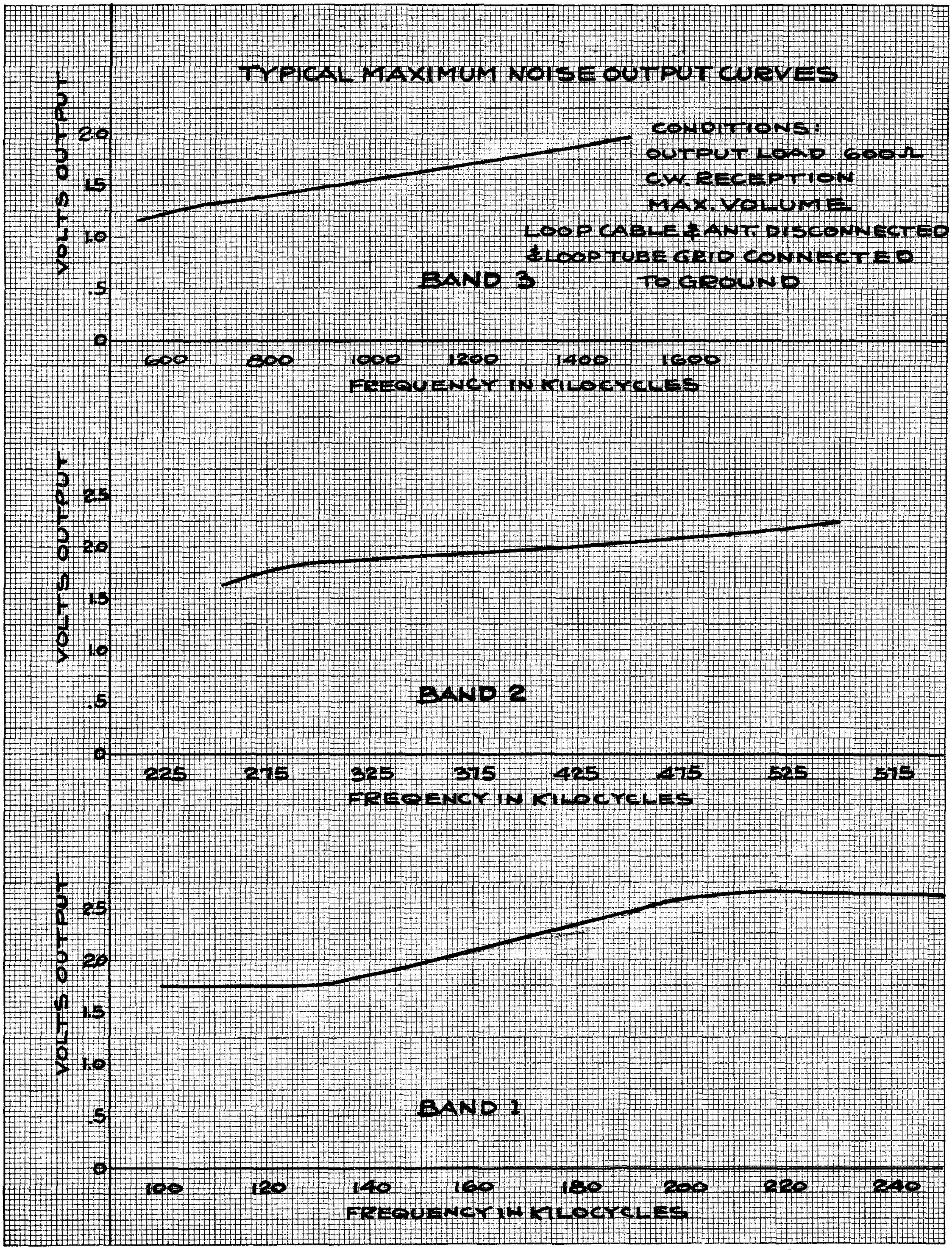


Figure 35—Typical Maximum Noise Output Curve
(*S*-839545—*Sub* 0)