SERIAL NUMBER 486.

INSTRUCTION BOOK

FOR

Model RAT and Model RAT-1 Aircraft Radio Telegraph and Telephone Receiving Equipment

AIRCRAFT RADIO CORPORATION
BOONTON, NEW JERSEY

CONTRACT NUMBER NOs-67258
Dated June 24, 1939

RESTRICTED

INSTRUCTION BOOK

FOR

Model RAT and Model RAT-1 Aircraft Radio Telegraph and Telephone Receiving Equipment

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Frequency Range: 13.5 to 27 Megacycles (MC)

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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.

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AIRCRAFT RADIO CORPORATION
BOONTON, NEW JERSEY

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Dated June 24, 1939

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND UPON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER POWER EQUIPMENT. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF ENGINEERING CIRCULAR LETTER NO. 5a OF 3 OCTOBER 1934, OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO—SAFETY PRECAUTIONS TO BE OBSERVED."

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GUARANTEE:

The equipment, including all parts and spare parts, except vacuum tubes, storage batteries, rubber and material normally consumed in operation, is guaranteed for a period of TWO YEARS with the understanding that, as a condition of this contract, all items found to be defective as to design, material, workmanship or manufacture will be replaced without delay and at no expense to the Government, provided that such guarantee and agreement will not obligate the contractor to make replacement of defective material unless the failure, exclusive of normal expected shelf life deterioration, 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 or are found defective to the extent of ten per cent (10)% or more of the total number of similar units furnished under the contract (exclusive of spares), such part or parts, whether supplied in the equipment or as spares, will be conclusively presumed to be of defective design, and as a condition of contract subject to one hundred per cent (100%) replacement by suitable redesigned units.

Failure due to poor workmanship while not necessarily indicating poor design will be considered in the same category as failure due to poor design. Redesigned replacements which will assure proper operation of the equipment will be supplied promptly, transportation paid, to the Naval activity using such equipment, upon receipt of proper notice and without cost to the Government.

All such defective parts will be subject to ultimate return to the contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective item or unit prior to replacement without jeopardizing the integrity of the Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such item or unit in order to prevent extended interruption of communications. In such cases the return of a defective item or unit for examination by the contractor prior to replacement will not be required. The report of a responsible authority, including details of the conditions surrounding the failure will be acceptable for effective adjustment under the provisions of the contractual guarantee.

The above period of TWO YEARS will 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. All replacement parts will be guaranteed to give TWO YEARS of satisfactory service.

Report of Failure of any part of this equipment, during its life shall be made on Form N. Aer. 4112—"Report of Unsatisfactory or Defective Material" in accordance with latest instructions issued by the Bureau of Aeronautics. Three copies of this report shall be forwarded to the Bureau of Ships and one copy shall be sent to the Inspector of Naval Material, New York, 30 Church Street, New York City. Copies required for other activities shall be forwarded in accordance with existing instructions.

Such reports of failure shall include:

(a) Contract Number_____ Date of Contract_____
(b) Model Letter of Equipment_____ Navy Type_____
(c) Serial Number of Equipment_____
(d) Date of acceptance by the Navy_____
(e) Date placed in service_____
(f) Part which failed_____
(g) Nature and cause of failure_____
(h) Covered by contract guarantee_____
(i) Replacement needed (Yes or No)_____
(j) Remedy used or proposed_____
(k) Date, name and location of reporting activity_____
Contract NOs 67258, Dated June 24, 1939
Serial number of equipment_____
Date of acceptance by Navy_____
Date of delivery to contract destination_____
Date placed in service_____

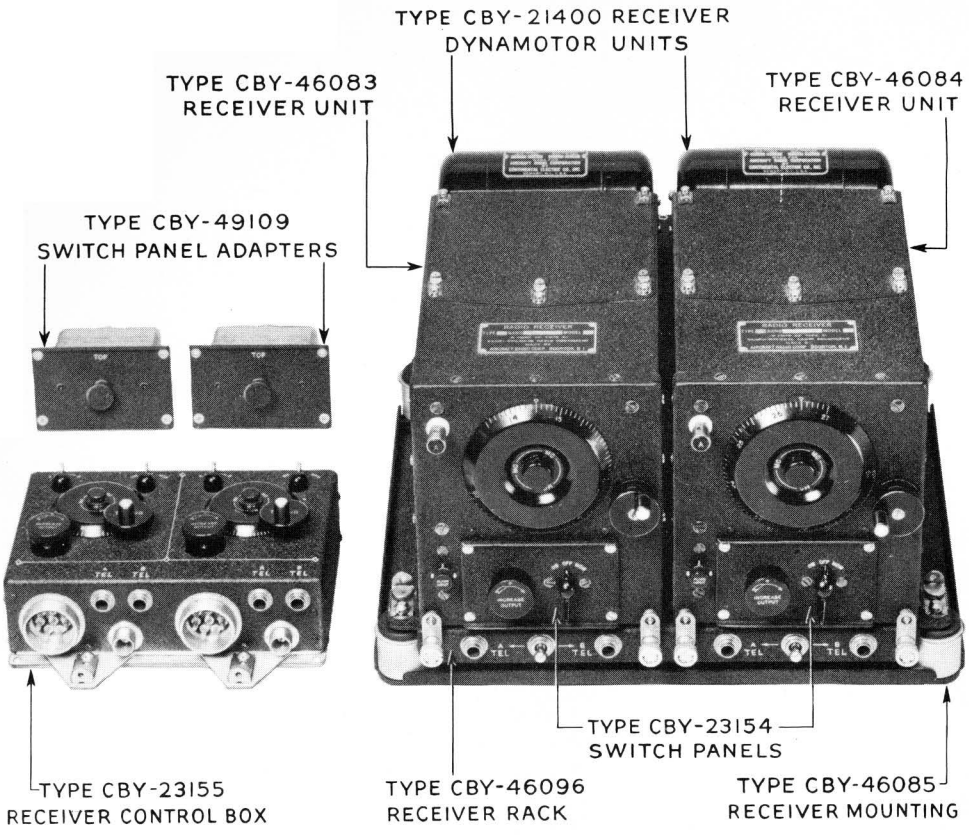


FIG. 1A—PRINCIPAL UNITS, MODEL RAT EQUIPMENT

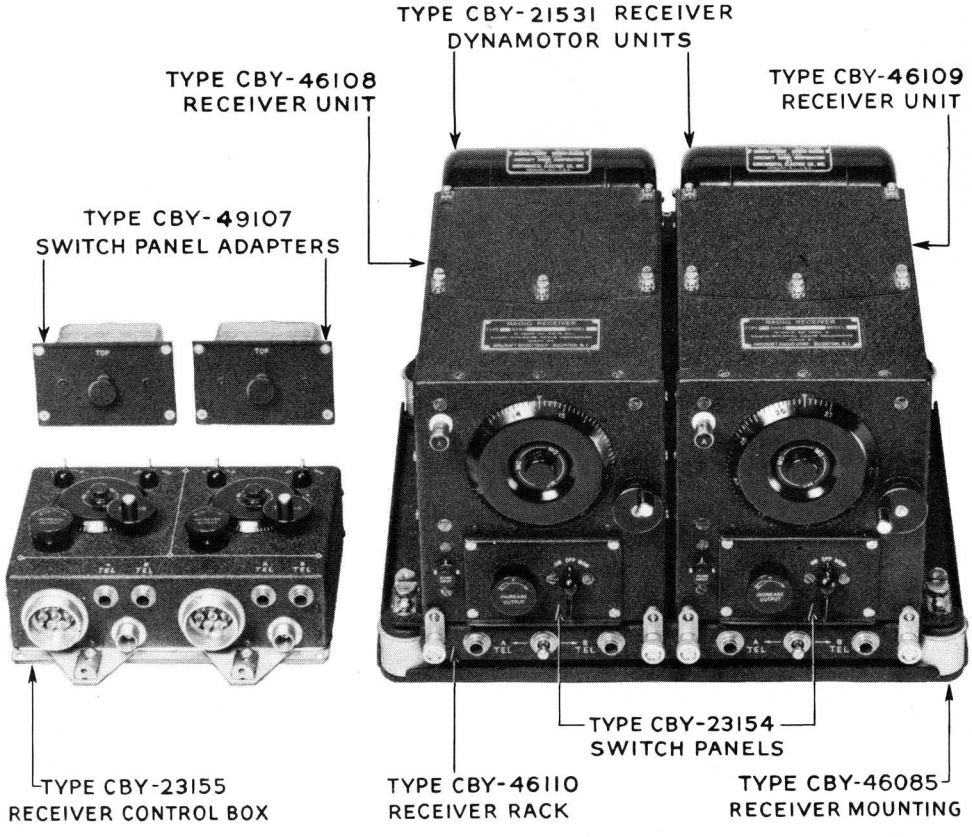


FIG. 1B—PRINCIPAL UNITS, MODEL RAT-1 EQUIPMENT

(See Table 1, page 22, for complete list of items supplied with each equipment)

Model RAT and Model RAT-1 Aircraft Radio Receiving Equipment

I. DESCRIPTION

GENERAL

Model RAT (12-volt) and Model RAT-1 (24-volt) are similar Aircraft Radio Receiving Equipments; each consisting of two complete superheterodyne aircraft radio receivers designed for individual or simultaneous operation in the frequency bands of 13.5 to 20 megacycles and 20 to 27 megacyles. The principal units of each of these equipments are shown in Figures 1 A and 1 B, on page 6 and a complete list of the items supplied with each equipment on this contract is shown in Table I. Except for dynamotors, relays, and heater wiring, corresponding units of Model RAT and Model RAT-1 are alike. The equipments may be described generally as follows:

(1) Primary power is obtained from the 12-volt dc supply on the airplane for Model RAT and from the 24-volt dc supply for Model RAT-1.

(2) Six 12-volt, octal-base, metal tubes are employed in each receiver.

(3) The receivers may be operated one at a time or simultaneously. Either may be remotely or locally controlled.

(4) The output of both receivers may be paralleled on a single headset, or may be separated for split or double headset operation.

(5) Continuous-wave or amplitude-modulated radio signals may be received.

(6) Both receivers may be connected to a single antenna of the fixed or trailing-wire type.

(7) Manual control of sensitivity is employed, aided by an auxiliary circuit which prevents strong radio signals from blocking reception.

(8) Tuning dials are calibrated directly in megacycles.

(9) The schematic circuit diagrams of both receivers of Model RAT are alike and both those of Model RAT-1 are alike. The intermediate frequency of all receivers is 4.2 megacycles.

(10) Dynamotors, relays, and vacuum tube heater circuits of Model RAT are designed for 12-volt operation whereas similar items of Model RAT-1 are designed for 24-volt operation, hence the only major units of Model RAT which are interchangeable with corresponding units of Model RAT-1 are Switch Panels, Receiver Control Boxes, Receiver Mountings, and Switch Panel Adapters.

Corresponding units of Model RAT-1 are interchangeable with those of the 24-volt Model RAV equipment and of the 24-volt Model ARA equipment.

Nameplates on major units of the 12-volt Model RAT equipment have a black background to assist in distinguishing them from the 24-volt Model RAT-1 units whose nameplates have a blue background.

Table 1, page 22 shows the list of major units and accessories supplied with each Model RAT and each Model RAT-1 equipment on Contract Number NOs-67258.

NOMENCLATURE

In the following text, Type CBY-( ) Receiver Unit for any frequency range may be referred to as "the receiver" together with an indication of the frequency range, if significant; the Type CBY-( ) Receiver Rack may be referred to as "the rack"; the Type CBY-( ) Receiver Mounting as "the mounting"; the Type CBY-( ) Receiver Dynamotor Unit as "the dynamotor"; and the Type CBY-( ) Switch Panel as "the switch panel".

The abbreviation "RF" will be used throughout the text to denote the "radio frequency" of the incoming signal or the "radio frequency" of the oscillator associated with the mixer tube. "IF" will be used to indicate the resonant "intermediate frequency" of the tuned circuits following the mixer. This frequency is "intermediate" between the "RF" and the frequencies of the audible signals. "AF" will be used to indicate the "audio frequency" of the audible signals.

SYMBOL AND PART NUMBERS

The symbol numbers used in the following discussion refer to parts shown in the photographs and drawings, and referenced in the "Parts List by Symbol Designation". Part numbers are manufacturer's "drawing numbers".

A symbol number has been assigned to each function, for example "Z-5" to the RF Coil Set assembly. This assembly is a different one for each of the frequency ranges, hence two "parts numbers" will be found under "Z-5". Most parts will be found common to all receivers but wherever this is not true, a separate listing for each receiver will indicate the correct part number.

SERIAL NUMBERS

Serial numbers appear on all units having Navy Type designation. In *one* Model RAT or RAT-1 equipment there are 2 similar dynamotors, 2 similar switch panels, and 2 *different* receivers. An example of the serial numbering of 50 Model RAT or RAT-1 equipments follows: dynamotors numbered 1-100; switch panels numbered 1-100; mountings numbered 1-50; racks numbered 1-50; *each* receiver range numbered 1-50.

A serial number on the rear of each receiver chassis corresponds to the serial number appearing

on the receiver nameplate attached to the outer shield. Serial numbers which are for manufacturing record purposes only, will be found rubber-stamped on each gang capacitor, and steel-stamped on the *side* of each dynamotor. These apply to the gang capacitor and dynamotor and not to the receiver.

The nameplate on the base of each dynamotor unit is hidden from view when it is mounted on the receiver. In order to aid in checking the dynamotor unit serial number without dismounting it, an additional serial-number plate has been provided which is mounted conspicuously on the top of the dynamotor machine. This plate is of the "write-in" type, so that if it becomes necessary to mount a new machine on the base, the proper number may be inscribed on the "write-in" plate. *The number engraved on the Dynamotor Unit nameplate is the permanent serial number of that unit.*

A plate is riveted to the front of the switch panel and switch panel adapter which bears the serial number *of this unit. This number should not be confused with the serial number of the receiver unit.*

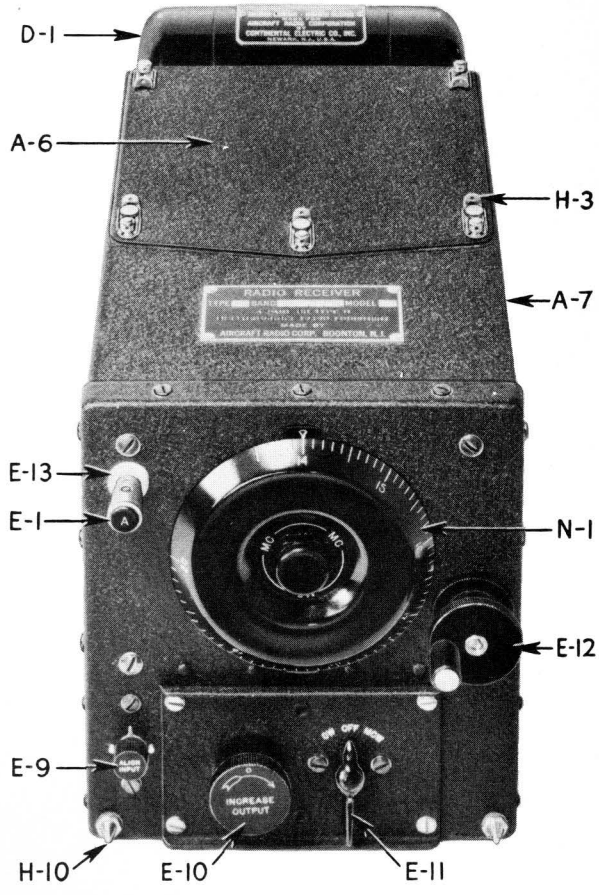


FIG. 2—TYPICAL RECEIVER UNIT
(The Switch Panel must be replaced with the Switch Panel Adapter when the receiver is controlled remotely)

SLIP COVERS

One waterproof slip cover, designed to cover two receiver units, is supplied with each equipment. It is important that the receivers be protected from water or dust. Slip covers should be removed before operating the receivers in order to avoid excessive temperature rise.

VACUUM TUBES

Six octal-base metal tubes are employed in each receiver as follows: one 12SK7 as a radio frequency (RF) amplifier, one 12K8 as a "mixer" or "converter", two 12SK7 as intermediate frequency (IF) amplifiers, one dual purpose 12SR7 as a detector and CW oscillator, and one 12A6 as an audio amplifier. The heaters of all of these tubes are rated at 12.6 volts. All tubes terminate in a standard octal base and except for the 12K8 which has its signal grid brought out at a top cap, are of the single-ended type. The 12SK7 is a "triple-grid, super-control" RF amplifier tube. It is sometimes referred to as a "remote cut-off" or "variable-mu" tube. The 12K8 is a combination "triode-hexode" used to perform the functions of oscillation and of modulating or "mixing" this oscillation with the incoming RF signal to produce the IF. In early superheterodyne receivers these functions were performed by two tubes called the "first detector" and the "RF oscillator". The 12SR7 is a "duodiode-triode", that is, it consists of two diode plates, plus a triode. One diode plate is used as a detector and the second diode plate is grounded externally. The triode section is used as a heterodyne oscillator for CW reception. The 12A6 is an audio amplifier power output tube, sometimes referred to as a "beam" power tube. Table II lists the electrical characteristics and terminal arrangements for each of the four types of tubes used in the equipment.

All tubes supplied with the equipment shall be consumed prior to the employment of tubes from general stock.

RECEIVER OUTPUT CONNECTIONS

By means of a three-position toggle switch associated with each receiver, the output of one or both receivers may be connected to either of two telephone lines terminated at jacks marked "A Tel" or "B Tel", or may be left disconnected from all telephone jacks (three-position switch left in the center position).

The receiver output connections are shown in Fig. 3. For local control operation, the receiver control box switches are not employed. It will be noted that a switch on the rack connects the first receiver output to the "A Tel" line, or to the "B Tel" line, or leaves the output disconnected, and similarly, a second switch connects the second receiver output to the "A Tel" line, or to the "B Tel" line, or leaves the output disconnected. The switch which controls the output of a receiver, is on the front of the rack directly under that receiver. If the equipment is to be operated by

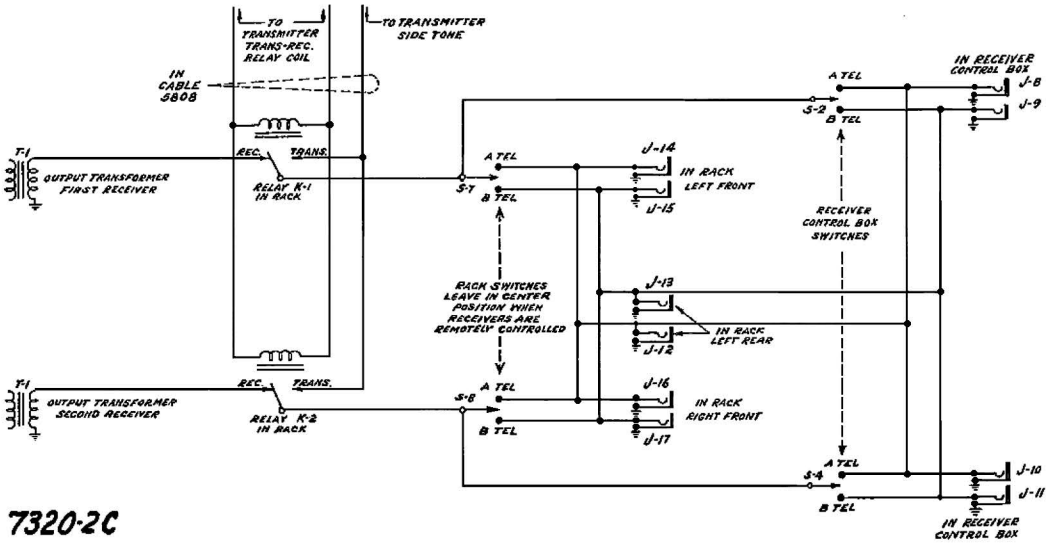


FIG. 3—RECEIVER OUTPUT CONNECTIONS

(All "TEL" switches are shown in the mid-position. S-2 or S-4 may be thrown to "A TEL" or "B TEL" in remote-control installations and S-7 or S-8 may be thrown to "A TEL" or "B TEL" in local-control installations)

remote control, all switches shown in Fig. 3 are in the circuit, *but the switches on the rack must be left in the center or neutral position. When this is done, the disposition of receiver outputs is controlled by the two control box "A-B" switches.* Here also it is possible to connect either or both receivers to "A Tel" or "B Tel" jacks, or to leave the output of either or both receivers disconnected.

Fig. 3 shows a relay associated with each receiver. The function of each relay is to connect the telephone line either to the side tone line from an external transmitter, or to the output of the receiver. These relays are designed and connected to operate simultaneously with the keying relay of a transmitter.

ANTENNA

A single antenna of the trailing-wire or fixed type may be connected to both receivers. Any convenient length of wire greater than 5 feet may be used. Separate antennas may be used, if desired.

GAIN CONTROL

The gain control is a variable resistor in the cathode to ground circuit of the first IF amplifier tube and the RF amplifier tube (see Fig. 10). In addition to this manual gain control a high-level automatic gain control is provided which comes into action *only when a signal otherwise strong enough to overload the radio amplifiers is present,* and which thereby prevents blocking of reception. The result is that regardless of the setting of the manual gain control resistor, strong signals will not block the receiver, and at the same time *the sensitivity for weak signals will not be less than that for which the manual gain control is set.*

DIALS

The dials of the receivers and receiver control boxes are direct-reading in megacycles (MC).

THE RECEIVER UNITS

Schematic circuit diagrams of the Model RAT and Model RAT-1 receivers are shown in Figs. 10 and 11. The wiring diagrams of the receivers are shown in Figs. 14 and 15. Fig. 3 shows the output circuits of receivers from the secondary of each of the output transformers to the several headset jacks.

The "radio frequency" (RF) part of the receivers consists of the following circuits and tubes, starting at the antenna: a tuned RF antenna input circuit, a 12SK7 RF amplifier tube, a second tuned RF amplifier circuit, a 12K8 "mixer" tube, and an RF oscillator circuit. The RF antenna, the RF amplifier, and the RF oscillator circuits are tuned by sections of a three equal-section gang capacitor C-4 (A,B,C). The plate current of the 12K8 "mixer" tube contains a frequency component which is equal to the difference between the frequency of the applied RF signal and that of the RF oscillator voltage. It is termed "intermediate frequency" because it is a frequency between that of the input RF signal and that of the output "audio frequency" signal.

Antenna coil L-1 is contained in Z-5A which is a unit of the plug-in RF coil set assembly Z-5. Z-5B contains the RF amplifier coils L-2 and L-3. Z-5C contains L-4, L-5, R-3, and R-6, of the RF oscillator. L-1 of Z-5A, L-3 of Z-5B, and L-5 of Z-5C contain iron cores which are used to adjust each coil to a particular value of inductance. After this adjustment at the factory, the iron cores are sealed in position. A subsequent change

in the setting of any of these will result in mistracking of that circuit.

C-1 is a small fixed capacitor which couples the antenna to the input tuned circuit. The capacitances of C-1 and C-2 are so designed that for any capacitive antenna, it is possible to resonate the antenna circuit by tuning C-2.

L-5 of the RF oscillator has a lower inductance than L-3 of the RF amplifier circuit. This lower value of L-5, aided by the insertion of C-10 between L-5 and ground, results in an RF oscillation which is higher in frequency than the signal frequency. By design, this difference is equal to the intermediate frequency throughout the tuning range of the receiver. L-4 and L-5 are the grid and plate coils of the RF oscillator. C-4C with trimmers C-4E and C-4G, and C-10 with trimmer C-9, together determine the tuning capacitance across L-5. C-8 is a grid "blocking" capacitor, and R-3 is a grid resistor. R-6 is a series resistor in the plate circuit which not only serves to drop the dynamotor voltage to the proper value for the RF oscillator, but also acts as an RF filter in conjunction with C-10, to keep RF voltages from appearing on the high-voltage supply line. C-11 is a compensating capacitor connected across the RF oscillator tuning capacitor to reduce the frequency drift during the first half hour of operation.

The "intermediate frequency" (IF) part of the receivers consists of three IF coupling units, Z-1, Z-2, and Z-3 (Fig. 16) following the 12K8 mixer tube, the 12SK7 first IF amplifier tube, and the 12SK7 second IF amplifier tube respectively.

There is but one IF tuned circuit in each of the IF coupling units of these receivers. Each of these tuned circuits consists of a coil (for example L-6 in Z-1) with a fixed tuning capacitor C-12 and a "trimming" tuning capacitor C-13. In these receivers, the single IF tuned circuit is capacitively coupled (for example by C-14 in Z-1) to the vacuum tube input circuit following. L-7, L-9, and L-11 act only as RF chokes.

The detector and "audio frequency" (AF) part of these receivers consists of a diode section of the 12SR7 tube acting as a detector resistance coupled to the 12A6 tube, and an 8 to 1 output transformer. C-24 is an RF by-pass capacitor, and R-18 is the diode series resistor, across which the detected audio voltage is developed. R-18 and C-24 act to prevent IF from appearing across the input to the audio amplifier tube. C-29 is a blocking capacitor, and R-20 is the audio grid resistor. C-31, across the primary of T-1, assists C-20B across the secondary, in reducing the output of high audio frequencies. The design of leakage reactance in T-1 is such that with the aid of C-31 and C-20B, frequencies above 3000 cycles per second are attenuated.

V-1 and V-2 are small neon lamps acting as devices to protect the equipment when exceptionally strong signals are received. These lamps glow at approximately 80 volts. As soon as the glow starts, any increase in voltage across the lamp terminals causes a relatively large increase in current. In this manner the voltage is limited to 80 volts across L-1, and likewise across half of the primary winding of T-1.

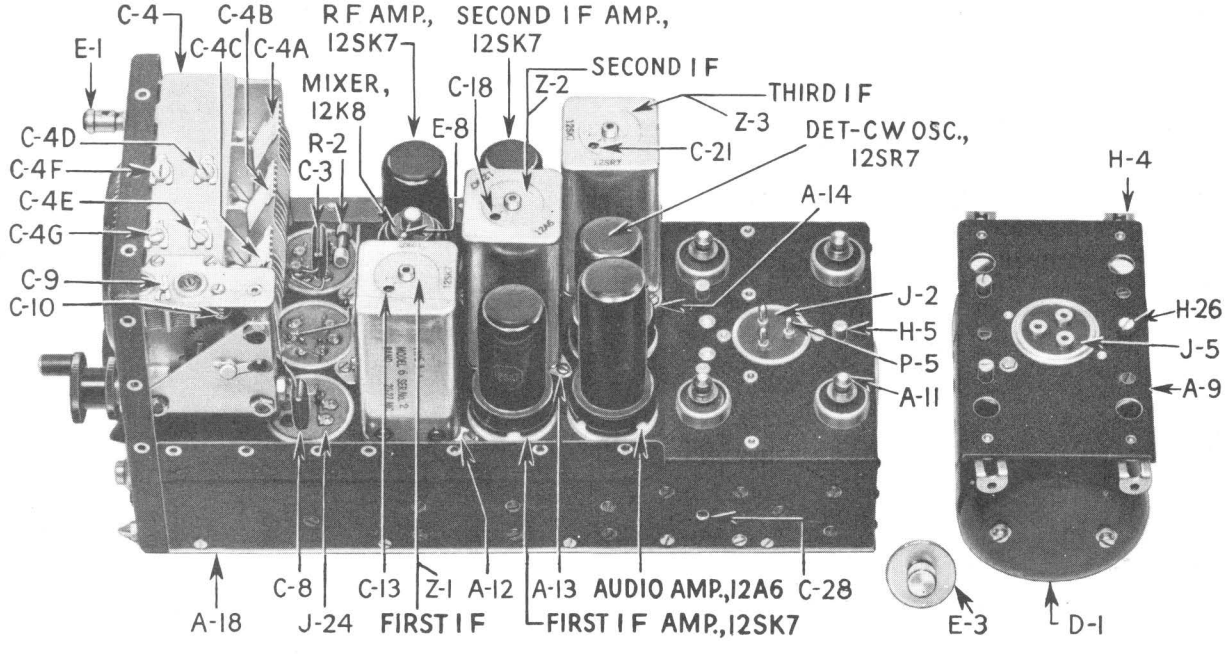


FIG. 4—TYPICAL RECEIVER UNIT, TOP VIEW, INSIDE, AND BOTTOM VIEW OF RECEIVER DYNAMOTOR UNIT
(Gang condenser shield and outer dust shield have been removed)

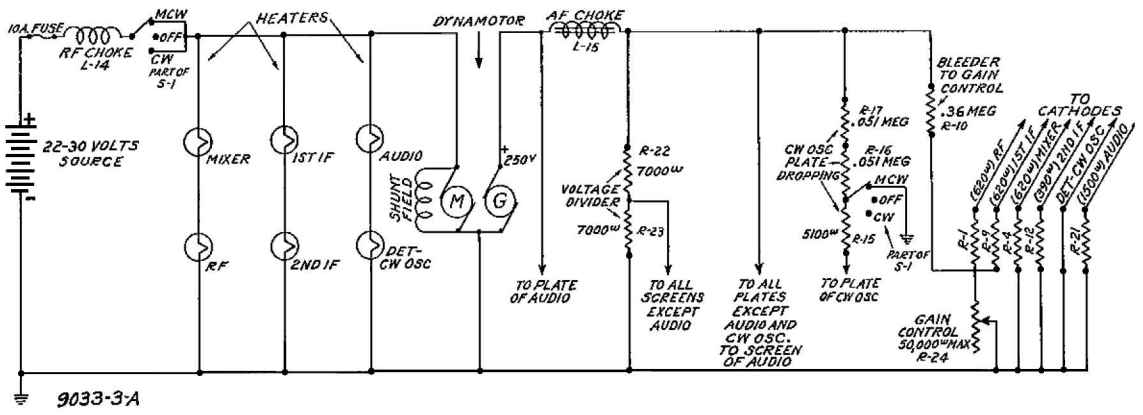


FIG. 5—DC CIRCUITS OF A TYPICAL MODEL RAT-1 RECEIVER
(Heaters of Model RAT receivers are in parallel across the 11-15 volt source).

"Gain" or "volume" is manually controlled by a 0-50,000 ohm variable resistor located in the switch panel or control box. The cathode circuits of the RF amplifier and first IF amplifier are completed to ground through R-24. As this resistor is increased from 0 to 50,000 ohms, the voltage between ground and either cathode increases, and since the grids of these tubes are at ground potential for dc, the grids become increasingly negative with respect to the cathodes. This results in a reduction of amplification in each of the controlled tubes, and in an overall reduction in the "gain" of the receiver by a factor exceeding 50,000 to 1 as the gain-control resistor reaches its maximum resistance. About 0.6 of a millampere of dc is conducted from the + 250 volt dynamotor line through R-10 and R-24 to ground so that in the minimum "gain" position there is a difference of potential of 30 volts even when the cathode current is negligible (see Fig. 5). From this it can be seen that R-10 acts to make the "control" voltage less dependent upon the cathode current of the tubes being controlled.

The control grid of the RF amplifier and of the first IF amplifier tubes are returned to ground through a common resistor R-11 in the control grid circuit of the 12SK7 second IF amplifier tube. The object of this "auxiliary gain control circuit" is to prevent overload of the RF or IF amplifier by signals producing as much as 2 volts in the antenna circuit. In effect it is a high-level automatic gain control which is operative only on signals so strong that they would otherwise harmfully overload the receiver. When this condition arises, grid current flows through R-11 to the second IF amplifier in such a sense that the grid side of R-11 is negative with respect to ground. By connecting the grid-to-ground circuits of the RF and first IF amplifier tubes to this potential, the gain of these tubes will be reduced to the point where overload by grid current in the stages is prevented. At the maximum gain position, a uniform output is maintained for all values of radio signals from approximately 100 microvolts to 2 volts. When the gain is manually reduced by 10 to 1, the *same* audio level is maintained for all radio signals from approximately 1000 microvolts to 2 volts, . . . etc. From these figures it may be seen that the automatic gain control does not come into action on weak signals, and that if the manual gain control is retarded, weak signals may be lost. It may therefore be desirable to keep the gain control near maximum, particularly on pilot-operated receivers.

The dc circuits of all cathodes connect to ground. C-6C, C-7B, C-15B, C-20A, and C-30 are cathode resistor by-pass capacitors for the six receiver tubes, excepting only the detector-CW oscillator whose cathode is connected directly to ground. All of these capacitors are of the foil-paper type except C-30 which is a 15 microfarad electrolytic unit. C-30 is an audio frequency by-pass capacitor across R-21 designed to prevent audio degeneration in the output amplifier.

All control grids have a dc path to ground. R-2 and R-20 are each 2 megohms, but the resistance to ground of all other control grids is 100,000 ohms or less.

The screen grid circuits of the 12SK7 tubes and the 12K8 tube connect to the junction of a voltage divider or "bleeder" formed by R-22 and R-23 across the high voltage side of the dynamotor. Resistor R-8, with capacitors C-7A and C-16A, act as a "decoupling" filter to prevent RF and IF from appearing on the dynamotor high voltage supply line.

The screen grid of the 12A6 audio amplifier tube connects to the high voltage filtered plate supply line.

The suppressor-grid of each 12SK7 tube is connected to the cathode at the tube socket.

The plates of all tubes connect either direct, or through decoupling resistors, to the high voltage dynamotor line. R-6 with C-10, R-7 with C-6A, and R-13 with C-20C, act as RF filters or "decouplers" to prevent RF from appearing on the

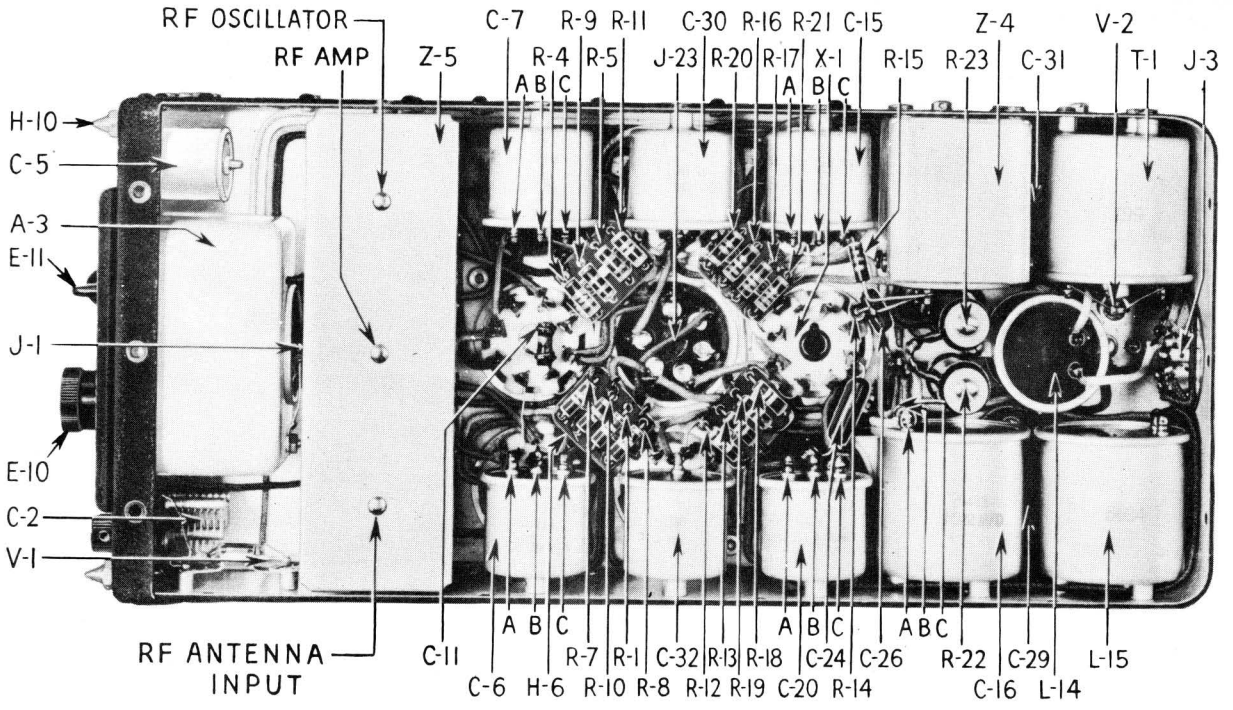


FIG. 6—TYPICAL RECEIVER UNIT, BOTTOM VIEW, INSIDE

Capacitor C-5 and resistor R-5 are located as shown above in Model RAT-1 receivers but will not be found in Model RAT receivers. The location of resistor R-9 in Model RAT receivers corresponds to the location of resistor R-5 in this photograph

high voltage line. C-10 is the fixed series capacitance in the RF oscillator circuit and only incidentally assists in the "decoupling" function. R-15, R-16, and R-17 act in the dual capacity of voltage dropping and as a filter, with C-15C and C-25, to prevent CW heterodyne voltage from appearing on the supply line. The plate of the 12A6 output tube is connected through the primary of T-1 to the dynamotor side of L-15. The object of this is to reduce the possibility of "motor-boating" caused by heavy audio currents in the 12A6 plate circuit. By connecting the 12A6 plate across C-16B, the audio voltage across C-32 is considerably reduced, and hence the audio modulation of the screen and plate supplies of all other tubes (which is a cause of "motorboating") is reduced.

The CW heterodyne oscillator circuit is composed of a "tuned-plate" oscillator using the triode section of the 12SR7 tube. L-12 and L-13 are the grid and plate coils. C-27 and trimmer C-28 are tuning capacitors. C-26 and R-14 are the oscillator grid capacitor and resistor. C-25, with R-15, is an important RF filter or "decoupling" element which prevents the oscillator voltage from appearing on the plate supply line. C-33 is connected between the plate of the CW oscillator and the control grid of the second IF amplifier. C-33 is a capacitance formed by proximity of pin plugs in the second IF receptacle, and is less than 2 micromicrofarads. The amplitude of oscillation in the CW oscillator and the capacitance of C-33, are designed to produce the correct heterodyne voltage at the control grid of the second IF amplifier for reception of CW signals. A connection at the junction of R-15 and R-17 goes to a grounding switch on S-1 (see Fig. 5). In the MCW position, S-1 grounds this line thus cutting off the CW oscillator plate supply. In the CW position the ground is removed and normal plate supply is obtained from the dynamotor through dropping resistors R-15, R-16 and R-17. The audio filter circuit in the high voltage supply consists of C-16B, a 0.22 microfarad foil-paper capacitor, and C-32, a 5 microfarad electrolytic capacitor, and L-15, a 3 Henry AF choke. This prevents all but a negligible audio ripple from appearing across C-32.

C-16C is an RF filter capacitor designed to reduce RF dynamotor disturbances. (C-34 is a .001 microfarad capacitor which is connected across the motor-brush terminals of the dynamotor as an additional suppressor of RF disturbances from the dynamotor.)

L-14 is an RF choke designed to prevent RF disturbances of any type from getting out of the receiver onto the primary source line where it might radiate enough energy to be picked up by a second receiver.

TYPE CBY-23155 RECEIVER CONTROL BOX

The Type CBY-23155 Receiver Control Box may be seen in Figs. 1A, 1B, and 7. A schematic

circuit diagram of the unit is shown in Fig. 10, and a wiring diagram in Fig. 15. Its dimensions and weight may be found in Fig. 13.

This control box contains all of the electrical circuits and controls for the remote operation of the two receiver units in this equipment. An engraved line down the center of the control box face separates the controls for the two receivers.

nuts. Each rack contains a 10-ampere fuse in series with the battery-supply to each receiver, a "sidetone-receiver output" relay for each receiver, a battery cable receptacle, receptacles for connections to an external transmitter and to a second similar rack, and two receptacles which are provided for connection to the receiver control box.

There are also three pairs of "A Tel" "B Tel"

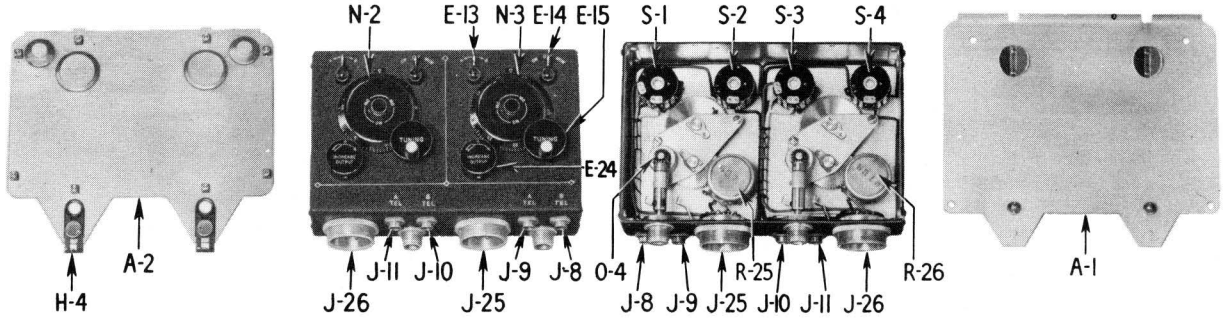


FIG. 7—TYPE CBY-23155 RECEIVER CONTROL BOX, FRONT AND REAR VIEWS WITH BASE AND MOUNTING

The "A-B" switch, the "CW-OFF-MCW" power switch, the gain control, and the tuning control, perform the same functions in remote operation that the "A Tel, B Tel" switch on the rack, the "CW-OFF-MCW" power switch, and the gain control on the control panel, and the local tuning knob on the receiver, perform in local operation of the equipment.

The remote tuner dial may be adjusted to correspondence with the dial on the receiver which it controls by unscrewing the knurled nut in the center and rotating the dial to give the same indication as the receiver dial, at which position it should be locked *by hand tightening only* of the knurled nut.

Headset plugs may be inserted into either of the "A Tel" or "B Tel" jacks without regard to location of these jacks. The "A-B" switch associated with each of the receiver controls, determines whether that receiver shall be connected to either of the "A Tel" or "B Tel" jacks. See Fig. 3 for the schematic circuit arrangement.

TYPE CBY-46096 AND TYPE CBY-46110 RECEIVER RACKS

A receiver rack, representing the Type CBY-46096 and Type CBY-46110 Receiver Racks is shown in Fig. 8. Schematic and wiring diagrams are shown in Figs. 10 and 17. Fig. 13 shows the dimensions and weight. The two racks are alike except for the coils on the relays K-1 and K-2 which are wound for 12 volts for Type-CBY-46096 Receiver Rack and 24 volts for the Type CBY-46110 Receiver Rack.

Each rack acts as a receptacle for either of the two receivers of the Model RAT or Model RAT-1. These receivers may be slid into stalls and locked in place by means of clamps held firmly by knurled

headset jacks, two on the front, and one on the left rear of each rack. Two three-position toggle switches are located on the front of each rack, one at the center of each stall. The paragraph above entitled "Receiver Output Connections" describes the functions of these toggle switches in transferring the receiver output to the "A" or the "B" headset jacks and the schematic diagram, Fig. 3, shows the circuits.

TYPE CBY-23154 SWITCH PANEL

A Type CBY-23154 Switch Panel is supplied with each of the receivers. It contains a manual gain control resistor R-24, a "CW-OFF-MCW" switch S-5, and a coupling plug J-6. It is connected into receptacle J-1 for local control of the receiver into which it is plugged. A photograph of the unit may be seen in Fig. 9. Fig. 10 shows the schematic circuit diagram and Fig. 19 shows the wiring diagram.

TYPE CBY-49107 AND TYPE CBY-49109 SWITCH PANEL ADAPTERS

A switch panel adapter representing the Type CBY-49107 and Type CBY-49109 Switch Panel Adapters is shown in Fig. 9. These are designed to replace the switch panel in the lower front opening of any of the receivers of Model RAT or Model RAT-1 equipment when such equipment is connected for remote control. Type CBY-49107 and Type CBY-49109 Switch Panel Adapters are interchangeable.

TYPE CBY-21400 AND TYPE CBY-21531 RECEIVER DYNAMOTOR UNITS

A receiver dynamotor unit representing the Type CBY-21400 and Type CBY-21531 Receiver Dynamotor Units is shown in Figs. 4 and 18.

A Type CBY-21400 Receiver Dynamotor Unit is used with each receiver of Model RAT, and a

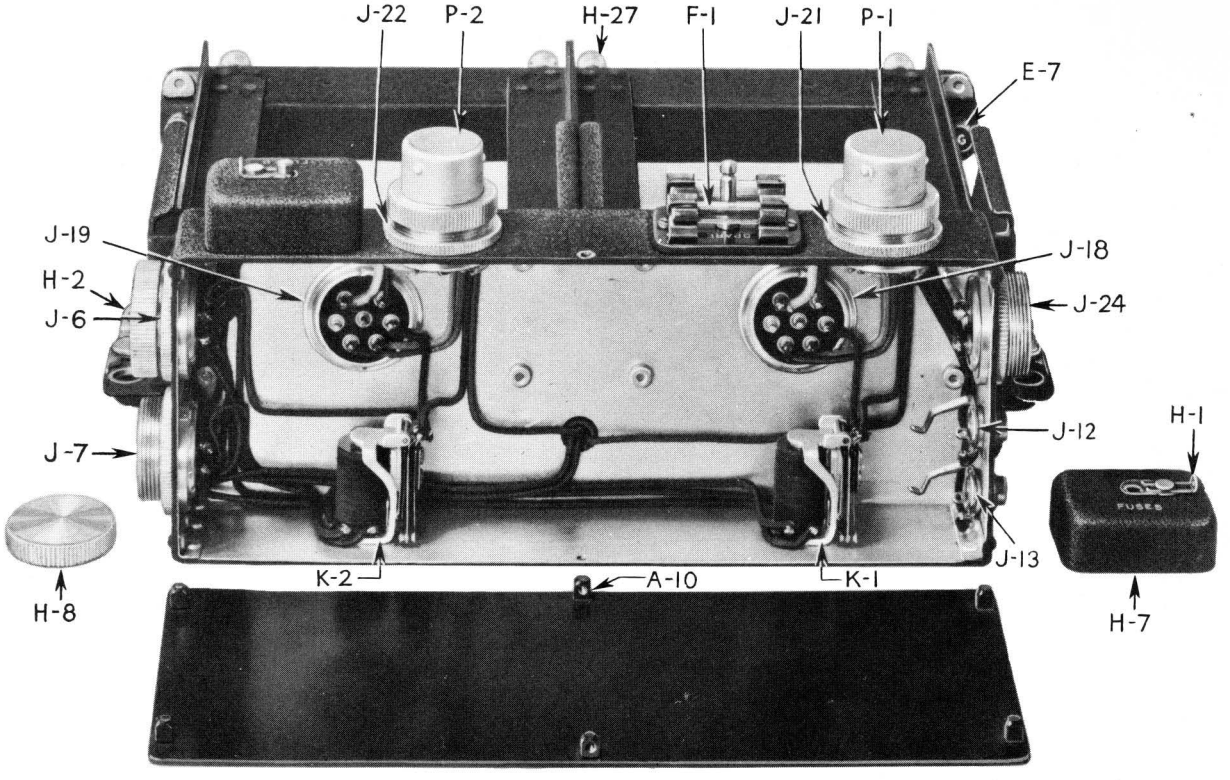


FIG. 8—TYPICAL RECEIVER RACK, REAR VIEW, WITH COVER REMOVED
(Type CBY-46096 (14-volt) and Type CBY-46110 (28-volt) Receiver Racks are alike except for the coils on relays K-1 and K-2)

Type CBY-21531 Receiver Dynamotor Unit is used with each receiver of Model RAT-1. Schematic circuit and wiring diagrams may be seen in Figs. 10 and 17. Each dynamotor generates the high-voltage direct current only for the receiver to which it is attached. Each receiver is therefore independent of the other, but in an emergency, due to failure of one dynamotor, another dynamotor may be substituted in its place. Coupling plug J-5 on the dynamotor is designed to be loose, so that motion of the dynamotor relative to the receiver will not place an undue strain on the pin plugs of the coupling receptacle J-2. Bumper studs on the dynamotor mounting plate and chassis act as shock "limiters". They also prevent damage to pin plugs on the coupling receptacle due to improper insertion of the dynamotor.

A capacitor, C-34, across the motor brush terminals, acts as an RF filter. The high voltage audio filter is a part of the receiver unit (see choke L-15 and capacitors C-16B and C-32 in Fig. 10).

Table 10 shows the dynamotor ratings.

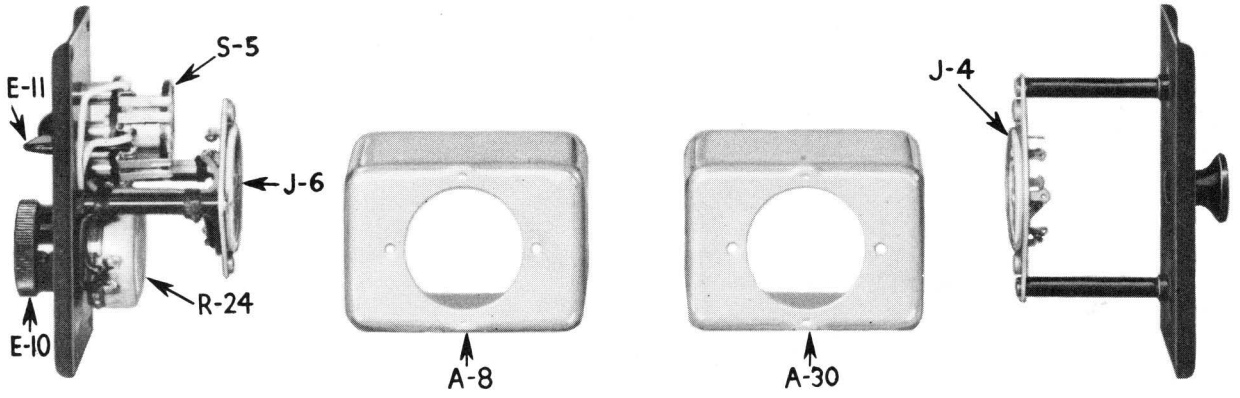


FIG. 9—TYPE CBY-23154 SWITCH PANEL (LEFT), SIDE VIEW, WITH COVER REMOVED, AND TYPICAL SWITCH PANEL ADAPTER (RIGHT), SIDE VIEW, WITH COVER REMOVED
(Type CBY-49107 and Type CBY-49109 Switch Panel Adapters are identical and are shown on the right as a "typical" switch panel adapter)

II. INSTALLATION

GENERAL

Fig. 13 shows the dimensions and weights of the several units comprising the equipment and Fig. 12 shows the cabling for both local control and remote control installations.

Due to the high frequencies covered by these receivers it is recommended that they be operated by local control whenever practicable. "CW" tuning by long lengths of flexible shaft is difficult.

ANTENNA

A single capacitive antenna, five feet or longer, and of either the fixed or tailing-wire type, should be connected to the antenna binding posts of the receivers. Separate antennas may be used if for any reason it is desirable. A satisfactory antenna connection may be made to the "receive" binding post on the antenna relay of the transmitting equipment.

Antenna leads inside the airplane should be as short as possible. Heavy, rubber-covered insulation is undesirable. The ideal installation approximates that of the transmitting antenna lead which is ordinarily of bare wire supported on ceramic insulators. This results in low capacity to ground and low RF losses. For a receiving antenna this would result in a stronger signal.

For protection of the receivers from exceptionally strong atmospherics, it is recommended that a 5 megohm, 2 watt, metallized resistor (International Resistance Co. Type F-2 or equal) may be connected between antenna and ground at some convenient point between the antenna binding post on the receiver and the "receive" post on the antenna relay of the transmitting equipment. This prevents extremely high voltage from being built up which might damage the antenna series capacitors.

CABLES

Assembly drawings of cables are shown in Fig. 19.

Each cable has a tough outside covering to protect the shielding braid. However, it is recommended that cables be kept away from sharp metal edges which might chafe through the coating to the shielding. If it appears necessary to violate this precaution, a layer or two of rubber or friction tape should be used at this point as additional protection.

"Nokorode" or other acid-type fluxes should be positively avoided in connection with the maintenance of these cables—or of any other part of this equipment. Use a resin flux and the smallest amount of heat practicable, in order to avoid damage to the equipment. It is suggested to supervisors that this be set up as an inviolable rule.

Particular attention should be paid to the note on the Cable Assembly drawing, Fig. 19 regarding twisting of the cable.

INPUT ALIGNMENT

The final installation adjustment is the alignment of the antenna input circuit of each receiver for the particular antenna used. The alignment knob is on the lower left front of the receiver and is marked "ALIGN INPUT". Both receivers should be connected to the antenna. Only one receiver should be turned on at a time. The controls should be set for "CW" and maximum "INCREASE OUTPUT" position of the gain control. *The receiver must be tuned to the high frequency end of the dial.* Adjust the "ALIGN INPUT" knob for maximum background noise. Turn off this receiver and repeat the operation for each of the other units. A slight improvement may be obtained by repeating the alignment of all units. The adjustment is not critical but there should be a maximum amount of background noise at some point. If the length of the antenna happens to be near a half wave-length, the noise will be about equal for any setting of this "trimmer". If this situation is encountered, tune to the middle of the receiver dial and repeat the operation.

III. OPERATION

Operation of this equipment involves the use of High Voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. See safety instructions on page 2 of this book.

LOCAL CONTROL OPERATION

There are two switches, a gain control knob, and a tuning control associated with the operation of each receiver. In the center ("OFF") position of the switch panel switch, all power is off. In the "MCW" position, power is on the vacuum tube heaters and dynamotor. In the "CW" position the same is true, and in addition the CW oscillator is turned on. A three-position toggle switch is mounted on the rack under each receiver. When this switch is thrown to the left to "A Tel" the output of the receiver directly above is connected to "A" telephone line, and when thrown to the right it is connected to the "B" telephone line. When the switch is in the center position, the receiver output is connected to neither line (see Fig. 3). Thus the output of each receiver may be connected to either or neither line by means of these switches. The dials of both receivers are direct-reading in megacycles (MC). The tuning dial may be rotated until a small dot just above the highest calibrated frequency comes under the fiducial mark. Do not attempt to tune beyond this point. This is the minimum capacitance position of the gang capacitor. If considerable force is applied in attempting to tune beyond this point, the gang capacitor may be damaged.

If cable 5808 is connected to a transmitter relay coil and a sidetone line, and "A Tel-B Tel" switches are on either "A" or "B", sidetone will be heard on telephones plugged into either "A Tel" or "B Tel" jacks whenever the transmitter is keyed.

The design of the receivers is such that under "stand by" conditions the gain control may be left in the maximum gain position without fear of losing a signal from a nearby transmitter due to RF or IF amplifier overload. The automatic gain control action comes into play only on *very* strong signals which would otherwise harmfully overload the receiver.

REMOTE CONTROL OPERATION

There are two switches, a gain control knob and a tuning control associated with the operation of each receiver by remote control. The function of each of these controls is the same as for the corresponding control described above under "LOCAL CONTROL OPERATION". Tuning is accomplished by a mechanical linkage, and therefore will require more care, particularly on "CW" than local tuning at the receiver, due to the residual backlash in the system. As in the case of local control, each receiver with its section of the receiver control box may be considered operatively as a completely separate instrument.

INTERFERENCES

In these superheterodyne receivers the RF oscillators operate at a frequency higher than the indicated receiver dial frequency by the amount of the IF, and may cause interference in a nearby receiver. For example, the RF oscillator of the 13.5-20 MC receiver oscillates at a frequency of 4.2 MC higher than the indicated receiver dial frequency so that in tuning from 13.5-20 MC, the RF oscillator is tuned from 17.7 to 24.2 MC. If the 20-27 MC receiver is operating on "CW" in the region of 20-24.2 MC, a beat note may be heard caused by the first receiver. If such an interference should occur, a slight retuning of the first receiver will eliminate the difficulty. A knowledge of the IF for a given receiver, plus its indicated dial frequency, is sufficient to determine at what frequency an interference may be expected.

The "CW" oscillator of a receiver or one of its harmonics may sometimes be heard in the same or a second receiver. The frequency of this "CW" oscillator interference is 4200 KC or any of its harmonics.

IV. MAINTENANCE

INSPECTION BEFORE EACH FLIGHT

An aural check on the operation of each receiver may be made by listening to signals on "CW" at maximum gain while tuning through the entire band. If each receiver responds normally as indicated above, no further test is necessary. If it does not, then LOOK FOR THE SIMPLE CAUSES OF FAILURE FIRST. Check that (1) switches are in the proper positions, (2) headsets are connected to the proper jacks, (3) plugs are securely attached, (4) battery voltage is satisfactory, (5) dynamotor is operating properly, (6) tubes are in good condition, (7) antenna is connected and antenna input circuit is properly aligned.

MAINTENANCE OF DYNAMOTORS

If the receiving equipment is operating satisfactorily with the dynamotor noise at a suitably low level, the dynamotor should rarely be touched. Frequent sanding of commutators, manipulating brushes, or excessive greasing, is likely to do more harm than good. The dynamotors supplied with this equipment are provided with grease-sealed ball bearings containing sufficient lubricant for 1,000 hours of operation. Hence the routine inspection should consist of a check on the "radio" and "audio noise" attributable to the dynamotor, and a cleaning of carbon or copper dust, which may have accumulated in the vicinity of the commutators.

The check on the "radio noise" may be made by operating the receiver at maximum gain and comparing the noise output with that from a machine known to be satisfactory. After a little experience it will be possible to distinguish dynamotor noise from other types, and a comparison machine will not be necessary. "Dynamotor noise" is sometimes due to a break in the shielding of one of the cables. If the shielding braid is broken, or if the equipment is not properly grounded to the metal fuselage, noise may be experienced even when the dynamotor is operating satisfactorily. The check on "audio noise" may be made by operating the receiver at minimum gain. If a loud low pitch tone is heard, it is indicative of commutator or armature trouble. In a normal dynamotor, the "ripple" will be so low that in the presence of a small amount of external radio noise it can barely be distinguished. If the "audio noise" is loud, make certain that all brushes make good contact with the commutators and that the brushes slide easily in their slots. If the noise still persists, remove the brushes and check each coil winding of the armature for an open circuit. This is accomplished by placing the terminals of an ohmmeter on adjacent commutator bars (do not connect prod to that part of the commutator normally contacted by the brush) and continuing the test around the commutator. Each test around the commutator should indicate the same resistance—approximately 25 ohms for the high voltage side and approximately 0.4 ohms for the low-voltage side of the 28-volt machines and 0.2 ohms for the low-voltage side of the 14-volt machines. Any appreciable variation from this indicates an open circuit, a short circuit, or a partial short circuit, in which case the armature must be replaced. Check part numbers carefully in order to be certain of having the correct 14 or 28-volt armature. They look alike.

When it becomes necessary to replace the brushes, make certain that each new brush slides smoothly in its slot, that the pigtail connector inside the spring is secure, and that the brush is the one indicated in the Parts List. Each brush is stamped + or — and the bearing brackets are likewise marked + or — adjacent to the respective brush holders. The brushes should always be inserted in their respective holders with the polarity mark upward in order to insure correct replacement at all times. Low voltage brushes should have a useful life of at least 1,000 hours and high voltage brushes 2,000 hours. The end of the useful life of the brushes comes when they have worn down to ¼ inch. Whenever new brushes are installed, the commutators should be carefully sanded with grade 0000 or a finer sandpaper. Machines should be "run in" on the bench for a period of 6 hours (or until at least 80% of the surface of all brushes are in contact with the commutators) under normal load before being replaced in service.

If it becomes necessary to remove the armature, or to replace the bearings, the following notes may be of assistance: To remove the armature, proceed as follows: Remove the end covers followed by all four brushes, then the tie rods by unscrewing acorn nuts. The high-voltage bracket should then be pulled out of the frame. This bracket fits snugly and if difficulty is encountered in removing it, tap it lightly. Withdraw the armature. A bearing puller should then be used to remove the bearings from the shaft, as any other method is likely to damage the shaft or commutator. In an emergency, however, two screwdrivers inserted between the grease slinger and the iron core of the commutator may be used as wedges to pry the bearings off the shaft. Be sure to straighten the grease slingers, if damaged, and replace them before attaching new bearings. New bearings should never be removed from their cartons until ready for use in order that they be kept free of foreign

matter. Be certain that the bearings run smoothly before placing them on the shaft. The shielded side of the bearings should be towards the commutator. A light rap with the palm of the hand should be sufficient to drive them onto the bearing shoulders. Reverse the removal procedure in replacing the armature and bearings assembly.

Replacement bearings are furnished lubricated with sufficient grease for several hundred hours of operation and may be operated temporarily without further addition of grease. The bearing cover plates must be thoroughly cleaned of old grease. When available, enough grease should be applied to fill the reserve space before replacing the cover plates. Use only soft grade grease meeting Navy Specification M-372. "LUBRIKO" M-6 made by Master Lubricants Co., Philadelphia, Pa., or F-927 made by New York and New Jersey Lubricant Co., New York, N. Y., is recommended. See page 26 for Dynamotor Ratings.

GENERAL MAINTENANCE OPERATIONS

A systematic service inspection should be performed on the equipment at approximately sixty day intervals. If an aural check on the operation of the equipment indicates that it is performing normally this check should include: removal of carbon dust from the dynamotor by use of an air hose, a check on the condition of the brushes and commutators of the dynamotor, a check on dynamotor bearing noise (do not grease bearings oftener than once in about 1,000 hours of operation), a check on tightness of all plug locking rings, knurled nuts holding receiver clamps, snapslides, and screws holding all covers in place, and the condition of the antenna and ground leads.

SERVICING FAULTY RECEIVERS

If an aural check indicates that the equipment is *not* operating properly, FIRST LOOK FOR ALL THE SIMPLE CAUSES OF FAILURE such as battery voltage, cabling, plug connections, switch positions (including "A TEL", "B TEL" switches), tubes, and dynamotors. *It is suggested that a standard set of specially marked tubes be kept handy for a quick check.* A dynamotor from another receiver known to be operating properly may be used as a dynamotor check. If these simple tests do not reveal the trouble, the receiver should be removed from the rack and bench tested for more serious faults.

DISASSEMBLY OF SUCH PARTS AS MAY BE REQUIRED FOR SERVICING FAULTY RECEIVERS

(1) *Receiver from the rack.*

Disconnect the antenna lead from the receiver antenna binding post, unscrew the two knurled nuts far enough to allow the lugs to be disengaged from the pointed studs. Slide the receiver out of the rack.

(2) *Cover for bottom of chassis.*

Remove the fourteen bright screws around the bottom edge of the chassis and front panel.

(3) *RF coil set assembly.*

After removing the bottom cover of chassis, as above, remove the two black screws, one at each side of the chassis at approximately the center of the RF coil set assembly, and then lift the coil set assembly out squarely so as not to damage the pin plugs.

(4) *Outer receiver shield.*

First unfasten the four dynamotor snapslides and lift out the dynamotor. Remove the eight bright screws (four rearmost screws along the top edge of the tie strap on each side of the chassis), and slide the outer shield back and off. *This outer shield is NOT fastened by the three foremost black screws along the top edge of the tie strap on each side of the chassis, nor by the black screws around the outer edge of the front panel.*

(5) *IF coupling unit assemblies and tubes.*

These components may be removed without taking off the outer receiver shield. Each IF coupling unit assembly is secured by two bright screw at its base. Remove these screws and pull the assembly out squarely so as not to damage the pin plugs.

Location of Faults.

One or both of the following methods may be used to locate trouble in a receiver.

After removal of the chassis bottom cover, connect the receiver to Test Set 7918 shown in Fig. 20. (Test Set 7918 is not part of Model RAT or RAT-1 equipment.) The switch panel attached to the receiver should be on "CW" and the gain control should be at minimum gain in order to transfer complete control of switching and gain control to the Test Set. Meters should read as indicated in the table on Fig. 20. Following this, a systematic measurement of the voltages at each of the tube terminals listed in Table 3 will determine which of the dc circuits, if any, is defective. This measurement will also check continuity or shorts in the RF and IF plate circuits. If the trouble is not located at the conclusion of the above tests, use an ohmmeter to check the continuity of the coils in the grid circuits of all RF and IF circuits.

Check the secondary of the output transformer for continuity.

EXAMPLE: All voltages check closely to those shown in Table 3 except that 0 voltage is measured at terminal 8 (plate) on the second IF amplifier tube. Fault: either the resistor R-13 or IF coil L-10 is open, probably caused by a short circuit from plate to ground in the second IF amplifier tube or by a short in capacitors C-21, or C-20C.

A second method of locating faults in a receiver is to measure the microvolts at each of several points required to produce 10 milliwatts (1.73 volts across 300 ohms). Table 4 lists the test points and shows a value of "sensitivity" in

microvolts which may be considered normal for each of these points. By systematically applying the signal generator to the points indicated, the stage in which the fault lies may be quickly determined. Specific instructions follow: *Note the general precautions to observe in the application of Table 4. This table is meant merely as a guide, and departures of 2 to 1 from these figures do not necessarily indicate a fault.*

Equipment required: (1) A standard signal generator which covers the tuning range of the receivers which may be modulated 30% at 400 cps., (2) an output meter of the copper oxide rectifier or vacuum tube voltmeter type, (3) a resistor of such value that combined with that of the headset and the voltage measuring instrument across it, the effective load resistance will be close to 300 ohms, (4) a bench Test Set, Aircraft Radio Corporation #7918, or equivalent, consisting of necessary cables, meters, jacks, gain control, and power switch, (5) a crystal frequency indicator (or equivalent) for accurately determining test frequencies. (The variable portion of the alignment tuning capacitors in this equipment is so small, that unless the signal generator frequency is precise, it may not be possible to find a resonant point within the range of the aligning capacitor.) The receiver may be connected to this equipment for convenient inspection and adjustment in any position. In lieu of this special equipment, a bench test of a receiver may be made by connecting the battery + to terminal 6 (see Fig. 10) and battery− to the chassis. The battery voltage should be close to that indicated in Table 4. The headphones, output meter, and load resistor, may be connected in parallel between terminal 2 and the chassis. The receiver may then be operated with a switch panel on the front of the receiver.

Order of test. (It is not necessary to remove the outer receiver shield for these tests.) (See Table 4 for intermediate frequency and normal sensitivity values for all receivers.)

(1) Connect the ground lead from the signal generator output to the receiver chassis.

(2) Connect the other lead from the signal generator output direct to the antenna binding post. See that the lengths of both leads from the signal generator are no greater than necessary (less than one foot) and that these leads are kept close together.

(3) Set the signal generator modulation to 30% at 400 cps., set the signal generator microvolts to 200, set the receiver indicated frequency to the lowest calibrated value, switch to MCW position, turn the gain control to maximum, and vary the signal generator frequency through the indicated receiver frequency and far enough on either side to avoid errors in signal generator frequency calibration. Use head telephones in the receiver output circuit. If a 400 cycle output is heard, retune the receiver to the highest calibrated frequency and retune the signal generator through this frequency. Keeping the signal generator output microvolts adjusted to produce not more than 10 milliwatts output tune the signal generator and "align input" knob to produce maximum output. If not more than twice the number of microvolts listed in Table 4 is now required to produce 10 milliwatts, output, the receiver sensitivity is not abnormally low, and any serious defect apparent in MCW operation must be found elsewhere. If the MCW sensitivity is satisfactory as indicated above, check the CW position, and consider the CW sensitivity satisfactory if not more than one-half the MCW microvolts is required on CW to produce a maximum beat audio output of 10 milliwatts.

(4) If the receiver sensitivity on MCW is abnormally low, measured at the antenna post, determine whether the fault lies ahead of, within, or following the "mixer" stage, by checking the sensitivity at the mixer grid (top cap of type 12K8 tube).

(5) Set the signal generator modulation to 30% at 400 cps., and tune its frequency through the indicated receiver frequency as before. If not more than twice the microvolts indicated in Table 4 is required for 10 milliwatts output, the fault lies between the antenna binding post and the output of the RF amplifier stage. If three or four times the number of microvolts indicated in the table is required in this RF test, change the signal generator frequency to the IF for this receiver (see Table 4) and vary its frequency and output level progressively to obtain a maximum output of 10 milliwatts. If the normal number of microvolts is now required, the fault lies in the oscillator tube elements, or oscillator circuit of the mixer stage.

(6) Check the mixer tube voltages, and if these are normal, replace the mixer tube with one known to be operative. The use of a "standard" set of tubes will usually facilitate location of faults.

(7) If considerably more than the normal microvolts at IF on the mixer grid is required the fault lies further along the amplifier including, or in, the mixer tube elements not used for oscillation.

(8) Continue with the signal generator sensitivity checks at IF on the control grid of the first IF tube. Wrap a wire around the control grid terminal (fourth terminal clockwise from the locating pin as viewed from the bottom), for connection to the signal generator.

(9) If this check still shows faulty sensitivity, repeat the measurement in a similar manner on the control grid of the second IF tube, checking the terminal voltages of the tubes and circuits involved, in order to locate the position of the fault more exactly. Abnormally low sensitivity at the second IF grid indicates trouble between this point and the audio output circuit. The signal generator is not useful beyond the second IF grid.

Using this method, the source of the trouble may be quickly narrowed down. *It is then possible to use an ohmmeter to check the components* between the tube which was found to give correct sensitivity, and the first one toward the antenna which failed to do so.

(10) After the fault has been removed, recheck the CW operation at IF by returning the signal generator to the mixer grid (top cap) to see if less than half of the MCW microvolts are there required to produce 10 milliwatts beat audio output when in the CW receiver position. The signal generator tuning which here produces maximum MCW output should agree closely with that required to produce zero beat on CW.

RECEIVER RF STAGE AND RF OSCILLATOR ALIGNMENT

THIS OPERATION SHOULD NOT BE ATTEMPTED WITHOUT PROPER EQUIPMENT AND AUTHORITY. If the sensitivity of a receiver is found to be low, and the tubes, dynamotor, and circuit elements are normal, it may be necessary to realign ("trim") the several stages. The equipment required for this operation is the same as that indicated above for "location of faults", plus a small screwdriver. The outside diameter of the shank must not exceed $^{5}/_{32}$ inch.

Table 4 shows the "sensitivity in microvolts for standard output" for all receivers. It also lists the microvolts required at the grid of the RF amplifier, the mixer grid, and the grids of the first and second IF amplifier tubes, required to produce standard output. These values should be used as a guide in determining the condition of the receiver under test. Alignment of these receivers should never be attempted without the use of a good standard signal generator and crystal frequency standard. Never attempt to align any of the several stages on an outside radio signal except in a real emergency and then only on a continuously tone-modulated signal. The alignment operations should be performed in the following order:

(1) Set the signal generator to the IF, modulated 30% at 400 cps. The signal generator setting should be as precise as possible. Use a crystal frequency indicator. The receiver should be operating on "MCW" at maximum gain position of the gain control. The 13.5–20 MC, and the 20–27 MC receiver each has three IF coupling units, but with one tuned circuit per unit.

(2) Connect the signal generator leads to the control grid of the 12K8 mixer tube and to the chassis of the receiver, as described under "Location of Faults". Do not remove the grid cap.

(3) Increase the signal generator input to the smallest amount which will produce an easily readable level in the output meter (say 10 milliwatts which is 1.73 volts across 300 ohms).

(4) Using a small screwdriver, tune the capacitor under "1" in Z-3.

(5) Similarly, tune the capacitor in the second IF coupling unit Z-2.

(6) Similarly, tune the capacitor in the first IF coupling unit Z-1.

(7) Switch to "CW" and tune the CW oscillator trimmer capacitor C-28 for zero beat. Capacitor C-28 may be tuned with the same small screwdriver through the hole in the right rear of the chassis.

(8) If further alignment appears necessary, remove the outer receiver shield. It is necessary to remove this to gain access to the RF amplifier trimmer C-4D and to the RF oscillator trimmer capacitors C-4E and C-9. C-4D is reached through the left hole in the gang capacitor shield (as viewed facing the front of the receiver). C-4E may be reached through the next hole to the right and C-9 through the remaining hole.

(9) Next, with the signal generator lead still connected to the mixer grid, and with its output not more than twice the mixer grid sensitivity value listed in Table 4, set the tuning dial of the receiver to the high end alignment frequency and set the signal generator as accurately as possible to the corresponding frequency. (Use crystal frequency indicator.) Next, tune the RF oscillator shunt trimmer capacitor C-4E for maximum output.

PRESELECTOR AND RF OSCILLATOR ALIGNMENT FREQUENCIES

Receiver	*High-End Alignment Frequency* *Align C-4E C-4D, and C-2 At*	*Low-End Alignment Frequency* *Align C-9 At*
13.5–20 MC	*20 MC*	*13.8 MC*
20–27 MC	*27 MC*	*20 MC*

SPECIAL TUNING NOTE

If two different capacitance settings of C-4E can be found at which the output is a maximum, be sure to use only the setting corresponding to the higher capacitance.

The maximum capacitance position of the rotors of all air trimming capacitors (except auxiliary trimmers C-4F and G-4G under the gang capacitor shield) in the equipment is obtained when the top of the "cross" or "arrow" on the rotor shaft is lined up with the fixed fiducial mark on the dust shield, IF can, or chassis. Turning the rotor 180° in either direction reduces the capacitance to a minimum. When trimming a circuit always tune in a counter clockwise motion from the maximum capacitance setting. This will always result in a setting of the trimmer such that a *clockwise* motion *increases* capacitance. Uniform practice in this operation is desirable.

(10) Next, connect the signal generator to the antenna post, and leaving its frequency and the receiver dial setting unchanged, align the RF amplifier trimmer C-4D, and the antenna input C-2 ("align input") knob. Switch to "CW" and trim C-4E for zero beat.

(11) Next, tune the receiver to the low-end alignment frequency, and the signal generator to the corresponding frequency. Return switch to "MCW". Tune the RF oscillator series trimmer capacitor C-9 for the maximum output which can be obtained by tuning the receiver slowly back and forth between trial settings of trimmer C-9.

(12) Retune the receiver dial and the signal generator to the high-end alignment frequency, and switch to "CW". Retrim C-4E for zero beat.

Auxiliary aligning capacitors C-4F and C-4G are in parallel with aligning capacitors C-4D and C-4E. C-4F and C-4G may be tuned only after removal of the gang capacitor shield. These are adjusted at the factory either to maximum, half, or minimum capacitance, depending on the receiver and the capacitor, and should not be altered subsequently. The correct settings for each receiver is as follows:

Receiver	*Setting of cross mark on auxiliary gang trimmers, as seen from the front of the receiver*	
	C-4F (Mixer input)	*C-4G (RF Osc.)*
13.5-20 MC	*Half* →	*Max.* ↓
20-27 MC	*Half* →	*Half* →

Replace all screws holding shields, covers, etc. and securely tighten them. The large number of screws are there for the purpose not only of holding parts together but of reducing undesired electrical interferences created within the receiver.

Anyone charged with servicing of the equipment should make it a point to learn the plate, screen, and cathode voltages to be expected at the terminals of the several tubes. He should be able to identify the several RF and IF units, the functions of the several tubes, the sections of the gang capacitor, and the several terminals of each tube. The above knowledge, plus a systematic approach, will expedite trouble shooting. LOOK FOR THE SIMPLE CAUSES OF FAILURE FIRST.

V. SUPPLEMENTARY DATA

TABLE 1

MAJOR UNITS AND ACCESSORIES SUPPLIED WITH EACH MODEL RAT AND MODEL RAT-1 EQUIPMENT ON CONTRACT NUMBER NOs-67258

(FOR DIMENSIONS AND WEIGHTS SEE FIG. 13 IN THE BACK OF THIS BOOK)

Name of Major Unit or Accessary	*Navy Type Designation*	*A. R. C. Part No.*	*Quantity per Model RAT Equipment*	*Quantity per Model RAT-1 Equipment*
Receiver Control Box (2-unit)	23155	6546	1	1
Receiver Mounting	46085	5694	1	1
Receiver Dynamotor Unit	21400	5206	2	
Receiver Dynamotor Unit	21531	7351		2
Receiver Rack	46096	6593	1	
Receiver Rack	46110	5018		1
Receiver Unit (13.5-20 MC) with tubes	46083	6716	1	
Receiver Unit (20-27 MC) with tubes	46084	6717	1	
Receiver Unit (13.5-20 MC) with tubes	46108	7331		1
Receiver Unit (20-27 MC) with tubes	46109	7332		1
Switch Panel	23154	6434	2	2
Switch Panel Adapter	49109	6433	2	
Switch Panel Adapter	49107	6433		2
MISCELLANEOUS				
Cables, assembled as follows:				
Receiver Rack to battery, 10 feet		6694	1	1
Receiver Rack to Receiver Control Box, 5 feet		6693	2	2
Patch (to external equipment) 10 feet		5808	1	1
Instruction Book, final			10	10
Local Tuner		6743	2	2
Mechanical Linkage (5 feet, assembled)		6151	2	2
Operating Spare Parts. One set includes:			1 set	1 set
Control grid clip		4754	2	2
Dynamotor shock proof ring assembly		4681	1	1
Fuse, 10 amp		4414	8	8
Receiver mounting shockproof cup assembly		5185	1	1
Relay contacts (relay K-1), complete, ready for assembly to relay frame			1 set	1 set
Vacuum tubes. One set includes three 12SK7, one 12K8, one 12SR7, and one 12A6			1 set	1 set
Plug, Wired		6787	2	2
Slip Cover (2-receiver)		6939	1	1
Tools, maintenance. One set includes:				
Bristo set screw wrench #6		8021	1	1
Phillips screw driver #1		8020	1	1
Tube extractor		7489	1	1

TABLE 2

VACUUM TUBE DATA

Values shown are "characteristic ratings" for the type of tube, and are not necessarily the values at which they are operated in this equipment

Type	*12SK7*	*12K8*	*12SR7*	*12A6*
Function in this equipment..	RF and IF amp.	Mixer	Det. and CW Osc.	Audio Amp.
Heater voltage.....	12.6 v	12.6 v	12.6 v	12.6 v
Heater current.....	.15 a	.15 a	.15 a	.15 a
Control grid voltage.....	−3 v	−3 v	−9 v	−12.5 v
Plate voltage.....	250 v	250 v	250 v	250 v
Screen grid voltage.....	100 v	100 v	...	250 v
Plate current.....	9.2 ma	2.5 ma	9.5 ma	30 ma
Screen grid current.....	2.4 ma	6.0 ma	...	3.5 ma
Osc. plate voltage (12K8)....	...	100 v	...	...
Osc. plate current (12K8)....	...	3.8 ma	...	...
Cathode current.....	11.6 ma	12.3 ma	9.5 ma	33.5 ma
Conversion conductance.....	...	350 micromhos	...	...
Transconductance(micromhos)	2000	(triode) 3000	1900	3000
Plate resistance.....	0.8 megohm	(hexode) 0.6 megohm	8500 ohms	70,000 ohms
Amplification factor.....	1600	...	16	210
Power output.....	...	...	...	2.8 watts into 7500 ohms (7% total harmonic distortion)
*Base connections #1....	Shell (S)	Shell (S)	Shell (S)	Shell (S)
#2....	Heater (H)	Heater (H)	Control grid (G)	Heater (H)
#3....	(Suppressor grid) (Su)	Plate (hexode) (P)	Cathode (K)	Plate (P)
#4....	Control grid (G)	Screen grid (hexode) (Gs)	Diode plate (2) (Dp2)	Screen grid (Gs)
#5....	Cathode (K)	Control grid (osc) and grid #1 hexode (Go)	Diode plate (1) (Dp1)	Control grid (G)
#6....	Screen grid (Gs)	Plate (osc) (Po)	Plate (triode) (P)	...
#7....	Heater (H)	Heater (H)	Heater (H)	Heater (H)
#8....	Plate (P)	Cathode (K)	Heater (H)	Cathode (K)
Top cap		Control grid (hexode) (GHex)	...	...

* Base connections are numbered clockwise from the locating pin as viewed from the bottom.

NOTE.—Keys on the tube bases vary somewhat in size, with the result that occasionally a tube may be found which can be jammed part way down into the socket with incorrect pin orientation. Line up the key on the tube base with the keyway of the socket visually or by feel, before exerting any considerable pressure on the tube.

TABLE 3

VACUUM TUBE TERMINAL VOLTAGES

(Use Test Set #7918, See Fig. 20)

Normal dc voltages between each of the tube socket terminals and the chassis. Input voltage 14 (RAT), and 28 (RAT-1). Receiver in the "CW", maximum gain condition. Variations of ±10% from the following values may be obtained due to differences in tubes, resistors, dynamotors, and measuring equipment. Some terminals are accessible only with a bent voltmeter prod. Reference to the wiring diagrams, Figs. 14 and 15, will indicate more accessible points which connect directly to these terminals. Plate and screen voltages shown in the following table were measured with a voltmeter having a resistance of 600,000 ohms.

Tube	*RF 12SK7*	*Mixer 12K8*	*First IF 12SK7*	*Second IF 12SK7*	*Detector CW Osc. 12SR7*	*Audio Amp. 12A6*
*Base Connection #1	0	0	0	0	0	0
*Base Connection #2	0	0 (RAT) 14 (RAT-1)	0 (RAT) 14 (RAT-1)	0	**No Test	14 (RAT) 28 (RAT-1)
*Base Connection #3	4	240	4	3	0	240
*Base Connection #4	0	85	0	0	0	240
*Base Connection #5	4	**No Test	4	3	0	0
*Base Connection #6	85	40	85	85	57	. . .
*Base Connection #7	14	14 (RAT) 28 (RAT-1)	14 (RAT) 28 (RAT-1)	14	14	0 (RAT) 14 (RAT-1)
*Base Connection #8	240	4	240	240	0	17
Top Cap	. . .	0	. . .	. . .	. . .	. . .

* Base connections are numbered clockwise from the locating pin as viewed from the bottom.

** Under oscillating conditions, a small dc voltage exists between these terminals and ground, but the application of voltmeter leads may stop oscillations, resulting in unreliable voltmeter readings.

TABLE 4

SENSITIVITY

Microvolts, modulated 30 percent at 400 cps, required to produce 10 milliwatts (1.73 volts into 300 ohms resistive load) is shown for six points in each of the receivers, operating independently. The frequencies at which the measurements must be made are in parenthesis. Input voltage, 14 for RAT and 28 for RAT-1.

Receiver	*Ant. RF, at Ant. Bind. Post*	*RF Control Grid RF, at Term. #4*	*Mixer Control Grid RF, at Top Cap*	*Mixer Control Grid IF, at Top Cap*	*First IF Control Grid IF, at Term. #4*	*Second IF Control Grid IF, at Term. # 4*
13.5-20 MC	25 (20 MC)	250 (20 MC)	1,100 (20 MC)	1,200 (4.2 MC)	4,000 (4.2 MC)	90,000 (4.2 MC)
20-27 MC	20 (27 MC)	200 (27 MC)	1,000 (27 MC)	1,200 (4.2 MC)	4,000 (4.2 MC)	90,000 (4.2 MC)

This table of sensitivities is for use as a guide in servicing receivers. It applies to undamaged and perfectly-aligned receivers, under reasonable climatic conditions. Microvolt values shown are to be regarded as "desired", to be obtained if possible when adjusting the equipment after overhaul or long service use. Departures from these values are not cause for major operations on the equipment, and they should be employed with caution and discretion, particularly in the case of measurements carried out under extreme conditions of temperature or humidity. A signal generator whose accuracy is not definitely known, and a set of vacuum tubes which are not "average" may contribute to results varying considerably from those shown in the table.

TABLE 5

SELECTIVITY

The SELECTIVITY, expressed in kilocycles, is defined as the displacement of the carrier frequency from the resonant frequency required to produce 10 milliwatts output, when the radio frequency voltage input is twice (2X), ten times (10X), one hundred times (100X), and one thousand times (1000X) that required to produce 10 milliwatts output at resonance (1.73 volts across 300 ohms). The radio frequency voltage input to the receiver must be modulated 30% at 400 cycles for both the resonant and off-resonant measurements. The selectivity values shown below are those resulting from an average of the selectivity measurements made on either side of resonance.

Receiver	*Frequency*	*Selectivity Factor For*			
		2×	*10×*	*100×*	*1000×*
13.5-20 MC	13.5 MC	14.2	34.2	68.4	118.2
20-27 MC	20 MC	14.2	34.2	73.0	133.0

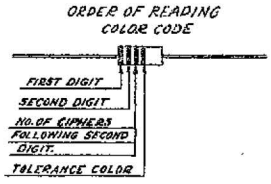
The above table of selectivities is presented for use as a guide in servicing the receiver units. It applies to undamaged and perfectly-aligned receivers, under reasonable climatic conditions. These values are to be regarded as "desired", to be obtained if possible when adjusting the equipment after overhaul or long service use. Departures from these values are not necessarily cause for major operations on the equipment, and they should be employed with caution and discretion, particularly in the case of measurements carried out under extreme conditions of temperature or humidity, or with a signal generator whose accuracy is not definitely known.

TABLE 6

RESISTOR COLOR CODE

Small composition resistors are color coded to indicate the resistance in ohms as follows: three narrow rings are painted around the body, starting at one end. The color of the end ring represents the first digit, the second ring the second digit, and the third ring the number of ciphers after the second digit. A fourth ring represents the tolerance, ±5% by gold and ±10% by silver.

0—Black	3—Orange	7—Violet
1—Brown	4—Yellow	8—Gray
2—Red	5—Green	9—White
	6—Blue	



EXAMPLE: 360,000 ohms. Orange, blue, and yellow rings, starting at one end. If the fourth ring were silver, it would indicate ±10% tolerance from nominal.

See Table 8 for acceptable operating limits for composition resistors used in this equipment.

TABLE 7

CAPACITOR COLOR CODE

Fixed-capitance molded mica capacitors, which are too small to be conveniently marked with capacitance values, are color coded by the use of three dots. Colors represent the same numbers as listed above for resistors. Reading from left to right in the direction of the arrow, the micromicrofarads capacitance is indicated by the following: first color, first digit; second color, second digit; third color the number of ciphers after the second digit.

EXAMPLE: 200 micromicrofarads (0.00020 mfd.) would have a red dot, a black dot, and a brown dot, reading from left to right.

Fixed-capacitance mica capacitors C-10, C-12, C-14, C-17, C-19, C-22, C-23, C-27, are coded to show their nominal capacitance by means of colored lacquer. One long colored line or spot followed by two small colored lines or spots arranged clockwise as seen from the top of the nut, indicate the nominal capacitance in micromicrofarads. Colors represent the same numbers as listed above for resistors except that the third line or spot represents the third digit instead of the number of ciphers after the second digit.

EXAMPLE: 180 micromicrofarads (0.00018 mfd.) would have a long brown line or spot followed clockwise on the nut by a gray and a black line or spot. Each of these capacitors is subject to a manufacturing tolerance of ±2.5 micromicrofarads, hence a capacitor coded as 180 may have any value between 177.5 and 182.5 micromicrofarads.

TABLE 8

EQUIPMENT OPERATING RESISTANCE TOLERANCES FOR COMPOSITION RESISTORS

Composition resistors used in this equipment increase in resistance with age and with the application of heat. The equipment should be satisfactorily operable if the resistance of the several units is within the limits shown in this table.

Symbol	*Equipment Operating Resistance Tolerance*
R-1, R-3, R-4, R-6, R-9, R-12, R-15, R-16, R-17, R-21	±20%
R-5, R-10, R-11, R-14, R-18	±30%
R-2, R-7, R-8, R-13, R-19, R-20	±50%

TABLE 9

INPUT CURRENT

Equipment	*Total Input Current (2 receivers)*
Model RAT (14 volts)	6.4 amperes
Model RAT-1 (28 volts)	3.2 amperes

TABLE 10

DYNAMOTOR RATINGS (Continuous duty)

Dynamotor	*INPUT*		*OUTPUT*	
	Volts	*Amperes (dc)*	*Volts*	*Milliamperes (dc)*
CBY-21400 Receiver Dynamotor Unit (part of Model RAT)	14	2.2	250	60
CBY-21531 Receiver Dynamotor Unit (part of Model RAT-1)	28	1.1	250	60

TABLE 11

PARTS LIST BY SYMBOL DESIGNATION

Parts of Type CBY-23155 Receiver Control Box

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
A-1		Mounting base		A		6831
A-2		Rear cover		A		6833
E-13,E-14	Switch lever	Lever		A		5444
E-15	"Tuning"	Remote tuning knob		A		6747 make replacements with 7955
E-24	"Increase output"	Gain control knob		A		6749
H-4		Snapslide assembly		A		2540
		Other parts of the mechanism include:				
		Button		A		2116
		Guide		A		4750
		Stud		A		1450
		Washer		A		5171
J-8,J-9, J-10, J-11	"Tel" jack	Headset jack		A		4691
J-25, J-26		Coupling receptacle, 8 circuit (to control box)		A		6418
N-2		Dial, 20 to 27 MC		A		6193
N-3		Dial, 13.5 to 20 MC		A		6056
O-4		Gearing unit assembly		A		6550
R-25,R-26	Gain control	Resistor, variable 0-50,000 ohms, ±20%		AB	J	6488
S-1, S-3	"CW-OFF-MCW"	Switch, rotary		A		6536
S-2, S-4	"A-B" switch	Switch rotary		A		6540

Parts of Type CBY-46085 Receiver Mounting

		Absorber assembly, shock		A		5185
		Mounting Frame (less absorber assemblies)		A		5695

Parts of Type CBY-21400 (14 volt), CBY-21531 (28 volt) Receiver Dynamotor Units. Parts listed below are the same for both the 14 and 28 volt dynamotors unless specifically indicated to the contrary.

A-9		Mounting base assembly, including casting		A		5722
C-34	RF filter	Capacitor, 0.001 mfd. ±5%, 400 volts, mica		AV	1465	4251
H-4	Snapslide			A		2540
		Other parts of the mechanism include:				
		Guide		A		4750
		Button		A		2116
		Washer		A		5171
		Stud		A		4672
H-26		Stud, for prevention of incorrect insertion of dynamotor		A		5219
J-5		Coupling plug, three circuit (to receiver)		A		5211

The following D-1 Dynamotor parts are manufactured by Continental Electric Company, Newark, N. J., and part number shown originated with that company. See Fig. 18.

A-15	Bearing Bracket, L.V. and H.V.	CE	26201	
A-16	Frame	CE	22944	
A-17	End bell	CE	19964-1	
A-20	Pole, field	CE	21667	
D-1	Dynamotor assembly			
	Part of Type CBY-21400 Receiver Dynamotor Unit (14 volt)	CE	Type DM-310 25926-WS 6328	5324
	Part of Type CBY-21531 Receiver Dynamotor Unit (28 volt)	CE	Type DM-310 25926-WS 7610	6936

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-21400 (14 volt), CBY-21531 (28 volt) Receiver Dynamotor Units. Parts listed below are the same for both the 14 and 28 volt dynamotors unless specifically indicated to the contrary—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
E-2		Armature assembly Part of Type CBY-21400 Receiver Dynamotor Unit (14 volt)		CE	27829-WS 6328	
		Part of Type CBY-21531 Receiver Dynamotor Unit (28 volt)		CE	27829-WS 7610	
E-16		Screw cap, brush holder, L.V. and H.V.		CE	23607-2	
E-17		Brush holder, L.V.		CE	23610-1-X	
E-18		Brush assembly, L.V. (+)		CE	23609-3(+)	
E-19		Brush assembly, L.V. (−). (E-18 and E-19 are alike except for the + and − marking		CE	23609-3(−)	
E-20		Brush assembly, H.V. (+)		CE	23609-4(+)	
E-21		Brush assembly, H.V. (−). E-20 and E-21 are alike except for the + and − marking		CE	23609-4(−)	
E-22		Brush holder, H.V.		CE	23610-2-X	
E-23		Guard, wire		CE	12077	
H-11		Screw, bearing cover		CE	25926-23	
H-12		Cover plate		CE	26207	
H-13		Lock pin, brush holder, L.V. and H.V.		CE	25926-19	
H-14		Dowel, bracket locking		CE	25926-26	
H-15		Tie rod		CE	25926-13	
H-16		Lock washer, tie rod		CE	25926-25	
H-17		Nut, tie rod		CE	25926-24	
H-18		Grommet		CE	25926-18	
H-19		Screw, cover holding		CE	25926-14	
H-20		Lock washer, cover screw		CE	25926-28	
H-21		Plain washer, cover screw		CE	25926-27	
H-22		Screw, connecting, L.V. and H.V.		CE	25926-20	
H-23		Lock washer, connecting screw		CE	25926-21	
H-24		Screw, pole		CE	25926-17	
H-25		Grease slinger		CE	21666	
L-16		Coil, field, Part of Type CBY-21400 Receiver Dynamotor Unit (14 volt)		CE	21668-WS 6328	
		Part of Type CBY-21531 Receiver Dynamotor Unit (28 volt)		CE	21668-WS 7610	
O-1		Ball Bearing assembly		CE	25926-10	
W-1		Ground lead and terminals, L.V. (−) and H.V. (−) #20 gage, bare		CE	25926-33	
W-2		Connecting lead and terminal, L.V. (+) #20 gauge, white		CE	25926-31	
W-3		Connecting lead and terminal, H.V. (+) #20 gauge, red		CE	25926-32	

Parts of Type CBY-46096 and Type CBY-46110 Receiver Racks

A-10	Rear cover	A		6415
E-7	Ground binding post with engraved "G"	A		6067
F-1, F-2	Fuse, 10 amperes	LIT	3AG	4414
H-1	Snapslide (on fuse cover)	A		3888
	Other parts of the mechanism include:			
	Guide	A		3887
	Button	A		3890
	Stud	A		5134
	Washer	A		3889
H-2	Snapslide (on rack)	A		2540
	Other parts of the mechanism include:			
	Guide	A		4750
	Button	A		5172
	Washer	A		5171

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46096 and Type CBY-46110 Receiver Racks—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr's. Desig.*	*Dwg. and Part No.*
H-7		Fuse cover assembly		A		6414
H-8		Protective cap		A		5319
H-27		Locking strap and screw assembly		A		5912
J-12 to J-17, inc.		Headset Jack		A		4691
J-21, J-22		Coupling receptacle, 8 circuit (to control box)		A		6418
J-18, J-19		Coupling receptacle, 7 circuit (to receiver)		A		5842
J-6, J-7		Coupling receptacle, 6 circuit (to cable 5808)		A		5577
J-24		Coupling receptacle, 2 circuit (to battery)		A		6485
K-1, K-2	Sidetone-receiver output switching	Relay, S.P.D.T.				
		Part of Type CBY-46096 Receiver Rack (14 volt), (Res. of coil 100 ohms ±10%)		A		6318
		Part of Type CBY-46110 Receiver Rack (28 volt), (Res. of coil 320 ohms ±10%)		A		7251
P-1, P-2	Takes place of control box cable in local control installations	Wired plug		A		6787
S-6, S-7	"A-B" Tel. line switching	Toggle switch, S.P.D.T.		A		6575

Parts of Type CBY-46083, CBY-46084, CBY-46108, and CBY-46109 Receiver Units. Parts listed below are the same for all Receiver Units unless specifically indicated to the contrary.

A-3		Shield over coupling receptacle		A		5691
A-4		Shield, over gang capacitor		A		5738
A-6		Cover, over tube compartment		A		6266
A-7		Shield, over tubes, IF units, etc.		A		6276
A-11		Shock absorber assembly (for dynamotor)		A		4681
A-12		Mounting Plate, 1st IF		A		4638
A-13		Mounting Plate, 2nd IF		A		5220
A-14		Same as A-12, 3rd IF				
A-18		Cover (under side of chassis)		A		5508
C-1	Ant. Coupling	Capacitor, fixed, mica, approximately 6.5 mmf.		A		5603 make replacements with 9044
C-2	Input Alignment	Capacitor, variable, air, △C approximately 15 mmf.		A		5676
C-3	RF amp. grid blocking	Capacitor, 0.0001 mfd., ±5%, 400 volts, mica	48674-5	CD	5	4520
C-4	Gang tuning	Gang capacitor assembly with tuning and aligning sections C-4A to C-4G				
		For 13.5-20 MC receiver		A		6558
		For 20-27 MC receiver		A		4609
C-5	Gain control line filter	Capacitor, 3 mfd., 300 volts, electrolytic. Impedance at 60 cycles not over 1750 ohms. Used on both receivers of Model RAT-1 but on neither receiver of Model RAT. Replacement may have a capacitance of 4 to 12 mfd. at 20° C.		A		7582
C-6 (A-B-C)	See below	Capacitor, 0.05/0.05/0.05 mfd., ±15%. 300 volts, paper		A		5414
C-6A	Mixer plate by-pass	Part of C-6				
C-6B	Gain control line by-pass	Part of C-6				
C-6C	First RF cathode by-pass	Part of C-6				
C-7 (A,B,C)	See below	Capacitor, 0.05/0.05/0.05 mfd., same as C-6				
C-7A	Mixer screen by-pass	Part of C-7				
C-7B	Mixer cathode by-pass	Part of C-7				
C-7C	Grid return by-pass, 1st and 2nd IF grid	Part of C-7				

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46083, CBY-46084, CBY-46108, and CBY-46109 Receiver Units. Parts listed below are the same for all Receiver Units unless specifically indicated to the contrary—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
C-8	RF osc. grid blocking	Capacitor, 0.0002 mfd., ±5%, 400 volts mica	48675-5	CD	5	4513
C-9	RF osc. series trimmer	Capacitor, variable, air, △C approximately 40 mmf.		A		3865
C-10	RF osc. fixed series	Capacitor, fixed, 400 volts, mica, See color code in Table 7.				
		The nominal capacitances as listed below are each subject to a manufacturing tolerance of ±2.5 mmf.				
		For 13.5-20 MC receivers 335 mmf., 340 mmf., or 345 mmf.		A		6701 make replacements with 7935
		For 20-27 MC receivers, 295 mmf., 300 mmf., or 305 mmf.		A		6701 make replacements with 7935
C-11	RF osc. tube drift compensator	Capacitor, compensator, 3 mmf., ±½ mmf., with temperature coefficient of 0.00075 mmf., per mmf., per degree Centigrade, ±15%		C	807	7020
C-12	Fixed capacitance part of 1st IF tuning	Capacitor, 180 mmf., ±2.5 mmf., 400 volts mica, part of assembly Z-1		A		5145 make replacements with 7935
C-13	1st IF trimmer	Capacitor, variable, air, △C approximately 17 mmf., part of assembly Z-1				
C-14	Stage coupling	Capacitor, 175 mmf., 180 mmf., or 185 mmf., 400 volts, mica, part of assembly Z-1. These nominal capacitances are each subject to a manufacturing tolerance of ±2.5 mmf.		A		5145 make replacements with 7935
C-15 (A,B,C)	See below	Capacitor, 0.05/0.05/0.05 mfd., same as C-6				
C-15A	Grid return by-pass, 1st and 2nd IF grid on receivers of Model RAT-1 and 1st IF cathode by-pass on receivers of Model RAT	Part of C-15				
C-15B	1st IF cathode by-pass on receivers of Model RAT-1	Part of C-15				
C-15C	CW osc. plate filter	Part of C-15				
C-16 (A,B,C)	See below	Capacitor, 0.22/0.22/0.22 mfd., ±20%, 300 volts, paper		A		5413
C-16A	Second IF screen by-pass	Part of C-16				
C-16B	Dynamotor high voltage filter	Part of C-16				
C-16C	Dynamotor low voltage filter	Part of C-16				
C-17	Fixed capacitance part of second IF tuning	Capacitor, 180 mmf., same as C-12, but part of Z-2				
C-18	Second IF trimmer	Capacitor, variable, △C approx. 17 mmf., same as C-13, but part of Z-2				
C-19	Stage coupling	Capacitor, 180 mmf., same as C-14, but part of Z-2. Refer to C-14 for more details				
C-20 (A,B,C)	See below	Capacitor, 0.05/0.01/0.05 mfd., ±15%, 300 volts, paper		A		5415
C-20A	Second IF amp. cathode by-pass	0.05 mfd. section of C-20				
C-20B	Output filter	0.01 mfd. section of C-20				
C-20C	Second IF amp. plate by-pass	0.05 mfd. section of C-20				

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46083, CBY-46084, CBY-46108, and CBY-46109 Receiver Units. Parts listed below are the same for all Receiver Units unless specifically indicated to the contrary—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
C-21	Third IF trimmer	Capacitor, variable, $\triangle$C approx. 17 mmf., same as C-13, but part of Z-3				
C-22	Fixed capacitance part of third IF tuning	Capacitor, 180 mmf., same as C-12, but part of Z-3				
C-23	Stage coupling	Capacitor, 180 mmf., same as C-14, but part of Z-3. Refer to C-14 for more details.				
C-24	Diode series resistor by-pass	Capacitor, 0.0002 mfd., same as C-8				
C-25	CW osc. plate by-pass	Capacitor 0.001 mfd., $\pm$5%, 400 volts, mica., part of CW osc. assembly Z-4		CD	5	4157
C-26	CW osc. grid blocking	Capacitor, 0.0001 mfd., $\pm$5%, 400 volts, mica		CD	5	4520
C-27	Fixed capacitance part of CW osc. tuning	Capacitor, 180 mmf., $\pm$2.5 mmf., 400 volts, mica, part of CW osc. assembly Z-4		A		5145 make replacements with 7935
C-28	CW osc. trimmer	Capacitor, variable, air, $\triangle$C approximately 34 mmf., part of CW osc. assembly Z-4				
C-29	Audio coupling	Capacitor, 0.006 mfd., $\pm$5%, 400 volts, mica	48672	AV	1461	4091
C-30	Audio amp. cathode by-pass	Capacitor, 15 mfd., 35 volts, dry electrolytic. Replacement may have a capacitance of 15 to 90 mfd.		A		5416
C-31	Output filter across pri. of T-1	Capacitor, 0.001 mfd., $\pm$5%, 400 volts, mica	48695	AV	1461	4114
C-32	High voltage filter	Capacitor, 5 mfd., 300 volts, electrolytic. Replacement may have a capacitance of 4.5 to 15 mfd. at 20° C.		A		6350
C-33	CW osc. coupling	C-33 is formed by capacitance between pin plugs in the second IF receptacle and is less than 2 mmf.				
E-1		Antenna binding post with engraved "A"		A		4667
E-3		Screw-cap-top of assemblies Z-1, Z-2, Z-3		A		4664
E-8		Grid clip		A		4754
E-9	Input alignment control	Knob		A		4713
E-12	Local tuning control	Knob		A		6743
E-13	Insulator	Binding post insulator in two sections				3485 (outside) 6597 (inside)
H-3		Snapslide		A		3888
		Other parts of the mechanism include:				
		Guide (on cover)		A		3887
		Button (on cover)		A		3890
		Stud (in shield)		A		4708
		Washers (on cover)		A		3889
H-5		Stud, for prevention of incorrect insertion of dynamotor		A		5480
H-6		Typical resistor panel assembly		A		5452
H-9		Bakelite washer for use with socket 6559		A		6566
H-10		Conical stud for locking receiver in rack		A		4710
J-1		Coupling receptacle assembly, 8 circuit (to switch panel)		A		4724
J-2		Coupling receptacle assembly, 3 circuit (to dynamotor)		A		4718
J-3		Coupling plug, 7 circuit (to rack)		A		5488
J-23		Typical IF coupling unit receptacle assembly		A		4723

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46083, CBY-46084, CBY-46108, and CBY-46109 Receiver Units. Parts listed below are the same for all Receiver Units unless specifically indicated to the contrary—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
J-24		Typical RF coil receptacle assembly		A		4722
L-1	Input tuning inductor	Input tuning inductor. The inductance is set to a standard value with the coil in the shield can by means of an adjustable iron core. This core is subsequently locked in place and sealed.				
		For 13.5-20 MC receivers		A		6250
		For 20-27 MC receivers		A		6177
L-2, L-3	Mixer input RF transformer	Mixer input RF transformer. The inductance of L-3 is set to a standard value by means of an adjustable iron core with the coil in the shield can. This core is subsequently locked in place and sealed.				
		For 13.5-20 MC receivers		A		6252
		For 20-27 MC receivers		A		6179
L-4, L-5	RF osc.	RF oscillator, plate and grid coils. L-5 inductance is set to a standard value in the shield can by means of an adjustable iron core. This core is subsequently locked in place and sealed				
		For 13.5-20 MC receivers		A		6254
		For 20-27 MC receivers		A		6181
L-6, L-7	1st IF	Coils, part of 1st IF coupling unit assembly Z-1				
		For 13.5-20 MC receivers		A		6168
		For 20-27 MC receivers		A		6168
L-8, L-9	2nd IF	Coils, part of 2nd IF coupling unit assembly Z-2				
		For 13.5-20 MC receivers		A		6168
		For 20-27 MC receivers		A		6168
L-10, L-11	3rd IF	Coils, part of 3rd IF coupling unit assembly Z-3				
		For 13.5-20 MC receivers		A		6168
		For 20-27 MC receivers		A		6168
L-12, L-13	CW osc.	Plate and grid coils, part of CW oscillator assembly Z-4				
		For 13.5-20 MC receivers		A		6695
		For 20-27 MC receivers		A		6695
L-14	RF choke	Choke, 112 microhenries ±10%, dc resistance not over .15 ohms		A		5546
L-15	AF Choke	Choke, 3 Henrys with .05 amperes dc, dc resistance 325 ohms, ±15%		A		5634
N-1		Calibrated dial				
		For 13.5-20 MC receivers		A		5616
		For 20-27 MC receivers		A		6345
P-5		Pin plug (on dynamotor receptacle assembly)		A		3995 make replacements with 7949 assembly
R-1	First RF cathode auto bias	Resistor, 620 ohms, ±10%, ⅓ watt, carbon	63433	AB	E	6004
R-2	RF amp. grid	Resistor, 2 megohms, ±10%, ⅓ watt, metallized		IRC	F⅓	4439
R-3	RF osc. grid	Resistor, 51,000 ohms, ±10%, ⅓ watt, carbon (part of assembly Z-5C)	63433	AB	E	4569
R-4	Mixer cathode	Resistor, 620 ohms, same as R-1				
R-5	AGC line decoupling	Resistor, 0.15 megohm, ±10%, ⅓ watt, carbon, used only on receivers of Model RAT-1 equipment	63433	AB	E	4571
R-6	RF osc. series plate	Resistor, 0.1 megohm, ±10%, ⅓ watt, carbon, part of RF osc. Z-5C	63433	AB	E	4501

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46083, CBY-46084, CBY-46108, and CBY-46109 Receiver Units. Parts listed below are the same for all Receiver Units unless specifically indicated to the contrary—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
R-7	Mixer plate decoupling	Resistor, 200 ohms, ±10%, ⅛ watt, carbon	63433	AB	E	4497
R-8	RF amp. and mixer screen decoupling	Resistor, 200 ohms, same as R-7				
R-9	First IF cathode auto bias	Resistor, 620 ohms, same as R-1				
R-10	Connects high voltage to gain control resistor	Resistor, see below, ±10%, ⅛ watt, carbon				
		.20 megohm for Model RAT receivers	63433	AB	E	4502
		.36 megohm for Model RAT-1 receivers	63433	AB	E	8032
R-11	AGC resistors	Resistor, 0.1 megohm, same as R-6				
R-12	2nd IF cathode auto bias	Resistor, 390 ohms, ±10%, ⅛ watt, carbon	63433	AB	E	6006
R-13	Second IF plate decoupling	Resistor, 200 ohms, same as R-7				
R-14	CW osc. grid	Resistor, 0.1 megohm, same as R-6				
R-15	CW osc. plate dropping and decoupling	Resistor, 5,100 ohms, ±10%, ⅛ watt, carbon	63433	AB	E	6001
R-16	CW osc. plate dropping	Resistor, 51,000 ohms, same as R-3				
R-17	Same as R-16	Resistor, 51,000 ohms, same as R-3				
R-18	Diode series	Resistor, 0.51 megohm, ±10%, ⅛ watt, carbon	63433	AB	E	4570
R-19	RF decoupling	Resistor, 0.1 megohm, same as R-6				
R-20	Grid resistor	Resistor, 2 megohms, ±10%, ⅛ watt, carbon	63433	AB	E	4503
R-21	Audio amp. cathode auto bias	Resistor, 1500 ohms, ±10%, ⅛ watt, carbon	63433	AB	E	4506
R-22	High voltage bleeder	Resistor, 7000 ohms, ±2%, 7 watts, wire wound		WL		5895
R-23	Same as R-22	Resistor, 7000 ohms, same as R-22				
T-1	Output transformer	Transformer, turns ratio 8 to 1, primary resistance, 1160 ohms ±15%, secondary resistance 21 ohms ±15%		A		5631
V-1	RF input voltage limiter	Neon lamp		GE	T-2 modified	5913
V-2	Audio output voltage limiter	Neon lamp, same as V-1				
V-3	RF amp.	Triple-grid, super-control (variable-mu), RF amplifier	12SK7	HS	12SK7	
V-4	Mixer	Triode-hexode mixer	12K8	RCA	12K8	
V-5	First IF amp.	12SK7, same as V-3				
V-6	Second IF amp.	12SK7, same as V-3				
V-7	Diode detector and CW osc.	Duo-diode triode used as diode detector and triode CW oscillator	12SR7	HS and RCA	12SR7	
V-8	Audio, amp.	"Beam" tetrode audio power amplifier	12A6	RCA	12A6	
X-1	Tube socket	Octal-base tube socket for any of the receiver tubes. (Does not include bakelite washer (6566))		AMPH	S-8 modified	6559
Z-1	1st IF	1st IF coupling unit, complete assembly including shield can and mounting plate, IF=4200 KC		A		6165
Z-2	2nd IF	2nd IF coupling unit, complete assembly including shield can and mounting plate. IF=4200 KC		A		6169
Z-3	3rd IF	3rd IF coupling unit, complete assembly including shield can and mounting plate. IF=4200 KC		A		6172
Z-4	CW osc.	CW osc. complete assembly including shield can. IF=4200 KC				5857

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46083, CBY-46084, CBY-46108, and CBY-46109 Receiver Units. Parts listed below are the same for all Receiver Units unless specifically indicated to the contrary—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr's. Desig.*	*Dwg. and Part No.*
Z-5 (A-B-C)	RF coil set	RF coil set assembly complete including antenna coil Z-5A, RF amplifier Z-5B, and RF osc. Z-5C, in shield cans, mounted on a cover				
		For 13.5-20 MC receivers		A		6248
		For 20-27 MC receivers		A		6175

Parts of Type CBY-23154 Switch Panel

A-8		Cover		A		5199
E-10	Gain control knob	Knob		A		6749
E-11	Lever, for "CW-OFF-MCW" switch	Lever		A		3912
J-6		Coupling plug, eight circuit (to receiver)		A		3929
R-24	Gain control	Resistor, variable, 0-50,000 ohms, ±20%		AB	J	6310
S-5	CW-OFF-MCW switch	Switch, rotary type		A		6536

Parts of Type CBY-49107 and Type CBY-49109 Switch Panel Adapters

A-30		Cover		A		5199
J-4		Coupling plug, 8 circuit (to receiver)		A		3929

Cable and Mechanical Linkage Assemblies (See Fig. 19)

(Complete assembled cables and mechanical linkages were supplied on Contract Number NOs. 67258)

		Cable assembly, control box to receiver rack, 5 feet, consisting of:		A		6693
		Bulk cable, 5 feet		GC		6711
		Plug assembly (2)		A		6577
		Identification tag		A		6803
		Cable assembly, battery to receiver rack, 10 feet, consisting of:		A		6694
		Bulk cable, 10 feet		GC		6712
		Plug assembly (1)		A		6578
		Ferrule at battery end		A		6780
		Nut at battery end		A		6781
		Identification tag		A		6804
		Cable assembly, external equipment to receiver rack, 10 feet, consisting of:		A		5808
		Bulk cable, 10 feet		G		6794
		Plug assembly (2)		C		6784
		Identification tag		A		6941
		Mechanical linkage assembly, receiver to receiver control box, 5 feet, consisting of:		A A		6151
		Shafting		WT		1174
		Casing		WT		3406
		Sleeves (2)		A		6585
		Nuts (2)		A		1167
		Splines (2)		A		6788
		Identification tag		A		6789

Miscellaneous Parts

		Slip cover (2 receiver)		A		6939
		Bristo set screw wrench #6		A		8021
		Phillips screw driver #1		A		8020
		Tube extractor		A		7489

TABLE 11—PARTS LIST BY SYMBOL DESIGNATION—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr.'s Desig.*	*Dwg. and Part No.*
		SCREWS APT TO BE REQUIRED IN SERVICING THE EQUIPMENT:				
		Binding head, brass, #3—48x3/16", nickel plated		AS		4058
		Binding head, brass, #3—48x1/8", nickel plated		AS		4134
		Set screw, Bristo, cup pointed, #6—32 1/8"		AS		4140
		Binding head, brass, #3—48x1/4", nickel plated		AS		4168
		Binding head, brass, #2—56x1/8", nickel plated		AS		4378
		Binding head, brass, #4—40x1/4", nickel plated		AS		6008
		Phillips, flat head, brass, #3—48x3/16", black oxidized		AS		6010
		Phillips, flat head, brass, #3—48x5/16", black oxidized		AS		6015
		Binding head, brass, #3—48x7/32", black oxidized		AS		6017
		Binding head, brass, #3—48x7"/16, nickel plated		AS		6018
		Binding head, brass, #4—40x3/16", black oxidized		AS		6019
		Binding head, brass, #3—48x5/32", black oxidized		AS		6020
		LOCK WASHERS APT TO BE REQUIRED IN SERVICING THE EQUIPMENT:				
		Shakeproof #1902, for size #2 screw, Phosphor bronze, nickel plated		SH	1902	7001
		Shakeproof #1903, for size #3 screw, phosphor bronze, nickel plated		SH	1903	4558
		Shakeproof #1904, for size #4 screw, phosphor bronze, nickel plated		SH	1904	4242

TABLE 12

IDENTIFICATION OF MANUFACTURERS

Code Letters in Table 11	*Name*
A	Aircraft Radio Corporation, Boonton, N. J.
AB	Allen-Bradley Company, Milwaukee, Wis.
AMPH	American Phenolic Corporation, Chicago, Ill.
AS	American Screw Co., Providence, R. I.
AV	Aerovox Corporation, New Bedford, Mass.
C	Centralab, Milwaukee, Wis.
CD	Cornell-Dubilier Corporation, South Plainfield, N. J.
CE	Continental Electric Company, Newark, N. J.
GC	General Cable Corporation, 205 East 42nd Street, New York, N. Y.
GE	General Electric Vapor Lamp Co., Hoboken, N. J.
HS	Hygrade Sylvania Corporation, Emporium, Pa.
IRC	International Resistance Company, Philadelphia, Pa.
LIT	Littelfuse Laboratories, Chicago, Ill.
RCA	RCA Manufacturing Company, Harrison, N. J.
SH	Shakeproof Lock Washer Co., Chicago, Ill.
WL	Ward Leonard Electric Company, Mount Vernon, N. Y.
WT	Walker-Turner Company, Plainfield, N. J.

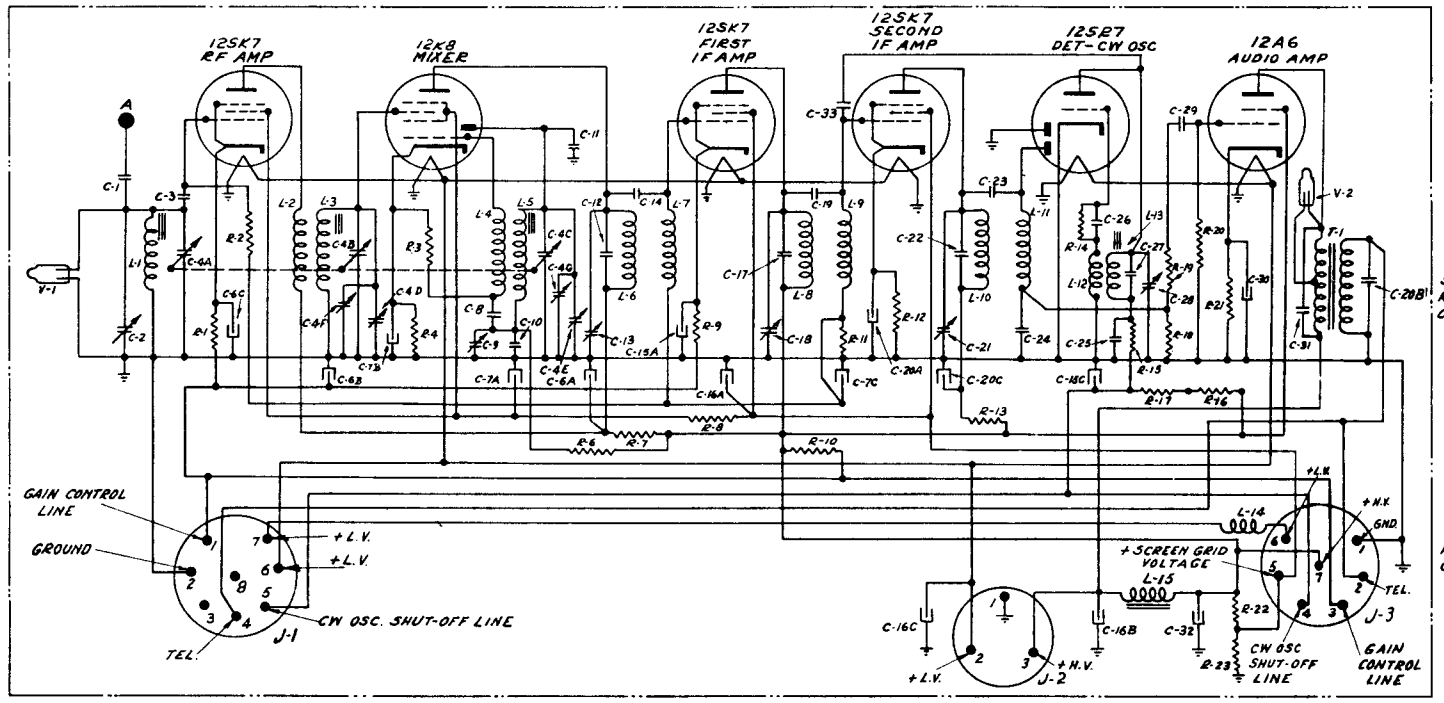
TABLE 13

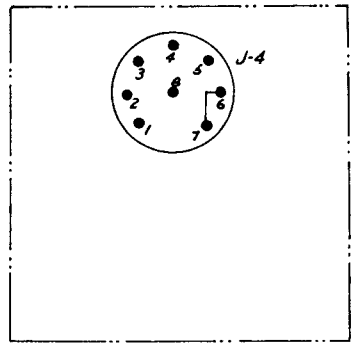
PARTS LIST BY NAVY TYPE NUMBERS

(The following list applies to Model RAT and to Model RAT-1 except where specifically indicated to the contrary)

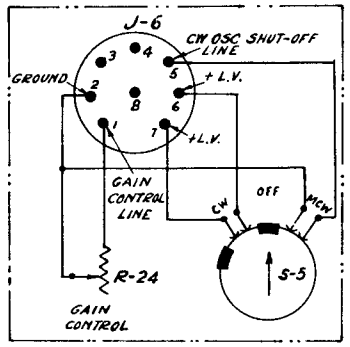
Quantity Per Equipment	*Navy Type Numbers*	*Symbol Designations Involved*
		Transformers and Reactors, AF
2		T-1 (8 to 1)
2		L-15 (3 Henrys)
		Inductors, RF
2		L-14 (112 microhenries)
		Capacitors
2	48672	C-29, .006 mfd.
4	48674	C-3, C-26, .0001 mfd.
4	48675	C-8, C-24, .0002 mfd.
2	48695	C-31, .001 mfd.
2		C-11, .000003 mfd.
2		C-25, .001 mfd.
2		C-34, .001 mfd.
6		C-6, C-7, C-15, .05/.05/.05 mfd.
2		C-20, .05/.01/.05 mfd.
2		C-16, .22/.22/.22 mfd.
2		C-5, 3 mfd. (Model RAT-1 only)
2		C-32, 5 mfd.
2		C-30, 15 mfd.
		Resistors
6	63433	R-7, R-8, R-13, 200 ohms
2	63433	R-12, 390 ohms
6	63433	R-1, R-4, R-9, 620 ohms
2	63433	R-21, 1500 ohms
2	63433	R-15, 5100 ohms
6	63433	R-3, R-16, R-17, 51,000 ohms
8	63433	R-6, R-11, R-14, R-19, 100,000 ohms
2	63433	R-5, 150,000 ohms (Model RAT-1 only)
2	63433	R-10, 200,000 ohms (Model RAT only)
2	63433	R-10, 360,000 ohms (Model RAT-1 only)
2	63433	R-18, 510,000 ohms
2	63433	R-20, 2 megohms
4		R-22, R-23, 7,000 ohms
2		R-2, 2 megohms
2		R-24, 0-50,000 ohms, variable resistor
2		R-25, R-26, 0-50,000 ohms, variable resistor
		Switches
4		S-1, S-3, S-5
2		S-2, S-4
2		S-6, S-7
		Vacuum Tubes
4		V-1, V-2
6		V-3, V-5, V-6
2		V-4
2		V-7
2		V-8
		Relays
2		K-1, K-2
		Fuses
2		F-1, F-2
		Headset Jacks
10		J-7, J-8, J-9, J-10, J-11, J-12, J-13, J-14, J-15, J-16
		Dynamotors
2		D-1

TYPE CBY-46083 (135-20MC) OR TYPE CBY-46084 (20-27MC) RECEIVER UNIT

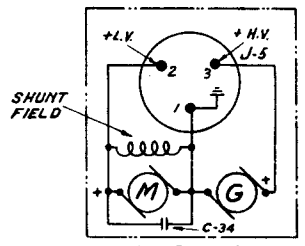




TYPE CBY-49109
SWITCH PANEL ADAPTER
(USED ONLY IN REMOTE-CONTROL INSTALLATIONS)



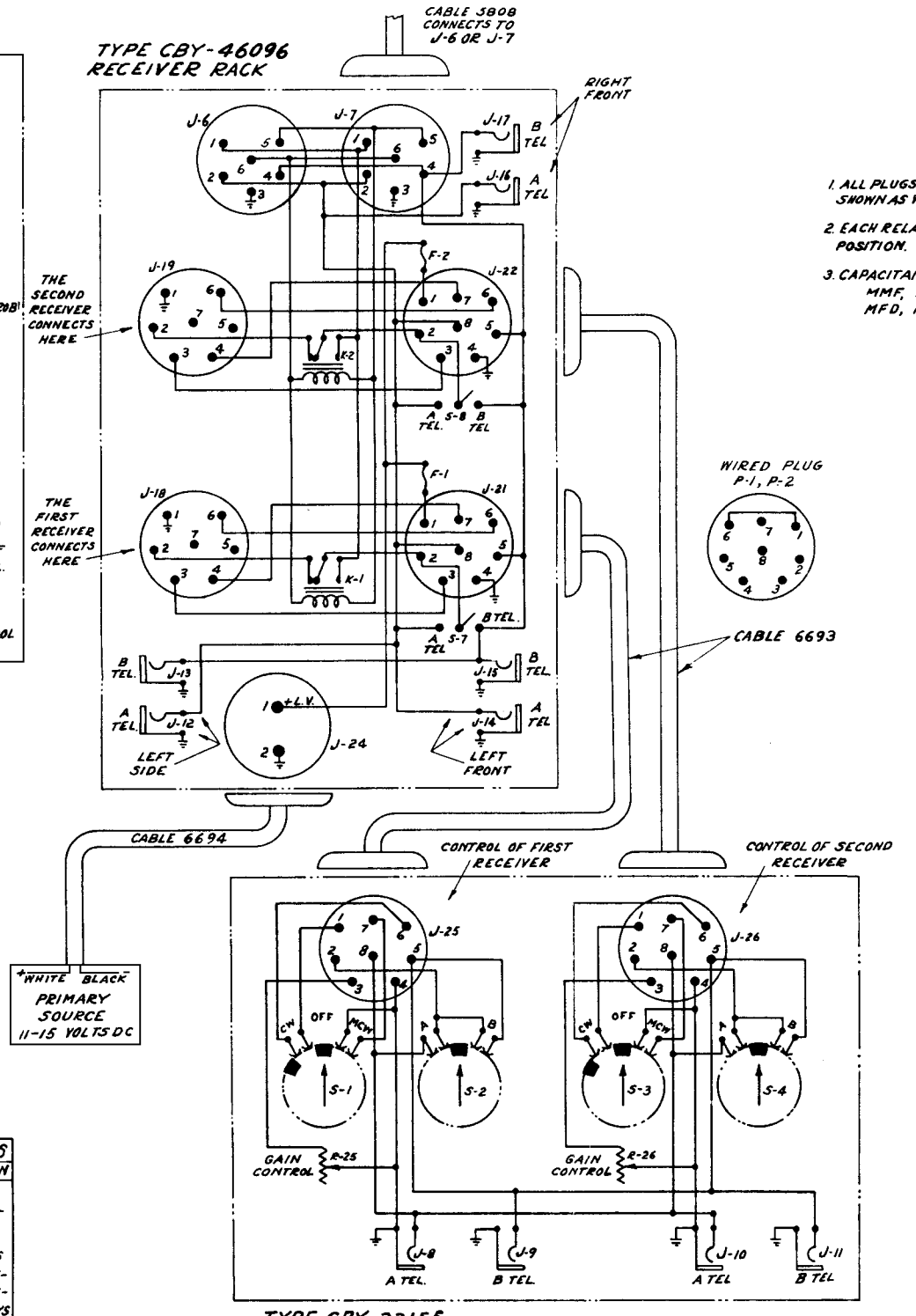
TYPE CBY-23154
SWITCH PANEL
(USED ONLY IN LOCAL-CONTROL INSTALLATIONS)



TYPE CBY-21400
RECEIVER DYNAMOTOR UNIT

CAPACITANCES		CAPACITANCES		CAPACITANCES		INDUCTANCES		RESISTANCES		RESISTANCES		MISCELLANEOUS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION
C-1	6.5 MMF	C-15(ABC)	.05/.05/.05 MFD	C-29	.006 MFD	L-1	ANT. INPUT	R-1	620	R-15	5,100	T-1	8 TO 1 OUTPUT TRANSFORMER
C-2	15 MMF	C-16(ABC)	.22/.22/.22 MFD	C-30	15 MFD	L-2, L-3	RF AMP	R-2	2,000,000	R-16	51,000		
C-3	100 MMF	C-17	180 MMF	C-31	.001 MFD	L-4, L-5	RF OSC	R-3	51,000	R-17	51,000		
C-4 (ATO G)	GANG	C-18	17 MMF	C-32	5 MFD	L-6, L-7	IN 1ST IF	R-4	620	R-18	510,000	V-1, V-2	NEON TUBES
		C-19	180 MMF	C-33	LESS THAN 2 MMF	L-8, L-9	IN 2ND IF			R-19	100,000	K-1, K-2,	REC. OUTPUT-TRANS. SIDE-TONE RELAYS
C-6(ABC)	.05/.05/.05 MFD	C-20(ABC)	.05/.01/.05 MFD	C-34	.001 MFD	L-10, L-11	IN 3RD IF	R-6	100,000	R-20	2,000,000		
C-7(ABC)	.05/.05/.05 MFD	C-21	17 MMF			L-12, L-13	CW OSC	R-7	200	R-21	1,500		
C-8	200 MMF	C-22	180 MMF			L-14	RF CHOKE, 112 μH	R-8	200	R-22	7,000		
C-9	40 MMF	C-23	180 MMF					R-9	620	R-23	7,000	F-1, F-2,	10A. FUSES
C-10	340 FOR 13.5-20 / 300 FOR 20-27	C-24	200 MMF			L-15	AF CHOKE 3 H.	R-10	200,000	R-24	0-50,000		
C-11	3 MMF	C-25	.001 MFD					R-11	100,000	R-25	0-50,000		
C-12	180 MMF	C-26	100 MMF					R-12	390	R-26	0-50,000		
C-13	17 MMF	C-27	180 MMF					R-13	200				
C-14	180 MMF	C-28	34 MMF					R-14	100,000				

TYPE CBY-46096 RECEIVER RACK



TYPE CBY-23155
RECEIVER CONTROL BOX

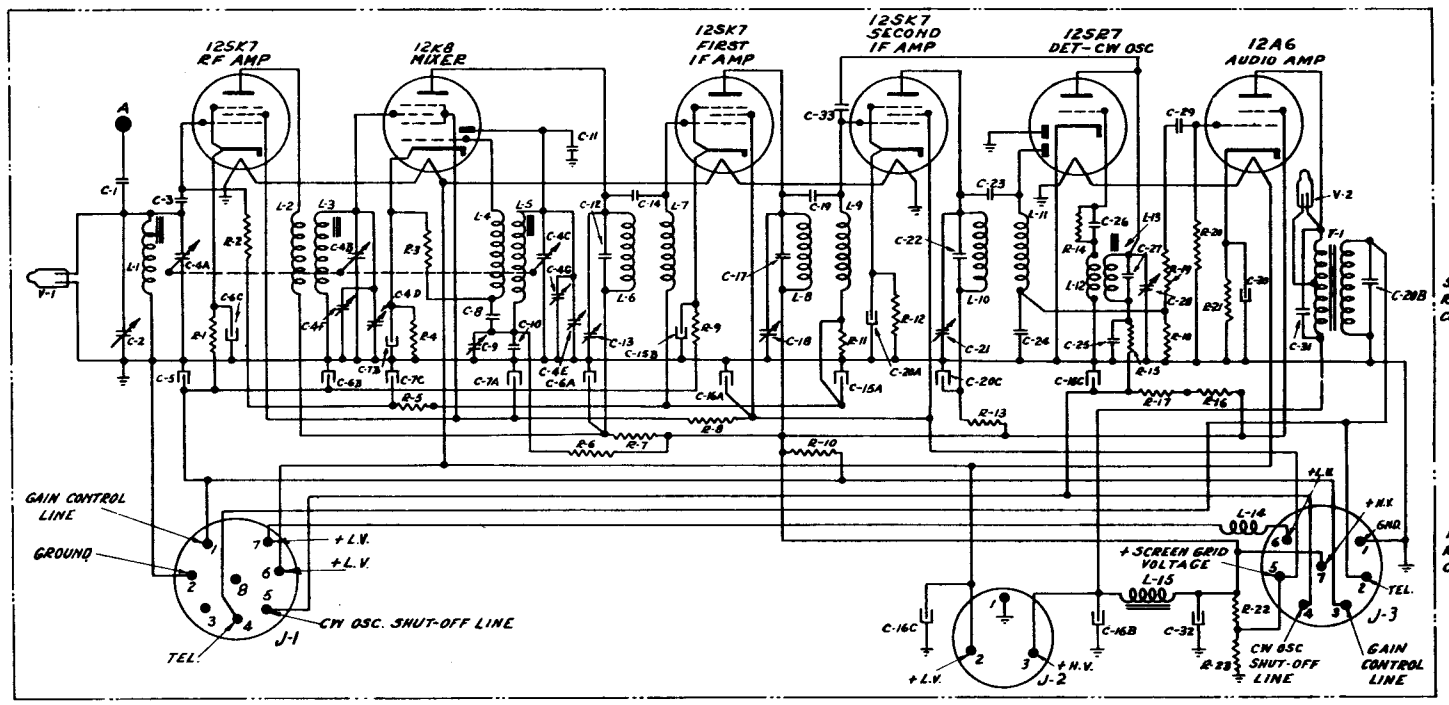
NOTES

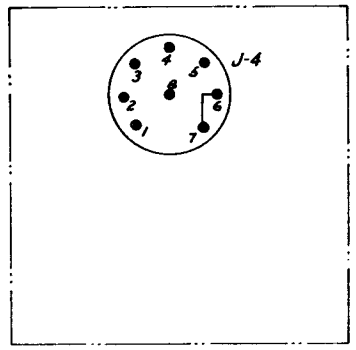
1. ALL PLUGS AND RECEPTACLES ARE SHOWN AS VIEWED FROM THE OUTSIDE.
2. EACH RELAY IS SHOWN IN THE NON-ENERGIZED POSITION.
3. CAPACITANCE ABBREVIATIONS:
   MMF, MICROMICROFARADS.
   MFD, MICROFARADS.

6421-4-D

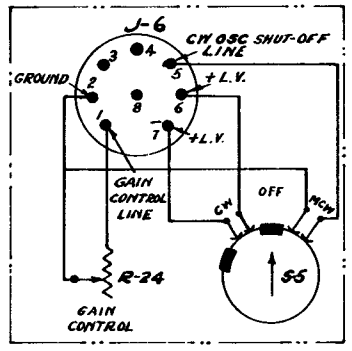
Fig. 10—Schematic Circuit Diagram, Model RAT Equipment

TYPE CBY-46108 (13.5-20 MC) OR TYPE CBY-46109 (20-27 MC) RECEIVER UNIT

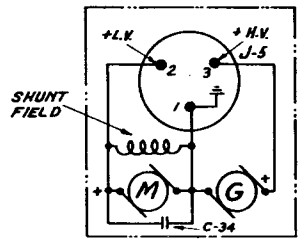




TYPE CBY-49107
SWITCH PANEL ADAPTER
(USED ONLY IN REMOTE-CONTROL INSTALLATIONS)



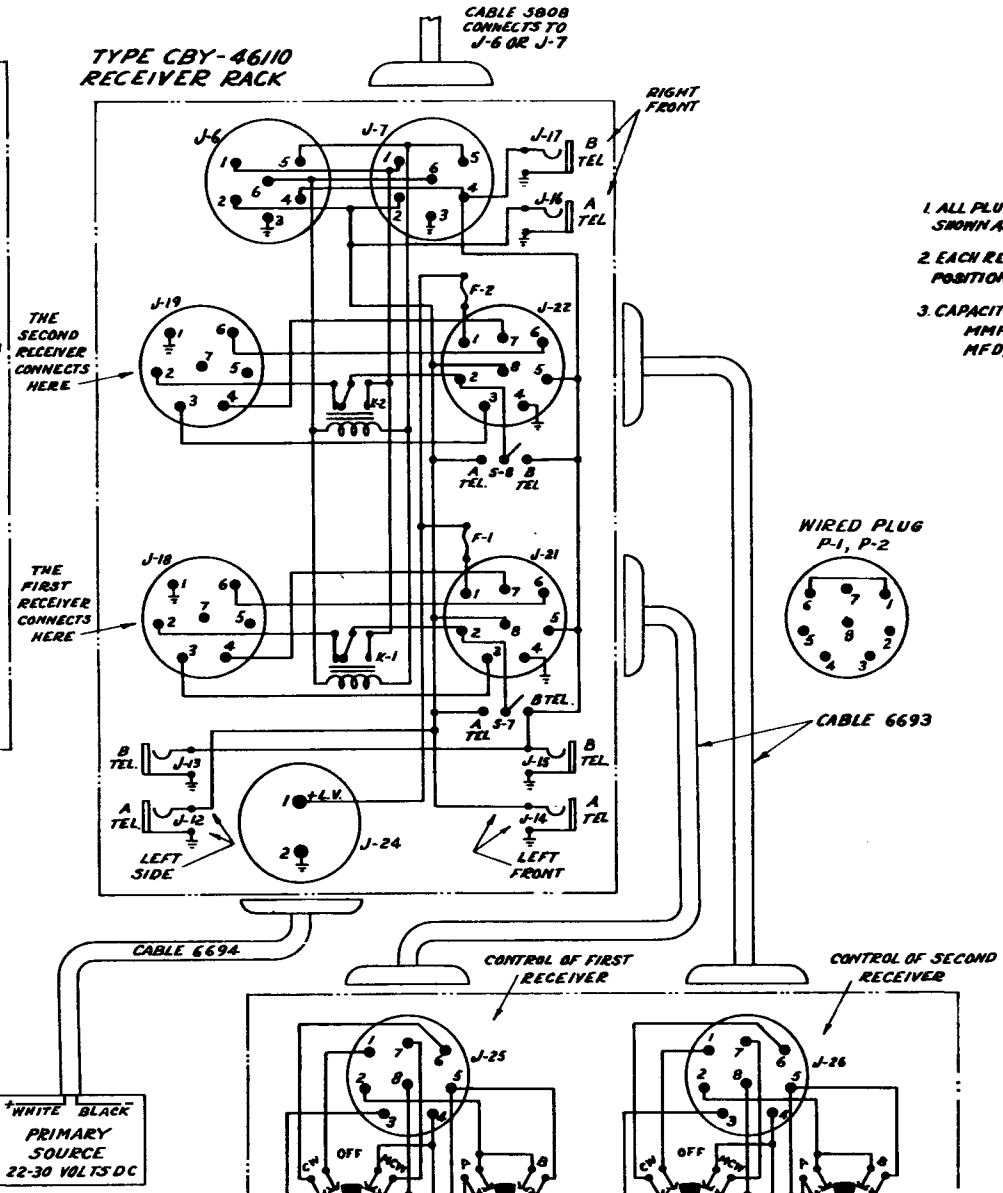
TYPE CBY-23154
SWITCH PANEL
(USED ONLY IN LOCAL-CONTROL INSTALLATIONS)



TYPE CBY-21531
RECEIVER DYNAMOTOR UNIT

CAPACITANCES		CAPACITANCES		CAPACITANCES		INDUCTANCES		RESISTANCES		RESISTANCES		MISCELLANEOUS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION
C-1	6.5 MMF	C-15(ABC)	.85/.05/.85 MFD	C-29	.006 MFD	L-1	ANT. INPUT	R-1	620	#R-15	5,100	T-1	8 TO 1 OUTPUT TRANSFORMER
C-2	15 MMF	C-16(ABC)	.22/.22/.22 MFD	C-30	.15 MFD	L-2, L-3	RF AMP	R-2	2,000,000	#R-16	51,000		
C-3	100 MMF	C-17	180 MMF	C-31	.001 MFD	L-4, L-5	RF OSC	R-3	51,000	#R-17	51,000		
C-4(ATO G)	GANG	C-18	17 MMF	C-32	.5 MFD	L-6, L-7	IN 1ST IF	R-4	620	R-18	510,000	V-1, V-2 K-1, K-2,	NEON TUBES REC. OUTPUT-TRANS. SIDE-TONE RELAYS
C-5	.3 MFD	C-19	180 MMF	C-33	LESS THAN 2 MMF	L-8, L-9	IN 2ND IF	R-5	150,000	R-19	100,000		
C-6(ABC)	.05/.05/.05 MFD	C-20(ABC)	.05/.01/.05 MFD	C-34	.001 MFD	L-10, L-11	IN 3RD IF	R-6	100,000	R-20	2,000,000		
C-7(ABC)	.05/.05/.05 MFD	C-21	17 MMF			L-12, L-13	CW OSC	R-7	200	R-21	1,500		
C-8	200 MMF	C-22	180 MMF			L-14	RF CHOKE, 112 μH	R-8	200	R-22	7,000	F-1, F-2,	10A. FUSES
C-9	4.0 MMF	C-23	180 MMF					R-9	620	R-23	7,000		
C-10	3.40 FOR 13.5-20 300 FOR 20-27	C-24	200 MMF			L-15	AF CHOKE 3 H.	R-10	360,000	R-24	0-50,000		
C-11	3 MMF	C-25	.001 MFD					R-11	100,000	R-25	0-50,000		
C-12	180 MMF	C-26	100 MMF					R-12	390	R-26	0-50,000		
C-13	17 MMF	C-27	180 MMF					R-13	200				
C-14	180 MMF	C-28	34 MMF					R-14	100,000				

TYPE CBY-46110 RECEIVER RACK



TYPE CBY-23155
RECEIVER CONTROL BOX

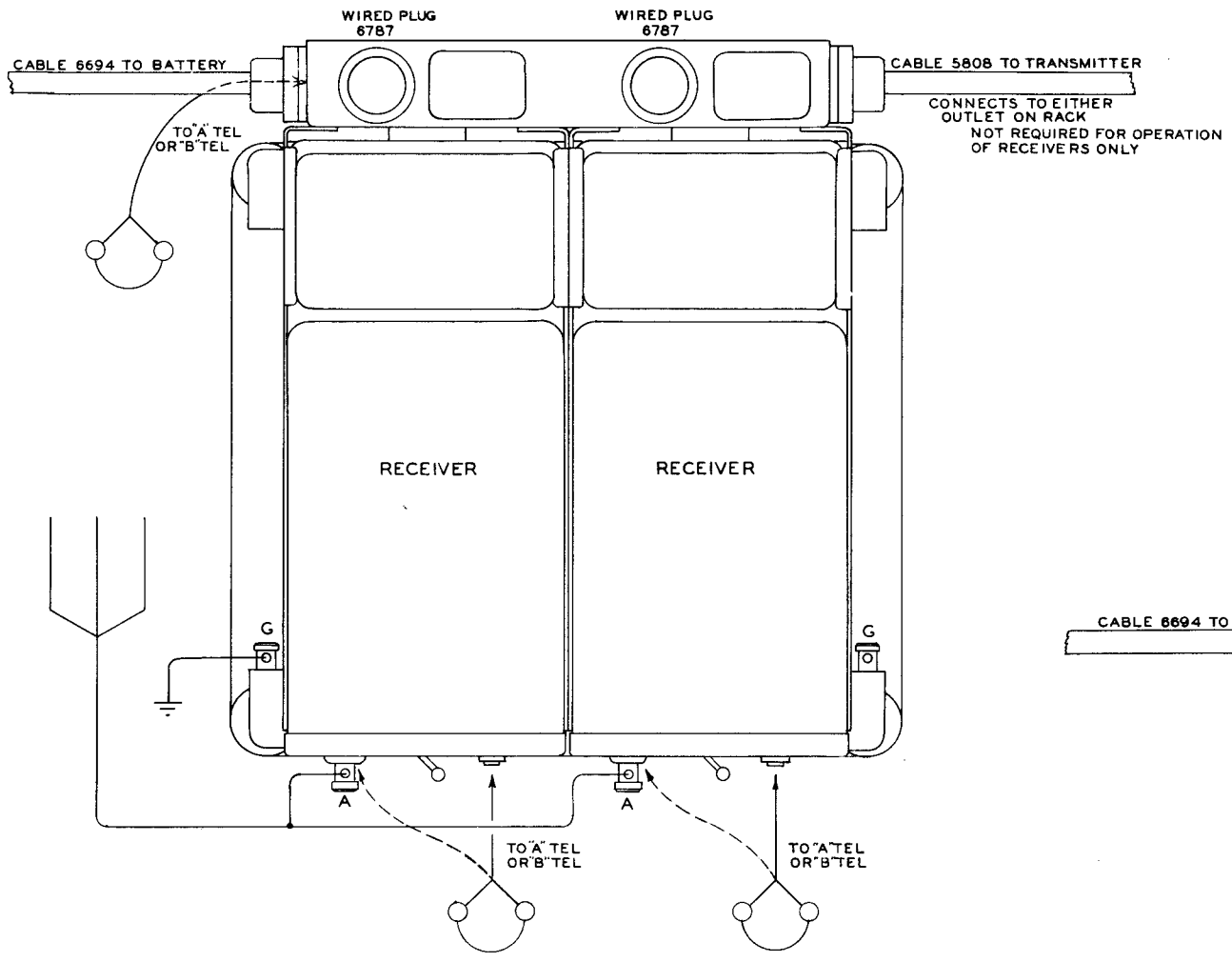
NOTES

1. ALL PLUGS AND RECEPTACLES ARE SHOWN AS VIEWED FROM THE OUTSIDE.
2. EACH RELAY IS SHOWN IN THE NON-ENERGIZED POSITION.
3. CAPACITANCE ABBREVIATIONS:
   MMF, MICROMICROFARADS.
   MFD, MICROFARADS.

Fig. 11—Schematic Circuit Diagram, Model RAT-1 Equipment

7658-4-B

CABLE CONNECTIONS FOR LOCAL CONTROL



NOTES:

BOTH OUTLETS ON THE RIGHT REAR OF THE RACK ARE IDENTICAL AND ARE WIRED IN PARALLEL. ONE OF THESE CONNECTS THE TRANSMITTER SIDETONE AND POWER RELAY CIRCUITS (SEE SCHEMATIC CIRCUIT DIAGRAM) INTO THIS EQUIPMENT. THE OTHER MAY BE USED AS A "PATCH" OUTLET FOR CONNECTION TO THE CORRESPONDING OUTLET IN A SECOND SIMILAR RECEIVER RACK. WHEN THIS IS DONE, THE OUTPUT OF ALL RECEIVERS MAY BE CONNECTED TO EITHER "A" OR "B" TELEPHONE LINES AND NO ADDITIONAL CABLE TO TRANSMITTER IS REQUIRED.

CABLE CONNECTIONS FOR REMOTE CONTROL

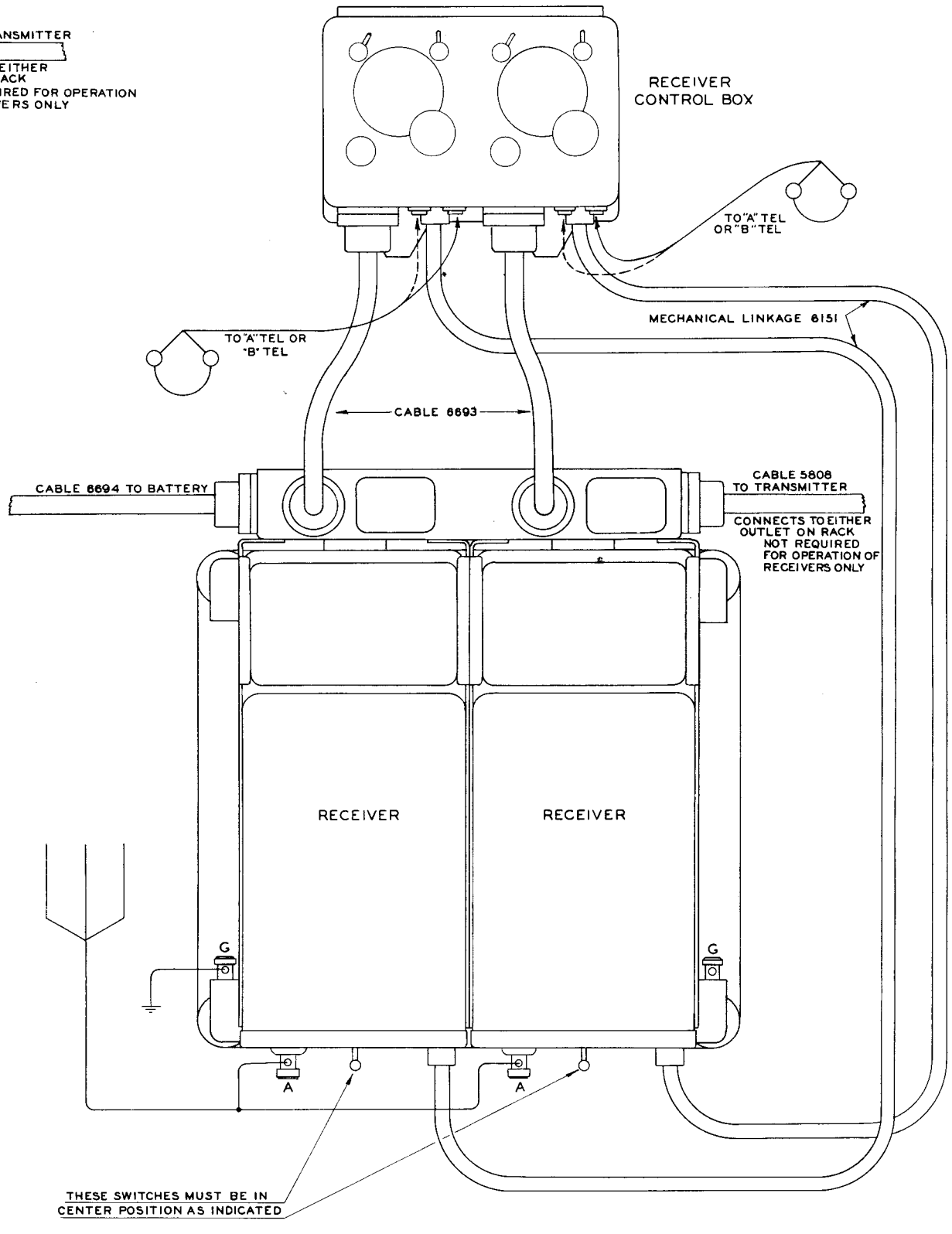
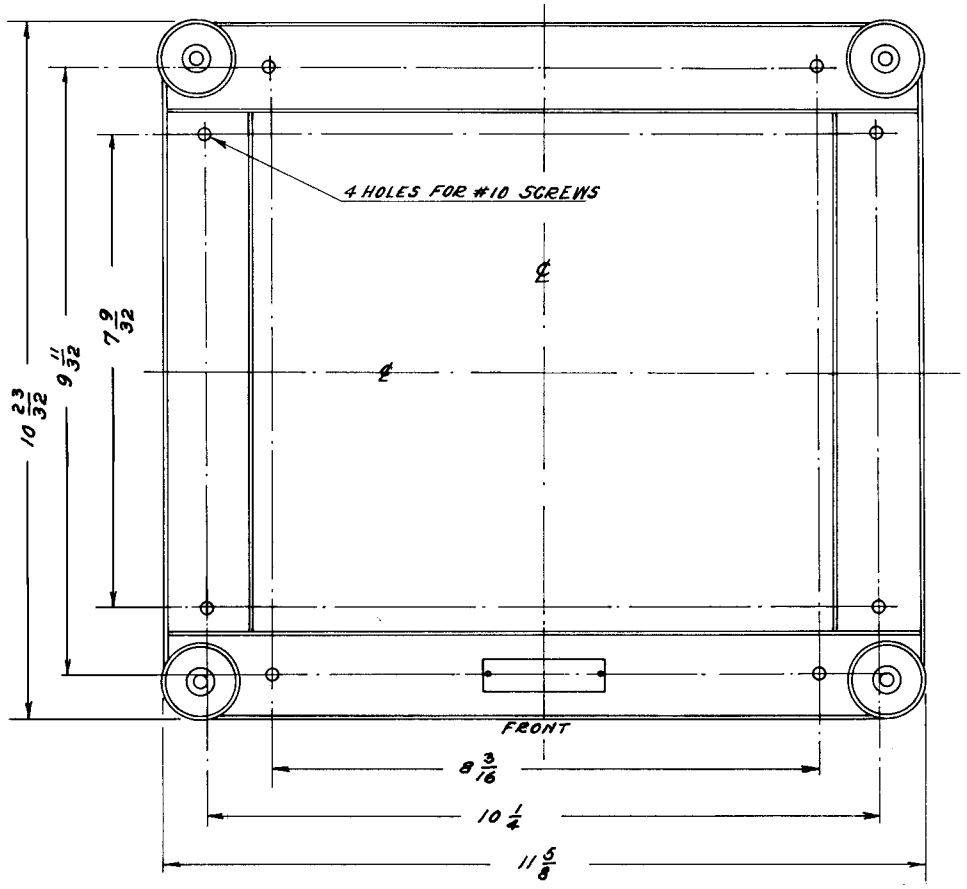


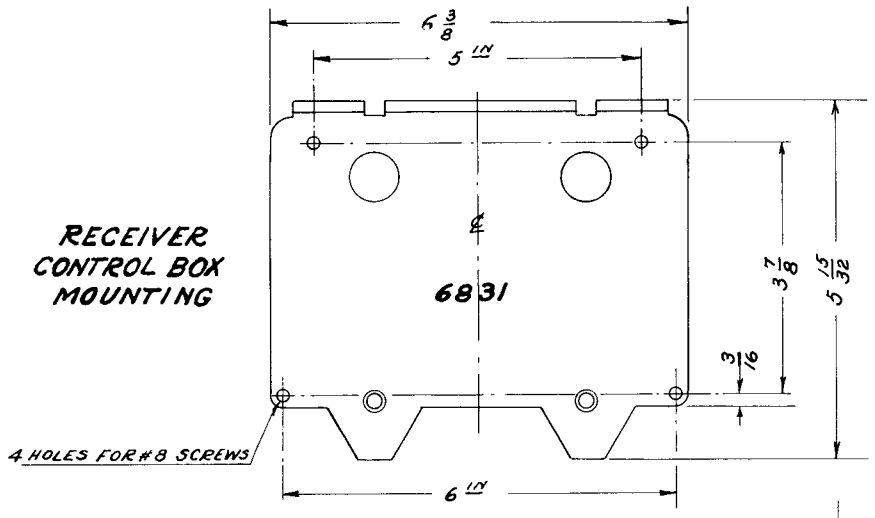
Fig. 12—Cabling Diagram, Model RAT and Model RAT-1 Equipment

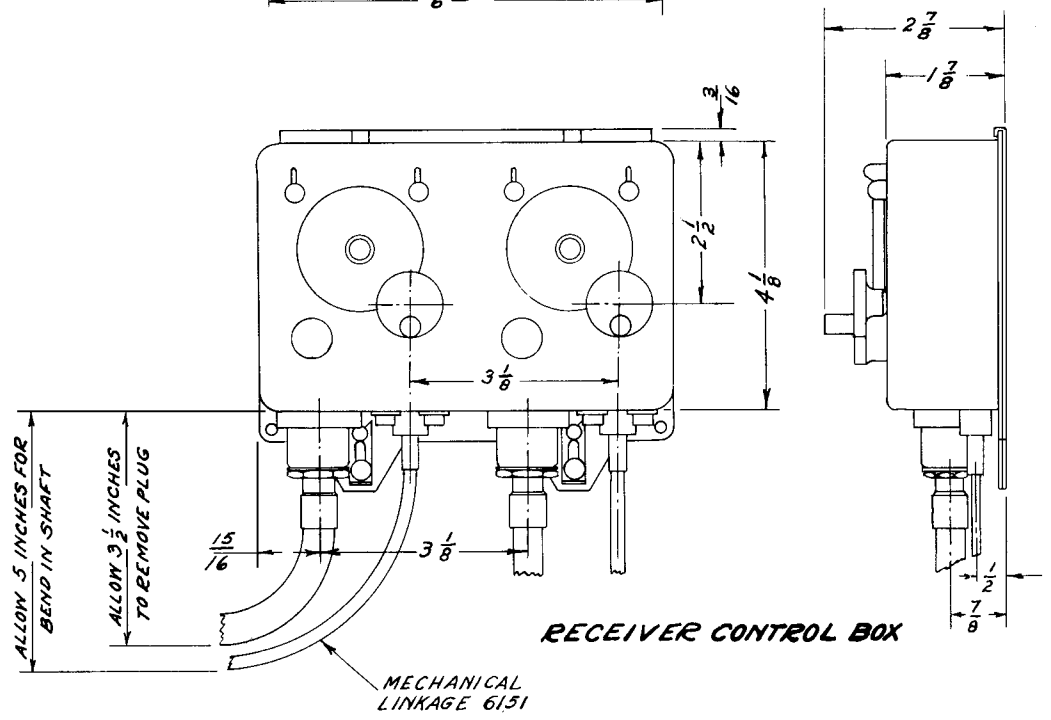
6423-3-E

RECEIVER MOUNTING



RECEIVER CONTROL BOX MOUNTING

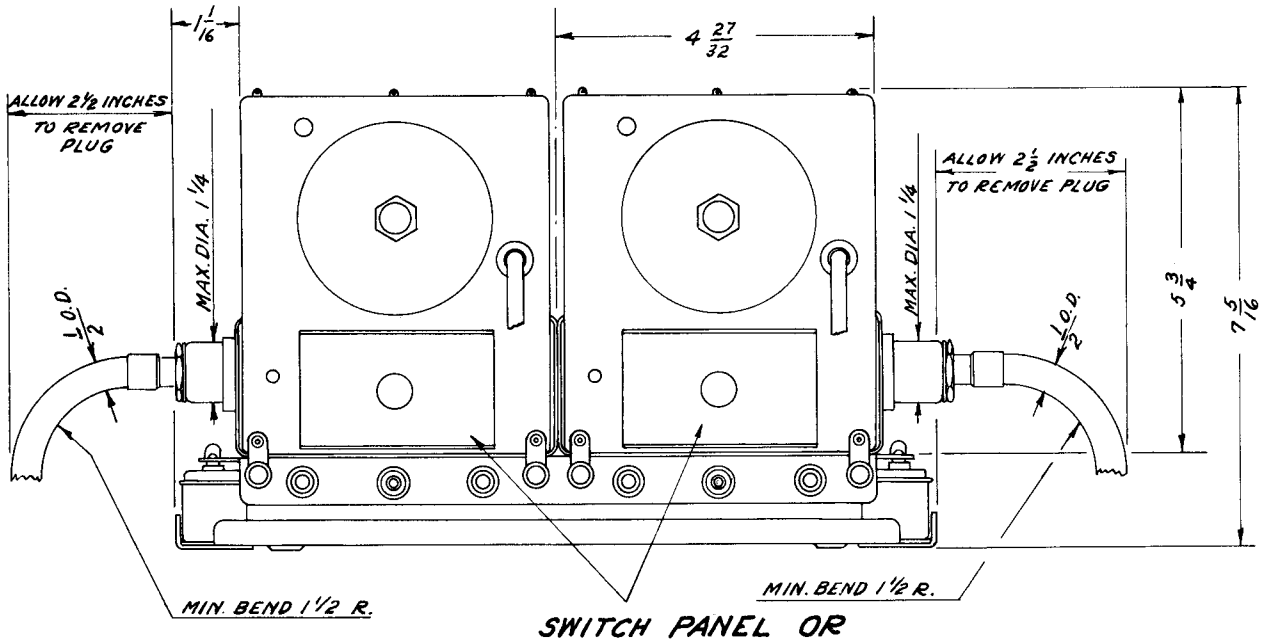




RECEIVER CONTROL BOX

WEIGHTS OF COMPONENT UNITS

WEIGHT OF COMPLETE EQUIPMENT FOR LOCAL CONTROL, LESS CABLE	22.0 LBS.
WEIGHT OF COMPLETE EQUIPMENT FOR REMOTE CONTROL, LESS CABLES	23.6 LBS.
ONE RECEIVER UNIT (LESS TUBES, DYNAMOTOR, SWITCH PANEL)	5.7 LBS.
ONE SET TUBES	0.3 LBS.
ONE DYNAMOTOR UNIT	3.0 LBS.
ONE SWITCH PANEL	0.2 LBS.
ONE SWITCH PANEL ADAPTER	0.15 LBS.
RECEIVER RACK	2.7 LBS.
RECEIVER MOUNTING	0.8 LBS.
RECEIVER CONTROL BOX AND MOUNTING	1.8 LBS.
SHIELDED CABLE (AVERAGE OF ALL SIZES, PER FOOT)	0.16 LBS.
ONE PLUG (AVERAGE OF ALL PLUGS)	0.1 LBS.
ONE WIRED PLUG (6787)	0.08 LBS.
MECHANICAL LINKAGE, PER FOOT	0.12 LBS.



SWITCH PANEL OR SWITCH PANEL ADAPTER

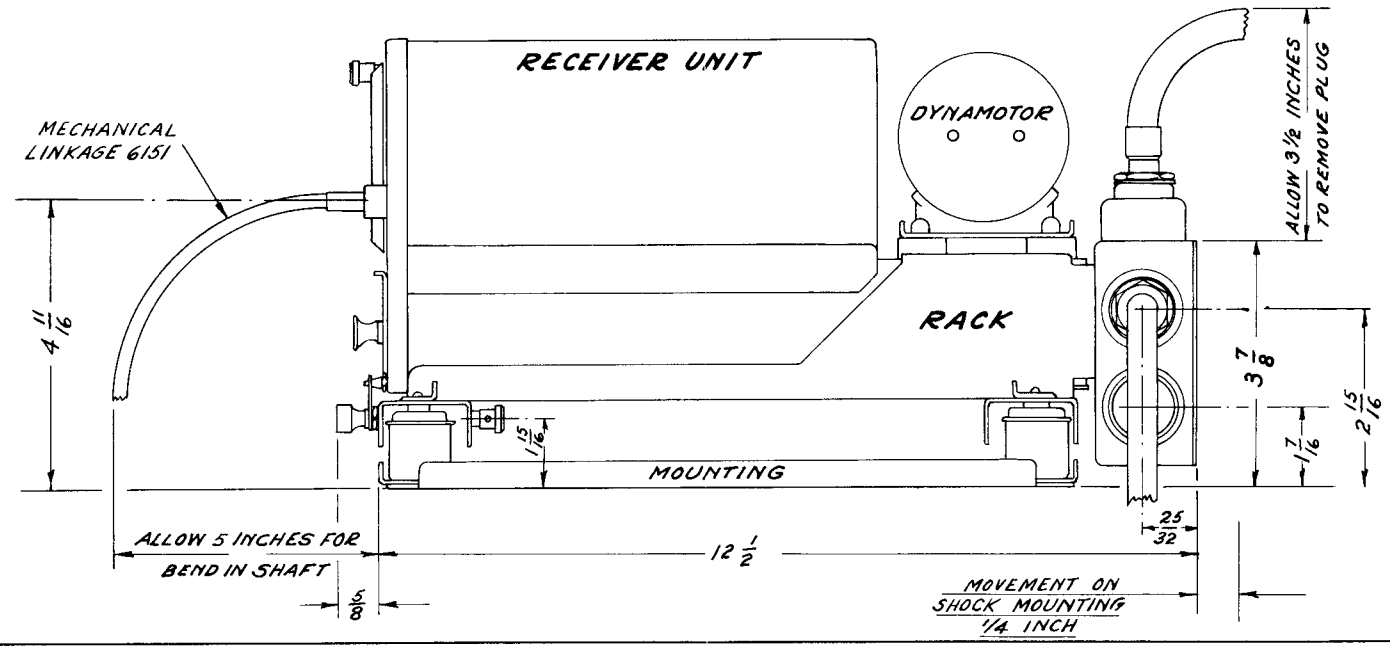
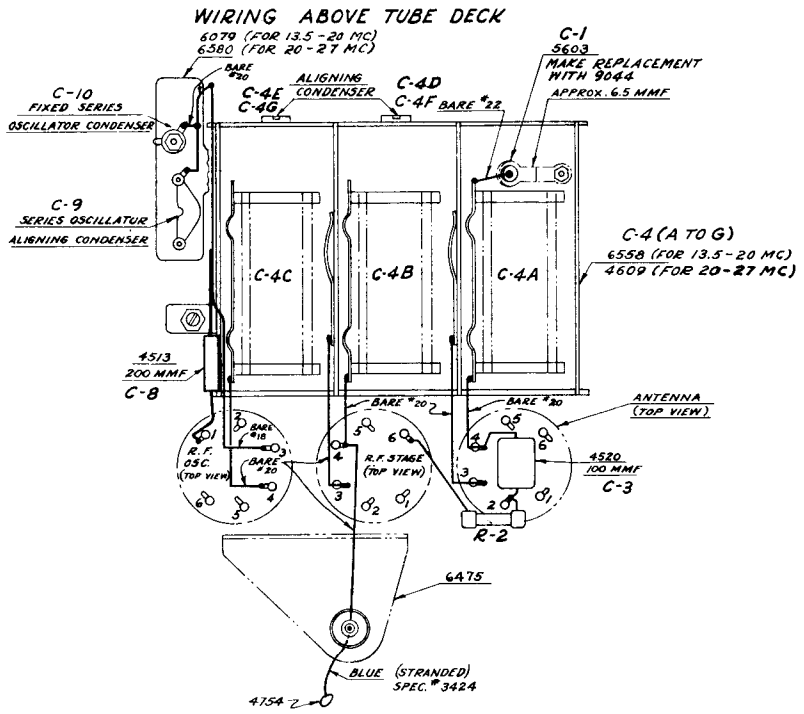
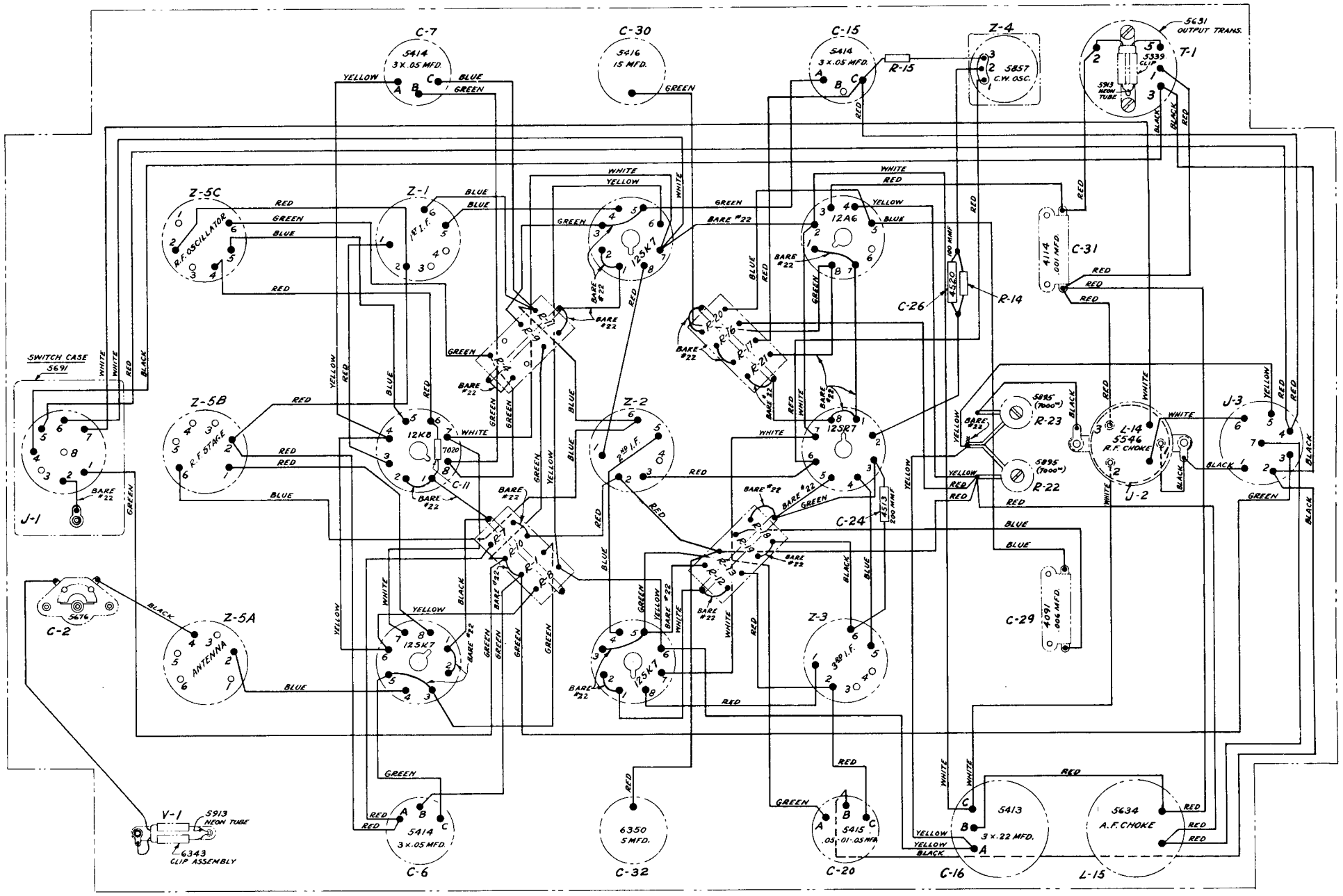


Fig. 13—Installation Dimensions and Weights, Units of Model RAT and Model RAT-1 Equipment





NOTES:
1. ALL WIRES MARKED WITH COLOR NOTE ARE #22 SOLID COPPER; WIRE SPECIFICATION #6424 EXCEPT AS NOTED.
2. BARE WIRES ARE TINNED COPPER WITH SIZES AS SHOWN.
3. SEAL ALL SOLDERED CONNECTIONS WITH RED LACQUER.
4. TERMINAL NUMBERS SHOWN ARE FOR IDENTIFICATION PURPOSES. THEY DO NOT APPEAR ON THE EQUIPMENT EXCEPT ON TUBE SOCKETS AND OUTPUT TRANSFORMER.

9110-4-A

Fig. 14—Type CBY-46083 Receiver Unit (13.5-20 MC), and Type CBY-46084 Receiver Unit (20-27 MC), Practical Wiring Diagram

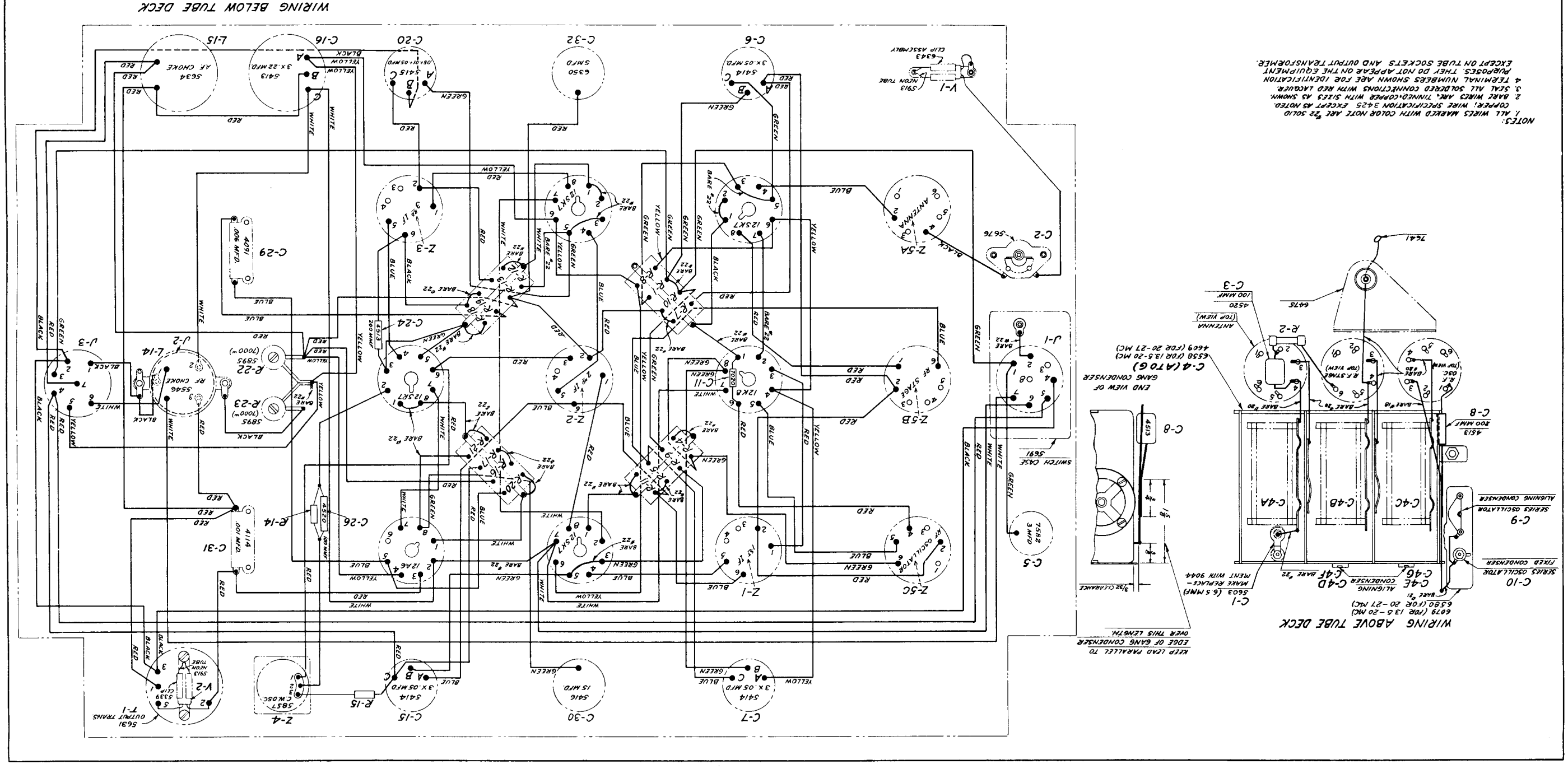
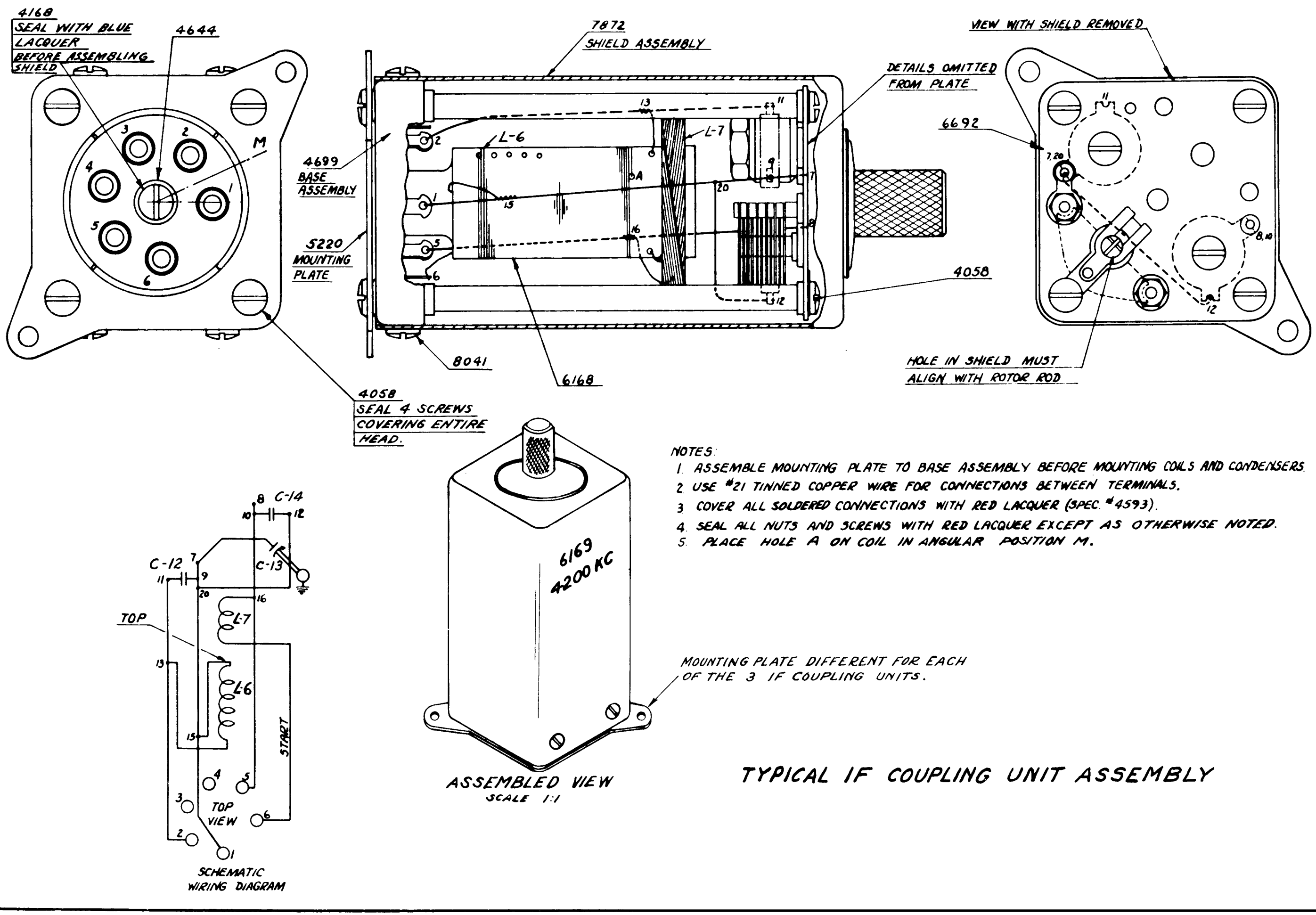


Fig. 15—Type CBY-46108 Receiver Unit (13.5-20MC), and Type CBY-46109 Receiver Unit (20-27 MC), Practical Wiring Diagram

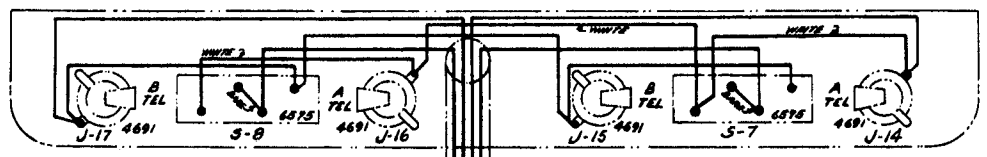


NOTES:

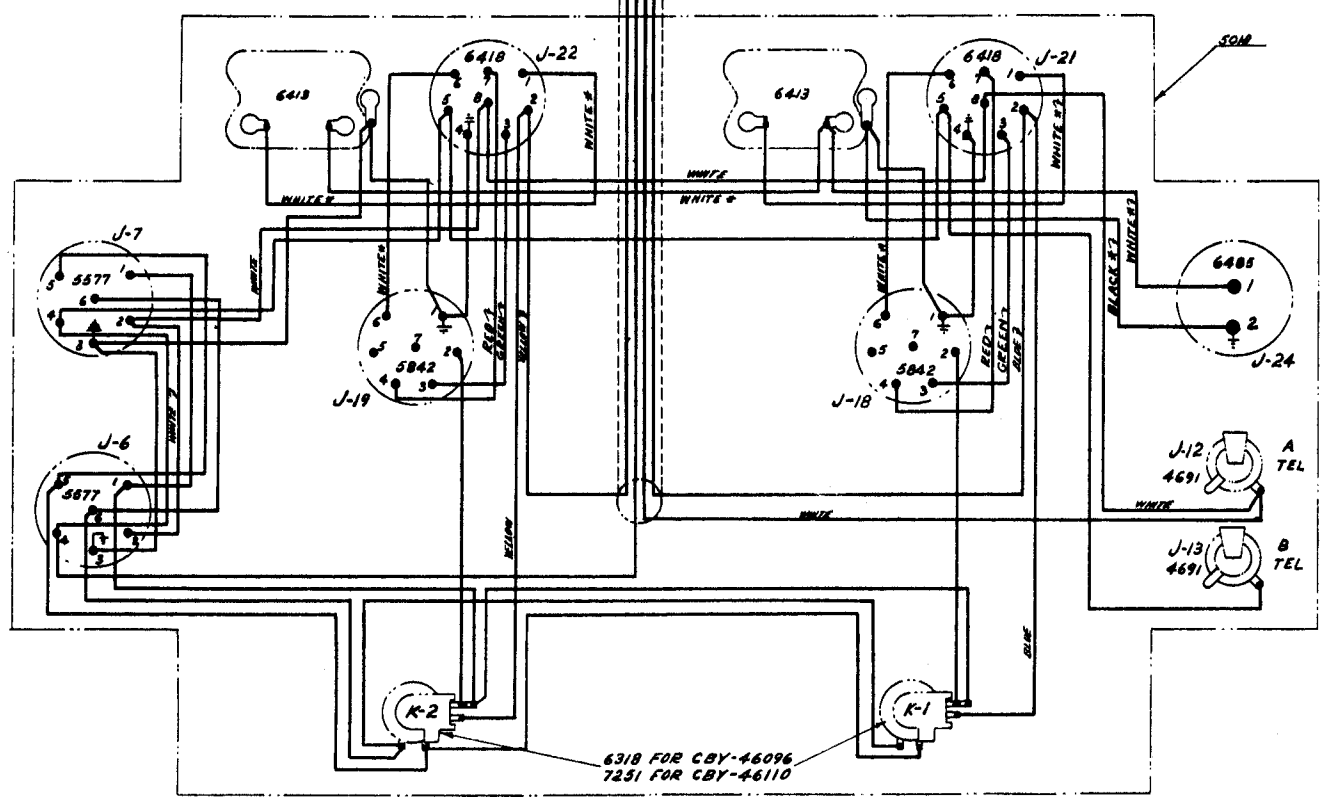
1. ASSEMBLE MOUNTING PLATE TO BASE ASSEMBLY BEFORE MOUNTING COILS AND CONDENSERS.
2. USE #21 TINNED COPPER WIRE FOR CONNECTIONS BETWEEN TERMINALS.
3. COVER ALL SOLDERED CONNECTIONS WITH RED LACQUER (SPEC. #4593).
4. SEAL ALL NUTS AND SCREWS WITH RED LACQUER EXCEPT AS OTHERWISE NOTED.
5. PLACE HOLE A ON COIL IN ANGULAR POSITION M.

TYPICAL IF COUPLING UNIT ASSEMBLY

Fig. 16—Typical IF Coupling Unit Assembly (IF=4200 KC)



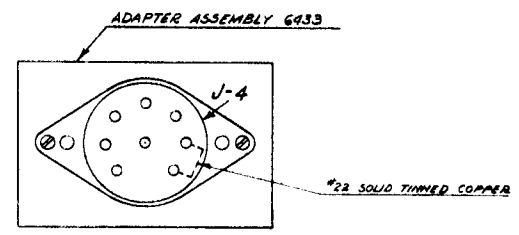
REAR VIEW OF FRONT CHANNEL



REAR VIEW OF COUPLING BOX

NOTES:
1. ALL WIRES MARKED (R) TO BE #18 STRANDED COPPER (SPEC.#3423).
2. ALL BARE WIRES TO BE #22 TINNED COPPER.
3. ALL OTHER WIRES TO BE #22 SOLID COPPER (SPEC.#3425).
4. ALL WIRES TO BE BLACK EXCEPT AS OTHERWISE INDICATED.
5. SEAL ALL SOLDERED JOINTS WITH RED LACQUER (SPEC.#4393)
6. BIND LEADS IN GROUPS WHERE REQUIRED FOR MECHANICAL STABILITY.

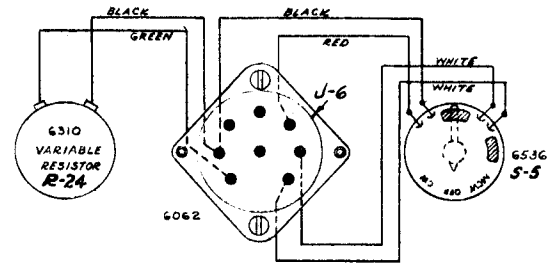
TYPE CBY-46096 OR TYPE CBY-46110
RECEIVER RACK



VIEW FROM REAR OF UNIT

NOTES:
1. SEAL ALL SOLDERED CONNECTIONS WITH RED LACQUER. (SPEC. #4593)

TYPE CBY-49107 OR TYPE CBY-49109
SWITCH PANEL ADAPTER
(MAKE REPLACEMENTS WITH TYPE CBY-49107)

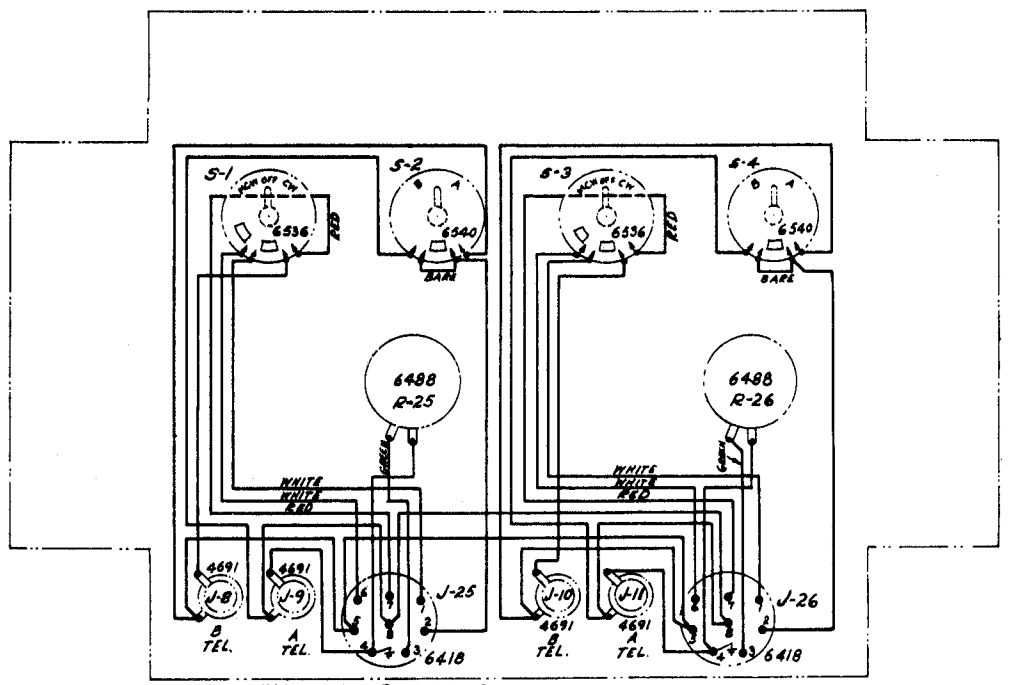


VIEW FROM REAR OF UNIT

NOTES:
1. SEAL ALL SOLDERED CONNECTIONS WITH RED LACQUER. (SPEC.#4593)
2. ALL WIRES ARE #22 SOLID COPPER.(SPEC.# 3425).

TYPE CBY-23154
SWITCH PANEL

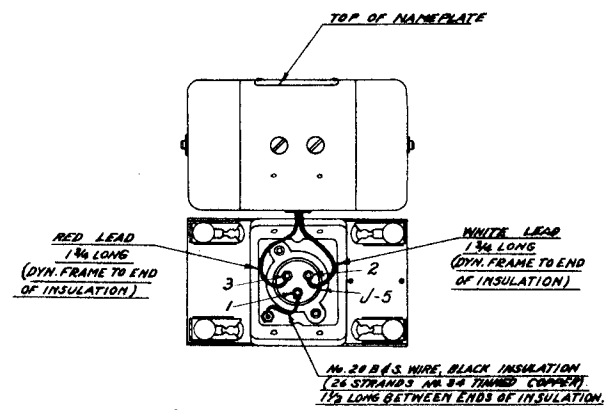
TYPE CBY-23155
RECEIVER CONTROL BOX



VIEW FROM REAR OF UNIT

NOTES:
1. ALL WIRES TO BE #22 SOLID COPPER,(SPEC.#3425) UNLESS OTHERWISE NOTED.
2. ALL WIRES TO BE BLACK EXCEPT AS OTHERWISE INDICATED.
3. SEAL ALL SOLDERED JOINTS WITH RED LACQUER (SPEC.#4393).
4. BIND LEADS IN GROUPS WHERE REQUIRED FOR MECHANICAL STABILITY.

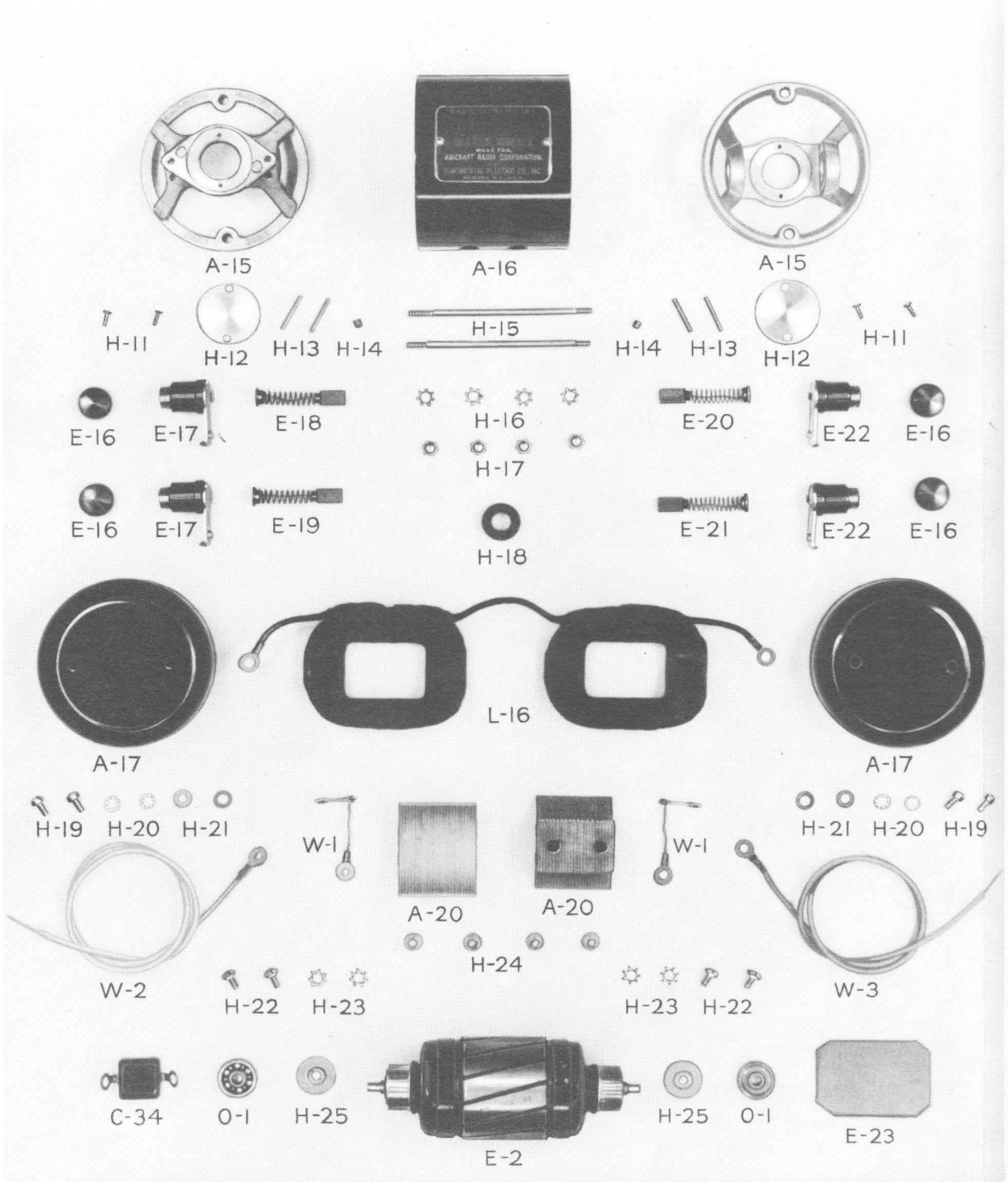
TYPE CBY-21400 (14 VOLT)
OR TYPE CBY-21531 (28 VOLT)
RECEIVER DYNAMOTOR UNIT

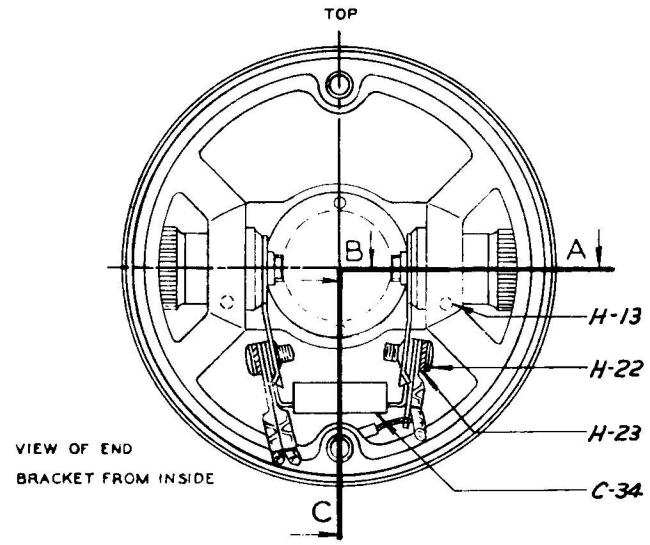


VIEW WITH DYNAMOTOR DISPLACED
SHOWING WIRING
SCALE 1:2

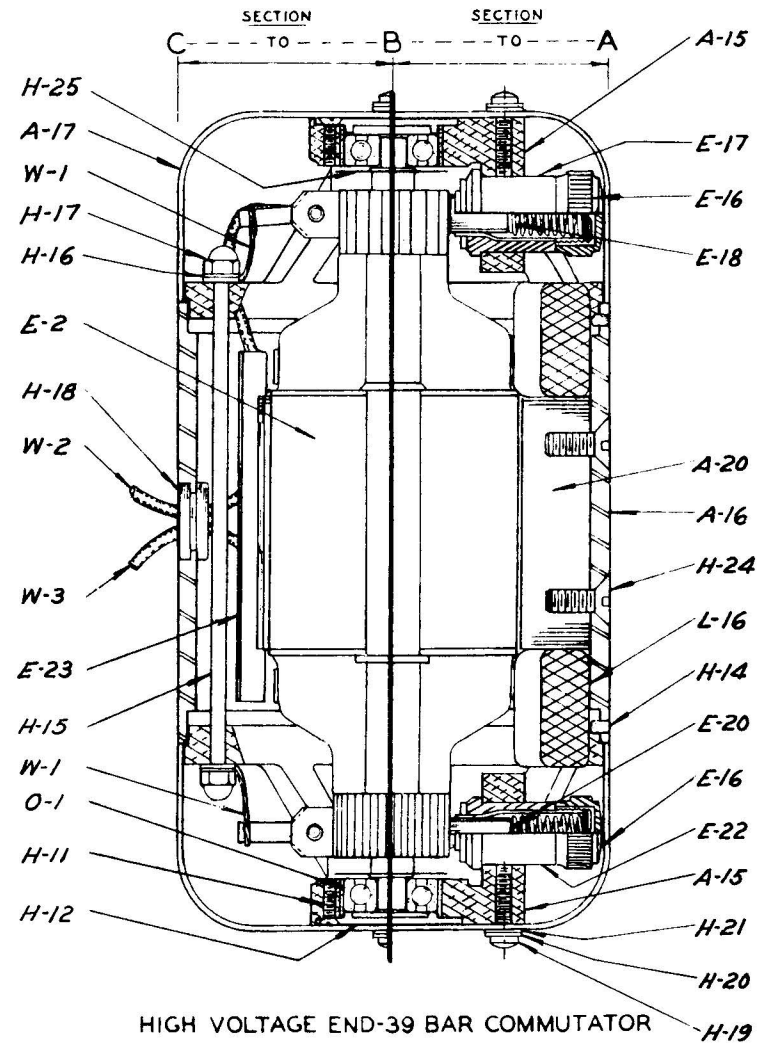
NOTES:
1. KEEP LEAD INSULATION CLOSE TO TERMINALS. PAINT BETWEEN ENDS OF LEAD INSULATION AND TERMINALS WITH THICK RED LACQUER FOR REENFORCEMENT.
2. TOPS OF TERMINALS MUST BE FREE FROM SHARP METALLIC POINTS.
3. TERMINAL NUMBERS SHOWN ARE FOR IDENTIFICATION PURPOSES. THEY DO NOT APPEAR ON THE UNIT.

Fig. 17—Receiver Racks, Switch Panel Adapters, Switch Panel, Receiver Control Box, and Receiver Dynamotor Units, Practical Wiring Diagrams



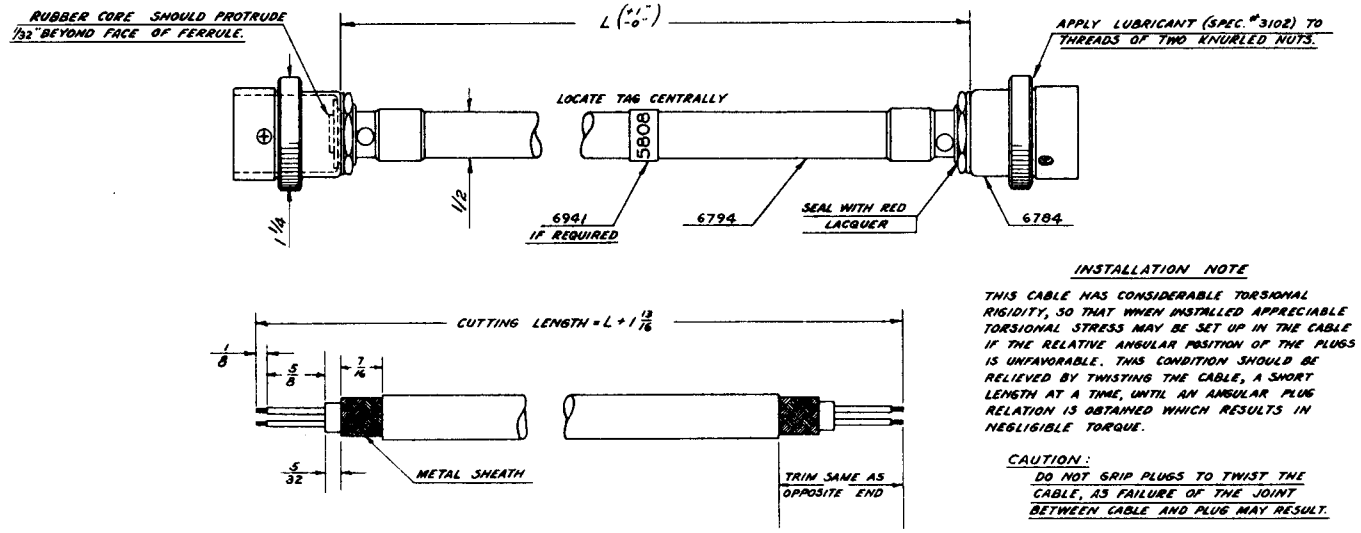


LOW VOLTAGE END-26 BAR COMMUTATOR



HIGH VOLTAGE END-39 BAR COMMUTATOR

Fig. 18—Photograph of Parts, and Line Drawing of Dynamotor Machine Used in Receiver Dynamotor Units



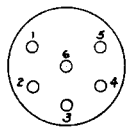
INSTALLATION NOTE

THIS CABLE HAS CONSIDERABLE TORSIONAL RIGIDITY, SO THAT WHEN INSTALLED APPRECIABLE TORSIONAL STRESS MAY BE SET UP IN THE CABLE IF THE RELATIVE ANGULAR POSITION OF THE PLUGS IS UNFAVORABLE. THIS CONDITION SHOULD BE RELIEVED BY TWISTING THE CABLE, A SHORT LENGTH AT A TIME, UNTIL AN ANGULAR PLUG RELATION IS OBTAINED WHICH RESULTS IN NEGLIGIBLE TORQUE.

CAUTION:
DO NOT GRIP PLUGS TO TWIST THE CABLE, AS FAILURE OF THE JOINT BETWEEN CABLE AND PLUG MAY RESULT.

WIRING COLOR CODE

1. BLUE
2. RED
3. BLACK (GROUND)
4. GREEN
5. YELLOW
6. WHITE



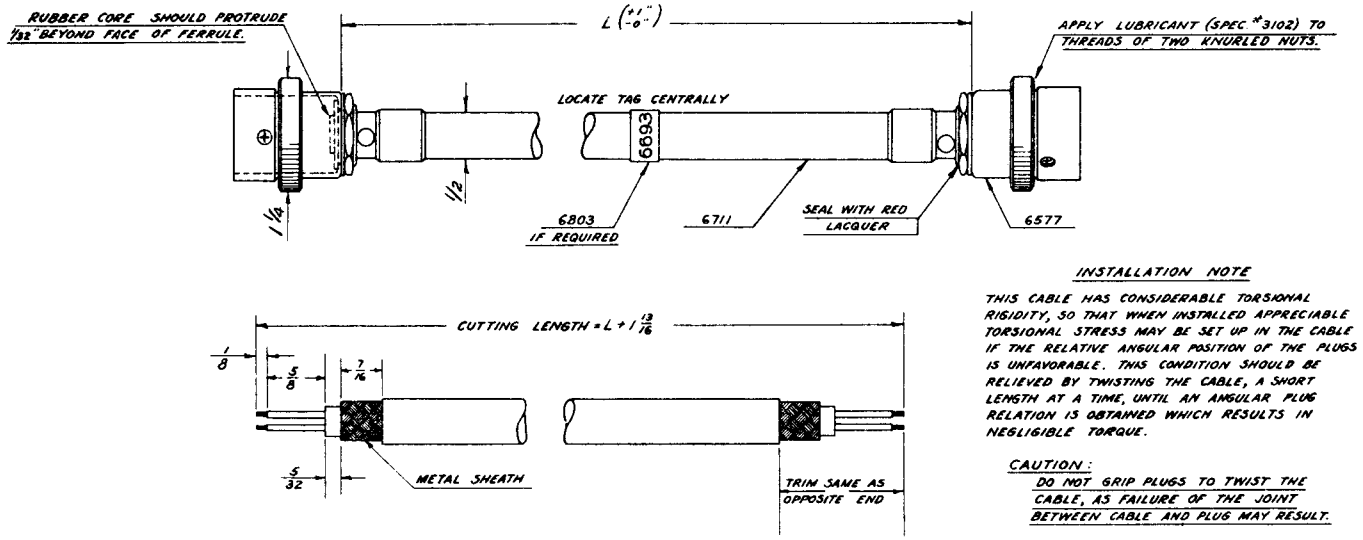
REAR VIEW OF PLUG

ASSEMBLY PROCEDURE:

A. STRIP CABLE ENDS TO DIMENSIONS INDICATED.
B. TIN ENDS OF CONDUCTORS.
C. INSERT CABLES INTO PLUG ASSEMBLIES.
D. BACK OFF NUTS, WASHERS AND SHELLS.
E. SOLDER WIRES TO RESPECTIVE JACKS PER WIRING COLOR CODE SO AS TO PRODUCE MINIMUM CROSS-OVERS OF CABLE CONDUCTORS.
F. SOLDER FERRULES THOROUGHLY TO SHEATH THROUGH 8 SIDE HOLES, WITH FERRULE PINS IN LINE WITH JACKS #3.
G. ASSEMBLE INSULATOR ASSEMBLIES INTO SHELLS WITH SCREWS; BRING PINS INTO SLOTS IN SHELLS; THEN TIGHTEN AND SEAL NUTS.

CABLE ASSEMBLY
RECEIVER RACK TO EXTERNAL EQUIPMENT

5808



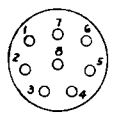
INSTALLATION NOTE

THIS CABLE HAS CONSIDERABLE TORSIONAL RIGIDITY, SO THAT WHEN INSTALLED APPRECIABLE TORSIONAL STRESS MAY BE SET UP IN THE CABLE IF THE RELATIVE ANGULAR POSITION OF THE PLUGS IS UNFAVORABLE. THIS CONDITION SHOULD BE RELIEVED BY TWISTING THE CABLE, A SHORT LENGTH AT A TIME, UNTIL AN ANGULAR PLUG RELATION IS OBTAINED WHICH RESULTS IN NEGLIGIBLE TORQUE.

CAUTION:
DO NOT GRIP PLUGS TO TWIST THE CABLE, AS FAILURE OF THE JOINT BETWEEN CABLE AND PLUG MAY RESULT.

WIRING COLOR CODE

1. WHITE
2. RED
3. BLUE
4. GREEN (GROUND)
5. YELLOW
6. BLACK
7. BROWN
8. ORANGE



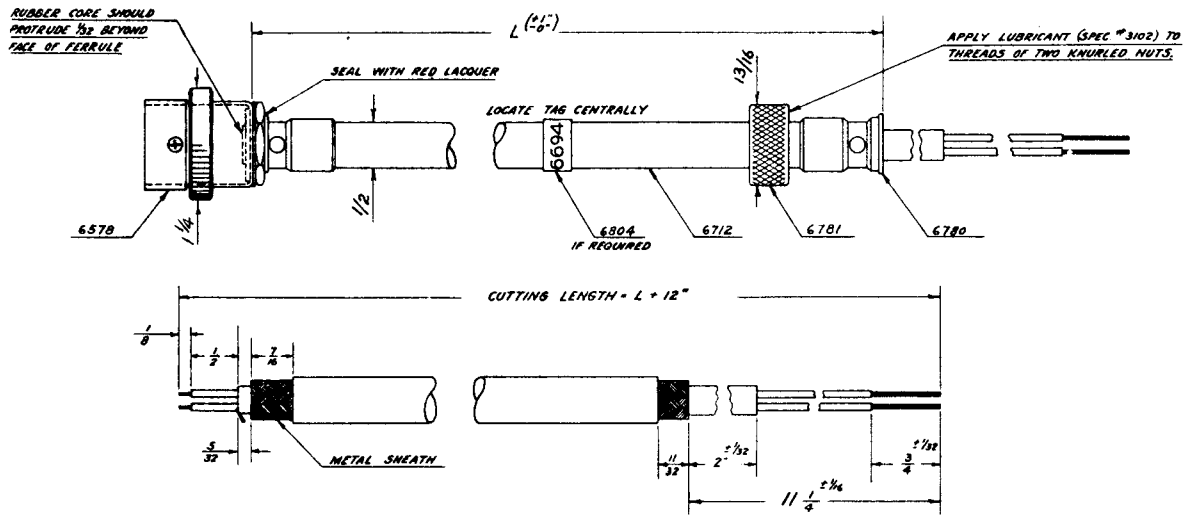
REAR VIEW OF PLUG

ASSEMBLY PROCEDURE:

A. STRIP CABLE ENDS TO DIMENSIONS INDICATED.
B. TIN ENDS OF CONDUCTORS.
C. INSERT CABLES INTO PLUG ASSEMBLIES.
D. BACK OFF NUTS, WASHERS AND SHELLS.
E. SOLDER WIRES TO RESPECTIVE JACKS PER WIRING COLOR CODE SO AS TO PRODUCE MINIMUM CROSS-OVERS OF CABLE CONDUCTORS.
F. SOLDER FERRULES THOROUGHLY TO SHEATH THROUGH 8 SIDE HOLES, WITH FERRULE PINS IN LINE WITH JACKS #4.
G. ASSEMBLE INSULATOR ASSEMBLIES INTO SHELLS WITH SCREWS; BRING PINS INTO SLOTS IN SHELLS; THEN TIGHTEN AND SEAL NUTS.

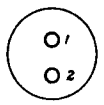
CABLE ASSEMBLY
RECEIVER RACK TO RECEIVER CONTROL BOX

6693



WIRING COLOR CODE

1. WHITE
2. BLACK (GROUND)



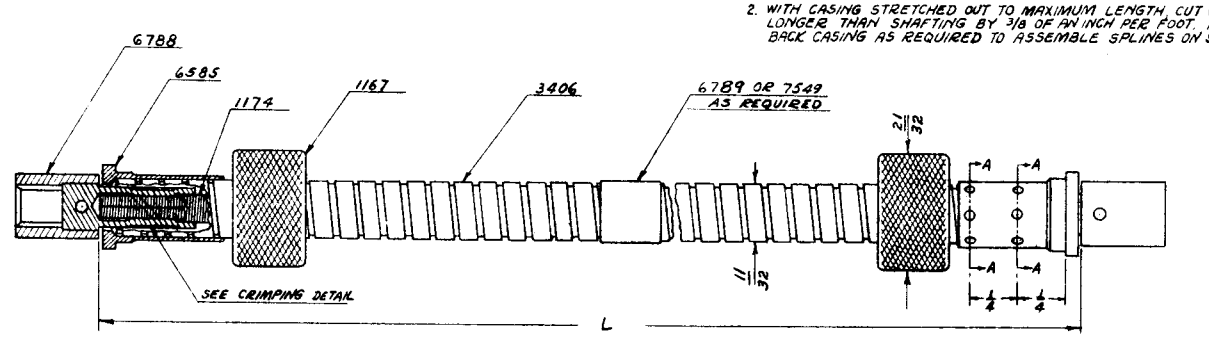
REAR VIEW OF PLUG

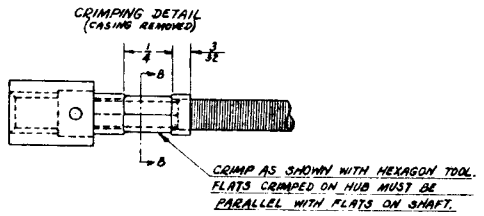
ASSEMBLY PROCEDURE

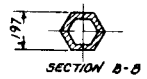
A. STRIP CABLE ENDS TO DIMENSIONS INDICATED.
B. TIN ENDS OF CONDUCTORS.
C. INSERT CABLE INTO PLUG ASSEMBLY AND FERRULE.
D. BACK OFF NUTS, WASHER AND SHELL.
E. SOLDER WIRES TO RESPECTIVE JACKS PER WIRING COLOR CODE.
F. SOLDER FERRULES THOROUGHLY TO SHEATH THROUGH 8 SIDE HOLES. FERRULE PIN OF PLUG 6578 SHOULD BE IN LINE WITH JACK #2.
G. ASSEMBLE INSULATOR ASSEMBLY INTO SHELL WITH SCREW; BRING PIN INTO SLOT IN SHELL; THEN TIGHTEN AND SEAL NUT.

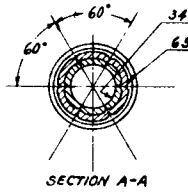
CABLE ASSEMBLY
PRIMARY POWER SUPPLY TO RECEIVER RACK

6694









STAKE ITEM 6585 TO CASING AT BOTH ENDS OF SHAFT AS SHOWN. WHEN STAKING USE PILOT OF SUITABLE SIZE TO MAKE FINAL INSIDE DIAMETER OF CASING = .242 +.006 -.000.

LUBRICATION:
FOR SHAFT; STANDARD OIL CO. "UNIVIS #40" OR EQUIVALENT.
FOR THREADS OF NUTS; APPLY ANTI-SEIZE LUBRICANT (SPEC. #3102)

MECHANICAL LINKAGE ASSEMBLY

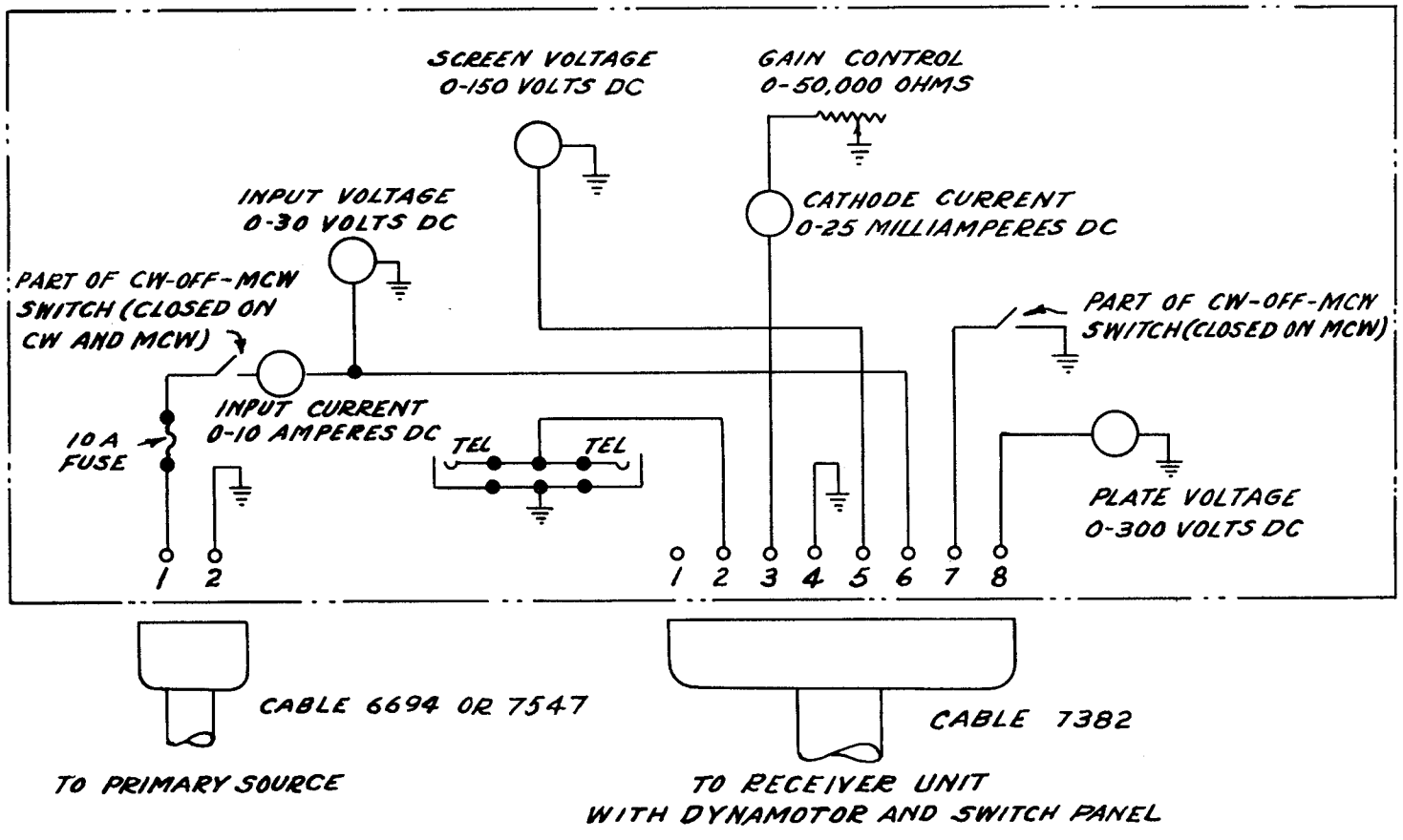
6131

Fig. 19—Cable Assemblies and Mechanical Linkage

RECEIVER TEST SET #7918 CONSISTS OF THE FOLLOWING:

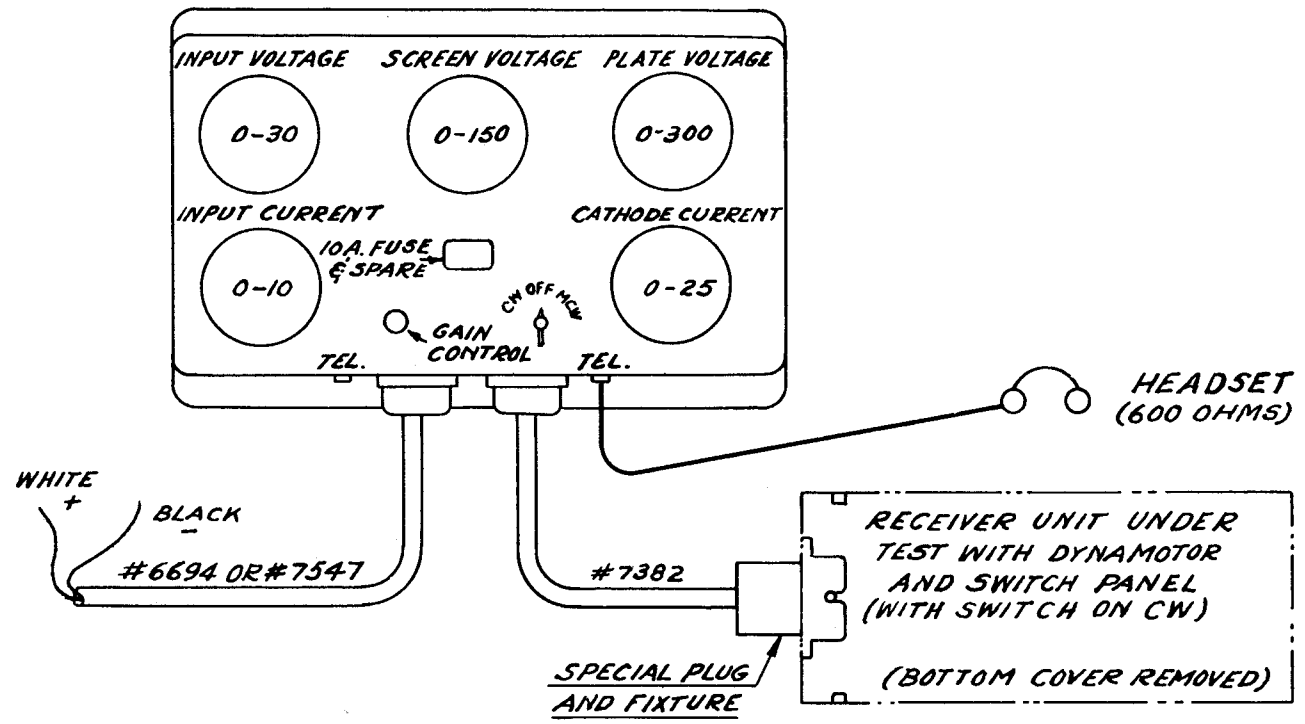
1 RECEIVER TEST UNIT #7369.
1 RECEIVER TEST RACK #7509 (FOR 1 RECEIVER).
1 MOUNTING #7059 (FOR 1 RECEIVER TEST RACK).
1 CABLE ASSEMBLY #7382.
1 LOCAL TUNER (KNOB ASSEMBLY) #6743.

THIS TEST SET MAY BE USED WITH-BUT IS NOT SUPPLIED AS PART OF MODEL RAT OR RAT-1 EQUIPMENT.



SCHEMATIC CIRCUIT DIAGRAM OF RECEIVER TEST UNIT #7369

RECEIVER TEST UNIT #7369



METER LABELLED	READS	METER READINGS FOR "CW" OR "MCW" POSITIONS OF CONTROL SWITCH, GAIN CONTROL AT MAXIMUM	
		RAT	RAT-1
INPUT VOLTAGE	PRIMARY SOURCE (VOLTS)	14.0	28.0
SCREEN VOLTAGE	SCREEN GRID SUPPLY TO 12SK7 & 12K8 TUBES (VOLTS)	78-92	78-92
PLATE VOLTAGE	PLATE SUPPLY TO 12SK7 & 12K8 TUBES & SCREEN GRID SUPPLY TO 12A6 TUBE (VOLTS)	230-250	230-250
INPUT CURRENT	TOTAL CURRENT FROM PRIMARY SOURCE (AMPERES)	2.8-3.4	1.4-1.7
CATHODE CURRENT	CATHODE CURRENT OF RF AMP AND 1ST IF AMP TUBES 12SK7 (MILLIAMPERES)	11-15	11-15

CONNECTIONS FOR SERVICING RECEIVER UNITS

(THIS ARRANGEMENT PROVIDES FOR ACCESS TO ELECTRICAL COMPONENTS INSIDE THE RECEIVER UNDER TEST. TABLE 3 LISTS ALL VACUUM TUBE TERMINAL VOLTAGES.)