INSTRUCTION BOOK

For

RADIO TELEPHONE AND TELEGRAPH
TRANSMITTING AND RECEIVING EQUIPMENT
MODELS TCS-7, TCS-9, TCS-10, TCS-11 AND TCS-12

NAVSHIPS 900, 291-IB

RESTRICTED

COLLINS RADIO CO., CEDAR RAPIDS, IOWA
STEWART WARNER CORP., CHICAGO, ILL.

CONTRACTOR

COLLINS RADIO CO., CEDAR RAPIDS, IOWA

FOR

U. S. NAVY DEPT. BUREAU OF SHIPS

Contracts:

NXss-18851 NXss-29815 NXsr-36727 NXsr-46026
NXss-22666 NXss-33361 NXsr-43404 NXsr-47395

Approved 14 November 1944

520 9069 00

TABLE OF CONTENTS

SECTION I GENERAL DESCRIPTION

SECTION II FUNCTIONAL CHARACTERISTICS

SECTION III INSTALLATION

SECTION IV OPERATION

TABLE OF CONTENTS

SECTION V MAINTENANCE

SECTION VI DATA

SECTION VII APPENDIX

LIST OF PHOTOGRAPHS AND DRAWINGS

LIST OF PHOTOGRAPHS AND DRAWINGS

LIST OF PHOTOGRAPHS AND DRAWINGS

* Also applicable to the Navy Type –20242 Power Unit.

** Also applicable to the following Power Units: Navy Type –21774, –21775, –21909, –21776, –21777, –21827, –21827-A, and –211100.

*** This illustration applies to the Types –211035, –21881 and –21881-A power units.

LIST OF TABLES

NOTICE OF EQUIPMENT DIFFERENCES

This instruction book covers NAVY MODELS TCS-7, TCS-9, TCS-10, TCS-11 and TCS-12 equipments. Due to design changes, there are a few differences that exist between the different models of TCS. These differences are listed below:

(A) Navy Model TCS-7 employs air tuned I.F. transformers in the receiver while all subsequent models employ iron core inductively-tuned I.F. transformers. This difference requires a change in alignment procedure which is described in the text in the MAINTENANCE Section. A separate receiver top view photo is furnished showing each type of transformer.

(B) Capacitor C225 is a .00002 mfd value capacitor, part number 912N420C-M, in the Navy Model TCS-7 equipment while in all later models capacitor C225 has a value of .000025 mfd, part number 912N425C-K.

(C) The spare parts list for the different models of equipment are not necessarily alike; therefore, a separate list is incorporated in a SPARE PARTS CATALOG which is included with each instruction book.

(D) Antenna meter M102 appears in the ground circuit of the antenna tuning network in all contracts prior to NXsr-46026; in contract NXsr-46026 and all subsequent contracts, antenna meter M102 is located in the antenna lead of the antenna tuning network.

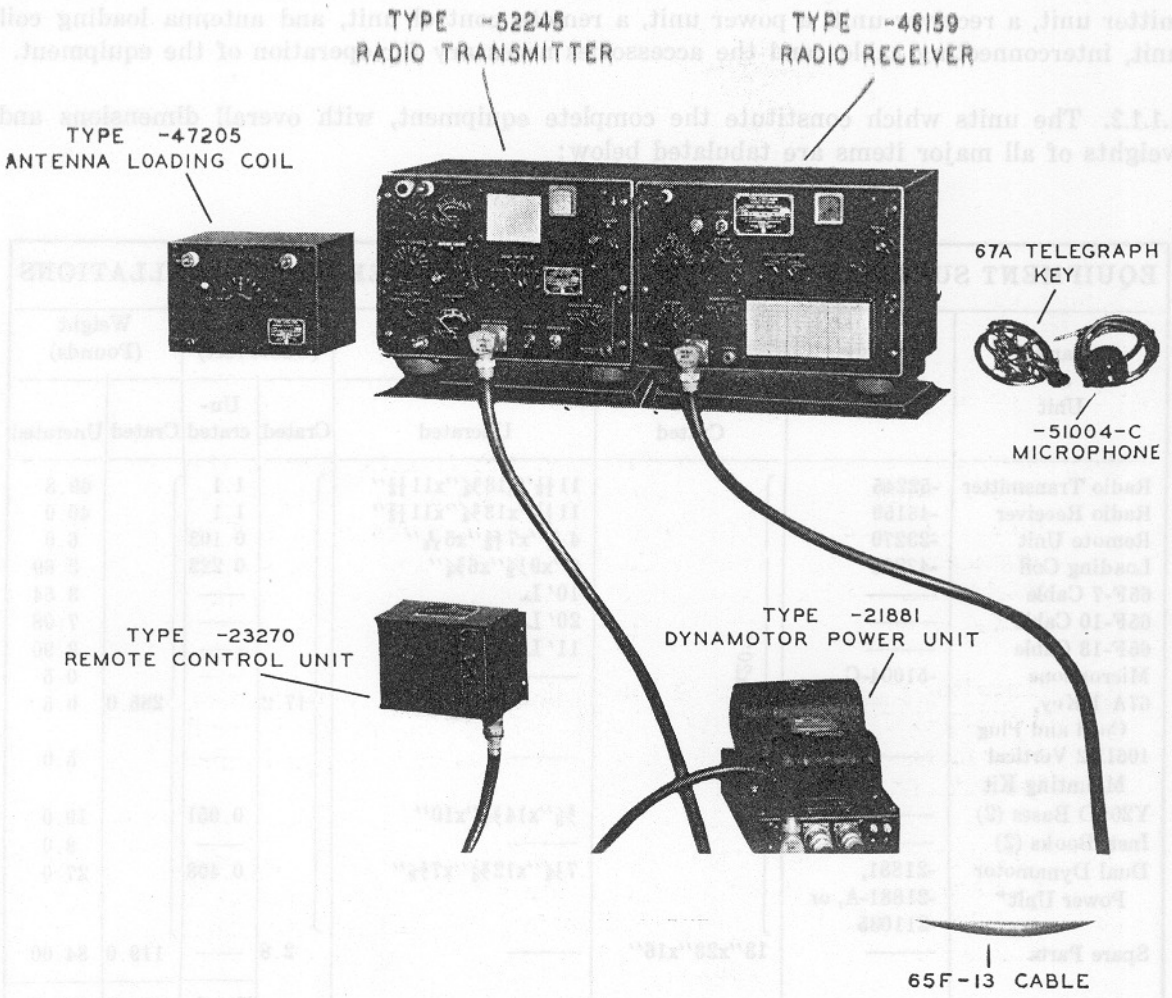


Fig. 1. Complete TCS Equipment.

1.1.2. Tube Complement

One set of tubes for the complete equipment consists of:

Symbol Designation	Quantity	Type Number	Circuit Function	Unit Type Number
V101	1	12A6	Master Oscillator	–52245
V102	1	12A6	Crystal Oscillator	–52245
V103	1	12A6	Buffer-Doubler	–52245
V104, V105	2	1625	Power Amplifiers	–52245
V106, V107	2	1625	Modulators	–52245
V201	1	12SK7	R-F Amplifier	–46159
V202	1	12SA7	Converter	–46159
V203	1	12A6	Oscillator	–46159
V204	1	12SK7	First I-F Amplifier	–46159
V205	1	12SK7	Second I-F Amplifier	–46159
V206	1	12SQ7	Detector-BFO	–46159
V207	1	12A6	Audio Amplifier	–46159

When using the Type –20218 Power Supply, the Type –20242 Power Supply, or the Type –20309 Power Supply, the following additional tubes are necessary:

V301, V302, V501, V502, V2201, V2202	2	5R4GY	H. V. Power Rectifier
V303, V304, V503, V504, V2203, V2204	2	6X5GT	L. V. Power Rectifier

1.2. GENERAL

1.2.1. The equipment covered by these instructions is a complete radio transmitting and receiving installation and is designed for use in portable and mobile services. The equipment is suitable for installation in trucks, ambulances, motor cars, tanks, motor boats and in other services where severe vibration and shock may be encountered.

1.2.2. Each unit is securely mounted in a cabinet constructed of corrosion resisting sheet steel. The cabinets are finished on the inside with flat black enamel and on the outside with baked black enamel crinkle finish. All parts of the cabinets are adequately reinforced to withstand the vibration and shock incident to normal service.

1.2.3. Sub-assembly type of construction has been used extensively in this equipment. This type of construction facilitates the removal of component parts without major disassembly of the unit. A table included in the MAINTENANCE Section of this Instruction Book lists the steps that are necessary to gain access to all components within the equipment. The table is designed to aid the maintenance personnel in servicing the equipment.

1.3. POWER INPUT

1.3.1. The power that is drawn from the source is largely dependent upon the type of power unit used. The maximum power is drawn from the power source when the transmitter carrier is voice modulated and the re-

ceiver is in the stand-by condition. A table of power input requirements, covering all of the types of supplies that are available with the TCS equipment, is included in the DATA Section of this Instruction Book.

1.4. TRANSMITTER CHARACTERISTICS

1.4.1. The transmitter employs an oscillator-buffer-amplifier circuit with provision for operation on any one of four crystal controlled frequencies or for continuous coverage master oscillator operation.

1.4.2. Frequency Range

1.4.2.1. The frequency range, 1500 kc to 12,000 kc, is covered in three bands, Band 1—1500 kc to 3000 kc, Band 2—3000 kc to 6000 kc, and Band 3—6000 kc to 12,000 kc. A three position, two section switch is used to select the desired band.

1.4.3. Frequency Stability

1.4.3.1. The transmitter is rigidly constructed to give a high degree of frequency stability under the conditions common to the types of services for which the equipment was designed. The frequency variation due to vibration of an amplitude of $\frac{1}{16}$ inch in any plane and at a frequency of thirty cycles per second for thirty minutes will not exceed 0.05%; the variation due to changes in line supply voltage from 10% above to 10% below the normal value will not exceed 0.01%. Increasing the humidity from normal values to 95% humidity will cause a frequency variation which will not exceed 0.10%.

1.4.4. Emission

1.4.4.1. The transmitter is capable of emitting either CW or voice modulated signals. The type of emission may be selected by the operation of the VOICE-CW switch that is located on the front panel of the transmitter. The audio system is capable of modulating the carrier at least 90% for voice emission. The carrier may be keyed at speeds up to 38 WPM WHEN USING M.O. FREQ. CONTROL WITHOUT OBJEC-tionable chirp. In general, the keying speeds are limited to 20 words per minute or less when using crystal control. The reduced speed of keying when using crystal frequency control is a characteristic of the quartz crystal and is not the fault of the transmitter.

1.4.5. Audio

1.4.5.1. The frequency response of the transmitter is uniform within plus or minus 3 db from 300 cps to 3000 cps. The audio frequency distortion is less than 10% rms measured with 90% modulation at 400 cps. The residual noise level on the carrier is more than 40 db below the 100% modulation level. The audio input circuit of the transmitter is designed to operate from a carbon microphone of approximately 100 ohms internal resistance. An audio input of 0.86 volt is required to modulate the carrier 90% at 400 cps.

1.4.6. Power Output

1.4.6.1. The power output, as measured at the plates of the power amplifier tubes with normal supply voltages, is 20 watts on voice and 40 watts on CW at all frequencies. The actual power delivered to the antenna, however, is dependent upon the type of antenna used. The output network of the unit is designed to match an antenna 20 feet long and of the type known as the "whip" antenna. A table showing actual power output, as measured into a dummy load that simulates the 20 feet vertical radiator, is included in the DATA Section of this book.

1.4.7. Crystals

1.4.7.1. It is recommended that crystals ground to frequencies in the range 1500 kc to 3000 kc be used. The first, second, or fourth harmonic freqencies of these crystals may be used, giving output on any frequency within the range of the transmitter. Any one of the four crystals may be selected by THE OPERATION OF THE OSCILLATOR SELECTOR SWITCH

1.5. RECEIVER CHARACTERISTICS

1.5.1. The receiver employs a sensitive superheterodyne circuit designed for either crystal or master oscillator controlled operation. One stage of r-f amplification and two stages of i-f amplification are employed to give the sensitivity and selectivity that is necessary for operation under the conditions experienced in normal service.

1.5.2. Frequency Range

1.5.2.1. The frequency range, the same as that of the transmitter, is covered in three bands. Band 1 covers the frequency range 1500 kc to 3000 kc, Band 2 covers the frequency range 3000 kc to 6000 kc and Band 3 covers the frequency range 6000 kc to 12,000 kc. An OSCILLATOR SELECTOR switch control knob, located on the front panel, permits the selection of any one of the bands of frequencies. Crystal controlled operation is most satisfactory in Bands 1 and 2 but is possible in Band 3 with somewhat reduced sensitivity.

1.5.3. Audio

1.5.3.1. With gain control set for 1.0 watt audio output the distortion is less than 5.0%. The output circuit of the receiver is designed to work into a 500 ohm load. The maximum output, measured at the output jack with a signal 30% modulated at 400 cps being fed into the receiver at the ANTENNA terminal, is 1.5 watts.

1.5.4. Sensitivity

1.5.4.1. The receiver is of moderate sensitivity and will deliver 6 milliwatts audio power with less than 15 microvolts input on all bands.

1.5.5. Selectivity

1.5.5.1. Two stages of intermediate frequency amplification provide good selectivity. The band is approximately 9 kc wide at 6 db down, 18 kc wide at 20 db down and 30 kc wide at 40 db down.

1.5.6. Input Circuit

1.5.6.1. The input circuit of the receiver is designed to operate efficiently from the regular transmitting antenna, the 20 foot vertical "whip". When installed for operation and a jumper is connected between the ANTENNA terminal on the receiver and the RECEIVER ANTENNA terminal on the transmitter, the antenna is automatically transferred to the receiver input circuit from the transmitter output circuit whenever the push-to-talk button on the microphone is released or the telegraph key is open.

1.5.7. Crystals

1.5.7.1. It is recommended that crystals ground in the frequency range 1500 kc to 3000 kc be used in the receiver. The second, third, and fourth harmonic frequencies of the crystals may be used but operation on the third and fourth harmonic frequencies will result in reduced sensitivity.

1.6. POWER UNITS

1.6.1. Power units are available for operation from 12 volts d-c, 24 volts d-c, 32 volts d-c, 115 volts d-c, 230 volts d-c, 115 volts 60 cps a-c, and 230 volts 60 cycle a-c power sources. Operation from the above power sources is accomplished by the use of separate power units. The output voltages of the power units are adequately filtered to reduce the objectionable ripple and noise components to negligible values.

1.6.2. Dynamotor Power Units

1.6.2.1. The Dual Machine Dynamotor Power Unit consists of dual dynamotors and operates exclusively from a 12 volt d-c power source. One dynamotor supplies 225 volts for application to the plates and screens of the receiver tubes and for the low voltage stages of the transmitter. The other dynamotor supplies 400 volts for application to the plates of the power amplifier and modulator tubes in the transmitter.

1.6.2.2. The Single Machine Dynamotor Power Unit consists of a multiple winding dynamotor capable of operating from either a 12 v or a 24 v d-c source simply by changing the position of a plug located within the unit chassis.

1.6.3. Motor Generator Power Unit

1.6.3.1. The Types –21775, –21776, –21777, –21826, –21774, –21909, –211100, –21827 and the –21827-A Power Units utilize two motors and two generators to supply the voltages necessary for the operation of the transmitter and receiver. The Types –21826 and –21774 are designed to operate from a 24 volt d-c power source; the Type –21775 Power Unit is designed to operate from a 32 volt d-c power source; the Types –21776 and –211100 are designed to operate from a 115 volt d-c power source; the Types –21827 and –21827-A are designed to operate from a 230 volt d-c power source; and the Types –21777 and –21909 are designed to operate from a 115 volt 60 cycle power source. This motor generator power unit may be operated from any of the above power sources simply by changing the motors.

1.6.4. Rectifier Power Units

1.6.4.1. The Type –20218 Power Unit is designed to operate from the 115 volt 60 cps a-c power source. This unit utilizes two full-wave vacuum tube rectifier systems and a dry disc rectifier to supply the voltages necessary for the operation of the transmitter and receiver. The Type –20242 Power Unit is identical to the Type –20218 Power Unit except that it is designed for 230 volt 60 cycle power source.

1.6.4.2. The Type –20309 Power Unit is designed for use with either 115v 50/60 cycle or 230 volts 50/60 cycles a-c simply by changing the position of a toggle switch. This unit utilizes two full wave vacuum tube rectifier systems and a dry disc rectifier to furnish the necessary voltages for operation of the transmitter and receiver.

1.7. CONTROL UNIT

1.7.1. The Type –23270 Remote Control Unit contains all the components necessary for power and emission control of the transmitter, and, power and audio input control to the speaker or headphones, from a remote point. The unit contains a loudspeaker that may be used for reception or, if it is desired to use headphones, the headphones cord plug may be inserted into the PHONES jack. A switch permits the selection of either loudspeaker or phones reception.

1.8. ACCESSORIES

1.8.1. Interconnecting Cables—A complete set of cables is furnished to interconnect the various units for the complete installation.

1.8.2. Cable (Transmitter to Power Unit)—The 65F-7 cable consists of 11 conductors encased in a rubber covered metal shield. This cable is 10 feet long and is fitted with a shielded 16 terminal female locking type plug on each end.

1.8.3. Cable (Control Unit to Power Unit)—The 65F-10 cable consists of 7 conductors encased in a rubber covered metal shield. The cable is 20 feet long and each end is fitted with a 9 terminal female connector plug.

1.8.4. Cable (Receiver to Power Unit)—The 65F-13 cable consists of 7 conductors encased in a rubber covered metal shield. The cable is 11 feet long and is fitted with a 12 terminal female connector plug on each end.

1.8.5. Microphones

1.8.5.1. The microphones supplied with the equipment are of the single button carbon type and are complete with a push-to-talk switch for the operation of the transmitter relays. The internal resistance of these microphones is approximately 100 ohms. The frequency characteristics and construction of the microphones are such as to give excellent articulation on voice while reducing the effects of surrounding noise. The microphones are designed for close talking.

1.8.6. Telegraph Key

1.8.6.1. The telegraph key is of the standard type with a shorting lever. The jack on the transmitter panel accommodates either the microphone or telegraph key cord plug.

1.8.7. Tools

1.8.7.1. One #10 Bristo wrench and one #6 Bristo wrench are mounted on the inside of the rear panel of the transmitter. These wrenches are intended to be used for the removal or adjustment of the control knobs on the equipment.

1.8.8. Headphones

1.8.8.1. Headphones are not supplied with the equipment but will be desirable in most installations. Headphones of approximately 500 ohms impedance should be used.

1.9. ABBREVIATIONS

1.9.1. Throughout the Instruction Book abbreviations have been used in place of some of the more common radio terms and phrases. The abbreviations that are used in the sections that follow will not be defined but it will be assumed that reference will be made to the list below:

a. P.A.—Power Amplifier
b. CW—Continuous-Wave
c. VOICE—Voice Modulated
d. A-F—Audio Frequency
e. I-F—Intermediate Frequency
f. R-F—Radio Frequency
g. REMOTE—Control of the transmitter and receiver from a remote position using the Type –23270 Remote Control Unit.
h. BFO—Beat Frequency Oscillator
i. AVC—Automatic Volume Control

1.10. SYMBOL DESIGNATIONS

1.10.1. The symbol designations used throughout this book refer to the symbols used on the schematic diagrams and photographs. These symbols are also used in the Parts List and the Spare Parts List to coordinate circuit components and component part numbers and descriptions.

2.1. POWER CONTROL CIRCUITS

2.1.1. The transmitter and receiver may be controlled from the panels of the respective units or may be controlled from a remote position using the Type –23270 Remote Control Unit. The POWER switch, S107, in the transmitter and TRANSMITTER switch, S602, are connected in parallel and when operated, apply filament power to the tubes in the transmitter unit. The POWER switch, S205, in the receiver and the RECEIVER switch, S603, in the Remote Control Unit are connected in parallel and when operated, close the circuit necessary for the application of filament power to the receiver. The primary power control switch in this installation is the POWER switch, S205, on the receiver panel or the RECEIVER switch, S603. It is necessary to operate either of these switches before any power can be applied to the transmitter. Operating either switch S205 or switch S603 will apply filament power to the receiver tubes and apply primary power to the low voltage section of the power unit which will in turn apply plate and screen power to all tubes in the receiver unit. When the receiver power circuit has been closed, the operation of the POWER switch, S107, in the transmitter or the operation of the TRANSMITTER switch, S602, in the remote control unit will apply filament power to the tubes in the transmitter and actuate the relay or relays in the power unit that will apply primary power to the high voltage section of the power unit.

2.1.2. If the OSCILLATOR SELECTOR switch, S104, in the transmitter is operated to the MO TEST position and the transmitter POWER switch, S107, is operated to the ON position, filament, plate and screen power will be applied to the oscillator and buffer tubes. If the OSCILLATOR SELECTOR switch is in any position other than the MO TEST position it is necessary to operate the push-to-talk button on the microphone or the telegraph key, to close the carrier control circuit through J101 or J602, before high voltage will be applied to any tubes in the transmitter. The operating of the push-to-talk button on the microphone or the closing of the telegraph key completes the circuit necessary for the operation of relays K102 and K103 in the transmitter. If the EMISSION selector switch, S105, in the transmitter is operated to the VOICE position, relay K101 is energized and when operated, completes the circuit from the modulator tube plates and screens to the carrier control relay so that when circuit through J101 is completed, plate power is applied to the modulator tubes, V106 and V107. The operation of switch S105 also completes the circuit necessary for the application of filament power to the modulator tubes.

2.2. TRANSMITTER

2.2.1. Filament Circuits

2.2.1.1. The tube filaments of the master oscillator, V101, the crystal oscillator, V102, the buffer-doubler, V103, and the power amplifier, V104, are connected in parallel and have filament power applied whenever the POWER switch, S107, on the transmitter panel or the TRANSMITTER switch, S602, located in the Type –23270 Remote Control Unit, is operated. The filament of the remaining power amplifier tube, V105, is energized when the EMISSION selector switch, S105, is operated to the CW position. The operation of the EMISSION selector switch, S105, to the VOICE position energizes the filaments of the modulator tubes, V106 and V107, and removes filament power from the power amplifier tube, V105.

2.2.1.2. When using the Dynamotor Power Unit, filament power for both transmitter and receiver is drawn directly from the power source. When the Types –21775, –21776, –21777, –21826, –21827, –21774, –21909, –211100 or the Type –21827-A Power Units are used, the filament power is supplied by one of the generators. When using the Type –20218 Rectifier Power Unit, filament power is supplied by the step-down transformer, T303. When using the Type –20242 Rectifier Power Unit, the filament power is supplied by the step-down transformer, T503, when

using the Type –20309 Power Unit, the filament power is supplied by the step-down transformer, T2203.

2.2.2. High Voltage Circuits

2.2.2.1. Approximately 225 volts is necessary for application to the plates of the master oscillator tube, V101, the crystal oscillator tube, V102, and the buffer-doubler tube, V103. Approximately 400 volts is necessary for application to the plates of the power amplifier tubes, V104 and V105, and the modulator tubes, V106 and V107. Plate and screen voltages are applied to the power amplifier and modulator tubes by the operation of the antenna relay, K102. Plate and screen voltages are applied to the master oscillator, crystal oscillator, and buffer-doubler tubes by the operation of the carrier control relay, K103.

2.2.3. Carrier Control

2.2.3.1. The r-f carrier of the transmitter is controlled by the application and removal of the plate and screen voltages of all tubes. For further positive carrier control, the antenna is disconnected from the power amplifier output circuit by the operation of the antenna relay, K102. Plate and screen voltages are applied to the master oscillator, V101, and the buffer-doubler, V103, tubes without the operation of the carrier control or antenna relays when the OSCILLATOR SELECTOR switch, S104, is operated to the MO TEST position. The antenna relay, K102, and the carrier control relay, K103, are operated by closing the circuit through the MICROPHONE or KEY jack, J101, or the circuit through the MIKE jack, J602. The energizing circuits for these relays may be completed by operating the push-to-talk button on the microphone or by closing the telegraph key. The operation of relays K102 and K103 also disables the receiver by grounding the antenna terminal and by removing screen voltage from the r-f amplifier, V201, and the converter tube, V202.

2.2.4. Exciter

2.2.4.1. Refer to Figure 2. Either of two oscillator circuits may be used to control the frequency of the transmitter output. Each oscillator circuit employs a Type 12A6 beam pentode amplifier tube. The master oscillator tube, V101, operates in a Hartley circuit and is continuously tunable from 1500 kc to 3000 kc. The grid circuit of V101 is tuned by capacitor section C101A. Variable capacitor C101 is operated by the TUNING control on the transmitter front panel. A tuning slug within grid inductor L101 and trimmer capacitor C102 are used to set the endpoints of the frequency band. When the BAND SWITCH is operated to Positions 1 and 2 the plate circuit of the master oscillator tube is untuned and the output is coupled directly to the grid of the buffer-doubler tube, V103. When the BAND SWITCH is in the above positions the output of the oscillator is within the frequency range 1500 kc to 3000 kc. When the BAND SWITCH is operated to Position 3, a tank circuit consisting of inductor L103 and capacitors C101B and C107, is coupled to the plate of V101 and is tuned to twice the frequency of the grid circuit. A tuning slug within L103 and trimmer capacitor C107 are used to align the tank circuit. Therefore, with the BAND SWITCH in position 3, output from the oscillator is obtained in the frequency range 3000 kc to 6000 kc. The plate tank circuit is tuned by capacitor section C101B, a section of the same variable capacitor that is used to tune the grid circuit. When the OSCILLATOR SELECTOR switch, S104, is operated to the MO TEST position, plate and screen voltages are applied to the master oscillator tube, V101, and the buffer-doubler tube, V103, to permit the measuring of the frequency of the output without applying screen and plate voltages to the power amplifier tubes. When the OSCILLATOR SELECTOR switch, S104, is operated to the MO position it is necessary to close the MICROPHONE or KEY jack circuit and operate relay K103 to apply plate and screen voltages to the master oscillator and buffer-doubler tubes.

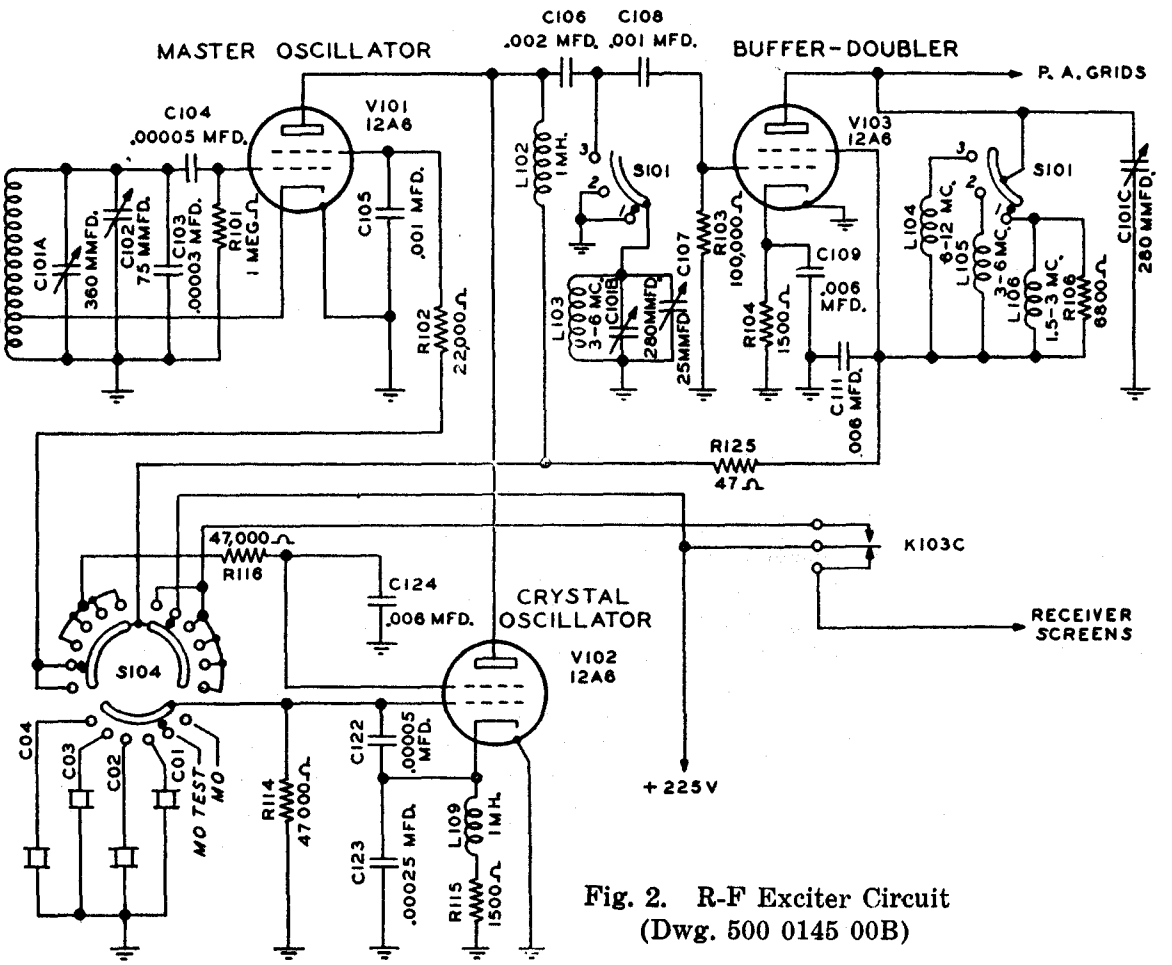


Fig. 2. R-F Exciter Circuit (Dwg. 500 0145 00B)

2.2.4.2. The crystal oscillator circuit may be selected by the operation of the OSCILLATOR SELECTOR switch, S104. Any one of 4 crystals may be selected. During periods that the master oscillator is being used for frequency control, screen voltage is removed from the crystal oscillator tube so that the circuit is rendered inoperative. When S104 is operated to one of the crystal positions, plate and screen voltages may be applied to V102 by closing the MICROPHONE or KEY jack circuit. Screen voltage is obtained from the 225 volt power source through the dropping resistor, R116. The plates of the crystal oscillator tube and the master oscillator tube are connected in parallel and therefore voltage is applied to the plates of both tubes when switch S104 is in the MO TEST position or when the carrier control relay, K103, is operated. When the BAND SWITCH is operated to Position 3, the tank circuit, consisting of inductor L103 and capacitors C101-B and C107, is connected to the plate of V102 to permit the tuning of the plate circuit to any frequency in the range 3.0 mc to 6.0 mc.

2.2.4.3. The buffer-doubler stage employs a Type 12A6 beam power amplifier tube. The stage operates as a straight amplifier when the BAND SWITCH is operated to Position 1 and operates as a frequency doubler when the BAND SWITCH is operated to Positions 2 or 3. Switch section S101 is operated by the BAND SWITCH and selects the proper inductor so that the plate tank circuit of V103 may be tuned to the desired frequency by capacitor section C101C. Capacitor section C101C is operated by the TUNING control. Plate and screen voltages are obtained

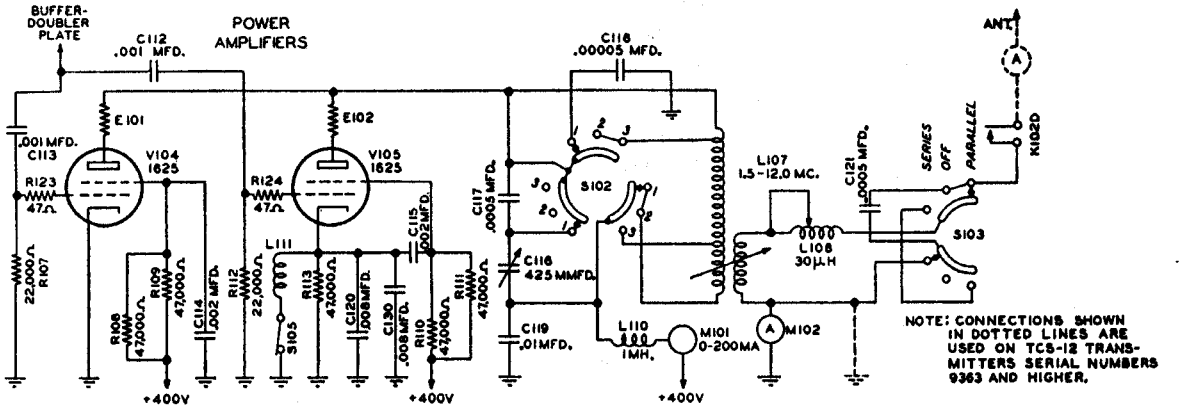


Fig. 3. P.A. Output & Antenna Coupling Circuits
(Dwg. 500 0144 00B)

from the 225 volt power source and are applied to V103 by the operation of switch S104 to the MO TEST position or by the operation of the carrier control relay, K103. A combination of grid and cathode bias is employed.

2.2.5. Power Amplifier and Output Network

2.2.5.1. Refer to Figure 3. The power amplifier employs two Type 1625 beam pentode tubes connected in parallel. During periods of VOICE emission, only V104 is in operation. The other power amplifier tube, V105, is rendered inoperative by the operation of the EMISSION selector switch, S105, to the VOICE position. When switch S105 is operated to the VOICE position, a resistor, R113, is connected between the cathode of the tube and ground, and the filament voltage is removed from V105. The full voltage of the power unit, 400 volts, is applied to the plates of V104 and V105. Series feed is employed. Screen voltage for the tubes is obtained through dropping resistors R108, R109, R110, and R111. The tubes are self-biased by the grid resistors, R107 and R112.

2.2.5.2. The combination of tank inductor, L107, the variable capacitor, C116, and the padding capacitors, C117 and C118, will tune the plate tank circuit of the power amplifier to any frequency within the range 1500 kc to 12,000 kc. Switch S102 is operated by the BAND SWITCH. When the BAND SWITCH is operated to Position 1, the entire inductance of inductor L107 is utilized, the padding capacitor, C117, is shorted out and the padding capacitor, C118, is connected in parallel with the capacitor combination, C116 and C119. When the BAND SWITCH is operated to Position 2, the inductor L107 is tapped at a position near the maximum inductance end, the padding capacitor, C118, is removed from the circuit and the padding capacitor, C117, is connected in series with the variable capacitor, C116. When the BAND SWITCH is operated to Position 3, a larger portion of the inductor, L107, is shorted out, the padding capacitor, C118, is removed from the circuit and the padding capacitor, C117, is connected in series with the variable capacitor, C116, across the remaining section of inductor L107.

2.2.5.3. The antenna coupling network consists of the rotor section of the variometer, L107, the loading inductor, L108, and the padding capacitor, C121. The coupling between the power amplifier plate tank circuit and the antenna circuit may be varied by the adjustment of the variometer, L107. The loading inductor, L108, is connected in series with the antenna lead and the amount of inductance connected in the circuit is determined by the position of the variable tap on

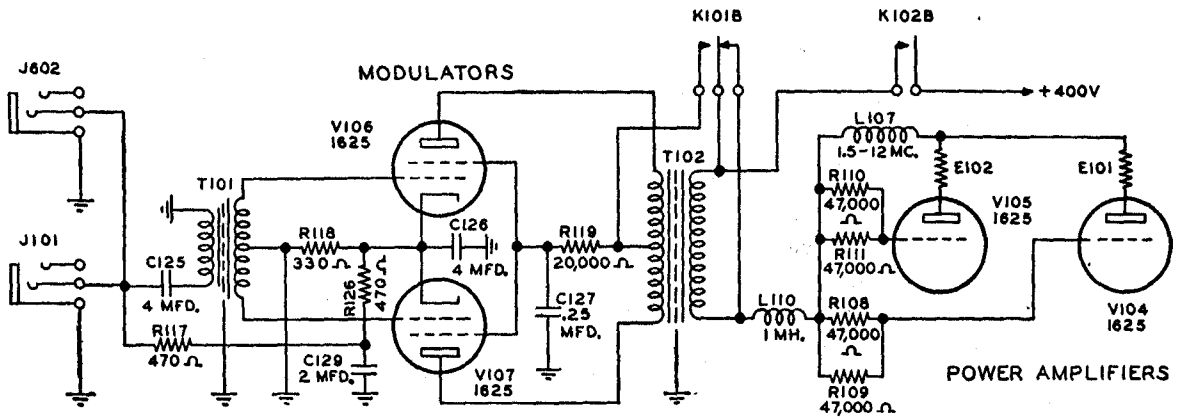


Fig. 4. Modulator Circuit (Dwg. 500 0138 00A)

the inductor. The ANT. COND. switch, S103, makes possible the connecting of padding capacitor, C121, in series or in parallel with the lead from the loading inductor, L108, to the antenna relay, K102, or the connecting of the inductor, L108, directly to the antenna relay, K102.

2.2.5.4. The power amplifier tank and antenna coupling circuits have been designed to give the most desirable L/C ratio over the entire frequency range of the transmitter. By selecting the proper position of switch S103, regulating the degree of coupling between the power amplifier plate tank circuit and the antenna coupling circuit and by adjusting the amount of inductance that is connected n series with the lead between the output of the power amplifier and the antenna, a wide range of antenna lengths may be properly matched.

2.2.6. Audio Circuit

2.2.6.1. Refer to Figure 4. The modulator, employing two Type 1625 beam pentode tubes, makes up the audio system of this transmitter. The two modulator tubes, V106 and V107, are connected in push-pull and operate Class B. The output of the microphone is coupled to the grids of the modulator tubes by transformer T101. Cathode bias and voltage for the microphone is developed across the cathode resistor, R118. Jacks J101 on the transmitter panel and J602 in the remote unit are connected in parallel and are coupled to the primary of the input transformer by capacitor C125. The full voltage of the power unit, 400 volts, is applied to the plates of the modulator tubes. Screen voltage is obtained through dropping resistor R119. Relay K101 is energized when the EMISSION selector switch, S105, is operated to the VOICE position. During periods of CW transmission, relay K101 is unoperated and the normally closed contacts of the relay short the secondary of the modulation transformer. The plate and screen voltages are not applied to the modulator tubes until the antenna relay, K102, is actuated. Both the screens and plates of the power amplifier tubes, V104 and V105, are modulated.

2.3. RECEIVER

2.3.1. The Type –46159 Radio Receiver Unit employs a 7 tube superheterodyne circuit. One stage of radio frequency amplification and two stages of intermediate frequency amplification provide a high degree of sensitivity and selectivity. A separate oscillator tube is employed to excite the converter to improve the operation on high frequencies. A diode detector has been incorporated in the receiver to give low distortion output.

2.3.2. Filament Circuits

2.3.2.1. All seven tubes employed in the receiver require 12 volts for application to the

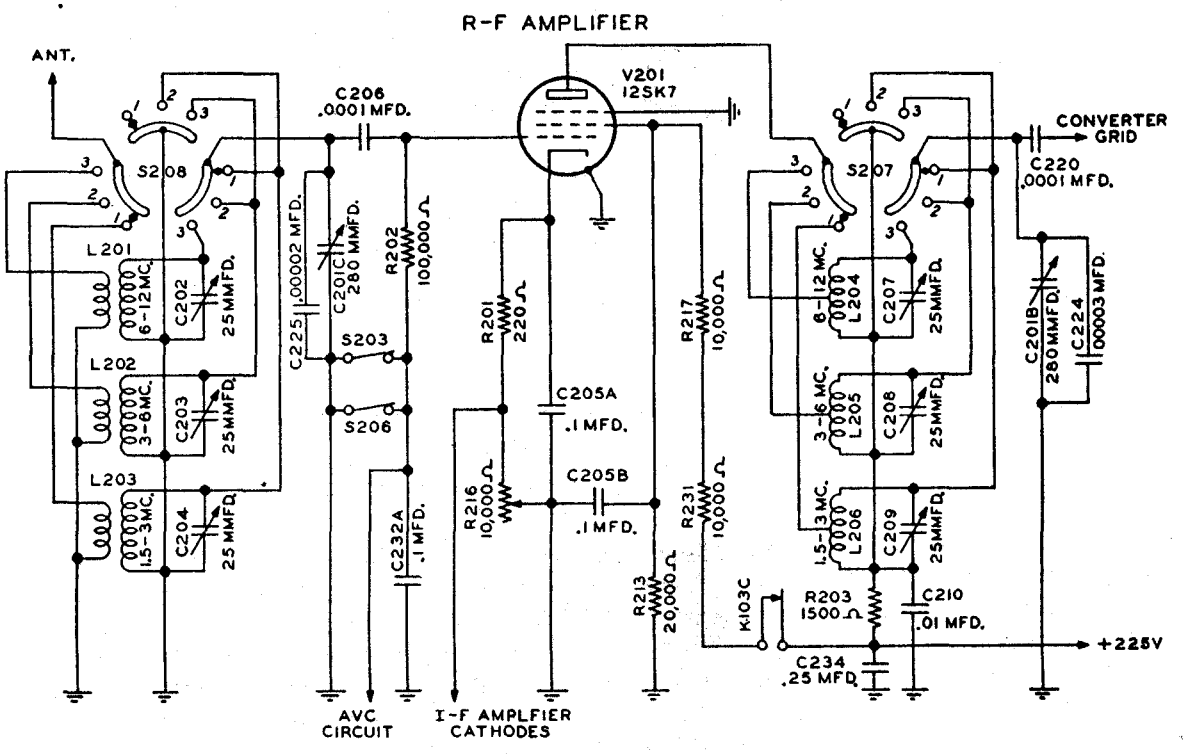


Fig. 5. R-F Amplifier Circuit (Dwg. 500 0139 00A)

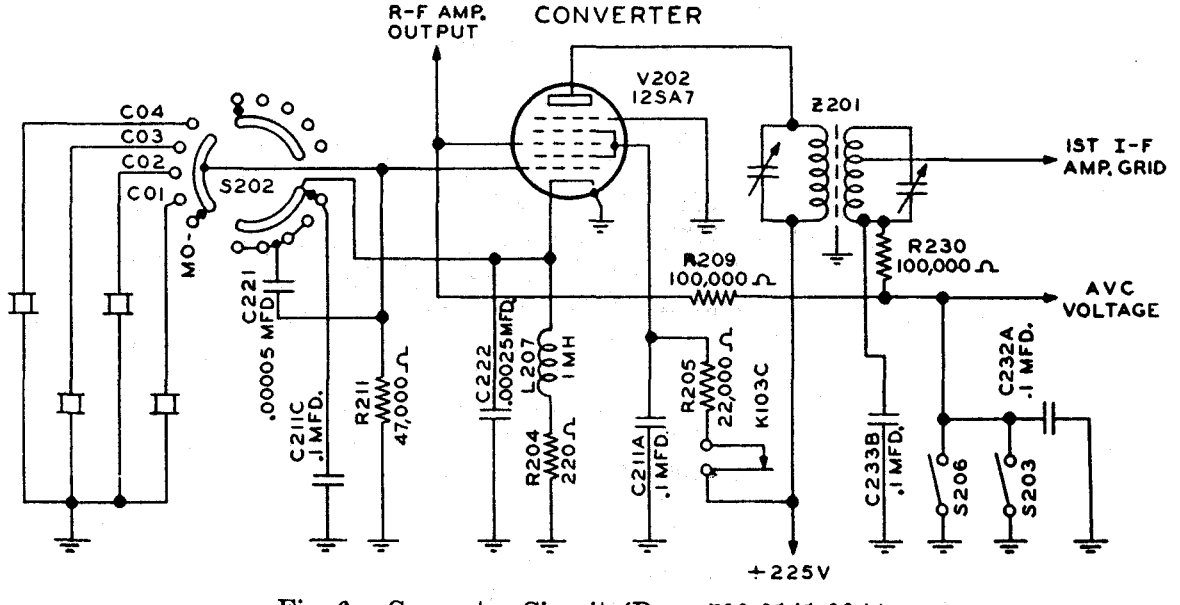


Fig. 6. Converter Circuit (Dwg. 500 0141 00A)

filaments. The filaments of the tubes are connected in parallel. (Note: Refer to paragraph 2.2.1.2. for a detailed explanation of how filament power is supplied when using the various types of power units.)

2.3.3. High Voltage Circuits

2.3.3.1. All tubes in the receiver require approximately 225 volts for application to the plates. The required voltage is supplied by the low voltage section of the power unit. (Note: Refer to paragraph 2.1.1. for a detailed explanation of how the voltage is controlled.)

2.3.4. R-F Amplifier Circuit

2.3.4.1. Refer to Figure 5. The single stage of r-f amplification employs a Type 12SK7 triple grid amplifier tube. Switch section S208 is operated by the BAND SWITCH on the receiver panel and connects the proper antenna coupling circuit to the grid of V201 to cover the band of frequencies upon which reception is desired. Tuning slugs within inductors L201, L202 and L203 and trimmer capacitors, C202, C203, and C204 permit the aligning of the antenna coupling circuit to obtain the maximum transfer of energy from the antenna to the grid circuit of the r-f amplifier. Switch section S207 is also operated by the BAND SWITCH and selects the proper plate tank circuit for V201 to cover the desired band of frequencies. The grid and plate tank circuits of V201 are tuned by capacitor sections C201C and C201B, respectively. Capacitor C201 is operated by the TUNING control. The gain of this stage is controlled by varying the cathode resistance with potentiometer R216. The AVC voltage is applied to the grid of V201 when the MOD./CW switch, S203, is in the MOD. position, and the R.F. GAIN control is fully advanced so that switch S206 is open. But when CW reception has been selected by the operation of switch S203, the AVC circuit is rendered inoperative by grounding the lower end of the grid resistor, R202. Plate voltage is supplied to V201 through the series resistor, R203, the plate inductor and the contacts of switch, S207. Screen voltage for the r-f amplifier is obtained from the 225 volt supply and is dropped through a voltage dividing circuit consisting of R213, R217 and R231. The receiver is disabled by the operation of relay K103 in the transmitter. Relay contacts K103C open to remove screen voltage from the r-f amplifier and converter tubes when the transmitter carrier is on.

2.3.5. Converter

2.3.5.1. Refer to Figure 6. A Type 12SA7 pentagrid tube is employed in the converter stage. The tube is excited by a separate oscillator except during periods of crystal controlled operation. When crystal reception has been selected by the operation of the OSCILLATOR SELECTOR switch, S202, a section of V202 operates as the oscillator to self-excite the converter. The full 225 volts output of the low voltage section of the power unit is applied to the plate through the primary of the i-f transformer, Z201. Screen voltage for the tube is obtained by connecting a resistor, R205, in series with the plate voltage supply. When the transmitter carrier is on, screen voltage is removed from V202 by the operation of the carrier control relay, K103, in the transmitter. AVC voltage is applied to the grid of the converter tube through the grid resistor, R209. The AVC circuit is rendered inoperative by the operation of the MOD./CW switch, S203, or the operation of switch S206. (Switch S206 is operated by the R.F. GAIN control.) The operation of either switch grounds the lower end of the grid resistor, R209.

2.3.6. Oscillator

2.3.6.1. Refer to Figure 7. The oscillator stage employs a Type 12A6 beam power amplifier tube. When MO reception is selected by the operation of the OSCILLATOR SELECTOR switch, S202, the oscillator tube, V203, is brought into operation. The separate oscillator tube is employed to excite the converter for best results when operating at high frequencies. The grid tank circuit selector switch, S201, is operated by the BAND SWITCH and selects the tank circuit that will tune the oscillator to a frequency 455 kc

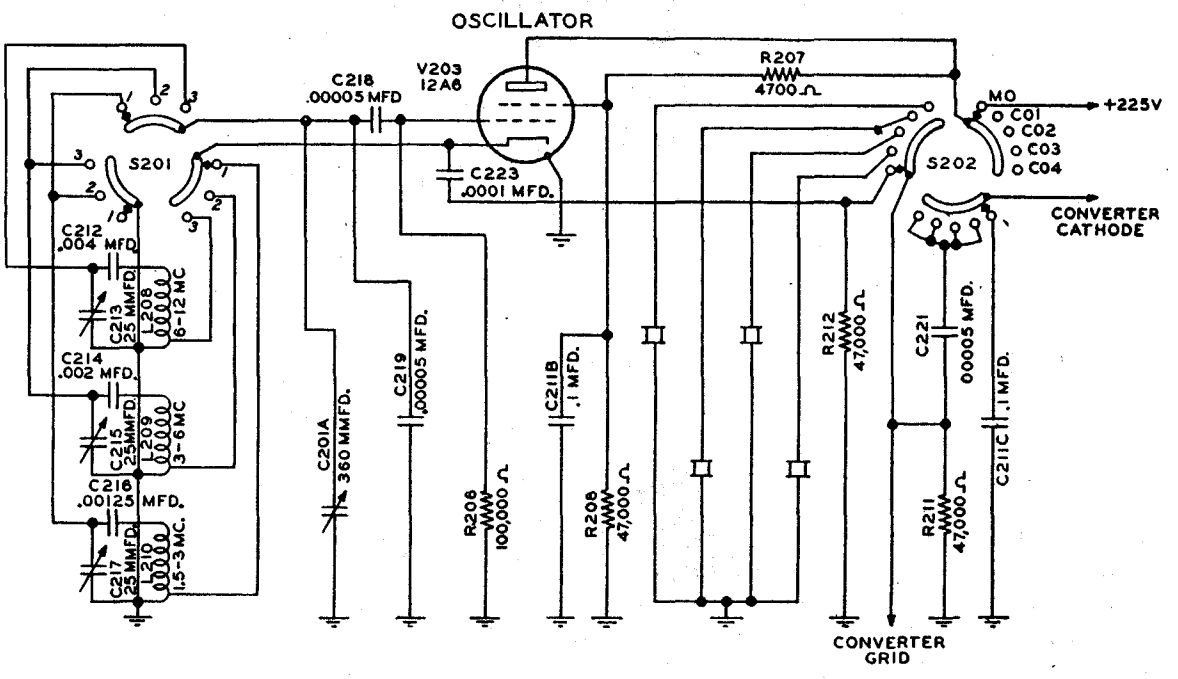


Fig. 7. H-F Oscillator Circuit (Dwg. 500 0140 00A)

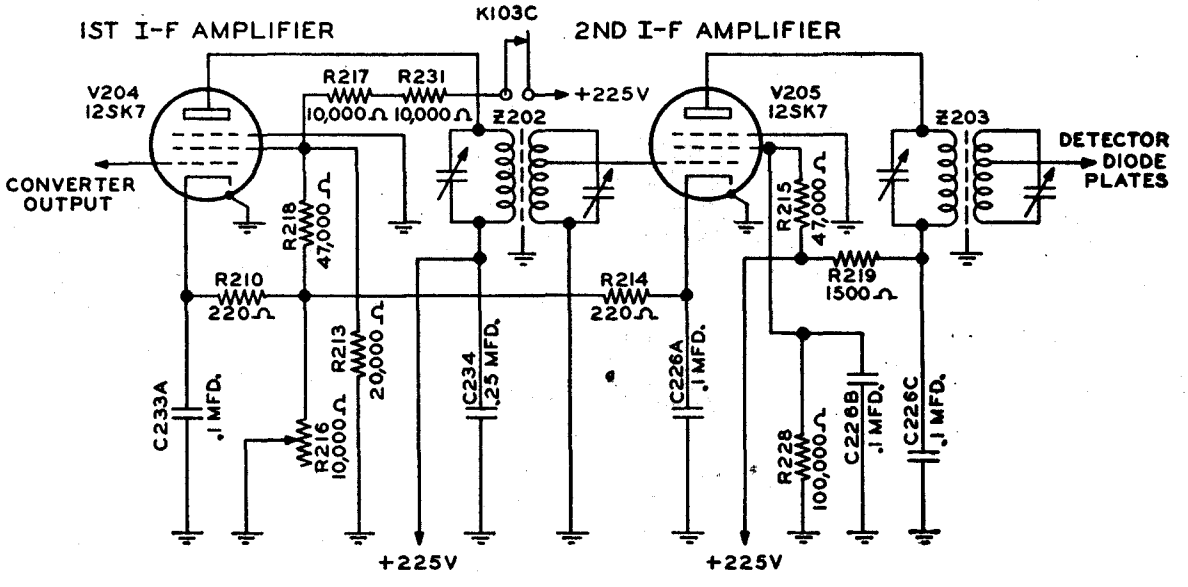


Fig. 8. I-F Amplifier Circuit (Dwg. 500 0137 00A)

higher than the frequency of the signal that is being received. The grid tank circuits have been provided with inductance and capacitance trimmers to permit the tracking of the oscillator circuit with the grid and plate tank circuits of the r-f amplifier. The frequency of the output of the oscillator within the band is determined by the position of the variable capacitor section, C201A. This capacitor, C201A, is one section of the three section capacitor that is operated by the TUNING control. When crystal control of reception has been selected, the oscillator, V203, is disabled by removing the plate and screen voltages. Switch section S202 performs the functions of connecting or removing the high voltage from V203, connecting the crystals into the grid circuit of the oscillator section of the converter tube and reducing the value of grid resistance by connecting an additional resistor in parallel with resistor R211 and increasing the cathode bypass capacitance of the converter when MO operation is selected.

2.3.7. I-F Amplifier Circuit

2.3.7.1. Refer to Figure 8. Two stages of i-f amplification are employed in the receiver to obtain the desired selectivity and output with a low percentage of distortion. Two Type 12SK7 triple grid amplifier tubes are utilized. The output of the converter is coupled to the grid of the first i-f amplifier, V204, by the i-f transformer, Z201. AVC voltage is applied to the grids of the first i-f amplifier when receiving modulated signals. When CW reception is selected by the operation of the MOD./CW switch, S203, or switch S206 is operated by the R.F. GAIN control, the lower end of the grid resistor, R230, is connected to ground, disabling the AVC circuit. The output of the first i-f amplifier, V204, is coupled to the grid of the second i-f amplifier, V205, by the i-f transformer, Z202. This stage operates as a straight i-f amplifier and no AVC voltage is applied.

2.3.7.2. The gain of the r-f amplifier and i-f amplifier stages is controlled by the R.F. GAIN control, R216, which varies the cathode resistance of V201, V204, and V205. Plate voltage for the i-f amplifier tubes is obtained from the low voltage section of the power unit. Screen voltage is obtained by connecting dropping resistors in series with the plate supply. Either air dielectric or movable "powdered iron" cores in the i-f transformers, Z202 and Z203, permit the adjustment of the input and output circuits of the i-f stages to give the best selectivity and maximum gain. When the transmitter carrier is turned on, screen voltage is removed from the first i-f amplifier tube, V204, by the operation of relay K103 in the transmitter. When relay K103 returns to the unoperated position, upon the release of the push-to-talk button on the microphone or the opening of the telegraph key, screen voltage is reapplied to V204. The output of the i-f amplifier is coupled to the diode plates of the detector, V206, by the transformer Z203.

Note: While both capacitor tuned and iron core slug tuned I.F. transformers are used in the various TCS equipments, the illustrations on these pages show capacitor tuned transformers.

2.3.8. Detector-BFO

2.3.8.1. Refer to Figure 9. A duplex-diode high-mu triode Type 12SQ7 is employed as a combination detector and beat frequency oscillator. The diode detector gives output that is low in distortion when a proper value of signal voltage is applied to the diode plates. With two stages of i-f amplification, the detector in this receiver is, in general, driven to the point of optimum performance. The diode plates of the Type 12SQ7 are connected together and coupled to the output of the second i-f amplifier by the transformer Z203. The audio gain control, R220, couples the output of the detector section of V206 to the grid of the triode amplifier section of the same tube through resistor R232 and capacitor C228. The voltage necessary for the operation of the AVC circuits is obtained by tapping the junction of the load resistor, R225, and the potentiometer, R220. The filter made up of resistor R227 and capacitor C232 filters out the audio components of the AVC

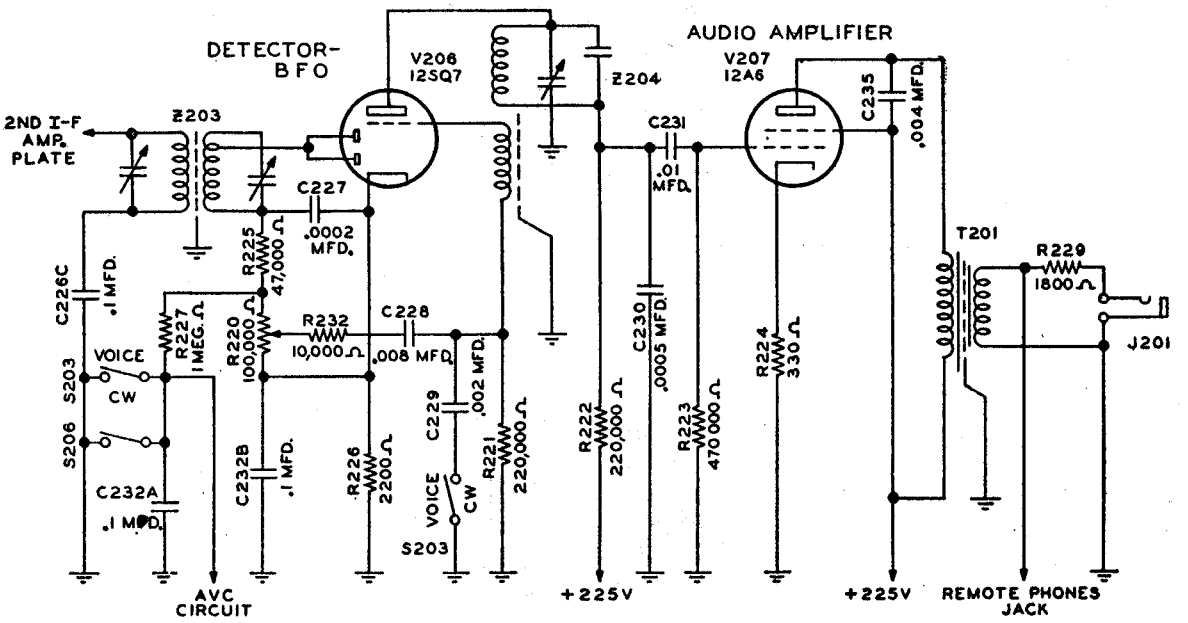


Fig. 9. Detector-BFO & Audio Amplifier Circuits
(Dwg. 500 0142 00A)

voltage. When CW reception has been selected by the operation of the MOD./CW switch, S203, or when switch S206 has been operated by the R.F. GAIN control, the lower end of resistor R227 is connected to ground and the AVC circuit is rendered inoperative. The triode section of V206 operates as an amplifier and as a beat frequency oscillator. When CW reception is selected by the operation of switch S203 the impedance of the grid circuit is changed by connecting capacitor C229 across the grid resistor R221. Thus the circuit made up of cathode, grid and triode plate is made to oscillate by the feedback coupling of transformer Z204. The output of the oscillator beats with the incoming signal to give an audible beat note that is fed to the grid of the audio amplifier, V207. The frequency of the beat note may be varied over a small range by the operation of the trimmer capacitor incorporated in the transformer, Z204. The trimmer capacitor is operated by the CW PITCH control. The plate voltage for V206 is obtained from the low voltage section of the power unit and coupled through the secondary of transformer, Z204.

2.3.9. Audio Amplifier

2.3.9.1. Refer to Figure 9. The Class A audio amplifier circuit employs a Type 12A6 beam power tube. The output of the detector is coupled to the grid of V207 by capacitor C231. The output of the amplifier is coupled to the headphones and speaker circuits by transformer T201. Voltage for the screen and plate of the audio amplifier is obtained from the low voltage section of the power unit.

2.3.10. AVC Circuit

2.3.10.1. Refer to Figure 10. The AVC voltage is applied to the grids of three tubes in the receiver, the r-f amplifier, V201, the converter, V202, and the first i-f amplifier, V204. A portion of the negative voltage that is developed across the load resistors, R225, R220, and R226 of the detector is utilized to control the output of the receiver. The filter consisting of resistor R227 and capacitor C232A, filters out the audio component of the voltage that is applied to the grids. A combination of series and shunt feed is employed. The r-f amplifier and the converter tubes are shunt fed through resistors R202 and R209 and the

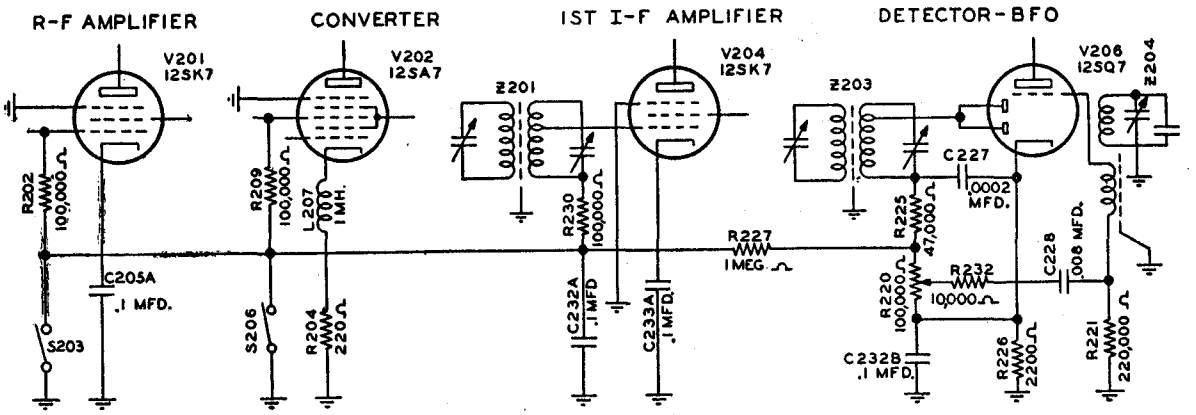


Fig. 10. A.V.C. Circuit (Dwg. 500 0143 00A)

i-f amplifier is series fed through resistor R230 and the secondary of the i-f transformer Z201. During periods of CW reception the lower ends of the grid resistors, R202, R209, and R230 are grounded by the operation of the MOD./CW switch, S203, or by the operation of switch S206. (Switch S206 operates in conjunction with the R.F. GAIN control.)

2.4. POWER UNITS

2.4.1. Dynamotor Power Units

2.4.1.1. The Dual Machine Dynamotor Power Unit employs two dynamotors that operate from a 12 volt power source. One dynamotor supplies 225 volts d.c. for the operation of the receiver and the low voltage stages of the transmitter. The other dynamotor supplies 400 volts for the application to the plates and screens of the power amplifier and modulator tubes in the transmitter. Both the input and output circuits of the dynamotors are filtered to reduce the interference caused by brush arcing and to reduce the ripple components of the output. A single relay in the power unit controls the filament voltages to the receiver and transmitter and the voltage that is applied to the motor section of the high voltage dynamotor. A spark suppressing circuit consisting of resistor R402 and capacitor C412 is connected across the contacts of the relay, K401. This relay is operated by the closing of the POWER switch, S107, on the transmitter panel or by the operation of the TRANSMITTER switch, S602, on the remote control unit. Operating either of these switches completes the circuit from the relay coil to ground. The primary control switch in all power circuits is the POWER switch, S205, in the receiver unit. It is necessary that this switch be operated to the ON position before any power can be applied to the transmitter circuits. The operation of switch S205 applies primary power to the low voltage dynamotor, D402, applies filament power to the receiver tubes and connects the positive lead of the power source to the relay coil. Switch S603, located in the remote control unit, performs the same function as switch S205 in the receiver unit. The operation of the transmitter POWER switch, S107, or the TRANSMITTER switch, S602, and the resultant operation of relay K401 applies primary power to the high voltage dynamotor, D401, and applies the filament power to the tubes in the transmitter.

IMPORTANT: A terminal strip has been provided on the Type –211035 and Type –21881 Units so that either positive or negative voltage may be applied to the ground circuit. In this unit the input leads to the dynamotors have been brought out to the terminal strip on top of the chassis so that by making the proper connections on the terminal strip either the positive or negative lead from the power source may be connected to the GND. power input terminal. Refer to the schematic diagram, Figure 80, for a better understanding of connections that will be necessary if it is desired to reverse the polarity of the power input.

2.4.1.2. The Single Machine Dynamotor Power Unit employs but one dynamotor which operates from either a 12 V or a 24 V d-c source. Two of the dynamotor's four windings are high voltage windings and are connected in series for the 440 volt transmitter power supply. Refer to Fig. 14. Just one of the high voltage windings is used for the 225 volt receiver power supply. The third winding is connected in series with the remaining winding when a 24 volt input is used. It also,while connected thus, furnishes filament power for the transmitter and receiver. This third winding is connected in parallel with the remaining winding when a 12 volt input is used. A special plug located inside the unit is employed to convert from a 12 v d-c input to a 24 v d-c input. Any polarity input can be used simply by plugging in POLARITY PLUG P2404, which is a special polarity changing device located inside the unit, to correspond to the polarity employed. The input to the dynamotor is controlled by operation of the receiver POWER switch S205 or the remote RECEIVER switch S603 through relay K2401. A separate relay K2402 applies filament and relay power to the transmitter when the POWER Switch, S107, on the transmitter or the TRANSMITTER switch, S602, on the remote box is operated. A spark suppressing circuit composed of C2413 and R2401 is shunted across the contacts of relay K2401. Noise suppressing circuits are employed on both the input and the output windings of the dynamotor. Smoothing of the d-c output is accomplished by ripple filters in the high voltage output of the dynamotor. The components are protected from direct short circuits by fuse F2404 in the input circuit, fuses F2403 and F2402 in the high voltage circuits, and fuse F2401 in the filament circuits. For 12 v d-c operation, fuse F2404 should be a 40 amp. fuse. If 24 v d-c operation is desired, F2404 should be a 20 amp. fuse. Refer to Fig. 81 for details concerning the connections of the VOLTAGE PLUG and the POLARITY PLUG.

2.4.2. Motor Generator Power Unit

2.4.2.1. The Types –21775, –21776, –21777, –21826, –21827, –21774, –21909, –211100, and the Type –21827-A Power Units employ two motors and two generators to supply the voltages necessary for the operation of the transmitter and receiver. The basic power unit for these motor generators is the same for all of the above types. The type number indicates the power source voltage that is necessary for the operation of the particular unit. A table included in the DATA Section of this Instruction Book shows the power source voltage requirements of each.

2.4.2.2. The external control circuits are identical to those outlined above for the dynamotor unit. However, this power unit employs two relays to perform the functions of starting the motor that drives the high voltage generator and closing the circuit necessary to apply filament power to the tubes in the transmitter and make available the voltage necessary for the operation of relays K101, K102, and K103 in the transmitter. The coils of these two relays are connected in parallel and are operated when the POWER switch, S107, in the transmitter is operated to the ON position. Filament and relay power for the transmitter and receiver and power for the relays in the power unit is supplied by a second winding on the low voltage generator. All input and output voltages are adequately filtered to reduce the noise component to a negligible value.

2.4.3. Rectifier Power Units

2.4.3.1. The Type –20218 Power Unit employs two full-wave rectifier systems to supply 225 volts and 400 volts for application to the plates and screens of the tubes in the transmitter and receiver. Filament power is supplied by the step-down transformer, T303. A second winding on transformer T303 is connected to a dry disc rectifier, CR301. The disc rectifier supplies the d-c voltage necessary for the operation of the relays in the transmitter and relay K301 in the power unit. The low voltage section of the power unit employs two type 6X5GT high vacuum full-wave rectifiers with the plates connected in parallel and the filaments connected in series. Relay K301 is energized by the operation

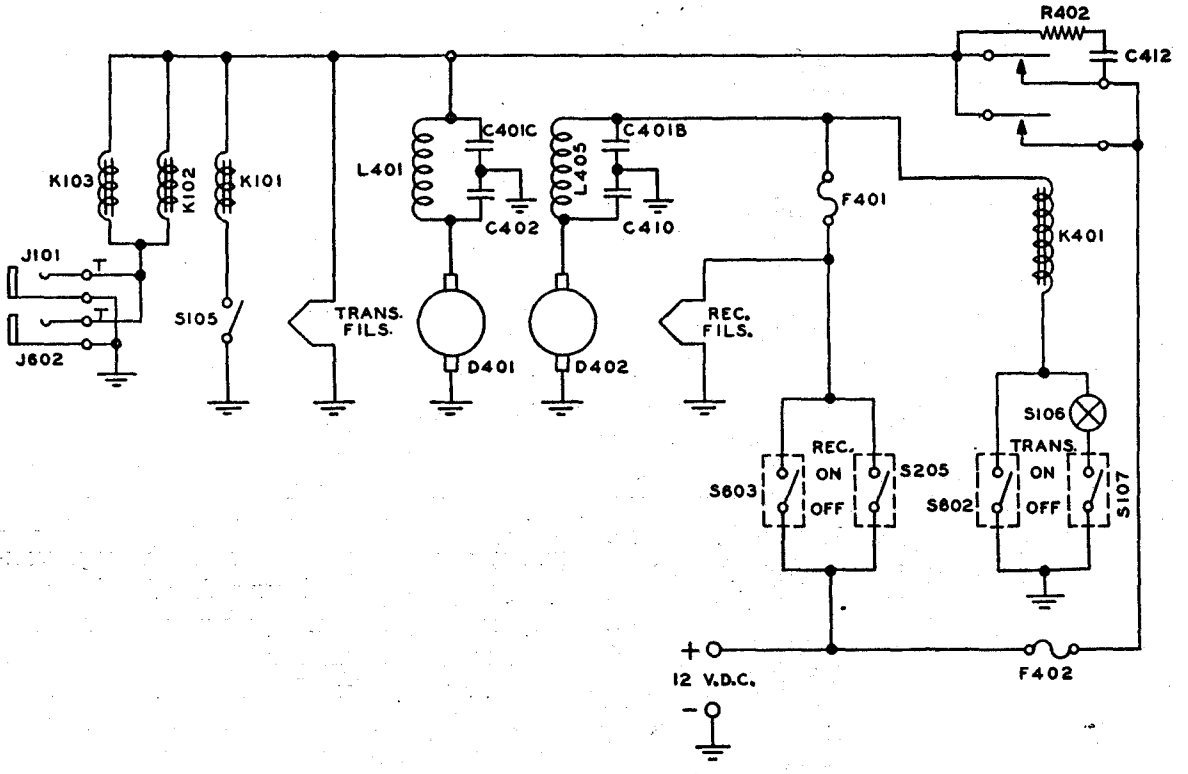


Fig. 11. TCS Primary Power Circuits using the Dual Dynamotor Power Unit (Dwg. 500 9968 001)

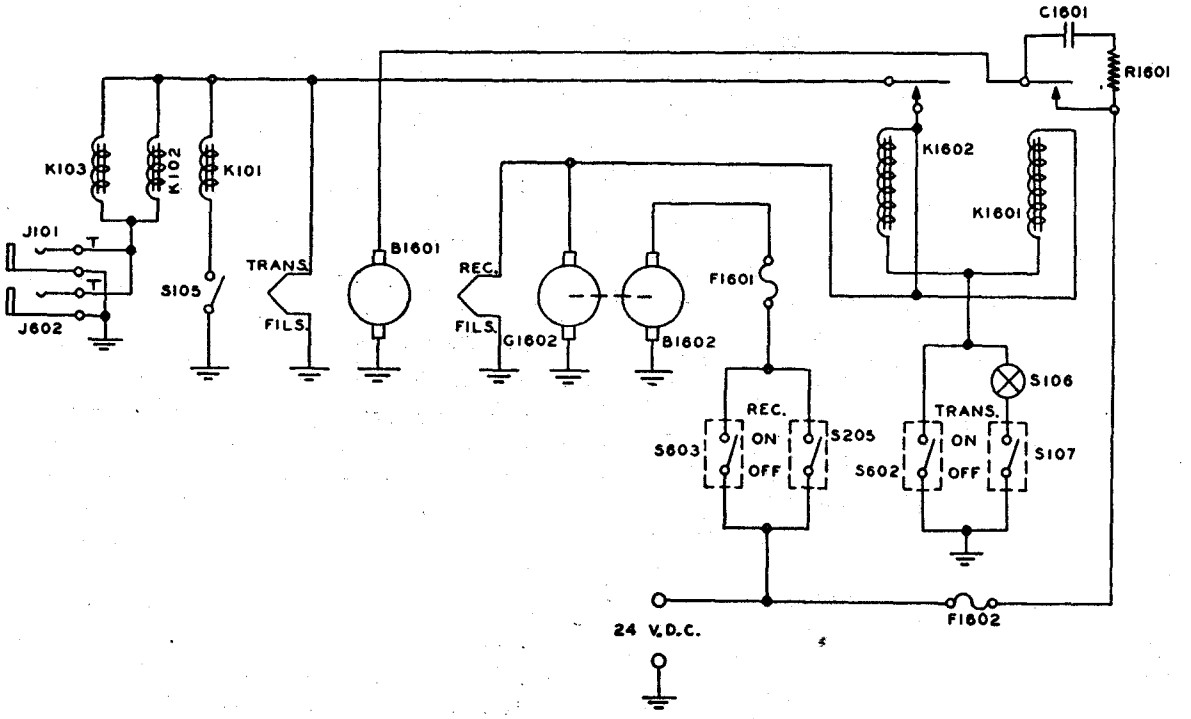


Fig. 12. TCS Primary Power Circuits using the Motor-Generator Power Unit (Dwg. 500 9969 001)

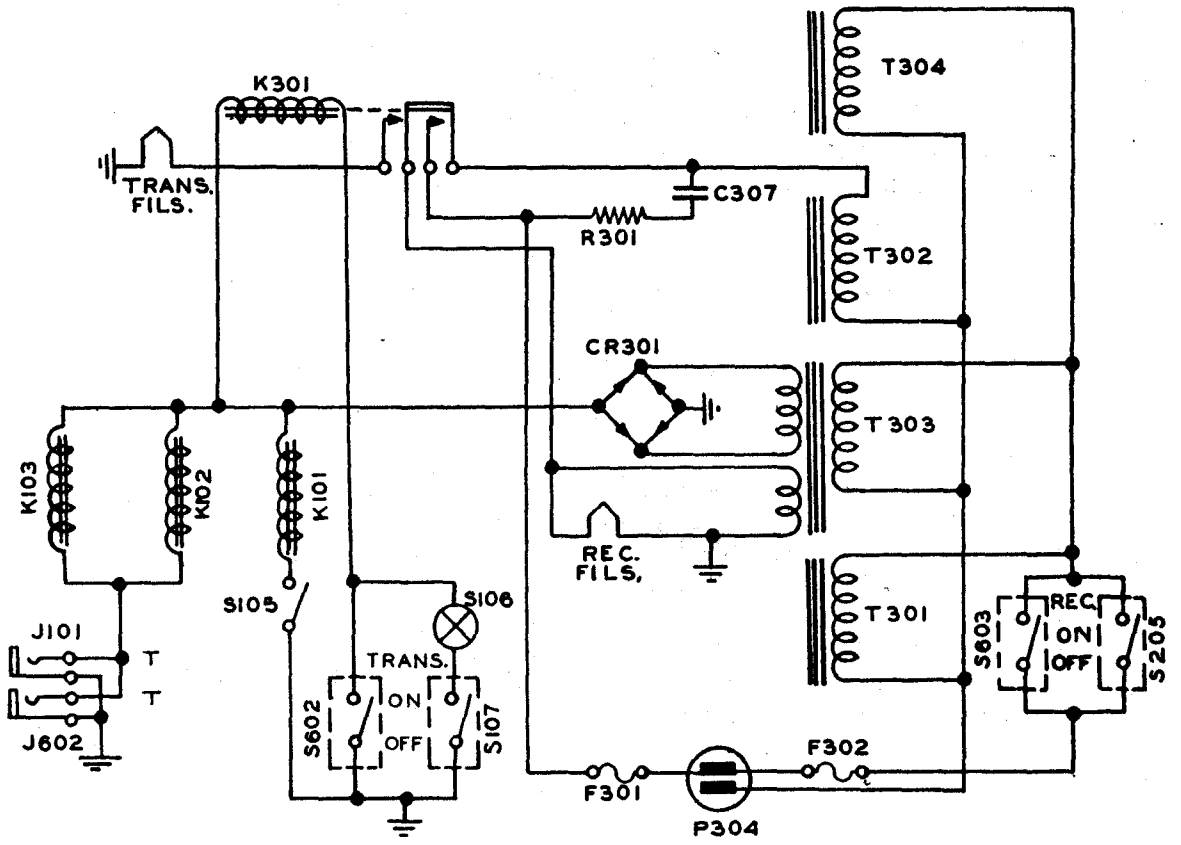


Fig. 13. TCS Primary Power Circuits using the Rectifier Power Unit (Dwg. 500 9970 001)

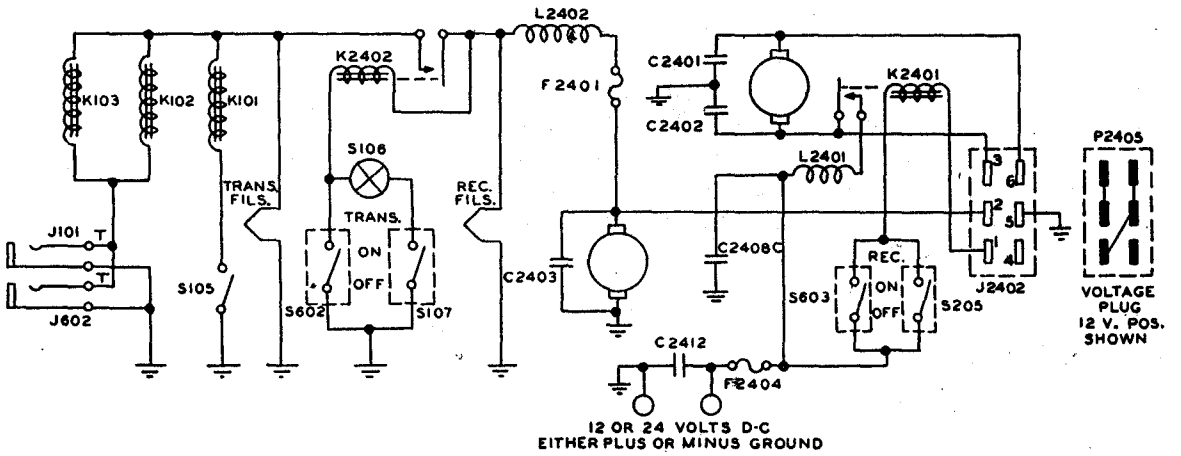


Fig. 14. TCS Primary Power Circuits using the Single Dynamotor Power Unit (Dwg. 500 9967 001)

of the POWER switch, S107, in the transmitter. The high voltage section of the power unit employs two Type 5U4G or two Type 5R4GY high vacuum full-wave rectifier tubes. The plates of these tubes are connected in parallel across the secondary of the high voltage transformer, T302. Filament power necessary for the operation of the high voltage rectifiers, V301 and V302, is supplied by transformer, T304. The operation of relay K301 closes the primary circuit of the high voltage transformer, T302, and energizes filament circuits of the transmitter and receiver. The output voltages of both sections of the power unit are adequately filtered to reduce the ripple voltage to a negligible value and each supply is equipped with a bleeder resistor to discharge the filter capacitors when the unit is turned off. A fuse in the primary of each section of the power unit protects rectifiers and transformers from damage due to overload. It is important that only fuses of the correct values be used.

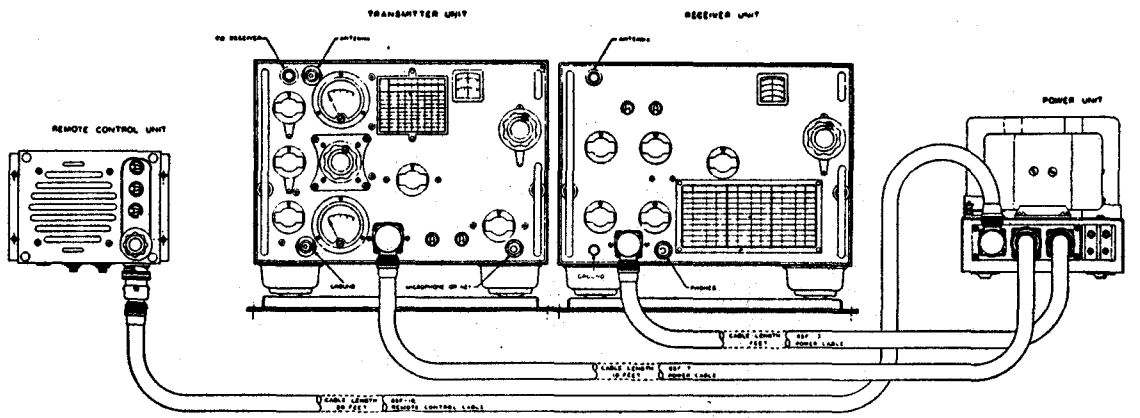
2.4.3.2. The Type –20242 Power Unit employs two full-wave rectifier systems to supply 225 volts and 400 volts for application to the plates and screens of the tubes in the transmitter and receiver. Filament power is supplied by the step-down transformer, T503. A second winding on transformer, T503, is connected to a dry disc rectifier, CR501. The disc rectifier supplies the d-c voltage necessary for the operation of the relays in the transmitter and relay, K501, in the power unit. The low voltage section of the power unit employs two Type 6X5GT high vacuum full-wave rectifiers with the plates connected in parallel and the filaments connected in series. Relay K501 is energized by the operation of the POWER switch, S107, in the transmitter. The high voltage section of the power unit employs two Type 5U4G or two Type 5R4GY high vacuum full-wave rectifier tubes. The plates of these tubes are connected in parallel across the secondary of the high voltage transformer, T502. Filament power necessary for the operation of the high voltage rectifiers, V501 and V502, is supplied by transformer, T504. The operation of relay K501 closes the primary circuit of the high voltage transformer, T502, and energizes filament circuits of the transmitter and receiver. The output voltages of both sections of the power unit are adequately filtered to reduce the ripple voltage to a negligible value, and each supply is equipped with a bleeder resistor to discharge the filter capacitors when the unit is turned off. A fuse in the primary of each section of the power unit protects rectifiers and transformers from damage due to overload. It is important that only fuses of the correct values be used.

2.4.3.3. The Type –20309 Power Unit is designed for operation from either a 115 v or a 230 v 50/60 cycle A-C power source. Dual input voltage operation is accomplished by means of tapped transformer primaries. A toggle switch, S2201, is employed to select the proper primary taps for the line voltage used. The Type –20309 Power Unit employs two full-wave rectifier systems to supply 225 volts and 400 volts for application to the plates and screens of the tubes in the transmitter and receiver. Filament power is supplied by the step-down transformer, T2203. A second winding on transformer, T2203, is connected to a dry disc rectifier, CR2201. The disc rectifier supplies the d-c voltage necessary for the operation of the relays in the transmitter and relay, K2201, in the power unit. The low voltage section of the power unit employs two Type 6X5GT high vacuum full-wave rectifiers with the plates connected in parallel and the filaments connected in series. Relay K2201 is energized by the operation of the POWER switch, S207, in the transmitter. The high voltage section of the power unit employs two Type 5U4G or two Type 5R4GY high-vacuum full-wave rectifier tubes. The plates of these tubes are connected in parallel across the secondary of the high voltage transformer, T2202. Filament Power necessary for the operation of the high voltage rectifiers, V2201 and V2202,

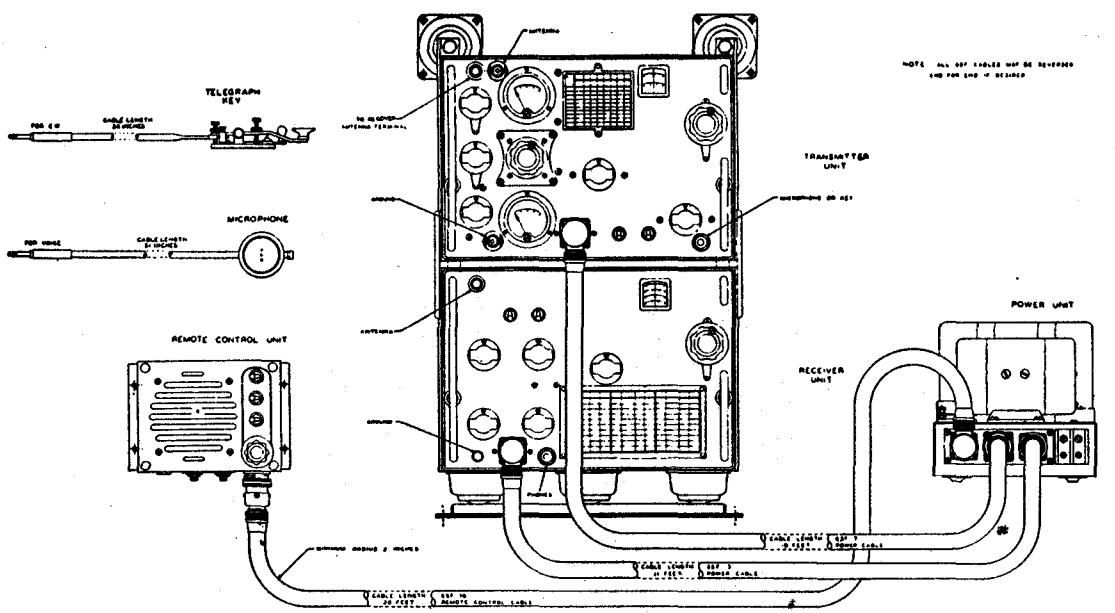
is supplied by transformer, T2204. The operation of relay K2201 closes the primary circuit of the high voltage transformer, T2202, and energizes filament circuits of the transmitter and receiver. The output voltages of both sections of the power unit are adequately filtered to reduce the ripple voltage to a negligible value, and each supply is equipped with a bleeder resistor to discharge the filter capacitors when the unit is turned off. A fuse in the primary of each section of the power unit protects rectifiers and transformers from damage due to overload. Separate fuses are used for 115 v and for 230 v operation. It is important that only fuses of the correct values be used. Do not allow the 115 v and the 230 v fuses to become interchanged.

2.5. REMOTE CONTROL UNIT

2.5.1. The Type –23270 Remote Control Unit incorporates all the components necessary for the control of transmitter and receiver power, transmitter emission and audio input to the speaker and phones. Switches S602 and S603 perform the same functions as the POWER switches S107 and S205, in the transmitter and receiver units. The MIKE jack, J602, is connected in parallel with the MICROPHONE or KEY jack, J101, in the transmitter unit and permits the control of the transmitter carrier from the remote position. Switch S601 permits the selection of either loudspeaker or headphones reception. The VOLUME CONTROL, R601, is in the form of a "T" pad and is connected in series with the output from the receiver.



(a) Horizontal Mounting Arrangement



(b) Vertical Mounting Arrangement

Fig. 15. Complete Installation Diagram (Dwg. 470E)

3.1. UNCRATING

3.1.1. Open packing crates with care and when crates are marked with arrows to indicate the upright position, remove crate covers only and lift the units out carefully. Loosen the knurled locking nuts on the front of the transmitter and receiver panels and remove the units from the cabinets. Inspect cables and wiring and be sure that all terminal connections are tight. Be sure that all controls such as switches, dials, etc., operate properly. Carefully check cabling and terminal connections in the power unit, loading coil, and control unit. Search all packing material for small packages. All claims for damage should be filed promptly with the transportation company. If a claim for damage is to be filed, the original packing case and packing material must be preserved.

3.2. GENERAL

3.2.1. Figure 15 shows a complete installation of the TCS equipment. (Note: The headphones are not supplied.) Either of two types of installation may be used, however, it is preferable to use a horizontal type of installation wherever possible.

WARNING: DO NOT DISTURB TRIMMING ADJUSTMENTS OF CAPACITORS OR INDUCTORS. There are two capacitance trimmers and five inductance trimmers in the transmitter and nine capacitance trimmers and sixteen inductance trimmers in the receiver. The disturbance of any of these trimmers may easily render the unit inoperative and will require laboratory facilities for realignment.

3.3. TUBES

3.3.1. When the inspection of the units has been completed the vacuum tubes and crystals may be installed in the transmitter and receiver units. The tube placement diagrams, Figures 16 and 17, show the outlines of the transmitter and receiver cabinets, as viewed from the top, and should be referred to when placing the tubes and crystal holders in the sockets. The tube clamps in the transmitter should be fastened securely so that the tubes will be held firmly in the sockets.
Note: Be sure that the plate lead connectors on the Type 1625 tubes in the transmitter are placed firmly on the plate caps.

3.3.2. Do not replace the transmitter and receiver units in the cabinets until the cabinets have been mounted in the operating position.

3.4. OPERATIONAL CHECK

3.4.1. If a considerable number of installations are being made at one base, it is desirable to make up a test bench so that each installation may be checked before being mounted in the mobile unit. Considerable time and labor may be saved if all units are checked and in operating condition before being installed in the operating position.

WARNING: BE SURE TO CHECK THE TYPE NUMBER OF THE POWER UNIT AGAINST THE TABLE OF UNITS THAT IS INCLUDED IN THE DATA SECTION OF THIS BOOK TO DETERMINE WHAT SOURCE OF PRIMARY POWER IS NECESSARY FOR THE OPERATION OF THE UNIT INVOLVED. IF THE WRONG VOLTAGE IS APPLIED TO THE INPUT TERMINALS, THE UNIT MAY BE DAMAGED TO THE EXTENT THAT IT WILL BE NECESSARY TO REPLACE COMPONENTS WHICH MAY INVOLVE CONSIDERABLE LABOR AND DELAY.

3.4.2. When making the operational check, all of the cables, the telegraph key and the microphone that are to be used with the installation should be employed.

3.4.3. The following test procedure should reveal any damage that will affect the operation of the equipment:

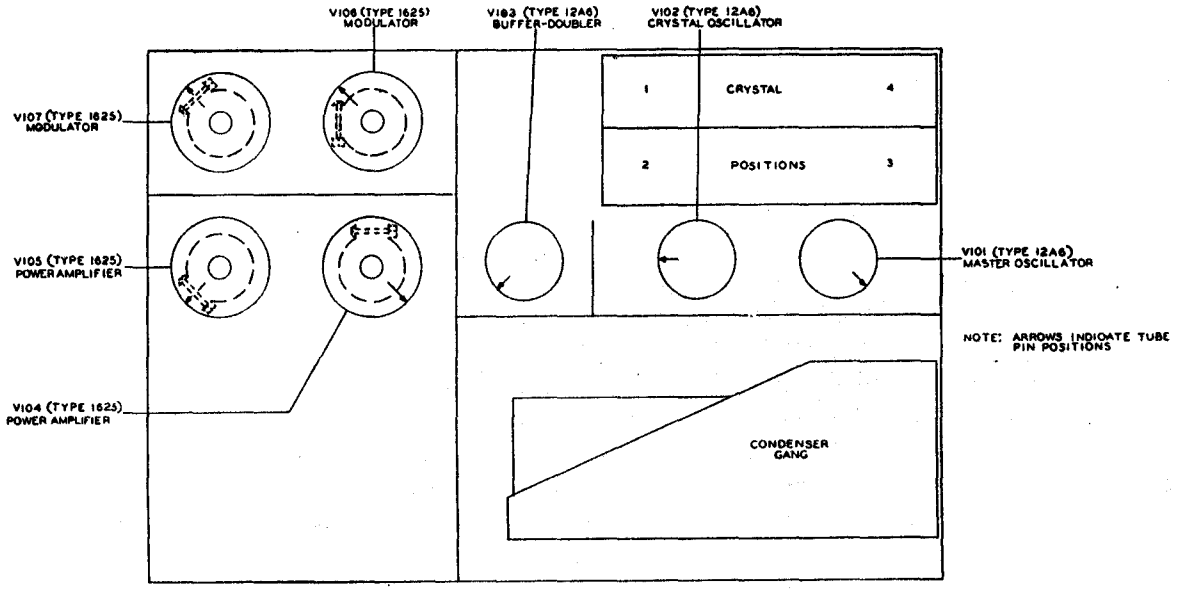


Fig. 16. Transmitter Tube Placement Diagram (Dwg. 1828B)

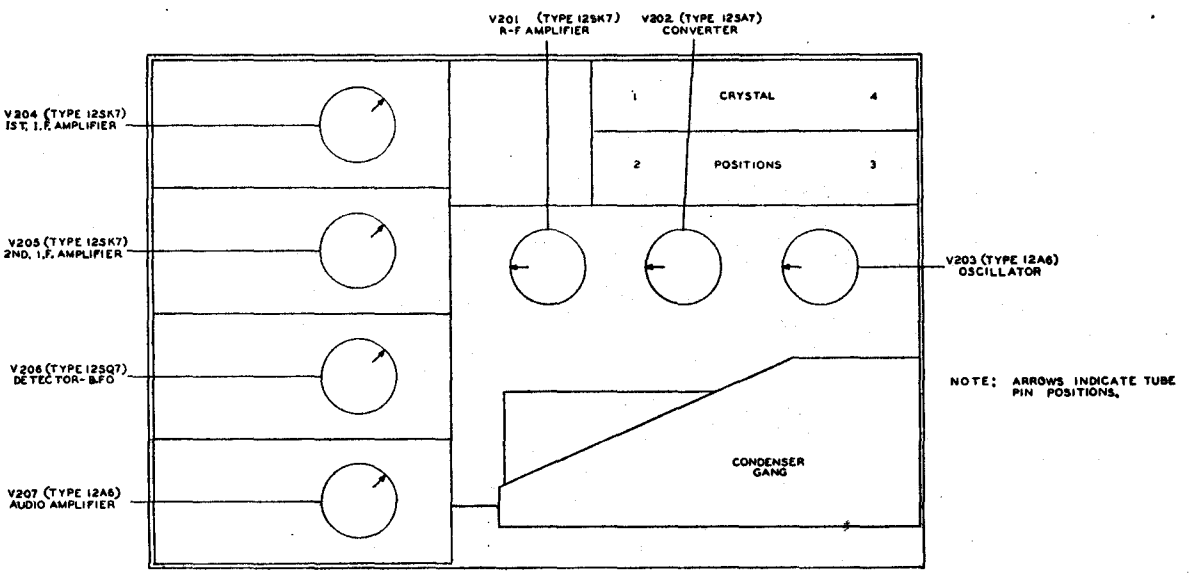


Fig. 17. Receiver Tube Placement Diagram (Dwg. 1830B)

a. Connect a dummy load consisting of 100 mmfd in series with a non-inductive resistance of 13.6 ohms between the ANTENNA and GROUND terminals of the transmitter.

Note: If tests are made near 1500 kc increase the capacity to 300 mmfd.

b. Connect an antenna of approximately the same length as the "whip" to the ANTENNA terminal on the receiver and a good ground to the GROUND terminal.

c. Using the cables that have been supplied with the equipment, make the inter-unit connections between the transmitter, receiver, power unit and remote control unit.

d. Connect the power unit to the power source using heavy leads or a cable.

e. Operate the POWER switches that are located on the transmitter and receiver front panels, to the ON positions.

f. Insert the microphone cord plug into the MICROPHONE OR KEY jack on the transmitter panel and the earphones cord plug into the PHONES jack on the receiver panel.

g. Operate the EMISSION selector switch on the transmitter panel to the CW position.

h. Operate the push-to-talk button on the microphone and immediately rotate the PLATE TUNING control until the PLATE CURRENT meter indicates a sharp dip in plate current. Tune for exact minimum plate current.

Note: Refer to the OPERATION Section of this book for detailed tuning instructions.

3.4.4. Carefully check the operation of the transmitter, receiver, power unit and control unit by using both the panel controls and the controls located on the remote control unit to perform the functions necessary for the transmission and reception of both modulated and CW signals.

3.4.5. When the equipment has been carefully checked and all units are found to be operating satisfactorily the equipment may be installed in the mobile unit.

3.5. MOUNTING OF UNITS

3.5.1. Outline drawings in the APPENDIX Section of this book show the overall and mounting dimensions of the units supplied with the TCS equipment.

3.5.2. When mounting the units it should be remembered that there must be at least 6½" clearance between the end of the power unit that has the cable connector plugs and any other object so that the connecting cables will not be bent too sharply. To bend the cable too sharply may cause the rubber covering or metal shielding to break and eventually damage the wires within the cable.

3.5.3. Transmitter and Receiver

3.5.3.1. Two types of installation are possible with the TCS equipment. Refer to Figures 69 and 70. The transmitter and receiver units may be mounted end to end or may be mounted one above the other, whichever type of installation that may be best accommodated in the space available. (Note: it is recommended that wherever possible the horizontal type of installation be used.) Angle irons, mounting brackets, and base plates are supplied with each equipment to facilitate the mounting of the cabinets in either position. When mounted end to end, the installation requires a space 28¾" long by 11⅝" high by 11 13/16" deep. Enough additional space should be allowed for free circulation of air about the cabinets. Before

replacing the transmitter and receiver units in the cabinets, the cabinets should be firmly bolted to the mounting bases.

3.5.3.2. When the vertical type of mounting is used a space 23 15/32" high by 16" wide by 13 1/16" deep is required. When this type of installation is to be used, all four shock mounts should be removed from the transmitter cabinet. Two of the shock mounts that were removed from the transmitter cabinet should be fastened to the receiver cabinet, giving a total of 6 shock mounts to support the combination of transmitter and receiver. The two remaining shock mounts should be bolted to the ends of the long angle irons. The receiver cabinet should be securely bolted to one of the base plates and the long angles bolted to the rear corners of the cabinet. The transmitter cabinet should be bolted to the angles above the receiver cabinet. The two small angles that support the front edges of the transmitter should be bolted in place. These angles are tapped 8/32 so that bolts may be screwed into them from the inside of the cabinets. The cabinet assembly may now be mounted in the operating position. The assembly should be fastened securely to the operating table and wall or to a mounting rack. When the cabinets have been mounted, the transmitter and receiver units may be inserted into the cabinets and the locking nuts tightened.

3.5.4. Motor Generator Power Units

3.5.4.1. The Types –21775, –21776, –21777, –21826, –21827, –21774, –21909, and the Type –21827-A Power Units are mounted on identical bases, and therefore require identical mounting facilities. Figure 72 shows the mounting dimensions of the unit. Bolts 3/8" in diameter should be used to secure the unit. This unit is rather heavy and considerable care should be exercised in the selecting of the mounting position so that the table or bench is firm enough to withstand the vibration caused by the rotating machines.

3.5.5. Dynamotor Power Units

3.5.5.1. The Dynamotor Power Units have been provided with shock mounts to reduce the effects of the vibration. Figures 71 and 74 show the overall and mounting dimensions of the units. The base plates must be removed from the chassis for mounting. Bolts should be inserted from the inside of the shock mounts and tightened firmly before the units are fastened to the base plates. The units may be changed or removed for servicing without disturbing the base plates by removing the screws that hold the chassis to the base plates.

3.5.6. Rectifier Power Units

3.5.6.1. The Types –20218, –20242, and –20309 Power Units require a space 16 1/4" by 17 1/4" by 10 1/8" high for mounting. Refer to Figure 73 and Figure 75. The units should be secured in position with four 3/8" bolts.

3.5.7. Control Unit

3.5.7.1. The Type –23270 Remote Control Unit chassis has been provided with flanges so that the unit may be mounted using four 1/8" bolts. Refer to Figure 76. The unit should be mounted in a position such that the output from the speaker is directed toward the operator and also within easy reach of the operator so that he may control the transmitter and receiver power and the audio input to the speaker and phones. A minimum clearance of 6 1/2" should be allowed between the edge of the chassis nearest the connected plug and any other object which may interfere with the cable. Sharp bends in the cable tend to weaken the rubber covering and the metal shielding and may eventually damage the wires within the cable.

3.5.8. Loading Coil

3.5.8.1. The Type –47205 Antenna Loading Coil Unit need not be mounted within reach of the operator but should be mounted in a

position so that the control knob may be operated during the adjustment of the transmitter. Figure 97 shows the outline and mounting dimensions of the unit. Two small mounting angles are supplied with the unit and may be fastened to the top, rear, or bottom edges of the cabinet.

3.6. CONNECTIONS

3.6.1. When all the units have been mounted, the installation may be completed by making the power, inter-unit and antenna connections. Refer to Figure 15.

3.6.2. Power Connections

3.6.2.1. The connections from the power source to the power unit should be made with heavy wires or a cable. The size of wire required will be dependent on the type of power unit that is to be used. When using the Dual Dynamotor Power Unit, wire rated at least 20 amperes should be used. Under normal conditions this supply will draw approximately 17 amperes. Correspondingly smaller wire may be used with the other types of power units. The approximate current drawn from the power source by each type of unit may be calculated from data that may be found in the table showing the power input requirements of the power units in the DATA Section of this book. Carefully tighten the terminal nuts so that a good connection is made between the power input cable and the unit input terminal.

CAUTION: The Type –211035 and Type –21881 Power Units have been designed so that by changing connections on a terminal board on the top of the chassis either the negative or the positive lead from the power source may be connected to the GND terminal. As supplied, the terminal board connections are such that negative lead from the power source should be connected to the GND terminal. If it is desired to connect a positive power source lead to the GND terminal, remove the cover plate from the terminal board and reverse the connections to terminals A and B and reverse the connections to terminals C and D. It must be remembered that the input connections to both dynamotors must be reversed if the polarity of the power source is to be changed. The schematic diagram of these Power Units is shown on Figure 80 and should be referred to when changing power source polarity. When the motor generator power unit is being used either polarity of input power connections may be used.

3.6.2.2. The Single Machine Dynamotor Power Unit may be connected to operate with either the negative or the positive power lead grounded by removing the bottom plate of the power unit and placing the POLARITY PLUG P2404 into the socket J2401 so that the stamping on plug P2404, as read from the bottom of the chassis, corresponds to the grounded polarity.

3.6.2.3. Since the Single Machine Dynamotor Power Unit has been designed for either 12 or 24 volt d-c operation, it is important that VOLTAGE PLUG P2405 be inserted into socket J2402 so that the stamping on the plug, as read from the bottom of the unit, is the same as the input voltage used. This plug, P2405, is located by taking the bottom plate off of the unit.

3.6.3. Inter-Unit Connections

CAUTION: Place the POWER switches on the transmitter, receiver and remote control units in the OFF positions before connecting any of the inter-unit cables.

3.6.3.1. The cable that is equipped with the 16 prong connector plugs should be connected between the Type –52245 Transmitter Unit and the power unit. The right angle connector plug on the cable should be inserted into the plug receptacle on the transmitter and the straight connector plug should be inserted into the 16 prong plug receptacle on the power unit. Carefully tighten the locking nuts and fasten securely with safety wire.

3.6.3.2. The cable that is equipped with 9 prong connector plugs should be connected between the Type –23270 Remote Control Unit and the power unit. The straight connector plug on the cable should be inserted in the plug receptacle on the remote control unit. The right angle connector plug on the other end of the cable should be inserted in the 9 terminal connector plug receptacle on the power unit. Carefully tighten the connector plug locking nuts.

3.6.3.3. The cable that is equipped with 12 prong connector plugs should be connected between the Type –46159 Receiver Unit and the power unit. Insert the right angle connector plug on the cable into the plug receptacle on the receiver unit and the straight connector plug on the other end of the cable into the 12 prong connector plug receptacle on the power unit. Tighten the cable connector locking nuts.

Note: The cables ends may be reversed if it is found more convenient to connect the cable in the reverse direction from that suggested above. The plugs are identical on each cable except that one is straight and the other one right angle.

IMPORTANT: Secure each cable connector lock nut with a safety wire.

3.6.4. Antenna Connections

3.6.4.1. Either a single antenna or separate antennas may be used for transmission and reception. If a single antenna is to be used a jumper should be connected between the RECEIVER ANTENNA terminal on the transmitter and the ANTENNA terminal on the receiver. If separate antennas are to be used no jumper will be necessary.

3.6.4.2. The output network of the transmitter and the input circuit of the receiver are designed to satisfactorily match a 20 foot vertical antenna of the type known as the "whip" or "fishpole" antenna. However, if the transmitter is to be operated in the frequency range 1500 kc to 3000 kc, it is desirable to connect the Type –42705 Antenna Loading Coil Unit in series with the antenna to permit a better matching of the transmitter output network to the vertical radiator.

3.6.4.3. The leads from the antenna terminals and loading coil should be as short as possible within the mobile unit to keep r-f losses down to a minimum. It is recommended that bare wire supported on ceramic insulators be used wherever practicable for antenna connections.

3.6.4.4. A good ground connection is an important part of the radiation system and should be given careful consideration. Connections should be made from the GROUND terminals on the transmitter and receiver to the frame of the mobile unit in which the installation is being made.

3.6.4.5. Careful consideration should be given to the length of the leads to the receiver and transmitter ANTENNA and GROUND terminals to permit the free movement of the units on the shock mounts. It is also necessary to allow enough slack in the leads so that the vibration encountered in service will not pull the leads from the clip type terminals on the receiver and transmitter.

3.6.5. Hand Set Connections

3.6.5.1. A terminal strip inside of the Type –23270 Remote Control Unit has been provided to permit the connecting of a hand set. To gain access to the terminal strip, loosen the four knurled bolts that hold the unit chassis to the mounting plate. A hole has been provided in the chassis to admit the hand set cord. A circuit of a suitable hand set is shown on Figure 93. The terminals on the strip within the control unit are numbered from 1 through 4. Terminal #4 is connected to ground and is therefore the

common lead. Terminal #1 is the audio lead from the receiver. Terminal #2 is the carrier control lead and should be connected to the push-to-talk switch on the hand set. Terminal #3 is the audio input lead to the transmitter and should be connected to the microphone output of the hand set.

3.7. FUSES

3.7.1. Each of the power units has been provided with two sets of fuses, one to protect the low voltage section of the power unit and the other to protect the high voltage section of the power unit.

3.7.2. Before attempting to operate the equipment the fuses should be removed from the receptacles and checked against the ratings given in the parts list in the APPENDIX Section of this Instruction Book. Only fuses of correct ratings should be used.

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO HUMAN LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. (SEE PAGES xi and xii.)

4.1. GENERAL

4.1.1. The TCS equipment may be controlled from either the panel or from a remote position. However, all tuning adjustments must be made with controls located on the transmitter and receiver panels before assuming control from the remote position.

4.2. TRANSMITTER CONTROLS

4.2.1. Control A—OSCILLATOR SELECTOR

4.2.1.1. Control A operates switch S104 and selects the oscillator circuit that is to control the frequency of the transmitter output. This control is also used for crystal selection. Switch S104 is of the single section, six position type. Two positions of the control have been assigned to the master oscillator and the four remaining positions have been assigned to the crystal oscillator. When Control A is operated to the MO TEST position plate and screen voltages are applied to the oscillator and buffer stages of the transmitter and the frequency of the oscillator may be measured without operating the push-to-talk button on the microphone or the telegraph key. When the control is operated to the MO position, connections are made so that when the push-to-talk button or the telegraph key is operated, full power output is obtained. Operating Control A to any one of the four crystal positions removes the screen voltages from the master oscillator tube and applies screen voltage to the crystal oscillator tube.

4.2.2. Control B—BAND SWITCH

4.2.2.1. Control B operates switches S101 and S102. These switches are of the single section, three position type. Switch S101 selects the proper plate tank circuits for the master oscillator and buffer and buffer-doubler tubes. Switch S102 selects the proper tap on the power amplifier plate tank inductor and makes the proper connections to the plate tank padding capacitors to cover the frequency range 1500 kc to 12,000 kc.

4.2.3. Control C—TUNING

4.2.3.1. Control C operates the three section gang capacitor, C101. Capacitor section C101-A tunes the grid circuit of the master oscillator tube; capacitor section C101B tunes the plate circuit of the master oscillator tube when operating on Band 3; and capacitor section C101C tunes the plate circuit of the buffer-doubler on all 3 frequency bands.

4.2.4. Control D—COUPLING

4.2.4.1. Control D operates the rotor section of the variometer, L107, and is used to vary the coupling between the power amplifier plate tank circuit and the antenna. The dial is divided into 10 divisions and the coupling is a maximum when the pointer indicates 10. A lock has been provided on this control so that when the correct coupling has been determined, the control may be locked in position.

4.2.5. Control E—PLATE TUNING

4.2.5.1. Control E operates the power amplifier plate tank circuit tuning capacitor, C116. The dial is divided into 10 divisions and the capacity is a maximum at 0 and a minimum at 10. A lock has been provided on the dial to prevent detuning by vibration.

4.2.6. Control F—ANT. COND.

4.2.6.1. Control F operates the single section, three position switch, S103. Switch S103 connects the capacitor C121 in series or in parallel with the lead from the loading inductor, L108, to the antenna or connects the lead from L108 directly to the antenna.

4.2.7. Control G—ANTENNA LOADING

4.2.7.1. Control G determines the position of the tap on the loading inductor L108. The

inductance that is connected in series with the lead from the variometer L107 to the antenna is a maximum when the dial indicates 0 and the entire coil is shorted-out when the dial indicates 43.

4.3. ANTENNA LOADING INDUCTOR CONTROL

4.3.1. Control H operates the tap switch S701 in the Type –47205 Antenna Loading Coil Unit. The inductance in the circuit is a maximum when the dial indicates 0 and a minimum when the dial indicates 6.

4.4. RECEIVER CONTROLS

4.4.1. Oscillator Selector

4.4.1.1. This control operates the five position, single section switch, S202. One position of the control has been assigned to the master oscillator and is designated as MO. The other four positions of the switch are used to select a desired frequency crystal. When crystal controlled reception has been selected, the plate and screen voltages are removed from the oscillator tube, V203. When the control is operated to any one of the other four positions, connections are made so that a section of the converter tube operates as an oscillator.

4.4.2. Band Switch

4.4.2.1. This control operates the three, three-position switches, S201, S207, and S208. These three switches select the proper grid tank circuits for the r-f amplifier, the converter and the oscillator tubes.

4.4.3. R-F Gain

4.4.3.1. This control operates the potentiometer, R216, and controls the resistance that is connected in series with the cathodes of the r-f amplifier and the first and second i-f amplifier tubes. Switch S206 is also operated by the control. When the R-F Gain control is operated as far as possible in a clockwise direction, the r-f and i-f gain is a maximum and the circuit through switch S206 is opened to place the AVC circuit in operation. **Note:** The AVC circuit is also in operation when the MOD-CW switch, S203, is in the MOD position, provided switch, S206, is open. The AVC is automatically switched off when the MOD-CW switch is in the CW position.

4.4.4. A-F Gain

4.4.4.1. This control operates the potentiometer, R220, and controls the input to the grid of the triode section of the detector-BFO tube, V206. The dial is divided into 10 divisions with minimum gain at 0 and maximum gain at 10.

4.4.5. CW Pitch

4.4.5.1. The tank circuit of the beat frequency oscillator is tuned by this control. The frequency of the output of the BFO may be varied over a limited range by the rotation of the control in either direction from the zero setting.

4.5. TRANSMITTER ADJUSTMENT

4.5.1. Master Oscillator Operation

a. Operate the OSCILLATOR SELECTOR switch, S104, to the MO TEST position.

b. Rotate the BAND SWITCH to the position that includes the frequency upon which output is desired.

c. Adjust the TUNING control until the dial indicates the desired frequency.

Note: If the r-f output must be on exact specified frequency, it will be necessary to use a frequency monitor or other frequency measuring device to accurately set the position of the TUNING control. The crystal oscillator tube, V102, should be in the proper socket even though master oscillator frequency control is being employed. Removing tube V102 will affect the frequency of the master oscillator by changing the capacity of the master oscillator plate tank circuit and thus affect the dial calibration.

d. Operate the POWER switches, S107 and S205, to the ON positions and after allow-

ing sufficient time for the tubes to warm up, measure the frequency of the oscillator output.

e. When the frequency of the oscillator has been set, lock the TUNING control and operate the OSCILLATOR SELECTOR switch, S104, to the MO position.

f. Operate the EMISSION selector switch, S105, to the CW position.

Note: It is recommended that all tuning adjustments of the r-f circuit be made with switch S105 in the CW position. When switch S105 is in the CW position the modulator tubes are inoperative and both power amplifier tubes are operating to give a larger value of power amplifier plate current. Consequently the results of power amplifier plate tank tuning and antenna loading adjustments are more clearly indicated by the swing of the PLATE CURRENT meter needle. The power amplifier plate tank tuning and loading procedure is the same for both VOICE and CW. If tuning adjustments are made with switch S105 in the VOICE position, the power amplifier plate current should not be more than 90 ma but if adjustments are made with switch S105 in the CW position the power amplifier should be loaded to approximately 180 ma.

g. Operate the PLATE TUNING control to 10, the COUPLING control to 0, the ANTENNA LOADING control to 43 and the ANT. COND. control to the OFF position. In general, the higher the frequency of the transmitter output, the greater the dial reading of the PLATE TUNING and ANTENNA LOADING controls. The setting of the COUPLING control will be near midscale at most frequencies but the position of this control will be largely dependent upon the type of antenna being used and the position of the ANT. COND. control that has been selected.

h. With the controls in the above position, operate the push-to-talk button on the microphone or the telegraph key and immediately attempt to resonate the power amplifier plate tank circuit by rotating the PLATE TUNING control.

WARNING: CARE SHOULD BE EXERCISED WHEN MAKING TUNING ADJUSTMENTS TO PREVENT DAMAGE TO THE POWER AMPLIFIER TUBES DUE TO OVERHEATING WHILE OPERATING THE PLATE TANK CIRCUIT OUT OF RESONANCE. DO NOT HOLD THE PUSH-TO-TALK BUTTON OPERATED OR THE TELEGRAPH KEY CLOSED FOR MORE THAN A SHORT INTERVAL WITH THE TANK CIRCUIT OF THE POWER AMPLIFIER TUBES OUT OF RESONANCE.

i. When resonance has been established and the plate tuning capacitor has been adjusted to give exact minimum PLATE CURRENT the power amplifier should be loaded to 180 ma.

The procedure to be followed for the loading of the power amplifier, will be somewhat dependent on the type of antenna used, but the procedure for making loading adjustments into a short vertical radiator, as outlined below, may be followed for other types of radiators:

j. When resonance has been established and with the push-to-talk switch on the microphone or the telegraph key held operated, the COUPLING control should be advanced to 3 and the ANTENNA LOADING control should be rotated slowly in a counterclockwise direction while observing the ANTENNA CURRENT meter, M102. The meter should indicate a sharp rise in antenna current as the inductance that is connected in series with the antenna is increased.

k. If there is no noticeable rise in antenna current as the ANTENNA LOADING control is rotated from 43 toward 0, the push-to-talk switch or the telegraph key should be released and the ANTENNA LOADING control returned to 43. The COUPLING control should be advanced to 5. The push-to-talk button or telegraph key should again be operated. The ANTENNA LOADING control should be

rotated toward 0 until the ANTENNA CURRENT meter indicates a sharp rise in antenna current.

l. The above procedure of increasing the loading and coupling should be repeated until proper loading of the power amplifier circuit is obtained.

m. If it is impossible to load the power amplifier and to obtain the desirable antenna current reading by following the above procedure, the push-to-talk switch or telegraph key should be released and the ANT. COND. control should be operated to the SERIES or PARALLEL position and further attempts made to establish proper loading of the power amplifier.

The above paragraphs give a general outline of the procedure to be followed for the tuning and loading of the transmitter circuits. The procedure may be varied slightly but the operator should keep in mind that the goal is a maximum ANTENNA CURRENT reading with a rated PLATE CURRENT reading (VOICE—90 ma; CW—180 ma).

The following table of typical dial readings has been compiled to aid the operator in selecting the correct positions for the controls:

FREQ. IN MC	OSCILLATOR SELECTOR A	BAND SWITCH B	TUNING C	COUPLING D	PLATE TUNING E	ANT. COND. F	ANT. LOADING G	EXTERNAL LOAD COIL H
1.50	MO	1	1.50	6.0 to 8.5	0.8 to 1.5	OFF	7.5	2
2.25	MO	1	2.25	6.0 to 7.5	7.3 to 7.8	OFF	5.0	6
3.00	MO	1	3.00	6.0 to 7.0	9.0 to 9.5	OFF	20.0	6
3.00	MO	2	3.00	6.0 to 7.0	0.8 to 1.2	OFF	20.0	6
4.50	MO	2	4.50	6.0 to 7.0	8.0 to 8.5	OFF	33.0	6
6.00	MO	2	6.00	5.5 to 6.5	9.0 to 9.5	OFF	39.0	6
6.00	MO	3	6.00	4.0 to 5.0	0.5 to 1.0	OFF	39.0	6
9.00	MO	3	9.00	4.0 to 5.0	7.5 to 8.0	SERIES	35.0	6
12.00	MO	3	12.00	3.0 to 4.0	0.9 to 9.8	SERIES	41.5	6

NOTE: The above readings were taken using a dummy antenna that has characteristics similar to the characteristics of a 20 ft. whip antenna.

4.5.1.1. No audio circuit adjustments have been provided in the transmitter and therefore when the r-f circuits have been tuned and loaded, the transmitter is ready for either CW or VOICE emission with the power and emission controlled from either the transmitter panel or from the Type –23270 Remote Control Unit.

4.6. CRYSTAL CONTROLLED OPERATION

4.6.1. The tuning procedure for operation using the crystal oscillator to control the frequency, is similar to that outlined above for operation using master oscillator frequency control. A separate oscillator tube has been incorporated in the transmitter and is brought into operation when crystal controlled operation is selected by operating the OSCILLATOR SELECTOR switch to the C01, C02, C03, or C04 position. Any one of four crystals may be selected by the operation of the OSCILLATOR SELECTOR switch, S104. Output may be obtained on the first, second and fourth harmonics of crystals ground within the frequency range of 1500 kc to 3000 kc. The following procedure is

recommended for the adjustment of the r-f circuit for operation with crystal oscillator frequency control:

a. Operate the OSCILLATOR SELECTOR switch, S104, to the crystal position that corresponds to the crystal frequency upon which operation is desired.

b. Rotate the TUNING control until the desired operating frequency is indicated on the dial.

c. Operate the POWER switches, S107 and S205, to the ON positions.

d. With the microphone or telegraph key cord plug inserted into the MICROPHONE OR KEY jack, J101, press the push-to-talk button on the microphone or operate the telegraph key.

e. Rotate the PLATE TUNING control until the PLATE CURRENT meter needle dips sharply, indicating power amplifier plate tank circuit resonance.

NOTE: Considerable care should be exercised in the adjustment of the PLATE TUNING control to prevent doubling in the power amplifier circuit. It has been found that it is often possible to obtain two power amplifier plate current dips for a single frequency. The dip that gives the lowest value of plate current is not always the correct setting for the PLATE TUNING Control. With some antennas at some frequencies the power amplifier stage is operating as a frequency doubler when the meter indicates a minimum plate current. In general, starting the PLATE TUNING Control at "0", the first plate current dip that is obtained when rotating the control in a clockwise direction is the correct one.

f. When the adjustments of the power amplifier plate tank circuit have been completed the TUNING control should be rotated through resonance. The tuning of the oscillator and buffer stages is rather broad when using crystal control, but the TUNING control should be set at the position that gives a minimum plate current reading, indicating resonance at the exciter stages.

g. Adjust the loading of the power amplifier following the procedure outlined in Steps j, k, l, and m in paragraph 4.5.1., under Master Oscillator Operation.

4.6.1.1. Operation on CW with crystal frequency control will usually not be satisfactory with keying speeds greater than 20 words per minute. This is inherent in the crystal and is not the fault of the transmitter. Many crystals do not key satisfactorily even at slow speeds.

4.7. LOADING COIL ADJUSTMENTS

4.7.1. For operation within the frequency range 1500 kc to 3000 kc the performance of the transmitter will be greatly improved if the Type –47205 Antenna Loading Coil is connected in series with the antenna lead-in. Control G operates the tap switch, S701, to vary the inductance that is connected in the circuit. If operation is to be within the above frequency range, the tap switch, S701, should be adjusted while making the adjustments of the COUPLING, ANTENNA LOADING and ANT. COND. on the transmitter panel. The inductance that is connected in series with the antenna is a maximum at 0 dial reading and a minimum when the dial indicates 6. The control should be adjusted until proper loading is obtained and the ANTENNA CURRENT meter indicates maximum antenna current.

4.8. RECEIVER ADJUSTMENT

4.8.1. Either crystal controlled or continuous coverage reception is possible with the Type –46159 receiver. Any one of four crystals may be selected by the operation of the OSCILLATOR SELECTOR switch on the receiver front panel.

4.8.2. Continuous Coverage Reception

4.8.2.1. The following procedure is recommended for the adjustment of the receiver controls for reception with continuous frequency coverage:

a. Operate the OSCILLATOR SELECTOR switch, S202, to the MO position.

b. Insert an earphones cord plug into the PHONES jack, J201.

c. Operate the POWER switch, S205, to the ON position.

d. Operate the selector switch, S203, to the position that corresponds to the type of reception that is desired. (Note: MOD. has been engraved on the receiver panel to indicate the proper position of the switch for the reception of voice modulated or modulated CW signals.)

e. If CW reception has been selected it is recommended that the A-F GAIN control R220, be placed in the fully advanced position and that all gain adjustments be made with the R-F GAIN control, R216. The pitch of the beat note between the CW signal that is received and the output of the BFO may be varied by the operation of the CW PITCH control.

f. If MOD. reception has been selected, rotate the R.F. GAIN control in a clockwise direction until switch S206 is operated, so that the AVC circuit is operating, and partially advance the A.F. GAIN control.

g. Tune the receiver to the desired signal, using the TUNING control.

4.8.3. Crystal Controlled Reception

4.8.3.1. Crystal controlled reception is possible on all bands of this receiver.

On band 1 the Crystal frequency should be 455 KC higher than the received frequency, or between 1955 kilocycles and 3455 kilocycles. On band 2 the second harmonic of the crystal should fall 455 kilocycles higher than the received frequency, so that Crystal frequencies between 1727.5 kilocycles and 3227.5 kilocycles will be required. For band 3 the third harmonic of the crystal should be 455 kilocycles below the desired frequency, requiring crystals in the range 1848.3 kilocycles to 3848.3 kilocycles. The procedure for the adjustment of the receiver for crystal controlled operation is as follows:

a. Operate the OSCILLATOR SELECTOR switch, S202, to the crystal position that corresponds to the frequency upon which operation is desired.

b. Rotate the TUNING control until the dial indicates the desired reception frequency.

c. Operate the POWER switch, S205, to the ON position. While listening to the output of the receiver, rotate the TUNING control until the position of the control is found that gives maximum output. The tuning is rather broad when using crystal control.

4.9. REMOTE CONTROL

4.9.1. When all tuning adjustments of the transmitter and receiver have been completed, the control of the emission, power and the audio input to the speaker or headphones may be controlled from the Type –23270 Remote Control Unit. It is not possible to make any tuning adjustments from the remote unit and therefore the controls on the transmitter and receiver panels should be locked in position before assuming control from the remote position. When it is desired to use remote control, the procedure outlined herewith should be followed:

a. Having set and locked all panel controls, operate the POWER switches on the transmitter and receiver panels to the OFF positions.

b. Operate the EMISSION selector switches, S105 and S203, to the positions that correspond to the type of emission and reception desired.

c. If CW has been selected, operate the A.F. GAIN control on the receiver panel to the full gain position, corresponding to 10 on the dial, and partially advance the R.F. GAIN control. If MOD. reception has been selected the R.F. GAIN control should be fully advanced and the A.F. GAIN control only partially advanced.

(Note: The output of the receiver with either type of reception should be adjusted so that the input to the headphones is greater than would be normally desired. Thus the input to the speaker or headphones at the remote position may be controlled by operating the VOLUME CONTROL on the remote control unit panel.)

d. Operate the TRANSMITTER and RECEIVER switches, S602 and S603, on the Type –23270 Remote Control Unit, to the ON positions.

e. Insert the microphone or the telegraph key cord plug into the MIKE jack, J602, on the remote unit.

f. Insert the headphones cord plug into the PHONES jack, J601.

g. Operate the SPEAKER-PHONES switch, S601, to the position corresponding to the type of reception desired.

h. While listening to the output of the speaker or headphones, advance the VOLUME CONTROL, R601, until the audio output reaches the desired level.

i. The transmitter emission may now be controlled by operating the microphone push-to-talk button or the telegraph key.

4.10. ROUTINE OPERATION

4.10.1. Panel Control

a. Operate the EMISSION selector switch on the transmitter panel and the reception selector switch on the receiver panel to the positions corresponding to the type of operation desired.

b. Select the desired type of frequency control by operating the OSCILLATOR SELECTOR switches on the transmitter and receiver panels.

c. Adjust the BAND SWITCHES to the positions that include the frequency upon which operation is desired.

d. Rotate the TUNING controls until the dials indicate the desired frequency.

e. Insert the headphones cord plug into the PHONES jack on the receiver panel.

f. Insert the microphone or telegraph key cord plug into the MICROPHONE OR KEY jack on the transmitter panel.

g. Operate the POWER switches to the ON positions.

h. Allow a few seconds for the filaments of the tubes to warm up and then close the telegraph key or press the push-to-talk button on the microphone and adjust the power amplifier plate tuning and antenna loading controls on the transmitter panel. (Note: The power amplifier plate tuning and antenna loading procedure is outlined in detail in paragraph 4.5.1., under Master Oscillator Operation.)

When the above adjustments have been completed, the installation is ready for operation with emission and reception controlled from the panels of the receiver and transmitter. The usual tuning and output adjustments of the receiver will have to be made in order to receive the desired signal.

IMPORTANT: It must be remembered when changing from CW to VOICE emission or from VOICE to CW emission that additional tubes in the transmitter are being brought into operation and sufficient time must be allowed for these tubes to warm up before full power output can be obtained.

4.10.2. Remote Control

4.10.2.1. When the tuning adjustments of the transmitter and receiver have been made and the controls locked in position, control of the installation may be assumed from the Type –23270 Remote Control Unit. The procedure for routine operation from the remote position is outlined below:

a. Insert the telegraph key or microphone cord plug into the MIKE jack.

b. Operate the TRANSMITTER and RECEIVER switches to the ON positions. Operate the SPEAKER-PHONES switch to the position corresponding to the type of reception desired.

c. When sufficient time has been allowed for the transmitter and receiver tubes to warm up, the push-to-talk button on the microphone or telegraph key may be operated and the input to the speaker or phones adjusted by the operation of the VOLUME CONTROL.

4.11. EMERGENCY OPERATION

4.11.1. Vacuum Tube Failure

4.11.1.1. Several of the same type of tubes are used in the transmitter and if no spare tubes are available and a vacuum tube fails it may be possible to keep the transmitter in operation by exchanging tubes.

4.11.1.2. The master oscillator, the crystal oscillator and the buffer-doubler stages of the transmitter employ Type 12A6 tubes. The buffer-doubler tube must be in operation at all times but it is only necessary to have one of the oscillator tubes operating. Therefore, if the buffer-doubler tube, V103, fails, either of the oscillator tubes, V101 or V102, may be used for replacement. Removing either of the oscillator tubes will affect the calibration of the dial and of course will only permit frequency control by the oscillator tube that has been left in position but the transmitter may be kept operating by making a substitution as suggested above. If either of the oscillator tubes fails, the remaining oscillator may be used for frequency control.

4.11.1.3. Both the power amplifier and modulator circuits employ Type 1625 tubes. During periods of VOICE emission only one power amplifier tube, V104, is operating. Therefore, if tube V104 fails and VOICE emission is desired, V105 may be used for replacement. If either of the power amplifier tubes fails and CW emission is desired either of the modulator tubes may be used for replacement.

4.11.1.4. In the receiver it is practically imperative that all tubes be operating. There is one possibility of tube substitution, however. The oscillator tube, V203, is inoperative when crystal control of reception has been selected and therefore the Type 12A6 tube used as an oscillator may be substituted for the audio amplifier tube.

4.11.2. Power Unit Failure

4.11.2.1. If the output voltage of the dynamotor or generator drops to zero and the fuses and the brushes on the machine are found to be in good condition the only solution is to replace the dynamotor or generator or the complete power unit. However, the voltage may drop as a result of a partial breakdown of the armature and it may be possible to operate the equipment with reduced output.

4.12. BATTERY CHARGER

4.12.1. If a battery charger is employed, it is desirable to stop the machine while the radio equipment is in use. The battery charging process results in an excessive voltage across the battery. This abnormal voltage applied to the radio equipment, places an overload on the power unit, receiver and transmitter and may shorten the life of the tubes and other component parts. It is desirable to charge the battery during times when the radio equipment is idle.

This radio equipment has been constructed of materials considered to be the best obtainable for the purpose and has been carefully inspected and adjusted at the factory. However, certain parts of the equipment require a normal amount of attention in order to maintain the most efficient and dependable operation.

5.1. ROUTINE CHECK

5.1.1. To assure dependable service, periodical inspection and operational checks of the equipment should be made. A definite schedule of maintenance should be set up and closely followed.

5.1.2. The following section gives suggestions for inspection and operational checks. Others may suggest themselves to the maintenance personnel.

5.1.3. Equipment Inspection

a. Carefully check all connecting cables for breaks and to be sure that the cable plug connector locking rings are tight and fastened with safety wires.

b. Check the antenna and ground connections and the wire that connects the transmitter RECEIVER ANTENNA terminal to the ANTENNA terminal on the receiver to be sure that the spring connector terminals are making good contact with the wires and that none of the wires have been weakened or broken by vibration.

c. Remove the end bells from the dynamotors, generators and motors and using compressed air blow out all carbon and copper dust that may have accumulated on the commutator and surrounding surfaces. Inspect the brushes of the machines for wear and if any brush is shorter than one-fourth inch, replacement should be made. The bearings on the motors, dynamotors and generators will require lubrication at intervals of approximately 1000 hours of machine operation. It is recommended that Andock "C" grease, manufactured by the Standard Oil Company of New Jersey, or a similar grade of lubricant be used for the lubrication of the machines.

d. The relay contacts in the transmitter and power unit should be carefully checked for alignment, pitting and corrosion. If the contacts require cleaning a burnishing tool should be used—never use sandpaper or emery cloth.

5.1.4. Operational Check

5.1.4.1. It is recommended that the operation of the transmitter, receiver and control unit be checked at regular intervals. All controls should be checked for proper operation and the calibration of the transmitter and receiver should be checked against a frequency standard. Refer to the OPERATION Section of this Instruction Book and follow the procedure outlined for Routine Operation in paragraph 4.10., to check the operation of the tuned elements.

WARNING: CONNECTIONS IN THIS EQUIPMENT ARE SUCH THAT IF THE RECEIVER POWER SWITCH ON THE EQUIPMENT FRONT PANEL OR RECEIVER POWER SWITCH ON THE REMOTE CONTROL UNIT IS IN THE ON POSITION AND THE TRANSMITTER POWER SWITCH ON THE REMOTE CONTROL UNIT IS IN THE ON POSITION THE INTERLOCK SWITCH, ASSOCIATED WITH THE TRANSMITTER, IS INOPERATIVE. BEFORE REMOVING A UNIT FROM THE CABINET, THE OPERATOR SHOULD CAREFULLY OPERATE ALL POWER SWITCHES TO THE OFF POSITION.

5.2. ALIGNMENT

5.2.1. The alignment procedure must be followed in detail and it is recommended that only experienced personnel be allowed to make alignment adjustments on the transmitter and receiver.

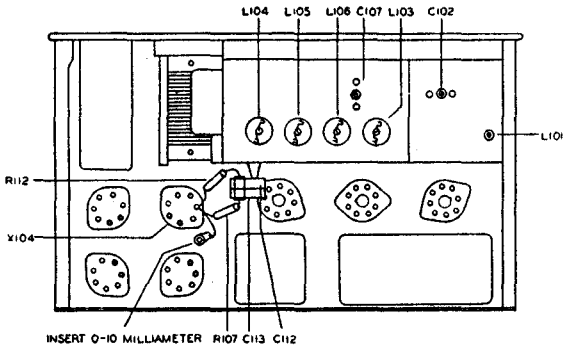


Fig. 18 Type –52245 Radio Transmitter—Aligning Adjustments (Dwg. 500 9972 002)

5.2.2. The transmitter and receiver circuits have been properly aligned at the factory and should not require readjustment unless the unit has been damaged.

5.2.3. Transmitter Alignment

5.2.3.1. Improper alignment of the transmitter is indicated by low grid excitation to the power amplifier and by inaccurate dial calibration, especially at the high frequency end of each band. To check the excitation insert a 0-10 ma meter between the junction of resistors R107 and R112 and ground. Refer to Figure 18. The grid current should be between 3.5 ma and 5.0 ma. If realignment appears to be necessary the equipment needed to align the transmitter circuits consists of a means of accurately measuring frequency, a low range d-c milliammeter (0-10 ma) and suitable screwdrivers and wrenches.

5.2.3.2 All alignment is accomplished using the master oscillator section of the transmitter. The EMISSION selector switch may be placed in either the VOICE or CW position while making the alignment adjustment. It is recommended, however, that the selector switch be placed in the CW position so that both power amplifier tubes are operating and so that the grid current is of a large enough value to give a good indication of proper circuit alignment.

5.2.3.3. The transmitter unit should be removed from the cabinet and placed on a flat table or bench with the front panel facing upward. When the transmitter is in this position the interlock switch is held operated and will permit voltage to be applied to the tubes.

5.2.3.4. Disconnect the wire which connects the junction of power amplifier grid resistors R107 and R112, to ground and insert the milliammeter between the junction of the resistors and the ground connection. (Refer to Figure 18 for the location of the resistors mentioned above.) The alignment procedure outlined below should be followed in detail:

a. Operate the OSCILLATOR SELECTOR switch to the MO TEST position.

b. Operate the BAND SWITCH to position 1 and rotate the TUNING control until the dial indicates 3.0 mc.

c. Operate the POWER switches S107, S205 to the ON position.

d. While checking the frequency of the output with an accurate frequency measuring device, adjust the trimmer capacitor, C102, until the oscillator frequency is exactly 3.0 mc.

e. Rotate the TUNING control until the dial indicates 1.5 mc and adjust the inductance trimmer within inductor, L101, until the frequency of the oscillator output is exactly 1.5 mc. (Refer to Figure 14 for the location of the capacitance and inductance trimmers.)

f. Repeat Steps d. and e. until no further adjustment of the inductance or capacitance is required.

5.2.3.5. The above procedure completes the alignment of the oscillator grid circuit and no further adjustments of these trimmers should be necessary.

g. Rotate the TUNING control to 1.5 mc on Band 1 and adjust the inductance trimmer within L106 for maximum power amplifier grid current.

h. Rotate the BAND SWITCH to Position 2.

i. Rotate the TUNING control to 3.0 mc and adjust the inductance trimmer in L105 for maximum power amplifier grid current.

j. Operate the BAND SWITCH to Position 3 and rotate the TUNING control until the dial indicates 12.0 mc.

k. Adjust the capacitance trimmer C107 for maximum power amplifier grid current.

l. Rotate the TUNING control until the dial indicates 6.0 mc and adjust the trimmers within inductors L103 and L104 for maximum power amplifier grid current.

m. Repeat Steps j, k, and l, until no further adjustment of the trimmers will increase the power amplifier grid current.

5.2.3.6. The above procedure completes the alignment of the transmitter circuits but before the meter is removed from the power amplifier grid circuit a careful check should be made of the excitation on all bands. The grid current should be between 3.5 ma and 5.0 ma and should be nearly uniform over the entire band. Any variation in grid current reading should be smooth as the TUNING control is rotated over the band. If any sharp dips in grid current are noticed, the alignment procedure should be repeated.

5.2.4. Receiver Alignment

5.2.4.1. If the receiver circuits require realignment to obtain satisfactory performance, the equipment needed for the aligning consists of an audio output meter, a signal generator covering the frequency range 450 kc to 12,000 kc and suitable screwdrivers and wrenches.

5.2.4.2. The procedure outlined below should be followed in detail to obtain proper alignment of the receiver circuits. (Refer to Figure 19 for location of trimmers.)

a. Connect the output meter to the receiver output circuit. If the meter does not present a 500 ohm load to the receiver, a 500 ohm resistor should be connected across the input terminals to the meter.

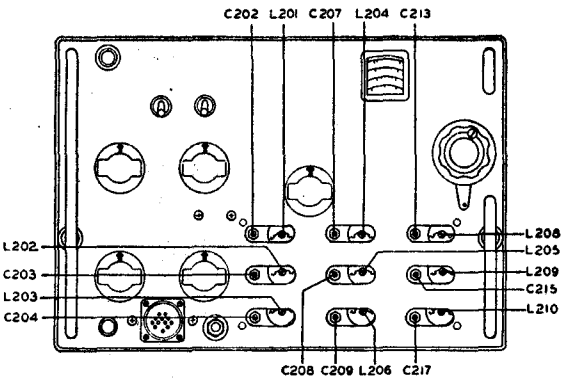


Fig. 19 Type –46159 Radio Receiver — Aligning Adjustments (Dwg. 500 9971 002)

b. Operate the MOD-CW switch, S203, to the MOD position.

c. Advance the R.F. GAIN control to the full on position.

d. Advance the A.F. GAIN control to the full on position.

e. Operate the POWER switch, S205, to the ON position.

5.2.4.3. I-F ALIGNMENT FOR TCS RECEIVERS HAVING IRON CORE I-F TRANSFORMERS. A special long thin tool approximately $\frac{3}{16}$" in diameter and made of bakelite, fibre, or wood (—DON'T USE METAL!), with a screwdriver tip, will be required when aligning the i-f transformers. The adjustable cores in the primary and the secondary of each transformer are both accessible thru the hole in the top of the shield can. The long thin non-metallic adjusting tool will engage the primary adjustable core when it is inserted as far as it will go. The secondary adjustable core is located close to the top of the transformer and may be seen when looking thru the opening in the top of the shield can. (It looks like a collar with slots at each side which are used to engage with the adjusting tool.) Any non-metallic adjusting tool with a tip wide enough to properly engage in this collar will be satisfactory for adjustment of the secondary core.

a. Remove oscillator tube V203 (12A6) from its socket and do not replace it until the

entire alignment procedure has been completed.

b. Set Band Switch to position #1.

c. A 10,000 ohm ¼ watt resistor with short leads attached to each end will be required in the following procedure. It is desirable to have clips on each lead so that the resistor may be conveniently connected into and removed from the various positions described below.

d. Connect the 10,000 ohm resistor between terminals #3 and #4 of the 3rd I-F transformer (Z203). Terminal numbers are stamped into base of transformer.

e. Set Signal Generator to 455 kc and connect ground terminal of generator to any convenient ground on the receiver chassis. Connect a 0.1 mfd condenser in series with the generator output lead. Then connect output lead to grid of 2nd I-F amplifier tube V205 (terminal #4 of X205).

f. Adjust both cores in I-F transformer Z203 until a maximum reading is obtained on the output meter.

g. Disconnect 10,000 ohm resistor from terminals #3 and #4 of transformer Z203 and reconnect to terminals #1 and #2 of same transformer. Then recheck the adjustment of the TOP core in transformer Z203 to be sure it is peaked for a maximum reading on the output meter.

h. Disconnect 10,000 ohm resistor from transformer Z203 and then connect it to terminals #3 and #4 of transformer Z202. Disconnect signal generator output lead from grid of tube V205 and reconnect to grid of tube V204 (terminal #4 of X204). Now adjust both cores in transformer Z202 for maximum reading on output meter.

i. Disconnect 10,000 ohm resistor from terminals #3 and #4 of transformer Z202 and reconnect it to terminals #1 and #2 of same transformer. Then recheck the adjustment of the TOP core in transformer Z202 to be sure it is peaked for a maximum reading on the output meter.

j. Disconnect 10,000 ohm resistor from transformer Z202 and then connect it to terminals #3 and #4 of transformer Z201. Disconnect signal generator output lead from grid of tube V204 and reconnect to control grid of tube V202 (terminal #8 of X202). Now adjust both cores in transformer Z201 for maximum reading on output meter.

k. Disconnect 10,000 ohm resistor from terminals #3 and #4 of transformer Z201 and reconnect it to terminals #1 and #2 of same transformer. Then recheck adjustment of TOP core in transformer Z202 to be sure it is peaked for a maximum reading on the output meter.

l. The alignment of I-F transformer is now complete and 10,000 ohm resistor now connected to terminals #1 and #2 of Z201 should be removed, signal generator output lead should be disconnected from grid of V202 and oscillator tube V203 (12A6) should be replaced in its socket.

5.2.4.4. I-F ALIGNMENT FOR TCS RECEIVERS HAVING CONDENSER TUNED I-F TRANSFORMERS. (Identified by the two holes in the tops of the transformer cans.)

a. Connect the output meter to the receiver output circuit. If the meter does not present a 500 ohm load to the receiver, a 500 ohm resistor should be connected across the input terminals to the meter.

b. Operate the MOD/CW switch, S203, to the MOD position.

c. Advance the R.F. GAIN control to the full on position.

d. Advance the A.F. GAIN control to the full on position.

e. Connect the output (455 kc) of the signal generator directly to the grid of the second i-f amplifier tube (Terminal #4 of X205).

f. Operate the POWER switch, S205, to the ON position.

g. Adjust the trimmers of the i-f transformer, Z203, until the output meter reads a maximum.

h. Connect the output of the signal generator directly to the grid of the first i-f amplifier tube (Terminal #4 of X204).

i. Adjust the trimmers of the i-f transformer, Z202, for maximum output.

j. Connect the output of the signal generator to the control grid of the converter tube, V202 (Terminal #8 of X202).

k. Adjust the trimmers of the i-f transformer, Z201, and readjust the trimmers of i-f transformers Z202 and Z203 for maximum output.

5.2.4.5. In outlining the above procedure for the alignment of the i-f circuits it has been assumed that the i-f transformers are being replaced or that the trimmers are completely out of adjustment. If only slight misalignment is indicated it will be possible to connect the output of the signal generator to the grid of the converter tube, V202, and to align all i-f transformers without having to progressively connect the signal generator to each of the i-f stages.

5.2.4.6. R.F. ALIGNMENT: Be sure instructions in paragraph 5.2.4.2. Steps a. thru e. have been carried out before using the following procedure.

a. Connect the output of the signal generator to the receiver ANTENNA and GROUND terminals (short leads). The "hot" lead from the signal generator must be connected in series with a 10 ohm non-inductive resistor in series with a 100 mmfd. capacitor before connecting to receiver antenna lead.

b. Operate the OSCILLATOR SELECTOR switch to the MO position.

c. Remove the tuning chart from the front panel and loosen the capacitance trimmer lock nuts.

d. Operate the BAND SWITCH to Position 1 and adjust the receiver TUNING control to 1.5 mc and the signal generator for an output on 1.5 mc.

e. Adjust inductance trimmers within inductors L203, L206, and L210 for a maximum output reading.

f. Rotate the TUNING control until the dial indicates 3.0 mc and adjust the signal generator to give output on 3.0 mc.

g. Adjust the capacitance trimmers C204, C209 and C217 for maximum output.

h. Repeat Steps d, e, f, and g, until no further adjustment of these trimmers will increase the output.

i. Operate the BAND SWITCH to Position 2, rotate the TUNING control until the dial indicates 3.0 mc and adjust the signal generator to give output on 3.0 mc.

j. Adjust the inductance trimmers within inductors L202, L205, and L209 for maximum output.

k. Rotate the receiver TUNING control to 6.0 mc and adjust the signal generator controls so that output is obtained on 6.0 mc.

l. Adjust capacitance trimmers C203, C208, and C215 for maximum output.

m. Repeat Steps i, j, k, and l, until no further adjustment of the trimmers will increase the output.

n. Operate the BAND SWITCH to Position 3 and rotate the receiver TUNING control to 6.0 mc. Adjust the signal generator to give output on 6.0 mc. Adjust the inductance trimmers within inductors L201, L204 and L208 for maximum output.

o. Rotate the TUNING control to 12.0 mc and adjust the signal generator to give output on 12.0 mc.

p. Adjust the trimming capacitors, C202, C207, and C213 for maximum output. Repeat Steps n and o, until no further adjustment of the trimmers will increase the receiver output.

q. When all trimming adjustments have been completed, rotate the TUNING control to the midpoint of each band and check the calibration and sensitivity of the receiver. If the sensitivity is low or the calibration is too much in error the alignment procedure should be repeated.

r. When proper alignment has been obtained and with a signal being fed into the receiver, the capacitance trimmer lock nuts should be tightened with the trimmers in the positions that give maximum output

5.2.5. BFO Alignment

5.2.5.1. If the beat frequency oscillator becomes inoperative the procedure outlined below should be followed for the realignment of the circuit:

a. Set the CW PITCH control to 0.

b. With the MOD/CW switch in the MOD position, tune the receiver to a modulated signal (455 kc) which is fed into the receiver from the signal generator.

c. With the receiver tuned to the incoming signal, the modulation that is being applied to the signal by the signal generator should be switched off and the receiver MOD/CW switch operated to the CW position.

d. Without retuning the receiver, the trimmer (adjustable "powdered iron" core or capacitor) in the beat frequency oscillator coil Z204 should be adjusted to exact zero beat with the incoming signal.

e. Rotate the CW PITCH control in both directions from zero. The pitch of the beat note should increase as the control is rotated in either direction from 0 toward 5.

f. If the pitch of the note increases as described in Step e, it indicates proper adjustment of the BFO tank circuit.

5.3. PROCEDURE FOR DISASSEMBLING TCS EQUIPMENT FOR SERVICING

5.3.1. Sub-assembly type of construction has been used extensively in this equipment. This type of construction facilitates the removal of component parts without major disassembly of the unit.

5.3.2. The following information will enable the service man to quickly determine the steps necessary in removing any of the components subject to damage or deterioration.

Assembly	Items Included	Instructions for Assembly Removal
Exciter Figs. 31, 32, and 35	C102, C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, L101, L102, L103, L104, L105, L106, R101, R102, R103, R104, R106, R125, S101, X101, X102, X103	Removal of Exciter is not generally advisable if the component is otherwise at all accessible. Most internal component replacements can be made by removing bottom plates, Fig. 35 or 98L Capacitor, Fig. 37. The bottom plate can be removed by removing S104 shaft, which slides out after knob is removed, and taking out all the machine screws observed in the bottom plate. In removing top plates it is necessary to remove all machine screws observed in top plates. External components may be replaced more easily by loosening or removing Transmitter Back Plate and Crystal Bracket Assemblies. (See paragraphs on Back Plate and Crystal Bracket Assemblies.) If it is necessary to remove Exciter Assembly, it is best accomplished in the following manner. Remove right end casting by taking out back-plate screws, Panel studs, Cabinet locks, and screws holding Exciter and Crystal Brackets. Remove two screws in top bracket next to V102 and V103. Remove four screws in left end of exciter (2 hold C128). Remove S101 and S104 shafts by removing knobs and sliding them out. Remove cable clamps and connecting wires. Disconnect three bus wires from C101. The assembly may now be removed from right end of transmitter.
Crystal Bracket Figs. 33 and 34	C122, C123, C124, C129, K101, L109, R114, R115, R116, S104, X108, X109	All components on Crystal Bracket are accessible by removing Back Plate from transmitter. By removing the Back Plate mounting screws, the Plate can be pulled away from the Crystal Bracket exposing Crystal Bracket Parts. If it should become necessary to remove Crystal Bracket, it is best to take the transmitter Back Plate off first. Then, by taking out two screws in the right end casting, removing connecting wires, and taking out S104 shaft, the Bracket can be slid out the bottom of the transmitter.

Assembly	Items Included	Instructions for Assembly Removal
98L Capacitor Figs. 37 and 38	C101A, C101B, C101C	The 98L Capacitor Assembly is removed in the following manner: Reach through the hole near the panel in the right end casting with a # 6 Bristo wrench and loosen the two set screws in the bushing of the shaft extension. Remove knob and shaft extension together. Rotate the dial lock to the left until it comes free. Slide the brace wire back by loosening the set screws in the blocks on the end of the capacitor and on the panel. Remove the mounting bolts. One from the right end casting and two from the bracket at the bottom of the capacitor (these two are screwed into the top of the exciter casting). Take the ground connector bolt out of the exciter casting and unsolder all other connecting wires. To facilitate unsoldering the connections it may be possible to remove the exciter tubes and shove the soldering iron tip through slots in the shield between the tubes and C101. Lift the unit out of the top of the transmitter.
Back Plate Figs. 27 and 28	C125, C126, C127, C129, T101. T102	In servicing the transmitter much consideration should be given the possibilities offered by removing the Back Plate. Not only are the components mounted directly on the back panel made accessible by its removal but many other components in the transmitter are fully exposed. To remove the Back Plate, the following screws should be taken out: 4 on each edge bolting the plate to the end castings, 2 to the crystal bracket, 2 in about the center of the plate (these two screw into rivet nuts), 3 that bolt the plate and the vertical Modulator Compartment shield together, and one bolting the modulator chassis and the left end casting together. This leaves the modulator tube chassis bolted to the back plate. No other screws need be removed. With these screws out, the plate may be lifted away from the transmitter frame as far as the connecting wires will permit. It is possible to cut a few cable ties to gain more clearance.

Assembly	Items Included	Instructions for Assembly Removal
Front Panel	S101 Detent, S101 Rotor	The Front Panel need only be removed for replacement of S101 detent and rotor.
L107	L107	To remove L107 it will be necessary to remove the dial and dial lock. The dial lock is removed by taking out its mounting screws and turning the lever counterclockwise. After this has been done the coil may be unbolted from the end casting and the connecting wires clipped. It is recommended that the connecting wires be clipped and replaced rather than unsoldered while the coil is still in the transmitter. The coil can now be brought out through the end casting.
L108	L108	L108 can be removed merely by taking out the 4 mounting screws bolting the bakelite escutcheon to the panel, loosening the screw in the rear bracket, and unsoldering the connecting wires. The whole unit being brought through the panel.
C116	C116	C116 is best removed by removing L108 and bringing C116 out through the L108 mounting hole. The bolts securing C116 to the left end casting are removed and the connecting wires unsoldered. The dial lock should first be removed by taking out its mounting screws and turning the lever counterclockwise.

RECEIVER

Assembly	Items Included	Instructions for Assembly Removal
R.F., Converter, and H.F. Oscillator Assemblies Figs. 46, 47, and 48	C202, C203, C204, C206, C207, C208, C209, C210, C212, C213, C214, C215, C216, C217, C218, C220, C223, L201 L202, L203, L204, L205, L206, L208, L209, L210, S201, S207, S208	Much of the service work to be done on these units can be accomplished without removing them from the receiver. The three units are covered on the bottom by a plate which is secured by 11 screws. This plate must be removed when servicing this section of the receiver. If it is necessary to remove any of these units, the following steps should be taken: Remove the S201, S207, S208 shaft by loosening set screw in gear end of shaft. This shaft can be pressed out of switch sections and through the hole in the right end casting. The section of the switch shaft going through the front panel is removed by taking off its knob and pulling the shaft thru the detent bushing. The front panel must be removed to get at the screws bolting the oscillator section to the end casting. Six screws on top and three along the front edge of the R.F. Chassis must now be taken out. The units are now free except for the connecting wires. These must be removed with caution so as not to damage any of the components.
R.F. Chassis Figs. 49 and 50	C205, C211, C219, C221, C222, L207, R201, R202, R203, R204, R205, R206, R207, R208, R211, R212, R213, S202, T201, X201, X202, X203, X208, X209	By taking off the back plate of the receiver, and loosening the large resistor board, all of the components on the R.F. Chassis can be replaced with ease. In taking the back plate off, all of the screws excepting those holding the Bristo wrenches are removed. Before attempting to loosen the resistor board, C234 must be taken off and pulled away from the board. The four mounting screws holding the resistor board can now be removed. The connecting leads are sufficiently flexible to allow the resistor board to be turned so that the components on the lower side can be serviced.

Assembly	Items Included	Instructions for Assembly Removal
I.F. and B.F.O. Assemblies Figs. 51, 52, 53, and 54	C226, C227, C228, C229, C231, C232, C233, C235, R210, R214, R215, R216, R218, R219, R221, R222, R223, R224, R225, R226, R232, X204, X205, X206, X207, Z201, Z202, Z203, Z204	Most of the components in these assemblies are serviceable without major disassembly. To remove the I.F. Assemblies, disconnect the connecting wires and remove the 4 mounting screws on top of the individual chassis. Note that there are interconnecting wires between the different stages which must be removed and pulled through the shields.
R.F. Gain Control	R216	To replace the R216 gain control it is necessary to get enough room behind it to pull it from behind the panel. This can be done by removing the four mounting screws from the BFO Assembly and tipping it back at the bottom. It will not be necessary to remove the CW Pitch knob, or any connecting leads from the BFO unit. When replacing R216 be certain that the positioning pin is aligned with the hole in the panel.
98L Capacitor Assembly Figs. 37 and 38	C201A, C201B, C201C	The 98L Capacitor Assembly is removed in the following manner: Reach through the hole near the panel in the right end casting with a # 6 Bristo wrench and loosen the two set screws in the bushing of the shaft extension. Remove knob and shaft entension together. Rotate the dial lock to the left until it comes free. Slide the brace wire back by loosening the set screws in the blocks on the end of the capacitor and on the panel. Remove the single mounting bolt from the right end casting and the two from the bracket at the bottom of the capacitor. Unsolder all connecting wires and lift the capacitor assembly out of the receiver.

5.4. LOCATION OF FAULTS

5.4.1. The most common cause of improper operation of radio equipment is tube failure. A complete set of tested tubes of the same type as specified should be kept on hand at all times. If faulty operation of the transmitter is observed and tube failure suspected, each tube may be checked by replacing the tube with a tube known to be in good condition. If an open fuse is found it is an indication of an overload. The overload may be caused by a defective capacitor, defective tubes or a high voltage arc. A direct short is most readily found by means of a continuity check. The d-c resistance of the various circuits may be checked in order to locate the fault.

5.4.2. Defective tubes causing an overload in power circuits may usually be located by inspection. It will be found that excessive heating or sputtering within the tube is a good indication of a fault in the tube circuit. High voltage arcs may be caused by bent condenser plates, corrosion or dust. One of the greatest sources of trouble in equipment located in a salt atmosphere is corrosion. Corrosion resulting from salt spray or salt laden atmosphere may cause failure of the equipment for no apparent reason. In general it will be found that contacts such as tap switches, tube prongs, cable plug connectors and relay contacts are most affected by corrosion. When it is necessary to operate equipment in localities subject to such corrosive atmosphere, inspection of wiping contacts, cable plugs, relay contacts, etc., should be made more frequently in order to keep the equipment in good condition.

5.4.3. In case of trouble, look for simple causes first. Analyze and isolate the difficulty before attempting to remove or dismantle any part of the equipment. A few moments of thought and study of the complete schematic circuit diagram (Fig. 79), together with a tabulation of the various possible causes of failure, may save hours of haphazard labor. Radio equipments are often damaged by needless disassembly and removal of parts, when the real cause of trouble is merely a broken lead or a faulty connection.

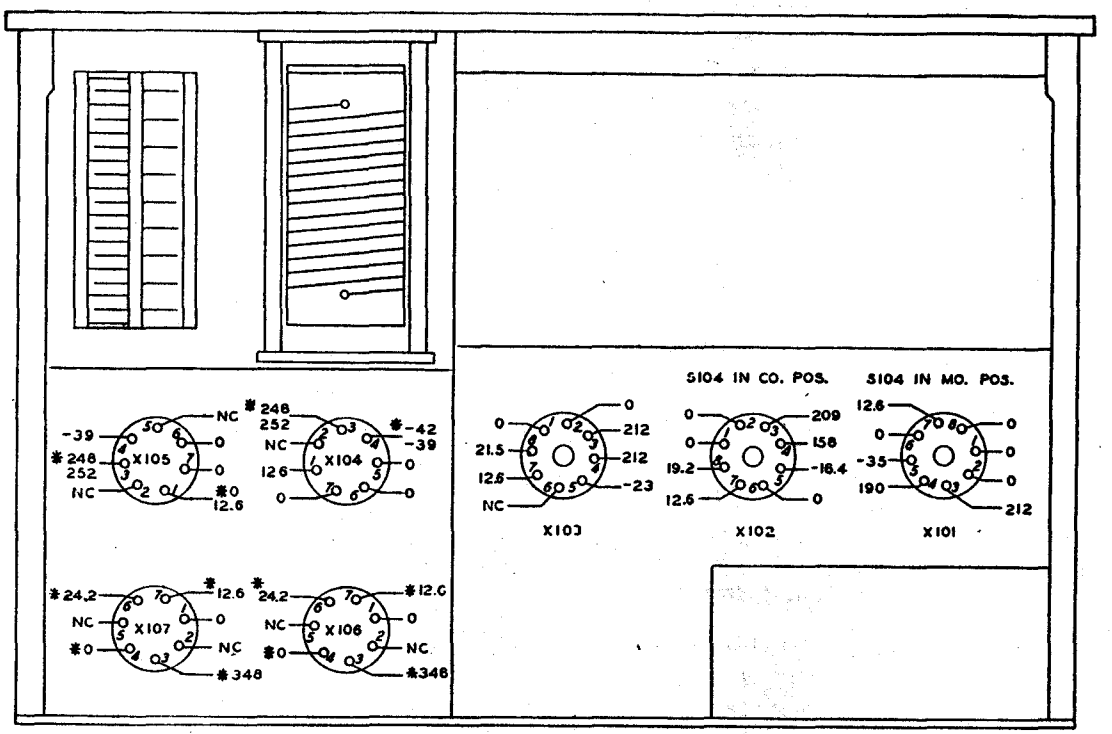
5.4.4. Fig. 22 is a simplified schematic of the entire Type –46159 receiver which shows dc voltages appearing at various accessible points. Measurements are from the indicated point to ground using a vacuum tube type of voltmeter such as the Senior Voltohmyst. The receiver under test should be adjusted to the conditions indicated in Fig. 22. The receiver will operate well within specifications with a deviation of 10% from any one of the designated voltage values. A deviation of 20% or more from any one of the indicated voltage values may be serious and the components involved should be checked. A 10% deviation of more than one of the indicated voltage values could cause trouble.

5.4.5. Open heaters or tubes of low emission will cause screen voltage readings to be higher than normal and bias voltages to be low or completely absent.

5.4.6. Shorted or leaky filter and by-pass capacitors cause a reduction in voltage in the associated circuits. Open filter or by-pass capacitors cause instability, loss of signal level, increase in noise level, and, in some instances, a reduction in voltage in the circuit. Leaky coupling capacitors may cause distortion or excessive tube heating.

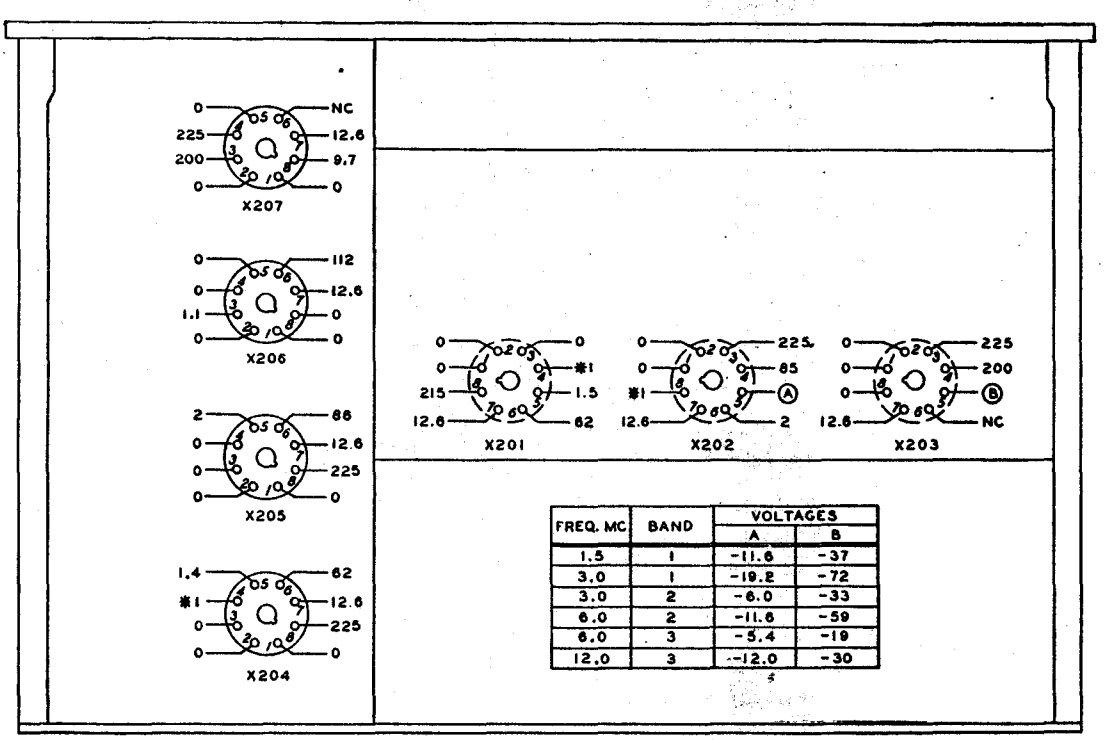
5.4.7. Defective resistors may cause a reduction in voltage in the circuit, a blocked grid, or objectionable hum. A resistor that heats excessively may indicate a shorted by-pass capacitor, in which case it is likely that the resistor will be damaged and will also require replacement.

5.4.8. In event the relay contacts of the various relays become dirty or corroded, erratic operation or complete failure of operation will result. Since many of the contacts are made of soft silver, a burnishing tool rather than a file or sandpaper should be used in cleaning the contacts. The contact leafs should not require adjusting unless they have become damaged. Adjustment of contact leafs should only be attempted by trained



* VOICE OPERATION

Fig. 20 Type –52245 Radio Transmitter Socket Voltages
(Dwg. 500 9975 002)



FREQ. MC	BAND	VOLTAGES	
		A	B
1.5	1	-11.6	-37
3.0	1	-19.2	-72
3.0	2	-6.0	-33
6.0	2	-11.6	-59
6.0	3	-5.4	-19
12.0	3	-12.0	-30

* WITH AVC ON, VOLTAGES AT THIS POINT WILL BE APPROXIMATELY 1 VOLT.

Fig. 21 Type –46159 Radio Receiver Socket Voltages
(Dwg. 500 9976 002)

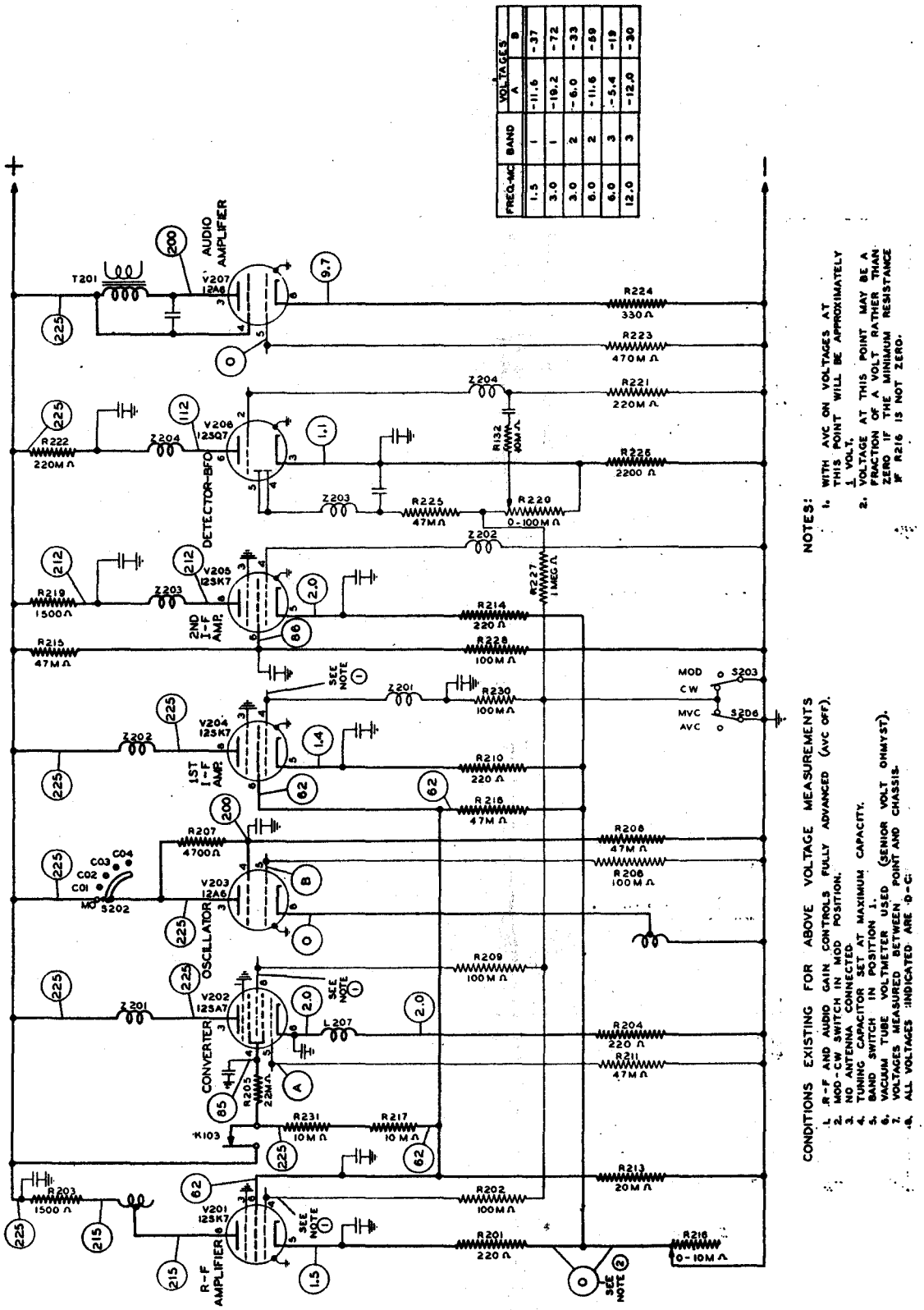


Fig. 22 Type –46159 Radio Receiver Circuit Voltages
(Dwg. 500 9973 003)

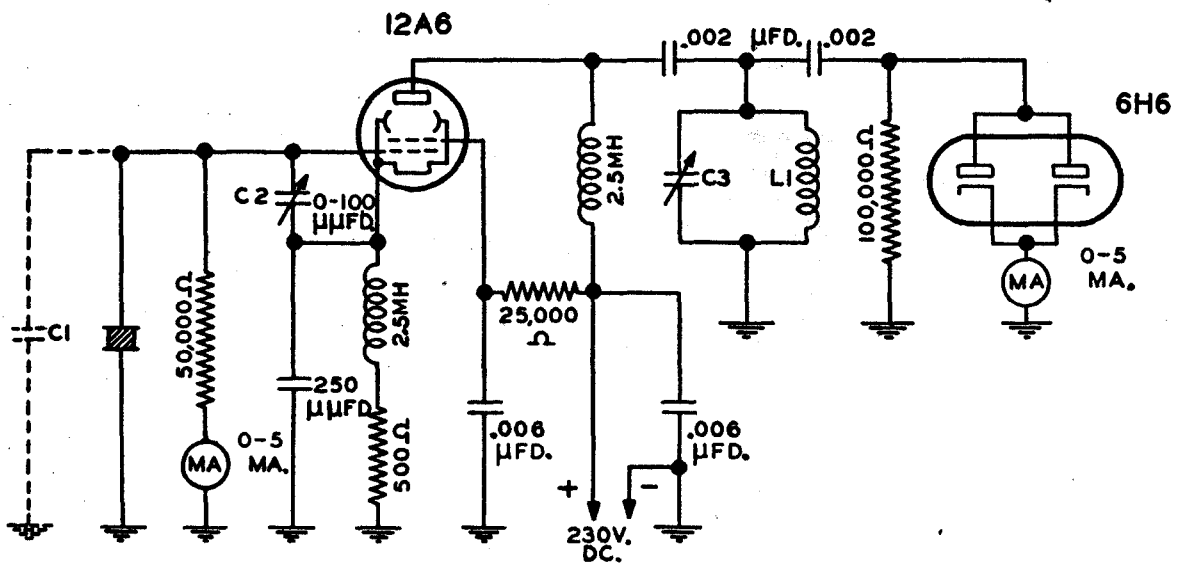


Fig. 23 Transmitter—Typical Crystal Oscillator Circuit
(Dwg. No. 781A)

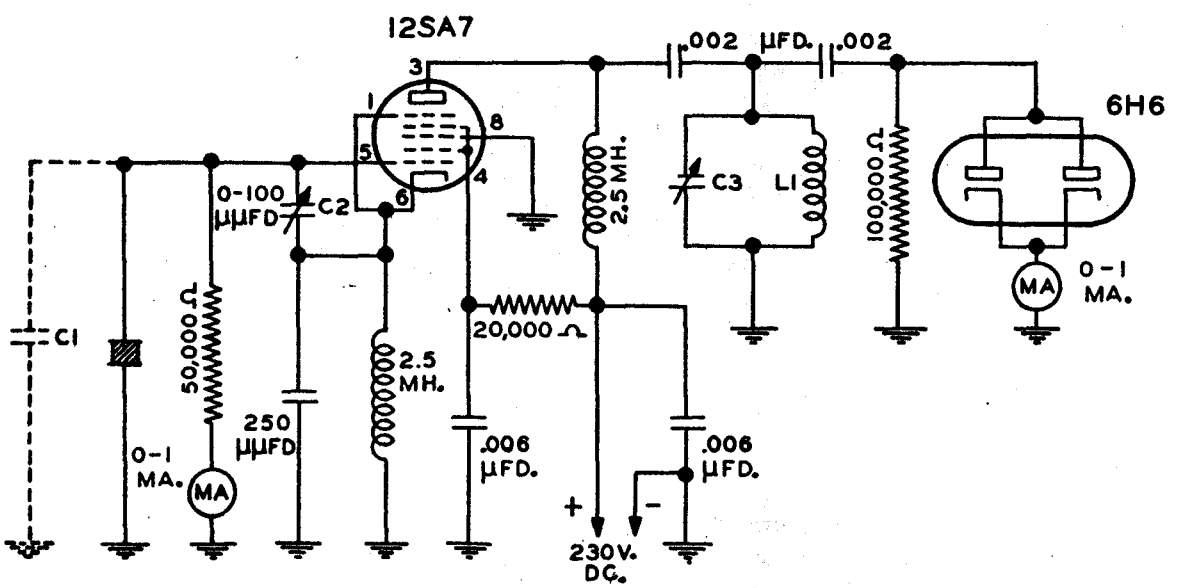


Fig. 24 Receiver—Typical Crystal Oscillator Circuit
(Dwg. No. 780A)

personnel and with adequate tools designed for the purpose. Failure of the normally closed contacts of voice CW relay K101 in the CW position will allow the P.A. plate current to flow through the modulation transformer secondary winding. This results in a lower than normal output from the transmitter on CW. If cleaning the contacts does not remedy the situation, the pressure of the contact leaf can be increased by bending the contact leaf slightly towards the normally closed contact. Only the amount of tension necessary for vibration proof operation should be applied since too much pressure may cause the normally open Voice Contacts to become faulty in operation.

5.4.9. It is possible for the loading coil L108 to become erratic in operation in dust laden air. This coil can be cleaned by brushing with a straight motion parallel with the wire using a rather stiff brush moistened with carbon tetrachloride. A tooth brush can be used in an emergency—do not use anything that would scratch the wire.

5.5. CRYSTALS

5.5.1. If new crystals are to be ground for use in this equipment, it is recommended that the following procedure be followed when testing and calibrating the crystals.

5.5.2. The circuit shown on Figure 23 should be employed in testing and calibrating replacement quartz crystals for operation in the crystal oscillator circuit of the transmitter unit of the Navy Model TCS Series Radio Equipment. The following procedure must be used in the adjustment of the circuit.

1. Remove the type 12A6 tube and the crystal holder from the sockets.
2. Adjust C2, a 100 mmfd trimmer capacitor, until the total grid to ground capacity, represented by C1 measures 62 mmfd.
3. Replace the tube and the crystal and holder in the circuit. Apply 230 volts d.c. to the plate circuit as shown. The filament of the 12A6 tube will require a potential of 12.6 volts. A potential of 6.3 volts is required for the filament of the 6H6 tube.
4. Adjust the tank coil, L1, to a suitable value of inductance and tune the variable tank capacitor, C3, so that the tank circuit resonates with the second harmonic of the crystal frequency. Resonance is indicated by a maximum reading of the output meter.

5.5.3. The following observations should be considered in the testing and calibration of crystals in this circuit.

1. The ratio of inductance to capacitance in the plate tank circuit is not critical. Due to the inherent characteristics of the circuit, changes in tuning or plate circuit loading do not affect the grid circuit.
2. During the grinding process and testing on a test plate, variation of the air gap on the crystal should not cause any sudden changes in the reading of the grid current meter.
3. During a variation in temperature of 0° C. to 50° C. in testing the crystal, the output meter reading should not drop more than 25% from the peak value.

5.5.4. The circuit shown on Figure 24 should be employed in testing and calibrating replacement quartz crystals for operation in the crystal oscillator circuit of the receiver unit of the Navy Model TCS Series Radio Equipment. The following procedure must be used in the adjustment of the circuit.

1. Remove the type 12SA7 tube and the crystal holder from the sockets.
2. Adjust C2, a 100 mmfd trimmer capacitor, until the total grid to ground capacity, represented by C1, measures 65 mmfd.
3. Replace the tube and the crystal and holder in the circuit. Apply 230 volts d.c. to the plate circuit as shown. The filament of the 12SA7 tube will require a potential of 12.6 volts. A potential of 6.3 volts is required for the filament of the 6H6 tube.

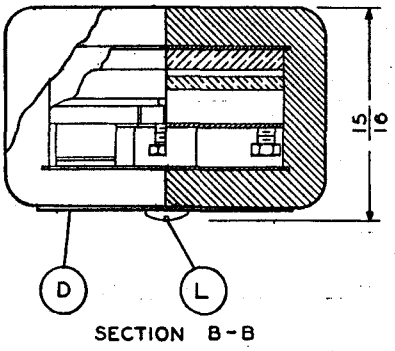
4. Adjust the tank coil, L1, to a suitable value of inductance and tune the variable tank capacitor, C3, so that the tank circuit resonates with the second harmonic of the crystal frequency. Resonance is indicated by a maximum reading of the output meter.

5.5.5. The following observations should be considered in the testing and calibration of crystals in this circuit.

1. The ratio of inductance to capacitance in the plate tank circuit is not critical. Due to the inherent characteristics of the circuit, changes in tuning or plate circuit loading do not affect the grid circuit.
2. During the grinding process and testing on a test plate, variation of the air gap on the crystal should not cause any sudden changes in the reading of the grid current meter.
3. During a variation in temperature of 0° C. to 50° C. in testing the crystal, the output meter reading should not drop more than 25% from the peak value.

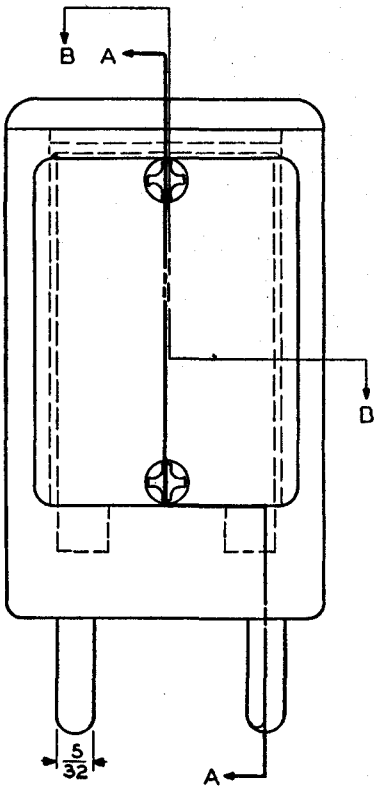
5.5.6. Replacement quartz crystals for the transmitter should be ground within the range 1500 to 3000 kc. Crystals for band 1 (1500-3000 kc) should be ground to the operating frequency; those for band 2 (3000-6000 kc) and band 3 (6000-12,000 kc) should be ground to one-half and one-quarter the operating frequency respectively.

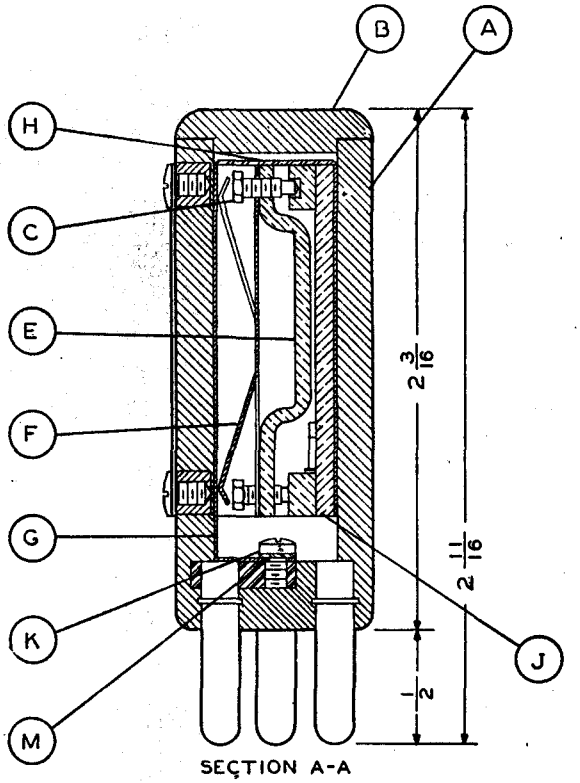
5.5.7. Crystals for the receiver should be ground as follows: On Band 1 the Crystal frequency should be 455 kc higher than the received frequency, or between 1955 kilocycles and 3455 kilocycles. On Band 2 the second harmonic of the crystal should fall 455 kilocycles higher than the received frequency, so that crystal frequencies between 1727.5 kilocycles and 3227.5 kilocycles will be required. For Band 3 the third harmonic of the crystal should be 455 kilocycles below the desired frequency, requiring crystals in the range 1848.3 kilocycles to 3848.3 kilocycles.



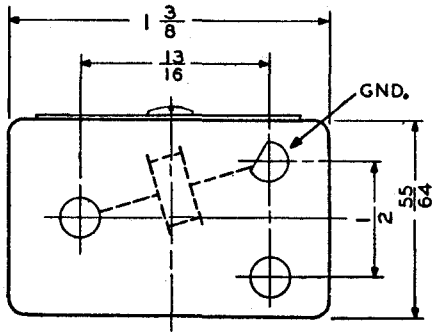
SECTION B-B

QTY.	IT.	PART NO.	DESCRIPTION
1	A	571 0558 10	CRYSTAL HOLDER
1	B	150 3100 00	CRYSTAL HOLDER COVER
3	C	330 4150 00	2-64 HEX. MACH. SCREW
1	D	280 ---- --	NAMEPLATE (COLLINS)
1	E	507 4949 00	CRYSTAL ELECTRODE
1	F	507 5424 00	COMPRESSION SPRING
2	G	507 4952 00	CRYSTAL CONTACT PLATE
1	H	507 4948 00	SUB. COVER
1	J	571 0305 10	CRYSTAL ELECTRODE ASSY
2	K	347 0020 00	2-56 PH. FIL. HD. SCREW
2	L	343 0108 00	2-56 PH. BD. HD. BRASS SCR.
2	M	373 3120 00	#2 SHAKEPROOF





SECTION A-A



ELECTRICAL CHARACTERISTICS:
- FREQ. RANGE: 1.5 TO 5.0 MEGACYCLES
- CRYSTAL CUT: AT (MAY SPECIFY BT)
- TEMPERATURE RANGE: 0° TO 50° C
- CALIBRATION: ±.005% AT 25° C
- TEMPERATURE COEFFICIENT: NOT EXCEEDING 3 PPM.- CLOSER TOL. MAY BE SPECIFIED
- USE: FREQUENCY CONTROL

MECHANICAL CHARACTERISTICS:
- SOCKET: W. E. 3 PIN CRYSTAL HOLDER SOCKET
- BLANK SIZE: "1" SQ.
- INTERCHANGEABILITY: POSSIBLE SUBSTITUTE FOR HOWARD 5H

Fig. 25 Navy Type –40068 Crystal Unit (Dwg. 502 0328 003)

VI DATA

Typical Transmitter Performance Data

TABLE I—TCS POWER INPUT REQUIREMENTS

POWER UNIT BY NAVY TYPE NUMBER

Input Voltage	-21770 12v dc	-21881 12v dc	-211035 12v dc	-21826 24v dc	-21774 24v dc	-21775 32v dc	-21776 115v dc	-211100 115v dc	-21827 230v dc	-21827-A 230v dc	-21777 115v ac	-21909 115v ac	-20218 115v ac	-20242 230v ac	-20309 115/230v ac
CONDITIONS															
CW-Key Open-Receiver ON	108 w	108 w	108 w	359 w	108 w	350 w	288 w	288 w	275 w	275 w	275 w	275 w	150 w	150 w	150 w
CW-Key Closed-Receiver ON	185	185	185	414	185	448	391	391	385	385	360	360	234	234	234
VOICE-Key Open Receiver ON	110	110	110	352	110	358	288	288	275	275	275	275	150	150	150
VOICE-90% Modulation-Receiver ON	205	205	205	445	205	474	397	205	385	385	390	390	243	243	243
Transmitter OFF-Receiver ON	58	58	58	175	58	184	144	58	140	140	135	135	89	89	89

TABLE II—TRANSMITTER POWER INPUT REQUIREMENTS

a. Filament Power Required—

	Volts	Amps
CW	12.0	1.28
VOICE	12.0	1.72

b. Plate Power Required—

	Volts	Amps
CW	220	.030
	440	.186
VOICE	220	.029
	440	.188

Typical Transmitter Performance Data

TABLE III—TRANSMITTER POWER OUTPUT

a. CW Emission

Band	Frequency	Power Output
1	1.5 mc	34.0 watts
1	3.0 mc	25.1 watts
2	3.0 mc	23.8 watts
2	6.0 mc	31.8 watts
3	6.0 mc	28.8 watts
3	12.0 mc	34.9 watts

b. VOICE Emission

Band	Frequency	Power Output
1	1.5 mc	16.0 watts
1	3.0 mc	11.9 watts
2	3.0 mc	10.6 watts
2	6.0 mc	14.5 watts
3	6.0 mc	11.4 watts
3	12.0 mc	15.3 watts

Note: The above power measurements were made using a dummy load consisting of 300 mmfd in series with 13.6 ohms of non-inductive resistance on Band 1 and 100 mmfd in series with 13.6 ohms of non-inductive resistance on Bands 2 and 3. The high and low voltage power supply voltages were 440 and 220 respectively.

TABLE IV—TRANSMITTER AUDIO FREQUENCY DATA

a. Audio Frequency Response

Frequency	90% Mod.
200 cps	+0.68 db
300 cps	+0.44 db
400 cps	+0.38 db
1000 cps	0.00 db
2000 cps	—1.01 db
3000 cps	—2.03 db
5000 cps	—3.56 db

b. Audio Input

0.86 volt for 90% modulation.

c. Audio Distortion

9.0% rms at 400 cps and with 90% modulation.

d. Noise Level

48 db below the 100% modulation level with input at 1000 cps.

Typical Transmitter Performance Data

TABLE V—TYPICAL TRANSMITTER OPERATING VOLTAGES AND CURRENTS

NOTE: The power supply, used in making these measurements, delivered 440 and 220 volts respectively. Some power supplies are designed for slightly lower voltages. Thus the values shown here will be proportionately lower in cases where the supply voltage differs from 440 and 220 volts.

Tube	Type of Emission	Filament Volatge	Plate Voltage		Screen Voltage		Grid Voltage		Grid Current		Cathode Voltage		Cathode Current	
			1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc
V101 (12A6)	CW	12.6	217	213	192	181	— 38	— 73	——	——	0	0	——	——
	Voice	12.6	218	217	190	183	— 38	— 73	——	——	0	0	——	——
V102 (12A6)	CW	12.6	217	213	170	148	— 15.3	— 12.4	——	——	20.4	16.7	13.6	11.0
	Voice	12.6	218	217	171	148	— 12.2	— 12.3	——	——	20.7	16.7	13.6	11.0
V103 (12A6)	CW	12.6	218	211	218	211	— 22.3	— 77.0	——	——	24.0	30.0	16.0	20.0
	Voice	12.6	218	213	218	213	— 22.0	— 74.0	——	——	23.8	30.3	15.8	20.2
V104 (1625)	CW	12.6	445	430	257	267	— 42.0	— 41.0	1.9	1.8	0	0	90	90
	Voice	12.6	420	420	255	267	— 44.5	— 47.0	2.0	2.1	0	0	90	90
V105 (1625)	CW	12.6	445	430	257	267	— 42.0	— 41.0	1.9	1.8	0	0	90	90
	Voice	0	420	420	420	420	0	0	0	0	0	0	0	0
V106 & V107 (1625)	CW	0	0	0	0	0	0	0	——	——	0	0	0	0
	Voice	12.6	440	440	358	355	0	0	——	——	28.5	28.6	86.4	86.4

Note: All voltage measurements made between tube prongs and ground and with power amplifier loaded to rated input. A vacuum tube voltmeter was used for all voltage measurements.

Typical Receiver Performance Data

TABLE VI—RECEIVER POWER INPUT REQUIREMENTS

a. Filament Power Required—

	Volts	Amps
CW	12.0	1.15
MOD.	12.0	1.15

b. Plate Power Requirements—

	Volts	Ma
CW	215	97
MOD.	215	97

Typical Receiver Performance Data

TABLE VII—RECEIVER AUDIO FREQUENCY DATA

a. Overall Frequency Response

Frequency (cps)	1000 cps Sig. 30% Mod. (db)
200	+0.5
300	+1.0
500	+1.6
1000	0.0
1500	—1.0
2000	—2.6
2500	—4.0
3000	—5.0
4000	—6.4

b. Sensitivity

(1) CW

Band 1		Band 2		Band 3	
Freq. (mc)	Input (Microvolts)	Freq. (mc)	Input (Microvolts)	Freq. (mc)	Input (Microvolts)
1.5	3.0	3.0	2.5	6.0	2.6
1.9	1.3	3.8	1.2	7.5	1.1
2.3	1.1	4.5	1.0	9.0	1.0
2.6	1.0	5.2	1.0	10.5	1.0
3.0	1.0	6.0	1.0	12.0	1.0

(2) MCW

Band 1		Band 2		Band 3	
Freq. (mc)	Input (Microvolts)	Freq. (mc)	Input (Microvolts)	Freq. (mc)	Input (Microvolts)
1.5	13.0	3.0	8.4	6.0	5.5
1.9	7.2	3.8	7.5	7.5	5.1
2.3	4.5	4.5	5.0	9.0	3.8
2.6	2.7	5.2	2.2	10.5	2.1
3.0	4.2	6.0	1.4	12.0	2.0

c. Selectivity

Ratio *	Band Width (kc)
2	9.0
10	18.0
100	30.0
1,000	45.0

* The figure in the column under Ratio is obtained by dividing the input that is necessary to obtain a given output off resonance by the input that is required to give the same output with the receiver tuned to resonance.

d. Image Ratio

Band 1		Band 2		Band 3	
Freq. (mc)	Ratio (db)	Freq. (mc)	Ratio (db)	Freq. (mc)	Ratio (db)
1.5	64.	3.0	63.	6.0	51.
2.3	57.	4.5	49.	9.0	40.
3.0	53.	6.0	49.	12.0	22.

e. AVC Characteristics

Freq.—Input (Microvolts)	2.3 mc Output (db)	4.5 mc Output (db)	9.0 mc Output (db)
1	—22	—24	—26
5	—13	—8	—14
10	—6	—2	—5
100	+8	+11	+11
1,000	+13	+14	+16
10,000	+16	+17	+18
100,000	+20	+20	+20

Note: Audio input 30% modulated at 400 cps. A.F. GAIN control set for +20 db output with 100,000 mv input.

f. Distortion and Power Output

Power Output		Distortion
db	watts	
19.2	0.500	6.5%
22.2	1.000	6.7%
23.8	1.437	9.8%
24.0	1.500	10.0%

TABLE VIII—TYPICAL RECEIVER OPERATING VOLTAGES

NOTE: The power supply, used in making these measurements, delivered 220 volts. Some power supplies are designed for slightly lower voltages. Thus the values shown here will differ proportionately in cases where the supply voltage differs from 220 volts.

Tube	Filament Voltage	Plate Voltage		Screen Voltage		Control Grid Voltage		Suppressor Grid Voltage		Cathode Voltage	
		1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc	1.5 mc	12.0 mc
V201 (12SK7)	12.0	210	210	64	64	—	—	0	0	1.7	1.7
V202 (12SA7)	12.0	210	210	80	80	—11	—11	0	0	2.0	2.0
V203 (12A6)	12.0	210	210	185	185	—32	—28	—	—	—	—
V204 (12SK7)	12.0	210	210	64	64	—	—	0	0	1.4	1.4
V205 (12SK7)	12.0	200	200	84	84	—	—	0	0	2.0	2.0
V206 (12SQ7)	12.0	100	100	—	—	0	0	—	—	1.0	1.0
V207 (12A6)	12.0	195	195	215	215	—	—	—	—	9.2	9.2

Note: All measurements were made with a vacuum tube voltmeter between tube prongs and ground, with r-f and audio gain controls set for maximum gain, with the AVC circuit inoperative and with the MOD/CW switch in the MOD. position.

TABLE IX—RESISTANCE MEASUREMENTS

From Cable Connector Plugs Terminals to Ground.

Pin No.	Transmitter Conn. P101	Receiver Conn. P201	Remote Unit P601
1	Inf.	Inf.	Inf.
2	Inf.	39,000	Inf.
3	Inf.	36,000	Inf.
4	100	Inf.	Inf.
5	0 (Gnd)	2	Inf.
6	Inf.	0.2	Inf.
7	Inf.	Inf.	0 (Gnd.)
8	1200	Inf.	R601 Max-500 R601 Min-40
9	Inf.	79	Inf.
10	Inf.	Inf.	—
11	Inf.	Inf.	—
12	Inf.	Inf.	—
13	1.1	—	—
14	Inf.	—	—
15	0 (Gnd.)	—	—
16	79	—	—

Conditions: Tubes in sockets; POWER switches in OFF positions
Transmitter-MO; VOICE; Band 1
Receiver-MO; MOD; Band 1; AVC on.

TABLE X—TRANSMITTER AND RECEIVER RESISTANCE MEASUREMENTS

Note: All measurements from socket terminals to ground.

Pin No.	V101 (12A6)	V102 (12A6)	V103 (12A6)	V104 (1625)	V105 (1625)	V106 (1625)	V107 (1625)	V201 (12SK7)	V202 (12SA7)	V203 (12A6)	V204 (12SK7)	V205 (12SK7)	V206 (12SQ7)	V207 (12A6)
1	0 (Gnd)	0 (Gnd)	0 (Gnd)	1	0.5	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)
2	0 (Gnd)	0 (Gnd)	0 (Gnd)	Inf.	Inf.	Inf.	Inf.	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	0 (Gnd)	225,000	0 (Gnd)
3	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	0 (Gnd)	40,000	40,000	0 (Gnd)	0 (Gnd)	2,400	38,000
4	Inf.	Inf.	Inf.	22,000	22,000	3,000	2,800	1.2 Meg	60,000	35,000	1.0 Meg	1.6	150,000	38,000
5	1 Meg	50,000	110,000	0 (Gnd)	Inf.	Inf.	Inf.	220	22,000	110,000	220	220	150,000	550,000
6	Inf.	Inf.	Inf.	0 (Gnd)	47,000	290	290	15,000	240	Inf.	15,000	50,000	275,000	Inf.
7	1	1	1	0 (Gnd)	0 (Gnd)	1	1	2	2	2	2	2	2	2
8	0 (Gnd)	1500	1500	——	——	——	——	40,000	1 Meg	0.4	38,000	40,000	0 (Gnd)	320

Conditions: All tubes in sockets; cables disconnected.

Transmitter—Band 1; VOICE Emission; Power off; MO.

Receiver—Band 1; MOD. reception; AVC on; MO.

TABLE XI—INTERCHANGEABILITY OF UNITS

Unit Description	Navy Type No.	TCS	TCS-1	TCS-2	TCS-3	TCS-4	TCS-5	TCS-6	TCS-7	TCS-8	TCS-9	TCS-10	TCS-11	TCS-12
Radio Transmitter	–52245	x	x	x	x	x	x	x	x	x	x	x	x	x
Radio Receiver	–46159	x	x	x	x	x	x	x	x	x	x	x	x	x
Remote Control Unit	–23270	x	x	x	x	x	x	x	x	x	x	x	x	x
Antenna Loading Coil	–47205	x	x	x	x	x	x	x	x	x	x	x	x	x
Dynamotor Power Unit. 12 V DC Input	–21770	x	x	x	x	x	x	x	x	x	x	x	x	x
Dynamotor Power Unit. 12 V DC Input	–21881	x	x	x	x	x	x	x	x	x	x	x	x	x
Dynamotor Power Unit. 12 V DC Input	–21881-A	x	x	x	x	x	x	x	x	x	x	x	x	x
Dynamotor Power Unit. 12 V DC Input	–211035	x	x	x	x	x	x	x	x	x	x	x	x	x
Dynamotor Power Unit. (Single Machine)	–211330	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 24 V DC Input	–21826	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 24 V DC Input	–21774	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 32 V DC Input	–21775	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 115 V DC Input	–21776	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 115 V DC Input	–211100	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 115 V AC Input	–21777	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 115 V AC Input	–21909	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 230 V DC Input	–21827	x	x	x	x	x	x	x	x	x	x	x	x	x
Motor-Generator Power Unit. 230 V DC Input	–21827-A	x	x	x	x	x	x	x	x	x	x	x	x	x
Rectifier Power Unit. 115 V AC Input	–20218	x	x	x	x	x	x	x	x	x	x	x	x	x
Rectifier Power Unit. 230 V AC Input	–20242	x	x	x	x	x	x	x	x	x	x	x	x	x
Rectifier Power Unit. 115/230 V AC Input	–20309	x	x	x	x	x	x	x	x	x	x	x	x	x
65F-7 Cable. Transmitter to Power Unit	———	x	x	x	x	x	x	x	x	x	x	x	x	x
65F-8 Cable. Receiver to Power Unit	———	x	x	x	x	x	x	x	x	x	x	x	x	x
65F-10 Cable. Control Unit to Power Unit	———	x	x	x	x	x	x	x	x	x	x	x	x	x
65F-13 Cable. Receiver to Power Unit	———	x	x	x	x	x	x	x	x	x	x	x	x	x
65J-1 Cable. A. C. Line to Rectifier Unit	———	x	x	x	x	x	x	x	x	x	x	x	x	x

VII APPENDIX

TABLE XII—LIST OF MAJOR UNITS

Quantity							Symbol Group	Navy Type Designation	Collins Type Designation	Name of Major Unit	Assy. Dwg. No.
12 v. dc	24 v. dc	32 v. dc	115 v. dc	230 v. dc	115 v. 60 cps ac	230 v. 60 cps ac					
1	1	1	1	1	1	1	101 to 199	-52245	56Q	Radio Transmitter	471E, 472E
1	1	1	1	1	1	1	201 to 299	-46159	51Q	Radio Receiver	471E, 472E
					x		301 to 399	-20218	409M-5	A-C Power Supply	254D
						x	501 to 599	-20242	409M-6	A-C Power Supply	254D
					x	x	2201 to 2299	-20309	409M-7	115/230 V AC Power Supply	500951100D
x							401 to 499	-21770	416T-3	Dynamotor Power Supply	496C
x							401 to 499	-21881	416T-4	Dynamotor Power Supply	1031C
x							401 to 499	-21881-A	416T-4	Dynamotor Power Supply	1031C
x							401 to 499	-211035	416T-4	Dynamotor Power Supply	1031C
x	x						2401 to 2499	-211330	416T-9	Dynamotor Power Supply (Single Machine)	500920500C
	x						501 to 599	-21774	413C-1	Motor Generator Power Supply	255E
					x		501 to 599	-21777	413C-1	Motor Generator Power Supply	255E
	x						1601 to 1699	-21826	413C-2	Motor Generator Power Supply	255E
		1					1701 to 1799	-21775	413C-3	Motor Generator Power Supply	255E
			x				1801 to 1899	-21776	413C-4	Motor Generator Power Supply	255E
					x		1901 to 1999	-21909	413C-5	Motor Generator Power Supply	255E
				x			2001 to 2099	-21827	413C-6	Motor Generator Power Supply	255E
			x				2101 to 2199	-211100	413C-7	Motor Generator Power Supply	255E
						x	2301 to 2399	-21827-A	413C-8	Motor Generator Power Supply	255E
1	1	1	1	1	1	1	601 to 699	-23270	314M-1	Remote Control	654A
1	1	1	1	1	1	1	701 to 799	-47205	190Z-1	Antenna Loading Coil	623C
1	1	1	1	1	1	1	801 to 899	———	65F-7	Power Cable (Trans.)	193A
1	1	1	1	1	1	1	1001 to 1099	———	65F-10	Control Cable	748A
1	1	1	1	1	1	1	1401 to 1499	———	65F-13	Power Cable (Rec.)	2155A

x Either of these Units may be supplied.

APPENDIX

TABLE XIII

LIST OF MANUFACTURERS

CAI	16A	Aladdin Radio Industries, Inc. 501 W. 35th Street Chicago, Illinois
	40A	American Brass Co. of Illinois 1326 W. Washington Blvd. Chicago, Illinois
CAS	56A	American Lava Corporation Kruesi Building Chattanooga, Tennessee
CHH	84A	Arrow-Hart & Hegeman Co. 103 Hawthorne Street Hartford, Connecticut
	92A	Auto Electric Co. Mankato, Minnesota
CZB	68B	Breeze Corp. 24 South Sixth Street Newark, New Jersey
CTB	72B	Bristol Company 66 Bride Street Waterbury, Connecticut
CFA	97B	Bussman Mfg. Company St. Louis Missouri
CED	10C	Cannon Electrical Devel. Co. 3209 Humboldt Street Los Angeles, California
CBN	25C	Centralab, Inc. 900 East Keefe Milwaukee, Wisconsin
CTC	49C	Chicago Telephone Supply Elkhart, Indiana
CTR	55C	Chicago Transformer Corp. 3501 West Addison Chicago, Illinois
COL	64C	Collins Radio Company Cedar Rapids, Iowa
CPD	65C	Communications Products, Inc. 245 Custer Avenue Jersey City, New Jersey
CD	75C	Cornell-Dubilier Electric Corp. 333 Hamilton Boulevard South Plainfield, New Jersey
CAE	96C	Cutler-Hammer 1333 West St. Paul Avenue Milwaukee, Wisconsin
CEB	36E	Hugh H. Eby, Inc. 4704 Stenton Avenue Philadelphia, Pennsylvania
CEK	60E	Eicor, Inc. 1060 W. Adams Street Chicago, Illinois
	95E	The Electro Motive Mfg. Co. Willimantic, Conn.
CBV	17F	John E. Fast & Co. 3123 N. Crawford Chicago, Illinois
	88F	Fractional Motors 1501 N. Halsted Chicago, Illinois
CDP	25G	General Ceramics Company 30 Rockefeller Plaza New York, New York
CG	40G	General Electric Company Schenectady, New York
	63G	General Instrument Company Elizabeth, New Jersey
CGE	85G	Guardian Elec. Mfg. Co. 1620-27 W. Walnut Street Chicago, Illinois
CHC	05H	Hammarlund Mfg. Company 424 W. 33rd Street New York, New York
CHU	80H	Harvey Hubbell, Inc. 1930 Thomas Street Bridgeport, Connecticut
CIR	28J	International Resistance Co. 1100 Terminal Commerce Bldg. Philadelphia, Pennsylvania
CIT	35J	International Telephone Dev. Co., Inc. 137 Varick Street New York, New York

APPENDIX

LIST OF MANUFACTURERS

CBU	42J	Isolantite Corporation 10 Park Place New York, New York
CJE	65J	Jefferson Electric Company Bellwood, Illinois
CJS	70J	Jensen Radio Mfg. Co. 6601 South Laramie Avenue Chicago, Illinois
CEJ	77J	E. F. Johnson Company Waseca, Minnesota
CLR	42L	Leach Relay Company 5915 Avalon Street Los Angeles, California
CLF	78L	Littlefuse Laboratories 4765 Ravenswood Avenue Chicago, Illinois
	87L	R. G. Loftus Advertising Co. Cedar Rapids, Iowa
	90L	Lord Manufacturing Company 1639 West 12th Street Erie, Pennsylvania
CML	35M	Meissner Mfg. Company Mt. Carmel, Illinois
CNA	05N	National Company, Inc. Malden, Massachusetts
	21N	National Fabricated Products Co. 2650 Beldon Avenue Chicago, Illinois
	55N	New Departure Div. of G. M. Corp. Bristol, Connecticut
COC	05P	Oak Manufacturing Company 711 West Lake Street Chicago, Illinois
COM	25P	Ohmite Mfg. Company 4837 Flournoy Street Chicago, Illinois
	40P	Paper Products DeWitt, Iowa
	65P	Pheoll Mfg. Company 5708 Roosevelt Road Chicago, Illinois
	96R	Russell Electric Co. 340 W. Huron Chicago, Illinois
CAN	02S	Sangamo Electric Company 1935 Funk Street Springfield, Illinois
	05S	Searle Aero Industries, Inc. Orange, California
	10S	Shakeproof Lock Washer Co. 2573 N. Keeler Avenue Chicago, Illinois
CSE	42S	Signal Electric Mfg. Co. 1939 Troam Street Menominee, Michigan
	50S	Simplex Wire & Cable Co. 79 Sidney Street Cambridge, Massachusetts
CSL	64S	Solar Mfg. Corporation Bayonne, New Jersey
CPQ	65S	Speer Resistor Co. St. Marys, Pensylvania
CSF	66S	Sprague Specialties North Adams, Massachusetts
CTE	10T	Telephonics Corporation 350 West 31st Street New York, New York
CTH	20T	Thordarson Electric Mfg. Co. Huron & Kingsbury Streets Chicago, Illinois
	53U	U. S. Rubber Company 440 W. Washington Avenue Chicago, Illinois
CAY	35W	Westinghouse Elec. & Mfg. Co. Hill Street East Pittsburgh, Pennsylvania

APPENDIX

LIST OF MANUFACTURERS

CV	45W	Weston Electrical Inst. Corp. 619 Frelinghuysen Avenue Newark, New Jersey
	85W	Wincharger Corporation Sioux City, Iowa
	95W	Wrought Washer Mfg. Co. 2105 South Bay Street Milwaukee, Wisconsin
	50X	X-L Radio Laboratories 420 W. Chicago Avenue Chicago, Illinois

APPENDIX

PARTS LIST

Refer to Table XIV.

Component parts of the equipment are identified by means of symbol designations. Wherever it is required to reference a component, the same symbol designation is used. Thus, a part appearing on a simplified schematic, a complete circuit diagram, a wiring diagram, photograph or layout drawing, will always be identified by means of the same symbol designation. In addition, each component part is stamped with its corresponding symbol designation. These symbol designations identify the various component parts which appear in the following parts lists. No symbol designation is used to identify more than one part.

The alphabetical portion of symbol designations have been selected from the following list in accordance with the classification of the component parts concerned.

(A) Structural parts, panels, frames, castings, etc.

(B) Motors and other prime movers, self-synchronous motors, etc.

(C) Capacitors of all types.

(D) Dynamotors.

(E) Miscellaneous electrical parts: insulators, knobs, brushes, etc.

(F) Fuses.

(G) Generators, exciters, etc.

(H) Hardware, screws, bolts, studs, pins, snapslides, etc.

(I) Indicating devices (except meters and thermometers), pilot lamps, etc.

(J) Jacks and receptacles (stationary).

(K) Contactors, relays, circuit breakers, etc.

(L) Inductors, R.F., and A.F.

(M) Meters of all types, gauges, thermometers, etc.

(N) Nameplates, dials, charts, etc.

(O) Mechanical parts, bearings, shafts, couplings, gears, ferrules, flexible shafts, housings, etc.

(P) Plugs.

(Q) Diaphragms, (microphone, telephone, projector, etc.)

(R) Resistors, fixed and variable, potentiometers, etc.

(S) Switches, interlocks, thermostats.

(T) Transformers, R.F., and A.F., and power.

(U) Hydraulic parts.

(V) Vacuum and gaseous discharge tubes.

(W) Wires, interconnecting cables, without plugs.

(X) Sockets.

(Y) Mechanical oscillators, crystals, magnetestriction tubes, etc.

(Z) Impedance such as traps (wave), etc.

The numerical portion of the Symbol Designation has been assigned to identify the component part with a particular major unit assembly. The numerical portions of symbol designations begin with 101 for the first component part in each class (i.e., component part in each alphabetical class as described above) and run consecutively for the remaining component parts in a particular class. A different numerical series of numbers is used for each major unit of the equipment. The series 101 to 199 is reserved for the first major unit. The series 201 to 299 is reserved for the second major unit. The series 301 to 399 is reserved for the third major unit. In this manner, each major unit of the entire equipment is identified with a series of numerals to be used for the designation of component parts.

The List of Major Units, Table XII, gives a complete list of symbol designation numbers in correlation with the major units.

Only one Symbol Designation is assigned to cover component parts with multiple electrical or mechanical characteristics. However, since at times it is desirable to identify certain electrical or mechanical sections of these component parts, suffix letters are added when necessary. Thus, C121A, C121B, and C121C identify each section of triple capacitor C121, and K101A, K101B, K101C, and K101D identify the relay coil and various contacts of relay K101.

Replacement Parts

The prefix "SW" or "CWS", on part numbers stamped upon component parts of any TCS equipment, indicates that the part in question was furnished by the Stewart-Warner Corporation. The prefix "CMX" indicates that the part was furnished by the Magnavox Company.

The Model TCS Series equipment consists of basic transmitting and receiving units with various accessory units including power supplies for operation from six different power sources. Due to the quantity of units produced it has been found necessary to furnish dynamotor and motor generator combinations manufactured by several different concerns. The parts lists which follow have, therefore, been tabulated on a unit basis.

Table XIV consists of the main list of replacement parts tabulated by symbol designation and arranged so that all component parts related to a particular unit appear in one group regardless of the electrical classification of the individual part. These unit parts list groups are arranged in the book in the order of their "Symbol Group" designation as shown in Table XII.

A spare parts catalog is furnished for each separate contract covered by this instruction book. Compare the equipment contract number with that listed on the cover of the spare parts catalog before attempting to order replacement parts.

TABLE XIV

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –52245 TRANSMITTER: **CAPACITORS**

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C101	C101A, C101B, C101C	Triple Section Variable			64C	GA-693D		571 0693 40 or 693D
						GA-694D		571 0694 40 or 694D
C101A	V101 Grid Tuning Cap.	360 mmfd section of C101						
C101B	V101 Plate Tuning Cap.	280 mmfd section of C101						
C101C	V103 Plate Tuning Cap.	280 mmfd section of C101						
C102	V101 Grid Trimmer Cap.	75 mmfd Midget Variable	-482114		05H	APC		922 4200 00 or 922N42, 922 5300 00 or 922N53
C103	V101 Grid Padding Cap.	20 mmfd ±2½%, Neg. 750 PPM/°C ±130 PPM/°C 1000 T.V.	-CC30UJ200G	C75.12-1944	25C			913 0008 00 or 913N420N7.5
C104	V101 Grid Coupling Cap.	.00005 mfd ±10% 1000 T.V.	*-CM30C500-K	JAN-C-5	28J	1RS		912 4501 20 or 912N450A-K
C105	V101 Screen Bypass	.001 mfd ±20% 1500 T.V.	-481410-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2105 40 or 915N210E-M
C106	V101 Plate Coupling Cap.	.002 mfd ±20% 1500 T.V.	-482111-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2205 40 or 915N220E-M
C107	V101 Plate Trimmer Cap.	25 mmfd Midget Variable			05H	APC-25-C		922 0003 00 or 922 0004 00
C108	V103 Grid Coupling Cap.	Same as C105						
C109	V103 Cathode Bypass	.006 mfd ±20% 1500 T.V.	-481411-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2605 40 or 915N260E-M
C111	V103 Plate Blocking Cap.	Same as C109						
C112	V105 Grid Coupling Cap.	Same as C105						
C113	V104 Grid Coupling Cap.	Same as C105						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

CAPACITORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C114	V104 Screen Bypass	Same as C106						
C115	V105 Screen Bypass	Same as C106						
C116	P. A. Plate Tuning Cap.	425 mmfd Midget Variable	-482115		05P			922 5200 00 or 922N52
					63G			922 4600 00 or 922N46
								922 4700 00 or 922N47
C117	P. A. Plate Tank Padding Cap.	.00063 mfd ±10% 5000 T. V.	-CM55B631-K	JAN-C-5	75C 02S 64S	9LS A2-50 XM		950 3631 20 or 950N363A-K
C118	P. A. Plate Tank Padding Cap.	.00005 mfd ±20% 5000 T.V.	*-CM55B500M	JAN-C-5	75C 02S 64S	9L A-50 XM		950 4501 40 or 950N450A-M
C119	P. A. Plate Blocking Cap.	.01 mfd ±20% 2500 T.V.	*-CM55B103-M	JAN-C-5	02S 75C 64S	A-25 9L XM		925 1101 40 or 925N110A-M
C120	V105 Cathode Bypass	.008 mfd ±20% 300 W.V.	*-CM30B802-M	JAN-C-5	75C	1WLS		909 2803 54 or 909N280CN-M
C121	Ant. Coupling Padding Cap.	.00005 mfd ±10% 1500 T.V.	-481690-10		25C	840		913 4503 20 or 913N450C-K
C122	V102 Cathode Coupling Cap.	.00005 mfd ±10% 1000 T.V.	-482112-B-10	RE-13A-389M RE 48A 276B	02S	BE-10		910 4505 20 or 910N450E-K
C123	V102 Cathode Bypass	.00025 mfd ±10% 1000 T.V.	*-481405-B-10	RE-13A-389M	02S	BE-10		910 3255 20 or 910N325E-K
C124	V102 Screen Bypass	Same as C109						
C125	Audio Input Coupling Cap.	4.0 mfd ±20% 300 v a.c.	-481249-20	RE 13A 488E RE 48A 110Q	75C	KGU		930 8240 00 or 930N8B-M
C126	Mod. Cathode Bypass	Same as C125						
C127	Mod. Screen Bypass	.25 mfd ±20% 600 W.V.	-481392-20	RE 13A 488E RE 48A 128J	75C	S		956 2056 40 or 956NS05W-M

* Use This Part Number for Replacements.

CAPACITORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C128	C128A, C128B	Dual Section .1 mfd ±20% 600 W.V.	-48312-B-20	RE 13A 488E RE 48A 128J	75C	S		956 4016 40 or 956ND01W-M
C128A	Spark Suppressor Cap.	Section of C128						
C128B	Spark Suppressor Cap	Section of C128						
C129	Micr. Current Filter Cap.	2.0 mfd ±20% 400 W.V.	*-48403-B-20	RE 13A 488E	75C			954 2484 00 or 954NS4Y-M
C130	V105 Cathode Bypass	Same as C120						

MISCELLANEOUS PARTS

E101	V104 Pl. Parasitic Sup.	47 ohm resistor shunted by 8 turn coil			64C	GA-704A		571 0704 10 or 704A
E102	V105 Pl. Parasitic Sup.	Same as E101						
E103	Conical Standoff	¾" Low Loss Ceramic			42J 05N	 GS-10		190 2570 00 or 190NSN7
E104	Cylindrical Standoff	⅜" x ½" Cylindrical, Iso.			42J	#395-L½		190 2329 00 or 190NSL5
E105	ANTENNA Binding Post	¼" x 28" x 2⅜" Stud			64C			507 6671 00 or X-6671
E106	GROUND Binding Post	¼" x 28" x ½" Machine Screw			65P			343 0064 00 or 343N24JTBN
E107	RECEIVER Antenna Binding Post	Push Type Black Bakelite			50X	BI		372 1300 00 or 372N13
E108	RECEIVER Antenna Post Insulator	Glazed barrier for binding post			56A			190 4730 00 or 190NMP3
E109	Wing Nut	Wing Type ¼" x 28"			65P			334 2180 00 or 334N218
E110	ANTENNA Terminal Feedthru	Glazed Low Loss Ceramic Bushing			42J 25G			190 2923 00 or 190NBI23
E111	Cylindrical Standoff	½" x 1" Cylindrical			25C 42J	X-110 #397-L1		190 2327 00 or 190NSL3
E112	Button Feedthru	3/16" x ⅝" Bushing Insert, Iso.			42J			190 2932 00 or 190NB17

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

JACKS AND RECEPTACLES

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
J101	Microphone or Key Jack	3 circuit midget			10T	TC61		358 1100 00 or 358N110

RELAYS AND CONTACTORS

K101	Modulator Power Relay	12 v d-c coil SPDT			85G	G29662		410 1220 00 or 410N12B
K102	Antenna Relay	12 v d-c coil DPDT cont.			42L	1077-ABF		407 8610 00 or 407N86A
					85G	G33728		410 2300 00 or 410N23
					92A			410 0003 00
K103	Carrier Control Relay	Same as K102						

INDUCTORS AND REACTORS

L101	V101 Grid Inductor	1.5 to 3 mc			64C	GA-321D		571 0321 40 or 321D
L102	Osc. Plate Choke	1 mh 0.300 amp 10 ohm 3 Pie 190 t #32 sse per Pie			05N	R-300		240 5700 00 or 240N57
L103	V101 Plate Tank Inductor	3-6 mc			64C	GA-790D		571 0790 40 or 790D
L104	V103 Plate Tank Inductor	6-12 mc			64C	GA-792D		571 0792 40 or 792D
L105	V103 Plate Tank Inductor	3-6 mc			64C	GA-791D		571 0791 40 or 791D
L106	V103 Plate Tank Inductor	1.5-3 mc			64C	GA-793D		571 0793 40 or 793D
L107	P. A. Plate Tuning Inductor	1.5-12.0 mc			64C	GE-568D		575 0568 40 or 568D
L108	Antenna Loading Inductor	Variable Inductor			64C	GA-840D		571 0840 40 or 840D

* Use This Part Number for Replacements.

INDUCTORS AND REACTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
L108	Alternate				64C			571 0840 41
L109	V102 Cathode Choke	Same as L102						
L110	P. A. Plate Choke	1 mh 0.300 amp 10 ohm 3 Pie 190 t per Pie #32 sse			05N	R-300U		240 5800 00 or 240N58

METERS

M101	P. A. Plate Milliammeter	0-200 ma D.C.	*-MR25B200 DCMA	17-I-12 except case	45W			458 0710 00 or 458N0710
M102	Antenna Ammeter	0-3 amp R.F. 0.1 amp per division	-22438	17-I-12 except case	45W	507		457 1140 00 or 457N114
					35W	NT33		457 1240 00 or 457N124

PLUG CONNECTORS

P101	Power Plug	16 term wall mtg. 14-10 amp 2-30 amp			10C	SK-C16-32S		371 3060 00 or 371N306

RESISTORS

R101	V101 Grid Resistor	1 megohm ±5% 1 w			28J	BT1-Navy		729 0019 00 or 729NG1Meg-J
R102	V101 Screen Dropping Res.	22,000 ohm ±20% 1 w	*-RC31BF223M	AWS C75.7-1943	28J	BT1-Navy		729 7224 40 or 729NG22M-M
R103	V103 Grid Resistor	100,000 ohm ±20% 1 w	*-RC31BF104M	AWS C75.7-1943	28J	BT1-Navy		729 7160 44 or 729NG100M-M
R104	V103 Cathode Resistor	1500 ohm ±20% 1 w	*-RC31BF152M	AWS C75.7-1943	28J	BT1-Navy		729 7150 04 or 729NG1500-M
R106	V103 Tank Loading Res.	6800 ohm ±20% 1 w	*-RC31BF682M	AWS C75.7-1943	28J	BT1-Navy		729 7680 04 or 729NG6800-M

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

RESISTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
R107	V104 Grid Resistor	Same as R102						
R108	V104 Screen Dropping Res.	47,000 ohm ±20% 2 w	*-RC41BF473M	AWS C75.7-1943	28J	BT2		729 8474 40 or 729NH47M-M
R109	V104 Screen Dropping Res.	Same as R108						
R110	V105 Screen Dropping Res.	Same as R108						
R111	V105 Screen Dropping Res.	Same as R108						
R112	V105 Grid Resistor	Same as R102						
R113	V105 Cathode Res.	47,000 ohm ±20% 1 w	*-RC31BF473M	AWS C75.7-1943	28J	BT1-Navy		729 7474 40 or 729NG47M-M, 745 3157 00
R114	V102 Grid Resistor	Same as R113						
R115	V102 Cathode Res.	Same as R104						
R116	V102 Screen Dropping Res.	Same as R113						
R117	Limiting Resistor	470 ohm ±20% 1 w	*-RC31BF471M	AWS C75.7-1943	28J	BT1-Navy		729 7470 44 or 729NG470-M
R118	Mod. Cathode Res.	330 ohm ±20% 5 w	-631870-20		28J	MPJ		730 1330 64 or 730NA330F-M
R119	Mod. Screen Res.	20,000 ohm ±20% 5 w	-631871-20		28J	MPJ		730 1204 64 or 730NA20MF-M
R120	Spark Suppressor Res.	Same as R117						
R123	V104 Grid Parasitic Res.	47 ohm ±20% 1 w	*-RC30BF470M	AWS C75.7-1943	65S			729 7474 00 or 729NG47-M
R124	V105 Grid Parasitic Res.	Same as R123						
R125	V103 Screen Parasitic Res.	Same as R123						
R126	Limiting Resistor	Same as R117						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

SWITCHES

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
S101	Band Switch	3 Position			64C	GM-178C		590 6617 00C or GM-178C
S102	Band Switch	Same as S101						
S103	Antenna Coupling Switch	Same as S101						
S104	Oscillator Selector	6 Position			64C	GL-178C		500 6616 00C or GL-178C
S105	Voice-CW Switch	DPDT 1 amp 250 v toggle	-24003	RE 24A4 118A	84A	20905-EP		266 1030 00 or 266N103
S106	Interlock Switch	3 amp 250 v push-toggle	-24014	RE 24AA 118A	84A	3592-N		266 1050 00 or 266N105
S107	Transmitter ON-OFF Switch	SPST 35 amp lever-toggle	-24118-A	RE 24AA 118A	96C	8801		266 1040 00 or 266N104

TRANSFORMERS

T101	Microphone Trans.	Pri: 75 ohm 240 t #32 Enamel Sec: 125,000 C.T. .02 w 150-5000 cps 9922 t #42 Enamel			20T 55C			677 2130 00 or 677N213
T102	Modulation Trans.	Pri: 6000 ohm C.T. 1700 t #33 Enamel Sec: 6000 ohm 1702 t #33 Enamel 20 w 200-5000 cps			20T 55C			677 2010 00 or 677N201

TUBES

V101	Master Oscillator	Beam Power Amplifier	-12A6		* *	12A6		254 0236 00
V102	Crystal Oscillator	Same as V101						

* Use This Part Number for Replacements.

* * Supplied by numerous well-known manufacturers.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

TUBES (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Desig nation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
V103	Buffer-Doubler	Same as V101						
V104	Power Amplifier	Beam Power Pentode	-1625		* *	1625		254 0458 00
V105	Power Amplifier	Same as V104						
V106	Modulator	Same as V104						
V107	Modulator	Same as V104						

TUBE SOCKETS

X101	Socket for V101	8 prong, Octal, Isolantite	-49367	RE 13A 524 RE 49AA 314	77J			220 5810 00 or 220N581
X102	Socket for V102	Same as X101						
X103	Socket for V103	Same as X101						
X104	Socket for V104	7 prong, Isolantite	-49366	RE 13A 524 RE 49AA 314	77J			220 5730 00 or 220N573
X105	Socket for V105	Same as X104						
X106	Socket for V106	Same as X104						
X107	Socket for V107	Same as X104						
X108	Socket for Crystals 1 & 4	Dual 3 Pin Ceramic			05H			220 8130 00 or 220N813
X109	Socket for Crystals 2 & 3	Same as X108						

* Use This Part Number for Replacements.

* * Supplied by numerous well-known manufacturers.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –46159 RECEIVER: CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C201	C201A, C201B, C201C	Triple Sect. Variable			64C	GA-715D		571 0715 40 or 715D
C201A	V203 Grid Tuning Cap.	360 mmfd, section of C201			64C	GA-716D		571 0716 40 or 716D
C201B	V201 Plate Tuning Cap.	280 mmfd, section of C201						
C201C	V201 Grid Tuning Cap.	280 mmfd, section of C201						
C202	L201 Trimmer Cap.	25 mmfd Midget Variable	-482113		05H	APC-25C		922 3710 00 or 922N37A
C203	L202 Trimmer Cap.	Same as C202						
C204	L203 Trimmer Cap.	Same as C202						
C205	C205A, & C205B	Dual Sect. 0.1 mfd ±20% 400 W.V.	*-48312-B-20	RE 13A 488E	75C			954 4016 40 or 954ND01W-M
C205A	V201 Cathode Bypass	Section of C205						
C205B	V201 Screen Bypass	Section of C205						
C206	V201 Grid Coupling Cap.	0.0001 mfd ±20% 1000 T.V.	*-CM30C101-M	JAN-C-5	75C	5R		912 3103 40 or 912N310C-M
C207	L204 Trimmer Cap.	Same as C202						
C208	L205 Trimmer Cap.	Same as C202						
C209	L206 Trimmer Cap.	Same as C202						
C210	V201 Plate Supply Bypass	0.01 mfd ±20% 1000 T.V.	*-CM45B103-M	JAN-C-5	75C	4LSE		910 1103 40 or 910N110C-M
C211	C211A, C211B, C211C	Triple Sect. 0.1 mfd ±20% 400 W.V.	*-48713-B-20	RE 13A 488E	75C			954 3018 40 or 954NT01Y-M
C211A	V202 Screen Bypass	Section of C211						
C211B	V203 Screen Bypass	Section of C211						
C211C	V202 Cathode Bypass	Section of C211						
C212	Series Padding Cap.	0.004 mfd ±5% 600 T.V.	*-CM30C402-J	JAN-C-5	75C	1R		912 2401 10 or 912N240A-J
C213	L208 Trimmer Cap.	Same as C202						

* Use This Part Number for Replacements.

CAPACITORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C214	Series Padding Cap.	0.002 mfd ±5% 1000 T.V.	*-CM30C202-J	JAN-C-5	75C	1R		912 2201 10 or 912N220A-J
C215	L209 Trimmer Cap.	Same as C202						
C216	Series Padding Cap.	0.00125 mfd ±5% 1000 T.V.	*-CM30C1251-J	JAN-C-5	75C	1R		914 0002 00 or 914N2125A-J
C217	L210 Trimmer Cap.	Same as C202						
C218	V203 Grid Coupling Cap.	0.00005 mfd ±20% 1000 T.V.	*-CM20C500-M	JAN-C-5	75C	5R		912 4503 40 or 912N450C-M
C219	V203 Grid Padding Cap.	20 mmfd ±2½%, Neg. 750 PPM /°C ±130 PPM /° C 1000 T.V.	-CC30UJ200G	C75.12-1944	25C			913 0008 00 or 913N420N7.5
C220	V202 Grid Coupling Cap.	Same as C206						
C221	V202 Feedback Cap.	Same as C218						
C222	V202 Cathode Bypass	0.00025 mfd ±20% 1000 T.V.	*-CM20C251-M	JAN-C-5	75C			912 3253 40 or 912N325C-M
C223	V208 Cathode Coupling Cap.	Same as C206						
C224	V201 Plate Tank Padding Cap.	0.00003 mfd ±10% 1000 T.V.	*-CM20C300-K	JAN-C-5	75C	5R		912 4303 20 or 912N430C-K
C225	V201 Grid Tank Padding Cap.	0.000025 mfd ±10% 1000 T.V.	*-CM20C250-K	JAN-C-5	75C			912 4253 20 or 912N425C-K
C226	C226A, C226B, C226C	Same as C211						
C226A	V205 Cathode Bypass	Section of C226						
C226B	V205 Screen Bypass	Section of C226						
C226C	V205 Plate Filter Cap.	Section of C226						
C227	V206 Filter Cap.	0.0002 mfd ±20% 1000 T.V.	*-CM30C201-M	JAN-C-5	75C	1R		912 3201 40 or 912N320A-M
C228	V206 Audio Coupling Cap.	0.008 mfd ±20% 600 T.V.	*-CM30B802-M	JAN-C-5	75C	1WLS		909 2803 54 or 909N280CN-M
C229	V206 Grid Bypass	Same as C214						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

CAPACITORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C230	V206 Plate Bypass	0.0005 mfd ±20% 1000 T.V.	*-CM30C501-M	JAN-C-5	75C	1R		912 3501 40 or 912N350A-M
C231	V207 Grid Coupling Cap.	Same as C210						
C232	C232A & C232B	Dual Sect. 0.1 mfd ±20% 400 W.V.	-481465-20	RE 13A 488E RE 48A 129K	75C			954 4018 40 or 954ND01Y-M
C232A	AVC Voltage Filter	Section of C232						
C232B	V206 Cathode Bypass	Section of C232						
C233	C233A & C233B	Same as C232						
C233A	V204 Cathode Bypass	Section of C233						
C233B	V204 Grid Bypass	Section of C233						
C234	H. V. Supply Filter Cap.	0.25 mfd ±20% 600 W.V.	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C235	V207 Plate Coupling	0.004 mfd ±20% 2500 T.V.	-CM50B402-M	JAN-C-5	75C	4LSE		925 2403 40 or 925N240C-M

MISCELLANEOUS ELECTRICAL PARTS

E201	Antenna Post	Push type black bakelite top			50X			372 1300 00 or 372N13
E202	Ground Post	Same as E201						
E203	Cylindrical Standoff	⅜" x ½" Cylindrical Iso. Standoff			42J	#395-L½		190 2329 00 or 190NSL5
E204	Button Feedthru	3/16" x ⅝" Bushing Insert Iso.			42J			190 2932 00 or 190NBI7
E205	Button Feedthru	3/16" x ⅝" Antenna-Post Bushing			42J			190 2929 00 or 190NBI4

JACKS AND RECEPTACLES

J201	Headphone Jack	2 circuit midget			49C 21N	J259		358 1080 00 or 358N108

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

INDUCTORS AND REACTORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
L201	Ant. Inductor, Band 3	6.0 to 12.0 mc			64C	GA-806D		571 0806 40 or 806D
L202	Ant. Inductor, Band 2	3.0 to 6.0 mc			64C	GA-798D		571 0798 40 or 798D
L203	Ant. Inductor, Band 1	1.5 to 3.0 mc			64C	GA-805D		571 0805 40 or 805D
L204	V201 Plate Inductor, Band 3	6.0 to 12.0 mc			64C	GA-801D		571 0801 40 or 801D
L205	V201 Plate Inductor, Band 2	3.0 to 6.0 mc			64C	GA-799D		571 0799 40 or 799D
L206	V201 Plate Inductor, Band 1	1.5 to 3.0 mc			64C	GA-803D		571 0803 40 or 803D
L207	V202 Cathode R-F Choke	Mult. Sect. 1 mh 300 ma 10 ohm 3 Pie 190 t #32 sse per Pie			05N			240 5700 00 or 240N57
L208	V203 Grid Inductor, Band 3	6.0 to 12.0 mc			64C	GA-800D		571 0800 40 or 800D
L209	V203 Grid Inductor, Band 2	3.0 to 6.0 mc			64C	GA-804D		571 0804 40 or 804D
L210	V203 Grid Inductor, Band 1	1.5 to 3.0 mc			64C	GA-802D		571 0802 40 or 802D

PLUG CONNECTORS

P201	Power Connector	12 term. wall mtg. plug			10C	GK-12-32S		371 2040 00 or 371N204

RESISTORS

R201	V201 Cathode Res.	220 ohm ±10% 1 w	-63703-10		28J	BW1-Navy		708 2205 20 or 708N220N-K

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

RESISTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
R202	V201 Grid Resistor	100,000 ohm ±20% 1 w	*-RC31BF104M	AWS C75.7-1943	28J	BT1-Navy		729 7100 44 or 729NG100M-M
R203	V201 Plate Resistor	1500 ohm ±20% 1 w	*-RC31BF152M	AWS C75.7-1943	28J	BT1-Navy		729 7150 04 or 729NG1500-M
R204	V202 Cathode Res.	Same as R201						
R205	V202 Screen Res.	22,000 ohm ±20% 2 w	*-RC41BF223M	AWS C75.7-1943	28J	BT2-Navy		729 8224 40 or 729NH22M-M
R206	V203 Grid Resistor	Same as R202						
R207	V203 Screen Res.	4700 ohm ±20% 2 w	*-RC41BF472M	AWS C75.7-1943	28J	BT2		729 8470 04 or 729NH4700-M
R208	V203 Voltage Dividing Res.	47,000 ohm ±20% 2 w	*-RC41BF473M	AWS C75.7-1943	28J	BT2-123-2470-7		729 8474 40 or 729NH47M-M
R209	V202 Grid Resistor	Same as R202						
R210	V204 Cathode Res.	Same as R201						
R211	V202 Injection Grid Res.	47,000 ohm ±20% 1 w	*-RC31BF473M	AWS C75.7-1943	28J	BT1-Navy		729 7474 40 or 729NG47M-M, 745 3157 00
R212	V202 Injection Grid Res.	Same as R211						
R213	V201 & V204 Screen Voltage Dividing Resistor	20,000 ohm ±20% 2 w	*-RC41BF203J	AWS C75.7-1943	28J	BT2-Navy		729 8204 40 or 729NH20M-M
R214	V205 Cathode Res.	Same as R201						
R215	V205 Screen Res.	Same as R211						
R216	R-F Gain Control & AVC Sw.	10,000 ohm Pot. with SPST switch	-631873-20		28J	CS		380 5104 20 or 380NE10MS
R217	V201 & V204 Screen Dropping Resistor	10,000 ohm ±20% 2 w	*-RC41BF103M	AWS C75.7-1943	28J	BT2-Navy		729 8104 40 or 729NH10M-M
R218	V204 Screen Decoupling Resistor	Same as R211						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

RESISTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
R219	V205 Plate Resistor	Same as R203						
R220	A-F Gain Control	100,000 ohm Potentiometer	-631872-20		28J	CS		380 1030 00 or 380N103
R221	V206 Grid Resistor	220,000 ohm ±20% 1 w	*-RC31BF224M	AWS C75.7-1943	28J	BT1-Navy		729 7220 44 or 729NG220M-M
R222	V206 Plate Resistor	Same as R221						
R223	V207 Grid Resistor	470,000 ohm ±20% 1 w	*-RC31BF474M	AWS C75.7-1943	28J	BT1-Navy		729 7470 44 or 729NG470M-M
R224	V207 Cathode Res.	330 ohm ±10% 1 w	-63703-10		28J	BW1-Navy		708 3305 20 or 708N330N-K
R225	Diode Load Resistor	Same as R211						
R226	V206 Cathode Res.	2200 ohm ±20% 1 w	*-RC31BF222M	AWS C75.7-1943	28J	BT1-Navy		729 7220 04 or 729NG2200-M
R227	AVC Voltage Filter Resistor	1 megohm ±20% 1 w	*-RC31BF105M	AWS C75.7-1943	28J	BT1-Navy		729 0021 00 or 729NG1Meg-M
R228	V205 Screen Decoupling Resistor	Same as R202						
R229	Limiting Resistor	1800 ohm ±20% 1 w	*-RC31BF182K	AWS C75.7-1943	28J	BT1-Navy		729 7180 04 or 729NG1800-M
R230	V204 Grid Resistor	Same as R202						
R231	V201 & V204 Screen Resistor	Same as R217						
R232	Audio Coupling Res.	10,000 ohm ±20% 1 w	*-RC41BF103M	AWS C75.7-1943	28J	BT1-Navy		729 7104 40 or 729NG10M-M

SWITCHES

S201	Band Switch	3 pos. 9 contact			64C	GJ-178C		500 6614 00C or GJ-178C
S202	Band Switch	5 pos. 15 contact			64C	GK-178C		500 6615 00C or GK-178C

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

SWITCHES (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
S203	VOICE-CW Switch	DPDT 1 amp 250 v a.c. 3 amp 125 v d.c.	-24003	RE 24A4 118A	84A			266 1030 00 or 266N103
S205	Power Switch	SPST 35 amp lever toggle	-24118-A	RE 24AA 118A	96C	8801K3		266 1040 00 or 266N104
S206	AVC Switch	Part of R216						
S207	Band Switch	Same as S201						
S208	Band Switch	Same as S201						

TRANSFORMERS

T201	Output Transformer	Pri: 7500 ohm 3040 t #38 Enamel Sec: 500 ohm C.T. 884 t #33 Enamel 2.4 w 200-5000 cps			20T 55C			677 2270 00 or 677N227

TUBES

V201	R-F Amplifier	Triple-Grid Amplifier	-12SK7		* *	12SK7		254 0256 00
V202	Converter	Pentagrid Converter	-12SA7		* *	12SA7		254 0247 00
V203	Oscillator	Beam Amplifier	-12A6		* *	12A6		254 0236 00
V204	1st I-F Amplifier	Same as V201						
V205	2nd I-F Amplifier	Same as V201						
V206	Detector-BFO	Duplex-Diode-Triode	-12SQ7		* *	12SQ7		254 0260 00
V207	Audio Amplifier	Same as V203						

SOCKETS

X201	Socket for V201	8 prong Octal ceramic	-49367	RE 13A 524 RE 49AA 314	77J	Navy		220 5810 00 or 220N581

* Use This Part Number for Replacements.

* * Supplied by numerous well-known manufacturers.

SOCKETS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
X202	Socket for V202	Same as X201						
X203	Socket for V203	Same as X201						
X204	Socket for V204	Same as X201						
X205	Socket for V205	Same as X201						
X206	Socket for V206	Same as X201						
X207	Socket for V207	Same as X201						
X208	Sockets for Crystals 1 & 4	Dual 3 pin ceramic			05H			220 8130 00 or 220N813
X209	Sockets for Crystals 2 & 3	Same as X208						

I. F. TRANSFORMERS

Z201	First I. F. Trans.	Interstage 455 kc			16A			278 4300 00 or 278N43
Z202	Second I. F. Trans.	Same as Z201						
Z203	Third I. F. Trans.	Diode Output 455 kc			16A			278 4400 00 or 278N44
Z204	Beat Osc. Coil Assembly	455 kc I. F.			16A			278 3800 00 or 278N38
Z204	Alternate	455 kc I. F.			16A 86G			278 0006 00

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –20218 POWER UNIT—FOR OPERATION FROM A 115 V A-C SOURCE

CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C301	C301A, C301B	Dual Sect. 4 mfd ±10% 600 W.V.	-481399-10	RE 13A 488E RE 48A 272A	64C			956 4712 00 or 956ND7J-K
C301A	H. V. Filter Cap.	Section of C301						
C301B	H. V. Filter Cap.	Section of C301						
C302	C302A, C302B	Same as C301						
C302A	H. V. Filter Cap.	Section of C302						
C302B	H. V. Filter Cap.	Section of C302						
C303	C303A, C303B	Same as C301						
C303A	L. V. Filter Cap.	Section of C303						
C303B	L. V. Filter Cap.	Section of C303						
C304	C304A, C304B	Same as C301						
C304A	L. V. Filter Cap.	Section of C304						
C304B	L. V. Filter Cap.	Section of C304						
C305	C305A, C305B	Dual Sect. 0.1 mfd ±20% 400 W.V.	*-48312-B-20	RE 13A 488E	75C			954 4016 40 or 954ND01W-M
C305A	A-C Line Filter Cap.	Section of C305						
C305B	A-C Line Filter Cap.	Section of C305						
C306	Transient Filter Cap.	0.25 mfd ±20% 600 W.V.	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C307	Transient Filter Cap.	Same as C306						

DRY DISC RECTIFIERS

CR301	Relay Power Rectifier	12 v d-c 1.2 amp			35J	4B1C2		353 2700 00 or 353N27

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

MISCELLANEOUS ELECTRICAL PARTS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
E301	Receptacle for F301	Bakelite post for 1¼" x ¼" fuse			78L	1075A		265 2030 00 or 265N203
E302	Receptacle for F302	Same as E301						
		FUSES						
F301	H. V. Rectifier Pri. Fuse	3 amp 250 v 1¼" x ¼" cartridge			97B 78L	3AG 3AG		264 4080 00 or 264N408
F302	L. V. Rectifier Pri. Fuse	Same as F301						
		RELAYS						
K301	Power Control Relay	12 v d-c coil DPDT Main Contacts			85G	G-33728		410 2300 00 or 410N23
		INDUCTORS AND REACTORS						
L301	H. V. Input Filter Reactor	4 hy 0.3 amp 31 ohm 1664 t #24 EN.			55C	6317A		678 1171 00 or 678N117A
L302	H. V. Output Filter Reactor	Same as L301						
L303	L. V. Input Filter Reactor	6 hy 0.15 amp 71.9 ohm d-c 2195 t #28 EN.			55C	CD-N132		678 1320 00 or 678N132
L304	L. V. Output Filter Reactor	Same as L303						
		PLUG CONNECTORS						
P301	Remote Control Cable Recpt.	10 amp 9 conductor plug connector, wall mtg.			10C	GK-9-32S		371 2110 00 or 371N211
P302	Transmitter Cable Recpt.	16 term. plug connector wall mtg.			10C	SK-C16-32S		371 3060 00 or 371N306

* Use This Part Number for Replacements.

PLUG CONNECTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
P303	Receiver Cable Recpt.	12 conductor plug connector wall mtg.			10C	GK-12-32S		371 2040 00 or 371N204
P304	A-C Line Input Recpt.	2 conductor plug connector flush wall mtg.			80H	6808		368 0004 00 or 368N1
	A-C Line Input Plug	2 conductor plug			80H	6630		368 2000 00 or 368N2

RESISTORS

R301	Transient Filter Resistor	330 ohm ±10% 1 w	-63703-10		28J	BW1-Navy		708 3305 20 or 708N330N-K
R302	Transient Filter Resistor	Same as R301						
R303	L. V. Power Bleeder Resistor	12,500 ohm ±5% 12 w	-631022E-5	RE 13A 372J	25P	Navy		733 8330 00 or 733ND12500-J
R304	H. V. Power Bleeder Resistor	Same as R303						

SWITCHES

S301	Power Change Sw.	1 amp 250 v d.c. Toggle DPDT	-24003	RE 24A4 118A	84A	20905-GH		266 1030 00 or 266N103

TRANSFORMERS

T301	L. V. Plate Power Trans.	Pri: 105, 110, 115, 120, 125 v 50/60 cps 37.5 VA 503 t #23 Enamel Sec: 500 v 0.106 amp C. T. 2150 t #30 Enamel			55C	7156		672 2240 00 or 672N224

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

TRANSFORMERS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
T302	H. V. Plate Power Trans.	Pri: 105, 110, 115, 120, 125 v 50/60 cps 165 VA 265 t #18 sce Sec: 1100 v 0.212 amp CT 2462 t #27 Enamel			55C	8100		672 2680 00 or 672N268
T303	Fil. & Relay Power Trans.	Pri: 105, 110, 115, 120, 125 v 50/60 cps 580 t #25 Enamel Sec #1: 15.6 v 1.0 amp 28 t #22 Enamel Sec #2: 12.6 v 3.5 amp CT 64 t #16 sce			55C	CD-N243		672 2430 00 or 672N243
T304	H. V. Rect. Fil. Power Transformer	Pri: 105, 110, 115, 120, 125 v 50/60 cps 30 VA 694 t #26 Enamel Sec: 5.0 v 6.0 amp CT 30 t #13 sce			55C	7147		672 2170 00 or 672N217

TUBES

V301	H. V. Rectifier	Full-wave Rectifier	-5R4GY -5U4G		* *	5R4GY 5U4G		254 0099 00 254 0101 00
V302	H. V. Rectifier	Same as V301						
V303	L. V. Rectifier	Full-wave Rectifier	-6X5GT		* *	6X5GT		254 0203 00
V304	L. V. Rectifier	Same as V303						

* Use This Part Number for Replacements.

* * Supplied by numerous well-known manufacturers.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –21881 DYNAMOTOR POWER UNIT—FOR OPERATION FROM A 12 V D-C SOURCE

CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C401	C401A, C401B, C401C	Triple Section 0.1 mfd ±20% 600 W.V.	-48849-A-20	RE 13A 488E RE 48A 128J	75C			956 3016 40 or 956NT01W-M
C401A	H. V. Dynamotor Pri. Noise Filter Cap.	Section of C401						
C401B	L. V. Dynamotor Sec. Noise Filter Cap.	Section of C401						
C401C	L. V. Dynamotor Pri. Noise Filter Cap.	Section of C401						
C402	H. V. Dynamotor Pri. Noise Filter Cap.	0.006 mfd ±20% 900 T.V.	*-CM30B602-M	JAN-C-5	75C 02S	1W C		909 2603 40 or 909N260C-M
C403	H. V. Noise Filter Cap.	0.006 mfd ±20% 1500 T.V.	-481411-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2605 40 or 915N260E-M
C404	H. V. Noise Filter Cap.	Same as C403						
C405	H. V. Noise Filter Cap.	4.0 mfd ±20% 600 W.V.	-481249-20	RE 13A 488A RE 48A 110Q	75C	KG-3040		30 8240 00 or 930N8B-M
C406	Spark Suppressor Cap.	0.25 mfd ±20% 600 W.V.	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C407	L. V. Noise Filter Cap.	Same as C405						
C409	L. V. Noise Filter Cap.	Same as C402						
C410	L. V. Dynamotor Pri. Noise Filter Cap.	Same as C402						
C412	Spark Suppressor Cap.	Same as C406						

DYNAMOTORS

D401	Dynamotor	Input: 12 v 9.9 amp Output: 400 v .180 amp	-211041		60E			231 4100 00 or 231N41

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

DYNAMOTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
D402	Dynamotor	Input: 12 v 3.8 amp Output: 220 v .100 amp			85W			231 4010 00 or 231N40A

FUSES

F401	L. V. Dynamotor Pri. Fuse	15 amp 25 v 9/32" x 1¼" cartridge			78L	4AG		264 5060 00 or 264N506
F402	H. V. Dynamotor Pri. Fuse	30 amp 25 v 9/32" x 1¼" cartridge			78L	4AG		264 5090 00 or 264N509

RELAYS AND CONTACTORS

K401	Motor Control Contactor	12 v d-c coil DPDT SPDT Aux.			42L	1077-AB		407 8610 00 or 407N86A
					85G	633728		410 2300 00 or 410N23
					92A			410 0003 00

INDUCTORS AND REACTORS

L401	H. V. Dynamotor Pri. Noise Filter Inductor	22 microh .02 ohm 55 t #12 EN.			64C	GB-416A		572 0416 10 or GB-416A
L402	H. V. Noise Filter Inductor	1 mh 0.3 amp 10 ohm 3 Pie 190 t #32 sse per Pie			05N	R-300U		240 5800 00 or 240N58
L403	L. V. Ripple Filter Reactor	8 hy 0.10 amp 161 ohm 2334 t #31 EN.			55C			678 1251 00 or 678N125A
L404	L. V. Noise Filter Inductor	Same as L402						
L405	L. V. Dynamotor Pri Noise Filter Inductor	Same as L401						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

PLUG CONNECTORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
P401	Remote Cable Connector	9 term. wall mtg.			10C	GK-9-32S		371 2110 00 or 371N211
P402	Transmitter Power Connector	16 term. wall mtg.			10C	SK-C16-2S		371 3060 00 or 371N306
P403	Receiver Power Connector	12 term. wall mtg.			10C	GK-12-32S		371 2040 00 or 371N204

RESISTORS

R401	Spark Suppressor Resistor	330 ohm ±20% 1 w	-63703-20		28J	BW1-Navy		708 3305 40 or 708N330N-M
R402	Spark Suppressor Resistor	Same as R401						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –21881-A DYNAMOTOR POWER UNIT—FOR OPERATION FROM A 12 V D-C SOURCE

CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C401	C401A, C401B, C401C	Triple Section 0.1 mfd ±20% 600 W.V.	-48849-A-20	RE 13A 488E RE 48A 128J	75C			956 3016 40 or 956NT01W-M
C401A	H. V. Dynamotor Pri. Noise Filter Cap.	Section of C401						
C401B	L. V. Dynamotor Sec. Noise Filter Cap.	Section of C401						
C401C	L. V. Dynamotor Pri. Noise Filter Cap.	Section of C401						
C402	H. V. Dynamotor Pri. Noise Filter Cap.	0.006 mfd ±20% 900 T.V.	*-CM30B602-M	JAN-C-5	75C 02S	1W C		909 2603 40 or 909N260C-M
C403	H. V. Noise Filter Cap.	0.006 mfd ±20% 1500 T.V.	-481411-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2605 40 or 915N260E-M
C404	H. V. Noise Filter Cap.	Same as C403						
C405	H. V. Noise Filter Cap.	4.0 mfd ±20% 600 W.V.	-481249-20	RE 13A 488A RE 48A 110Q	75C	KG-3040		930 8240 00 or 930N8B-M
C406	Spark Suppressor Cap.	0.25 mfd ±20% 600 W.V.	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C407	L. V. Noise Filter Cap.	Same as C405						
C409	L. V. Noise Filter Cap.	Same as C402						
C410	L. V. Dynamotor Pri. Noise Filter Cap.	Same as C402						
C412	Spark Suppressor Cap.	Same as C406						

DYNAMOTORS

D401	Dynamotor	Input: 12 v 9.9 amp Output: 400 v .180 amp	-211041		60E			231 4100 00 or 231N41
D402	Dynamotor	Input: 12 v 3.8 amp Output: 220 v .100 amp	-211042-B		60E			231 4000 00 or 231N40

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

FUSES

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
F401	L. V. Dynamotor Pri. Fuse	15 amp 25 v 9/32" x 1¼" cartridge			78L	4AG		264 5060 00 or 264N506
F402	H. V. Dynamotor Pri. Fuse	30 amp 25 v 9/32" x 1¼" cartridge			78L	4AG		264 5090 00 or 264N509

RELAYS AND CONTACTORS

K401	Motor Control Contactor	12 v d-c coil DPDT SPDT Aux.			42L	1077-AB		407 8610 00 or 407N86A
					85G	633728		410 2300 00 or 410N23
					92A			410 0003 00

INDUCTORS AND REACTORS

L401	H. V. Dynamotor Pri. Noise Filter Inductor	22 microh .02 ohm 55 t #12 EN.			64C	GB-416A		572 0416 10 or GB-416A
L402	H. V. Noise Filter Inductor	1 mh 0.3 amp 10 ohm 3 Pie 190 t #32 sse per Pie			05N	R-300U		240 5800 00 or 240N58
L403	L. V. Ripple Filter Reactor	8 hy 0.10 amp 161 ohm 2334 t #31 EN.			55C			678 1251 00 or 678N125A
L404	L. V. Noise Filter Inductor	Same as L402						
L405	L. V. Dynamotor Pri. Noise Filter Inductor	Same as L401						

PLUG CONNECTORS

P401	Remote Cable Connector	9 term. wall mtg.			10C	GK-9-32S		371 2110 00 or 371N211

* Use This Part Number for Replacements.

PLUG CONNECTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
P402	Transmitter Power Connector	16 term. wall mtg.			10C	SK-C16-2S		371 3060 00 or 371N306
P403	Receiver Power Connector	12 term. wall mtg.			10C	GK-12-32S		371 2040 00 or 371N204

RESISTORS

R401	Spark Suppressor Resistor	330 ohm ±20% 1 w	-63703-20		28J	BW1-Navy		708 3305 40 or 708N330N-M
R402	Spark Suppressor Resistor	Same as R401						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –211035 DYNAMOTOR POWER UNIT—FOR OPERATION FROM A 12 V D-C SOURCE

CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C401	C401A, C401B, C401C	Triple Section 0.1 mfd ±20% 600 W.V.	-48849-A-20	RE 13A 488E RE 48A 128J	75C			956 3016 40 or 956NT01W-M
C401A	H. V. Dynamotor Pri. Noise Filter Cap.	Section of C401						
C401B	L. V. Dynamotor Sec. Noise Filter Cap.	Section of C401						
C401C	L. V. Dynamotor Pri. Noise Filter Cap.	Section of C401						
C402	H. V. Dynamotor Pri. Noise Filter Cap.	0.006 mfd ±20% 900 T.V.	*-CM30B602-M	JAN-C-5	75C 02S	1W C		909 2603 40 or 909N260C-M
C403	H. V. Noise Filter Cap.	0.006 mfd ±20% 1500 T.V.	-481411-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2605 40 or 915N260E-M
C404	H. V. Noise Filter Cap.	Same as C403						
C405	H. V. Noise Filter Cap.	4.0 mfd ±20% 600 W.V.	-481249-20	RE 13A 488A RE 48A 110Q	75C	KG-3040		930 8240 00 or 930N8B-M
C406	Spark Suppressor Cap.	0.25 mfd ±20% 600 W.V.	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C407	L. V. Noise Filter Cap.	Same as C405						
C409	L. V. Noise Filter Cap.	Same as C402						
C410	L. V. Dynamotor Pri. Noise Filter Cap.	Same as C402						
C412	Spark Suppressor Cap.	Same as C406						

DYNAMOTORS

D401	Dynamotor	Input: 12 v 9.9 amp Output: 400 v .180 amp			85W			231 4110 00 or 231N41A
D402	Dynamotor	Input: 12 v 3.8 amp Output: 220 v .100 amp	-211042-B		60E			231 4000 00 or 231N40

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

FUSES

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
F401	L. V. Dynamotor Pri. Fuse	15 amp 25 v 9/32" x 1¼" cartridge			78L	4AG		264 5060 00 or 264N506
F402	H. V. Dynamotor Pri. Fuse	30 amp 25 v 9/32" x 1¼" cartridge			78L	4AG		264 5090 00 or 264N509

RELAYS AND CONTACTORS

K401	Motor Control Contactor	12 v d-c coil DPDT SPDT Aux.			42L	1077-AB		407 8610 00 or 407N86A
					85G	633728		410 2300 00 or 410N23
					92A			410 0003 00

INDUCTORS AND REACTORS

L401	H. V. Dynamotor Pri. Noise Filter Inductor	22 microh .02 ohm 55 t #12 EN.			64C	GB-416A		572 0416 10 or GB-416A
L402	H. V. Noise Filter Inductor	1 mh 0.3 amp 10 ohm 3 Pie 190 t #32 sse per Pie			05N	R-300U		240 5800 00 or 240N58
L403	L. V. Ripple Filter Reactor	8 hy 0.10 amp 161 ohm 2334 t #31 EN.			55C			678 1251 00 or 678N125A
L404	L. V. Noise Filter Inductor	Same as L402						
L405	L. V. Dynamotor Pri. Noise Filter Inductor	Same as L401						

PLUG CONNECTORS

P401	Remote Cable Connector	9 term. wall mtg.			10C	GK-9-32S		371 2110 00 or 371N211
P402	Transmitter Power Connector	16 term. wall mtg.			10C	SK-C16-2S		371 3060 00 or 371N306

* Use This Part Number for Replacements.

PLUG CONNECTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
P403	Receiver Power Connector	12 term. wall mtg.			10C	GK-12-32S		371 2040 00 or 371N204

RESISTORS

R401	Spark Suppressor Resistor	330 ohm ±20% 1 w	-63703-20		28J	BW1-Navy		708 3305 40 or 708N330N-M
R402	Spark Suppressor Resistor	Same as R401						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –20242 POWER UNIT—FOR OPERATION FROM A 230 V A-C SOURCE

CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C501	C501A, C501B	Dual Sect. 4 mfd ±10% 600 WV	-481399-10	RE 13A 488E RE 48A 272A	75C	KC-9		956 4712 00 or 956ND7J-K
C501A	H. V. Filter Cap.	Section of C501						
C501B	H. V. Filter Cap.	Section of C501						
C502	C502A, C502B	Same as C501						
C502A	H. V. Filter Cap.	Section of C502						
C502B	H. V. Filter Cap.	Section of C502						
C503	C503A, C503B	Same as C501						
C503A	L. V. Filter Cap.	Section of C503						
C503B	L. V. Filter Cap.	Section of C503						
C504	C504A, C504B	Same as C501						
C504A	L. V. Filter Cap.	Section of C504						
C504B	L. V. Filter Cap.	Section of C504						
C505	C505A, C505B	Dual Sect. 0.1 mfd ±20% 400 WV	*-48312-B-20	RE 13A 488E	75C			954 4016 40 or 954ND01W-M
C505A	A-C Line Filter Cap.	Section of C505						
C505B	A-C Line Filter Cap.	Section of C505						
C506	Transient Filter Cap.	0.25 mfd ±20% 600 WV	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C507	Transient Filter Cap.	Same as C506						

DRY DISC RECTIFIERS

CR501	Relay Power Rectifier	12 v d-c 1.2 amp			35J	4B1C2		353 2700 00 or 353N27

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

MISCELLANEOUS ELECTRICAL PARTS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
E501	Receptacle for F501	Bakelite post for 1¼" x ¼" fuse			78L	1075A		265 2030 00 or 265N203
E502	Receptacle for F502	Same as E501						
		FUSES						
F501	H. V. Rectifier Pri. Fuse	2 amp 250 v 1¼" x ¼" cartridge			97B	3AG		264 4070 00
					78L	3AG		or 264N407
F502	L. V. Rectifier Pri. Fuse	Same as F501						
		RELAYS						
K501	Power Control Relay	12 v d-c coil DPDT Main contacts			85G	G-33728		410 2300 00 or 410N23
					42L	1077-ABF		407 8610 00 or 407N86A
					92A			410 0003 00
		INDUCTORS AND REACTORS						
L501	H. V. Input Filter Reactor	4 hy 0.3 amp 31 ohm 1664 t #24 EN.			55C	6317A		678 1171 00 or 678N117A
L502	H. V. Output Filter Reactor	Same as L501						
L503	L. V. Input Filter Reactor	6 hy 0.15 amp 71.9 ohm 2195 t #28 EN.			55C	CD-N132		678 1320 00 or 678N132
L504	L. V. Output Filter Reactor	Same as L503						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

PLUG CONNECTORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
P501	Remote Control Cable Receptacle	10 amp 9 conductor plug connector, wall mtg.			10C	GK-9-32S		371 2110 00 or 371N211
P502	Transmitter Cable Receptacle	16 term. plug connector wall mtg.			10C	GK-C16-32S		371 3060 00 or 371N306
P503	Receiver Cable Receptacle	12 conductor plug connector wall mtg.			10C	GK-12-32S		371 2040 00 or 371N204
P504	A-C Line Input Receptacle	2 conductor plug connector flush wall mtg.			80H	6808		368 0004 00 or 368N1
	A-C Line Input Plug	2 conductor plug			80H	6630		368 2000 00 or 368N2

RESISTORS

R501	Transient Filter Resistor	330 ohm ±10% 1 w	-63703-10		28J	BW1-Navy		708 3305 20 or 708N330N-K
R502	Transient Filter Resistor	Same as R501						
R503	L. V. Power Bleeder Resistor	12,500 ohm ±5% 12 w	-631022E-5	RE 13A 372J	25P	Navy		733 3330 00 or 733ND12500-J
R504	H. V. Power Bleeder Resistor	Same as R503						

SWITCHES

S501	Power Change Switch	1 amp 250 v d.c. Toggle DPDT	-24003	RE 24A4 118A	84A	20905-GH		266 1030 00 or 266N103

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

TRANSFORMERS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
T501	L. V. Plate Power Trans.	Pri: 210, 220, 230, 240, 250 v, 50/60 cps 37.5 VA 1008 t #26 Enamel Sec: 500 v 0.106 amp 2150 t #30 Enamel			55C			672 2830 00 or 672N283
T502	H. V. Plate Power Trans.	Pri: 210, 220, 230, 240, 250 v 50/60 cps 165 VA 530 t #21 Enamel Sec: 1100 v 0.212 amp CT 2462 t #27 Enamel			55C			672 2840 00 or 672N284
T503	Fil. and Relay Power Trans.	Pri: 210, 220, 230, 240, 250 v 50/60 cps 1155 t #28 Enamel Sec: 15.6 v 1 amp 78 t #22 Enamel 12.6 v 3.5 amp CT 64 t #16 sce			55C			672 2850 00 or 672N285
T504	H. V. Rect. Fil. Power Transformer	Pri: 210, 220, 230, 240, 250 v 50/60 cps 30 VA 1385 t #29 Enamel Sec: 5 v 6.0 amp CT 30 t #13 sce			55C			672 2860 00 or 672N286

TUBES

V501	H. V. Rectifier	Full-wave Rectifier	-5R4GY		* *	5R4GY		254 0099 00
			-5U4G			5U4G		254 0101 00
V502	H. V. Rectifier	Same as V501						
V503	L. V. Rectifier	Full-wave Rectifier	-6X5GT		* *	6X5GT		254 0203 00
V504	L. V. Rectifier	Same as V503						

* Use This Part Number for Replacements.

* * Supplied by numerous well-known manufacturers.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

SOCKETS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
X501	Tube Socket for V501	Tube Socket for Octal Base	-49367	RE 13A 524 RE 49AA 314	77J			220 5810 00 or 220N581
X502	Tube Socket for V502	Same as X501						
X503	Tube Socket for V503	Same as X501						
X504	Tube Socket for V504	Same as X501						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –23270 REMOTE CONTROL UNIT:

MISCELLANEOUS ELECTRICAL PARTS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
E601	Handset Term. Board	4 term. bakelite strip			64C	GA-2230A		571 2230 10 or 2230A

JACKS AND RECEPTACLES

J601	Phone Jack	2 circuit Midget			21N 49C	J259		358 1080 00 or 358N108
J602	Microphone Jack	3 circuit Midget			21N			358 1100 00 or 358N110

LOUDSPEAKERS

LS601	Loudspeaker	5" O. D. 6 ohm voice coil Permanent Magnet	-49437		70J	PM5C		271 2200 00 or 271N220

PLUG CONNECTORS

P601	Power Cable Connector	9 conductor wall mtg.			75C	GK-9-32S		371 2110 00 or 371N211

RESISTORS

R601	Receiver Vol. Control	500 ohm metallized bridged T-pad	-631874-20 Potentiometer only with 2 type RC21BE511M resistors		28J	CSMPD		380 2010 00 or 380N201

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

RESISTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
R602	Limiting Resistor	1800 ohm ±5% 1 w	*-RC31BF182K	AWS C75.7-1943	28J	BT1-Navy		729 7180 04 or 729NG1800-M

SWITCHES

S601	Speaker-Phones Switch	DPDT 1 amp 250 v d.c. or 3 amp 125 v d.c. toggle	-24003	RE 24A4 118A	84A	AWS Type ST24N		266 1030 00 or 266N103, 266 0002 00
S602	Trans. On-Off Sw.	SPST 35 amp lever toggle	-24118-A	RE 24AA 118A	96C	8801K3		266 1040 00 or 266N104
S603	Receiver On-Off Sw.	Same as S602						

TRANSFORMERS

T601	Speaker Transformer	Pri: 500 ohm 800 t #31 Enamel Sec: 6 ohm 95 t #26 Enamel			7CJ			667 7051 00 or 667.S705A

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –47205 ANTENNA LOADING COIL:

MISCELLANEOUS ELECTRICAL PARTS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
E701	Ground Terminal	Push Button Type			36E			372 1420 00 or 372N14B
E702	Input Terminal	¼" x 28 x 2/14" Stud			64C			507 6712 00 or X-6712
E703	Output Terminal	Same as E702						
E704	Terminal Bushing	Glazed Low Loss Ceramic Bushing			42J 25G 25C	 X-110		190 2923 00 or 190NBI23
C705	Wing Nut	Wing Type ¼" x 28			65P			334 2180 00 or 334N218

INDUCTORS AND REACTORS

L701	Loading Inductor	97 mh total inductance tapped at 15, 27, 44, 60 and 76 mh			64C	GA-596D		571 0596 40 or 596D

MECHANICAL PARTS

O701	Switch Detent Assembly	Plate, spring, bearing			64C	187B-8		571 1188 30 or 1188C
O702	Shaft Assembly	Shaft and taper pin			64C	GD-2194A		571 2194 10 or GD-2194A

SWITCHES

S701	Tap Switch	6 pos. 9 contacts			64C	186N-2		571 1194 30 or 1194C

* Use This Part Number for Replacements.

65F-7 (520 0171 00, 571 0193 10) POWER CABLE (Transmitter to Power Unit)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
E801	Conduit Assembly	½" I.D. Flexible Shielded Conduit			68B 05S 40A			018 1631 20 or 18N16L120
P801	90° Connector Plug	14-10 amp 2-30 amp cont.			10C	SK-C16-23-½AC		371 3070 00 or 371N307
P802	Straight Connector Plug	14-10 amp 2-30 amp cont.			10C	SK-C16-21-½AC		371 3080 00 or 371N308

65F-10 (520 0168 00, 571 0748 10) POWER CABLE (Control Unit to Power Unit)

E1001	Conduit Assembly	½" I.D. Flexible Shielded Conduit			68B 05S 40A			018 1632 40 or 18N16L240
P1001	90° Connector Plug	9-10 amp contacts			10C	GK-9-23-½AC		371 2150 00 or 371N215
P1002	Straight Connector Plug	9-10 amp contacts			10C	GK-9-21-½AC		371 2140 00 or 371N214

65F-13 (520 0183 00, 571 2155 10) POWER CABLE (Receiver to Power Unit)

E1401	Conduit Assembly	½" I.D. Flexible Shielded Conduit			68B 05S 40A			018 1631 32 or 18N16L132
P1401	90° Connector Plug	12-10 amp contacts			10C	GK-12-23-½AC		371 2130 00 or 371N213
P1402	Straight Connector Plug	12-10 amp contacts			10C	GK-12-21-½AC		371 2120 00 or 371N212

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –21827 POWER UNIT—FOR OPERATION FROM A 230 V D-C SOURCE

MOTORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
B2001	Motor for H. V. Generator	3/16 hp 230 v d-c 3450 rpm	-211223		96R	13525		230 1090 00 or 230N109
B2002	Motor for L. V. Generator	Same as B2001						

CAPACITORS

C2001	Spark Suppressor Cap.	0.025 mfd ±20% 600 WV	-481392-20	RE 13A 488E RE 48A 128J	75C			956 2056 40 or 956NS05W-M
C2002	Motor Noise Filter Cap.	0.006 mfd ±20% 600 TV	*-CM30B802-M	JAN-C-5	75C	1W		909 2803 54 or 909N280CN-M
C2003	Motor Noise Filter Cap.	Same as C2002						
C2004	H. V. Filter Cap.	0.006 mfd ±20% 1000 TV	*-CM55B602-M	JAN-C-5	75C			910 2608 40 or 910N260H-M
C2005	H. V. Filter Cap.	0.008 mfd ±20% 1500 TV	-481411-B-20	RE 13A 389M RE 48A 276B	02S	BE-15		915 2605 40 or 915N260E-M
C2006	H. V. Filter Cap.	4.0 mfd ±20% 600 WV	-481249-20	RE 13A 488E RE 48A 110Q	75C	KGU		930 8240 00 or 930N8B-M
C2007	Filament Supply Noise Filter Cap.	Same as C2002						
C2008	Filament Supply Noise Filter Cap.	Same as C2002						
C2009	Filament Supply Noise Filter Cap.	Same as C2001						
C2010	Motor Noise Filter Cap.	Same as C2002						
C2011	Motor Noise Filter Cap.	Same as C2002						
C2012	L. V. Filter Cap.	Same as C2002						
C2013	L. V. Filter Cap.	Same as C2006						
C2014	L. V. Filter Cap.	Same as C2006						

* Use This Part Number for Replacemeats.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

CAPACITORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C2015	C2015A, C2015B	Dual Sect. 0.1 mfd ±20% 400 WV	*-48312-B-20	RE 13A 488E	75C			954 4016 40 or 954ND01W-M
C2015A	Power Input Filter Cap.	Section of C2015						
C2015B	Power Input Filter Cap.	Section of C2015						
C2016	Spark Suppressor Cap.	Same as C2001						

FUSES

F2001	B2001 Primary Fuse	6 amp 250 v 9/16" x 2" cartridge			65C	Ferrule		264 2060 00 or 264N206
F2002	B2002 Primary Fuse	Same as F2001						

GENERATORS

G2001	H. V. Generator	425 v d-c 0.180 amp 3450 rpm	-211220-A		96R	13450		231 7020 00 or 231N702
G2002	L. V. Plate & Filament Generator	240 v 0.100 amp and 12.5 v 4.0 amp 3450 rpm	-211219-A		96R	13475		231 6030 00 or 231N603

RELAYS AND CONTACTORS

K2001	H. V Motor Control Contactor	12 v d-c coil DPDT Main Contacts			42L	1077-ABF		407 8610 00 or 407N86A
K2001	Alternate				85G	G-33728		410 2300 00 or 410N23
K2001	Alternate				92A			410 0003 00
K2002	Filament Voltage Control Contactor	12 v d-c coil SPST Cont.			85G	SC #2		401 7800 00 or 401N78

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

INDUCTORS AND REACTORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
L2001	H. V. Filter Inductor	Mult. Sect. 1 mh 300 ma 10 ohm 3 Pie 190 t #32 sse Per Pie			05N	R-300		240 5700 00 or 240N57
L2002	L. V. Filter Inductor	Same as L2001						
L2003	L. V. Filter Reactor	6 hy 0.15 amp 71.9 ohm 2195 t #28 EN.			55C	C8A-10-1¼"		678 1321 00 or 678N132A
L2004	Fil. Voltage Filter Inductor	22 microh .02 ohm 55 t #12 EN.			64C	194J-1		572 0416 10 or 416A

MECHANICAL PARTS

O2001	H. V. Gen. Flexible Coupling	1¼" x 2" Cold Rolled Steel			90L	J-1211-3		015 3060 00 or 15N306
O2002	L. V. Gen. Flexible Coupling	Same as O2001						

PLUG CONNECTORS

P2001	Remote Control Cable Receptacle	9 contacts wall mtg. receptacle			10C	GK-9-32S		371 2110 00 or 371N211
P2002	Transmitter Conn. Receptacle	16 term. wall mtg. recpt.			10C	K		371 3060 00 or 371N306
P2003	Receiver Conn. Recpt.	12 term. wall mtg. recpt.			10C	GK-12-32S		371 2040 00 or 371N204

RESISTORS

R2001	Spark Suppressor Res.	330 ohm ±20% 1 w	-63703-20		28J	BW1-Navy		708 3305 40 or 708N330N-M
R2002	Spark Suppressor Res.	Same as R2001						

* Use This Part Number for Replacements

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

Type –20309 POWER UNIT—FOR OPERATION FROM A 115 OR 230 V 50/60 CPS SOURCE

CAPACITORS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
C2201	High Voltage Filter Capacitor	4 mfd ±20% 600 WV Paper	-481054	RE 48A 207 RE 13A 488E	75C	TL-6040		930 3400 00 or 930N3-M
C2202	High Voltage Filter Capacitor	Same as C2201						
C2203	High Voltage Filter Capacitor	Same as C2201						
C2204	High Voltage Filter Capacitor	Same as C2201						
C2205	Low Voltage Filter Capacitor	Same as C2201						
C2206	Low Voltage Filter Capacitor	Same as C2201						
C2207	Low Voltage Filter Capacitor	Same as C2201						
C2208	Low Voltage Filter Capacitor	Same as C2201						
C2209	Transient Filter Capacitor	0.25 mfd ±20% 600 WV	-481392-20	RE 13A 488E RE 48A 128J	75C 64S			956 2056 40 or 956NS05W-M
C2210	Transient Filter Capacitor	Same as C2209						
C2211	C2211A and C2211B	Dual Section 0.1 mfd ±20% 400 WV	*-48312-B-20	RE 13A 488E	75C			954 4016 40 or 954ND01W-M
C2211A	Line Filter	Section of C2211						
C2211B	Line Filter	Section of C2211						

DRY DISC RECTIFIERS

CR2201	Relay Power Rectifier	12 v d.c. 1.2 amp			35J	4B102		353 2700 00 or 353N27

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

MISCELLANEOUS ELECTRICAL PARTS

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
E2201	Receptacle for F2201	Bakelite Post for 1¼" x ¼" Fuse			78L	1075A		265 2030 00 * or 265N203
E2202	Receptacle for F2202	Same as E2201						
E2203	Receptacle for F2203	Same as E2201						
E2204	Receptacle for F2204	Same as E2201						
		FUSES						
F2201	H. V. Primary Fuse	2 Amp. 250 v 1¼" x ¼"			78L 97B	1042 ATS		264 4070 00 or 264N407
F2202	H. V. Primary Fuse	Same as F2201						
F2203	L. V. Primary Fuse	3 Amp. 250 v 1¼" x ¼"			78L 97B	1043 ATS		264 4080 00 or 264N408
F2204	L. V. Primary Fuse	Same as F2203						
		RELAYS						
K2201	Power Control Relay	DPDT and SPST Contacts 12 v Coil			92A 85G	G-25714		410 0003 00, 410 2300 00 or 410N23
		INDUCTORS AND REACTORS						
L2201	H. V. Input Filter Reactor	4-12 hy 0.035-0.300 Amp. 2538 t #26 EN.			55C	8690		678 0009 00
L2202	L. V. Input Filter Reactor	6 hy 0.150 Amp. 2104 t #28 EN.			55C	8499-C		678 0007 00

* Use This Part Number for Replacements.

INDUCTORS AND REACTORS (Cont.)

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
L2203	L. V. Output Filter Reactor	Same as L2202						
L2204	H. V. Output Filter Reactor	4 hy 0.300 Amp. 40 ohm 1664 t #24 EN.			55C	6317-D		678 0008 00

PLUG CONNECTORS

P2201	Remote Control Cable Connector	9 Conductor Connector Wall Mounting			10C	GK-9-32S		371 2110 00 or 371N211
P2202	Transmitter Cable Receptacle	16 Conductor Connector Wall Mounting			10C	SK-C16-32S		371 3060 00 or 371N306
P2203	Receiver Cable Receptacle	12 Conductor or Connector Wall Mounting			10C	GK-12-32S		371 2040 00 or 371N204
P2204	A. C. Line Input Receptacle	2 Conductor A. C. Connector Receptacle			40G	GE-2711		368 3700 00 or 368N37
	A. C. Line Input Plug	2 Conductor A. C. Connector Plug			40G	#2981		368 0002 00

RESISTORS

R2201	Transient Filter Resistor	330 ohm ±20% 1 w	-63703-20		28J	BW1-Navy		708 3305 40 or 708N330N-M
R2202	Transient Filter Resistor	Same as R2201						
R2203	L. V. Bleeder Resistor	12,500 ohm ±20% 40 w						733 1410 00
R2204	H. V. Bleeder Resistor	Same as R2203						

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

SWITCHES

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
S2201	Primary Voltage Change Switch	DPDT Lever Toggle 1 Amp. 250 v	-24003	RE 24AA 118A	40G 84A	1GA4C56 20905-GH		266 0002 00, 266 1030 00 or 266N103

TRANSFORMERS

T2201	L. V. Plate Power Trans.	Pri: 115, 230 v 37.5 VA 460 ½ t #27 En. & 454 t #24 En. Sec: 500 v CT 0.106 Amp. 2104 ½ t CT #31 En.			55C	8678		672 0003 00
T2202	H. V. Plate Power Trans.	Pri: 115, 230 v 165 VA 249 t #21 En. & 244 t #18 En. Sec: 1100 v CT 0.212 Amp. 2462 t CT #27 En.			55C	8679		672 0004 00
T2203	Fil. and Relay Power Trans.	Pri: 115, 230 v 494 t #28 En. and 489 t #24 En. Sec. #1: 16.6 v 1.25 Amp. 79 ½ t #22 En. Sec. #2: 12.6 v 3.5 Amp. 60 t 2 #20 En.			55C	8681		672 0005 00
T2204	H. V. Rectifier Filament Power Transformer	Pri: 115, 230 v 30 VA 602 ½ t #30 En. & 590 t #27 En. Sec: 5 v 6 Amp. CT 28 t #13 SCE			55C	8680		672 0006 00

* Use This Part Number for Replacements.

PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODEL TCS SERIES RADIO EQUIPMENT

TUBES

Symbol Designation	Function	Description	Navy Type Designation	Navy Spec. or Dr. Number	Mfr. Code	Mfr's. Designation	Spcl. Tol. or Mod.	Contractor's Drawing or Part Number
V2201	H. V. Rectifier	Full Wave High Vacuum	-5R4GY		* *			254 0099 00 or 5R4GY
V2202	H. V. Rectifier	Same as V2201						
V2203	L. V. Rectifier	Full Wave High Vacuum	-6X5GT		* *			254 0203 00 or 6X5GT
V2204	L. V. Rectifier	Same as V2203						

SOCKETS

X2201	Tube Socket for V2201	Tube Socket for Octal Base	-49367	RE 13A 524 RE 49AA 314	77J			220 5810 00 or 220N581
X2202	Tube Socket for V2202	Same as X2201						
X2203	Tube Socket for V2203	Same as X2201						
X2204	Tube Socket for V2204	Same as X2201						

* Use This Part Number for Replacements.

Fig. 26 Type –52245 Radio Transmitter—Front

Fig. 23 Type –52245 Radio Transmitter—Front

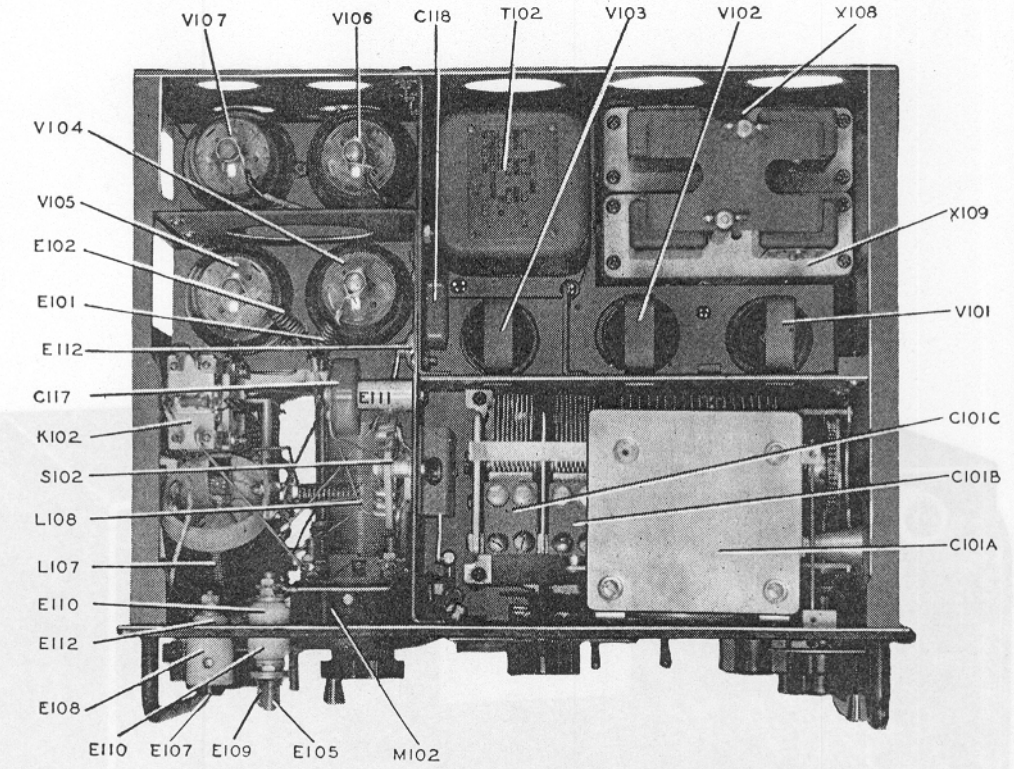


Fig. 27 Type –52245 Radio Transmitter—Top Open

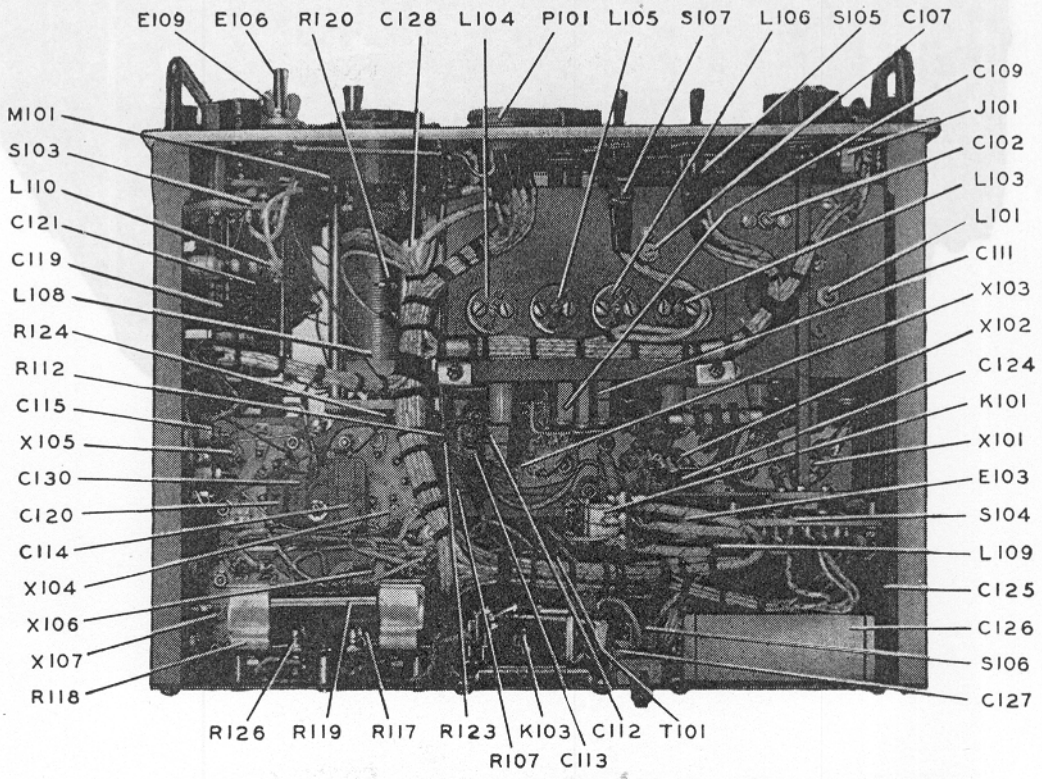


Fig. 28 Type –52245 Radio Transmitter—Bottom Open

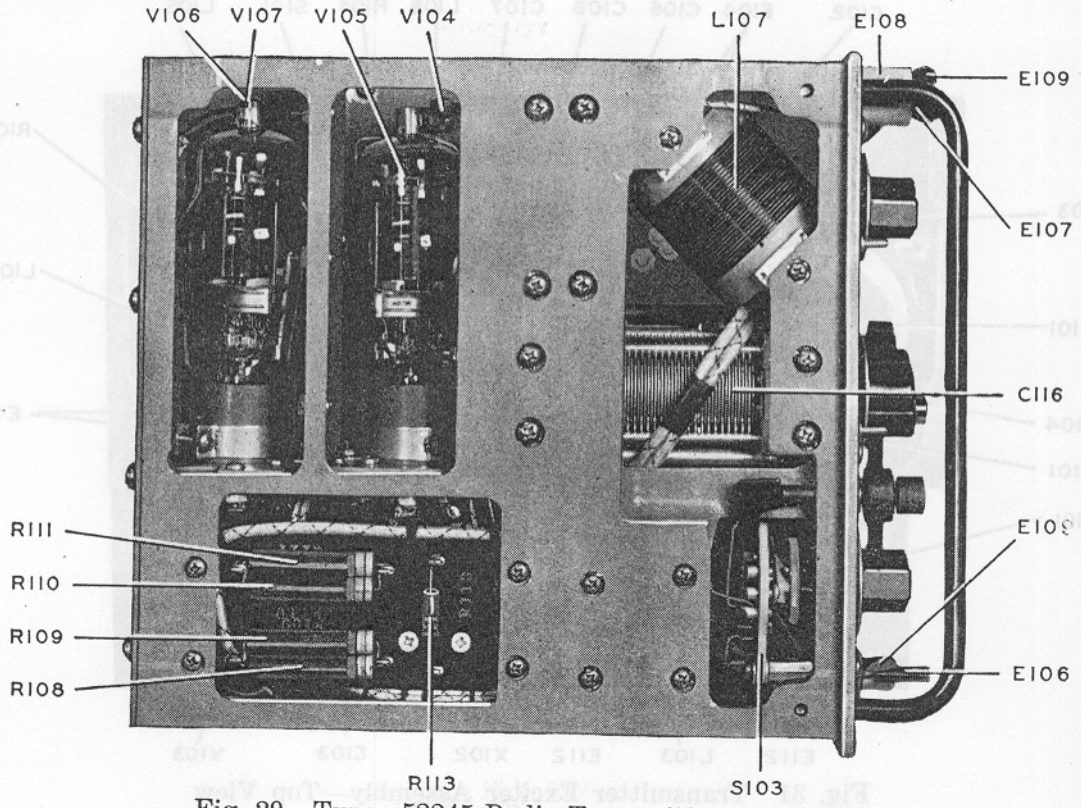


Fig. 29 Type –52245 Radio Transmitter—Left End

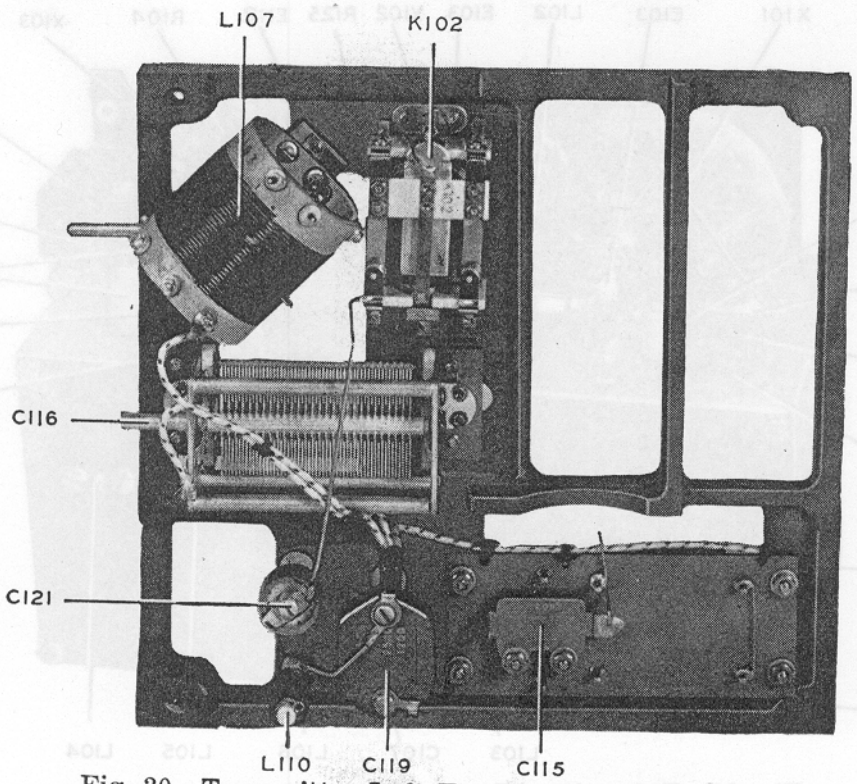


Fig. 30 Transmitter Left End Casting—Inside View

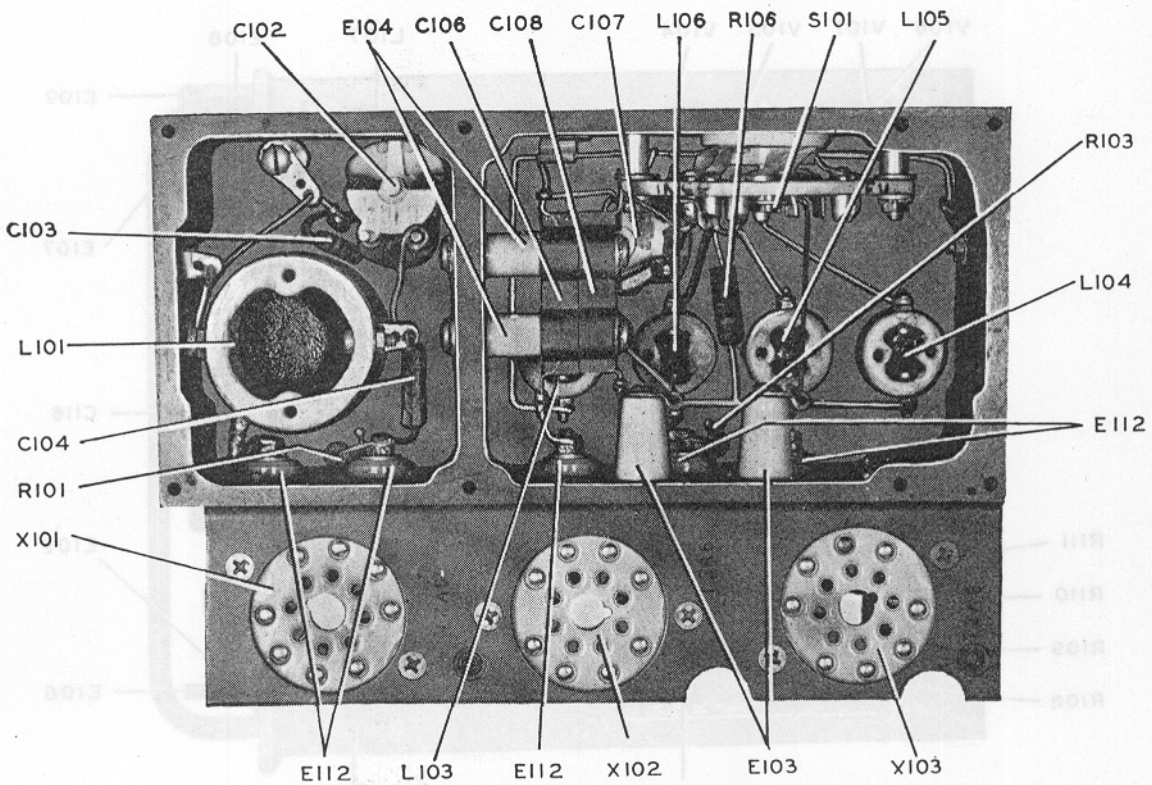


Fig. 31 Transmitter Exciter Assembly—Top View

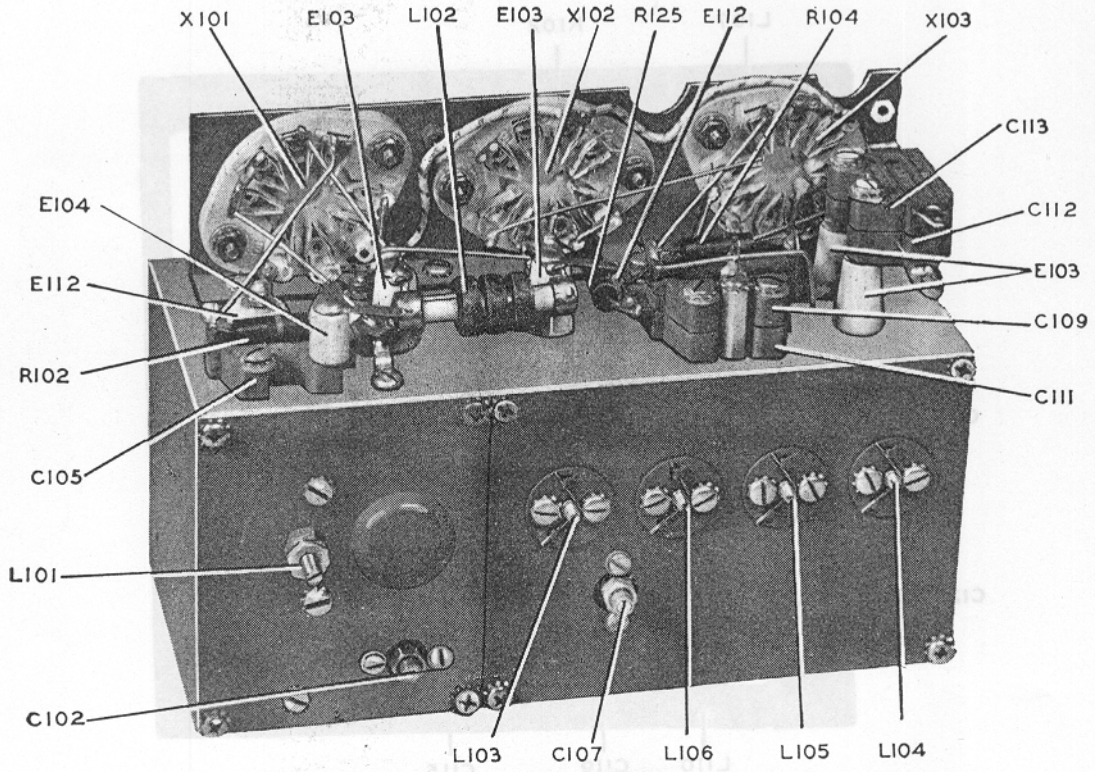


Fig. 32 Transmitter Exciter Assembly—Bottom View

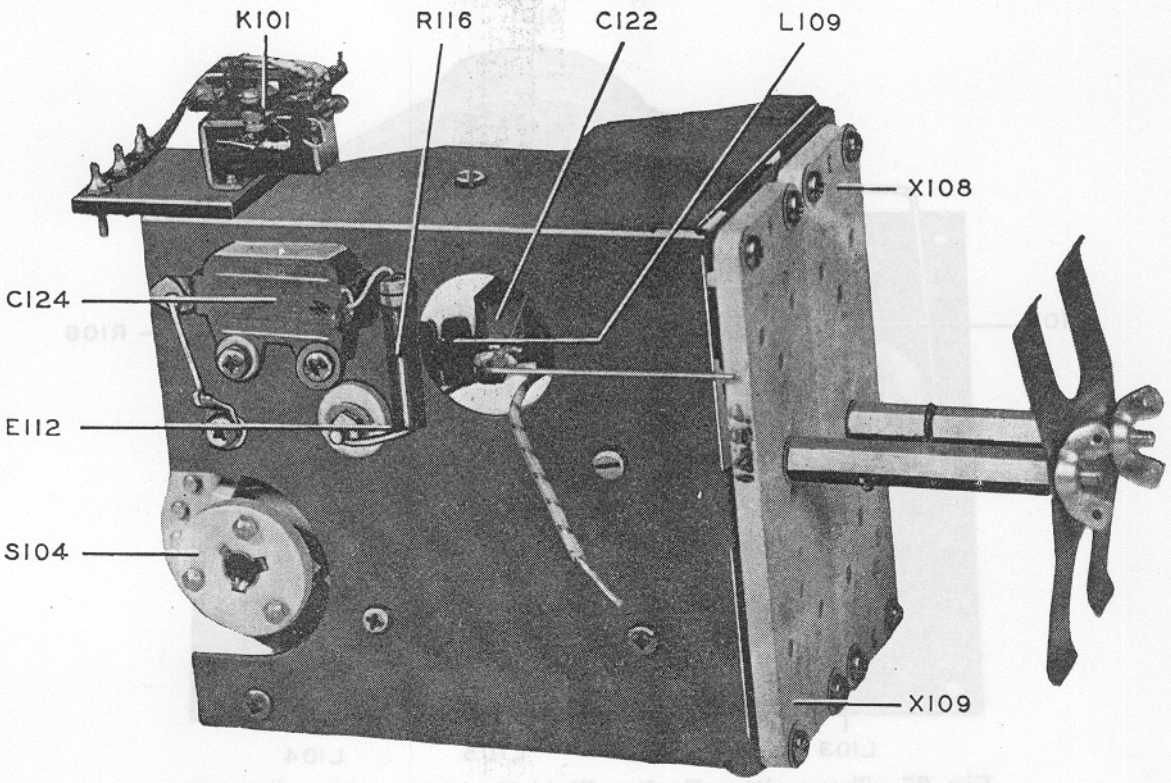


Fig. 33 Transmitter Crystal Bracket Assembly—Top View

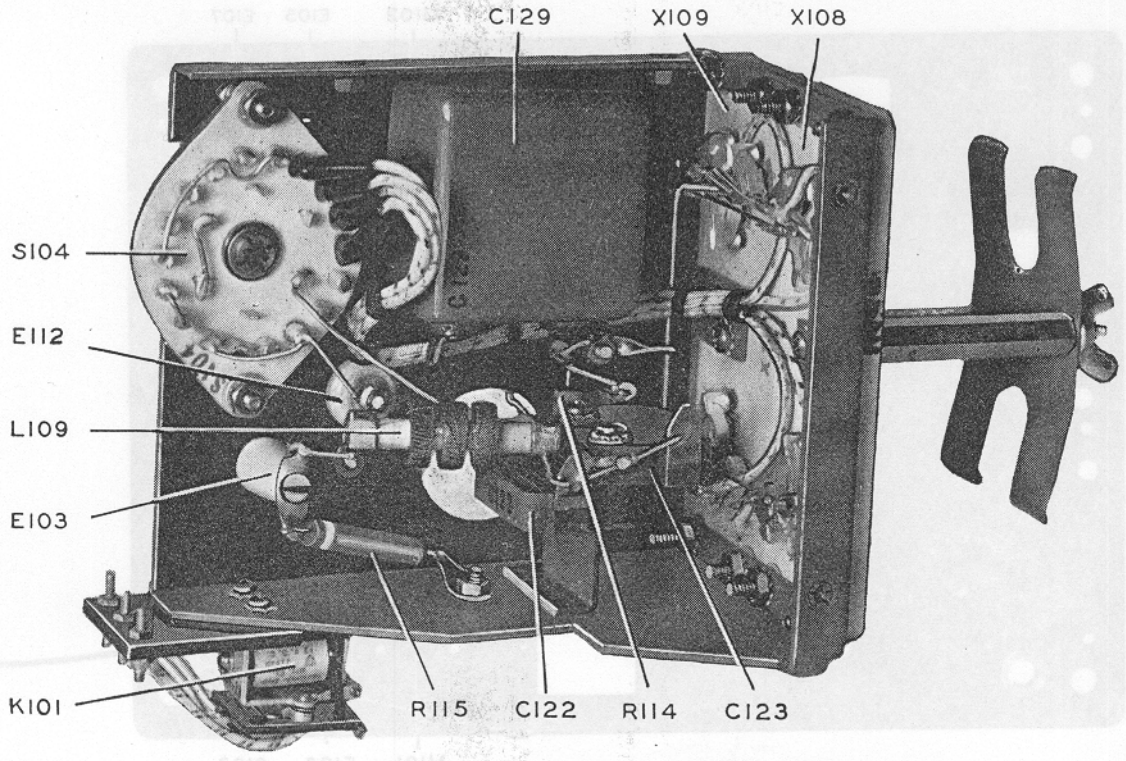


Fig. 34 Transmitter Crystal Bracket Assembly—Bottom View

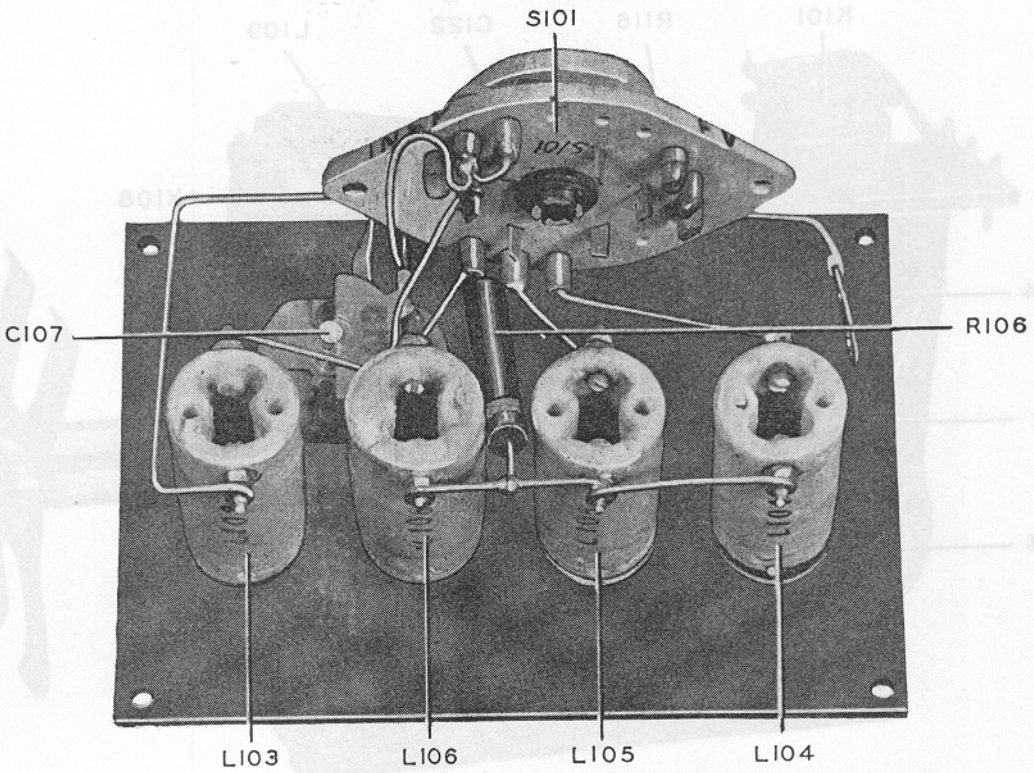


Fig. 35 Transmitter Exciter Plate Tank Assembly—Top View

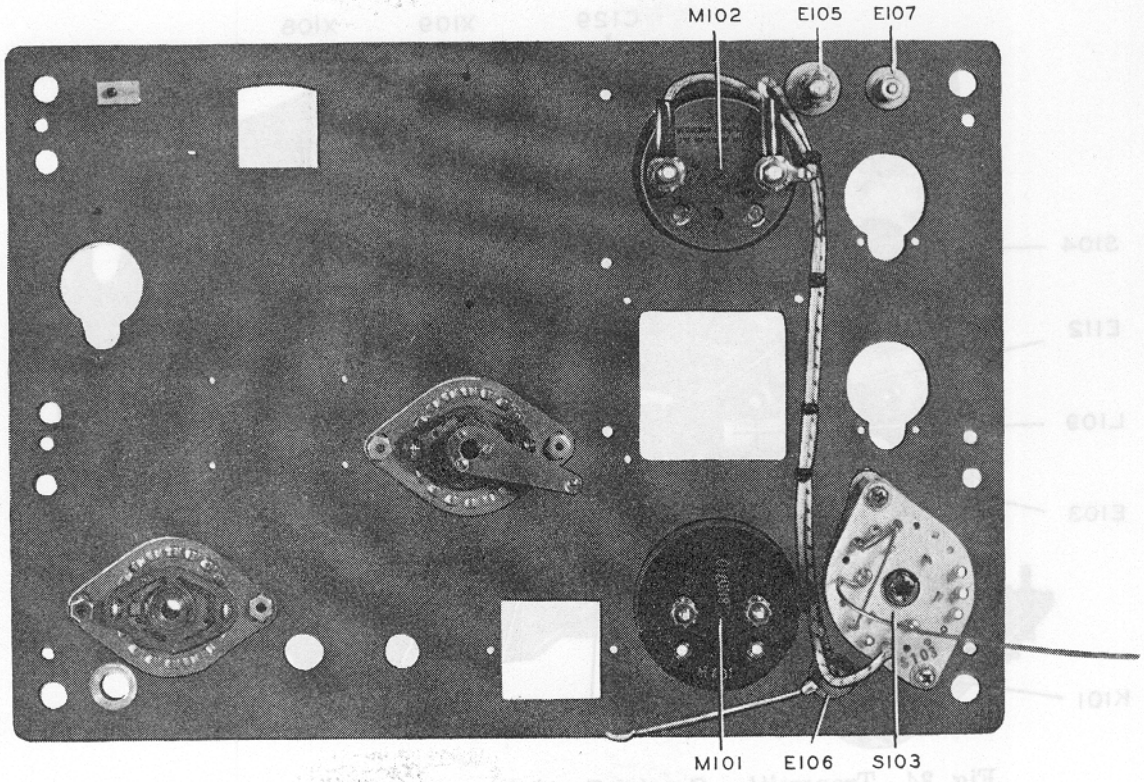


Fig. 36 Transmitter Front Panel—Inside View

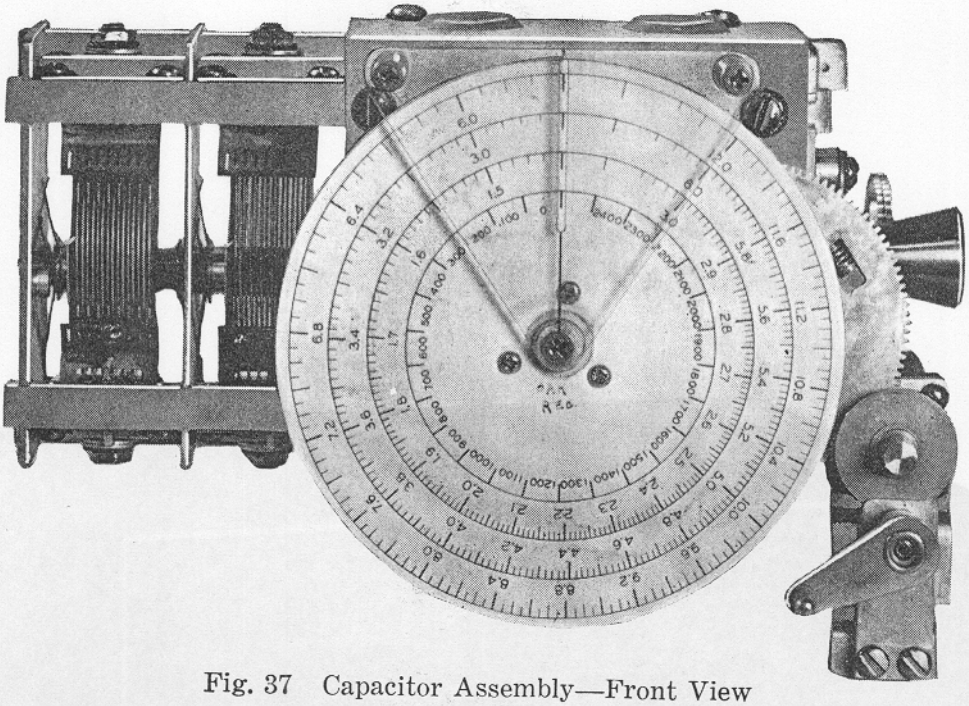


Fig. 37 Capacitor Assembly—Front View

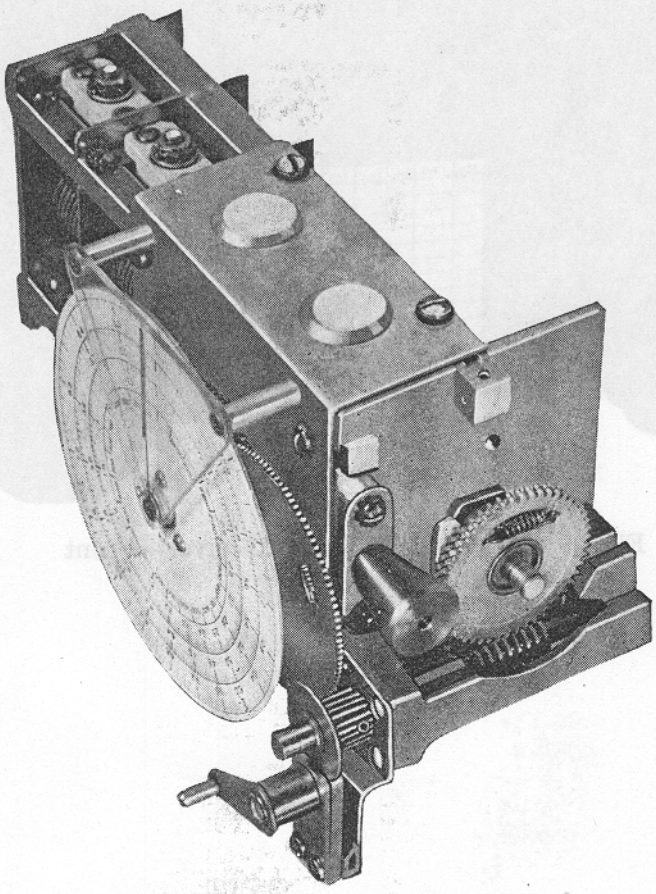


Fig. 38 Capacitor Assembly—End View

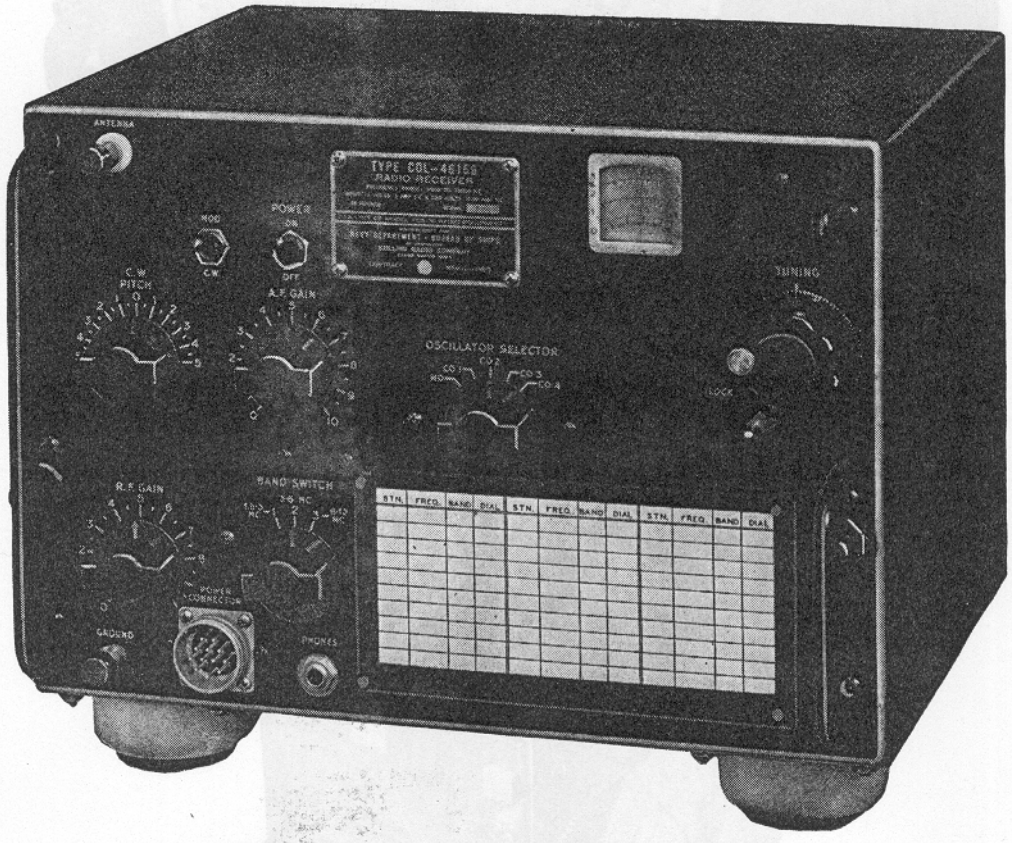


Fig. 39 Type –46159 Radio Receiver—Front

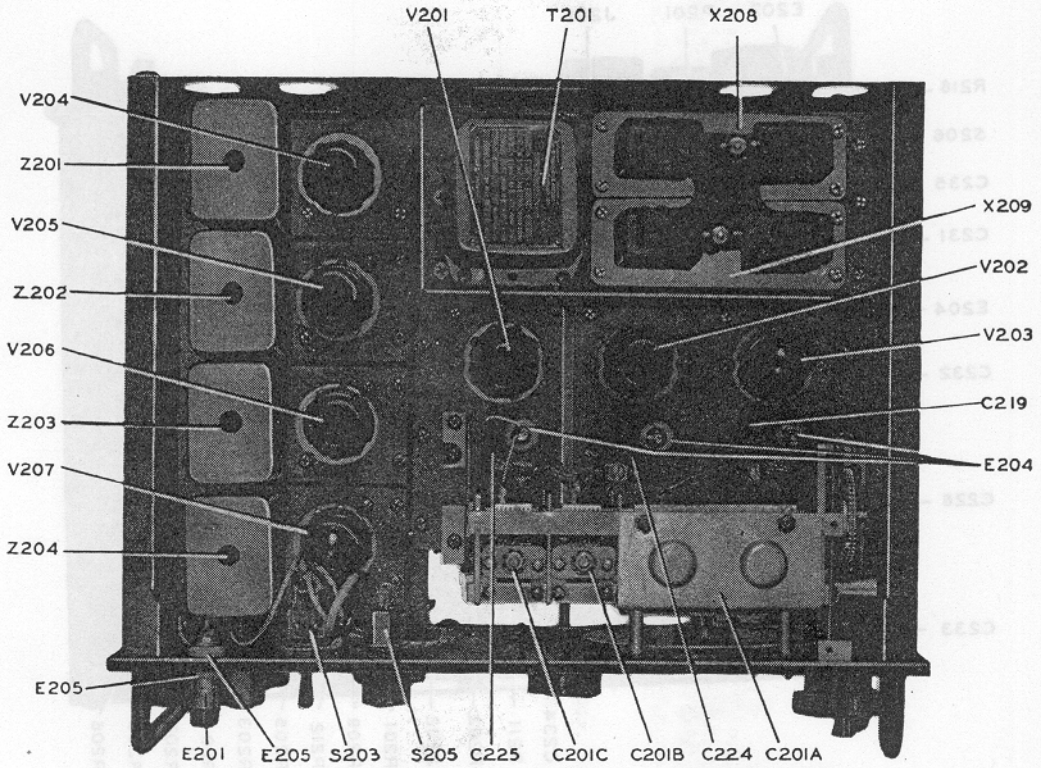


Fig. 40 Type –46159 Radio Receiver—Top Open

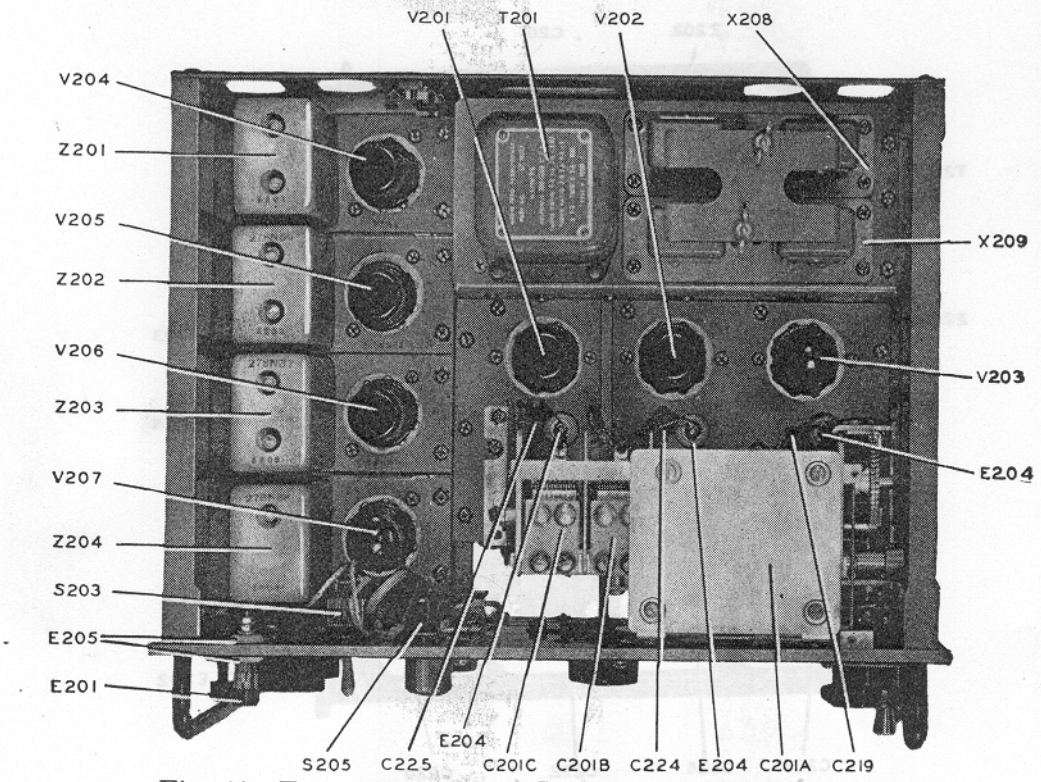


Fig. 41 Type –46159 Radio Receiver (TCS-7)—Top Open

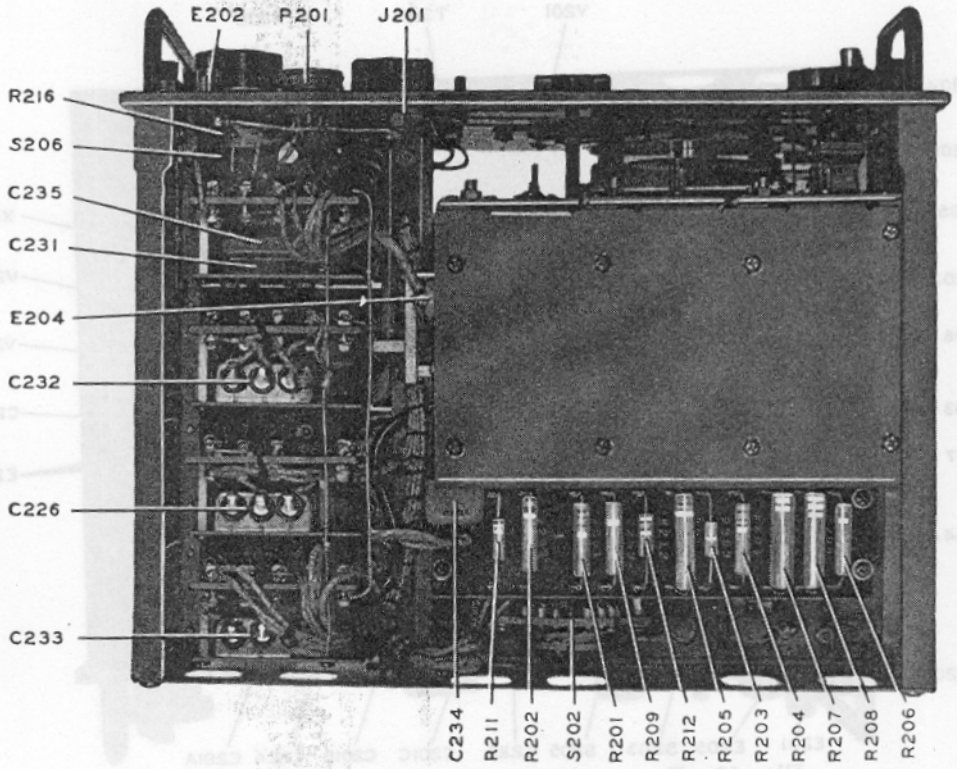


Fig. 42 Type –46159 Radio Receiver—Bottom

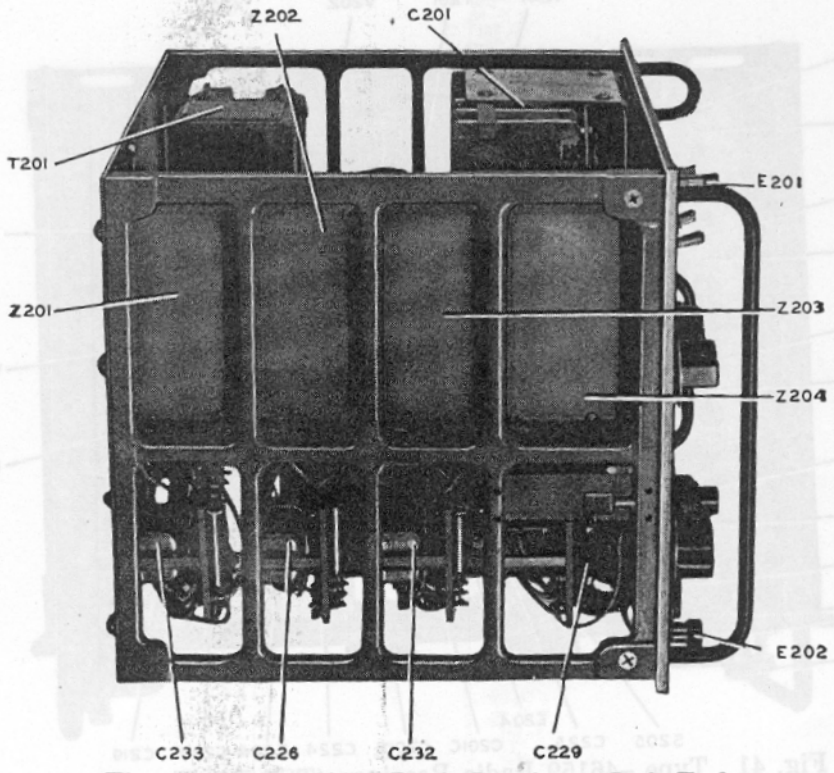


Fig. 43 Type –46159 Radio Receiver—Left End

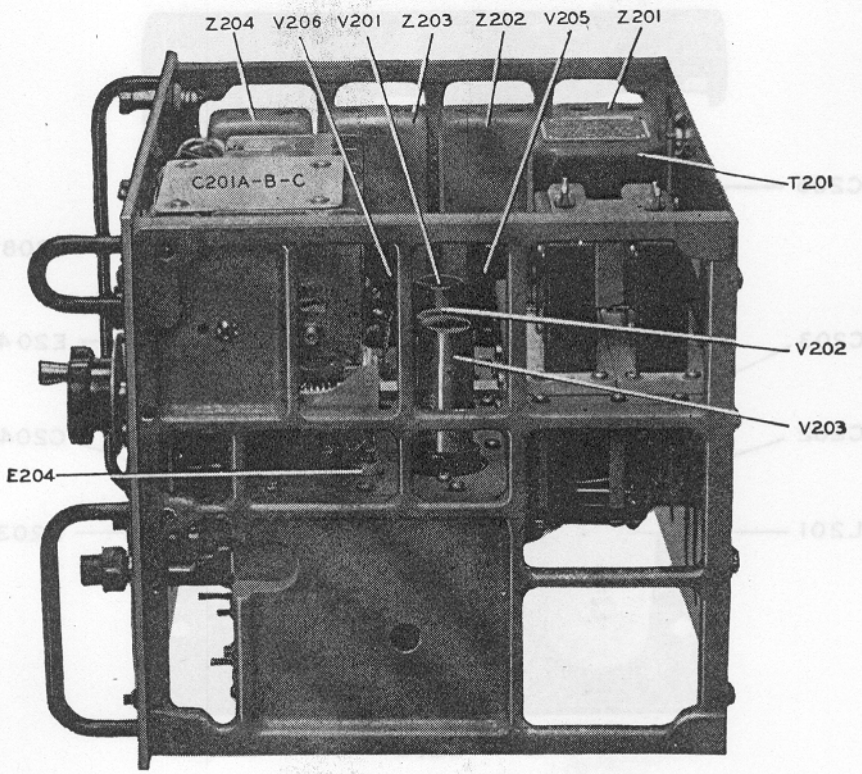


Fig. 44 Type –46159 Radio Receiver—Right End

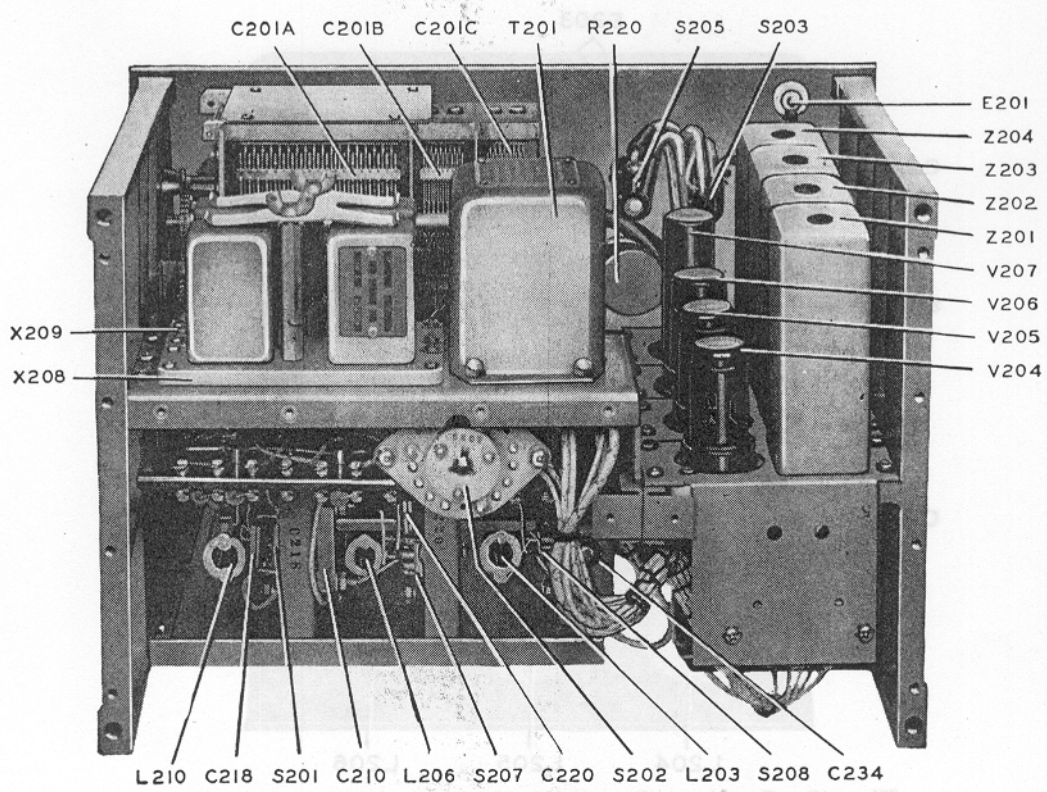


Fig. 45 Type –46159 Radio Receiver—Rear Open

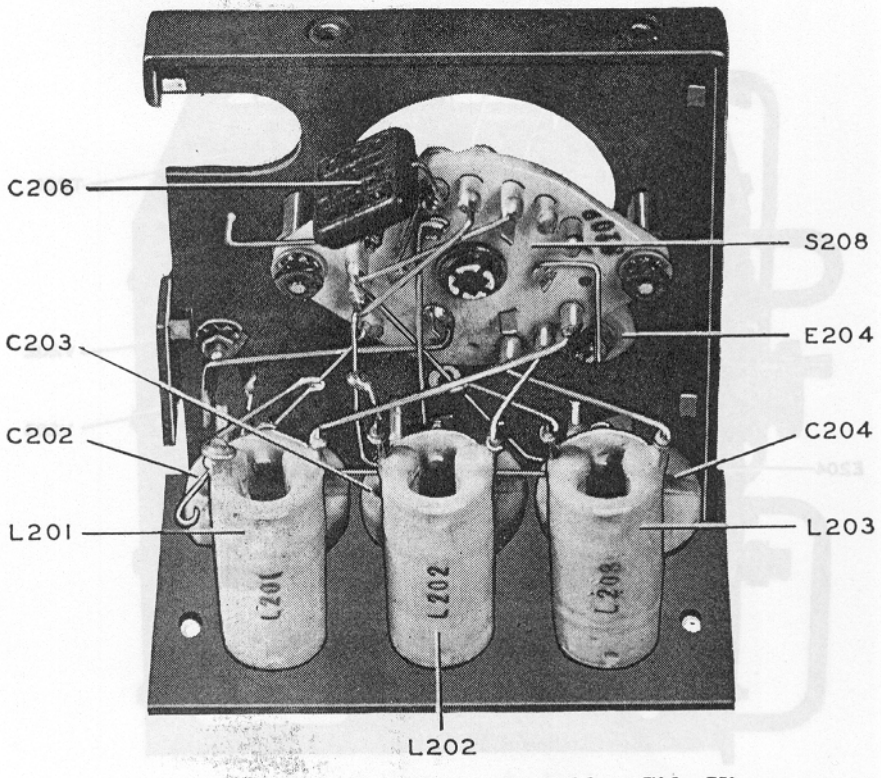


Fig. 46 Receiver R-F Tank Assembly—Side View

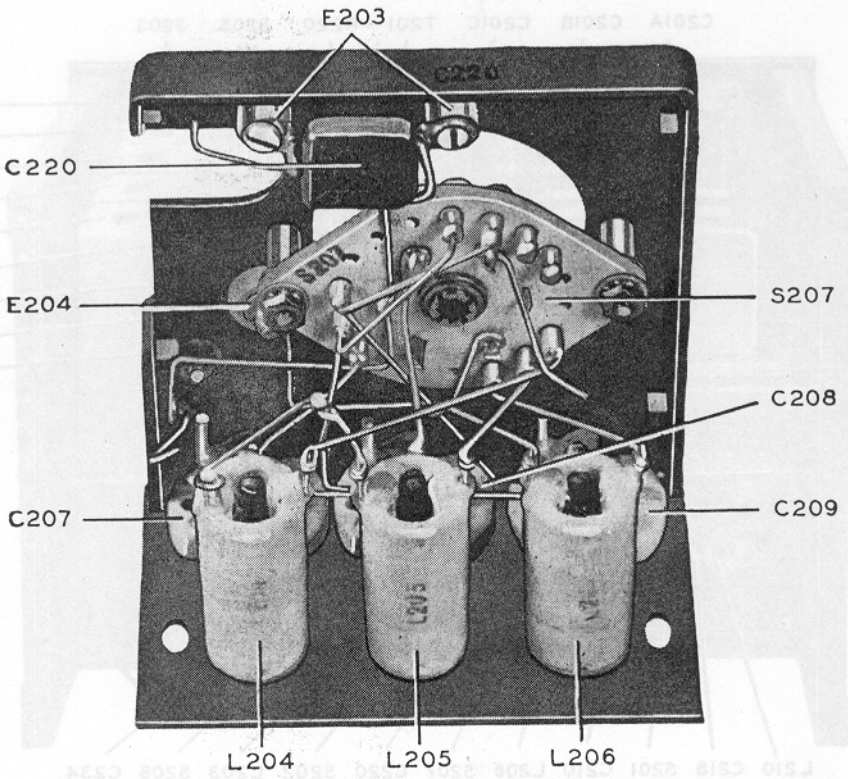


Fig. 47 Receiver Converter Tank Assembly—Side View

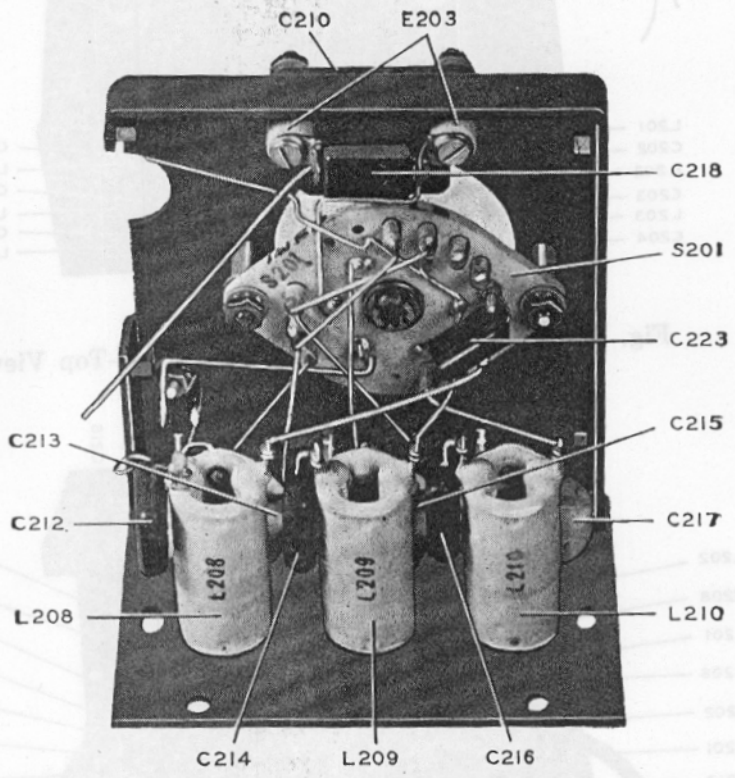


Fig. 48 Receiver Oscillator Tank Assembly—Side View

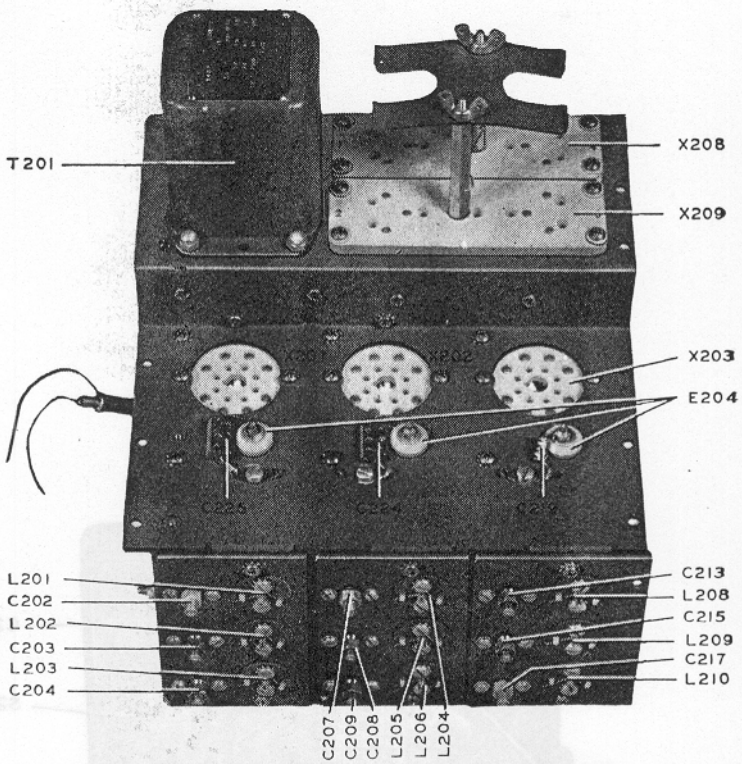


Fig. 49 Receiver R-F Chassis Assembly—Top View

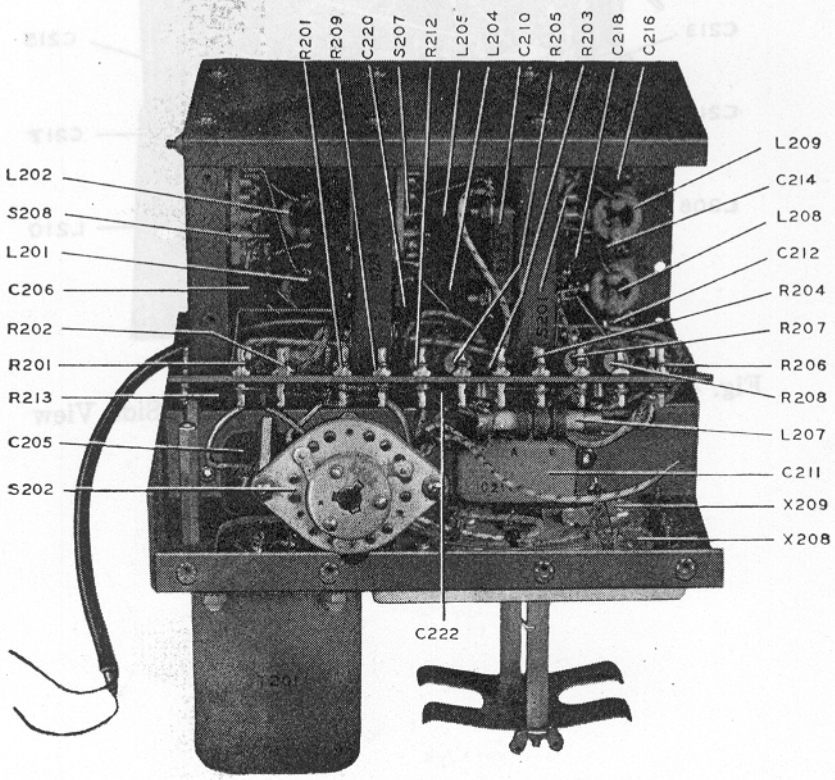


Fig. 50 Receiver R-F Chassis Assembly—Bottom View

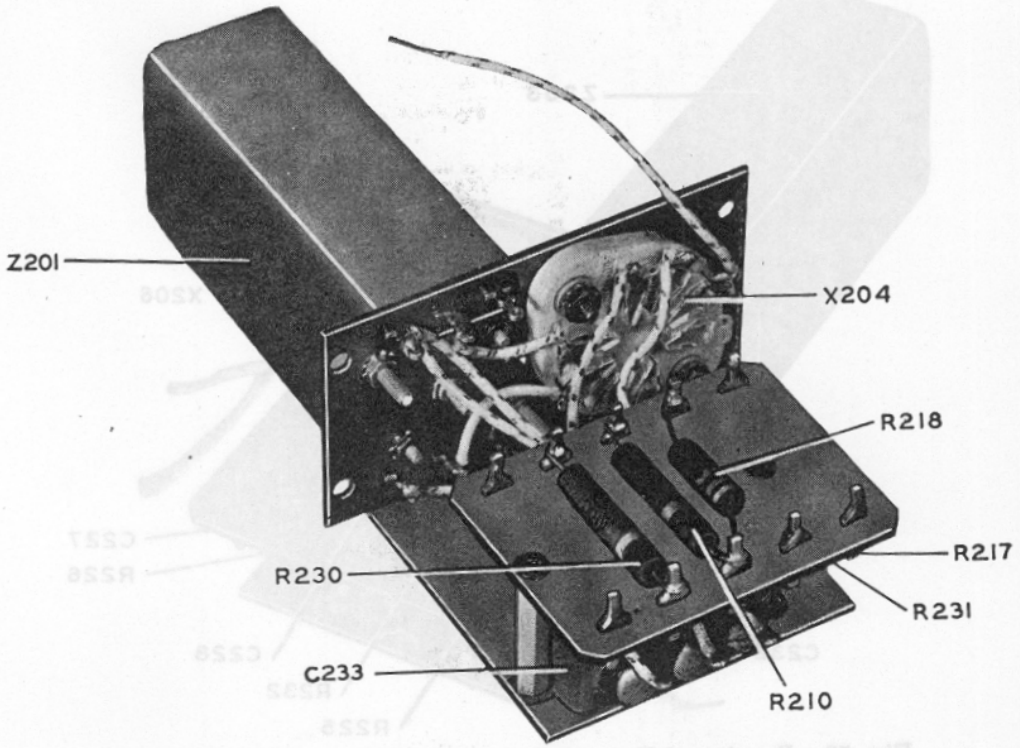


Fig. 51 Receiver 1st I-F Amp. Assembly—Bottom View

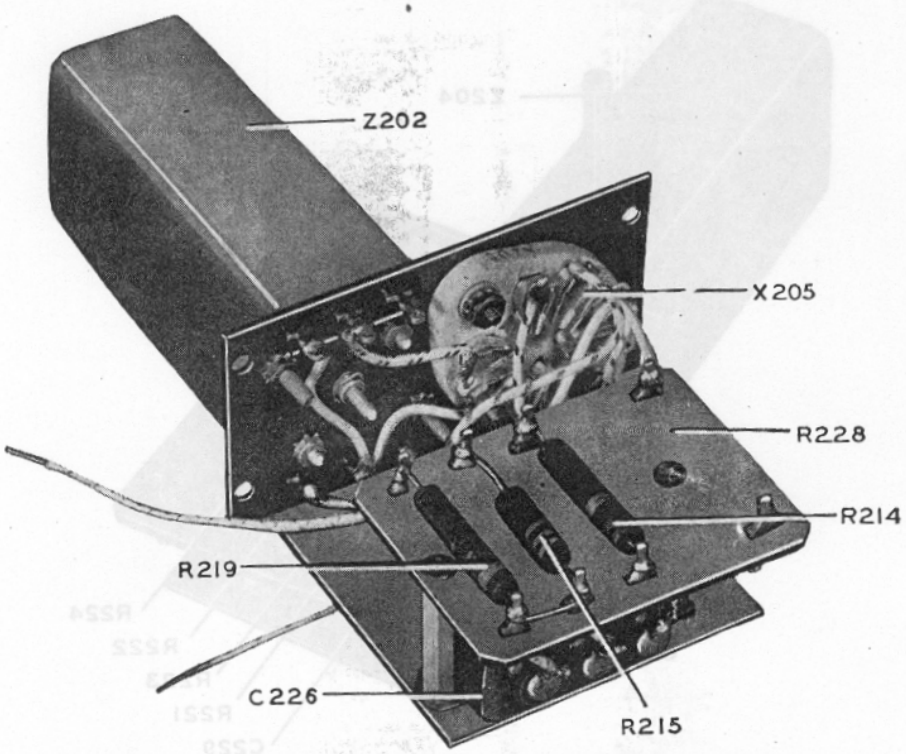


Fig. 52 Receiver 2nd I-F Amp. Assembly—Bottom View

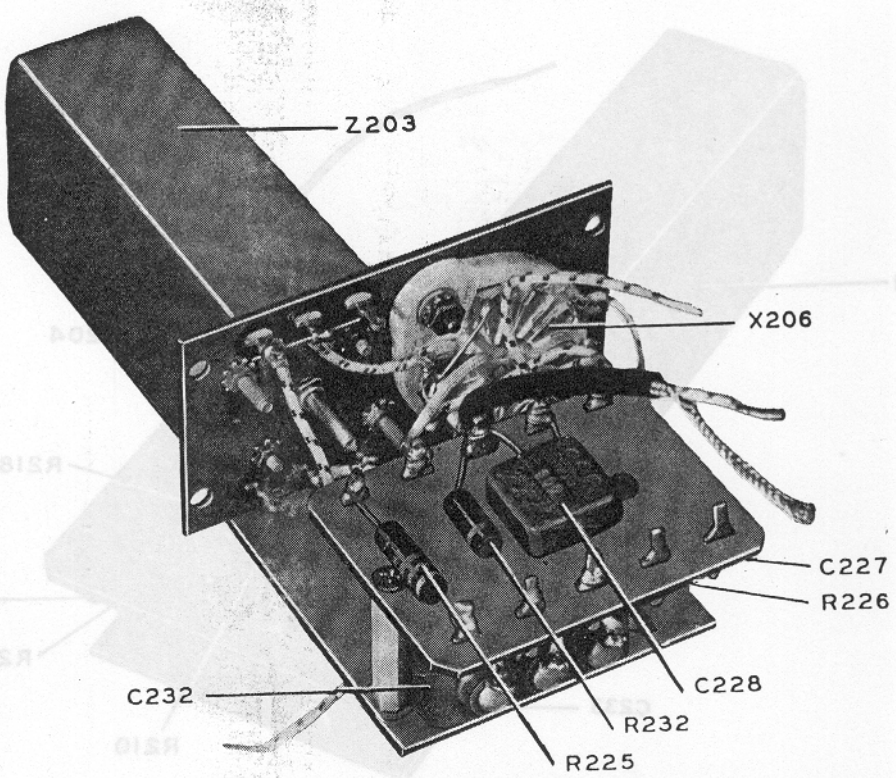


Fig. 53 Receiver I-F Amp. Detector Assembly—Bottom View

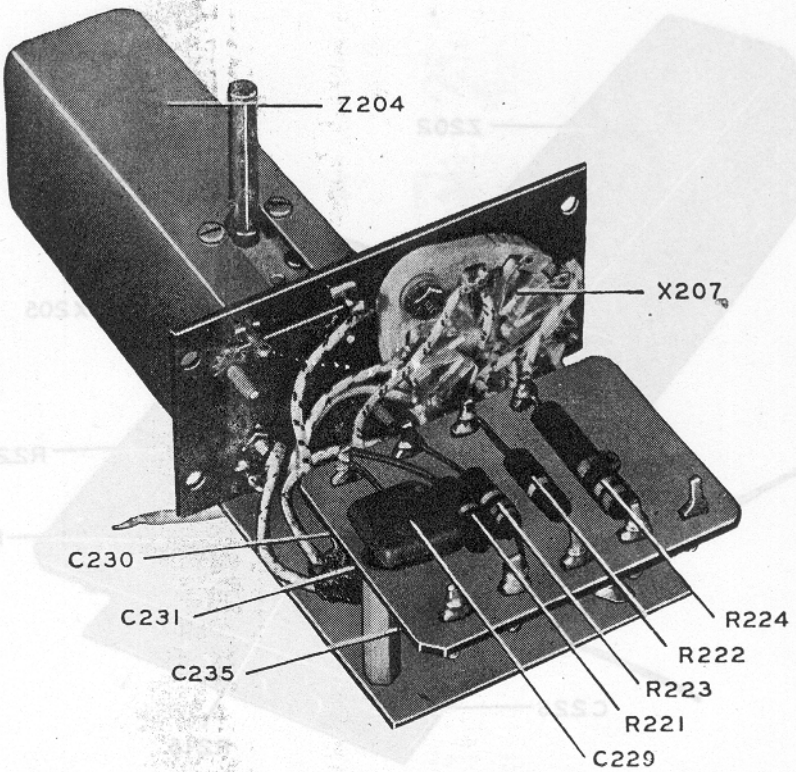


Fig. 54 Receiver BFO and Audio Amp. Assembly—Bottom View

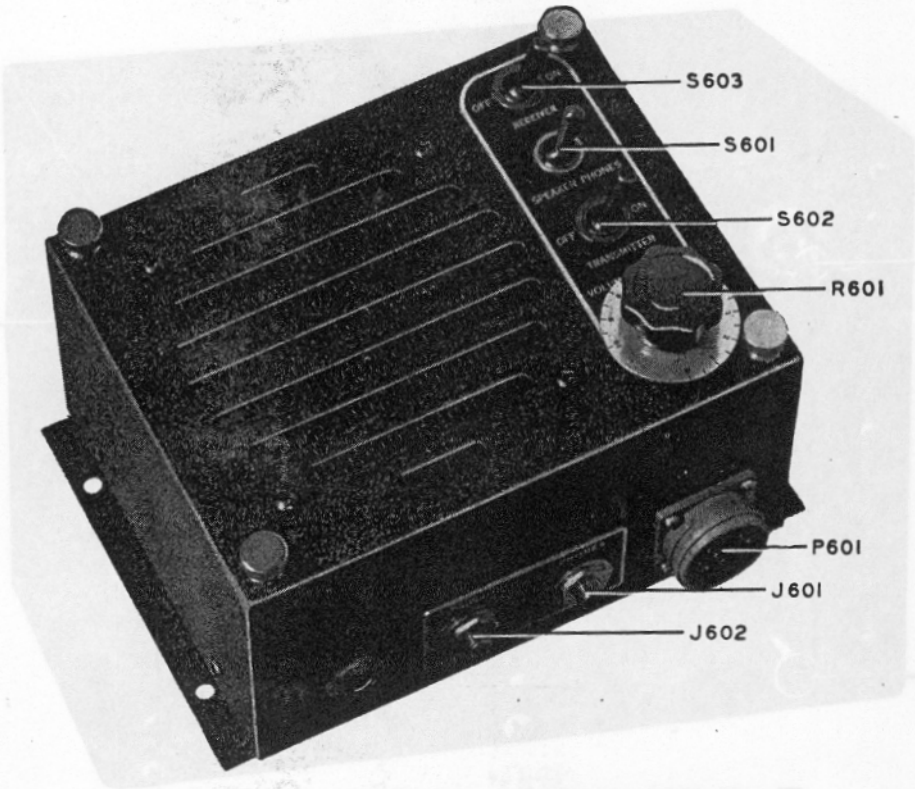


Fig. 65 Type –23270 Remote Control Unit—Top

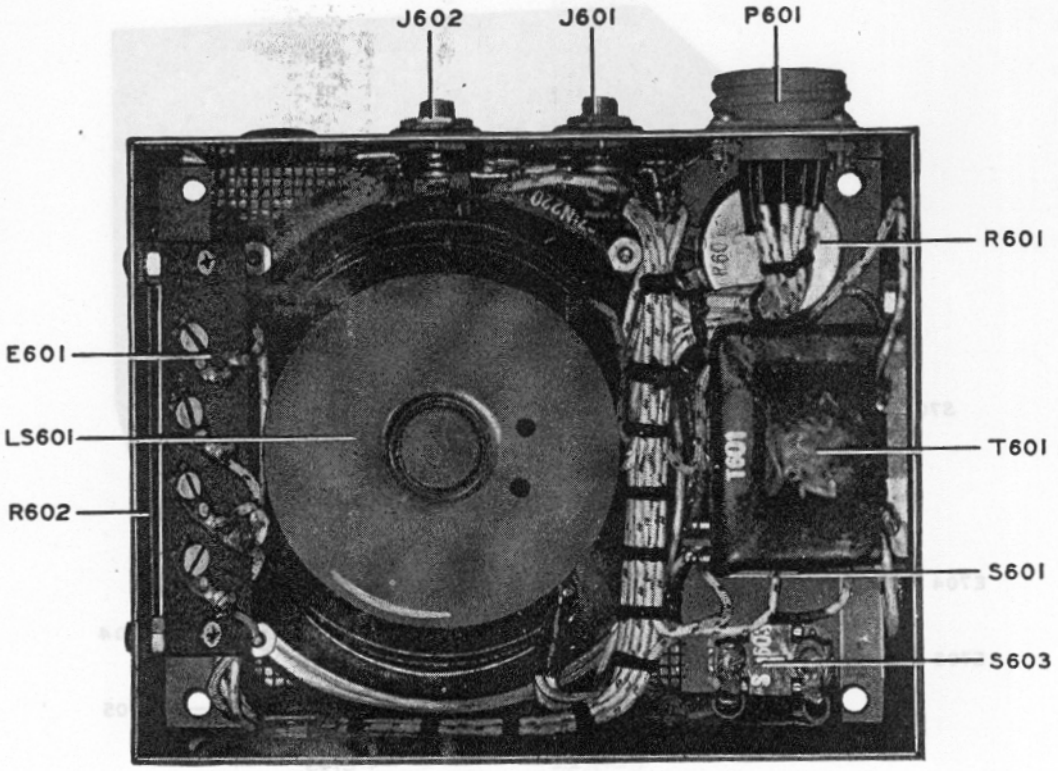


Fig. 66 Type –23270 Remote Control Unit—Rear Open

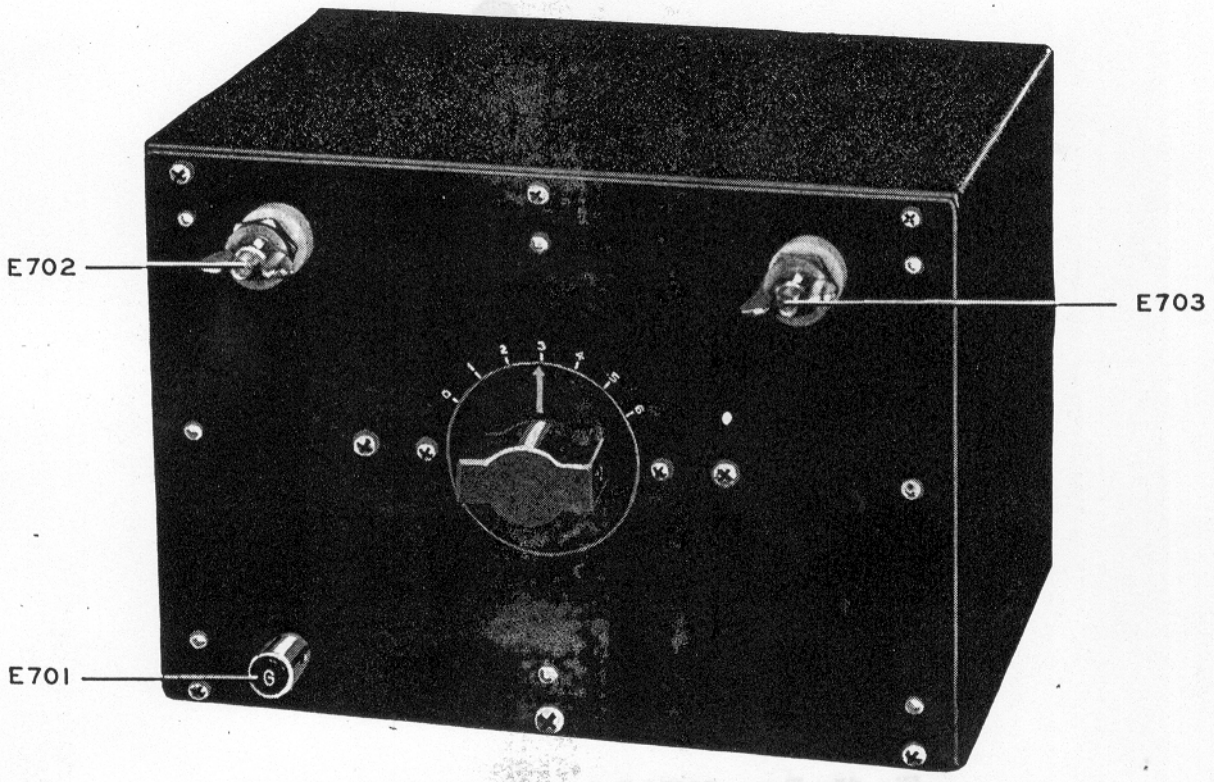


Fig. 67 Type –47205 Antenna Loading Coil—Front

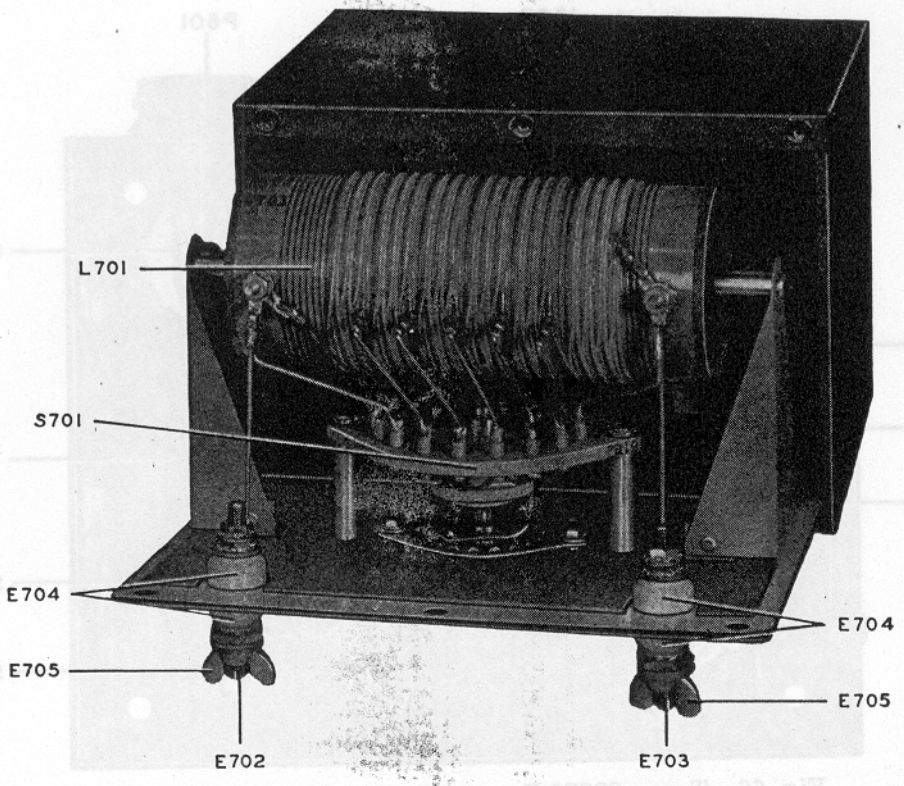


Fig. 68 Type -47205 Antenna Loading Coil—Front Open

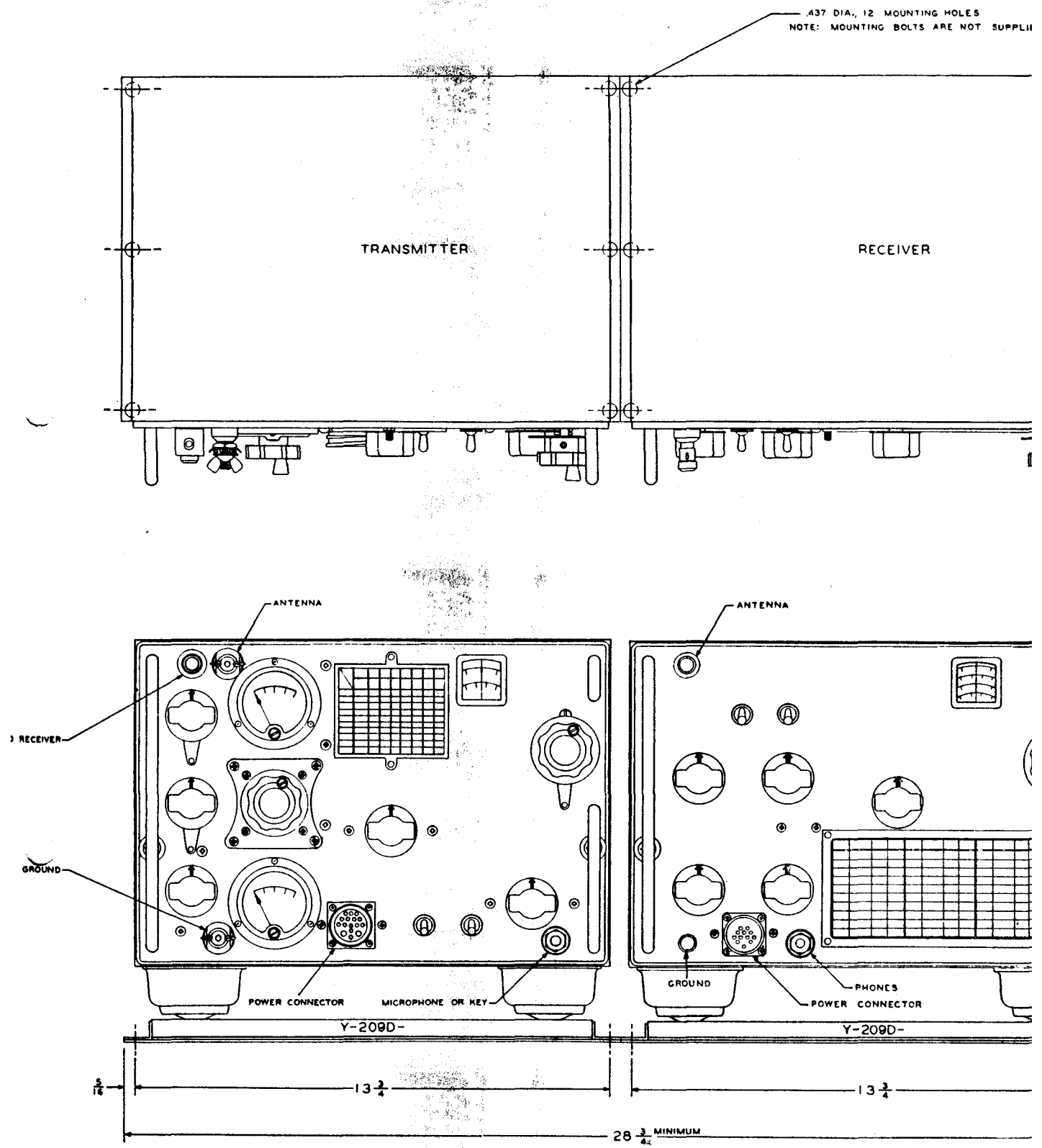
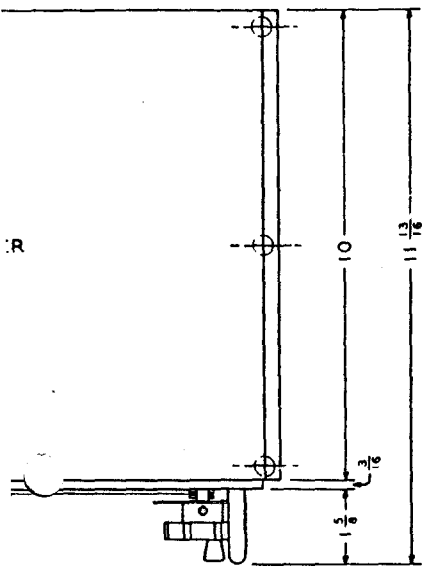
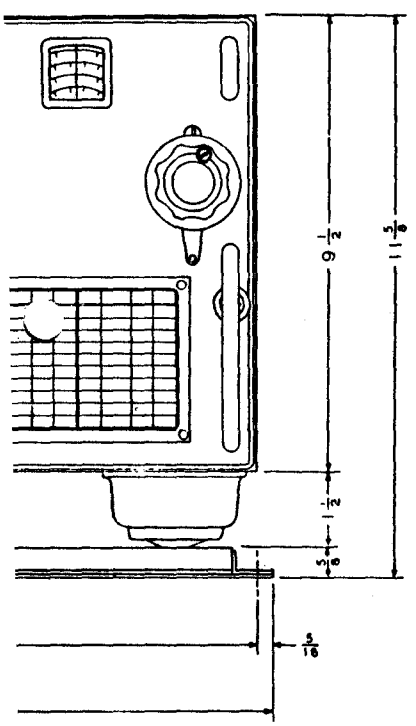


Fig. 69 TCS Horizontal Instal
(Dwg. No. 472E

TING HOLES
TS ARE NOT SUPPLIED



WEIGHT TRANS.	49.8 LBS.
WEIGHT REC.	40.0 LBS.
WEIGHT Y-209D-	5.0 LBS.
WEIGHT Y-209D-	5.0 LBS.
TOTAL WEIGHT	99.8 LBS.



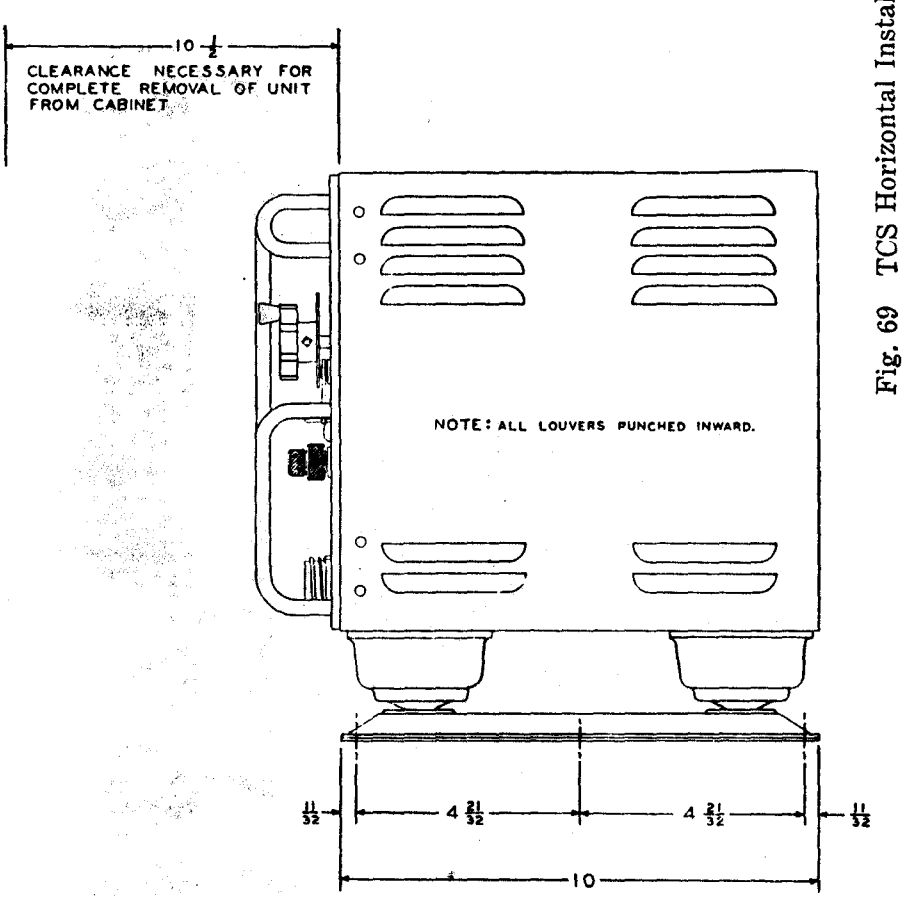


Fig. 69 TCS Horizontal Installation Diagram (Dwg. No. 472E)

ɔntal Installation Diagram
. No. 472E)

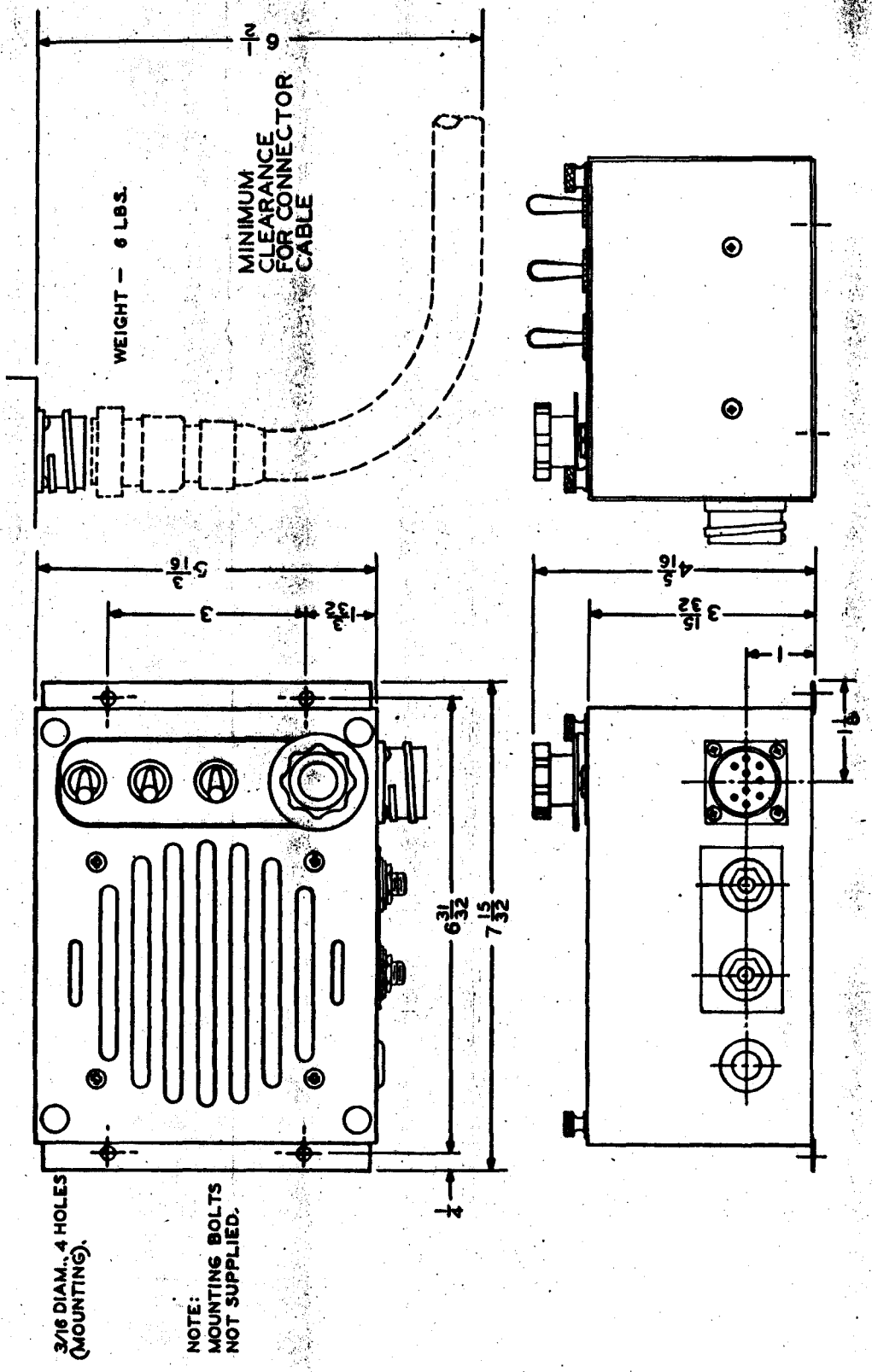


Fig. 76 Type –23270 Remote Control Unit Installation Diagram (Dwg. No. 654A)

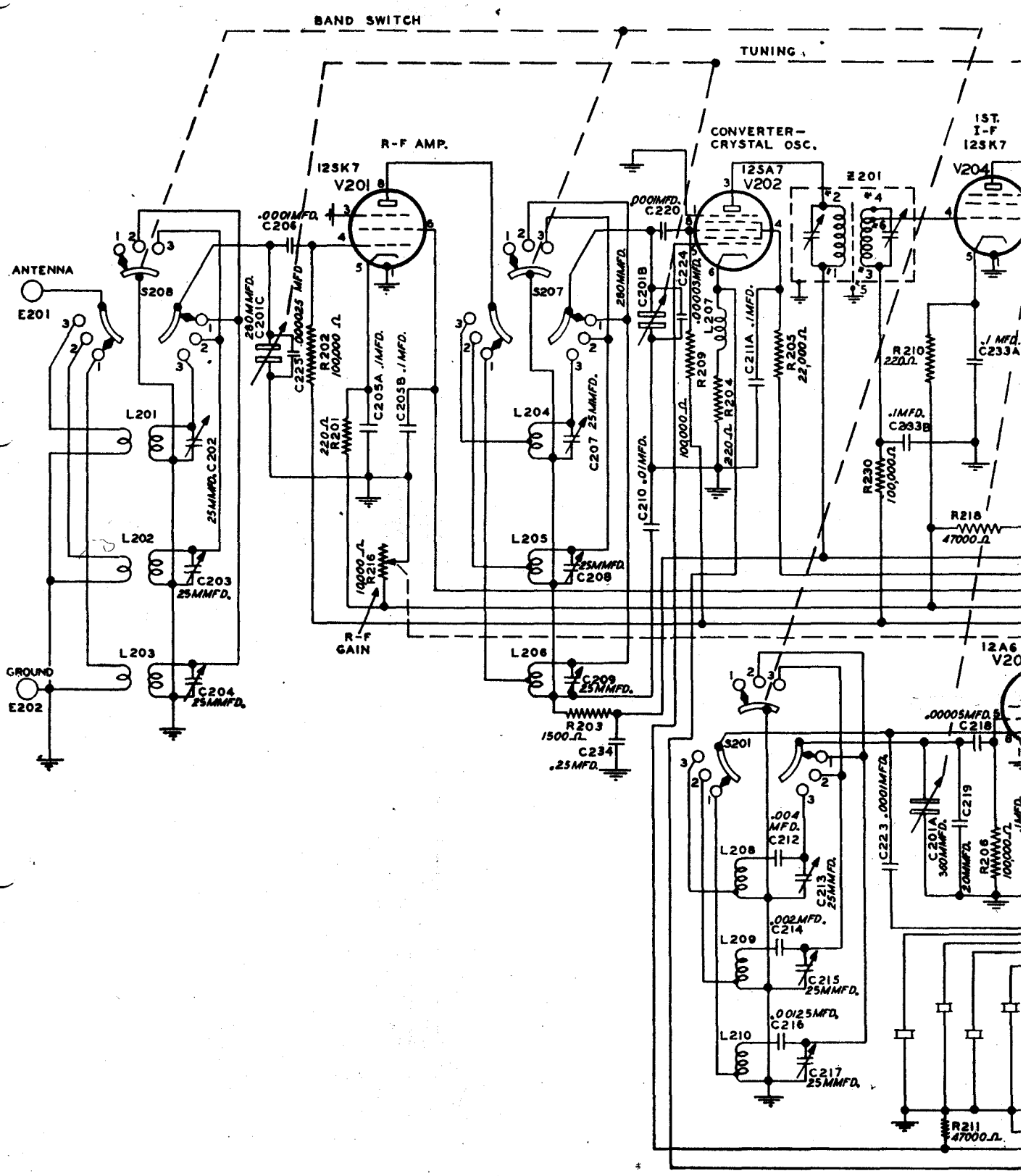


Fig. 78 Type –46159 Radio Re
(Dwg. No. 1

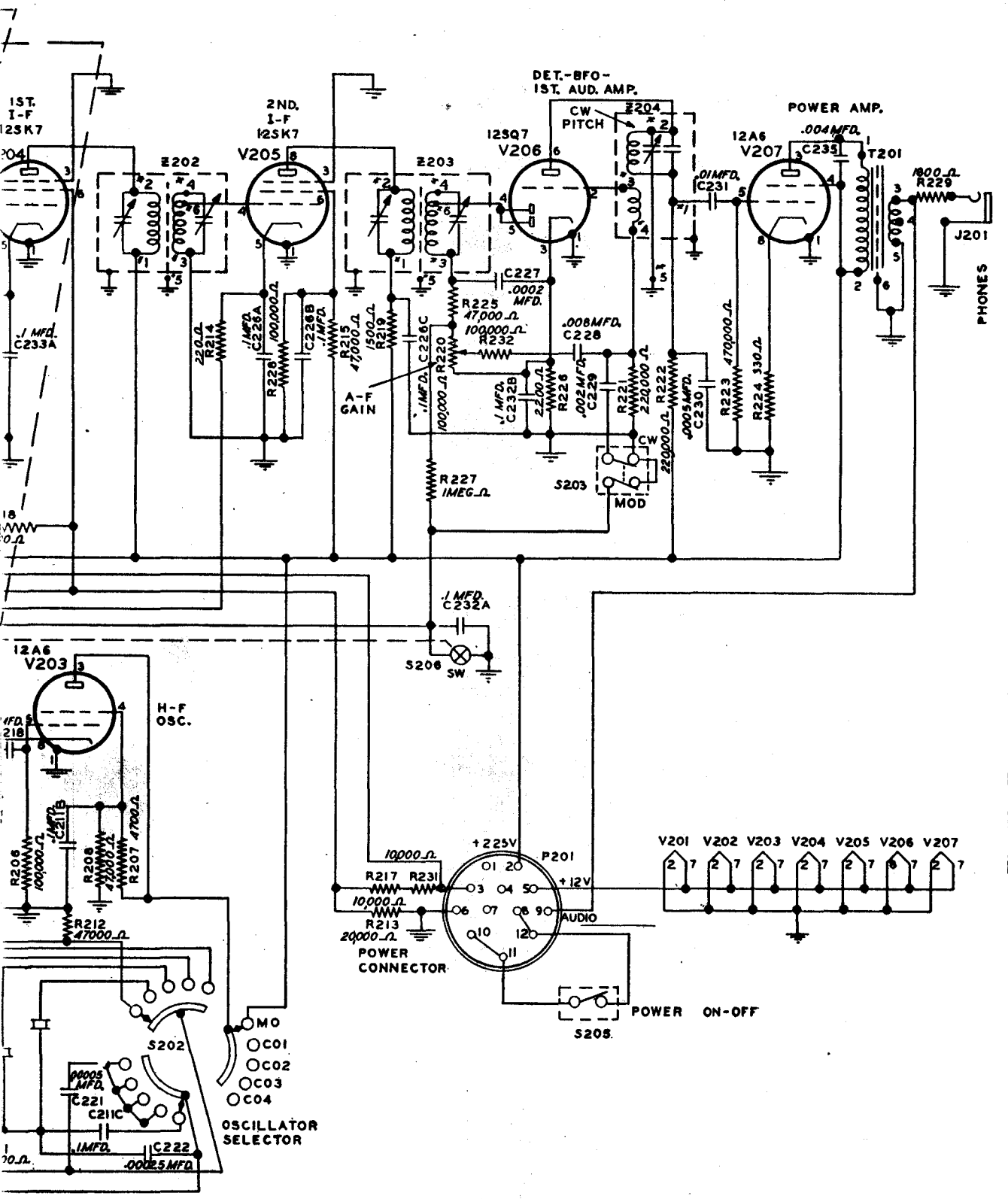
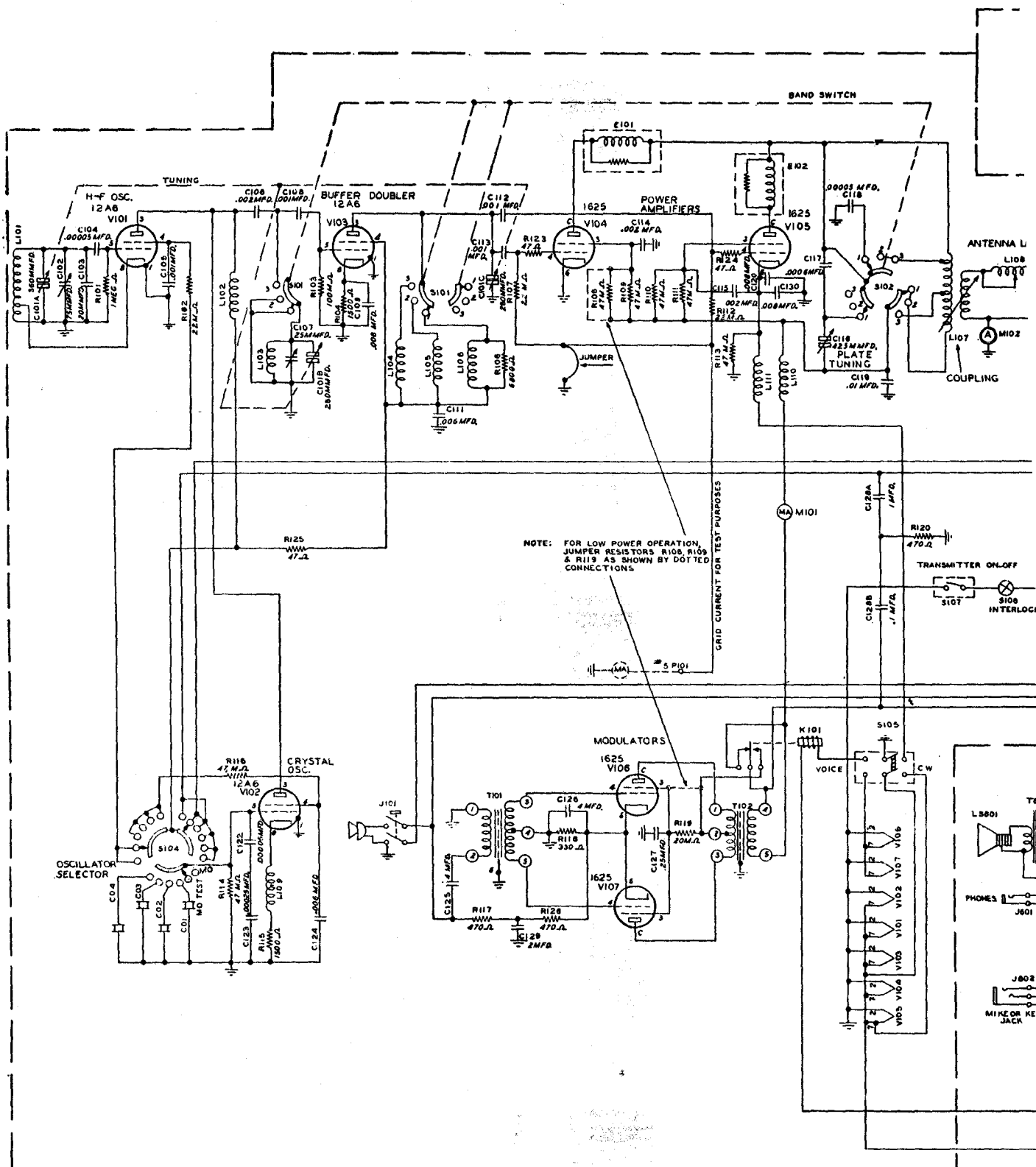


Fig. 78 Type –46159 Radio Receiver Schematic Diagram (Dwg. No. 1510C)

o Receiver Schematic Diagram
No. 1510C)


BAND SWITCH
TUNING
H-F OSC. 12A6 V101
BUFFER DOUBLER 12A6 V103
1625 POWER AMPLIFIERS V104
1625 V105
E101
E102
ANTENNA L
L108
M102
COUPLING
PLATE TUNING
JUMPER
NOTE: FOR LOW POWER OPERATION, JUMPER RESISTORS R108, R109 & R119 AS SHOWN BY DOTTED CONNECTIONS.
GRID CURRENT FOR TEST PURPOSES
M101
TRANSMITTER ON-OFF
S107
S108 INTERLOCK
CRYSTAL OSC. 12A6 V102
OSCILLATOR SELECTOR
S104
MODULATORS 1625 V106
1625 V107
K101
S105
VOICE
CW
J101
T101
T102
L5801
PHONES
J601
J602
MIKE OR KEY JACK
V106
V107
V102
V101
V103
V104
V105

Fig

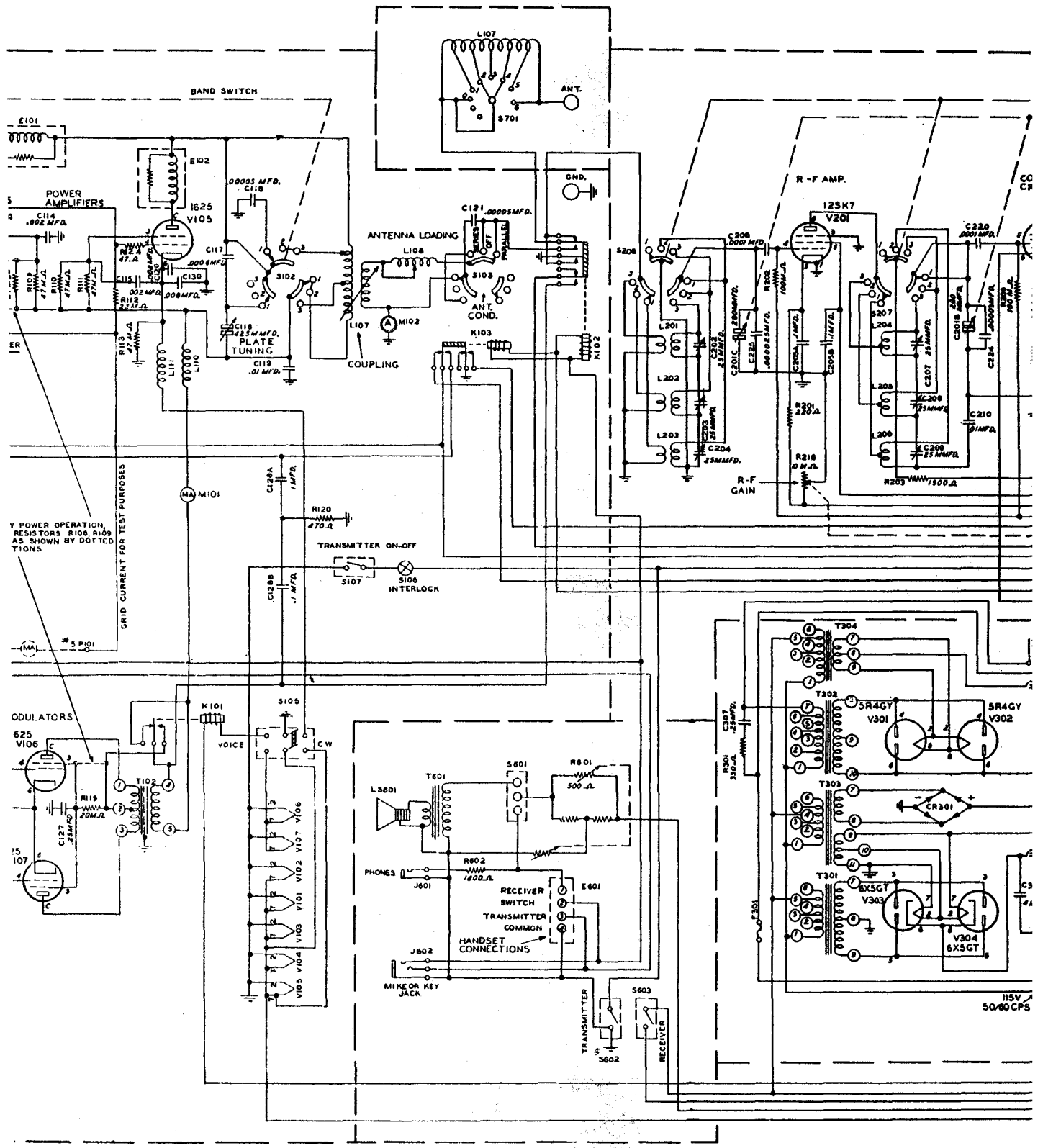


Fig. 79 Typical Complete Schematic, Type –20218 Power Unit Sl
(Dwg. No. 500 9974 005)

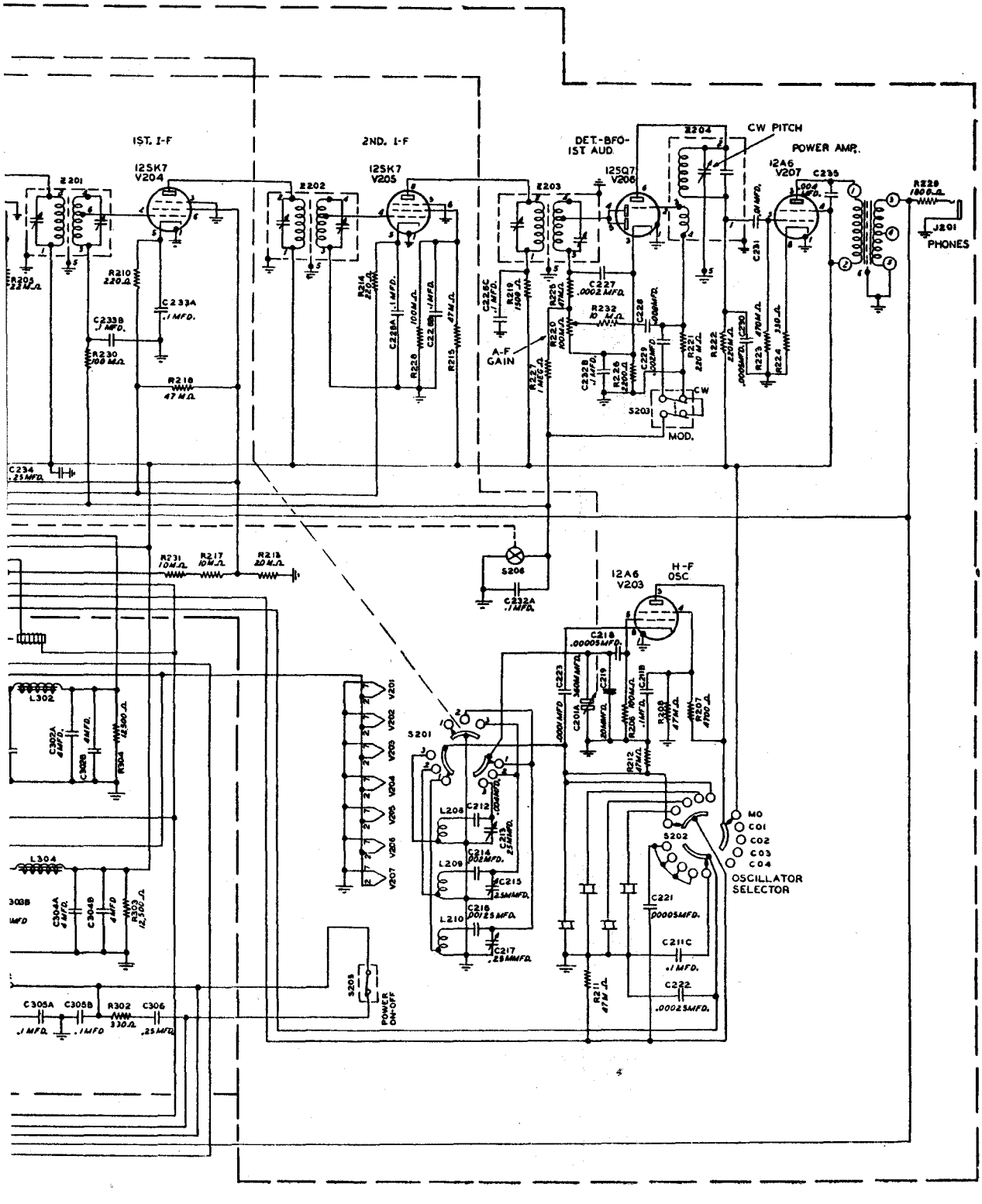


Fig. 79 Typical Complete Schematic, Type -20218 Power Unit Shown (Dwg. No. 500 9974 005)

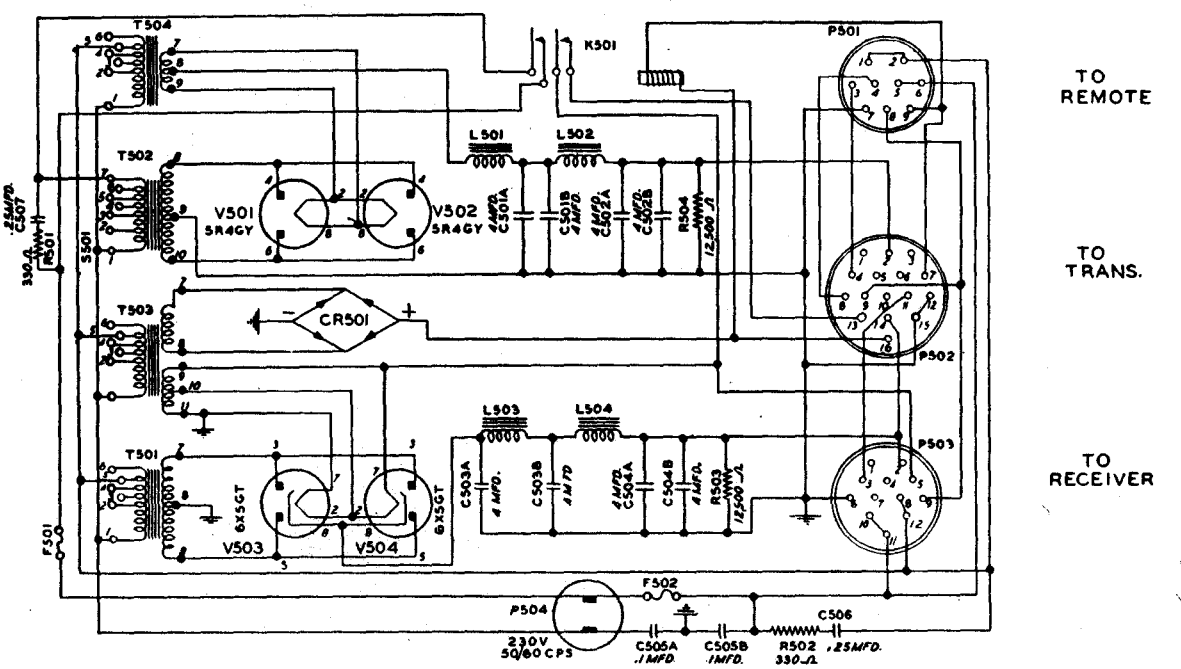


Fig. 90 Type –20242 Power Unit Schematic Diagram
(Dwg. No. 1813B)

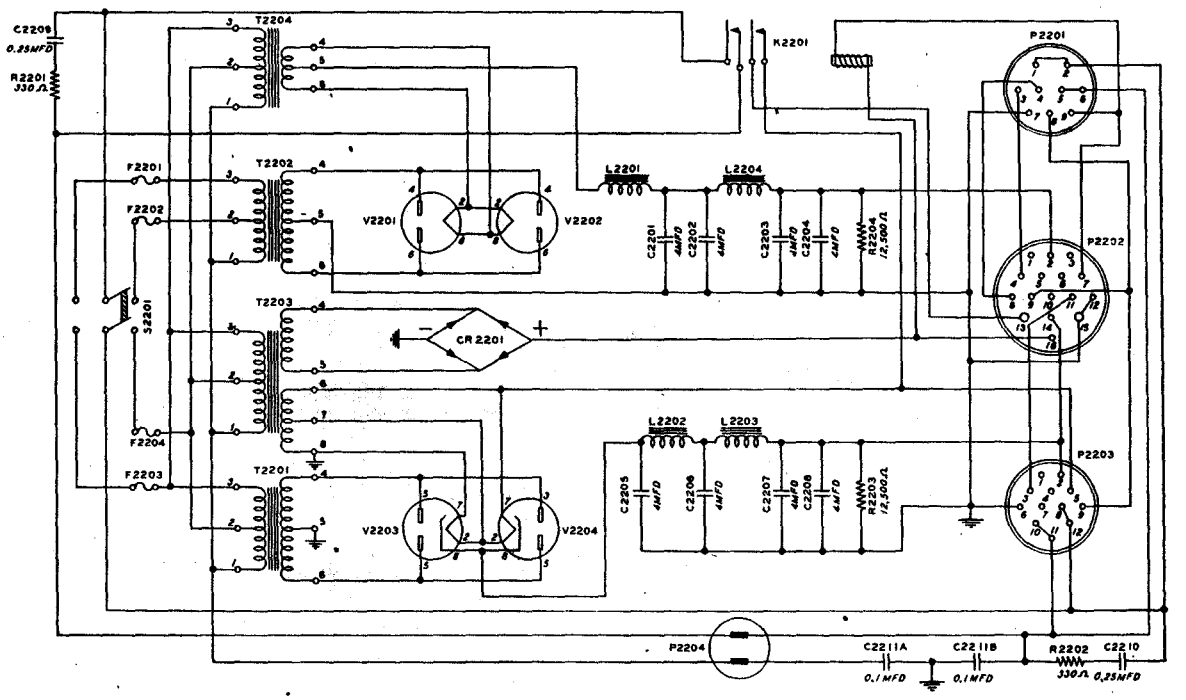


Fig. 91 Type –20309 Power Unit Schematic Diagram
(Dwg. No. 500 8949 00B)

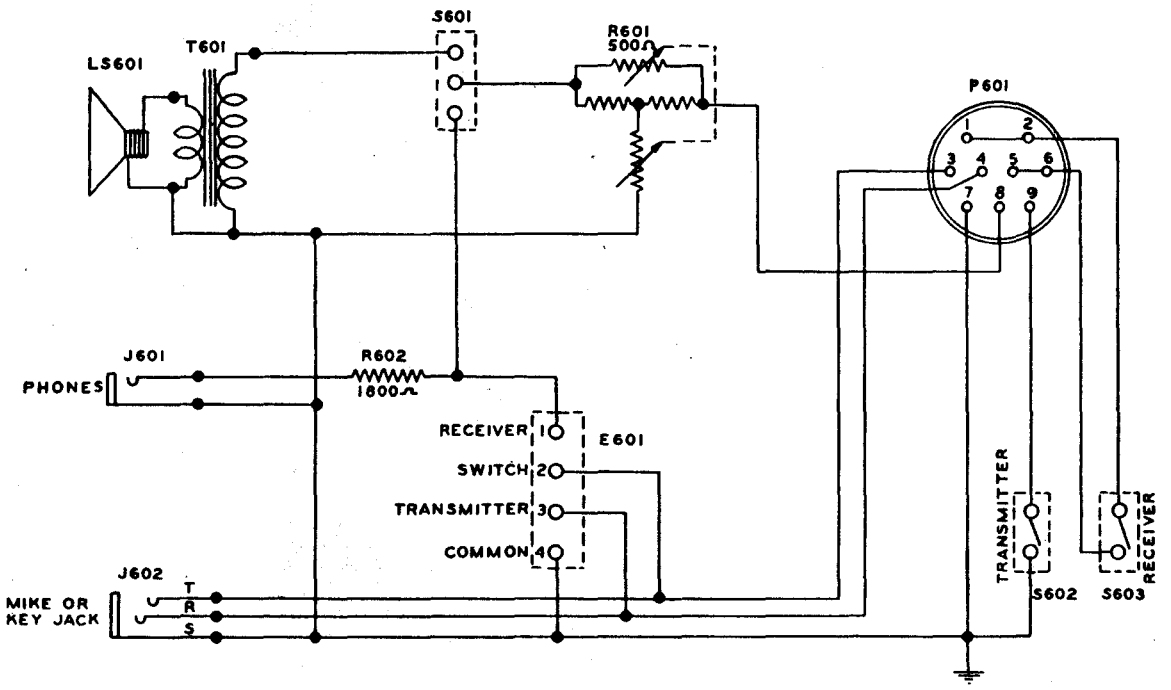


Fig. 92 Type –23270 Remote Control Unit Schematic Diagram
(Dwg. No. 694A)

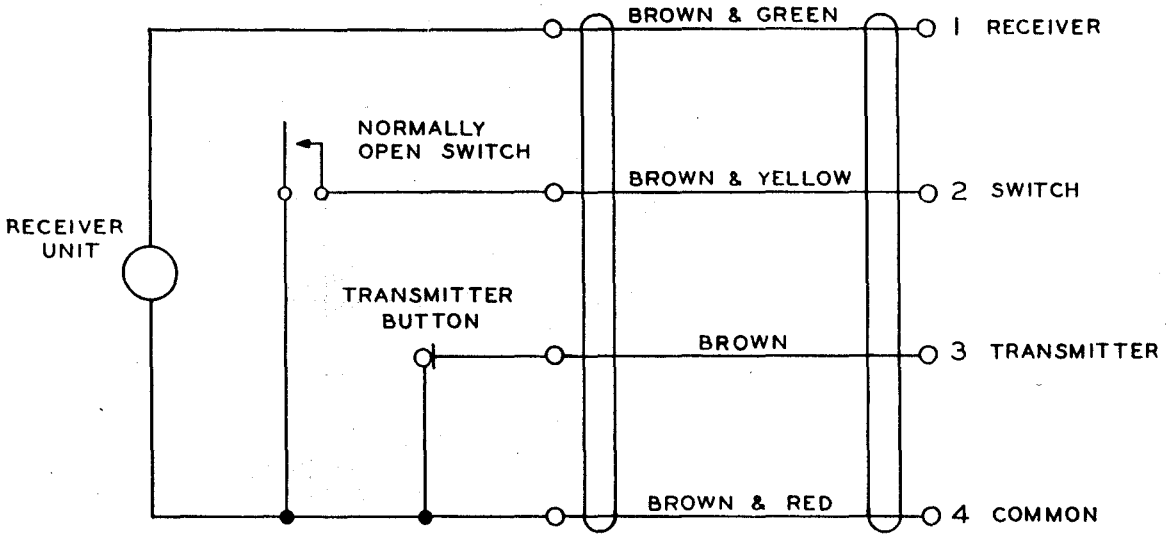


Fig. 93 Handset Schematic (Dwg. No. 1066A)

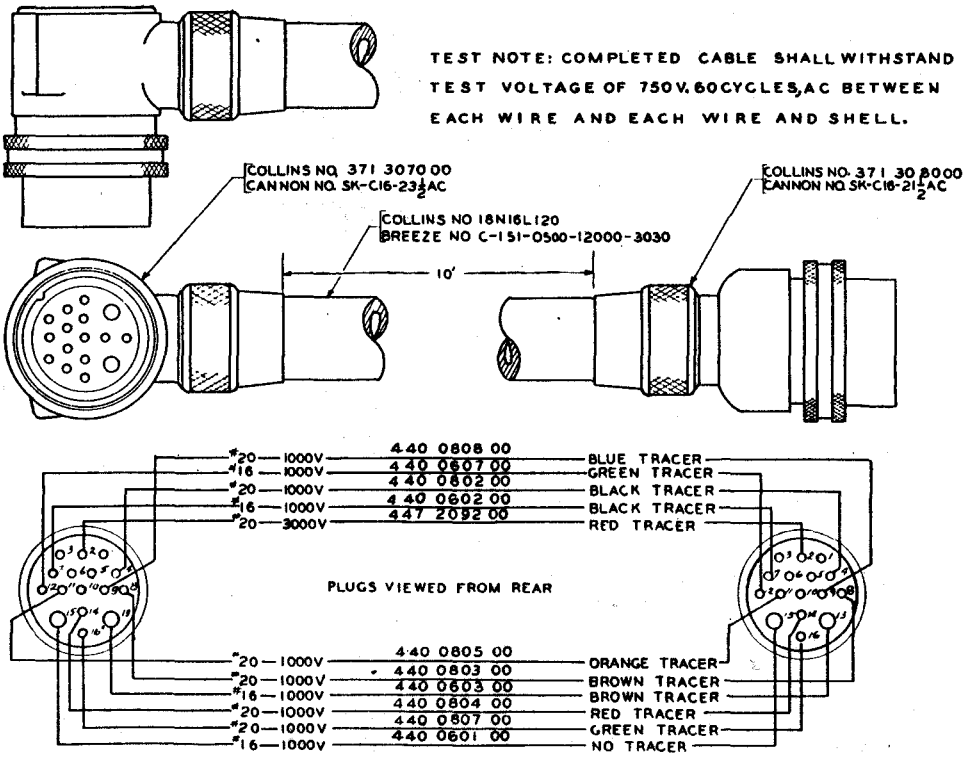


Fig. 94 65F-7 Power Cable (Transmitter to Power Unit)
(Dwg. No. 193A)

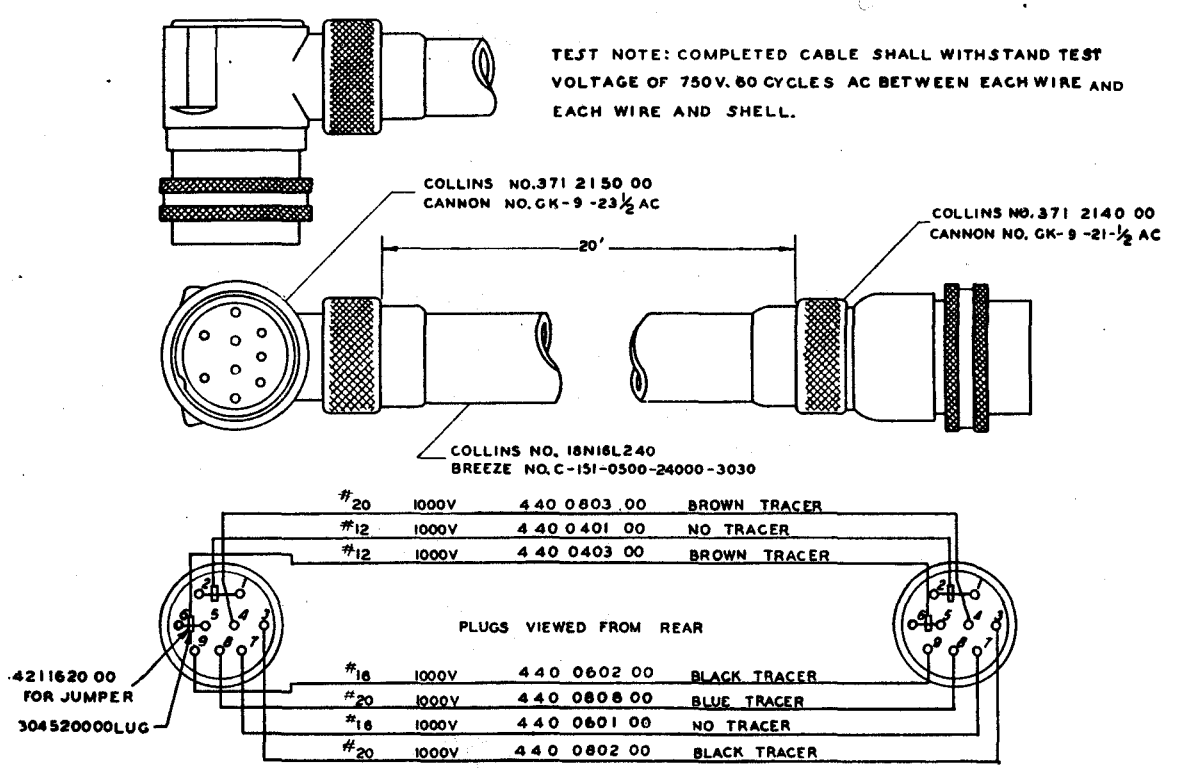


Fig. 95 65F-10 Control Cable (Control Unit to Power Unit)
(Dwg. No. 748A)

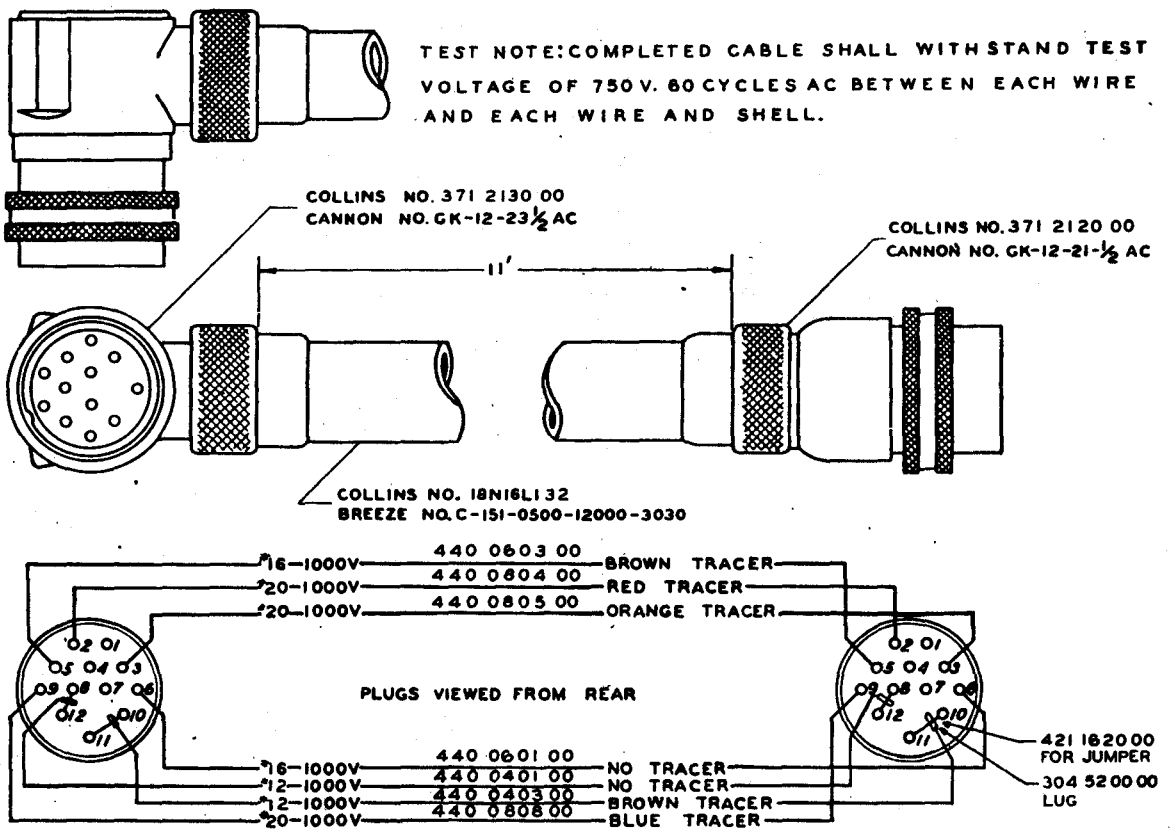
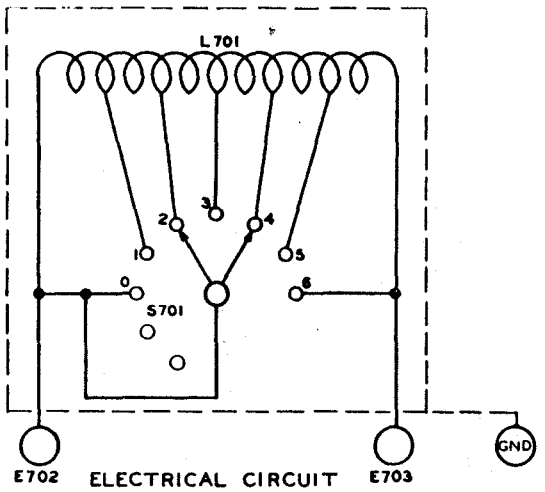


Fig. 96 65F-13 Power Cable (Receiver to Power Unit) (Dwg. No. 2155A)



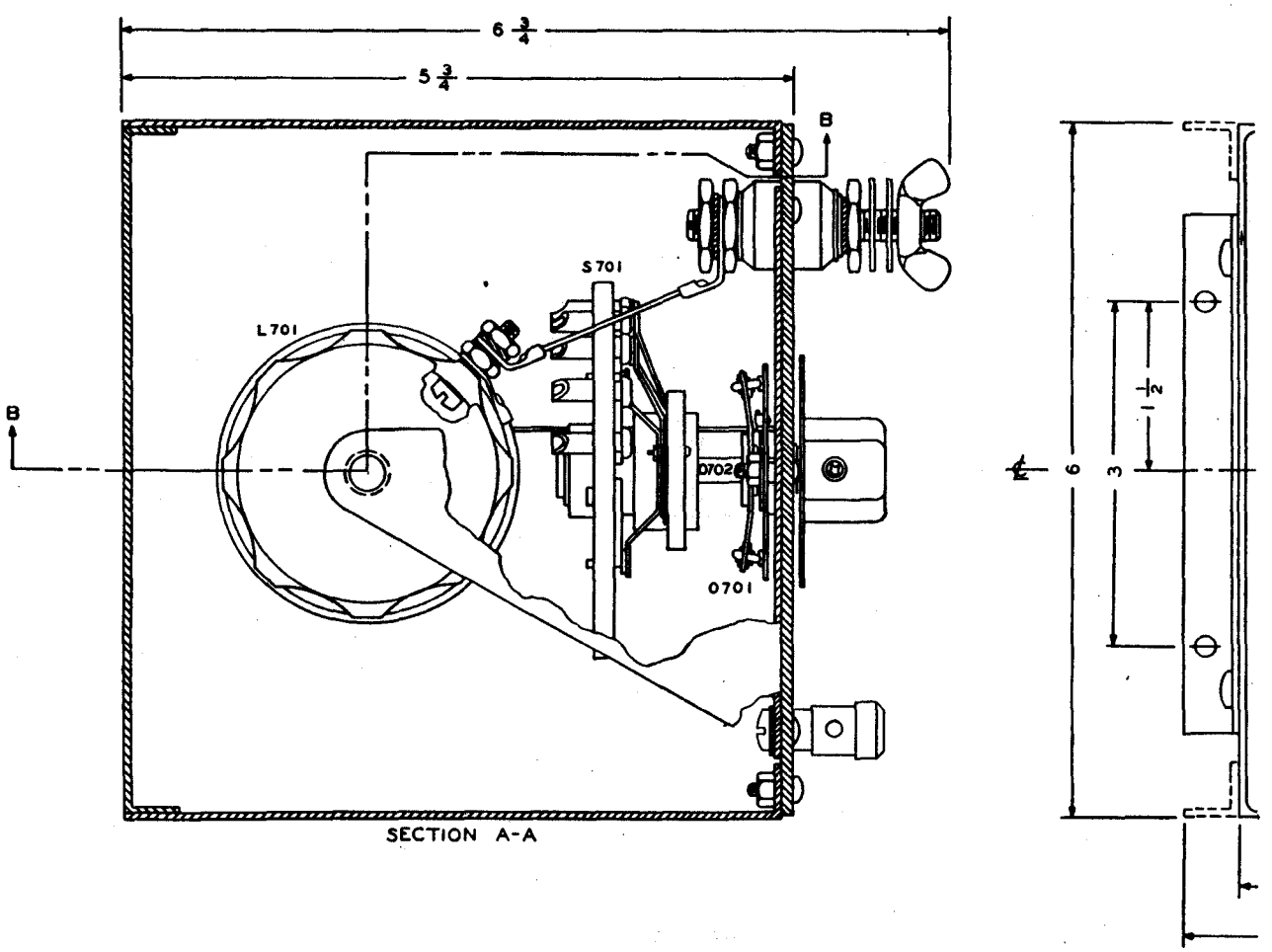
ELECTRICAL CIRCUIT

NOTE:

UNIVERSAL MOUNTING BRACKETS ARE SHOWN AT REAR OF UNIT FOR WALL MOUNTING. THEY MAY ALSO BE MOUNTED IN DOTTED POSITIONS INDICATED.

NOTE:

ALL ITEM NO'S TO BE STAMPED ON INSIDE OF COIL MTG. BRACKET ADJACENT TO PARTS REFERRED TO EXCEPT 0702 TO BE STAMPED ON SHAFT.



SECTION A-A

Fig. 97 Type –47205 Loading Schematic Diagram (Dw

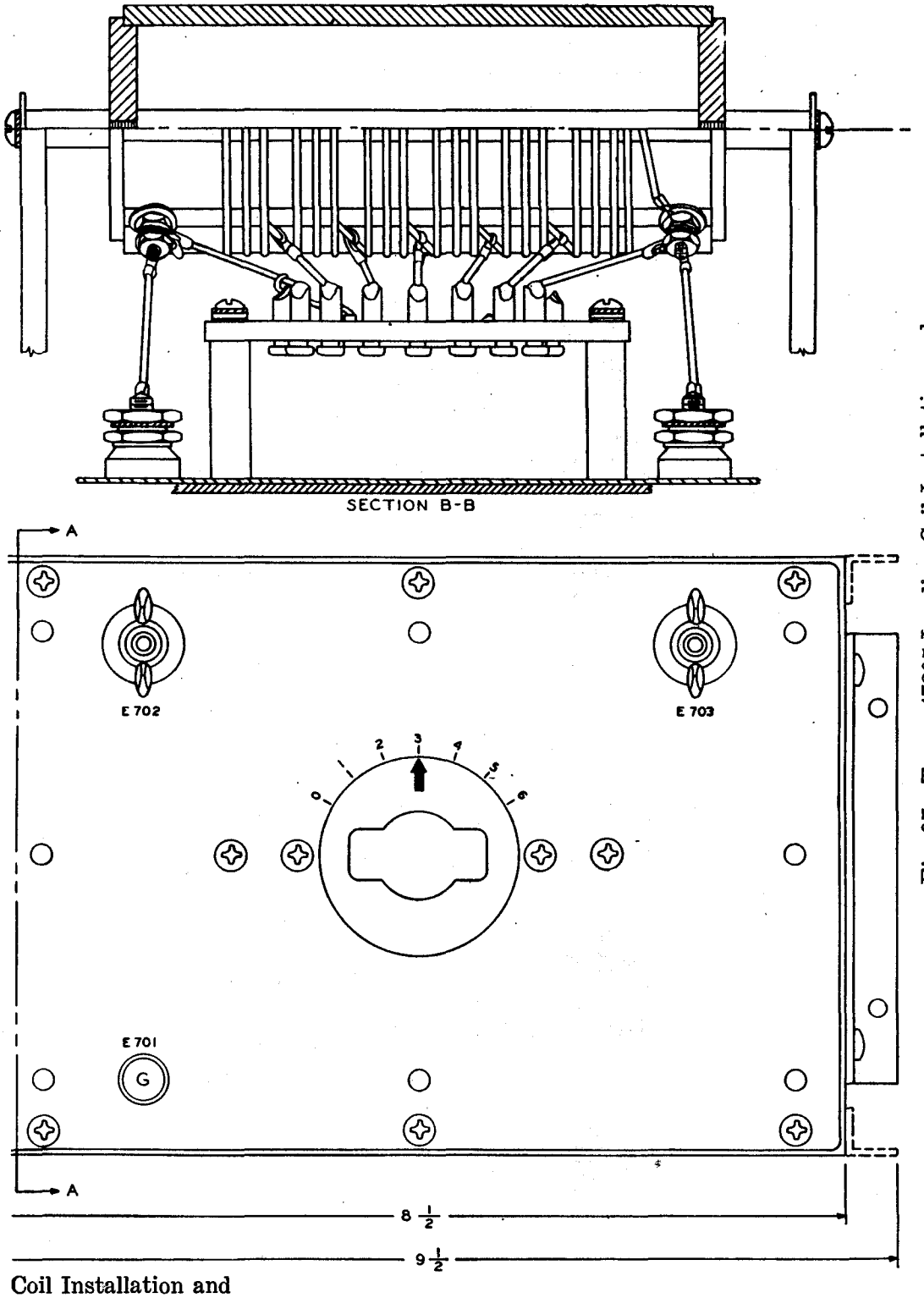


Fig. 97 Type –47205 Loading Coil Installation and Schematic Diagram (Dwg. No. 1597C)

Coil Installation and
g. No. 1597C)

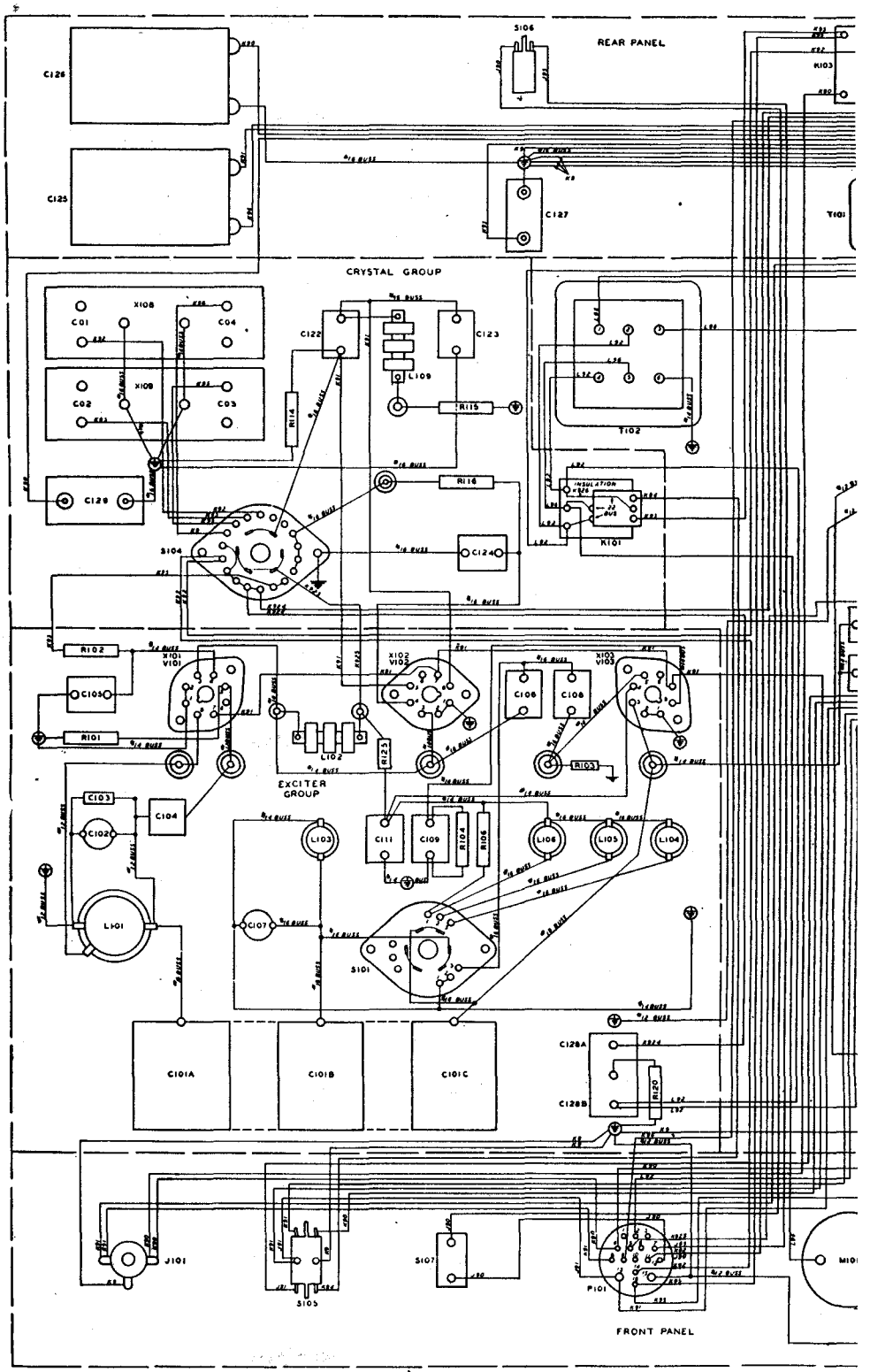


Fig. 98 Transmitter Practical
(Dwg. No. 485E

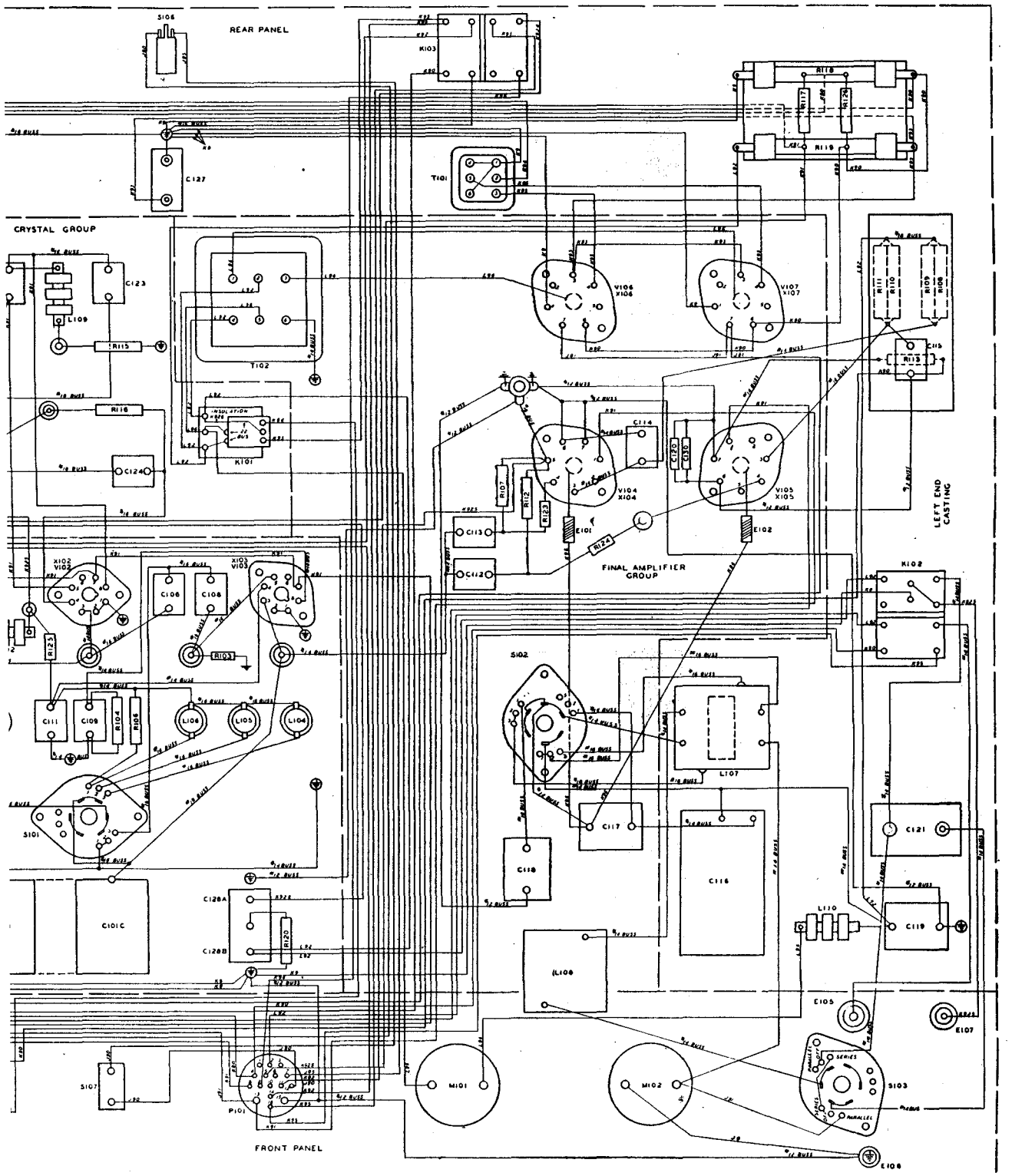


Fig. 98 Transmitter Practical Wiring Diagram
(Dwg. No. 485E)

Fig. 98 Transmitter Practical Wiring Diagram
(Dwg. No. 485E)

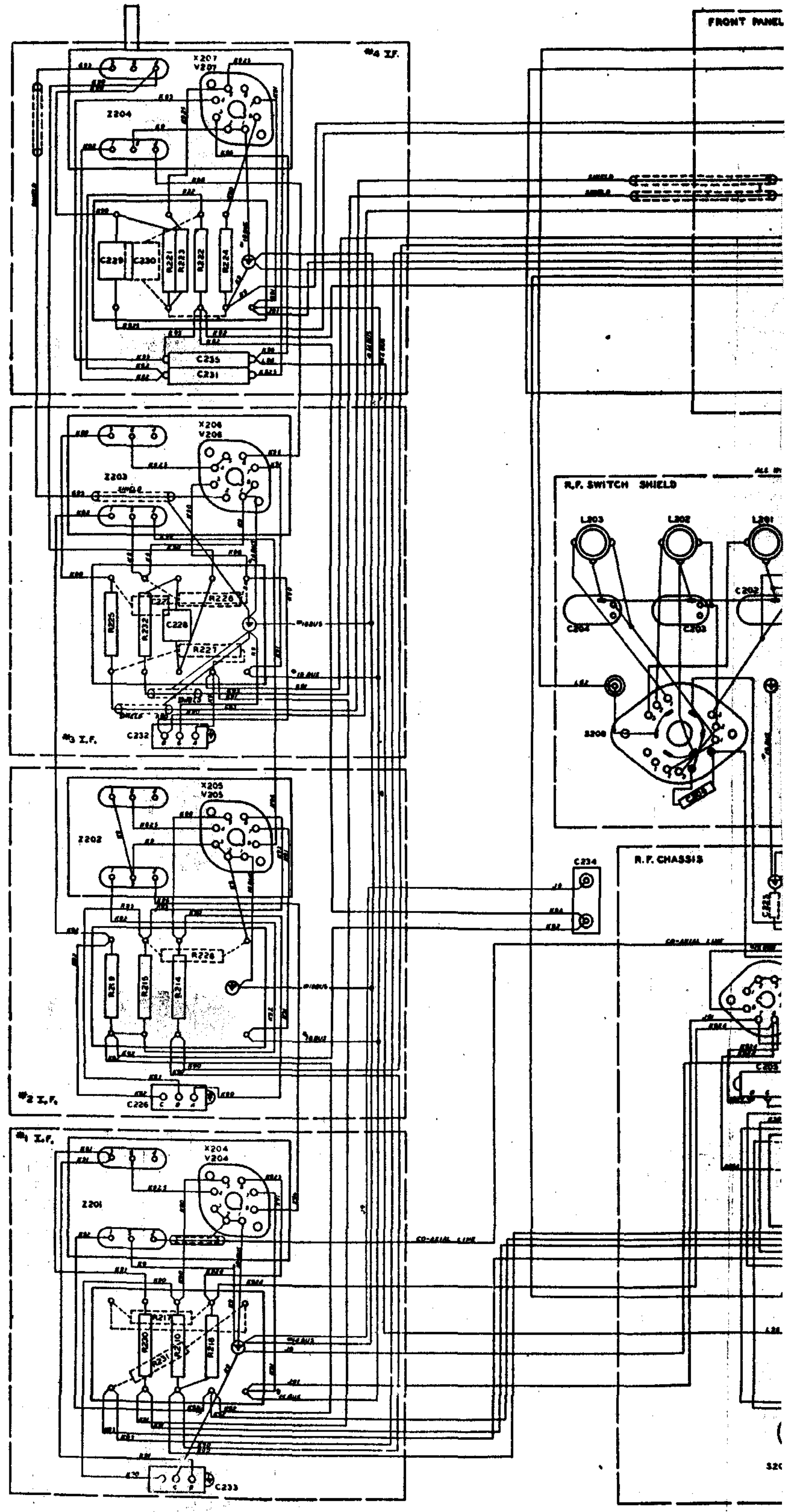


Fig. 99 Receiver Pr
(Dwg. I

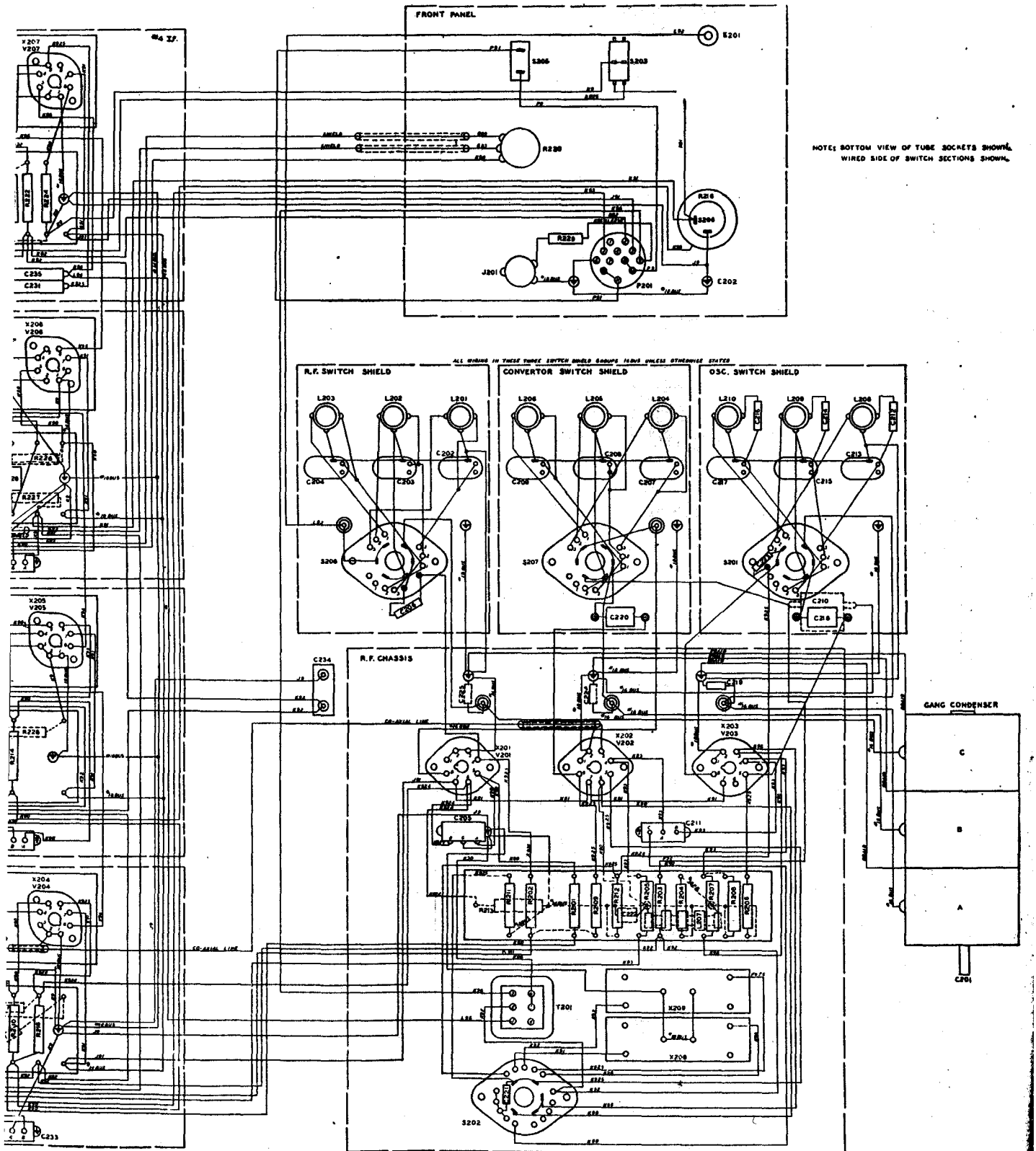


Fig. 99 Receiver Practical Wiring Diagram
(Dwg. No. 486E)

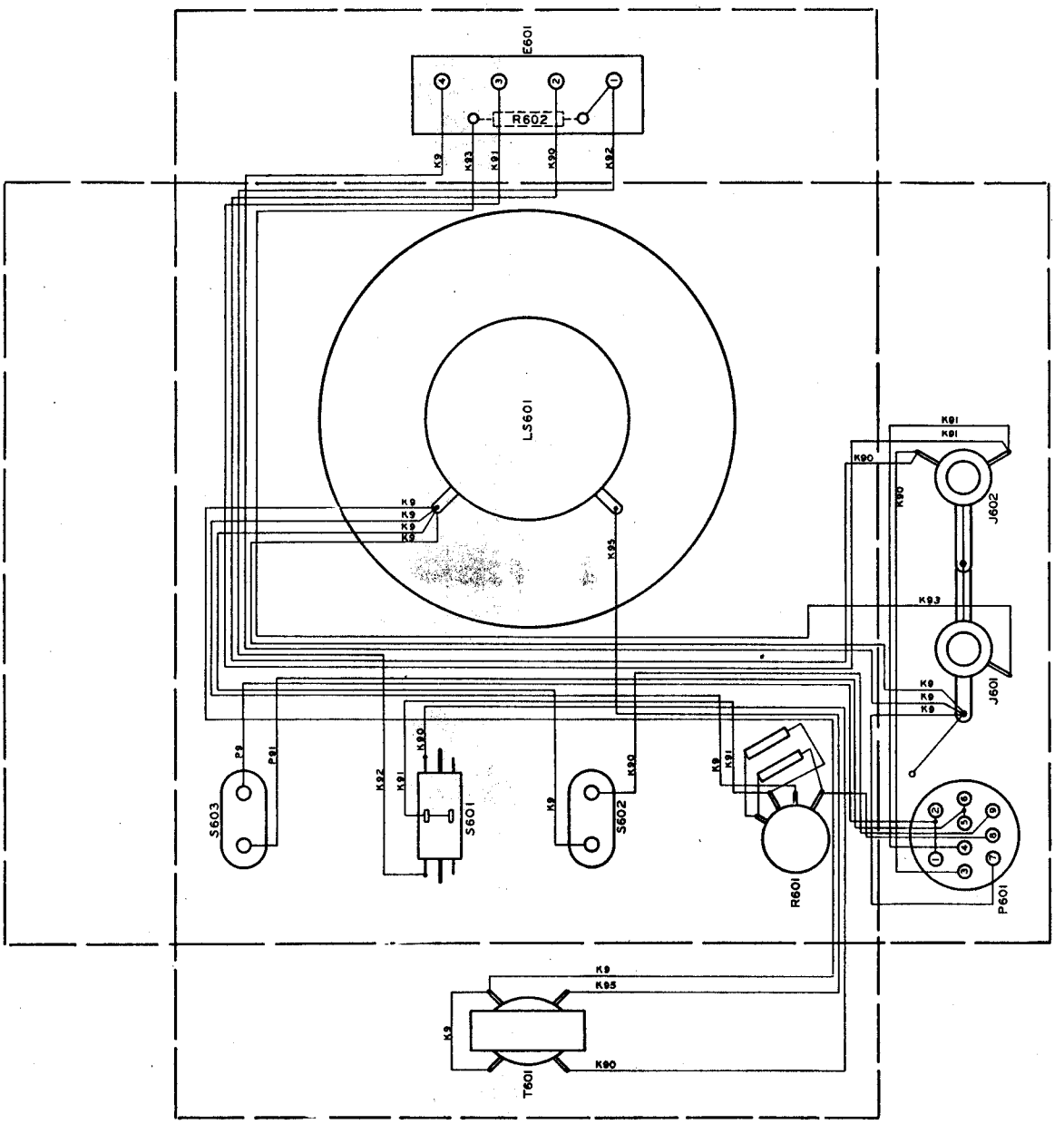
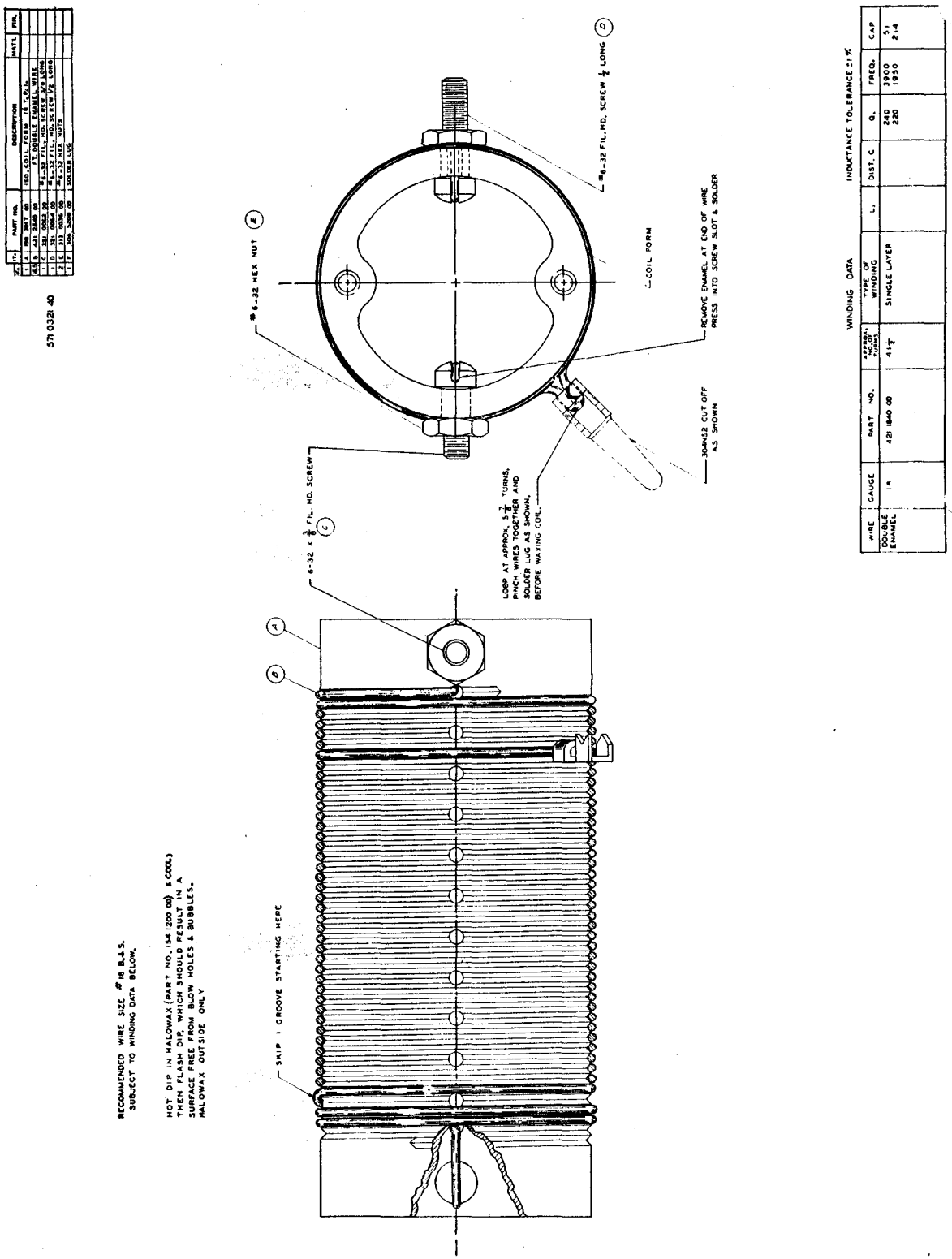
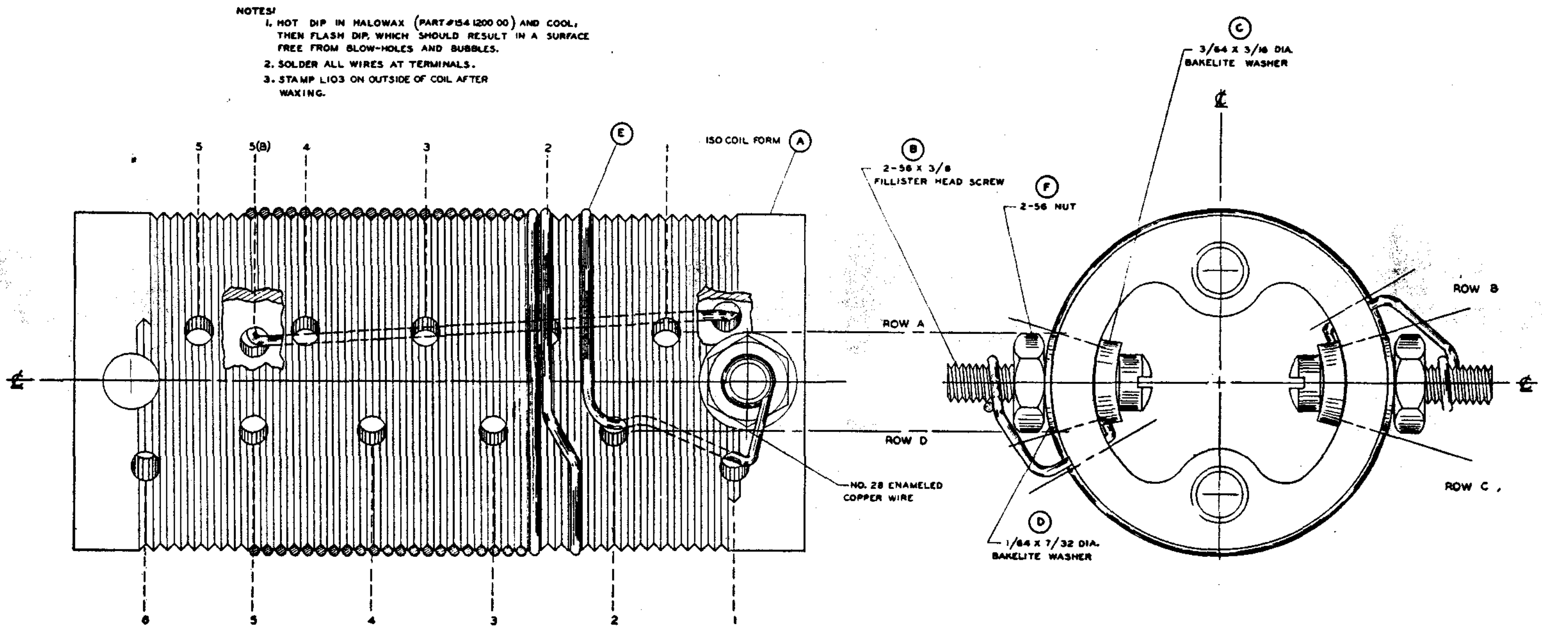


Fig. 112 Remote Control Unit Practical Wiring Diagram
(Dwg. No. 567C)



WIRE	GAUGE	PART NO.	APPROX. NO. OF TURNS	TYPE OF WINDING	L,	DIST. C	Q.	FREQ.	CAP
DOUBLE ENAMEL	18	421 1840 00	41½	SINGLE LAYER			240 220	3900 1950	51 214

Fig. 113 Transmitter Master Oscillator Grid Inductor—L101 (Dwg. No. 321D)



57 0790 40

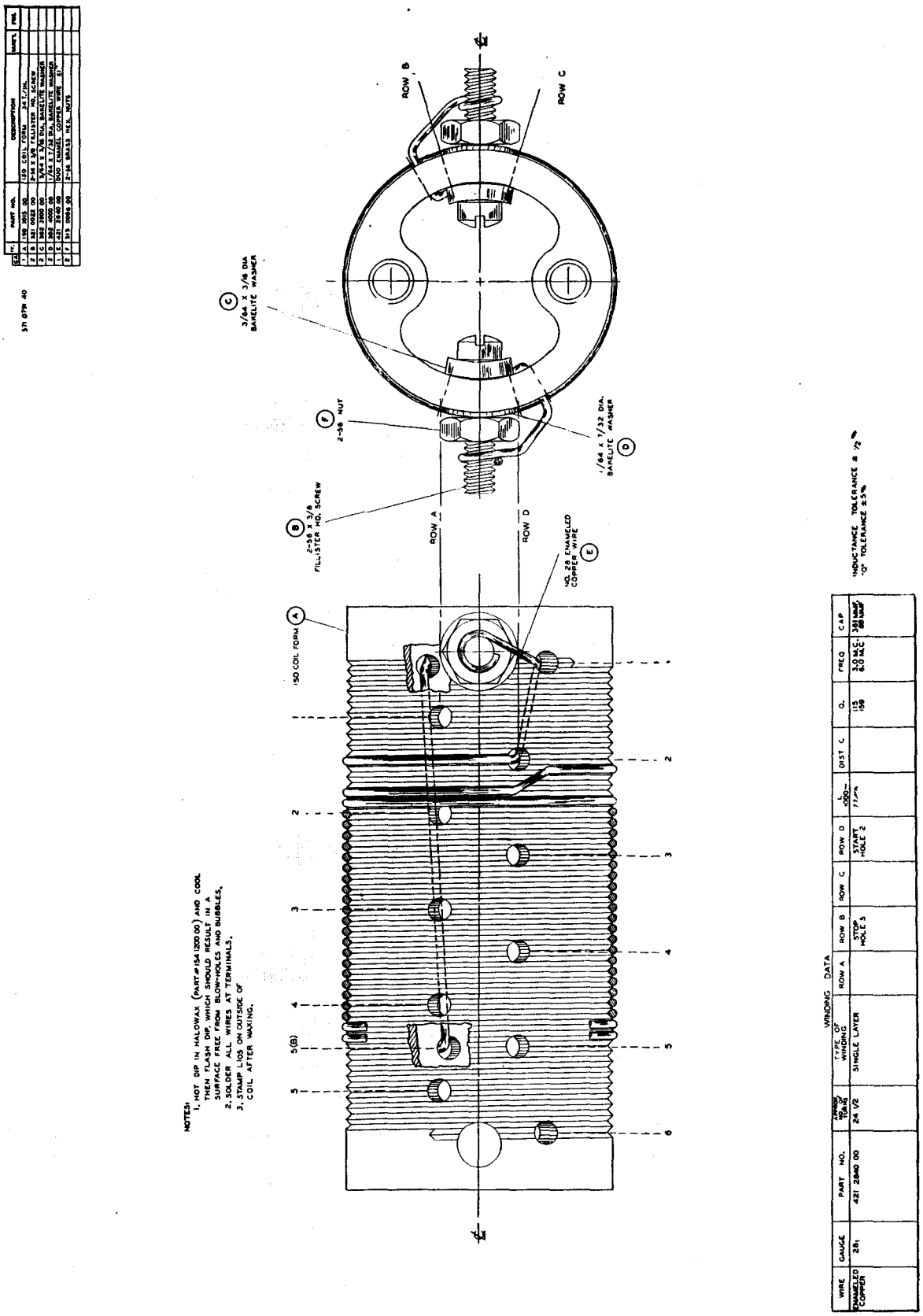
QTY.	IT.	PART NO.	DESCRIPTION	MAT'L	FIN.
1	A	190 3015 00	150 COIL FORM 34 T./IN.		
2	B	321 0022 00	2-56 X 3/8 FILLISTER HD. SCREW		
2	C	302 3900 00	3/64 X 3/16 DIA. BAKELITE WASHER		
2	D	302 4000 00	1/64 X 7/32 DIA. BAKELITE WASHER		
1	E	421 2840 00	DUO ENAMEL COPPER WIRE 61"		
2	F	313 0006 00	2-56 BRASS HEX NUT		

WINDING DATA

WIRE	GAUGE	PART NO.	APPROX. NO. OF TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L 1000~	DIST. C	Q.	FREQ.	CAP.
ENAMELED COPPER	28•	421 2840 00	23 1/2	SINGLE LAYER		STOP HOLE 5		START HOLE 2	7.4 μh		115 151.5	3.0 MC. 6.0 MC.	376 MMF. 91 MMF.

INDUCTANCE TOLERANCE ± 1/2 %
"Q" TOLERANCE ± 5 %

Fig. 114 Transmitter Oscillator Plate 2.9–6.1 Mc Inductor—L103
(Dwg. No. 790D)



QTY	PART NO.	DESCRIPTION	SHEET	PRL
1 A	190 3105 00	150 COIL FORM .24 T/INL		
2 B	321 1022 00	2-56 X 3/8 FILLISTER HD. SCREW		
2 C	342 2200 00	3/64 X 3/16 DIA. BAKELITE WASHER		
1 D	342 4000 00	1/64 X 7/32 DIA. BAKELITE WASHER		
1 E	361 4000 00	NO. 28 ENAMELED COPPER WIRE		
2 F	371 0006 00	2-56 BRASS HEX. NUTS		

371 079 40

WINDING DATA

WIRE	GAUGE	PART NO.	WRAP TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L .000	DIST C	Q.	FREQ	CAP
ENAMELED COPPER	28	421 2840 00	24 1/2	SINGLE LAYER		STOP HOLE 5		START HOLE 2			115 158	3.0 MC 6.0 MC	381 MMF 381 MMF

Fig. 115 Transmitter 2.9–6.1 Mc Inductor—L105
(Dwg. No. 791D)

WIRE	GAUGE	PART NO.	NUMBER OF TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L 1000~	DIST. C	Q.	FREQ.	C.A.R.
ENAMELED COPPER	28	421 2840 00	9 1/2	SINGLE LAYER			STOP HOLE 4	START HOLE 2	18.4		87 122	8.0 MC. 12.0 MC.	380 MMF. 94 MMF.

Fig. 116—Transmitter Doubler Plate 6.0–12.0 Mc Inductor—L104
(Dwg. No. 792D)

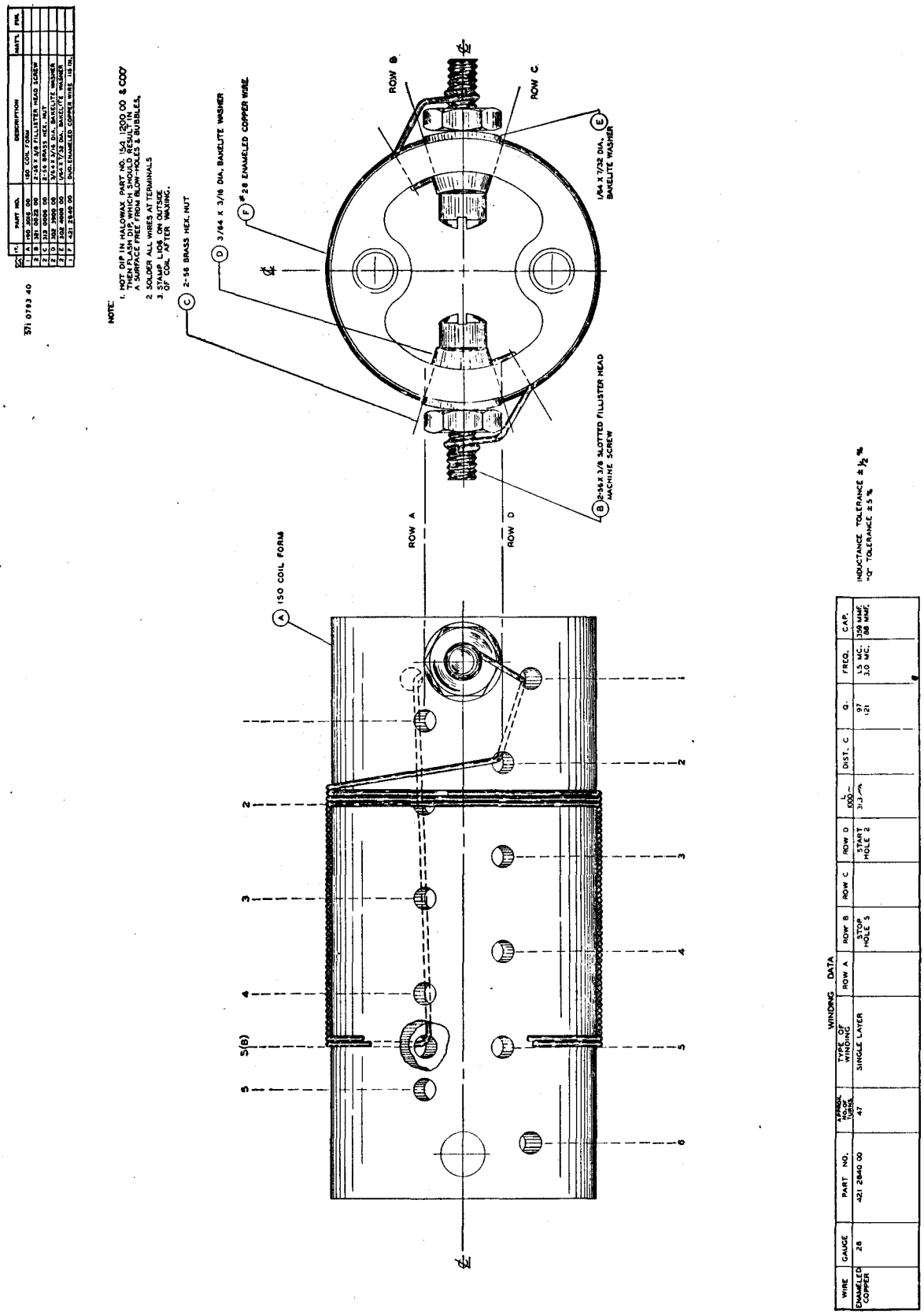
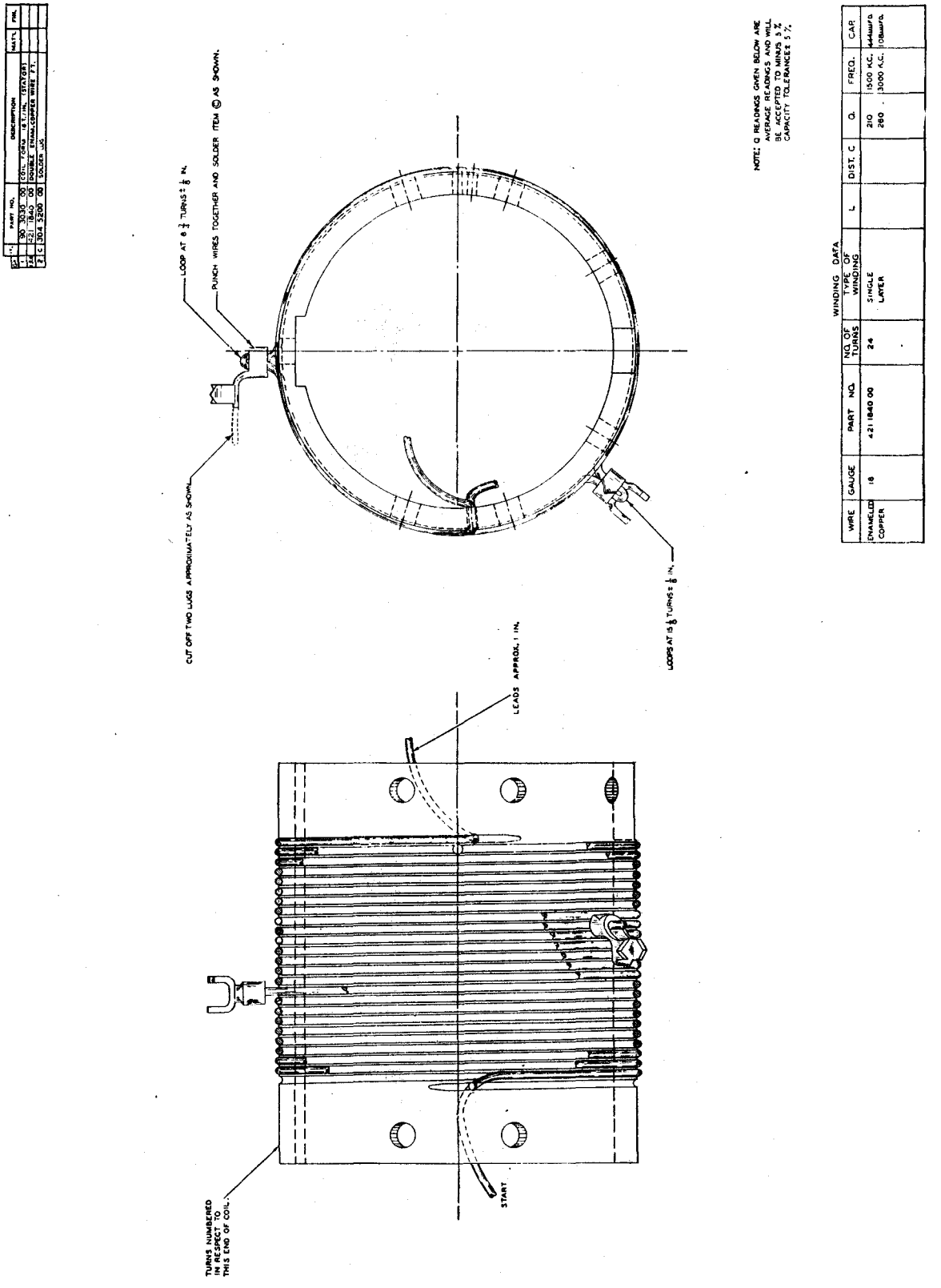


Fig. 117 Transmitter Buffer Tank Inductor—L106
(Dwg. No. 793D)



ITEM	PART NO.	DESCRIPTION	MATL.	FIN.
1	30 3030 00	COIL FORM 18 T. IN. (STATOR)		
2	31 1140 00	WIRE DOUBLE ENAM. COPPER WIRE FT.		
3	304 1200 00	SOLDER LUG		

WIRE	GAUGE	PART NO.	NO. OF TURNS	TYPE OF WINDING	L	DIST. C	Q.	FREQ.	CAP.
ENAMELED COPPER	18	421 1840 00	24	SINGLE LAYER			210 280	1500 K.C. 3000 K.C.	440mmfd. 108mmfd.

Fig. 118 Variometer—Stator—L107 (Dwg. No. 567D)

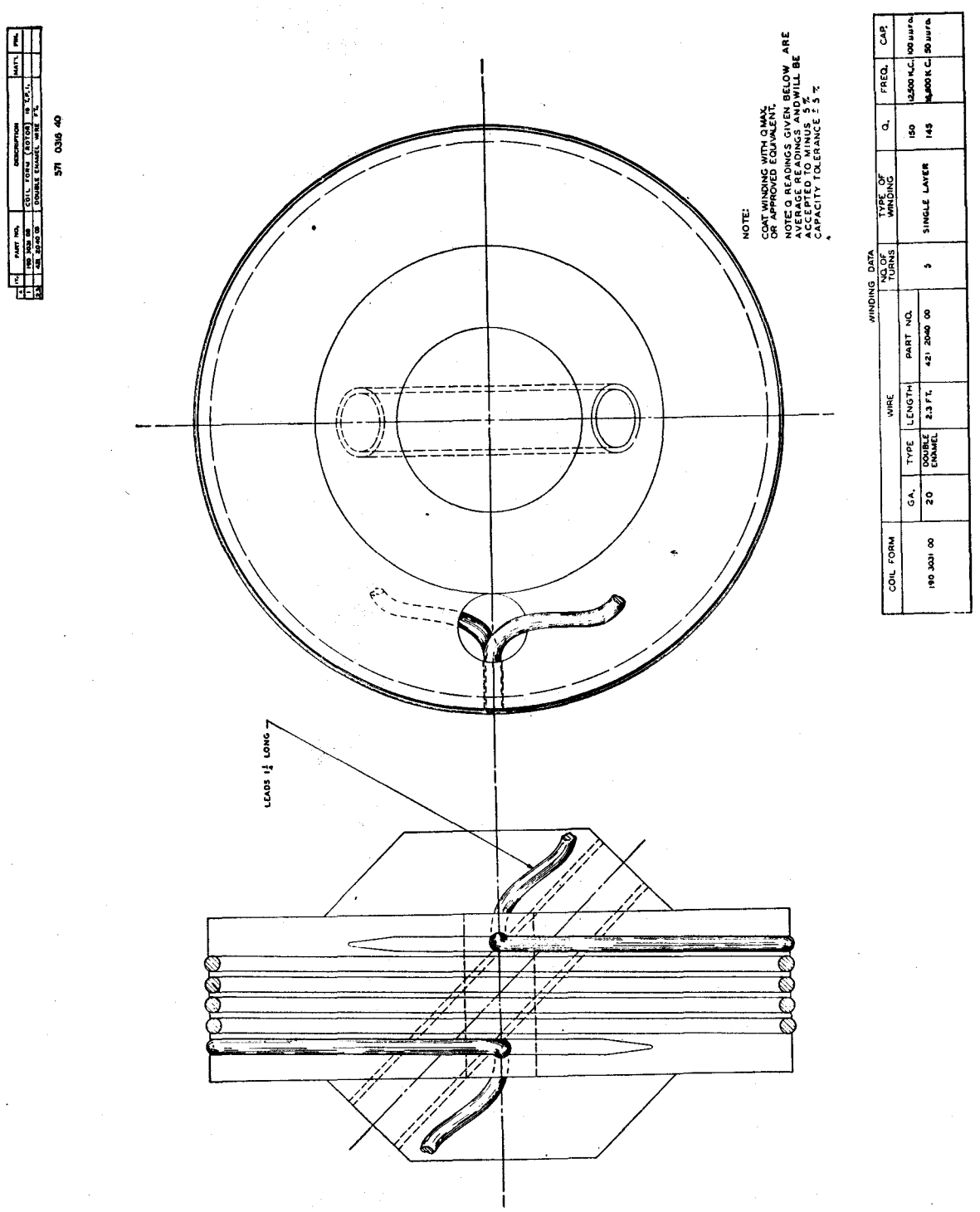


Fig. 119 Variometer—Rotor—L107 (Dwg. No. 316D)

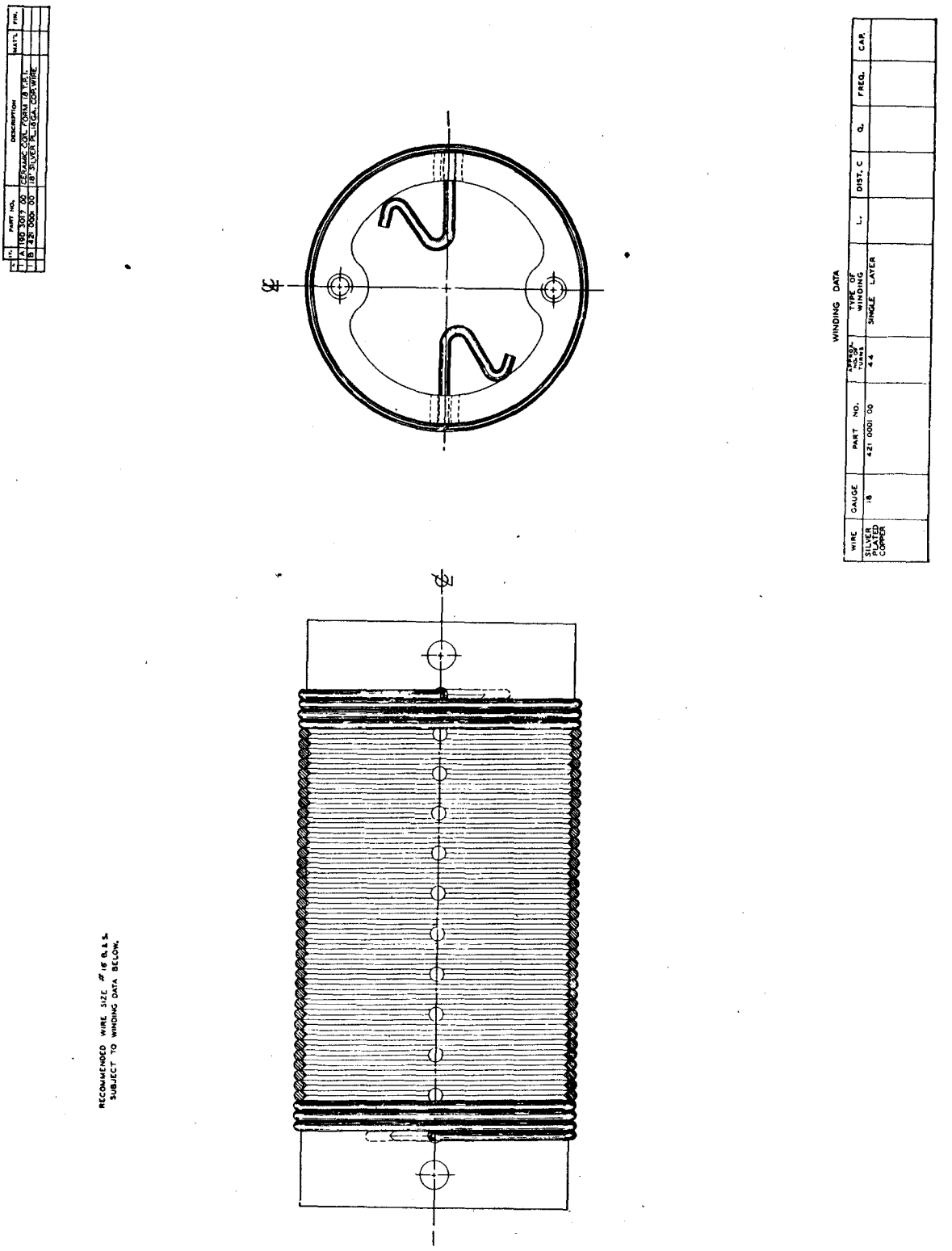
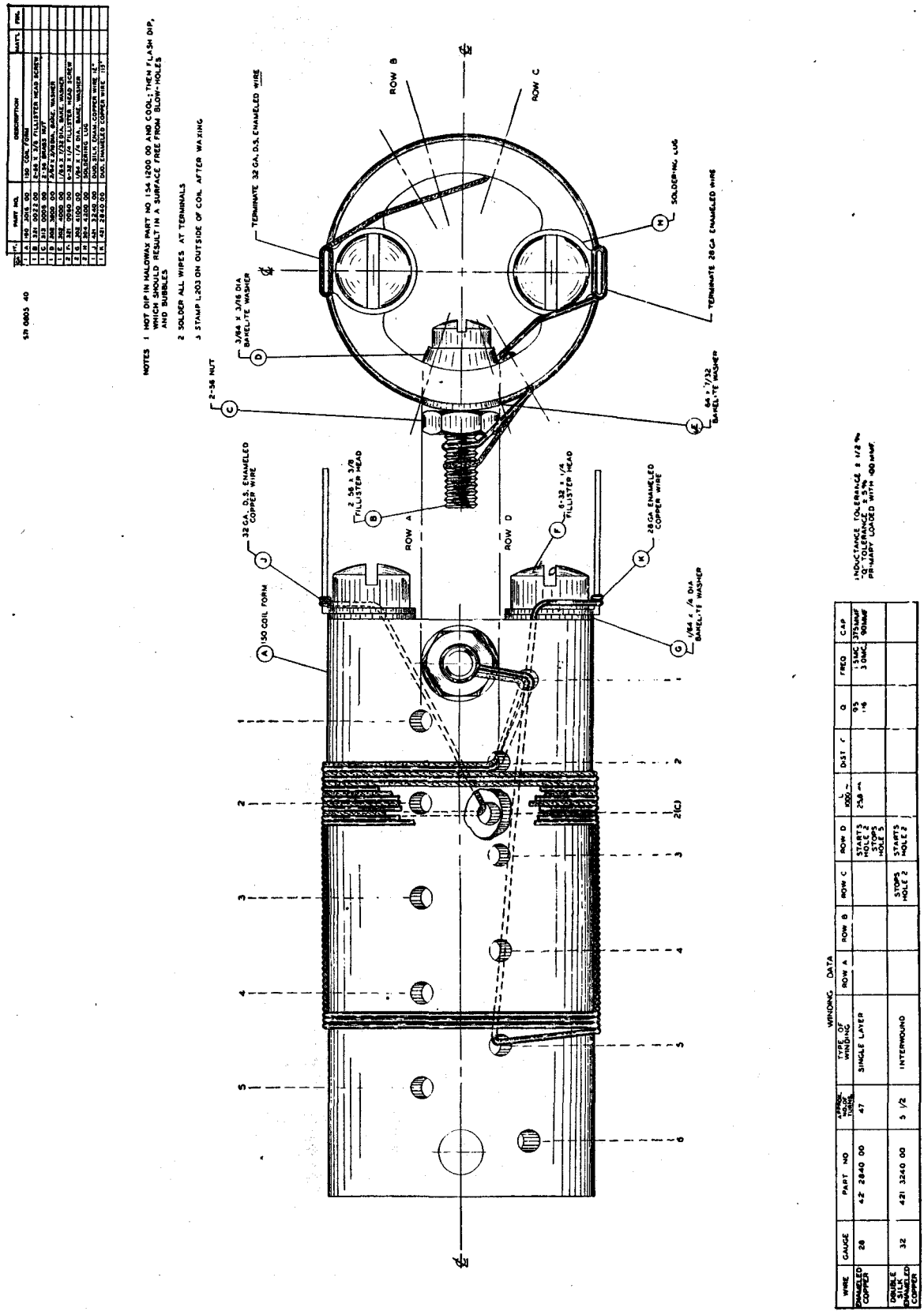


Fig. 120 Antenna Loading Inductor—L108 (Dwg. No. 335D)



WINDING DATA														
WIRE	GAUGE	PART NO	APPROX. NO. OF TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L 1000 ~	DIST r	Q	FREQ	CAP
ENAMELED COPPER	28	42 2840 00	47	SINGLE LAYER				STARTS HOLE 2 STOPS HOLE 5	258 μh		95 115	1 5MC 3 0MC	375MMF 90MMF
DOUBLE SILK ENAMELED COPPER	32	421 3240 00	5 1/2	INTERWOUND			STOPS HOLE 2	STARTS HOLE 2					

Fig. 121 Receiver Antenna Inductor 1.5–3.0 Mc—L203
(Dwg. No. 805D)

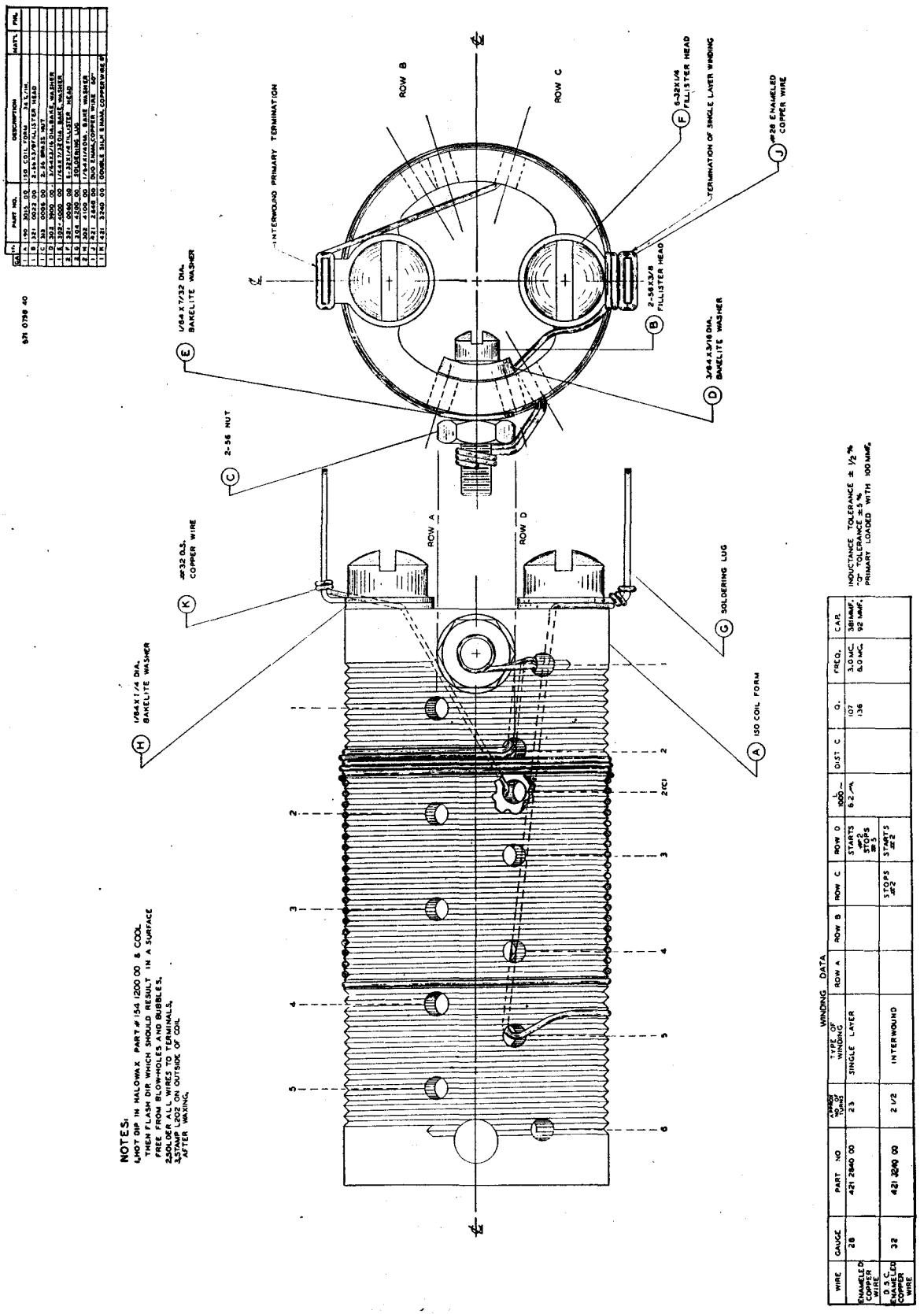
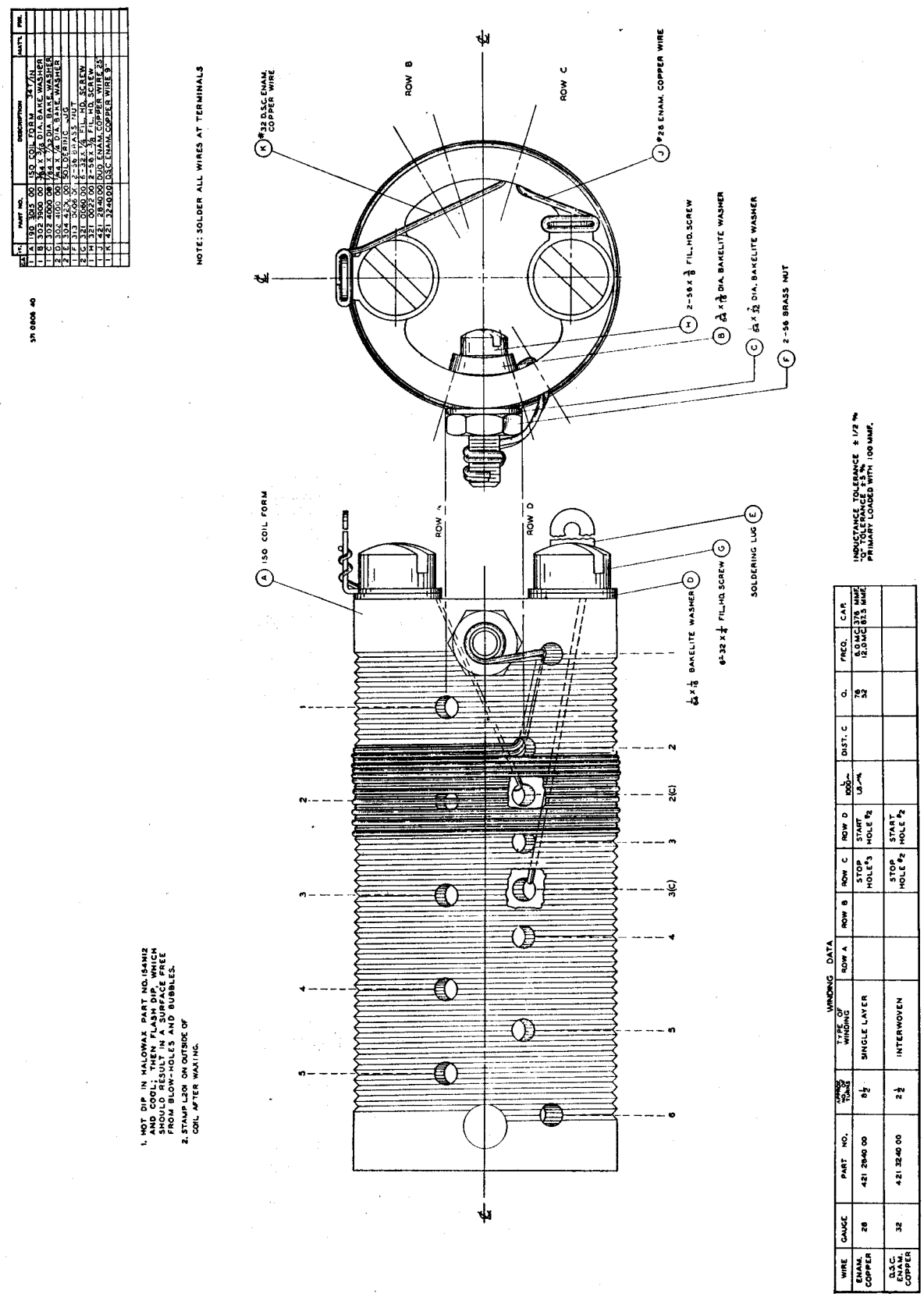


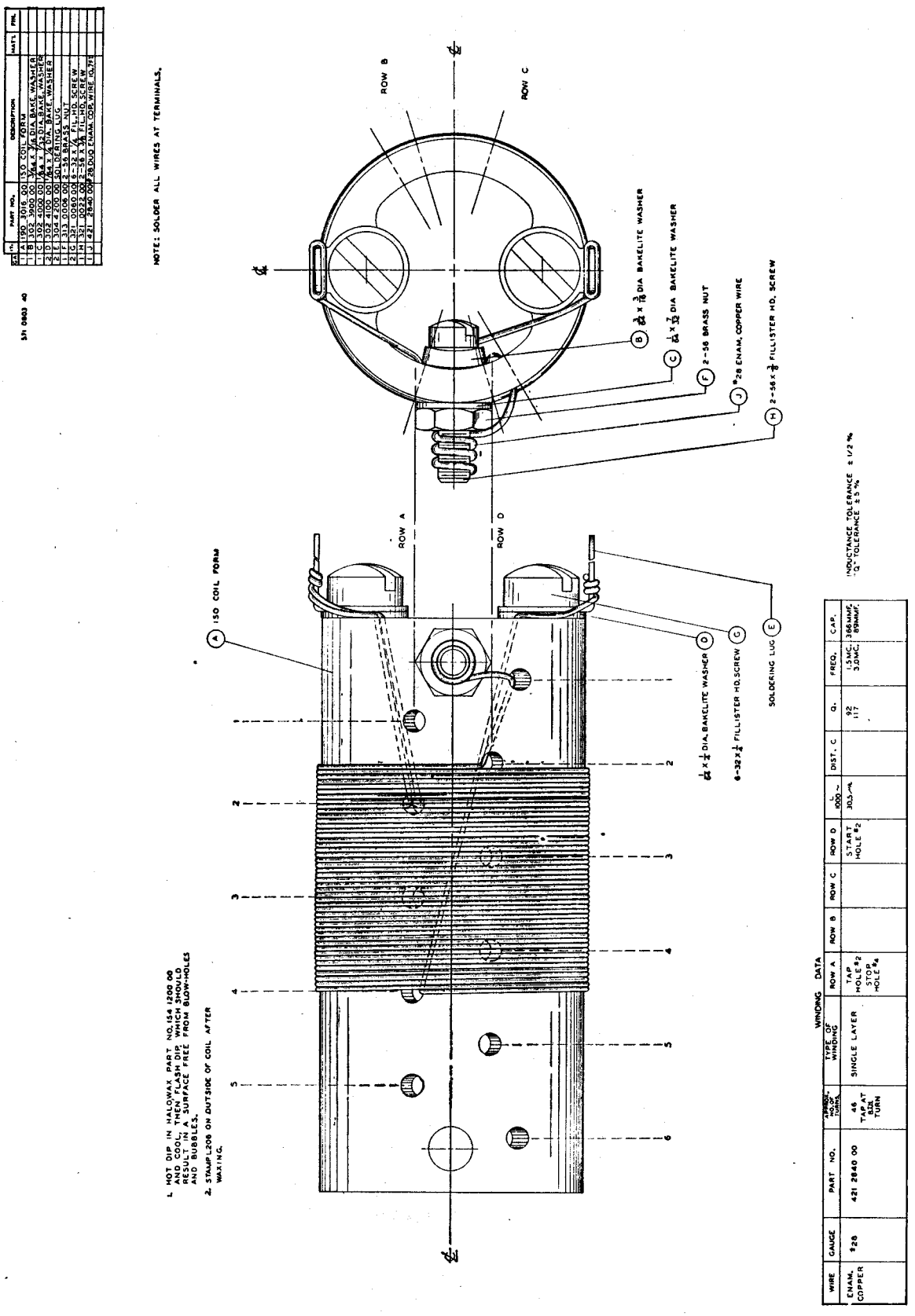
Fig. 122 Receiver Antenna Inductor 3.0–6.0 Mc—L202
(Dwg. No. 798D)



SYM.	PART NO.	DESCRIPTION	MAT'L	PRE.
1 A	130 3015 00	150 COIL FORM 24 I/N		
1 B	302 3900 00	6-32 X 3/8 DIA. BAKE. WASHER		
1 C	302 4000 06	6-32 X 1/2 DIA. BAKE. WASHER		
2 D	302 4000 00	6-32 X 1/2 DIA. BAKE. WASHER		
2 E	304 4324 00	SOLDERING LUG		
1 F	313 0406 01	2-56 BRASS NUT		
2 G	321 0060 00	6-32 X 1/4 FIL. HD. SCREW		
1 H	321 0080 00	2-56 X 3/8 FIL. HD. SCREW		
1 K	421 2840 00	#32 D.S.C. ENAM. COPPER WIRE 25"		
1 K	421 3240 00	#28 ENAM. COPPER WIRE 9"		

WIRE	GAUGE	PART NO.	WINDING DATA: APPROX. TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L (1000~)	DIST. C	Q	FREQ.	CAP.
ENAM. COPPER	28	421 2840 00	8½	SINGLE LAYER			STOP HOLE #3	START HOLE #2	1.8 μH		75 32	8.0 MC 12.0 MC	375 MMF 815 MMF
D.S.C. ENAM. COPPER	32	421 3240 00	2½	INTERWOVEN			STOP HOLE #2	START HOLE #2					

Fig. 123 Receiver Antenna Inductor 6.0–12.0 Mc—L201
(Dwg. No. 806D)



ITEM	PART NO.	DESCRIPTION	MAT'L	FIN.
1 A	180 3015 00	150 COIL FORM		
1 B	302 3900 00	1/4 x 7/16 DIA BAKE. WASHER		
1 C	302 4000 00	1/4 x 7/32 DIA BAKE. WASHER		
2 F	304 4000 00	2-56 BRASS NUT		
2 E	304 4200 00	SOLDERING LUG		
1 F	313 0006 00	2-56 X 3/8 FIL. HD. SCREW		
2 G	321 0060 00	6-32 X 1/4 FIL. HD. SCREW		
1 H	421 2840 00	#28 ENAM. COPPER WIRE, 10.7FT		

WINDING DATA

WIRE	GAUGE	PART NO.	APPROX. NO. OF TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L @ 1000 ~	DIST. C	Q.	FREQ.	CAP.
ENAM. COPPER	#28	421 2840 00	46 TAP AT 8TH TURN	SINGLE LAYER	TAP HOLE #2 STOP HOLE #4			START HOLE #2	303 μH		92 117	1.5 MC. 3.0 MC.	386 MMF. 89 MMF.

Fig. 124 Receiver Converter Inductor 1.5–3.0 Mc—L206 (Dwg. No. 803D)

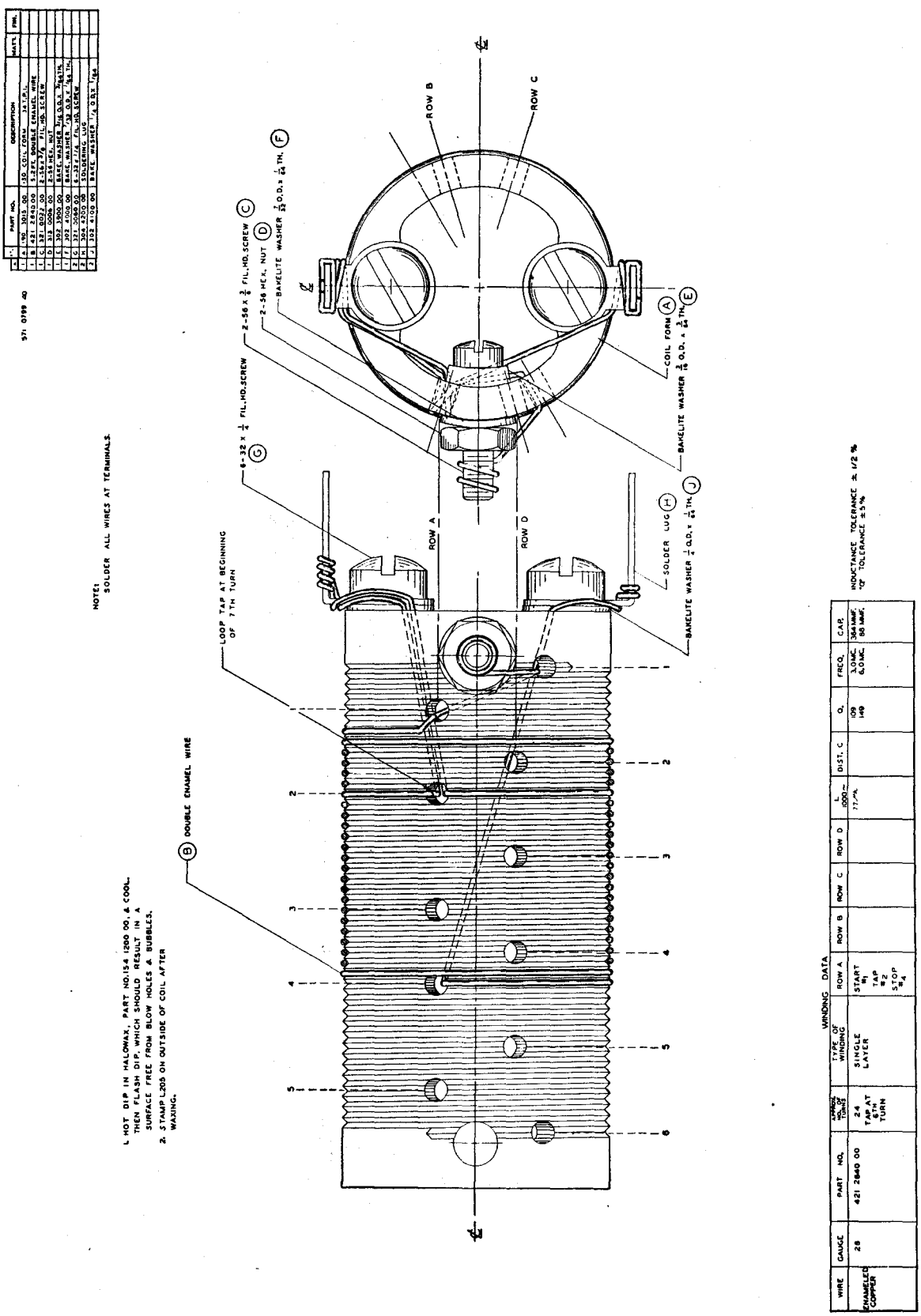


Fig. 125 Receiver Converter Inductor 3.0–6.0 Mc—L205 (Dwg. No. 799D)

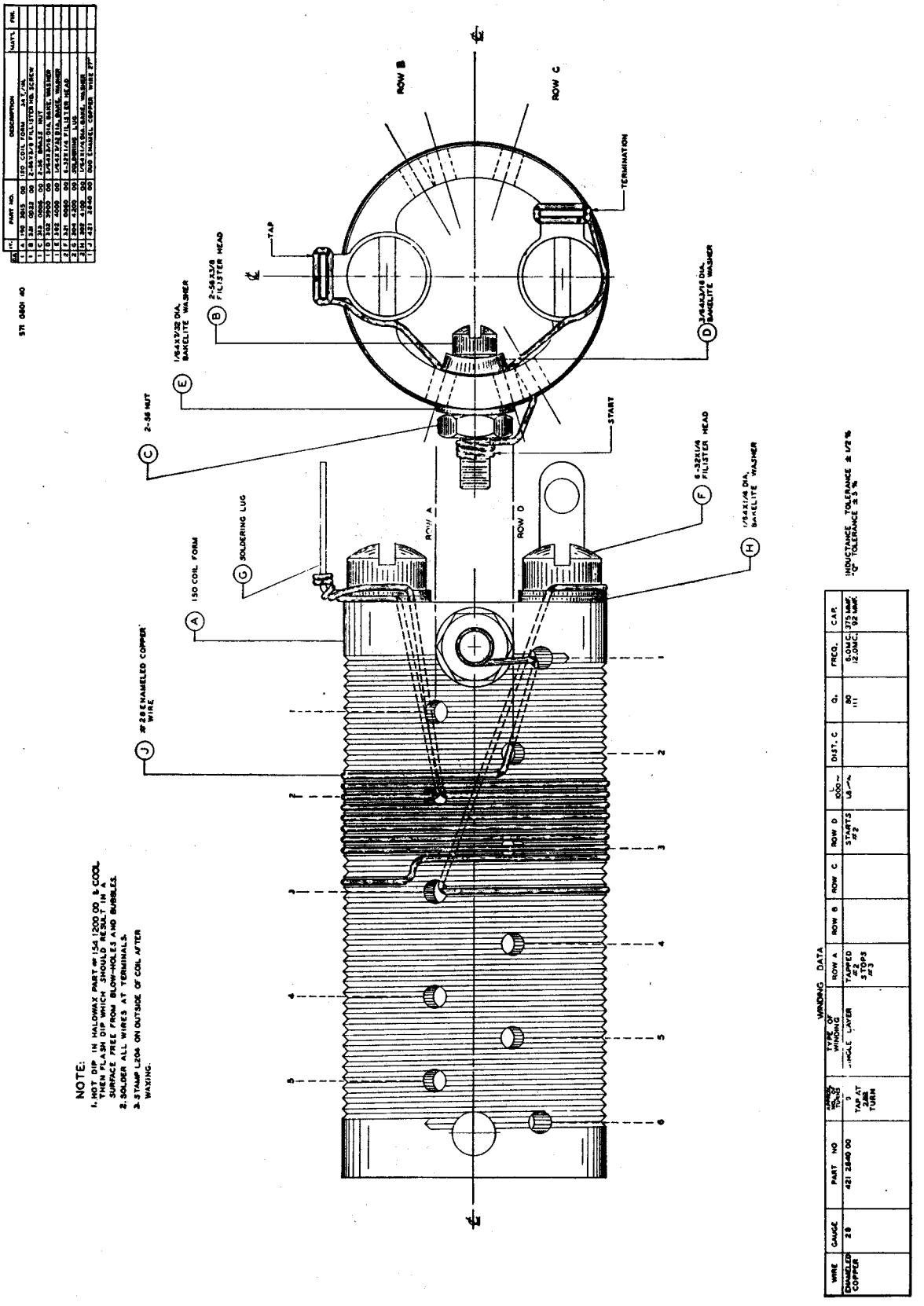


Fig. 126 Receiver Converter Inductor 6.0–12.0 Mc—L204
(Dwg. No. 801D)

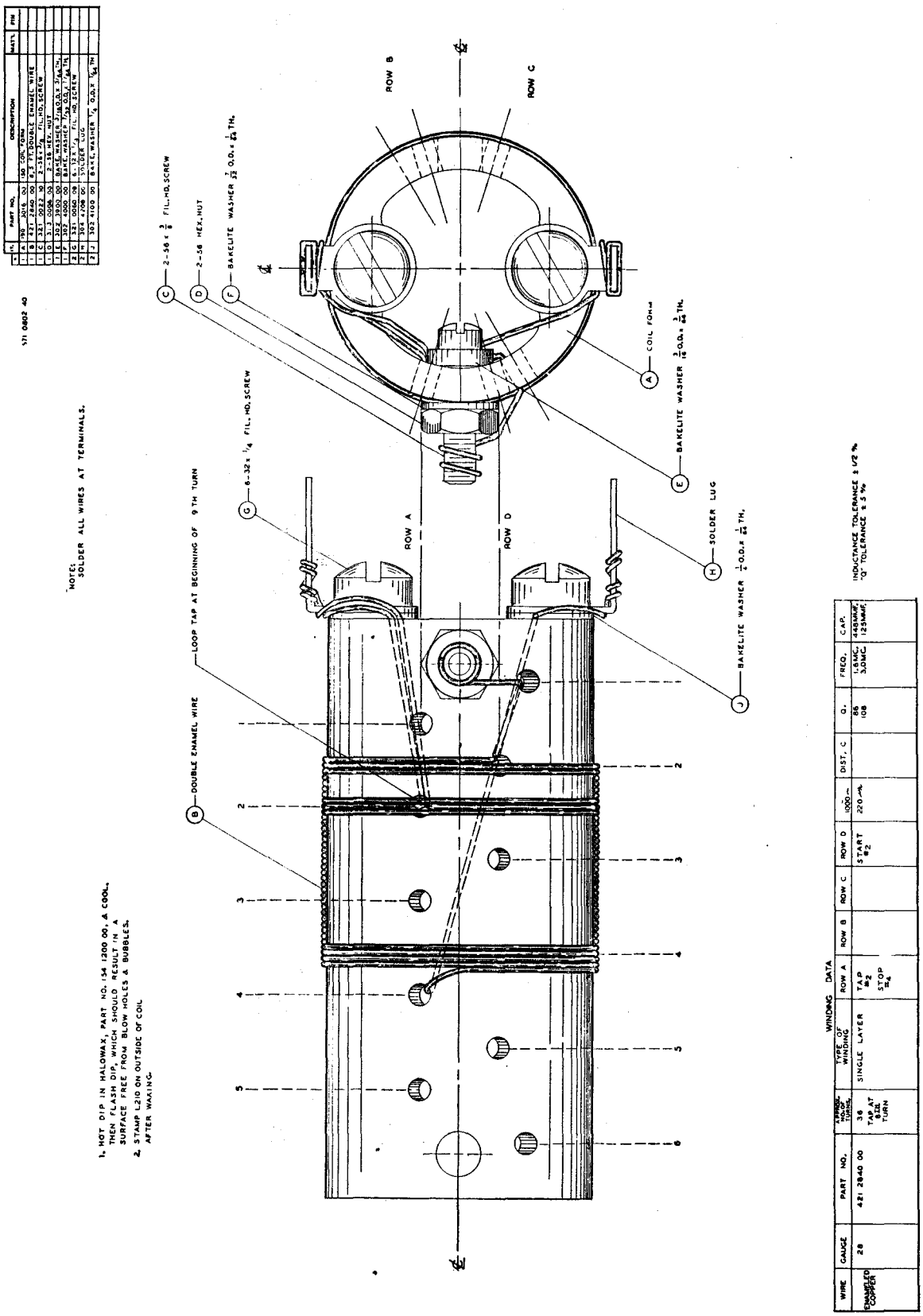
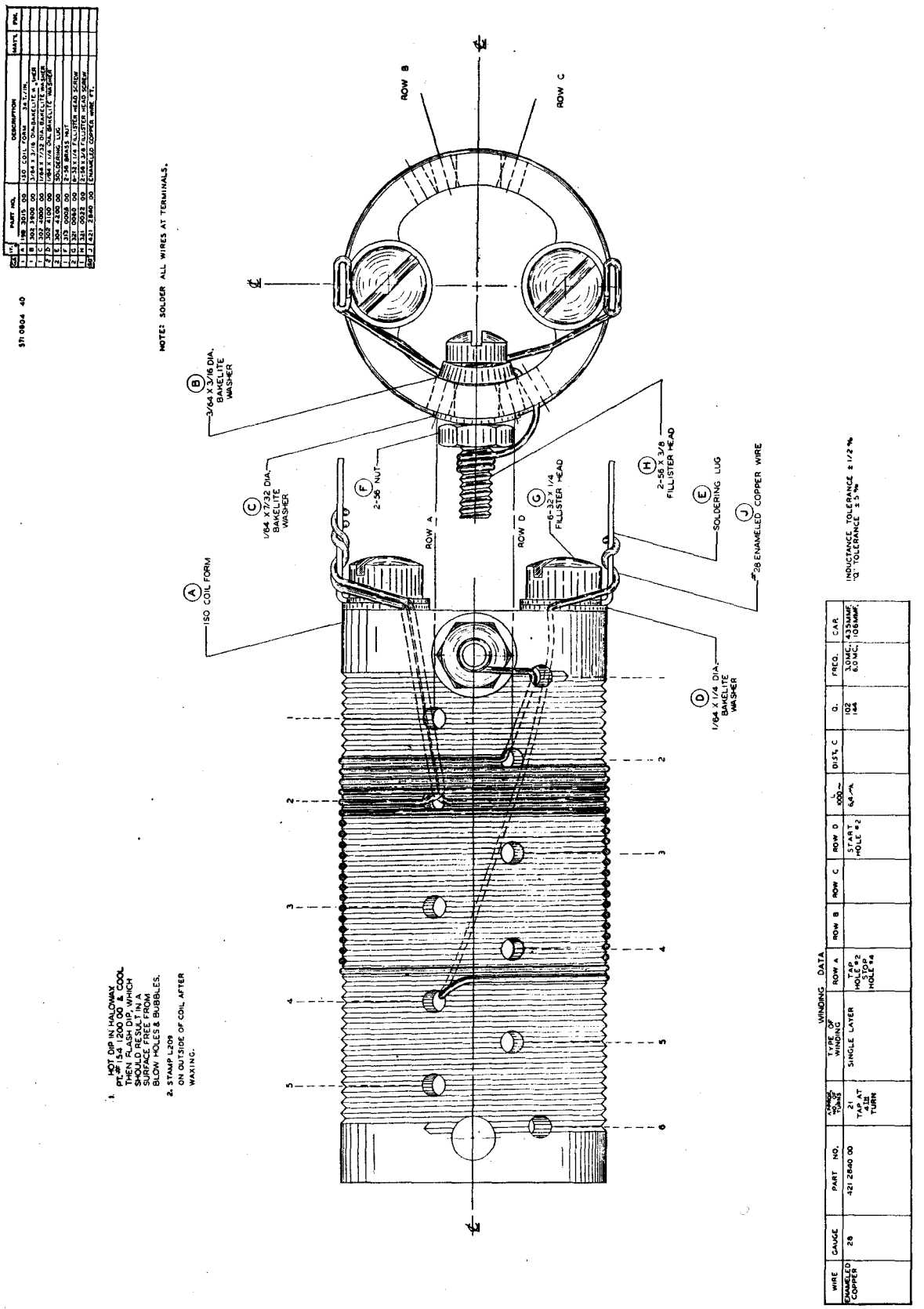


Fig. 127 Receiver Osc. Inductor 1.5–3.0 Mc—L210
(Dwg. No. 802D)



CAT. #	PART NO.	DESCRIPTION	MATL	FIN.
1	4 198 3015 00	150 COIL FORM 3/8 D/IN.		
1	18 392 3900 00	3/64 x 3/16 DIA BAKELITE WASHER		
1	19 392 4000 00	1/64 x 7/32 DIA BAKELITE WASHER		
7	5 392 4100 00	1/64 x 1/4 DIA BAKELITE WASHER		
2	6 394 4100 00	SOLDERING LUG		
1	6 375 0009 00	2-56 BRASS NUT		
1	6 375 0064 00	2-56 x 1/4 FILLISTER HEAD SCREW		
1	14 381 0032 00	2-56 x 3/8 FILLISTER HEAD SCREW		
60'	7 421 2840 00	ENAMELED COPPER WIRE #28		

WIRE	GAUGE	PART NO.	CHECK TOTAL TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	100 ~	DIS % C	Q.	FREQ.	CAP.
ENAMELED COPPER	28	421 2840 00	21 TAP AT 4 1/2 TURN	SINGLE LAYER	TAP HOLE #2 TOP #1 HOLE #4			START HOLE #2	64 MA.		102 144	3.0 MC. 435 MMF. 6.0 MC. 106 MMF.	

Fig. 128 Receiver Osc. Inductor 3.0–6.0 Mc—L209
(Dwg. No. 804D)

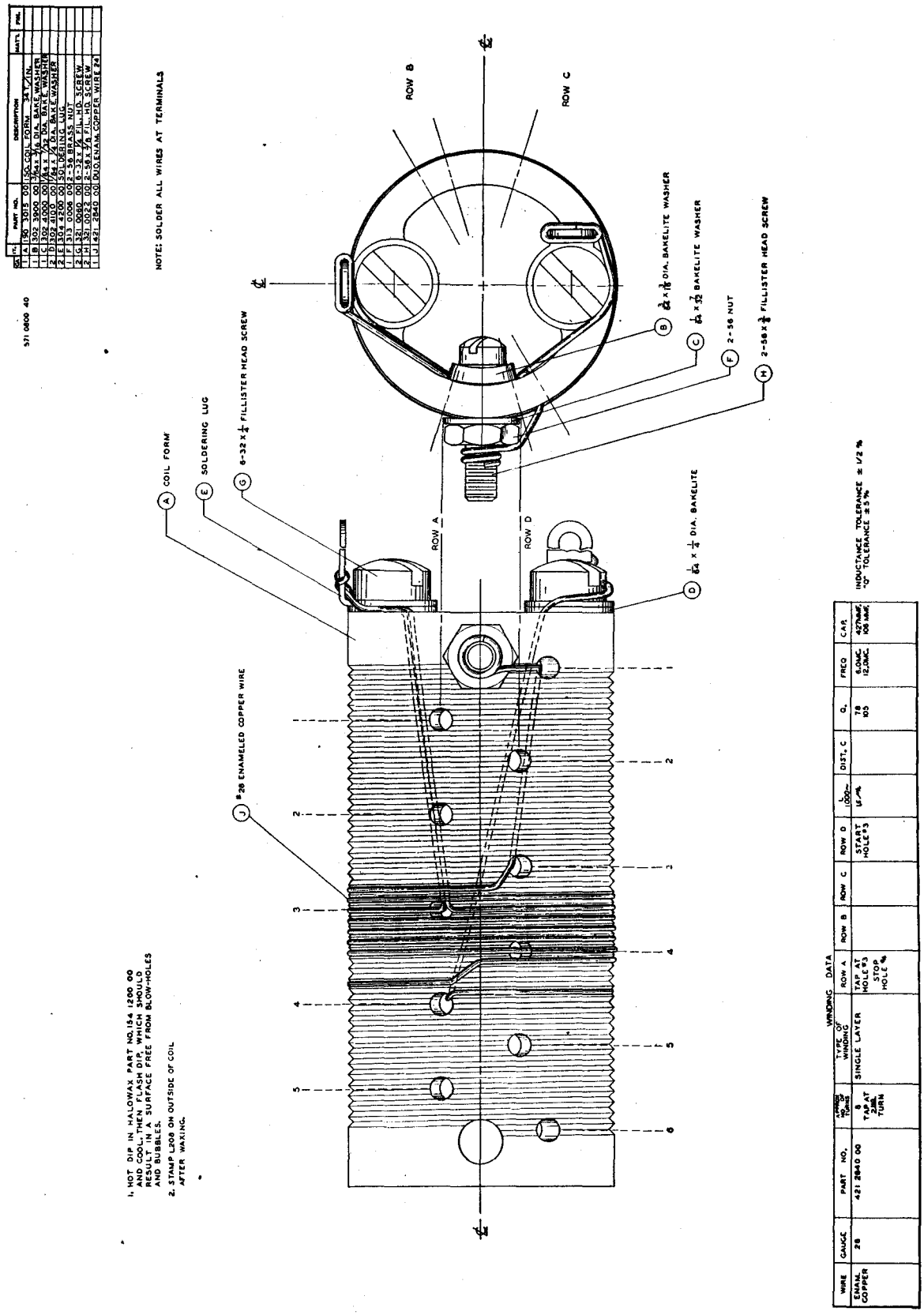
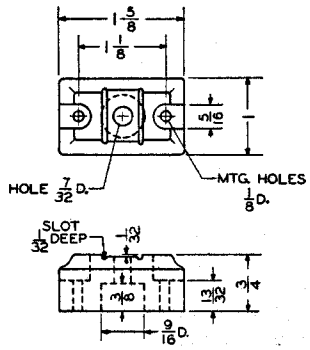


Fig. 129 Receiver Osc. Inductor 6.0–12.0 Mc—L208
(Dwg. No. 800D)

Fig. 130 Ceramic Insulators (Dwg. No. 502 0327 003)

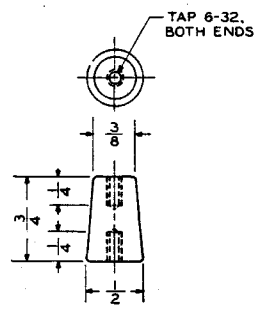
193 1000 00
OR 193N1



MATERIAL: PORCELAIN

E103

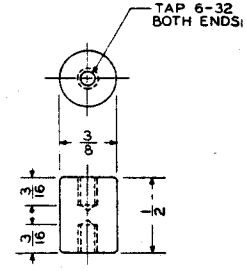
190 2570 00
OR 190NSN7



MATERIAL: LOW LOSS CERAMIC

E104
E203

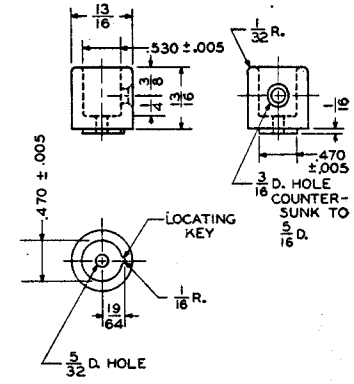
190 2329 00
OR 190NSL5



MATERIAL: LOW LOSS CERAMIC

E108

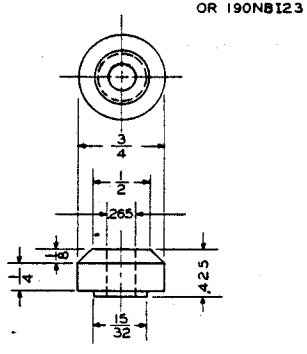
190 4730 00
OR 190NMP3



MATERIAL: LOW LOSS CERAMIC

E110
E704

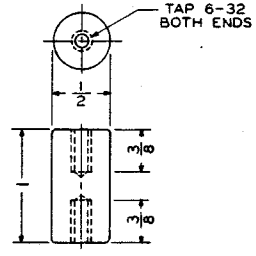
190 2923 00
OR 190NBI23



MATERIAL: LOW LOSS CERAMIC

E111

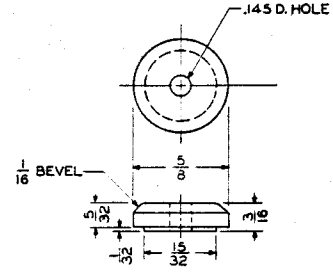
190 2327 00
OR 190NSL3



MATERIAL: LOW LOSS CERAMIC

E112
E204

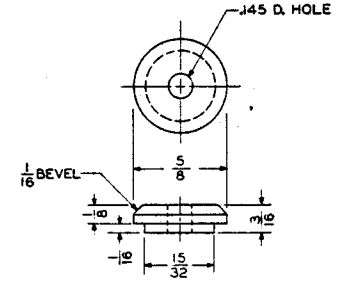
190 2932 00
OR 190NBI7



MATERIAL: LOW LOSS CERAMIC

E205

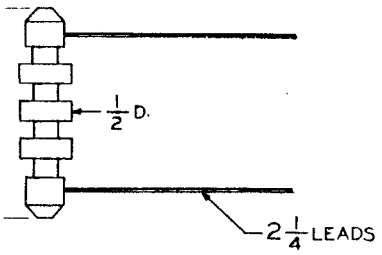
190 2929 00
OR 190NBI4



MATERIAL: LOW LOSS CERAMIC

5700 00
240N57

L102, L109,
L207, L1601,
L1602, L1701,
L1702, L1801,
L1802, L1901,
L1902, L2001,
L2002, L2101,
L2102, L2301,
L2302

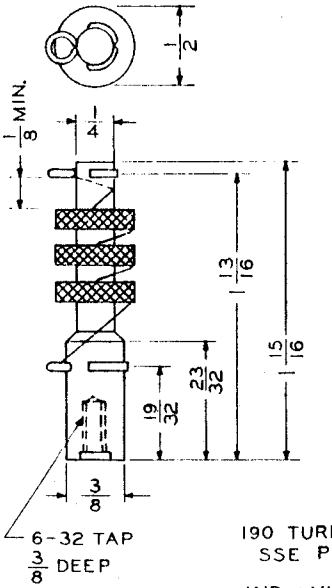


0 TURNS #32
SSE PER P1

IND.-1 MH ±10%
MAX. CURRENT-300 MA
DC RES.-10 OHMS

L110, L402,
L404

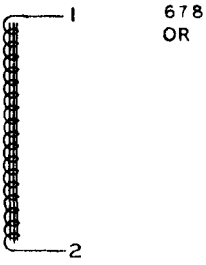
240 5800 00
OR 240N58



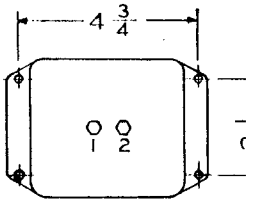
190 TURNS #32
SSE PER P1

IND. 1 MH±10%
MAX. CURRENT-300 MA
DC RES.-10 OHMS

L301
L501



678
OR 67

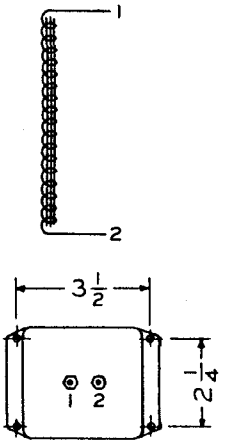


#24

IND.-4HY +
MAX. CURRENT-(
DC RES.-
MAX. VOLTS-

L303, L304,
L503, L504,
L1603, L1703,
L1803, L1903,
L2003, L2103,
L2303

678 1320 00
OR 678N132

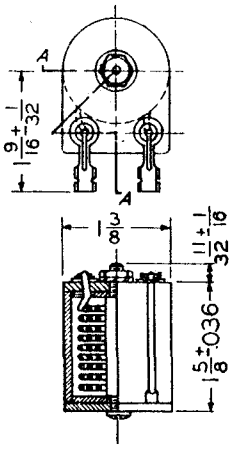


2195T
#28 ENAMEL

IND.-6 HY + 20-0%
MAX. VOLTS-500 DC
MAX. CURRENT-0.15 AMP
DC RES.-71.9 OHMS

L401, L405,
L1604, L1704,
L1804, L1904,
L2004, L2104,
L2304

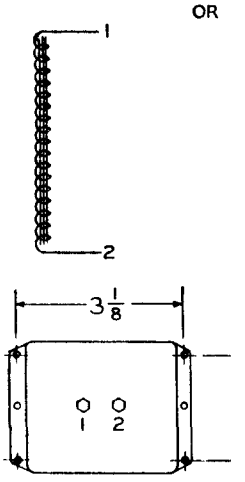
572 0416 10
OR GB-416A



55T
#12 ENAMEL

IND.-22 MICROH.
DC RES. 0.02 OHM

678
OR



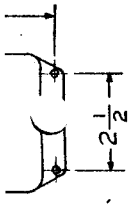
2334 T
#31 ENAMEL

IND.-8HY+
MAX. VOLTS-
MAX. CURRENT-(
DC RES.-16

Fig. 131 Choke and Reactor
(Dwgs. 502 0326 003 and 50

L301, L302
L501, L502

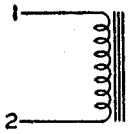
678 1171 00
OR 678N117A



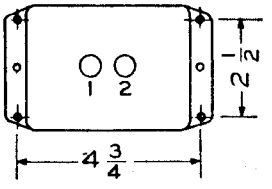
1664T
#24 ENAMEL

D.-4HY + 20-0%
URRENT-0.3 AMP
DC RES.-31 OHMS
. VOLTS-500 DC

678 0009 00 L2201

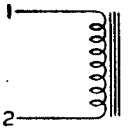


2538T
#26 EN.

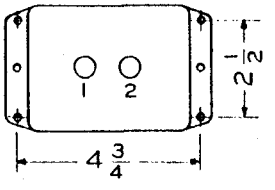


IND.-12 TO 4 HY
MAX. VOLTS-500 D.C.
MAX. CURRENT-0.3 AMP.

678 0008 00 L2204

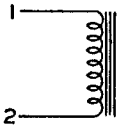


1664T
#24 EN.

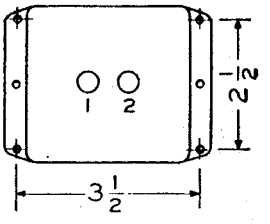


IND.-4 HY + 20-0%
MAX. VOLTS-500 D.C.
MAX. CURRENT-0.3 AMP.
D.C. RES.-40 OHMS

678 0007 00 L2202
L2203



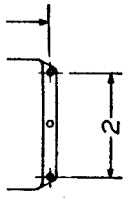
2104T
#28 EN.



IND.-6 HY + 20-0%.
MAX. VOLTS-500 DC.
MAX. CURRENT-0.15 AMP.
D.C. RES.-100 OHMS

L403

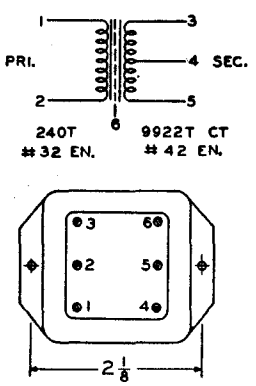
678 1251 00
OR 678N125A



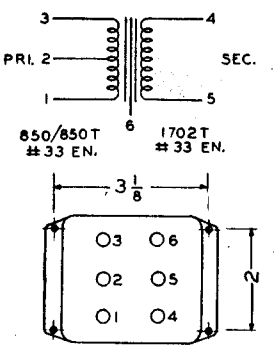
).-8HY+20-0%
VOLTS-500 DC
RENT-0.1 AMP
RES.-161 OHMS

Fig. 131 Choke and Reactor Winding Data
(Dwgs. 502 0326 003 and 502 0498 003)

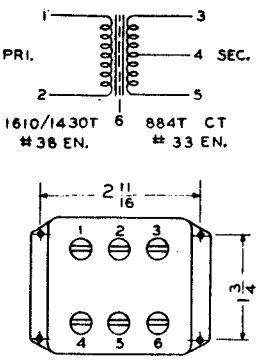
T101 677 2130 00 OR 677N213



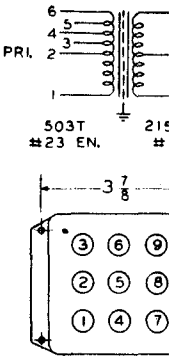
T102 677 2010 00 OR 677N201



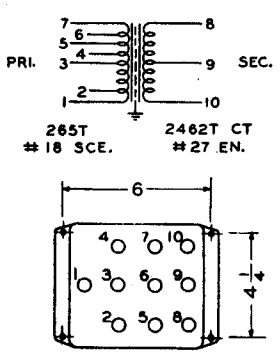
T201 667 2270 00 OR 667N227



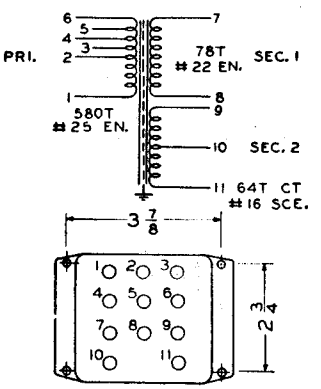
T301 672 OR



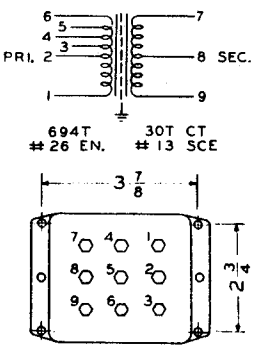
T302 672 2680 00 OR 672N268



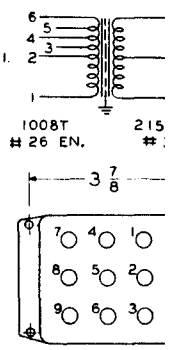
T303 672 2430 00 OR 672N243



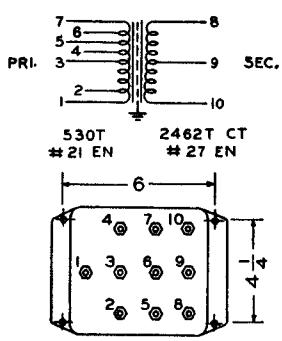
T304 672 2170 00 OR 672N217



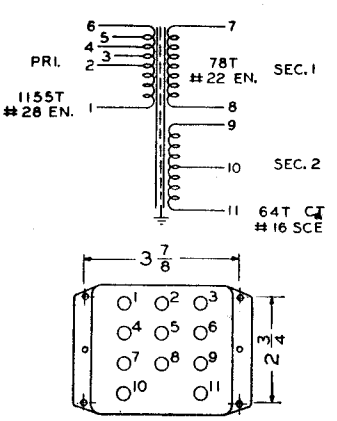
T501 672 OR



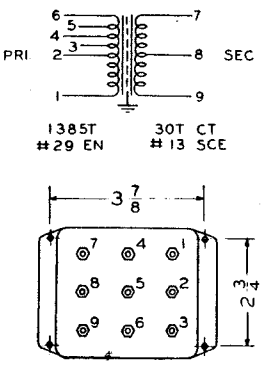
T502 672 2840 00 OR 672N284



T503 672 2850 00 OR 672N285



T504 672 2860 00 OR 672N286



T601 667 OR

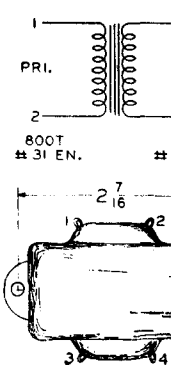
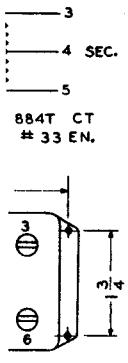


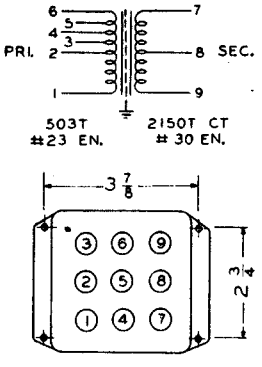
Fig. 132 Audio and Power Transformer Winc
(Dwg. No. 502 0329 004)

667 2270 00
OR 667N227



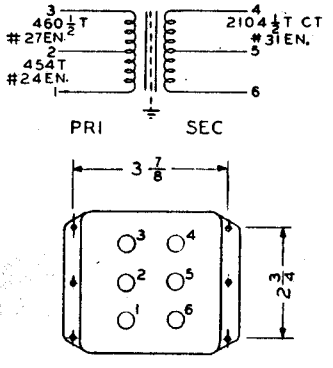
T301

672 2240 00
OR 672N224



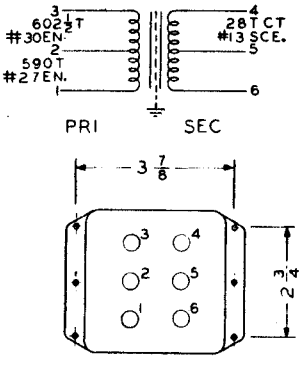
T2201

672 0003 00

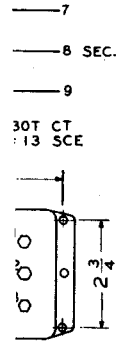


T2204

672 0006 00

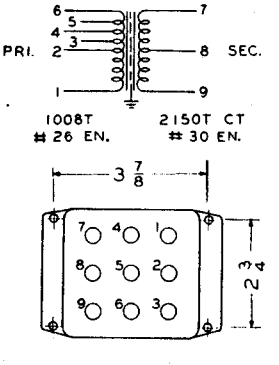


672 2170 00
OR 672N217



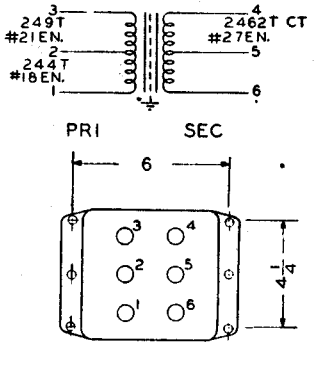
T501

672 2830 00
OR 672N283

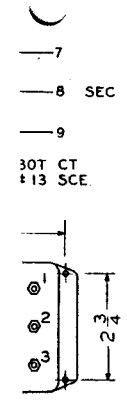


T2202

672 0004 00

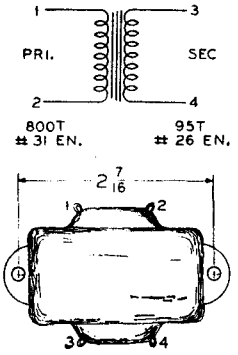


672 2860 00
R 672N286



T601

667 7051 00
OR 667S705A



T2203

672 0005 00

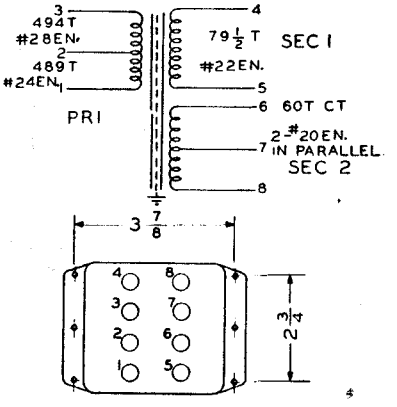


Fig. 132 Audio and Power Transformer Winding Data (Dwg. No. 502 0329 004)

io and Power Transformer Winding Data
(Dwg. No. 502 0329 004)

APPENDIX

TABLE XVI VACUUM TUBE DATA

INDEX TO TUBE DATA

WARNING: In order to obtain satisfactory tube life the following precautions must be taken:

1. Operate all tube filaments within ±5% of rated voltage.
2. Do not exceed rated plate current in any of the tubes during normal operation of the equipment.
3. When tuning, do not exceed rated plate current except for periods of short duration.

Failure to observe the above precautions may result in the destruction of tubes.

ALL TUBES SUPPLIED WITH THE EQUIPMENT OR AS SPARES ON THE EQUIPMENT CONTRACT SHALL BE USED IN THE EQUIPMENT PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

The following tube data is reproduced by permission of
Radio Corporation of America

12A6

BEAM POWER AMPLIFIER

Heater#	Coated Unipotential Cathode	
Voltage	12.6	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances (Approx.)°		
Grid to Plate	0.3	μμf
Input	9.0	μμf
Output	9.0	μμf
Maximum Overall Length		3-1/4"
Maximum Seated Height		2-11/16"
Maximum Diameter		1-5/16"
Bulb		Metal Shell, MT-8
Base		Small Wafer Octal 7-Pin
Pin 1 - Shell		Pin 5 - Grid
Pin 2 - Heater		Pin 7 - Heater
Pin 3 - Plate		Pin 8 - Cathode
Pin 4 - Screen		
Mounting Position		Any

BOTTOM VIEW (7AC)

Maximum Ratings Are Design-Center Values

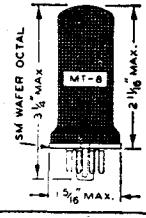
AMPLIFIER

Plate Voltage	250 max.	volts
Screen Voltage	250 max.	volts
Plate Dissipation	7.5 max.	watts
Screen Dissipation	1.5 max.	watts
Operating Conditions and Characteristics-Class A_1 Amplifier:		
Plate	250	volts
Screen	250	volts
Grid*	-12.5	volts
Peak A-F Grid Voltage	12.5	volts
Zero-Signal Plate Current	30	ma.
Max.-Signal Plate Current	32	ma.
Zero-Signal Screen Current	3.5 approx.	ma.
Max.-Signal Screen Current	5.5 approx.	ma.
Plate Resistance	70000 approx.	ohms
Transconductance	3000	μmhos
Load Resistance	7500	ohms
Total Harmonic Distortion	7	%
Max.-Signal Power Output	3.4	watts

In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.

* The d-c resistance in the grid circuit should not exceed 0.1 megohm when fixed bias is used, or 0.5 megohm when cathode bias is used.

° With shell connected to cathode.

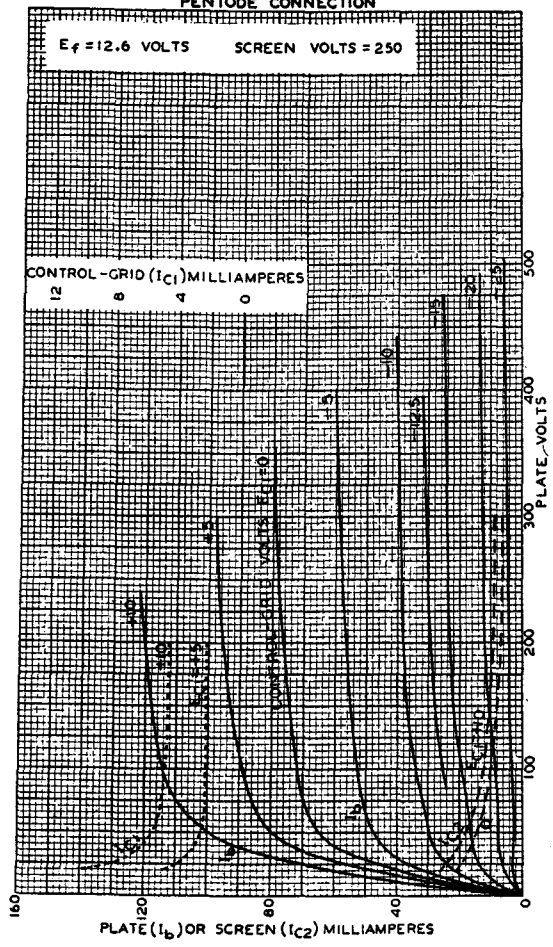


→ Indicates a change

12A6

AVERAGE PLATE CHARACTERISTICS

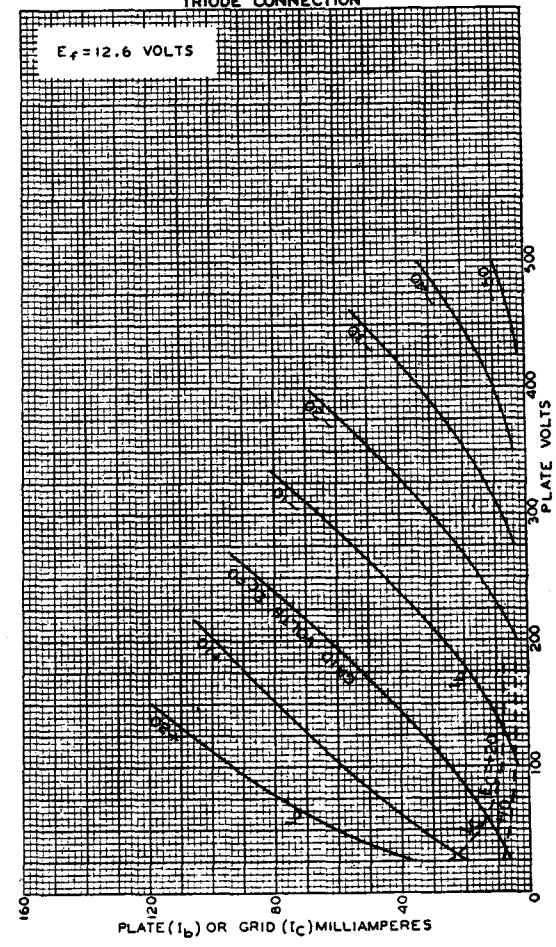
PENTODE CONNECTION



12A6

AVERAGE PLATE CHARACTERISTICS

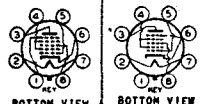
TRIODE CONNECTION



Except for the heater rating, the electrical characteristics of the 12SA7 are the same as the 6SA7, 6SA7-GT/G shown below. The heater rating of the 12SA7 is 12.6 volts, 0.15 amp.

6SA7, 6SA7-GT/G
PENTAGRID CONVERTER

Heater ■	Coated Unipotential Cathode		
Voltage	6.3	a-c or d-c volts	
Current	0.3	amp.	
Direct Interelectrode Capacitances:	6SA7	6SA7-GT/G	←
Grid #3 to All Other Electrodes (R-F Input)	9.5▲	11▲▲	μμf
Plate to All Other Electrodes (Mixer Output)	12▲	11▲▲	μμf
Grid #1 to All Other Electrodes (Osc. Input)	7▲	8▲▲	μμf
Grid #3 to Plate	0.13 max.▲	0.5 max.▲▲	μμf
Grid #3 to Grid #1	0.15 max.▲	0.4 max.▲▲	μμf
Grid #1 to Plate	0.06 max.▲	0.2 max.▲▲	μμf
Grid #1 to Shell, Grid #5, and All Other Electrodes except Cathode	4.4	-	μμf
Grid #1 to All Other Electrodes except Cathode & Grid #5	-	5	μμf
Grid #1 to Cathode	2.6	-	μμf
Grid #1 to Cathode & Grid #5	-	3	μμf
Cathode to Shell, Grid #5, and All Other Electrodes except Grid #1	5	-	μμf
Cathode and Grid #5 to All Other Electrodes except Grid #1	-	14	μμf
Maximum Overall Length	2-5/8"	3-5/16"	
Maximum Seated Height	2-1/16"	2-3/4"	
Maximum Diameter	1-5/16"	1-5/16"	
Bulb	Metal Shell MT-8	T-9	
Base	Small Wafer Octal 8-Pin	Intermed. Sh. Octal 8-Pin	
Pin 1	6SA7, Shell, Grid #5 / 6SA7-GT/G, No Conn.		
Pin 2	Heater		
Pin 3	Plate		
Pin 4	Grids #2 & #4		
Pin 5	Grid #1		
Pin 6	6SA7, Cathode / 6SA7-GT/G, Cathode & Grid #5		
Pin 7	Heater		
Pin 8	Grid #3		
Mounting Position	Any		



Maximum And Minimum Ratings Are Design-Center Values

CONVERTER SERVICE

Plate Voltage	300 max. volts
Grids #2 & #4 Voltage	100 max. volts
Grids #2 & #4 Supply Voltage	300 max. volts
Grid #3 Voltage *	0 min. volts
Plate Dissipation	1.0 max. watt
Screen Dissipation	1.0 max. watt
Total Cathode Current	14 max. ma.

■ In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.
▲ With shell connected to cathode.
▲▲ With external shield connected to cathode.
* For self-excited oscillator.
← Indicates a change.

6SA7, 6SA7-GT/G
PENTAGRID CONVERTER

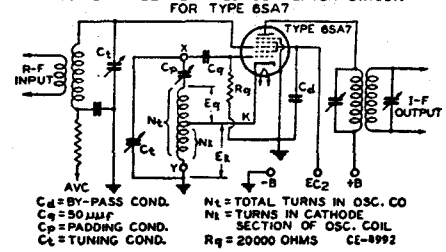
(continued from preceding page)

Characteristics:	Self-excitation*		Separate Excitation		
Plate Voltage	100	250	100	250	volts
Grids #2 & #4 Volt.	100	100	100	100	volts
Grid #3 (Control) Volt.	0	0	-2	-2	volts
Grid #1 Resistor	20000	20000	20000	20000	ohms
Plate Res. (Approx.)	0.5	1.0	0.5	1.0	megohm
Conversion Transcond.	425	450	425	450	μmhos
Conversion Transcond. (Approx.) ‡	2	2	2	2	μmhos
Plate Current	3.3	3.5	3.3	3.5	ma.
Grids #2 & #4 Current	8.5	8.5	8.5	8.5	ma.
Grid #1 Current	0.5	0.5	0.5	0.5	ma.
Total Cathode Current	12.3	12.5	12.3	12.5	ma.

NOTE: The transconductance between Grid #1 and Grids #2 & #4 connected to plate (not oscillating) is approximately 4500 μmhos under the following conditions: Grids #1, #3, and shell at 0 volts; Grids #2 & #4 and plate at 100 volts.

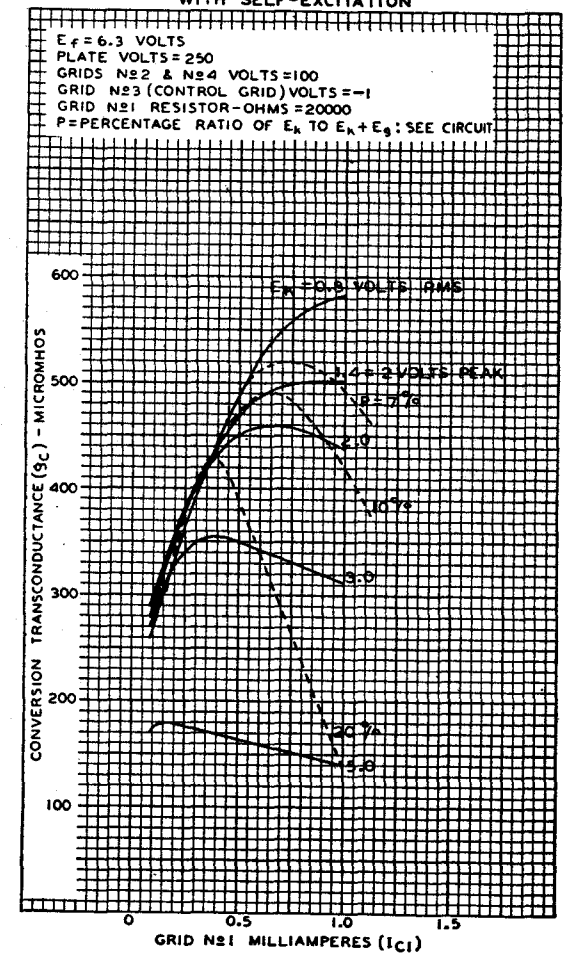
* Characteristics are approximate only and are shown for a Hartley circuit with a feedback of approximately 2 volts peak in the cathode circuit.
‡ With Grid #3 bias of -35 volts.

TYPICAL SELF-EXCITED CONVERTER CIRCUIT FOR TYPE 6SA7



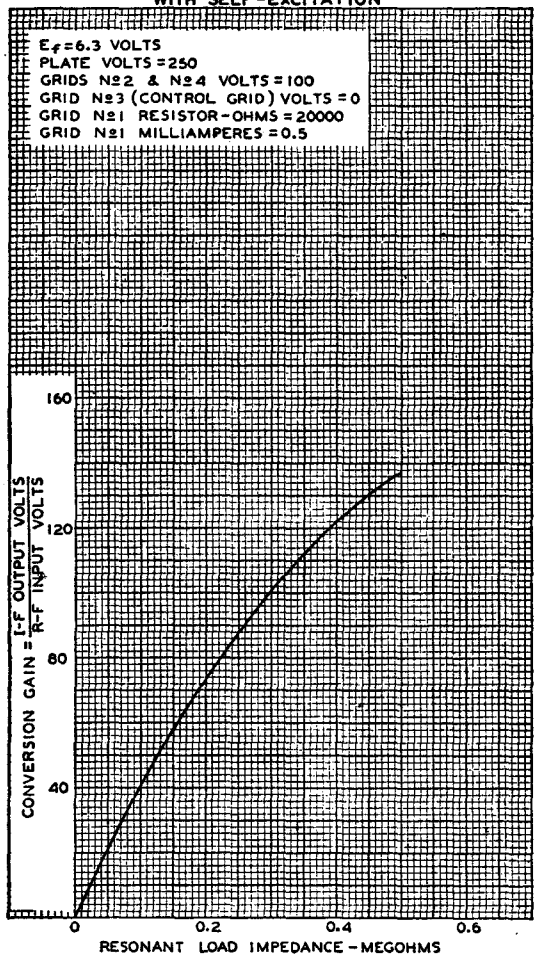
C_d = BY-PASS COND.
C_g = 50 μμF
C_p = PADDING COND.
C_t = TUNING COND.
N_t = TOTAL TURNS IN OSC. CO
N_t = TURNS IN CATHODE SECTION OF OSC. COIL
R_g = 20000 OHMS CE-8992

6SA7
OPERATION CHARACTERISTICS WITH SELF-EXCITATION

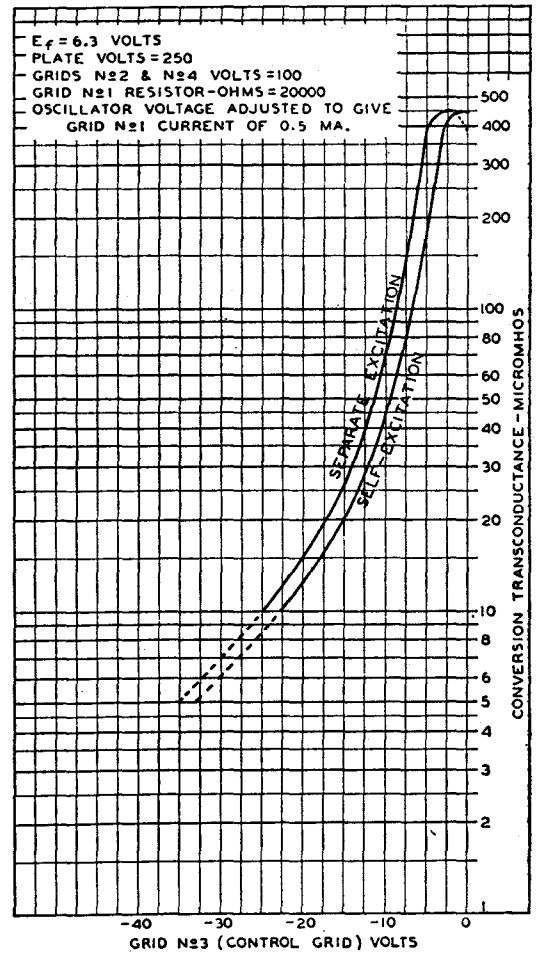


Except for the heater rating, the electrical characteristics of the 12SA7 are the same as the 6SA7, 6SA7-GT/G shown below. The heater rating of the 12SA7 is 12.6 volts, 0.15 amp.

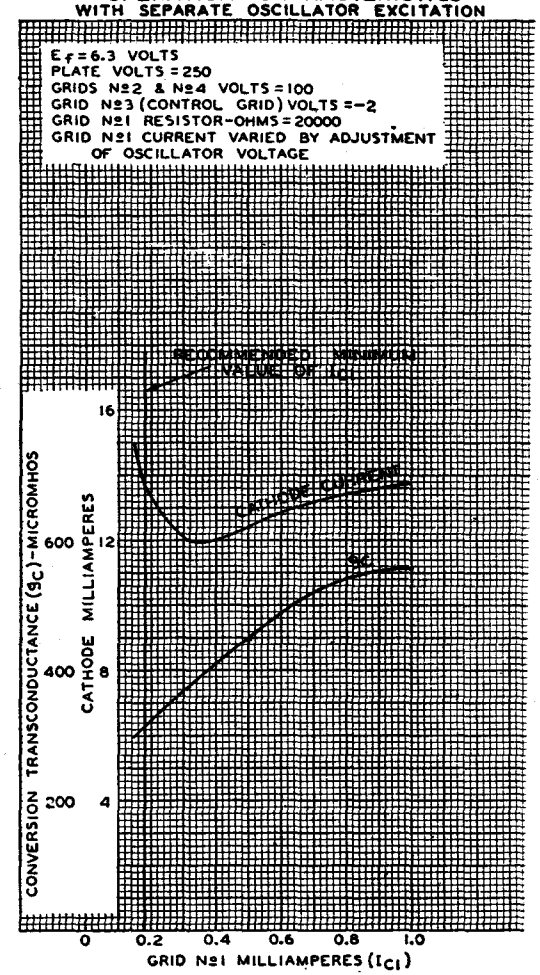
6SA7
OPERATION CHARACTERISTIC
WITH SELF-EXCITATION



6SA7
OPERATION CHARACTERISTICS



6SA7
OPERATION CHARACTERISTICS
WITH SEPARATE OSCILLATOR EXCITATION



Except for the heater rating, the electrical characteristics of the 12SK7 are the same as the 6SK7, 6SK7-GT/G shown below. The heater rating of the 12SK7 is 12.6 volts, 0.15 amp.

6SK7, 6SK7-GT/G

TRIPLE-GRID SUPER-CONTROL AMPLIFIER

Heater■	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.3	amp.
	6SK7	6SK7-GT/G
Direct Interelectrode Cap.	▲	▲▲
Grid to Plate	0.003 max.	0.005 max. μμf
Input	6.0	6.5 μμf
Output	7.0	7.5 μμf
Maximum Overall Length	2-5/8"	3-5/16"
Maximum Seated Height	2-1/16"	2-3/4"
Maximum Diameter	1-5/16"	1-5/16"
Bulb	Metal Shell, MT-8	T-9
Base	Small Wafer, Octal 8-Pin	Small Wafer Octal 8-Pin, Sleeve
Basing Designation	8N	GT-8N
Pin 1	6SK7, Shell; 6SK7-GT/G, Base Sleeve	
Pin 2	Heater	
Pin 3	Suppressor	
Pin 4		Grid
Pin 5		Cathode
Pin 6		Screen
Pin 7		Heater
Pin 8		Plate
Mounting Position		Any

BOTTOM VIEW

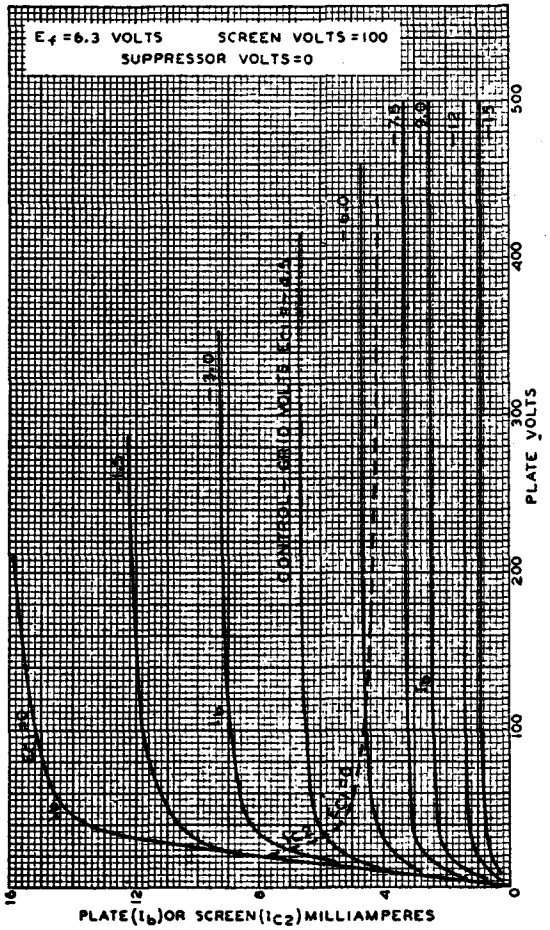
Maximum And Minimum Ratings Are Design-Center Values

AMPLIFIER

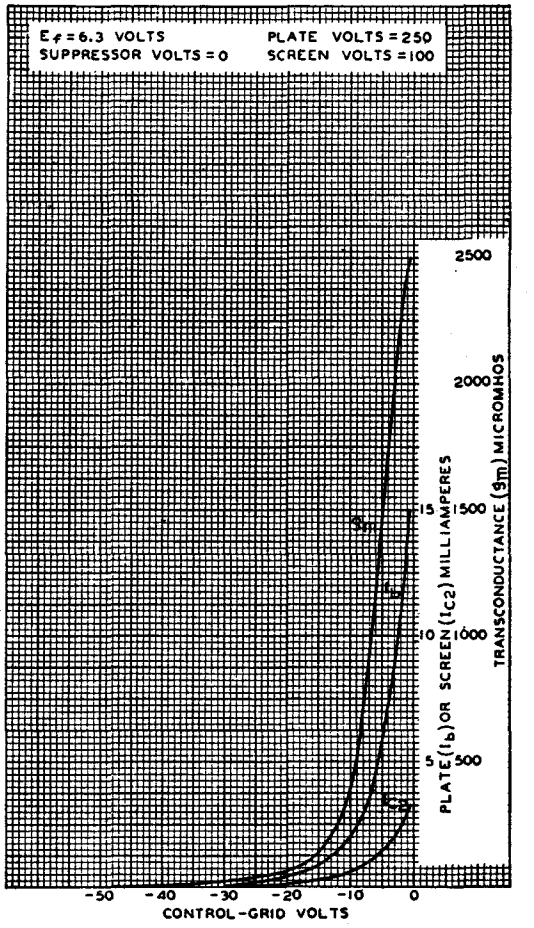
Plate Voltage		300 max.	volts
Screen Voltage		125 max.	volts
Screen Supply Voltage		300 max.	volts
Grid Voltage		0 min.	volts
Plate Dissipation		4.0 max.	watts
Screen Dissipation		0.4 max.	watt
Typical Operation and Characteristics - Class A, Amplifier:			
Plate	100	250	volts
Screen	100	100	volts
Grid	-1	-3	volts
Suppressor	Connected to cathode at socket		
Plate Res.	0.12	0.8	approx. megohm
Transcond.	2350	2000	μmhos
Grid Bias for transcond. of 10 μmhos	-35	-35	volts
Plate Cur.	13	9.2	ma.
Screen Cur.	4.0	2.6	ma.

■ In circuits where the cathode is not connected directly to the heater, the potential difference between heater and cathode should be kept as low as possible.
▲ With shell connected to cathode.
▲▲ With shield connected to cathode.

6SK7
AVERAGE PLATE CHARACTERISTICS



6SK7
AVERAGE CHARACTERISTICS



Except for the heater rating, the electrical characteristics of the 12SQ7 are the same as the 6SQ7, 6SQ7-GT/G shown below. The heater rating of the 12SQ7 is 12.6 volts, 0.15 amp.

6SQ7, 6SQ7-GT/G
DUPLEX-DIODE HIGH-MU TRIODE

Heater ■	Coated Unipotential Cathode		
Voltage	6.3		a-c or d-c volts
Current	0.3		amp.
	6SQ7	6SQ7-GT/G	
Direct Interelectrode Cap.	▲	c	
Triode Unit:			
Grid to Plate	1.8	1.8	μμf
Grid to Cathode	3.6	4.2	μμf
Plate to Cathode	3.2	3.4	μμf
Maximum Overall Length	2-5/8"	3-5/16"	
Maximum Seated Height	2-1/16"	2-3/4"	
Maximum Diameter	1-5/16"	1-5/16"	
Bulb	Metal Shell ST-8	T-9	
Base	Small Wafer, Octal 8-Pin	Small Wafer Octal 8-Pin, Sleeve	
Basing Designation	8Q	GT-8Q	

Pin 1 { 6SQ7, Shell / 6SQ7-GT/G, Base Sleeve

Pin 2 - Triode Grid
Pin 3 - Cathode
Pin 4 - Diode Plate #2
Pin 5 - Diode Plate #1
Pin 6 - Triode Plate
Pin 7 - Heater
Pin 8 - Heater

BOTTOM VIEW

Mounting Position: Any

Maximum Ratings Are Design-Center Values

TRIODE UNIT

Plate Voltage		300 max.	volts
Characteristics - Class A_1 Amplifier:			
Heater ■	6.3	6.3	volts
Plate	100	250	volts
Grid	-1	-2	volts
Amp. Fact.	100	100	
Plate Res.	110000	91000	ohms
Transcond.	900	1100	μmhos
Plate Cur.	0.4	0.9	ma.

Typical Operation - Resistance-Coupled Amplifier:
Same as Type 75 in RESISTANCE-COUPLED AMPLIFIER CHART

DIODE UNITS - Two

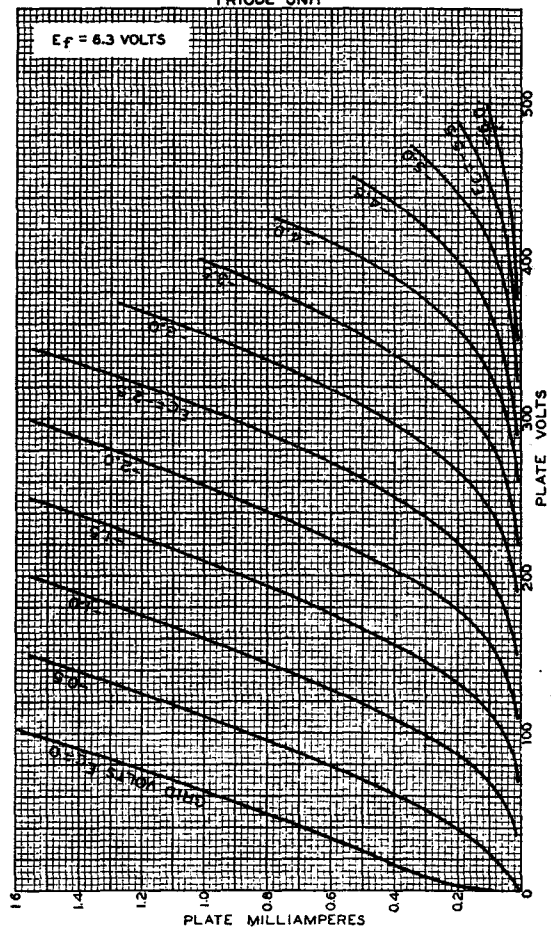
Consideration of these units is given under Type 85. Circuits will be similar to those shown for Type 55 with fixed bias. Diode biasing of the triode unit of the 6SQ7 or 6SQ7-GT/G is not suitable. Diode curves under Type 6B7 apply to the 6SQ7 and 6SQ7-GT/G.

■ In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.
▲ With shell connected to cathode. Values are approximate.
○ With no external shield. Values are approximate.

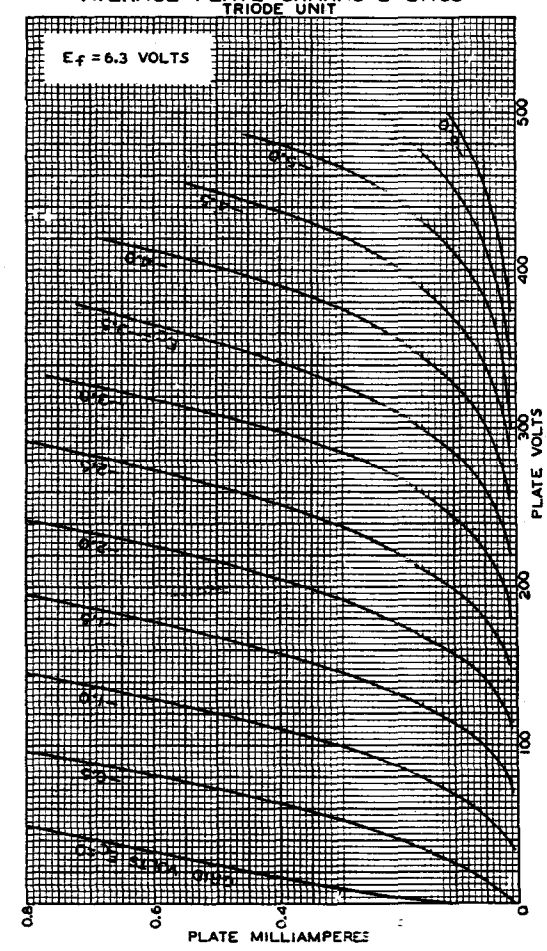
The curve under Type 75 also applies to the 6SQ7 and the 6SQ7-GT/G.

→ Indicates a change.

6SQ7
AVERAGE PLATE CHARACTERISTICS
TRIODE UNIT



6SQ7
AVERAGE PLATE CHARACTERISTICS
TRIODE UNIT



Except for the heater rating, the electrical characteristics of the 1625 are the same as the 807 shown below. The heater rating of the 1625 is 12.6 volts, 0.45 amp.

807

TRANSMITTING BEAM POWER AMPLIFIER

Heater*	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.9	amp.
Transconductance for plate cur. of 72 ma.	6000 approx.	μmhos
Grid-Screen Mu-Factor	8	
Direct Interelectrode Capacitances:		
Grid to Plate (With external shielding)	0.2 max.	μμf
Input	11	μμf
Output	7	μμf
Maximum Overall Length	5-3/4"	
Maximum Diameter	2-1/16"	
Bulb	ST-16	
Cap	Small Metal	
Base	Medium 5-Pin, MICANOL△	

MAXIMUM CCS and ICAS RATINGS with TYPICAL OPERATING CONDITIONS

CCS = Continuous Commercial Service
ICAS = Intermittent Commercial and Amateur Service

A-F POWER AMPLIFIER & MODULATOR - Class AB_2#

	CCS	ICAS	
D-C Plate Voltage	600 max.	750 max.	volts
D-C Screen Voltage (Grid #2)	300 max.	300 max.	volts
Max.-Signal D-C Plate Cur.*	120 max.	120 max.	ma.
Max.-Signal Plate Input*	60 max.	90 max.	watts
Screen Input*	3.5 max.	3.5 max.	watts
Plate Dissipation*	25 max.	30 max.	watts

Typical Operation: *Unless otherwise specified, values are for 2 tubes*

D-C Plate Voltage	400	500	600	750	volts
D-C Screen Voltage	300	300	300	300	volts
D-C Grid Voltage (Fixed bias, Grid #1)	-25	-25	-30	-32	volts
Peak A-F Grid-to-Grid Voltage	78	78	78	92	volts
Zero-Sig. D-C Plate Cur.	100	100	60	60	ma.
Max.-Sig. D-C Plate Cur.	240	240	200	240	ma.
Zero-Sig. D-C Screen Cur.	5	5	5	5	ma.
Max.-Sig. D-C Screen Cur.	10	10	10	10	ma.
Load Resistance (Per tube)	800	1060	1600	1740	ohms
Effective Load Resistance (Plate to plate)	3200	4240	6400	6950	ohms
Peak Grid Input Power°	0.2	0.2	0.1	0.2	approx.watt
Max.-Sig. Power Output°°	55	75	80	120	approx.watts

* In circuits where the cathode is not directly connected to the heater, the potential difference between them should not exceed 100 volts. Under the maximum plate and screen dissipation conditions, the heater voltage should not fluctuate so that it exceeds 7.0 volts.
* Averaged over any audio-frequency cycle of sine-wave form.
# Subscript 2 indicates that grid current flows during some part of input cycle.
△ Registered trademark.
←Indicates a change.
°, °°: See next page.

807

TRANSMITTING BEAM POWER AMPLIFIER

(continued from preceding page)

R-F POWER AMPLIFIER - Class B Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

		CCS		ICAS		
D-C Plate Voltage		600 max.		750 max.		volts
D-C Screen Voltage (Grid #2)		300 max.		300 max.		volts
D-C Plate Current		80 max.		90 max.		ma.
Plate Input		37.5 max.		45 max.		watts
Screen Input		2.5 max.		2.5 max.		watts
Plate Dissipation		25 max.		30 max.		watts
Typical Operation:						
D-C Plate Voltage	400	500	600	750		volts
D-C Screen Voltage	250	250	250	300		volts
D-C Grid Volt. (Grid #1)†	-25	-25	-25	-35		volts
Peak R-F Grid Voltage	30	30	20	27		volts
D-C Plate Current	75	75	62.5	60		ma.
D-C Screen Current	4	4	3	3		ma.
D-C Grid Cur. (Approx.)	0	0	0	0		ma.
Driving Power (Approx.)°°	0.25	0.25	0.2	0.12		watt
Power Output (Approx.)	9	12.5	12.5	15		watts

°° At crest of a-f cycle with modulation factor of 1.0.

PLATE-MODULATED R-F POWER AMPLIFIER - Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

		CCS		ICAS		
D-C Plate Voltage		475 max.		600 max.		volts
D-C Screen Voltage (Grid #2)		300 max.		300 max.		volts
D-C Grid Voltage (Grid #1)		-200 max.		-200 max.		volts
D-C Plate Current		83 max.		100 max.		ma.
D-C Grid Current		5 max.		5 max.		ma.
Plate Input		40 max.		60 max.		watts
Screen Input		2.5 max.		2.5 max.		watts
Plate Dissipation		16.5 max.		25 max.		watts
Typical Operation:						
D-C Plate Voltage	325	400	475	600		volts
D-C Screen Voltage◊	225	225	225	275		volts
	20000	30000	50000	50000		ohms
D-C Grid Voltage△†	-75	-80	-85	-90		volts
	25000	22800	21300	22500		ohms
Peak R-F Grid Voltage	90	95	110	115		volts
D-C Plate Current	80	80	83	100		ma.
D-C Screen Current	5	5.75	5	6.5		ma.

° Driver stage should be capable of supplying the grids of the class AB_2 stage with the specified peak values at low distortion. The effective resistance per grid circuit of the class AB_2 stage should be kept below 500 ohms and the effective impedance at the highest desired response frequency should not exceed 700 ohms.
◊ Obtained preferably from modulated fixed supply, or from modulated plate supply through resistor of value shown.
△ May be obtained from grid resistor (25000, 22800, 21300, 22500) although combination of either grid resistor and cathode resistor or grid resistor and fixed supply is recommended.
°° With zero-impedance driver and perfect regulation, plate-circuit distortion does not exceed 2%. In practice, plate-voltage regulation, screen-voltage regulation, and grid-bias regulation, should not be greater than 5%, 5%, and 3%, respectively.
† See end of tabulation.
← Indicates a change.

807

TRANSMITTING BEAM POWER AMPLIFIER

(continued from preceding page)

	CCS			ICAS		
D-C Grid Current (Approx.)	3	3.5	4	4		ma.
Driving Power (Approx.)	0.25	0.3	0.4	0.4		watt
Power Output (Approx.)	17.5	22.5	27.5	42.5		watts

R-F POWER AMPLIFIER & OSCILLATOR - Class C Telegraphy

Key-down conditions per tube without modulation ##

		CCS		ICAS		
D-C Plate Voltage		600 max.		750 max.		volts
D-C Screen Voltage (Grid #2)		300 max.		300 max.		volts
D-C Grid Voltage (Grid #1)		-200 max.		-200 max.		volts
D-C Plate Current		100 max.		100 max.		ma.
D-C Grid Current		5 max.		5 max.		ma.
Plate Input		60 max.		75 max.		watts
Screen Input		3.5 max.		3.5 max.		watts
Plate Dissipation		25 max.		30 max.		watts
Typical Operation:						
D-C Plate Voltage	400	500	600	750		volts
D-C Screen Voltage §	250	250	250	250		volts
	20000	42000	50000	85000		ohms
D-C Grid Voltage□ †	-45	-45	-45	-45		volts
	12800	12800	12800	12800		ohms
	410	410	410	410		ohms
Peak R-F Grid Voltage	65	65	65	65		volts
D-C Plate Current	100	100	100	100		ma.
D-C Screen Current	7.5	6	7	6		ma.
D-C Grid Cur. (Approx.)	3.5	3.5	3.5	3.5		ma.
Driving Power (Approx.)	0.2	0.2	0.2	0.2		watt
Power Output (Approx.)	25	30	40	50		watts

† The total effective grid-circuit resistance should not exceed 25000 ohms.
Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.
§ Obtained from separate source, from a potentiometer, or from plate supply through a series resistor of value shown.
□ Obtained from fixed supply, by grid resistor (12800), by cathode resistor (410), or by combination methods.

Data on operating frequencies for the 807 are given on the sheet TRANS. TUBE RATINGS vs FREQUENCY.

←Indicates a change.

Except for the heater rating, the electrical characteristics of the 1625 are the same as the 807 shown below. The heater rating of the 1625 is 12.6 volts, 0.45 amp.

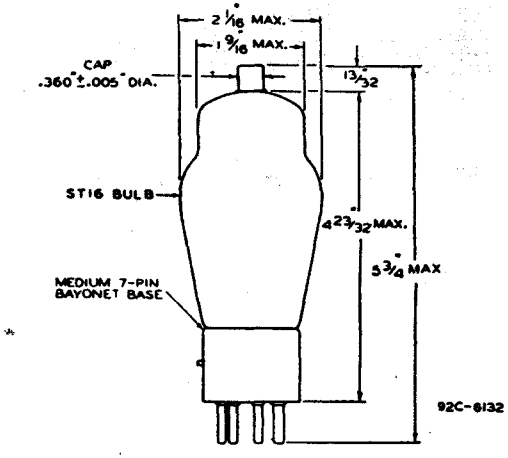
1625

TRANSMITTING BEAM POWER AMPLIFIER

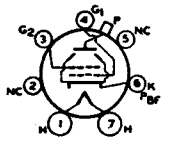
Heater[o]	Coated Unipotential Cathode	
Voltage	12.6	a-c or d-c volts
Current	0.45	amp.
Maximum Overall Length		5-3/4"
Maximum Diameter		2-1/16"
Bulb		ST-16
Cap		Small Metal
Base		Medium 7-Pin, MICANOL* Bayonet

[o] In circuits where the cathode is not directly connected to the heater, the potential difference between them should not exceed 100 volts. Under the maximum plate and screen dissipation conditions, the heater voltage should not fluctuate so that it exceeds 1a volts.
* Registered trademark.

Except for the heater rating, the electrical characteristics of the 1625 are the same as those of the 807



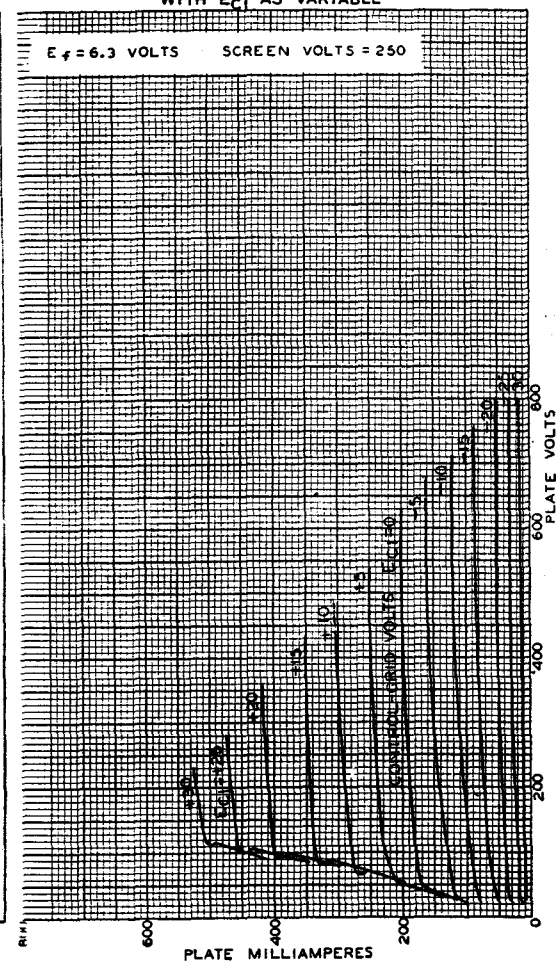
BOTTOM VIEW OF SOCKET CONNECTIONS.



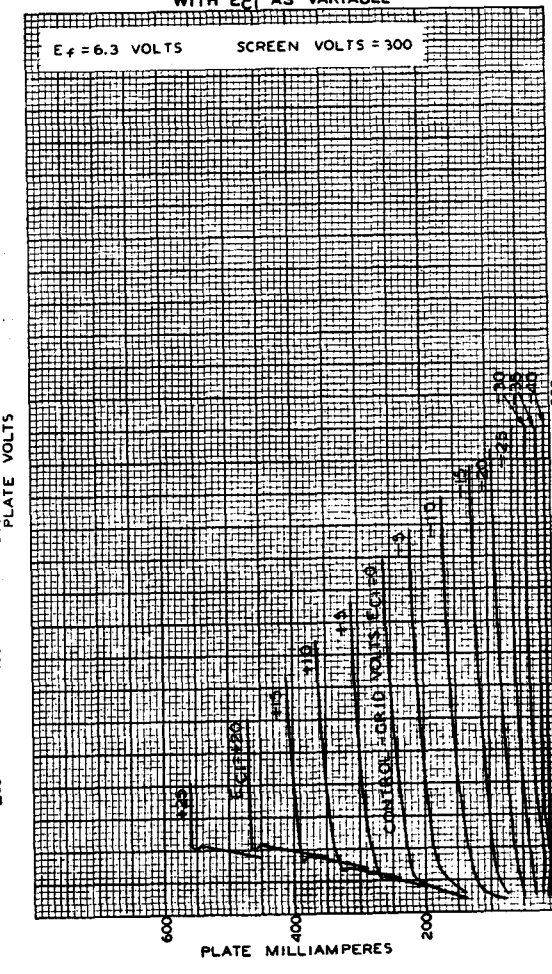
Pin 1 – Heater
Pin 2 – No Connection
Pin 3 – Screen
Pin 4 – Grid
Pin 5 – No Connection
Pin 6 – Cathode, Beam-Forming Plates
Pin 7 – Heater
Cap – Plate

TUBE MOUNTING POSITION
VERTICAL or HORIZONTAL

807
AVERAGE PLATE CHARACTERISTICS
WITH E_{c1} AS VARIABLE



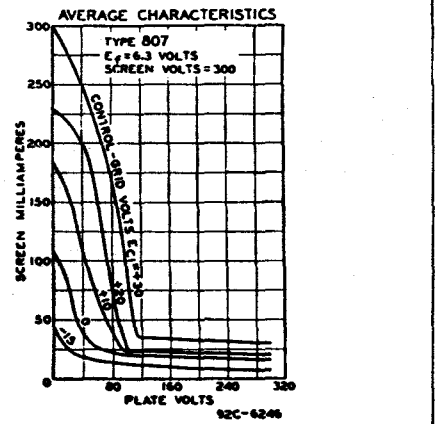
807
AVERAGE PLATE CHARACTERISTICS
WITH E_{c1} AS VARIABLE

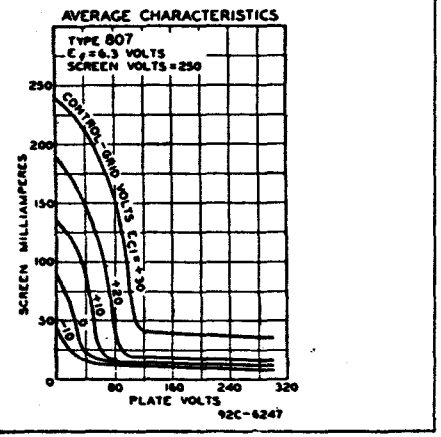


Except for the heater rating, the electrical characteristics of the 1625 are the same as the 807 shown below. The heater rating of the 1625 is 12.6 volts, 0.45 amp.

807

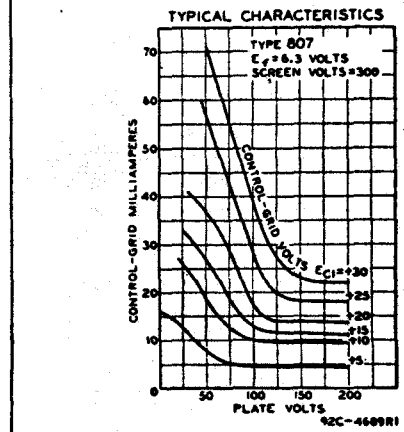
TRANSMITTING BEAM POWER AMPLIFIER

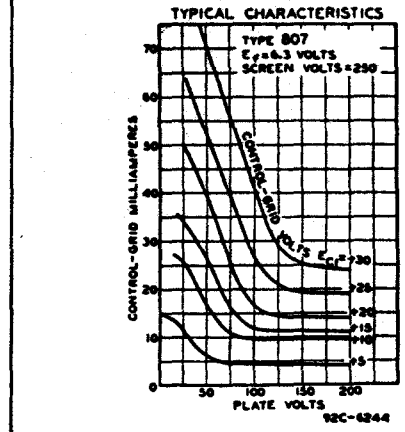




807

TRANSMITTING BEAM POWER AMPLIFIER





6X5, 6X5-GT/G

FULL-WAVE HIGH-VACUUM RECTIFIER

Heater	Coated Unipotential Cathode		
Voltage	6.3		a-c or d-c volts
Current	0.6		amp.
	6X5	*6X5-GT/G*	
Maximum Overall Length	3-1/4"	3-5/16"	
Maximum Seated Height	2-11/16"	2-3/4"	
Maximum Diameter	1-5/16"	1-5/16"	
Bulb	Metal Shell, MT-8	T-9	
Base	Small Wafer, Octal 6-Pin	Intermed. Sh., Octal 6-Pin	
Basing Designation	6S	G-6S	
Pin 1	6X5, Shell; 6X5-GT/G, No Con.	Pin 5 - Plate #1	
Pin 2 - Heater		Pin 7 - Heater	
Pin 3 - Plate #2		Pin 8 - Cathode	
Mounting Position		6X5: Vertical◊; 6X5-GT/G: Any	

BOTTOM VIEW

Maximum Ratings Are Design-Center Values

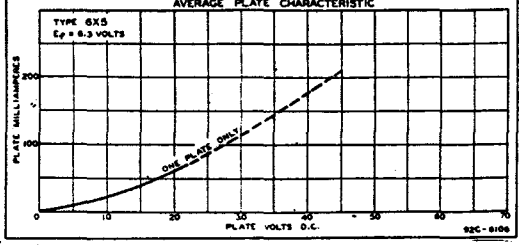
FULL-WAVE RECTIFIER

Peak Inverse Plate Voltage	1250 max. volts
Peak Plate Current per Plate	210 max. ma.
D-C Output Current:	
With condenser input to filter	70 max. ma.
With choke input to filter	70◉ max. ma.
D-C Heater-Cathode Potential	450 max. volts

Typical Operation:	*Condenser-Input Filter*	*Choke-Input Filter*	
A-C Plate-to-Plate Supply Voltage (RMS)	650	900	volts
Filter Input Condenser	4	-	μf
Min. Total Effect. Plate-Supply Imped. per Plate	150	-	ohms
Filter Input Choke	-	8	henries
D-C Output Current	70	70	ma.
D-C Voltage (At input to filter):*			
At half-load current (35 ma.)	405	385	volts
At full-load current (70 ma.)	370	380	volts
Difference (Voltage Regulation)	35	5	volts
Percentage Regulation	8.5	1.3	%

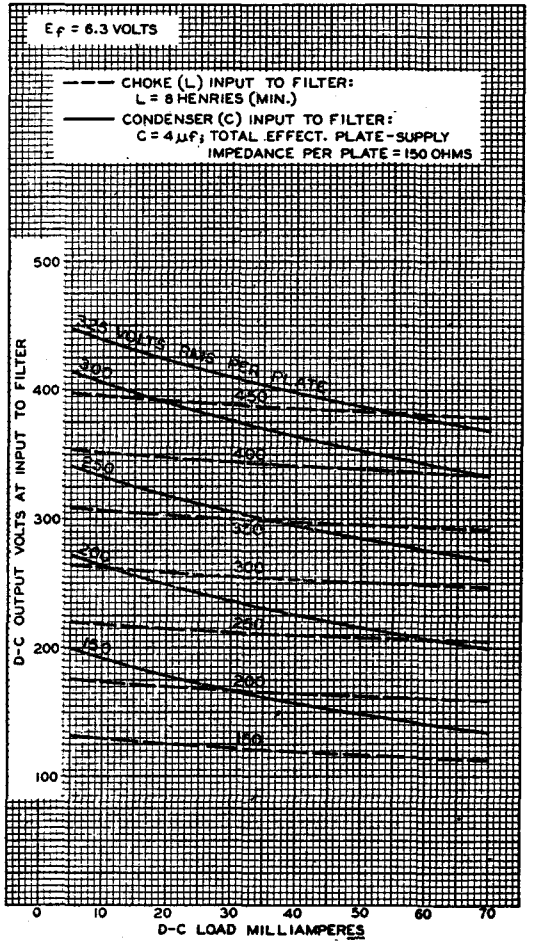
◊ Horizontal operation permitted if pins 3 & 5 are in a horizontal plane.
◉ For choke not less than 8 henries.
* Approximate values.

AVERAGE PLATE CHARACTERISTIC



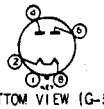
6X5

OPERATION CHARACTERISTICS



5R4-GY
FULL-WAVE HIGH-VACUUM RECTIFIER

Filament#	Coated	
Voltage	5.0	a-c volts
Current	2.0	amp.
Maximum Overall Length		5-5/16"
Maximum Seated Height		4-3/4"
Maximum Diameter		2-1/16"
Bulb		ST-16
Base	Medium Shell Octal 5-Pin, Micanol	
Pin 1 - No Connection	Pin 6 - Plate No.1	
Pin 2 - Filament	Pin 8 - Filament	
Pin 4 - Plate No.2		
Mounting Position		Vertical##



BOTTOM VIEW (G-5T)

Maximum Ratings Are Design-Center Values

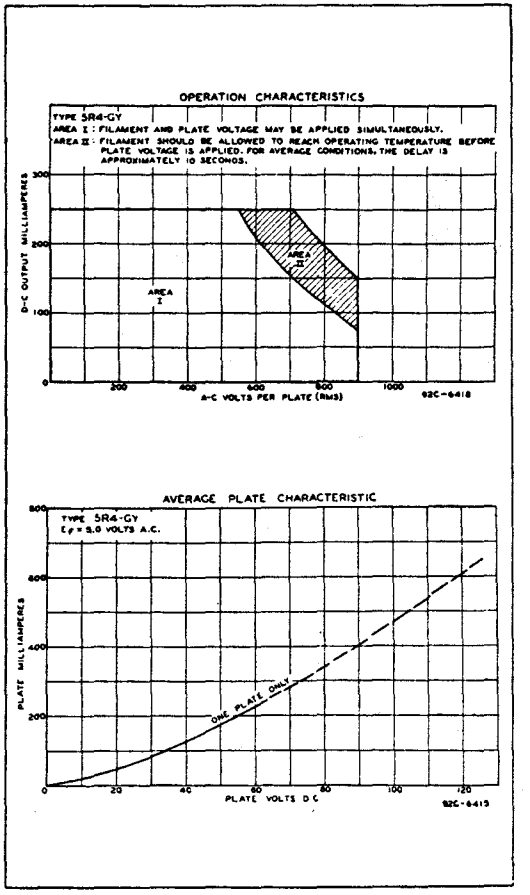
FULL-WAVE RECTIFIER

	Rating 1	Rating 2	Rating 3	
Peak Inverse Plate Voltage (No load)	2100 max.	2400 max.	2800 max.	volts
Peak Plate Current per Plate	650 max.	650 max.	650 max.	ma.
D-C Output Current.				
With condenser input to filter	250 max.	175 max.	150 max.	ma.
With choke input to filter	250 max.	250 max.○	175 max.●ma.	

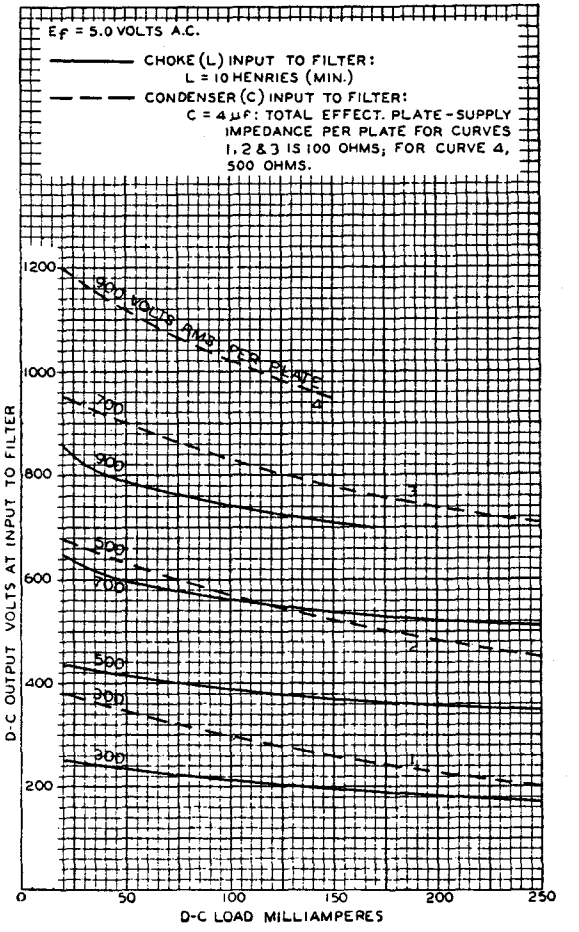
Typical Operation:	Condenser-Input Filter		Choke-Input Filter		
A-C Plate-to-Plate Supply Voltage(RMS) Full Load	1400	1800	1500	1900	volts
A-C Plate-to-Plate Supply Voltage(RMS) No Load	1500	2000	1700	2000	volts
Filter Input Condenser	4	4	-	-	µf
Total Effect. Plate-Supply Impedance per Plate**	125	575	-	-	ohms
Filter Input Choke	-	-	5	10	henries
D-C Output Current	250	150	250	175	ma.
D-C Output Voltage (At Input to Filter)	700*	950*	550*	750*	volts
Voltage Regulation (Half-Load to Full-Load Current)	90*	110*	40*	60*	volts

\# See curve for conditions necessitating delay in application of plate voltage until filament has reached operating temperature.
Horizontal operation is permissible if pins 1 and 4 are in a vertical plane.
○ For choke not less than 5 henries.
● For choke not less than 10 henries.
** Indicated values for conditions shown will limit peak plate current to maximum rated value. When a filter-input condenser larger than 4 µf is used, it may be necessary to use more plate-supply impedance than the value shown to limit the peak plate current to the rated value.
* Values are approximate.

5R4-GY
FULL-WAVE HIGH-VACUUM RECTIFIER



5R4-GY
OPERATION CHARACTERISTICS



APPENDIX

TABLE XVII APPLICABLE COLOR CODES

RESISTOR COLOR CODE

The Standard RMA Color Code is used to indicate the resistance of the small resistors used in the equipment. The colors and corresponding numbers are listed below:

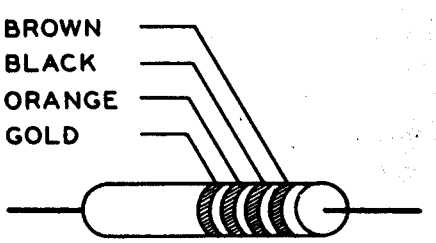
0—Black	5—Green
1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Gray
4—Yellow	9—White

The resistors are marked with three colored "bands" near one end. All resistance values are in ohms. The color sequence begins with the color nearest the end of the resistor. The first "band" indicates the first number of the sequence, the second "band" the second number and the third "band" the number of zeros following the second number.

Tolerance values for the resistors are designated by the fourth "band" on the resistor body using the following colors to indicate the percentage of tolerance:

1%—Brown	6%—Blue
2%—Red	7%—Violet
3%—Orange	8%—Gray
4%—Yellow	9%—White
5%—Green	5%—Gold
	10%—Silver

For example, the resistor shown below has a resistance of 10,000 ohms and a tolerance of ±5%. Brown (1), black (0), orange (3), and gold (5).



(Dwg. 1067A)

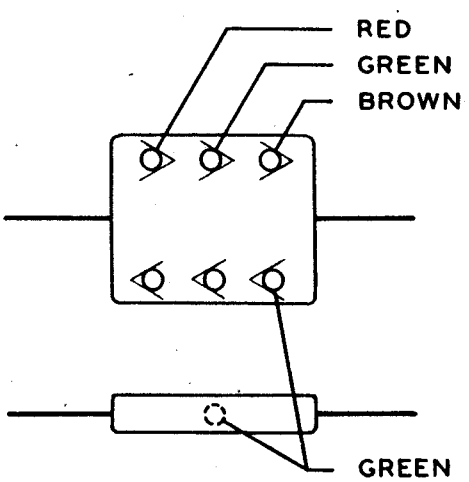
CAPACITOR COLOR CODE

The Standard RMA Color Code is used to indicate the capacity of some of the midget mica capacitors used in the equipment. The colors and corresponding numbers are listed below:

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

Three colored dots, with arrows indicating the sequence of colors indicate the capacity. The third dot of color indicates the number of zeros following the first two figures. All capacity values are in micromicrofarads (mmfd). The tolerance in percent is indicated by the spot of color on the edge of the capacitor.

For example, the capacitor shown below has a capacity of 250 mmfd (0.00025 mfd). The color sequence is red (2), green (5) and brown (1). The tolerance is ±5% as indicated by the spot of green on the edge of the capacitor.



(Dwg. 1069A)

CABLE WIRE CODE

This wire code is the standard code for all wiring in connection with the Type TCS Transmitting Equipment.

Two classes of wire are employed, consisting of Insulated and bus bar.

Insulated wire is supplied in two degrees of insulation rated at 1000 volts and 3000 volts.

Standard RMA Color Code numerals are used for designating the body color and the color of the tracers. The code is as follows:

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

The wire color code is made up of a letter designating the wire size and voltage rating of insulation followed by numerals designating the body color and colors of up to three tracers.

The standard TCS wire code is as follows, note that complete wire specifications and means for wiring the part number of each wire are supplied:

CODE FOR BUS-BAR

The code for bus-bar shall be made up of the letter designation BB followed by the wire size as shown below:

#24____BB24	#16____BB16
#20____BB20	#14____BB14
#18____BB18	#12____BB12

APPENDIX

CABLE WIRE CODE

Numerals refer to RMA color code.
Letters refer to wire size and type.

Color Code	Color	Construction and Ratings	Part No.
G93	White—Orange Tracer	No. 18 Ga. 1000 v rating. Lacquered glass braid. Copper tinned braid shield.	443 2189 30
J9	White	No. 16 Ga. 1000 v rating. Lacquered glass braid.	440 0601 00
J90	White—Black Tracer		440 0602 00
J91	White—Brown Tracer		440 0603 00
J95	White—Green Tracer		440 0607 00
J96	White—Blue Tracer		440 0608 00
J902	White—Black, Red Tracers		440 0609 00
K9	White	No. 20 Ga. 1000 v rating. Lacquered glass braid.	440 0801 00
K90	White—Black Tracer		440 0802 00
K91	White—Brown Tracer		440 0803 00
K92	White—Red Tracer		440 0804 00
K93	White—Orange Tracer		440 0805 00
K94	White—Yellow Tracer		440 0806 00
K95	White—Green Tracer		440 0807 00
K96	White—Blue Tracer		440 0808 00
K902	White—Black, Red Tracers		440 0809 00
K924	White—Red, Yellow Tracers		440 0813 00
K925	White—Red, Green Tracers		440 0815 00
L92	White—Red Tracer	No. 20 Ga. 3000 volt rating. Lacquered glass braid.	447 2092 00
L96	White—Blue Tracer		447 2096 00
P9	White	No. 12 Ga. 1000 volt rating. Lacquered glass braid.	440 0401 00
P91	White—Brown Tracer		440 0403 00

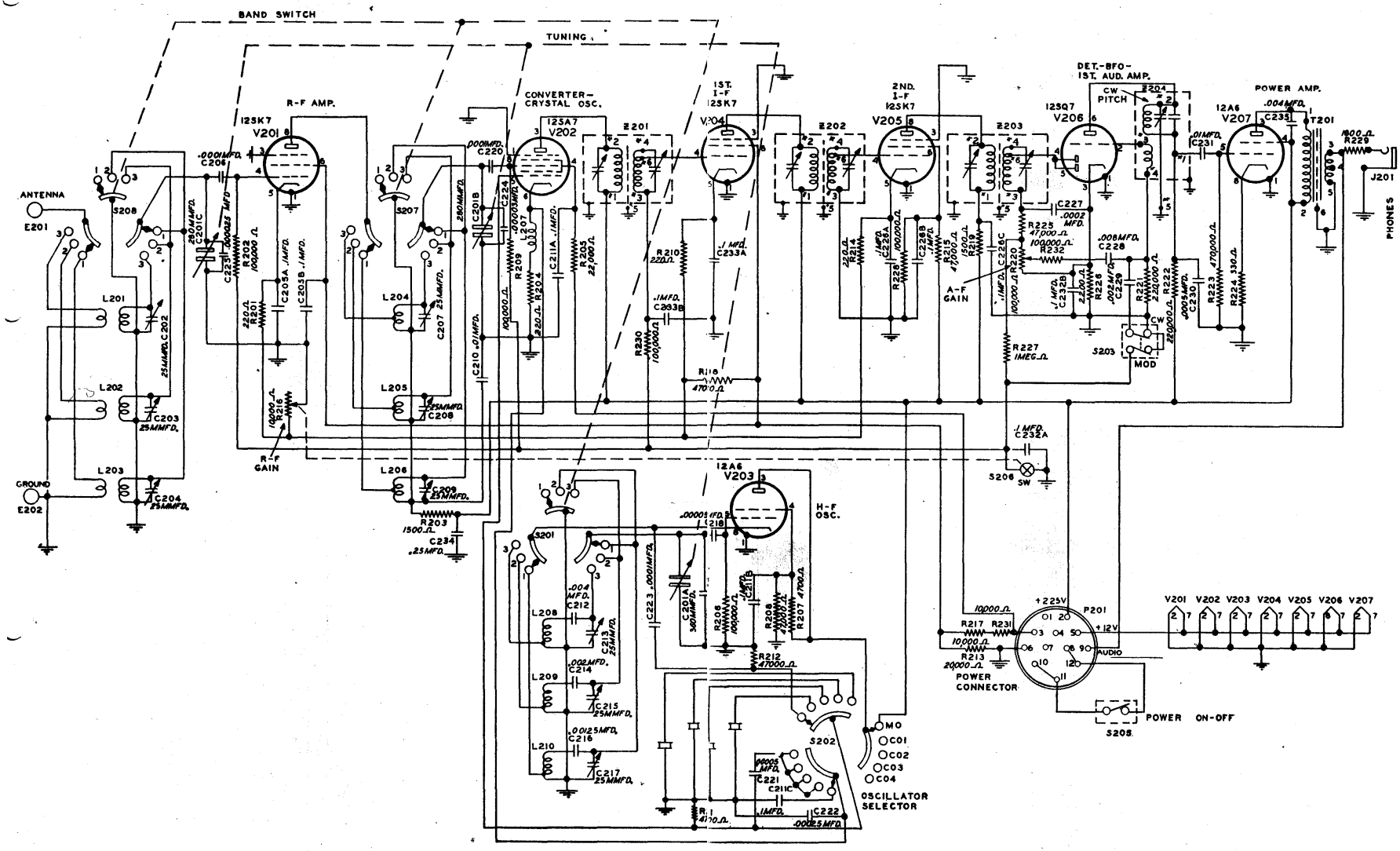


Fig. 78 Type –46159 Radio Receiver Schematic Diagram
(Dwg No. 1510C)

Fig. 78 Type –46159 Radio Receiver Schematic Diagram
(Dwg. No. 1510C)

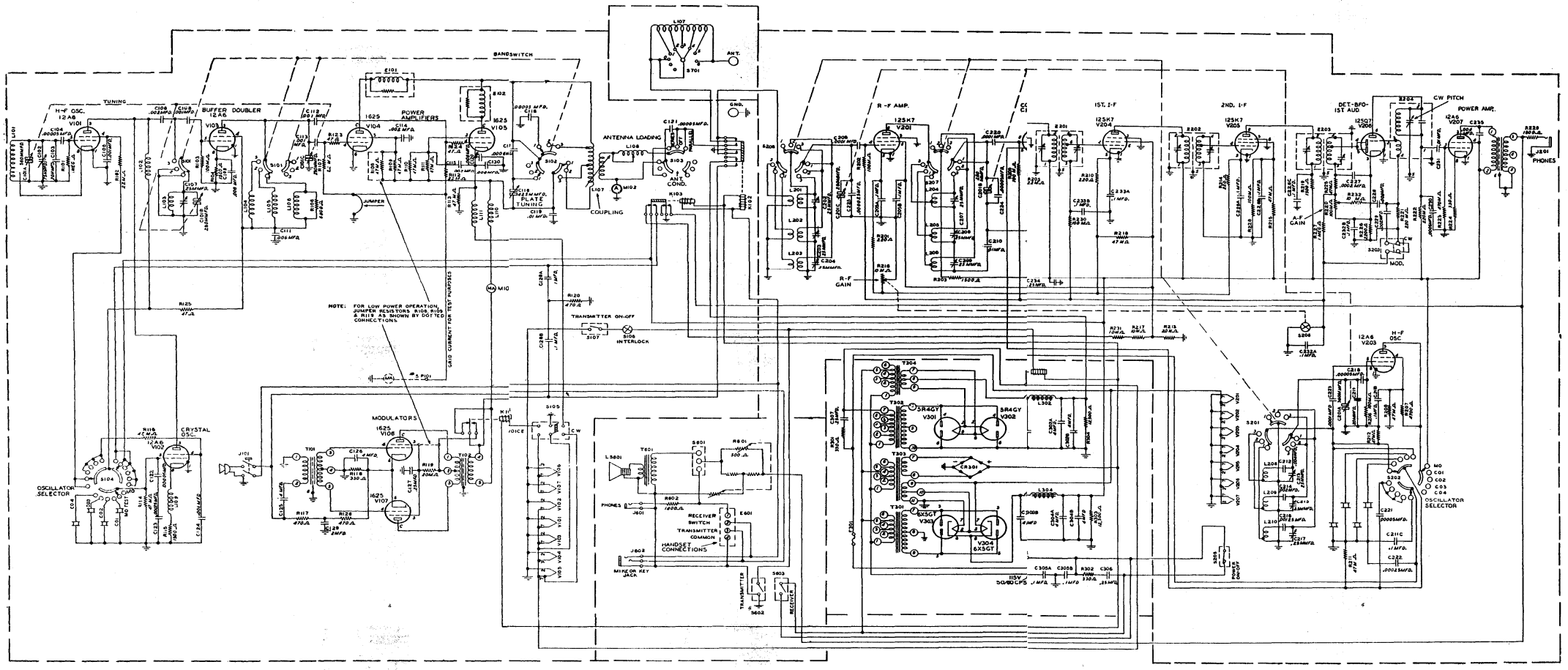


Fig. 79 Typical Complete Schematic, Type –20218 Power Unit S
(Dwg. No. 500 9974 005)

Fig. 79 Typical Complete Schematic, Type –20218 Power Unit Shown
(Dwg. No. 500 9974 005)

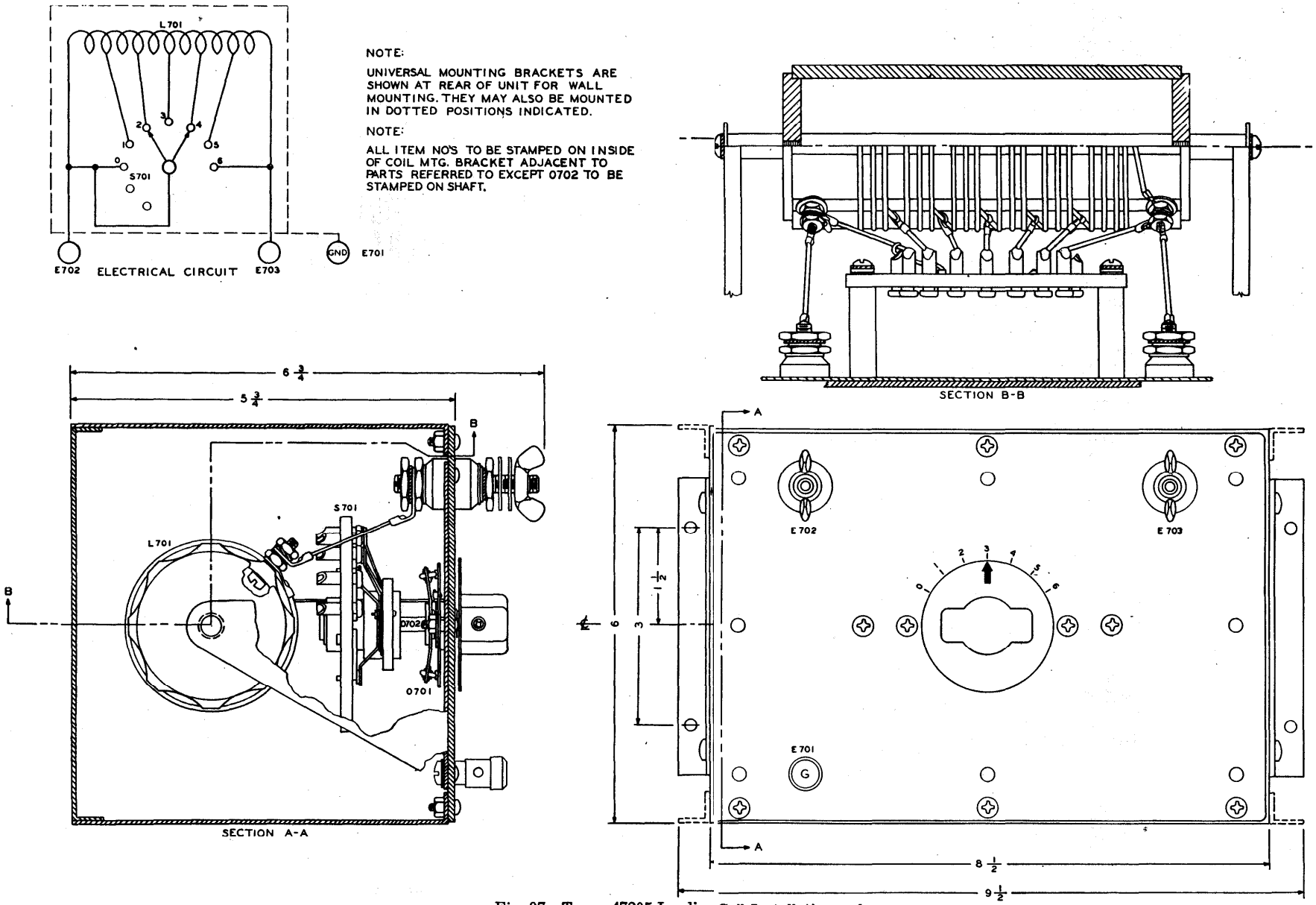


Fig. 97 Type –47205 Loading Coil Installation and Schematic Diagram (Dwg. No. 1597C)

Fig. 97 Type –47205 Loading Coil Installation and Schematic Diagram (Dwg. No. 1597C)