0281-037-1000

DIVING BOAT

NAVSHIPS 95322 **Serial No.**

PRELIMINARY
INSTRUCTION BOOK

for

NAVY MODEL TCS-13
RADIO TELEPHONE AND TELEGRAPH
TRANSMITTING AND RECEIVING EQUIPMENT

Output 25 Watts Telegraph
Or 10 Watts Telephone

Frequency Range 1500 kc to 12,000 kc

Manufactured for

United States Navy Department **Bureau of Ships**

by

HAMILTON RADIO CORPORATION

NEW YORK, NEW YORK

Contract: NXsr-38307 **Contract Dated: September 22, 1943**

NAVY—BPS 4ND—PHILA., PA.

CORRECTIONS AND ADDITIONS ON TCS-13

PRELIMINARY INSTRUCTION BOOK

Page X	Figure 48	Should read Dwg. No. ML 1030
Page X	Figure 53	Should read Dwg. No. MX 1051
Page XII		Add to Major Units: 2 Instruction Books.
Page 1	Column 1	Add to 4th Paragraph (Only if the transmitter switch on the remote control unit is in the "off" position)
Page 1	Column 2	10th line should read: frequency doubler, or frequency quadrupler
Page 3		Delete paragraph on tools and add as follows: Two sets of Bristo wrenches (for removing or tightening control knobs, etc.) are mounted on the inside wall of the receiver and the transmitter unit. Each set consisting of one #6 and one #10 wrench. One set of Allen Wrenches, consisting of one #6 and one #8 wrench, for removing or tightening the fan, and the brush holders in the Dynamotors are mounted on the top of the Power Supply Chassis. This set of wrenches was added on the equipment starting with serial #1123.
Page 11	Column 2	Delete lines 2 and 3 and insert as follows: ----dial setting which results in a pronounced dip of the plate current meter is the correct setting. In general, the higher the frequency of the transmitter output the greater the dial reading of the plate tuning and antenna loading controls. The other dip indicates----
Page 27		Add *(asterisk) preceding symbol designations C-206, C-210
Page 27		Delete *(asterisk) preceding symbol designations C-213, C-215 and C-217
Page 30		Correct lines 3 and 4 under miscellaneous electrical parts to read as follows:

Symbol Designation	Function	Description	Mfr	Hamilton Dwg. No.
*E-103	Standoff	3/4" long tapered ceramic	25C	MP-1079
*E-104	Standoff	3/8"D x ½" long ceramic	25C	MP-1073

Page 30 — Add in numerical order the following:

*E-108	Binding Post Barrier	Ceramic	25C	MP-1077
*E-111	Standoff	½"D x 1" long ceramic	25C	MP-1081
*E-203	Standoff	Same as E-104		

Page 32 — Correct Navy No. on K-102, K-103 and K-401 to read 29220

Page 33 — Add in numerical order:

Symbol Designation	Function	Description	Mfr.	Hamilton Dwg. No.
L-111	Cathode Choke	15 turns of K-90 Wire	224H	CA-1078

Page 33	Delete *(asterisk) preceding symbol designations L-401 and L-405
Page 35	Add *(asterisk) preceding symbol designations P-402, P-403 and P-601
Page 36	Add *(asterisk) preceding symbol designation R-115
Page 43	Change Hamilton Dwg. No. on Z-201 to SA-2612 and Z-203 to SA-2613
Page 46 & 53	Change Navy type No. on RL-1002 to 29220

NAVY-NPS 4ND, PHILA., PA. — REPRINT

CORRECTIONS AND ADDITION ON TCS-13

PRELIMINARY INSTRUCTION BOOK

Page 51

Add the following symbol designations and manufacturers' Navy type prefix to the following:

Hamilton Dwg. No.	Symbol Designation	Mfr.
MP-1077	E-108	25C
MP-1078	E-104, E-203	25C
MP-1079	E-103	25C
MP-1081	E-111	25C

Page 53

Add in proper numerical and alphabetical order:

Description	Hamilton Part No.
#8 Allen Wrench	WR-H-1005
#6 Allen Wrench	WR-H-1006

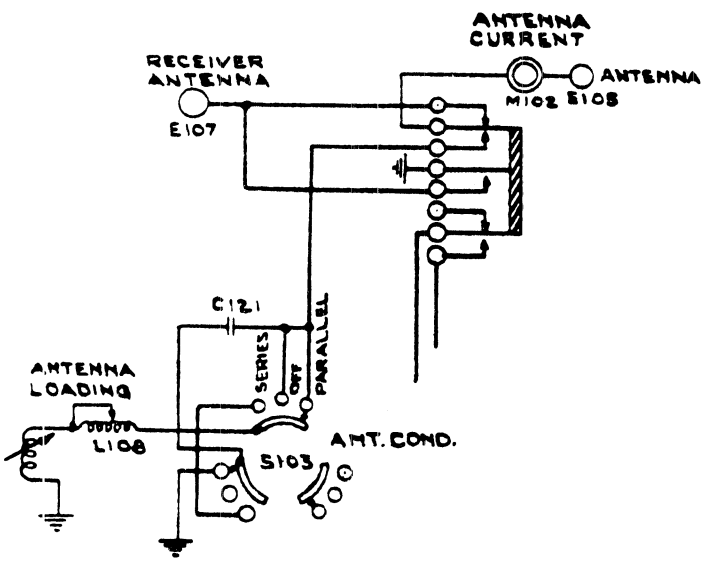
TYPICAL TRANSMITTER DIAL SETTINGS WITH A DUMMY ANTENNA LOAD EQUIVALENT TO A 20 FT. WHIP ANTENNA ARE AS FOLLOWS:

Control Freq.in M.C.	Osc. Sel. A	Band Switch B	Tuning C	Coupling D	Plate Tuning E	Ant. Cond. F	Ant. Load. G	Ext.Load Coil H
1.5	M.O	1	1.5	6 to 8.5	.8 to 1.5	off	2.5	2
2.25	M.O	1	2.25	6 to 7.5	7.3 - 7.8	off	5	6
3.0	M.O	1	3.0	6 to 7	9 to 9.5	off	20	6
3.0	M.O	2	3.0	6 to 7	.8 - 1.2	off	20	6
4.5	M.O	2	4.5	6 to 7	8	off	33	6
6.0	M.O	2	6.0	5.5 - 6.5	9 to 9.5	off	39	6
6.0	M.O	3	6.0	4 to 5	.5 to 1	off	39	6
9.0	M.O	3	9.0	4 to 5	7.5 to 8	Ser.	35	6
12.0	M.O	3	12.0	3 to 4	9 to 9.8	Ser.	41.5	6

NOTICE OF WIRING CHANGE OF R. F. AMMETER ON TRANSMITTER

As a result of tests conducted at the Naval Research Laboratory it was found that under certain loading conditions it was possible to obtain an appreciable current reading on the internal ammeter when connected in the ground lead, (as shown on the transmitter wiring diagram, Dwg. #ML-1033, page 87), but would not show any indication on an external meter connected to the antenna output.

The position of the R. F. ammeter in the ground lead may thus lead to a false indication of proper loading. Starting with serial #1387, the antenna current meter has been removed from the ground lead and placed in the high potential side of the antenna loading circuit, as shown in the sketch below.



PRELIMINARY
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NAVY MODEL TCS-13
RADIO TELEPHONE AND TELEGRAPH
TRANSMITTING AND RECEIVING EQUIPMENT

Output 25 Watts Telegraph
Or 10 Watts Telephone

Frequency Range 1500 kc to 12,000 kc

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

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

Manufactured for

United States Navy Department **Bureau of Ships**

by

HAMILTON RADIO CORPORATION

N E W Y O R K , N E W Y O R K

Contract: NXsr-38307 **Contract Dated: September 22, 1943**

WARNING

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

MEDICAL DEPARTMENT
UNITED STATES NAVY

ELECTRIC SHOCK
FIRST-AID TREATMENT

SAFETY FIRST

Regard electrical apparatus generally, and especially all current-carrying parts, as dangerous, irrespective of voltage. Exercise great care in handling, and avoid broad contacts such as are made by standing on a metal deck or in water.

Dangerous contact may result through lessened resistance when the skin and clothing are wet with perspiration. Contact with damp metal surfaces decks, bulkheads, guns, machinery may allow the current to ground through the moist skin and body.

Electric shock is due to current passing through the body current actually passing irrespective of the voltage. A pressure as low as 110 volts has caused death. Current passing through the body in the region of the heart is especially dangerous. In using electric breast drills avoid the possibility of a ground.

Usually electric shock does not kill instantly. Life can often be saved even though breathing has stopped.

I. FREE THE VICTIM FROM THE CIRCUIT IMMEDIATELY

Use a dry nonconductor (rubber gloves, clothing, rope, board) to move either the victim or the wire. Beware of using metal or moist material.

Shut off the current.

If necessary to cut a live wire, use an ax or hatchet with a dry wooden handle; turn your face away from the electrical flash.

II. ATTEND INSTANTLY TO THE VICTIM'S BREATHING

Begin resuscitation at once on the spot. Do not stop to loosen clothing; every moment counts.

RESUSCITATION BY THE PRONE PRESSURE METHOD OF ARTIFICIAL RESPIRATION

GAS ASPHYXIATION — ELECTRIC SHOCK — DROWNING

Waste no time. When the patient is removed from the water, gas, smoke, or electric contact, get to work at once with your own hands. Send for the medical officer or nearest physician.

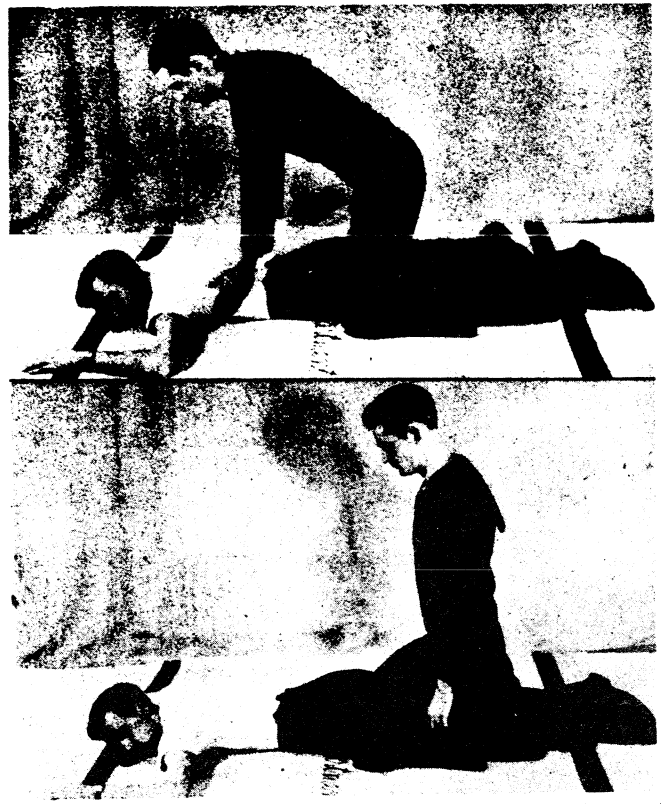
No reliance should be placed upon any special mechanical apparatus, as it is frequently out of order and often is not available when most needed. The patient's mouth should be cleared of any obstruction such as chewing gum or tobacco, false teeth, or mucus, so that there is no interference with the entrance and escape of air.

POSITION

1. Lay the patient on his belly, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing.

2. Kneel straddling the patient's thighs with your knees placed at such a distance from the hip bones as will allow you to assume the position shown in Figure 1.

Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position, and the tips of the fingers just out of sight (See fig. 1.)



FIRST MOVEMENT

3. With arms held straight, swing forward slowly, so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. (See fig. 2.) Do not bend your elbows. This operation should take about two seconds.

SECOND MOVEMENT

4. Now immediately swing backward, so as to remove the pressure completely. (See fig. 3.)

5. After two seconds, swing forward again. Thus repeat deliberately twelve to fifteen times a minute the double movement of compression and release, a complete respiration in four or five seconds.

6. Continue artificial respiration without interruption until natural breathing is restored. Do not get discouraged at the slow results that sometimes happen when resuscitating the apparently drowned. Efforts often have to be continued a long time before signs of life are apparent. Do not discontinue the efforts until certain that all chance is lost. Sometimes, even after several hours' work, recovery takes place.

7. As soon as this artificial respiration has been started and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest, or waist. TO KEEP THE PATIENT WARM DURING ARTIFICIAL RESPIRATION IS MOST IMPORTANT AND IT MAY BE NECESSARY TO COVER HIM WITH BLANKETS AND WORK THROUGH THEM, AS WELL AS TO APPLY HOT-WATER BOTTLES, HOT BRICKS, ETC. Do not give any liquids whatever by mouth until the patient is fully conscious.

8. To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, he should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water or a hot drink of coffee or tea, etc. Continue to keep the patient warm and at rest.

9. Resuscitation should be carried on at the nearest possible point to where the patient received his injuries. As a general rule he should not be moved from this point until he is breathing normally of his own volition and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, etc., to move the patient before he is breathing normally, resuscitation should be carried on during the time that he is being moved.

10. A brief return of natural respiration is not a certain indication for stopping the resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched, and if natural breathing stops, artificial respiration should be resumed a once.

11. In carrying out resuscitation it may be necessary to change the operator. This change must be made without losing the rhythm of respiration. The relief operator should kneel behind the one giving the artificial respiration and at the end of the movement, the operator crawls forward while the relief takes his place. By this procedure no confusion results at the time of change of operator, and a regular rhythm is kept up.

PRACTICE IN THE PERFORMANCE OF ARTIFICIAL RESPIRATION ON A VOLUNTEER SUBJECT SHOULD BE OBTAINED BY EVERYONE

WARNING

Since the use of high voltages which are dangerous to human life is necessary to the successful operation of the radio transmitting equipment covered by these instructions, certain reasonable precautionary measures must be carefully observed by the operating personnel during the adjustment and operation of the equipment.

The transmitter of the equipment is a complete unit contained in an individual cabinet, and this unit is fitted with a safety interlock switch that acts to cut off all power to the unit when the latter is withdrawn from the cabinet.

It should be borne in mind, however, that when the transmitter unit is removed from its cabinet and placed on a flat surface with the front panel facing upward, the interlock switch is held in the closed position, and that under these circumstances there is access to circuits carrying voltages dangerous to human life.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS

Under no circumstances should any person be allowed to reach into or in any manner gain access to the transmitter unit while it is in its cabinet with the interlock switch closed and the power-supply line switch to the equipment closed; or to approach or to handle any portion of the equipment which is supplied with power, or to connect any apparatus external to the transmitter unit to circuits within the equipment; or to apply voltages to the equipment for testing purposes while the transmitter unit is removed from its cabinet and placed so that the interlock switch is held in the closed position. Whenever feasible in testing circuits, check for continuity and resistance rather than directly checking voltage at various points.

DON'T SERVICE OR ADJUST ALONE

Under no circumstances should any person reach within the transmitter unit while it is in its cabinet, or while it is so placed that the interlock switch is held closed, for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH THE INTERLOCK

Under no circumstances should the safety interlock switch be removed, short-circuited, or tampered with in any way, nor should reliance be placed upon the interlock switch for removing voltages from the transmitter unit.

THE ATTENTION OF ENGINEER OFFICERS, RADIO OFFICERS, AND OPERATING PERSONNEL IS DIRECTED TO MANUAL OF ENGINEERING INSTRUCTIONS, CHAPTER 31 (MIMEOGRAPHED FORM), OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO-SAFETY PRECAUTIONS TO BE OBSERVED."

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LIST OF ILLUSTRATIONS

LIST OF DRAWINGS

REPORTS OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 31 (mimeographed form) of the Manual of Engineering Instructions, or Bureau of Ships Radio and Sound Bulletin Number 7, dated July 1, 1942, or superseding instructions.

PERTINENT DATES

Contract No. NXsr-38307 Date of Contract: September 22, 1943

Serial Number of Equipment_____

Date of Acceptance by the Navy_____

Date of Delivery to Contract Destination_____

Date of Completion of Installation_____

Date Placed in Service_____

Blank spaces in this book shall be filled in at the time of installation. Operating personnel shall also mark the "date placed in service" on the date plate located below the model nameplate on the equipment, using suitable methods and taking care to avoid damage to the equipment.

REQUESTS FOR REPLACEMENT MATERIAL

All requests or requisitions for replacement material should include complete descriptive data covering the part desired, in the following form:

1. Name of part desired.
2. Navy Type number (if assigned) (including prefix and suffix as applicable).
3. Model designation (including suffix) of equipment in which used.
4. Navy Type designation (including prefix and suffix where applicable) of major unit in which part is used.
5. Symbol designation of part.
6. (a) Navy Drawing Number
   (b) Hamilton Drawing Number
7. Rating or other descriptive data.
8. Commercial designation.

MAJOR UNITS AND ACCESSORIES OF THE TCS-13 RADIO EQUIPMENT

1 Transmitter Unit, Type CIH-52245-A

1 Transmitter Cabinet with shock mounts

1 Receiver Unit, Type CIH-46159-A

1 Receiver Cabinet with shock mounts

2 Base Plates, for transmitter and receiver

1 Vertical-Mounting Hardware Kit

1 Power-Supply Unit, Type CIH-21881-B, for operation from 12-volt direct current

1 Remote-Control Unit, Type CCY-23270-A

1 Antenna Loading Coil Unit, Type CML-47205

1 Cable 11 feet long for connecting the transmitter and power-supply units

1 Cable 10 feet long for connecting the receiver and power-supply units

1 Cable 20 feet long for connecting the remote-control and power-supply units

1 Telegraph Key, Type CSE-26018, with cord and plug assembly

2 Carbon Microphones, Type CMX-51004-C, with cord and plug assembly

† Crystal Holders, Type CHF-40130, with CJW crystals, for the transmitter unit

‡ Pair of Headphones, Type CTE-49016, with headbands, cord and plug assembly

1 Set of Vacuum Tubes for both transmitter and receiver units totaling five 12A6, one 12SA7, four 1625, one 12SQ7, and three 12SK7

1 Spare Parts Case containing the spare parts supplied with each equipment

† Quantity as specified in the contract: may be 8, 4, or 0.
‡ Quantity as specified in the contract: may be 2, 1, or 0.

I. GENERAL DESCRIPTION

The TCS-13 Radio Equipment (refer to Figs. 38, 39, and 40) is a complete radio transmitting and receiving installation. It is designed for use in mobile and portable services: motor boats, motor cars, trucks, ambulances, tanks, and in other services where severe vibration and shock may be encountered.

The parts of each major unit are securely mounted in a cabinet constructed of cold-rolled sheet steel. These cabinets are finished on the inside with dull black lacquer and on the outside with black wrinkle. The front panels are made of zinc sheet with a chemical mat finish. All parts of the cabinets are adequately reinforced to withstand the vibration and shock incident to normal service.

The sub-assembly type of construction has been used extensively in this equipment. This type of design facilitates the removal of component parts without major dis-assembly of the units. Removal of the proper sub-assembly makes it possible to reach many apparently inaccessible components.

For the protection of the operating personnel, the transmitter is provided with an interlock switch. When the transmitter unit is removed from its cabinet, the interlock switch opens and all power is removed from the unit.

TRANSMITTER CHARACTERISTICS

The transmitter has an oscillator and a buffer amplifier with provisions for the emission of either CW or voice-modulated signals, as selected by a VOICE-CW switch on the front panel.

The frequency range, 1500 kc to 12,000 kc, is covered in three bands as selected by a three-position, two-section switch on the front panel:

Band 1: 1500 kc to 3000 kc
Band 2: 3000 kc to 6000 kc
Band 3: 6000 kc to 12,000 kc

Either master-oscillator-controlled or crystal-controlled operation is available. Continuous coverage of the entire frequency range is provided by the master oscillator, to which two positions of the OSCILLATOR-SELECTOR switch (on the front panel) are assigned. These two positions are: (1) "MO TEST", used for tuning and frequency test only; and (2) "MO", used for actual operation.

Crystal-controlled operation is available when crystals are supplied. (Crystals are supplied with some, but not all, TCS-13 equipments; the quantity is 8, 4, or 0, as specified in the contract.) The description below applies to the use of one set of four crystals. When additional crystals are supplied, the number of available frequency choices is correspondingly enlarged.

Any one of the set of four crystals may be selected by rotating the OSCILLATOR-SELECTOR switch to the desired crystal-oscillator position ("CO-1", "CO-2", "CO-3", or "CO-4"). The crystals, all of which are ground within the range of 1500 kc to 3000 kc, may be operated on their fundamentals or on their second harmonics, thus providing eight possible frequency choices, within the range of 1500 kc to 6000 kc, from the crystal-oscillator circuit. By the use of the buffer-amplifier stage as a frequency-doubler or frequency-tripler, additional operating frequencies may be obtained.

The frequency response of the transmitter is uniform within ±3 decibels over the audio range of 300 cycles to 3000 cycles. The audio-frequency distortion is less than 10% root-mean-square, measured with 90% modulation at 400 cycles. The residual noise level on the carrier is more than 40 decibels below the 100% modulation level. This number of decibels corresponds to a voltage ratio of only 1%.

The transmitter is rigidly constructed to give a high degree of frequency stability under the conditions incident to normal operation. The frequency variation due to vibration and shock will not exceed 0.02%; the variation due to changes in the battery-supply voltage from 10% above the normal value to 10% below will not exceed 0.01%. Increasing the humidity from normal values to 95% humidity will cause a frequency variation not exceeding 0.10%.

The power output as measured at the plates of the power-output tubes with normal supply voltage is 20 watts on voice and 40 watts on CW at all radio 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 operate into a single twenty-foot vertical radiator of the type known as a "whip" antenna. Approximately 60% of the above plate power is obtainable with this antenna.

The transmitter tube complement is as follows:

Quan.	*Tube Type*	*Function*
1	12A6	Crystal Oscillator
1	12A6	Master Oscillator
1	12A6	Buffer-Doubler
2	1625	R-F Power Amplifier
2	1625	Modulators

The transmitter dimensions and weight (unpacked, but including cabinet with [illegible] shock mounts) are as follows:

Height	*Width*	*Depth*	*Weight*
11⅝"	13¾"	11⅛"	50.0 lbs.

For the transmitter base plate, which is separate from the cabinet and shock mounts, the dimensions and weight are as follows:

½"	10"	14⅜"	5.0 lbs.

RECEIVER CHARACTERISTICS

The receiver employs a sensitive superheterodyne circuit, which will deliver 6 milliwatts audio power with less than 15 microvolts input throughout its frequency range.

The receiver's frequency range is the same as that of the transmitter, 1500 kc to 12,000 kc, and it is covered in three bands as selected by a three-position switch on the front panel:

Band 1: 1500 kc to 3000 kc
Band 2: 3000 kc to 6000 kc
Band 3: 6000 kc to 12,000 kc

Continuously tunable operation is normally employed, but provision is made for the optional use of crystal control. (The latter is satisfactory in Bands 1 and 2, but in Band 3 it results in somewhat reduced sensitivity.)

Two stages of intermediate-frequency amplification provide good selectivity. The band width is 8 kc at 6 decibels down, 15 kc at 20 decibels down, and 25 kc at 40 decibels down. These bandwidths include both sides of the resonance curve, which is standard practice.

The output circuit is designed to work into a 500-ohm load. The audio output obtainable with 10% harmonic distortion is roughly one watt, and the audio-frequency response is uniform within 5 decibels from 300 cycles to 3000 cycles.

The receiver cabinet is identical with that of the transmitter. The receiving unit may be mounted either beside or below the transmitting unit.

The receiver tube complement is as follows:

Quan.	*Tube Type*	*Function*
1	12SK7	R-F Amplifier
1	12SA7	Converter
1	12A6	Oscillator
1	12SK7	1st 1-F Amplifier
1	12SK7	2nd 1-F Amplifier
1	12SQ7	Detector
1	12A6	Audio Amplifier

The receiver dimensions and weight (unpacked, but including cabinet with its shock mounts) are as follows:

Height	*Width*	*Depth*	*Weight*
11⅜"	13¾"	11⅛"	42.0 lbs.

For the receiver base plate, which is separate from the cabinet and shock mounts, the dimensions and weight are as follows:

½"	10"	14⅜"	5.0 lbs.

POWER-SUPPLY CHARACTERISTICS

The power supply consists of a Type 21881-B Dual Dynamotor Unit (refer to Figs. 29 through 33, and 41) operating from a twelve-volt direct-current source of power. One dynamotor furnishes a 225-volt plate supply and the other furnishes a 400-volt plate supply. Adequate filtering is provided for the reduction of objectionable ripple and noise components in the output voltage.

The power supply has the following dimensions and weight (unpacked):

Height	*Width*	*Depth*	*Weight*
7⅛"	12⅛".	7⅛"	28.0 lbs.

ACCESSORIES

Remote-Control Unit

The Type CCY-23270-A Remote-Control Unit (refer to Figs. 34, 35, and 42) contains all the components necessary for power-supply control and emission control of the transmitter and for power-supply control and audio-output control of the receiver. It is fitted with a MICROPHONE-OR-KEY jack and contains a permanent-magnet loudspeaker with a five-inch cone.

The remote-control unit has the following dimensions and weight (unpacked):

Height	*Width*	*Depth*	*Weight*
5 1/16"	7⅜"	4⅜"	7.0 lbs.

Antenna Loading Coil

The Type CML-47205 Antenna Loading Coil (refer to Figs. 36, 37, and 49) is essential to the satisfactory performance of the transmitter when the latter is used with the recommended twenty-foot vertical "whip" antenna in the frequency range of 1500 kc to 3000 kc (Band 1). The inductance of this coil is variable in steps marked from "0" to "6". Step "0" (which is maximum inductance) is for the lower frequencies in this range, and step "6" (minimum inductance) is for the higher frequencies.

The antenna loading coil has the following dimensions and weight (unpacked):

Height	*Width*	*Depth*	*Weight*
6"	9½"	7"	4.0 lbs.

Interconnecting Power Cables

The transmitter cable (refer to Figs. 38 and 48) consists of eleven conductors and is used between the transmitter and the power-supply unit. It is eleven feet long and is fitted with a shielded 16-terminal female locking-type plug on each end.

The receiver cable (refer to Figs. 38 and 48) consists of seven conductors and is used between the re-

ceiver and the power-supply unit. It is ten feet long and is fitted with a shielded 12-terminal female locking-type plug at each end.

The control cable (refer to Figs. 38 and 48) consists of seven conductors and is used between the remote-control and the power-supply units. It is twenty feet long and is fitted with a shielded 9-terminal female locking-type plug at each end.

The plugs at the two ends of each cable are alike, except that one is right-angled and the other straight, so that each cable may be reversed end-for-end, if desired, for convenience in setting up an installation.

Microphones

Two Type CMX-51004-C Microphones are supplied with the equipment. Each microphone is of the single-button carbon type and is equipped with a "push-to-talk" switch wired in a control circuit operating the transmitter relays. This microphone is designed for close talking and when so used gives good intelligibility combined with marked reduction of the effects of surrounding noise. Each microphone has a 51-inch 3-conductor cord equipped with a 3-circuit plug that may be inserted into a MICROPHONE-OR-KEY jack on either the transmitter panel or the remote-control unit. The connections of the microphone plug and the jack are given in Fig. 43. These are the type "A" or "Red" connections, as indicated by a red ring on both the plug and the jack.

Headphones

The Type CTE-49016 Headphones, 600 ohms per pair, are supplied with some, but not all, TCS-13 equipments. (The quantity is 2, 1, or 0 pairs, as specified in the contract.) The unit includes a Type -49028 Headband, Type CTE-49012 Cotton Cord, and a Type NAF-1136-1 Headphone Plug that may be inserted into the PHONES jack on either the receiver panel or the remote-control unit.

Telegraph Key

The Type CSE-26018 Telegraph Key is the standard hand type equipped with a shorting lever. It has a lacquered brass finish and platinor points. It is accompanied by a cord-and-plug assembly including a 34-inch 2-conductor cord and a 3-terminal plug that may be inserted into a MICROPHONE-OR-KEY jack on either the transmitter panel or the remote-control unit. The connections of the key plug and the jack are given in Fig. 43.

Crystal Holders

Type CHF-40130 Crystal Holders, for the transmitter unit, are supplied with some, but not all, TCS-13 equipments. (The quantity is eight, four, or zero crystal holders with crystals, as specified in the contract.) The crystal holders are the clamped type, with three pins, and electrodes for one-inch crystals. They are to be inserted in the sockets X-108 (for crystals 1 and 4) and X-109 (for crystals 2 and 3) in the transmitter unit. No crystal holders are supplied for the receiver unit, although provision is made for their use, if desired (sockets X-208 and X-209 in the receiver unit).

Tools

Two Bristo wrenches (for removing or tightening control knobs, etc.) are mounted on the inside rear wall of the receiver unit. One of these is No. 6 and the other No. 10.

Spare-Parts Case

The spare parts supplied with each equipment are contained in a case constructed of cold-rolled steel with a gray lacquer finish. It is equipped with carrying handles and a locking device. Its outside dimensions are approximately 24" x 15" x 9" , and the total weight of this case with the spare parts is 90 lbs.

Vertical Mounting Kit

The necessary hardware for the vertical mounting of the transmitter and receiver units (refer to Fig. 40) is contained in a carton with tuck-in ends. The outside dimensions of the carton are approximately 2" x 2" x 21", and the total weight of this carton with the vertical mounting hardware is 3.0 lbs.

II. CIRCUIT DESCRIPTION

POWER-CONTROL CIRCUITS

The power-control circuits are designed so that either the receiver panel POWER switch S-205 or the RECEIVER ON-OFF switch S-603 on the remote-control unit must be in the "ON" position before power can be applied to the transmitter. When both these switches are in the "OFF" position, all power is removed from the equipment. Closing either switch energizes the low-voltage section of the power unit and applies both filament and plate power to the receiver.

If either S-205 or S-603 is in the "ON" position, filament power may be applied to the transmitter by throwing either the POWER switch S-107 on the transmitter panel or the TRANSMITTER ON-OFF switch S-602 on the remote-control unit to the "ON" position. Closing either circuit actuates the relay K-401 in the power-supply unit, which in turn closes the transmitter filament-power circuit. However, the high-voltage power is not applied to the plates of the transmitter tubes until the microphone plug or the key-cord plug is inserted in one of the MICROPHONE-OR-KEY jacks J-101 or J-602, and the circuit is closed by depressing the key or the microphone "push-to-talk" button. Closing this circuit actuates the combined power-and-antenna relay K-102 and applies plate voltage to the transmitting tubes. Closing the MICROPHONE-OR-KEY jack circuit also actuates the send-receive relay K-103, which disables the receiver.

If the OSCILLATOR-SELECTOR switch S-104 is rotated to the "MO TEST" position, plate voltage is applied to the oscillator and buffer stages without the necessity of closing the MICROPHONE-OR-KEY circuit. The VOICE-CW switch S-105, when thrown to the "VOICE" position, actuates the voice relay K-101, which applies filament power to the modulator tubes V-106 and V-107. Plate power is applied to these tubes by the depression of the microphone "push-to-talk" button and the actuation of the combined power-and-antenna relay K-102.

For remote control of the transmitter and receiver, the POWER switches on both panels should be in the "OFF" position and the type of emission selected with the EMISSION selector switches. All power circuits then can be completely controlled by the remote-control unit's RECEIVER ON-OFF and TRANSMITTER ON-OFF switches, which have the same function as the POWER switches on the receiver and transmitter front panels.

POWER-SUPPLY CIRCUITS (Refer to Fig. 45)

The Type -21881-B Power Supply consists of a dual dynamotor unit operating from a twelve-volt direct-current source of power. One dynamotor D-401 furnishes 400-volt direct current for the high-voltage stages of the transmitter; the other D-402 furnishes 225-volt direct current for the low-power stages of the transmitter and for the operation of the receiver. Both circuits employ ripple-filter systems to reduce the ripple voltage to a negligible amount. Transmitter and receiver tube filaments and the relays are supplied from the same source of power as the dynamotor (batteries or other 12-volt direct-current source).

Either power-source lead may be connected to the GROUND terminal on the power unit, providing the connections on the terminal board are correct for the polarity selected. As supplied, the terminal-board connections are such that the negative lead from the power source should be connected to the GROUND terminal on the power unit.

TRANSMITTER CIRCUITS (Refer to Fig. 43)

Oscillator

Either of two frequency-control circuits may be used when operating the transmitter. The master-oscillator section employs a type 12A6 tube V-101 in a Hartley circuit, and it is continuously tunable from 1500 kc to 3000 kc. Output may be obtained on any frequency within this band by the adjustment of the TUNING capacitor C-101A. The crystal oscillator V-102 provides crystal-controlled output from any one of four crystals. Both oscillator sections are designed so that output may be obtained on the second harmonic frequencies as well as on the fundamentals.

In Bands 1 and 2, the plate circuit of the oscillator (either V-101 or V-102) is capacitively coupled through C-106 and C-108 to the grid circuit of the buffer-doubler tube V-103. In Band 3, however, a tank circuit consisting of L-103, C-107, and C-101B, is switched into the oscillator plate circuit and the oscillator acts as a harmonic generator. Thus, output from the oscillator may be obtained in the band of frequencies 3000 kc to 6000 kc.

Two positions of the OSCILLATOR-SELECTOR switch S-104 are assigned to the master-oscillator circuit and four positions to the crystal-oscillator circuit. The two master-oscillator positions are "MO TEST" (which applies plate potential to the oscillator and buffer stages, permitting preliminary frequency adjustment to be made) and "MO" (which is used for actual operation). In any one of the four crystal-oscillator positions, S-104 removes the screen voltage from the master oscillator V-101 and applies it to the crystal oscillator V-102.

Buffer Amplifier

Tube V-103 is a type 12A6 that acts as a buffer amplifier, with or without frequency doubling. The grid

circuit is capacitively coupled through C-106 and C-108 to the plate circuit of the oscillator. Combination grid-leak and cathode bias is employed. When operating in Band 1, V-103 acts as an impedance-coupled straight amplifier. In Bands 2 and 3, V-103 acts as a buffer-doubler. The BAND SWITCH S-101 selects the proper inductor, and the plate circuit is tuned to the proper frequency by the adjustment of the TUNING capacitor C-101C.

Final Amplifier

The final amplifier employs two type 1625 tubes V-104 and V-105 operating as Class C amplifiers in a parallel-connected circuit. Grid resistors R-107 and R-112 supply the necessary bias. Both tubes are used in CW, but only one in VOICE transmission. When the VOICE-CW switch S-105 is in the "VOICE" position, only V-104 is operative: V-105 is disabled by an open filament circuit and a high resistance R-113 in its cathode circuit. The output stage operates as a straight amplifier on all frequencies. A direct-current potential of approximately 400 volts is applied to the plates of the tubes. Screen voltage is obtained from the dropping resistors R-108, R-109, R-110, and R-111 in the high-voltage circuit.

Modulation System

The modulation system employs two type 1625 tubes V-106 and V-107 in a push-pull modulator. The grids of these tubes are operated through the transformer T-101 by the microphone MI-801. Microphone current is obtained from the cathode circuit of the modulators. Modulator bias is obtained by the use of a cathode resistor R-118.

When the VOICE-CW switch S-105 is placed in the "VOICE" position, the voice relay K-101 is actuated, applying filament power to the modulators. When the microphone "push-to-talk" button is pressed, the combined power-and-antenna relay K-102 is actuated, applying power to the plates of the modulator tubes. Both the plate and screen of the final amplifier tube V-104 are modulated.

Output Circuit

The output circuit consists of a tank inductor L-107, a tuning capacitor C-116, and the padding capacitors C-117 and C-118. This combination will tune over the entire frequency range of the transmitter. The output tank BAND-SWITCH section S-102 is ganged with the exciter BAND-SWITCH section S-101. The taps of the tank inductor and the padding capacitors are so arranged that a favorable L C ratio is maintained throughout the entire tuning range of the tank circuit.

The combination plate-tank inductor and variable coupler L-107 regulates the degree of coupling between the final amplifier tank circuit and the antenna. The variable inductor L-108 and the antenna-padding capacitor C-121 provide a variable means of matching the ouput circuit of the transmitter to the radiation system. With the ANT. COND. switch S-103 in the "OFF" position, C-121 is out of the circuit and L-108 is connected directly to the antenna; in the "PARALLEL" position, C-121 is in parallel with the antenna and ground, while L-108 is still connected directly to the antenna; in the "SERIES" position, C-121 is connected in series with L-108 and the antenna. By selecting the proper combination, a wide range of antenna lengths can be properly matched.

RECEIVER CIRCUITS (Refer to Fig. 44)

The receiver employs a seven-tube superheterodyne circuit and covers the frequency range of 1.5 megacycles to 12 megacycles in three bands.

A single stage of radio-frequency amplification is employed. Two stages of intermediate-frequency amplification provide a high degree of sensitivity and selectivity.

The r-f amplifier V-201 is coupled to the antenna through the BAND-SWITCH section S-208, the transformer L-201, or L-202, or L-203, and the fixed capacitor C-206. The variable capacitor C-201C tunes the secondaries of the transformers L-201, L-202, and L-203 and is one section of the three-section variable capacitor that is rotated by the TUNING control on the front panel of the receiver.

The plate of the r-f amplifier V-201 is coupled to the grid of the converter tube V-202 through the BAND-SWITCH section S-207, the inductor L-204, or L-205, or L-206, and the fixed capacitor C-220. The variable capacitor section C-201B tunes this circuit.

It is probable that the receiver, for most of the time, will be operated continuously tunable over its entire frequency range. For this type of operation the OSCILLATOR-SELECTOR switch S-202 is rotated to the "MO" position, switching in a separate oscillator V-203 to excite the converter V-202. The oscillator frequency (455 kc higher than the signal frequency to be received) is determined by a tuned circuit consisting of the TUNING capacitor section C-201A and the inductor L-208, L-209, or L-210, as selected by the BAND-SWITCH section S-201.

However, provision is made for optional crystal-controlled operation, and in that case the triode section of V-202 serves as the high-frequency oscillator, while V-203 is disabled by the removal of its plate and screen power. Four positions of the OSCILLATOR-SELECTOR switch S-202 are provided for crystal-controlled operation. The crystals themselves may be ground within the range of 1500 kc to 3000 kc, or they may be ground to higher frequencies if desired. They may be operated on the fundamental, the second harmonic, or—if necessary—the fourth harmonic, and in all cases their operat-

ing frequency should be 455 kc above or below the desired reception frequency. This is because the receiver is a superheterodyne with an intermediate frequency of 455 kc.

The output of the converter tube V-202 is fed into the grid of the first intermediate-frequency amplifier tube V-204 through the interstage transformer Z-201. The plate of the first i-f amplifier tube V-204 is coupled to the grid of the second i-f amplifier tube V-205 by the second interstage transformer Z-202.

The second i-f stage is coupled to the diode section of the combined detector and audio-amplifier tube V-206 through the third interstage transformer Z-203. The ouput of the diode detector is amplified in the triode audio-amplifier section of V-206 and is resistance-coupled to the audio output tube V-207. The output of V-207 is coupled to the output circuit by the audio transformer T-201, whose secondary impedance is 500 ohms. This output is fed through a limiting resistor R-229 to the PHONES jack J-201 on the front panel of the receiver. It can also be fed through the receiver and control cables to the remote-control unit, which contains another PHONES jack J-601 and the loudspeaker (refer to "Remote-Control Circuits" below).

Both R-F GAIN and A-F GAIN controls are provided. The R-F GAIN control R-216 is located in the cathodes of the r-f amplifier V-201 and the i-f amplifiers V-204 and V-205. The r-f overall gain is thus regulated by adjusting the bias on these three tubes. The A-F GAIN control R-220 is connected in the grid circuit of the detector—amplifier V-206, permitting the output of the amplifier section of V-206 to be varied by varying the input.

In CW reception the triode section of the detector-amplifier V-206 is made to oscillate by feeding back a portion of the plate output through transformer Z-204 to the grid input. This feedback circuit, brought into play by throwing the MOD.-CW switch S-203 to the "CW" position, heterodynes with the incoming signal to produce an audio-beat-frequency note, the pitch of which may be varied by the CW PITCH control Z-204.

Automatic volume control is provided and is controlled by the AVC switch S-206, which is operated by advancing the R-F GAIN control R-216 in the clockwise direction until a click is heard (at the maximum clockwise position).

When the transmitter is operated, the receiver is disabled by removing the screen voltage from the r-f amplifier, the converter, and the first i-f amplifier stages; by shorting out the secondary of the audio-output transformer and by grounding the ANTENNA terminal. These disabling actions are accomplished by the operation of the send-receive relay K-103 in the transmitter, which is actuated when the MICROPHONE-OR-KEY circuit is closed.

REMOTE-CONTROL CIRCUITS (Refer to Fig. 46)

The Type CCY-23270-A Remote-Control Unit enables the TCS-13 equipment to be operated from a remote point (up to twenty feet—the length of the cable connecting the remote-control and power-supply units). The remote-control unit contains the switches and controls necessary for the operation of both the transmitter and the receiver.

S-602 is the TRANSMITTER "ON-OFF" power switch, controlling both filament and plate power to all stages of the transmitter. S-603 is the RECEIVER "ON-OFF" power switch. S-601 is the SPEAKER-PHONES switch for the selection of the desired output circuit. A permanent-magnet speaker is coupled to the receiver-output circuit by the speaker transformer T-601, and a PHONES jack J-601 is provided for the optional use of earphones for reception. The audio input to either speaker or earphones is regulated by the volume control, R-601. A MICROPHONE-OR-KEY jack J-602 is provided for the insertion of either the microphone plug or the key-cord plug.

III. INSTALLATION

UNCRATING

Open the packing crates carefully. When the crates are marked with arrows to indicate the upright position, remove the crate covers only and carefully lift out the units. Search all packing material for small packages. Remove the wrappings and blow or lightly brush away the packing dust and shavings. Inspect each unit for shipment damage and if apparent damage is found, file a claim immediately with the shipping agency.

TRANSMITTER

Loosen the two knurled nuts on the front panel to relieve the cabinet clamps and remove the transmitter unit from its cabinet. Inspect all components visually for evidence of possible damage and tighten all screws or bolts that may have become loosened in shipment.

WARNING: DO NOT DISTURB TRIMMING ADJUSTMENTS OF CAPACITORS OR INDUCTORS. There are two capacitance trimmers and five inductance trimmers in the transmitter. Disturbing any of these adjustments may easily render the unit inoperative and laboratory facilities will be required for realignment.

If tubes are in place, make sure that they are undamaged and that each tube is pressed firmly down in its proper socket. If tubes are not in place, insert them, referring to the illustrations (Figs. 2 and 3) for the location of the sockets. Fasten each tube clamp securely.

Transmitter Tube-Socket Locations

Tube Symbol	*Tube Type*	*Circuit Function*	*Location (transmitter viewed from the front)*
V-101	12A6	Master Oscillator	Octal socket nearest right-hand side of chassis
V-102	12A6	Crystal Oscillator	2nd octal socket from right side of chassis
V-103	12A6	Buffer-Doubler	3rd octal socket from right side of chassis
V-104	1625	Power Amplifier	Behind antenna-coupling inductor
V-105	1625	Power Amplifier	Behind final tank capacitor
V-106	1625	Modulators	Left rear corner of chassis
V-107	1625		

The four three-prong sockets in the right rear corner of the chassis are for the "plug-in" crystal holders (supplied with some, but not all, TCS-13 equipments, as specified in the contract).

The unit should not be replaced in the cabinet until the cabinet has been mounted (refer to Figs. 39 and 40).

RECEIVER

The receiver cabinet is identical with the transmitter cabinet. In removing the receiver from its cabinet, follow the same procedure as for the transmitter. Carefully inspect all components for possible shipment damage and observe the same warning against disturbance of the trimming adjustments of capacitors and inductors. (There are nine capacitance trimmers and nine inductance trimmers, as well as six i-f transformer capacitance trimmers, and a b-f-o capacitance trimmer, in the receiver.)

If tubes are in place, make sure that they are undamaged and that each tube is pressed firmly down in its proper socket. If tubes are not in place, insert them, referring to the illustrations (Figs. 15 and 16) for the location of the sockets. Fasten each tube clamp securely.

Receiver Tube-Socket Locations

Tube Symbol	*Tube Type*	*Circuit Function*	*Location (receiver viewed from the front)*
V-201	12SK7	R-F Amplifier	3rd octal socket from right-hand side of chassis
V-202	12SA7	Converter	2nd octal socket from right-hand side of chassis
V-203	12A6	Oscillator	Octal socket nearest right-hand side of chassis
V-204	12SK7	1st I-F Amplifier	Left rear corner of chassis
V-205	12SK7	2nd I-F Amplifier	2nd octal socket from left rear corner of chassis
V-206	12SQ7	Detector-Amplifier	3rd octal socket from left rear corner of chassis
V-207	12A6	Audio Output Amplifier	Left front corner of chassis

The four three-prong sockets located in the right rear corner of the chassis are for the "plug-in" crystal holders (not supplied with the TCS-13 equipment).

Do not replace the receiver in its cabinet until the cabinet has been mounted (refer to Figs. 39 and 40).

INSTALLATION

POWER-SUPPLY UNIT

Remove the power-supply unit from its packing material and examine carefully for any damage that may have been caused in shipment. Tighten all mounting screws and terminal connections that may have become loosened in shipment.

Remove the fuses from their holders and check the ratings. Make sure that fuses of the proper ratings are in place and that no faulty fuse is used. Remove the dynamotors' end bells and examine their brushes and commutators for possible damage in shipment.

INSTALLATION FOR OPERATION

Reference should be made to the various installation drawings (Figs. 38 through 42) for installation details.

Before replacing the transmitter and receiver units in their cabinets, the cabinets should be mounted in the desired position. They may be placed end-to-end or stacked one above the other. *It is recommended, however, that wherever possible the horizontal type of installation be used* (*Fig.* 39). Angle irons, mounting brackets, and base plates are supplied with each equipment for mounting the cabinets in either position. In this way, the mounting-space requirement may be changed, as demanded by space exigencies, without need for special cabinets.

Shock mounts are supplied with both the transmitter and receiver cabinets. Due to the varied service conditions under which the TCS-13 equipment may be called upon to operate, it has been considered impracticable to furnish shock mounts that will provide optimum performance under all conditions. Stiff shock mounts are furnished with this equipment to protect it from damage due to shock vibrations of steep wave front, such as might be encountered in transit or during gunfire. Soft shock mounts would be advantageous where the equipment is subjected to continuous vibration and where it must be operated during such vibration.

When the transmitter and receiver are mounted horizontally (refer to Fig. 39), the actual installation will require a space 28¾" long by 11⅝" high by 11⅛" deep. However, enough additional space should be allowed for the free circulation of air about the cabinets. Both cabinets should be bolted firmly to their respective base plates and the latter should be bolted firmly to the operating table or mounting rack. After the cabinets have been fastened in position, the transmitter and receiver units should be placed in the cabinets and clamped in position.

If the transmitter and receiver have to be stacked one above the other (vertical mounting, refer to Fig. 40), the actual installation will require a space 23$^{15}/_{32}$" high by 16" wide by 13$^{7}/_{8}$" deep. For this type of installation, all four shock mounts should be removed from the upper (transmitter) cabinet and two of them bolted to the center-front and center-rear of the lower (receiver) cabinet so that the latter will be supported by six shock mounts. The two remaining shock mounts should be bolted to the respective tops of the right-hand and left-hand long vertical-mounting angle irons so that the two shock-mount bases may be bolted later to a wall or rack. Then the lower cabinet should be bolted to its base plate and the two cabinets fastened firmly together by bolting the two long vertical-mounting angle irons to their rear corners.

The cabinet assembly is now ready for mounting and should be bolted firmly to the operating table and wall or the mounting rack. The transmitter and receiver units now may be placed in their cabinets and clamped in position. The small front mounting angles, used to support the front of the upper cabinet, should be screwed firmly to the front corners of both cabinets (refer to details of Fig. 40).

The power-supply chassis is equipped with flanges for mounting. For dimensions and details, refer to Fig. 41. The power-supply unit may be mounted in any position with ten feet (the length of the transmitter power cable) of the transmitter—receiver combination. The power may be controlled from the transmitter and receiver front panels or from the remote-control unit, so it is not necessary for the power-supply unit to be within reach of the operator.

The remote-control unit may be mounted in any position within twenty feet (the length of the control cable) of the power-supply unit. The control-unit cabinet is also supplied with flanges for mounting (refer to Fig. 42).

Connections

When the installation of the major units has been completed, the interconnecting cables may be plugged in (refer to Figs. 38 and 48). Follow the procedure outlined below in connecting the cables and completing the installation:

1. Place the POWER switches on the transmitter, receiver, and remote-control units in the "OFF" position.

2. Insert one end of the transmitter power cable into the plug receptacle P-101 on the transmitter and the other end into the sixteen-prong receptacle P-402 on the power-supply unit.

NOTE: The plugs at the two ends of this and the other interconnecting cables are alike, except that one is right-angled and the other straight, so that each cable may be reversed, if desired, for convenience in setting up the interconnected equipment.

3. Insert one end of the receiver power cable into the plug receptacle P-201 on the receiver and the other end into the twelve-prong receptacle P-403 on the power-supply unit.

4. Insert one end of the control cable into the plug receptacle P-601 on the remote-control unit and the other end into the remaining receptacle (P-401, nine-prong) on the power-supply unit.

5. Connect the power-supply unit to a twelve-volt direct-current power source with a suitably insulated cable or power cord. Either the negative or the positive lead from the power source may be connected to the GROUND terminal on the power-supply unit, providing the connections on the terminal board are correct for the polarity selected. As supplied, these connections are such that the *negative* lead from the power source should be connected to the GROUND terminal. If it is desired to connect the positive power-source lead to the GROUND terminal, remove the cover plate from the terminal board, reverse the connections to terminals A and B, and reverse the connections to terminals C and D.

IMPORTANT: When changing the polarity of the power input to the power-supply unit, it must be remembered that the input connections to *both* dynamotors must be changed. Refer to the Power-Supply Unit Schematic, Fig. 45. The engraving on the terminal board itself corresponds with the lettered terminals on the schematic.

6. For VOICE operation, the microphone plug should be inserted in either of the MICROPHONE-OR-KEY jacks, J-101 on the front panel of the transmitter, or J-602 on the remote-control unit. For CW operation, the telegraph key-cord plug should be inserted instead in either J-101 or J-602.

7. If a single antenna is to be used for both transmitting and receiving, connect a short wire from the ANTENNA post E-201 on the receiver to the RECEIVER-ANTENNA post E-107 on the transmitter.

8. Make ANTENNA and GROUND connections as directed in the following paragraphs:

Antenna

A single antenna or separate antennas may be used for transmitting and receiving. If a single antenna is used, a "jumper" should be connected as described in procedure-item 7 above. No jumper is necessary if separate antennas are used.

The output network of the transmitter is designed for operation into a twenty-foot vertical radiator of the type known as the "whip" or "fish-pole" antenna. However, satisfactory performance in the frequency range of 1500 kc to 3000 kc (Band 1) can be obtained only through the use of the Type CML-27405 Antenna Loading Coil. Where a twenty-foot vertical "whip" antenna is employed within this frequency range, the antenna loading coil should be connected in series with the antenna lead-in. This inductor is then a part of the antenna coupling network and should be mounted on the operating table or wall near the transmitter for convenience in adjustment. Mounting brackets are supplied (refer to Fig. 49).

Ground

A good ground is an important part of the radiation system. When used in mobile service, the transmitter and receiver GROUND posts should be connected to the frame of the vehicle. If the equipment is operated as a "fixed" station, a good earth ground should be used.

[Handset

[A handset is not supplied with the TCS-13 equipment, but provisions are made for handset connections to a terminal strip inside the remote-control unit. Refer to the control-unit and handset schematics, Figs. 46 and 47. The leads in the handset schematic have been numbered to correspond with the engraving on the terminal strip in the remote-control unit, and like-numbered leads and terminals should be connected together.]

IV. ADJUSTMENT AND OPERATION

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL SAFETY PRECAUTIONS. SEE PAGE VI.

DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND ON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER POWER EQUIPMENT AND OPEN THE MAIN SWITCH IN THE SUPPLY LINE TO EQUIPMENT.

WHILE THE TRANSMITTER IS IN OPERATION, CARE SHOULD BE TAKEN TO AVOID ANY CONTACT WITH THE ANTENNA OR THE ANTENNA POST E-105, SINCE SUCH CONTACT MAY RESULT IN SERIOUS R-F BURNS.

PRELIMINARY.

After the complete equipment has been uncrated and installed, as directed in Section III, the operator should make the following checks before proceeding with any adjustments for actual operation. In addition, constant reference should be made to Figs. A and B, which show the locations of the various transmitter and receiver front-panel controls mentioned in the text.

Be sure that the POWER switches on both the transmitter and receiver panels are in the "OFF" position. Tighten the two knurled nuts, marked with a double-headed arrow, on the transmitter cabinet "hold-in" screws so that the power-interlock switch S-106 is held securely in the closed position. One of these knurled nuts is located on each side of the panel.

Check the installation of the interconnecting cables between the transmitter and power-supply units, the receiver and power-supply units, and the remote-control and power-supply units. Tighten all cable-connector nuts.

Check the connection of the power-supply unit to the batteries or other source of twelve-volt direct-current source of power. Check the fuses F-401 and F-402 in the power-supply unit, making sure that fuses of the proper ratings are in place and that no faulty fuse is used.

Check the ANTENNA and GROUND connections to the transmitter and receiver units.

TRANSMITTER ADJUSTMENT

Master-Oscillator Operation

Turn the BAND SWITCH S-101 and S-102 to the band that includes the desired transmission frequency, and adjust the TUNING control C-101 to the desired frequency as indicated by the dial calibration appearing in the window slightly above and to the left of the TUNING control.

(NOTE: The crystal-oscillator tube V-102 should be in its socket during "MO" and "MO TEST" operation, so that its capacitance will be present to maintain the alignment of the 3-gang tuning capacitor C-101 of the transmitter.)

If the radio-frequency output must be on an exactly specified frequency, it is advisable to use a frequency monitor or other means of checking the frequency. If a frequency-measuring device is available, place the OSCILLATOR-SELECTOR switch S-104 in the "MO TEST" position, and the POWER switch S-107 in the "ON" position. (The receiver POWER switch S-205 of course must also be in the "ON" position, as directed in Section II under "Power-Control Circuits.") The oscillator and buffer stages are now in operation and the frequency may be measured.

Any necessary frequency change may be made by adjusting the TUNING control C-101. When the oscillator has been tuned to the desired frequency, the TUNING control should be locked in position.

When the transmission frequency has been set, the OSCILLATOR-SELECTOR switch S-104 should be rotated to the "MO" position and the other controls set in the following positions:

PLATE TUNING	at	"10"
COUPLING	at	"0"
ANTENNA LOADING	at	"0"
ANT. COND.	at	"OFF"

The rated PLATE-CURRENT readings on M-101 are as follows:

VOICE	80	to	90	ma
CW	170	to	180	ma

There is a ratio of approximately 1:2 between these values for "VOICE" and "CW" because the final amplifier stage has only V-104 operating on "VOICE", but it has both V-104 and V-105 operating on "CW".

The type of emission is selected by throwing the EMISSION switch S-105 to either the "VOICE" or "CW" position as desired. Providing the correct respective PLATE-CURRENT readings are obtained, the adjusting procedure is the same for both "VOICE" and "CW" operation.

With the various controls set as specified above, the microphone "push-to-talk" button should be pressed if "VOICE" operation is chosen (or the telegraph key depressed, or its shorting lever closed, in "CW" operation), and the final amplifier plate-tank and antenna-coupling circuits adjusted as directed below.

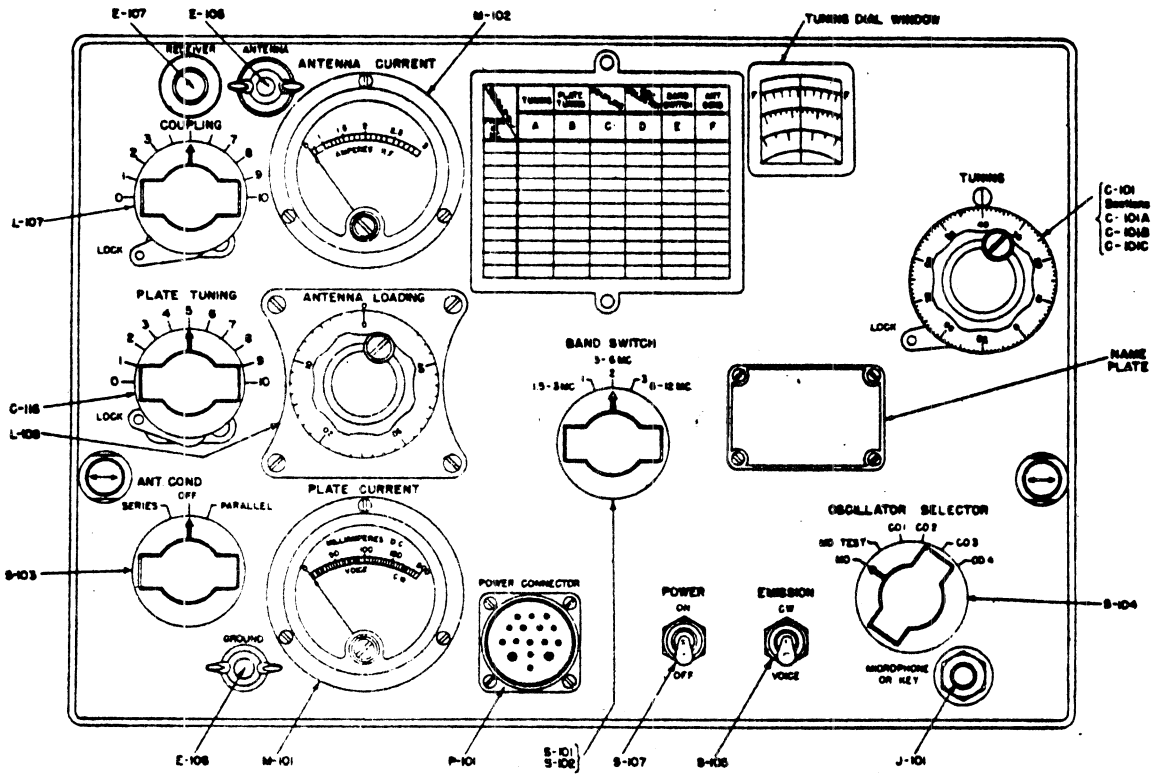


Fig. A Transmitter Unit Front Panel
(showing controls; handles are not shown)

WARNING: Great care must be exercised to prevent damage to the final amplifier tubes due to over-heating in out-of-resonance operation while tuning up. The PLATE-CURRENT reading on M-101 should be watched closely. Under no circumstances should it be allowed to exceed—for any length of time—the rated values (as specified above and indicated by the red "VOICE" and "CW" bands on the scale of the meter). Until resonance is obtained, a momentary excess of plate current may be unavoidable, but it should be reduced as quickly as possible to the maximum safe level.

Resonance is obtained by rotating the PLATE-TUNING capacitor C-116 until the PLATE CURRENT, as indicated on M-101, dips sharply. Tune for the exact minimum PLATE-CURRENT meter reading.

WARNING: Care should be exercised, while making PLATE-TUNING adjustments, to avoid doubling the oscillator-output frequency in the power-amplifier circuit. This stage is designed for operation only as a straight amplifier. It is often possible to obtain PLATE-CURRENT dips with two different settings of the PLATE-TUNING control C-116, but only the lower dial setting (which also gives the lower PLATE-CURRENT reading) is correct. The other dip indicates that the power amplifier is acting as a frequency-doubler; this is undesirable because it loses the advantage of a favorable L, C ratio. All frequency multiplying should be done in the oscillator and buffer stages by selecting the correct position of the BAND switch.

From this point, the tuning will be dependent on the operating frequency and the type of antenna used. The following paragraphs outline the procedure for transmitter adjustments when the recommended "short" (twenty-foot) vertical radiator is employed.

To couple the final amplifier tank circuit with the antenna, the antenna COUPLING control L-107 should be rotated *slowly* in the clockwise direction. As the coupling is increased, the ANTENNA-CURRENT meter M-102 should show a sharp rise in antenna current.

If there is no marked rise in antenna current as the antenna COUPLING control is slowly increased from "0" to its maximum "10", return the setting to "0"

Then re-set the ANTENNA-LOADING control L-108 a few degrees higher, and try again to obtain a sharp rise in antenna current by slowly increasing the setting of the antenna COUPLING control.

If there still is no marked rise in antenna current, return the antenna COUPLING control to "0", re-set the ANTENNA-LOADING control a few degrees higher, and again try increasing the setting of the antenna COUPLING control. Repeat this procedure until a sharp rise in antenna current is obtained and the transmitter can be loaded to the rated plate current.

If it is found impossible to load the transmitter to the rated plate current through adjustments of the antenna COUPLING and ANTENNA-LOADING controls, as directed above, the ANT. COND. switch S-103 should be rotated from the "OFF" to the "SERIES" position, and the loading procedure attempted again. (The "SERIES" setting of S-103 is likely to be required only in operation at the high-frequency end of the transmitter's range.)

NOTE: The "PARALLEL" setting of the ANT. COND. switch S-103 should not be necessary when the Type CML-47205 Antenna Loading Coil is available for properly loading the transmitter to the rated plate current in operation on Band 1 with the recommended "short" antenna. If the antenna loading coil should not be available for operation on Band 1 with the recommended "short" antenna, good operation may be unobtainable. In this case, the "PARALLEL" setting of the ANT. COND. switch should be used. If improvement is still needed, try a longer antenna.

The above paragraphs give a general outline of the tuning and loading adjustments. The procedure itself may be varied slightly, but the operator always should keep in mind the fact that the desired objective is *a maximum ANTENNA-CURRENT reading with the rated PLATE CURRENT.*

Type CML-47205 Antenna Loading Coil

For operation within the frequency range of 1500 kc to 3000 kc (Band 1) with the recommended "short" vertical radiator, it is necessary to use the Type CML-47205 Antenna Loading Coil, connected in series with the antenna lead-in. This is a separate major unit and is distinct from the ANTENNA-LOADING control L-108, which is provided on the transmitter panel. (Referring to Fig. 49, remove the antenna lead-in from the ANTENNA post E-105 on the front panel of the transmitter; connect it to one of the terminal posts, with wing-nuts, on the front panel of the antenna loading coil; and connect a "jumper" wire from the other terminal post of the antenna loading coil to the transmitter ANTENNA post E-105. Another "jumper" wire should be connected from the GROUND post E-703, marked "G", on the front panel of the antenna loading coil to the GROUND post E-106 on the transmitter front panel.

The inductance of the Type CML-47205 Antenna Loading Coil can be varied in steps from "0" (its maximum inductance) to "6" (minimum inductance), as determined by the setting of the tap switch S-701 on the loading-coil panel. These steps are designed so that it is possible to obtain continuously variable loading through the combination of this antenna loading coil and the internal loading coil L-108.

NOTE: In making loading adjustments, whenever the Type CML-47205 Antenna Loading Coil and the transmitter internal loading coil L-108 are used in conjunction, the most effective combination of the two is with the lowest-numbered possible setting (maximum inductance) of S-701 on the Type CML-47205 coil and the highest-numbered possible setting (minimum inductance) of the ANTENNA-LOADING control L-108 on the transmitter front panel.

Remote-Control Operation

Remote operation of the transmitter is possible from the Type CCY-23270-A Remote-Control Unit.

Before changing from transmitter-panel control to remote control, the EMISSION switch and all TUNING adjustments should be made with the panel controls. Then the panel POWER switch should be placed in the "OFF" position, the microphone or the key inserted into the MICROPHONE-OR-KEY jack J-602 on the control unit, and the TRANSMITTER ON-OFF switch S-602 on the control unit placed in the "ON" position. The transmitter now may be voice-modulated or keyed (depending on the setting of the EMISSION switch on the transmitter panel) from any position within the limits of the twenty-foot control cable.

Crystal-Controlled Operation

A separate oscillator tube V-102 is provided for crystal-controlled operation. Any one of four crystals may be selected by setting the OSCILLATOR-SELECTOR switch S-104 in the proper position ("CO-1", "CO-2", "CO-3", or "CO-4"). Crystal-oscillator output may be obtained on the fundamental frequencies or the second harmonic frequencies of the crystals, which are ground within the frequency range of 1500 kc to 3000 kc. The tuning procedure is similar to that described for "Master-Oscillator Operation."

The BAND SWITCH S-101 and S-102 should be set to the band that includes the desired operating frequency. The TUNING control C-101 should be adjusted until the TUNING dial indicates the desired operating frequency. In operation on Band 1, this operating frequency will correspond with the fundamental frequency of the crystal in use; on Band 2 it will corre-

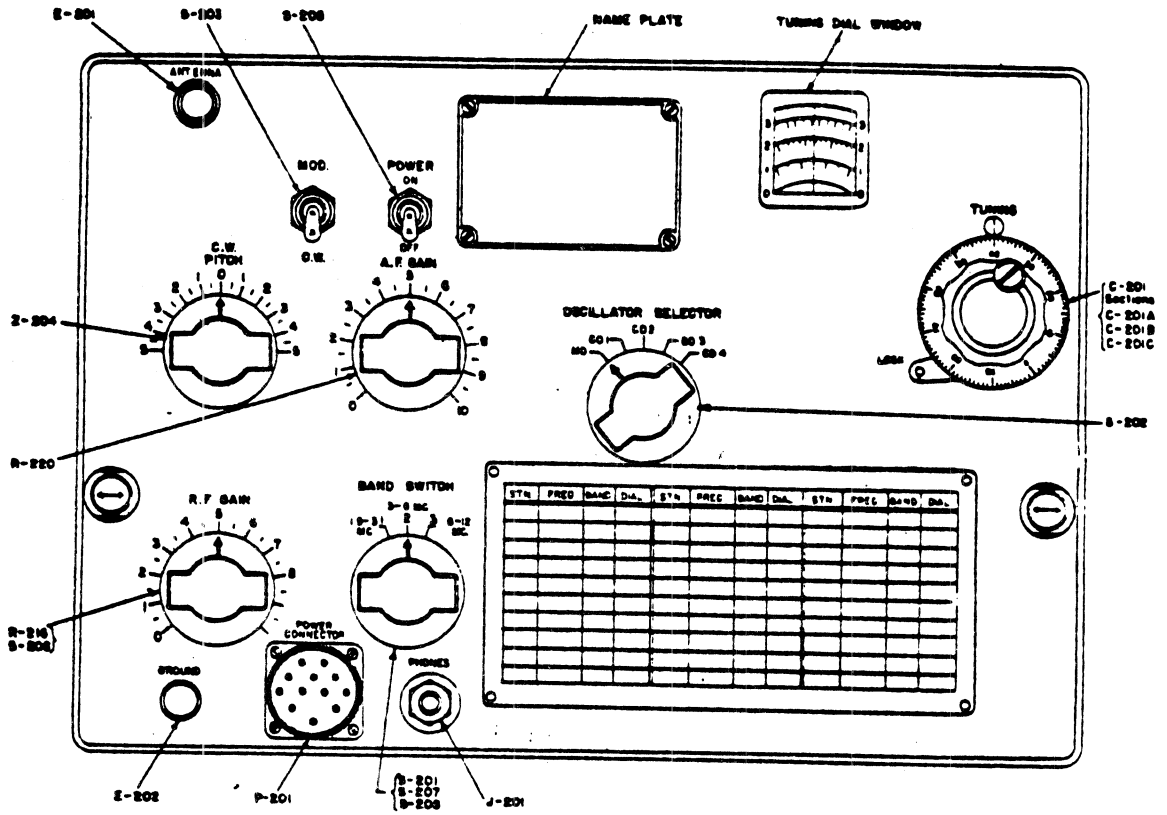


Fig. B Receiver Unit Front Panel
(showing controls; handles are not shown)

spond with the second harmonic frequency of the crystal in use and on Band 3 it will correspond with the fourth harmonic frequency of the crystal in use.

The TUNING control C-101 should be locked in place and then the microphone "push-to-talk" button should be pressed, or the telegraph key depressed or the key shorting switch closed.

Rotate the PLATE-TUNING control C-116 until the plate current (as shown by the PLATE-CURRENT meter M-101) dips sharply, indicating resonance. The same precautions outlined under "Master-Oscillator Operation" should be observed here to avoid damaging the final amplifier tubes by over-heating in out-of-resonance operation while tuning up. In addition, the warning against frequency-doubling in the final amplifier applies here as well as in master-oscillator operation.

In crystal-controlled operation the tuning of the oscillator and buffer stages is rather broad, but in all cases the PLATE-TUNING control should be adjusted to give a minimum PLATE-CURRENT reading, indicating resonance.

Load the final amplifier to the rated-load plate current, following the procedure outlined under "Master-Oscillator Operation."

Many crystals do not key satisfactorily even at slow speeds. This is inherent in the crystal and is not the fault of the transmitter. In general, the keying speed will be limited to twenty words a minute, or less, in crystal-controlled operation.

RECEIVER ADJUSTMENT

Set the OSCILLATOR-SELECTOR switch S-202 in the "MO" position. Set the POWER switch S-205 in the "ON" position. Rotate the BAND SWITCH S-201, S-207, and S-208 to the band that includes the desired reception frequency. The signal to be received may now be located by the adjustment of the TUNING control C-201.

For CW reception throw the MOD.-CW switch S-203 to the "CW" position and partially advance the R-F GAIN control R-216. (Until the R-F GAIN control is advanced to its maximum clockwise position and a click is heard, the automatic volume control is in-

operative.) It is recommended that the A-F GAIN control R-220 be placed in the fully advanced position and that the desired sensitivity and audio output be obtained by adjustments of the R-F GAIN control R-216 only.

For VOICE reception throw the MOD.-CW switch S-203 to the "MOD." position. The R-F GAIN control R-216 should be advanced to its maximum clockwise position until a click is heard indicating that the automatic volume control is placed in operation by the action of the AVC switch S-206. The A-F GAIN control R-220 now may be adjusted to give the desired audio output.

Remote-Control Operation

Before shifting over from receiver-panel control to remote control, all tuning adjustments should be made on the receiver panel and the TUNING control C-201 locked in position. The MOD.-CW switch should be set for the type of operation desired, and the R-F GAIN and A-F GAIN controls adjusted as directed above. In "MOD." reception the VOLUME CONTROL R-601 in the remote-control unit should be fully advanced, and the A-F GAIN control R-220 on the receiver panel should be adjusted to give more than enough speaker output for intelligible reception.

When the above adjustments have been completed, the receiver POWER switch S-205 should be returned to the "OFF" position. The power now may be controlled by the RECEIVER ON-OFF switch S-603 on the remote-control unit, and the audio output may be reduced to its desired level by the use of the VOLUME CONTROL R-601 on the remote-control unit.

Crystal-Controlled Operation

It is probable that the receiver will, for most of the time, be operated continuously tunable over its entire frequency range. However, provision is made for the optional use of crystal-controlled operation. The latter is possible on all three frequency bands, but it may be employed on Band 3 (6000 kc to 12,000 kc) only at the cost of reduced sensitivity.

For crystal-controlled operation the OSCILLATOR-SELECTOR switch S-202 should be rotated to the desired crystal position ("CO-1", "CO-2", "CO-3", or "CO-4"). The BAND switch S-201, S-207, and S-208 should be set to the band that includes the desired reception frequency, and the signal should be "tuned in" by the adjustment of the TUNING control C-201.

Since the apparent selectivity of the receiver in crystal-controlled operation is determined by the sharpness of the r-f couplings into and out of the r-f stage V-201, the adjustment of the TUNING control C-201 may appear rather broad without affecting the actual selectivity. For correct tuning it is sufficient that the OSCILLATOR-SELECTOR switch is set in the proper crystal position and that C-201 is adjusted so that the desired reception frequency is indicated on the calibrated dial.

The crystals themselves (not supplied with the receiver unit of the TCS-13 equipment) should be ground for frequencies within the range of 1500 kc to 3000 kc. Allowance should be made so that the fundamental or harmonic frequency to be used is either higher or lower than the desired reception frequency by the amount of the intermediate frequency, 455 kc. The second and fourth harmonic frequencies of the crystals may be used, but operation with the fourth harmonic will result in reduced sensitivity. The use of the third harmonic is not recommended.

USE OF A BATTERY CHARGER

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

Battery chargers often produce acoustic and electrical noise, which may interfere with the use of the receiver. This is an additional reason for charging the batteries only when the radio equipment itself is not in use.

ROUTINE OPERATION

In the following paragraphs the routine operating procedure is outlined in brief form:

CW or VOICE Operation—Panel Control

1. Place the EMISSION switches S-105 and S-203 on the transmitter and receiver in the positions corresponding with the type of emission and reception desired: "VOICE" (or "MOD.") or "CW".

2. Plug the microphone or the telegraph key into the MICROPHONE-OR-KEY jack J-101 on the transmitter panel.

3. Plug the headphones into the PHONES jack J-201 on the receiver panel.

4. Select the desired type of oscillator control for both transmitter and receiver with the OSCILLATOR-SELECTOR switches S-104 and S-202 ("MO" or choice of four "CO" positions).

5. Adjust the BAND switches and the TUNING controls C-101 and C-201 to the desired frequency.

6. Place the transmitter and receiver POWER switches S-107 and S-205 in the "ON" position.

7. Allow a few seconds for the tube filaments to heat up. Then close the telegraph key (or press the microphone "push-to-talk" button), and adjust the transmitter PLATE-TUNING and ANTENNA-LOADING control as outlined earlier in this section under

"Master-Oscillator Operation." As noted there, the Type CML-47205 Antenna Loading Coil must also be used if the transmitter is to operate within the frequency range of 1500 kc to 3000 kc (Band 1).

After the above adjustments have been made, the complete equipment is ready for operation.

CW or VOICE Operation—Remote Control

Before the equipment can be controlled from the remote position, all tuning adjustments must be made with the transmitter and receiver panel controls.

1. Place the EMISSION switches S-105 and S-203, on the transmitter and receiver panels, in the positions corresponding with the type of emission and reception desired: "VOICE" (or "MOD.") or "CW".

2. Plug the microphone or the telegraph key into the MICROPHONE-OR-KEY jack J-101 on the transmitter panel.

3. Select the desired type of oscillator control for both the transmitter and receiver with the OSCILLATOR-SELECTOR switches S-104 and S-202 ("MO" or choice of four "CO" positions).

4. Adjust the BAND switches and the TUNING controls C-101 and C-201 to the desired frequency.

5. Place the transmitter and receiver POWER switches S-107 and S-205 in the "ON" positions.

6. Allow a few seconds for the tube filaments to heat up. Then close the telegraph key (or press the microphone "push-to-talk" button), and adjust the transmitter PLATE-TUNING and ANTENNA-LOADING controls as outlined earlier in this section under "Master-Oscillator Operation." As noted there, the Type CML-47205 Antenna Loading Coil must also be used if the transmitter is to operate within the frequency range of 1500 kc to 3000 kc (Band 1).

7. When the above adjustments have been completed, return both panel POWER switches to the "OFF" positions.

8. Throw the TRANSMITTER ON-OFF and RECEIVER ON-OFF switches S-602 and S-603, on the remote-control unit, to the "ON" position.

9. Remove the microphone or the telegraph key from the MICROPHONE-OR-KEY jack J-101 on the transmitter panel and insert it into the MICROPHONE-OR-KEY jack J-602 on the remote-control unit.

10. If headphones are to be used, plug them into the PHONES jack J-601 on the remote-control unit, and throw the SPEAKER-PHONES switch S-601, on the same unit, to the "PHONES" position.

11. For speaker operation, the SPEAKER-PHONES switch S-601 should be thrown to the SPEAKER position.

Application of power to the transmitter and the receiver now may be controlled from any position within twenty feet (the length of the control cable) of the power unit. Receiver audio output may be adjusted with the VOLUME CONTROL R-601 on the remote-control unit.

WARNING:

When changing from VOICE to CW emission or from CW to VOICE emission, allow ample time for heating the filaments of the additional tubes being brought into operation before *attempting to obtain full power output.*

VOICE emission requires a lower setting of the Antenna COUPLING control L-107 than CW emission. To prevent damage to the tubes, this control should always be reduced before *throwing the EMISSION-SELECTOR switch S-105 from "CW" to "VOICE" position.*

V. MAINTENANCE AND SERVICE

This radio equipment is 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 nominal amount of attention in order to maintain the most efficient and dependable operation.

ROUTINE SERVICE

Tubes in the TCS-13 equipment may require replacement after several hundred hours of service. It will generally be possible to determine if a tube is defective by checking the performance of the unit when a new tube is substituted.

Blow or lightly brush dirt from the equipment periodically. It is particularly important to prevent the accumulation of dust around the transmitter dials and tuning capacitors.

The relays should be checked periodically for proper operation. The contacts should be carefuly inspected to make certain that the surfaces are clean and free from pits and projections.

A blown fuse indicates a short circuit or other abnormal load condition. The fault should be cleared before replacing the fuse. Replace fuses only with a similar fuse of the same rating.

The bearings on the motors, dynamotors, and generators require lubrication at intervals of 1000 hours or about 6 months of ordinary service. The manufacturers' lubrication instructions, which are printed inside the end bells of the machines, should be followed closely.

TRANSMITTER ALIGNMENT

The tracking adjustments of the transmitter are accurately set at the factory and should not require readjustment unless the unit has been damaged or tampered with. Improper tracking is indicated by low grid excitation to the final amplifier and by inaccurate dial calibration, particularly at the high-frequency end of each band.

If realignment becomes necessary, there is needed an accurate frequency meter, a low-range direct-current milliammeter (0-10 ma), and suitable screwdrivers, wrenches, etc. The master-oscillator section of the transmitter is used in aligning and the procedure is as follows:

Remove the transmitter from its cabinet and place it on a flat surface with the front panel facing upward. In this position, the interlock switch S-106 is held in the closed position, making it possible to apply plate power to the tubes.

The VOICE-CW switch S-105 may be set in either the "CW" or "VOICE" position for alignment adjustments, but the former is preferable. When the switch is in the "CW" position, the modulator filament circuit is opened, reducing power consumption, and both power-amplifier tubes are in operation, giving higher readings of power-amplifier grid current and less critical adjustments. If on "CW", short the key with its shorting switch; if on "VOICE", hold down the "press-to-talk" button.

Set the OSCILLATOR-SELECTOR switch S-104 in the "MO" position.

Take out the screw that holds the grounding lug connecting the final-amplifier grid resistors R-107 and R-112 to the chassis, detach this lug from the chassis-grounding post, and insert the direct-current milliammeter between the junction of the resistors and the chassis (refer to Fig. 3).

Set the BAND SWITCH S-101 in position "1" and rotate the TUNING control C-101 until the tuning dial indicates 3000 kc. Throw the POWER switch S-107 to the "ON" position. (The receiver POWER switch S-205 of course must also be in the "ON" position, as explained in Section II under "Power-Control Circuits.")

Adjust the trimmer capacitor C-102 (refer to Fig. 7) until the oscillator frequency is exactly 3000 kc, as indicated by the frequency meter.

Rotate the TUNING control until the tuning dial indicates 1500 kc and adjust the inductance trimmer L-101 until the oscillator frequency is exactly 1500 kc. Repeat this procedure until no further adjustment of the inductance or capacitance trimmers is required.

The oscillator grid circuit has now been properly aligned with the dial scale, and no further adjustment of this circuit should be necessary.

Rotate the TUNING control to 1500 kc on Band 1 (if it is not already there) and adjust the inductance trimmer L-106 (refer to Fig. 7) for maximum final-amplifier grid current, as indicated by the auxiliary direct-current milliammeter.

Re-set the BAND SWITCH S-101 to position "2", rotate the TUNING control C-101 to 3000 kc (which is the low-frequency end of this band), and adjust the inductance trimmer L-105 (refer to Fig. 7) for maximum final-amplifier grid current.

Re-set the BAND SWITCH to position "3", rotate the TUNING control to 12,000 kc, and adjust the capacitance trimmer C-107 (refer to Fig. 7) for maximum final-amplifier grid current. Rotate the TUNING control to 6000 kc and adjust the inductance trimmers L-103 and L-104 for maximum final-amplifier grid current. Repeat this procedure on Band 3 until no further adjustment of capacitance or inductance trimmers is necessary.

The final-amplifier grid current now should be reasonably uniform on all bands. The meter reading for CW operation may vary from 3.0 ma to 5.0 ma (for VOICE operation the values will be about half as much), but any variation should be in the form of a smooth curve as the TUNING control is tuned over the range of any one band. If any sharp dips are noticed, the alignment procedure should be repeated.

After realignment, the power should be shut off, the auxiliary meter removed, and the grounding lug to which the final-amplifier grid resistors R-107 and R-112 are soldered should be firmly screwed back in its original chassis-ground position. The transmitter then may be replaced in its cabinet.

RECEIVER ALIGNMENT

All circuits are accurately aligned at the factory before shipment. No readjustments should be required or attempted unless the receiver is out of alignment to the extent that its operating performance is seriously impaired.

In case realignment is definitely required, follow the procedure given below. The equipment needed for this purpose includes a good signal generator covering the frequency range from 450 kc to 12,000 kc, an audio-output meter that will present a 500-ohm load to the receiver output, and suitable screwdrivers, wrenches, etc.

Remove the receiver from its cabinet and connect the audio-output meter to the receiver output circuit across Terminal 9 of P-201 and ground (refer to Fig. 16).

Turn off the automatic volume control by a slight counter-clockwise rotation of the R-F GAIN control R-216 from its maximum clockwise position. Rotate this control only until a click is heard (indicating the throwing of the AVC switch S-206) and leave the control in this position. Fully advance the A-F GAIN control R-220.

Intermediate-Frequency Alignment

Connect the signal-generator output across the grid of the converter tube V-202 and ground (no dummy antenna should be used). Feed a 455-kc signal, 30% modulated at 400 cycles, into the converter tube, and adjust all i-f transformer trimmers for maximum output as indicated by the audio-output meter.

If the i-f stages are completely out of alignment, it will be necessary to feed the signal into the grid of the second i-f stage V-205 to obtain enough output. In this case, start by aligning the output circuit of the second i-f stage by adjusting the trimmers of transformer Z-203 for maximum output as indicated by the audio-output meter. Then remove the signal-output lead from the grid of V-205, connect it to the grid of V-204, and adjust the trimmers of Z-202 for maximum output. Then remove the signal-output lead from the grid of V-204 and connect it to grid No. 2 (Terminal No. 8) of the converter tube V-202. Adjust the trimmers of Z-201 and re-adjust the other i-f trimmers (Z-202 and Z-203) for maximum output.

Overall Sensitivity Test

In most cases, realignment of the i-f stages should result in satisfactory performance by the receiver unit. However, if the operator has reason to believe that the proper adjustment of the inductance and capacitance trimmers of the r-f stage has been disturbed, or if unsatisfactory receiver performance indicates that this is the case, it will be necessary to realign the r-f stage.

The proper way of determining whether or not realignment of the r-f stage is demanded is by means of an overall sensitivity test. This requires a signal generator whose output can be calibrated in microvolts and some means of measuring the receiver output in milliwatts. Connect a dummy antenna between the output lead of the signal generator and the receiver ANTENNA terminal E-201. The recommended dummy antenna consists of a ten-ohm non-inductive resistor in series with a hundred-micromicrofarad capacitor. Various r-f signals (30% modulated at 400 cycles) within the frequency range of the equipment should be fed into the receiver, and the receiver itself should be accurately tuned to each such signal. For an audio output of six milliwatts, the signal input should be less than fifteen microvolts at all frequencies within the range of the equipment. If more than this signal input is required to give a six-milliwatt output, the sensitivity of the receiver should be considered unsatisfactory.

Radio-Frequency Alignment

Remove the tuning chart from the front panel of the receiver, exposing nine slots in the panel that give access to the trimmers requiring readjustment. Loosen the capacitance-trimmer lock-nuts on C-202, C-203, C-204, C-207, C-208, C-209, C-213, C-215, and C-217.

The dummy antenna specified above (10-ohm non-inductive resistor in series with a 100-micromicrofarad capacitor) should be connected in series with the signal-output lead and the receiver ANTENNA terminal E-201. Set the receiver front-panel control as follows:

POWER	at	"ON".
OSCILLATOR SELECTOR	at	"MO"
MOD.-CW	at	"MOD."

1. For alignment of Band 1, set the BAND SWITCH S-201 in position "1". Set the receiver TUNING control C-201 and the signal generator to 1500 kc, and adjust the inductance trimmers L-203, L-206, and L-210 for maximum output as indicated by the audio-output meter.

2. Advance the receiver TUNING control and the signal generator to 3000 kc, and adjust the capacitance trimmers C-204, C-209, and C-217 for maximum output.

3. Repeat steps 1 and 2 until no further adjustment of the inductance and capacitance trimmers will increase the output. Two or three adjustments at each frequency will usually be enough.

4. Re-set the receiver TUNING control and the signal generator to 2250 kc (the midpoint of Band 1) and check calibration and sensitivity.

5. For alignment of Band 2, set the BAND SWITCH in position "2". Set the receiver TUNING control and the signal generator to 3000 kc, and adjust the inductance trimmers L-202, L-205, and L-209 for maximum output.

6. Advance the receiver TUNING control and the signal generator to 6000 kc, and adjust the capacitance trimmers C-203, C-208, and C-215 for maximum output.

7. Repeat steps 5 and 6 until no further adjustments of the inductance and capacitance trimmers will increase the output.

8. Re-set the receiver TUNING control and the signal generator to 4500 kc (the midpoint of Band 2) and check calibration and sensitivity.

9. For alignment of Band 3, set the BAND SWITCH in position "3". Set the receiver TUNING control and the signal generator to 6000 kc, and adjust the inductance trimmers L-201, L-204, and L-208 for maximum output.

10. Advance the receiver TUNING control and the signal generator to 12,000 kc, and adjust the capacitance trimmers C-202, C-207, and C-213 for maximum output.

11. Repeat steps 9 and 10 until no further adjustment of the inductance and capacitance trimmers will increase the output.

12. Re-set the receiver TUNING control and the signal generator to 9000 kc (the midpoint of Band 3) and check calibration and sensitivity.

13. Tighten the lock-nuts on all nine capacitance trimmers.

Having completed the realignment, the receiver may be replaced in its cabinet and the tuning chart refastened to the front panel.

Beat-Frequency Oscillator

In CW reception, if it is impossible to adjust the beat-frequency oscillator to produce an audible signal of variable pitch, this stage should be realigned as follows:

1. Loosen the adjusting-screw lock-nut on the capacitance trimmer of the beat-frequency oscillator coil Z-204.

2. Set the CW PITCH control to "0".

3. Set the MOD.-CW switch in the "MOD." position and tune the receiver to the exact frequency of any r-f signal, within the equipment's range, fed into it from the signal generator through the dummy antenna specified above.

4. Switch off the modulation on the signal from the signal generator and re-set the receiver MOD.-CW switch in the "CW" position.

5. Without re-tuning the receiver, adjust the capacitance trimmer of Z-204 for "zero beat" (zero audio output as indicated by the output meter).

6. Re-tighten the adjusting-screw lock-nut on the Z-204 trimmer.

As a check on the realignment of the beat-frequency oscillator, the CW PITCH control should be rotated. The pitch of the audio-frequency beat note should rise as the control is rotated from "0" toward "5" in either direction.

PROCEDURE FOR DIS-ASSEMBLING TCS-13 EQUIPMENT FOR SERVICING

The removal of component parts without major dis-assembly of individual units is facilitated in the TCS-13 equipment by the extensive employment of the sub-assembly type of construction.

The following instructions, presented in chart form, should be used as a guide by the service man who removes and replaces any TCS-13 component parts that are subject to damage or deterioration.

TRANSMITTER

Assembly	Parts Included	Instructions for Assembly Removal
Back Plate Figs. 2 and 3	C-125, C-126, C-127, C-129, T-101, T-102	Removal of the back plate simplifies much of the service work on the transmitter: it gives immediate access to the parts mounted directly on the back panel and it also fully exposes many other transmitter parts. To remove the back plate, take out the following screws: the 4 on each edge that bolt the plate to the end castings, the 2 that fit into the crystal bracket, the 2 (screwing into stake-nuts) that are near the center of the plate, the 3 that bolt the plate to the vertical modulator-compartment shield, and the one bolting the modulator chassis to the left-end casting. The modulator tube chassis is left bolted to the back plate and no other screws need be taken out. The back plate can now be lifted away from the transmitter frame as far as the connecting wires permit. Some additional clearance may be gained by cutting some of the cable ties.
Front Panel Fig. 11	S-101 Detent, S-101 Rotor	Removal of the front panel is necessary only for replacement of the S-101 detent and rotor.
Crystal Bracket Figs. 8 and 9	C-122, C-123, C-124, C-129, K-101, L-109, R-114, R-115, R-116, S-104, X-108, X-109	Removal of the back plate (see above) gives access to all crystal-bracket parts. When its mounting screws are taken out, the back plate can be pulled away from the crystal bracket. If it becomes necessary to remove the crystal bracket entirely: first, take off the back plate; then take out the 2 screws fitted into the right-end casting, remove the connecting wires, take off the knob of S-104, and slide out the S-104 shaft. The crystal bracket now can be slid out the bottom of the transmitter.
Variable Capacitor Figs. 12 and 13	C-101A, C-101B, C-101C	To remove the variable-capacitor assembly: Take off the "TUNING" knob and the dial lock (unscrew the dial-lock handle counter-clockwise). Reaching through a hole in the right-end casting with a #6 Bristo wrench, loosen the set screws in the shaft extension and remove the shaft extension. Unsolder the 3 wires to the exciter and the braided ground wire. Take out one mounting screw from the right-end casting and 2 from the mounting-foot fitted into the top plate of the exciter. Remove screw from front panel holding tie rod mounting block. The variable capacitor now can be lifted out the top of the transmitter. In unsoldering the 3 wires going from the variable-capacitor sections to the exciter, it is helpful to remove the three tubes, V-101, V-102, and V-103, and to pass the soldering iron through the large slots in the shield between these tubes and the variable capacitor.

Assembly	Parts Included	Instructions for Assembly Removal
Exciter Figs. 6, 7, and 10	C-102, C-103, C-104, C-105, C-106, C-107, C-108, C-109, C-111, C-112, C-113, L-101, L-102, L-103, L-104, L-105, L-106, R-101, R-102, R-103, R-104, R-106, R-125, S-101, X-101, X-102, X-103	Removal of the exciter is not advisable unless the part sought for replacement is otherwise inaccessible. External parts can be replaced by loosening or removing the transmitter back plate and the crystal bracket (refer to the preceding page). Internal parts can be replaced by removing the variable capacitor C-101, Fig. 12 (refer to the preceding page), or the bottom plate of the exciter, Fig. 10. To remove this bottom plate, take off the knob of S-104, slide out the shaft of S-104, and take out all bottom-plate machine screws. To remove the top plate, take out all its machine screws. If it is necessary to remove the exciter assembly itself, the procedure is as follows: Remove the right-end casting by taking out the back-plate screws, front-panel handles, cabinet locks, and the screws holding the exciter and the crystal bracket. Take out the 2 screws in the top bracket next to V-102 and V-103. Take out the 4 screws in the left end of the exciter, 2 of which hold C-128. Take off the knobs of S-101 and S-104 , loosen #6 Bristo set screw at end of shaft and slide out the shafts of these switches. Remove the cable clamps and the connecting wires. Disconnect three buss wires from the variable capacitor C-101. The exciter assembly now can be removed from the right end of the transmitter.
Final Amplifier Plate Inductance Figs. 4 and 5	L-107	Before removing L-107, take off its "COUPLING" dial and dial lock (the latter is removed by taking out the mounting screws and turning the lever counterclockwise). The coil then can be unbolted from the left-end casting, its connecting wires clipped, and the coil brought out through the casting. (Note: It is recommended that the connecting wires be clipped and replaced rather than unsoldered while the coil is still in the transmitter.)
Antenna Loading Coil Figs. 2 and 3	L-108	To remove L-108: take out the 4 mounting screws bolting the bakelite escutcheon to the front panel, take out one screw in the rear bracket, and unsolder the connecting wires. The whole unit then can be brought out through the front panel.
Plate-Tuning Capacitor Figs. 4 and 5	C-116	To remove C-116, L-108 must first be removed as directed above. Then take off the dial lock of C-116 by taking out its mounting screws and turning the lever counterclockwise. Take out the bolts securing C-116 to the left-end casting and unsolder the connecting wires. C-116 then can be brought out through the mounting hole for L-108.

RECEIVER

Assembly	Parts Included	Instructions for Assembly Removal
R-F, Converter, and H-F Oscillator Assemblies Figs. 20, 21, and 22	C-202, C-203, C-204, C-206, C-207, C-208, C-209, C-210, C-212, C-213, C-214, C-215, C-216, C-217, C-218, C-220, C-223, L-201, L-202, L-203, L-204, L-205, L-206, L-208, L-209, L-210, S-201, S-207, S-208	These three units are exposed for servicing by the removal of a bottom plate secured by 11 screws, and most service work on them can be done without removing the units themselves. However, if it is found necessary to remove them, the procedure is as follows: Loosen the set screw in the gear end of the band-switch shaft (S-201, S-207, S-208), press the shaft out of the switch sections and through the hole in the right-end casting. The section of the switch shaft going through the front panel may be removed by taking off its knob and pulling the shaft section out through the detent bushing. Remove the front panel to gain access to the screws bolting the oscillator section to the right-end casting. Take out 6 screws on top and 3 along the front end of the r-f chassis. The units now are free except for their connecting wires, which must be removed carefully so as not to damage any component parts.
R-F Chassis Figs. 23 and 24	C-205, C-211, C-219, C-221, C-222, C-224, C-225, L-207, R-201, R-202, R-203, R-204, R-205, R-206, R-207, R-208, R-209, R-211, R-212, R-213, S-202, T-201, X-201, X-202, X-203, X-208, X-209	All parts on the r-f chassis are made easily available for replacement by taking off the receiver back plate and loosening the large resistor board. In taking off the back plate, remove all the screws. Before attempting to loosen the resistor board, C-234 should be taken off and pulled away from the board. Then the 4 mounting screws holding the resistor board can be taken out. The connecting leads are flexible enough so that the resistor board can be turned, giving access to the parts on the lower side.
I-F and B-F-O Assemblies Figs. 25, 26, 27, and 28	C-226, C-227, C-288, C-229, C-231, C-232, C-233, C-235, R-210, R-214, R-215, R-218, R-219, R-221, R-222, R-223, R-224, R-225, R-226, R-228, R-230, R-232, X-204, X-205, X-206, X-207, Z-201, Z-202, Z-203, Z-204	Most of the parts in these assemblies are serviceable without major dis-assembly. To remove the i-f assemblies, disconnect the connecting wires and take out 4 mounting screws on the top of each assembly plate. The inter-connecting wires between the different stages must be removed and pulled through the plates. To repair the b-f-o transformer Z-204: take off the nuts from the studs holding the shield-can to the chassis, remove two screws on front panel adjacent to b-f-o shaft. Loosen bearing plate to permit access and removal of trimmer capacitor mounting screws thru holes in front panel, and pull off the shield-can.
R-F Gain Control Figs. 16, 17, and 18	R-216	The removal of R-216 involves gaining enough room behind it so that it may be taken off the rear of the front panel. This is done by taking out the 4 b-f-o assembly mounting screws and tipping back the b-f-o assembly. It is not necessary to remove the CW PITCH knob or any b-f-o unit connections. When replacing R-216, align its positioning pin with the hole in the panel.
Variable Capacitor Figs. 12 and 13	C-201A, C-201B, C-201C	The variable capacitor C-201 may be removed as follows: Take off the "TUNING" knob and the dial lock (unscrew the dial-lock handle counterclockwise). Reach through the hole in the right-end casting with a #6 Bristo wrench, loosen the set screws in the shaft extension, and remove the shaft extension. Unsolder the connecting wires, take out one mounting screw from the right-end casting and two from the mounting-foot fitted into the r-f chassis. Remove screw from front panel holding tie rod mounting block. Lift the variable capacitor out the top of the receiver.

LOCATION OF FAULTS

The most common cause of improper operation of radio equipment is tube failure. A complete set of tested tubes of the same types 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 it 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.

Defective tubes causing an overload in the 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 capacitor 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 equpiment 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.

Decreased B-plus voltage and increased ripple components are likely to result from operation with power-supply dynamotors whose commutators require cleaning or whose brushes require cleaning or replacement. This may be the cause of an otherwise inexplicable drop in power output, "hash" in the transmitter output, and excessive noise in the audio output.

Dynamotor brushes and commutators should be examined periodically. Remove both end bells of each dynamotor (take out two screws in each end bell). Brushes that are badly worn should be replaced from the supply of spares, and care should be taken that each spare selected is identical in voltage and polarity rating with the brush it is to replace. Brushes that are not badly worn may be wiped off with a clean cloth free from lint and replaced in exactly their original positions in their holders. Commutators may be cleaned by wiping with a clean cloth that has been dipped in alcohol. Time should be allowed for the alcohol to evaporate (about five minutes should be sufficient) before the end bells are replaced on the dynamotors.

Warning: Do not use emery cloth, or any other abrasive containing conductive particles, to clean the commutator. If necessary, a very fine grade of sandpaper may be used, but only if great care is taken to avoid scoring the commutator segments.

VI. POWER REQUIREMENTS

POWER REQUIREMENTS

The maximum power taken from the power source under the various conditions encountered in normal operation is listed below.

Conditions	*Power Required*
CW-Key Open, Receiver ON	108 watts
CW-Key Closed, Receiver "Stand-by"	185 watts
VOICE—"Stand-by", Receiver ON	110 watts
VOICE—90% Modulated, Receiver "Stand-by"	205 watts
Transmitter OFF, Receiver ON	58 watts

FILAMENT-POWER REQUIREMENTS

Transmitter—CW	11.6 volts	1.28 amps
Transmitter—VOICE	11.6 volts	1.72 amps
Receiver	10.9 volts	1.02 amps

PLATE-POWER REQUIREMENTS

Transmitter

Type of Emission	*L.V. Stages*	*H.V. Stages*	*Total Current*
CW	26 ma	156 ma	182 ma
VOICE	26 ma	178 ma	204 ma

The above measurements were made with milliammeters inserted in the leads between the power unit and the transmitter.

Receiver

The receiver requires approximately 95 ma of plate current for either CW or MOD. reception.

VII. TABLES

TABLE I.

LIST OF MAJOR UNITS FOR NAVY MODEL TCS-13 RADIO EQUIPMENT

Navy Type Designation	Name	Symbol Group	Assembly Drawing
CIH-52245-A	Transmitter (including cabinet with shock mounts)	101 to 199	Figs. 38, 39, and 40
CIH-46159-A	Receiver (including cabinet with shock mounts)	201 to 299	Figs. 38, 39, and 40
——	Not used	301 to 399	——
CIH-21881-B	Power Supply	401 to 499	Fig. 41
——	Not used	501 to 599	——
CCY-23270-A	Remote Control	601 to 699	Fig. 42
CML-47205	Antenna Loading Coil	701 to 799	Fig. 49
——	Accessories	801 to 899	——

PARTS LIST AND SPARE PARTS LIST

Preliminary Notes

Table II, on the following pages, is the main parts list of the complete TCS-13 equipment. The parts are grouped in classes arranged in the alphabetical order of their symbol designation prefixes: (C) Capacitors, (D) Dynamotors, (E) Miscellaneous Electrical Parts, etc. Within each class, the parts are tabulated in numerical order by their symbol designations: C-101, C-102, C-103, ..., C-201, C-202, ..., C-401, C-402, etc.

Parts whose symbol designation is preceded by an asterisk (*) have spares and are therefore also listed in the Spare Parts List (Table III).

Table III is arranged similarly to Table II except that it is divided into two sections. Section I contains the Spare Parts List for the Transmitter, Receiver, and Remote-Control Units; Section 2 contains the Spare Parts List for the Type -21881-B Power-Supply Unit. (No spare parts are furnished for the Antenna Loading Coil Unit.)

Throughout Tables II and III the usual "Contractor's Drawing and Part Number" column is replaced by two columns: "Collins Drawing and Part Number" and "Hamilton Drawing and Part Number." The reason for this is that other models in the TCS Series have been and are being manufactured by the Collins Radio Company, Cedar Rapids, Iowa, and wherever the Collins drawing and part number is available for a part identical with that in the TSC-13 equipment, this number has been included here *for reference purposes only.*

Care should be taken, when ordering replacement parts for any model of the TCS Series Radio Equipment, to determine the actual contractor for that particular model (as indicated by the equipment's nameplates), and to order the replacement part under the applicable drawing and part number. All orders for replacement parts of course should also include all other necessary data, as specified under "Requests for Replacement Material," page xi

Throughout Tables II and III, wherever the abbreviation "W. V." is used in the voltage rating of capacitors, the value is *direct-current working voltage* unless stated otherwise.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATING OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(C) CAPACITORS							
C-101	C-101A, C-101B, C-101C	Triple-section variable			2220	M-10750		6940	SA-1433-1
C-101A	V-101 Grid tuning	301 μμf section of C-101							
C-101B	V-101 Plate tuning	301 μμf section of C-101							
C-101C	V-103 Plate tuning	301 μμf section of C-101							
C-102	V-101 Grid trimmer	4.5 to 75 μμf midget variable, 600 W.V.	481880		2425	ARL-7 Single		922842	CO-798
*C-103	Temperature comp.	Ceramic, 20 μμf ±2-1/2%, 500 W.V., temp. coef. -.00075%			290	Class D		913N20D7.5	CO-945
*C-104	V-101 Grid cap.	Silvered mica, 50 μμf, ±10%, 500 W.V.	481279-B10	MR-484-1437	648	MDBH		912M50A	CO-790
*C-105	V-101 Screen bypass	Mica, 0.001 μf ±20%, 750 W.V.			025	BE-15		915R210E	CO-762
*C-106	V-101 Plate coupling	Mica, 0.002 μf ±20%, 750 W.V.			025	BE-15		915R220E	CO-763
C-107	V-101 Plate trimmer	3 to 25 μμf midget variable, 600 W.V.	481881		2425	ARL-21 Single		922837A	CO-799
*C-108	V-103 Grid coupling	Same as C-105							
*C-109	V-103 Cathode bypass	Mica, 0.006 uf ±20%, 750 W.V.			025	BE-15		915R260E	CO-803
C-110	Not used								
*C-111	V-103 Plate blocking	Same as C-109							
*C-112	V-105 Grid coupling	Same as C-105							
*C-113	V-104 Grid coupling	Same as C-105							
*C-114	V-104 Screen bypass	Same as C-106							
*C-115	V-105 Screen bypass	Same as C-106							
C-116	Plate tuning	20 to 425 μμf midget variable, 800 W.V.	481849		2408	80114		922852	CO-797
*C-117	Series final tank	Mica, 600 μμf +20% -0%, 2000 W.V.			025	A2-50		950M350A	CB-1006
*C-118	Shunt final tank	Mica, 50 μμf ±20%, 2000 W.V.			025	A2-50		950M50A	CO-766

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPECIFICATION OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(C) CAPACITORS - continued							
*C-119	Final plate blocking	Mica, 0.01 µf ±20%, 1200 W.V.			666	S-6742		925W110A	CO-767
*C-120	V-105 Cathode bypass	Mica, 0.008 µf ±20%, 300 W.V.			648	[illegible]		909W280CW	CO-787
*C-121	Padding capacitor	Silvered ceramic, 50 µµf ±10%, 2500 v. wrkg. at 2.0 mc			25C	850		913N450C	CO-865
*C-122	V-102 Grid capacitor	Mica, 50 µµf ±10%, 600 W.V.			028	RE-10		910M450E	CO-802
*C-123	V-102 Cathode bypass	Mica, 250 µµf ±10%, 500 W.V.			028	RE-10		910M325E	CO-771
*C-124	V-102 Screen bypass	Same as C-109							
*C-125	Mike coupling	Oil-filled paper, 4.0 µf ±20%, 600 W.V.	481249-20	RE-131-488E RE-48A-110	666	S-7784		930B8	CO-772
*C-126	Mod. cathode bypass	Same as C-125	481249-20						
*C-127	Mod. screen bypass	Foil paper 0.25 µf ±20%, 600 W.V.	481392-20	RE-13A-488E RE-48A-128	666	S-6413		956RB05W	CO-773
*C-128	C-128A, C-128B	Foil paper, dual-section, 0.1 µf ±20%, 600 W.V.	48312-820	RE-13A-488E RE-48A-128	666	P-9453		956ND01W	CO-806
C-128A	Spark suppressor	Section of C-128							
C-128B	Spark suppressor	Section of C-128							
*C-129	Mike current filter	Foil paper, 2.0 µf ±20%, 400 W.V.	448403-820	RE-13A-488E RE-48A-129	666	P-9454		954M84Y	CO-775
*C-130	V-105 Cathode bypass	Same as C-120							
C-201	C-201A, C-201B, C-201C	Triple-section variable			2220	U-10730		7159	SA-178C-1
C-201A	Osc. tuning	301 µµf, section of C-201							
C-201B	Converter tuning	301 µµf, section of C-201							
C-201C	R-F tuning	301 µµf, section of C-201							

* Spare parts furnished; see Table III.
Δ For replacement use

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOP PATH OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(C) CAPACITORS - continued							
C-202	R-F trimmer, band 3	Same as C-107	481881						
C-203	R-F trimmer, band 2	Same as C-107	481881						
C-204	R-F trimmer, band 1	Same as C-107	481881						
*C-205	C-205A and C-205B	Foil paper, dual-section, 0.1 µf ±20%, 400 W.V.	648312-B20	RE-13A-488E RE-48A-129	66S	P-9451		954WD01W	CO-776
C-205A	V-201 Cathode bypass	Section of C-205							
C-205B	V-201 Screen bypass	Section of C-205							
C-206	V-201 Grid coupling	Silvered mica, 100 µµf ±20%, 500 W.V.			6AS	MOSW		912W310A	CO-769
C-207	Conv. trimmer, band 3	Same as C-107	481881						
C-208	Conv. trimmer, band 2	Same as C-107	481881						
C-209	Conv. trimmer, band 1	Same as C-107	481881						
C-210	Plate supply bypass	Mica, 0.01 µf ±20%, 500 W.V.			028,66S	RLS-1110		910W110C	CO-778
*C-211	C-211A, C-211B, C-211C	Foil paper, triple-section, 0.1 µf ±20%, 400 W.V.	648713-B20	RE-13A-488E RE-48A-129	66S	P-9454		954WT01Y	CO-804
C-211A	V-202 Screen bypass	Section of C-211							
C-211B	V-203 Screen bypass	Section of C-211							
C-211C	V-202 Cathode bypass	Section of C-211							
*C-212	Series padding	Silvered mica, 0.004 µf ±5%, 300 W.V.	48929-B5		6AS	MASW		912W240A	CO-780
*C-213	Osc. trimmer, band 3	Same as C-107	481881						
*C-214	Series padding cap.	Silvered mica, 0.002 µf ±5%, 500 W.V.	48856-B5		6AS	MASW		912W220A	CO-781
*C-215	Osc. trimmer, band 2	Same as C-107	481881						
*C-216	Series padding cap.	Silvered mica, 0.00125 µf ±5%, 500 W.V.			6AS	MASW		914W2125A	CO-782
*C-217	Osc. trimmer, band 1	Same as C-107	481881						

* Spare parts furnished; see Table III.
Δ For replacement use

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPARE PARTS FURNISHED SEE TABLE III	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(C) CAPACITORS - continued							
*C-218	V-203 Grid coupling	Silvered mica, 50 µµf ±20%, 500 W.V.	48895-B20		648	MDSV		912M450C	CO-770
*C-219	Osc. tuning padding	Same as C-103							
*C-220	V-202 Grid coupling	Same as C-206							
*C-221	V-202 Grid feedback	Same as C-218	48895-B20						
*C-222	V-202 Grid feedback	Silvered mica, 250 µµf ±20%, 500 W.V.			648	MDSV		912M825C	CO-783
*C-223	Osc. coupling cap.	Same as C-206							
*C-224	Converter tuning pad.	Silvered mica, 30 µµf ±10%, 500 W.V.			648	MDSV		912M430C	CO-784
*C-225	R-F tuning padding	Silvered mica, 25 µµf ± 5%, 500 W.V.			648	MDSV		912M420C	CO-1016
*C-226	C-226A, C-226B, C226C	Same as C-211	448713-B20						
C-226A	V-205 Cathode bypass	Section of C-226							
C-226B	V-205 Screen bypass	Section of C-226							
C-226C	V-205 Plate decoupling	Section of C-226							
*C-227	V-206 Diode feedback	Silvered mica, 200 µµf ±20%, 500 W.V.	481235-B20		648	MDSV		912M320A	CO-786
*C-228	V-206 Audio coupling	Same as C-120							
*C-229	V-206 Grid bypass	Same as C-214	48856-B5						
*C-230	V-206 Plate bypass	Silvered mica, 500 µµf ±20%, 500 W.V.			648	MDSV		912M350A	CO-761
*C-231	V-207 Audio coupling	Same as C-210							
*C-232	C-232A and C-232B	Foil paper, dual-section, 0.1 µf ±20%, 400 W.V.	481465-20	RE-13A-4882 RE-484-129	668	P-9452		954MD01F	CO-774
C-232A	AVC bypass	Section of C-232							
C-232B	V-206 Cathode bypass	Section of C-232							
*C-233	C-233A and C-233B	Same as C-232	481465-B0						

Spare parts furnished; see Table III

▲ For replacement use

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SHEET 5 OF 19

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	[illegible]	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(C) CAPACITORS - continued							
C-233A	V-204 Cathode bypass	Section of C-233							
C-233B	V-204 Grid bypass	Section of C-233							
*C-234	Plate supply filter	Same as C-127	481392-20						
*C-235	V-207 Plate bypass	Mica, 0.004 µf ±20%, 1200 W.V.			02S	HLS-2210		925R240C	CO-789
*C-401	C-401A, C-401B, C-401C	Foil paper, triple-section 0.1 µf ±20%, 600 W.V.	48849-A20	RE-13A-488E RE-48A-128	66S	2527-8		956RTOIW	CO-779
C-401A	H-V dynamotor pri. noise-filter	Section of C-401							
C-401B	L-V dynamotor sec. noise-filter	Section of C-401							
C-401C	L-V dynamotor pri. noise-filter	Section of C-401							
*C-402	H-V dynamotor pri. noise-filter	Mica, 0.006 µf ±20%, 500 W.V.			64S	MWSW		909R260CW	CO-764
*C-403	H-V noise-filter	Same as C-109							
*C-404	H-V noise-filter	Same as C-109							
*C-405	H-V noise-filter	Same as C-125	481249-20						
*C-406	Spark suppressor	Same as C-127	481392-20						
*C-407	L-V noise-filter	Same as C-125	481249-20						
C-408	Not used								
*C-409	L-V noise-filter	Same as C-402							
*C-410	L-V dynamotor pri. noise-filter	Same as C-402							
C-411	Not used								
*C-412	Spark suppressor	Same as C-127	481392-20						

* Spare parts furnished; see Table III

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPARE PARTS FURNISHED OR NOT	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(D) DYNAMOTORS							
*D-401	Dynamotor	Input: 12v., 9.9 amp., d.c. output: 400 v., 0.18 amp., d.c.; 4700 rpm	211041		60E	ML-4120-46		231E41	DM-1000
*D-402	Dynamotor	Input: 12 v., 3.8 amp., d.c. output: 220 v., 0.1 amp., d.c.; 4400 rpm	211042		200W	35X030-A		231E40A	DM-1001
		(E) MISCELLANEOUS ELECTRICAL PARTS							
*E-101	V-104 Pl. parasitic sup.	47-ohm res. ±20%, 1 w., shunted by 8-turn coil			224E	SA-1549		704A	SA-1549
*E-102	V-105 Pl. parasitic sup.	Same as E-101							
E-103	Not used								
E-104	Not used								
E-105	Trans. antenna post	Stud, wing nut, lockwasher, washers, and ceramic bushing			224H	Part of SA-1518			Part of SA-1518
E-106	Trans. ground post	Screw, wing nut, lock-washer and washers			224H				
E-107	Rec. antenna post	Push type with locating pin			50X	B1P			TE-1001
E-201	Rec. antenna post	Push type without locating pin			50X	B1		372E13	TE-1005
E-202	Rec. ground post	Same as E-107							
E-601	Handset term. bd.	4-Terminal, bakelite strip			210C	SA-1443		223DA	SA-1443
E-701	Dial assembly	Dial plate and knob			224H	SA-1525		472A-A	SA-1525
E-702	Terminal bushing	3/4" O.D. ceramic			213C,25C	D-647		190BE123	MP-1076
E-703	Ground post	Push type, black bakelite top,			214E,50X			372E14B	TE-1082

* Spare parts furnished; see Table III

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	PRICE BASIS CODE	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(F) FUSES							
*F-401	L-V dynamotor pri.	15 amp., 25v., 9/32" x 1-1/4", cartridge			78L, 97B	4A0		264N506	FU-1002
*F-402	H-V dynamotor pri.	30 amp., 25 v., 9/32" x 1-1/4", cartridge			78L, 97B	4A0		264N509	FU-1001
		(H) HARDWARE							
*H-201	Wrench	#6 Bristo wrench			20BB	PI-1026		24N973	PI-1026
*H-202	Wrench	#10 Bristo wrench			20BB	PI-1024		24N971	PI-1024
H-801	Cabinet mounting kit	Contains the necessary hardware for mounting the transmitter and receiver cabinets horizontally or vertically (angle brackets, screws, nuts, and washers contained in a cardboard carton)			22HH	MA-1053			MA-1053
H-802	Clamp for W-801	Die-cast aluminum body, plated brass screws, plated phosphor-bronze spring lockwasher			20AA	AN-3057-8			DC-1015
H-803	Clamp for W-801	Same as H-802							
H-804	Clamp for W-802	Same as H-802							
H-805	Clamp for W-802	Same as H-802							
H-806	Clamp for W-803	Same as H-802							
H-807	Clamp for W-803	Same as H-802							
		(HT) HEADPHONES							
HT-801**	Headphones	Two type -49016 headphones, 600 ohms per pair; complete with type -49028 headband, type CTE-49012 cotton cord, and type MAF-1136-1 headphone plug	49016		10F	TH-37			PI-2021

* Spare parts furnished; see Table III

** Quantity as specified in the contract; may be 2, 1, or 0

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOC RATING OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
			(J) JACKS AND RECEPTACLES						
*J-101	Key and mike jack	3-Circuit, midget			235M	PI-1023		358N102	PI-1023
*J-201	Headphone jack	2-Circuit, midget			235M	PI-1022		358N101	PI-1022
*J-601	Phone jack	Same as J-201							
*J-602	Key and mike jack	Same as J-101							
			(K) RELAYS AND CONTACTORS						
*K-101	Modulator power relay	12 v. d-c coil, 75-ohms, ±10%, SPST, normally closed	29219		85G	G-35680		410N12B	RL-1001
*K-102	Antenna relay	12 v. d-c coil, 40 ohms, DPDT, SPST aux., normally open; pull-in v. 6.5 to 7.5; drop-out v. 2.0 to 3.5	29221		85G	G-35714		407N86A	RL-1002
*K-103	Send-receive relay	Same as K-102	29221						
*K-401	Motor control contactor	Same as K-102	29221						
			(L) INDUCTORS AND REACTORS						
L-101	V-101 Grid inductor	1.5 to 3 megacycles			242S	SA-1454		321D-1	SA-1454
*L-102	V-101 Plate choke	3-Sect., 1 mh ±10%, 300 ma max., 10 ohms			242S	PI-1009		240N57	PI-1009
L-103	V-101 Plate tank ind.	3-6 megacycles			242S	SA-1450		790D	SA-1450
L-104	V-103 Plate tank ind.	6-12 megacycles			242S	SA-1453		792D	SA-1453
L-105	V-103 Plate tank ind.	3-6 megacycles			242S	SA-1451		791D	SA-1451
L-106	V-103 Plate tank ind.	1.5-3 megacycles			242S	SA-1452		793D	SA-1452
L-107	P.A. plate inductance	1.5-12 megacycles			253M	SA-1464		568D-2	SA-1464

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOOL OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(L) INDUCTORS AND REACTORS - continued							
L-108	Antenna loading coil	Variable inductor			233H	SA-1520			SA-1520
*L-109	V-102 Cathode choke	Same as L-102							
*L-110	P.A. plate choke	3-Sect., 1 mh ±10%, 300 ma max., 10 ohms			242S	PI-1008		240858	PI-1008
L-201	R-F coil, band 3	6.0 to 12.0 megacycles			242S	SA-1459		806D	SA-1459
L-202	R-F coil, band 2	3.0 to 6.0 megacycles			242S	SA-1460		798D	SA-1460
L-203	R-F coil, band 1	1.5 to 3.0 megacycles			242S	SA-1458		805D	SA-1458
L-204	Converter coil, band 3	6.0 to 12.0 megacycles			242S	SA-1455		801D	SA-1455
L-205	Converter coil, band 2	3.0 to 6.0 megacycles			242S	SA-1457		799D	SA-1457
L-206	Converter coil, band 1	1.5 to 3.0 megacycles			242S	SA-1461		803D	SA-1461
*L-207	V-202 Cathode R-F choke	Same as L-102							
L-208	Osc. coil, band 3	6.0 to 12.0 megacycles			242S	SA-1462			SA-1462
L-209	Osc. coil, band 2	3.0 to 6.0 megacycles			242S	SA-1463		804D	SA-1463
L-210	Osc. coil, band 1	1.5 to 3.0 megacycles			242S	SA-1456		802D	SA-1456
*L-401	H-V dynamotor pri. noise-filter ind.	0.023 mh ±10%, 0.020 ohms			233H	SA-1426		416A-1	SA-1426
*L-402	H-V noise-filter ind.	Same as L-110							
*L-403	L-V ripple-filter reactor	8 hy, 0.1 amp., 160 ohms, 2500 T.V., 120 cps.	301090		59C,244S	6508-C		678R125A	TR-1024
*L-404	L-V noise-filter ind.	Same as L-110							
*L-405	L-V dynamotor pri noise-filter ind.	Same as L-401							

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATING OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(L) INDUCTORS AND REACTORS - continued							
L-701	Loading inductor	97 μh total inductance, tapped at 15, 27, 44, 60, and 76 μh			233M	SA-1468		467B-4	SA-1468
		(LS) LOUDSPEAKERS							
LS-601	Loudspeaker	5" cone, 6-ohm voice coil, permanent magnet	49437		2100	PI-1003		271H220	PI-1003
		(M) METERS							
M-101	P.A. plate M.A.	D-C milliammeter, 0-200 ma; "Voice" centered at 85 ma, "CW" centered at 175 ma	22410	17-I-12	45M	506		458H0710D	MR-1001
M-102	Antenna ammeter	A-C thermoammeter, 0-3 amp., r.f.; 0.1 amp. per division	22022	17-I-12	45M	507		457M124	MR-1002
		(MI) MICROPHONES							
MI-801	Carbon microphone	Single-button type, complete with "push-to-talk" switch, 51-inch, 3-conductor cord and plug	51004-C		10T,231M	MB-38A		208A06	SA-1395
MI-802	Carbon microphone	Same as MI-801	51004-C						
		(O) MECHANICAL PARTS							
O-701	Switch detent ass'y	Plate, spring, bearing			25C,233M	SA-1717		1188C-1	SA-1717
O-702	Shaft ass'y	Shaft and taper pin			233M	SA-1523		226A-8	SA-1523
		(P) PLUG CONNECTORS							
*P-101	Power plug	16-Terminal, wall mounting; 14-10 amp., 2-30 amp.			10C	CE-C16-32S		371H306	MS-1020
*P-201	Power connector	12-Terminal wall mtg. plug			10D	CE-12-32S		371H204	MS-1021

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. NOTICE OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(P) PLUG CONNECTORS - continued							
*P-401	Remote cable conn.	9-Terminal, wall mounting			10C	UG-9-32B		371M211	MC-1019
P-402	Transmitter power conn.	Same as P-101							
P-403	Receiver power conn.	Same as P-201							
P-601	Power cable conn.	Same as P-401							
P-801	Part of W-801	16-Terminal, female, right angle			10C	SK-C16-23--1/2SC		317M307	PL-1014
P-802	Part of W-801	16-Terminal, female, straight			10C	SK-C16-21--1/2SC		317M308	PL-1015
P-803	Part of W-802	12-Terminal, female, right-angle			10C	UG-12-23--1/2SC		317M213	PL-1013
P-804	Part of W-802	12-Terminal, female, straight			10C	UG-12-21--1/2SC		317M212	PL-1012
P-805	Part of W-803	9-Terminal, female, right-angle			10C	UG-9-23--1/2SC		317M215	PL-1017
P-806	Part of W-803	9-Terminal, female, straight			10C	UG-9-21--1/2SC		317M214	PL-1016
		(R) RESISTORS							
*R-101	V-101 Grid resistor	Composition, 1 megohm ±5%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729M01Meg	RE-938
*R-102	V-101 Screen dropping	Composition, 22,000 ohms ±20%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729M022M	RE-933
*R-103	V-103 Grid resistor	Composition, 100,000 ohms ±20%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729M0100M	RE-935
*R-104	V-103 Cathode resistor	Composition, 1500 ohms, ±20%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729M01500	RE-929
*R-106	V-103 Tank loading	Composition, 6800 ohms, ±20%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729M06800	RE-931
*R-107	V-104 Grid resistor	Same as R-102	63291						

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOOL OR DRAWING NUMBER	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(R) RESISTORS - continued							
*R-108	V-104 Screen dropping	Composition, 47,000 ohms ±5%, 2 w.	63426	RE-13A-340C	28J	BT2-		729R047M	RE-943
*R-109	V-104 Screen dropping	Same as R-108	63426						
*R-110	V-105 Screen dropping	Same as R-108	63426						
*R-111	V-105 Screen dropping	Same as R-108	63426						
*R-112	V-105 Grid resistor	Same as R-102	63291						
*R-113	V-105 Cathode resistor	Composition, 47,000 ohms ±20%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729R047M	RE-934
*R-114	V-102 Grid resistor	Same as R-113	63291						
*R-115	V-102 Grid resistor	Same as R-104	63291						
*R-116	V-102 Screen dropping	Same as R-113	63291						
*R-117	Limiting resistor	Composition, 470 ohms ±20%, 1 w.	63291	RE-13A-340C	28J	BT1-Navy		729R0470	RE-928
*R-118	Mod. cathode resistor	Composition, 330 ohms ±20%, 5 w.			28J	MFJ		730RA330F	RE-944
*R-119	Mod. screen resistor	Composition, 20,000 ohms ±20%, 5 w.			28J	MFJ		730RA20KF	RE-945
*R-120	Spark suppressor	Same as R-117	63291						
*R-123	V-104 Grid parasitic	Composition, 47 ohms ±20%, 1 w.	63291	RE-13A-340C	65$	SI-1		729R047	RE-925
*R-124	V-105 Grid parasitic	Same as R-123	63291						
*R-125	V-103 Screen resistor	Same as R-123	63291						
*R-126	Limiting resistor	Same as R-117	63291						
*R-201	V-201 Cathode	Insulated wire-wound, 220 ohms ±10%, 1w.	63291		28J	BWI-Navy		706E220	RE-926
*R-202	V-201 Grid	Same as R-103	63291						
*R-203	V-201 Plate dropping	Same as R-104	63291						
*R-204	V-202 Cathode	Same as R-201	63291						

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	Group Assembly	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(R) RESISTORS - continued							
*R-205	V-202 Screen resistor	Composition, 22,000 ohms ±20%, 2 w.	63426	RE-13A-3400	28J	BT2-Navy		729RE22M	RE-942
*R-206	V-203 Grid	Same as R-103	63291						
*R-207	V-203 Screen	Composition, 4700 ohms ±20%, 2 w.	63426	RE-13A-3400	28J	BT2		729RF4700	RE-939
*R-208	V-203 Voltage dividing	Same as R-108	63426						
*R-209	V-202 Grid	Same as R-103	63291						
*R-210	V-204 Cathode	Same as R-201	63291						
*R-211	V-202 Control grid	Same as R-113	63291						
*R-212	V-202 Injector grid	Same as R-113	63291						
*R-213	V-201 and V-204 Screen voltage dividing	Composition, 20,000 ohms, ±20%, 2 w.	63426	RE-13A-3400	28J	BT2-Navy		729RF20M	RE-941
*R-214	V-205 Cathode	Same as R-201	63291						
*R-215	V-205 Screen dropping	Same as R-113	63291						
*R-216	R-F gain control and AVC switch	Potentiometer, 10,000 ohms ±20%, 1 w., with SPST switch	631556-20		211C	37W		360RE10B3	PT-1000
*R-217	V-201 and V-204 Screen dropping	Composition, 10,000 ohms ±20%, 2 w.	63426	RE-134-3400	28J	BT2-Navy		729RE10M	RE-940
*R-218	Bleeder	Same as R-113	63291						
*R-219	V-205 Plate dropping	Same as R-104	63291						
*R-220	A-F gain control	Potentiometer, 100,000 ohms ±20%, 1 w.	631557-20		211C	37W		360RE103	PT-1002
*R-221	V-206 Grid	Composition, 220,000 ohms ±20%, 1 w.	63291	RE-13A-3400	28J	BT2-Navy		729RG220M	RE-936
*R-222	V-206 Plate supply	Same as R-221	63291						
*R-223	V-207 Grid	Composition, 470,000 ohms ±20%, 1 w.	63291	RE-13A-3400	28J	BT1-Navy		729RG470M	RE-937
*R-224	V-207 Cathode	Insulated wire-wound, 330 ohms ±10%, 1 w.	63291		28J	BW1-Navy		708RF330M	RE-927

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOOL OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(R) RESISTORS - continued							
*R-225	Diode load	Same as R-113	63291						
*R-226	V-206 Cathode	Composition, 2200 ohms ±20%, 1 w.	63291	MIL-R-11A-340C	28J	BTL-Navy		729R02200	RE-930
*R-227	AVC feedback	Same as R-101	63291						
*R-228	V-205 Screen voltage dividing	Same as R-103	63291						
*R-229	Limiting	Composition, 1800 ohms ±20%, 1 w.	63291	MIL-R-11A-340C	28J	BTL-Navy		729R01800	RE-946
*R-230	V-204 Grid	Same as R-103	63291						
*R-231	V-201 and V-204 Screen dropping	Same as R-217	63426						
*R-232	Limiting	Composition, 10,000 ohms ±20%, 1 w.	63291	MIL-R-11A-340C	28J	BTL-Navy		729R010H	RE-932
*R-401	Spark suppressor	Same as R-224	63291						
*R-402	Spark suppressor	Same as R-224	63291						
*R-601	Rec. vol. control	Bridge-T pad, 500 ohms ±20%			28J, 56C	CSFPD		380R201	PT-1001
*R-602	Limiting	Same as R-229	63291						
		(S) SWITCHES							
S-101	Band switch	3 positions			29C	SA-1555		1780-4	SA-1555
*S-101A	Part of S-101	Rotor assembly #1 (for S-101 and S-104)			29C	SA-1562		3168-7	SA-1562
S-102	P.A. plate inductor sw.	Same as S-101							
S-103	Antenna sw. assembly	Same as S-101							
S-104	Crystal osc. control	6 positions			29C	SA-1578		1785-4	SA-1578
*S-104A	Part of S-104	Same as S-101A							

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOOL MAINT. OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(S) SWITCHES - continued							
*S-105	Voice-CW switch	DPDT, lever-toggle; 1 amp. 250 v., or 3 amp. 125 v.	24003	NE-24AA-118A	96C	8905		266W103	SW-1010
*S-106	Interlock switch-	Push-button, normally open; 3 amp., 250 v.	24014		96C	7190		266W105	SW-1016
*S-107	Transmitter ON-OFF sw.	SPDT, lever-toggle; 35 amp., 15 to 125 v.	24118	NE-24AA-118A	96C	8906		266W104	SW-1011
S-201	Osc. band switch	3 positions, 9 contacts			25C	SA-1630		178C	SA-1630
*S-201A	Part of S-201	Rotor assembly #2			25C	SA-1429		551B-3	SA-1429
S-202	Osc. selector switch	5 positions, 15 contacts			25C	SA-1627		178C-4	SA-1627
*S-203	MOD.-CW switch	Same as S-105	24003						
S-204	Not used								
*S-205	Power switch	Same as S-107	24118						
S-206	AVC switch	Part of R-216							
S-207	Converter band sw.	Same as S-201							
S-208	R-F amp. band sw.	Same as S-201							
*S-601	Speaker-phones sw.	Same as S-105	24003						
*S-602	Transmitter ON-OFF sw.	Same as S-107	24118						
*S-603	Receiver ON-OFF sw.	Same as S-107	24118						
S-701	Tap switch	0-6 positions, 9 contacts			25C,233M	SA-1435		1194C-1	SA-1435

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. DOC. RATING OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
			(S) SWITCHES - continued						
S-901	Telegraph key	Standard type, with shorting lever, brass finish lecquered, platinor points	26018		42S	M-100		274N11	PI-1002
			(T) TRANSFORMERS						
*T-101	Microphone trans.	Pri: 75 ohms; sec: 125,000 ohms, C.T.; C.02 w., 150-5000 cps.	301087		55C,244S	8004-C		677R213	TR-1020
*T-102	Modulation trans.	Pri: 6000 ohms, C.T.; sec: 6000 ohms; 20 w., 200-5000 cps.	301089		55C,244S	7533-A		677R201	TR-1022
*T-201	Output transformer	Pri: 7500 ohms; sec: 600 ohms, C.T.; 2.5 w., 200-5000 cps.	301088		55C,244S	7537B		677R227	TR-1021
*T-601	Speaker transformer	Pri: 500 ohms; sec: 6 ohms, 2 w.; 200-5000 cps.			210C	TR-1023		6675705A	TR-1023
			(V) TUBES						
*V-101	Master oscillator	Beam power amplifier	12A6			12A6			
*V-102	Crystal oscillator	Same as V-101	12A6						
*V-103	Buffer-doubler	Same as V-101	12A6						
*V-104	Power amplifier	Beam power pentode	1625			1625			
*V-105	Power amplifier	Same as V-104	1625						
*V-106	Modulator	Same as V-104	1625						
*V-107	Modulator	Same as V-104	1625						
*V-201	R-F amplifier	Triple-grid amplifier	12SK7			12SK7			
*V-202	Converter	Pentagrid converter	12SA7			12SA7			

* Spare parts furnished; see Table III.

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPARE PARTS FOR ONE SET	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(V) TUBES - continued							
*V-203	H-F oscillator	Same as V-101	12A6						
*V-204	1st I-F amplifier	Same as V-201	12SK7						
*V-205	2nd I-F amplifier	Same as V-201	12SK7						
*V-206	Detector-amplifier	Duplex-diode-triode	12SQ7			12SQ7			
*V-207	Audio amplifier	Same as V-101	12A6						
		(W) WIRES AND INTERCONNECTING CABLES							
*W-801	Trans. power cable	Includes P-801 and P-802, and 11 feet of 16-conductor shielded plastite cable			22HH	CA-1059		193A-1	CA-1059
W-801A	Cable (wire) only	Tinned soft copper; 4 conductors 16 gauge, 26 strands #30; 7 conductors, 20 gauge, 10 strands #30; dielectric test 1500 v., 60 cycles, between conductors, and 1000 v. between all conductors together to shield and ground			2230	B-1001			CA-1096
*W-802	Rec. power cable	Includes P-803 and P-804, and 10 feet of 7-conductor shielded plastite cable			22HH	CA-1060		2155A	CA-1060
W-802A	Cable (wire) only	Tinned soft copper; 2 conductors, 12 gauge, 65 strands #30; 2 conductors 16 gauge, 26 strands #30; 3 conductors 20 gauge, 10 strands #30; dielectric test as for W-801A			2230	B-1002			CA-1095
*W-803	Control cable	Includes P-804 and P-806, and 20 feet of 7-conductor shielded plastite cable			22HH	CA-1058		768A-1	CA-1058
W-803A	Cable (wire) only	Same as W-802A			2230	B-1003			CA-1099
*W-804	Key cord and plug	Includes phone plug, 3-circuit phone plug, and 34 inches of 2-conductor cord			509,2230	CA-1390		426M7	CA-1390

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATINGS OR TIMING	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
		(W) WIRES AND INTERCONNECTING CABLES - continued							
W-804A	Cord only	2 conductors, 16 strands #30			508	CA-1082		42687	CA-1082
		(X) SOCKETS							
*X-101	Socket for V-101	Octal, ceramic	49367	RE-49AA-314B	77J	228		2208581	SO-1012
*X-102	Socket for V-102	Same as X-101	49367						
*X-103	Socket for V-103	Same as X-101	49367						
*X-104	Socket for V-104	7-Pin, ceramic	49366	RE-49AA-314B	77J	227		2208573	SO-1013
*X-105	Socket for V-105	Same as X-104	49366						
*X-106	Socket for V-106	Same as X-104	49366						
*X-107	Socket for V-107	Same as X-104	49366						
*X-108	Socket, crystals 1, 4	Dual, 3-pin ceramic			235N	SA-1577			SA-1577
*X-109	Socket, crystals 2, 3	Same as X-108							
*X-201	Socket for V-201	Same as X-101	49367						
*X-202	Socket for V-202	Same as X-101	49367						
*X-203	Socket for V-203	Same as X-101	49367						
*X-204	Socket for V-204	Same as X-101	49367						
*X-205	Socket for V-205	Same as X-101	49367						
*X-206	Socket for V-206	Same as X-101	49367						
*X-207	Socket for V-207	Same as X-101	49367						
*X-208	Socket, crystals 1 and 4	Same as X-108							
*X-209	Socket, crystals 2 and 3	Same as X-108							

TABLE II

PARTS LIST BY SYMBOL DESIGNATIONS

MODEL TCS-13 RADIO EQUIPMENT

SYMBOL DESIGNATION	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATING OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
			(Y) CRYSTAL HOLDERS						
Y-101**	Crystal holder no. 1	Clamped type, 3-pin; electrodes for 1" crystals	40130		226H	5H			MA-1085
Y-102**	Crystal holder no. 2	Same as Y-101	40130						
Y-103**	Crystal holder no. 3	Same as Y-101	40130						
Y-104**	Crystal holder no. 4	Same as Y-101	40130						
Y-105**	Crystal holder no. 5	Same as Y-101	40130						
Y-106**	Crystal holder no. 6	Same as Y-101	40130						
Y-107**	Crystal holder no. 7	Same as Y-101	40130						
Y-108**	Crystal holder no. 8	Same as Y-101	40130						
			(Z) I-F TRANSFORMERS						
*Z-201	1st I-F transformer	Interstage, 455 kc ±10%			242S	SA-2612		278M36	SA-1378
*Z-202	2nd I-F transformer	Same as Z-201.							
*Z-203	3rd I-F transformer	Diode output, 455 kc ±10%			242S	SA-2613		278M37	SA-1379
*Z-204	Beat osc. coil ass'y	455 kc I. F.			242S	SA-1380		278M38	SA-1380

** Supplied with some, but not all, TCS-13 equipments. The Navy Type number shown does not apply to the crystal itself, but only to the holder. When ordering replacements, specify full information applicable to the crystal holder, and in addition specify the desired crystal frequency.

TABLE III

SPARE PARTS LIST BY SYMBOL DESIGNATION

Section 1: Transmitter, Receiver, and Remote-Control Units
(Symbol Groups 101 to 199, 201 to 299, 601 to 699)

MODEL TCS-13 RADIO EQUIPMENT

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	SPEC TOL RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON, DRAWING AND PART NUMBER
				(C) CAPACITORS						
5	1		C-103, C-219	Ceramic, 20 µµf ± 2-1/2%, 500 W.V., Temp. Coef. -.00075%		25C	Class D		913N420N7.5	CO-945
5	1	481279-B10	C-104	Silvered mica, 50 µµf ±10%, 500 W.V.	RE-48A-143F	66S	MOSW		912N450A	CO-790
6	1		C-105, C-108, C-112, C-113	Mica, 0.001 µf ±20%, 750 W.V.		02S	BE-15		915N210E	CO-762
6	1		C-106, C-114, C-115	Mica, 0.002 µf ±20%, 750 W.V.		02S	BE-15		915N220E	CO-763
6	1		C-109, C-111, C-124	Mica, 0.006 µf ±20%, 750 W.V.		02S	BE-15		915N260E	CO-803
20	1		C-117	Mica, 600 µµf +20%, 2000 W.V. -0%		02S	A2-50		950N350A	CO-1006
20	1		C-118	Mica, 50 µµf ±20%, 2000 W.V.		02S,66S	A2-50		950N450A	CO-766
20	1		C-119	Mica, 0.01 µf ±20%, 1200 W.V.		66S	S-6742		925N110A	CO-767
5	1		C-120, C-130, C-228	Mica, 0.008 µf ±20%, 300 W.V.		66S	MWB/		909N280CN	CO-787
20	1		C-121	Silvered ceramic, 50 µµf ±10%, 2500 v. wrkg. at 2.0 mc		25C	850		913N450C	CO-865
6	1		C-122	Mica, 50 µµf ±10%, 600 W.V.		02S	BE-10		910N450E	CO-802
6	1		C-123	Mica, 250 µµf ±10%, 500 W.V.		02S	BE-10		910N325E	CO-771
21	1	481249-20	C-125, C-126	Oil-filled paper, 4.0 µf, ±20%, 600 W.V.	RE-13A-488E RE-48A-110	66S	S-7784		930N8	CO-772

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 1, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	SPEC TOL RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(C) CAPACITORS - continued						
20	1	481392-20	C-127, C-234	Foil paper, 0.25 μf ±20%, 600 W.V.	RE-13A-486E RE-48A-128	66S	S-6413		956M306W	CO-773
20	1	48312-B20	C-128	Foil paper, dual-sect., 0.1 μf ±20%, 600 W.V.	RE-13A-486E RE-48A-128	66S	P-9455		956MD01W	CO-805
21	1	Δ48403-B20	C-129	Foil paper, 2.0 μf ±20%, 400 W.V.	RE-13A-486E RE-48A-129	66S	P-9454		954M54Y	CO-775
20	1	Δ48312-B20	C-205	Foil paper, dual-sect., 0.1 μf ±20%, 400 W.V.	RE-13A-486E RE-48A-129	66S	P-9451		954MD01W	CO-776
4	1		C-206, C-220, C-223	Silvered mica, 100 μμf ±20%, 500 W.V.		64S	MOSW		912M310A	CO-769
20	1		C-210, C-231	Mica, 0.01 μf ±20%, 500 W.V.		02S	HLS-1110		910M110C	CO-778
20	1	Δ48713-B20	C-211, C-226	Foil paper, triple sect., 0.1 μf ±20%, 400 W.V.	RE-13A-486E RE-48A-129	66S	P-9454		954MTD1Y	CO-804
4	1	48929-B5	C-212	Silvered mica, 0.004 μf ±5%, 300 W.V.		64S	MMSW		912M240A	CO-780
4	1	48856-B5	C-214, C-229	Silvered mica, 0.002 μf ±5%, 500 W.V.		64S	MMSW		912M220A	CO-781
4	1		C-216	Silvered mica, 0.00125 μf ±5%, 500 W.V.		64S	MMSW		914M2125A	CO-782
4	1	48895-B20	C-218, C-221	Silvered mica, 50 μμf ±20%, 500 W.V.		64S	MOSW		912M450C	CO-770
5	1		C-222	Silvered mica, 250 μμf ±20%, 500 W.V.		64S	MOSW		912M525C	CO-783
5	1		C-224	Silvered mica, 30 μμf ±10%, 500 W.V.		64S	MOSW		912M430C	CO-784
5	1		C-225	Silvered mica, 25 μμf ±5%, 500 W.V.		64S	MOSW		912M420C	CO-1016
5	1	481255-B20	C-227	Silvered mica, 200 μμf ±20%, 500 W.V.		64S	MOSW		912M320A	CO-786

Δ For replacement use

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 1, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	USE FOR RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(C) CAPACITORS - continued						
4	1		C-230	Silvered mica, 500 μμf ±20%, 500 W.V.		64S	MMSW		912N350A	CO-761
20	1	Δ481465-20	C-232, C-233	Foil Paper, Duel-sect., 0.1 μf ±20%, 400 W.V.	RE-13A-488E RE-48A-129	66S	P-9452		954ND01Y	CO-774
20	1		C-235	Mica, 0.004 μf ±20%, 1200 W.V.		02S, 66S	MLS-2240		925N240C	CO-789
				(H) WRENCHES						
22	1		H-201	#6 Bristo Wrench		208B	PI-1026		24N973	PI-1026
22	1		H-202	#10 Bristo Wrench		208B	PI-1024		24N971	PI-1024
				(J) JACKS						
9	1		J-101, J-602	3-Circuit Midget		235N	PI-1023		358N102	PI-1023
9	1		J-201, J-601	2-Circuit Midget		235N	PI-1022		358N101	PI-1022
				(E) MISCELLANEOUS ELECTRICAL PARTS						
22	1		E-101, E-102	47 ohm Res. ±20%, 1 w., shunted by 8-turn coil		224H	SA-1549		704A	SA-1549
				(K) RELAYS AND CONTACTORS						
9	1	29219	K-101	12v. d-c coil, 75 ohms ±10% SPST. normally closed		85G	G-35680		410N12B	RL-1001
9	1	29221	K-102, K-103	12v. d-c coil, 40 ohms, DPDT, SPST aux., normally open; pull-in v. 6.5 to 7.5; drop-out v. 2.0 to 3.5		85G	G-36714		407N86A	RL-1002

Δ For replacement use

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 1, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(L) INDUCTORS AND REACTORS						
19	1		L-102, L-109, L-207	3-Sect., 1 mh ±10%, 300 ma max., 10 ohms		242S	PI-1009		240N57	PI-1009
19	1		L-110	3-Sect., 1 mh ±10%, 300 ma max., 10 ohms		242S	PI-1008		240N5A	PI-1008
				(P) PLUG CONNECTORS						
9	1		P-101	16-Terminal, wall mounting: 14-10 amp., 2-30 amp.		10C	SK-C16-32S		371N306	RC-1020
9	1		P-201	12-Terminal wall mtg. plug		10C	GK-12-32S		371N204	RC-1021
9	1		P-601	Same as P-401						
				(R) RESISTORS						
3	1	63291	R-101, R-227	Composition, 1 megohm ±5%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG1Meg	RE-938
2	2	63291	R-102, R-107, R-122	Composition, 22,000 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG22M	RE-933
2	3	63291	R-103, R-202, R-206, R-209, R-228, R-230	Composition, 100,000 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG100M	RE-935
1	2	63291	R-104, R-115, R-203, R-219	Composition, 1500 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG150D	RE-929
2	1	63291	R-106	Composition, 6800 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG6800	RE-931
3	3	63426	R-108, R-109, R-110 R-111, R-208	Composition, 47,000 ohms ±5%, 2 w.	RE-13A-340C	28J	BT2		729NH47M	RE-943
2	3	63291	R-113, R-114, R-116, R-211 R-212, R-215, R-218, R-225	Composition, 47,000 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG47M	RE-934
1	2	63291	R-117, R-120, R-126	Composition, 470 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG470	RE-928

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 1, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	SPEC. VOL. RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(R) RESISTORS (Continued)						
19	1		R-118	Composition 330 ohms ±20%, 5 w.		28J	MPJ		730NA330F	RE-944
19	1		R-119	Composition 20,000 ohms ±20%, 5 w.		28J	MPJ		730NA20MF	RE-945
1	2	63291	R-123, R-124, R-125	Composition, 47 ohms ±20%, 1 w.	RE-13A-340C	65S	S1-1		729NG47	RE-925
1	2	63291	R-201, R-204, R-210, R-214	Insulated wire-wound, 220 ohms ±10%, 1 w.		28J	BW1-Navy		708N220	RE-926
3	1	63426	R-205	Composition, 22,000 ohms ±20%, 2 w.	RE-13A-340C	28J	BT2-Navy		729NH22M	RE-942
3	1	63426	R-207	Composition, 4700 ohms ±20%, 2 w.	RE-13A-340C	28J	BT2		729NH4700	RE-939
3	1	63426	R-213	Composition, 20,000 ohms ±20%, 2 w.	RE-13A-340C	28J	BT2-Navy		729NH20M	RE-941
19	1	631556-20	R-216	Potentiometer, 10,000 ohms ±20%, 1w., with SPST switch		211C	37W		380NE10MS	PT-1000
3	1	63426	R-217, R-231	Composition, 10,000 ohms ±20%, 2 w.	RE-13A-340C	28J	BT2-Navy		729NH10M	RE-940
19	1	631557-20	R-220	Potentiometer, 100,000 ohms ±20%, 1 w.		211C	37W		380N103	PT-1002
3	1	63291	R-221, R-222	Composition, 220.000 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG220M	RE-936
3	1	63291	R-223	Composition, 470,000 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG470M	RE-937
1	1	63291	R-224	Insulated wire-wound, 330 ohms ±10%, 1 w.		28J	BW1-Navy		708N330N	RE-927
1	1	63291	R-226	Composition, 2200 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG2200	RE-930
3	1	63291	R-229, R-602	Composition, 1800 ohms ±20%, 1 w.	RE-13A-340C	28J	BT1-Navy		729NG1800	RE-946

TABLE III

SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section I, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC TOL RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(R) RESISTORS - Continued						
2	1	63291	R-232	Composition, 10,000 ohms ±20%, 1 w.	RE-13A-340C	28J	BTI-Navy		729N310M	RE-932
19	1		R-601	Bridge-T Pad, 500 ohms ±20%		28J, 56C	CSMPD		380N201	PT-1001
				(S) SWITCHES						
17	3		S-101A, S-104A	Switch rotor assembly #1		25C	SA-1562		316B-7	SA-1562
22	1	24003	S-105, S-203, S-601	DPDT, lever-toggle; 1 amp. 250 v., or 3 amp. 125 v.	RE-24AA-118A	84A 96C	8905 8225		266N103	SM-1010
22	1	24014	S-106	Push-button, normally open; 3 amp., 250 v.		96C	7190		266N105	SM-1016
22	1	24118	S-107, S-205, S-602, S-603	SPST, lever-toggle, 35 amp., 15 to 125 v.	RE-24AA-118A	96C	8905		266N104	SM-1011
17	2		S-201A	Switch rotor assembly #2		25C	SA-1429		551B-3	SA-1429
				(T) TRANSFORMERS						
13	1	301087	T-101	Microphone transformer; pri: 75 ohms; sec: 125,000 ohms, C.T.; 0.02 w., 150-5000 cps		55C, 244S	8004-C		677N213	TR-1020
14	1	301089	T-102	Modulation transformer; pri: 6000 ohms, C.T.; sec: 6000 ohms; 20 w., 200-5000 cps.		55C, 244S	7533-A		677N201	TR-1022
15	1	301088	T-201	Audio transformer; pri: 7500 ohms; sec: 600 ohms, C.T.; 2.5 w., 200-5000 cps.		55C, 244S	7537-B		677N227	TR-1021
13	1		T-[illegible]	Speaker Transformer; pri: 500 ohms; sec: 6 ohms; 2w 200-5000 cps.		210C	TR-1023		667S705A	TR-1023

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 1, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(V) TUBES						
	10	12A6	V-101, V-102, V-103, V-203, V-207	beam power amplifier			12A6			TU-1024
	8	1625	V-104, V-105, V-106, V-107	Beam power pentode			1625			TU-1025
	6	12SK7	V-201, V-204, V-205	Triple-grid amplifier			12SK7			TU-1037
	2	12SA7	V-202	Converter			12SA7			TU-1026
	2	12SQ7	V-206	Duplex-diode-triode			12SQ7			TU-1027
				(W) CABLES						
8	1		W-801	Includes P-801 and P-802, and 11 feet of 16-conductor shielded plastite cable		224H	CA-1059		193A-1	CA-1059
8	1		W-802	Includes P-803 and P-804, and 10 feet of 7-conductor shielded plastite cable		224H	CA-1060		2155A	CA-1060
8	1		W-803	Includes P-804 and P-806, and 20 feet of 7-conductor shielded plastite cable		224H	CA-1058		748A-1	CA-1058
8	1		W-804	Includes phone plug, 3-circuit phone plug, and 34 inches of 2-conductor cord		508,223G	SA-1390		42687	SA-1390
				(X) SOCKETS						
18	2		X-108, X-109, X-208, X-209	Dual 3 pin ceramic		235H	SA-1577			SA-1577
18	5	49367	X-101 To X-105, X-201 To X-207	Octal, ceramic	RE-49AA-314B	77J	228		220A561	SO-1012
17	2	49366	X-104 To X-107	7-Pin Ceramic	RE-49AA-314B	77J	229		220A575	SO-1013

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 1, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC TOL RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(Z) - TRANSFORMERS						
12	1		Z-201, Z-202	Interstage, 455 kc ±10%		242S	SA-2612			SA-2612
12	1		Z-203	Diode output, 455 kc ±10%		242S	SA-2613			SA-2613
12	1		Z-204	455 kc I.F.		242S	SA-1380			SA-1380
				STANDOFF, SHOCKMOUNTS						
22	1			Barrier, Ceramic Binding Post						MP-1077
22	4			Standoff, Ceramic, 3/8" Dia. x 1/2" Long						MP-1078
22	5			Standoff, Ceramic, Tapered, 3/4" Long						MP-1079
22	1			Standoff, Ceramic 1/2" x 1" Long						MP-1081
8	2			Shock Mount						PI-1001
8	1			Shock Mount						PI-1019
				Spare parts box	42-B9-B	201A				MS-H-2456

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 2, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANU-FACTURER	MANUFACTURER'S DESIGNATION	SPEC TOL RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
			Section 2: Power-Supply Unit (Symbol Group 401 to 499)							
			(C) CAPACITORS							
20	1	48849-A20	C-401	Foil paper, triple-sect., 0.1 μf ±20%, 600 W.V.	RE-13A-488E RE-48A-128	66S	2527-8		956N101W	CO-779
4	1		C-402, C-409, C-410	Mica, 0.006 μf ±20%, 500 W.V.		64S	MWSW		909N260CN	CO-764
6	1		C-403, C-404	Mica, 0.006 μf ±20%, 750 W.V.		02S	BE-15		915N260E	CO-803
21	1	481249-20	C-405, C-407	Oil-filled paper, 4.0 μf ±20%, 600 W.V.	RE-13A-488E RE-48A-110	66S	S-7784		930N8	CO-772
20	1	481392-20	C-406, C-412	Foil paper, 0.25 μf ±20%, 600 W.V.	RE-13A-488E RE-48A-128	66S	S-6413		956NS05W	CO-773
			(D) DYNAMOTORS							
11	1	211041	D-401	Dynamotor		60E	ML-4120-46		231N41	SA-1791
10	1	211042	D-402	Dynamotor		200W	35x030-A		231N40A	SA-1790
			(D) DYNAMOTOR BRUSHES							
7	5		D-401A	Positive brush for L-V sect.		207B			234N104	PI-1011
7	5		D-401B	Negative brush for L-V sect.		207B			234N105	PI-1010
7	5		D-401C	Positive brush for H-V sect.		207B			234N102	PI-1065
7	5		D-401D	Negative brush for H-V sect.		207B			234N103	PI-1013
7	5		D-402A	Positive brush for L-V sect.		200W	44X009		234N100A	PI-1016
7	5		D-402B	Negative brush for L-V sect.		200W	44X010		234N101A	PI-1015
7	5		D-402C	Positive brush for H-V sect.		200W	44X011		234N102A	PI-1014
7	5		D-402D	Negative brush for H-V sect.		200W	44X012		234N103A	PI-1012

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 2, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC. TOL. RATING OR MOD	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				(F) FUSES						
7	20		F-401	15 amp., 25v., 9/32" x 1-1/4" cartridge		78L, 97B	4AG		264N506	FU-1002
7	20		F-402	30 amp., 25v., 9/32"x 1-1/4" cart		78L, 97B	4AG		264N509	FU-1001
				(K) RELAYS AND CONTACTORS						
9	1	29221	K-401	12 v. d-c coil, 40 ohms, DPDT, SPST aux. normally open; pull-in v. 6.5 to 7.5; drop-out v. 2.0 to 3.5		85G	G-35680		407N86A	RL-1002
				(L) INDUCTORS AND REACTORS						
19	1		L-402, L-404	3-Sect., 1.0 mh ±10%, 300 ma max., 10 ohms		242S	PI-1008		240N58	PI-1008
13	1	301090	L-403	8 hy, 0.1 amp., 160 ohms, 2500 T.V., 120 cps.		55C, 244S	6508-C		678N125A	TR-1024
				(P) CONNECTORS						
9	1		P-401	9-Terminal, wall mounting		10C	GK-9-32S		371N211	RC-1019
9	1		P-402	Same as P-101						
9	1		P-403	Same as P-201						
				(R) RESISTORS						
1	1	63291	R-401, R-402	Insulated wire-wound, 330 ohms, ±10%, 1 w.		28J	BW1-Navy		708N330	RE-927
				BRUSH HOLDERS & BRUSH CAPS						
7	2			Brush Holder Cap, L.V. For Large Dynamotor D-401		60E				BC-H-1011
7	2			Brush Holder Cap, H.V. For Large Dynamotor D-401		60E				BC-H-1012
7	4			Brush Holder Cap for Small Dynamotor D-402		200W				BC-H-1013

TABLE III
SPARE PARTS LIST BY SYMBOL DESIGNATION

MODEL TCS-13 RADIO EQUIPMENT (Section 2, Continued)

BOX NUMBER	QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPECIFICATION	MANUFACTURER	MANUFACTURER'S DESIGNATION	SPEC TOL RATING OR MOD.	COLLINS DRAWING AND PART NUMBER	HAMILTON DRAWING AND PART NUMBER
				BRUSH HOLDERS & BRUSH CAPS (Continued)						
7	2			Brush Holder, L.V. For Dynamotor D-401		60E				BH-H-1001
7	2			Brush holder, H.V. For Large Dynamotor D-401		60E				BH-H-1002
7	1			Right Brush Holder, L.V.For Small Dynamotor D-402		200W				BH-H-1003
7	1			Left Brush Holder, L.V. For Small Dynamotor D-402		200W				BH-H-1004
7	1			Right Brush Holder, H.V. For Small Dynamotor D-402		200W				BH-H-1005
7	1			Left Brush Holder, H.V. For Small Dynamotor D-402		200W				BH-H-1006

TABLE IV.

STANDARD CABLE WIRE CODE

Letters refer to wire size and type

Numerals refer to RMA Color Code*

Wire Code	Color	Construction & Ratings
G93	White—Orange Tracer	No. 18 A.W.G. Shielded 7 strands 0.0159 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
J9 J90 J91 J95 J96	White White—Black Tracer White—Brown Tracer White—Green Tracer White—Blue Tracer	No. 16 A.W.G. 26 strands 0.010 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
K9 K90 K91 K92 K93 K94 K95 K96 K924 K925	White White—Black Tracer White—Brown Tracer White—Red Tracer White—Orange Tracer White—Yellow Tracer White—Green Tracer White—Blue Tracer White—Red & Yellow Tracers White—Red & Green Tracers	No. 20 A.W.G. 7 strands 0.0126 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
L92 L96	White—Red Tracer White—Blue Tracer	No. 20 A.W.G. 7 strands 0.0126 tinned copper 3000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
P9 P91	White White—Brown Tracer	No. 12 A.W.G. 61 strands 0.010 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid

* *Note on Color Designations:* Numbers represent colors in the same ways as on resistors and capacitors (see next page); thus 2 = red, 9 = white, etc.

TABLE V.

(a) 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:

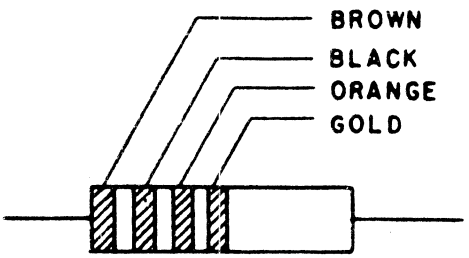
0—Black	5—Green
1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Gray
4—Yellow	9—White

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 digit of the sequence, the second "band" the second digit and the third "band" the number of zeros following the second digit.

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 or Gold	10%—Silver
	20%—No color

For example, the resistor shown below has a resistance of 10,000 ohms and a tolerance of ±5%, as indicated by the sequence of colors: brown (1), black (0), orange (3), and gold (5%).

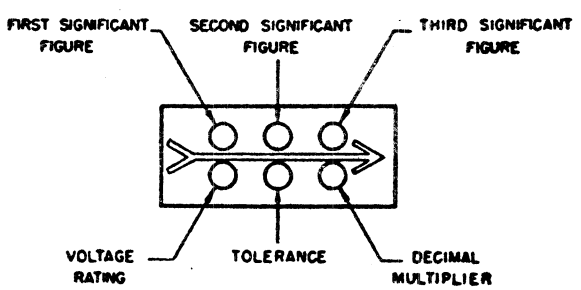


(b) CAPACITOR COLOR CODE

The Standard 6-dot RMA Color Code is used to indicate the capacitance in micromicrofarads of some of the midget mica capacitors used in the equipment. The colors employed to designate these significant digits in mmf. are listed below. Note that codes are read from left to right in the position required for reading of words molded in case, or by arrow.

Color	Numeral	Volts	Multiplier	Tolerance
Black	0		1	
Brown	1	100	10	1%
Red	2	200	100	2%
Orange	3	300	1,000	3%
Yellow	4	400	10,000	4%
Green	5	500	100,000	5%
Blue	6	600	1,000,000	6%
Violet	7	700	10,000,000	7%
Gray	8	800	100,000,000	8%
White	9	900	1,000,000,000	9%
Gold		1000	.1	
Silver			.01	10%
No Color		500		20%

On units marked with six dots, the upper three dots are significant figures of capacity in mmf. multiplied by the multiplier indicated by the lower right hand dot. The remaining dots are tolerance and D.C. working voltage rating, as shown in sketch.



EXAMPLE:

Brown	Red	Green	} =	1250 mmf.,
Orange	Green	Brown	}	300 v.d.c.w. ± 5%

TABLE VI.

LIST OF MANUFACTURERS

Code Desig.	Navy Type Prefix	Name and Address
02S	CAN	Sangamo Electric Company 1935 Funk Street Springfield, Illinois
05N	CNA	National Company, Inc. 61 Sherman Street Malden, Massachusetts
10C	CED	Cannon Electrical Devel. Co. 3209 Humboldt Street Los Angeles, California
10T	CTE	Telephonics Corporation 350 West 31st Street New York, New York
25C	CBN	Centralab, Inc. 900 East Keefe Avenue Milwaukee, Wisconsin
28J	CIR	International Resistance Co. 401 North Broad Street Philadelphia, Pennsylvania
42L	CLR	Leach Relay Company 5915 Avalon Boulevard Los Angeles, California
42S	CSE	Signal Electric Mfg. Company 1939 Troom Street Menominee, Michigan
45W	CV	Weston Electrical Inst. Corp. 618 Frelinghuysen Avenue Newark, New Jersey
50X		X-L Radio Laboratories 420 West Chicago Avenue Chicago, Illinois
55C	CTR	Chicago Transformer Corporation 3501 West Addison Street Chicago, Illinois
56C	CTC	Chicago Telephone Supply Co., Elkhart, Ind
60E	CEK	Eicor, Inc. 1501 West Congress Street Chicago, Illinois
64C	COL	Collins Radio Company Cedar Rapids, Iowa
64S	CSL	Solar Manufacturing Corporation 588 Avenue A Bayonne, New Jersey
65S	CPQ	Speer Resistor Corporation Theresia Street St. Mary's, Pennsylvania
66S	CSP	Sprague Specialties Company North Adams, Massachusetts
77J	CEJ	E. F. Johnson Company Waseca, Minnesota
78L	CLF	Littelfuse Laboratories 4765 Ravenswood Avenue Chicago, Illinois
84A	CHH	Arrow-Hart & Hegeman Company 108 Hawthorne Street Hartford, Connecticut
85G	CGE	Guardian Electric Mfg. Company 1400 West Washingron Blvd. Chicago, Illinois
96C	CAE	Cutler-Hammer 1333 West St. Paul Avenue Milwaukee, Wisconsin
97B	CFA	Bussmann Mfg. Company 2538 West University Street St. Louis, Missouri
200W	CWO	Webster Products 3825 Armitage Avenue Chicago, Illinois
201A		Acme Metal Products Corporation Dover, New Jersey
204A	CPH	American Phenolic Corporation 1830 South 54th Street Chicago, Illinois
207B		Becker Bros. Carbon Company 340 South 52nd Avenue Chicago, Illinois
208B	CTB	The Bristol Company 117 Bristol Road Waterbury, Connecticut
210C	CCY	Cinaudagraph Speakers, Inc. 3929 South Michigan Blvd. Chicago, Illinois
211C	CMC	Clarostat Mfg. Company, Inc. 285 North Sixth Street Brooklyn, New York

TABLE VI. LIST OF MANUFACTURERS (*Continued*)

Code Desig.	Navy Type Prefix	Name and Address
213C		Henry L. Crowley Company 1 Central Avenue West Orange, New Jersey
214E	CEL	Hugh H. Eby, Inc. 18 West Chelten Avenue Philadelphia, Pennsylvania
222G		General Instruments Corporation 829 Newark Avenue Elizabeth, New Jersey
223G		Graybar Electric Company, Inc. 420 Lexington Avenue New York, New York
224H	CIH	Hamilton Radio Corporation 510 Sixth Avenue New York, New York
226H	CHF	Howard Manufacturing Company 15 Fourth Street Council Bluffs, Iowa
231M	CMX	The Magnavox Company 2131 Bueter Road Fort Wayne, Indiana
233M	CML	Meissner Manufacturing Company 7th & Belmont Street Mt. Carmel, Illinois
235N		National Fabricated Products Co. 2650 West Belden Avenue Chicago, Illinois
240R	CRK	Radio Condenser Company Davis & Copewood Streets Camden, New Jersey
242S	CFW	F. W. Sickles Company P. O. Box 920 Springfield, Massachusetts
243S	CSA	Stackpole Carbon Company 1942 Tannery Street St. Mary's, Pennsylvania
244S	CSN	Standard Transformer Corp. 1500 North Halsted Street Chicago, Illinois

Fig. 1 Transmitter Unit — Front View

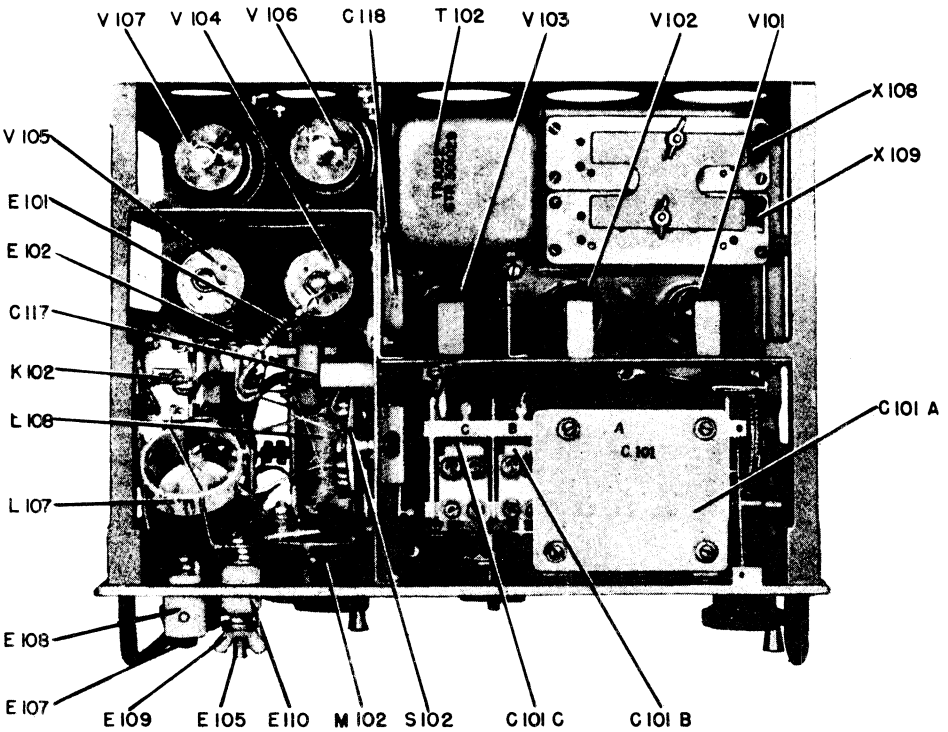


Fig. 2 Transmitter Unit — Top Open View

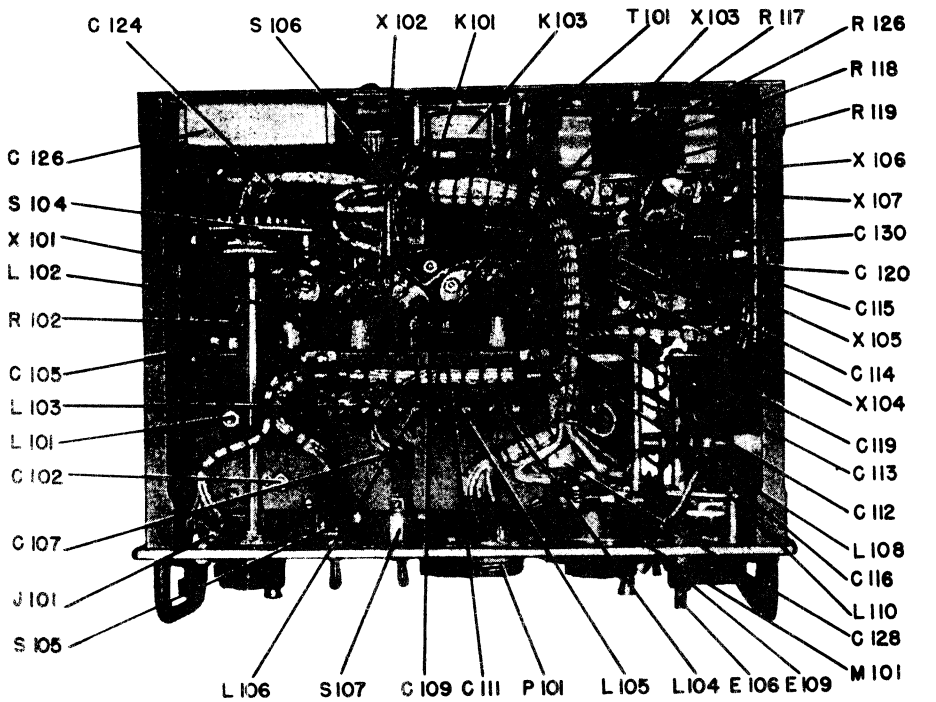


Fig. 3 Transmitter Unit — Bottom Open View

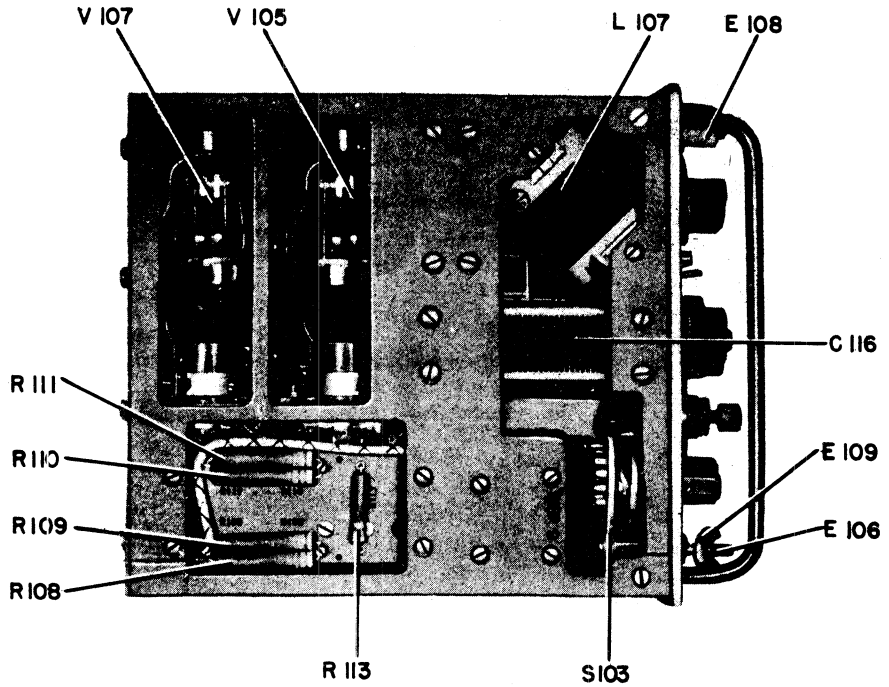


Fig. 4 Transmitter Unit — Left Side Open View

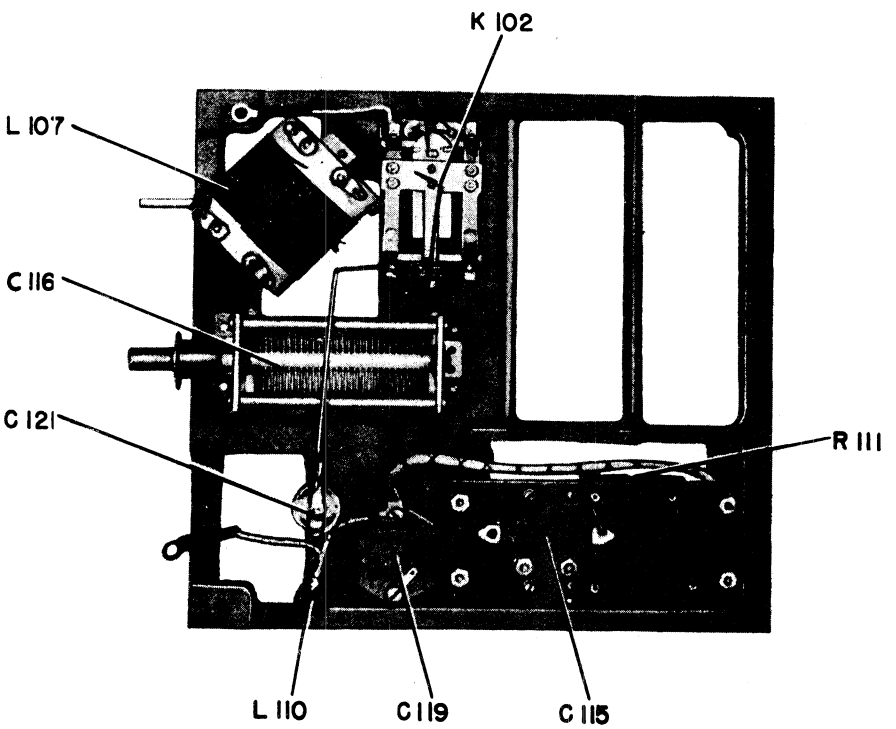


Fig. 5 Transmitter Left-End Casting — Inside View

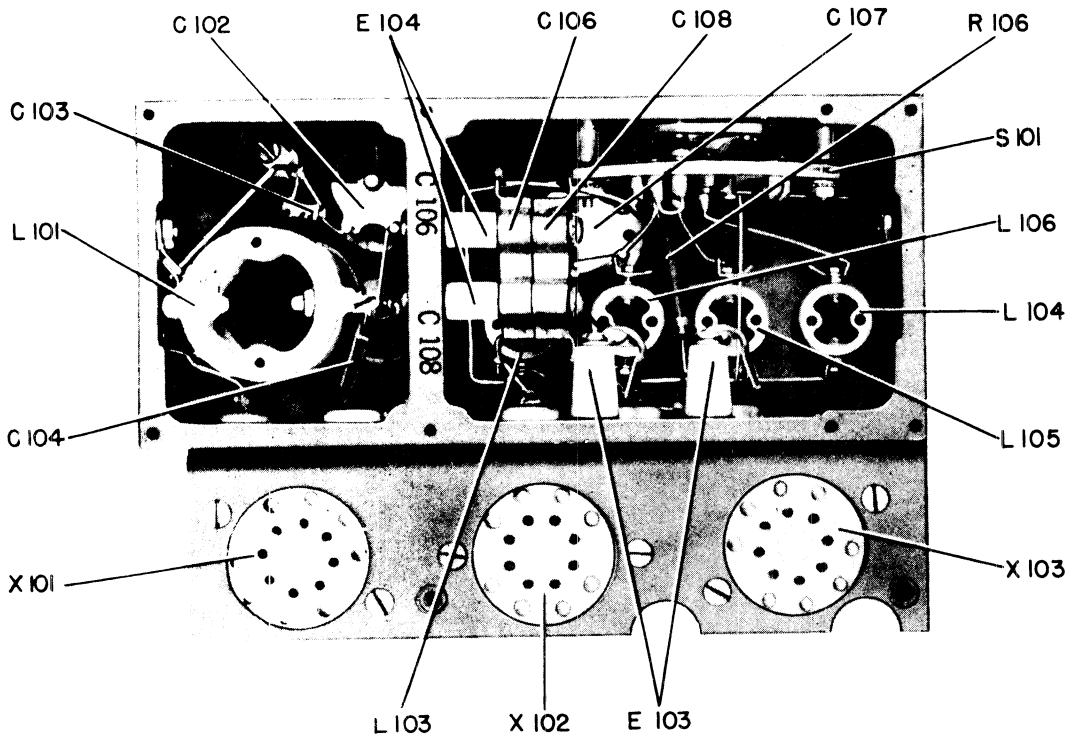


Fig. 6 Transmitter Exciter Assembly — Top View

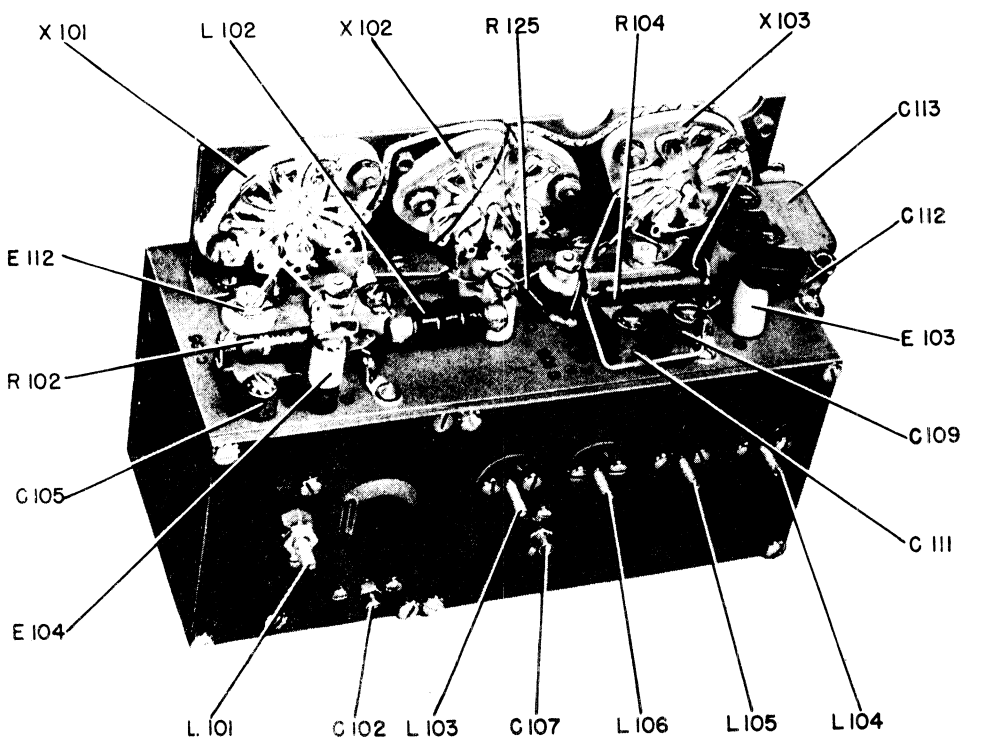


Fig. 7 Transmitter Exciter Assembly — Bottom View

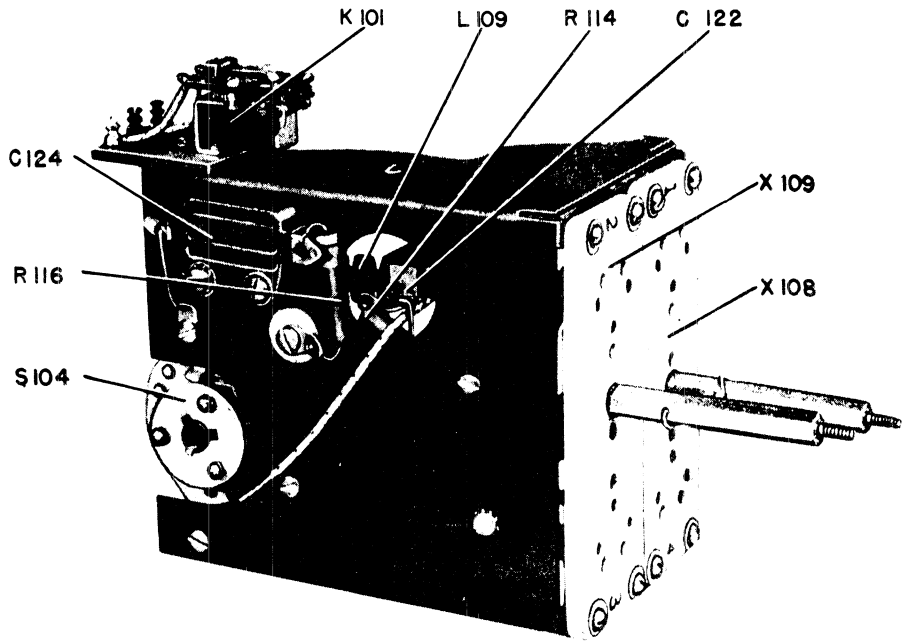


Fig. 8 Transmitter Crystal-Bracket Assembly — Top View

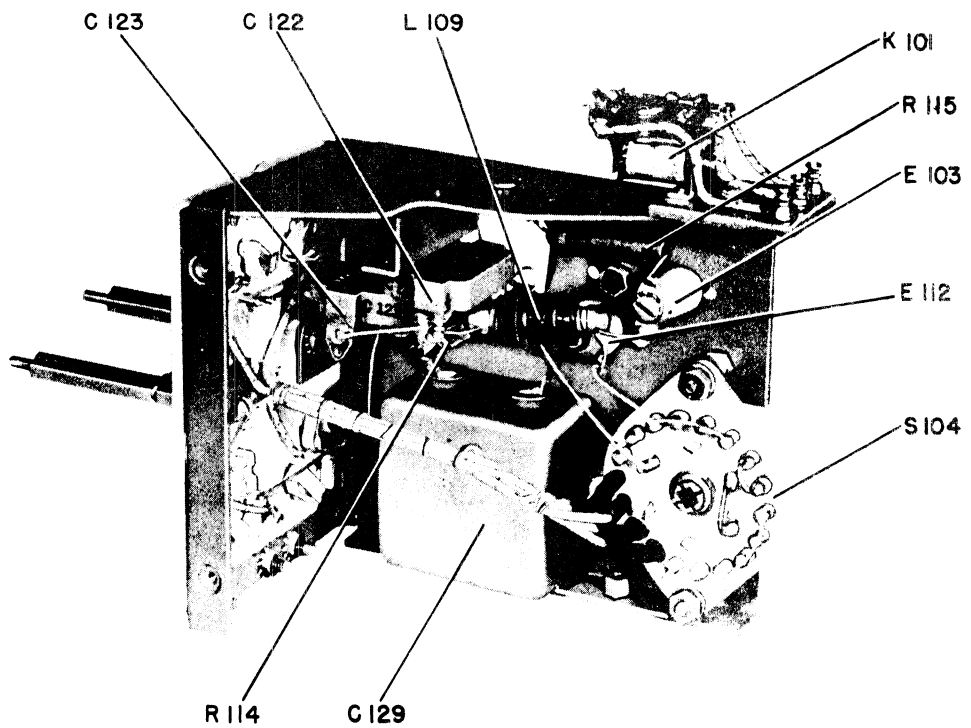


Fig. 9 Transmitter Crystal-Bracket Assembly — Bottom View

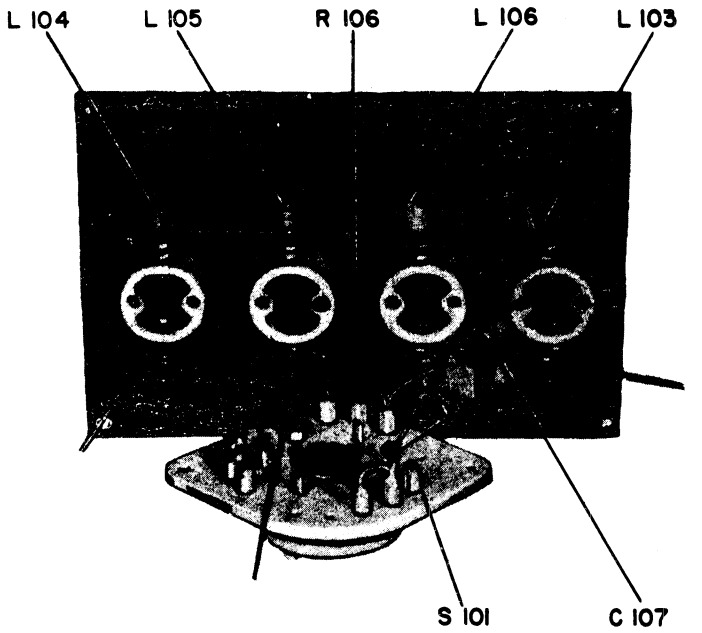


Fig. 10 Transmitter Exciter Plate-Tank Assembly — Top View

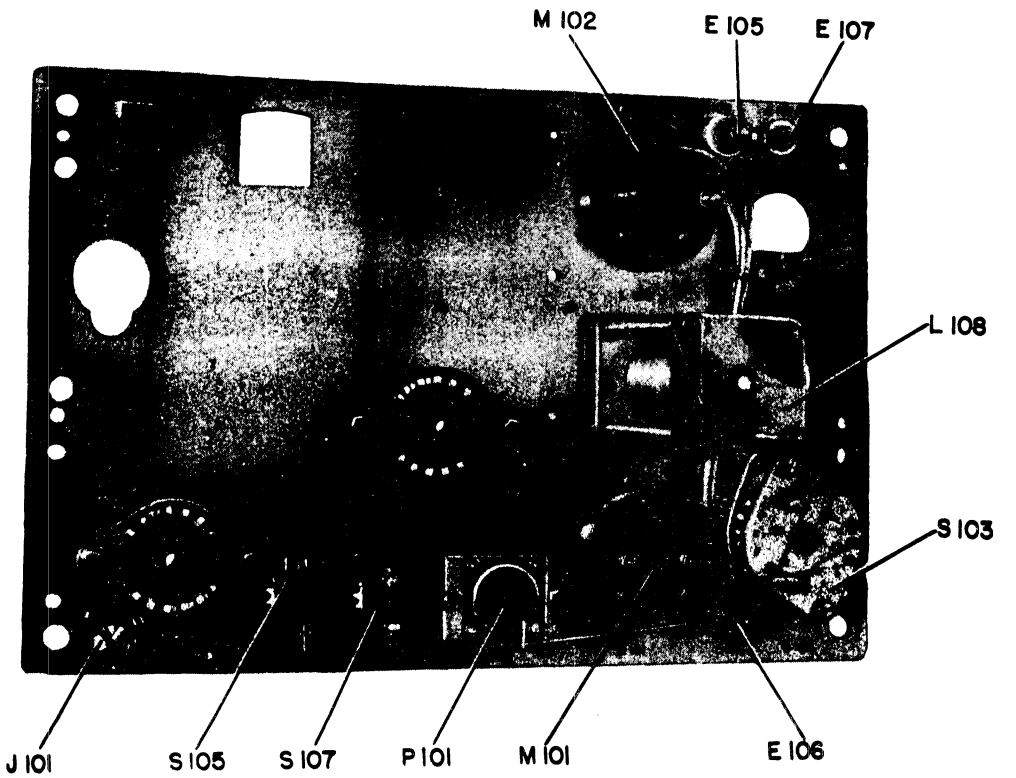


Fig. 11 Transmitter Front Panel — Inside View

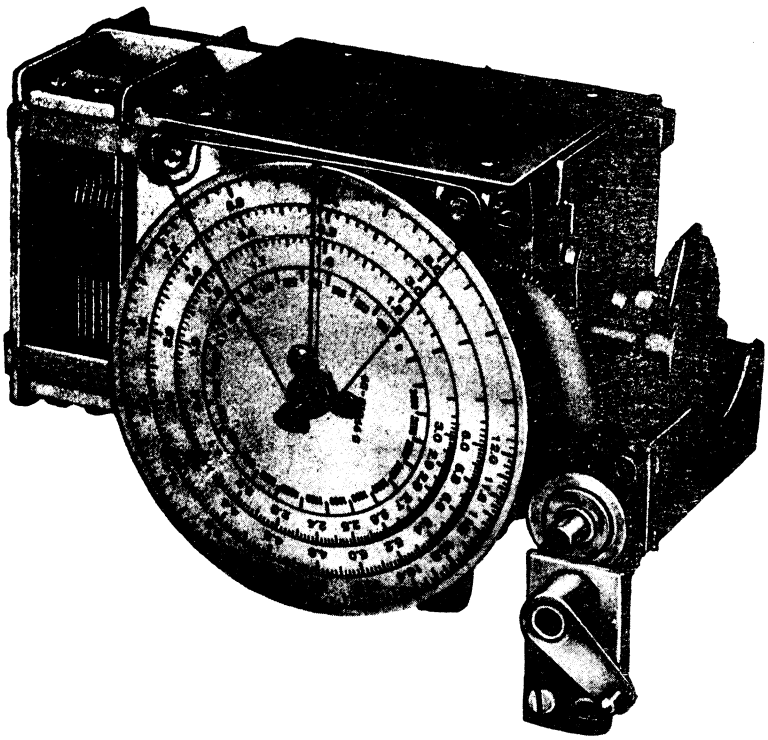


Fig. 12 Ganged Variable Capacitor Assembly — Front View

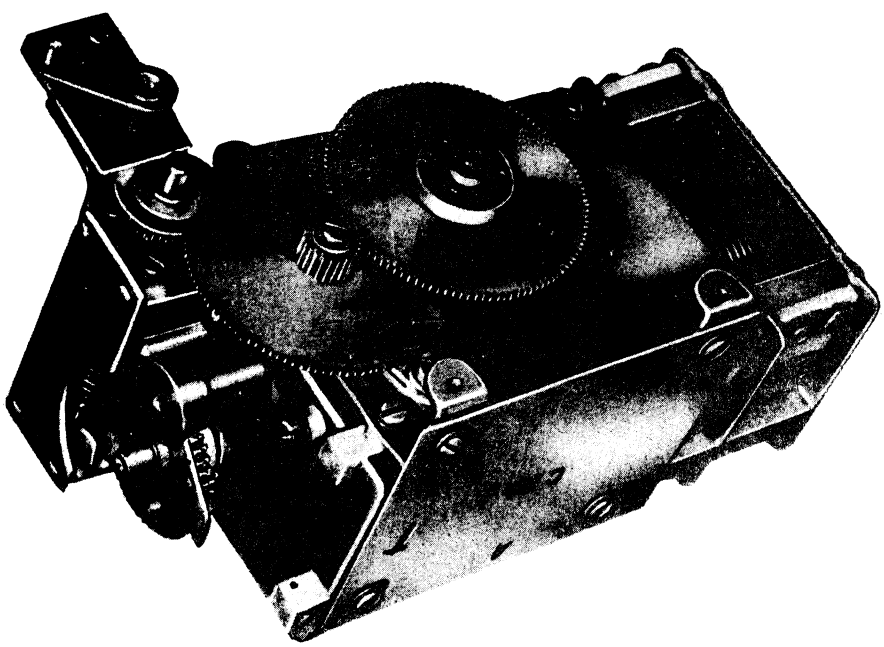


Fig. 13 Ganged Variable Capacitor Assembly — End View

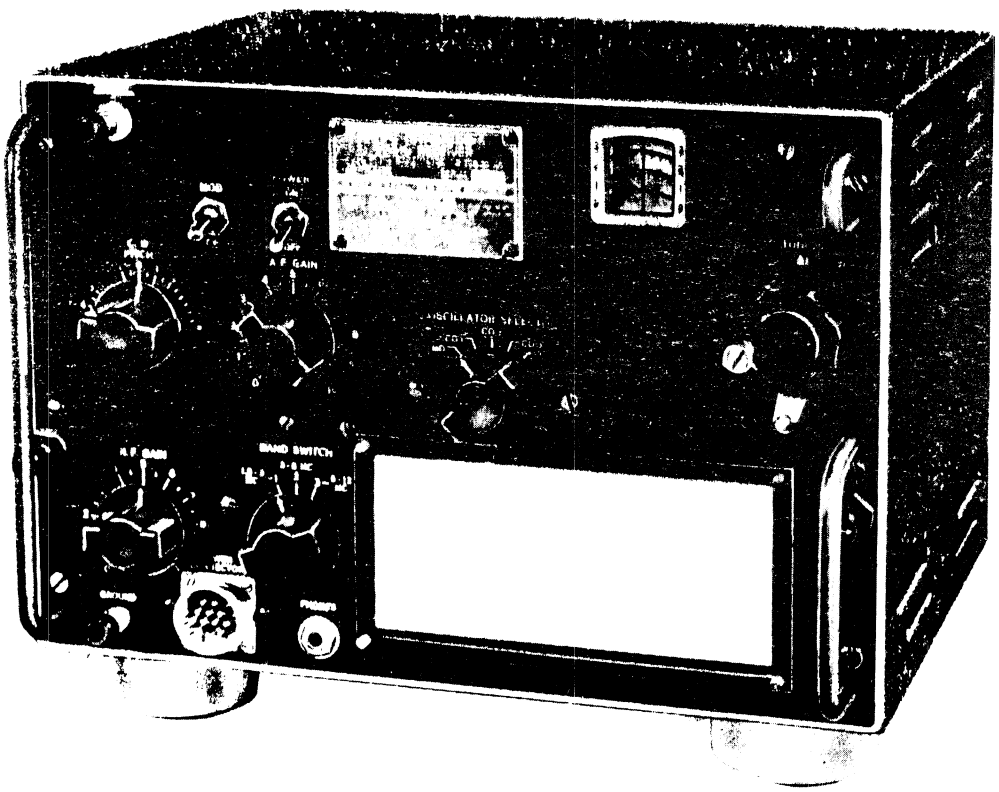


Fig. 14 Receiver Unit — Front View

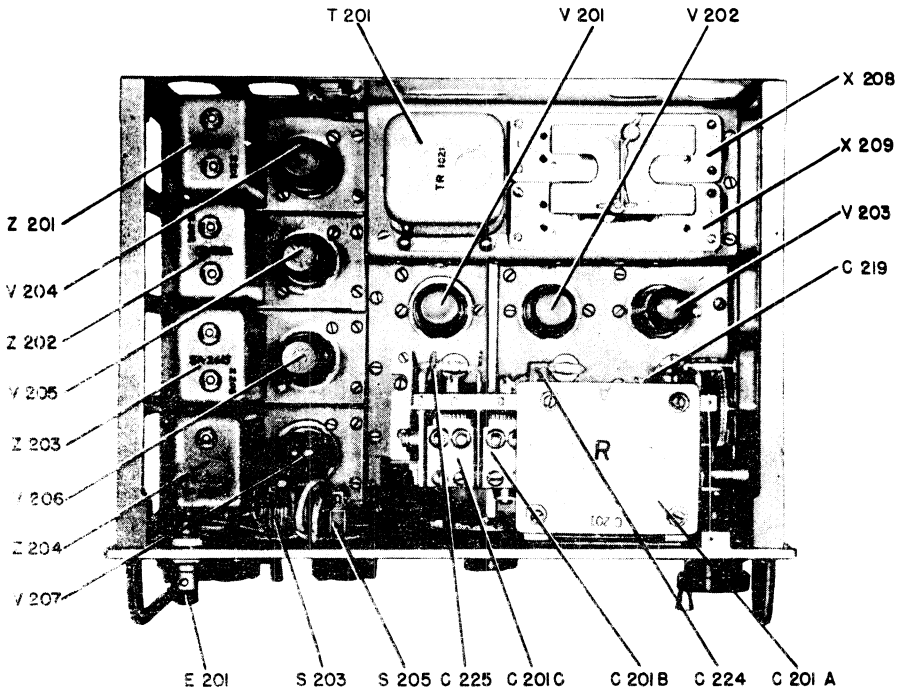


Fig. 15 Receiver Unit — Top Open View

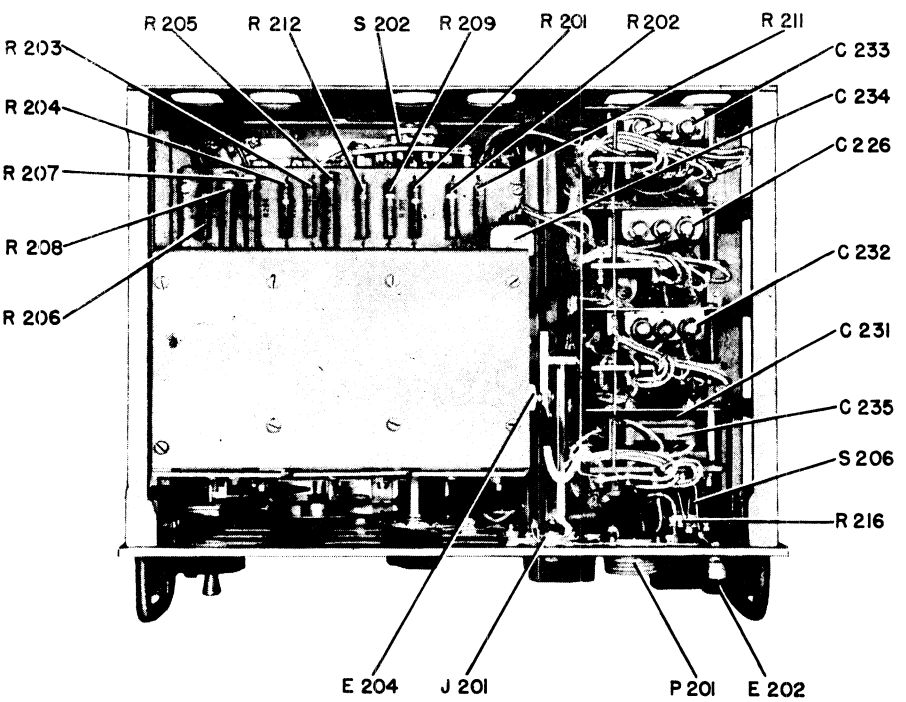


Fig. 16 Receiver Unit — Bottom Open View

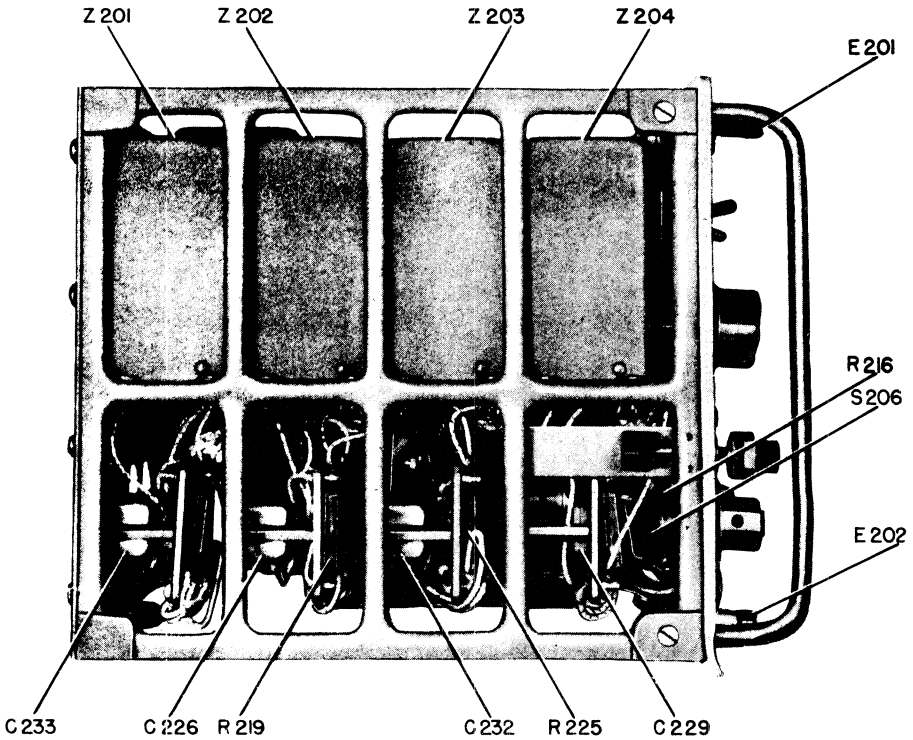


Fig. 17 Receiver Unit — Left End Open View

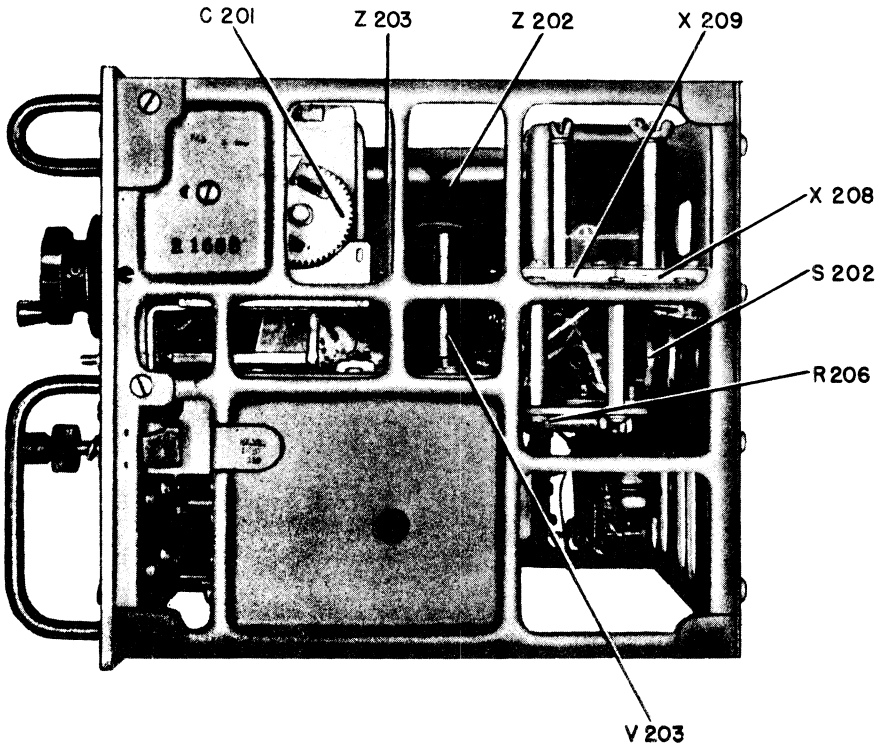


Fig. 18 Receiver Unit — Right End Open View

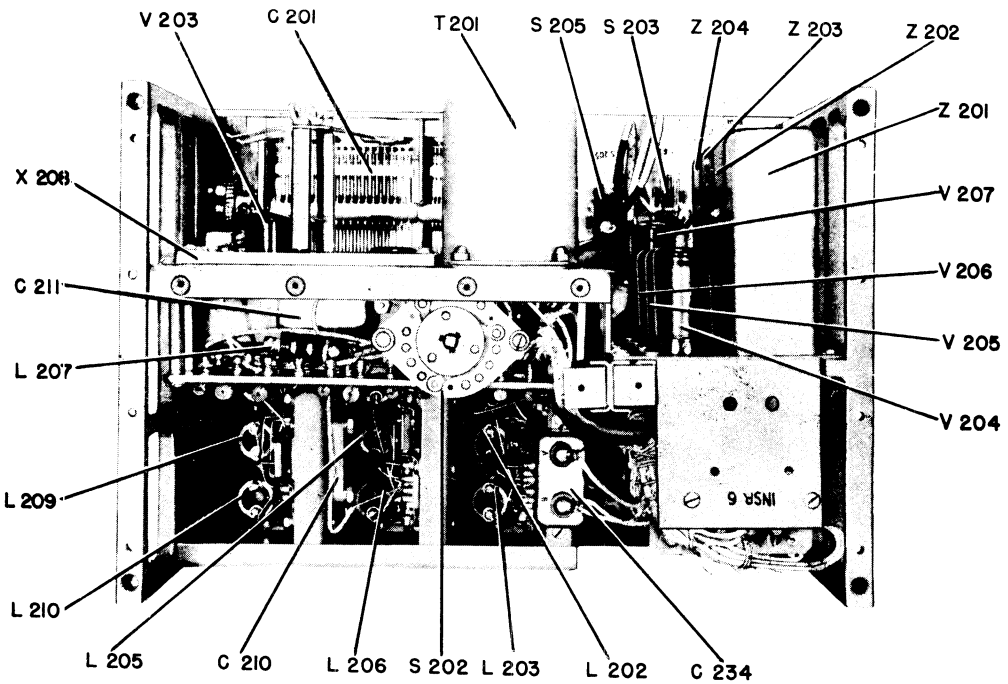


Fig. 19 Receiver Unit — Rear Open View

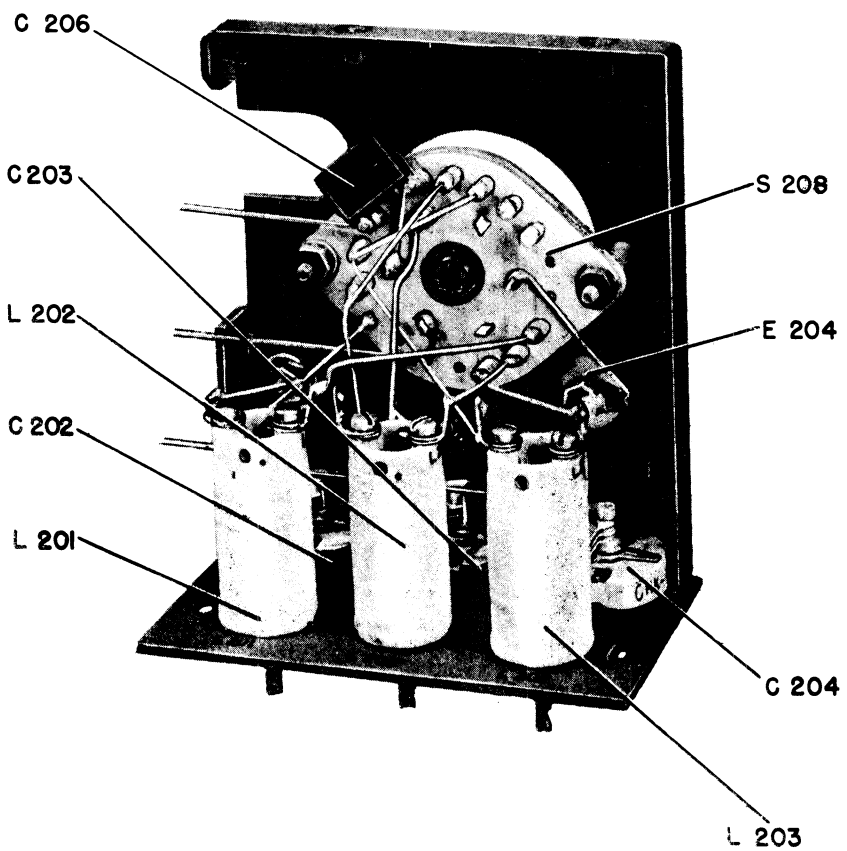


Fig. 20 Receiver R-F Assembly — Side View

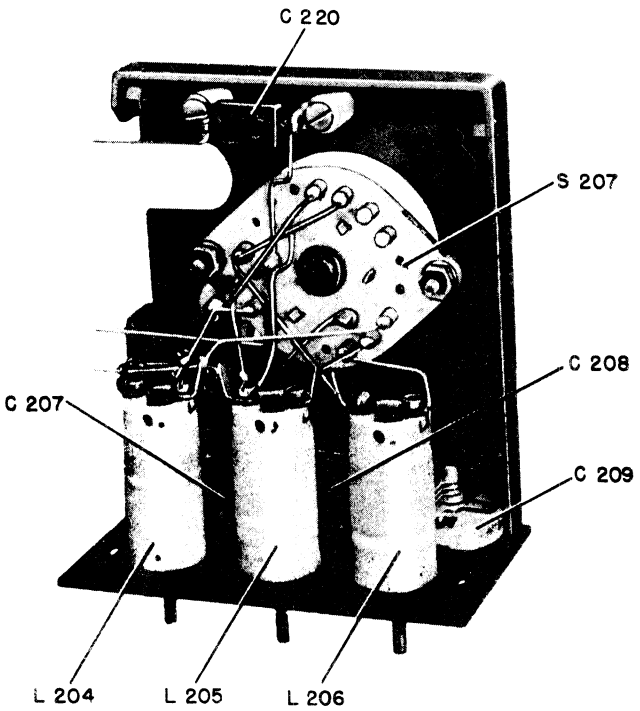


Fig. 21 Receiver Converter Assembly — Side View

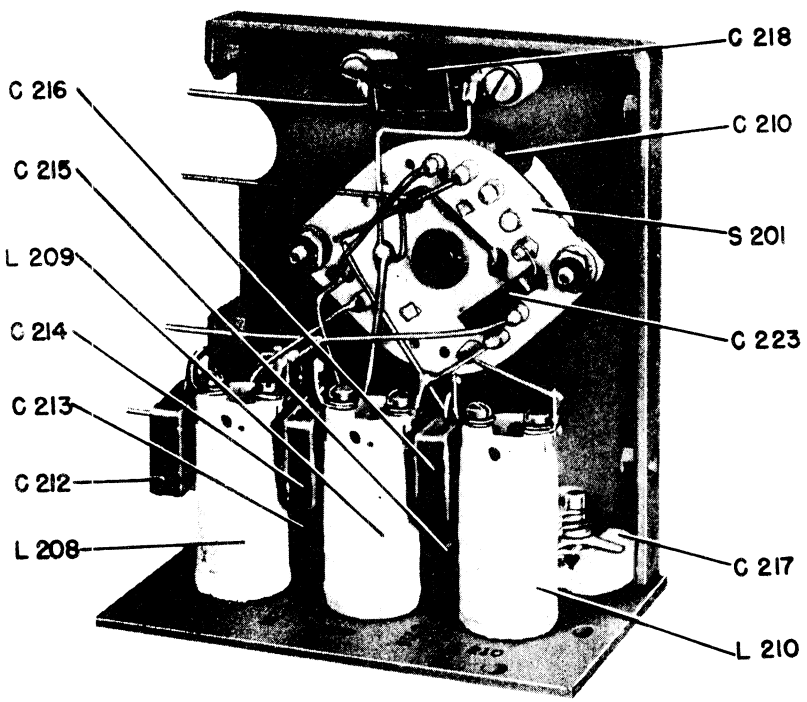


Fig. 22 Receiver Oscillator Assembly — Side View

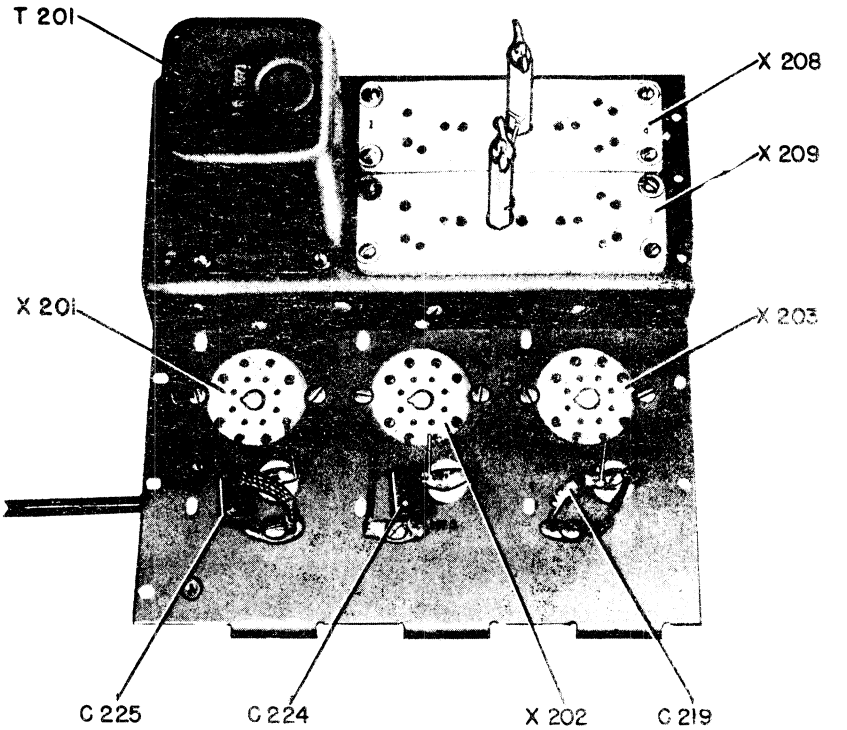


Fig. 23 Receiver R-F Chassis — Top View

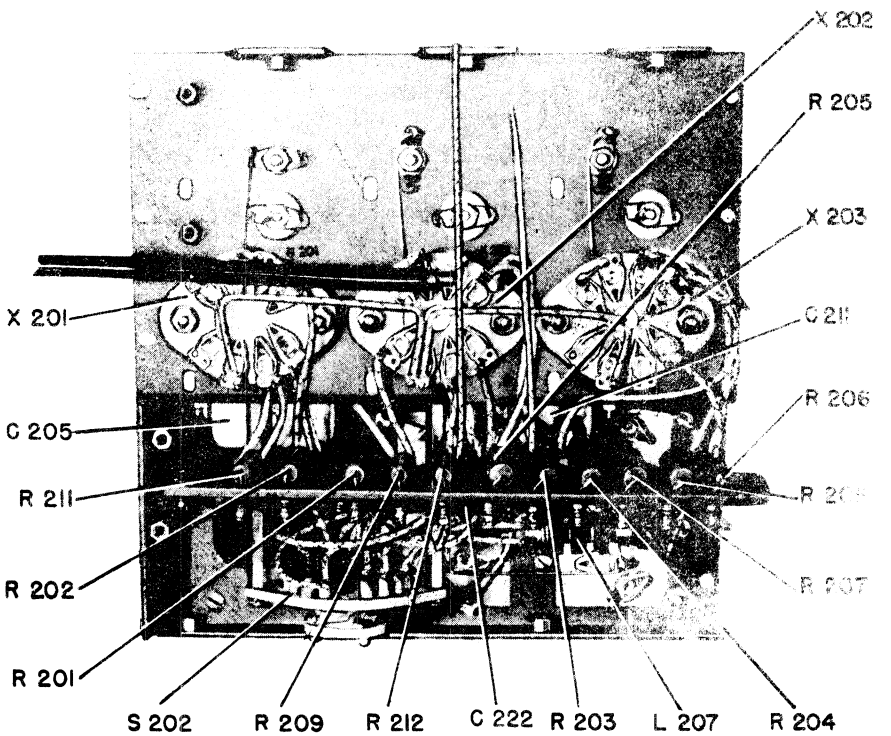


Fig. 24 Receiver R-F Chassis - - Bottom View

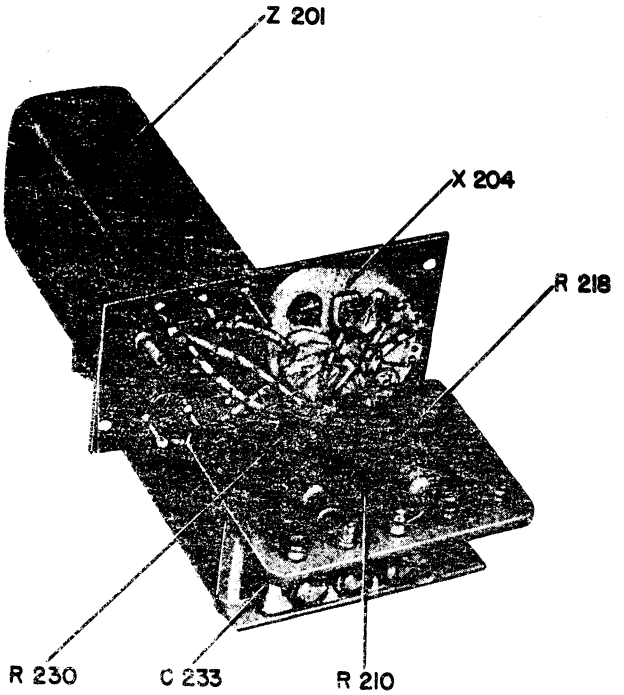


Fig. 25 Receiver 1st I-F Assembly — Bottom View

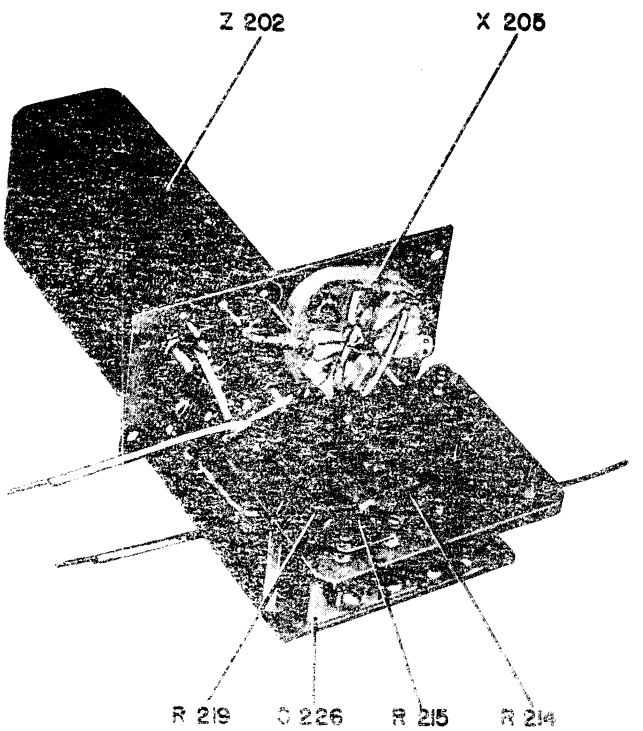


Fig. 26 Receiver 2nd I-F Assembly — Bottom View

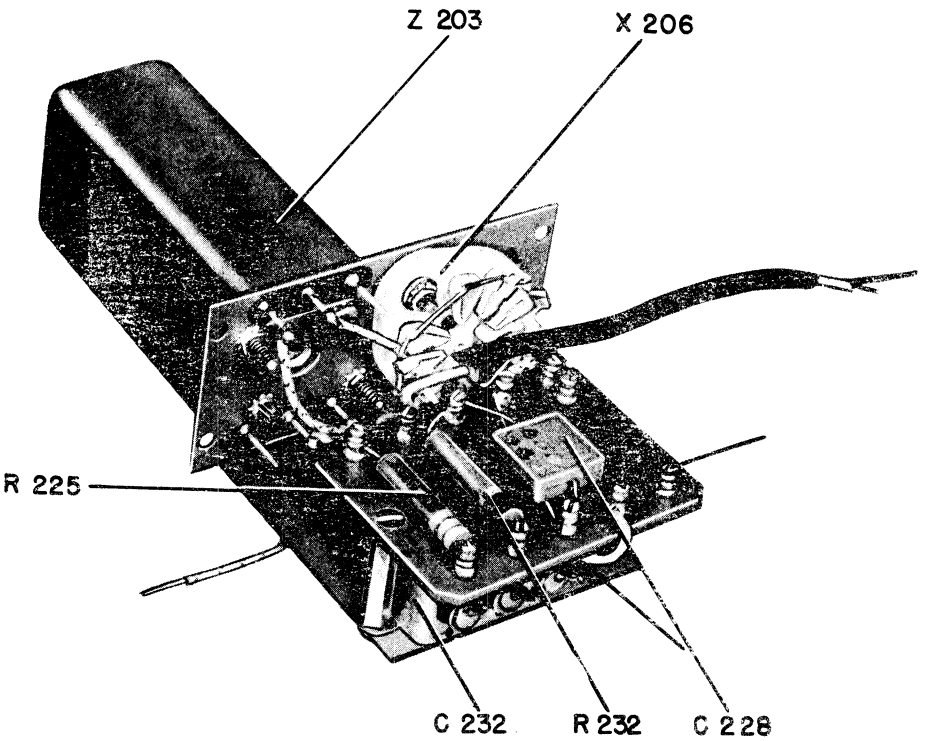


Fig. 27 Receiver 3rd I-F Assembly — Bottom View

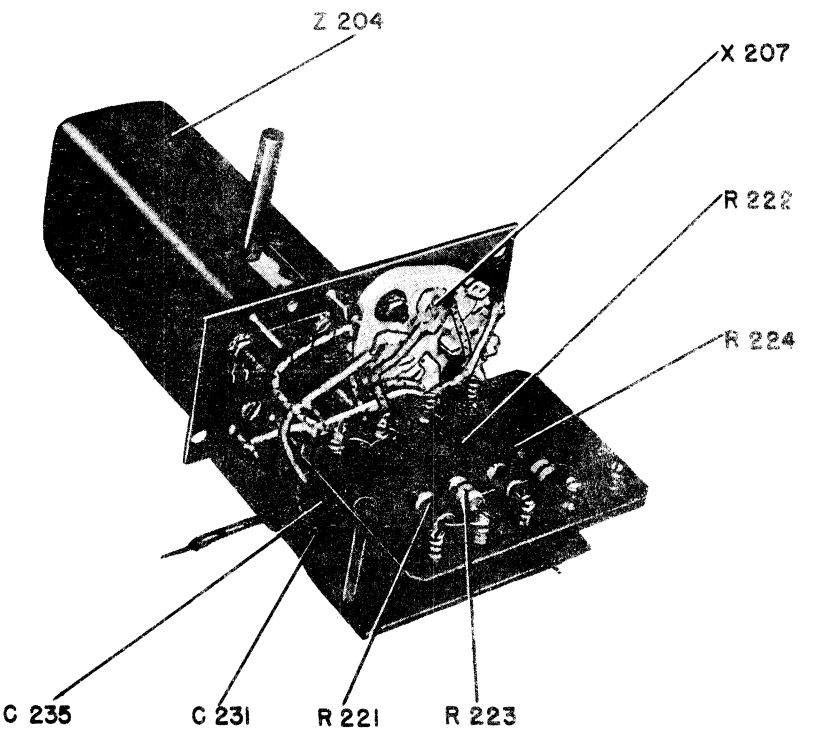


Fig. 28 Receiver B-F-O Assembly — Bottom View

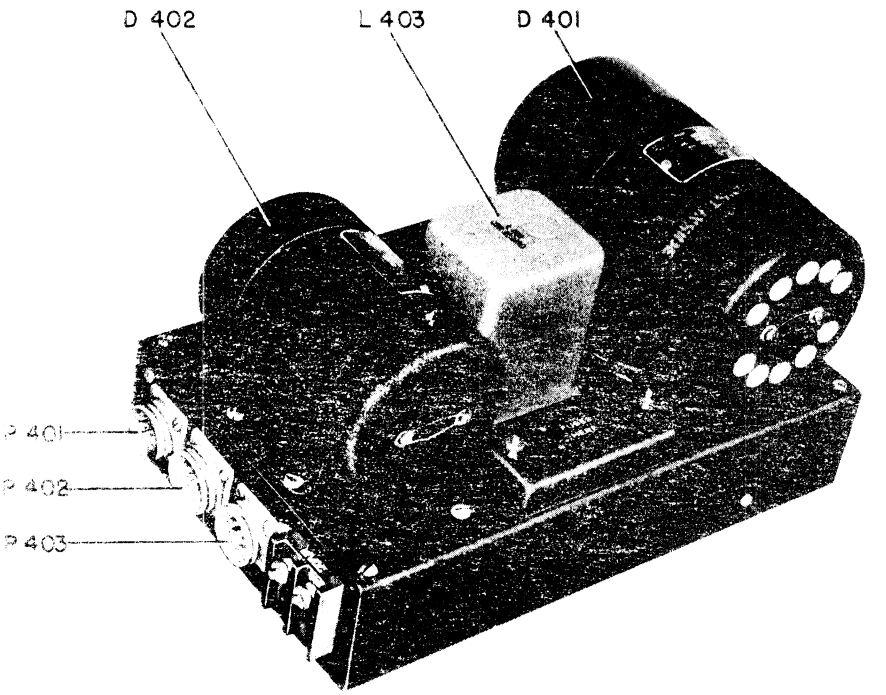


Fig. 29 Power-Supply Unit — Front View

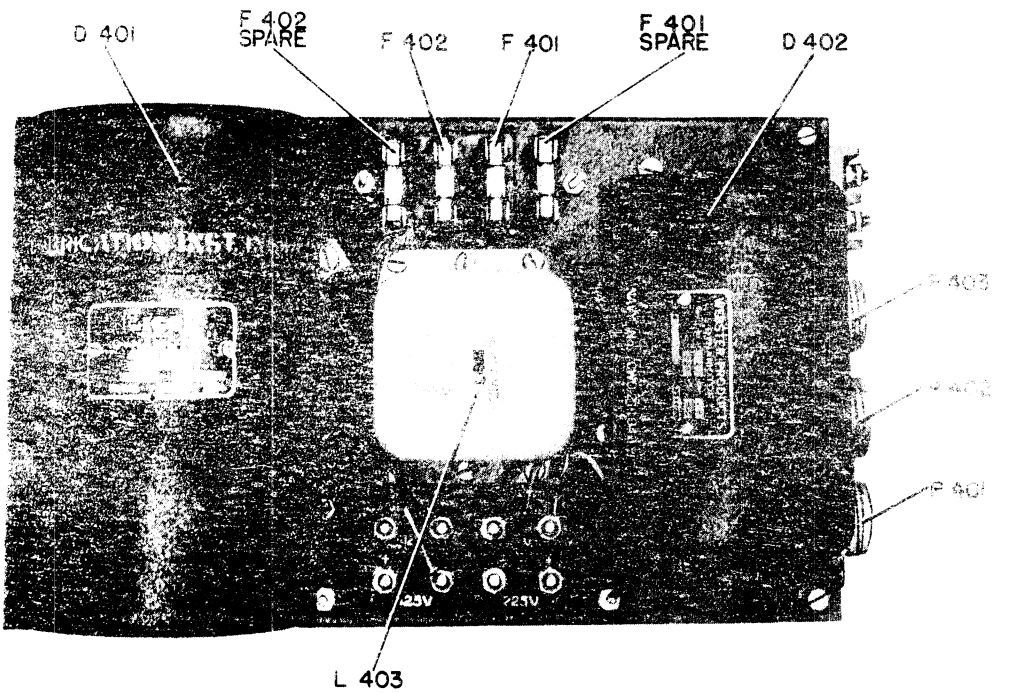


Fig. 30 Power-Supply Unit — Top View

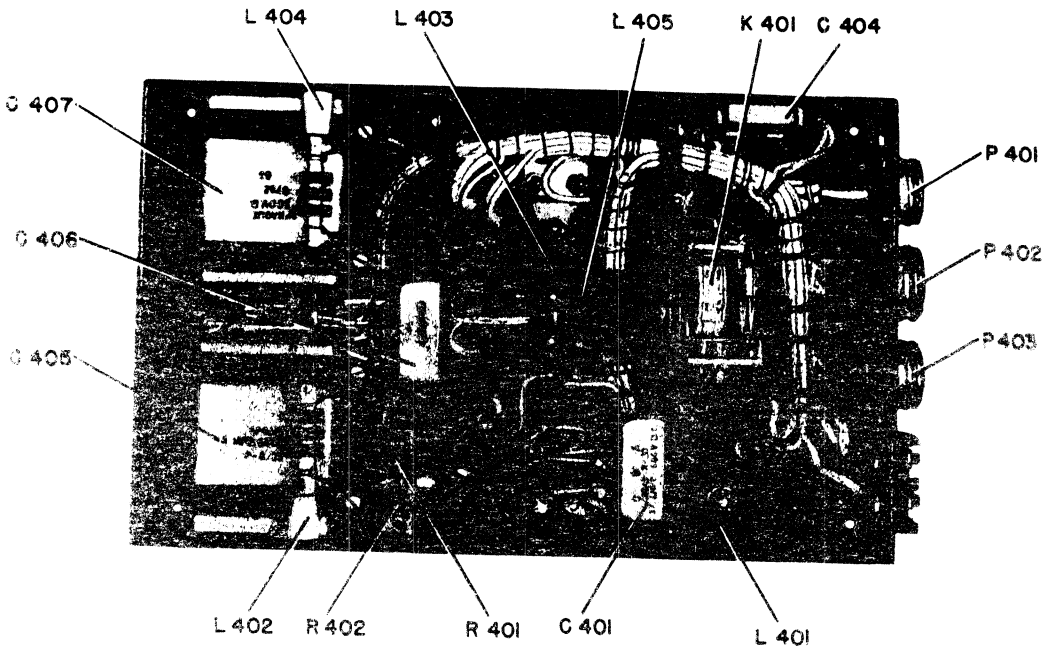


Fig. 31A Power-Supply Unit — Bottom Open View

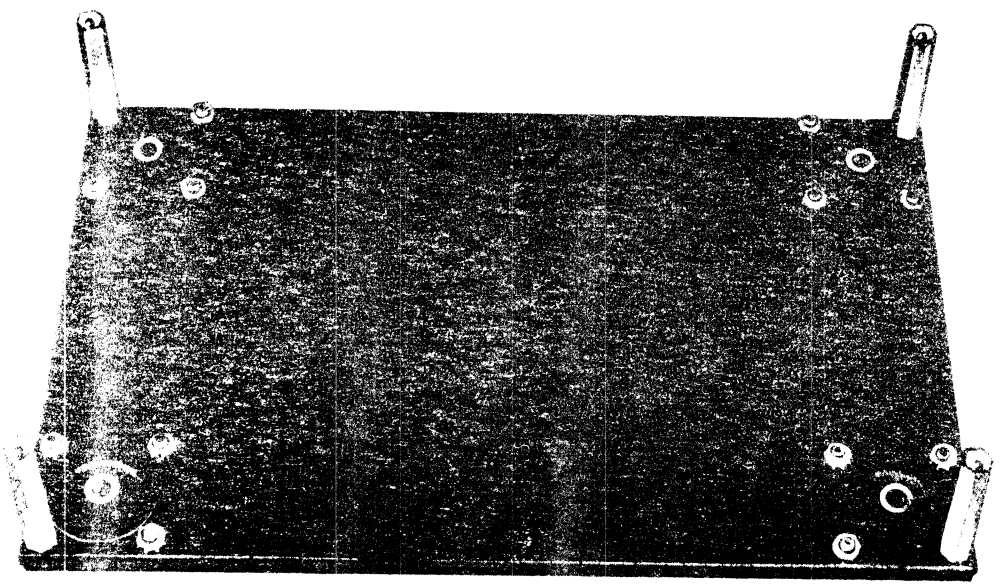


Fig. 31B Power-Supply Unit Base Plate — Top View

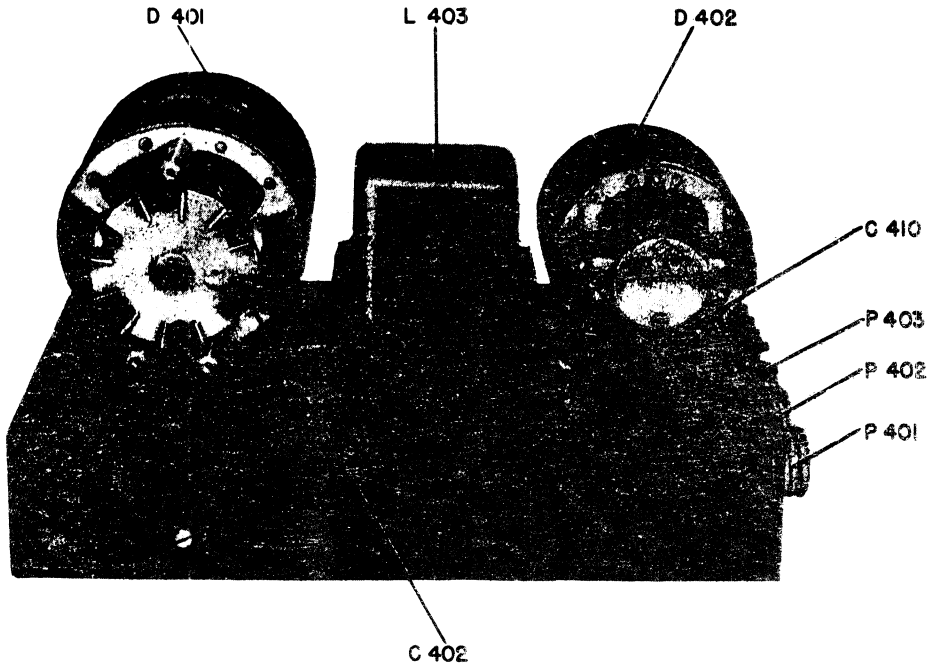


Fig. 32 Power-Supply Unit — Left-Side View

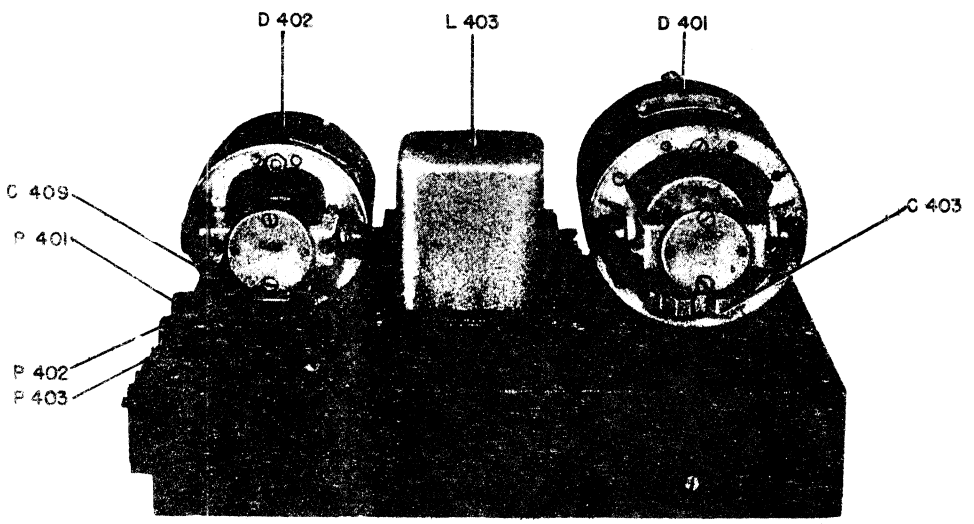


Fig. 33 Power-Supply Unit — Right-Side View

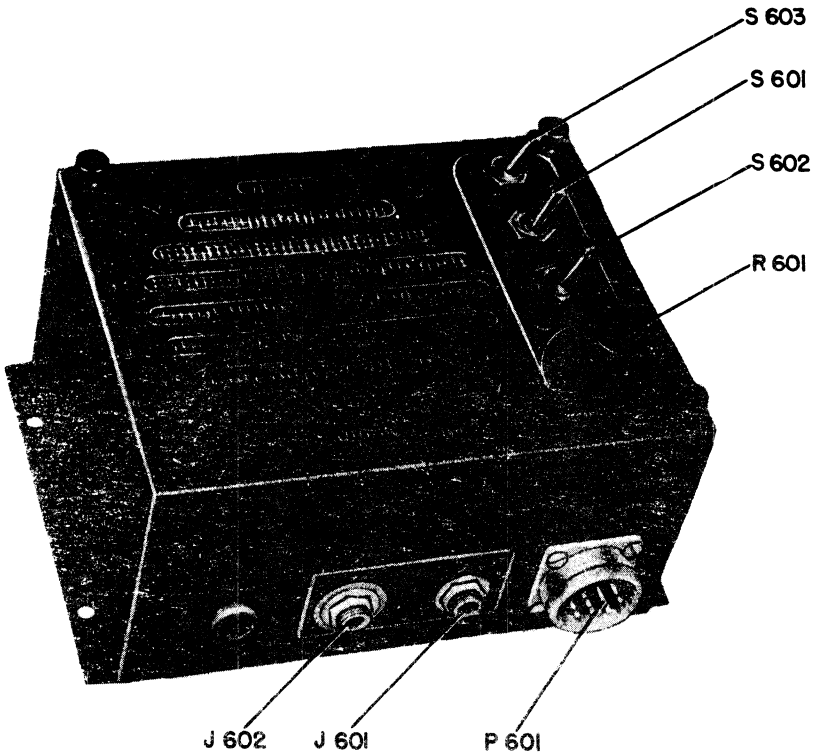


Fig. 34 Remote-Control Unit — Top View

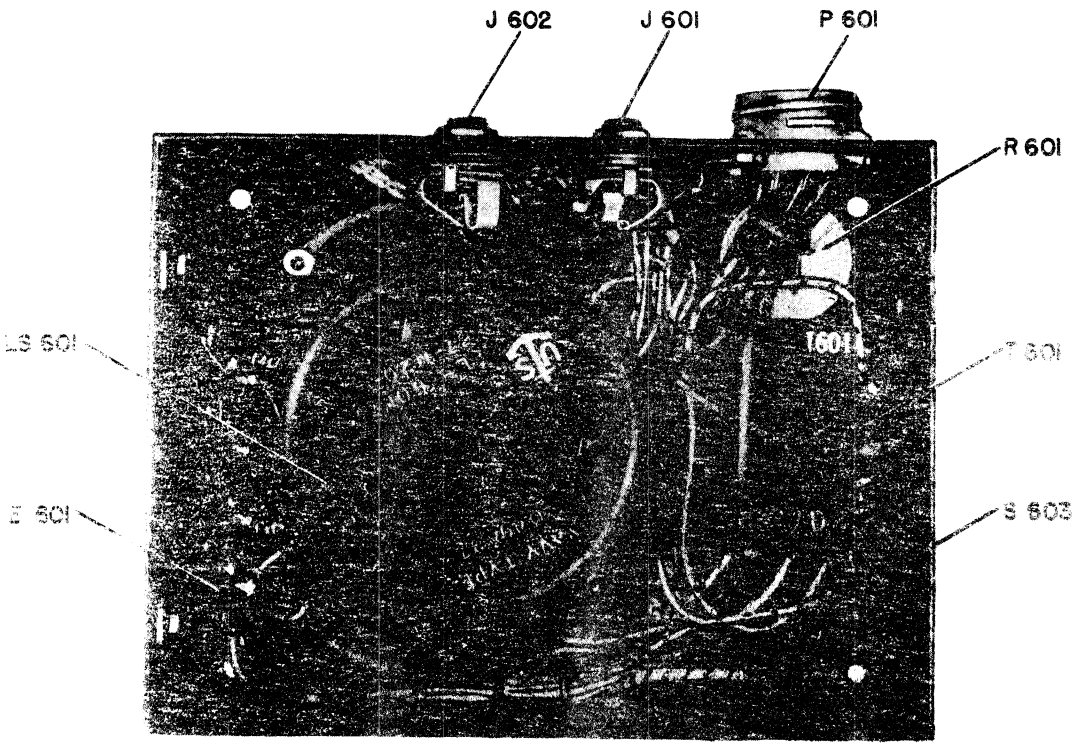


Fig. 35 Remote-Control Unit — Bottom Open View

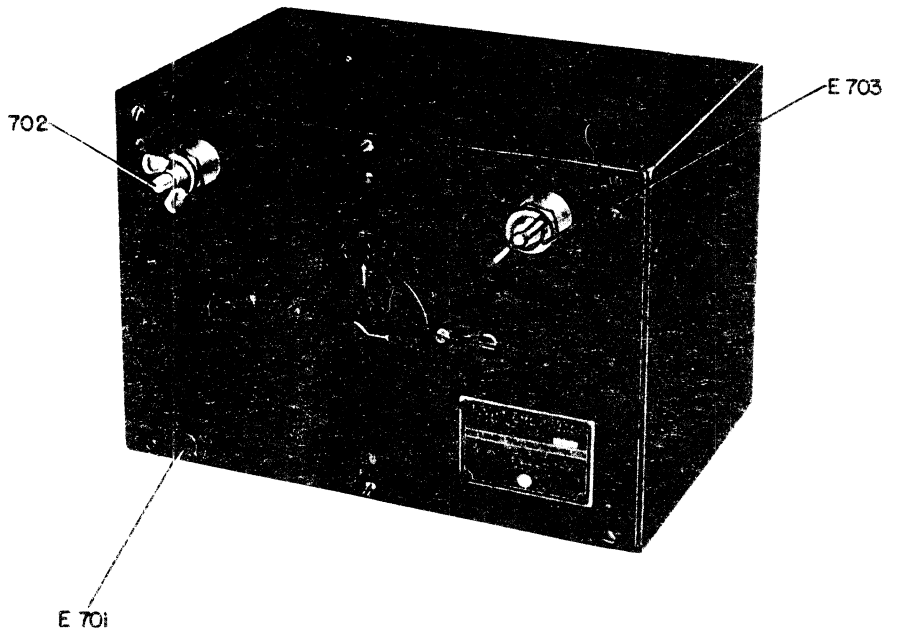


Fig. 36 Antenna Loading Coil Unit — Front View

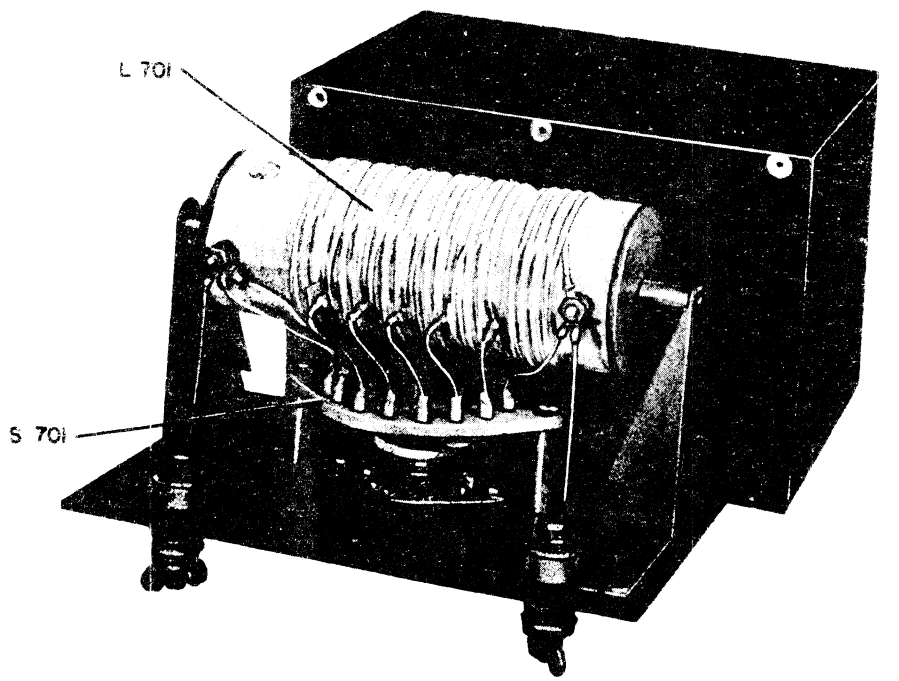


Fig. 37 Antenna Loading Coil Unit — Front Open View

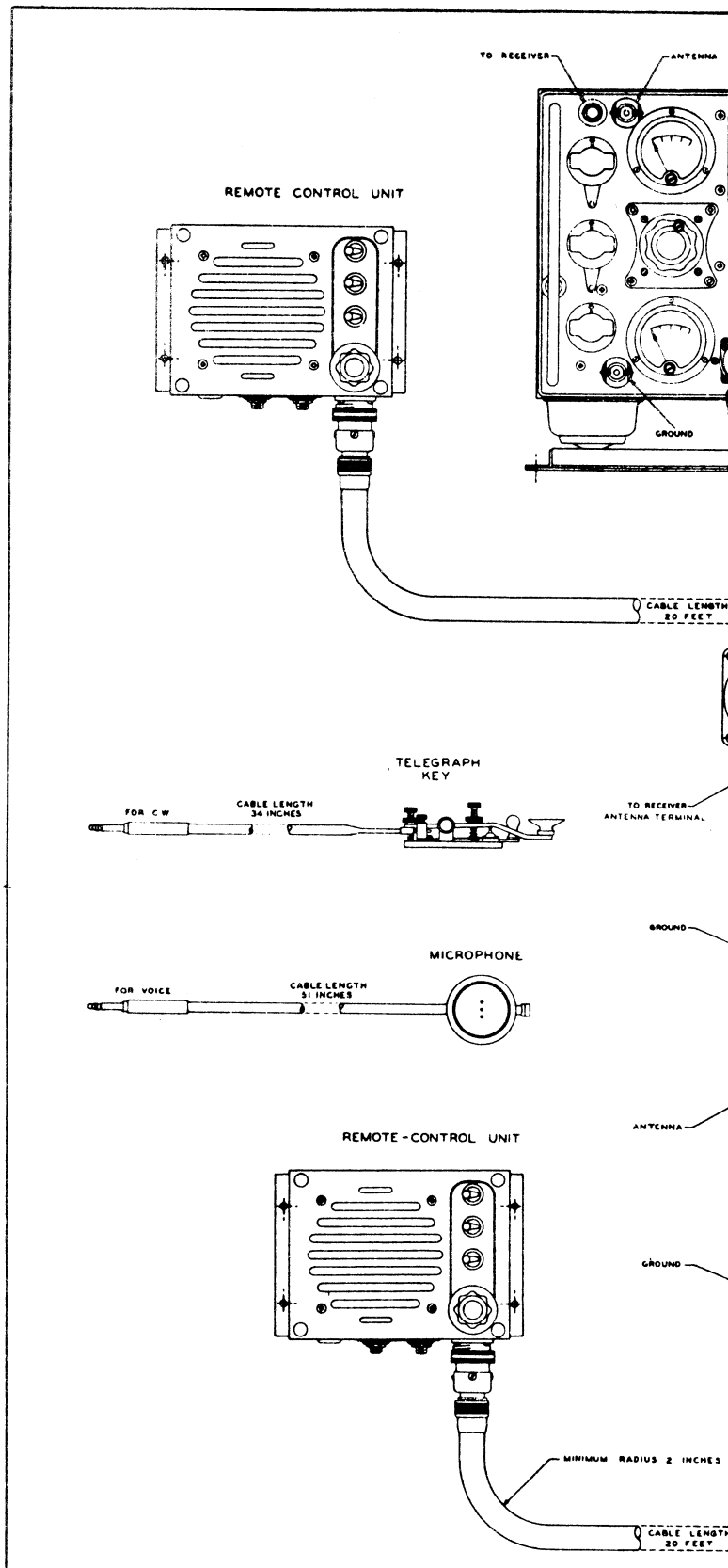


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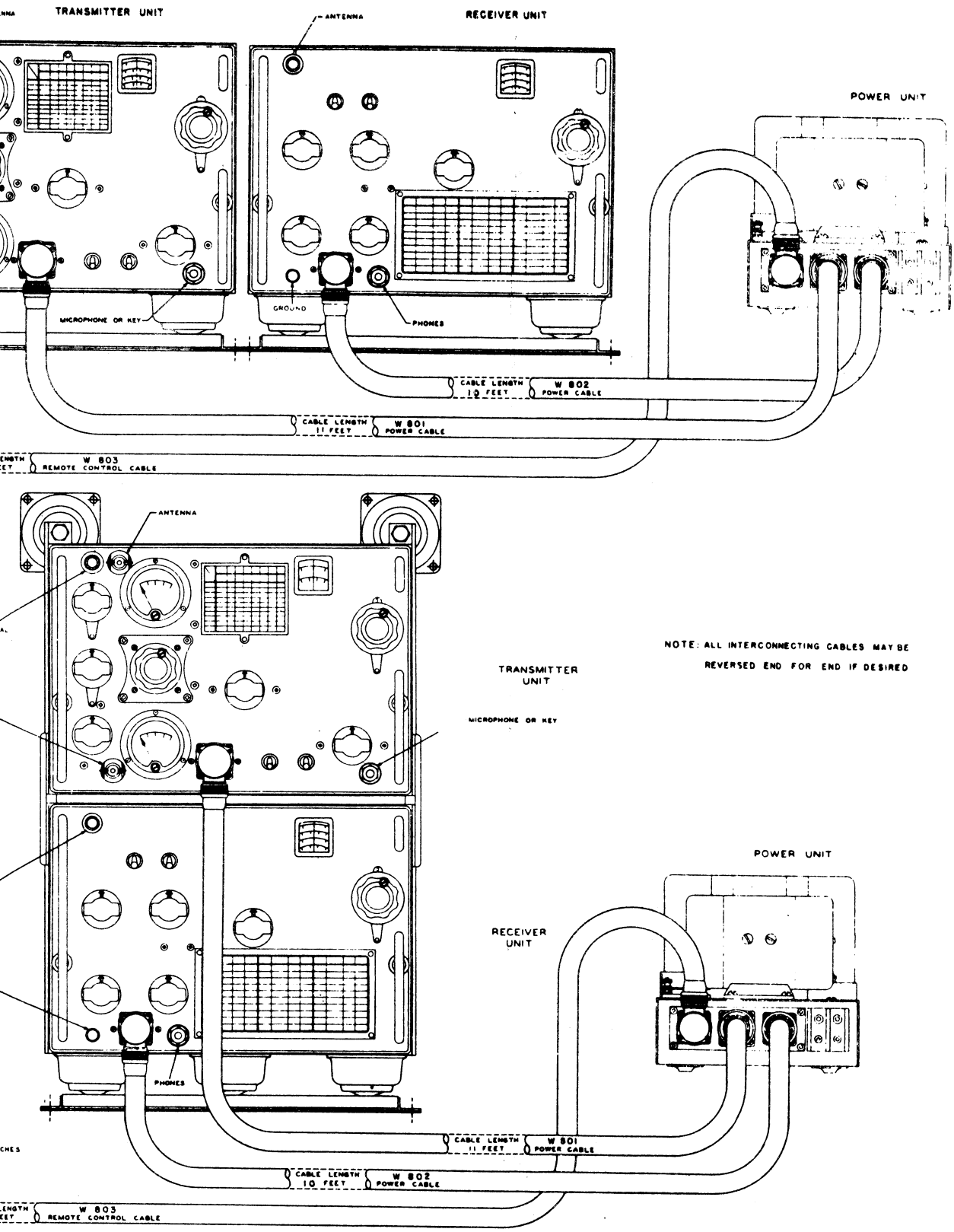
FIG. 38 – C



– GENERAL VIEW OF TCS-13 EQUIPMENT WITH INTERCONNECTING CABLES

DRAWING NUMBER MX-1053

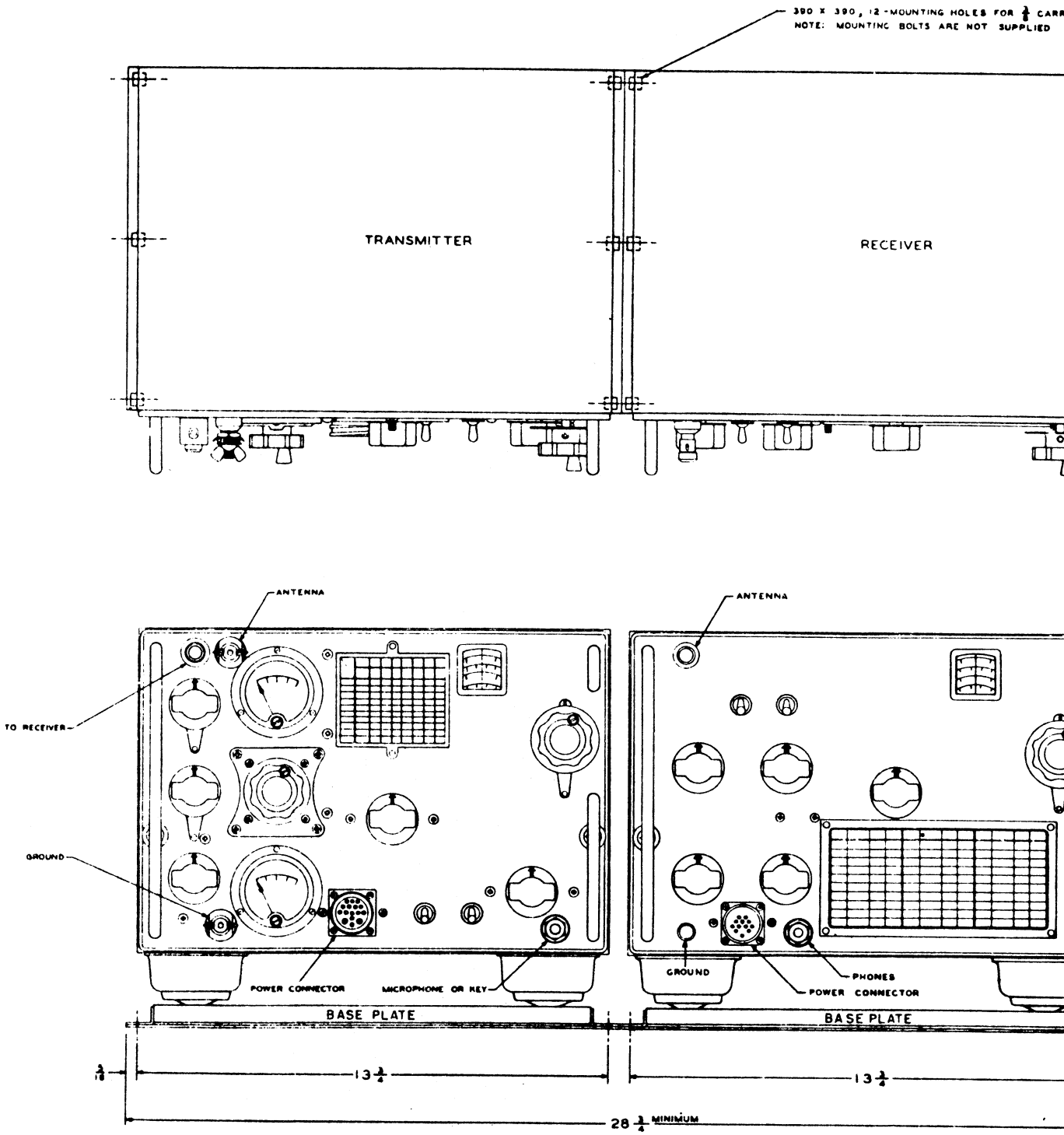


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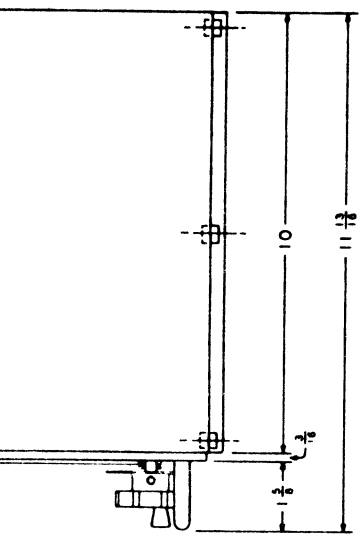
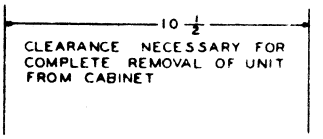
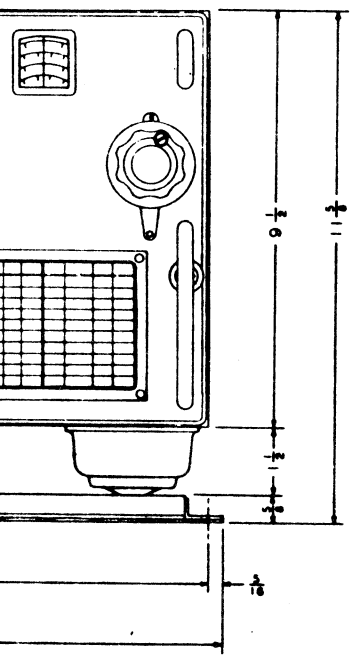
FIG. 39- TRANSMITTER AND RECEIVER L

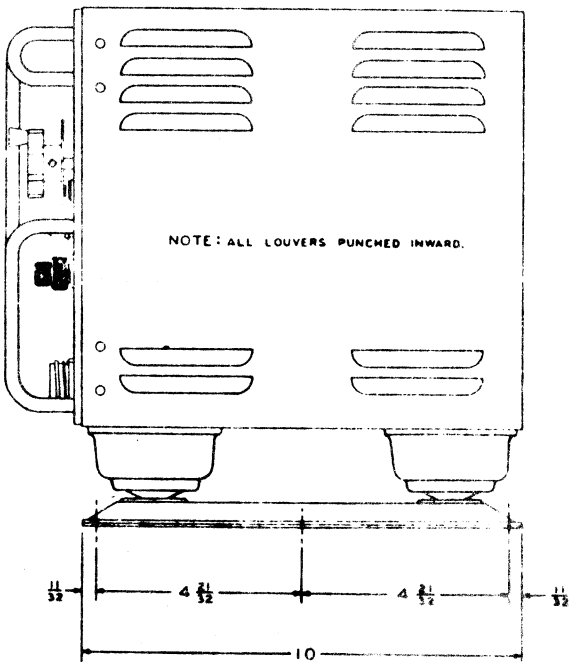
HOLES FOR $\frac{1}{2}$ CARRIAGE BOLTS.
ARE NOT SUPPLIED



WEIGHT TRANSMITTER	50 0 LBS.
WEIGHT RECEIVER	42 0 LBS
WEIGHT BASE PLATES	5 0 LBS. EACH
TOTAL WEIGHT	102 0 LBS







RECEIVER UNITS - HORIZONTAL MOUNTING-

DRAWING NUMBER
MX-1052

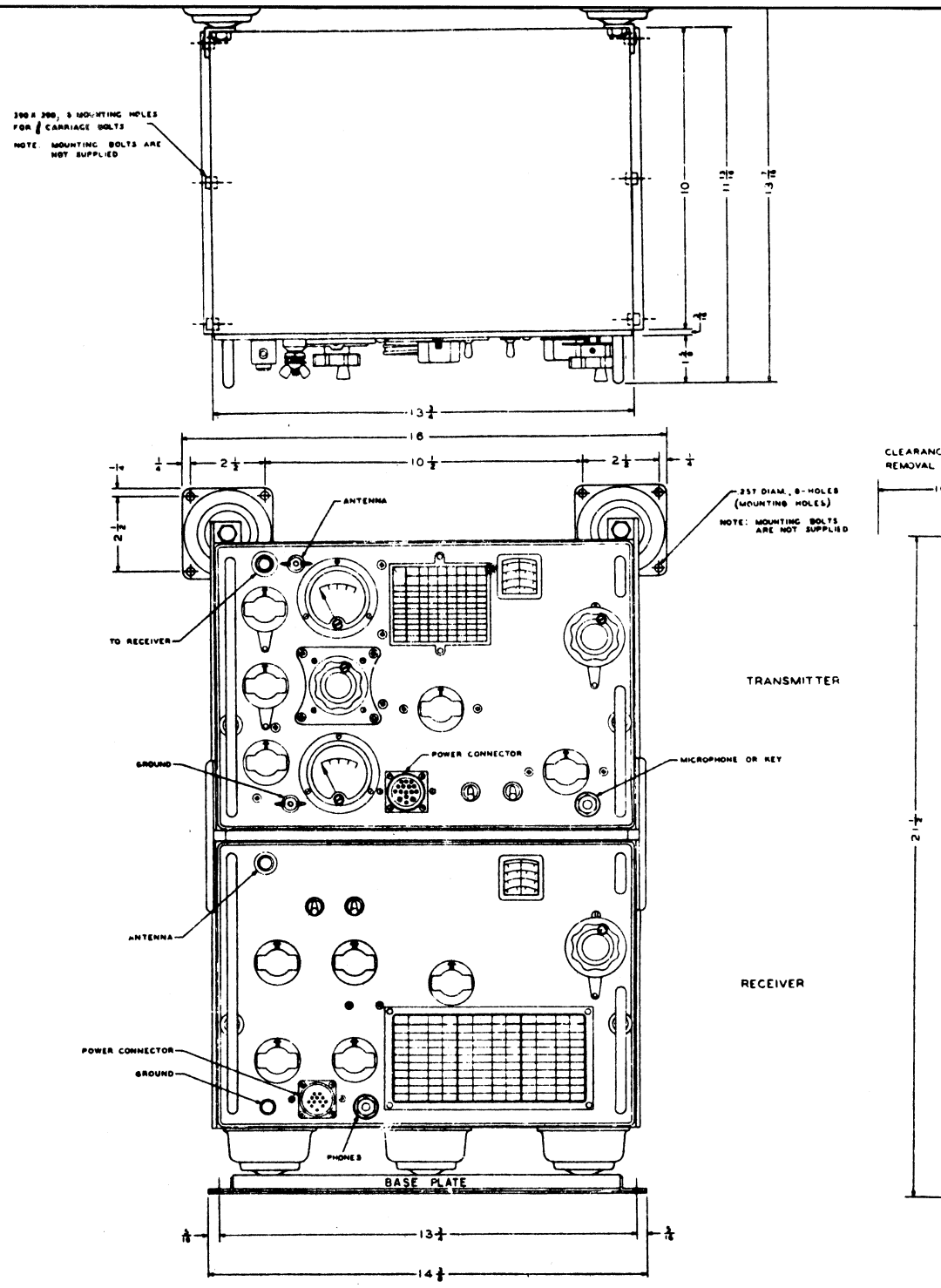


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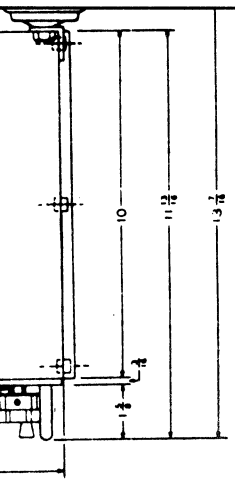
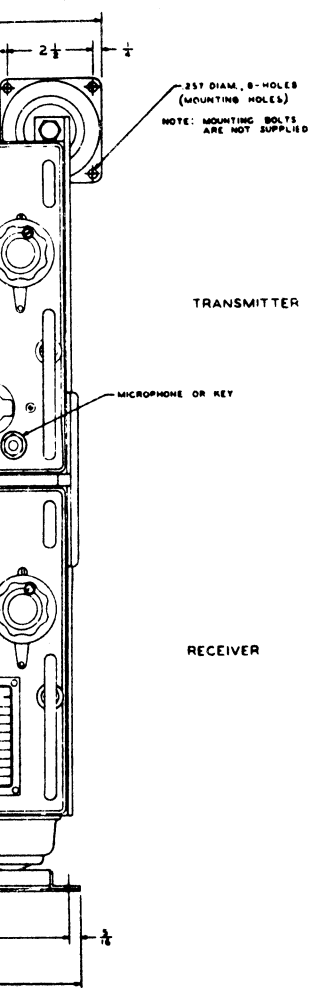
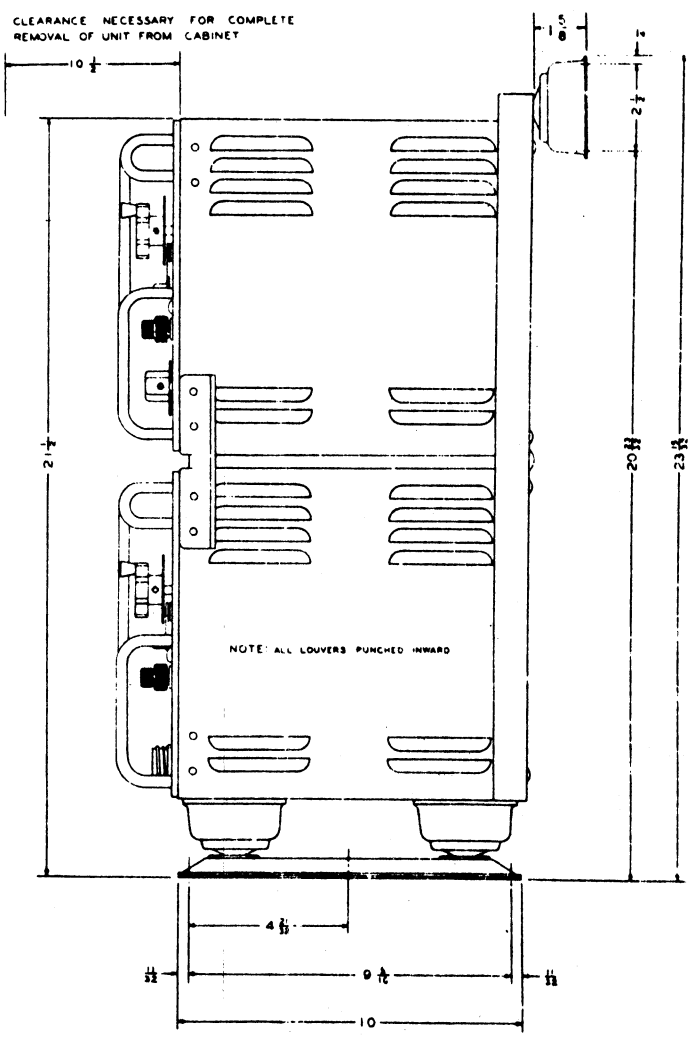
FIG. 40 - TRANSMITTER AND RECEIVER UNITS- VE

WEIGHT TRANSMITTER	50 0 LBS
WEIGHT RECEIVER	42 0 LBS
WEIGHT H 801	3 0 LBS
WEIGHT BASE PLATE	5 0 LBS
TOTAL WEIGHT	100 0 LBS

NOTE: H 801, CONTAINS HARDWARE NECESSARY FOR VERTICAL ASSEMBLY OF TRANSMITTER AND RECEIVER







-TRANSMITTER AND RECEIVER UNITS- VERTICAL MOUNTING.

DRAWING NUMBER
MX-1055

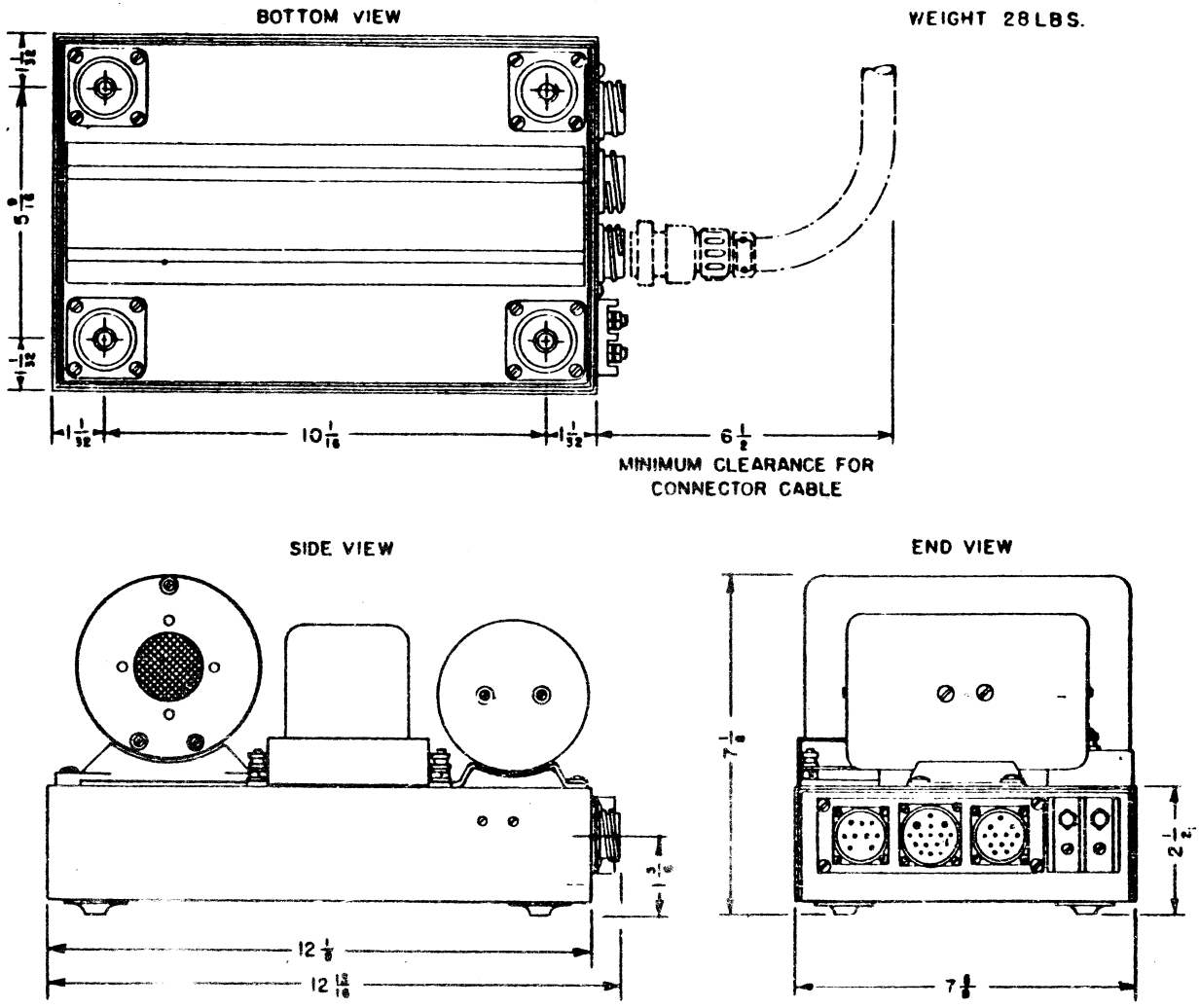


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FIG. 41. POWER-SUPPLY UNIT - INSTALLATION

DRAWING NUMBER
MM-1053

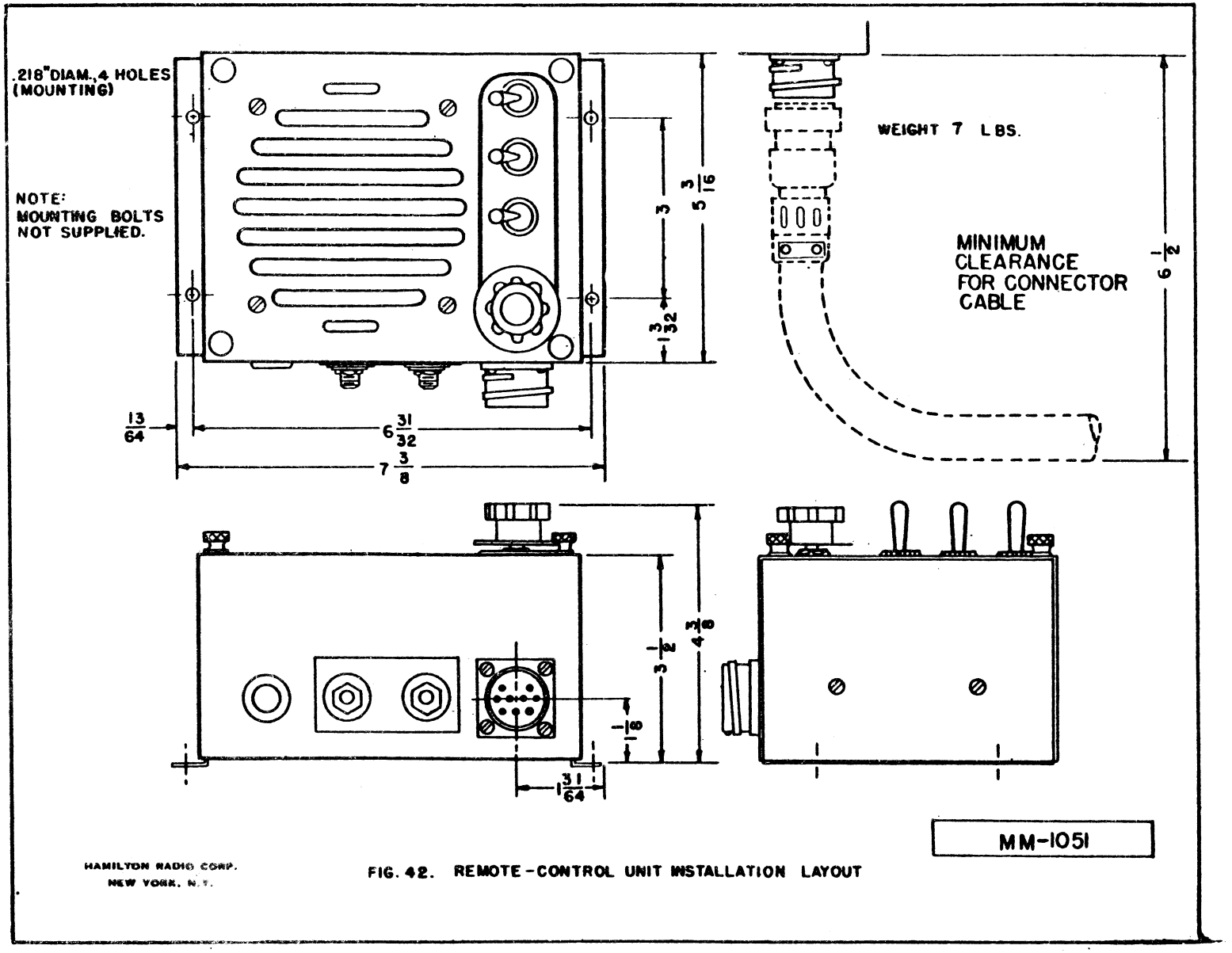

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FIG. 42. REMOTE-CONTROL UNIT INSTALLATION LAYOUT

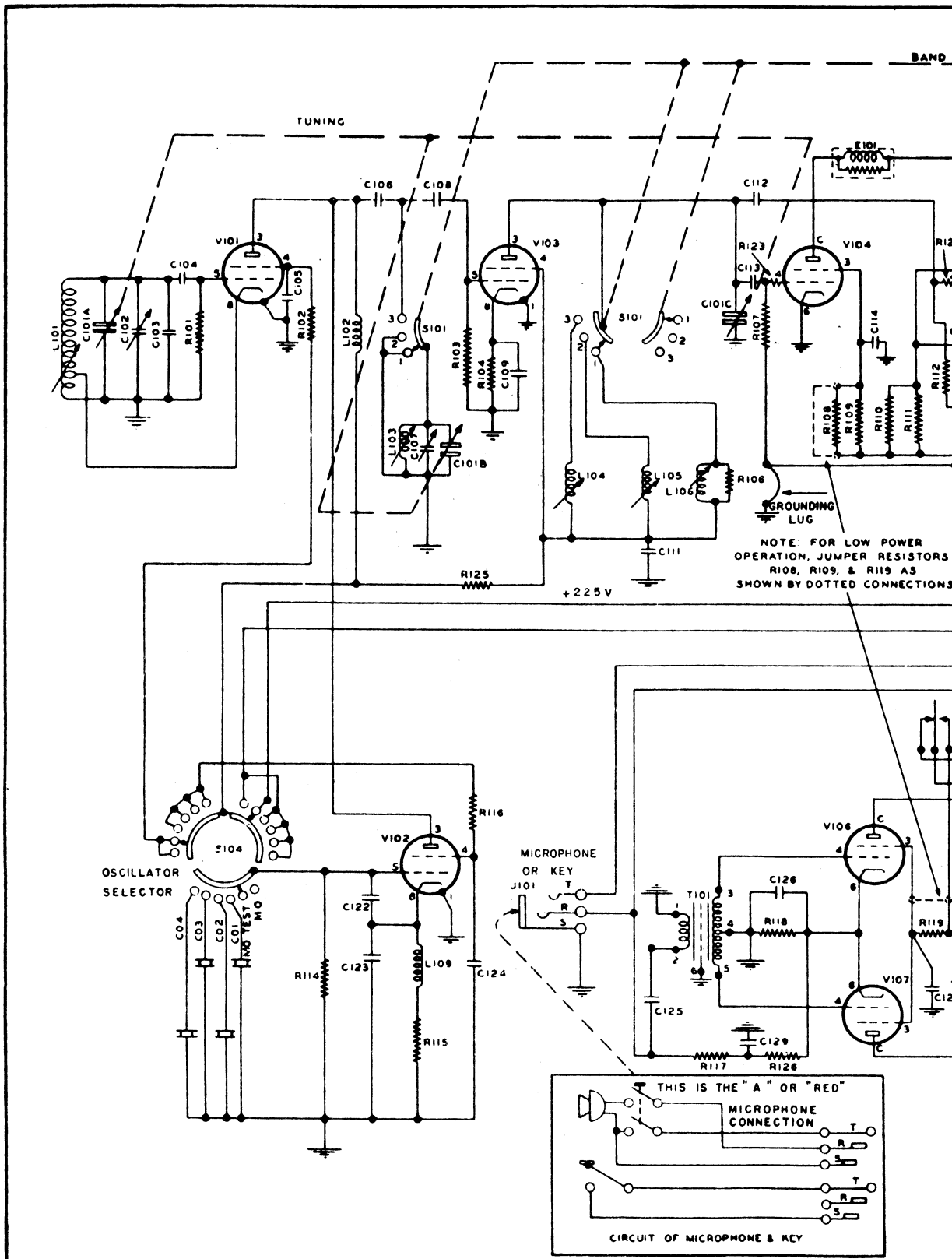

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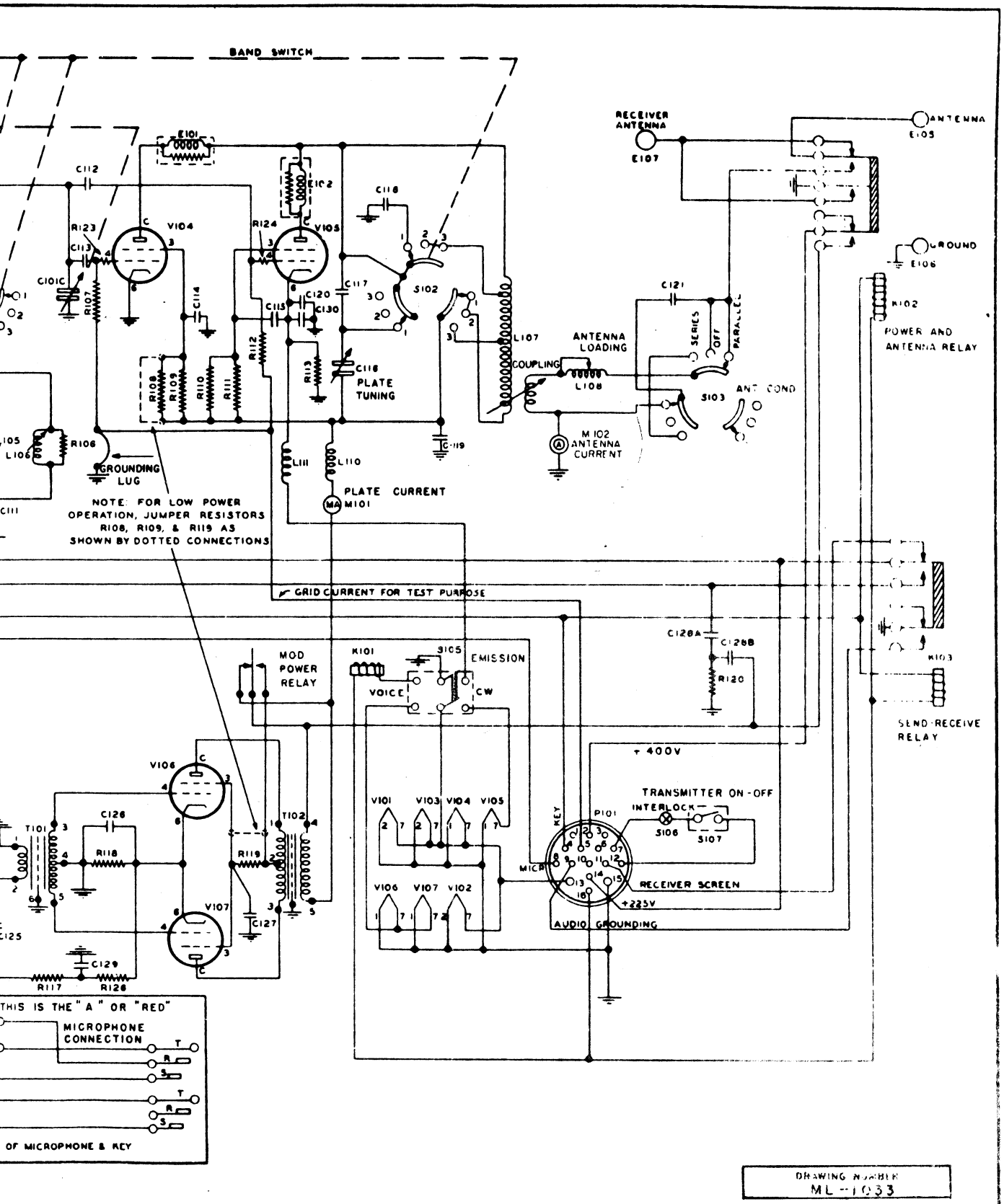
FIG. 43 TRANSMITTER UNIT S



DRAWING NUMBER
ML-1033

TRANSMITTER UNIT SCHEMATIC

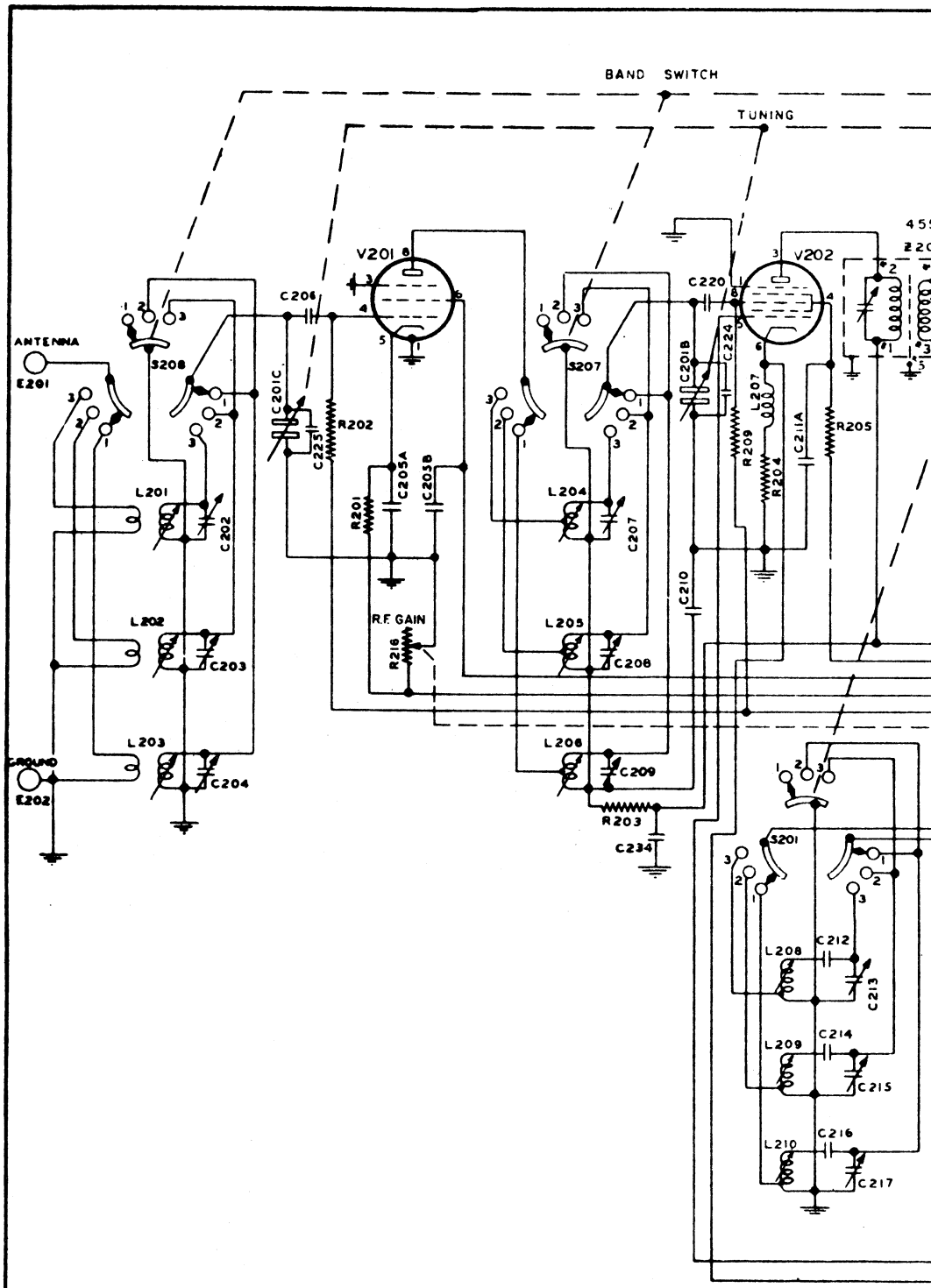


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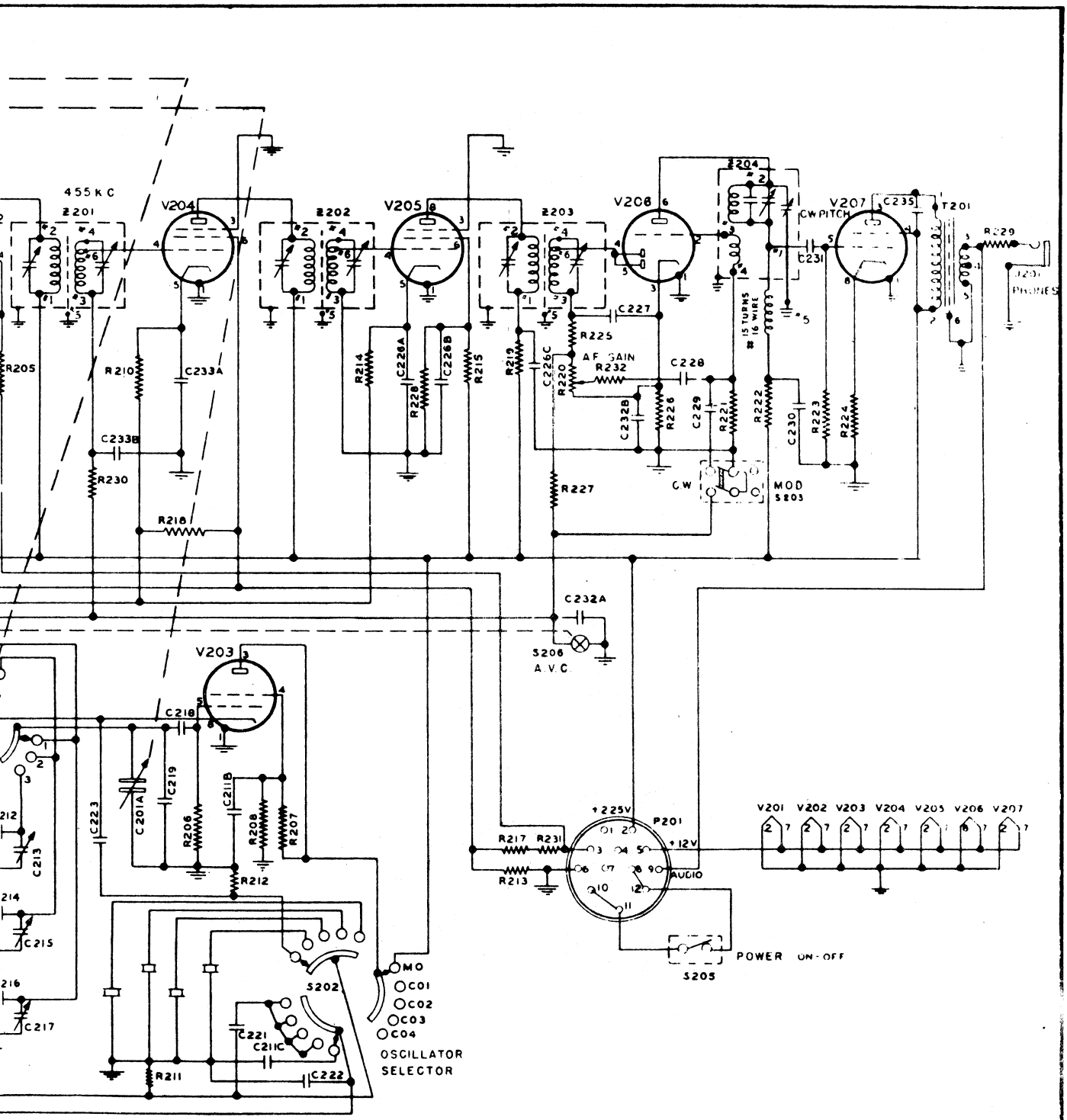
FIG. 44 – R



44 – RECEIVER UNIT SCHEMATIC

DRAWING NUMBER
MX – 1054

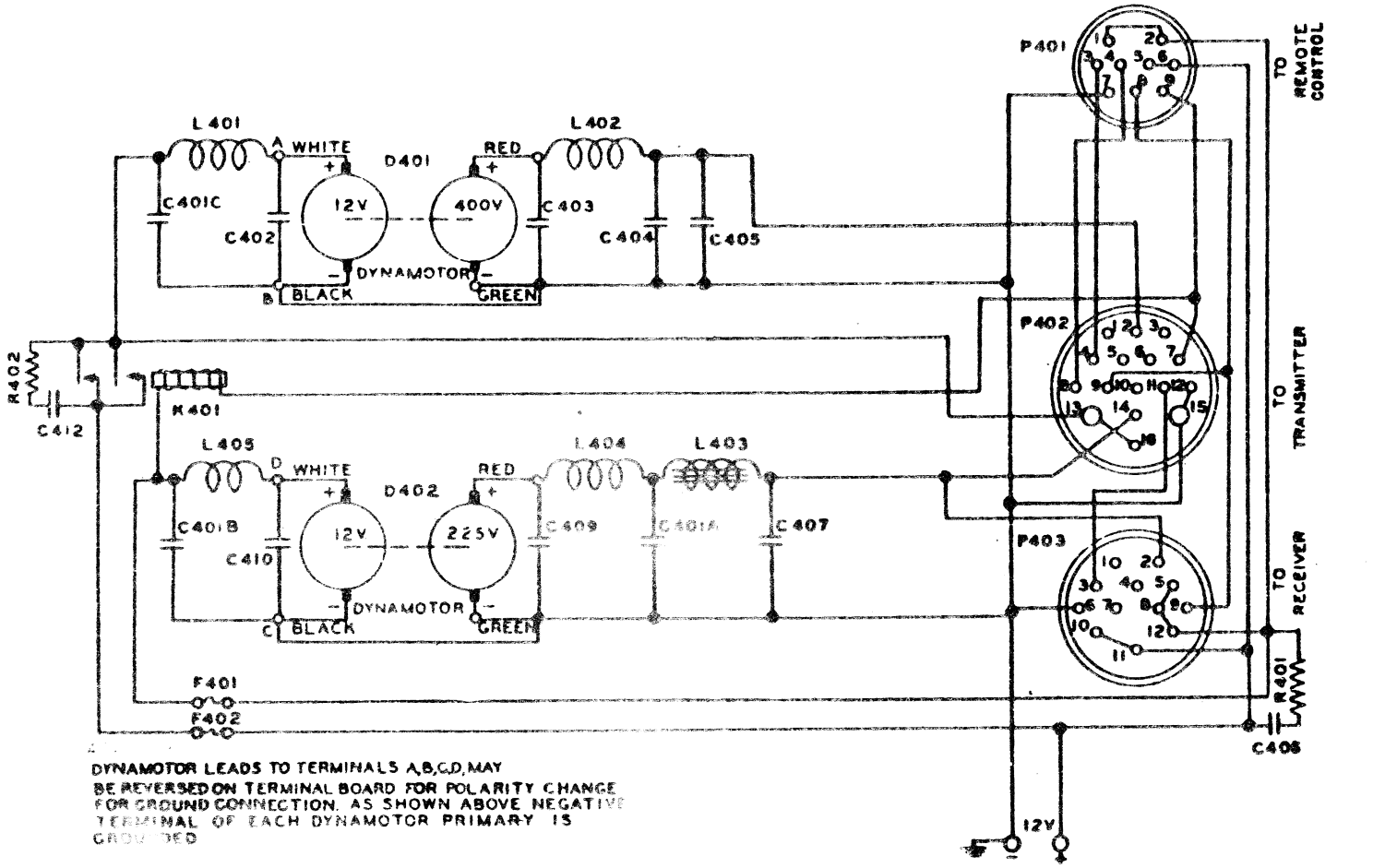


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FIG. 45 POWER-SUPPLY UNIT

SCHEMATIC

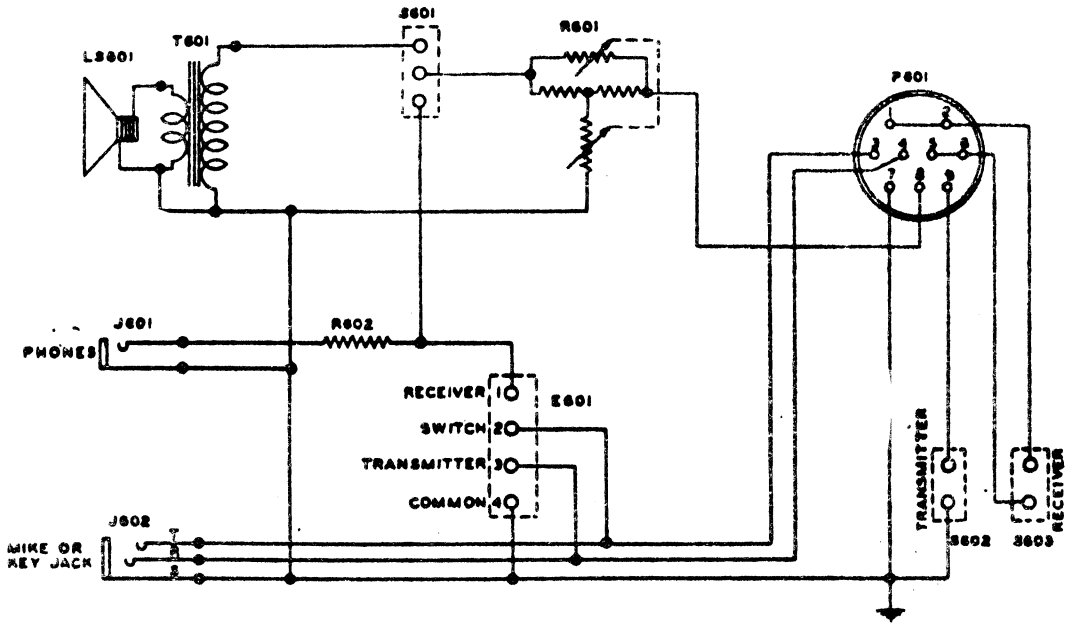

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FIG. 46.—REMOTE-CONTROL UNIT SCHEMATIC

DRAWING NUMBER
MM-1056

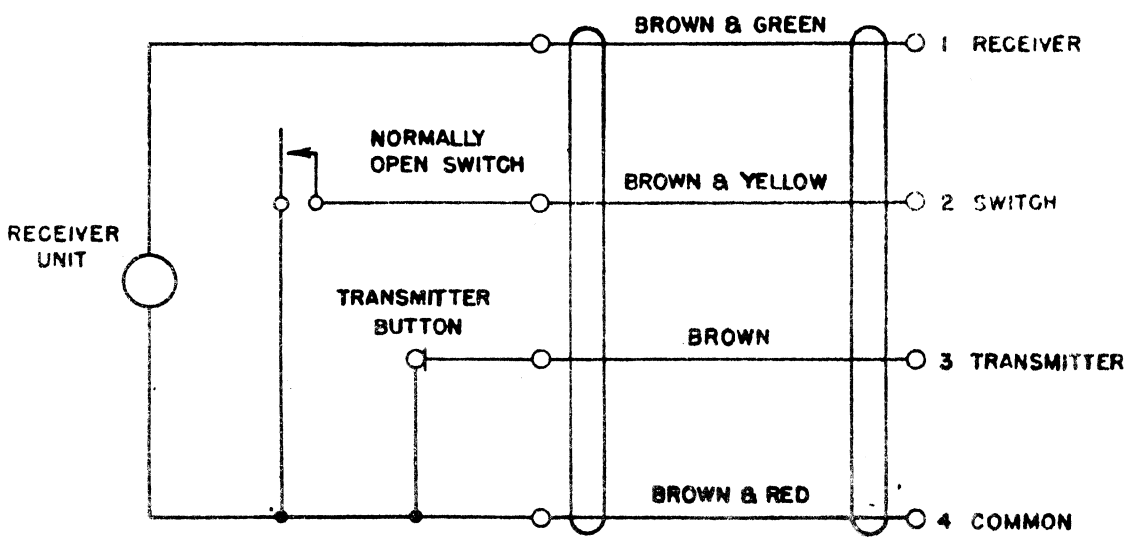

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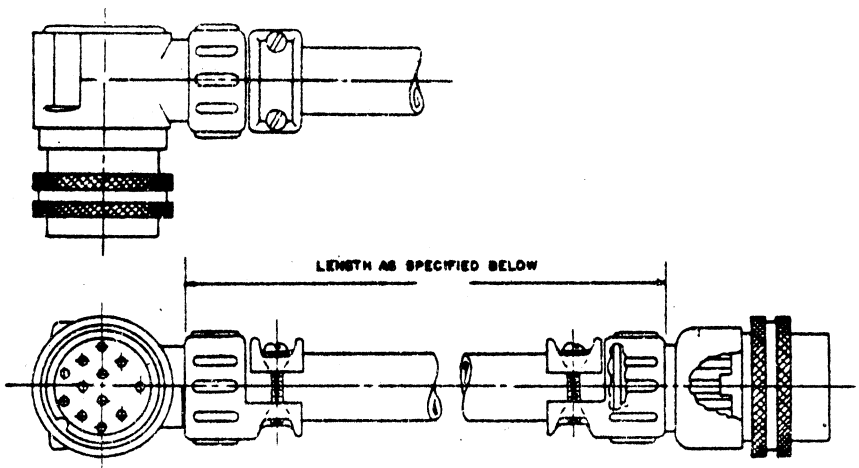
FIG. 47. HANDSET SCHEMATIC

DRAWING NUMBER
MM-1052

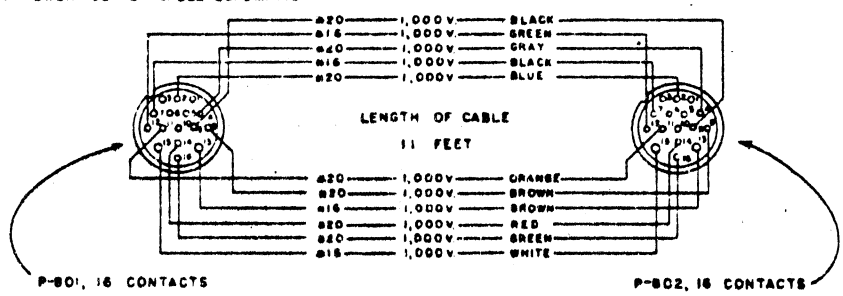
(A)- ASSEMBLY



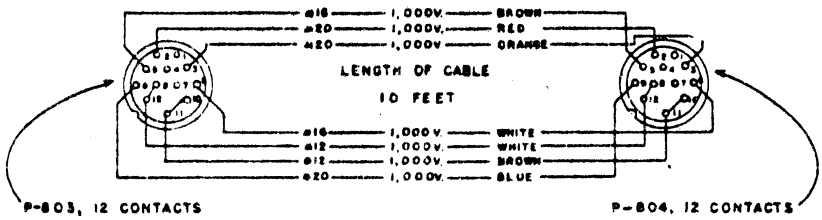
CONNECTOR P-801, P-803, OR P-805
CONTACTS AS SPECIFIED BELOW

CONNECTOR P-802, P-804, OR P-806
CONTACTS AS SPECIFIED BELOW

(B)-TRANSMITTER POWER-SUPPLY CABLE SCHEMATIC
W-801



(C)- RECEIVER POWER-SUPPLY CABLE SCHEMATIC
W-802



(D)- REMOTE-CONTROL CABLE SCHEMATIC
W-803

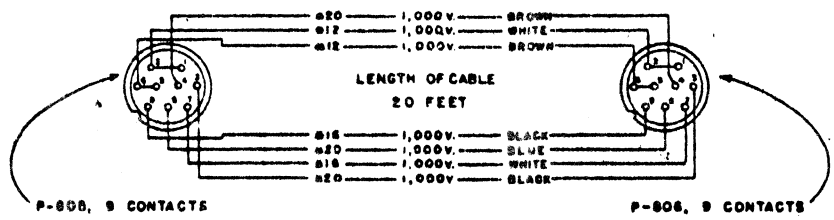


FIG. 48- INTERCONNECTING CABLES - SCHEMATICS AND ASSEMBLY

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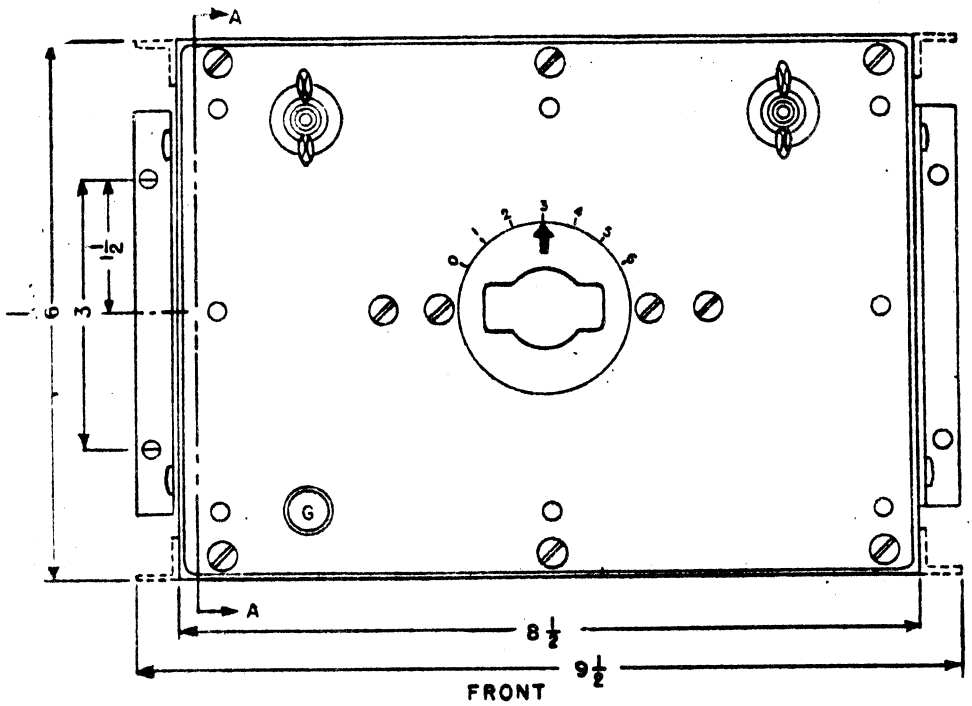
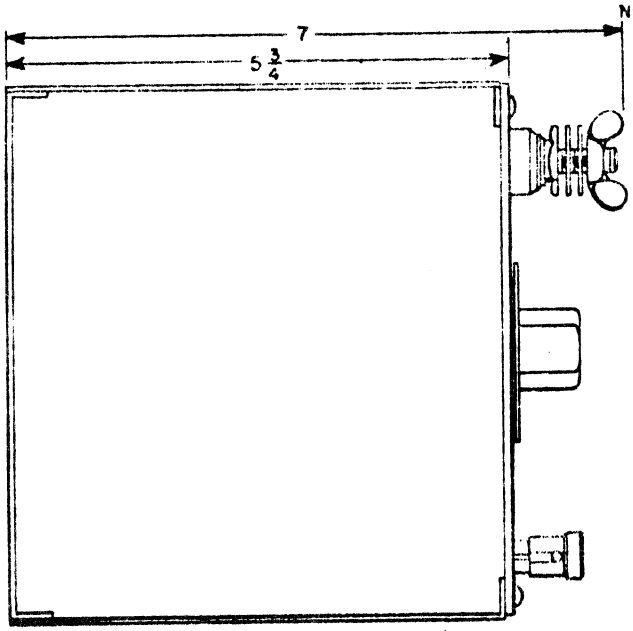
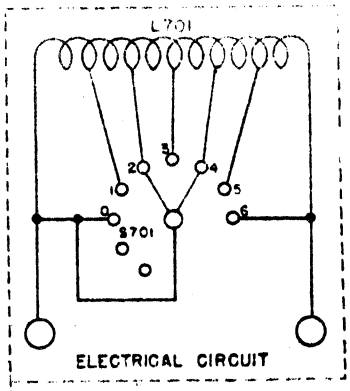
DRAWING NUMBER
ML-1030



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





DRAWING NUMBER
MM-1054

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FIG. 49. ANTENNA LOADING COIL UNIT

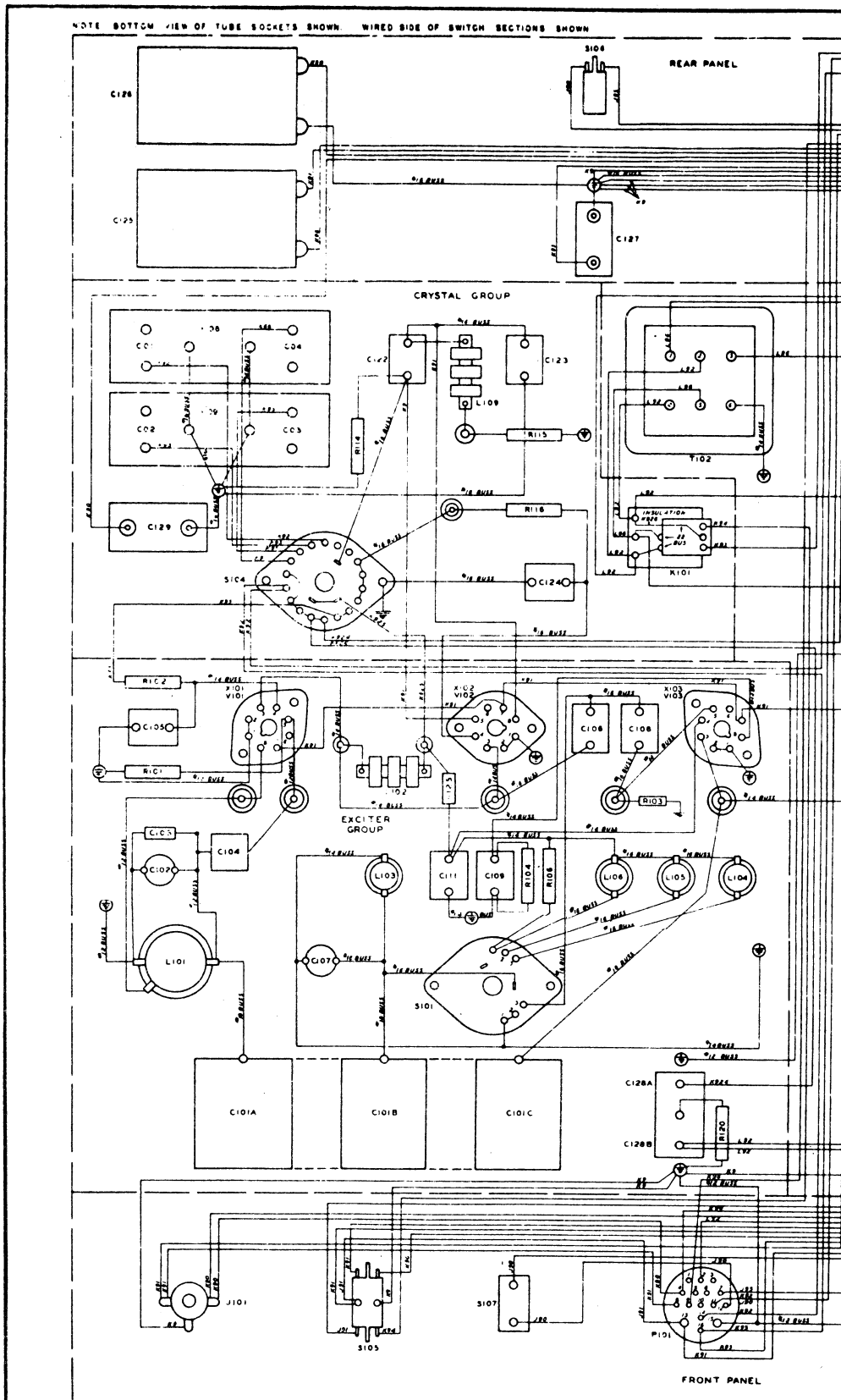

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FIG. 50 TRANSMITTER UNIT PRA

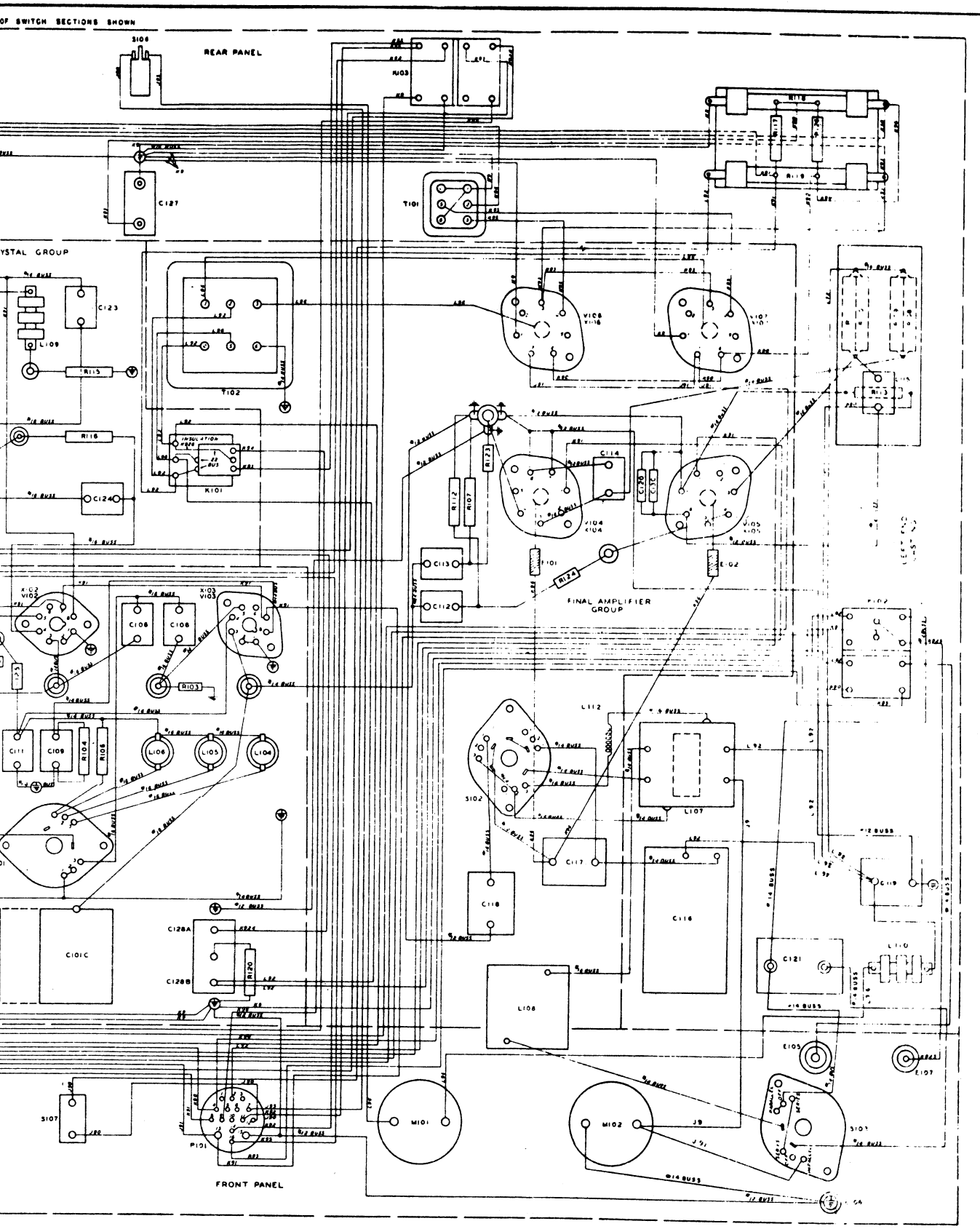

FIG. 50 TRANSMITTER UNIT PRACTICAL WIRING DIAGRAM

DRAWING NUMBER MX-1061

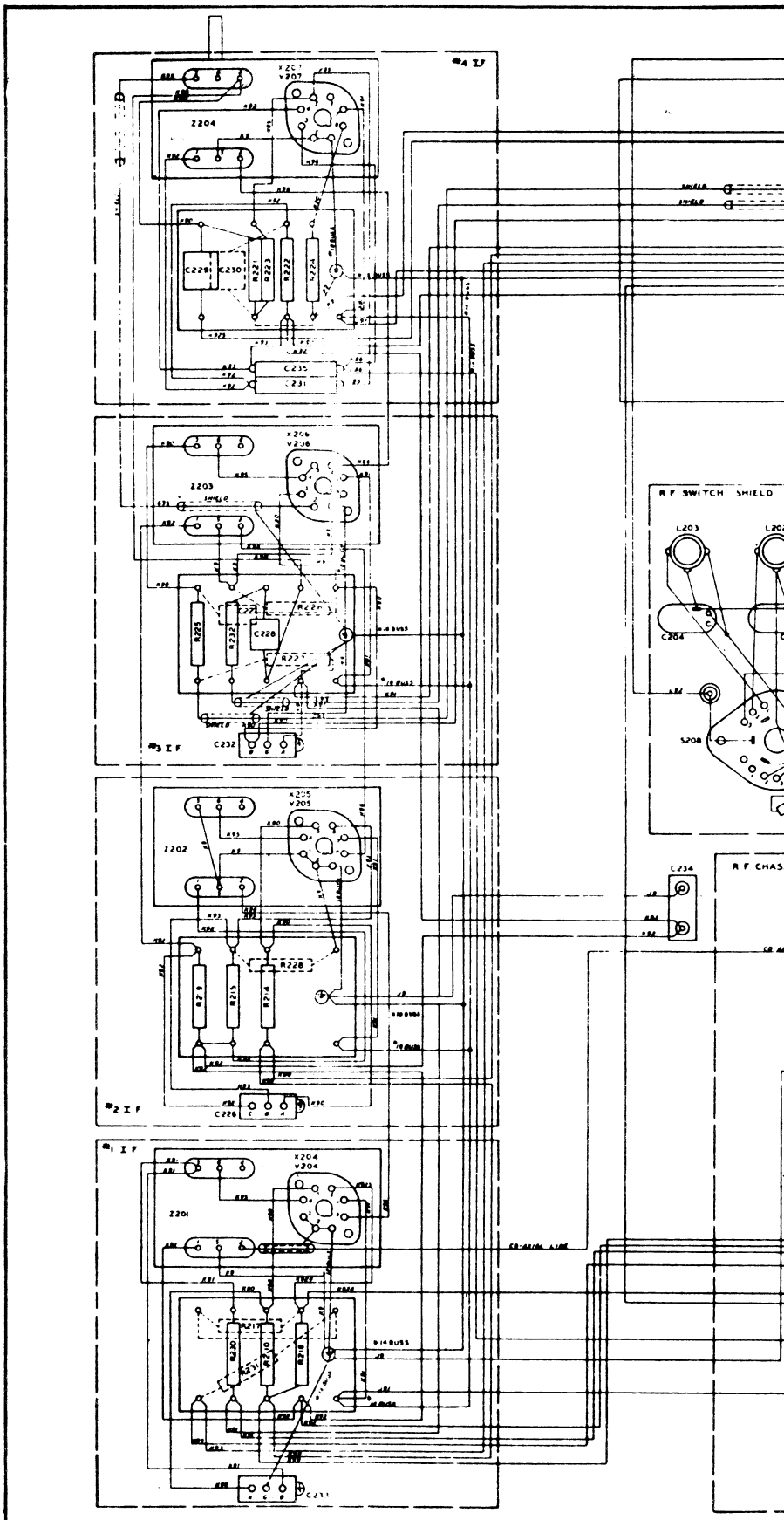

FIG. 51 RECEIVER UNI

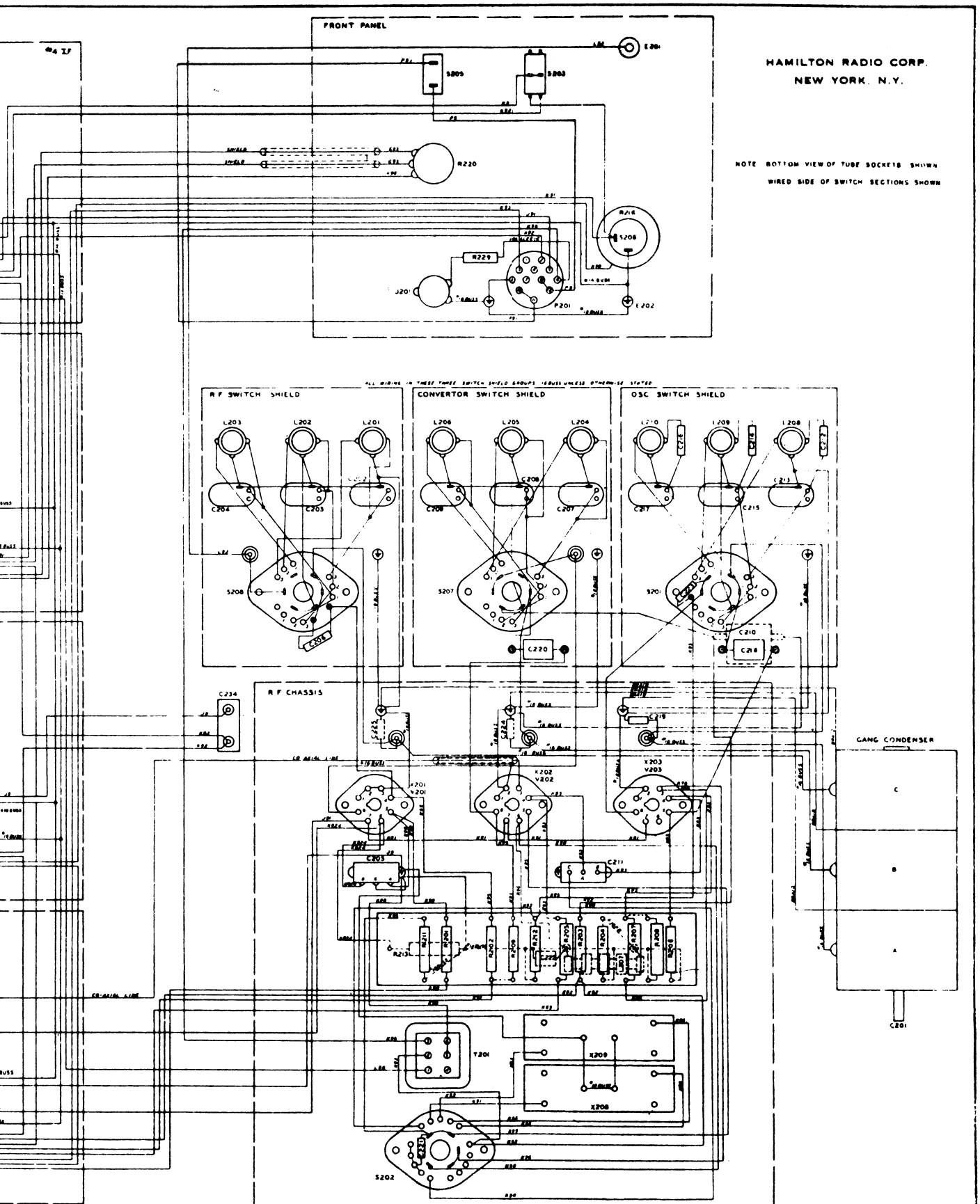

FIG. 51 RECEIVER UNIT PRACTICAL WIRING DIAGRAM

DRAWING NUMBER
MX- 1062

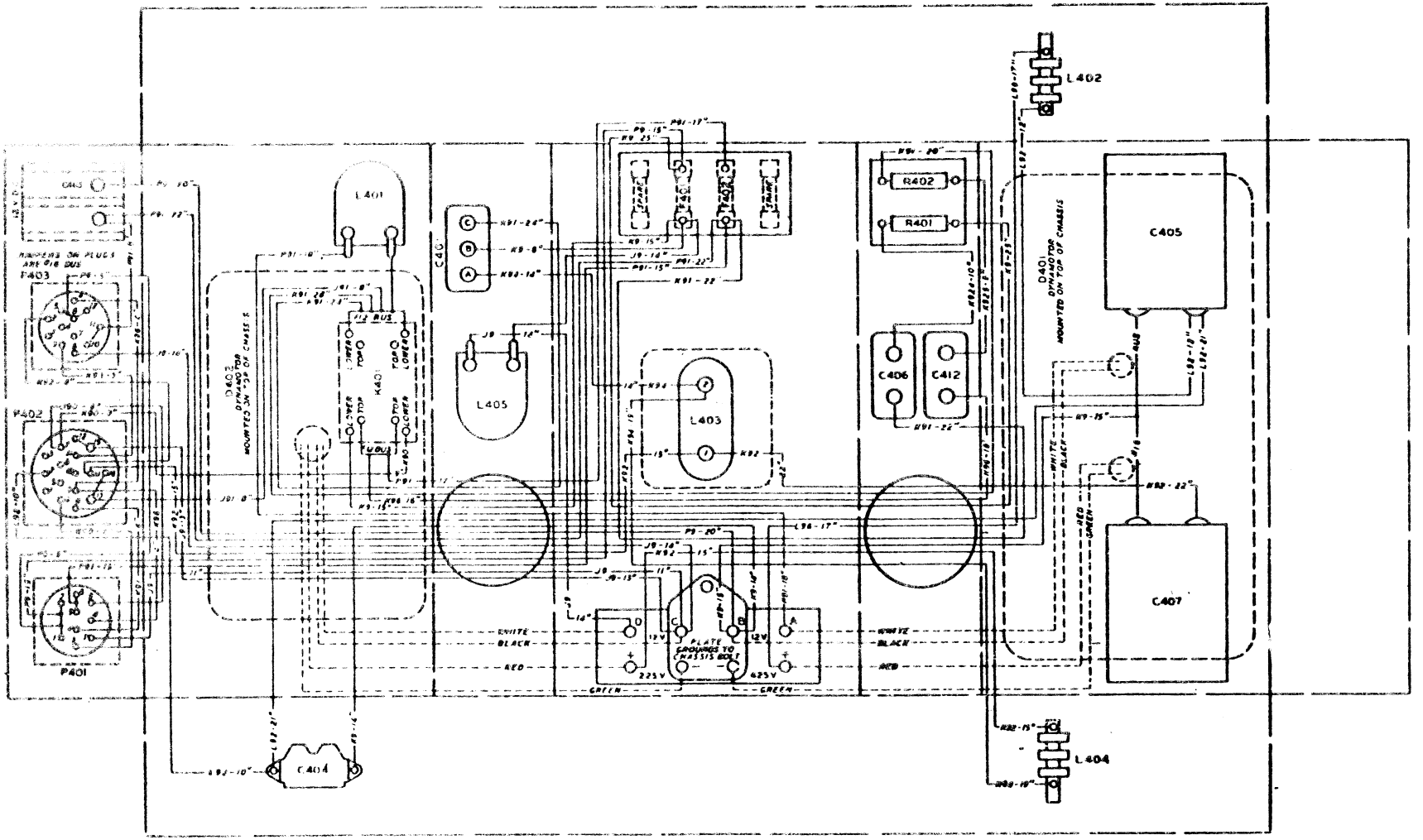

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FIG 52 POWER-SUPPLY UNIT PRACTICAL WIRING DIAGRAM

DRAWING NUMBER
MX-1056

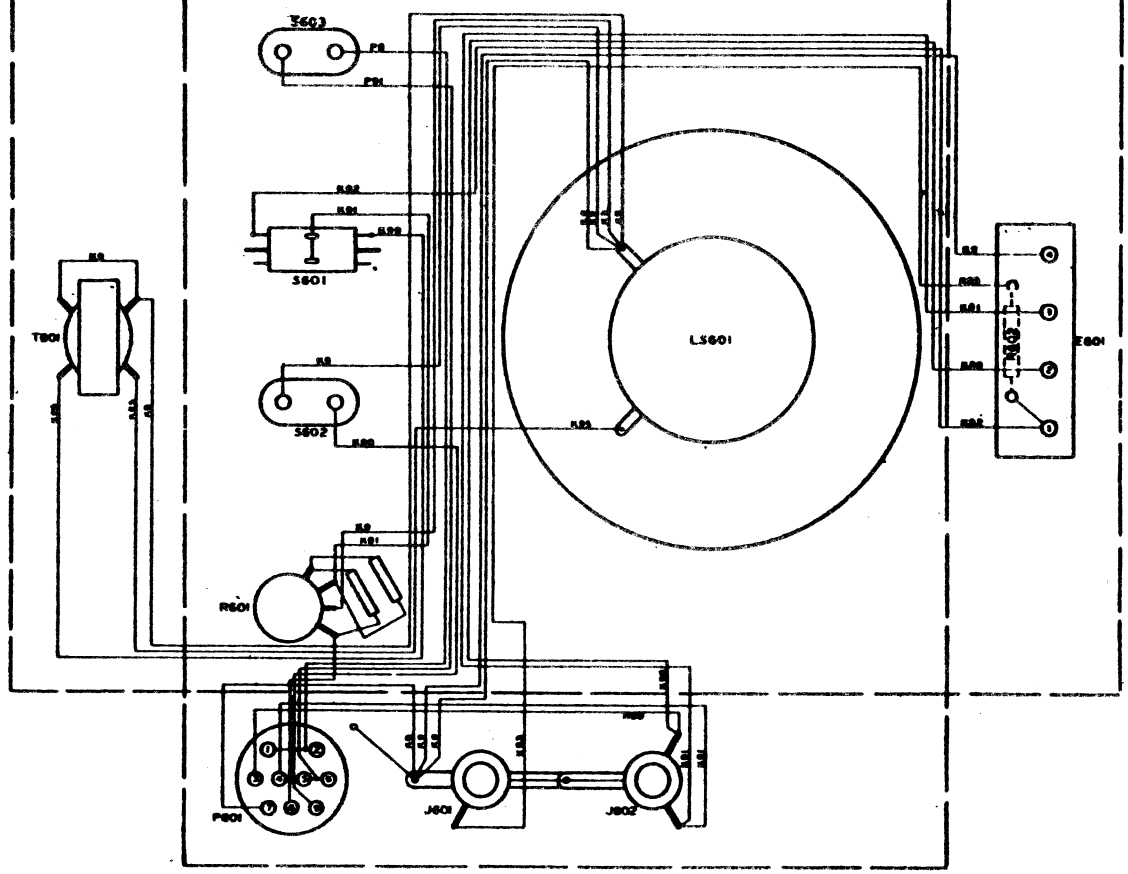

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FIG. 53 REMOTE - CONTROL UNIT PRACTICAL WIRING DIAGRAM

DRAWING NUMBER
MX-1051