TM 11-872A

WAR DEPARTMENT TECHNICAL MANUAL

DIVERSITY RECEIVING EQUIPMENT AN/FRR-3A

WAR DEPARTMENT

26 JUNE, 1944

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TM 11-872, Diversity Receiving Equipment AN/FRR-3a is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

X
(For explanation of symbols see FM 21-6.)

RADIOTELETYPE RECEIVING EQUIPMENT

A N / F R R-3a

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A N / F R R-3a

LIST OF ILLUSTRATIONS

DESTRUCTION NOTICE

WHY - To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN - When ordered by your commander.

HOW -

1. Smash - Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.
2. Cut - Use axes, handaxes, machetes.
3. Burn - Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
4. Explosives - Use firearms, grenades, TNT.
5. Disposal - Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT -

1. Smash - Meters, controls, panels.
2. Cut - Cables and all wiring.
3. Burn - Resistors, capacitors, all technical manuals, instruction books, tube charts.
4. Bury or scatter - Any or all of the above pieces after destroying their usefulness.

S A F E T Y N O T I C E

THE EQUIPMENT EMPLOYS HIGH VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING ON THE EQUIPMENT.

IN SERVICING, CAREFULLY GROUND ANY COMPONENT BEFORE TOUCHING OR REMOVING IT FROM ITS CHASSIS.

IF IT IS NECESSARY TO WORK ON ANY OF THE UNITS WHEN THE POWER IS ON, BE SURE YOU ARE THOROUGHLY FAMILIAR WITH THE EQUIPMENT AND THE INFORMATION ABOUT IT CONTAINED IN THIS BOOK.

N O T I C E

THROUGHOUT THIS MANUAL

REFERENCE TO

"RADIOTELETYPE RECEIVING EQUIPMENT"

WILL BE UNDERSTOOD

TO REFER TO

"DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

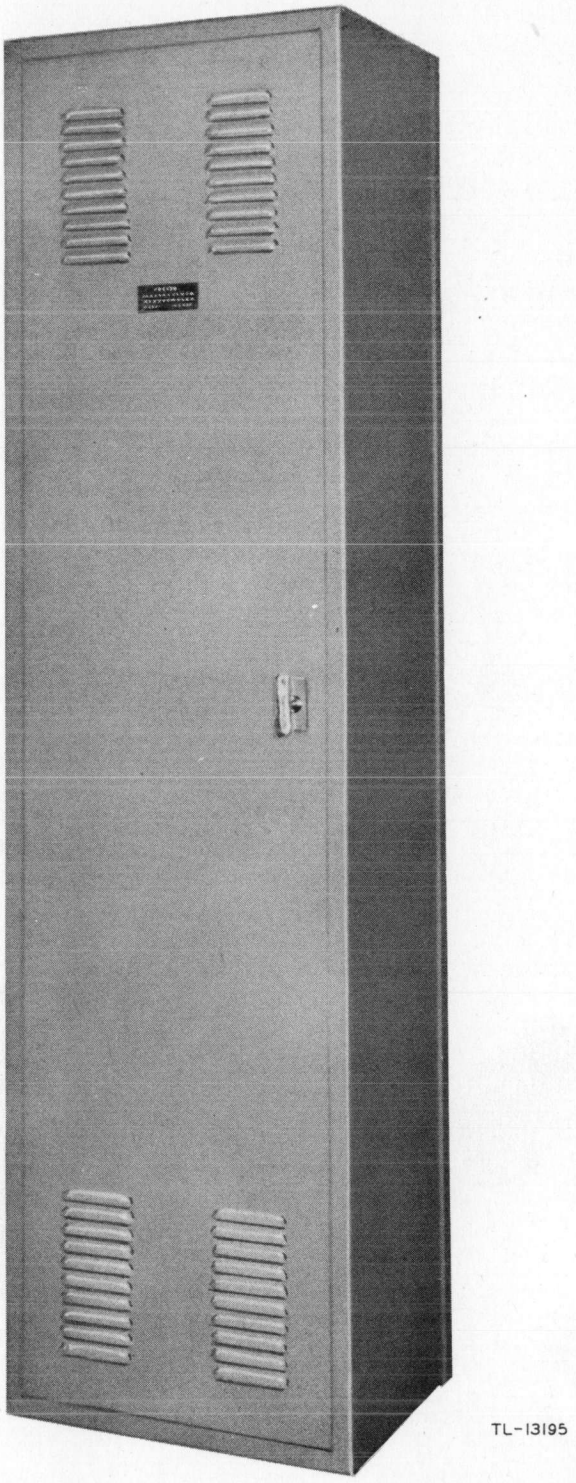

Figure 1. Diversity Receiving Equipment AN/FRR-3A, front view.

RADIOTELETYPE RECEIVING EQUIPMENT

A N / F R R-3a

SECTION I

DESCRIPTION

1. Introduction

a. It is well established that radio fading is caused by cancellation of the signal impulses at the receiving antenna. A radio frequency wave from the transmitter may travel different paths before arriving at the receiving antenna and, by traveling these different paths, may result in the signal arriving at the receiving antenna in opposing phase. This phase opposition causes cancellation (fading) at the receiving antenna. By spacing two antennas approximately 1000 feet apart and coupling each into a separate receiver, sufficient signal energy will always be received at one of the antennas to give satisfactory reception in its receiver.

b. The AN/FRR-3a uses two identical superheterodyne receivers operating on separate antennas. The output of the two receivers is then combined to actuate the teletype terminal equipment.

c. The AVC is common to both receivers. When the signal fades in one of the receivers, its noise level is held down to a very low value by effectively reducing its sensitivity. This is a result of the AVC voltage produced by the stronger signal in the other receiver.

2. General Description

a. Electrical.- In addition to two identical superheterodyne receivers, the AN/FRR-3a Radioteletype Receiving Equipment contains common high-frequency and beat-frequency oscillators, separate antenna matching networks for each receiver, a self-contained power supply and provisions for both local and a remote automatic dial control for selecting any of five pre-tuned radio frequencies and/or any combination of four antennas.

b. Tuning Range.- AN/FRR-3a covers a frequency range of 2.4 to 23.0 mc. It is designed for operation on any one pre-tuned frequency in each of five bands as follows:

Band 1	2.4 - 4.2 mc.
Band 2	4.2 - 6.9 mc.
Band 3	6.9 - 11.2 mc.
Band 4	11.2 - 17.5 mc.
Band 5	15.0 - 23.0 mc.

NOTE

Provisions are included for extending the high-frequency range limit to 26 mc. (see Section II, paragraph 5, page 16).

c. Physical.- Nine chassis are housed in a steel cabinet-type rack 84" high, 22-1/2" wide and 17" deep. Doors at front and rear provide accessibility to the units.

3. List of Components

NOTE

The units are listed from top to the bottom of the cabinet.

a. ANTENNA.- A motor-driven switching network for selecting antennas and a motor-driven band switch which selects the five tuning ranges.

b. RECEIVER "B".- A superheterodyne receiver with motor-driven band switching for the five tuning ranges.

c. MULTIPLIER.- Comprises a frequency multiplier, which terminates in a pair of isolation amplifiers, supplying high-frequency injection voltages for each receiver. Also provided on this chassis are a pair of isolation amplifiers for coupling the BFO to the receivers. The unit has motor-driven band switching for selecting the five tuning ranges and is coupled by a flexible shaft to the oscillator band switch on the Oscillator chassis.

d. OSCILLATOR.- A temperature-controlled oven containing beat-frequency and high-frequency oscillators. The oscillators may be controlled by crystals or by manually-tuned coils.

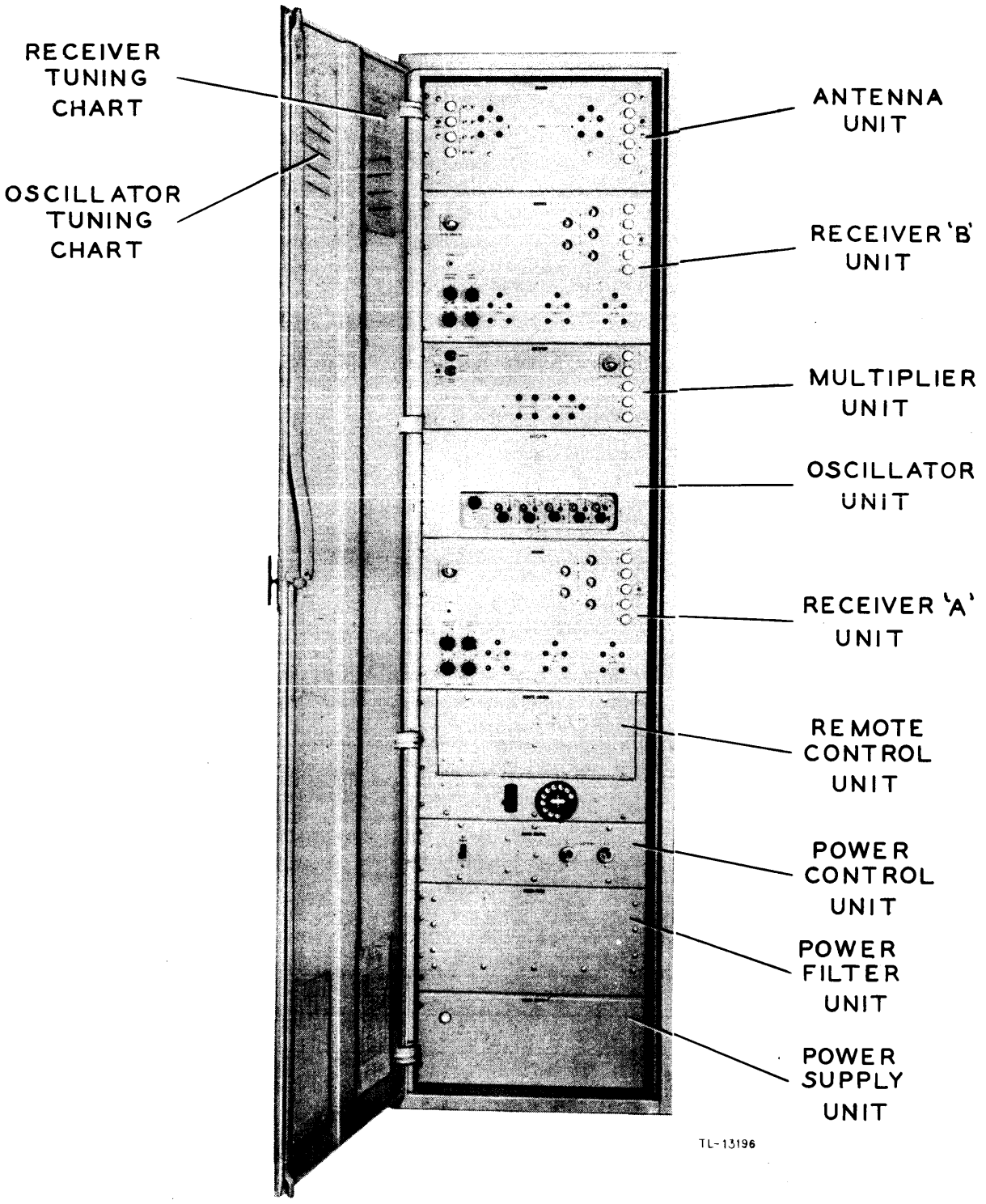

Figure 2. Diversity Receiving Equipment AN/FRR-3A, front view, door open.

e. RECEIVER "A".- Same as RECEIVER "B".

f. REMOTE CONTROL.- An automatic dial control system for operating the AN/FRR-3a and the Radio Teletype Terminal equipment. A chart for dial operation is on the front door of the cabinet. (see page 15)

g. POWER CONTROL.- The power entrance panel, with a manual ON-OFF switch to terminate the incoming a-c line. The unit contains also the main fuses, heater lamps and the Power Relay which controls the a-c power to the Terminal equipment.

h. POWER FILTER.- A filter section containing the chokes and capacitors for the Power Supply.

i. POWER SUPPLY.- A power unit containing the transformer and rectifiers for the AN/FRR-3a equipment.

4. Power Requirements

a. Source.- The AN/FRR-3a is designed to operate on the following power sources:

Line Voltage	Cycles
100-130	50-60
200-260	50-60

b. Consumption.-

AN/FRR-3a Power consumption - approx. 400 watts

AN/FGC1 Power consumption - approx. 350 watts

TOTAL Power consumption - approx. 750 watts

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5. Weights and dimensions

Components	Weight	Cubic Measurements
Antenna	36.0 lbs.	18-3/4" x 8-3/4" x 13-5/8"
Receiver "B"	46.0 lbs.	18-3/4" x 12-1/4" x 13-3/4"
Multiplier	29.5 lbs.	18-3/4" x 13-3/4" x 7"
Oscillator	35.0 lbs.	18-3/4" x 8-3/4" x 10-5/8"
Receiver "A"	46.0 lbs.	18-3/4" x 12-1/4" x 13-3/4"
Remote Control	24.25 lbs.	18-3/4" x 10-1/2" x 8"
Power Control	15.25 lbs.	18-3/4" x 5" x 7-1/2"
Power Filter	62.5 lbs.	18-3/4" x 8-3/4" x 11-1/4"
Power Supply	61.75 lbs.	15" x 8-1/2" x 13-5/8"

The total weight including the cabinet is approximately 600 lbs.

RADIOTELETYPE RECEIVING EQUIPMENT

A N / F R R-3a

SECTION II

EMPLOYMENT

WARNING

THE UNPACKING AND INSTALLATION OF EQUIPMENT MUST BE DONE WITH UTMOST CARE!

1. Unpacking

a. Carefully remove the AN/FRR-3a cabinet and the cartons containing the various chassis from the wooden packing cases. One complete set of equipment consists of the following items:

Box No.	Contents	Gr. Wt. in lbs.	Cu. ft.
1	Cabinet, in which are installed the POWER SUPPLY, POWER FILTER, POWER CONTROL, and REMOTE CONTROL chassis. Separately packed in the cabinet are the AUXILIARY DIAL CONTROL, VT244 rectifier tubes, spare tubes, and test cables.	800	37-10/12
2	MULTIPLIER, OSCILLATOR, and ANTENNA, with tubes packed separately.	183	7-10/12
3	RECEIVER (CHANNEL "A"), RECEIVER (CHANNEL "B"), with tubes packed separately.	163	7-2/12

b. Carefully remove all chassis from the cardboard cartons and examine for loose or broken parts. Make sure that all tubes, except VT244 rectifier tubes, are firmly seated in their respective sockets, and that there is no evidence of damage during shipment. (see tube location chart on rear door of cabinet.)

NOTE

Do not install the rectifier tubes. These tubes are omitted during preliminary adjustments in order that there shall be no B+ voltage on units until initial installation is completed.

c. Remove the packing from the plugs.

2. Installation

a. Cabinet.-

(1) When the cabinets of both AN/FRR-3a and AN/FGC1 are properly installed, AN/FRR-3a will stand on the left of AN/FGC1, as viewed from the front. Before bringing the two cabinets together, be sure to remove the cable-hole cover plates at the top and bottom of the adjoining side surfaces of both cabinets.

(2) Place the cabinets so as to allow at least 30 inches clearance around the entire equipment. The flooring under the equipment should be firm and free from vibration.

(3) Bolt the two cabinets securely together through the four holes in the corners of each of the cable-hole openings at the top and bottom of the cabinets. Then bolt the cabinets to the floor through the four holes in the corners of the bottom of each cabinet. Use either lag or expansion screws.

(4) Bond the two cabinets together through the upper and the lower cable-hole entrances with the two braids supplied with the AN/FRR-3a equipment. Fasten the braids under the #10-32 mounting screws on the right side of AN/FRR-3a and the left side of AN/FGC1.

NOTE

In bonding the two units together, make sure that all paint, grease, dirt or foreign matter is thoroughly removed from the bonding surfaces. Scrape or file until metal is exposed.

(5) Ground both cabinets to the best available ground point. Keep the lead as short and direct as possible.

b. Power Connections.-

(1) Take out the four mounting screws holding the Power Control unit in the cabinet and remove the unit from the rack.

(2) Remove the six large binder-head screws along the top and bottom edges of the Power Control panel that hold the panel to the chassis and tip the panel forward, avoiding strain on the wiring.

CONNECT ALL POWER TERMINALS

ON THE FOLLOWING CHASSIS

AS SHOWN IN SKETCH BELOW

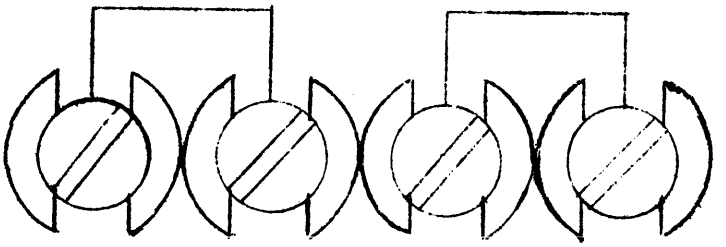
1-ANTENNA

1-RECEIVER "B"

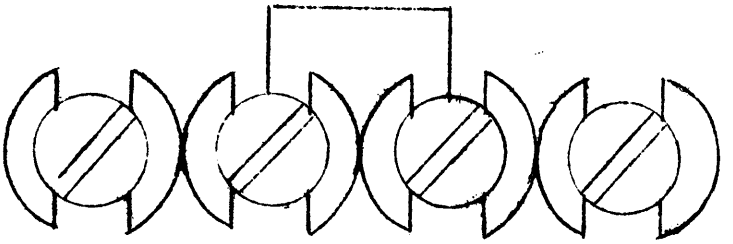
1-MULTIPLIER

1-RECEIVER "A"

4-POWER SUPPLY



CONNECTION FOR 110 VOLT LINE



CONNECTION FOR 220 VOLT LINE

50 - 60 CYCLES

SKETCH "A"

(3) Temporarily, remount the chassis in the rack with two screws, leaving the panel tipped forward, but supported by one of the packing cartons.

(4) Remove the lower left (as viewed from front) cable-hole cover on the cabinet and bring in the power line. Use BX or conduit and provide wiring capable of handling a 750 watt load.

(5) Bring the line into the Power Control chassis through the 7/8" hole in the left end of the chassis by means of a 90° fitting.

(6) Cut and skin leads long enough to reach the power switch S-30 and connect them to the two unused terminals. See that the switch is turned off.

(7) Tip the panel back into vertical position, remove temporary mounting screws, and reassemble the chassis. Mount chassis in rack.

(8) Place the two 100 watt, 120 volt heater lamps in the sockets at the rear of the Power Control chassis. Check the fuses on the front panel to see that they are correct rating (10 amps.) and that they are screwed in firmly. (Note that these fuses protect AN/FRR-3a only.)

(9) The AN/FRR-3a is shipped ready for 220 volt operation. When operating with 110 volts, line connections located on the following components must be changed: Antenna Unit 1 connection, Receiver Channel "B" 1 connection, Multiplier Unit 1 connection, Receiver Channel "A" 1 connection, and Power Supply Unit 4 connections. (See page 7.)

c. Chassis Interconnections.-

(1) Cables for interconnecting the component chassis of AN/FRR-3a are securely stitched to the cable supports in the sides of the main cabinet. To avoid damage during shipment, the plug ends of these cables are tied down. Before installing any chassis in the cabinet untie the cords holding the plugs but use caution to avoid disturbing the permanent cable anchorage.

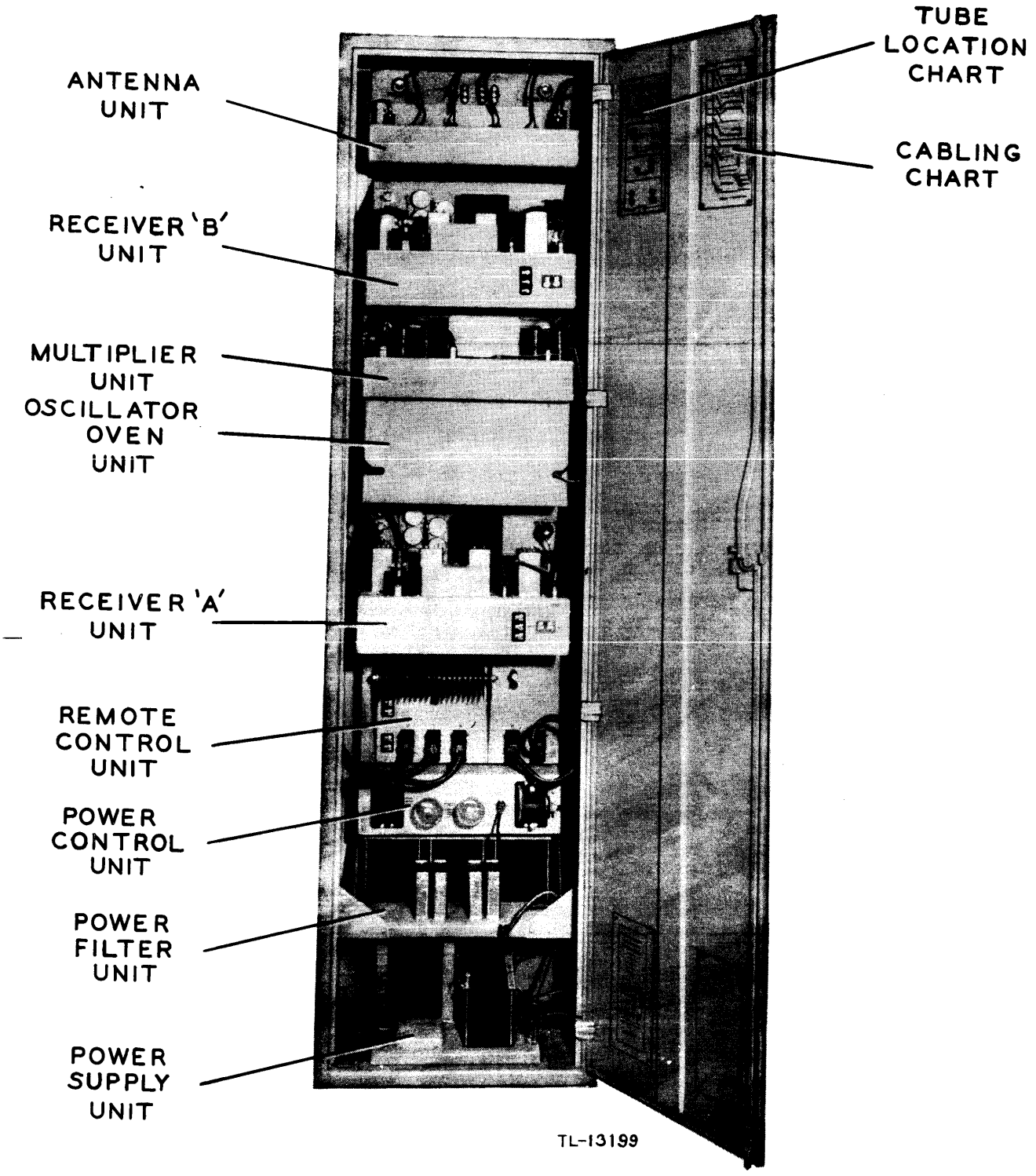


Figure 3. Diversity Receiving Equipment AN/FRR-3A, rear view, door open.

(2) Fasten all chassis in the cabinet with the 10-32 fillister head screws and washers (obtained from the small cloth bags tied to each chassis). The order of chassis from top to bottom in the cabinet is as follows:

Antenna Matching Panel	(marked ANTENNA)
Superheterodyne Receiver	(marked RECEIVER CHANNEL "B")
Multiplier Panel	(marked MULTIPLIER)
High & Low Freq. Oscillator	(marked OSCILLATOR)
Superheterodyne Receiver	(marked RECEIVER CHANNEL "A")
Relay Control Panel	(marked REMOTE CONTROL)
Power Control Panel	(marked POWER CONTROL)
Power Filter Panel	(marked POWER FILTER)
Power Supply Panel	(marked POWER SUPPLY)

NOTE

An Auxiliary Dial Control unit is provided for remote control and should be installed at the Signal Center.

d. Cable Connections.- Plug all cable connections into their proper chassis following the cable diagram, Figure 31. These connectors are keyed so that it is impossible to make a wrong connection. To aid in installation, each plug is numbered corresponding to the number stenciled on the proper chassis beside its associated receptacle.

e. Antenna Connections.-

(1) The AN/FRR-3a Receiver may be used with four high-gain directional antennas (ordinarily rhombics) grouped in pairs. Antennas of each pair should have identical directional characteristics, but should be separated by a considerable distance to achieve diversity effect.

(2) There are four pairs of twisted leads attached to the bottom of the antenna feed-through insulators on the top of the Cabinet. Connect these leads to the four correspondingly numbered pairs of terminals on the Antenna chassis, so that one pair of diversity antennas is connected to Antenna I and to Antenna IV, and the other pair to Antenna II and Antenna III. (See sketch "D", page 33)

(3) The following surge impedance values of prescribed antenna transmission lines may be considered average:

Twisted pair	70 ohms
Coaxial cable	70 ohms
Parallel-lay-Polyethylene	70 ohms
Four wire line (Per DWG ES-E-386B)	200 ohms
Two wire line (Per DWG-ES-E-250D)	600 ohms

(4) An antenna matching network with adjustable taps is provided. Using the preceding table as a guide, make the connections on the rear of the Antenna chassis, to obtain proper impedance matching, as indicated in sketch "C", page 30)

f. Power Supply Test.-

(1) Throw the power switch to the ON position. The heater lamps in the rear and the two neon lamps on the multiplier chassis, marked OVEN HEAT, should light. (Since the heater lamps are in series, they can be used on either 110 v. or 220 v., but will not light to full brilliance on 110 v.). Make sure that power is actually reaching the Power Control chassis if the lamps fail to light.

(2) Raise lever key and dial "01". Note that, when dialing a two-digit number, the lever key should be held up until the dial has returned to rest after dialing the final digit. The heater lamps will go off and the red indicator lamp on the Power Supply will light. Also, one of each of the indicator lamps on the various chassis will light unless the switch happens to be resting between bands. The lamps can be made to light in turn by pushing the MOTOR SWITCH for that panel.

g. Oscillator-Multiplier Coupling Shaft.-

(1) Remove the rear cover of the Oscillator unit.

(2) Remove the 1" plug button from the rear of the Multiplier chassis. This will give access to the switch shaft.

(3) Dial "3" so that the flat surface of the Multiplier switch shaft will face the rear.

(4) From the cloth bag attached to the Multiplier chassis remove the flexible shaft and its mounting screws. Feed this flexible shaft through the opening in the top of the Oscillator unit into the Multiplier chassis and fasten it to the switch shaft. A flashlight aimed through the one-inch opening will greatly help in this operation.

(5) Manually rotate the Oscillator band switch to the #3 position. (When the black paint dot points toward rear of chassis.) Place the free end of the flexible shaft on the switch shaft and tighten securely.

(6) Have an assistant press the red MOTOR SWITCH on the Multiplier chassis until the other pair of set screws becomes accessible. Tighten these screws on the flexible shaft.

(7) Dial positions "1" to "5" inclusive and observe that the oscillator band switch connects properly to coils "1" to "5". Throw POWER SWITCH OFF.

(8) After carefully checking the oscillator switch and after inserting the proper complement of crystals in the oscillator, the back cover of the oscillator oven should be replaced and fastened.

h. Rectifier Tubes.- Install the two VT244 rectifier tubes in their sockets in the Power Supply chassis.

i. AFC Connections.- A shielded wire terminating in two lugs comes out through the right side at the rear of the Oscillator unit. Connect this lead to the terminal strip on the Multiplier chassis marked "AFC". The shielded "GRD" is fastened to terminal 1 and the wire within the cable goes to terminal 2. The terminal strip has no internal connections, but is used merely as a binding strip for connecting the leads from AN/FGC1 to the oscillator.

j. Connections to Radio Teletype Terminal Equipment AN/FGC1.-

(1) Bond the ground connection in the AN/FRR-3a Radio Receiver to the ground connection on the cabinet upright in the AN/FGC1 cabinet. (Lower left as you face the rear of the cabinet.)

(2) Using shielded pair, with shield connected as designated, make the following connections:

AN/FRR-3a		AN/FGC1		
Panel	Terminal Designation	Panel	Terminal Block	Terminal Number
Rec. A	Audio Output 600	→ Limiter A	A	1
Rec. A	Audio Output Gnd.	→ Limiter A	A	2
	Shield	→ Limiter A	A	2
Rec. B	Audio Output 600	→ Limiter B	A	1
Rec. B	Audio Output Gnd.	→ Limiter B	A	2
	Shield	→ Limiter B	A	2
	AFC #2	→ AFC	B	5
	AFC #1	→ AFC	B	7
	Shield	→ AFC	B	8
Remote Control	AN/FGC1 Disabling	→ Bay Terminals	A	9
Remote Control	AN/FGC1 Disabling	→ Bay Terminals	A	10

NOTE

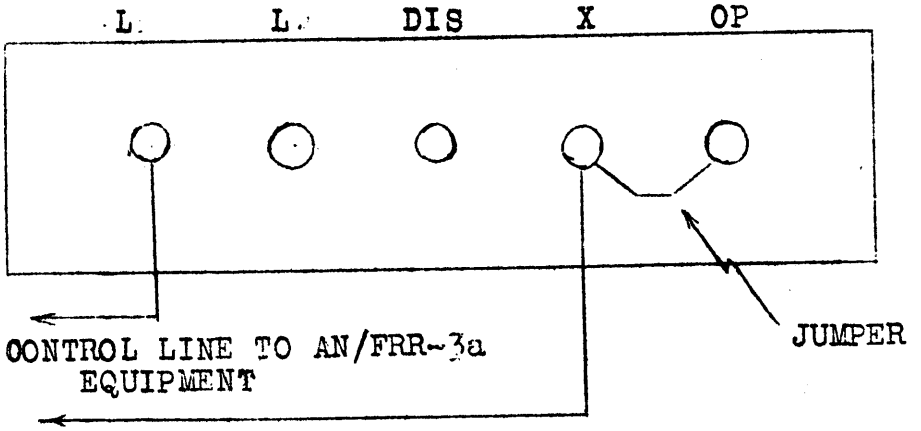
Read Par. 8 in TM 11-356 (AN/FG01 Technical Manual) and proceed in accordance with the routine outlined there prior to making the following operation.

(3) Feed the power cable from the AN/FG01 equipment through the openings between the two cabinets and plug the power connector into the socket on the rear of the POWER CONTROL chassis.

k. Auxiliary Dial Control.- The Auxiliary Dial Control is used to control the equipment from the remote point. The following procedure should be followed to make the connections to this unit:

(1) Connect a two wire "loop" of not more than 950 ohms resistance to the two terminals marked CONTROL LINE on the rear of the Remote Control chassis on the AN/FRR-3a. Short circuit the far end of this line and connect an ohmmeter in series with the line at the termination in the AN/FRR-3a unit. Remove the plug button from the front of the Rmote Control panel and set the screw-driver adjustment to a resistance of 950 ohms.

(2) Connect the remote end of the line to the Auxiliary Dial Control unit. Refer to sketch "B" for the connections to the terminal strip inside the unit.



SKETCH "B"

(3) When the AN/FRR-3a receiver is used on a simplex radio circuit, the disabling of the receiver is accompanied by an inter-connection wiring arrangement between the remote control circuit and the 132A2 set. Information on this inter-connection is to be furnished by the O.C. Sig. O.

3. Remote Control System

a. Dialing Mechanism.-

(1) The AN/FRR-3a and the AN/FGC1 equipment are controlled by means of a selector dial and lever key. The operating numbers for the dial (page 15) are shown on a panel attached to the front door of the cabinet. When the main switch on the Power Control panel is turned ON, the selector dial and the lever key can be used to turn the equipment ON or OFF, select any of the five tuning ranges, select antennas, and disable both the units when a transmitter is operating in close proximity to the equipment. The disabling in the AN/FRR-3a grounds the antennas and audio. Disabling is accomplished by placing the lever key in the position marked SEND.

(2) To dial the equipment ON or OFF, or to select antennas, or to operate on any of the five tuning ranges, the lever key is held in the position marked DIAL. The selector dial is then operated in accordance with the dial code.

NOTE

It is necessary to hold the lever key in position marked DIAL while dialing. The key can be released after dialing is completed as the relays are then holding the circuits and remain energized until the circuit switching is completed.

(3) Before dialing, the main switch on the Power Control panel must be turned ON. Both the AN/FRR-3a and the AN/FGC1 are tuned ON by dialing "01" Dialing "02" turns both the AN/FGC1 and AN/FRR-3a equipments OFF. The heater lamps go ON when "02" is dialed. The oven heaters and the 50 volt direct current supply remain energized as long as the power switch on the Power Control unit is ON, regardless of whether the equipment is dialed ON or OFF.

(4) For a complete shut-down of both AN/FRR-3a and the AN/FG01, the main switch on the Power Control panel must be turned OFF. The crystal oven and heater lamps should remain on at all times to insure that the equipment will be in condition for immediate operation.

b. Dialing Functions.- The following is a list of operations that can be performed by the Remote Control System:

CODE	RESULTS
01	Equipment ON
02	Equipment OFF
1	Band 1
2	Band 2
3	Band 3
4	Band 4
5	Band 5
6	Receiver B on Antenna I Receiver A on Antenna IV
7	Receiver B on Antenna II Receiver A on Antenna III
8	Receiver B on Antenna II Receiver A on Antenna IV
9	Receiver B on Antenna I Receiver A on Antenna III

NOTE

A chart listing these operations is on the inside front door of the cabinet.

4. Temperature Control.

a. After the equipment is turned ON, it will require approximately three hours for the Oscillator oven to reach its operating temperature of 55° C.

b. Several hours more will be required for all components to absorb heat and stabilize at this temperature. During this period both the Beat-Frequency and High-Frequency oscillators will drift slightly and will require correction.

c. The condition of the oven temperature is indicated by the two lamps marked OVEN HEAT, at the left side of the Multiplier panel. Lighting of both lamps indicates that the oven is below operating temperature. At operating temperature, the lower lamp marked COLD will go out and the upper lamp marked NORMAL will light intermittently.

d. Over-shooting of temperature may be expected for some time after power has been OFF, or the oven has been opened. The time required for temperature stabilization as well as the length of the heating cycle will vary with the ambient temperature.

5. Extension to 26 Megacycles.

a. As given in the table on page 17, the range of tuning over the band in the AN/FRR-3a is 2.4 to 26.0 megacycles. It will be noted, however, that band 5 is normally set to cover 15 to 23 mc. Provisions have been made to change the tuning range of this band to cover 17.5 to 26.0 mc. if desired. This can be accomplished by removing the 12 mmfd. capacitors (C-101, C-101a and C-101b) from across each band coil in both the Receivers. If the capacitors are removed from the circuit, extreme care should be taken that no damage is done to any of the components in the r-f tuning boxes.

b. It will be necessary, in addition to these, to remove two capacitors (C-110 and C-110a), each 30 mmfd, from the Multiplier unit. These are across band 5 of the Multiplier and Amplifier coils respectively. See Figure 25 .

6. Manual Band Switching

a. Provisions have been made so that, in the event of band switching motor trouble, band switching may be accomplished manually.

b. Before the band switch shaft can be turned by hand it will be necessary to remove the unit from the cabinet and disconnect the motor from the shaft. Close to the motor a mark has been placed on the shaft. A similar mark has been placed on the sleeve or nut opposite this part of the shaft. When these two marks are aligned so that the mark on the shaft is opposite the mark on the sleeve - the switch will be on band 3. Looking from the motor end and rotating the shaft to the left will select band 4 or band 5. Conversely, rotating the shaft to the right will select band 2 or band 1.

7. Crystal Operation

a. Crystal Selection.-

(1) In order to limit the crystals to frequencies below 4 mc., frequency multiplication is employed to produce the high frequency injection voltage. The harmonics used for the various tuning ranges are:

Band	Frequency Range	Crystal Frequencies	Harmonic Used
1	2.4 to 4.2 mc.	1.4 to 2.3 mc.	2nd
2	4.2 to 6.9 mc.	2.3 to 3.7 mc.	2nd
3	6.9 to 11.2 mc.	2.4 to 3.9 mc.	3rd
4	11.2 to 17.5 mc.	2.3 to 3.6 mc.	5th
5	15.0 to 23.0 mc.	2.2 to 3.4 mc.	7th
5*	17.5 to 26.0 mc.	2.5 to 3.8 mc.	7th

*Alternate

(2) Select crystals of the proper frequency according to the following formula:

Carrier frequency in kilocycles, plus 465, divided by the order of the harmonic, equals the crystal frequency required.

EXAMPLE: To compute the crystal frequency, let us assume a carrier of 12,000 kc. Referring to the band frequency chart (above) we learn that 12,000 kc. lies in Band 4, and that the 5th harmonic of the crystal is used.

The formula becomes:

$$\text{Crystal frequency} = \frac{(\text{Carrier Freq.} + \text{IF})}{\text{Harmonic}}$$

$$\frac{(12000 + 465)}{5} = 2493 \text{ kc.}$$

Crystals supplied for use in AN/FRR-3a will be marked as follows:

For carrier Frequency e.g. 12,000 kc.
Actual Xtal Frequency e.g. 2,493 kc.

b. Tuning Procedure.-

(1) By means of a screwdriver turn the slotted shaft (S-50) on the Oscillator panel, corresponding to the band in use, to the XTAL + position.

(2) On the Multiplier panel, set the MULTIPLIER and AMPLIFIER tuning adjustments, corresponding to the band in use, in accordance with the settings as indicated on the chart on the inside of the front door.

(3) Set the Frequency Meter SCR-211 to the crystal frequency as determined by the formula in paragraph a. (2) above.

(4) Insert the tube adapter plug P-37 (packed with the multiplier chassis) in place of the B-22 h-f amplifier tube in the socket marked "FREQ. CHECK".

(5) Couple the "red-black" wire of the plug to the output terminal of the Frequency Meter.

CAUTION: DO NOT TOUCH THE BARE WIRE WHILE MAKING CONNECTIONS TO THE FREQUENCY METER. REMEMBER, THIS LEAD CARRIES B+ VOLTAGE SUFFICIENT TO GIVE YOU A SERIOUS SHOCK!

(6) Tune the crystal vernier control bakelite knob on the Oscillator panel, corresponding to the band in use, until zero beat is heard in the phones of the SCR-211 Frequency Meter. If zero beat cannot be obtained, turn switch S-50 to the XTAL - position and tune the crystal vernier for zero beat. If zero-beat is unobtainable in either the plus or minus position, it can be assumed that the crystal is not of the correct frequency.

(7) Remove the adapter plug and replace the VT-112 tube.

(8) On the Multiplier panel, trim the MULTIPLIER and AMPLIFIER tuning adjustments, corresponding to the band in use, for maximum closure of the OUTPUT INDICATOR "eye".

(9) Set the Frequency Meter SCR-211 to the frequency of the signal that is to be received.

(10) On the Receiver "B" (upper) set the MIXER, 2ND RF, and 1ST RF tuning adjustments, corresponding to the band in use, to the approximate settings as indicated on the chart on the inside of the front door

(11) Turn the AVC switch to "OFF", DIVERSITY switch to "OFF", and set SENSITIVITY control to maximum (clockwise). Plug a headset into the PHONES jack of the receiver.

CAUTION

Do not remove the headset plug from the jack of the frequency meter. This would open the filament circuit of SCR-211.

(12) Set the BFO switch to the XTAL position.

(13) Remove the VT-112 2ND RF tube (B-22a) and insert the adapter plug.

(14) Connect the "white-red" wire of the plug to the output terminal of the Frequency Meter.

(15) Trim the MIXER tuning adjustment (corresponding to the band in use) for maximum signal and closure of the TUNING INDICATOR

(16) Remove the adapter plug and replace the VT-112 tube.

(17) Set the Antenna tuning adjustment in Channel "B" (corresponding to the band in use) to the approximate setting as indicated on the chart on the inside of the front door.

(18) Connect the output of the Frequency Meter to one of the "ANT I" terminals.

(19) Lift the key of the Remote Control panel and dial number 6.

(20) Trim the MIXER, 2ND RF, 1st RF and Antenna CHANNEL B tuning controls for maximum sensitivity, as indicated by the TUNING INDICATOR "eye". Repeat this several times. It may be necessary to reduce the sensitivity control of the band in use so as not to overload the receiver.

(21) On Receiver "A" (lower) set the MIXER, 2ND RF and 1ST RF tuning adjustments, corresponding to the band in use, to the approximate settings as determined from the chart on the inside of the front door.

(22) Repeat steps (11) through (16) on Receiver "A".

(23) Connect the output of the SCR-211 Frequency Meter to one of the "ANT IV" terminals.

(24) Trim the MIXER, 2ND RF, 1ST RF and Antenna CHANNEL A controls for maximum sensitivity, as indicated by the TUNING INDICATOR "eye". Repeat this several times. It may be necessary to reduce the sensitivity control of the band in use so as not to overload the receiver.

3. Operation with VFO (Variable Frequency Oscillator)

NOTE

Operation with VFO is similar to crystal operation except for the control positions and tuning adjustments of the Oscillator panel.

a. By means of a screwdriver, turn the slotted shaft (S-50) on the Oscillator panel corresponding to the band in use to the "VFO" position.

b. All VFO ranges are from approximately 2 to 4 mc. and frequency multiplication is employed to produce the correct high frequency injection voltage. The harmonics used for the various tuning ranges are shown in the following table:

Band	Frequency Range	VFO Frequency	Harmonic Used
1	2.4 to 4.2 mc.	2.86 to 4.66 mc.	Fundamental
2	4.2 to 6.9 mc.	2.3 to 3.7 mc.	2nd
3	6.9 to 11.2 mc.	2.4 to 3.9 mc.	3rd
4	11.2 to 17.5 mc.	2.3 to 3.6 mc.	5th
5	15 to 23 mc.	2.2 to 3.4 mc.	7th
5*	17.5 to 26 mc.	2.5 to 3.8 mc.	7th

* Alternate.

c. Select the VFO frequency in accordance with the formula:

Carrier frequency in kilocycles, plus 465, divided by the order of harmonics (as given in the above table.)

EXAMPLE:

Assume a carrier frequency of 12,000 kc.

Referring to the frequency chart above, the 5th harmonic is indicated.

The formula then becomes:

$$\text{VFO frequency} = \frac{12{,}000 + 465}{5}$$

$$= 2493 \text{ kc.}$$

d. Set the VFO tuning control (L-121) corresponding to the band in use, to the VFO frequency obtained by the formula and in accordance with the chart found on the inside of the front door.

e. Tighten the knurled nut on the VFO tuning control (L-121) to obtain the desired amount of friction.

f. Insert the tube adapter plug in place of the h-f amplifier tube in the socket marked "FREQ. CHECK" of the Multiplier unit.

g. Couple the "red-black" wire of the plug to the output terminal of the SCR-211 Frequency Meter.

h. Set the SCR-211 Frequency Meter to the exact VFO frequency as obtained from the formula above.

i. Trim the VFO tuning control for zero beat as heard in the SCR-211 phones.

j. On the Multiplier panel, set the MULTIPLIER and AMPLIFIER tuning adjustments, corresponding to the band in use, in accordance with the settings indicated by the charts on the inside of the front door.

k. Proceed as in paragraph 7. b. (7) through (24).

9. Radioteletype Operation

a. Reception from Distant Station.-

(1) In first establishing radioteletype communication, there is usually no easy way to communicate directly with the distant station. It is desirable, therefore, to make as many local tests as possible before attempting overall communication. These tests include careful checks of both the transmitting and receiving facilities. The poling of the transmitting side is checked by sending a steady marking signal from the teletype equipment, observing the condition of the sending relay at the transmitter, and then zero beating the output of the frequency shifter with an SCR-211 Frequency Meter. Then a steady spacing signal is sent from the teletype equipment. The position of the sending relay is observed, and the SCR-211 is again set to zero beat.

(2) If the marking frequency is higher than the spacing frequency, as it should be, it will be necessary to turn the SCR-211 dial very slightly in a counter-clockwise direction (toward the lower end of the scale) to get back zero beat on the spacing frequency. If the reverse condition occurs, there is a turnover which must be corrected. Care must be taken to correct this turnover at the right point. That is, all teletype equipment must be poled the same way at the Signal Center so that patches may be made at the loop switchboard without causing turnovers.

(3) The steady spacing signal referred to above may be transmitted by stopping the TD motor, operating the armature of the starting magnet, by hand, and then slowly turning the flywheel of the motor toward the right, as viewed from the front, until the brushes rest on the "Start" segment.

(4) Similar tests should be made on the receiving equipment to insure proper poling. When the armature of the 255A relay in the AN/FGC1 terminal is held on the right side, the teletypewriter or reperforator should be "closed". When the armature is held on the left side, the reperforator should run "open"

NOTE

In the case of a simplex circuit, or a duplex circuit when a monitoring receiver is available, it is usually desirable to send teletype signals out on the air, pick them up at the local receiver, and copy them with the receiving teletype equipment. If this cannot readily be done, local loop tests should be made at the Signal Center by patching the output of the sending teletype equipment to the input of the receiving equipment.

The general test procedure, herein described, that of sending a signal on the proper frequency from an SOR-211 into the receiver may further be utilized in checking the position of the various relays.

(5) It is usually necessary to arrange by radiogram for overall tests. A good plan is to have the distant station send steady carrier (marking) for a specified period long enough to tune the receiver. During the testing period, the station call letters should be sent occasionally, since there may be a steady carrier on a nearby frequency which might be confused with the desired frequency. The radiogram should also specify that extended "marks" and "spaces" be sent for a short period following the steady marking signal. This is done so that the filter outputs, receiving relay current, and relay position in the AN/FGC1 Equipment can be checked. Finally, reversals RY, or a test sentence should be transmitted.

(6) The recommended test tape shall be: (Space) THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890** SENDING (carriage return) (line feed) (space). Perforate a tape consisting of the above, repeated three times. Join the ends, and insert the endless tape in the TD set for test transmissions.

(7) When transmission is satisfactory in one direction on one frequency, similar action should be taken in the other direction. Finally, two-way communication may be established and the remaining frequencies lined up. It is undesirable, and confusion will result if both directions are simultaneously aligned, or if both directions shift to a different frequency at the same time. Try to maintain communication in one direction of transmission while tests or changes are being made in the other direction. If necessary, instructions may be sent "blind" because it will be known that personnel at the other end of the radio circuit are listening.

b. Antenna Connections.- Connect the pair of Diversity Antennas to be used to Antenna terminals I and IV. Dial "6" to connect Receiver A to Antenna IV and Receiver B to Antenna I. If reception is to be obtained from an additional point, connect the second pair of diversity antennas to terminals I and III. (See Sketch D, page 33).

c. Adjustments.-

(1) Dial Band desired. (previously set-up in accordance with paragraph 8 or 9.)

(2) Set BFO oscillator control to XTAL, AVC to ON, DIVERSITY to OFF.

(3) Turn AFC knob in AN/FGC1 cabinet to OFF. Press AFC DISCHG button momentarily. Wait a few seconds for frequency to stabilize.

(4) Adjust the vernier control until the Frequency Indicator on the AN/FGC1 equipment indicates zero, and REC RELAY 1 current is positive (showing marking current). The slotted shaft (S-50) may be set to either XTAL + or XTAL - position to obtain this condition.

(5) Set BFO oscillator control to BFO and adjust BFO trimmer screw until zero beat is obtained. Turn the trimmer clockwise until an audio tone of 2125 cycles is obtained as indicated by the Frequency Indicator.

NOTE

Turning BFO trimmer clockwise a small amount will cause the Frequency Indicator meter to indicate toward the left. Readjust the trimmer control to obtain zero on the Frequency Indicator.

(6) Turn AFC knob in AN/FGC1 cabinet to ON and note that the Frequency Indicator reads about zero. Assuming that the AFC leads have been properly poled in the initial procedure, a high meter reading indicates that the BFO is improperly adjusted.

(7) Calibrate the AFC circuit in accordance with paragraph 9 i (1) (e) of TM 11-356.

d. Adjustment for Proper Audio Output.- With AVC "ON", DIVERSITY "OFF", and the SENSITIVITY controls of both receivers advanced to maximum clockwise positions, measure the audio outputs of both receivers while listening to the distant station as it sends a steady "mark". Be certain that the AUDIO LEVEL controls are on the same step. Measure as follows:

(1) Patch AC METER to RAD REC OUT jacks of each channel and note the difference in average levels over a period of several minutes. If the outputs do not differ by more than 6 db., no further adjustment of the sensitivity control is required.

NOTE

A quick way to determine the number of degrees on the meter scale which equal 6 db., is to read the output of the receiver on the 1st audio step. Since each audio step equals very nearly 6 db., the change in reading on the AC METER will equal 6 db., i.e., if on step "one" the reading is 4, and on step "two" the reading is 9, then, 6 db. is represented in the range 4 to 9.

(2) If the difference is greater than 6 db., readjust the SENSITIVITY control on the Receiver having the lower level until it is within the 6 db., requirement. It is undesirable to operate with one receiver set at maximum sensitivity and the other receiver at a point near minimum sensitivity. If this occurs, it indicates an unbalanced condition, and the alignment of the RF portion of the receiver having the poorer sensitivity should be checked.

(3) Adjust the individual audio outputs to obtain an average reading in RAD REC OUT jack corresponding to that obtained on NORMAL TEST LEVEL. THE SETTINGS OF THE AUDIO LEVEL POTENTIOMETERS SHOULD NOT DIFFER BY MORE THAN ONE STEP.

(4) Turn both DIVERSITY switches ON.

NOTE

When operating in Diversity, the two receivers must have similar overall performance. If the receivers are more than 6 db. apart, one of the sets will probably never contribute to reception, and will, in fact, adversely effect the operation of the system.

c. Mark and Space Turn-overs.-

(1) One of the features of the Radioteletype System is its symmetry. Except for the arbitrary designations "Mark" and "Space", there is no difference between the two conditions used for signalling.

(2) If, however, a turn-over occurs at some point in the circuit, marks and spaces will be reversed and unintelligible copy will be received. This could be corrected at any point in the circuit as far as transmission results are concerned, and occasionally, it may be necessary to operate temporarily in this manner. Such operation will, in the long run, cause excessive confusion and make extra work for those in charge.

(3) In a circuit where a turn-over can occur at any one of five points, there are many possible correction points, only one of which is the correct one. It is quite improbable, therefore, that the correct arrangements will be found by random experiment. When difficulty is experienced, it is generally desirable to check each point.

(a) Ask the transmitting station for a mark. Operate on manual BFO and adjust until marking detector current is received and the Frequency Indicator meter indicates zero.

(b) Increase the frequency of the BFO (turn the screw counter-clockwise) and note whether the audio frequency is lowered or raised and the corresponding action of the Frequency Indicator.

(c) If the frequency of the BFO is above the i-f, turn the AFO off and retune the BFO until the signal is tuned in with the BFO below the frequency.

(d) Increase the frequency of the HFO (High Frequency Oscillator) by adjusting its vernier control, determine whether the HFO is above or below the carrier frequency. Except for an error in crystal frequency, it is improbable that the HFO will be below the signal frequency. If this should occur, however, it will be necessary to operate temporarily with the VFO

(e) If the above tests indicate that the HFO is above the desired frequency, and that the BFO is below the i-f frequency, ask the transmitting station to send a "space" signal and note the REC REL CURRENT.

(f) If the marking and spacing currents correspond to those transmitted, the turn-over, if any, must exist in the DC portion of the receiving circuit.

(g) If they do not correspond, the turn-over is at the transmitting end and may be due to improper connections to the keying equipment.

f. Note on Diversity Operation.- With space diversity operation, two duplicate channels are used at the receiving end. The system will work, although in an inferior manner, if for some reason one channel becomes disabled. For example, one tube might become weak, a stage become detuned, or by mistake, the sensitivity control of one receiver might be left at a low setting It is desirable, therefore, to listen to the outputs of the two receivers occasionally to find out if they are similar. Another test which may be useful is to watch the received copy while disabling first Receiver A and then Receiver B, and note that copy is similar in each case. This, of course, is not advisable on a working circuit.

g. Bias.-

(1) The bias tolerance of the overall system is about 35% maximum. This means that the transmitting end might introduce 5%, the receiving equipment 5% and the air path add 25% bias. It will be recognized that bias should be kept as low as possible in order to cope with radio conditions which often rapidly change from ideal to poor.

(2) If the cumulative bias is not kept within close limits, (for example 15%,) inferior operation will result during those periods which occur each day when signals become weak and spotty.

CAUTION

THE DESIRABILITY OF REMOVING BIAS CANNOT BE OVER-EMPHASIZED.

RADIOTELETYPE RECEIVING EQUIPMENT

A N / F R R - 3a

SECTION III

FUNCTIONING OF PARTS

1. Radioteletype Operation

a. The "mark" and "space" signals required for teletype operation are produced in the transmitter by shifting the carrier. One frequency is established for "mark" and another, 850 cycles lower, for "space" The carrier of the transmitter is always on the air. Instead of keying the transmitter on and off, the carrier is shifted alternately from "mark" to "space".

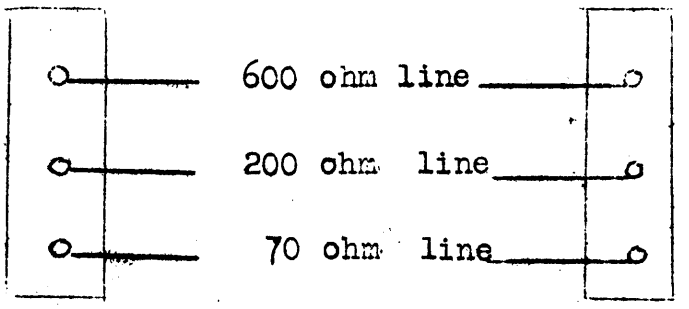
b. AN/FRR-3a contains a beat oscillator which converts the "mark" and "space" incoming signals to audio frequencies of 2,125 cycles and 2,975 cycles respectively. The individual tones are amplified and fed to the AN/FGC1 equipment.

c. The AN/FGC1 Teletype Terminal equipment filters amplifies, limits and rectifies the individual tones from the AN/FRR-3a receivers. The rectified direct current pulses energize the "mark" or "space" windings of a polar relay which in turn operates the teletype unit

2. Antenna Unit

a. Circuit Operation.- The primary purpose of the Antenna panel is to match the input impedance of the receivers to the impedance of the transmission line.

(1) The Antenna panel is divided into two sections designated as Channel A and Channel B. Inasmuch as the two channels are electrically identical, Channel A will be discussed with the understanding that the circuit operation of Channel B is the same.



(2) Transmission line connections are made at terminal strips W-24b and W-24c. Provisions have been made so that transmission lines having surge impedance values of 70, 200 and 600 ohms may be handled. The terminal strips have three points at which connections can be made. (Refer to Sketch C). For 70 ohm line, connections are to be made at the bottom terminals, 200 ohm line at the middle terminals (as shown) and 600 ohm line at the top terminals.

(3) The signal is then applied through one of five slug-tuned transformers to a triode B-27a. The output from this tube is taken from the cathode across a 200 ohm unbypassed resistor (R-141c). This cathode follower type circuit provides an impedance match from the antenna panel to the receiver and insures maximum transfer of energy. The output of the Antenna panel is taken from plug P-13a.

b. Band Selection.-

(1) The five pilot lights at the right of the front panel marked 1, 2, 3, 4, and 5 indicate the position of the motor driven Band Selector Switch S-53.

(2) When, for example, band 5 is selected, d-c voltage from the Remote Control panel appears on the band switch, energizing Relay N-12. This relay operates and closes the a-c circuit to Motor H-11a. The motor rotates the band switch shaft until the open section of the revolving disc contact arrives at the contact supplying the voltage from Remote Control panel for d-c Relay N-12. The relay energizing circuit then opens, the relay contacts are released, the a-c circuit is opened and the motor stops. The revolving contact on the front of the wafer now rests on #5 pilot lamp contact, lighting lamp #5 on the right side of the front panel, indicating the band in use.

c. Tuning Adjustments.-

The tuning of the coupling coils in the antenna matching panel is accomplished by varying the position of the screw-driver adjustments through the front panel opposite the correct band number. The tuning adjustments on the right side of the front panel are for Channel A. The tuning adjustments on the left side of the front panel are for Channel B.

d. Antenna Selection.-

(1) The four pilot lights on the left of the front panel indicate the position of the Antenna Selector Switch. Each lamp is marked to identify one of four possible antenna combinations, two of which are marked OPERATE and two of which are marked MONITOR. The selector switch is motor-driven through the automatic dial control system in the Remote Control unit.

(2) Antenna selection is accomplished in a manner similar to the band switch operation. This circuit, however, utilizes the Antenna Selector Switch S-52, Motor H-11, and Motor Relay N-12a.

NOTE

Sketch D, Antenna Switching System, will be helpful in understanding the antenna connections to the two channels.

(3) Selecting A^{IV} - B^{I} connects a pair of antennas to the two sets of coupling coils for Channels A and B in the antenna unit. Antenna IV will be switched into Channel A and Antenna I will be switched into Channel B This will provide each receiver channel with an antenna directed upon the same azimuth for diversity operation.

(4) Likewise, selecting A^{III} - B^{II} will set up the antenna combinations for diversity on another azimuth through Channels A and B.

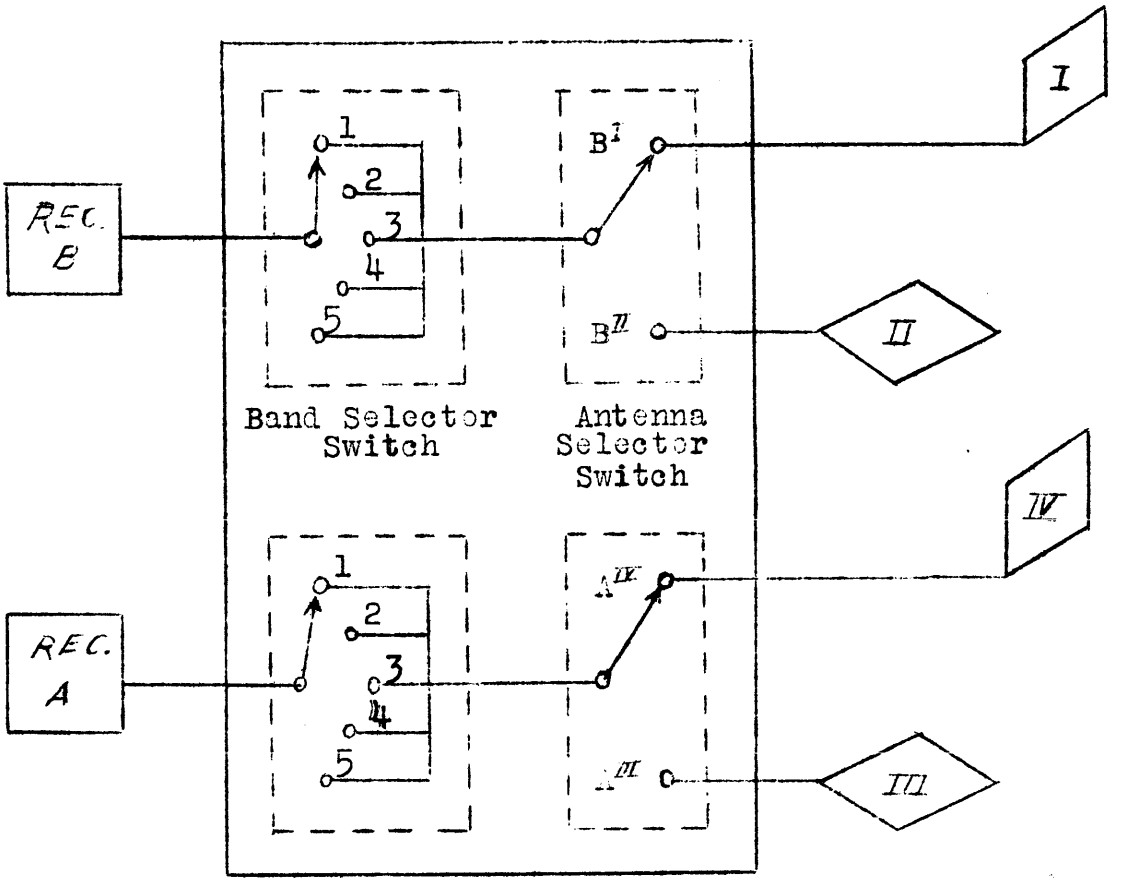
(5) Selecting A^{IV} - B^{II} will switch <u>one</u> antenna from one directional pair into Channel A and one from the other pair into Channel B for monitoring in two directions Similarly, selecting A^{III} - B^{I} will provide two-direction monitoring with the other antennas.

(6) In the event of failure of either of the receivers or either antenna, this switching arrangement permits single receiver operation in either direction.

e. Motor Switch.- Two motor switches, S-37 and S-37a, are provided on the front panel to operate respectively the Antenna Selector Switch and Band Switch through the motor relays, independent of the remote control system. These switches permit individual operation in the event of stepper switch failure and are convenient for testing purposes

RADIOTELETYPE RECEIVING EQUIPMENT

A N / F R R - 3a



ANTENNA SWITCHING SYSTEM

SKETCH "D"

f. Disabling.- Four double-pole relays, N-19 to N-19c, ground both sides of the four transmission lines entering the antenna unit when the key switch on the Remote Control panel is in the SEND position. This is important when the receiver is being operated in the field of a companion transmitter. These disabling relays also operate during switching operations.

3. Receiver Unit

a. Receiver Controls.- The two receivers marked RECEIVER B and RECEIVER A are electrically and mechanically identical. The lights on the right side of the panel indicate the position of the selector switch. The controls on the left side of the front panel serve the following functions:

1. The INDICATOR CONTROL varies the sensitivity of the TUNING INDICATOR "eye" on the front panel.

2. An AUDIO LEVEL control in 6 db. steps is provided on each receiver to permit adjustment of the audio output level.

3. The AVC switch turns the AVC on or off, permitting removal of the AVC for setting up or adjusting the receivers.

4. The DIVERSITY switch is provided to open or close the inter-acting circuit between the two AVC systems. This permits each receiver to operate individually on its own AVC system.

b. Circuit Function.-

(1) Each receiver has two stages of tuned radio-frequency amplification. Each stage has five tuning ranges. One operating channel may be pre-tuned within the limits of each tuning range. A mixer stage, similarly tuned, follows the r-f amplifiers.

(2) Three stages of intermediate frequency amplification follow the mixer. A portion of the Signal voltage from the 2nd i-f stage is fed to the control grid of the AVC i-f amplifier B-28c. The output of this tube is then rectified in the AVC detector B-26a. This direct-current voltage provides Automatic Volume Control for all r-f and i-f stages.

(3) Two stages of audio frequency amplification follow the signal detector B-26. The final audio output is connected to a terminal strip on the rear of the chassis. Output impedances of 600 and 150 ohms are available. The PHONES jack on the front panel is "bridged" across the 600 ohm output terminals.

(4) Tuning controls for the first three stages in the receiver are provided on the front panel marked 1ST RF, 2ND RF, and MIXER, and numbered in accordance with their respective bands. Sensitivity controls are provided in each band so that the gain of both receivers may be balanced to insure proper diversity operation. Means for accurate visual tuning of the r-f and mixer stages is provided in the form of a tuning "eye", marked TUNING INDICATOR, on the left of the Receiver panel.

(5) The TONE KEYER terminals on the rear of the RECEIVER deliver rectified direct-current proportional to the applied signal. This circuit, however, is not utilized in teletype service, but is provided in the event the equipment is to be used on radio telegraph circuits.

4. Multiplier Unit

a. Functional Description.- The Multiplier unit has the primary function of multiplying the frequency of the HFO. Two BFO isolation amplifiers provide effective isolation for BFO injection into the individual receivers.

(1) Tuned circuits in the multiplier and amplifier stages are selected by means of a motor-driven band switch. The lights on the right of the front panel indicate the band in use. Resonance of the multiplier and amplifier stages is indicated by an electronic tuning indicator on the front panel.

(2) The coils of the multiplier and amplifier stages are tuned from the front panel and are marked with their respective band numbers. The tuning chart attached to the front door indicates the settings for the tuning coil adjustment screws.

(3) In addition, the MULTIPLIER chassis contains two voltage regulator tubes. One tube stabilizes the D.C. plate voltage to the BFO, the other to the HFO.

(4) A flexible shaft couples the Multiplier band selector switch to the band selector switch in the Oscillator unit. The purpose of this connection is to change the Oscillator tuning ranges simultaneously with the change in the Multiplier tuning ranges.

(5) The two indicator lamps marked NORMAL and COLD on the left side of the front panel of the Multiplier unit indicate the operation of the double thermostat. For interpretation of the lamp indications see Section II, paragraph 4. c. on page 16.

b. Circuit Operation.-

(1) HFO Section.- The input to the Multiplier unit from the HFO is through plug P-13. In the first stage, the signal is applied to the cathode circuit across a 150 ohm unbypassed resistor. The control grid of this tube is grounded. This circuit arrangement provides the proper load termination for the HFO. This stage functions as an isolation amplifier, and is capacity-coupled to the second stage (B-22a). Tube B-22a is biased so that harmonics will be generated in the plate circuit. Capacity-coupling is again used between the second stage (the Multiplier) and the third stage (the Buffer). The grid circuit of the Buffer is slug tuned. Five individual circuits (one for each band) select the desired harmonic that has been generated in the plate circuit of the Multiplier tube. The Buffer is capacity-coupled to a High Frequency Isolation Amplifier. Herein are employed two 6V6GT tubes (B-21 and B-21a), which are excited in parallel. The outputs from these two tubes are taken from the cathodes and applied to plugs P-17 and P-17a respectively. A portion of the output of B-21a is applied to tube B-17, where it is rectified and thence applied to the Tuning Indicator B-24.

(2) BFO Section.- The output of the BFO is applied to the Multiplier unit through plug P-13a and presented to the control grids of tubes B-21b and B-21c in parallel. These tubes function as buffer amplifiers and serve to isolate the receivers from undesirable common couplings. The outputs from these tubes are taken from plugs P-15 and P-15a.

5. Oscillator Unit

a. General Description.-

(1) The Oscillator unit is contained in a temperature-controlled oven operating at approximately 55° C. It consists of a High Frequency Oscillator and a Beat Frequency Oscillator.

(2) Selection of any of five tuning ranges is accomplished automatically, in accord with band selection throughout the entire unit, by means of a flexible shaft connected between the Multiplier band selector switch and the band selector switch (S-55) on the Oscillator chassis.

(3) Heating of the Oscillator oven is accomplished with four heating elements, R-98, R-98a, R-122 and R-122a. These elements are located in pairs on each side of the Oscillator chassis within the oven. A double mercury-contact theromstat maintains an oven temperature of approximately 55° C.

b. High Frequency Oscillator.-

(1) The High Frequency Oscillator operates on five individual bands. Either XTAL or VFO operation may be chosen by means of switches S-50, S-50a, S-50b, S-50c, and S-50d, located on the Oscillator front panel. Each switch is effective only in its respective band.

(2) When operating in the XTAL position, the frequency of the HFO can be varied by means of a trimmer capacitor located in the crystal circuit, and controlled from the Oscillator front panel. Five trimmers, C-111, C-111a, C-111b, C-111c, and C-111d, are provided, each effective only in its respective band.

c. Beat Frequency Oscillator.- A BFO switch, mounted on the Oscillator front panel, and marked OFF-BFO-XTAL, is located in the grid circuit of tube B-20a. This provides two choices of BFO operation;

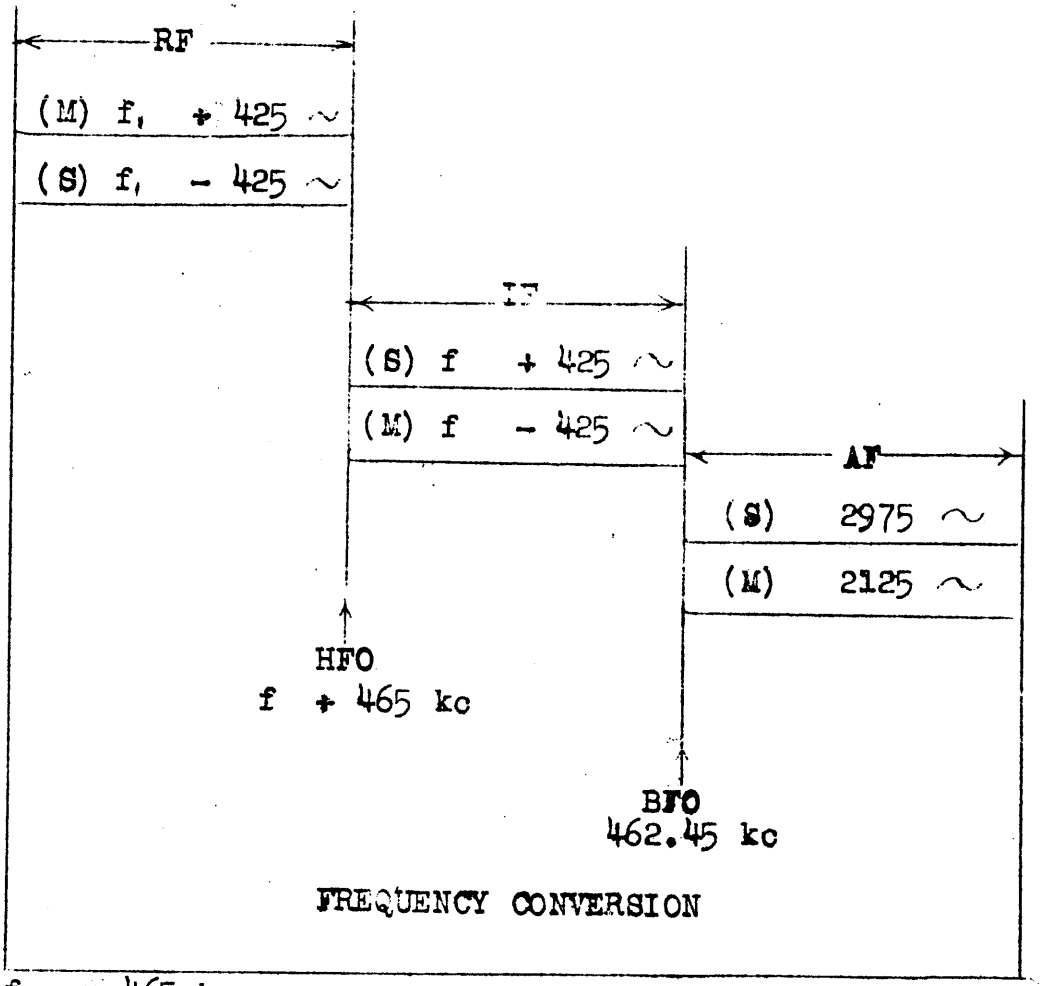
(1) Crystal - 462.45 kc

(2) Self-excited

(a) Automatic Frequency control by means of a variable reactance tube coupled to the AFC circuit in the Terminal equipment.

(b) Manual control is available by turning the AFC control in the AN/FGC1 equipment to OFF and the BFO switch on the oscillator panel of AN/FRR-3a to BFO. See sub-paragraph e (2), page 40.

d. Frequency Conversion System.-



f = 465 kc
f = Assigned Frequency

M= Mark
S= Space

SKETCH "E"

(1) If, for example, the assigned carrier frequency were 12,000 kc., the transmitter would be adjusted to provide the following mark and space frequencies:

(a) Mark = 12,000 + 0.425 = 12,000.425 kc

(b) Space = 12,000 - 0.425 = 11,999.575 kc.

(2) Since the harmonic of the High Frequency Oscillator is 465 kc. greater than the carrier frequency, the marking and spacing frequencies in the i-f stages will be inverted so that the marking frequency is the lower of the two. The i-f and audio output frequencies obtained therefore are:

(a) I-F (465 kc.)
Mark 465 - 0.425 = 464.575 kc.
Space 465 + 0.425 = 465.425 kc.

(b) Audio Output
Mark 464.575 - 462.450 = 2.125 kc
Space 465.425 - 462.450 = 2.975 kc

e. Automatic Frequency Control.-

(1) A component of the AN/FGC1 equipment which electrically and automatically converts the difference between 2125 cycles (Mark) and the input mark frequency to a proportional voltage which is applied to the AFC tube in the Oscillator unit. Its action is to maintain the correct frequency, irrespective of slight variations in the transmitter frequency or the BFO. The control voltage, which is zero when the mark frequency is exactly correct (2125 cycles), appears across an ungrounded pair of terminals. It is important, therefore, that the output of the AFC circuit be correctly poled when it is connected to the AFC tube in the receiver.

(2) Occasionally, it may be impossible to use the crystal BFO and the AFC circuit may be affected by unwanted interference. By turning the AFC control in the AN/FGC1 equipment to OFF and the BFO switch on the oscillator panel of AN/FRR-3a to BFO, the tunable beat-frequency oscillator is available for manual tuning of the BFO. This is the least desirable arrangement, but it may be used to provide service when temporary conditions make the use of crystal and AFC-BFO impracticable. In general, AFC should be used at all times. If not practicable to use AFC, crystal or manual oscillator should be used in that order.

6. Electrical Characteristics

SENSITIVITY	3 microvolts or less for 50 milliwatt output (at any frequency with carrier 30% modulated at 400 cps.).
IMAGE RATIO	Better than 60 db. at any frequency
SIGNAL TO NOISE RATIO	Better than 10 db. at any frequency
SELECTIVITY	5 kc bandwidth at 6 db. down
AVC REGULATION	Within 3 db for a signal change of 10,000 to 1

7. Remote Control System

a. Power Source.- All relays and the stepper switch operate on 50 volts direct current. The power is obtained from a transformer mounted on the Power Supply unit. The alternating current from this transformer is fed to a selenium-oxide rectifier mounted on the rear of the Remote Control unit.

b. Stepper Switch.-

(1) The stepper switch, located on the Remote Control unit, consists of a six-bank rotary switch. The wipers move in unison and are driven by an electro-magnet through a ratchet mechanism. When the electro-magnet is energized by pulses of current which are controlled by the selector dial, the switch moves from the neutral position to adjacent contacts.

(2) If, for example, position 4 is dialed, four pulses will appear on the stepper line, and the stepper switch will move to contact No. 4. The stepper remains on contact 4 until all the operations are completed by the motor-driven band switches in the Antenna, Receivers and Multiplier chassis. After the operations of the motor-driven band switches are completed, the holding current is released and the stepper switch "homes" to the neutral or starting position.

c. Lever Key Functions.- The lever key serves the dual function of preventing noise from operating the stepper switch when the teletype is working, and also disabling the AN/FRR-3a and AN/FGC1, should the equipment be located in the field of a strong transmitter.

(1) SEND Position.- When the lever key adjacent to the dial on the front of the Remote Control unit, or the lever key on the Auxiliary Control box, is placed in the SEND position, the line is closed through Resistor R-102. Current then flows through the circuit, energizing Relay D, grounding the antenna transmission lines through the antenna relays, and disabling the associated AN/FGC1 equipment through its disabling circuits. Relay A (marginal) does not operate, due to current limiting resistor R-102.

(2) OPER Position.- The position of the lever key marked "OPER" opens the control line and all the disabling circuits outlined in the preceeding paragraph.

(3) DIAL Position.-

(a) Holding the lever key in position marked "DIAL" closes the control line circuit, which energizes relays D and A in the Remote Control unit. Relay D closes contacts, disabling the AN/FRR-3a and the AN/FGC1 so that no impulses appear on the teletype during the dialing operations. Relay A first removes voltage from the homing wipers of the stepper switch and then energizes Relay B, located in the Remote Control unit. Relay B prevents the homing circuit from operating until all the motor-driven band switching has been completed.

(b) The coils of Relays D and A are in series across the control line. When Relay B, which is slow acting, becomes energized, it short-circuits the windings of D, allowing the full pulsing voltage from the dial control to act on A.

(c) Relay B also energizes Relay C, located on the Remote Control unit. Relay C, which is the last to operate on both the start and finish of the dialing operation, also holds the disabling circuit closed, and removes voltage from the motor control wipers on the stepper switch.

(d) When dialing, each current pulse operates Relay A only. Relay A in turn operates the stepper switch, causing it to come to rest on the desired position, placing power on the motor control relays located on the Antenna, Receiver B, Multiplier and Receiver A chassis. When the motor relays are closed, they provide 110 volts alternating current to the five band switch motors. After the motors complete their operation, and each motor-driven switch in turn comes to the desired position on the motor-control wafers, the holding circuits are released and the stepper switch is "homed" to its neutral or starting position.

d. Auxiliary Dial Control.- A small Auxiliary Dial Control unit, similar to that on the front panel of the Remote Control unit, is provided for remote control operation. A chart for dial operation is inside the front door (see page 15). Both the main dial on the AN/FRR3 cabinet and the Auxiliary Dial Control unit operate with the same dialing code.

e. Motor Control Relays.-

(1) Motor control relays are located on the Antenna, Receiver B, Multiplier and Receiver A units. They supply alternating current to the motors to operate the band switches. They also apply braking current to the motors to prevent over-travel of the band switches. The motor-control relays receive their voltage from the stepper switch in the Remote Control unit.

(2) When voltage appears on the stepper switch, it is applied to the corresponding fingers on the various motor control wafers of the band switches, closing the motor relays. This applies alternating current to the motors from the individual transformers mounted on the respective units. Each relay also returns 50 volts direct current back to the relay in the Remote Control unit, holding the stepper switch and preventing it from "homing" until band selection is accomplished.

f. Band Switch Motors.-

(1) The motors rotate the band switches until the notch on the motor control wafer reaches the finger on which the control voltage appears. This interrupts the circuit to the motor control relay causing it to open. Opening of this motor control relay removes the alternating current from the motor, applies 50 volt direct current to its field through a limiting resistor, and short circuits the armature of the motor through a low resistance. This effectively brakes the motor.

(2) When the last of the five motor relays opens, the holding voltage is removed from Relay A in the REMOTE CONTROL unit, and the stepper switch "homes" to its neutral or starting position. During these operations, the "brake return" relay in the Remote Control unit has been held closed. The contacts on this relay have provided a ground return for the d-c braking current applied to the motors. When the stepper switch "homes", the "brake return" relay opens, thus interrupting the braking current.

(3) Motor switches are located on the Antenna, Receiver B, Multiplier and Receiver A panels. Should any part of the disabling system become inoperative, the tuning ranges of the equipment may be changed by using the Motor Control switches.

8. Power Supply System

a. Power Control.-

(1) The power switch on the front of the power control panel is in the input line and controls the power furnished to the AN/FRR-3a and terminal units.

(2) A relay within the Power Control unit serves the dual function of turning on or off the power to AN/FRR-3a and Terminal equipment and to operate the heater lamps on the rear of the Power Control unit. Fuses are mounted on the front panel of the Power Control unit.

b. Power Filter.- The power filter chassis contains the filter chokes and filter condensers for the d-c plate supply to the receivers, multiplier and oscillator circuits.

c. Power Supply.-

(1) The power supply chassis contains the plate voltage supply transformers and tube rectifiers for the d-c plate supply. It also has the power transformer supplying alternating current to the selenium-oxide rectifier on the Remote Control unit.

(2) An isolation transformer is located on the power supply chassis furnishing power to the heating elements in the oscillator oven and also alternating current to operate the relay in the Power Control unit

(3) A pilot light is provided on the front panel of the power supply. When the lamp is on, it is an indication that plate voltage is "on".

SECTION IV

MAINTENANCE

1. General Trouble Checking

The following order should be used when checking for trouble:

a. Fuses.- Check the fuses in the Power Control unit.

b. Cables.- Check all cabling against the cabling chart found on the inside of the back door. Check the cable plugs and make sure that the pins establish good contact to the plug. Check all cables for continuity.

c. Power.- Dial "01". Power will be applied to all of the units. If no power is present, as indicated by Tube Socket Voltage measurements, check the power supply and investigate the power cables leading from the Power Supply to the various units.

d. Tube Terminal Voltages.- Check all filament and plate terminal voltages in the various units against the tables provided on pages 53-55. If the plate voltages are consistently low or non-existent throughout the unit, Power Supply trouble is indicated.

e. Tube Circuits.- If trouble still persists, measure all voltages at the tube socket terminals. If they do not agree with the values found in the tables on pages 53-55, check the circuit for defective resistors, capacitors, and connections. If all the voltages are of the proper value, the trouble is due to tube failure or to trouble in the circuits immediately associated with these tubes.

2. Trouble Checking by Chassis

After having localized the difficulty according to the procedure outlined in the preceeding paragraph, the following information will be of assistance in correcting the faulty unit:

a. Antenna Panel.- Little difficulty will be experienced in this unit. Band switch contacts should be inspected and cleaned at regular intervals. If relay trouble is suspected, refer to the Contact Sequence Chart on page 51, and the Relay Maintenance procedure on page 49.

b. Receivers.- The circuits of both superheterodyne receivers are typical and the procedure outlined above generally will suffice in locating the faulty component. If the trouble is not eliminated by tube replacement, make continuity tests and resistance measurements on the associated tube circuits.

NOTE

To check the receiver circuits and tube socket terminal voltages it will be necessary to remove the receiver from the cabinet and place it on a test bench nearby. A special extension cable and plug assembly is provided to connect the receiver to the Power Supply in this case.

c. I-F Alignment.- In the event of poor receiver performance, it may be necessary to realign the i-f transformers. This should be undertaken only after the operator has assured himself that all tube voltages are correct, that all tuned circuits are tuning sharply, and that the difficulty is definitely in the i-f amplifier. If i-f alignment is at fault proceed as follows:

(1) Dial "01" to supply power to the receiver.

(2) Set receiver to band #1 by dialing "1". Remove 2nd r-f tube of receiver to be lined up and insert in its place the adapter plug P-37.

(3) Connect the red-white wire of the plug to the output terminal of SCR-211 Frequency Meter.

(4) Turn receiver AVC and DIV switches to OFF and turn band #1 SENSITIVITY CONTROL to the extreme right position. Turn BFO switch on oscillator panel OFF.

(5) Connect a high resistance voltmeter across the terminals marked TONE KEYER at right rear of the receiver. (As an alternative to this an output meter may be used across the AUDIO OUTPUT terminal, and the BFO used in either XTAL or BFO positions.

(6) Set the Frequency Meter to 465 kc in accordance with standard procedure.

(7) Carefully adjust primary and secondary tuning screws on L-131 (Fig. 7) until maximum response is obtained. Then adjust L-130, L-129 and L-128, in that order.

WARNING

These screws have been sealed in position at the factory with glyptol and the screw slots are relatively fragile; hence a small screw driver that fits the slots should be used and great care exercised in loosening the screws to avoid damage to the screw slots.

(8) Repeat (7) for a final "touch-up".

(9) Turn DIV switch ON and tune L-132 for minimum voltage at KEYER terminals.

(10) Receiver i-f channel is now properly aligned. Restore second r-f tube and proceed.

d. Multiplier and Oscillator Units.- If these units fail to function properly:

(1) Make continuity tests on all of the tuning coils.

(2) Replace the tubes.

(3) Make tests for open or short-circuited capacitors or defective resistors.

WARNING

Dial "02" before attempting the following operation:

(4) Check for broken tuning slug by running the suspected slug screw all the way into the coil, then withdraw the screw. Carefully probe inside the coil to detect a broken part.

(5) If the two pilot lights on the Multiplier panel labeled "OVEN HEAT" remain on, investigate the oven and notice if it is heating properly. Resistors R-98, R-98a, R-122 and R-122a are the heating elements. Replace those that may have burned out.

e. Remote Control Panel.-

(1) To service the Remote Control panel loosen the two "Airloc" fasteners on the hinged front panel. The relays associated with this unit may now be seen clearly.

(2) Turn the main power switch ON. When the lever key on the panel is placed in the DIAL position, the following relays will be actuated: A, B, C, and D. When the lever key is in the SEND position, relay D will be actuated. When power is applied to the equipment and "01" is dialed, the stepper switch will rotate and relays A, B, C, D, and E will be actuated. Refer to the article on Relay Maintenance, Section IV, paragraph 3, and the Contact Sequence chart on page 51, if these relays do not react as described above.

f. Power Supply, Power Control, and Power Filter.-

(1) Power Supply trouble can generally be traced to weak rectifier tubes.

(2) A very low or non-existent B+ voltage indicates a direct short circuit to ground.

WARNING

Turn the main power switch OFF
before attempting the following:

(3) Remove the power cables leading from the Power Supply to the other units and, using an ohmmeter, measure the d-c resistance from the B+ output to ground. Normally this value of resistance should be about 100,000 ohms. If this resistance is appreciably less than 100,000 ohms, check all filter capacitors, chokes and power wiring.

(4) If there is no power present in the associated AN/FGC1 unit, relay N-18 in the Power Control panel should be checked, according to the Contact Sequence chart on page 51.

3. Relay Maintenance

NOTE

Little or no trouble is to be expected from the relays during the service life of the equipment, and unless repair work is absolutely necessary they should be left alone.

a. Cleaning the Contacts.-

(1) It is important that all relays, parts and contacts be kept clean, since failure is often traced to particles of dirt or lint between the contacts, or to dirty parts in the mechanical assemblies.

(2) After lone periods of use it may be necessary to remove accumulated corrosion that has formed on the relay contacts. In the case of normally closed contacts, this cleaning is done by burnishing or rubbing the contacts with a small piece of smooth, hard spring steel, inserted between the contacts, and gently moving it back and forth. (A standard burnishing tool is recommended for this operation.) In the case of normally open contacts, the relay should be manually operated, and while the contacts are closed the burnishing tool should be inserted between the contacts, as in the case of normally closed contacts. As a final step, clean the contacts with carbon tetrachloride after the burnishing process. DO NOT ATTEMPT TO CLEAN THE CONTACTS WITH SANDPAPER OR FILES.

b. Trouble Location.-

(1) If relay trouble is suspected, a continuity test of the relay coil should be performed. Coil resistance values for the various relays are found in the table on page 51. In addition, the table contains a detailed listing of the relay contacts that are closed and open when the relay is energized and not energized. It is important to remember how these contacts have been numbered. THE CONTACT NEAREST THE COIL IS DESIGNATED AS "1" - THE NEXT CONTACT READING OUT FROM THE COIL IS "2", etc. In the case of two spring contact piles mounted on the same relay and which are actuated by the same armature, the same contact numbering system is used; however, a subscript "a" has been added to distinguish between the two sets of contacts. The "Brake Return-Motor Control" relays, as well as relay "E", the "Power Control", and "Disabling" relays are examples of this case.

(2) According to the table, contacts "1" and "2" on Relay A should be closed when the coil is not energized and "2" and "3" should be open. When current is passed through the coil (energized), contacts "1" and "2" open and "2" and "3" close. If this contact sequence does not exist, adjustment of the spring contacts may be necessary. The adjustment consists simply of bending the contact spring very slightly one way or the other as required, using spring bending tools, as supplied in the tool kit with the Terminal equipment.

NOTE

SPRING BENDING MUST BE CAREFULLY PERFORMED SINCE THE TENSION IN THE SPRINGS IS VERY CRITICAL, - ESPECIALLY IN THE CASE OF RELAY "A".

(3) In addition to the preceeding instructions, check the following items:

(a) Make sure all relay mountings are tight.

(b) Make sure residual screws are tight. (The small screw located in the center of the armature)

(c) Make sure that the armature, when operated manually, moves freely.

CONTACT SEQUENCE CHART

RELAYS	REFERENCE NUMBER	COIL RESISTANCE IN OHMS	NON-ENERGIZED		ENERGIZED	
			CONTACTS CLOSED	CONTACTS OPEN	CONTACTS CLOSED	CONTACTS OPEN
Brake Return-Motor Control	N-22	1024	(1-2) (1a-2a)	(2-3) (2a-3a)	(2-3) (2a-3a)	(1-2) (1a-2a)
"A"	N-13	400	(1-2)	(2-3)	(2-3)	(1-2)
"B"	N-14	600	(1-2)	(2-3) (4-5) (6-7)	(2-3) (4-5) (6-7)	(1-2)
"C"	N-15	8	(1-2) (3-4)	(5-6)	(5-6)	(1-2) (3-4)
"D"	N-16	1300	- - - -	(1-2) (3-4)	(1-2) (3-4)	- - - -
"E"	N-17	1000	- - - -	(1a-2a) (1-2) (3-4) (5-6)	(1a-2a) (1-2) (3-4) (5-6)	- - - -
Power Control	N-18	110	(2-3) (2a-3a)	(1-2) (1a-2a)	(1-2) (1a-2a)	(2-3) (2a-3a)
Disabling	N-19	1425	- - - -	(1-2) (1a-2a)	(1-2) (1a-2a)	- - - -

NOTE:

Relays A, B, C, D, E and the BRAKE RETURN are in the REMOTE CONTROL unit.

The MOTOR CONTROL RELAYS are on the ANTENNA unit, RECEIVER B, MULTIPLIER, and RECEIVER A.

The POWER CONTROL RELAY is in the POWER CONTROL unit.

The DISABLING RELAYS are on the RECEIVERS and ANTENNA unit.

SECTION V

SUPPLEMENTARY DATA

1. Correlation of Signal Corps Vacuum Tube Types

Tube Number	Signal Corps Number
5U4G	VT-244
6AC7	VT-112
6E5	VT-215
6H6	VT-90
6J5GT	VT-94D
6SA7	VT-150
6SK7GT	VT-117A
6SN7GT	VT-231
6V6GT	VT-107A
VR150-30	VT-139

2. Tube Socket Terminal Voltages

a. Explanation of Voltage readings.-

(1) All d-c and a-c voltages, measured from GROUND to the designated TERMINAL, were taken with a vacuum tube voltmeter.

(2) All voltages are d-c voltages unless specified as a-c voltages.

(3) All voltages are positive unless specified as negative.

(4) N.C. - indicates no connection.

TUBE SOCKET VOLTAGES

b. Receiver A and B .-

Ref. No.	Tube	Function	1	2	3	4	5	6	7	8
B-19	6SA7	Mixer	GND	GND	245	95	0	3.5	6.1AC	0
B-22	6AC7	1st RF	GND	6.1AC	1.6	0	1.7	113	GND	240
B-22a	6AC7	2nd RF	GND	6.1AC	1.5	0	1.5	113	GND	240
B-24	6E5	Tuning Indicator	6.1AC	1.4	0	117	GND	GND		
B-26	6H6	Signal Detector	GND	6.1AC	-0.3	0	-0.3	N.C.	GND	N.C.
B-26a	6H6	AVC Detector	GND	6.1AC	0	3.9	-0.3	-0.1	GND	GND
B-27	6J5GT	1st Audio	GND	6.1AC	41	Tie point	0	Tie point	GND	2 5
B-27a	6J5GT	2nd Audio	GND	6.1AC	235	Tie point	0	N.C.	GND	5 5
B-28	6SK7GT	1st IF	GND	6.1AC	GND	0	4.9	92	GND	218
B-28a	6SK7GT	2nd IF	GND	6.1AC	GND	0	4.8	83	GND	225
B-28b	6SK7GT	3rd IF	GND	6.1AC	GND	0	6.8	115	GND	212
B-28c	6SK7GT	AVC IF	GND	6.1AC	GND	0	7.7	112	GND	225

All readings taken on band one with 600 ohm load; AVC switch and DIVERSITY switch in the OFF position; AUDIO control in the full clockwise position; All voltages ±10%

TUBE SOCKET VOLTAGES

c. Multiplier Unit.-

Ref. No.	Tube	Function	1	2	3	4	5	6	7	8
B-17	6H6	Detector	0	6.1AC	N.C.	10.	-0.4	10.	GND	GND
B-21	6V6GT	HF Isolation Amp.	GND	6.1AC	245	245	0	N.C.	GND	10.0
B-21a	6V6GT	HF Isolation Amp.	GND	6.1AC	245	245	0	N.C.	GND	10.0
B-21b	6V6GT	BFO Isolation Amp.	GND	6.1AC	150	150	0	N.C.	GND	8.2
B-21c	6V6GT	BFO Isolation Amp.	GND	6.1AC	150	150	0	GND	GND	8.2
B-22	6AC7	HF Amplifier	GND	6.1AC	1.7	GND	1.7	120	GND	130
B-22a	6AC7	Multiplier	GND	6.1AC	2.3	0	2.3	105	GND	175
B-22b	6AC7	Amplifier	GND	6.1AC	2.1	0	2.1	105	GND	205
B-24	6E5	Tuning Indicator	6.1AC	2.4	-0.05	250	GND	GND		
B-25	VR150-30	Voltage Regulator	N.C.	GND	N.C.	N.C.	150	N.C.	N.C.	N.C.
B-25a	VR150-30	Voltage Regulator	N.C.	GND	N.C.	N.C.	150	N.C.	N.C.	N.C.

All voltages taken with input from Oscillator unit removed.

All voltages ± 10%

TUBE SOCKET VOLTAGES

d. Oscillator Unit.-

Ref. No.	Tube	Function	1	2	3	4	5	6	7	8
B-20	6SN7GT	HFO	0.1	118	2.3	-0.2	90	GND	GND	6.1AC
B-20a	6SN7GT	BFO	0.1	100	4	0	145	6.7	GND	6 1AC
B-21	6V6GT	AFC	GND	GND	66	66	0	0	6.1AC	7.8

All voltage with BFO switch in the OFF position, HFO for the Channel in use in the XTAL position and the crystal removed; All voltages ± 10%

e. Antenna Unit.-

Ref. No.	Tube	Function	1	2	3	4	5	6	7	8
B-27	6J5GT	Channel "B"	GND	6.1AC	200	N.C.	0	N.C.	GND	6.1
B-27a	6J5GT	Channel "A"	GND	6.1AC	200	N.C.	0	N.C.	GND	6 3

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station † Stock	Region † Stock
	2S2001-3A	RADIO-TELETYPE RECEIVING EQUIPMENT, DUAL DIVERSITY: 5 BAND, 2.4 to 23 MC; 100/260 V; 50/60 cps, 400 WATT.			

3a.--Antenna Unit (Quantity 1 per unit)

C52,52a,52b,52c	3DKA2-110	CAPACITOR: mica; .002 mf; 500 v dc w.	4	2	4
C80,80a,80b,80c	3DA50-57	CAPACITOR: paper; .05 mf; 600 v dc w.	4	2	4
C97,97a	3D9020-21	CAPACITOR: silver mica; .00002 mf; 500 v dc w.	2	1	1
C108,108a,108b, 108c,108d,108e, 108f,108g,108h, 108k	3D9025V-52	CAPACITOR: variable; 4.5-25 mmf.	10	0	0
L111,111a,112, 112a,113,113a	2S2001-3A/C2	COIL: ant; 0.425 microhenry inductance; 0.3 ohm dc max resistance.	6	0	0
L114,114a	2S2001-3A/C10	COIL: ant; 0.42 microhenry inductance; 0.15 ohm dc max resistance.	2	0	0

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3a.--Antenna Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
L115,115a	2S2001-3A/C11	COIL: ant; 0.24 microhenry; .07 ohm dc max resistance.	2	0	0
L116,116a	2S2001-3A/C3	COIL: ant; 2340-4320 kc; 30.7 microhenry min inductance; 2.5 ohm dc max resistance.	2	0	0
L117,117a	2S2001-3A/C12	COIL: ant; 4080-7070 kc; 11.5 microhenry min inductance; 0.45 ohm dc max resistance.	2	0	0
L118,118a	2S2001-3A/C13	COIL: ant; 6730-11,480 kc; 4.35 microhenry min inductance; 0.25 ohm dc max resistance.	2	0	0
L119,119a	2S2001-3A/C14	COIL: ant; 10,920-17,960 kc; 1.77 microhenry min inductance; 0.1 ohm dc max resistance.	2	0	0
L120,120a	2S2001-3A/C15	COIL: ant; 17,060-26,600 kc; 0.79 microhenry min inductance; .025 ohm dc max resistance.	2	0	0
E13,13a	2Z3289-3	COUPLING: flexible; bakelite; 2-1/4" x 1/4" bushing 1-1/16" diam.	2	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3a.--Antenna Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
F11,11a,11b,11c, 11d,11e,11f,11g, 11h	2Z5925.1	LAMP: pilot; miniature bayonet base; 6-8 v; 150 ma.	9	3	6
A16,16a,16b,16c, 16d	2Z5883-13	LIGHT ASS'Y: pilot; green jewel; miniature bayonet base.	5	1	1
A17,17a,17b,17c	2Z5883-7	LIGHT ASS'Y: pilot; amber jewel; miniature bayonet base.	4	1	1
H11,11a	3H3100BS	MOTOR: band switching; 50 v dc; 110 v ac; 60 cps; 0.25 amp; 2-10 rpm final drive; reduction 1200-1.	2	1	1
P13,13a	2Z7228.6	PLUG: 4 contact; 1 pos; male.	2	0	1
P19	2Z7131.3	PLUG: 21 contact; 5 pos; male.	1	0	1
N12,12a	2Z7589-51	RELAY: DPDT; 50 v dc; motor control.	2	0	0
N19,19a,19b,19c	2Z7589-52	RELAY: DPST; 50 v dc; ant disabling.	4	0	0
R94,94a,94b,94c, 94d,94e,94f,94g	3Z6200-41	RESISTOR: carbon; 2000 ohm; 1 watt.	8	3	6
R96,96a	3Z6001-34	RESISTOR: carbon; 10 ohm; 1 watt.	2	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-5a

3a.--Antenna Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sta. 3-3)	
				Station Stock †	Region Stock †
R97,97a	3ZK6007E5-100K	RESISTOR: wirewound; 75 ohm; 10 watt.	2	1	1
R117,117a,117b, 117c	3RC31AE102K	RESISTOR: carbon; 1000 ohm; 1 watt.	4	2	4
R120,120a	3Z6350-22	RESISTOR: carbon; 3500 ohm; 1 watt.	2	1	1
R141,141a,141b, 141c,141d,141e	3RC31AE201K	RESISTOR: carbon; 200 ohm; 1 watt.	6	2	4
R142,142a,142b, 142c	3Z6005-44	RESISTOR: carbon; 50 ohm; 1/2 watt.	4	2	4
G16,16a,16b,16c, 16d,16e,16f,16g, 16h,16i	3G1837-48.3	SLEEVE: bakelite; adjusting screw guide.	10	2	2
A14,14a	2Z8795.12	SOCKET: tube; 8 prong; bakelite.	2	0	1
S37,37a	3Z9824-50.2	SWITCH: push button; SPST; motor incher.	2	1	2
S52	3Z9825-79.14	SWITCH: rotary; 10P; 5 section; 4 pos; ant selector.	1	0	1
S53	3Z9825-79.15	SWITCH: rotary; 14P; 7 section; 5 pos; wafer; ant band selector	1	0	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3a.--Antenna Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
T26	2Z9606.19	TRANSFORMER: fil; pri 1: 115 v; pri 2: 115 v; 60 cps; sec #1: 6.3 v @ 0.5 amp; sec #2: 115 v @ 0.5 amp.	1	0	1
B27,27a	2V6J5GT	TUBE: JAN6J5GT.	2	4	8

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

3b.--Receiver Unit (Quan per unit 2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock *	Region Stock †
C30	3D9100-70.1	CAPACITOR: mica; .0001 mf; 500 v dc w.	2	1	1
C45b,45c,45d,45f	3DA100-113.1	CAPACITOR: paper; 0.1 mf; 400 v dc w.	8	2	4
C52b,52c,52d,52e 52f,52g,52h,52k, 52m,52n,52p,52q	3DKA2-110	CAPACITOR: mica; .002 mf; 500 v dc w.	24	4	8
C62,62a	3D9500-24	CAPACITOR: mica; .0005 mf; 500 v dc w.	4	2	2
C65b,65d	3DA10-128	CAPACITOR: paper; .01 mf; 600 v dc w.	4	1	2
C76	3D9005-19.3	CAPACITOR: ceramic; .000005 mf; 500 v dc w.	2	1	1
C78,78a	3D9250-9	CAPACITOR: mica; .00025 mf; 500 v dc w.	4	1	2
C80j,80k,80l, 80m,80p,80q,80r, 80s	3DA50-57	CAPACITOR: paper; .05 mf; 600 v dc w.	16	5	10
C101,101a,101b, 101c	3D9012-10	CAPACITOR: silver mica; .000012 mf; 500 v dc w.	8	0	1
C110,110a,110b, 110c,110d,110e	3D9030-13	CAPACITOR: silver mica; .00003 mf; 500 v dc w.	12	0	2

†Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3b —Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per Unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock†	Region Stock †
C115,115a,115b, 115c,115d,115e, 115f,115g,115h, 115k,115m,115n, 115p,115q,115r	3D9025V-52	CAPACITOR: variable; 4.5-25 mmf.	30	0	2
C116,116a,116b, 116c,116d,116e,	3D9004-7	CAPACITOR: silver mica; .000004 mf; 500 v dc w.	12	0	2
L70a,70b,70c	3C323-55A	CHOKE: RF; 50 millihenrys inductance; 130 ohm dc resistance.	6	2	2
L127,127a	3C323-8U	CHOKE: RF; 12 millihenrys inductance; 90 ohm dc resistance.	4	0	1
L77,77a	3C1084X-41	COIL: RF; 2340-4320 kc; 125 microhenry max; 24.5 microhenry min inductance; 2.5 ohm dc resistance.	4	0	0
L78,78a	3C1084X-42	COIL: RF; 4080-7070 kc; 34 microhenry max; 9 microhenry min inductance; 0.25 ohm dc resistance.	4	0	0
L79,79a	3C1084X-43	COIL: RF; 6730-11,480 kc; 12.4 microhenry max; 4 6 microhenry min inductance; 0 45 ohm dc resistance.	4	0	0

†Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
L80,80a	3C1084X-44	COIL: RF; 10,920-17,960 kc; 4.4 microhenry max; 1.5 microhenry min inductance; 0.1 ohm dc resistance.	4	0	0
L81,81a	3C1084X-46	COIL: RF; 17,060-26,600 kc; 1.8 microhenry max; 0.69 microhenry min inductance; .025 ohm dc resistance.	4	0	0
L122	2S2001-3A/C1	COIL ASSEMBLY: RF; 2340-4320 kc; 30.7 microhenry min inductance; 2.5 ohm max resistance.	2	0	0
L123	2S2001-3A/C4	COIL ASSEMBLY: RF; 4080-7070 kc; 11.5 microhenry min inductance; 0.45 ohm DC max resistance.	2	0	0
L124	2S2001-3A/C5	COIL ASSEMBLY: RF; 6730-11,480 kc; 4.35 microhenry min inductance; 0.25 ohm dc resistance.	2	0	0
L125	2S2001-3A/C6	COIL ASSEMBLY: RF; 10,920-17,960 kc; 1.77 microhenry min inductance; 0.1 ohm dc max resistance	2	0	0

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per Unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock†	Region Stock†
L126	2S2001-3A/C7	COIL ASSEMBLY: RF; 17,960-26,600 kc; 0.79 microhenry min inductance; .025 ohm dc max resistance.	2	0	0
E13,13a	2Z3289-3	COUPLING: flexible; bakelite; bushings 7/16" diam x 1/4" high.	4	1	1
E15	2Z3270-22	COUPLING: flexible; bakelite; bushings 7/16" diam x 5/16" high.	2	1	1
J14	2Z5680A/7	JACK: phone; single ckt; open.	2	0	1
F11,11a,11b,11c, 11d,	2Z5925.1	LAMP: pilot; 6.8 v; 150 ma; miniature bayonet base.	10	4	8
A12,12a,12b,12c, 12d	2Z5883-13	LIGHT ASSEMBLY: pilot; green jewel; candelabra base.	10	2	2
H11	3H3100 BS	MOTOR: band switching; 50 v dc 110 v ac; 60 cps; 0.25 amp.	2	1	1
P13,15,17	2Z7228.6	PLUG: 4 contact; male.	6	0	2
P21	2Z7131.3	PLUG: 21 contact; 8 pos; male.	2	0	1
P29	2Z7228.30	PLUG: 2 contact; bakelite; male.	2	0	1
N12	2Z7589-51	RELAY: DPDT; 50 v dc.	2	0	0

†Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per Unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
N19	2Z7589-52	RELAY: DPST: 50 v dc disabling	2	0	0
R18a,18b	3ZK6080-37	RESISTOR: carbon; 800 ohm; 1 watt.	6	2	2
R20	3Z6700-15	RESISTOR: carbon; 100,000 ohm; 1/2 watt.	2	1	1
R26d,26e,26g,26h	3RC31AE104K	RESISTOR: carbon; 100,000 ohm; 1 watt.	8	3	6
R73,73a	3Z6625-24	RESISTOR: carbon; 25,000 ohm; 1/2 watt.	4	1	2
R79b	3RC20AE512J	RESISTOR: carbon; 5000 ohm; 1 watt.	6	2	4
R83,83a,83b,83c, 83d,83e,83f	3Z6750-30	RESISTOR: carbon; 500,000 ohm; 1 watt.	14	3	6
R84	3RC31AE105K	RESISTOR: carbon; 1 megohm; 1 watt.	2	1	1
R85,85a	3Z6500-64	RESISTOR: carbon; 500 ohm; 1/2 watt.	4	1	2
R87,87a,87b,87c, 87d	2Z7279-52	RESISTOR: pot; wirewound; 1000 ohm; 3 watt.	10	3	6
R88	2Z7272-65	RESISTOR: pot; carbon; 500,000 ohm; 1 watt.	2	1	2

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock†
R90,90a,90b	3Z6650-5	RESISTOR: carbon; 50,000 ohm; 1/2 watt.	6	2	4
R92a,92b,92c	3Z6725-20	RESISTOR: carbon; 250,000 ohm; 1 watt.	6	2	4
R94a	3Z6200-41	RESISTOR: carbon; 2000 ohm; 1 watt.	2	1	1
R96	3Z6001-34	RESISTOR: carbon; 10 ohm; 1 watt.	2	1	2
R97	3Z6007E5-23	RESISTOR: wirewound; 75 ohm; 10 watt.	2	1	2
R103	3Z6090-18	RESISTOR: carbon; 900 ohm; 1 watt.	2	1	2
R105	3Z6720-6	RESISTOR: carbon; 200,000 ohm; 1/2 watt.	2	1	2
R106c	3Z6720-25	RESISTOR: carbon; 20,000 ohm; 1/2 watt.	2	1	2
R110	3Z6650-6	RESISTOR: carbon; 50,000 ohm; 2 watt.	2	1	2
R111	3RC21AE101K	RESISTOR: carbon; 100 ohm; 1/2 watt.	2	1	2
R116	3Z6025-18	RESISTOR: carbon; 250 ohm; 1 watt.	2	1	2

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per Unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
R117	3RC31AE102K	RESISTOR: carbon; 1000 ohm; 1 watt.	2	1	2
R120	3Z6350-21	RESISTOR: carbon; 3500 ohm; 1 watt.	2	1	2
R131,131a	3RC21AE102K	RESISTOR: carbon; 1000 ohm; 1/2 watt.	4	2	2
R135	3Z6300-142	RESISTOR: carbon; 1500 ohm; 1 watt.	2	1	2
R141b,141c,141d	3RC31AE102K	RESISTOR: carbon; 200 ohm; 1 watt.	6	2	4
R153,153a	3Z6500-27	RESISTOR: carbon; 5000 ohm; 2 watt.	4	2	2
R154,154a	3Z4533	RESISTOR: carbon; 500,000 ohm; 1/2 watt.	4	2	2
R155	3Z6620-105	RESISTOR: carbon; 20,000 ohm; 1/2 watt.	2	1	2
R157,157a	3Z6670-1	RESISTOR: carbon; 70,000 ohm; 1/2 watt.	4	2	2
G16,16a,16b,16c, 16d,16e,16f,16g, 16h,16i,16j,16k, 16l,16m,16n	3G1837-48.3	SLEEVE: adjusting screw guide; bakelite; 1-1/2" long x 3/8" O.D. x 3/16" I.D.	30	6	6

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and Description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
A14,14a,14b,14c, 14d,14e,14f,14g, 14h,14i,14j	2Z8795.12	SOCKET: tube; octal; bakelite.	22	0	3
A24	2Z8676.47	SOCKET: tube; 6 contact; bakelite; tuning indicator.	2	1	1
S33	3Z9825-62.101	SWITCH: DP; 5 pos; bakelite; wafer; motor control.	2	0	1
S34,34a	3Z9825-72.2	SWITCH: rotary; SPDT; AVC.	4	1	2
S36	3Z9825-62.100	SWITCH: rotary; SP; 5 pos; audio level.	2	1	1
S37	3Z9824-50.2	SWITCH: push-button; SPST; bakelite; motor incher.	2	0	1
S48	3Z9825-79.4	SWITCH: rotary; 3P; 5 pos; 2 section; wafer.	2	0	0
S49	3Z9825-79.2	SWITCH: rotary; DP; 5 pos; wafer.	2	0	0
S54	3Z9825-79.10	SWITCH: rotary; 4P; 2 section; 6 pos.	2	0	0
T21	2Z9632.155	TRANSFORMER: audio; output; pri; 15,000 ohm; sec; 600 ohm; tapped at 150 ohm; line matching	2	1	1

†Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 1C-2)	
				Station Stock †	Region Stock †
T25	2Z9611.175	TRANSFORMER: fil; pri; #1; 115v; pri. #2; 115 v; 60 cps; sec. #1; 6.3 v @ 5 amp; sec. #2; 115 v @ 0.25 amp.	2	0	1
L128,129	2Z9641-110	TRANSFORMER ASSEMBLY: IF; consisting of: 1 CAPACITOR; mica; .000025 mf. 2 CAPACITOR; paper; .05 mf; 600 v dc w. 2 CAPACITOR; mica; .00015 mf. 1 CAPACITOR; mica; .0025 mf. 1 COIL; pri; 870 millihenry 4.9 ohm dc resistance. 1 COIL; sec; 780 millihenry 4.9 ohm dc resistance. 1 RESISTOR; 100,000 ohm; 1 watt. 1 RESISTOR; 1500 ohm; 1 watt 1 RESISTOR; 50,000 ohm; 1 watt. 1 RESISTOR; 5000 ohm; 1 watt	4	2	4

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-5a

--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
L130	2Z9641.109	TRANSFORMER ASSEMBLY: IF; consisting of: 2 CAPACITOR; mica; .00015 mf. 1 CAPACITOR; mica; .0025 mf. 2 CAPACITOR; paper; .05 mf; 600 v dc w. 1 COIL; pri. 870 millihenry 4.9 ohm dc resistance. 1 COIL; sec. 780 millihenry 4.9 ohm; dc resistance. 1 RESISTOR; 5000 ohm; 1 watt 1 RESISTOR; 50,000 ohm; 1 watt.	2	1	2
L131	2Z9641.108	TRANSFORMER ASSEMBLY: consisting of: 1 CAPACITOR; paper; .05 mf; 600 v dc w. 1 CAPACITOR; mica; .0025 mf. 2 CAPACITOR; mica; .00015 mf 1 COIL; pri; 870 millihenry 4.9 ohm; dc resistance. 1 COIL; sec; 780 millihenry 4.9 ohm; dc resistance. 1 RESISTOR; 5000 ohm; 1 watt	2	1	2

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3b.--Receiver Unit (Quan per unit-2)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per Unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
L132	2Z9641.107	TRANSFORMER ASSEMBLY: IF; consisting of: 2 CAPACITOR; mica; .00015 mf. 1 CAPACITOR; paper; .05 mf; 600 v dc w. 1 CAPACITOR; paper; 0.1 mf; 400 v dc w. 1 COIL: pri; 870 millihenry; 4.9 ohm dc resistance. 1 COIL: sec; 780 millihenry; 4.9 ohm; dc resistance. 1 RESISTOR; 5000 ohm; 1 watt. 1 RESISTOR; 10,000 ohm; 1 watt.	2	1	2
B19	2J6SA7	TUBE: JAN6SA7	2	4	8
B22,22a	2J6AC7	TUBE: JAN6AC7	4	8	16
B24	2J6E5	TUBE: JAN6E5	2	4	8
B26,26a	2J6H6	TUBE: JAN6H6	4	8	16
B27,27a	2J6J5GT	TUBE: JAN6J5GT	4	8	16
B28,28a,28b,28c	2J6SK7GT	TUBE: JAN6SK7GT	8	16	32

† Equipment not stocked on Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3c.--MULTIPLIER UNIT (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
C30a,30f	3D9100-95.1	CAPACITOR: mica; .0001 mf; 500 v dc w.	2	1	1
C52a,52b,52c,52d 52e,52f,52g,52j, 52k,52m,52p,52q, 52r,52s,52t,52u	3DKA2-110	CAPACITOR: mica; .002 mf; 500 v dc w.	16	4	8
C70	3D9025-24	CAPACITOR: mica; .000025 mf; 500 v dc w.	1	1	1
C78	3D9250-9	CAPACITOR: mica; .00025 mf; 500 v dc w.	1	1	1
C80,80a,80b,80c, 80d	3DA50-57	CAPACITOR: paper; .05 mf; 600 v dc w.	5	2	4
C87,87a	3D9050-10	CAPACITOR: silver mica; .00005 mf; 500 v dc w.	2	1	1
C97	3D9020-23.1	CAPACITOR: silver mica; .00002 mf; 500 v dc w.	1	1	1
C102c,102d	3DK9040-20	CAPACITOR: silver mica; .00004 mf; 500 v dc w.	2	1	1
C108,108a,108b, 108c,108d,108e, 108f,108g,108h	3D9025V-52	CAPACITOR: variable; 4.5-25 mf.	9	0	0
C110,110a,110b	3K2030032	CAPACITOR: silver mica; .00003 mf; 500 v dc w	3	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3c.---Multiplier Unit (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per Unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
C113,113a	3D9070-3	CAPACITOR: silver mica; .00007 mf; 500 v dc w.	2	1	1
C114	3D9060	CAPACITOR: silver mica; .00006 mf; 500 v dc w.	1	1	1
L70	3C323-155A	CHOKE: RF; 50 millihenry; 130 ohm.	1	1	1
L100,100a	3C323-85.1	CHOKE: RF; 370 microhenry inductance; 5.5 ohm dc resistance.	2	1	1
L93	3C1084X-33	COIL: buffer; 2865-4665 kc; 44 microhenry min; 1 ohm dc resistance.	1	0	0
L94,94a	3C1084X-35	COIL: buffer; 4665-7365 kc; 16.6 microhenry max; 4.15 microhenry min; 0.5 ohm dc resistance.	2	0	0
L95,95a	3C1084X-32	COIL: buffer; 7365-11,665 kc; 6.4 microhenry max. inductance; 1.6 microhenry min; .05 ohm dc resistance.	2	0	0
L96,96a	3C1084X-34	COIL: buffer; 11,665-17,965 kc; 2.2 microhenry max inductance; 0.66 microhenry min; .09 ohm dc resistance.	2	0	0

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3c --Multiplier Unit (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock†	Region Stock †
L97,97a	3C1084X-31	COIL: buffer; 17,965-26,465 kc 0.84 microhenry max inductance 0.34 microhenry min; .04 ohm dc resistance.	2	0	0
E13	2Z3289-3	COUPLING: flexible; bakelite.	1	1	1
F11,11a,11b,11c, 11d	2Z5925.1	LAMP: pilot; 6.8 v; 150 milli-amp; miniature bayonet base.	5	2	4
F21,21a	2Z5887-1	LAMP: neon; 110 v; 1/4 watt; candelabra base.	2	4	8
A16,16a,16b,16c, 16d	2Z5883-13	LIGHT ASSEMBLY: pilot; green jewel; miniature bayonet base.	5	1	1
A19,19a	2Z5883-17	LIGHT ASSEMBLY: pilot; clear glass jewel; candelabra base.	2	0	0
H11	3H3100BS	MOTOR: band switching; 50 v dc 110 v ac; 60 cps; 0.25 amp; max 2-10 rpm final drive; reduction: 1200 to 1.	1	0	1
P13,13a,15,15a, 17,17a	2Z7228.6	PLUG: 4 contact; male; bakelite.	6	0	0
P23,27	2Z7131.3	PLUG: 21 contact; male; bakelite.	2	0	0
P-37		ADAPTER PLUG ASSEMBLY PW 102-M-732			

† Equipment not stocked in Station Stock or Regional Stock is Stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3c.--Multiplier Unit (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
N12	2Z7589-51	RELAY: DPDT; 50 v dc.	1	0	0
R26	3RC31AE104K	RESISTOR: carbon; 100,000 ohm; 1 watt.	1	1	1
R73	3Z6625-24	RESISTOR: carbon; 25,000 ohm; 1/2 watt.	1	1	1
R78,78a	3Z6010-135	RESISTOR: carbon; 10,000 ohm 1 watt.	2	1	1
R79	3RC20AE512J	RESISTOR: carbon; 5000 ohm; 1 watt.	1	1	1
R83	3Z6750-30	RESISTOR: carbon; 500,000 ohm; 1 watt.	1	1	1
R84	3RC31AE105K	RESISTOR: carbon; 1 megohm; 1 watt.	1	1	1
R92	3Z6725-20	RESISTOR: carbon; 250,000 ohm; 1 watt.	1	1	1
R93,93a,93b,93d	3Z6650-116	RESISTOR: carbon; 50,000 ohm; 1 watt.	4	1	2
R94	3Z6200-41	RESISTOR: carbon; 2000 ohm; 1 watt.	1	1	1
R96a,96b,96c,96d, 96e	3Z6001-34	RESISTOR: carbon; 10 ohm; 1 watt.	5	2	4

†Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3c --Multiplier Unit (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-1)	
				Station Stock †	Region Stock †
R97	3Z6007E5-23	RESISTOR: wirewound; 75 ohm; 10 watt.	1	1	1
R106	3Z6720-25	RESISTOR: carbon; 20,000 ohm; 1 watt.	1	1	1
R114,114a	3Z6570-29	RESISTOR: wirewound; 7000 ohm 10 watt.	2	1	1
R115	3Z6400-66	RESISTOR: wirewound; 4000 ohm 10 watt.	1	1	1
R117,117a	3RC31AE102K	RESISTOR: carbon; 1000 ohm; 1 watt.	2	1	2
R120	3Z6350-21	RESISTOR: carbon; 3500 ohm; 1 watt.	1	1	1
R129	3Z6250-17	RESISTOR: wirewound; 2500 ohm; 10 watt.	1	1	1
R141,141a,141b	3RC31AE201K	RESISTOR: carbon; 200 ohm; 1 watt.	3	1	2
R144,144a	3Z6060-49	RESISTOR: carbon; 600 ohm; 1 watt.	2	1	1
R152	3RC21AE151K	RESISTOR: carbon; 150 ohm; 1/2 watt.	1	1	1
G16,16a,16b,16c, 16d,16e,16f,16g, 16h	3G1837-48.3	SLEEVE: adjusting screw guide bakelite.	9	2	2

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot

3c.--Multiplier Unit (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock†	Region Stock†
A14,14a,14b,14c, 14d,14e,14f,14g, 14h,14i,14j	2Z8795.12	SOCKET: tube; 8 prong; bakelite.	11	0	1
A24	2Z8676.47	SOCKET: tube; 6 contact; bakelite; portable; tuning indicator.	1	0	0
S37	3Z9824-50.2	SWITCH: push-button; SPST; bakelite.	1	0	1
S51	3Z9825-79.13	SWITCH: rotary; 6P; 3 section 5 pos; no stop.	1	0	0
T25	2Z9611.175	TRANSFORMER: fil pri #1; 115 v pri #2; 115 v 60 cps; sec #1: 6.3 v @ 5 amp; sec #2: 115 v @ 0.25 amp.	1	0	1
B17	2J6H6	TUBE: JAN6H6	1	2	4
B21,21a,21b,21c	2J6V6GT	TUBE: JAN6V6GT	4	8	16
B22,22a,22b	2J6AC7	TUBE: JAN6AC7	3	6	12
B24	2J6E5	TUBE: JAN6E5	1	2	4
B25,25a	2JVR150-30	TUBE: JANVR150-30	2	4	8

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3d.--Oscillator Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
C26a,26b	3D9100-70.1	CAPACITOR: silver mica; .0001 mf; 500 v dc w.	2	1	1
C45	3D9100-70.1	CAPACITOR: paper; 0.1 mf; 400 v dc w.	1	1	1
C52,52a,52d	3DKA2-110	CAPACITOR: mica; .002 mf; 500 v dc w.	3	1	2
C78f	3D9050-10	CAPACITOR: silver mica; .00005 mf; 500 v dc w.	1	1	1
C90,90a,90b	3D9500-25	CAPACITOR: silver mica; .0005 mf; 500 v dc w.	3	1	2
C97	3D9020-23.1	CAPACITOR: silver mica; .00002 mf; 500 v dc w.	1	1	1
C98,98a	3D9010-54	CAPACITOR: silver mica; .00001 mf; 500 v dc w.	2	1	1
C100	3D9600-15	CAPACITOR: silver mica; .0006 mf; 500 v dc w.	1	1	1
C107	3K2024132	CAPACITOR: silver mica; .00025 mf; 500 v dc w.	1	1	1
C109	3K2036122	CAPACITOR: silver mica; .00035 mf; 500 v dc w.	1	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

3d.--Oscillator Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
C110,110a,110b, 110c,110d	3D9030-13	CAPACITOR: silver mica; .00003 mf; 500 v dc w.	5	2	4
C111,111a,111b, 111c,111d	3D9080V-10	CAPACITOR: variable; 80 mmf.	5	0	0
C112	3D9039-6	CAPACITOR: silver mica; .000039 mf; 500 v dc w.	1	1	1
L36a	3C323-8S	CHOKE: RF; 2.2 mh inductance; 13 dc resistance.	1	1	1
L82	3C1084X-36	COIL: BFO; 462.5 kc; 576 microhenry max; 370 microhenry min inductance; 11.3 ohm dc resistance.	1	1	1
L121,121a,121b, 121c,121d	2S2001-3A/C16	COIL: VFO; 2.5-5.1 mc; 10.8 microhenry max inductance; 2.45 microhenry min 0.1 ohm dc resistance	5	1	1
X14	2X75-462.4	CRYSTAL: 462.45 kc.	1	0	0
P14,14a	6Z8364-4	PLUG: 4 contact; 1 pos; female.	2	0	0
P33		PLUG: 21 contact; 11 pos; female.	1	0	0

† Equipment not stocked in Station Stock or Regional Stock is obtainable on

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3d.--Oscillator Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
R23,23b,23c	3ZK6725-29	RESISTOR: carbon; 250,000 ohm; 1/2 watt.	3	1	2
R26,26b	3Z6700-100	RESISTOR: carbon; 100,000 ohm; 1 watt.	2	1	1
R51	3Z6610-114	RESISTOR: carbon; 10,000 ohm; 2 watt.	1	1	1
R79a,79b,79c	3RC20AE512J	RESISTOR: carbon; 5000 ohm; 1 watt.	3	1	2
R90	3Z6650-5	RESISTOR: carbon; 50,000 ohm; 1/2 watt.	1	1	1
R91	3Z6060-19	RESISTOR: carbon; 600 ohm; 1/2 watt.	1	1	1
R98,98a	3Z6033-22	RESISTOR: wirewound; 350 ohm; 28 watt.	2	1	1
R107a,107b	3Z6050-61	RESISTOR: carbon; 500 ohm; 1 watt.	2	1	1
R122,122a	3Z6020-88	RESISTOR: wirewound; 200 ohm; 28 watt.	2	1	1
R135a	3Z6150-57	RESISTOR: carbon; 1500 ohm; 1 watt	1	1	1
A14,14a,14b	2Z8795-12	SOCKET: tube; 8 prong; bakelite.	3	0	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

31.--Oscillator Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-5 Equipments (Per Sig [illegible])	
				Station Stock †	Region Stock †
A23, 23a, 23b, 23c, 23d, 23e	2Z8761-21	SOCKET: 3 contact; mikroy base; crystal holder.	6	0	0
S39	3Z9825-79.7	SWITCH: rotary; TP; 3 pos; 1 section.	1	0	1
S50, 50a, 50b, 50c, 50d	3Z9825-79.11	SWITCH: 3 pos; wafer; coil-crystal.	5	0	1
S55	3Z9825-79.12	SWITCH: rotary; DP; 1 section 6 pos.	1	0	0
X13	2Z9489.21	THERMOSTAT: oven regulator; range 50°-70°C; 115 v; 30 watt.	1	1	1
B20, 20a	2J6SN7GT	TUBE: JAN6SN7GT.	2	4	8
B21	2J6V6GT	TUBE: JAN6V6GT.	1	2	4

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3c.--Remote Control Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-8)	
				Station Stock †	Region Stock †
P19,21,21a,25,27	2Z7131.3	PLUG: 21 contact; male.	5	0	0
XII	3H4920	RECTIFIER: selenium oxide; 50 v dc output.	1	0	1
N12	2Z7589-51	RELAY: DPDT; 50 v dc.	1	0	0
N13	2Z7586-41	RELAY: (A); SPDT; 50 v dc.	1	1	1
N14	2Z7586-40	RELAY: (B); 1 SPDT; 2 SPST; 50 v dc.	1	1	1
N15	2Z7592-25	RELAY: (C); TPST; 50 v dc.	1	1	1
N16	2Z7589-53	RELAY: (D); DPST; 50 v dc.	1	1	1
N17	2Z7592-26	RELAY: (E); 4PST; 50 v dc.	1	1	1
R100	3Z6095-1	RESISTOR: wirewound; 950 ohm; 5 watt.	1	1	1
R102	3Z6960-18	RESISTOR: carbon; 3800 ohm; 2 watt.	1	1	1
R104	3Z6030-68	RESISTOR: wirewound; 300 ohm; 20 watt.	1	1	1
R125	2Z7279-54	RESISTOR: pot; wirewound; 950 ohm; 3 watt.	1	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3e.--Remote Control Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
Z11	3Z1893-13	SUPPRESSOR UNIT: spark; consisting of: CAPACITOR: 0.1 mf; 750 v test; in can RESISTOR: wirewound; 200 ohm.	1	1	1
S28	3Z9825-79.5	SWITCH: rotary; 6 pole; (4 pole non-shorting; 2 pole shorting).	1	0	0
S29	4C4981-2	SWITCH: key; lever type; DPDT; N.O.	1	0	1
S45	4B794.4-3	SWITCH: dialing; non-delayed impulse.	1	0	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3f.--Power Control Unit (Quantity 1 per unit)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
F18, 18a	3Z2610.12	FUSE: screw plug; 10 amp @ 120 v.	2	20	40
F19,19a	6Z6820-4	LAMP: frosted; std Edison base; 100 watt @ 120 v.	2	0	0
K18	3H5009-2	RELAY: DPDT; power	1	0	1
XF21,21a	6Z8357-11	SOCKET: porcelain; fuse holder; 15 amp @ 220 v.	2	0	1
XF22,22a	6Z8357-1	SOCKET: porcelain; std.Edison base; 150 amp @ 220 v.	2	0	1
P11,11a	2Z8674.88	SOCKET: female; power; 4 contact; 5000 v @ 25 amp.	2	0	1
P29	2Z7228.30	SOCKET: male; 2 contact	1	0	1
S30	3Z9857.51	SWITCH: toggle; DPST; 220 v; 15 amp; porcelain.	1	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

3g.---Power Filter (Quan in unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
C11,11a,11b,11c	3DB8-104	CAPACITOR: paper; oil; 8 mf; 600 v dc w.	4	1	2
L99,99a,99b	3C323-8T	CHOKE: filter; 4 h; 27 ohm dc resistance.	3	1	1
R121	3Z6700-32	RESISTOR: carbon; 100,000 ohm; 2 watt.	1	1	2
P15	2Z7228.6	SOCKET: male; 4 contact; molded bakelite.	1	0	0

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3h.--POWER SUPPLY (Quan in unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
F20	2Z5879-9	LAMP; pilot; 120 v; 6 watt; clear; candelabra	1	2	4
A18	2Z5883-8	LIGHT ASSEMBLY: pilot; red jewel; candelabra base.	1	0	0
P12	2Z3024-1	PLUG: male; polarized; 4 contact; 5000 v @ 25 amp.	1	0	1
P16	6Z8364-4	PLUG: female; 4 contact; 45 v @ 5 amp.	1	0	1
P26	2Z3082-1	PLUG: female; 21 contact; 45 v @ 5 amp.	1	0	1
P30	2Z3063-1	PLUG: female; 2 contact; 45 v @ 5 amp.	1	0	1
R124	3Z6015-55	RESISTOR: wirewound; 150 ohm; ±5%; 50 watt.	1	1	1
A14,14a	2Z8678.74	SOCKET: tube; 8 prong	2	0	1
T22	2Z9607-18	TRANSFORMER: plate; pri #1 & #2: 115 v 60 cps; sec: 840 v CT at no load.	1	1	2
T23	2Z9621-59	TRANSFORMER: power; pri #1 & #2: 115 v 60 cps; sec: 0-70-75 v to deliver 50 v dc	1	1	1

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3h.--Power Supply (Quan in unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
T24	2Z9606-5	TRANSFORMER: fil pri #1 & 2; 115 v 60 cps; sec: 5 v @ 12 amp.	1	1	1
T27	2Z9614-51	TRANSFORMER: power; pri #1 & 2 115 v 60 cps; sec: 115 v; 50 watt.	1	1	1
B23,23a	2J5U4G	TUBE: JAN5U4G	2	4	8

† Equipment not stocked in Station stock or Regional Stock is stocked in Depot

MAINTENANCE PARTS LIST FOR DIVERSITY RECEIVING EQUIPMENT AN/FRR-3a

3i.--Auxiliary Dial Control (Quan per unit-1)

Reference Symbol	Signal Corps Stock Number	Name of part and description	Quan per unit	1-3 Equipments (Ref Sig 10-2)	
				Station Stock †	Region Stock †
R102	3Z6960-18	RESISTOR: carbon; 3800 ohms; ± 1%; 2 watt.	1	1	1
S29	4C4981-2	SWITCH: lever key; DPDT; N.O.	1	0	0
S45	4B794.4-3	SWITCH: dialing; non-delayed impulse, N.C.	1	0	0

† Equipment not stocked in Station Stock or Regional Stock is stocked in Depot.

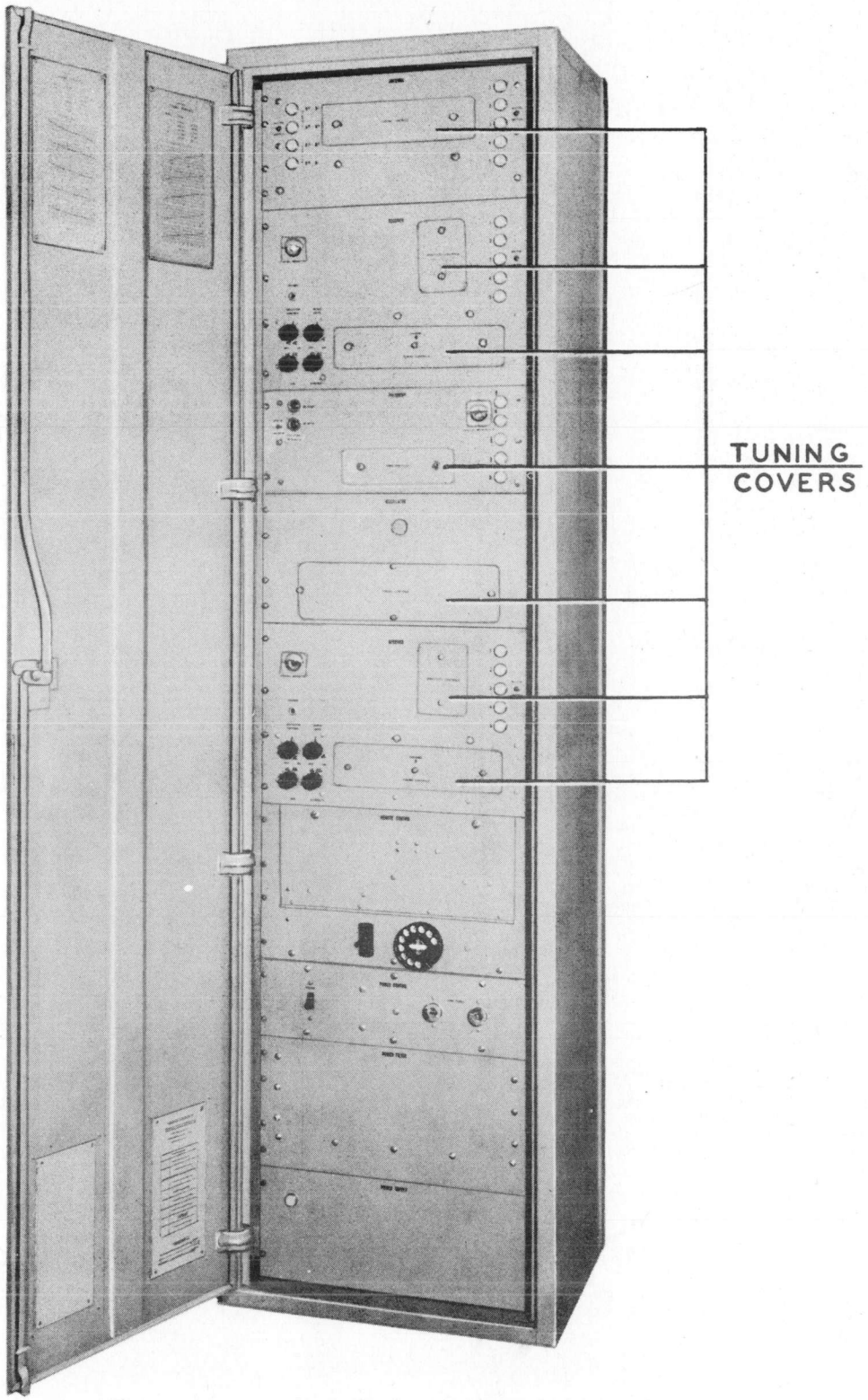


Figure 4. Diversity Receiving Equipment AN/FRR-3A, front view, tuning covers in place.

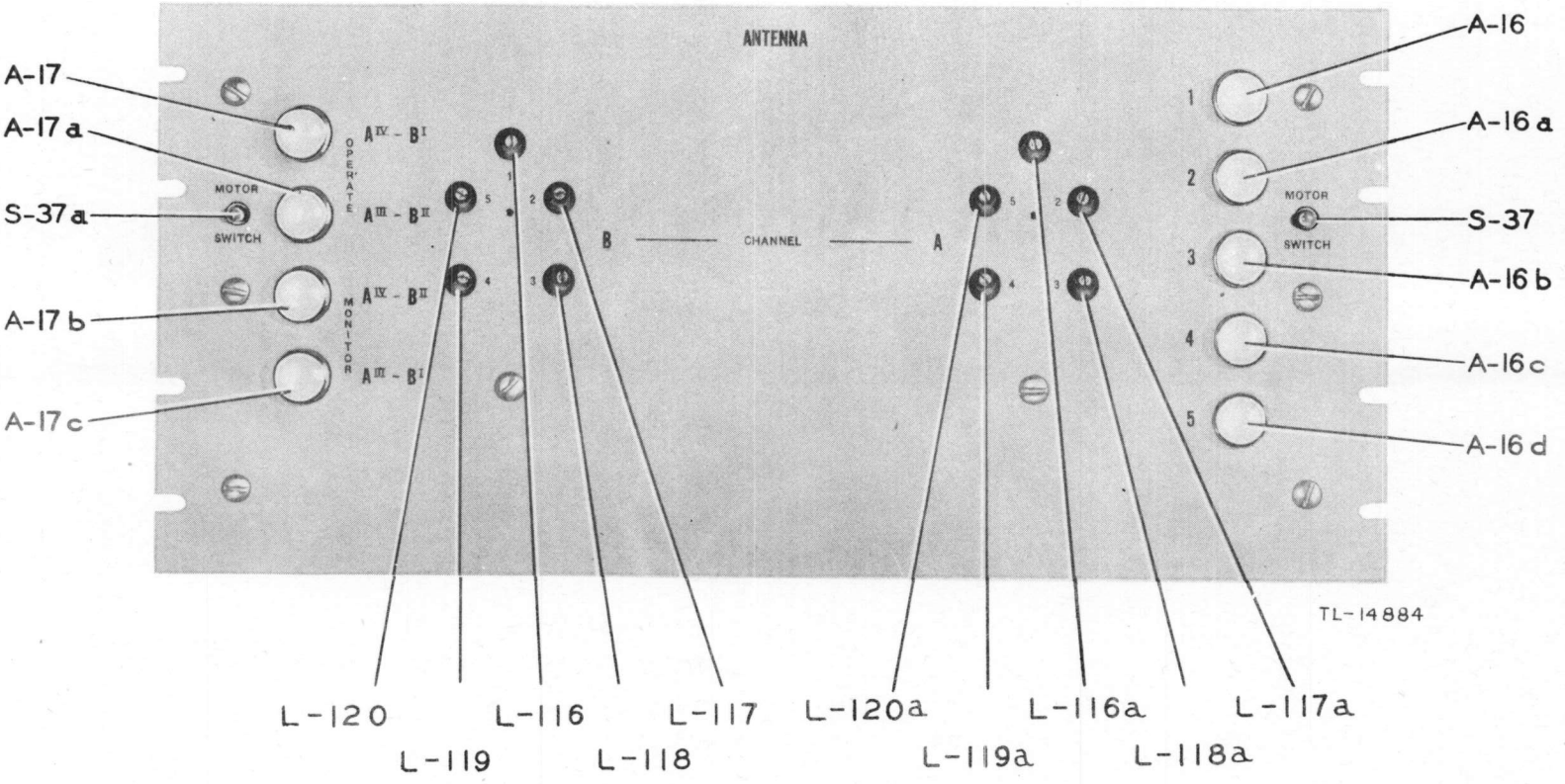


Figure 5. ANTENNA unit, front view, cover removed.

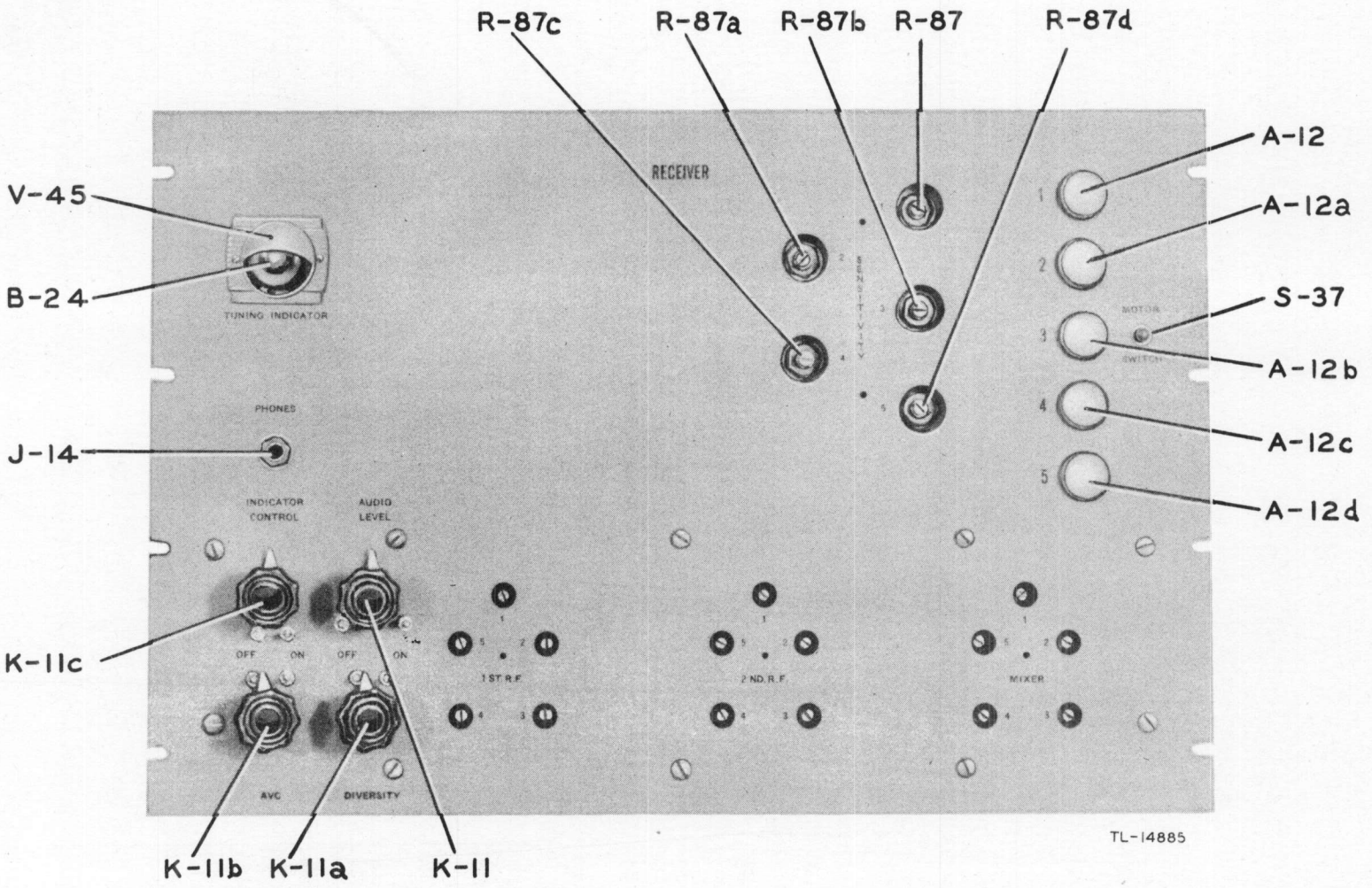


Figure 6. RECEIVER unit, front view, covers removed.

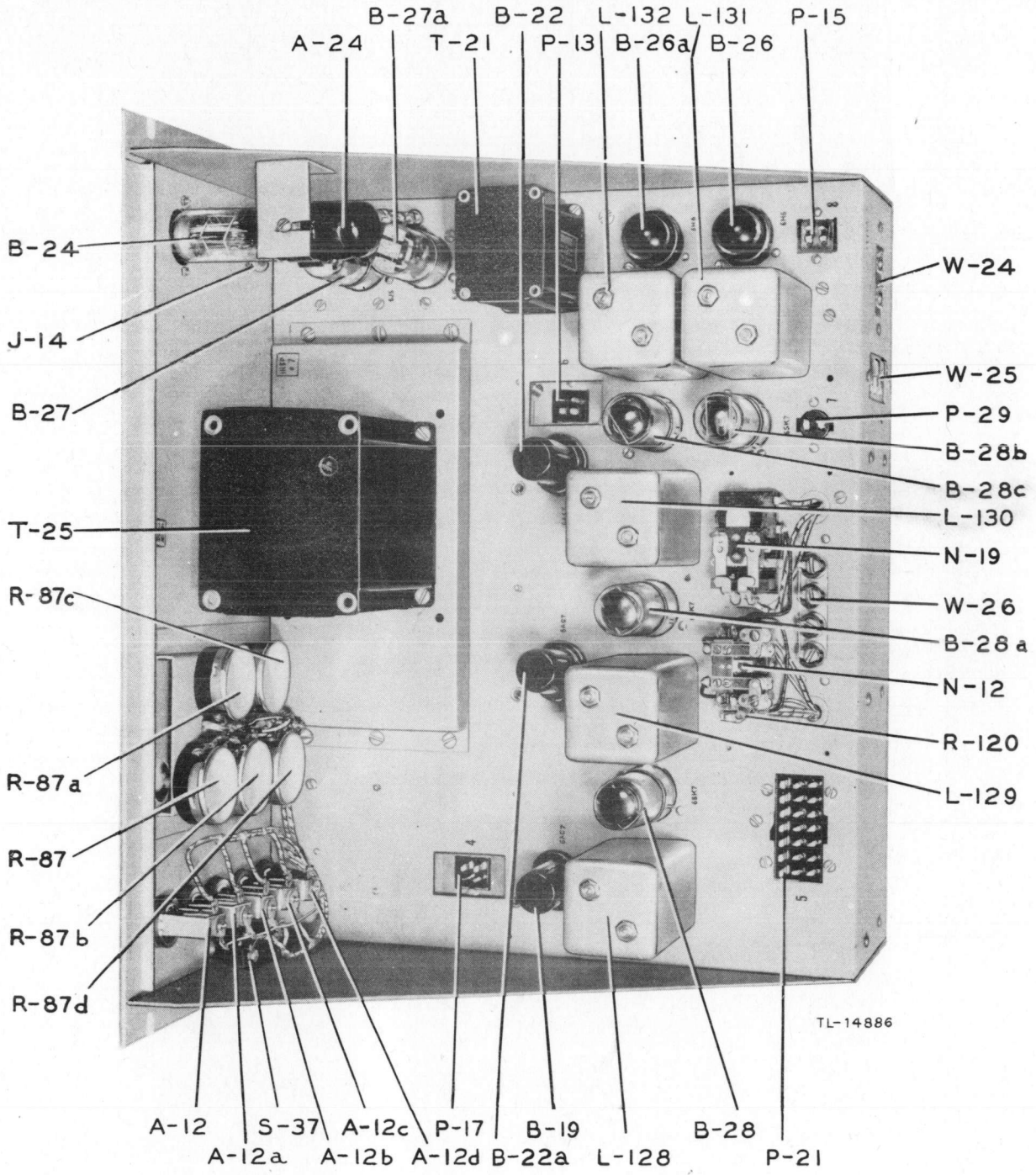


Figure 7. RECEIVER unit, top view.

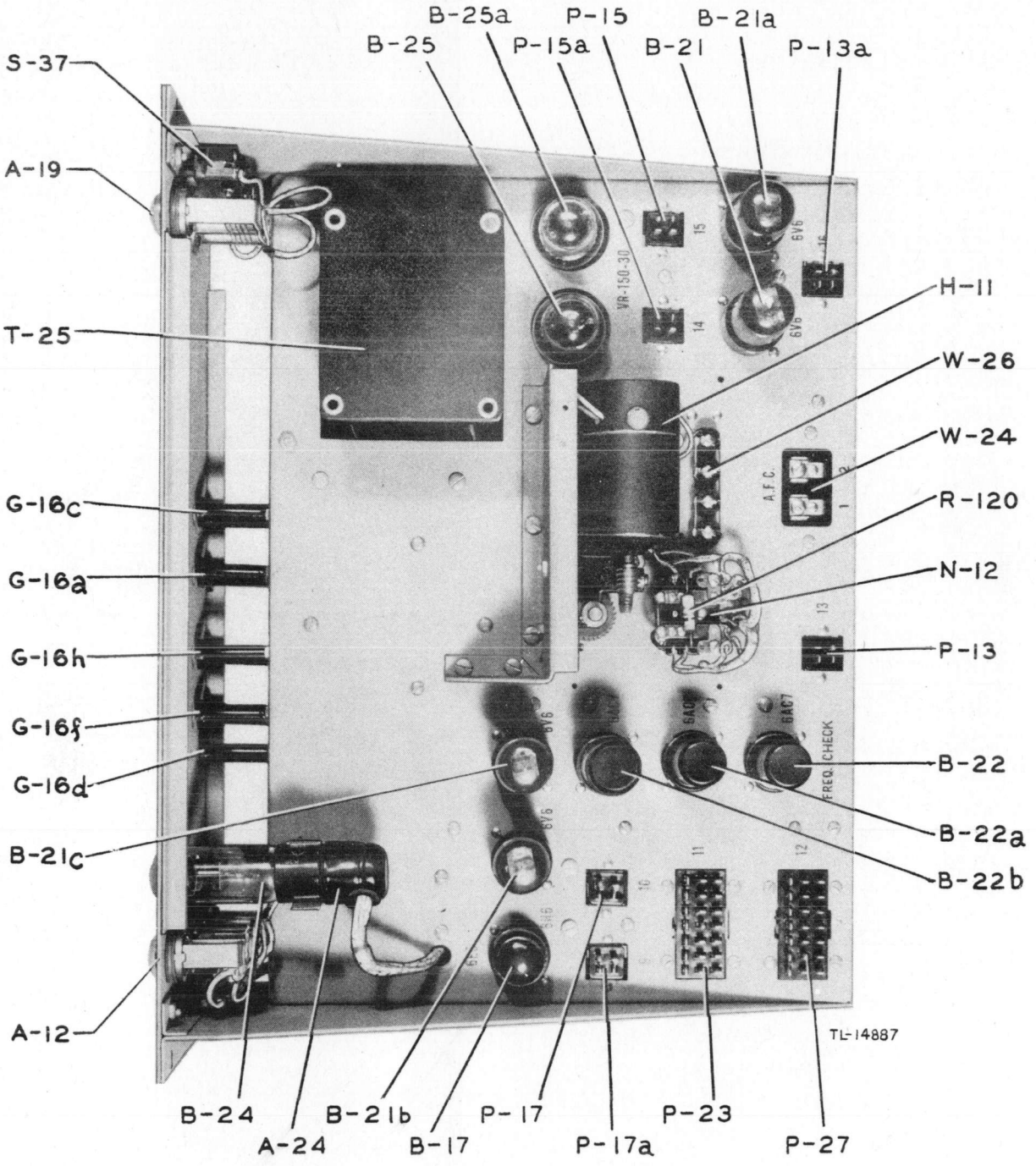


Figure 8. MULTIPLIER unit, top view.

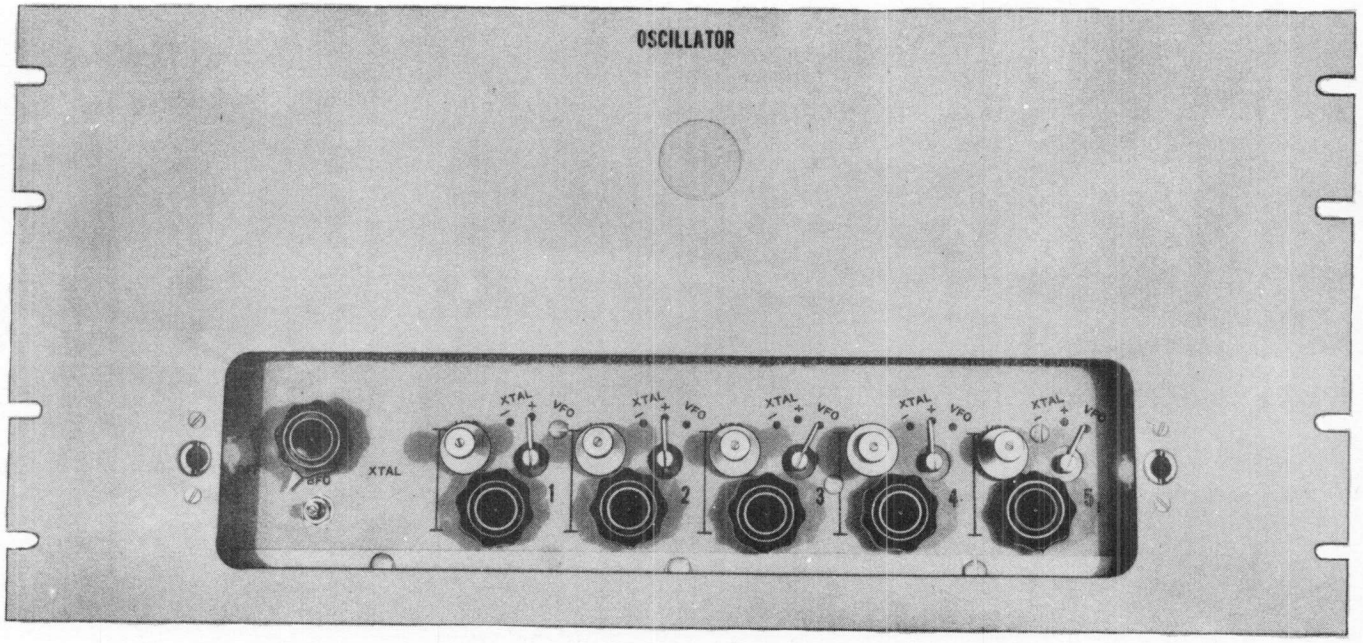


Figure 9. OSCILLATOR unit, front view, cover removed.

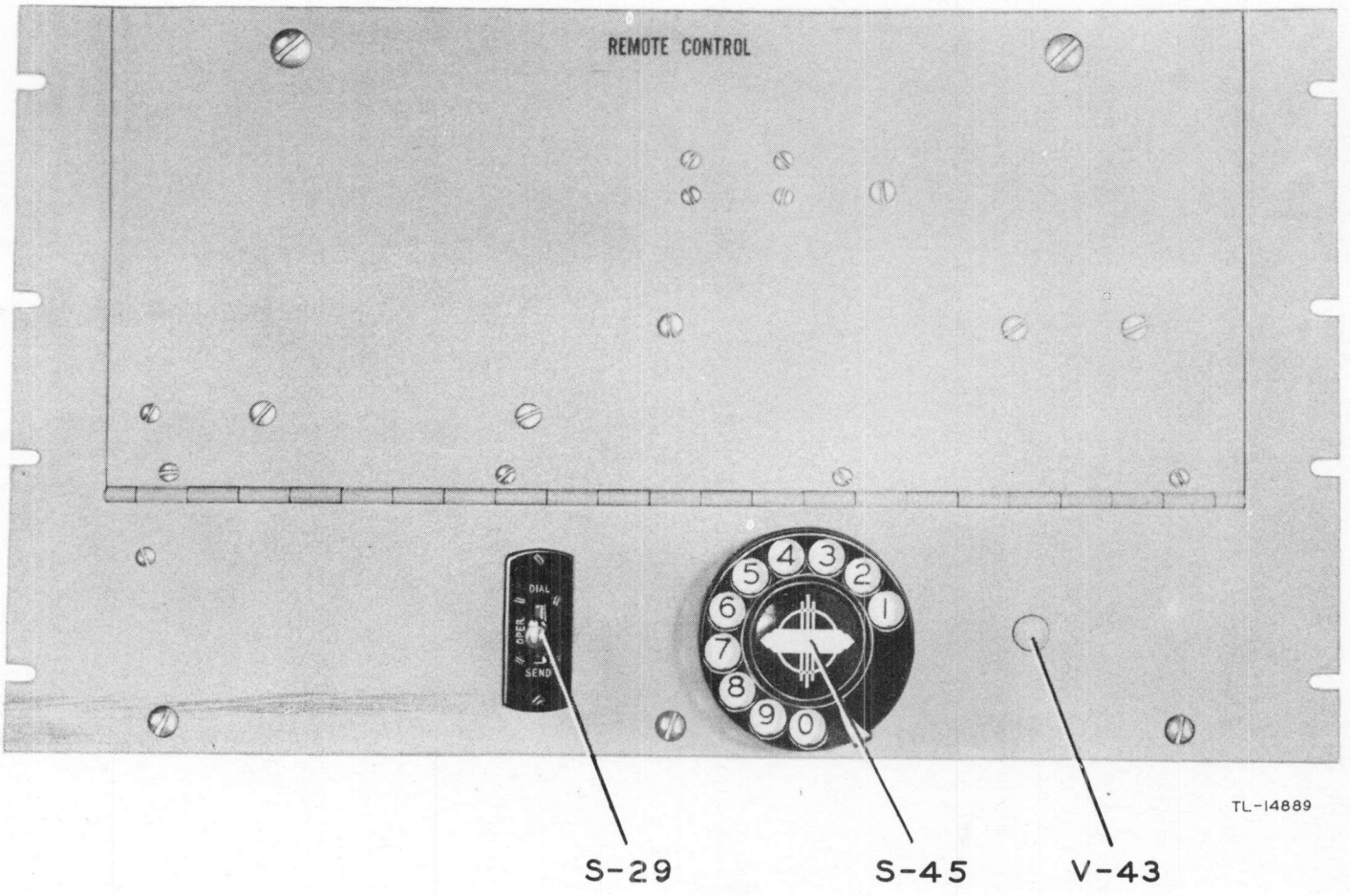


Figure 10. REMOTE CONTROL unit, front view.

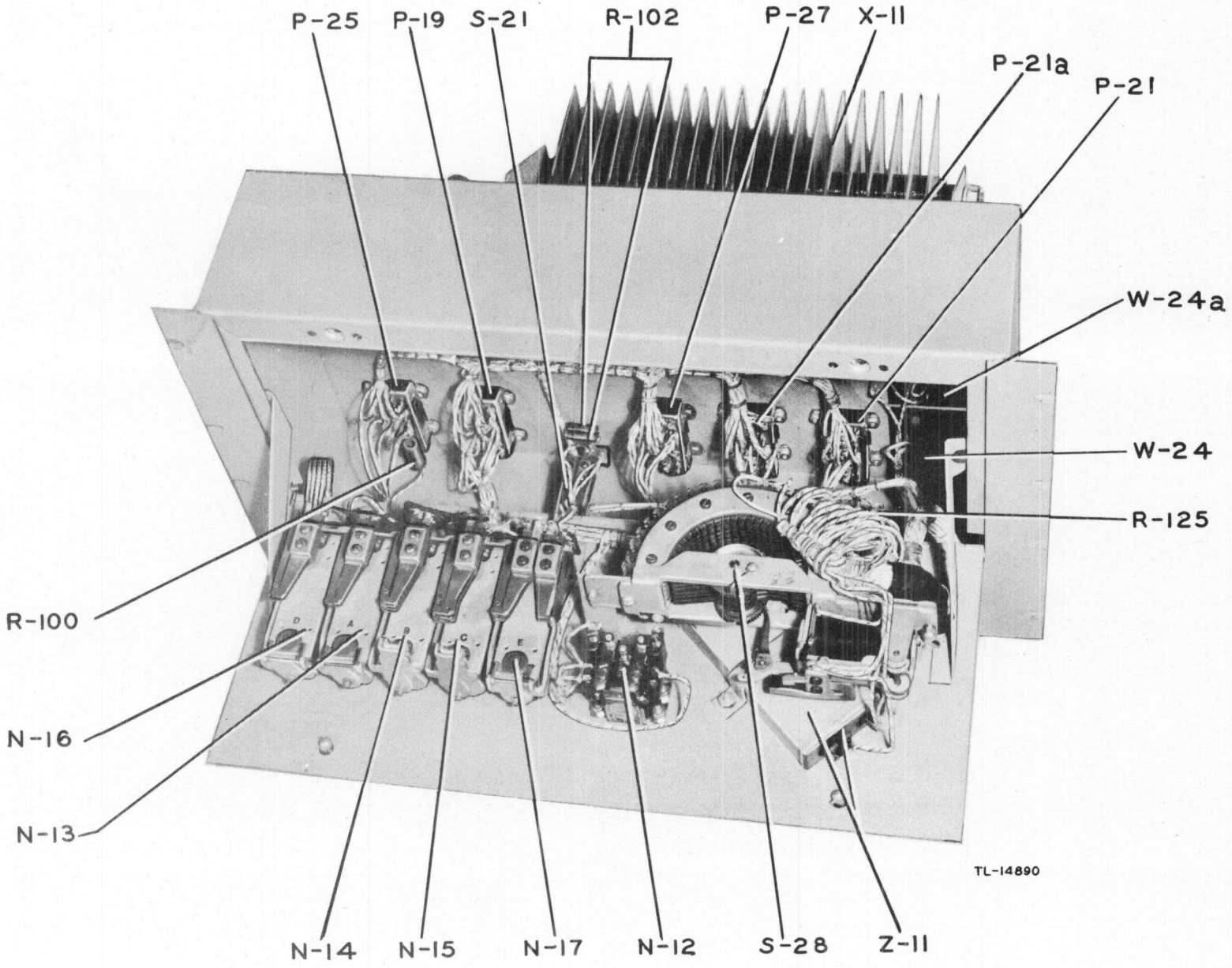


Figure 11. REMOTE CONTROL unit, top front view, panel open.

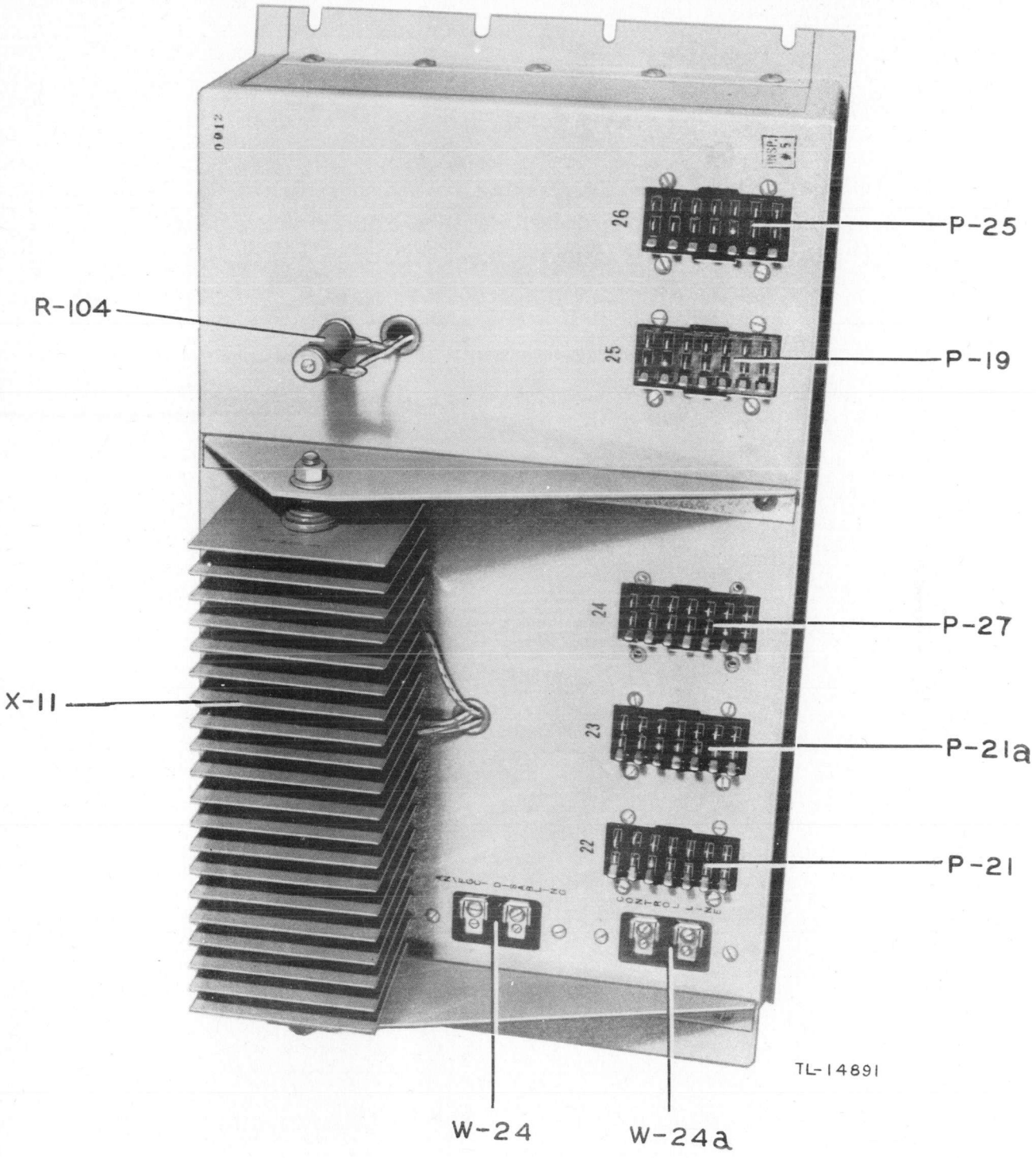


Figure 12. REMOTE CONTROL unit, rear view.

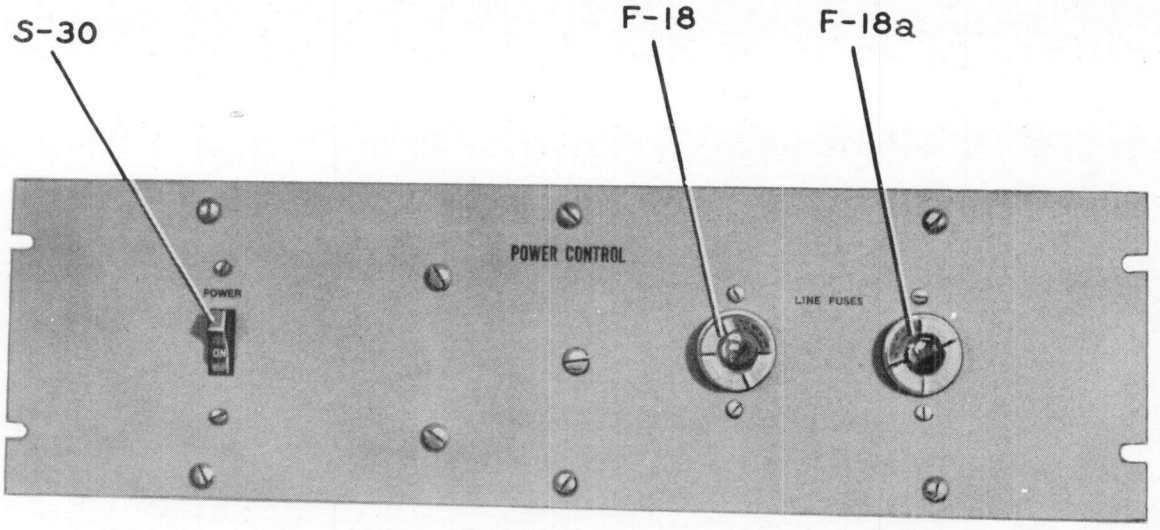


Figure 13. POWER CONTROL unit, front view.

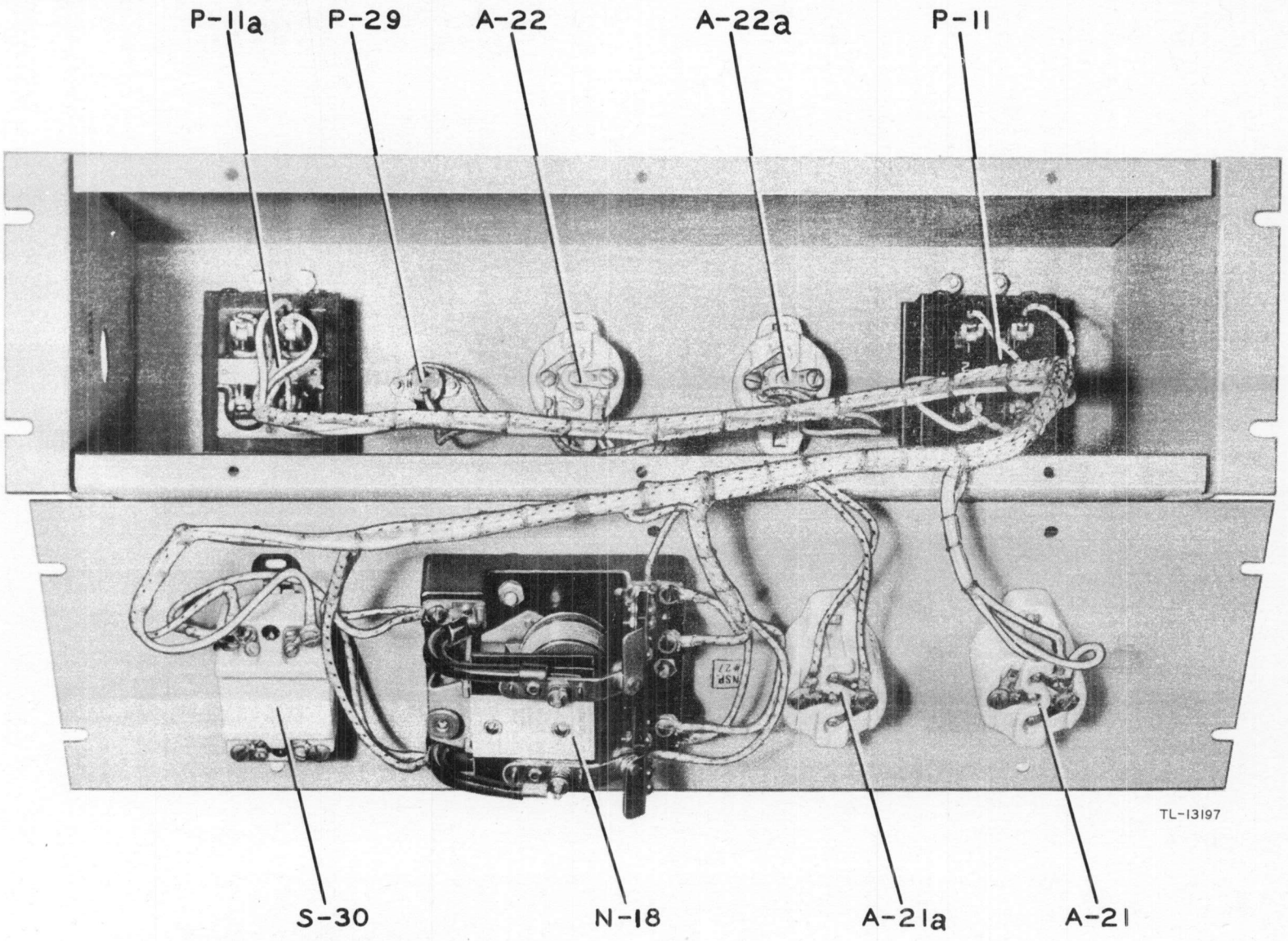


Figure 14. POWER CONTROL unit, front view, panel open.

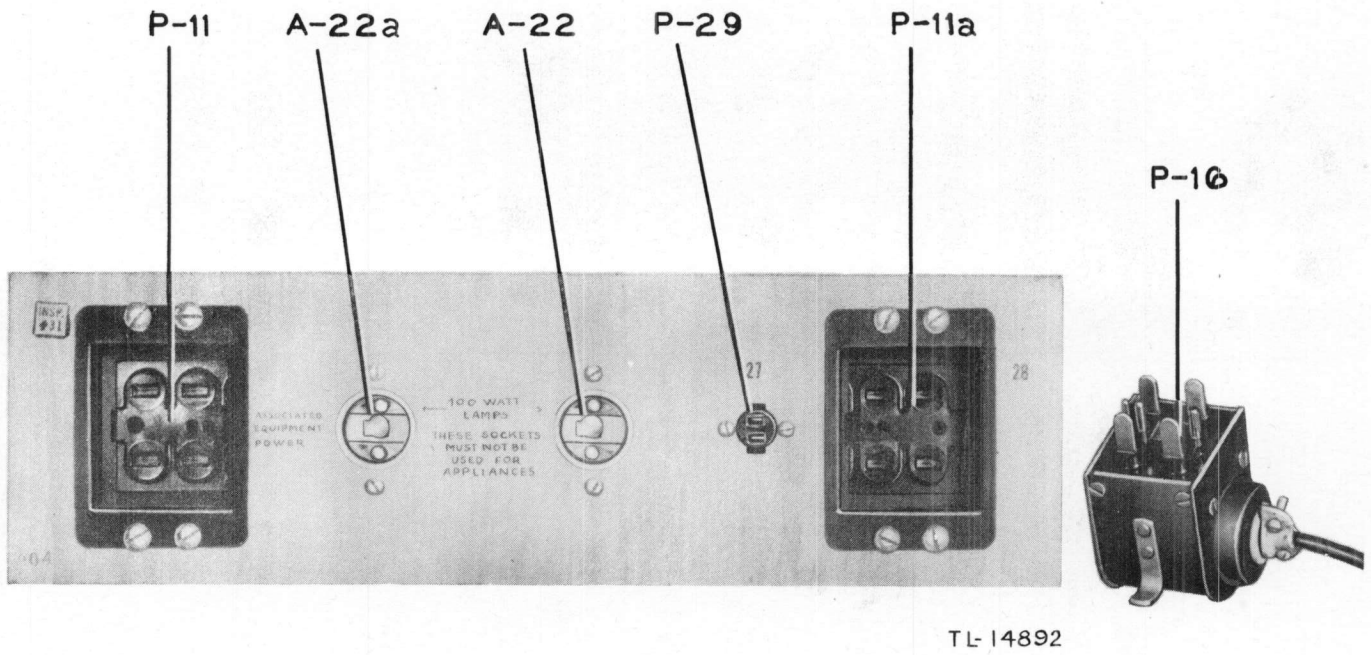


Figure 15. POWER CONTROL unit, rear view.

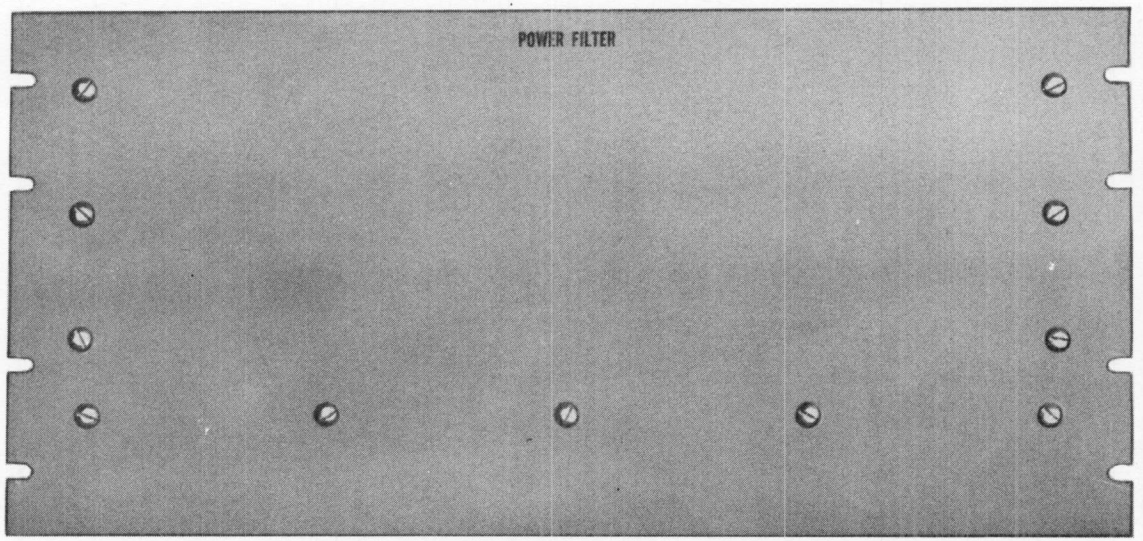


Figure 16. POWER FILTER unit, front view.

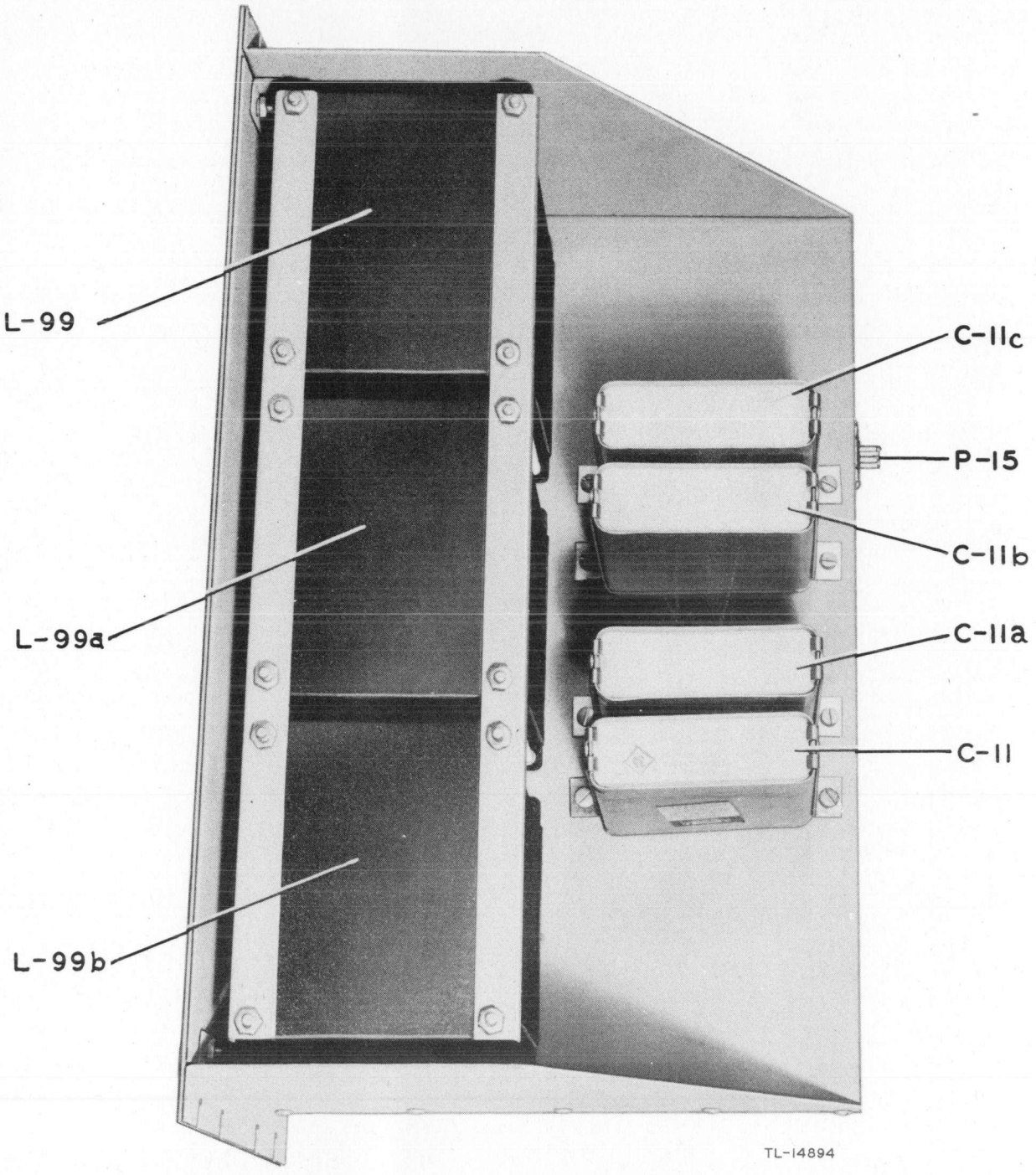


Figure 17. POWER FILTER unit, top view.

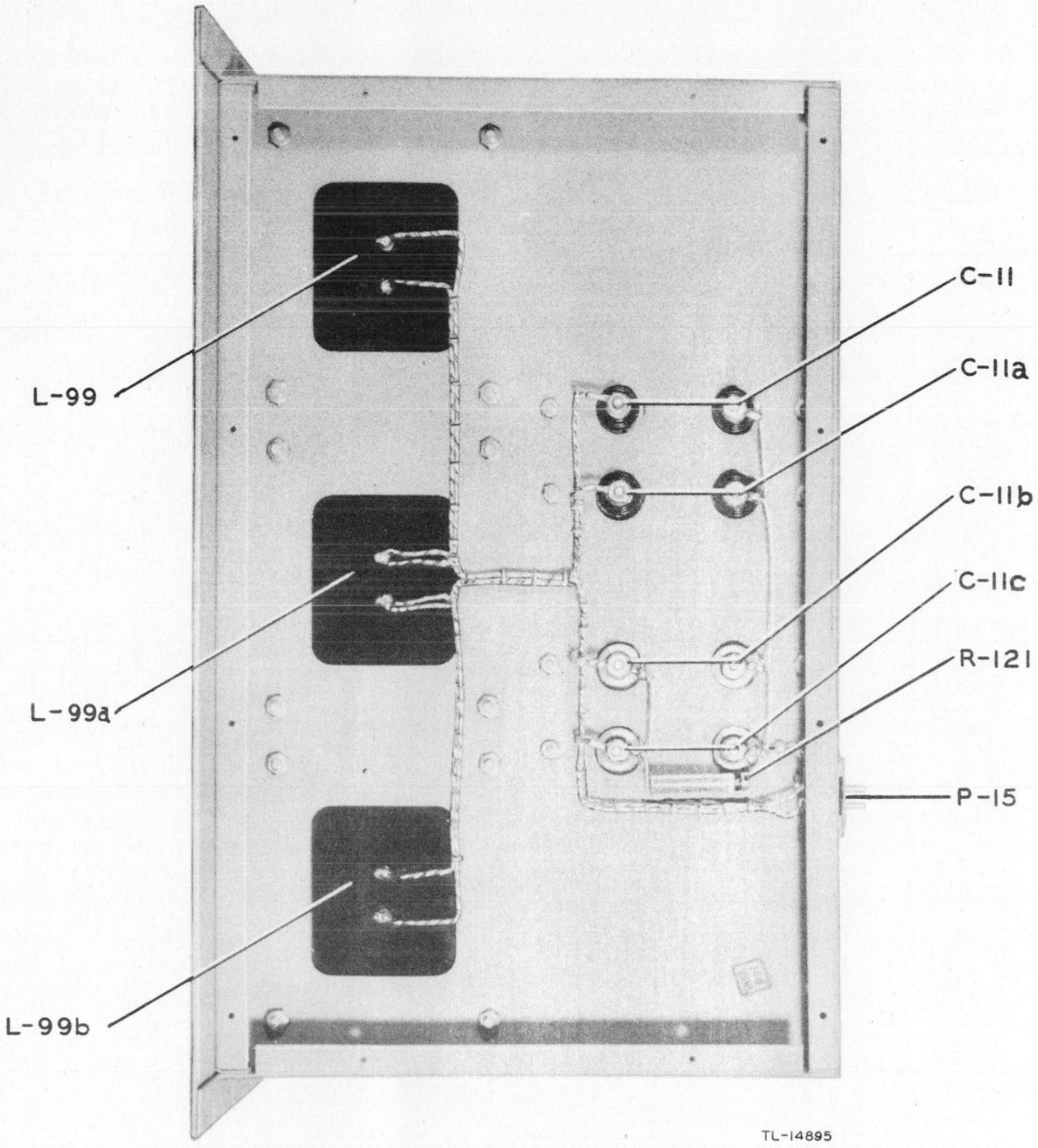


Figure 18. POWER FILTER unit, bottom view.

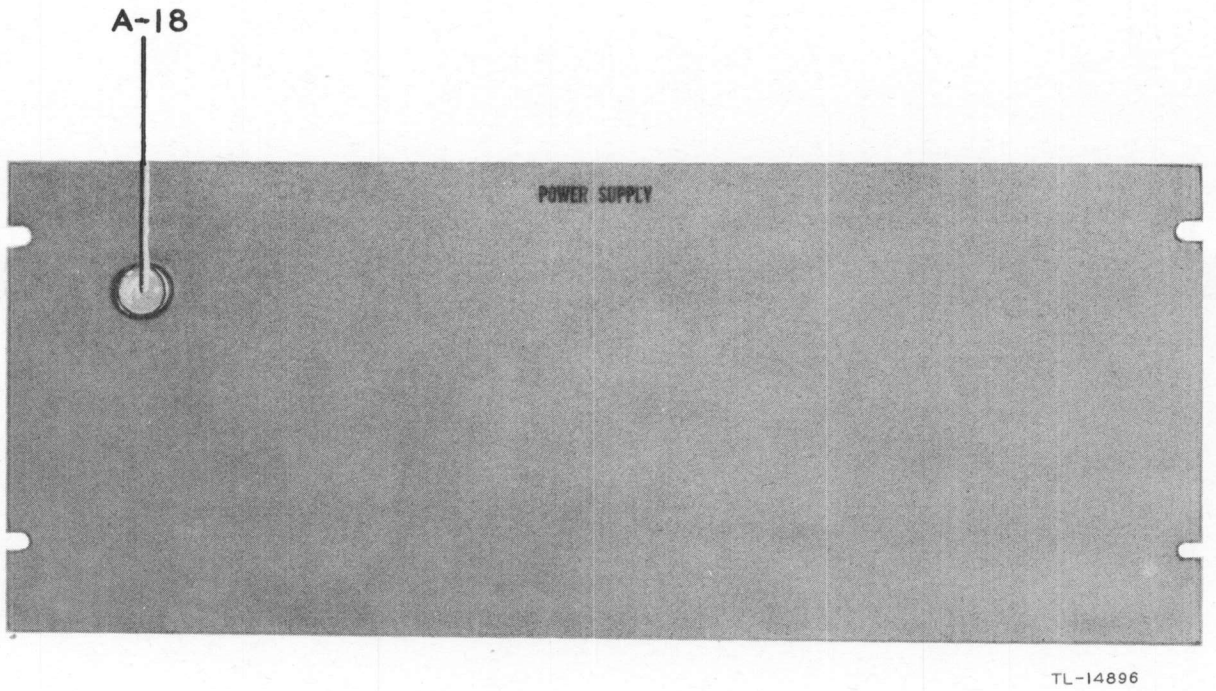


Figure 19. POWER SUPPLY unit, front view.

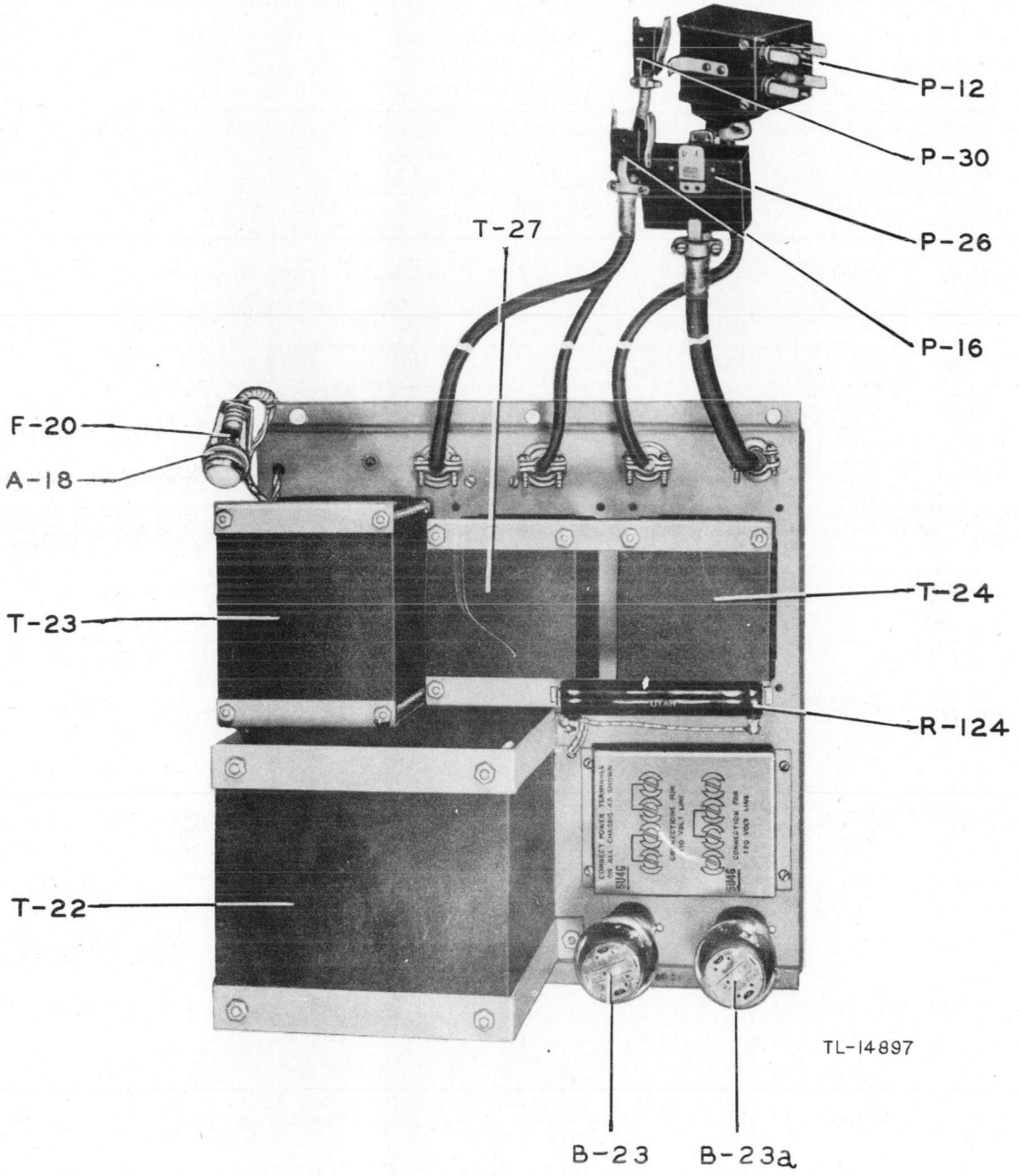


Figure 20. POWER SUPPLY unit, top view.

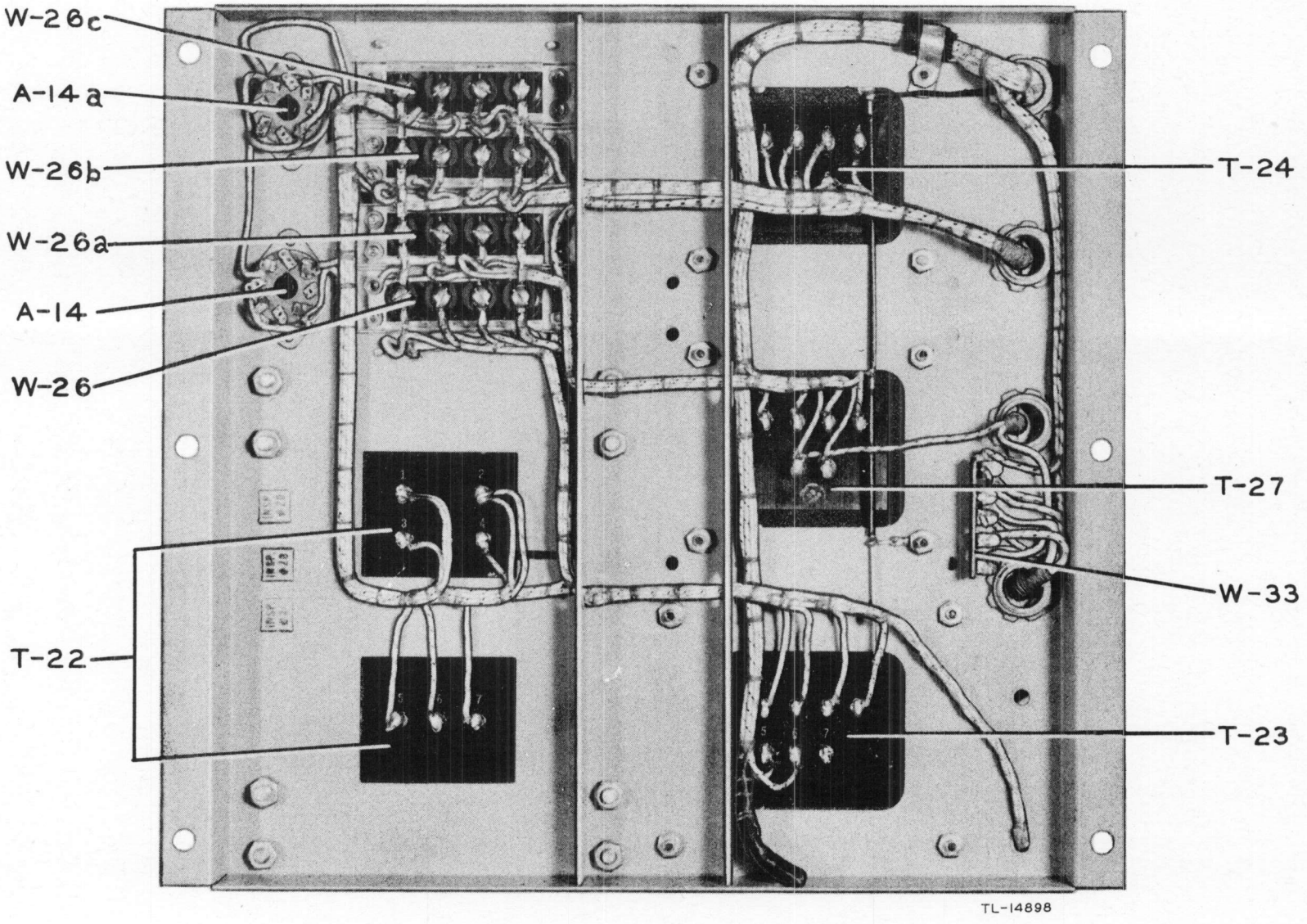


Figure 21. POWER SUPPLY unit, bottom view.

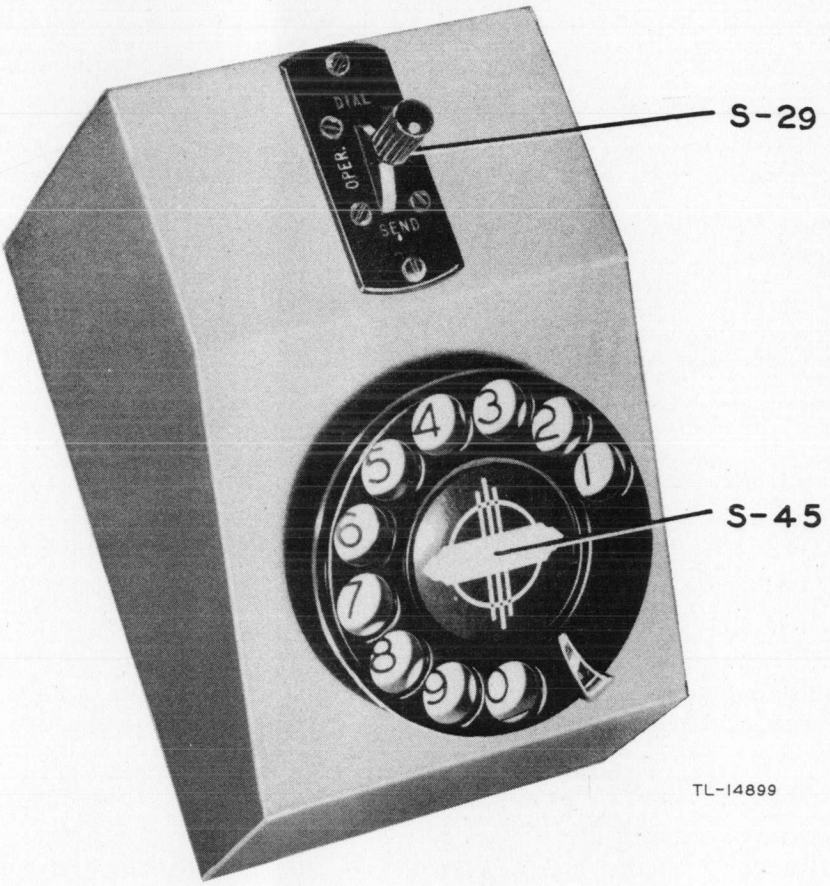
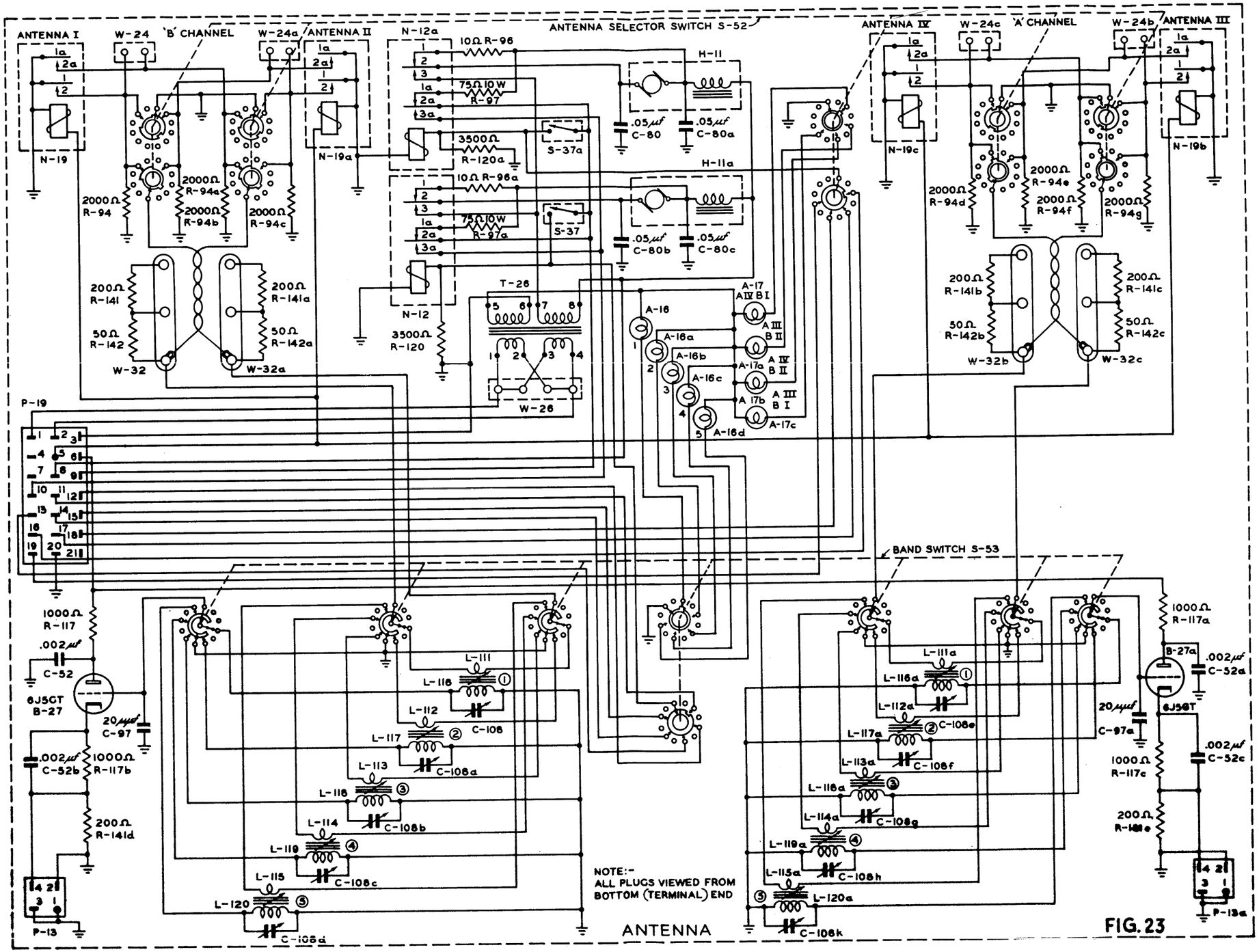


Figure 22. Auxiliary dial control, front view



ANTENNA

FIG. 23

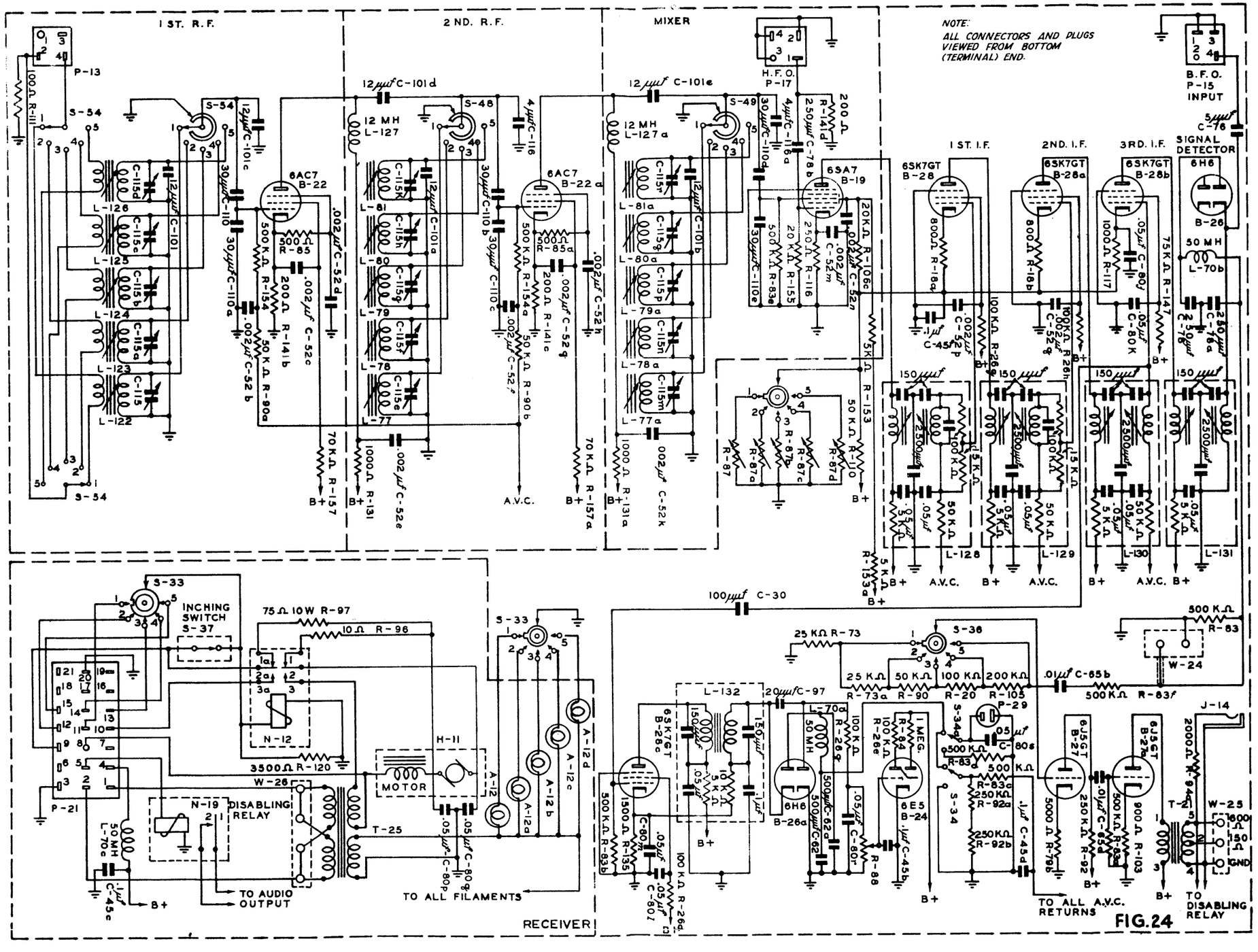

1 ST. R.F.
2 ND. R.F.
MIXER
NOTE:
ALL CONNECTORS AND PLUGS VIEWED FROM BOTTOM (TERMINAL) END.
P-13
S-54
6AC7 B-22
12 MH L-127
S-48
6AC7 B-22 a
12 MH L-127 a
S-49
H.F.O. P-17
6SA7 B-19
1 ST. I.F.
2ND. I.F.
3RD. I.F.
6SK7GT B-28
6SK7GT B-28a
6SK7GT B-28b
SIGNAL DETECTOR
6H6 B-26
B.F.O. P-15 INPUT
50 MH L-70b
L-122
L-123
L-124
L-125
L-126
L-127
L-128
L-129
L-130
L-131
A.V.C.
B+
S-33
INCHING SWITCH S-37
N-12
N-19 DISABLING RELAY
MOTOR
H-11
A-12
A-12a
A-12b
A-12c
A-12d
T-25
P-21
50 MH L-70c
TO AUDIO OUTPUT
TO ALL FILAMENTS
RECEIVER
S-36
S-34
P-29
L-132
6H6 B-26a
6E5 B-24
6J5GT B-27
6J5GT B-27a
J-14
W-24
W-25
T-26
TO ALL A.V.C. RETURNS
TO DISABLING RELAY
GND

FIG.24

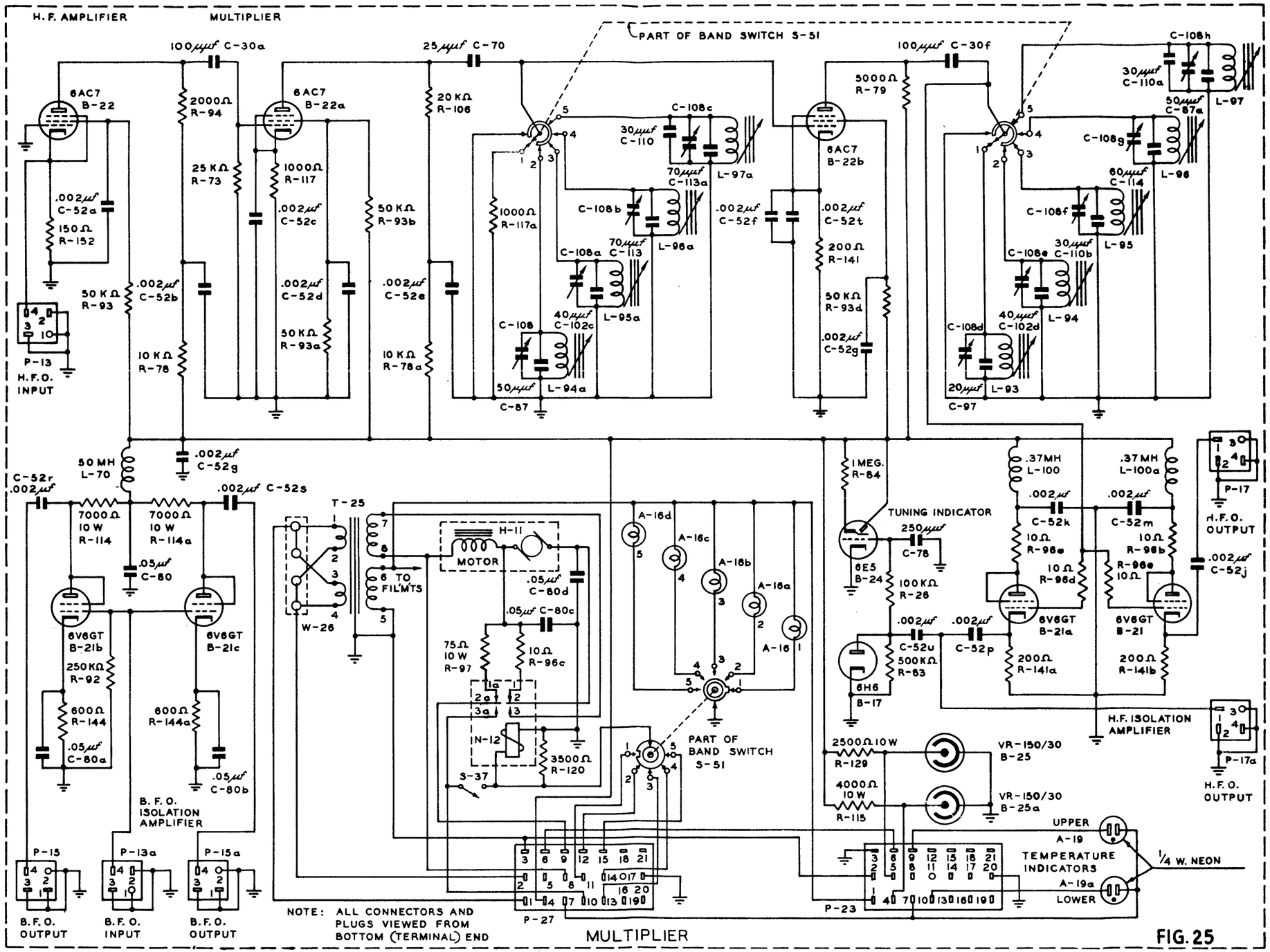

H.F. AMPLIFIER
MULTIPLIER
PART OF BAND SWITCH S-51
100μμf C-30a
25μμf C-70
100μμf C-30f
6AC7 B-22
6AC7 B-22a
6AC7 B-22b
2000Ω R-94
25 KΩ R-73
1000Ω R-117
20 KΩ R-106
5000Ω R-79
.002μf C-52a
150Ω R-152
50 KΩ R-93
.002μf C-52b
10 KΩ R-78
.002μf C-52d
50 KΩ R-93a
50 KΩ R-93b
.002μf C-52e
10 KΩ R-78a
1000Ω R-117a
C-108c
30μμf C-110
70μμf C-113a
L-97a
C-108b
70μμf C-113
L-96a
C-108a
L-95a
C-108
40μμf C-102c
50μμf C-87
L-94a
.002μf C-52f
.002μf C-52t
200Ω R-141
50 KΩ R-93d
.002μf C-52g
C-108h
30μμf C-110a
50μμf C-87a
L-97
C-108g
60μμf C-114
L-96
C-108f
L-95
C-108e
30μμf C-110b
L-94
C-108d
40μμf C-102d
20μμf
L-93
C-97
P-13
H.F.O. INPUT
50 MH L-70
.002μf C-52g
.002μf C-52r
.002μf C-52s
7000Ω 10 W R-114
7000Ω 10 W R-114a
.05μf C-80
6V6GT B-21b
6V6GT B-21c
250KΩ R-92
600Ω R-144
.05μf C-80a
600Ω R-144a
.05μf C-80b
B. F. O. ISOLATION AMPLIFIER
P-15
P-13a
P-15a
B.F.O. OUTPUT
B.F.O. INPUT
B.F.O. OUTPUT
T-25
W-26
6 TO FILMTS
H-11
MOTOR
.05μf C-80d
.05μf C-80c
75Ω 10 W R-97
10Ω R-96c
IN-12
3500Ω R-120
S-37
A-16d
A-16c
A-16b
A-16a
A-16
PART OF BAND SWITCH S-51
P-27
NOTE: ALL CONNECTORS AND PLUGS VIEWED FROM BOTTOM (TERMINAL) END
1 MEG. R-84
TUNING INDICATOR
250μμf C-78
6E5 B-24
100KΩ R-26
.002μf C-52u
500KΩ R-83
6H6 B-17
.002μf C-52p
.37MH L-100
.002μf C-52k
10Ω R-96a
10Ω R-96d
6V6GT B-21a
200Ω R-141a
.37MH L-100a
.002μf C-52m
10Ω R-96b
10Ω R-96c
6V6GT B-21
200Ω R-141b
P-17
H.F.O. OUTPUT
.002μf C-52j
H.F. ISOLATION AMPLIFIER
P-17a
H.F.O. OUTPUT
2500Ω 10W R-129
4000Ω 10W R-115
VR-150/30 B-25
VR-150/30 B-25a
UPPER A-19
TEMPERATURE INDICATORS
A-19a LOWER
1/4 W. NEON
P-23
MULTIPLIER

FIG. 25

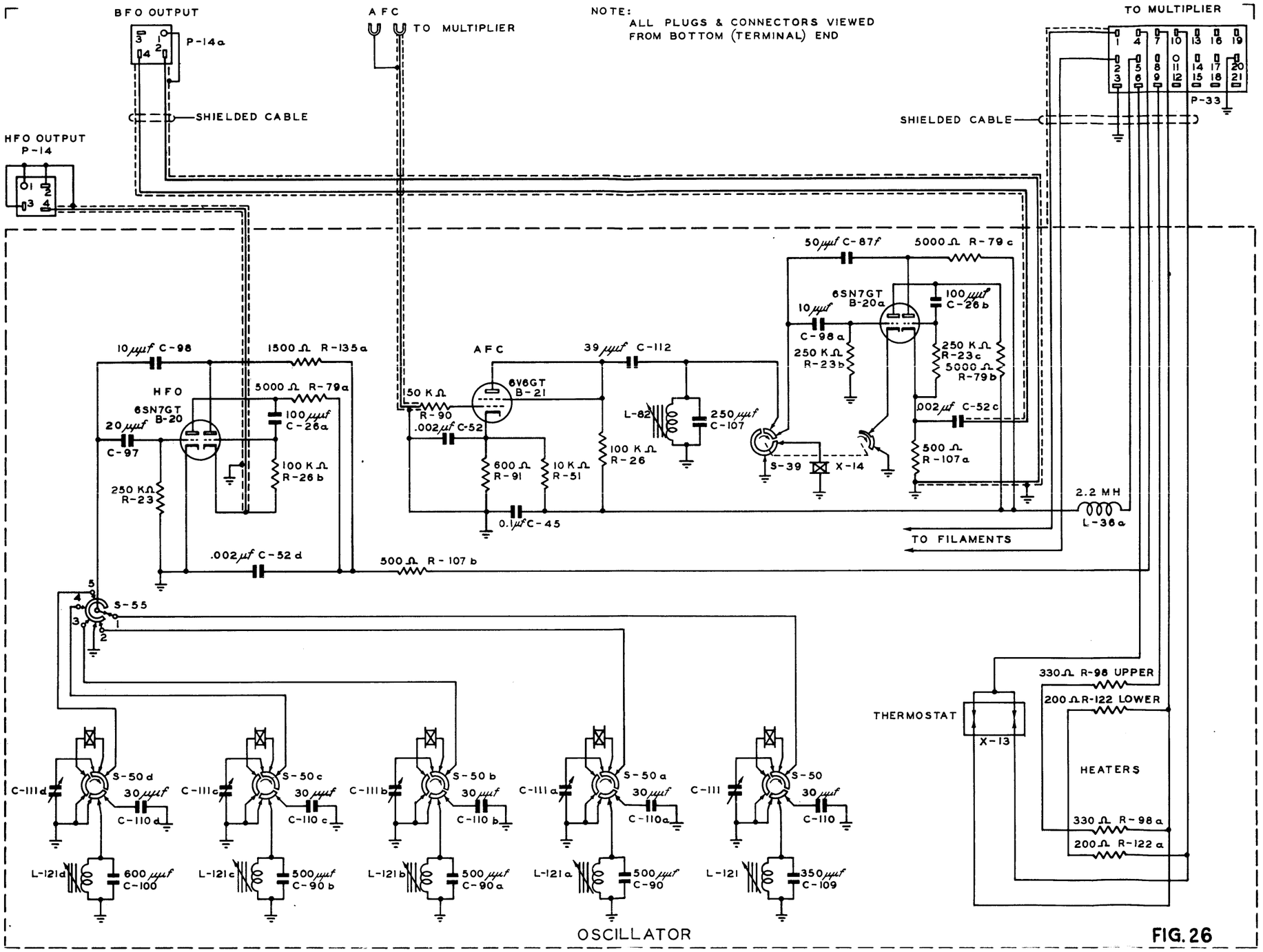
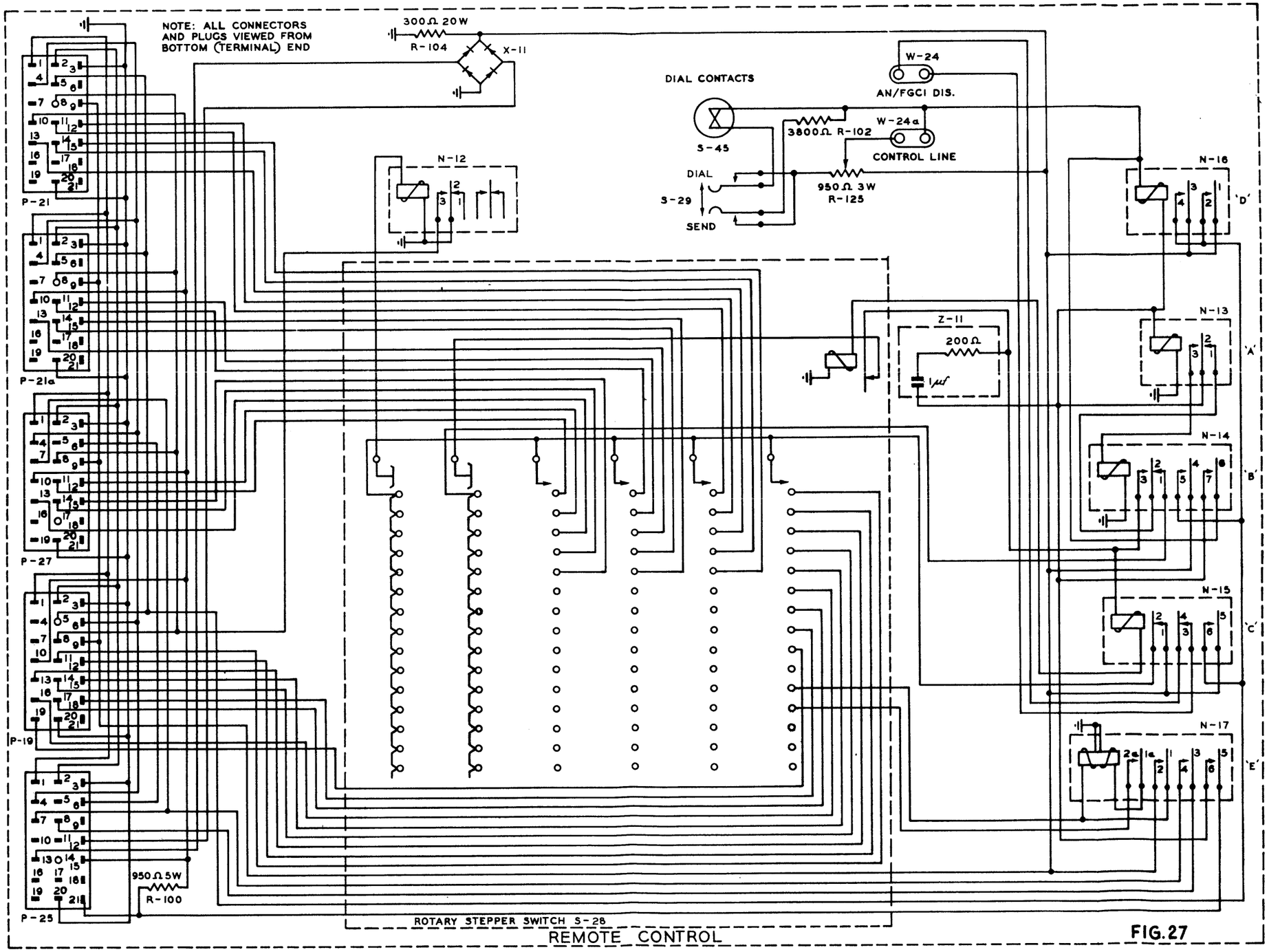
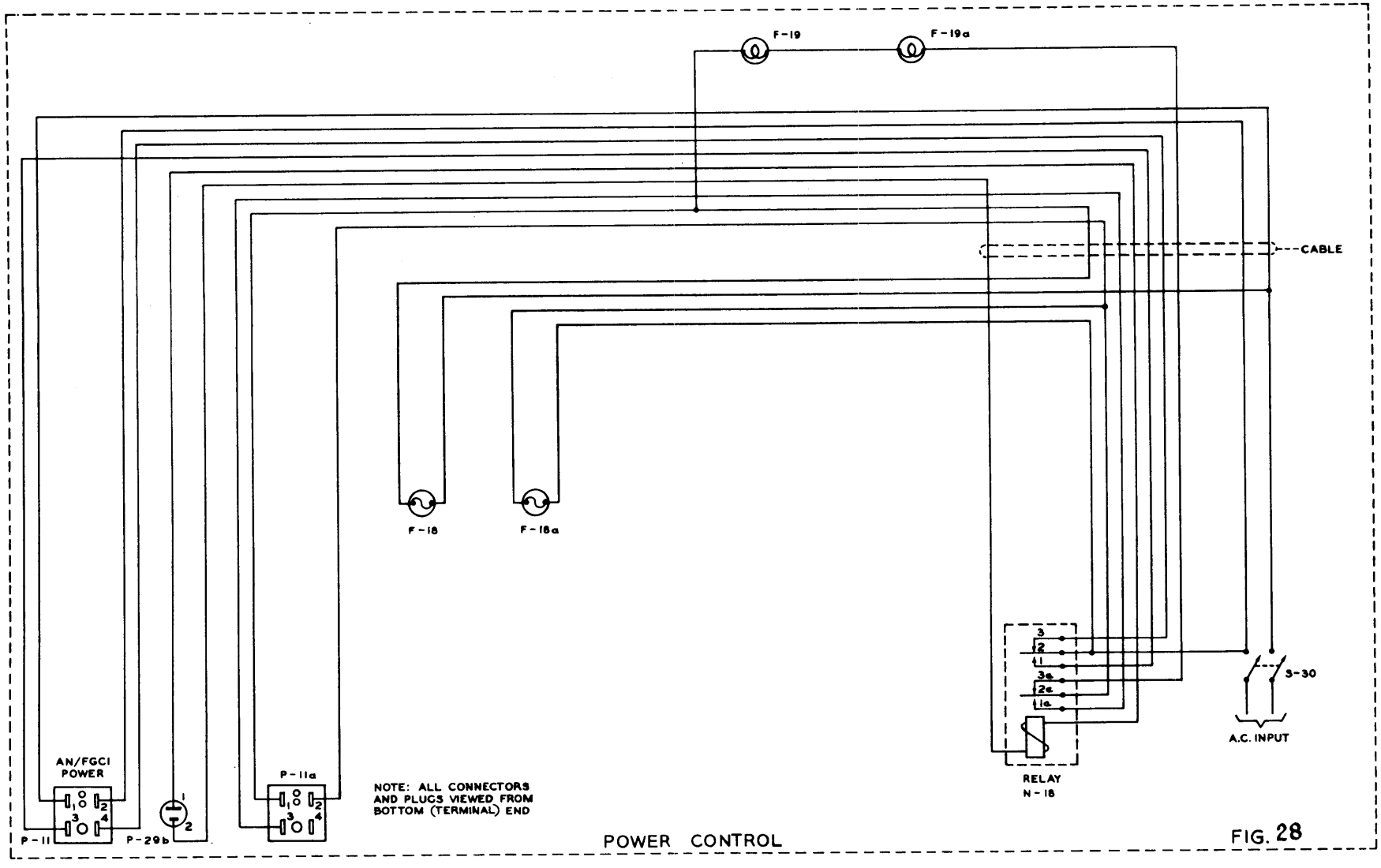

BFO OUTPUT
P-14a
SHIELDED CABLE
HFO OUTPUT
P-14
AFC
TO MULTIPLIER
NOTE:
ALL PLUGS & CONNECTORS VIEWED
FROM BOTTOM (TERMINAL) END
TO MULTIPLIER
P-33
SHIELDED CABLE
10 μμf C-98
1500 Ω R-135a
5000 Ω R-79a
HFO
6SN7GT
B-20
20 μμf
C-97
100 μμf
C-26a
100 K Ω
R-26b
250 K Ω
R-23
.002 μf C-52d
AFC
6V6GT
B-21
50 K Ω
R-90
.002 μf C-52
600 Ω
R-91
10 K Ω
R-51
0.1 μf C-45
39 μμf C-112
100 K Ω
R-26
L-82
250 μμf
C-107
S-39
X-14
50 μμf C-87f
5000 Ω R-79c
6SN7GT
B-20a
10 μμf
C-98a
250 K Ω
R-23b
100 μμf
C-26b
250 K Ω
R-23c
5000 Ω
R-79b
.002 μf C-52c
500 Ω
R-107a
2.2 MH
L-36a
TO FILAMENTS
500 Ω R-107b
S-55
S-50d
C-111d
30 μμf
C-110d
L-121d
600 μμf
C-100
S-50c
C-111c
30 μμf
C-110c
L-121c
500 μμf
C-90b
S-50b
C-111b
30 μμf
C-110b
L-121b
500 μμf
C-90a
S-50a
C-111a
30 μμf
C-110a
L-121a
500 μμf
C-90
S-50
C-111
30 μμf
C-110
L-121
350 μμf
C-109
THERMOSTAT
X-13
330 Ω R-98 UPPER
200 Ω R-122 LOWER
HEATERS
330 Ω R-98a
200 Ω R-122a
OSCILLATOR

FIG. 26



REMOTE CONTROL

FIG.27



POWER CONTROL

FIG. 28

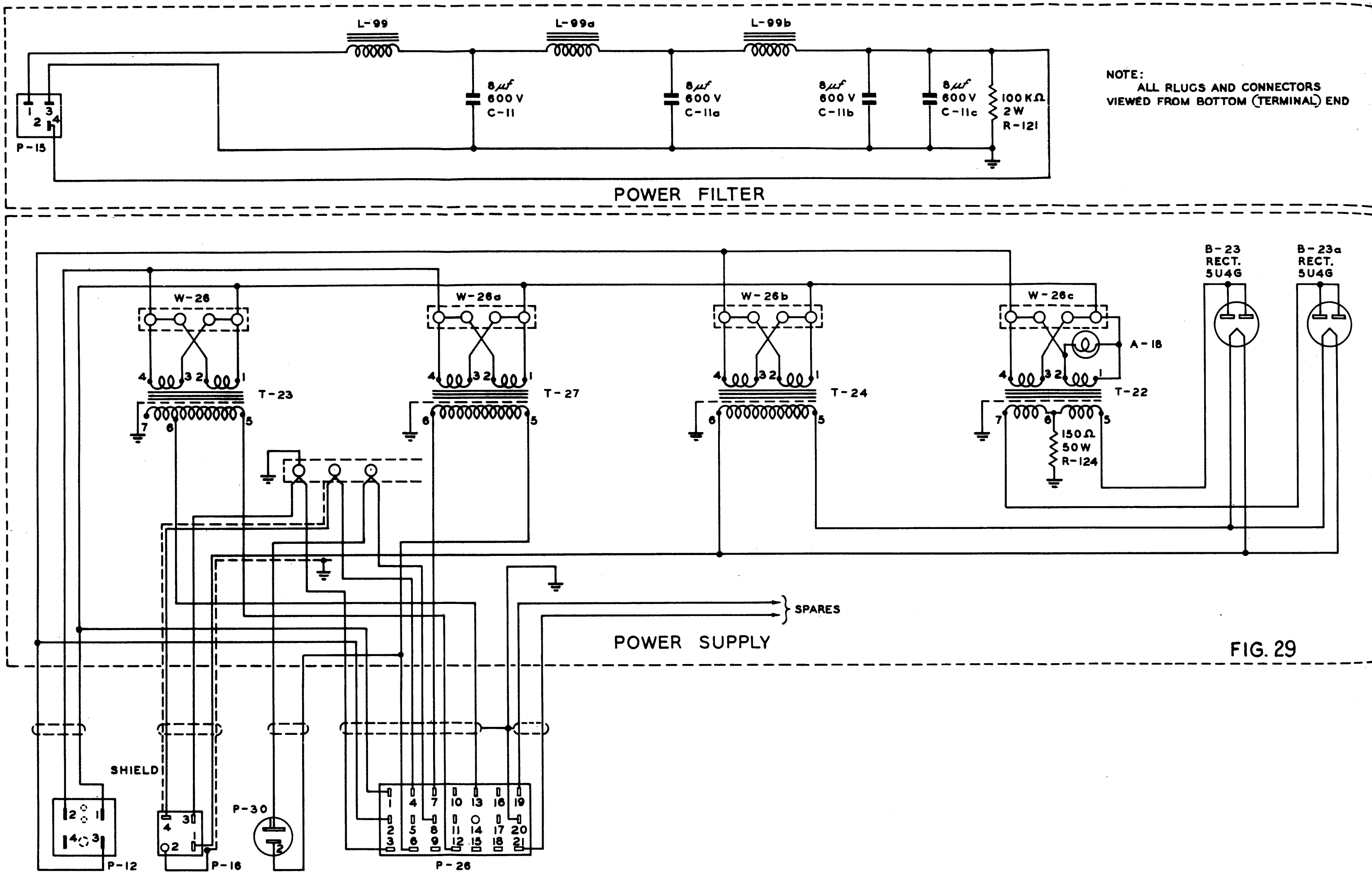

L-99
L-99a
L-99b
8 µf 600 V C-11
8 µf 600 V C-11a
8 µf 600 V C-11b
8 µf 600 V C-11c
100 KΩ 2 W R-121
P-15
NOTE:
ALL RLUGS AND CONNECTORS VIEWED FROM BOTTOM (TERMINAL) END
POWER FILTER
W-26
W-26a
W-26b
W-26c
T-23
T-27
T-24
T-22
A-18
150 Ω 50 W R-124
B-23 RECT. 5U4G
B-23a RECT. 5U4G
SPARES
POWER SUPPLY
SHIELD
P-12
P-16
P-30
P-26

FIG. 29

STATION NUMBERS - PLUG NUMBERS
QUICK CROSS REFERENCE TABLE

STATION	ANTENNA	RECEIVER "B"	MULTIPLIER	RECEIVER "A"	REMOTE CONT.	POWER CONT.	POWER SUP. FIL.
1	P-13a						
2	P-19						
3	P-13						
4	- - - -	P-17	- - -	P-17a			
5	- - - -	P-21	- - -	P-21a			
6	- - - -	P-13	- - -	P-13a			
7	- - - -	P-29	- - -	P-29a			
8	- - - -	P-15	- - -	P-15a			
9	- - - -	- - -	P-17a				
10	- - - -	- - -	P-17				
11	- - - -	- - -	P-23				
12	- - -	- - -	P-27				
13	- - -	- - -	P-13				
14	- - -	- - -	P-15a				
15	- - -	- - -	P-15				
16	- - -	- - -	P-13a				
22	- - -	- - -	- - -	- - -	P-21		
23	- - -	- - -	- - -	- - -	P-21a		
24	- - -	- - -	- - -	- - -	P-27		
25	- - -	- - -	- - -	- - -	P-19		
26	- - -	- - -	- - -	- - -	P-25		
27	- - -	- - -	- - -	- - -	- - -	P-29	
28	- - -	- - -	- - -	- - -	- - -	P-11a	
29	- - -	- - -	- - -	- - -	- - -	- - -	P-15

Figure 30

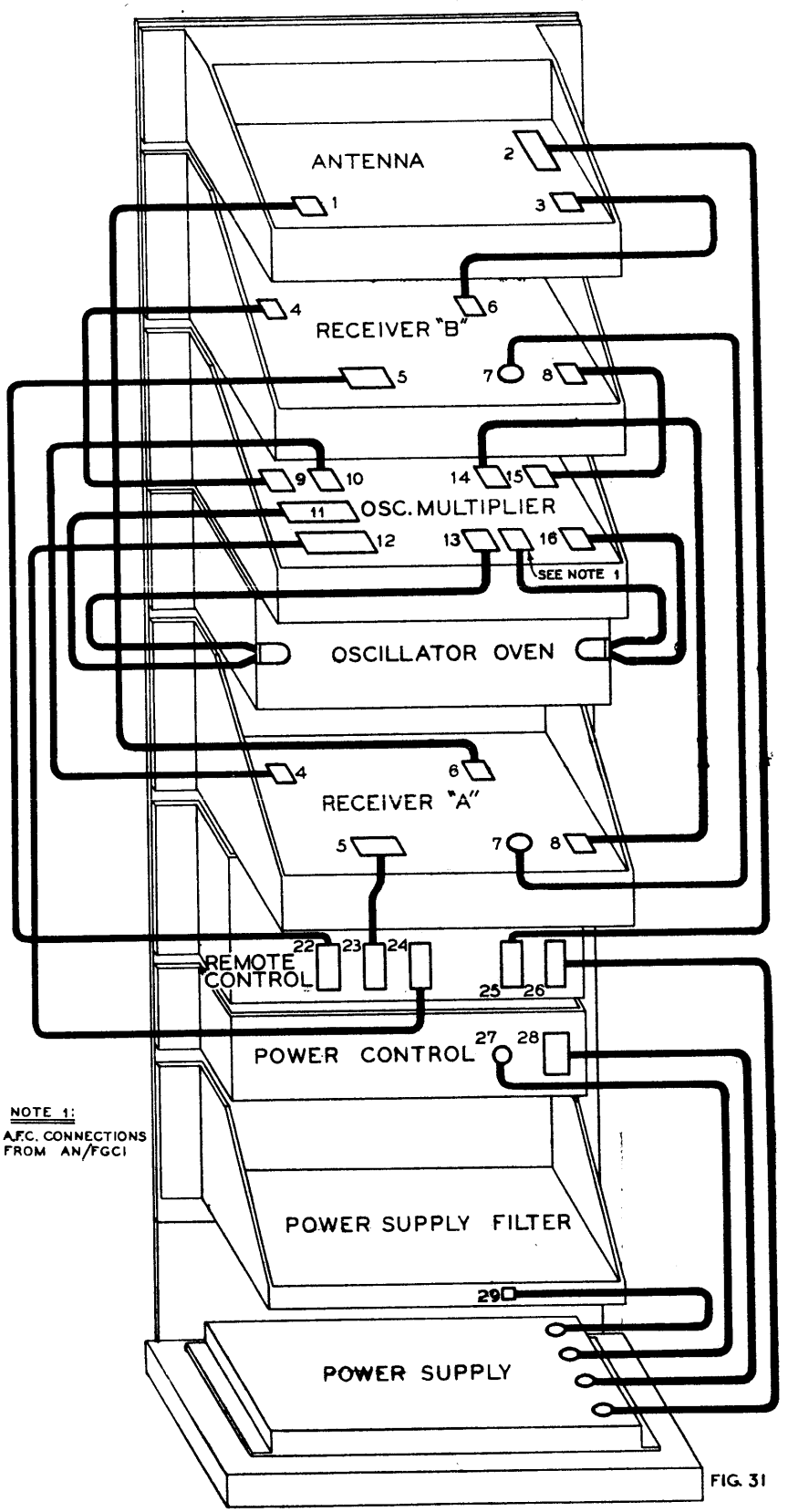


FIG. 31

——CABLING DIAGRAM——