PRELIMINARY
TECHNICAL MANUAL

TM-11-820

FOR

FRC TRANSMITTING EQUIPMENT

§

Manufactured by

AIRCRAFT ACCESSORIES CORPORATION
KANSAS CITY, KANSAS
U. S. A.

RESTRICTED

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JANUARY 17, 1944

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DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so,

DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

MEANS:

1. Explosives, when provided.
2. Hammers, axes, sledges or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available arms.
5. Where possible, and when time permits, bury all debris or dispose of it in streams or other bodies of water.

PROCEDURE:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring in electrical equipment. Smash gas, oil and water cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.

SAFETY NOTICE

WARNING

HIGH VOLTAGE is used in this equipment. It is dangerous to life. Utmost caution should be exercised by personnel. Only those familiar in working with high voltage should make adjustments within the apparatus.

SAFETY INTERLOCK SWITCHES are provided, one on each door of the Power Cabinet and one on each pull-out rack in the other cabinets. However, these switches must NEVER be depended upon to remove high voltage from any unit. They are jumpered with an "INTERLOCK" switch which can render them inoperative, therefore,

MAIN LINE SWITCH S201 should always be opened before any work is done within the transmitter. This switch is in the front of the Power Cabinet. Access to it is gained by opening the right door of that unit.

TUBES OR FREQUENCY RANGE should be changed only after the main line switch is opened.

GROUND the part to be adjusted, whenever possible, with a temporary connection, after power is removed. Capacitors may retain a charge when power is turned off, if a bleeder resistor should be open.

FIRST AID: It is desirable that all operating adjustments be made in the presence of another person who can render, or quickly secure, first aid.

SECTION I. DESCRIPTION OF EQUIPMENT

1. Summary of Characteristics.—

a. Power Rectifier PP-1/FRC.—

(1) *Mechanical.—*

Dimensions—60¾" high x 24" deep x 27 9/16" wide.

Weight—660 lbs.

(2) *Electrical.—*

Voltage—220 a-c single phase.

Current—50 a maximum.

Frequency—50-60 cycles.

b. Dual Modulator Unit MD-1/FRC.—

(1) *Mechanical.—*

Dimensions—60¾" high x 24" deep x 12⅛" wide.

Weight—475 lbs.

(2) *Electrical (Each Channel).—*

Response—Maximum variation 2 db from 200 to 4000 cycles per second, 1000 cycles per second reference frequency.

Nominal Power Output—300 watts.

Harmonic Distortion at 300 Watts Output—10% maximum at 400 cycles per second.

Input Impedance—500 ohms.

Output Impedance—2300 and 4600 ohms.

Noise Level— –40 db.

c. High R-F Unit T-4/FRC.—

(1) *Mechanical.—*

Dimensions—60¾" high x 24" deep x 12⅛" wide.

Weight—315 lbs.

(2) *Electrical.—*

Carrier Power Output—400 watts.

Output Impedance—Balanced 600 ohms.

Frequency Range—2 to 18 mc.

d. Low R-F Unit T-5/FRC—Less Tuning House.—

(1) *Mechanical.—*

Dimensions—60¾" high x 24" deep x 18⅛" wide.

Weight—315 lbs.

(2) *Electrical.*—

Power Output to Antenna—600 watts.

Output Impedance to Tuning House—500-600 ohms.

Frequency Range—150 to 550 kc.

e. Low Frequency Tuning House.—

(1) *Mechanical.*—

Dimensions—36" x 36" x 36" approximately.

Weight—100 lbs.

(2) *Electrical.*—

Input Impedance—500 to 600 ohms.

Tuning Range—150 to 550 kc with an antenna of 600 to 1000 mmf capacitance.

f. Remote Control Assembly.—

(1) *Mechanical.*—

Dimensions—Each SA-2/FRC Switch Panel, 3½" high x 4" deep x 19" wide.
Each 0-2/FRC Oscillator, 3½" high x 9½" deep x 19" wide.
Each AM-2/FRC Amplifier, 3½" high x 9½" deep x 19" wide.

Weight—Each SA-2/FRC Switch Panel, 4 lbs., 15 oz.
Each 0-2/FRC Oscillator, 15 lbs., 6 oz.
Each AM-2/FRC Amplifier, 16 lbs., 4 oz.

(2) *Electrical (Complete Assembly).*—

Input Voltage—110 a-c single phase.

Input Frequency—50-60 cycles per second.

Input Power—550 watts maximum.

2. Vacuum Tube Complement.—

a. Power Rectifier PP-1/FRC.—

Symbol	Application	Commercial Type	U. S. Army Type
VT201	H. V. Rectifier	872A	VT-42-A
VT202	H. V. Rectifier	872A	VT-42-A
VT203	H. V. Rectifier	872A	VT-42-A
VT204	H. V. Rectifier	872A	VT-42-A

b. Dual Modulator Unit MD-1/FRC.—

Modulator No. 1

VT101	1st Audio	6J5-GT/G	VT-94-D
VT102	2nd Audio	6J5-GT/G	VT-94-D
VT103	2nd Audio	6J5-GT/G	VT-94-D

Symbol	Application	Commercial Type	U. S. Army Type
VT104	Voltage Regulator	VR105/30	VT-200
VT105	Voltage Regulator	VR105/30	VT-200
VT106	Driver	807	VT-100-A
VT107	Driver	807	VT-100-A
VT108	Modulator	810	
VT109	Modulator	810	
VT110	Rectifier	866/866A	VT-46-A
VT111	Rectifier	866/866A	VT-46-A
	Modulator No. 2		
VT112	1st Audio	6J5-GT/G	VT-94-D
VT113	2nd Audio	6J5-GT/G	VT-94-D
VT114	2nd Audio	6J5-GT/G	VT-94-D
VT115	Voltage Regulator	VR105/30	VT-200
VT116	Voltage Regulator	VR105/30	VT-200
VT117	Driver	807	VT-100-A
VT118	Driver	807	VT-100-A
VT119	Modulator	810	
VT120	Modulator	810	
VT121	Rectifier	866/866A	VT-46-A
VT122	Rectifier	866/866A	VT-46-A

c. *High R-F Unit T-4/FRC.*—

VT1	Master Oscillator	6V6-GT/G	VT-107-A
VT2	I. P. A.	807	VT-100-A
VT3	Keyer	807	VT-100-A
VT4	Driver	807	VT-100-A
VT5	Driver	807	VT-100-A
VT6	Power Amplifier	810	
VT7	Power Amplifier	810	
VT8	Tone Amplifier	6V6-GT/G	VT-107-A
VT9	Tone Rectifier	5Y3-GT/G	VT-197-A
VT10	Voltage Regulator	VR/105/30	VT-200
VT11	Voltage Regulator	VR/105/30	VT-200
VT12	Bias Isolator	5Y3-GT/G	VT-197-A
VT13	Rectifier	866/866A	VT-46-A
VT14	Rectifier	866/866A	VT-46-A
VT15	Crystal Oscillator-Doubler	6V6-GT/G	VT-107-A

d. *Low R-F Unit T-5/FRC.*—

VT301	Master Oscillator	6V6-GT/G	VT-107-A
VT302	I. P. A.	807	VT-100-A
VT303	Keyer	807	VT-100-A
VT304	Driver	807	VT-100-A
VT305	Driver	807	VT-100-A
VT306	Power Amplifier	810	
VT307	Power Amplifier	810	
VT308	Power Amplifier	810	

Symbol	Application	Commercial Type	U. S. Army Type
VT309	Power Amplifier	810	
VT310	Crystal Oscillator-Doubler	6V6-GT/G	VT-107-A
VT311	Tone Rectifier	5Y3-GT/G	VT-197-A
VT312	Voltage Regulator	VR105/30	VT-200
VT313	Voltage Regulator	VR105/30	VT-200
VT314	Bias Isolator	5Y3-GT/G	VT-197-A
VT315	Rectifier	866/866A	VT-46-A
VT316	Rectifier	866/866A	VT-46-A
VT317	Tone Amplifier	6V6-GT/G	VT-107-A
VT318	Driver	807	VT-100-A

e. Oscillator O-2/FRC.—

Tone Oscillator	6J5-GT/G	VT-94-D
Tone Amplifier	6J5-GT/G	VT-94-D
Rectifier	5Y3-GT/G	VT-197-A

f. Amplifier AM-2/FRC.—

Amplifier	6J5-GT/G	VT-94-D
Rectifier	5Y3-GT/G	VT-197-A

3. Purpose.—

Throughout this manual wherever the term "TRANSMITTER" is used, the reference shall be to the assembly of units at the transmitting location, composed of one PP-1/FRC Power Rectifier, one MD-1/FRC Dual Modulator, three or four T-4/FRC High R-F Units, and in some cases, one T-5/FRC Low R-F Unit. These units will be treated as a group.

The term "REMOTE ASSEMBLY" shall refer to the assembly of units at the operating location, composed of four SA-2/FRC Switch Panels, six O-2/FRC Oscillators, and two AM-2/FRC Amplifiers. The term "EQUIPMENT" shall refer to the combination of all equipment, local and remote, furnished for each radio station by Aircraft Accessories Corporation.

The equipment is a multi-channel radio transmitter capable of CW telegraphy (Type A1 emission), MCW telegraphy (Type A2 emission), or radio telephony (Type A3 emission). Four channels may be operated simultaneously, one or two of them modulated with voice or tone, and the others on straight CW telegraph.

Each high r-f channel will operate on any frequency from 2 to 18 mc, and each low r-f channel from 150 to 550 kc.

The equipment is designed to be operated from the remote assembly, although in case of emergency, the transmitter can be operated on CW telegraph or radio telephone through the use of connections and controls on the transmitter itself.

A separate antenna must be used on each r-f channel.

Successful remote control operation can be maintained over as much as six miles of No. 22 B&S gauge wire.

4. Mechanical Arrangement.—

a. Transmitter.—All units of the transmitter are assembled in cabinets constructed of welded angle steel covered with sheet steel skins.

All units of the transmitter stand adjacently to one another with the power cabinet in the approximate center. A central blower system in the power cabinet draws air into the power cabinet through a filter and circulates it through air ducts to all other cabinets for cooling purposes.

Each r-f unit and dual modulator has its electrical components mounted on a pull-out rack for easy access in servicing, changing frequency bands, and inspection. The power cabinet does not have a pull-out rack. However, the components have been placed where they will be accessible for inspection and servicing.

Meters, indicator lamps, switches, output terminals, and door handles are recessed to minimize breakage when the equipment is transported from one place to another.

Interconnection between cabinets is by means of special interconnecting cables running through wire ducts at the base of the cabinets at the front. A cover plate at the base of each cabinet gives access to the wire duct.

b. Remote Assembly.—The remote control equipment consists of a number of small units, each designed for mounting on a standard width relay track. These units are divided into four groups and each group is installed in a separate rack to form four operating positions. Their installation is described in Paragraph 22.

5. Overall Electrical Characteristics.—

a. Power Supply and Line Requirements.—The transmitter obtains all power from a 220-volt a-c single phase power line, the frequency of which may vary over the range of 50 to 60 cycles per second.

The transmitter should not be left in prolonged operation on a power source whose voltage varies more than 10% from 220 volts.

Polarity need not be observed in connecting to the power source, as neither side of the line is grounded within the transmitter.

Approximately 8 kilowatts of input power are required to operate all channels at full power output simultaneously.

b. High Frequency Range.—Each high r-f unit will operate on any frequency within the range from 2 to 18 mc. This range is covered by switching coils or coil taps at the proper intervals as shown below:

Power Amplifier Stage

Coil No.	Frequency Range
1540*	2000 - 2441 kc
1540	2441 - 3516 kc
1541	3516 - 5195 kc
1548	5195 - 7180 kc
1549	7180 - 9230 kc
1542	9230 - 11720 kc
1543	11720 - 14850 kc
1544	14850 - 18000 kc

*Air padder condensers C40 and C41 in circuit

Driver and I. P. A. Stages

Coil No.	Frequency Range
1535	2000 - 2850 kc
1536	2850 - 4545 kc
1537	4545 - 7573 kc
1538	7573 - 11720 kc
1539	11720 - 18000 kc

Crystal Oscillator-Doubler

Tap on S8	Frequency Range
1	2000 - 2800 kc
2	2800 - 3800 kc
3	3800 - 6000 kc

Master Oscillator

Tap on S1	Frequency Range
1	2000 - 2300 kc
2	2300 - 2800 kc
3	2800 - 3500 kc
4	3500 - 4200 kc
5	4200 - 5000 kc
6	5000 - 6000 kc

The power amplifier and driver stages always operate on the assigned frequency. The I. P. A. stage acts as a frequency doubler or tripler from 6 to 18 mc, and as a straight amplifier or doubler from 2 to 6 mc. The crystal oscillator-doubler stage when used as a crystal oscillator, operates on the crystal fundamental frequency which is in the range of 2 to 6 mc. The master oscillator stage always operates at only half the frequency of the crystal which it replaces, or in the band 1 to 3 mc. The frequencies shown on the above chart are actually twice the frequency of the master oscillator plate circuit, but are shown in terms of the crystal frequency which would be used for the same transmitter output frequency.

c. Low Frequency Range.—The low r-f unit will operate on any frequency within the range 150 to 550 kc, by setting coil taps as follows:

P. A. Stage

Taps on L313	Frequency Range
1 and 6	150 - 195 kc
1 and 5	190 - 260 kc
2 and 5	250 - 375 kc
3 and 4	365 - 590 kc

Driver and I. P. A. Stages

Taps on L309 or L307	Frequency Range
1 and 8	150 - 195 kc
2 and 7	190 - 260 kc
3 and 6	250 - 375 kc
4 and 5	365 - 590 kc

Crystal Oscillator-Doubler

Tap on S303	Frequency Range
1	600 - 350 kc
2	398 - 228 kc
3	257 - 147 kc

Master Oscillator

Tap on S301	Frequency Range
1	161 - 137 kc
2	140 - 119 kc
3	122 - 104 kc
4	108 - 91.5 kc
5	96.5 - 82 kc
6	86 - 73.5 kc

If crystal control is used, all stages of the unit operate on the assigned frequency of the channel, which is also the crystal frequency.

If the master oscillator stage is used, it operates on half the assigned frequency of the channel from 150 to 275 kc and on one-quarter frequency from 275 to 550. All other stages always operate on the assigned frequency.

d. Power Output, H-F Unit.—The CW carrier power is 500 watts into a balanced, non-inductive load of 600 ohms. The carrier power on MCW and voice under the same condition is also 500 watts. Output power on CW may be reduced by varying the output coupling. Reduction of power for MCW or voice is not recommended because the underload relay will switch the modulator tubes out of service.

e. Power Output, L-F Unit.—The CW carrier power is 800 to 1000 watts into a grounded, non-inductive load of 500 to 600 ohms. The carrier power on MCW and voice is the same.

This unit working into the special antenna tuning unit designed for it will deliver approximately 600 watts to a low frequency antenna.

f. Keying Speed.—Each radio frequency unit is keyed electronically by a vacuum tube. Therefore keying speeds of 60 to 150 words per minute may be used.

g. Modulation.—Plate modulation of the final radio frequency power amplifier is employed. Each modulated channel may be modulated 100 per cent with low harmonic distortion.

h. Controls.—

(1) *Power Rectifier PP-1/FRC.*—The transmitter is provided with a set of controls to be used for local operation.

The main line switch is mounted inside the cabinet. To reach it, open the right door. The switch is mounted at the front of the cabinet about two feet from the base of the cabinet. This switch should be left on at all times except when servicing the transmitter.

In the center of the front panel of this cabinet, seven toggle switches are arranged in a vertical row. The upper five are channel selector switches and the lower two are filament and plate power switches.

Inside the left door, the "LOCAL-REMOTE" and "TUNE-OPERATE" toggle switches are at the top of the relay panel. The two dials labelled "MODULATOR No. 1" and "MODULATOR

No. 2" are for the purpose of setting the two modulators to whichever channels are to be modulated. Further description of their operation will be found in Section II.

(2) *Dual Modulator MD-1/FRC.*—The toggle switch labelled "STANDBY" may be used to turn off all tube filaments in the dual modulator unit in the event the unit is not to be used for a long period of time.

The toggle switch labelled "INTERLOCK" may be used to jumper the cabinet interlock switch if the unit is to be operated or tested in the "pulled out" position.

Controls for operation of both modulators are grouped near the top of the pull-out chassis; those for modulator No. 1 on the left and for modulator No. 2 on the right.

The jack on each side is to be used for connection of a microphone for local operation.

The "MICROPHONE-LOCAL-REMOTE" toggle switch changes the audio input circuit of each modulator for correct local or remote operation.

The "AUDIO GAIN" control may be used to regulate the gain for local operation.

(3) *High R-F Unit T-4/FRC.*—Tuning and neutralizing controls are arranged in a vertical line in the center of the panel. Each control function is designated on the accompanying nameplate. The "INTERLOCK" and "STANDBY" toggle switches at the base of the chassis serve the same purpose for this unit as the corresponding switches for the dual modulator unit.

The "TEST" key moves from neutral position either up or down. It may be moved in either direction with the same effect, the difference being that the "up" position is locking and the "down" position non-locking. Since the center or neutral position of the "TEST" key is the electrical "key up" position, it will be referred to in that manner in these instructions. Likewise, either the "up" or "down" positions of the key are the electrical "key down" positions and will be referred to in that way.

When operating remotely, the "TEST" key is always left in the center position.

(4) *Low R-F Unit T-5/FRC.*—Controls are the same as for the T-4/FRC.

(5) *Switch Panel SA-2/FRC.*—Each control panel contains key switches for operation of five channels. However, only four can be operated simultaneously; the fifth channel will be disconnected at the transmitter.

(6) *Oscillator O-2/FRC.*—The tone oscillator permits the use of any one of three audio frequencies for keying or modulating the transmitter. The frequencies are 400, 1000, and 1800 cycles per second. Output can be adjusted to 6 db maximum, although it is set at the factory for 0 db.

(7) *Amplifier AM-2/FRC.*—This unit contains a one stage audio amplifier for a single button carbon microphone. Overall gain is approximately 30 db. The four-position switch labelled "OPERATOR" is used to set the amplifier for any of the four operating positions. It may then be used only by the operator in that particular position.

6. Detailed Description of Power Rectifier PP-1/FRC.—

This unit houses the high voltage power supply (1600 volts) for the entire transmitter. Four Type 872A tubes (U. S. Army Type VT-42-A) are used in a full-wave rectifying circuit, with resistors properly placed to cause equal division of load between all tubes. Power transformer, tubes, rectifier tube filament transformers, bleeder resistors, and main line switch are mounted on an angle steel shelf two feet from the base of the cabinet. D-C output of the high voltage rectifiers is divided into six branches and each branch is separately filtered. These six branches provide power for the final power amplifiers of the four r-f channels, and for the plate circuits of the two modulator channels. The output of each branch is separately fused. Filter chokes and capacitors are divided into two groups and mounted on chassis, which are fastened to the side framework of the cabinet near the top.

This unit also houses a central blower system for cooling the entire transmitter. Room air is drawn in through the rear of the cabinet at mid-cabinet height, passes through a filter, is picked up by the blower intake and forced through air ducts to other cabinets of the transmitter. There it is exhausted through the tops of the cabinets.

Since the intake air is drawn into the power cabinet near the power transformer and rectifier tubes, it circulates around them, cooling them, before passing into the blower.

The air duct runs at the base of the cabinets in the center, and is approximately 4" by 11" in cross section. Cover plates on the sides of each cabinet are removed at time of installation to provide a continuous passage for air.

At the top front of the cabinet a relay and fuse board contains a central fusing system. All fuses for the entire transmitter are mounted on this board. The filament relay and channel relays for five channels are also mounted on the same board, to provide accessibility for cleaning or adjusting their contacts. On the top right side of the relay and fuse board, a system of high voltage plugs allows connecting r-f channels to the desired high voltage sources. The five plugs in the top row are the high voltage connections to the power amplifier plates of channels 1 through 5 reading from left to right. The lower row of four plugs are four sources of separately filtered high voltage, the left two unmodulated high voltage, and the right two modulated high voltage from the output of modulators 1 and 2, left to right. Since there are only four sources of high voltage, only four channels may be plugged in at one time; the fifth channel must be left disconnected. This plug board is used in conjunction with the tap switches described in the next paragraph to set each channel for modulated or unmodulated service.

Inside the left cabinet door, on the relay and fuse board, the two tap switches labelled "MODULATOR No. 1" and "MODULATOR No. 2" are used in conjunction with the plug board as described above to set each modulator on the desired r-f channel. The "TUNE-OPERATE" switch on the same side of the relay and fuse board reduces power supply voltage for "tune-up" by switching to an extended primary winding on the large power transformer, reducing the high voltage to half value. The "LOCAL-REMOTE" switch connects the relay power supply to operate the channel and filament relays only when switches at the local or remote position are used, in accordance with the position of the "LOCAL-REMOTE" switch.

A relay power supply is included in this cabinet. Its function is to supply d-c power for operation of the filament and channel relays. It is designed with ample reserve power to operate stepping switches and other relays if auxiliary remote control equipment should be installed. The power transformer is fastened to the inside top of the cabinet over the relay and fuse board, and the selenium rectifier is mounted on the rear of the board.

Three panels cover the rear of the power cabinet. The top panel can be removed for servicing the rear of the relay and fuse panel and the filter chassis. The center panel can be removed for replacing the air filter or for servicing any of the mid-section components. The lower panel can be removed for lubricating the blower and motor bearings and for access to the main plate contactor, power and control lead sockets.

A four-terminal recessed socket on the rear of the power cabinet provides entrance for the incoming power line. A multi-connection recessed socket is the terminus for wires to the remote control position.

On the front of the power cabinet, a removable plate at the base gives access to the wire duct and plug board. Interconnecting cables from all other cabinets plug into this plug board, then run from unit to unit to their respective cabinets through the wire duct, where they are concealed when the installation is completed.

The plug board also contains a grounding stud and five bakelite high voltage connectors. These connectors are wired at installation through the interconnecting wire duct, one to each similar connector on an r-f unit, and carry the high voltage (1600 volts) to that unit.

A variable resistor for adjusting the meter accuracy is mounted inside the right door near the main line switch. Its setting should not be altered in the field except as described in Paragraph 27.

Switches, lights, meter, door handles, and plugs are all recessed to safeguard them against breakage in transportation.

A disc type thermostat in the top of the cabinet shuts down the transmitter if the cabinet temperature becomes dangerously high, as might happen in case of failure of the forced air cooling system. The thermostat operates at 170° F.

Two push-type interlock switches are mounted on the center vertical panel of the cabinet, arranged to cut off high voltage if either door is opened.

7. Detailed Description of Dual Modulator MD-1/FRC.—

Two complete audio channels are housed in this one cabinet. Each is completely independent of the other, except they both use a common modulator current meter, switched from one to the other with a wafer switch.

Most of the electrical components are mounted on a pull-out chassis. Exceptions are the indicator lamps, meter, and interconnecting cable sockets.

A vertical partition on the pull-out chassis is the mounting base for most of the components except power supply. Components for each channel are not all mounted on one side of the partition, but "criss-cross" from side to side.

A horizontal sub-chassis at the base of the pull-out chassis contains components of the bias supply and 600-volt power supply for the driver and low power stages. Another chassis directly above holds the output transformers for both channels.

A push-type interlock switch is mounted near the base of the pull-out chassis and opens the coil circuit to the plate contactor in the power cabinet when the chassis is in the pulled-out position, unless jumpered by the "INTERLOCK" switch on the front panel of the modulator unit.

This cabinet, like the power cabinet, has a removable plate near the base, in the front, to allow access to the wire duct and plug board. The plug board contains the female portions of two multi-connection plugs for connection of the interconnecting cables from the power cabinet. The 6-terminal plug carries all high voltage connections and the 12-terminal plug carries all low voltage and control wiring from power cabinet to modulator cabinet. The board also carries a grounding stud and two bakelite connectors to be used for microphone local connections as desribed in Paragraph 20.

The plug on the left is for modulator No. 1 and the other for modulator No. 2.

A disc type thermostat set in the top of the pull-out chassis shuts off power to the unit if the cabinet temperature rises above 170° F.

The following electrical description is for one audio channel, but applies to either one. In cases where component symbols are mentioned such as "T101 or T109," the first mentioned belongs to modulator No. 1 and the second to modulator No. 2.

If the transmitter is to be remotely controlled, switch S103 or S104 on the front panel must be set to "MICROPHONE REMOTE." For local operation, the same switch must be set to "MICROPHONE LOCAL" and a microphone plugged into J101 or J102 on the front panel.

The input audio stage is a 6J5-GT/G (U. S. Army Type VT-94-D) with a gain control in the grid circuit. Each channel may be adjusted for level independently of the other channel. The

output of the first stage is resistance coupled to the second stage 6J5-GT/G tubes, VT102 or VT113. A portion of the output voltage from this stage is fed back to 6J5-GT/G tubes, VT103 or VT114. These tubes, VT102 and VT103 or VT113 and VT114, are part of an audio phase inverting circuit to drive the third or push-pull stage which uses 807 tubes (U. S. Army Type VT-100-A). Part of the output from this push-pull stage is fed back into the cathode circuit of the preceding stage through resistor-capacitor combinations. The purpose of the feedback is to reduce noise and second harmonic distortion in the output of the 807 stage. Output of the 807 or driver stage is transformer coupled to the modulator stage, a pair of Type 810 tubes in a class B circuit.

Plate voltage for the 810 or modulator stage is obtained from the high voltage power supply in the power cabinet. Plate and screen voltage for the other stages is supplied from a power supply in the modulator unit itself. All voltage except that for the plates of the 807 driver stage is regulated with a pair of VR105/30 tubes (U. S. Army Type VT-200).

Bias voltage to the output stage is furnished from a bias supply using a selenium rectifier. A bias interlocking relay E101 or E102 operating on the bias supply removes plate voltage from the low power stages and filament voltage from the modulator tubes in case of failure of the bias supply. All other stages except the modulator are self-biased with cathode resistors.

A rotary switch on the front panel switches the modulator current meter to either modulator No. 1 or No. 2 and has a center off position. The meter itself has a 1-volt movement and measures current by reading the voltage drop across a known resistance.

Panel lamps show which audio channels are in use; the lamp to the left indicating channel 1 and the one on the right channel 2. The bulbs have a 110-volt rating and are used with a fixed resistor in series across the 220 volt line.

8. Detailed Description of High R-F Unit T-4/FRC.—

The components for one high frequency channel are contained in each of these cabinets.

Construction is similar to that of the MD-1/FRC Dual Modulator Unit. Electrical parts with the exception of meters, indicator lamp, and connecting plugs are on a pull-out chassis. A vertical shield in the center of the chassis forms a mounting base for most of the parts or sub-chassis. This shield also serves as an electrical shield between input and output circuits of the power amplifier and driver stages, which have their input and output circuit components mounted on opposite sides of the partition.

A disc-type thermostat set in the pull-out chassis near the top shuts down the channel if the cabinet temperature exceeds 170° F.

A horizontal sub-chassis at the base of the pull-out chassis contains components of the bias supply and 600-volt power supply for the driver and low power stages.

A push-type interlock switch is mounted near the base and at the rear of the pull-out chassis, and opens the coil circuit to the plate contactor in the power cabinet when the chassis is in the pulled-out position, unless jumpered by the "INTERLOCK" switch on the front panel of the unit.

This cabinet also has a removable plate near the base at the front which exposes the wire duct and plug board. The plug board contains the female portion of a 12-terminal plug for connection of the interconnecting cable from the power cabinet, which carries all low voltage power and control wiring to the unit. A grounding stud and two bakelite connectors are also mounted on the plug board. One connector carries high voltage from the power cabinet to the r-f unit, and the other is for connection to a corresponding connector on the modulator cabinet for local push-to-talk telephone operation. These connections are described in Paragraph 20.

Tuning elements of the master oscillator and crystal oscillator stages are enclosed in a shield box to minimize feedback from the succeeding stages, which would affect the oscillator stability.

A 6V6-GT/G tube (U. S. Army Type VT-107-A) is used as a self excited master oscillator in the first stage. Frequency range is from 1 to 3 mc in six bands.

Output of the first stage is taken from its cathode circuit and applied to the grid circuit of the second stage, which uses another 6V6-GT/G tube. When the master oscillator is used, the second stage always operates as a frequency doubler, covering the range 2 to 6 mc in three bands. When crystal control is used, this stage is the oscillator and the first stage is idle. The frequency range is the same, 2 to 6 mc. Change from master oscillator to crystal operation is made with a wafer switch on the vertical partition of the pull-out chassis. The knob is designated "M. O.-CRYSTAL SWITCH" and is on the opposite side of the partition from the oscillator shield box.

The next stage is known as the I. P. A. (Intermediate Power Amplifier), and uses an 807 tube (U. S. Army Type VT-100-A).

The succeeding stages are biased so highly they will not operate until sufficient excitation is supplied from the I. P. A. tube. A separate tube, another 807, is employed to key the I. P. A. output for CW telegraph and push-to-talk carrier control. The keyer tube VT3 is connected in series with I. P. A. tube VT2. When the keyer tube presents a low resistance for passage of I. P. A. current, as it does during key-down intervals, I. P. A. output is normal and the succeeding stages are excited to full output.

The theory of operation of the keyer tube is as follows: Fixed bias is supplied to the keyer tube from the dry rectifier bias supply. The plate-to-cathode impedance of the tube is directly dependent on its control grid bias. Normally, the bias is high enough that the keyer tube resistance cuts off the I. P. A. tube plate current. Pressing the key shorts the control grid bias, reducing the keyer plate resistance to a few hundred ohms and allowing full output from the I. P. A.

Keying is done locally with a lever key on the front panel. The key shorts the keyer tube bias; a resistance in series preventing the shorted current from reaching a high value. Keying from the remote point is discussed in a later paragraph.

The plate circuit of the I. P. A. stage must always be tuned to the output frequency of the transmitter.

The next stage is referred to as the P. A. driver stage, and uses two type 807 tubes (U. S. Army Type VT-100-A) in push-pull. The plate circuit must always be tuned to the output frequency of the transmitter.

The output stage of the r-f unit consists of two type 810 tubes in a push-pull class C amplifier. The term P. A. (Power Amplifier) is generally used in referring to this stage. A standard cross-neutralized circuit is used. Power for the antenna is taken from this stage by an adjustable coupling coil in the center of the P. A. coil.

High voltage for the P. A. plate circuit comes from the power cabinet. All other voltages are developed in the power supplies of the unit itself.

Tubes VT13 and VT14 are the rectifier tubes of a 600-volt power supply, which supplies plate and screen voltages for all low power stages. Tube types are 866/866A (U. S. Army Type VT-46-A).

Bias voltages for the I. P. A., keyer, P. A. driver, and P. A. tubes are furnished by a selenium rectifier power supply. Bias interlock relay E2, also operating on the bias supply, shuts down the r-f channel if bias voltage should fail.

Combination overload-underload relay E3 has its coil in the cathode circuit of the P. A. tubes so the total plate and grid current of the tubes passes through it. The relay is so designed, that when the P. A. total current reaches approximately 300 ma, one set of contacts closes. If the r-f unit has been set for modulated service, the closing of the first set of contacts renders operative the modu-

lator tubes associated with that channel. When the total P. A. current reaches approximately 1 a, the second set of contacts on the relay opens the circuit to the time delay relay in the power cabinet, removing plate voltage from the P. A.

Rectifier tube V12, a Type 5Y3-GT/G (U. S. Army Type VT-197-A) is known as a bias isolator tube. Its function is to prevent the bias voltage on the P. A. driver from rising above the proper value when the P. A. grid current is sufficient to drive the P. A. to full output.

When the transmitter is being controlled from the remote operating position, either CW telegraph or push-to-talk telephone service, keying is done with audio tone signals over the intervening telephone lines. In the r-f unit, the tone signals are amplified by a 6V6-GT/G tube, VT8 (U. S. Army Type VT-107-A) and changed to d-c pulses by rectifier tube VT9, a 5Y3-GT/G tube (U. S. Army Type VT-197-A). The d-c pulses are then used to neutralize the d-c bias on the keyer tube, and thereby key the transmitter.

Two meters are used to monitor each r-f unit. The one on the left can be switched to the cathode circuits of crystal oscillator, I. P. A., and P. A. driver, and to the grid circuits of P. A. driver and P. A. The meter on the right is in the cathode circuit of the P. A. Both meters are 1-volt movement instruments and indicate current by reading the voltage drop across a known resistance.

The frequency range of 2 to 18 mc is covered by changing plug-in coils in the P. A., P. A. driver, and I. P. A. stages, and changing coil taps on the master oscillator and crystal oscillator stages. For the lowest frequency band, padder condensers C40 and C41 must be linked in parallel with tuning condenser C22.

A carrying case is furnished with each r-f unit to accommodate plug in coils which are not in use. Coils of the larger diameter are for the P. A. and the others can be used interchangeably for either I. P. A. or P. A. driver stages. Table 5 in Paragraph 52 shows which coil to use for any frequency.

The coil tap switches for the master oscillator and crystal oscillator are on the vertical partition of the pull-out chassis, on the opposite side from the oscillator shield box.

9. Detailed Description of Low R-F Unit T-5/FRC.—

The components for one low frequency channel are contained in each of these cabinets.

Construction is similar to the MD-1/FRC Dual Modulator Unit. Electrical parts with the exception of meters, indicator lamp, and connecting plugs are on a pull-out chassis.

A disc-type thermostat set in the pull-out chassis near the top shuts down the channel if the cabinet temperature exceeds 170° F.

A push-type interlock switch is mounted near the base and at the rear of the pull-out chassis, and opens the coil circuit to the plate contactor in the power cabinet when the chassis is in the pulled-out position, unless jumpered by the "INTERLOCK" switch on the front panel of the unit.

This cabinet also has a removable plate near the base of the cabinet front, which exposes the wire duct and plug board. The plug board contains the female portion of a 12-terminal plug for connection of the interconnecting cable from the power cabinet, which carries the low voltage and control wiring to the unit. A grounding stud and two bakelite connectors are also mounted on the plug board. One connector carries high voltage from the power cabinet to the r-f unit, and the other is for connection to a corresponding connector on the modulator cabinet for local push-to-talk operation. These connections are fully described in Paragraph 20.

Tuning elements of the master oscillator and crystal oscillator stages are enclosed in a sheet metal box to minimize feed-back from the succeeding stages, which would affect the oscillator stability.

A horizontal sub-chassis at the base of the pull-out chassis contains components of the 600-volt power supply, bias supply, and tone keyer.

Above the base chassis, on the right side when facing the front of the cabinet, is the shielded oscillator unit.

Directly above the oscillator, another horizontal sub chassis is the mounting base for the components of the I. P. A. (Intermediate Power Amplifier) and the P. A. driver (Power Amplifier Driver) stages. A vertical shield separates the I. P. A. at the rear from the P. A. driver at the front.

The P. A. (Power Amplifier) is built on the top shelf.

A 6V6-GT/G tube (U. S. Army Type VT-107-A) is used as a self excited master oscillator in the first stage. Frequency range is from 73.5 to 161 kc in six bands.

Output of the master oscillator is taken from its cathode circuit and applied to the grid circuit of the next stage, the crystal oscillator-doubler, which uses another 6V6-GT/G tube. When the master oscillator is used, the second stage always operates as a frequency doubler. When crystal control is used, the second stage operates as the oscillator and the first stage is idle.

The crystal always operates on the output frequency of the transmitter. Change from master oscillator to crystal control is made with a wafer switch inside the r-f unit. The knob is designated "M. O. CRYSTAL SWITCH," and is on the opposite side of the vertical partition from the oscillator shield box.

The next stage is known as the I. P. A. (Intermediate Power Amplifier), and uses an 807 tube (U. S. Army Type VT-100-A). This stage is controlled with another 807 tube, the keyer tube, for CW telegraph and push-to-talk telephone operation. The theory of the keying circuit is explained in the description of the T-4/FRC Unit in Paragraph 8. The frequency range of the I. P. A. is 150 to 550 kc in four bands. Variable inductance in the form of a variometer, and fixed mica capacitors are used as tuning elements. Changing frequency range is done by changing taps on the variometers in conjunction with linking in the proper mica capacitors. The I. P. A. always operates on the output frequency of the transmitter.

The next stage is referred to as the P. A. driver stage and uses three Type 807 tubes (U. S. Army Type VT-100-A) in parallel. Suppression resistors are used to prevent spurious oscillation. The plate circuit of the P. A. driver must always be tuned to the output frequency of the transmitter. Frequency range is from 150 to 550 kc in four bands. As in the I. P. A., variometers and fixed capacitors are used in the tuned circuit, and frequency range is selected in the same manner. The P. A. driver is biased beyond plate current cut-off, so there is no output from it until excited from the I. P. A.

The output stage of the r-f unit consists of four type 810 tubes in parallel, in a class C amplifier. The term P. A. (Power Amplifier) is generally used in referring to this stage. The output circuit is a pi network designed to match the P. A. tubes to a 500- to 600-ohm load.

High voltage for the P. A. plate circuit comes from the power cabinet. All other voltages are developed in the power supplies of the unit itself.

Tubes VT315 and VT316 are the rectifier tubes of a 600-volt power supply, which supplies plate and screen voltages for all low power stages. The tube type is 866/866A (U. S. Army Type VT-46-A).

Bias voltages for the I. P. A., P. A. driver, and P. A. tubes are furnished by a selenium rectifier power supply. Bias interlock relay E301 also operating on the bias supply, shuts down the channel if bias voltage should fail.

Combination overload-underload relay E302 has its coil in the cathode circuit of the P. A. tubes, so the total plate and grid current of the stage flows through it. The relay is so designed

that when the total current reaches approximately 500 ma, one set of contacts closes. If the r-f unit has been set for modulated service, the closing of the first set of contacts renders operative the modulator tube associated with that channel. When the total P. A. current reaches approximately 1500 ma, the second set of contacts on the relay opens the circuit to the time delay relay in the power cabinet, removing plate voltage from the P. A.

Rectifier tube VT314, a Type 5Y3-GT/G (U. S. Army Type VT-197-A) is known as a bias isolator tube. Its function is to prevent a reverse flow of current through the bias supply if the P. A. grid circuit is over driven by the P. A. driver stage.

The meters in this unit serve the same function and are switched in the same manner as described for the high frequency unit in Paragraph 8.

The coil tap switches for the master oscillator and crystal oscillator are on the vertical partition of the pull-out chassis, on the opposite side from the oscillator shield box.

10. Detailed Description of Antenna Tuning House.—

The tuning house, although built as a separate unit, is an integral part of the T-5/FRC low r-f unit. The two units are designed to work together to supply an antenna of 5 to 10 ohms radiation resistance and 600 to 1000 mmf capacitance with 600 watts of r-f power over the frequency range of 150 to 550 kc.

The tuning house is constructed with lignolite over a wooden framework. The use of ferrous metal is avoided to increase the efficiency of power transfer to the antenna.

A pair of outer doors cover the tuning dial and meter. Inner doors can be opened to change the coil tap settings. The inner doors are lined with screening material to prevent body capacity of the operator from affecting the tuning.

The electrical components consist of a large tuning coil, an r-f current meter, and a meter shorting switch.

11. Detailed Description of Remote Control Equipment.—

The remote control equipment furnished with each transmitting equipment consists of four type SA-2/FRC switch panels, six type O-2/FRC tone oscillators, and two type AM-2/FRC amplifiers. This equipment, at the time of installation, will be divided into four groups and each group installed in one operating position. Therefore, four operators may operate the transmitter simultaneously on individual channels.

Each operating position will have one switch panel for controlling filament and channel relays at the transmitter, and one oscillator to generate an audio tone for keying whichever channel is selected with the switch panel. The remaining tone oscillators and amplifiers are paired off, one oscillator and one amplifier together. These groups will be placed one in operator No. 1 position and the other in operator No. 2 position. The amplifier installed in operator No. 1 position is the line amplifier for modulator No. 1 at the transmitter, and its associated tone oscillator supplies tone when MCW is used. The other amplifier and tone oscillator are used for modulator No. 2 at the transmitter.

a. Switch Panel SA-2/FRC.—Component parts are on a standard relay rack panel, 19" x 3½". Each panel has six lever keys which function only in the downward or locking position. The first key on the left, labelled "POWER," closes filament relay E201 in the power cabinet of the transmitter by completing to ground the return circuit to the relay. A red lamp above the lever key lights on all four panels when any one or more of the four "POWER" keys is down. The remaining five keys on each panel operate the channel relays in the power cabinet at the transmitter. When any of the five keys is down on any panel, the corresponding indicator lamp shows on all four panels. The six pilot lamps do not indicate positive operation of their relays at the transmitter, but act only as an indicator to each operator as to which channels are in use.

Since the transmitter will permit simultaneous operation of four channels only, four of the five key switches only are active, the fifth channel being unplugged at the relay and fuse panel in the transmitter. The fifth key will light its indicator lamp on the panel, however.

Two microphone jacks on the right side of the switch panel are wired in parallel on all four switch panels and the two AM-2/FRC amplifiers; that is, the "MIC. MOD. 1" jack on the four switch panels and the "MICROPHONE" jack of the AM-2/FRC amplifier associated with modulator No. 1 at the transmitter are wired in parallel, and the "MIC. MOD. 2" jack on the switch panels and the "MICROPHONE" jack of the amplifier for modulator No. 2 are wired in parallel.

b. Amplifier AM-2/FRC.—The amplifier is constructed on a standard relay rack panel 19" x 3½" and a chassis of smaller dimensions mounted on the rear of the panel with spacers.

Electrically, the unit is a one stage pre-amplifier with self-contained power supply, for a microphone or tone oscillator.

Headphones may be plugged into the "HEADPHONES" jack to monitor the audio output. A microphone may be used in the "MICROPHONE" jack or may be plugged into the appropriate jack on one of the switch panels.

The tap switch labelled "OPERATOR" is used to set the amplifier for operation from one of the four operating positions.

c. Oscillator O-2/FRC.—The tone oscillator is similar in construction to the amplifier described in Sub-Paragraph *b* above.

Electrically, the unit is an audio tone generator and amplifier with self-contained power supply. A tap switch on the front panel permits the use of any one of three audio frequencies, 400, 1000, and 1800 cycles.

Output level is adjusted with a screwdriver from the front panel. Procedure is given in Paragraph 31 for setting the gain to the proper level.

The "KEY" jack is used for the CW telegraph key on the oscillators used for carrier keying, and for the MCW key or automatic keyer plug on the oscillators used for modulating the pre-amplifiers.

The "POWER OFF-ON" switch serves only as a regular line switch on the oscillators used for telegraph keying, but it serves an additional purpose on the oscillators used for tone modulation. In the latter case, when the switch is "ON," the microphone push-to-talk circuit does not break the r-f carrier but clears the carrier from tone so it may be voice modulated.

SECTION II. EMPLOYMENT

12. Factory Packing for Shipment.—

Each unit of the equipment—the power cabinet, the dual modulator cabinet, the high r-f cabinet, the low r-f cabinet, and the remote control assembly—is packed independently, with its own set of spare parts and accessories. Therefore, the equipment for a transmitting station can be assembled with any combination of the separate units without breaking open the boxes in a warehouse before shipment.

Each unit is packed in one, two, or three boxes, usually with the cabinet in one box and the tubes and spare parts in another box. The contents of each box is indicated by means of stenciling, such as "PP-1/FRC BOX 1 of 3" etc.

13. Unpacking.—

Each box should be opened carefully and by means of the proper tools. Steel strapping can be broken by prying up the band slightly with a claw hammer and then cutting it with tin snips. The contents of most boxes can be removed by opening any one of the four sides with a nail puller, or claw-hammer and wrecking bar. To open some of the boxes it may be necessary to remove a second side. This can be determined whenever the equipment fails to come out easily after the removal of a single side. It is important to remove the equipment from the box before taking off any wrapping or packing material.

Carefully inspect each piece of equipment for shipping damage as soon as it is taken out of its crate. If damage is discovered, report it at once to the proper authorities.

14. General Assembly Instructions.—

a. Transmitter.—The transmitting equipment should be set up in a place where it will be well protected from the weather and as close as possible to the radiating antenna system.

A floor space of approximately 9 x 3½ feet is required with all doors closed.

The cabinets must be placed so that there is at least two feet of space between the rear of the cabinets and the wall, to allow room for air intake to the ventilating system, and to allow space for personnel to remove rear panels and to lubricate blower bearings when necessary.

If the installation is to be permanent or semi-permanent, all cabinets should be bolted to the floor through holes provided in the base of each cabinet—two holes in each small cabinet and four holes in the large power cabinet. In any event, all cabinets must be bolted together.

b. Remote Control Equipment.—The control equipment consists of small units with 3½x19 inch panels. These units are to be separated into four groups and installed in four relay racks to provide four operating positions as described later.

15. Installation of Power Rectifier PP-1/FRC.—

This unit is shipped in three boxes. Open Box 1, containing the cabinet. Remove the cabinet from its packing crate, and leave it for the present well out from the wall, with plenty of room in the rear. Remove masking tape, packing blocks, etc., from all components.

Open Box 2 containing a large power transformer. Be careful while removing the packing crate, not to damage the porcelain insulators on each end of the transformer.

Remove all three rear panels from the cabinet and pull out the large air filter.

The transformer is to be mounted on the shelf exposed by removal of the air filter. Before mounting the transformer, unscrew and remove the four mounting bolts which have been placed in their holes for shipment. Untape and remove the small wiring cable and bus wire connection fastened to the cabinet frame near the tube sockets.

Lift the power transformer and place it on the shelf. The primary end of the transformer, the one containing 7 terminals, must be put in first, so it will be at the front of the cabinet. Slide the transformer in carefully so as not to damage the relay and fuse panel with the transformer case screws. Do not attempt to lift the transformer by its terminal insulators. Fasten the transformer in place with the four bolts previously removed. Make electrical connections at each end.

At the front of the cabinet, transformer wires are broken out of the main wiring cable. At the rear, use the small cable shipped with the transmitter to connect from transformer to rectifier tubes as indicated by tags on the cable. Connect the bus wire jumper from transformer terminal marked "O" to the side frame of the cabinet.

Wires are tagged with symbols corresponding to the marking of the transformer terminals to which each is to connect. If the transformer is ever again removed for shipment or repair, the wires should be re-tagged as they are taken off.

Lubricate the front and rear bearings of the blower and motor. The bearings are oiled by filling the two oil cups on the blower and the two on the motor with heavy weight motor or machine oil.

Move the cabinet into final position, leaving the rear panels removed. It will be placed in the approximate center of the space reserved for the transmitter, other units then being added on each side. Bolt or screw the cabinet to the floor if desired. No bolts for this purpose have been provided, since each installation may require a different size or type.

Box 3 containing the instruction books has already been opened. This box also contains three sets of tubes and one set of spare parts for the power cabinet, a 30-foot connecting cable with plugs and terminal block attached, two insulated leads with alligator clips at each end, and a four-connection power plug.

An instruction book holder is provided on the inside of each power cabinet door. Place the books in the holders.

Install one set of tubes in the power cabinet and clip the plate leads to their caps. Put the other two sets of tubes with the spare parts.

Lay aside the 30-foot cable, terminal blocks, clip leads, and power plug. Their use will be described later.

16. Installation of Dual Modulator MD-1/FRC.—

This unit is shipped in two boxes. Open Box 1 and remove the cabinet. Before placing the cabinet in its final position, take off the rear panel and remove the four shipping bolts holding the pull-out chassis to the cabinet. These bolts may be discarded or may be placed with the spare parts to be used again if the transmitter is moved. After removing the four shipping bolts loosen both lower brackets from the cabinet itself. Re-tighten these two brackets on the cabinet with their free ends extending downward. This is done to avoid fraying the flexible cables as the units are rolled in and out.

The modulator cabinet must be placed on the right side of the power cabinet and butting up against it. Before moving the two cabinets close together, remove five cover plates from each cabinet, two on each side at the bottom and one on the front at the bottom. The side cover plates will not be used, therefore place the plates and screws with the spare parts for future use. The front cover plates will be replaced after the installation is complete.

Move the modulator cabinet into position and bolt it to the power cabinet with the aid of four binder head screws which will be found in a cloth bag fastened to the pull-out handle of the modulator cabinet, whereas in the power cabinet the bag will be found tied to the frame near the main line switch. Do not replace the rear panel until the entire installation is complete.

Open Box 2 and place one set of vacuum tubes in the modulator pull-out chassis.

The tube type required is plainly marked near each socket. Take out the other two sets of tubes and the spare parts and store them in the proper place.

An interconnecting cable is shipped coiled up in the wire duct of the modulator. Take this cable out, thread it through the duct to the power cabinet, and plug it into the multi-connection socket marked "MOD" or J206. The two-connection plug removed from J206 must be placed with the spare parts for future use. Plug the other end of the inter-connecting cable into the 12-connection socket on the modulator plug board. The two 56-inch long single wire patch cords and the 17-inch long ground strap also found in the wire duct should be left near the modulator for the present.

Another patch cable with armored covering will be found in Box 2 with the spare parts. Thread this cable through the wire duct and plug it in the sockets provided on modulator and power cabinets.

17. Installation of High R-F Unit T-4/FRC.—

Each T-4/FRC is shipped separately in two boxes. Setup instructions are given for only one unit. Follow similar procedure for the additional units.

Open Box 1 and remove the cabinet. Take off the rear panel, the front plate, and two duct cover plates on each side. Remove the four shipping bolts holding the pull-out chassis in the cabinet. Save the shipping bolts for future use. After removing the four shipping bolts loosen both lower brackets from the cabinet itself and re-tighten them with their free ends extending downward.

The first high frequency unit is designated "CHANNEL 1" and must be installed adjacent to the power cabinet on the left side. Place the r-f cabinet in position and bolt the two cabinets together with four of the binder head screws which will be found in a cloth bag fastened to the pull-out handle of the r-f cabinet.

The interconnecting cables are shipped coiled up in the wire duct. Thread the multi-wire patch cable through the wire duct into the power cabinet and plug it into the socket marked "CH. 1." The other end is to be plugged into the 12-connection socket on the r-f unit plug board. The two shorted dummy plugs taken out of the power cabinet plug board must be laid aside with the spare parts for future use. The slack in the cable can be folded into the wire duct.

A high voltage patch cord is also shipped with the r-f unit. Thread this wire through the wire duct and fasten the connectors to the terminal marked "CH. 1" on the power cabinet board and to the Millen connector on the r-f plug board.

CAUTION: THE WIRE MUST BE ATTACHED TO THE MILLEN CONNECTOR WHICH IS MOUNTED ON BAKELITE, AND NOT TO THE ONE MARKED "MICROPHONE LOCAL CONNECT."

The 17-inch long ground strap, also found in the wire duct is to be set aside near the r-f unit for use later on.

Open Box 2, which contains one set of spare parts, three sets of tubes and 1 set of plug-in coils. The coils are in a carrying case. Open the case and put coils in the r-f unit for the desired operating frequency in accordance with Table 5, Paragraph 52. The large coils are for the power amplifier stage and the smaller coils are for either the driver or I. P. A. stages. Install one set of tubes in the r-f unit according to the marking by each socket. Store the extra coils and the spare parts.

If two or more high r-f units are to be used install the second unit to the left of the first r-f unit. It then will be known as Channel 2 and the Channel 2 sockets will be used for inter-connection.

If three or more high r-f units are to be used, install the first two as above and the third one to the right of the modulator. Use Channel 3 sockets for the last unit.

If four high r-f units are to be used, install the first three as above, and the fourth on the left side of the power cabinet. The arrangement will then always be as follows: Power cabinet in the center, then modulator and Channel 3 in order to the right, and Channels 1, 2, and 4 in order to the left of the power cabinet, counting from right to left. The low r-f unit, if one is used, will be placed on the right side of the power cabinet on the end. Do not remove the side air and wire duct plates of the unit on each outside end of the installation.

18. Installation of Low R-F Unit T-5/FRC.—

Instructions in Paragraph 17 apply also to the installation of this unit.

Whenever there are less than four other channels the low r-f unit must always be connected as Channel 5 and also as a modulated channel because the unmodulated channel filter packs do not have sufficient current carrying capacities. The power cabinet wiring for Channel 5 circuits is heavier than for the other circuits. The low r-f unit is placed on the right end of the transmitter. In the event two low r-f channels are used connect the second as Channel 4. Reference to Figure 1 will clearly indicate the various channel setup combinations.

19. Installation of Antenna Tuning House.—

The Tuning House is designed to couple the output of one low r-f channel into an antenna. High frequency antennas are described in Paragraph 26.

The unit may be installed out of doors if necessary, but should be afforded as much protection from the weather as possible. The location may be close to the transmitter or up to several hundred feet distant.

Run a 600-ohm transmission line between r-f unit and Tuning House. Follow instructions given in Paragraph 21 for construction of the line. Be sure to keep the transmission line up out of the way of accidental contact by personnel.

At the transmitter end, connect the two wires of the line to the two terminals on the low r-f unit. Connect one r-f unit output terminal to a good ground, preferably separate from that used for any of the high r-f units or the cabinets. At the Tuning House, connect the ungrounded wire to the small insulator on the side of the Tuning House, and the grounded wire to the ground stud on the underneath side of the Tuning House. Also connect a good earth ground to the same ground stud. The earth ground must be a good, low resistance connection if best results are to be obtained.

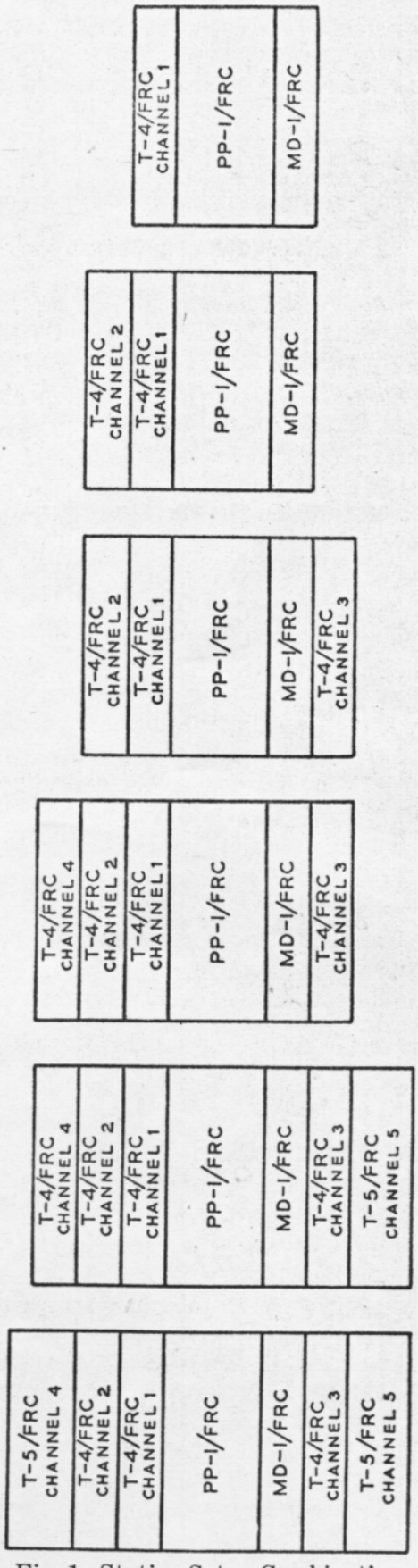


Fig. 1. Station Setup Combinations

Run a connection from the antenna to the large insulator on top of the Tuning House. High voltage is present on the antenna lead during normal operation and, therefore, great care must be used to insulate the lead for 10,000 volts when it comes close to other objects or passes through a building wall.

20. Assembly of Complete Transmitter.—

All cabinets must be securely bolted together as described in the preceding sections. In addition, each cabinet should be bolted to the floor, although this is not absolutely necessary if the installation is likely to be a temporary one. Each small cabinet has two bolt holes in the base, one in the front and one in the rear base angles. The larger power cabinet has two holes in front and two in the rear.

Strap ground connections from cabinet to cabinet. These straps are shipped one in the wire duct of each cabinet except the power cabinet. Fasten the straps to the stud on the plug board in the wire duct of each unit.

A good earth connection must be made to the ground stud on the plug board of one of the units. The ground connection must be separate from that used as a part of the radiating system of any r-f unit, and as short and direct as possible. The conductor size should be equivalent to No. 8 B&S or larger.

All 12-connection sockets on the plug board in the wire duct of the power cabinets must either have r-f units plugged into them or the series interlock circuit terminals must be jumpered by plugging shorted 2-connection plugs into the proper places. In the case of the five r-f channel sockets, one plug must be placed into the two end holes of each socket, shorting terminals 1 to 2 and 11 to 12. In the case of the 12-terminal modulator socket, only one plug is needed, shorting terminals 11 and 12, the two terminals on the left end of the socket. The unused shorted plugs should be stored with the spare parts so they can be used if any of the units should ever be removed.

If at the time of installation it is definitely known which r-f channels are to be modulated, run one of the 56-inch long connecting wires through the wire duct from the terminal marked "MICROPHONE-LOCAL CONNECT" on the wire duct plug board of one modulated r-f channel to one of the terminals marked similarly on the wire duct plug board of the modulator cabinet. Connect to the left terminal if modulator No. 1 is to be used, and to the right one if modulator No. 2 is to be used.

Run the other 56-inch long connecting wire from the other modulated r-f channel to the remaining "MICROPHONE-LOCAL CONNECT" terminal on the modulator. The 56-inch long connecting leads are shipped in the wire duct of the modulator cabinet and were previously laid aside.

The function of these two connections is to make possible the control of the carrier of modulated Channel No. 1 or No. 2 from the push-to-talk switch when the microphone is plugged into modulator No. 1 or No. 2 jack. They are required only for local operation and are not necessary for remote control operation.

Bolt all rear panels on the transmitter.

Replace all front wire duct covers.

Make sure the air duct cover is in place on each end of the installation. Install four binder head screws through the assembly holes in both outside cabinet walls of the complete transmitter in order to present a finished appearance.

Remove protective cover plates from the meter and lamp panel of each cabinet. These covers are sheet metal plates used to prevent breakage of the meters during shipment, and are fastened at the top front to the cabinet. To remove the plates, loosen their holding screws a few turns, slip the plates off, and re-tighten the screws. Retain the cover plates for use if the transmitter is re-shipped.

A 30-foot cable supplied with the transmitter and shipped in Box 3 of the power cabinet, is to be used to plug in the rear of the power cabinet and provide a terminus for the telephone lines coming from the remote control location.

Install the 30-foot cable with the terminal block in a place where it will be easily accessible for changing connections to terminals.

Connect the telephone lines to the terminal blocks in such a manner that the two wires of Pair No. 1 will be on terminals 3 and 4. The other telephone pairs must be connected to 5 and 6, 7 and 8, 9 and 10, 13 and 15, 16 and 17, and 2 and 14. One pair may later be moved to terminals 11 and 12 if a low frequency r-f unit is used.

Wire the 220-volt power line to the 4-connection female plug. Connect each side of the line to two prongs in parallel on the plug. A visual inspection of the male socket on the rear of the power cabinet will show which prongs to parallel. No polarity need be observed in connecting the power line.

The r-f units are designed to work into approximately a 500-ohm load. Therefore, some means must be provided for matching the output into an antenna. The two antennas described in the next section have transmission lines connected to the antenna in such a manner as to properly match impedances. These two antennas can be used only on a high r-f unit. A Tuning House is furnished with each low r-f unit to match it to an antenna of certain characteristics as described in Paragraph 10.

Each r-f unit must be connected to a separate antenna for simultaneous multi-channel operation.

21. Antenna Installation.—

The antenna described in this section is easily constructed and will work well with the transmitter.

Use only hard drawn copper wire or copper clad steel wire for the antenna. Soft drawn copper wire will stretch after whipping around in a high wind, thus affecting the resonant frequency. If only soft drawn wire is available, it can be hardened to some degree by stretching it before cutting it to length. The best wire to use is No. 10 B&S gauge enamel covered wire.

Important features to have in mind when constructing an antenna are to have it away from other large objects, especially metal, and to have it as high above the ground as possible —up to a half wavelength.

In the description to follow frequent reference is made to a half wavelength. The number of feet in a half wavelength is figured by dividing the frequency of the transmitter in megacycles into 467.4.

The "Y-Matched" Doublet Antenna resembles a single wire fed antenna, except in the feeder system employed. It is to be used only on the output of a high frequency r-f unit.

The doublet antenna consists of a "flat top" portion cut to an exact half-wavelength of the r-f unit output frequency. A 600-ohm open wire transmission line connects from the two output terminals of the r-f unit to the center of the antenna

Physically, the transmission line should be identical throughout its length, except close to the antenna as explained below. It should be constructed of two copper wires, enamel or tin covered, spaced several inches apart. Spacer insulators should be used sparingly and be made of good insulating material which will not absorb moisture. Lines up to several hundred feet long may be used without serious loss. Space the wires as shown in the following table:

Wire Size B&S Gauge	Spacing Between Conductors (Inches)
8	9½
10	7¾
12	6¼
14	4¾

The line should approach the center of the antenna as near to right angles with it as possible, and when at a distance (in feet) calculated by the expression: "Distance = 147.6 divided by transmitter output frequency in megacycles," must fan out and each wire attach to the antenna on opposite sides of center. The distance (in feet) from each end of the antenna to the nearest feeder wire must be "175 divided by transmitter frequency in megacycles."

22. Installation of Remote Control Equipment.—

All equipment for remote control of the transmitter is shipped in one box marked "REMOTE-BOX 1 of 1." Before installing the equipment at a distance from the transmitter it is suggested, if possible, to make a temporary setup of the remote equipment in the same room with the transmitter, to test for correct operation of all circuits.

The remote equipment consists of the following:

4—Type SA-2/FRC Switch Panels.
2—Type AM-2/FRC Amplifiers
6—Type O-2/FRC Oscillators.
3—Microphones.
3—Sets of Tubes for each Amplifier.
3—Sets of Tubes for each Oscillator.
1—Set of spare parts for remote equipment
4—Cabinet connecting cables for operator Positions 1, 2, 3, and 4.
3—Interconnecting cables for cabinet-to-cabinet connection.

a. General.—The equipment is designed to control the transmitter over a distance of not more than six miles when No. 22 B&S gauge wire is used. If larger size conductors are used a greater separation of transmitter and control equipment is permissible.

The relay voltage supply transformer (T201) is set at the factory for a six-mile line of No. 22 B&S gauge wire. If experience proves that all relays will not operate a higher voltage tap must be selected on the transformer.

Divide the equipment into four groups as described in detail later. Install these four groups, each one in a separate relay rack cabinet, to form four operating positions.

b. Operator No. 1 Position.—The first operating position is known as the master operating position because it is the terminus for transmitter control lines, and the most favorable position when only one operator is on duty.

Select the following items for Position No. 1:

1 Switch Panel.
2 Oscillators.
1 Amplifier.
1 Cabinet Connecting Cable.
2 Z-Brackets and Mounting Hardware

The proper cabinet connecting cable can be identified by the screw-type terminal block attached to it.

Mount the small chassis in Position No. 1 relay rack cabinet with the units arranged in the same order from top to bottom as shown in the remote control interconnecting schematic diagram at the end of this book. The spacing between units must be similar to the spacing between Jones plugs on the connecting cable.

Plug the Jones plugs into the sockets on the small units.

Fasten the screw-type terminal board and the 33-connection Jones socket in any convenient place in the base of the cabinets. Use the Z-brackets furnished for mounting the Jones socket.

Connection of 110-volt a-c power is described in Sub-Paragraph 22, *g*.

Connection of telephone lines is discussed in Paragraph 23.

c. Operator No. 2 Position.—The second operating position requires exactly the same number of units as the first position. The connecting cable for this position is similar to that for position No. 1 except that it contains two 33-connection Jones sockets and no screw-type terminal board.

Install the units in the same relationship to each other as those in Position No. 1.

Fasten the two 33-connection Jones sockets in any convenient place in the base of the cabinet.

The rack must be moved to a location not more than eight feet from Position No. 1.

d. Operator No. 3 Position.—Select for Position No. 3 the following:

1 Switch Panel.
1 Oscillator.
1 Cabinet Connecting Cable.
4 Z-Brackets and Mounting Hardware.

The cabinet connecting cable can be identified by the fact that it has two 33-connection Jones sockets attached to it.

Install the switch panel in the rack at approximately the same height from the floor as the switch panels in Position No. 1 and No. 2. Install the oscillator above the switch panel and close to it.

Mount the two 33-connection sockets anywhere in the base of the rack, using the Z-brackets furnished.

The distance between this position and operating Position No. 2 must not exceed eight feet.

e. Operation No. 4 Position.—The fourth position requires equipment similar to No. 3 position, and is assembled in the same manner. There will be only one 33-connection socket and it may be placed in the cabinet base in any position.

Distance between No. 3 and No. 4 Positions must not exceed eight feet.

f. Interconnection of Operating Positions.—Three 10-foot cables are furnished with each set of remote control equipment. Use these cables to interconnect the four operating positions. Plug into the 33-connection sockets in the base of each position. The three cables are interchangeable one with any other.

g. 110-Volt Power Connections.—Each of the 12 units which make up the four operating positions has a two-connection socket for entry of 110-volt power to the unit. When all units have been interconnected as described in Paragraph 22, Sub-Paragraphs *a* to *f*, the 110-volt circuits of all 12 units are in parallel. Therefore, any one of the 12 sockets may be used for power connection by unplugging the female half of the socket, connecting the power wires to it, and re-plugging it. The female portions are furnished with all sockets to be left as coverings over the unused sockets. This will prevent personnel from accidentally coming in contact with the 110-volt circuit.

CAUTION: DO NOT CONNECT 110-VOLT POWER TO MORE THAN ONE OF THE RECEPTACLES, FOR A SHORT CIRCUIT OF THE POWER SOURCE MAY OCCUR IF THE POLARITY ON ALL RECEPTACLES IS NOT THE SAME.

23. Telephone Line Connections.—

The telephone line requirements of the equipment are as follows:

All wires must provide a direct path between transmitter and remote. Insertion of line-to-line transformers, capacitors, or anything which breaks up the d-c path will prevent operation of the system.

The equipment was designed to operate satisfactorily over any distance up to six miles if the intervening conductors are No. 22 B&S gauge or larger. A greater separation of transmitter and control position is possible through the use of larger wire. For example, a separation of approximately 12 miles is possible by using No. 19 wire.

One pair of wires is required for operation of power circuits at the transmitter. Connect these wires to terminals 2 and 14 on the telephone terminal block at both transmitter and remote. Polarity must be observed in making these connections, as terminal 14 at each end is grounded.

One pair of wires is required for each modulator channel or a total of two pairs. Connect one pair to terminals 13 and 15 at each end, and the other pair to terminals 16 and 17.

The number of additional pairs of wire required depends upon the number of r-f channels to be controlled, one pair for each channel with a maximum of four additional pairs. Since only four channels may be operated simultaneously, only four pairs of channel control wires are needed even though five r-f units are installed at the transmitter. The terminals are:

3 and 4 to control Channel 1
5 and 6 to control Channel 2
7 and 8 to control Channel 3
9 and 10 to control Channel 4
11 and 12 to control Channel 5

The four pairs of telephone wires will be installed on four of the above pairs of terminals and the installation must conform with the setting of the plug board as described in Paragraph 26, and with the wafer switch settings also described in the same paragraph. One of the above pairs of terminals will be unconnected at each end. The unconnected pair will be the channel control circuit for the same channel which is unplugged at the plug board.

NOTICE: When one channel is taken out of service by changing the plug board at the transmitter, and is replaced by a previously unused channel, the telephone lines must be shifted on their terminal boards at both transmitter and remote.

Be sure the telephone lines are connected identically at transmitter and remote. Polarity of the lines need not be observed except on the one line to the power circuits, the one on terminals 2 and 14.

Connect a good earth ground to terminal 14 on the remote equipment telephone terminal board.

24. Teletype Operation.—

Provision has been made for connection of external teletype circuits to the control grid of the crystal oscillator-doubler tube in each r-f unit by means of a concentric line which terminates on the wire duct plug board.

Use a 72-ohm concentric cable with a Signal Corps No. PL-259 plug connector to run into the transmitter and fasten to an SO-239 socket mounted on the wire duct plug board of the unit to be teletype operated.

Leave the square cover off of the wire duct at one end of the installation to provide entry for the concentric cable from the teletype apparatus

When using teletype with any channel, the "M. O.-CRYSTAL SWITCH" inside that channel must be turned to the position marked "TEL."

25. Preliminary Checks.—

Before plugging the power line into the power cabinet, carefully check the transmitter to see that it is ready for operation. Check particularly the following:

(1) See that each tube is plugged into the correct socket and is pushed well down in place.

(2) Check the fuse panel to make sure the rating of each fuse agrees with the value given in Table 1, Paragraph 48.

(3) See that the blower and motor have been oiled.

(4) Check antenna connections for tightness. Each r-f unit must either be properly connected to an antenna or have a non-inductive load resistance of 500 to 600 ohms connected to its output terminals.

(5) If wire ducts are open, check all plug-in connections according to the data given in Paragraphs 15 to 20 inclusive.

(6) Check plug-in coils in each high r-f unit to see that each coil is correct for the assigned operating frequency. (See Table 5, Paragraph 52.) Set M. O. and Crystal Oscillator-Doubler tap switches according to the table.

(7) If crystal control is to be used, see that a crystal of the correct frequency is plugged into the crystal socket, and the "M. O.-CRYSTAL SWITCH" is set to "CRYSTAL."

26. Relay and Fuse Panel Adjustments.—

The two rotary tap switches labelled "MOD. NO. 1" and "MOD. NO. 2" are used to set each modulator channel filament and underload circuits for the desired r-f channel. For example, if it is desired to set the r-f unit occupying Channel 1 position to be modulated by Modulator No. 2, the rotary switch marked "MOD. NO. 2" must be rotated to "1" position. If only one modulator channel is to be used, the rotary switch for the other one should be set to "OFF."

The plug board on the right side of the relay and fuse panel, must be set to correspond with the tap switch settings described in the previous paragraph. The five upper plugs labelled "CHANNEL 1" to "CHANNEL 5" are the high voltage leads to the five r-f channels. The four plugs underneath are four sources of high voltage from the power supply. The two unmodulated r-f channels must be jumpered to the two sources labelled "UNMOD." Either channel may be plugged into either voltage source. The two modulated r-f channels must be plugged into the two sources labelled "MOD. NO. 1" and "MOD. NO. 2." The plugging of these last two channels must correspond to the tap switch setting previously described.

Four jumper connections are supplied with each transmitter. Since only four high voltage connections are provided, only four channels may be connected at any one time.

27. High Voltage Meter Adjustment.—

The single meter at the top of the power cabinet indicates the voltage output of the high voltage power supply. The meter circuit makes use of the power supply bleeder resistors, R203 and R204, as series multiplier resistors for the meter. Since the values of these two resistors may vary as much as 10 per cent from the correct value a variable resistor is provided shunting the meter with which adjustments may be made to correct the scale reading. The meter adjusting resistor is located in front of the main line switch in the power cabinet and is mounted underneath the transformer shelf so its setting cannot be accidentally disturbed. Its setting can be changed with a screwdriver inserted through the oil cup on the front of the shelf.

The meter adjusting resistor has been accurately set at the factory for the original bleeders supplied with the transmitter. If other bleeder resistors are substituted at any time, the accuracy of the meter may be affected slightly, and the adjusting resistor may require readjustment. This can be done by using an external high voltage voltmeter connected from the front end of the bleeder resistor on the right side (when facing the front of the transmitter) to cabinet ground. Unless some accurate means is available for readjusting the meter, the setting of the adjusting resistor should never be changed.

28. High Voltage Time Delay Adjustment.—

A time delay relay is incorporated in the power supply circuit of the transmitter. Its purpose is to prevent application of high voltage to the 872A rectifier tubes until their filaments have become thoroughly heated.

The relay is mounted at the top of the relay and fuse chassis inside the left door of the power cabinet. The timing delay can be varied from 0 to 60 seconds, when operating from a 50 cycle power line. If a 60 cycle power source is used, the dial graduations on the relay will not be accurate, the maximum timing delay being about 50 seconds.

To change the timing of the relay, unscrew the knurled screw on the front of the relay and pull off the plastic relay cover. Rotate the dial until the pointer indicates the desired time delay.

29. Inverse Feedback Adjustment.—

Each of the two audio channels incorporates inverse feedback from the 807 driver stage back to the preceding audio stage. The purpose of the circuit is to reduce noise and distortion in the output of the driver stage.

The amount of inverse feedback can be controlled by a variable resistor, R117 for Modulator 1 and R139 for Modulator 2. These resistors are fitted for screwdriver adjustment and mounted near the top of the vertical shield of the modulator pull-out chassis. No attempt should be made to readjust them from the factory setting unless equipment is available for observing audio waveform and measuring harmonic distortion.

30. Tone Keyer Gain Adjustment.—

The tone keyer amplifier of each r-f unit has a screwdriver adjustable gain control, mounted inside the pull-out chassis, left side, approximately 1 foot from the chassis base. The control is on the small horizontal chassis which contains most of the components of the tone keyer system.

This control must be adjusted after the transmitter and remote control operation is established. Starting with the control in the extreme counter-clockwise position, slowly rotate it clockwise just until the r-f channel responds reliably to CW telegraph keying from the remote control position. The keyer on each r-f channel must be individually adjusted.

To change the setting of this control, first use a wrench to loosen the locknut on the shaft, then rotate the shaft with a small screwdriver.

31. Adjustment of Remote Control Equipment.—

Do not alter the "GAIN" control settings of the O-2/FRC oscillators and AM-2/FRC amplifiers unless necessary. All these controls have been pre-set at the factory for zero db output level (6 milliwatts on a 500-ohm line).

As a general rule, all gain adjustments to compensate line loss are made at the transmitter with the "AUDIO GAIN" dials on the modulator and the keyer gain screwdriver adjustments on each r-f unit. In the case of extra long or high resistance control wires, if the audio level is still too low even with "AUDIO GAIN" controls at maximum, the remote unit "GAIN" adjustments must be raised. Increase the gain as little as possible to keep the input power to the lines close to zero level.

Never disturb the screwdriver adjustments in the top skirt of the chassis.

As voice power and waveform vary considerably with individuals, it is permissible to slightly re-adjust the "GAIN" setting of the amplifier units to compensate for operators with extra loud or soft voices.

If it becomes necessary to readjust the gain or frequency settings of the oscillator tones the following procedure is recommended:

1. Set the frequency selector switch at 400 cycles.
2. Set the front panel gain control R502 for maximum gain.
3. Adjust R501 for an output level of 6 db on a 500-ohm line (zero db equals 6 milliwatts on a 500-ohm line).
4. Adjust the frequency to within plus or minus 5% of 400 cycles by selecting taps on the plate circuit winding of transformer T501.
5. If output level has changed readjust R501 (see note 3 above)
6. Set the frequency selector switch at 1,000 cycles.
7. Adjust R506 for an output level of 6 db.
8. Adjust left hand section (when facing the front of the panel) of C502 until the frequency is within plus or minus 5% of 1,000 cycles

9. Readjust R506 for proper level.
10. Set the frequency selector switch at 1800 cycles.
11. Adjust R507 for an output level of 6 db.
12. Adjust the right hand section of C502 for a frequency of 1800 cycles, plus or minus 5%.
13. Readjust R507 for proper level.
14. Adjust the gain control R502 for an output level of zero db.

A locknut holds each gain adjustment against accidental disturbance. When changing the settings, first loosen the shaft locknut with a wrench, make the adjustment with a screwdriver, then retighten the locknut. The remote units must be dismounted from the rack and the top chassis skirt removed in order to reach the locknuts. On tone generators preceding Serial No. 433 and microphone amplifiers preceding Serial No. 145 the top skirt is not removable but there is sufficient space between the chassis and front panel to allow access to the shaft locks. If frequency changes are required, tighten the locknut sufficiently to bind the shaft but not completely lock it. Then adjustments can be made without loosening the shaft locks.

32. Master Oscillator Frequency Setting.—

When using the master oscillator, set the "MASTER OSC. TUNE" dial according to the tuning charts on the inside of the cabinet doors. Each oscillator is individually calibrated at the factory and a chart for each of the six bands is mounted in a holder.

The operator must not place too much reliance on the accuracy of the oscillator setting unless it is checked with a frequency meter. The master oscillator is intended for emergency use, in case of failure of or loss or damage to the crystal.

33. Changing Frequency Range—High R-F Unit.—

Table 5 in Paragraph 52 gives complete data for setting all adjustments and selecting the correct coil to use for any output frequency. Master oscillator and crystal oscillator bands are shifted by tap switches mounted inside the r-f unit. I. P. A., P. A. driver, and P. A. stages are shifted to various ranges by changing plug-in coils.

When setting the r-f unit on any particular output frequency, look down the output frequency column to find the group of frequencies in which the desired frequency is included. Then read horizontally across the page for the proper tap switch settings and the proper plug-in coils to use.

The second column shows the range of frequencies in which the crystal frequency should fall for any output frequency. In some cases the crystal frequency will be the same as the output frequency, and in other cases it will be exactly half or exactly a third of the output frequency.

The last column "P. A. AIR PADDERS" refers to the two air di-electric fixed capacitors, C40 and C41, mounted in the power amplifier stage. For the first two ranges, these capacitors must be linked, one in parallel with each section of the "P. A. PLATE TUNE" capacitor. For all other ranges, the two padders must be disconnected. A cap on a flexible shield braid lead is provided to act as a link when required.

34. Changing Frequency Range—Low R-F Unit.—

Master oscillator and crystal oscillator stages are shifted from one range to another with tap switches just as they are in the high r-f unit. Band changing in the I. P. A., P. A. driver, and P. A. stages is done by changing taps on the variometer and also linking in the proper capacity

value. Tables 2 and 3 show tap switch and coil tap settings. Use Table 2 if the self-excited master oscillator is being used, and Table 3 for crystal control operation. Table 4 shows the amount of capacity which must be used for each range of output frequencies.

A sufficient number of links are supplied with each transmitter so that any combination of fixed capacitors can be linked into any stage. Capacity values are marked on each capacitor.

The I. P. A. plate circuit capacitors are located close to the I. P. A. tube and variometer at the rear of the I. P. A. and P. A. driver shelf.

The P. A. driver capacitors are on the same shelf closer to the front of the cabinet. Two groups of capacitors are used in series. Each group has its capacitors mounted in a compact group, one on the left and the other on the right side of center. Notice that the capacity values given in Table 4 are for each of these groups.

The P. A. input capacitors are mounted in a group on the same shelf as the four 810 tubes. The four frequency changing capacitors are mounted directly to the shelf and the plate blocking capacitors mounted on top of one of them. The three frequency changing capacitors are the only ones to be switched when changing frequency range. The fourth, the one under the blocking capacitor, is 1000 mmf and must always be left in the circuit.

The P. A. output capacitors are mounted at the extreme top of the unit, underneath the top of the pull-out chassis.

35. Preliminary Tuning Procedure.—

Before connecting power to the transmitter, set all seven toggle switches on the power cabinet and the main line switch to "OFF." Rotate both "GAIN" controls on the modulator to the extreme counter-clockwise position. Set the "TEST" keys of all r-f units to the center position. Set the "LOCAL-REMOTE" switch to "LOCAL" and the "TUNE-OPERATE" switch to "TUNE."

Set "STANDBY" switches on all units to right hand or "ON" position, and "INTERLOCK" switches to right hand or "OFF" position. Roll all pull-out chassis into their cabinets.

36. Local Tune-Up—High R-F Channel.—

Plug the power line into the rear of the power cabinet.

Throw the main line switch to "ON."

Turn the "FILAMENTS" switch "ON." The relay E201 on the relay and fuse panel will close, the 872-A rectifier tubes and the green indicator lamp on the power cabinet will light, showing the filament power circuits are energized.

Allow time for the time delay relay to cycle then test for plate voltage by toggling the "PLATE" switch to "ON." The power cabinet doors must both be closed or the door interlock switches held closed by hand and all roll-out chassis must be in their cabinets. If the plate voltage circuits are working, the heavy plate contactor will be heard closing, the red indicator lamp will light, the high voltage meter will indicate approximately 800 volts, and the blower will start. Feel above each cabinet except power cabinet to be sure exhaust air is coming from each one, indicating the air circulating system is functioning. Turn plate voltage "OFF" with the "PLATE" switch.

With the power cabinet "FILAMENTS" switch "ON," the "STANDBY" switch of each r-f and modulator unit in the right hand position, and all power cabinet "CHANNEL" switches "OFF," observe the tube filaments in all units. All tubes except the Type 810's should be lighted. The VR105 tubes have no filaments, and therefore will be dead until the transmitter is operating. If metal tubes are used, check their filament circuits by feeling the metal shell of each one after power has been applied a few minutes. A tube which remains cold does not have its filament lighted.

As the first channel to be tuned will usually be Channel 1, the following description refers to Channel 1 relays, etc. The same description applies also to the other high r-f channels.

During the first tune-up of each r-f unit, it is generally advisable to have the unit in the pulled-out position, so that tube plates can be observed. After the original tune-up, however, leave the unit in its cabinet when tuning any of the circuits.

Pull Channel 1 r-f unit out of its cabinet while initial tuning is in process. Leave all other units in their cabinets and the power cabinet doors closed in order to complete the plate voltage interlock circuit. In order to maintain continuity in the interlock circuit when Channel 1 or any other unit is pulled out, change the "INTERLOCK" switch of that unit from the left to the right position. Always, when returning a unit to its cabinet, turn the "INTERLOCK" switch off, that is, to the right position again.

Make temporary connections from the output terminals on Channel 1 pull-out chassis to the antenna connections on top of the cabinet. Use the two clip leads provided for this purpose and shipped in box 3 of the power cabinet.

Turn "ON" the "CHANNEL 1" switch on the power cabinet.

Channel 1 filament relay E204 will close and the 810 tubes and indicator lamp on the channel will light.

The following description assumes that master oscillator and crystal band switches have been set properly for the output frequency. The correct P. A., P. A. driver, and I. P. A. plug-in coils, and the correct tap switch settings are given in Table 5, Paragraph 52, for every output frequency within the range of the high r-f unit.

Use the graph included in the Supplementary Data of this book, Figure 2, to set the "CRYSTAL OSC. DOUBLER TUNE" dial for the output frequency of the r-f unit. Notice that the graph gives crystal frequency and not output frequency. Refer to Table 5 for the crystal frequency for any output frequency.

Set the r-f channel meter switch to "CRYSTAL OSC. DOUBLER PLATE MILLIAMPERES" and slightly readjust the crystal stage for center of resonance as indicated by minimum reading of the "MILLIAMPERES" meter.

Set the "TEST" key to the upper or locking position.

Rotate the meter selector switch to "P. A. DRIVER GRID MILLIAMPERES," then tune the "P. A. DRIVER GRID TUNE" dial to maximum current, which should be at least 6 ma.

CAUTION: THE P.A. DRIVER STAGE MAY BE DRAWING EXCESSIVE PLATE CURRENT WHEN ITS GRID CURRENT IS TUNED, THEREFORE, IMMEDIATELY TUNE THE PLATE CIRCUIT TO RESONANCE AS DESCRIBED IN THE NEXT PARAGRAPH.

Rotate the meter switch to "P. A. GRID MILLIAMPERES," and tune the "P. A. DRIVER PLATE TUNE" dial to maximum current, which should be at least 100 ma. At this point, re-check dial settings of all dials previously tuned, to maximum P. A. grid current. Be sure not to disturb the setting of the master oscillator dial if that stage is being used.

Turn the "NEUTRALIZING" dial to 0.

With the meter switch still set for "P. A. GRID MILLIAMPERES" make preliminary neutralization of the power amplifier stage as follows:

Rotate the "P. A. PLATE TUNE" dial over the entire 180° of its travel, at the same time observing the grid current of the stage on the meter. Adjust the "NEUTRALIZING" dial until the grid current does not vary when the tuning dial is rotated throughout its range. When this condition is obtained, the channel is sufficiently well neutralized so the plate circuit may be tuned.

In the r-f unit, uncouple the antenna by rotating the P. A. coupling coil as far as possible out of alignment with the main coil.

Close the "PLATE" switch on the power cabinet.

Tune the "P. A. PLATE TUNE" dial to resonance as indicated by minimum current on the "POWER AMP. PLATE" meter.

Using a rod of good insulating material, slowly push the antenna coupling coil into better alignment with the P. A. coil. Couple very slowly returning the "P. A. PLATE TUNING" dial to resonance at frequent intervals. Load the P. A. stage until the plate current shows about 200 ma.

The r-f channel is now operating at approximately one-quarter power output.

Turn off "PLATE" voltage, remove the temporary antenna connections, and push the r-f unit into its cabinet. De-tuning will occur when the unit is pushed in the cabinet, therefore, re-check the tuning of all dials except "MASTER OSCILLATOR TUNE" and "NEUTRALIZE." Check particularly the "P. A. DRIVER GRID TUNE" dial.

CAUTION: ALWAYS TURN THE "INTERLOCK" SWITCH OFF, THAT IS, TO THE RIGHT POSITION WHENEVER THE R-F UNIT IS IN THE CABINET.

Change the "TUNE-OPERATE" switch to "OPERATE" and turn on plate voltage.

Check the power amplifier plate current of the r-f channel. Full power output occurs at approximately 400 ma plate current. Adjust the antenna coupling coil, at the same time maintaining resonance with the tuning dial until the power amplifier plate current reaches 400 ma. When making these final adjustments on the antenna coupling, be SURE the "INTERLOCK" switch is in the right position. Pull out the unit, slightly change the position of the coupling coil and return the unit to the cabinet to re-check the plate current and re-tune for resonance. Repeat this procedure until the unit is fully loaded.

In order to obtain good waveform for high speed keying, the r-f channel must be very carefully neutralized. This is particularly true for the higher output frequencies. The preliminary neutralization procedure as already described is satisfactory until the power amplifier stage is fully tuned and loaded into the antenna. Then, with normal voltage applied to all circuits, and with the r-f unit in its cabinet, carefully neutralize the unit as follows:

Set the meter selector switch to "P. A. GRID MILLIAMPERES." Now, the left meter shows power amplifier grid current, and the right meter shows power amplifier plate current. The object of the neutralizing procedure is to so adjust the "NEUTRALIZING" dial that the points of minimum plate current and maximum grid current fall at EXACTLY the same place on the "P. A. PLATE TUNE" dial. Set the tuning dial at the exact center of plate current dip, then slowly detune a short distance on one side of resonance while observing the grid meter. The pointer of the meter must never rise, even slightly, but should either remain motionless or gradually fall as the stage is detuned from resonance. Again set the tuning dial for the center of the plate current dip and repeat the same procedure on the other side of resonance. If a grid current rise is observed on either side of resonance, change the neutralizing capacitor setting slightly and again test on either side of resonance. Repeat the procedure, changing the neutralizing capacitor a little at a time until perfect neutralization is attained.

Lock all dials and record their settings when tuning is complete.

Place the "TEST" key in neutral position and turn "OFF" the "CHANNEL 1" switch before attempting to tune-up the second channel.

When the first channel is properly tuned and neutralized, return the "TUNE-OPERATE" switch to "TUNE" and repeat the procedure with the other r-f units.

37. Local Tune-Up—Low R-F Channel.—

This channel, Channel 5, is tuned similarly to a high r-f unit, except the grid currents to the P. A. Driver and P. A. stages will be approximately 18 ma and 225 ma respectively.

The graph in the rear of the book, Figure 6C, shows the approximate dial position of the power amplifier stage when the stage is loaded to 1000 watts output. The unloaded dial positions will vary considerably from those shown on the graph. To avoid damaging power amplifier tubes, have the "TUNE-OPERATE" switch in the "TUNE" position until antenna resonance is found and the transmitter at least partially loaded. In addition, de-tune the "I. P. A. PLATE TUNE" dial until the plate current meter of the power amplifier stage reads about 700 to 800 ma when the power amplifier is tuned out of resonance.

Tuning the low r-f unit into an antenna is necessarily a cut-and-try process, since dial setting on both power amplifier tuning and antenna tuning controls will vary unduly according to antenna characteristics. Once the dial settings are determined for a certain frequency with a given antenna, they should be recorded for future reference. The following instructions are general.

In the antenna tuning house, clip the transmission line connection 30 turns from the bottom of the coil, and the antenna connection at the top of the coil.

Use the graph in Figure 6C and set the "P. A. PLATE TUNE" dial as close as possible to the setting indicated on the graph for the output frequency being used. As mentioned before, this dial setting approximates the correct setting when the transmitter is fully loaded, but the power amplifier will not be in resonance at this setting until it has been loaded. Leave the dials on the transmitter alone and make all adjustments at the Tuning House until at least a small reading is obtained on the antenna ammeter. When there is an indication of antenna current then the transmitter "P. A. PLATE TUNE" dial may be readjusted to resonance.

Check to make sure the transmitter is set for "TUNE," then turn on the "PLATE" switch. Detune the "I. P. A. PLATE TUNE" dial as previously described. Be cautious when turning on plate voltage because the power amplifier current may be excessive. A safe method is first to detune the "I. P. A. PLATE TUNE" dial about 10 or 15 dial divisions before turning on plate voltage, then return the dial enough to obtain 700 to 800 ma out-of-resonance plate current in the power amplifier.

The general idea in coupling the low r-f unit to the antenna is first to find resonance in the antenna and then to increase or decrease loading to the desired power output.

The adjustments affecting antenna resonance are:

a. Position of the antenna clip on the antenna coil. Start with the entire coil in the circuit, then clip the antenna down on the coil, turn by turn, until the proper amount of inductance is found to resonate the antenna.

b. Setting of the "TUNING" dial on the tuning house. The inductance of the antenna coil can be varied slightly with the dial. However, the tuning circuit consists of a one turn shorted link inside the coil and is designed only for fine adjustment between turns on the coil. Major adjustment is clipping the antenna on at the nearest turn to the correct inductance.

The adjustment affecting antenna loading are:

a. Position of the transmission line clip on the coil. Because of variations in individual antennas, the exact setting of the tap must be determined by experiment. Start with the clip on about the 30th turn from the bottom and move it downward until the desired loading is reached.

b. Setting of the "P. A. PLATE TUNING" dial on the transmitter. This dial must be returned to resonance every time any change is made in any circuit at the Tuning House.

However, as described in previous paragraphs, the dial must be left at the graph setting until there is an indication of antenna current.

When the meter begins to indicate antenna current readjust the "P. A. PLATE TUNE" dial to resonance as indicated by minimum plate current, then experiment with the antenna clipped on various turns until the position is found giving maximum antenna current with the "TUNING" dial as near mid-range as possible. Every time the antenna clip is changed, be sure to return the power amplifier stage to resonance.

When the antenna clip has been set correctly, and the power amplifier set to resonance, retune the "I. P. A. PLATE TUNE" dial for maximum power amplifier plate current, if such is not excessive. Also keep a check on the antenna current meter during loading to see that it is not overloaded.

Change the transmitter from "TUNE" to "OPERATE," then load the power amplifier to between 800 and 1000 watts output, by moving the transmission line tap down on the antenna coil turn by turn.

CAUTION: NEVER ATTEMPT TO CHANGE TAPS ON THE ANTENNA COIL UNLESS YOU ARE POSITIVE THE TRANSMITTER PLATE POWER IS TURNED OFF AND WILL NOT BE ACCIDENTALLY TURNED ON WHILE YOU ARE MAKING ADJUSTMENTS. EXTREMELY HIGH VOLTAGE CAPABLE OF DESTROYING HUMAN LIFE IS PRESENT ON THE ANTENNA COIL WHEN IT IS TUNED TO RESONANCE.

Use the "POWER AMP. PLATE" meter to indicate loading. Compute power output as described in Paragraph 38. The antenna ammeter reading is of no value unless the loading is being done to a previously determined current value with the same antenna. Load the r-f unit to about 800 or 1000 watts output. At this power output, the ordinary tower radiator will be radiating approximately 600 watts.

Short the antenna ammeter with the knife switch when tuning is completed.

Use the method of neutralizing given in Paragraph 36 for a high frequency channel. Generally speaking, the neutralization of the low r-f channel is not as critical as for a high r-f unit.

Lock all dials and record their settings when tuning is complete.

38. Computing Power Output.—

Measuring power output of an r-f channel is difficult and requires special measuring instruments. The power output can be computed by the following means and will be accurate enough for most purposes:

Have the channel completely tuned and loaded into the antenna.

Read the high voltage as shown on the power cabinet meter.

Compute the plate current of the power amplifier by taking the reading of the "POWER AMP. PLATE" meter which actually reads combined plate and grid current, and subtracting the grid current as shown on the other meter with the meter switch in the "P. A. GRID MILLIAMPERES" position.

Multiply plate voltage by computed plate current to find the d-c power input to the final amplifier.

Assume the channel is operating at 80% efficiency.

Multiply the power input by 80% to find the approximate power output.

39. Modulator Testing.—

The following description assumes that the "MOD. NO. 1" and "MOD. NO. 2" tap switches and the high voltage plug board on the relay and fuse panel have been set correctly as previously described, and the modulated r-f channels have been tuned and loaded into their respective antennas.

Turn on the r-f channel to which modulator No. 1 is connected. Put the "TEST" key in center position. Filament and power circuits in the modulator channel will be energized automatically at the same time, provided the "STANDBY" switch on the modulator is in the right hand position.

Turn the "METER SELECTOR SWITCH" on the modulator to "MODULATOR 1" position.

Plug a microphone into the left or modulator No. 1 "MICROPHONE" jack. Use one of the microphones furnished with the equipment or one which has the same push-to-talk switch arrangement and plug polarity.

Set the "MICROPHONE-LOCAL-REMOTE" switch to "LOCAL."

Press the microphone push-to-talk switch, and while talking into the microphone, adjust the "AUDIO GAIN" control for modulator No. 1 until the modulator current meter rises to approximately 250 ma on peaks.

For more accurate adjustment to 100% modulation, use an oscilloscope with built-in sweep circuit. Use a coil of several turns of wire coupled to the r-f channel output coil for r-f pickup. Attach the pickup coil directly to the vertical plates of the oscilloscope. Vary the coupling to the r-f channel until a pattern of suitable height is obtained. Adjust the "GAIN" control until the negative peaks, or volleys in the pattern, just touch the horizontal axis.

When the "AUDIO GAIN" setting for 100% modulation is found, record the dial reading for future reference. The setting is correct for local operation only. When operating remotely, the dial will probably have a different setting as explained in Paragraph 40.

Similarly adjust the audio gain for modulator No. 2 with its associated r-f channel.

40. Remote Control Operation.—

Controls at the transmitter must be set as follows to permit remote control:

The "LOCAL-REMOTE" switch on relay and fuse panel set to "REMOTE."

The main line switch S201 turned "On."

The "TUNE-OPERATE" switch set to "OPERATE."

The "FILAMENTS" switch on the power cabinet set to "OFF."

The "PLATE" switch on the power cabinet set to "ON."

All "CHANNEL" switches on the power cabinet set to "OFF."

The "STANDBY" switches on all units which will be operated set to the right hand position.

The "INTERLOCK" switches on all units set to the right hand position.

All units pushed in their cabinets and power cabinet doors closed.

Power and telephone line connections made.

The description given in this section assumes that all remote control equipment has been interwired and connected to the transmitter as described in Section II.

Generally speaking, all channels at the transmitter can be controlled from any one of the four operating positions. However, the exception to this is that each of the two channels to be modulated is assigned as desired to a particular operating position and the equipment pre-set so that the modulated channels can only be operated from their respective positions. The pre-setting consists only of setting the "OPERATOR" switch on each of the two Type AM-2/FRC amplifiers

to the position from which operation is desired. The amplifier mounted in Operator No. 1 position is not for exclusive use of the No. 1 operator, but for the use of the operator designated by the setting of its "OPERATOR" switch. This unit is the line amplifier associated with modulator No. 1 at the transmitter. The amplifier mounted in operator No. 2 position is likewise for use by the operator designated by its tap switch setting. It is associated with modulator No. 2 at the transmitter.

Each of the two amplifiers has an associated oscillator mounted adjacently to it in the operating position. The oscillator supplies audio tone to the amplifier for MCW operation. The amplifier itself amplifies both the voice currents from the microphone, and tone from the oscillator.

Two types of microphone push-to-talk operation are available. If MCW is being used, the "POWER" switch of the particular MCW tone oscillator is "ON," and the r-f carrier is on steadily. Pressing the push-to-talk microphone switch does not disturb the carrier, but cuts off the audio tone, leaving the carrier clear for voice modulation. If CW telegraph is being used, the MCW tone oscillator is "OFF," causing the microphone push-to-talk switch to control the r-f carrier, turning it on when the switch is pressed. This allows break-in operation if desired.

The following description of the operation is for operator No. 1 position, but applies also to the other three positions.

On the type O-2/FRC CW keying oscillator, turn the "POWER" switch to "ON." The CW keying oscillator is the one mounted adjacently to the switch panel. This unit is used to send audio tone signals to the keying circuits at the transmitter and is used for all types of emission, to key the carrier for CW telegraph and to hold the carrier on steadily for telephone and MCW telegraph.

If position No. 1 is one of the positions operating a modulated r-f channel the associated AM-2/FRC amplifier must be turned "ON." If combined MCW and telephone operation is desired, also turn "ON" the type O-2/FRC oscillator adjacent to the amplifier. For straight telephone or break-in telephone, leave the oscillator "OFF."

To turn on the transmitter, push the "POWER" lever key on the switch panel to the downward position. The red panel lamp will light on all operating positions.

Push the "CHANNEL" lever key downward for the channel to be operated. The corresponding panel lamp will light in all four operating positions but the channel itself will not come on until the time delay relay has had time to cycle and apply plate voltage to the transmitter.

NOTE: If the transmitter is operating in a room where the temperature is below 0° F., the remote "POWER" switch must be "ON" at least two minutes before any channel is turned on. This permits the 866/866A tubes, which have no other time delay protection, to become well heated.

For CW telegraph, plug a key into the "KEY" jack of the CW keying oscillator, the one adjacent to the switch panel.

For telephone operation, plug a microphone into either the "MOD. NO. 1" or "MOD. NO. 2" jack on the switch panel. Use only the jack which is associated with the modulator and r-f channel for which the operating position has been designated.

For MCW operation, plug either a hand key or automatic keyer into the "KEY" jack of the oscillator adjacent to the amplifier.

Close the telegraph key and have someone at the transmitter adjust the r-f unit keyer gain control until the channel can be keyed satisfactorily. This procedure is described in Paragraph 30.

Push the microphone switch and while talking into the microphone have someone at the transmitter adjust the "AUDIO GAIN" for 100% modulation. The same method is used as described for local operation in Paragraph 39. The setting should be recorded for use on remote control operation.

"GAIN" controls on the Type O-2/FRC oscillator and AM-2/FRC amplifier should not be disturbed except as described in Paragraph 31

Follow the above procedure for the other three operator positions, preferably testing and adjusting one r-f channel from each position, to check correct operation of all remote control equipment.

Several special types of operation are available for use if desired. One operator may simultaneously key two or more r-f channels with the same key by pushing down "CHANNEL" switches on the same switch panel of all r-f channels he desires to key. Two or more operators may key the same channel by pushing down the "CHANNEL" switch of the desired channel on each operating position.

Unless the above special types of operation are desired, each operator must use care not to push down any "CHANNEL" key switch if the corresponding panel lamp is lighted, which indicates the channel is already in use by another operator. However, it is desirable for each operator to have his "POWER" key down to avoid accidental power shut-down by another operator.

To prevent any operator from accidentally plugging a microphone into the wrong jack, empty plugs or wooden plugs may be inserted into all jacks not to be used.

The automatic keyer, if one is in the installation may be used for keying both CW telegraph and MCW, by plugging it into a CW keying oscillator, or an MCW oscillator respectively.

SECTION III. MAINTENANCE AND REPAIR

41. Periodic Inspections.—

Make a careful examination of the transmitter and remote control position at least once a week, preferably immediately following a continuous run of several hours.

Record all meter readings. In the case of the "MILLIAMPERES" meter on each r-f cabinet, record the readings taken at every position of the "METER SELECTOR SWITCH," and on the modulator cabinet take readings for both positions of the "METER SELECTOR SWITCH." A comparison of these readings will show any sudden or gradual change in tube or operating conditions. A decrease in a plate current reading may indicate loss of emission in a tube filament. Tubes showing signs of failure should be replaced at once.

Examine indicator lamps and replace those that have burned out.

Upon shutting down after a long period of continuous operation, pull out the modulator and r-f pull-out chassis and carefully feel transformers and other major components for signs of excessive heating. No components except tubes and ferrule type resistors should be too hot to touch.

Fill the two oil cups on the blower and the two on the motor with heavy weight motor or machine oil.

If the transmitter is operated less than 85 hours per week, average, the blower need not be oiled except at the bi-monthly inspections described as follows.

42. Bi-Monthly Inspections.—

Every two months, the regular inspection should be more thorough and, in addition to the items listed in the last section, should include the following:

a. Examine all relays—six on the relay and fuse panel in the power cabinet, two in each r-f unit, one in each modulator cabinet, and one in each remote amplifier, for contact pitting and tightness. Move the armature of each one by hand to make sure it is free. Remove slight irregularities of the contact surfaces with a burnisher. Do not use a file or sandpaper. After burnishing, clean the contacts with alcohol, carbon tetrachloride, or ethyl acetate. If the contacts are badly pitted, replace them with spare contacts from the spare parts group. The contacts of the large plate contactor E203 do not need servicing unless they wear completely away, then they must be replaced.

b. Clean the equipment. Dust the outside surfaces with a cloth. Remove grease or finger marks with carbon tetrachloride on a clean cloth. Do not use soap or scouring powder. If the equipment is installed in a location free from dust, the appearance of the cabinets can be enhanced by applying a SMALL amount of furniture polish on a dry cloth to the outside wrinkle surfaces.

The interior of the cabinets can most easily be cleaned by blowing out with compressed air. If the latter is not available, dust off the accumulated dirt with a dry cloth. A grease solvent such as carbon tetrachloride may be used to clean off finger marks and grease if care is used not to let the cleaner come in contact with the symbol stamping as it may be dissolved. Avoid the use of carbon tetrachloride on any items containing rubber as it has a harmful effect on rubber.

c. Clean the air filter as described in Paragraph 46.

d. Check adjustment of gain controls on all units as described in Paragraph 31.

e. Check blower fan belt and replace when it shows signs of wear.

43. **Table of Routine Inspection and Service.—**

a. Weekly.—

Record all meter readings.

Examine indicator lamps.

Check for signs of overheating.

Oil blower and motor.

b. Every two months.—

Examine relays for free movement.

Examine relay contacts for pitting and replace if necessary.

Clean transmitter and remote equipment.

Clean air filter.

Check adjustments.

Check blower fan belt.

44. **Servicing Equipment Required.—**

The following equipment should be available on short notice for testing the transmitter in case of breakdown.

a. A Type I-56-C Signal Corps test set for making current, voltage, and resistance measurements and for testing most of the tubes.

b. A tool kit including a 100-watt soldering iron, large, medium, and small screwdrivers, pliers, a set of small open end wrenches and a relay burnishing tool. The Allen wrench required on the blower is in a small cloth bag attached to the blower. The tool kit should also include a supply of heavy motor oil, a medium sized oil can, and a supply of carbon tetrachloride or ethyl acetate.

45. **Methods of Testing Components.—**

a. Fuses.—Open the main line switch, then remove fuses from their clips, one at a time, and measure their resistance with an ohmmeter. All fuses must measure less than 25 ohms.

b. Capacitors.—A capacitor must always have at least one of its terminals disconnected from the circuit while being tested. Those which have broken down to provide a moderately low resistance or dead short circuit can readily be detected by resistance measurement with the test set. Intermittent capacitor failures can often be detected by connecting a high range voltmeter in series with the capacitor and applying a suitable voltage, not to exceed the working voltage rating. If the voltmeter does not return to zero, the capacitor is defective. Other checks of capacitor operation are difficult with field equipment and it is usually advisable to substitute a new capacitor for the one in question.

c. Inductors.—Trouble in a tuning coil is generally due either to an open circuit or to insulation breakdown between turns. A careful visual inspection will often reveal it. An ohmmeter may be used to detect an open circuit in a choke or tuning coil or a short circuit in a choke coil if it is sensitive enough to indicate a resistance of only a few ohms. If the inductor is connected in a circuit which provides a d-c shunt path around it, the inductor must have at least one terminal disconnected if a true indication is to be obtained.

d. Resistors.—The resistance of a resistor may be checked with an ohmmeter and compared with the value given in the parts list. It is advisable always to disconnect a resistor from the rest

of the circuit while measuring its resistance, as it may have shunt paths around it which are easily overlooked, but which affect the accuracy of the measurement.

e. Transformers.—Each winding of a power transformer may be tested for voltage and the values compared with those given in the parts list. Audio transformers may be tested with an ohmmeter to detect open or short circuits.

f. R-F Circuits.—Care should be used when measuring plate and grid voltages on an r-f unit. Unless the test meter is suitably by-passed to prevent r-f current from entering and damaging it, always measure d-c voltages at a point of zero r-f potential; that is, at the cold point on a coil rather than directly on the plate or grid connection of the tube.

46. Servicing Procedure.—

a. Lubrication of Air Circulating Mechanism.—Use heavy weight motor or machine oil to lubricate the blower and motor bearings. Open the power cabinet front doors and fill the front oil cup on both blower and motor. Remove the lower rear panel of the power cabinet and fill the rear oil cup on each of the units.

b. Cleaning of Air Filter.—Take out the air filter by first removing the center rear panel from the power cabinet, then pulling the filter out through the back of the cabinet. Wash the screen by agitating it in hot water until the dirt is removed. If the screen is very dirty, washing soap may be used in the water. Rinse and dry the filter thoroughly, then re-oil the screen by spraying with light weight machine oil. Use oil sparingly and allow any excess to drain off. A small hand sprayer is ideal for this job. However, if none is available sprinkle oil over the screen then allow the screen to drain at least 4 hours before replacing in the transmitter.

c. Replacing Indicator Lamp Bulbs.—One type lamp bulb is used for all indicator lamps in both transmitter and remote equipment. To replace a bulb, use a screwdriver to pry off the jewel from the front of the panel, then unscrew the bulb.

d. Replacing Fuses.—Always open the main line switch before attempting to replace a fuse. When replacing a blown fuse, check the rating on the fuse against the value given in Table 2, Paragraph 48.

e. Main Line Switch Re-Set.—The main line switch, S201, is equipped with an internal thermal cut-out which opens the power line circuit in case of a serious overload in the transmitter. After the switch has opened by thermal action, move the switch lever as far as possible beyond the "OFF" position, then return it to "ON."

f. Removing Pull-Out Chassis from Cabinet.—Each of the pull-out chassis can be taken completely out of its cabinet for servicing. Procedure is as follows:

Roll the chassis out as far as possible.

Unplug flexible cables from pull-out chassis.

On each roller mechanism, lift the stop arm up over the stop bracket and push the arm back into the main body of the mechanism. The stop arm and stop bracket ordinarily engage each other to prevent the unit from being pulled out completely. When they have been disengaged, roll the chassis out several inches further and then lift it free of the cabinet.

When replacing a unit in the cabinet push the stop arm back to its recessed position, lift the unit and roll it approximately 6 inches into the cabinet. Then lift the stop arm up and over in front of the stop bracket.

Because of the weight of each unit, two men are usually required to take one out of its cabinet.

47. **Checking Transmitter Failures.—**

In the event of a breakdown, an experienced maintenance man will usually be required. However, the following checks may be quickly made by less experienced personnel:

a. Make certain that 220-volt power is still available from the power house.

b. Check to see whether any external connections such as antenna connections, power line, or telephone line connections have become loosened or disconnected.

c. Unplug power from the power cabinet, then cautiously feel all components to detect signs of overheating.

d. Check all fuses after the main line switch has been opened.

e. Pull out each rack and check the tubes. Make sure each tube is pushed well down in its socket and see that all glass-type tubes are lighted. Cautiously feel all metal type tubes to see whether they are warm.

f. Test all tubes suspected to be at fault or replace with ones known to be good.

g. Compare meter readings with those taken at the previous inspection period. A wide variation in any reading may indicate the source of trouble, possibly a faulty tube.

h. Examine relays for free movement of the armature.

i. Make sure r-f unit plug-in coils are firmly in place.

j. If the trouble is in an r-f unit, switch from crystal to master oscillator on the same frequency, or vice versa.

k. Remove covers from all wire ducts and check plug and jumper connections, making sure each plug is pushed well into its socket and each jumper wire is making good connection.

SECTION IV. SUPPLEMENTARY DATA

48. Table 1—Transmitter Fuse Ratings and Operating Currents.—

Symbol	Fuse Rating (Amps)	Fuse Current (Amps)	Symbol	Fuse Rating (Amps)	Fuse Current (Amps)
F201	60	35	F211	2.5	2.3
F202	60	35	F212	5	2.44
F203	1	0.2	F213	1.6	0.9
F204	35	19	F214	1.6	0.9
F205	5	2.7	F215	1.5	0.5
F206	1	0.88	F216	1.5	0.5
F207	2.5	1.5	F217	1.5	0.4
F208	2.5	1.5	F218	1.5	0.4
F209	2.5	1.5	F219	1.5	0.8
F210	2.5	1.5	F220	1.5	0.8

49. Table 2—Output Frequency versus Coil Taps—T-5/FRC Low R-F Unit (Master Oscillator Operation).—

Output Frequency (Kilocycles)	M.O. Band Switch Tap No.	Crystal Band Switch Tap No.	I.P.A. Tap No.	P.A. Driver Tap No.	P.A. Tap No.
150-176	6	3	1-8	1-8	1-6
176-195	5	3	1-8	1-8	1-6
195-216	4	3	2-7	2-7	1-5
216-240	3	3	2-7	2-7	1-5
240-255	2	3	2-7	2-7	1-5
255-266	2	2	3-6	3-6	2-5
266-300	1	2	3-6	3-6	2-5
300-350	6	3	3-6	3-6	2-5
350-370	5	3	3-6	3-6	2-5
370-430	4	3	4-5	4-5	3-4
430-480	3	3	4-5	4-5	3-4
480-500	2	3	4-5	4-5	3-4
500-520	2	2	4-5	4-5	3-4
520-550	1	2	4-5	4-5	3-4

Use this table in conjunction with Table 4. See Paragraph 34 for explanation of the above table.

50. Table 3—Output Frequency versus Coil Taps—T-5/FRC Low R-F Unit (Crystal Control Operation).—

Output Frequency (Kilocycles)	Crystal Frequency (Kilocycles)	Crystal Band Switch Tap No.	I.P.A. Tap No.	P.A. Driver Tap No.	P.A. Tap No.
150-195	150-195	3	1-8	1-8	1-6
195-255	195-255	3	2-7	2-7	1-5
255-370	255-370	2	3-6	3-6	2-5
370-550	370-550	1	4-5	4-5	3-4

Use this table in conjunction with Table 4. See Paragraph 34 for explanation of above table.

51. Table 4—Output Frequency versus Tank Capacity—T-5/FRC Low R-F Unit.—

Output Frequency (Kilocycles)	I.P.A. Plate Circuit (mmf)	P.A. Driver each group (mmf)	P.A. Input Circuit (mmf)	P.A. Output Circuit (mmf)
150-195	2600	5200	2400	3600
195-255	2200	4400	1800	2600
255-370	1600	3200	1400	2000
370-550	1200	2400	1000	1400

Use this table in conjunction with Table 2 or 3. See Paragraph 34 for explanation of above table.

52. Table 5—Output Frequency versus Coil Tap and Plug-In Coil Combinations—T-4/FRC High R-F Unit.—

Output Frequency (Kilocycles)	Crystal or M.O. Frequency (Kilocycles)	M.O. Band Switch Tap No.	Crystal Band Switch Tap No.	I.P.A. Coil No.	P.A. Driver Coil No.	P.A. Coil No.	P.A. Air Padder
2000-2300	2000-2300	1	1	1535	1535	1540	IN
2300-2441	2300-2441	2	1	1535	1535	1540	IN
2441-2800	2441-2800	2	1	1535	1535	1540	OUT
2800-2850	2800-2850	3	2	1535	1535	1540	OUT
2850-3500	2850-3500	3	2	1536	1536	1540	OUT
3500-3516	3500-3516	4	2	1536	1536	1540	OUT
80 MTR 3516-3800	3516-3800	4	2	1536	1536	1541	OUT
3800-4200	3800-4200	4	3	1536	1536	1541	OUT
4200-4545	4200-4545	5	3	1536	1536	1541	OUT
4545-5000	4545-5000	5	3	1537	1537	1541	OUT
5000-5195	5000-5195	6	3	1537	1537	1541	OUT
5195-6000	5195-6000	6	3	1537	1537	1548	OUT
6000-7000	3000-3500	3	2	1537	1537	1548	OUT
40 MTR 7000-7180	3500-3590	4	2	1537	1537	1548	OUT
7180-7573	3590-3787	4	2	1537	1537	1549	OUT
7573-7600	3787-3800	4	2	1538	1538	1549	OUT
7600-8400	3800-4200	4	3	1538	1538	1549	OUT
8400-9230	4200-4615	5	3	1538	1538	1549	OUT
9230-10,000	4615-5000	5	3	1538	1538	1542	OUT
doub to 15 10,000-11,720	5000-5860	6	3	1538	1538	1542	OUT
11,720-12,000	5860-6000	6	3	1539	1539	1543	OUT
12,000-12,600	4000-4200	4	3	1539	1539	1543	OUT
20 MTR 12,600-14,850 doub to 10 MTR	4200-4950	5	3	1539	1539	1543	OUT
14,850-15,000	4950-5000	5	3	1539	1539	1544	OUT
15,000-18,000	5000-6000	6	3	1539	1539	1544	OUT

See Paragraph 33 for explanation of above table.

53. Radio Transmitter T-4/FRC—Table of Replaceable Parts.—

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
—	A1	Crystal and Holder. Not furnished with equipment			
1	A2	Rectifier, Selenium Type, 120 v, 150 ma; Code No. 1BOC10FF1C	Bias Supply	BLC	A-63300-6
1	A3	Socket, Pilot Lamp, Red; Cat. No. 1002-1	Channel On	GOT	A-65501-1
1	A4	Thermostat, Open on Temp. Rise, Open at 170° ±3° F; Type C-2851-5	Exhaust Air	SP	A-62302-1
1	C1	Capacitor, 250 mmf max.; Cat. No. 250H15	M. O. Tuning	EFJ	A-61226-7
2	C2	Capacitor, 250 mmf, 1,000 v working, Mica; Cat. No. H-2325	M. O. Grid Blocking	SA	L-61021-107
1	C3	Capacitor, 250 mmf ±2½%, 500 v working, T. C. –.00022 mmf/mmf/° C.; Cat. No. N220E	M. O. Tuning	ER	A-61044-14
3	C4	Capacitor, 250 mmf ±2½%, 500 v working, T. C. –.00003 mmf/mmf/mmf/° C.; Cat. No. N030F	M. O. Tuning	ER	A-61044-13
12	C5	Capacitor, .01 mfd ±20%, 1,000 v working; Cat. No. 345-25	M. O. Screen By-Pass	MM	L-61048-206
—	C6	Same as C5	C. O. Screen By-Pass		
5	C7	Capacitor, 500 mmf, 1,000 v working, Mica; Cat. No. H-2350	C. O. Plate Blocking	SA	L-61021-111
1	C8	Capacitor, 150 mmf max.; Cat. No. 150H15	C. O. Tuning	EFJ	A-61226-6
—	C9	Same as C5	C. O. Cathode By-Pass		
—	C10	Same as C7	C. O.-I. P. A. Coupling		
—	C11	Same as C7	I. P. A. Screen By-Pass		
—	C12	Same as C7	Keyer Plate By-Pass		
1	C13	Capacitor, 25 mmf, 2,500 v working; A-12626-501	I. P. A.-Driver Coupling	AAC	A-12626-501
2	C14	Capacitor, 200 mmf per section; Cat. No. 200FD20	I. P. A. Tuning	EFJ	L-61209-5
—	C15	Same as C5	Driver Screen By-Pass		
—	C16	Same as C5	Driver Screen By-Pass		
—	C17	Same as C14	Driver Tuning		
—	C18	Same as C5	P. A. Fil. By-Pass		
—	C19	Same as C5	P. A. Fil. By-Pass		
2	C20	Capacitor, 12 mmf max.; Cat. No. 12G70	P. A. Neutralizing	EFJ	A-61235-7
—	C21	Same as C20	P. A. Neutralizing		
1	C22	Capacitor, 150 mmf-50 mmf-50 mmf-150 mmf each section; Cat. No. 150-50DQ45	P. A. Tuning	EFJ	L-61237-1
1	C23	Capacitor, 500 mmf ±5%, 5,000 v test; Cat. No. F2L-535	P. A. Plate By-Pass	SA	L-61001-9
—	C24	Same as C5	Meter By-Pass		
1	C25	Capacitor, .05 mfd ±20%, 600 v working; Cat. No. 345-22	Screen By-Pass	MM	A-61048-169
3	C26	Capacitor, 2 mfd, 600 v working; Cat. No. P8062	By-Pass	SS	L-61013-20
—	C27	Same as C26	Tone Amp. Screen		
2	C28	Capacitor, 250 mmf ±10%, 2,500 v working; Cat. No. A2-5325	Driver-P. A. Coupling	SA	L-61030-14

53. Radio Transmitter T-4/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
1	C29	Capacitor, 10 mfd ±10%, 600 v working, Oil; Cat. No. P8736	Bias Filter	SS	L-61003-9
—	C30	Same as C5	Meter By-Pass		
2	C31	Capacitor, 8 mfd ±10%, 1,000 v working, Oil; Cat. No. P8737	Power Supply Filter	SS	L-61003-19
—	C32	Same as C31	Power Supply Filter		
—	C33	Same as C7	M. O.-C. O. Coupling		
—	C34	Same as C4	M. O. Tuning		
—	C35	Same as C4	M. O. Tuning		
—	C36	Same as C5	P. A. Grid By-Pass		
—	C37	Same as C5	Keyer Cathode By-Pass		
—	C38	Same as C5	Driver Cathode By-Pass		
—	C39	Same as C28	Driver-P. A. Coupling		
2	C40	Capacitor, 80 mmf, Plug-In Air; L-61236-501	P. A. Tuning	AAC	L-61236-501
—	C41	Same as C40	P. A. Tuning		
—	C42	Same as C2	I. P. A. Driver Coupling		
—	C43	Same as C26	Bias Filter		
1	E2	Relay, DPST, Coil 60 v, 1,500 ohms; Contacts 220 v, 7 a; Type 455	Interlock	AD	A-62227-1
1	E3	Relay, Special; Cat. No. A-13876	Overload and Underload	CPC	A-62230-1
1	I1	Lamp, Pilot, 115 v, 6 w; Cat. No. 6S6	Lamp for A3	GE	A-65101-1
1	L1	Inductance; A-12628-501	M. O. Tuning	AAC	A-12628-501
3	L2	R-F Choke, 2½ mh; Cat. No. 34100	M. O. Cathode	MI	A-63201-1
—	L3	Same as L2	C. O. Plate		
1	L4	Inductance; A-12627-501	C. O. Tuning	AAC	A-12627-501
—	L5	Same as L2	Keyer Grid Filter		
2	L6	Inductance	I. P. A. Tuning		
2	L6A	Inductance, 87 μh; Type No. 1535	I. P. A. Tuning	BW	A-63405-1
2	L6B	Inductance, 30.6 μh; Type No. 1536	I. P. A. Tuning	BW	A-63406-1
2	L6C	Inductance, 13.3 μh; Type No. 1537	I. P. A. Tuning	BW	A-63407-1
2	L6D	Inductance, 5.95 μh; Type No. 1538	I. P. A. Tuning	BW	A-63408-1
2	L6E	Inductance, 2 μh; Type No. 1539	I. P. A. Tuning	BW	A-63409-1
—	L7	Same as L6	Driver Tuning		
—	L7A	Same as L6A	Driver Tuning		
—	L7B	Same as L6B	Driver Tuning		
—	L7C	Same as L6C	Driver Tuning		
—	L7D	Same as L6D	Driver Tuning		
—	L7E	Same as L6E	Driver Tuning		
1	L8	Inductance	P. A. Tuning		

53. Radio Transmitter T-4/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
1	L8A	Inductance, 44.5 μh; Type No. 1540	P. A. Tuning	BW	A-63411-1
1	L8B	Inductance, 20.8 μh; Type No. 1541	P. A. Tuning	BW	A-63412-1
1	L8C	Inductance, 13 μh; Type No. 1548	P. A. Tuning	BW	A-63421-1
1	L8D	Inductance, 12 μh; Type No. 1549	P. A. Tuning	BW	A-63420-1
1	L8E	Inductance, 8 μh; Type No. 1542	P. A. Tuning	BW	A-63413-1
1	L8F	Inductance, 5 μh; Type No. 1543	P. A. Tuning	BW	A-63414-1
1	L8G	Inductance, 3.4 μh; Type No. 1544	P. A. Tuning	BW	A-63415-1
1	L9	Inductance, 7 μh; Type No. 1547	Output Coupling	BW	A-63417-1
1	L10	R-F Choke, 2 mh ±10%, 1 a; A-63214-501	P. A. Plate	AAC	A-63214-501
1	L11	R-F Choke, 1.1 mh, 0.5 a; Cat No. 752	Driver Plate	EFJ	A-63209-11
3	L12	R-F Choke, 1 mh, 300 ma; Cat. No. 34105	I. P. A. Plate	MI	A-63201-3
—	L13	Same as L12	P. A. Grid		
—	L14	Same as L12	P. A. Grid		
2	M1	Meter, 0-10, 50 scale divisions 0-1 v movement, 3" square case; Cat. No. 327A	Lower Power Stages	TRI	A-61421-1
—	M2	Same as M1	P. A. Plate Current		
3	R1	Resistor, 25,000 ohms ±20%, 2 w; Model PFA	M. O. Grid Leak	OCC	L-61337-152
3	R2	Resistor, 100,000 ohms ±20%, 2 w; Model PFA	C. O. Grid	OCC	L-61337-168
—	R3	Same as R2	I. P. A. Grid		
—	R4	Same as R1	Tone Amp. Screen		
1	R5	Resistor, 10.9 ±1%, 1 w; Type 190	I. P. A. Meter Shunt	SMC	A-61298-4
2	R6	Resistor, 1,000 ohms ±10%, 10 w; Type C	Driver Grid	CL	L-61376-233
2	R7	Resistor, 23.8 ohms ±1%, 1 w; Type 190	Driver Grid Meter Shunt	SMC	A-61298-5
1	R8	Resistor, 2.11 ohms ±1%, 1 w; Type 190	Driver Current Meter Shunt	SMC	A-61298-6
—	R9	Same as R1	Bias Filter		
1	R10	Resistor, 4.13 ohms ±1%, 1 w; Type 190	P. A. Grid Meter Shunt	SMC	A-61298-3
1	R11	Resistor, 250,000 ohms ±20%, Potentiometer, Slot Type; Series 35, Part 8	Tone Amp. Gain	CTS	A-61379-7
—	R12	Same as R6	Tone Amp. Cathode		
—	R13	Same as R2	Tone Filter Shunt		
1	R14	Resistor, 2,000 ohms ±5%, 60 w, Similar to Navy Style B; Cat. No. G-115W	P. A. Grid	CL	L-61306-34
2	R15	Resistor, 8,000 ohms ±5%, 24 w, Similar to Navy Style D; Cat. No. G-38N	Bias Bleeder	CL	L-61302-40
1	R16	Resistor, 10,000 ohms ±5%, 28 w, Similar to Navy Style C	Power Supply Bleeder	CCI	L-61304-41
1	R17	Resistor, 6,000 ohms ±5%, 28 w, Similar to Navy Style C	Voltage Dropping	CCI	L-61304-39

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
1	R18	Resistor, 1.01 ohms ±1%, 1 w; Type 190	P. A. Meter Shunt	SMC	A-61298-2
1	R19	Resistor, 2,500 ohms ±10%, 10 w; Type 10C, Type A terminals	Lamp Dropping Resistor	CL	L-61376-241
1	R20	Resistor, 500 ohms ±10%, 10 w; Type 10C, Type A terminals	C. O. Cathode Biasing	CL	L-61376-227
1	R21	Resistor, 5,000 ohms ±20%, 2 w; Model PFA	Keyer Grid	OCC	L-61337-130
—	R22	Same as R7	C. O. Meter Shunt		
1	R23	Resistor, 25,000 ohms ±10%, 10 w; Type 10C, Type A terminals	Keyer Screen	CL	L-61376-264
3	R24	Resistor, Special; A-12638-501	Parasitic Suppressor	AAC	A-12638-501
—	R25	Same as R24	Parasitic Suppressor		
—	R26	Same as R24	Parasitic Suppressor		
—	R28	Same as R15	Power Supply Bleeder		
2	R29	Resistor, 250,000 ohms ±20%, 2 w; Model PFA	Static Drain	OCC	L-61337-182
—	R30	Same as R29	Static Drain		
3	S1	Switch, One Deck, 11 contacts, Non-Shorting; Type No. 536	M. O. Band Change	SMC	A-62035-1
—	S2	Same as S1	M. O.-C. O. Selector		
1	S3	Switch, 2-Deck, Non-Shorting, 6 Contacts; Cat. No. 4750	Meter Shift	SMC	L-62036-2
2	S4	Switch, Toggle, DPST; Cat. No. 8360	"INTERLOCK"	CH	L-62000-54
—	S5	Same as S4	"STANDBY"		
1	S6	Switch, N. O., Push-Button, One Hole Mounting; Cat. No. 8410	Chassis Interlock	CH	A-62033-1
1	S7	Switch, Telephone Type; Piece No. ZD-321068	"TEST" Key	AE	L-62030-77
—	S8	Same as S1	C. O. Band Change		
1	T1	Transformer, Pri.: 500 ohms, C. T.; Sec.: 53,000 ohms; Type CS-4141	Tone Input	TEM	L-21072-1
1	T2	Transformer, Pri.: 5,000 ohms; Sec.: 10,000 ohms with C. T.; Type CS-3182	Tone Output	TEM	L-21073-1
1	T3	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: No. 1, 6.3 v @ 4.1 a; No. 2, 6.3 v @ 0.9 a; No. 3, 5.0 v @ 2.0 a with C. T.; Type CS-8709	Filament	TEM	L-21063-1
1	T4	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 150 v with C. T.; Type CS-8706	Bias Supply	TEM	L-21062-1
1	T5	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 10 v @ 10 a, C. T.; Type CS-8705	P. A. Filament	TEM	L-21084-1
1	T6	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: No. 1, 2.5 v @ 10 a with C. T.; No. 2, 5 v @ 3 a with C. T.; Type CS-8708	Filament	TEM	L-21075-1
1	T7	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 1,400 v with C. T.; Type CS-5566	Plate	TEM	L-21067-1

53. Radio Transmitter T-4/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
2	V1	Socket, Octal; Amphenol Type SS8	Socket for VT1	AP	A-65200-503
4	V2	Socket, 5-Prong Ceramic; Amphenol Type SS5	Socket for VT2	AP	L-65209-12
—	V3	Same as V2	Socket for VT3		
—	V4	Same as V2	Socket for VT4		
—	V5	Same as V2	Socket for VT5		
2	V6	Socket, Phosphor Bronze Contacts; Cat. No. 211	Socket for VT6	EFJ	A-65204-1
—	V7	Same as V6	Socket for VT7		
5	V8	Socket, Octal; Amphenol Type S8	Socket for VT8	AP	A-65200-504
—	V9	Same as V8	Socket for VT9		
—	V10	Same as V8	Socket for VT10		
—	V11	Same as V8	Socket for VT11		
—	V12	Same as V8	Socket for VT12		
2	V13	Socket, 4-Prong; Amphenol Type SS4	Socket for VT13	AP	A-65209-11
—	V14	Same as V13	Socket for VT14		
—	V15	Same as V1	Socket for VT15		
1	V16	Socket, Micalex, 3-Prong; Cat. No. E-50-A	Crystal Socket	EFJ	A-65207-1
3	VT1	Tube, Type 6V6-GT/G; Signal Corps VT-107A	M. O.	KEN	A-69225-3
4	VT2	Tube, Type 807; Signal Corps VT-100-A	I. P. A.	KEN	A-69105-1
—	VT3	Same as VT2	Keyer		
—	VT4	Same as VT2	P. A. Driver		
—	VT5	Same as VT2	P. A. Driver		
2	VT6	Tube, Type 810	P. A.	TT	A-69106-1
—	VT7	Same as VT6	Power Amplifier		
—	VT8	Same as VT1	Tone Amplifier		
2	VT9	Tube, Type 5Y3-GT/G; Signal Corps VT-197-A	Tone Rectifier	KEN	A-69203-1
2	VT10	Tube, Type VR105-30; Signal Corps VT-200	Voltage Regulator	SYL	A-69306-1
—	VT11	Same as VT10	Voltage Regulator		
—	VT12	Same as VT9	Bias Isolator		
2	VT13	Tube, Type 866-A; Signal Corps VT-46A	Power Rectifier	TT	A-69110-1
—	VT14	Same as VT13	Power Rectifier		
—	VT15	Same as VT1	C. O.-Doubler		
1	X1	Choke, 10 h, 0.1 a; Type CS-13809	Bias Supply	TEM	L-21080-1
2	X2	Choke, 6 h, 0.35 a; Type CS-13810	Power Supply	TEM	L-21065-1
—	X3	Same as X2	Power Supply		
1	X4	Filter; Cat. No. 72577	Tone Keyer	UTC	A-12587-1

54. Modulator MD-1/FRC—Table of Replaceable Parts.—

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
2	A101	Rectifier, Selenium Type, 60 v, 100 ma; Code No. 1BOB5FF1C	Bias Supply	BLC	L-63300-8
—	A102	Same as A101	Bias Supply		
2	A103	Socket, Pilot Lamp, Red; Cat. No. 1002-1	Mod. No. 1 ON	GOT	A-65501-1
—	A104	Same as A103	Mod. No. 2 ON		
1	A105	Thermostat, Open on Temp. Rise, Open at 170° ±3° F.; Type C-2851-5	Exhaust Air	SP	A-62302-1
11	C101	Capacitor, .05 mfd ±20%, 600 v working; Cat. No. 345-22	Inverse Feedback	MM	A-61048-169
8	C102	Capacitor, 2 mfd, 600 v working; Cat. No. P8062	1st Amp. Cathode By-Pass	SS	L-61013-20
—	C103	Same as C102	1st Amp. Plate By-Pass		
—	C104	Same as C101	1st-2nd Amp. Coupling		
2	C105	Capacitor, .01 mfd ±20%, 1,000 v working; Cat. No. 345-25	2nd Amp. Cathode By-Pass	MM	A-61048-206
—	C106	Same as C101	Driver Grid Coupling		
—	C107	Same as C101	Driver Grid Coupling		
—	C108	Same as C102	2nd Amp. Plate By-Pass		
—	C109	Same as C101	Inverse Feedback		
4	C110	Capacitor, 8 mfd ±10%, 1,000 v working, Oil; Cat. No. 8737	Power Supply Filter	SS	L-61003-19
—	C111	Same as C110	Power Supply Filter		
2	C112	Capacitor, 10 mfd ±10%, 600 v working, Oil; Cat. No. 8736	Bias Supply Filter	SS	L-61003-9
—	C113	Same as C101	Inverse Feedback		
—	C114	Same as C102	1st Amp. Cathode By-Pass		
—	C115	Same as C102	1st Amp. Plate By-Pass		
—	C116	Same as C101	1st-2nd Amp. Coupling		
—	C117	Same as C105	2nd Amp. Cathode By-Pass		
—	C118	Same as C101	Driver Grid Coupling		
—	C119	Same as C101	Driver Grid Coupling		
—	C120	Same as C102	2nd Amp. Plate By-Pass		
—	C121	Same as C101	Inverse Feedback		
—	C122	Same as C110	Power Supply Filter		
—	C123	Same as C110	Power Supply Filter		
—	C124	Same as C112	Bias Supply Filter		
—	C125	Same as C101	Meter By-Pass		
—	C126	Same as C102	Driver Screen By-Pass		
—	C127	Same as C102	Driver Screen By-Pass		
2	E101	Relay, DPST, N. O., Contacts 220 v @ 7 a, Coil 60 v, 1,500 ohms; Type 455	Bias Interlock	AD	A-62227-1
—	E102	Same as E101	Bias Interlock		

54. Modulator MD-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
2	I101	Lamp, Pilot, 115 v, 6 w; Cat. No. 6S6	Lamp for A103	GE	A-65101-1
—	I102	Same as I101	Lamp for A104		
2	J101	Jack; Cat. No. J-301	Mod. No. 1 Mic.	CTS	A-62513-1
—	J102	Same as J101	Mod. No. 2 Mic.		
1	M101	Meter, 0-10, 50 scale divisions, 0-1 v movement, 3″ square case; Cat. No. 327A	Mod. Plate Current	TRI	A-61421-1
2	R101	Resistor, 250,000 ohm ±20%, Potentiometer; Cat. No. Series 35, Part 10	Mod. No. 1 Gain	CTS	A-61379-8
6	R102	Resistor, 2,000 ohms ±20%, 2 w, Carbon; Model PFA	1st Amp. Cathode By-Pass	OCC	L-61337-115
8	R103	Resistor, 50,000 ohms ±20%, 2 w, Carbon; Model PFA	1st Amp. Plate Load	OCC	L-61337-160
—	R104	Same as R103	1st Amp. Plate Dropping		
2	R105	Resistor, 250,000 ohms ±20%, 2 w, Carbon; Model PFA	2nd Amp. Grid	OCC	L-61337-182
—	R106	Same as R102	2nd Amp. Cathode By-Pass		
—	R107	Same as R103	2nd Amp. Plate Load		
—	R108	Same as R103	2nd Amp. Plate Load		
6	R109	Resistor, 100,000 ohms ±20%, 2 w, Carbon; Model PFA	Driver Grid	OCC	L-61337-168
—	R110	Same as R109	2nd Amp. Grid		
—	R111	Same as R109	Driver Grid		
2	R112	Resistor, 10,000 ohms ±10%, 10 w; Type 10C, Type A terminals	Inverse Feedback	CL	L-61376-252
2	R113	Resistor, 315 ohms ±5%, 24 w, Similar to Navy Style D	Driver Cathode	CCI	L-61302-26
2	R116	Resistor, 10,000 ohms ±20%, Carbon, 2 w; Model PFA	2nd Amp. Plate Dropping	OCC	L-61337-138
2	R117	Resistor, 1,000 ohms ±20%, Potentiometer, Slot Type; Type B-8552	Inverse Feedback Control	CTS	A-61379-9
2	R118	Resistor, 10,000 ohms ±5%, 60 w, Similar to Navy Style B	Voltage Regulator	CCI	L-61306-41
2	R119	Resistor, 400 ohms ±5%, 24 w, Similar to Navy Style D	Bias Bleeder	CCI	L-61302-27
2	R120	Resistor, 5,000 ohms ±10%, 2 w, Carbon; Model PFA	Microphone Supply	OCC	L-61337-130
2	R121	Resistor, 1.01 ohms ±1%, 1 w; Type 190	Meter Shunt	SMC	A-61298-2
2	R122	Resistor, 2,500 ohms ±10%, 10 w; Type 10C, Type A terminals	Pilot Lamp Dropping	CL	L-61376-241
—	R123	Same as R101	Mod. No. 2 Gain		
—	R124	Same as R102	1st Amp. Cathode By-Pass		
—	R125	Same as R103	1st Amp. Plate Load		
—	R126	Same as R103	1st Amp. Plate Dropping		
—	R127	Same as R105	2nd Amp. Grid		
—	R128	Same as R102	2nd Amp. Cathode By-Pass		
—	R129	Same as R103	2nd Amp. Plate Load		
—	R130	Same as R103	2nd Amp. Plate Load		

54. Modulator MD-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
—	R131	Same as R109	Driver Grid		
—	R132	Same as R109	2nd Amp. Grid		
—	R133	Same as R109	Driver Grid		
—	R134	Same as R112	Inverse Feedback		
—	R135	Same as R113	Driver Cathode		
—	R138	Same as R116	2nd Amp. Plate Dropping		
—	R139	Same as R117	Inverse Feedback Control		
—	R140	Same as R118	Voltage Regulator		
—	R141	Same as R119	Bias Bleeder		
—	R142	Same as R120	Microphone Supply		
—	R143	Same as R121	Meter Shunt		
—	R144	Same as R122	Pilot Lamp Dropping		
2	R145	Resistor, 25,000 ohms ±10%; Type 10C, Type A terminals	Mod. Overbias	CL	L-61376-264
—	R146	Same as R145	Mod. Overbias		
—	R147	Same as R102	2nd Amp. Cathode By-Pass		
—	R148	Same as R102	2nd Amp. Cathode By-Pass		
1	S101	Switch, N. O., Push-Button, One hole mounting; Cat. No. 8410	Chassis Interlock	CH	A-62033-1
2	S103	Switch, Toggle, DPDT, Bat Handle; Cat. No. 8363	Mic.-Mod. No. 1	CH	L-62000-55
—	S104	Same as S103	Mic.-Mod. No. 2		
1	S105	Switch, 2-Deck, Non Shorting, 5 Contacts; Cat. No. 4725	Meter	SMC	L-62036-1
2	S106	Switch, Toggle, DPST; Cat. No. 8360	"INTERLOCK"	CH	A-62000-54
—	S108	Same as S106	"STANDBY"		
2	T101	Transformer, Pri.: 500 ohms, C. T.; Sec.: 53,000 ohms; Type CS-4141	Audio Input	TEM	L-21072-1
2	T102	Transformer, Pri.: 3,200 ohms; Turns ratio of Primary to ½ Secondary: 3.1 and 2.1 to 1; 160 ma through primary C. T.; Type CS-3183	Driver	TEM	L-21064-1
2	T103	Transformer, Pri.: 6,600 ohms, C. T., 500 ma; Sec.: 4,600 ohms, 400 ma; 2,300 ohms, 800 ma; Type CS-2156	Modulation	TEM	L-21074-1
2	T104	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 10 v @ 10 a, C. T.; Type CS-8705	Filament	TEM	L-21084-1
2	T105	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 150 v with C. T.; Type CS-8706	Bias Supply	TEM	L-21062-1
2	T106	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: No. 1, 2.5 v @ 10 a with C. T.; No. 2, 5 v @ 3 a with C. T.; Type CS-8708	Filament	TEM	L-21075-1

54. Modulator MD-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
2	T107	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 1,400 v with C. T.; Type CS-5566	Plate	TEM	L-21067-1
2	T108	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles; Sec.: 6.3 v @ 2.7 a; Type CS-8703	Filament	TEM	L-21083-1
—	T109	Same as T101	Audio Input		
—	T110	Same as T102	Driver		
—	T111	Same as T103	Modulation		
—	T112	Same as T104	Filament		
—	T113	Same as T105	Bias Supply		
—	T114	Same as T106	Filament		
—	T115	Same as T107	Plate		
—	T116	Same as T108	Filament		
10	V101	Socket, Octal; Amphenol Type S8	Socket for VT101	AP	A-65200-504
—	V102	Same as V101	Socket for VT102		
—	V103	Same as V101	Socket for VT103		
—	V104	Same as V101	Socket for VT104		
—	V105	Same as V101	Socket for VT105		
4	V106	Socket, 5-Prong; Amphenol Type SS5	Socket for VT106	AP	L-65209-12
—	V107	Same as V106	Socket for VT107		
4	V108	Socket, Phosphor Bronze Contacts; Cat. No. 211	Socket for VT108	EFJ	A-65204-1
—	V109	Same as V108	Socket for VT109		
4	V110	Socket, 4-Prong; Amphenol Type SS4	Socket for VT110	AP	L-65209-11
—	V111	Same as V110	Socket for VT111		
—	V112	Same as V101	Socket for VT112		
—	V113	Same as V101	Socket for VT113		
—	V114	Same as V101	Socket for VT114		
—	V115	Same as V101	Socket for VT115		
—	V116	Same as V101	Socket for VT116		
—	V117	Same as V106	Socket for VT117		
—	V118	Same as V106	Socket for VT118		
—	V119	Same as V108	Socket for VT119		
—	V120	Same as V108	Socket for VT120		
—	V121	Same as V110	Socket for VT121		
—	V122	Same as V110	Socket for VT122		
6	VT101	Tube, Type 6J5-GT/G; Signal Corps VT-94	1st Amplifier	KEN	A-69212-3
—	VT102	Same as VT101	2nd Amplifier		

54. Modulator MD-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
—	VT103	Same as VT101	2nd Amplifier		
4	VT104	Tube, Type VR105-30; Signal Corps VT-200	Voltage Regulator	SYL	A-69306-1
—	VT105	Same as VT104	Voltage Regulator		
4	VT106	Tube, Type 807; Signal Corps VT-100-A	Driver	KEN	A-69105-1
—	VT107	Same as VT106	Driver		
4	VT108	Tube, Type 810	Modulator	TT	A-69106-1
—	VT109	Same as VT108	Modulator		
4	VT110	Tube, Type 866-A; Signal Corps VT-46-A	Power Rectifier	TT	A-69110-1
—	VT111	Same as VT110	Power Rectifier		
—	VT112	Same as VT101	1st Amplifier		
—	VT113	Same as VT101	2nd Amplifier		
—	VT114	Same as VT101	2nd Amplifier		
—	VT115	Same as VT104	Voltage Regulator		
—	VT116	Same as VT104	Voltage Regulator		
—	VT117	Same as VT106	Driver		
—	VT118	Same as VT106	Driver		
—	VT119	Same as VT108	Modulator		
—	VT120	Same as VT108	Modulator		
—	VT121	Same as VT110	Power Rectifier		
—	VT122	Same as VT110	Power Rectifier		
2	X101	Choke, smoothing, 10 h, 0.1 a; Type CS-13809	Bias Filter	TEM	L-21080-1
4	X102	Choke, 6 h, 0.35 a; Type CS-13810	Power Filter	TEM	L-21065-1
—	X103	Same as X102	Power Filter		
—	X104	Same as X101	Power Filter		
—	X105	Same as X102	Power Filter		
—	X106	Same as X102	Power Filter		

55. Power Rectifier PP-1/FRC—Table of Replaceable Parts.—

1	A201	Rectifier, Selenium Type, 60 v, 1.5 a; Code No. 2EOB6S1	Relay Supply	BLC	A-63300-7
1	A202	Blower consisting of the following parts:	Cooling System		
1		Blower Motor, Repulsion Induction, 1425/1725 R.P.M., ½ HP, 220 v, 50/60 cyle; Type RA, Frame No. 65Y	Motor for A202	WAG	A-64005-1
1		Fan and Housing; Cat. No. 10½	Fan and Housing for A202	USA	W-40296-1
1		Belt; Cat. No. 1MO51	Belt for A202	DRM	A-64140-1

55. Power Rectifier PP-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
1		Pulley, V Drive, 3.2 P. D.; Cat. No. AK32	Motor Pulley for A202	DRM	A-64125-1
1		Pulley, V Drive, 9.0 P. D.; Cat. No. AK54	Blower Pulley for A202	DRM	A-64125-2
1	A203	Socket, Pilot Lamp, Red; Cat. No. 1002-1	Plate "ON"	GOT	A-65501-1
1	A204	Socket, Pilot Lamp, Green; Cat. No. 1002-2	Filaments "ON"	GOT	A-65501-2
1	A205	Thermostat, Open on Temp. Rise, Open at 170° ±3° F.; Type C-2851-5	Cabinet Temperature	SP	A-62302-1
8	C201	Capacitor, 8 mfd, 2,000 v working; Cat. No. P8738	Power Supply Filter	SS	L-61005-43
—	C202	Same as C201	Power Supply Filter		
—	C203	Same as C201	Power Supply Filter		
—	C204	Same as C201	Power Supply Filter		
—	C205	Same as C201	Power Supply Filter		
—	C206	Same as C201	Power Supply Filter		
—	C207	Same as C201	Power Supply Filter		
—	C208	Same as C201	Power Supply Filter		
6	E201	Relay, DPST, N. O., Contacts 220 v @ 7 a, Coil 60 v, 1,500 ohms; Type 455	Filament Power	AD	A-62227-1
1	E202	Relay, Motor 230 v, 50 cycles,Contacts 230 v, 5 a, N. O.; Model 21A	Time Delay	SA	A-62225-1
1	E203	Relay, 220 v, 50 cycles, 2 pole, Double Break; Contacts 220 v, 50 a; N. O.; Bulletin 702, Size 2	Plate Power	AB	L-62229-1
—	E204	Same as E201	Channel 1 "ON"		
—	E205	Same as E201	Channel 2 "ON"		
—	E206	Same as E201	Channel 3 "ON"		
—	E207	Same as E201	Channel 4 "ON"		
—	E208	Same as E201	Channel 5 "ON"		
2	F201	Fuse, Fusetron, 250 v, 60 a; No. 460	Main Line	BUSS	L-65304-21
—	F202	Same as F201	Main Line		
2	F203	Fuse, Fusetron, 250 v, 1 a; No. 401	Relay Supply	BUSS	L-65304-1
1	F204	Fuse, Fusetron, 250 v, 35 a; No. 435	H. V. Supply Primary	BUSS	L-65304-17
2	F205	Fuse, Fusetron, 250 v, 5 a; No. 405	Blower	BUSS	L-65304-8
—	F206	Same as F203	H. V. Filament Supply		
5	F207	Fuse, Fusetron, 250 v, 2.5 a; No. 4025	Channel 1	BUSS	L-65304-5
—	F208	Same as F207	Channel 2		
—	F209	Same as F207	Channel 3		
—	F210	Same as F207	Channel 4		
—	F211	Same as F207	Channel 5		
—	F212	Same as F205	Standby		

55. Power Rectifier PP-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
2	F213	Fuse, Fusetron, 250 v, 1.6 a; No. 4016	Mod. No. 1	BUSS	L-65304-3
—	F214	Same as F213	Mod. No. 2		
6	F215	Fuse, 2,500 v, 1.5 a; Cat. No. HVB1½	H. V. Supply	BUSS	L-65300-10
—	F216	Same as F215	H. V. Supply		
—	F217	Same as F215	H. V. Supply		
—	F218	Same as F215	H. V. Supply		
—	F219	Same as F215	H. V. Supply		
—	F220	Same as F215	H. V. Supply		
2	I201	Lamp, Pilot, 115 v, 6 w; Cat. No. 6S6	Lamp for A203	GE	A-65101-1
—	I202	Same as I201	Lamp for A204		
1	M201	Meter, 0-10, 50 scale divisions, 0-1 v movement, 3" square case; Cat. No. 327A	High Voltage	TRI	A-61421-1
2	R201	Resistor, 2,500 ohms ±10%, 10 w; Type 10C, Type A terminals	Pilot Lamp Dropping	CL	L-61376-241
—	R202	Same as R201	Pilot Lamp Dropping		
4	R203	Resistor, 10,000 ohms, ±5%, 200 w, Similar to Navy Style A, Grade 1, Class 1	H. V. Bleeder	SS	A-61290-41
—	R204	Same as R203	H. V. Bleeder		
1	R205	Resistor, 25 ohm ±20%, Potentiometer, Slot Type; Series 25	Meter Adjustment	CTS	A-61379-10
2	R206	Resistor, 10 ohm ±5%, 24 w, Similar to Navy Style D	Load Equalizing	CL	L-61302-11
—	R207	Same as R206	Load Equalizing		
—	R208	Same as R203	H. V. Bleeder		
—	R209	Same as R203	H. V. Bleeder		
1	S201	Switch, Breaker, DPST; Cat. No. 16955	Main Line Switch	SD	A-62038-1
2	S202	Switch, Toggle, DPDT; Cat. No. 8690	"LOCAL-REMOTE"	CH	L-62009-1
7	S203	Switch, Toggle, DPST; Cat. No. 8360	"FILAMENTS"	CH	L-62000-54
—	S204	Same as S203	"PLATE"		
2	S205	Switch, N. O., Push-Button, One Hole Mounting; Cat. No. 8410	Door Interlock	CH	A-62033-1
—	S206	Same as S205	Door Interlock		
—	S207	Same as S202	"TUNE-OPERATE"		
—	S208	Same as S203	Channel 1		
—	S209	Same as S203	Channel 2		
—	S210	Same as S203	Channel 3		
—	S211	Same as S203	Channel 4		
—	S212	Same as S203	Channel 5		
2	S213	Switch, 2-Deck, Non-Shorting, 6 Contacts; Cat. No. 4750	Mod. No. 1, Selector	SMC	A-62036-2
—	S214	Same as S213	Mod. No. 2, Selector		

55. Power Rectifier PP-1/FRC—Table of Replaceable Parts (Cont.)

Quan.	Symbol	Name of Part and Description	Function	Mfr.	AAC Part No.
1	T201	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles @ 195 va; Sec.: 105, 95, 85, 75; Type CS-8707	Relay Supply	TEM	L-21061-1
1	T202	Transformer, Pri.: 200, 210, 220, 230, 240 v, 50/60 cycles @ 6, 340 va; Sec.: 3,800 with C. T.; Type CS-5567	H. V. Plate Supply	TEM	L-21079-1
2	T203	Transformer, Pri.: 200, 220, 240 v, 50/60 cycles @ 125 va; Sec.: 5 v @ 20 a with C. T.; Type CS-8704	Filament Supply	TEM	L-21076-1
—	T204	Same as T203	Filament Supply		
4	V201	Socket, Phosphor Bronze Contacts; Cat. No. 211	Socket for VT201	EFJ	A-65204-1
—	V202	Same as V201	Socket for VT202		
—	V203	Same as V201	Socket for VT203		
—	V204	Same as V201	Socket for VT204		
4	VT201	Tube, Type 872-A; Signal Corps VT-42-A	H. V. Rectifier	TT	A-69111-1
—	VT202	Same as VT201	H. V. Rectifier		
—	VT203	Same as VT201	H. V. Rectifier		
—	VT204	Same as VT201	H. V. Rectifier		
6	X201	Choke, Smoothing, 16 h, 0.45 a; Type CS-13811	H. V. Filter	TEM	L-21081-1
—	X202	Same as X201	H. V. Filter		
—	X203	Same as X201	H. V. Filter		
—	X204	Same as X201	H. V. Filter		
—	X205	Same as X201	H. V. Filter		
—	X206	Same as X201	H. V. Filter		
2	X207	Choke, Smoothing, 4 h, 0.9 a; Type CS-13812	H. V. Filter	TEM	L-21082-1
—	X208	Same as X207	H. V. Filter		

56. Radio Transmitter T-5/FRC—Table of Replaceable Parts.—

—	A301	Crystal and Holder. Not furnished with equipment.			
1	A302	Rectifier, Selenium Type, 120 v, 150 ma; Code No. 1BOC10FF1C	Bias Supply	BLC	A-63300-6
1	A303	Socket, Pilot Lamp, Red; Cat. No. 1002-1	Channel On	GOT	A-65501-1
1	A304	Thermostat, Open on Temp. Rise, Open at 170° ±3° F.; Type C-2851-5	Exhaust Air	SP	A-62302-1
2	C301	Capacitor, 250 mmf max.; Cat. No. 250H15	M. O. Tuning	EFJ	A-61226-37
1	C302	Capacitor, 250 mmf, 1,000 v working, Mica; Cat. No. H-2325	M. O. Grid Blocking	SA	L-61021-107
8	C303	Capacitor, 250 mmf ±2½%, 500 v working, T. C.—.00003 mmf/° C.; Cat. No. N030F	M. O. Tuning	ER	A-61044-13

60. List of Manufacturers.—

Symbol	Name	Street Address	City and State
AAC	Aircraft Accessories Corporation	Fairfax and Funston Roads	Kansas City, Kansas
AB	Allen-Bradley Company	118 W. Greenfield Avenue	Milwaukee, Wisconsin
AD	Advance Electric Company	2160 W. 2nd Street	Los Angeles, California
AE	American Automatic Electric Company	1033 W. Van Buren	Chicago, Illinois
AP	American Phenolic Corporation	1830 S. 54th Avenue	Chicago, Illinois
ASP	American Steel Package Company		Defiance, Ohio
BLC	Benwood Linze Company	1811 Locust Street	St. Louis, Missouri
BUSS	Bussmann Manufacturing Company	2538 W. University Street	St. Louis, Missouri
BW	Barker & Williamson	235 Fairfield Avenue	Upper Darby, Pennsylvania
CCI	Continental Carbon, Inc.	13900 Lorain Avenue	Cleveland, Ohio
CH	Cutler-Hammer, Inc.	604 North 12th Street	Milwaukee, Wisconsin
CL	Clarostat Manufacturing Company	285-287 North 6th Street	Brooklyn, New York
CPC	C. P. Clare & Company	4719 Sunnyside Avenue	Chicago, Illinois
CRL	Centralab	900 East Keefe Avenue	Milwaukee, Wisconsin
CTS	Chicago Telephone Supply		Elkhart, Indiana
DRM	Dayton Rubber Manufacturing Company		Dayton, Ohio
EFJ	E. F. Johnson Company		Waseca, Minnesota
ER	Erie Resistor Company	644 W. 12th Street	Erie, Pennsylvania
FA	Frank Adams Electric Company	3652 Windsor Place	St. Louis, Missouri
FWS	F. W. Sickles		Springfield, Massachusetts
GE	General Electric Company	(Sales Office)	Schenectady, New York

60. List of Manufacturers (Cont.)

Symbol	Name	Street Address	City and State
GOT	Gothard Manufacturing Company	1300 North 9th	Springfield, Illinois
KEN	Ken-Rad Tube & Lamp Corporation		Owensboro, Kentucky
MI	James Millen Manufacturing Company	150 Exchange Street	Malden, Massachusetts
MIL	J. W. Miller Company	5917 South Main Street	Los Angeles, California
MM	Mica-Mold Radio	Flushing & Porter Avenues	Brooklyn, New York
OCC	Ohio Carbon Company	12508 Berea Road	Cleveland, Ohio
SA	Sangamo Electric Company		Springfield, Illinois
SD	Square-D Company	6060 Rivard Street	Detroit, Michigan
SMC	Shallcross Manufacturing Company	10 Jackson Avenue	Collingdale, Pennsylvania
SP	Spencer Thermostat Company	40 Forest Street	Attleboro, Massachusetts
SS	Sprague Specialty Company		North Adams, Massachusetts
SYL	Sylvania Electric Products, Inc.	500 5th Avenue	New York, New York
TEM	Thermador Electrical Manufacturing Company	5119 So. Riverside Drive	Los Angeles, California
TRI	Triplett Electrical Instrument Company		Bluffton, Ohio
TT	Taylor Tubes, Inc.	2341 Wabansia Avenue	Chicago, Illinois
USA	U. S. Air Conditioning Corp.	2101 Kennedy Street	Minneapolis, Minnesota
UTC	United Transformer Company	150 Varick Street	New York, New York
WAG	Wagner Electric Company		St. Louis, Missouri
WE	Western Electric Company	(Graybar Electric Div.)	Kansas City, Missouri
WN	Weston Electrical Instrument Corp.	619 Frelinghuysen Avenue	Newark, New Jersey

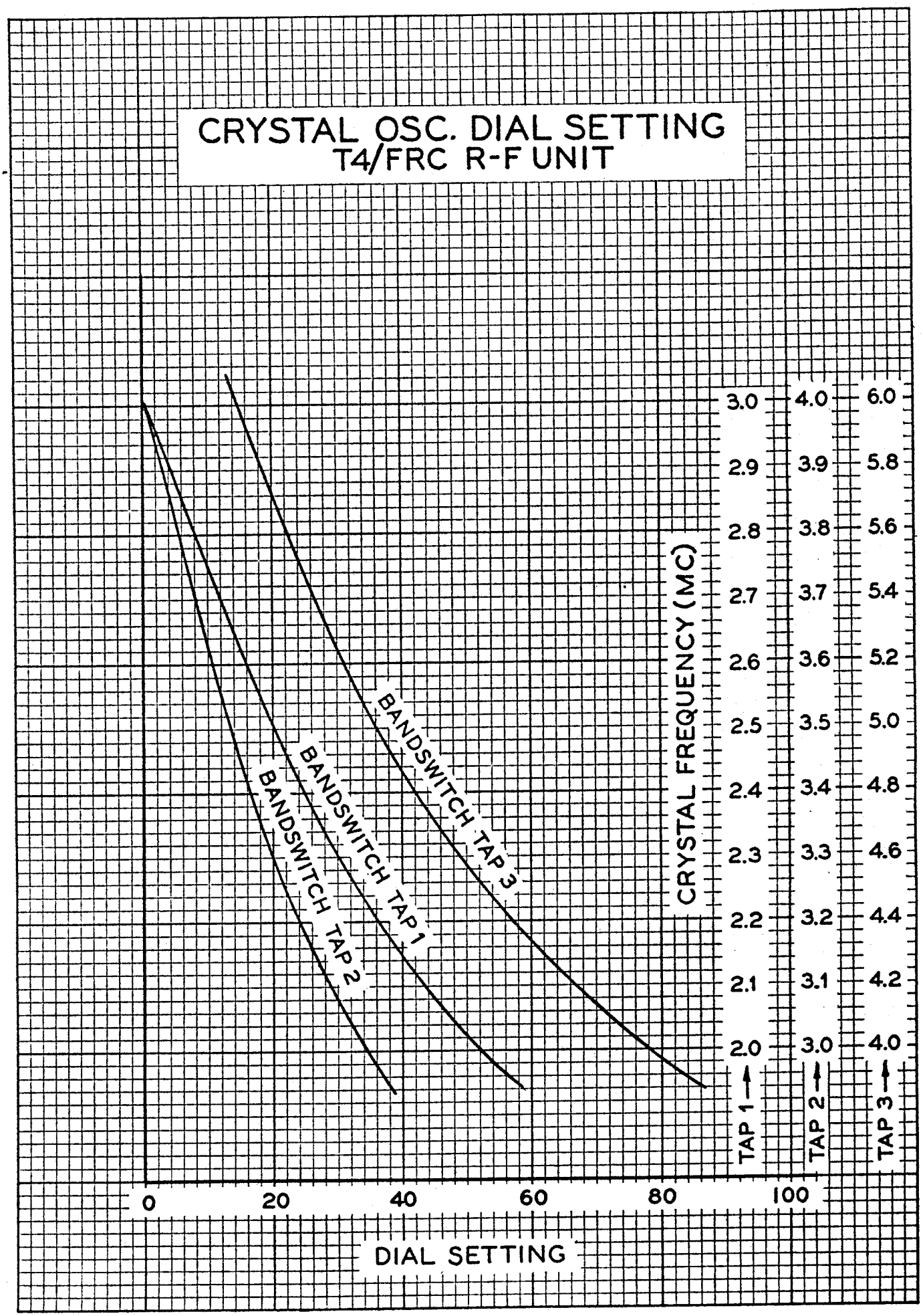


FIGURE 2. CRYSTAL OSC. DIAL SETTING—T-4/FRC

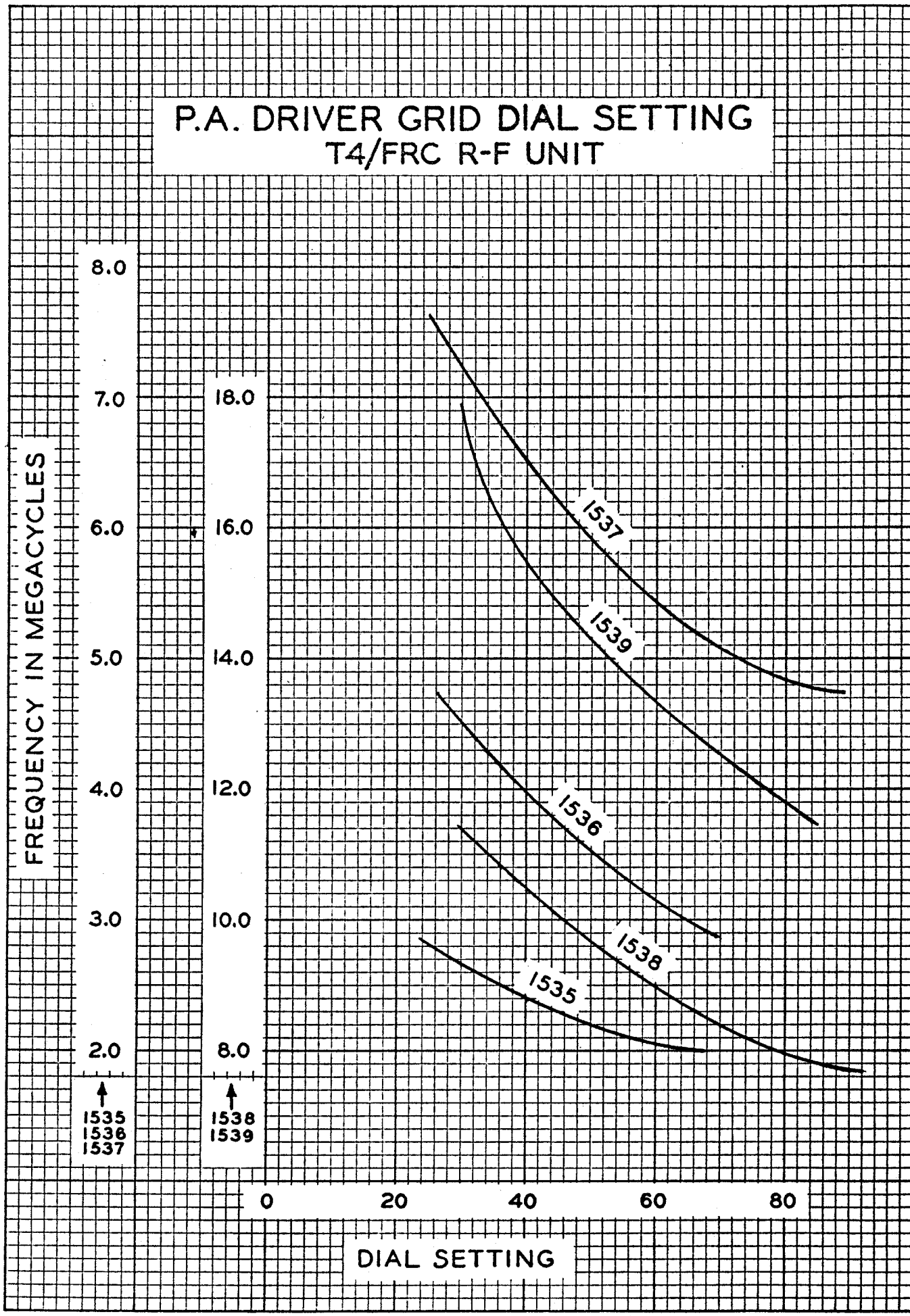


FIGURE 3. P. A. DRIVER GRID DIAL SETTING—T-4/FRC

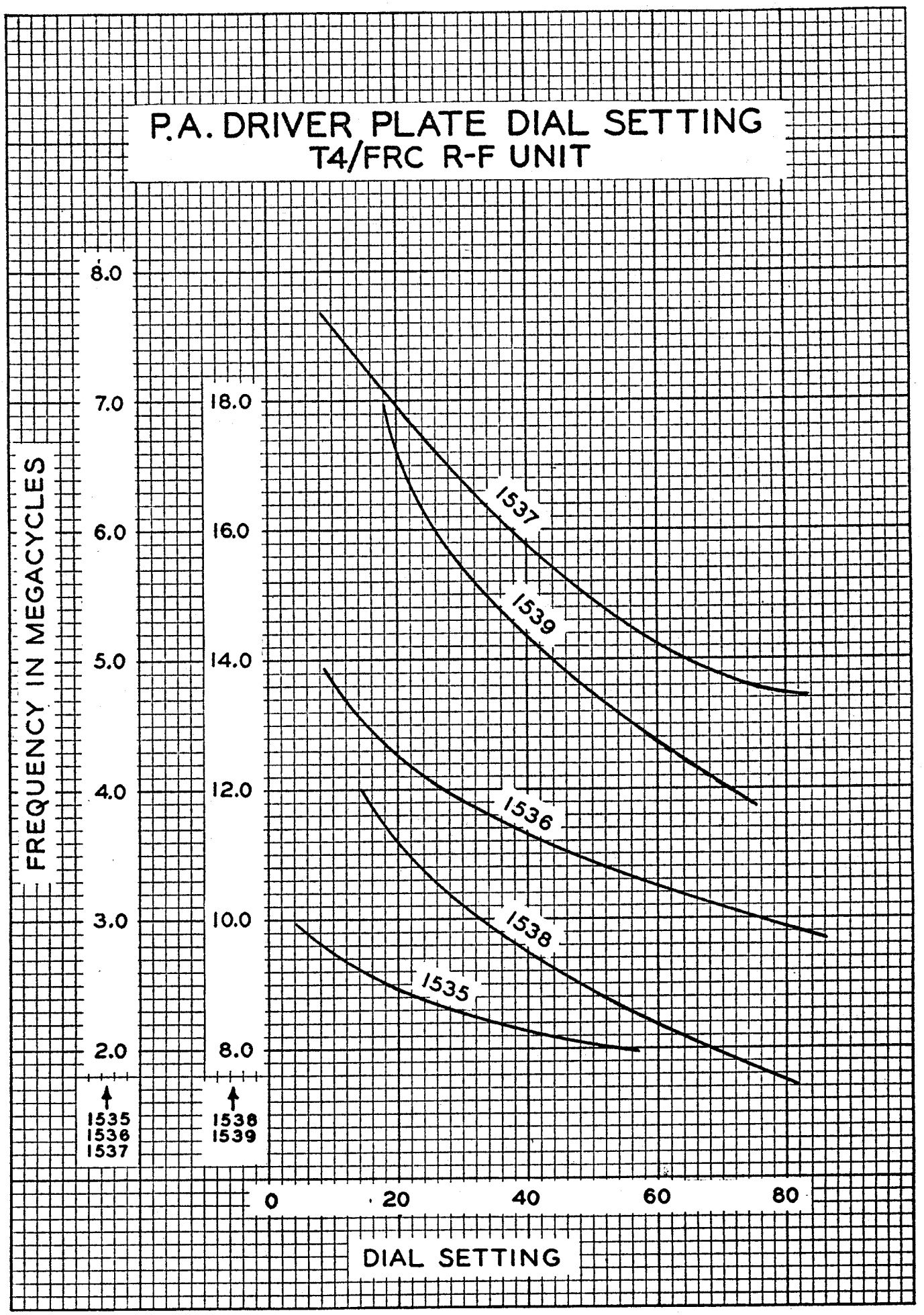


FIGURE 4. P. A. DRIVER PLATE DIAL SETTING—T-4/FRC

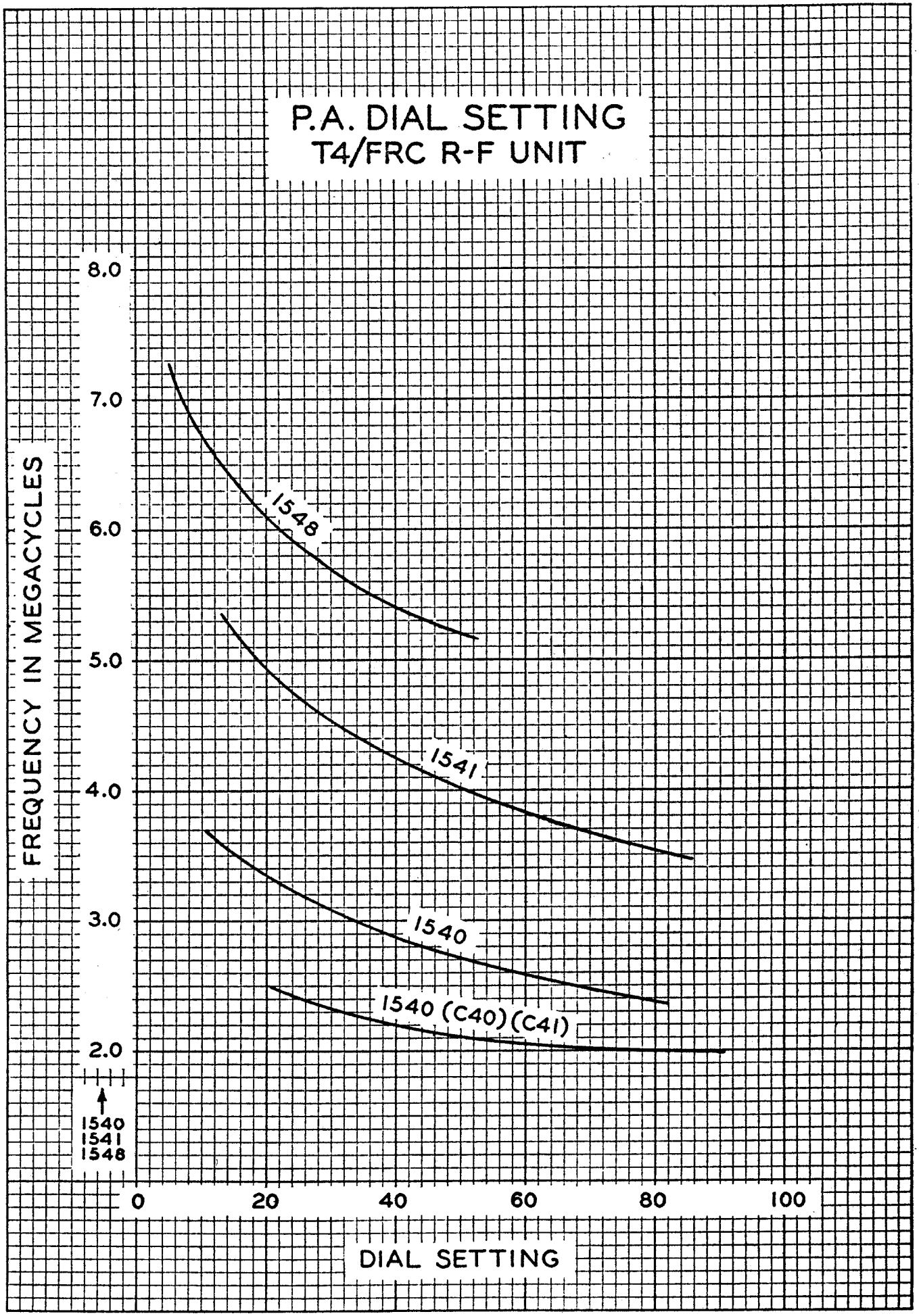


FIGURE 5. P. A. DIAL SETTING—T-4/FRC

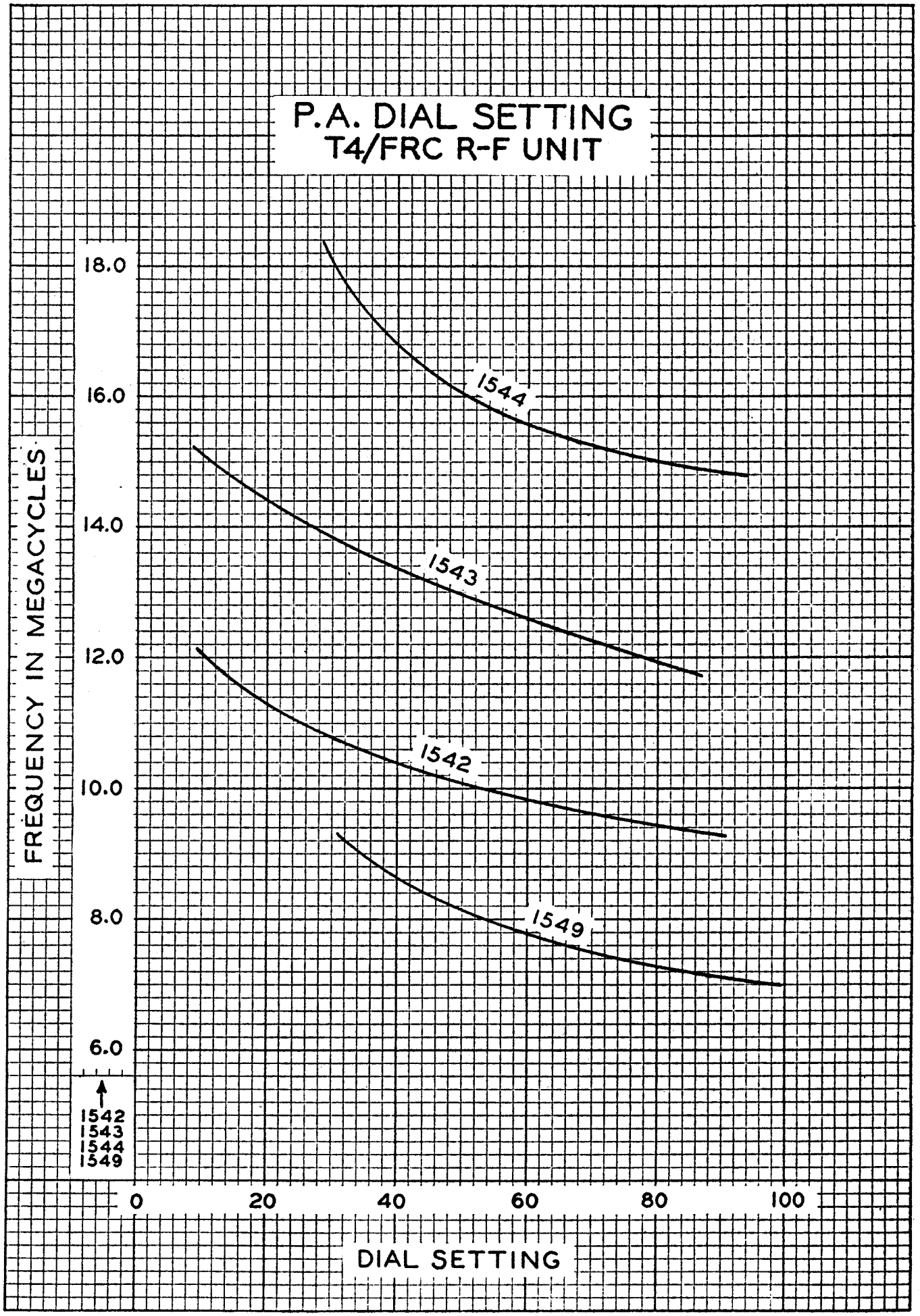


FIGURE 6. P. A. DIAL SETTING—T-4/FRC

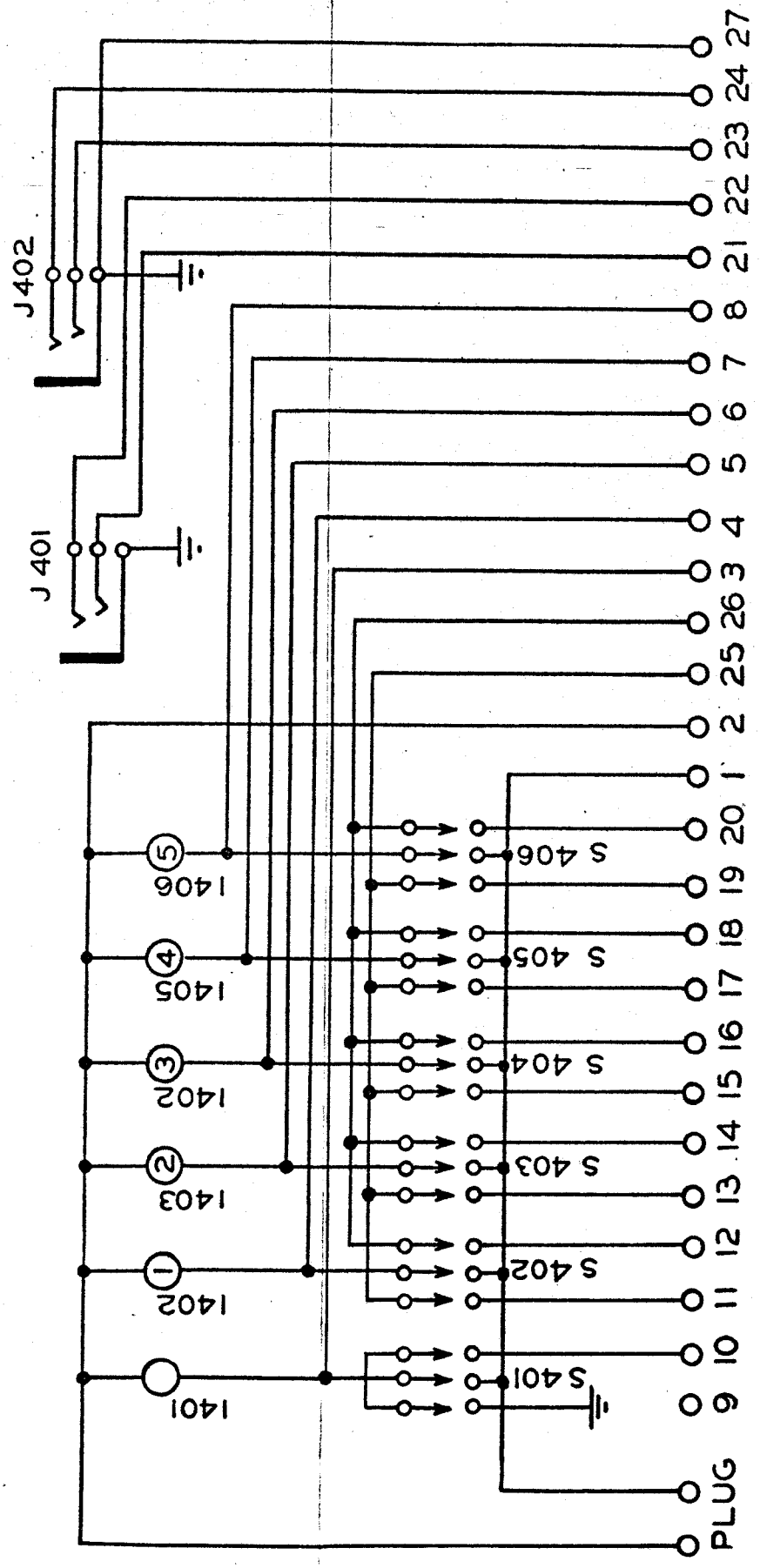
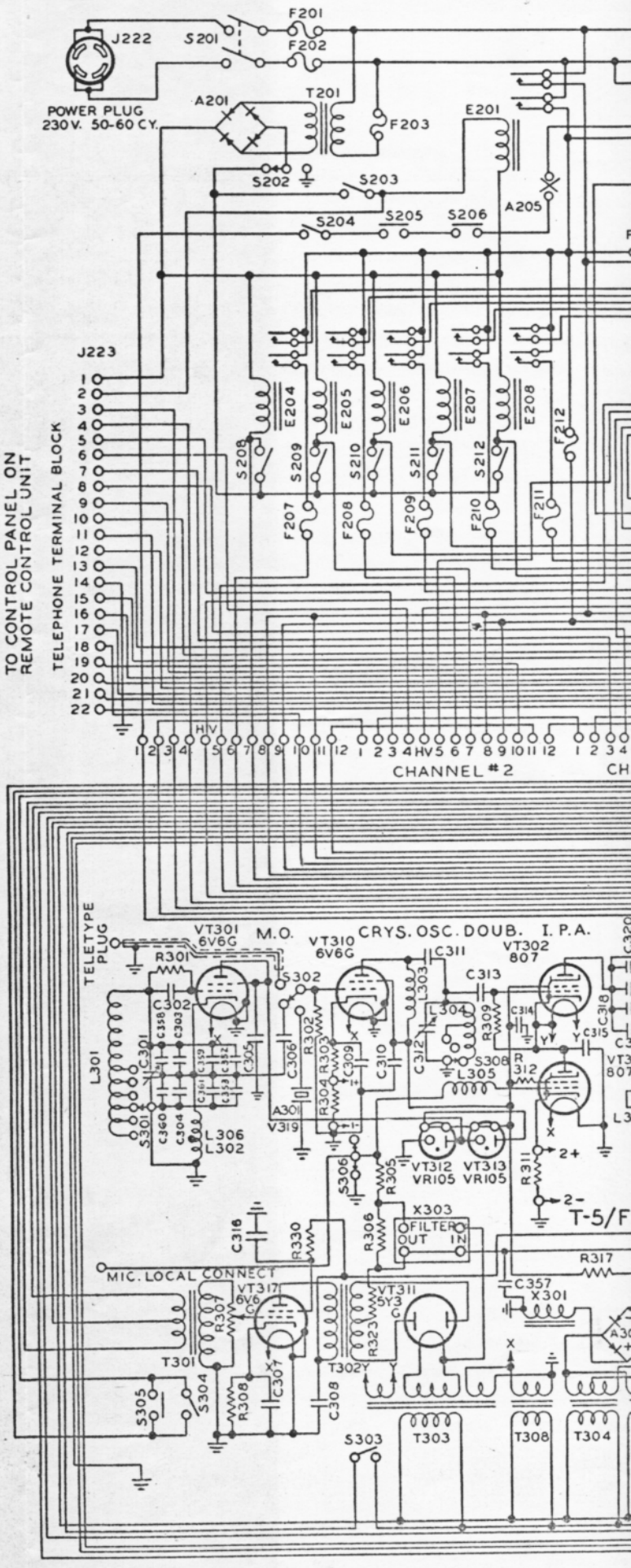


FIGURE 11. SCHEMATIC DIAGRAM—SWITCH PANEL SA-2/FRC

Plug connections to TH/FRC

1. } interlock SW
2. }
3. } to outside term of
4. } TONE control transf
5. High voltage to PA
6. one side of N.O. contact of over, under load relay
7. Center tap T1
8. 220 VAC
9. to standby SW and 230V
10. GND
11. } N.C. contact of over
12. } under load relay



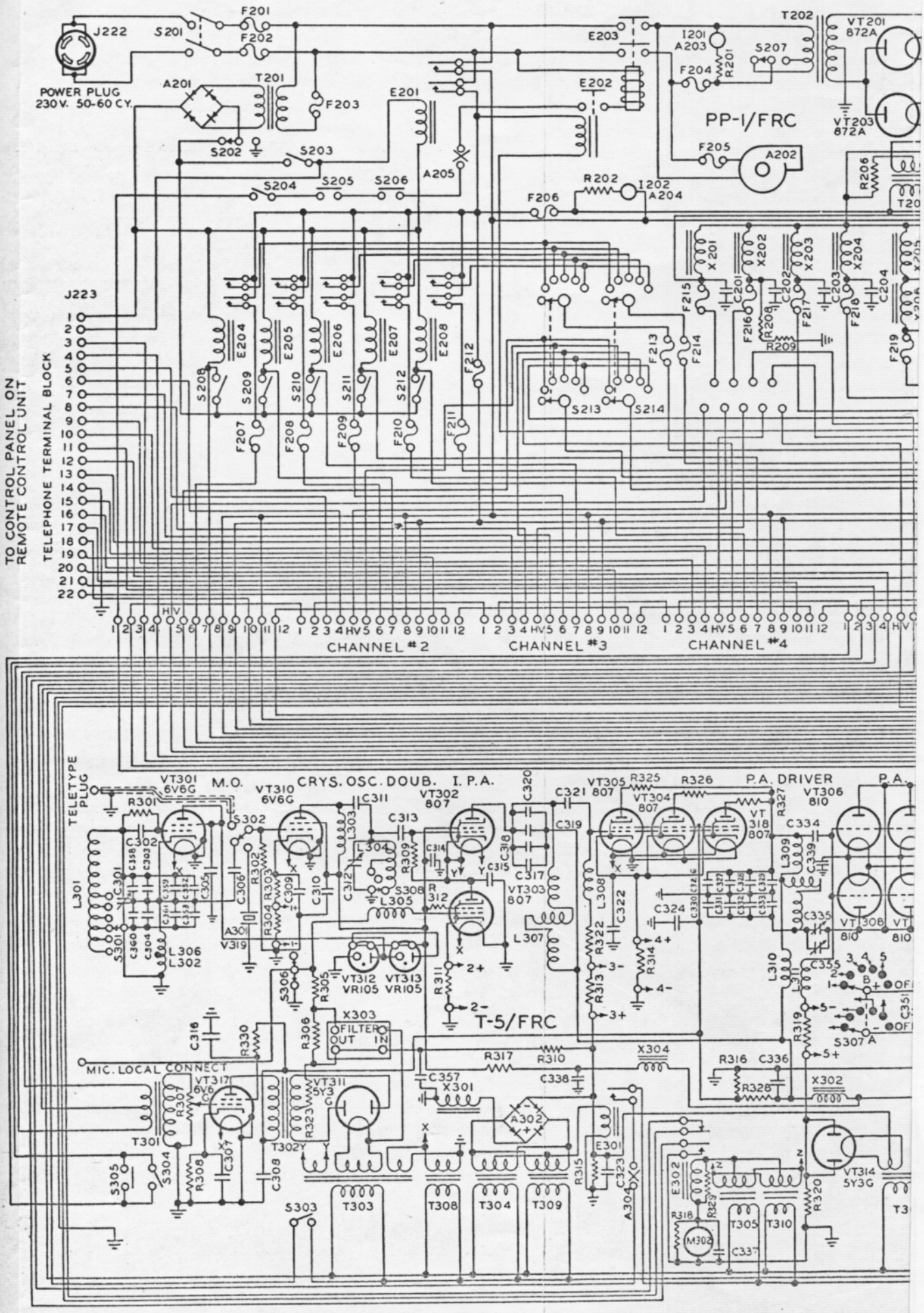
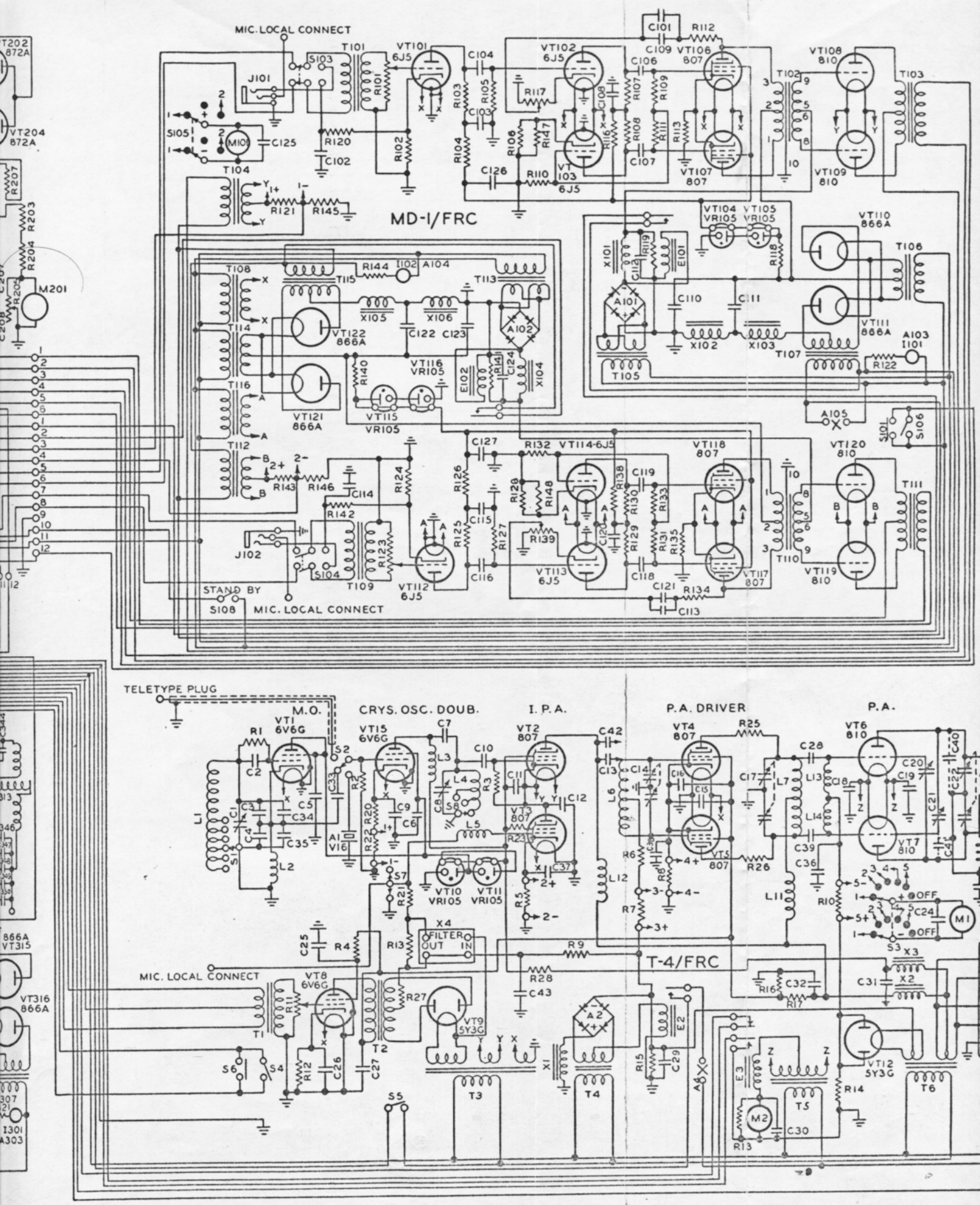
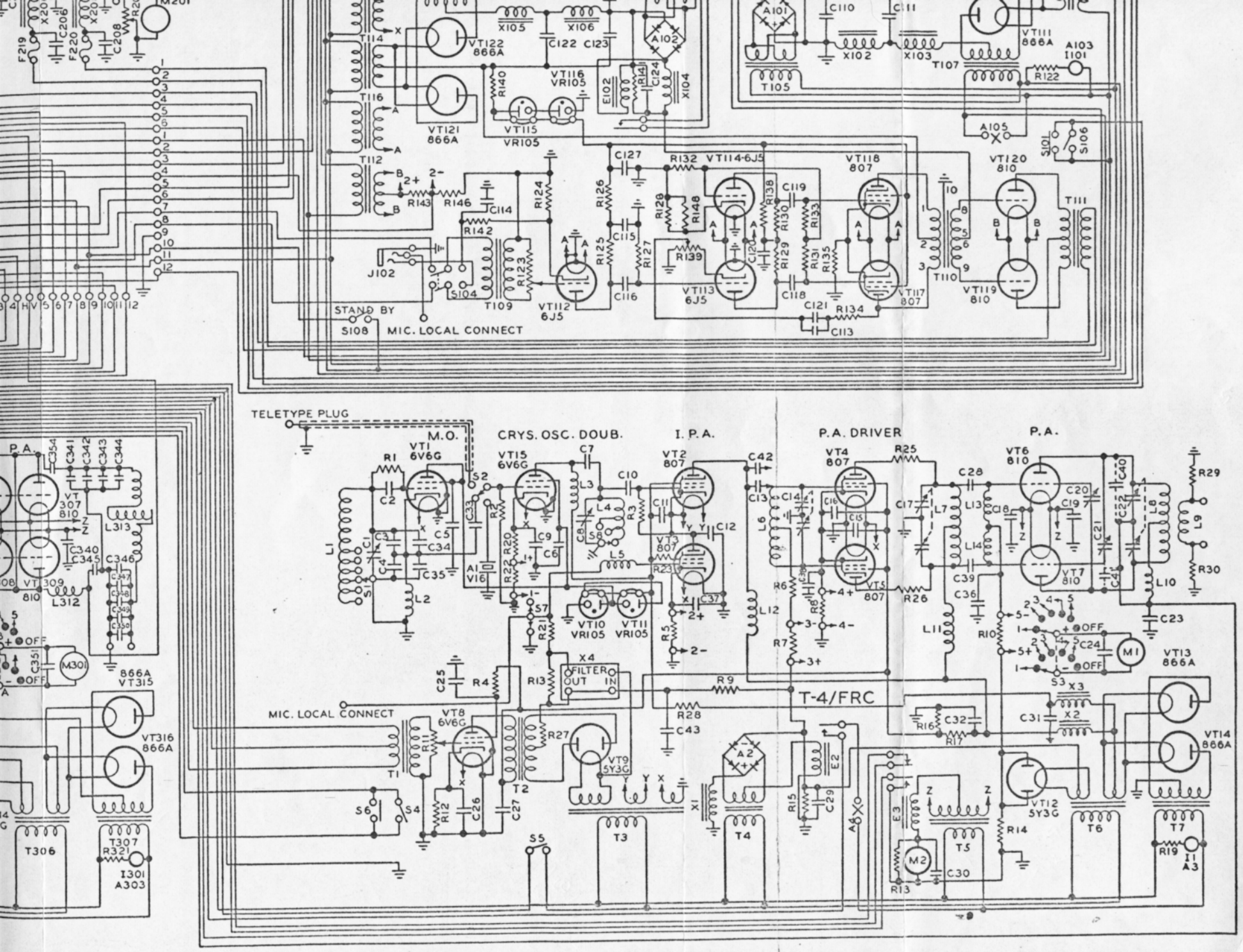

TO CONTROL PANEL ON REMOTE CONTROL UNIT
TELEPHONE TERMINAL BLOCK
J223
J222
POWER PLUG 230V. 50-60 CY.
PP-1/FRC
T-5/FRC
CHANNEL #2
CHANNEL #3
CHANNEL #4
TELETYPE PLUG
MIC. LOCAL CONNECT
M.O.
CRYS. OSC. DOUB.
I. P. A.
P.A. DRIVER
P.A.

FIGURE 7



EMATIC DIAGRAM—TRANSMITTER



RE 7. SCHEMATIC DIAGRAM—TRANSMITTER