Western Electric

RADIO FREQUENCY AMPLIFIER

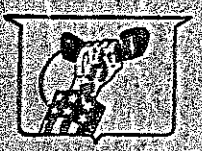
No. 6071 B

Instruction Bulletin No. 728

INCLUDING SUPPLEMENT "A"

Western Electric

ARSENAL OF COMMUNICATIONS EQUIPMENT



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RADIO FREQUENCY AMPLIFIER No. 6071B

INTRODUCTION

The Western Electric No. 6071B Amplifier is a radio-frequency amplifier designed for connection to a Western Electric No. 12B or other Radio Transmitter capable of delivering 100 watts. It may be operated at any frequency from 550 to 3000 kilocycles and will deliver 250, 500 or 1000 watts of completely modulated carrier into a suitable antenna. It is composed of a No. 71B Amplifier plus miscellaneous apparatus such as vacuum tubes, fuses, etc., required for operation.

The No. 71B Amplifier consists of a metal cabinet, similar to that of the No. 12B Radio Transmitter, containing the radio-frequency circuits, complete power supply equipment and all the necessary control and protective circuits. As the amplifier is completely a-c. operated, no motor-generators, batteries or other external power equipment are required.

The amplifier is designed to operate on 220-volt, 50- or 60-cycle, three-phase power supply. The following table gives the total power required for operation at the three output ratings in the standby and operating conditions. The power factor is 90 per cent.

Output Rating	*Full Operation*
1000 watts	4000 watts
500 watts	2400 watts
250 watts	1500 watts

A schematic diagram of the amplifier circuit is shown in Figure 1. The amplifier consists of two tubes operating in a balanced push-pull circuit, a circuit for suppressing radio-frequency harmonics, and provision for efficiently coupling the output to an antenna. Separate rectifiers provide the necessary direct current to the plate and grid circuits. Control and protective circuits interlock with those of the associated radio transmitter to provide protection to the equipment and the operating personnel.

The Nos. 302C, 303C, and 304C Radio Transmitting Equipments (250, 500, and 1000 watt output, respectively) each consist of a No. 12B Radio Transmitter and a No. 71B Amplifier with their necessary accessories. These equipments are supplied with tubes, tube sockets, condensers, etc. for the power output requested. They may be operated at reduced power by simple adjustments. The power rating may be changed by the substitution of the proper tubes, tube sockets and other components.

GENERAL DESCRIPTION

Amplifier Input Circuit

The radio-frequency input voltage is obtained from the tuned input transformer (L1B) coupled to the output of the associated radio transmitter. The input energy is dissipated in resistances (R1B and R2B) which are in tapped sections to permit adjust-

ment to the value required to produce the necessary radio-frequency grid voltage across the tuned circuit.

Amplifier Tubes

The amplifier employs two radiation-cooled vacuum tubes (V1B and V2B) operating as class "B" in a balanced push-pull circuit, the tubes being biased to approximate cut-off.

Amplifier Output Circuit

The plates of the tubes operate into a tuned output transformer containing a thermoammeter (M5B) to facilitate tuning and neutralizing.

Harmonic Suppression and Antenna Coupling

Harmonic suppression and antenna coupling is accomplished by the network consisting of L3B, C11B, C12B and L4B which couples the transmitter to the antenna and suppresses the radio-frequency harmonics. Meters (M6B and M7B) necessary to facilitate tuning are provided in this circuit. A resistance (R8B) of 100 ohms is included, which may be connected by means of a link (D14B) to serve as a load for testing at times when it is not permissible or desirable to energize the antenna.

Monitoring Circuit

An audio output transformer (T4B) connected in the high voltage return lead provides ample audio power for monitoring purposes.

Power Circuits

The filaments of all tubes operate on alternating current. The filament transformer primary voltage is measured by a voltmeter (M1B) and is maintained at 200 volts by adjustment of the variable auto-transformer (T6B).

Grid bias voltage is supplied by a single full-wave mercury vapor rectifier tube (V9B). The output of this rectifier is passed through a two-section filter and dissipated in an adjustable resistance (R10B).

Plate power for the amplifier tubes is supplied by a three-phase full-wave mercury vapor rectifier employing six tubes (V3B to V8B, incl.). The output of this rectifier is filtered by a single-section filter.

Power Control and Protection Circuits

The power control circuits consist of a combination of relays arranged to energize the various power circuits of the amplifier in the correct sequence and to provide the necessary delay before applying plate voltage to the rectifier tubes. The amplifier is completely energized automatically by the operation of the *"Master Control"* switch located on the No. 12B Radio Transmitter, if the *"Main Power Disconnect"* (D1B) and the *"Filaments"* (D3B) switches are closed, and when the *"High Voltage"* switches on both the transmitter and amplifier units are *"On."* For semi-automatic starting, the *"High Voltage"* switches are left in the *"Off"* position when the *"Master Control"* switch is closed. After the control circuits have functioned, the starting operation may be completed by closing the *"High Voltage"* switches. (See "Control Circuit Sequence Chart," Figure 2.)

The protection circuits (of the No. 71B Amplifier) consist of the following relays and fuses to protect the equipment and personnel.

The door switch relay (S3B) removes bias and plate voltages whenever a door switch (D7B) is operated either in the No. 12B Radio Transmitter or the No. 71B Amplifier.

The grid bias marginal relay (S5B) removes the plate voltage when the bias voltage is below a proper value and prevents application of the plate voltage when the bias voltage is low.

The overload relay (S6B) removes the plate voltage when an overload beyond the safe capacity of the rectifier occurs. The current demanded by modulation peaks and supplied by the filter condenser does not pass through this relay and cause unnecessary operation.

The surge relay (S7B) and the filter resistance relay (S8B) are provided to short out a

resistance, used to limit the condenser charging current, after the condenser has assumed its full charge. It is necessary to limit this charging current to prevent excessive loads on the rectifier tubes and false operation of the overload relay.

Fuses are provided in the 220-volt a-c. circuits and in the rectifier output circuits as additional protection to the apparatus against circuit defects.

INSTALLATION

General

The installation of the No. 71B Amplifier in conjunction with the No. 12B Radio Transmitter, being a typical case, is herein dealt with in detail. Installation in conjunction with a transmitter other than the No. 12B should be facilitated by these instructions.

The No. 302C, or 303C, Radio Transmitting Equipments should be installed in accordance with the installation drawings furnished. The transmitter and amplifier units should be installed in a light, well ventilated room and so situated as to provide easy access to the antenna and ground connections. At least three feet of clearance should be allowed on all sides and top of the units. If forced ventilation of the transmitter room is employed, care should be exercised in arranging this ventilation so that dust and dirt are not blown or drawn into the equipment.

Two hardwood bases should be prepared for the units in accordance with the installation drawing, and if practicable, all ground leads, power and audio conduits should be in place before the equipment is set up. The No. 12B Radio Transmitter should be placed on one of the hardwood bases and the back and two sides of the unit should be removed by removing the screws which fasten them to the frame. The right side of the transmitter unit is removed permanently and side guide pins at the top of the transmitter frame should be removed to permit the proper alignment of the transmitter and amplifier units.

Before the No. 71B Amplifier is set in place on its hardwood base, remove the knock-outs in the junction box in the No. 12B Radio Transmitter. This junction box is located in the lower front right-hand corner of the transmitter unit (see view "C-C" on installation drawing ESX-601752). Remove the back and the right side from the amplifier unit by removing the screws which fasten them to the frame. The left side of the unit should not be removed. When the amplifier unit is in place and carefully aligned with the transmitter unit, a 1½ inch Chase nipple and locknut should join the junction box in the transmitter unit to the amplifier unit.

Ground System

A typical interior ground system layout is shown on the installation drawing (ESR-601783). All metal structures such as building frame, water and steam pipes, conduits, roofs and stacks should be bonded to the interior ground system. All ground connections should be as short and direct as possible and all joints should be soldered or welded. Where installations are made in tall buildings the information given on ESR-601783 and associated drawings may not apply entirely, in which case additional engineering information should be requested.

The main ground terminal of the transmitter unit is located at the extreme lower right-hand corner in front of the junction box. It consists of a cadmium plated copper strip 4¾ inches long which is fastened to the main transmitter frame by means of two bolts located at the ends of the strip. The main ground terminal of the amplifier unit is located at the extreme lower left-hand corner of the cabinet in front of the terminal strip. It is similar in construction to that of the transmitter unit and is fastened to the main frame of the amplifier by means of bolts. The ground connection for each unit should consist of a 4 inch by 1/64 inch

copper strip, one end of which should be soldered to the removable strip which is then bolted to the ground terminal. The other end is soldered to the main ground system. It is suggested that the lugs which are bolted to the ground terminal in the transmitter unit be temporarily removed while soldering the ground strip. All ground connections should be as short and direct as possible.

Antenna

The No. 71B Amplifier can be operated with an antenna of any resistance and reactance, but where antennas of less than 12 or more than 90 ohms are encountered, additional engineering information should be requested. The antenna lead-in from the grounding switch is connected to terminal 27 located on top of the amplifier unit. Copper tubing is recommended for this purpose.

Power and Control Connections

A 1-inch conduit should be installed from the service entrance to the junction box in the transmitter unit and three No. 8 B&S gauge BRC wires should be pulled through from the 220-volt, 3-phase, 50- or 60-cycle power supply. These wires connect to terminals 1, 2 and 3 of the amplifier terminal block. Connect terminals 2 and 3 of the amplifier to terminals 1 and 2, respectively, of the transmitter terminal block. Using No. 14 B&S gauge BRC wire connect terminals 4, 5, 6 and 7 of the transmitter unit to terminals 4, 5, 6 and 7, respectively, of the amplifier unit.

Radio-Frequency Input Connections

In the No. 12B Radio Transmitter open link switch D28A and remove condensers C21A from their mounting posts. Connect the ground strap of the transmitter to terminal 26 of the amplifier. Connect the ungrounded post just vacated by condensers C21A to terminal 25 of the amplifier. When these connections are complete, link switch D2A may be used to connect resistance R12A into the circuit: that is, when this link is between "3" and "4" the resistance is in circuit, and when between "2" and "3" the resistance is out of circuit.

Audio-Frequency Connections

The speech input and monitoring output leads should be run in conduit and brought out near the terminal blocks in the transmitter unit. The speech input leads connect to terminals 15 and 16 on the transmitter terminal block and the monitoring output leads connect to the spare terminals 13 and 14 on the transmitter terminal block. Terminals 13 and 14 then should be connected to terminals 9 and 10, respectively, of the amplifier unit. A No. 19 B&S gauge twisted pair, rubber and lead covered cable per KS-6531 should be used for all audio leads. Both ends of the lead cable sheath should be bonded to the ground system with a No. 16 B&S gauge bare copper wire and all conduits should be soldered or welded to the ground system. In grounding the lead cable sheaths, terminal 10 of the transmitter unit or terminal 11 of the amplifier ur[illegible]nay be used.

Transformer Connections

The heaviest transformer (T5B) is shipped separately and must be mounted in its place in the lower compartment. Each transformer terminal is marked and each wire is correspondingly tagged. Remove the metal tags or slide them back upon the wires to avoid a chance of short circuiting, and connect numbered wires to the correspondingly numbered transformer terminals.

Rectifier transformers (T3B and T5B) are equipped with taps marked with the primary voltage. The line voltage should be measured at regular intervals during an operating day, the average taken, and the connections to the transformer taps made on that marked terminal which is nearest to the average voltage.

Miscellaneous Installation Notes

When the harmonic suppression coil is fitted with an internal supplementary coil it is shipped with fiber wedges to protect it from breakage. Remove these wedges before energizing the amplifier.

The equipment is shipped with condensers, meters, and other parts, all of which are appropriate for the frequency, power and antenna impedance specified in the order.

Change of Transmitter Nameplates

Certain apparatus designation nameplates on the No. 12B Radio Transmitter are changed when the transmitter is operated in conjunction with the No. 71B Amplifier. The new nameplates and mounting screws are included with the equipment and can be attached readily with a screwdriver. The nameplates to be substituted are listed below:

Apparatus Designation	*Original Nameplate Designation*	*New Nameplate Designation*
M3A	"Antenna Current"	"Output Current"
C19A	"Antenna Tuning"	"Output Tuning"

The correct equipment nameplate also will be included and should be mounted in the designated place in the center of the front panel of the No. 12B Radio Transmitter. The panel is drilled and tapped, and the proper screws are provided for this purpose.

PRELIMINARY ADJUSTMENTS OF POWER CIRCUITS

Power Supply Circuits

Open main switch D1B and install fuses in accordance with the following table which gives the fuse ratings in amperes.

R.F. Output Power	*F1B*	*F2B*	*F3B*
1000 watts	5	2	15
500 watts	4	2	10
250 watts	3	2	6

Install five 6-watt 120-volt (candelabra base) lamps in the panel lamp sockets.

Preheating Rectifier Tubes

Install six No. 249B Vacuum Tubes* (mercury vapor rectifiers) in the sockets (VS3B to VS8B, inclusive) and one No. 301A Vacuum Tube* (mercury vapor rectifier) in its socket (VS9B). Preheat these tubes in the following manner.

Set the *"High Voltage"* switch (D8B) on *"Off"* and temporarily remove bias rectifier fuses (F2.1B and F2.2B). Apply filament voltage to all rectifier tubes by closing the main switch (D1B), the *"Filaments"* switch (D3B), and the main switch on the transmitter unit. Adjust the *"Filaments Volts"* meter (M1B) to 200 volts by means of the variable auto-transformer (T6B) designated *"Filament Volts."* This places 2.5 ± 0.1 volts on the filaments of the plate rectifier tubes (V3B to V8B, incl.) and 5.0 ± 0.1 volts on the filament of the grid rectifier tube (V9B). After 15 minutes or more the preheat is complete and the switches may be opened and fuses replaced.

Delay Relay

During the preheating operation just described remove the cover from the delay relay (S2B) and verify its timing by comparison with the second hand of a watch. The time of operation should be at least 15 seconds from the instant *"Filaments"* switch D3B is closed. If this time is not obtained set and lock the calibrating disc within the relay to "15" or "16" (seconds) and verify the setting.

If the equipment is being operated upon a 50-cycle power supply the calibrating disc should be set at five-sixths of the desired number of seconds, for example, the correct setting for fifteen seconds is 12. Any setting made should be verified by timing with a watch.

A delay of 15 seconds assumes a room temperature of at least 60 degrees Fahrenheit. If room temperatures below 60 degrees but above 50 degrees are encountered, greater delay up to the full range of the relay must be used. If below 50 degrees, the tubes should be pre-

*The filaments of new mercury vapor tubes should be heated at least 15 minutes before the high voltage is applied. This preheating removes any particles of mercury adhering to the sides or elements of the tubes after shipment or handling, thus minimizing the possibility of flash-overs. (See section on "Maintenance.")

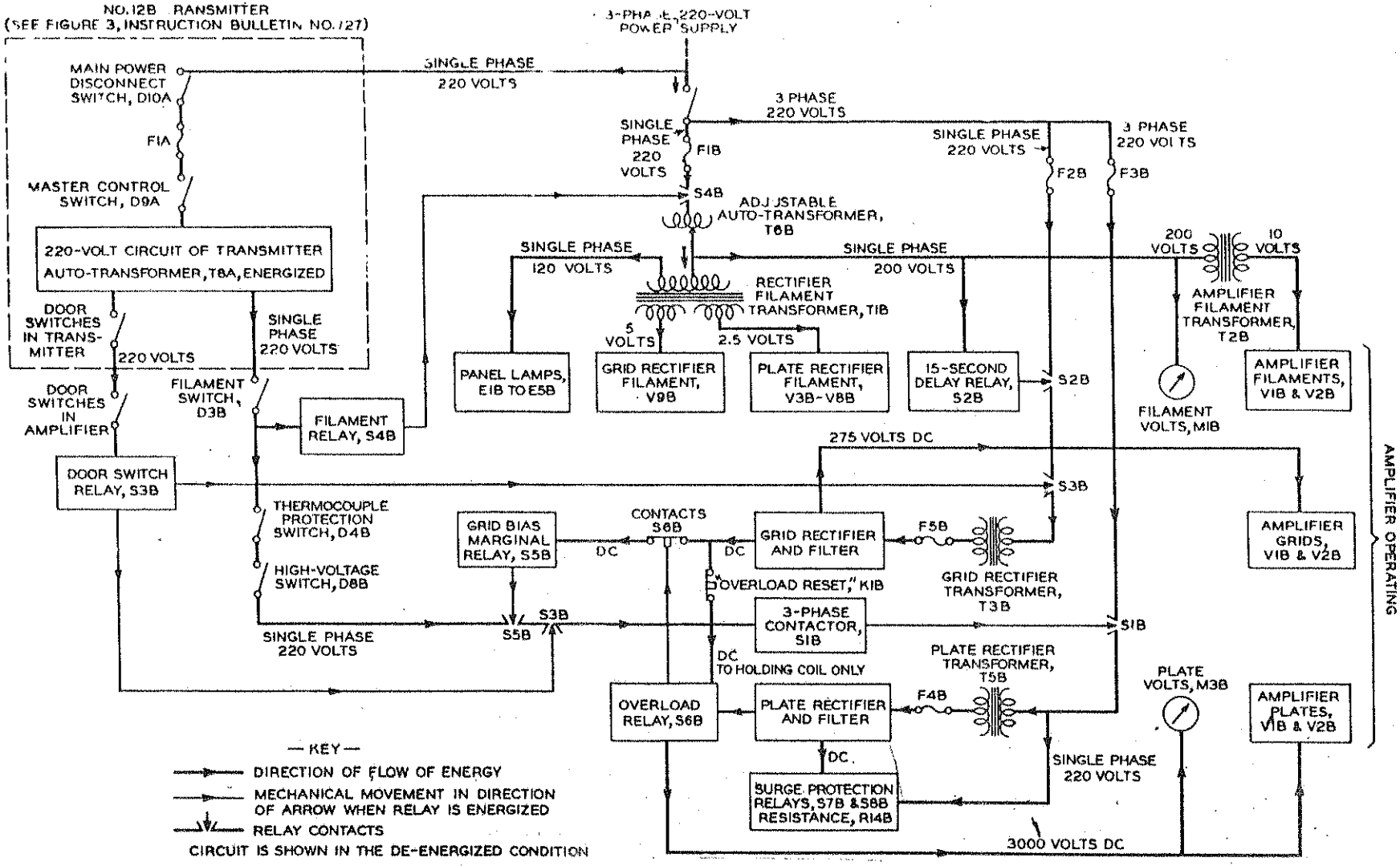

Fig. 2—Control Circuit Sequence Chart of the 6071-B Amplifier

heated for a greater length of time and the high voltage applied manually by means of the *"High Voltage"* switch (D8B). At 32 degrees this time should be at least 15 minutes.

Grid Bias Load Resistances

Connect an ammeter suitable for measuring 0.32 ampere direct current in series with the grid filter retardation coil (L21B). This may be done by unsoldering the wire from the terminal lug marked "1," soldering the negative ammeter lead to the lug, and the positive lead to the loose wire. Energize the grid bias rectifier by closing the main switch (D1B) and the *"Filaments"* switch (D3B) as in the preceding paragraph. Do not close the *"High Voltage"* switch (D8B).

The load resistances (R10.2B and R10.3B) are connected in parallel and must be adjusted together so they will have approximately equal resistances. Adjust these resistances by means of the lower slider clamps which short out the unused end turns so that the load current (including the current taken by the grid bias marginal relay in the operated condition) read on the ammeter is 0.32 ampere when the a-c. line voltage is at its average value.

The remaining sliders provide a potentiometer adjustment of the bias voltage on the tubes (V1B and V2B) and should be set for 275 volts measured between the grid terminals on sockets (VS1B and VS2B) and ground, pending final adjustment. In the case of the 250-watt equipment, the bias voltage shall be 250 volts. Having completed this adjustment the rectifier should be shut off, the meter removed, and the wire resoldered to lug "1" on the retardation coil (L21B).

Door Switch and Filament Relays

The filament relay (S4B) should operate promptly when the *"Filaments"* switch (D3B) is closed. Door switch relay (S3B), should operate and release positively whenever any door in either the transmitter or the amplifier is closed or opened. Check each door switch several times for positive operation.

Do not remove the strap from across the resistance (R5B) and condenser (C32B) in series with the door switch relay (S3B). This apparatus is provided only for use when the amplifier is operated with a transmitter other than the No. 12B which may have a 110-volt door switch circuit.

Plate Rectifier Contactor, Surge and Filter Resistance Relays

Close the main switch (D1B), *"Filaments"* switch (D3B), and all doors. Allow time for the delay relay (S2B) to operate. Observe the plate rectifier contactor (S1B) and the surge relay (S7B) for positive operation and the filter resistance relay (S8B) for somewhat delayed operation when the *"High Voltage"* switch (D8B) is closed. The surge relay (S7B) operates momentarily and drops back to permit the operation of (S8B).

Grid Bias Marginal Relay

The grid bias marginal relay (S5B) is adjusted by means of slider clamps on a resistance (R16B) in series with the relay winding. This relay (as well as all others) is adjusted when it leaves the factory and should not require readjustment. However, if the sliders have been moved it will be necessary to readjust it as follows:

Temporarily connect an adjustable resistance of 200 ohms maximum, capable of carrying ½ ampere in series with the primary of the bias rectifier plate transformer (T3B) and use this to adjust the voltage output of the rectifier. Connect a d-c. voltmeter with a 0-300 scale across the entire load resistance to measure this voltage. Set the d-c. voltage at 230 and adjust the resistance (R16B) to a value such that the relay will just pull up when the a-c. voltage is applied. Reduce the d-c. voltage to 200 and adjust that portion of the resistance (R16B) between the "break" contacts until the relay drops out at this voltage. Care must be taken not to attempt to make this marginal adjustment so close to the "operate" (230 volt) point that the relay will act as a buzzer at

some critical voltage. The voltages specified in this paragraph may be lowered for those installations which are subject to line voltage variations greater than ± 10 per cent from normal.

Overload Relay

The overload relay (S6B) is properly adjusted at the factory and should not require readjustment. Adjustment of its operating point in the circuit is controlled by a shunt resistance (R9B) which is set in the following manner.

This adjustment must be made with the cover of the relay (S6B) in place. Open the main switch (D1B). Connect the positive terminal of a six-volt battery to the transmitter ground, the negative terminal to a 12-ohm rheostat, and the other terminal of the rheostat to the cap terminal of the rectifier tube designated "V8B." Adjust the current indicated on *"Power Amp. Plate Current"* meter by means of the rheostat to the normal value indicated in the following table and allow the current to flow (i.e., "soak") for at least one minute.

Output Rating	*Normal Current*	*Overload Current*
1000 watts	1.00 amperes	1.50 ± 0.15 amperes
500 watts	0.50 amperes	1.00 ± 0.10 amperes
250 watts	0.25 amperes	0.50 ± 0.10 amperes

The shunting resistance (R9B) shall be adjusted so that the overload relay (S6B) operates on the overload value when the current is increased from the normal value. In the case of the 250 watt amplifier it is not possible to use the shunting resistance (R9B), therefore in this case remove the strap wire at one end of the resistance and test the relay for operation between the limits indicated in the table.

Upon completion of the above tests, close the main switch (D1B), open *"High Voltage"* switch (D8B) and energize the grid bias rectifier by closing *"Filaments"* switch (D3B). Operate the overload relay (S6B) manually, using a slender wooden rod through a perforation in the cabinet and note that the relay holds up after operation and is released by the *"Overload Reset"* key (K1B). This must be done with the relay cover off.

General

Remove all testing equipment, replace relay cover, energize the amplifier and observe for the sequence of operations indicated on the "Control Circuit Sequence Chart" Figure 2. Note that the plate voltmeter (M3B) indicates somewhat more than 3000 volts, that there is no appreciable current on the plate current meter (M4B) and that the panel lamps operate.

PRELIMINARY ADJUSTMENTS OF RADIO FREQUENCY CIRCUITS

General

Refer to the attached tuning chart and set up the specified number of turns on coils L1B, L2B and L3B. Verify that the fixed condensers listed in the table have been installed and connected. Small differences in tube characteristics and manufacturing variations in the coils and condensers may render the tuning chart inexact, therefore during the following tuning operations a change of a turn or two may be anticipated.

Adjustment of Antenna Impedance

If the antenna has positive reactance, it will be necessary to install an antenna series condenser (C13B) so that the total antenna reactance will be only enough positive to tune properly with the required value of coupling capacity (C12B). Space, temporarily closed by a link (D11B), has been provided for this capacity (C13B). Specifically if the antenna has more than j20 ohms positive reactance, the antenna series condenser (C13B) shall be

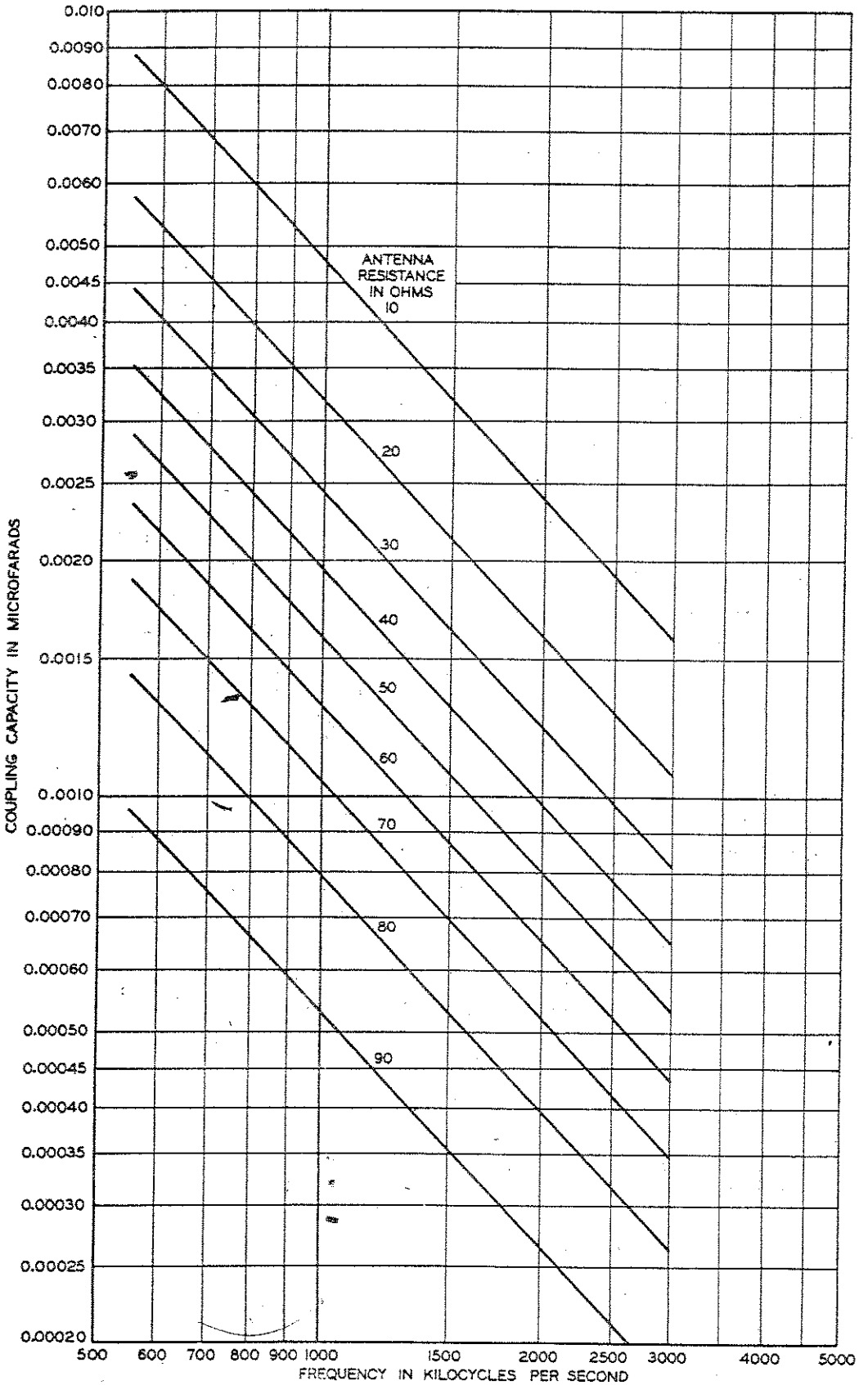

Fig. 3—Frequency Kilocycles

in accordance with the following table, wherein Ra is the resistance component of the antenna impedance. The necessary Cornell-Dubilier condenser may be ordered from the nearest Branch House of the Graybar Electric Company. For antennas of more than 90 ohms resistance, additional engineering information should be requested.

Frequency Kilocycles	*Capacity Mfd.*	*Ra Between 20 and 90 Ohms*
500 to 900	0.00120	PL-242-50
910 to 1800	0.00060	PL-265-50
1800 to 3000	0.00035	PL-288-50

Installation of Amplifier Tubes

Install the amplifier tubes in the sockets, taking care to see that they are not subject to any mechanical strains. In the case of the 250-watt equipment, two adapter assemblies for use in connection with the standard sockets, are provided and should be installed before the tubes are fitted to them.

Verify the proper installation of the tubes by lighting the filaments (close *"Master Control"* on transmitter, the main switch D1B and *"Filaments"* switch D3B) setting the *"Filaments Volts"* voltmeter (M1B) to 200 and reading 10.0 ± 0.1 volts across the filament terminals or pins on the tube with an accurate portable voltmeter. Poor socket contacts will cause low filament voltage measured across the tube terminals.

Energize the amplifier as previously described and adjust the plate currents of the two tubes to equality, as indicated upon the *"Balance"* meter (M2B), by adjusting the potentiometer slider on either load resistor (R10B) of the grid bias rectifier. One tube (V1B or V2B) should be biased to 275 volts, the other adjusted to balance. In the case of the 250 watt equipment the bias voltage shall be 250 volts balanced as above.

The *"Power Amp. Plate Current"* meter (M4B) readings should be approximately as given in the table below.

Type of Tubes	*Output Rating*	*Bias Volts*	*Plate Amperes*
279A	1000	–275	0.3 ± 0.1
251A	500	–275	0.3 ± 0.1
270A	250	–250	0.075 ± 0.025

TUNING ADJUSTMENTS

Preliminary

These instructions describe the tuning of the No. 71B Amplifier in connection with the No. 12B Transmitter as a typical case. It is assumed that the transmitter is tuned and adjusted in accordance with instructions contained in Bulletin No. 727. This preliminary tuning of the transmitter shall be done with the *"Input Coupling"* control (L1B) of the amplifier set on zero and the 100-ohm resistance (R12A) in series with the other elements of the link circuit, i.e., "D2A" shall connect "3" and "4" as described under "Radio Frequency Input Connections." If condenser C19A shows a tendency to flashover, reduce the turns on L13A and increase the capacity (C-19A). Note: – *"Antenna Tuning"* condenser (C19A) and *"Antenna Current"* meter (M3A) referred to in Bulletin No. 727 have been redesignated as *"Output Tuning"* and *"Output Current"* respectively.

Amplifier Input Circuit

With the amplifier *"Input Coupling"* control (L1B) set on zero, tune the output of the No. 12B transmitter until the full output power (100 watts) is dissipated in the 100-ohm resistance (R12A). Record all meter readings and dial settings on the No. 12B Transmitter, reduce the *"R.F. Output"* control (R20A) to zero and remove the 100-ohm resistance (R12A) by means of the link switch (D2A) described under "Radio Frequency Input Connections."

Energize the No. 6071B Amplifier by operating the main switch (D1B), and the *"Fila-*

RF CONTROL 50

POWER AMP
INPUT TUNING - 50

3 AMP TUNING 60

M4A 150 MIL

M2A 1.1

M3A .8

RF OUT 100 W

ments" switch (D3B). Leave the *"High Voltage"* switch (D8B) open. Increase the *"R.F. Control"* until a convenient reading (½ ampere or more) is obtained upon the *"Output Current"* meter (M3A), and increase the *"Input Coupling"* control (L1B) to five or ten divisions. Tune the amplifier input circuit with the *"Input Tuning"* control (C1B) until a distinct minimum is obtained on the *"Output Current"* meter (M3A) of the transmitter. During this tuning the *"Balance Adjust"* control (C2B) may be left on 50. When the input circuit has been tuned increase the *"Input Coupling"* control (L1B) only until the readings of the No. 12B Transmitter read as recorded in the preceding paragraph.

Neutralizing and Amplifier Output Tuning

Reduce the *"R.F. Output"* (R20A) to zero, connect the sensitive thermocouple (TC1B) by operating the four-pole knife switch (D4B) to the *"Neut."* position, set the *"Neutralizing Adjust"* control so that the neutralizing condenser plates (C4B and C5B) are about one-third engaged and set the *"Output Coupling"* (L2B) control on zero. Operation of the knife switch also opens the high voltage control circuit to prevent application of the plate power while the sensitive couple is in the circuit.

Increase the *"R.F. Output"* slightly and adjust the amplifier *"Output Tuning"* (C10B) for a maximum reading on the *"Power Amp. Output Current"* meter (M5B), adjusting the *"R.F. Output"* control carefully so that the meter (M5B) reading does not exceed full scale. Using the *"Neutralizing Adjust"* control (C4B and C5B) reduce the meter (M5B) reading to zero. Increase the *"R.F. Output"* control gradually to its maximum and at the same time carefully put a fine adjustment on the *"Neutralizing Adjust"* control so that the meter (M5B) reading is maintained at zero or very nearly so. When the *"R.F. Output"* control is on maximum and the meter (M5B) reads sensibly zero, the amplifier is properly neutralized.

Reduce the *"R.F. Output"* to zero, and operate the four-pole knife switch (D4B) to the *"Operate"* position to place the thermocouple TC2B in the circuit. Leave the *"Output Coupling"* (L2B) on zero. Apply plate voltage to the amplifier by operating the *"High Voltage"* switch (D8B) and increase the *"R.F. Output"* until mid-scale deflection is obtained on the *"Power Amp. Output Current"* meter (M5B). Check the *"Output Tuning"* (C10B) for minimum on the *"Power Amp. Plate Current"* meter (M4B).

Coupling Circuit Tuning

Connect the 100-ohm load resistance (R8B) into the coupling circuit by means of link switch D14B and disconnect the antenna circuit by opening the link switch D12B. Set the *"Output Coupling"* control (L2B) to about five divisions and adjust the *"Coupling Circuit Tuning"* (L3B) for a definite minimum on the *"Power Amp. Output Current"* meter (M5B), increasing or decreasing the number of turns on the harmonic suppression coil (L3B) as necessary. Adjust the *"Output Coupling"* (L2B) until the *"Coupling Cct. Current"* meter (M6B) reads in accordance with the "Table of Typical Meter Readings" when the *"Output Current"* meter (M3A) on the transmitter reads as previously recorded.

Adjustment of Output Transformer Turns

If after adjusting the *"Output Coupling"* (L2B) in accordance with the preceding paragraph, the *"Power Amp. Plate Current"* and *"Power Amp. Output Current"* meters (M4B and M5B) read in accordance with the "Table of Typical Meter Readings" the turns on the output transformer (L2B) are correct.

If the *"Power Amp. Output Current"* meter (M5B) reads too high, the number of active turns on the primary of the output transformer (L2B) should be increased and the tuning procedure repeated. If the meter (M5B) reads too low the turns should be decreased. Repeat this process until the desired readings are obtained upon the three meters (M4B, M5B and M6B).

With the amplifier delivering its full power into the 100-ohm load resistance (R8B), the

load on the amplifier tubes should be adjusted by setting the *"Balance Adjust"* control (C2B) so that the *"Balance"* meter (M2B) reads zero. This adjustment does not disturb any tuning adjustment.

Antenna Tuning

Set the link D14B so that the coupling condenser (C12B) is in the circuit and the load resistance (R8B) is short-circuited. Connect the antenna by closing link switch D12B. Substitute the frequency in kilocycles for "F" and the antenna resistance* for "Ra" in the following formula to obtain the value of coupling capacity "C" (in microfarads) which shall be set on condenser C12B.

$$C = \frac{1.59}{F} \times \sqrt{\frac{100 - Ra}{Ra}}$$

Adjust the turns on the antenna loading coil (L4B) and tune the circuit with the *"Antenna Coupling"* condenser (C12.1B) for a minimum reading of *"Coupling Cct. Current"* meter (M6B). Increase the *"R.F. Output"* control until the *"Power Amp. Plate Current"* meter reads in accordance with the *"Table of Typical Meter Readings,"* watching carefully that no other meter reads excessively. If the *"Coupling Cct. Current"* exceeds or fails to meet the required value increase or decrease the number of turns on the antenna loading coil (L4B) and readjust the *"Antenna Coupling"* condenser (C12.1B) for a minimum reading of the *"Coupling Cct. Current"* meter (M6B). A fine adjustment of the antenna loading coil (L4B) has been provided and designated *"Antenna Tuning."* With each adjustment of *"Antenna Tuning"* (L4B) the circuit must be retuned with the *"Antenna Coupling"* condenser (C12.1B). The *"Antenna Current"* meter (M7B) shall not be used as an indication of antenna tuning. *Caution*—When tuning the antenna circuit, care must be taken that no tuning controls not specified in these instructions are used.

Final Tuning Operations

The final tuning operation should be a careful check of all the tuned circuits in the equipment. When all adjustments have been completed, the plate currents balanced, and the equipment operating properly, a complete record of all control settings and meter readings should be taken. If desired the turns adjustments may be marked with a spot of India ink upon the winding.

Following is a table of typical meter readings:

TYPICAL METER READINGS

Meter	*Indicating*	*1000 Watts*	*500 Watts*	*250 Watts*
M3A	Output Current	1.0 ± 0.2	1.0 ± 0.2	1.0 ± 0.2
M1B	Filament Voltage	200	200	200
M2B	Balance (Milliamps.)	0	0	0
M3B	Amp. Plate Voltage	3000 ± 100	3000 ± 100	3000 ± 100
M4B	Amp. Plate Current†	1.00	0.50	0.25
M4B	With no R.F. Drive	0.3 ± 0.1	0.3 ± 0.1	0.075 ± 0.025
M5B	Amp. Output Current	3.00 ± 0.25	2.60 ± 0.25	2.25 ± 0.25
M6B	Coup. Cct. Current	3.20 ± 0.25	2.20 ± 0.25	1.60 ± 0.20
M7B	Antenna Current	$\sqrt{1000/Ra}$*	$\sqrt{500/Ra}$	$\sqrt{250/Ra}$

†A tolerance on plate current may be allowed so that the input plate power is held within ± 3 per cent.
*Wherein Ra = Antenna resistance in ohms.

Summary of Adjustments

Tune the INPUT CIRCUIT with the *"Input Tuning"* condenser (C1B) for a minimum reading of the *"Output Current"* meter (M3A) on the transmitter.

Tune the OUTPUT CIRCUIT with the *"Output Tuning"* condenser (C10B) for a minimum reading on the *"Power Amp. Plate Current"* meter (M4B).

*The antenna resistance may be determined using the No. 12B Transmitter as described on page 17 of Instruction Bulletin No. 727.

Adjust the BALANCE for a zero reading on the meter (M2B) by means of the *"Balance Adjust"* condenser (C2B).

Tune the COUPLING CIRCUIT by means of the rotor on the harmonic suppression coil (L3B) designated *"Coupling Cct. Tuning"* for a minimum reading on the *"Power Amp. Output Current"* meter (M5B).

Tune the ANTENNA with the *"Antenna Coupling"* condenser (C12.1B) for a minimum reading on the *"Coupling Circuit Current"* meter (M6B). Adjust the antenna loading inductance (L4B), designated *"Antenna Tuning,"* as necessary, but do not tune with this adjustment.

3- *Cct. Current"* meter (M6B) indicates the value of the current required at the reduced operating power as shown in Figure 4. Reduce the *"Output Coupling"* until 33⅓ per cent efficiency* is obtained and at the same time adjust *"R.F. Output"* control in order to keep →

1- If it is necessary to operate one of the 250, 500, or 1000 watt equipments at an output less than their rated power, the general procedure is as follows.

2- The amplifier is first tuned in accordance with the foregoing instruction for full rated output, and all meter readings brought in agreement with the specified values. Reduce the *"R.F. Output"* control until the *"Coupling*

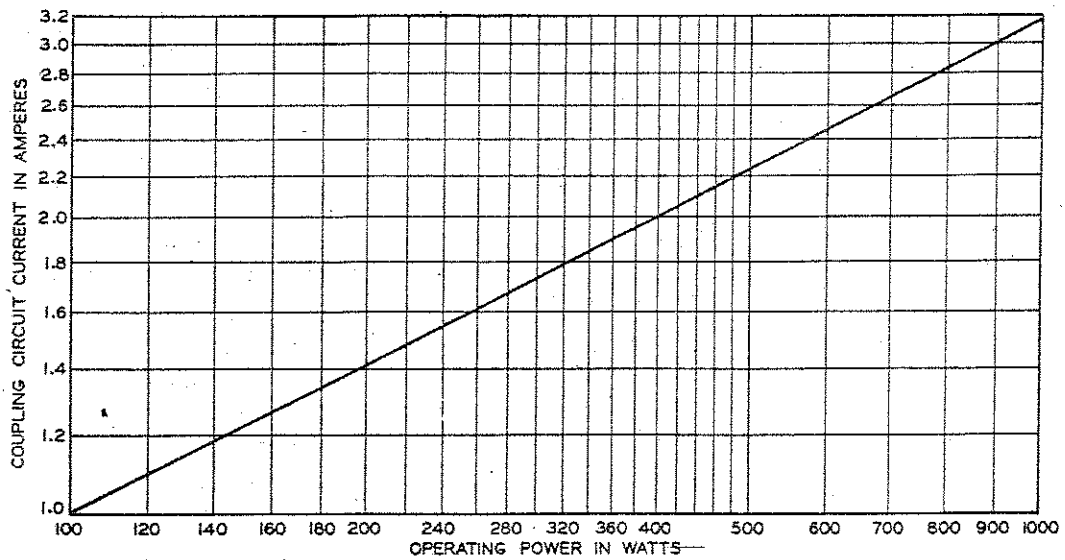

Fig. 4—Coupling Circuit Current for Reduced Power Operation

Operation at Reduced Power

the proper value of *"Coupling Cct. Current"* (M6B).

In case 33⅓ per cent efficiency cannot be obtained without the *"Power Amp. Output Current"* exceeding the value for full power operation, it is necessary to increase the number of turns on the primary of the power amplifier output transformer (L2B) and retune the circuit. Check the tuning of the coupling circuit and record the *"Power Amp. Plate Current* (M4B), the *"Power Amp. Output*

→ *Current"* (M5B) and the *"Antenna Current"* (M7B). The *"Antenna Current"* (M7B) should be of the correct value at the reduced operating power as computed from the formula $I = \sqrt{P}/Ra$, wherein "P" is the reduced power and "Ra" is the antenna resistance.

In cases where the output power is temporarily reduced to 250 watts, it may be desirable to reduce the plate voltage. This may be accomplished by installing a three-pole double throw switch to change the primary connections on the three phase transformer (T5B) from "delta-wye" to "wye-wye" and reduce the rectifier output from 3000 to 1750 volts. If this modification is desired, additional engineering information should be requested.

* $\left(\frac{\text{Required Power Output in Watts}}{\text{Plate Voltage (M2B)} \times \text{Plate Current (M4B)}}\right) = 0.33\frac{1}{3}$

At Normal Power

The audio input system to the Nos. 302C, 303C and 304C Radio Transmitting Equipments is arranged to operate from a 500-ohm circuit, and requires a speech input level of +10 db* above 0.006 watts for complete modulation.

During the operation of the No. 12B Radio Transmitter, the *"3rd Amplifier Grid"* current (M1A) should be checked occasionally. Any grid current in this amplifier during the program, with the exception of occasional pulses, is an indication that the transmitter is being over-modulated. The *"Test Meter"* switch D13A must not be left in the *"3rd Amplifier Grid"* position.

At Reduced Power

When the Nos. 302C, 303C, or 304C Radio Transmitting Equipments are operated at reduced power, the speech input level must be reduced in accordance with the curve on Figure 5 of this bulletin. This curve shows the

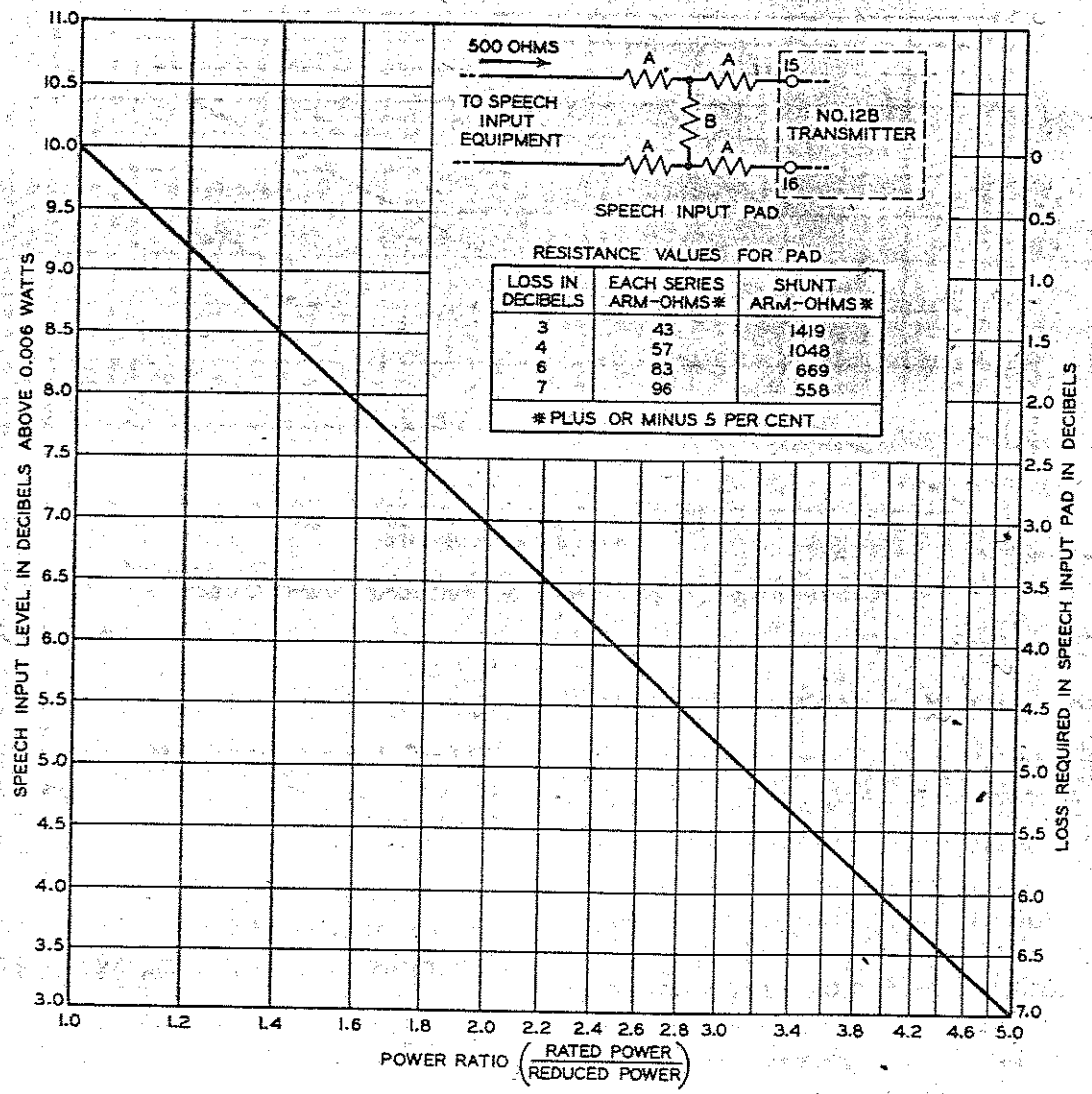

Fig. 5—Speech Input Levels for Reduced Power Operation

*Throughout this bulletin Reference Level = 0.006 watts.

correct speech input level for ratios of the *rated* operating power of the equipment to the *reduced* operating power. For instance, in operating the No. 304C (1000 watt) Radio Transmitting Equipment at 500 watts we have a power ratio of 2, i. e., 3 db. Reading from the curve, the correct speech input level to the No. 12B Radio Transmitter under these circumstances would be +7 db.

Similar adjustments must be made when a transmitter other than the No. 12B is used as a driver.

In operating permanently at reduced power, the necessary attenuation may be introduced bya 500-ohm balanced pad inserted between the output terminals of the speech input equipment and the radio transmitter. A typical balanced pad is shown on Figure 5 together with resistance values for the usual attenuations required.

MONITORING

Monitoring Levels

With the monitoring device connected as directed under "Installation," the maximum monitoring output levels obtainable for these equipments are approximately as follows:

Equipment	*Output Rating*	*Max. Monitoring Levels*
No. 304C	1000 watts	+ 16 db or 0.24 watts
No. 303C	500 watts	+ 13 db or 0.12 watts
No. 302C	250 watts	+ 10 db or 0.06 watts

The monitoring output levels may be reduced from the above listed maximum values by adjustment of the slider on resistance R11B. This may be necessary if there is an amplifier in the monitoring device.

When the 250, 500 or 1000 watt equipments are operated at reduced power, the monitoring output level will be reduced in the same proportion as the reduction in speech input level to the radio transmitter.

Monitoring Circuit Impedance

The monitoring circuit of this amplifier is designed to operate into a monitoring device of 500 ± 100 ohms impedance. Should the monitoring device have a different impedance, a suitable transformer should be used to match the impedance to 500 ohms.

The monitor circuit in the No. 12B Radio Transmitter unit is not normally employed when the transmitter is used in conjunction with the No. 71B Amplifier, and the terminating resistance in the transmitter, R37A, which is connected across the output of the monitoring output transformer T10A, *must* be left connected.

OPERATING PROCEDURE

Starting the Equipment

Before starting the equipment, see that the antenna is not grounded through the antenna grounding switch and be sure the mercury vapor rectifier tubes have been properly preheated. In the normal operation of the equipment full-automatic starting should be used. In the Nos. 302C, 303C and 304C equipments, the *"High Voltage"* switches (D5A and D8B) are left always in the *"On"* position, and the equipment is started by operating the *"Master Control"* switch (D9A) located on the transmitter unit. However, where two or more stations are sharing time on the same frequency and a minimum starting time is desirable, it is advantageous to use semi-automatic starting. This consists in placing the *"High Voltage"* switch (D5A) on the No. 12B Radio Transmitter and switch D8B on the No. 71B Amplifier in the *"Off"* position and operating the *"Master Control"* switch (D9A) on the transmitter. This may be done several minutes before the preceding station signs off, thus

allowing the time delay circuits to function and the vacuum tubes to reach normal operating temperature. The operator then can start the equipment instantly by closing the *"High Voltage"* switches (D5A and D8B).

As soon as the equipment is in operation, all meter readings should be checked and any necessary adjustments made.

Stopping the Equipment

To stop the equipment, open the *"Master Control"* switch on the transmitter unit and ground the antenna. When stopping the equipment for a brief interval, it is sufficient to open only the *"High Voltage"* switches on both units. This deenergizes the high voltage rectifiers and eliminates delay when restarting.

Overload Relay Reset

An overload in the plate circuit of the power amplifier tubes (V-B and V2B) will operate overload relay (S6B). This overload relay is of the holding type and must be released by momentarily depressing the *"Overload Reset"* button (K1B) which is located on the front panel of the amplifier. Should the overload relay continue to operate each time the *"Overload Reset"* button (K1B) is pressed, trouble in the amplifier output circuit is indicated and should be located in accordance with the procedure outlined under "Location of Trouble."

Operating Use of Meters

All meter readings should be read periodically during the operation of the equipment.

The *"Filament Voltage"* meter (M1B), connected across the primary of both filament transformers, indicates the proper adjustment of the variable auto-transformer (T6B). To insure maximum tube life the potential applied to the filament transformers should be held at 200 volts with no deviations greater than 5 percent of this value permitted.

The *"Balance"* meter (M2B) serves to indicate equal performance of the two amplifier tubes. Deflection of this meter during peaks of modulation indicates a dissimilarity between the two tubes, particularly in respect to filament emission. A continuous deflection from midscale indicates a lack of balance which may be corrected by a change in the setting of the *"Balance Adjust"* condenser (C2B).

The *"Power Amp. Plate Voltage"* and the *"Power Amp. Plate Current"* meters (M3B and M4B) indicate satisfactory operation of the plate rectifier, and the product of their readings indicates the power being delivered to the plates of the amplifier tubes. The power delivered to the plates serves as a good operating indication that the circuit is holding its proper tuning adjustment.

The *"Power Amp. Output Current"* meter (M5B) is used to indicate proper impedance matching the tubes and the connected circuit.

The *"Coupling Circuit Current"* meter (M6B) indicates the flow of radio frequency current into the resistance introduced* into the coupling circuit by the coupling condenser. Assuming proper tuning this meter provides a close check upon the output power.

With a constant and known value of antenna resistance the *"Antenna Current"* meter (M7B) provides a means of computing the power delivered to the antenna. Changes in its reading indicate a change from the original tuning of the antenna, a change in the condition of the antenna, or a change in the power output, therefore this meter should be read frequently during operation. Should the antenna current change somewhat while the transmitter is warming up, it should be adjusted to the correct value by means of the *"R.F. Output"* control. This adjustment should be made, if possible, when the transmitter is not modulated, or at a time of very low modulation.

The radio frequency meters (M5B, M6B and M7B) and the plate current meter (M4B) are subject to fluctuations of the order of 20 to 25 percent during modulation.

*By "resistance introduced" is meant the resistive component of the impedance which is formed by the antenna circuit shunted by the coupling capacity. The magnitude of this "introduced" resistance is dependent on the reactance of the antenna coupling condenser and the resistance of the antenna. By selecting the proper coupling capacity, the introduced resistance always can be made equal to 100 ohms at unity power-factor.

Operating Use of Load Resistance

A load resistance of 100 ohms (R8B), is provided in the amplifier which may be connected into the coupling circuit by means of link switch D14B. This resistance duplicates the resistance introduced by the antenna into the coupling circuit through the antenna coupling capacity (C12B) and allows the transmitter to be operated for test purposes under actual load conditions without causing interference to other stations. When this load resistance is used, the antenna should be disconnected by opening link switch D12B. Meter readings taken with the load resistance in circuit can be duplicated with the antenna connected, provided proper antenna coupling capacity is used, and are an assurance that the transmitter is delivering its full rated power to the antenna.

CONNECTION TO OTHER EQUIPMENT

Connection to Transmitter other than No. 12B

The preceding instructions have been written specifically to cover connection to a No. 12B Radio Transmitter. However, this apparatus is designed for connection to any transmitter capable of supplying 100 or 200 watts of radio-frequency energy within the frequency range of 550 to 3000 kilocycles.

The radio-frequency connections may be made by tying the antenna post of the transmitter to terminal 25 and ground to terminal 26. The tuning procedure will be in general as herein described for the connection to the No. 12B Transmitter. Control circuits vary considerably in design and purpose and if they differ materially from those of the No. 12B Transmitter it is recommended that additional engineering information be requested.

The following specific features are provided to facilitate interconnection.

If the door switch circuit of the transmitter operates on 110 volts remove the straps from between terminals 5 and 17 and from across resistance R5B and condenser C32B. The door switch relay (S3B) will then operate on 110 volts applied to terminals 6 and 17.

Terminals 19 and 20 provide 220 volts for the operation of the remainder of the control circuit when cross-connected to terminals 5 and 4. When so connected it should be noted that a fault in the control circuit may cause operation of fuses F1.1B and F1.2B. However, this operation also removes plate voltage from both rectifiers so none of the protective features of the control circuit are impaired.

Connection to Amplifier of Higher Power

Terminals 8, 12, 14, 15, 17 and 18 are provided to facilitate connection to amplifiers of higher power when this amplifier is used as a driver stage. These conditions provide necessary interlocks for protection of the associated equipment.

MAINTENANCE

General

Cleanliness is essential to the best operation of these equipments and the units must be kept free from dust and dirt. A vacuum cleaner or source of compressed air is recommended for cleaning the apparatus inside the cabinets. A soft clean cloth also may be used with good results. Cotton waste or oily cloth should never be used.

Care of the Cabinet

The lacquered surfaces and chromium trim may be polished by rubbing them with a piece of soft cloth moistened with "The Master

Finish Polish," a polish produced by the Master Finish Company, 8 Caroline Street, New York City, and finally wiping with a dry, clean, soft cloth. Any visible grease, oil or wax first to be removed with carbon tetrachloride before applying the above finish.

Damaged lacquered surfaces may be touched up with Western Electric Aluminum Gray No. 476 Finish obtainable in a double compartment can per Specification D-97106 from the nearest Branch House of the Graybar Electric Company. To use this touch-up finish clean any grease, oil, wax or polish from the marred area with soft cloth moistened with carbon tetrachloride. Stir all the aluminum powder into the gray enamel, and keep well stirred while using. Apply a coat of mixed enamel with a small soft camel's hair brush. The enamel is supplied at brushing consistency and requires no thinning. Do not use the mixture if the aluminum powder has been in the enamel for more than eight hours.

Cleaning Variable Air Condensers

The exposed variable air condensers in both the transmitter and amplifier units must be cleaned at least once a week with high pressure air or its equivalent, as the presence of dust or dirt on the plates may result in the condenser arcing over and taking the station off the air. A small bellows and clean dry cloth can be used to advantage for this purpose where a high pressure air system is not available. The dust covers of condensers C10.1B and C10.2B should not be removed unless absolutely necessary, as minute particles of dust may cause flashover of these condensers.

Relays and Magnetic Contactors

The contacts of all relays and contactors should be inspected and carefully cleaned once a month. Dust may collect on these contacts in spite of relay covers and cause erratic operation. Relay contacts in the protective and high voltage circuits should receive special attention. Crocus cloth can be used to advantage in cleaning relay contacts. Badly pitted power relay contacts may be carefully smoothed with a fine file.

Noise from alternating current relays is usually due to an accumulation of dust or foreign particles between the armature and pole piece. Attempts to adjust relays of this type by bending contact springs may change contact pressures and also cause noise.

Vacuum Tubes

In order to obtain both maximum life and satisfactory performance, it is important that vacuum tubes be operated within the voltage limits of ± 5 percent as read on the "Filament Volts" above or below an indication of 200 volts.

As far as possible the operator should anticipate tube failures and make the required tube replacements. Tube failures may be guarded against to some extent by keeping a careful record of the length of time the tubes have been in service and by observing from time to time the condition of the tube elements. Sagging or warped elements will, of course, increase the probability of tube trouble; therefore, such tubes should be replaced as soon as practicable.

It is essential that mercury vapor tubes which have been subjected to handling have their filaments heated for at least fifteen minutes before the high voltage is applied. This is done in order to remove any particles of mercury which may be adhering to the sides or the elements of the tubes and which might result in flashovers. It is suggested therefore that spare rectifier tubes be prepared for service in advance by placing them in the equipment when not in use and giving the filaments the necessary preheating with the "*High Voltage*" switches (D5A and D8B) in the "*Off*" position. This procedure should be repeated at least once a month. Spare rectifier tubes thus preheated should be handled carefully and always kept in an upright position until they are required.

Vacuum Tube Sockets

It is essential that the contacts of all tube sockets be kept clean and smooth. Care should be exercised to see that the power amplifier

vacuum tubes (V1B and V2B) are not subjected to any mechanical strains when placed in their sockets.

Repair of Thermocouples

In case of damage to any of the external heating elements or thermocouples associated with the radio-frequency meters, they must be returned directly to the manufacturer for repair. Such heating elements, with the exception of the sensitive thermocouple (TC1B) must be accompanied by the associated meter for calibration purposes. In replacing heating elements or thermocouples care must be taken to observe polarity makings on the meter side of the couple.

Additional Routine

Once a month all nuts, bolts and screws should be tested and any loose one tightened. Also, electrical connection should be closely inspected and if any loose ones are found they should be corrected. Cases of trouble often can be prevented by these precautions.

Resistances with adjustable slider clamps (R9B, R10.2B, R10.3B, R11B and R16B) should be carefully watched to see that their adjustment does not change. Care must be taken that these sliders are not clamped so tightly as to damage the resistance wire or the vitrified insulation.

The rectifier transformers (T3B and T5B) are provided with taps so that under average line voltage conditions proper grid and plate potentials are supplied to the tubes. It is recommended that the average line voltage be determined occasionally and the taps changed accordingly, particularly when the operating hours of the station are changed, or when it is suspected that load conditions have changed on the power line.

LOCATION OF TROUBLE

General

This equipment has been carefully designed and constructed to give the owner the minimum amount of trouble. To avoid the occurrence of trouble, routine maintenance should be performed by a competent operator who has familiarized himself with the equipment and the contents of this instruction book.

It is not practical to describe every possible cause of trouble with the methods best adapted to locate it; therefore, only the following specific examples are given together with a suggested procedure to serve as a guide.

CAUTION

Dangerous voltages exist within this amplifier, therefore the operator should observe all precautions necessary for his personal safety when working within the cabinet. Any temporary instrument connection must be adequately insulated not only for the DC voltage but for any radio frequency voltage to which it may come in contact.

Power Control Circuit

The power control circuits are interdependent to the following extent when the No. 12B Transmitter is used to energize the amplifier. Door switches of both units are in series, therefore failure of any one switch to close prevents the amplifier (and the transmitter) from being energized. The 220-volt power required to operate the control circuit is obtained from the transmitter unit directly from the auto-transformer (T8A) and is therefore dependent upon the proper operation of switches and fuses in the transmitter. When connected to a transmitter other than the No. 12B this interdependence may or may not exist depending upon the control system used. In general, simple troubles may be located by observing how far the starting sequence has proceeded and then investigating the circuit element upon which the next operation is dependent.

Fuses

Fuses may operate because of deterioration from corrosion, or because of physical imperfection, but generally their operation indicates a circuit defect or maladjustment which must be located and remedied.

Fuses connected to transformer primaries, particularly the rectifier plate transformer, are apt to operate on the starting current surge if they are too small for the duty.

Improper operation of the surge limiting circuit (relays S7B and S8B and resistance R14B) may cause the plate rectifier fuse (F4B) to operate.

Rectifier tubes not properly preheated or nearing the end of their lives may "arc back" and cause the plate transformer primary fuses (F2B or F3B) to operate.

Maladjustment of radio-frequency circuits, or lack of adequate biasing voltage on the grids of the tubes (improper operation of the marginal relay S5B) may cause operation of the plate rectifier fuses (F3B or F4B).

A radio-frequency arc between air condenser plates may cause operation of the rectifier fuses or overload relay.

Reduced or No Radiation

When looking for the cause of reduced or no radiation it is first necessary to determine whether the trouble is within the transmitter, the amplifier or the antenna. A comparison of all meter readings with previously recorded values will generally indicate whether the transmitter or the amplifier is at fault. If the amplifier is apparently at fault operate it into the resistance load (R8B) and retune if necessary. If readings (M5B and M6B) close to the previous values are obtained check the tuning of the antenna and if necessary examine the antenna-ground system for open or corroded connections. The latter faults are most apparent on days of abnormal weather conditions and will generally give some warning of their presence before actual failure.

Distortion

If poor quality is indicated at the output of the amplifier monitoring circuit, first check the quality at the monitoring output of the associated radio transmitter. If poor quality is found at this point, the trouble is either in the transmitter unit or speech input equipment. If the quality from the radio transmitter is good, and poor quality particularly at low frequencies persists at the amplifier monitor, the electrolytic condenser (C24B) may be at fault. The life of this condenser is limited and it should be replaced every two years. In replacing this condenser, it is essential that correct polarity be maintained.

If the monitoring circuit appears to be dead, it is possible that the fuse (F6B) has opened.

Harmonic distortion—i.e., distortion of wave form of the audio-frequency envelope of the carrier wave—may be caused by low grid bias on the amplifier and improper adjustment of the transmitter. An increase of 22½ ± 2½ percent in antenna current when the equipment is modulated 100 percent with a steady tone is an indication of proper adjustment, and if not obtained it is recommended that the grid bias on the amplifier tubes be increased. This may require readjustment of the output circuit turns (L2B) and a slight increase of the turns on the input transformer (L1B).

Noise

Faulty condensers or defective retardation coils in either the grid or plate rectifier filters will cause excessive hum. Poor contacts which cause arcing in any portion of the circuit will cause erratic and sputtering noises. Listening tests at the monitor outputs of both the transmitter and amplifier should reveal whether the fault is in the transmitter or amplifier.

SPARE PARTS

The following parts are recommended as a complement of spare equipment which may be purchased at the customer's option.

GENERAL LIST OF SPARE PARTS FOR THE 6071B AMPLIFIER

Condensers

1—Western Electric No. D-97412, (6 MF) (C28B to C30B, incl.).

1—Western Electric No. D-97413, (18 MF) (C25B to C27B, incl.).

Switches

3—H&H Electric Co. Door Switch Catlog No. 3592.

Resistances

1—Ward-Leonard Type 6-inch WX Resistor with bare side for adjustment and Type 603 Terminal band, 3 ohms ± 10 percent (R9B).

1—Ward-Leonard Type Resistor 6-inch WX with bare side for adjustment and Type 603 Terminal band—1,000 ohms ± 10 percent (R10.2B and R10.3B).

1—Ward-Leonard Type 6-inch WX Resistor with bare side for adjustment and Type 603 Terminal band, 16 ohms ± 10 percent (R11B).

1—Ward-Leonard Type 6-inch WX Resistor with No. 206 Type Terminals, 10,000 ohms ± 10 percent (R15B).

1—Ward-Leonard Type 6-inch WX Resistor, bare side for adjustment and Type 603 Terminal band, 15,000 ohms ± 10 percent (R16B).

1—Ward-Leonard Type 6-inch WX Resistor with No. 304 Type Terminals, 500 ohms ± 10 percent (R10.1B).

Retardation Coils

2—Western Electric No. 190A (or No. D-95312 for 1500 to 3000 KC) Retardation Coils (L11.1B, L11.2B, L16B and L17B).

Transformers

1—Western Electric No. 105B Repeating Coil (T4B).

Vacuum Tubes

2—Western Electric No. 301A Vacuum Tubes (V9B).

6—Western Electric No. 249B Vacuum Tubes (V3B to V8B, incl.).

Panel Lights

10—G. E. Edision Mazda Lamps, Type S-6 Candelabra Base, 6-Watt, 120-Volts (E1B to E5B, incl.).

Fuses

10—D&W Enclosed Cartridge Fuses, Catalog No. 91002, 2 Amperes, 250 Volts (F2.1B, F2.2B and F6B).

12—D&W Western Union Telegraph Fuses, Catalog No. 2760, 1 Ampere, 2500 Volts (F5B).

Miscellaneous Parts

1—Weston Heating Element per Weston Drawing CD-51014, Range 0-100 Milliampere (need not be calibrated with meter).

Special List of Spare Parts for the 1000-Watt Equipment

2—Western Electric No. 279A Vacuum Tubes (V1B, V2B).

10—D&W Enclosed Cartridge Fuses, Catalog No. 1463, 15 Amperes, 250 Volts (F3.1B, F3.2B, and F3.3B).

12—D&W Western Union Telegraph Fuses, Catalog No. 2760, 2 Ampere, 2500 Volts (F4B).

10—D&W Enclosed Cartridge Fuses, Catalog No. 1456, 5 Amperes, 250 Volts (F1.1B, F1.2B).

Special List of Spare Parts for the 500-Watt Equipment

2—Western Electric No. 251A Vacuum Tubes (V1B and V2B).
10—D&W Enclosed Cartridge Fuses, Catalog No. 1461, 10 Amperes, 250 Volts (F3.1B, F3.2B and F3.3B).
10—D&W Enclosed Cartridge Fuses, Catalog No. 1455, 4 Amperes, 250 Volts (F1.1B and F1.2B).

Special List of Spart Parts for the 250-Watt Equipment

2—Western Electric No. 270A Vacuum Tubes (V1B and V2B).
10—D&W Enclosed Cartridge Fuses, Catalog No. 14577, 6 Amperes, 250 Volts (F3.1B, F3.2B and F3.3B).
10—D&W Enclosed Cartridge Fuses, Catalog No. 1454, 3 Amperes, 250 Volts F1.1B and F1.2B).

ENGINEERING SERVICE AND INFORMATION FOR ORDERING REPLACEMENTS

Engineering service may be obtained through the nearest Branch House of the Graybar Electric Company, and authorization for such service should be placed with them. In Canada, this service may be obtained through the Northern Electric Company, Ltd.

Order for replacement apparatus should specify the apparatus designation (such as, R2B) shown on the drawings and usually stamped on the apparatus as well as the name, catalog number, nameplate data and serial number of radio transmitter and other pertinent information which is available.

RADIO FREQUENCY AMPLIFIER No. 6071B

SUPPLEMENT "A" TO INSTRUCTION BULLETIN NO. 728

This supplement covers the following:

SECTION 1, applying to amplifiers having Serial No. 117 and higher and replacing the paragraph *"Adjustment of Antenna Impedance"* on Page 14 of the Instruction Bulletin. It also refers to a new schematic Figure 1A and a chart, Figure 6, herewith.

SECTION 2, applying to 71B Amplifiers used with the D-98653 Osc. Mod. or equivalent driver, and replacing the paragraphs beginning with *"Tuning Adjustments"* up to *"Operation at Reduced Power."*

SECTION 3, including two Tuning Charts which apply to all 71B Amplifiers.

SECTION 4, describing certain changes which may be made in 71B Amplifiers using 279A Vacuum Tubes, and which effect a reduction in the current through the Variac autotransformer T6B. These changes involve the addition of a supplementary transformer in the filament supply circuit. This section refers to Figure 7, herewith.

SECTION 1

REVISED INFORMATION ON ANTENNA IMPEDANCE ADJUSTMENTS

In 71B Amplifiers bearing serial numbers 117 and higher the circuit is in accordance with the schematic shown in the attached Figure 1A.

This circuit differs from the circuit shown in Figure 1 only in the output coupling circuit in which the following changes have been made.

1. Link D16B has been added to protect the thermocouple TC3B which is needed only during tuning.
2. Link D17B has been added to disconnect the antenna drainage coils L16B and L17B when shunt-excited radiators are used.
3. Connections to the condenser bank C12B and to the meter M7B have been changed.
4. Condenser C36B has been added in series with the resistance R8B to compensate for the 7 or 8 microhenries inductance in the resistances.

In order to concur with the new schematic of the amplifier and to describe the adjustment of antenna impedance with shunt-excited radi-

ators and radio frequency transmission lines, the paragraph in Instruction Bulletin No. 728, covering *"Adjustment of Antenna Impedance"* is superseded by the following paragraphs.

Adjustment of Antenna Impedance

The antenna coupling circuit in this amplifier consists of the condensers designated C12B, antenna tuning coil L4B and when needed, a condenser to be designated C13B. Coupling condenser C12B may be set approximately from Figure 3 (I.B. No. 728) according to the frequency and antenna resistance.

When the amplifier is coupled directly to a base-insulated radiator having a resistance between 20 and 90 ohms, the value of C13B to be installed should be in accordance with the following table. The algebraic sum of its negative reactance, the reactance of the antenna (positive or negative) and the positive reactance of the antenna tuning coil L4B should give a net positive reactance of 30 to 50 ohms which may be tuned with C12B. The number of turns of L4B to be used for a given reactance is given in the curves shown in Figure 6. This figure also shows the percent change of reactance which may be obtained by operation of the *"Antenna Tuning"* control with different numbers of turns in circuit. When the antenna reactance is such that it is possible to obtain the required 30 to 50 ohms for tuning without condenser C13B, the space for this condenser may be closed by link D11B.

Frequency Kilocycles	*Capacity of C13B Mfd.*	*Reactance Ohms*	*Catalog Number*
550 to 900	0.00120	241 to 147	PL-242-50
910 to 1800	0.00065	275 to 136	PL-265-50
1801 to 3000	0.00035	253 to 152	PL-288-50

The necessary Cornell-Dubilier condenser may be ordered from the nearest branch house of the Graybar Electric Company. For antennas of less than 20 or more than 90 ohms resistance, additional engineering information should be requested.

When coupling directly to a base-grounded radiator it will be necessary to install, as C13B, a condenser capable of tuning out the high positive reactance (300 to 800 ohms) associated with this type of antenna and to use only as much of the antenna tuning coil L4B as may be necessary for adjustment. In some installations, where the reactance and the current are high, it may be necessary to mount this condenser external to the amplifier, because of the physical size of the condenser required under these conditions. If the resistance component of the radiator is from 25 to 75 ohms, a net positive reactance of 40 to 50 ohms will be required for tuning. The condenser selected for tuning out the positive reactance must be capable of passing the entire antenna current as determined from the following formula, where I is the required current rating of the condenser, P the rated carrier power, and R the antenna resistance.

$$I = \sqrt{\frac{3P}{2R}}$$

With a grounded radiator, the antenna drainage coils L16B and L17B are not needed and should be disconnected by opening link D17B. These coils should also be disconnected where a base-insulated radiator is used with a transmission line and the antenna coupling unit equipped with drainage coils.

When coupling to a transmission line, a non-reactive impedance of approximately 65 ohms is generally encountered. It will, therefore, be necessary to provide 40 to 50 ohms tuning reactance in the antenna tuning coil L4B. Referring to Figure 6, it is seen that this can be done with 4 to 6 turns of L4B without using condenser C13B at frequencies up to and including 1190 kilocycles. Above 1190 kilocycles the minimum reactance obtainable with L4B is greater than the required amount and therefore condenser C13B must be used. The following table gives the number of turns on L4B, and the necessary values of C13B required to tune the amplifier into a transmission line, having a characteristic impedance of not less than 20 or more than 80 ohms, in order to produce the required positive reactance of 40 to 50 ohms.

Frequency Range (Kilocycles)	Condenser C13B Cat. No.	Capacity	Turns* on "L4B"
500 to 650	none required		6
660 to 740	"	"	5
750 to 820	"	"	4
830 to 920	"	"	3
930 to 1000	"	"	2
1010 to 1190	"	"	1
1200 to 1300	PL-196-50	.0035	5
1310 to 1400	PL-196-50	.0035	4
1410 to 1500	PL-196-50	.0035	3
1510 to 1600	PL-196-50	.0035	2
1610 to 1750	PL-196-50	.0035	1
1751 to 1850	PL-242-50	.0012	5
1851 to 2000	PL-242-50	.0012	4
2001 to 2150	PL-242-50	.0012	3
2151 to 2300	PL-242-50	.0012	2
2301 to 2400	PL-242-50	.0012	1
2401 to 2550	PL-265-50	.00065	4
2551 to 2750	PL-265-50	.00065	3
2751 to 2900	PL-265-50	.00065	2
2901 to 3000	PL-265-50	.00065	1

*See Note 2 on Figure 6.

Final exact adjustment will be made on the *"Antenna Tuning"* control (rotor of L4B) and the tuning completed as described on page 15 of the Bulletin, or Section 2 herein. The operator is cautioned to use the *"Antenna Tuning"* control only as an adjustment and to tune with the *"Antenna Coupling"* condenser C12B for a minimum reading of the *"Coupling Circuit Current"* (M6B). An attempt to attain this adjustment with the rotor of L4B will cause erroneous tuning and may produce a resonant condition between L4B and C13B. With this latter condition, proper tuning is impossible.

SECTION 2

REVISED TUNING INFORMATION

Preliminary

The following describes the tuning of the 71B Amplifier when used in connection with the D-98653 Oscillator-Modulator Unit or with the 12B Radio Transmitter modified with the D-98546 Conversion Parts. It is assumed that the oscillator-modulator is tuned and adjusted in accordance with Instruction Bulletin No. 829. This preliminary tuning of the oscillator-modulator unit should be done with the *"Input Coupling"* control (L1B) of the amplifier set for zero coupling, which may not be zero setting on the indicator scale, and the 100-ohm load resistance R12A in series with the other elements of the link circuit, i.e. D2A should connect *"3"* and *"4"* as described (page 5, Instruction Bulletin No. 728) under *"Radio Frequency Input Connections."* This places the following elements in series: rotor of L11A, L13A, C19A, TC2A, R12A and rotor of L1B condensers C20A and C21A, and coil L14A are not used. The rotor of coupling coil L37A should be turned to the extreme counter-clockwise position. If condenser C19A tends to flash-over, reduce the number of turns on L13A and increase the capacitance of C19A.

NOTE:

"Antenna Tuning" condenser C19A and *"Antenna Current"* meter M3A referred to in Instruction Bulletin No. 829 have been redesignated *"Output Tuning"* and *"Output Current"* respectively.

Amplifier Input Circuit

With the amplifier *"Input Coupling"* control L1B set for zero coupling, tune the output circuit of the oscillator-modulator unit until the full output power (100 watts—1 ampere indicated by meter M3A) is dissipated in the 100-ohm load resistance R12A. Record all the meter readings and dial settings on the oscillator-modulator unit for this operating condition and reduce the *"R.F. Output"* control

(R20A and R53A) to zero. Remove the load resistance R12A by means of the link switch D2A described (Instruction Bulletin No. 728) under *"Radio Frequency Input Connections."*

Leave the main switch D1B in the *"Off"* position. Increase the *"R.F. Output"* until a convenient reading (1/2 to 1 ampere) is obtained upon the *"Output Current"* meter M3A, and increase the *"Input Coupling"* control (L1B) five or ten divisions. Tune the amplifier input circuit with the *"Input Tuning"* control (C1B) until a minimum is obtained on the *"Output Current"* meter M3A of the oscillator-modulator. The setting of C1B should not be at maximum or minimum capacitance. During this tuning procedure the *"Balance Adjust"* control (C2B) may be left on *"50"* divisions. The number of turns of L1B (each side) may be varied somewhat from the values specified on the tuning charts to raise (more turns) or lower (less turns) the driving voltage on the tubes; this will necessitate a corresponding decrease or increase, respectively, in the setting of C1B. When the input circuit has been tuned increase the *"Input Coupling"* control (L1B) until the meters of the oscillator-modulator unit indicate as recorded in accordance with the preceding paragraph. Some slight readjustment of the *"3rd Amp. Output Coupling"* control (L11A) and the *"Output Tuning"* control (C19A) may be necessary in conjunction with the adjustment of the "Input Coupling" control (L1B) to obtain the desired meter indications. If it is necessary to readjust the *"3rd Amp. Tuning"* control (C18A) to obtain a minimum indication on the *"3rd Amp. Plate Current"* meter M4A the *"Amplifier Input Circuit"* tuning procedure should be repeated. Likewise the adjustment of the *"Input Tuning"* control should not change with the adjustment of the coupling circuit.

Neutralizing and Amplifier Output Tuning

Energize the amplifier by operating the main switch D1B and *"Filaments"* switch D3B. Reduce the *"R.F. Output"* (R20A) to zero, connect the sensitive thermocouple TC1B by operating the four-pole knife switch D4B to the *"Neut."* position, set the *"Neutralizing Adjust"* control so that the neutralizing condenser plates (C4B and C5B) are about one-third engaged and set the *"Output Coupling"* control (L2B) on zero. Operation of the knife switch also opens the high voltage control circuit to prevent application of the plate power while the sensitive thermocouple is in the circuit.

Increase the *"R.F. Output"* slightly and adjust the amplifier *"Output Tuning"* (C10B) for a maximum reading on the *"Power Amp. Output Current"* meter M5B, adjusting the *"R.F. Output"* control carefully so that the meter M5B reading does not exceed full scale. Using the *"Neutralizing Adjust"* control (C4B and C5B), reduce the meter M5B reading to zero. Increase the *"R.F. Output"* control gradually to its maximum and at the same time carefully readjust the *"Neutralizing Adjust"* control so that the meter M5B indicates zero or very nearly so. When the *"R.F. Output"* control is on maximum and the meter M5B reads approximately zero, the amplifier is neutralized.

Reduce the *"R.F. Output"* to zero, and operate the four-pole knife switch D4B to the *"Operate"* position to place the thermocouple TC2B in the circuit. Leave the *"Output Coupling"* (L2B) on zero. Apply plate voltage to the amplifier by operating the *"High Voltage"* switch D8B and increase the *"R.F. Output"* until mid-scale deflection is obtained on the *"Power Amp. Output Current"* meter M5B. Check the *"Output Tuning"* (C10B) for minimum on the *"Power Amp. Plate Current"* meter M4B.

Coupling Circuit Tuning

Connect the 100-ohm load resistance R8B into the coupling circuit by means of link switch D14B and disconnect the antenna circuit by opening the link switch D12B. Open link D16B, placing TC3B and the associated meter M6B in the circuit. Set the *"Output Coupling"* control (L2B) to about five divisions and adjust the *"Coupling Circuit Tun-*

ing" (L3B) for a minimum indication on the *"Power Amp. Output Current"* meter M5B, increasing or decreasing the number of turns on the harmonic suppression coil L3B as necessary. Adjust the *"Output Coupling"* (L2B) until the *"Coupling Cct. Current"* meter M6B reads in accordance with the *"Table of Typical Meter Readings"* when the *"Output Current"* meter M3A on the oscillator-modulator unit reads as previously recorded.

Adjustment of Output Transformer Turns

If after adjusting the *"Output Coupling"* (L2B) in accordance with the preceding paragraph, the *"Power Amp. Plate Current"* and *"Power Amp. Output Current"* meters M4B and M5B read in accordance with the *"Table of Typical Meter Readings"* the turns on the output transformer L2B are correct.

If the *"Power Amp. Output Current"* meter M5B reads too high, the number of active turns on the primary of the output transformer L2B should be increased and the tuning procedure repeated. If the meter M5B reads too low the turns should be decreased. Repeat this process until the desired readings are obtained upon the three meters M4B, M5B and M6B.

With the amplifier delivering its full power into the 100-ohm load resistance R8B, the load on the amplifier tubes should be adjusted by setting the *"Balance Adjust"* control (C2B) so that the *"Balance"* meter M2B reads zero. This adjustment does not disturb any tuning adjustment.

Antenna Tuning

Set the link D14B so that the coupling condenser C12B is in the circuit and the load resistance R8B is removed from the circuit. Connect the antenna by closing link switch D12B. Substitute the frequency in kilocycles for *"F"* and the antenna resistance for *"Ra"* in the following formula to obtain the value of coupling capacity *"C"* (in microfarads) which shall be set on condenser C12B.

$$C = \frac{1.59}{F} \cdot \sqrt{\frac{100 - Ra}{Ra}}$$

Adjust the turns on the antenna loading coil L4B and tune the circuit with the *"Antenna Coupling"* condenser C12.1B for a minimum reading of *"Coupling Cct. Current"* meter M6B. Increase the *"R.F. Output"* control until the *"Power Amp. Plate Current"* meter reads in accordance with the *"Table of Typical Meter Readings,"* watching carefully that no other meter reads excessively. If the *"Coupling Cct. Current"* exceeds or fails to meet the required value increase or decrease the number of turns on the antenna loading coil L4B and readjust the *"Antenna Coupling"* condenser C12.1B for a minimum reading of the *"Coupling Cct. Current"* meter M6B. A fine adjustment of the antenna loading coil L4B has been provided and designated *"Antenna Tuning."* With each adjustment of *"Antenna Tuning"* (L4B) the circuit must be retuned with the *"Antenna Coupling"* condenser C12.1B. The *"Antenna Current"* meter M7B shall not be used as an indication of antenna tuning.

CAUTION:

When tuning the antenna circuit, care must be taken that no tuning controls not specified in these instructions are used.

If a radio frequency bridge is available, the antenna circuit may be adjusted using this instrument. With link D12B closed, link D14B connected to place C12B in the circuit and with connector link D13B open, connect the bridge across condenser C12B and adjust C12B and L4B until the bridge indicates 100 ohms resistance with no reactance. When this adjustment has been made, remove the bridge equipment, close connecting link D13B, operate the transmitting equipment and check *"Coupling Circuit Tuning."*

Feedback Adjustment

After the equipment has been tuned as above, *"Test Meter"* switch D13A should be placed in the *"Feedback Current"* position, and the rotor of L37A adjusted until *"Test Meter"* M1A indicates 7 milliamperes. Each adjustment must be made with the *"High Voltage"* switches in the *"Off"* position. After

each adjustment of L37A, it may be necessary to make a minor change in the adjustment of the second mesh circuit of the 71B Amplifier by means of the "*Coupling Circuit Tuning*" (L3B). With the feedback current properly adjusted, the audio input level for complete modulation with a single tone should be approximately 10 db above 6 milliwatts. The program level should be approximately 6 db lower. The amount of audio feedback is adjusted by potentiometers R86A and R87A, which may be varied until the desired audio input level is obtained. The feedback should be between 10 and 13 db. This may be determined by operating the equipment with and without V15A in place, the difference in the input levels in the two cases for the same percentage modulation as indicated by a modulation meter, being the amount of feedback.

The filament center tap potentiometer P1A is provided to adjust for a minimum noise level from the audio amplifier. This minimum noise level condition can be determined by listening to the monitor output or by noise level measurements and P1A should be left at the point giving minimum noise.

Typical Meter Readings

Meter	*Indicating*	*1000 Watts*	*500 Watts*	*250 Watts*
M3A	Output Current	1.0 ± 0.2	1.0 ± 0.2	1.0 ± 0.2
M1B	Filament Voltage	200	200	200
M2B	Balance (Milliamps.)	0	0	0
M3B	Amp. Plate Voltage	3000 ± 100	3000 ± 100	3000 ± 1000
M4B	Amp. Plate Current	1.0	0.50	0.25
M4B	With No R.F. Drive	0.3 ± 0.1	0.3 ± 0.1	0.075 ± 0.025
M5B	Amp. Output Current	3.00 ± 0.25	2.60 ± 0.25	2.25 ± 0.25
M6B	Coup. Cct. Current	3.20 ± 0.25	2.20 ± 0.25	1.60 ± 0.20
M7B	Antenna Current*	$\sqrt{1000/Ra}$	$\sqrt{500/Ra}$	$\sqrt{250/Ra}$
M1A	Feedback Current	7 ma.	7 ma.	7 ma.

*Ra = Antenna resistance in ohms.

SECTION 3

TUNING CHARTS

71B Amplifiers for 1000 Watt Operation (No. 279A Tubes)

Frequency Kilocycles	*L1B Turns Each Side*	*C3.1B C3.2B each*	*C6B C7B each*	*L2B Turns each side*	*C11.1B C11.2B each*	*L3.1B Outside Turns*
550-560	26	.0005	.0006	18	.00065	32
570-600	25	"	"	18	"	30
610-640	24	.0004	"	17	.0005	32
650-680	23	"	"	16	"	28
690-700	22	"	"	16	"	28
710-730	22	.0003	.0004	15	"	26
740-780	21	"	"	15	"	23
790-800	20	"	"	14	"	23
810-840	20	.0002	"	14	.00035	30
850-900	19	"	"	13	"	26
910-970	18	"	.0002	13	"	24
980-990	17	"	"	12	"	21
1000-1090	17	.0001	"	12	"	40
1100-1150	16	"	"	11	"	32
1160-1190	16	"	.0001	11	.00025	40
1200-1290	15	"	"	10	"	36
1300-1400	14	"	"	10	"	31
1410-1500	13	"	"	9	"	27

Above 1500 KC L2B is changed to D-96971 and L1B changed to D-97973.

1500-1600	16	not used	not used	10	.0002	27
1600-1700	15	"	"	10	"	26
1700-1900	14	"	"	9	"	24
1900-2150	13	"	"	9	.00015	25
2150-2400	12	"	"	8	"	20
2400-2750	11	"	"	7	"	15
2750-3000	10	"	"	7	"	10

71B Amplifier for 250 or 500 Watt Operation (No. 270A Tubes or No. 251A Tubes)

Frequency Kilocycles	*L1B Turns Each Side*	*C3.1B C3.2B each*	*C6B C7B each*	*L2B Turns Each Side*	*C11.1B C11.2B each*	*L3.1B Outside Turns*
550-560	26	.0005	.0004	22	.00065	32
570-600	25	"	"	21	"	30
610-640	24	.0004	"	20	.0005	32
650-680	23	"	"	19	"	28
690-700	22	"	"	19	"	28
710-730	22	.0003	.0002	18	"	26
740-780	21	"	"	17	"	23
790-800	20	"	"	17	"	23
810-840	20	.0002	"	16	.00035	30
850-900	19	"	"	16	"	26
910-970	18	"	.0001	15	"	24
980-990	17	"	"	15	"	21
1000-1090	17	.0001	"	14	"	40
1100-1150	16	"	"	13	"	32
1160-1190	16	"	"	13	.00025	40
1200-1290	15	"	"	12	"	36
1300-1400	14	"	"	12	"	31
1410-1500	13	"	"	11	"	27
Above 1500 KC L2B is changed to D-97971 and L1B changed to D-97973.						
1500-1600	16	not used	not used	12	.0002	27
1600-1700	15	"	"	12	"	26
1700-1900	14	"	"	11	"	24
1900-2150	13	"	"	11	.00015	25
2150-2400	12	"	"	10	"	20
2400-2750	11	"	"	9	"	15
2750-3000	10	"	"	8	"	10

Slight variations from the number of turns given in above tables may be required to meet the limits specified in *"Typical Meter Readings."*

Resistances R1.4B and R1.5B, also R2.1B and R2.2B should be strapped out at all frequencies when the amplifier is being driven by a 100 watt transmitter. If the amplifier is being driven by a 200 watt transmitter leave these resistances in circuit.

L3.2B, the inner coil of the harmonic suppression coil, is not used between 1000 and 3000 kilocycles.

SECTION 4

FILAMENT CIRCUIT CHANGES

In 71B Amplifiers already installed, and using 279A Vacuum Tubes, the brush current in autotransformer T6B is rather high. Should trouble result therefrom, or appear likely, the condition may be corrected by the installation of a supplementary transformer T7B, as follows:

Material Required (furnished upon request to the Graybar Electric Co.):

1—American Transformer Company Transformer per their specification 25179 drawing S-39353.

1—Mounting plate per our drawing ESA-744417.

6—Feet Yellow No. 16 BBE Wire.

6—Feet Red No. 16 BBE Wire.

6—Feet Brown No. 19 BBE Wire.

6—Feet Blue No. 19 BBE Wire.

1—Terminal lug *"Shakeproof"* 2106-6.

1—Drawing ESO-744416.

Procedure (refer to Figure 7):

Remove wire (marked A in Figure 7) from the lower right-hand corner of the terminal plate on the adjustable auto-transformer "T6B" located behind the "FILAMENT VOLTAGE" control. This terminal plate is accessible through the lower left-hand door. Solder a yellow No. 16 wire to the wire just removed, insulate the splice with two layers of friction tape and apply one coat of shellac.

Remove wires (marked B and C) from upper right-hand corner of terminal plate and solder a brown No. 19 wire to them. Attach these wires to the upper left terminal by means of an existing screw.

Remove wire (marked D) from the brush terminal and solder it and a red No. 16 wire to the terminal lug supplied. Attach this lug to the upper right terminal by means of an existing screw.

Solder a blue No. 19 wire to the brush terminal.

Cable the four wires (yellow, brown, red, and blue) together, wrap with two layers of friction tape. Apply one coat of shellac to prevent unraveling.

Pass this cable to the left along existing cable, down behind lower left door hinges, behind the terminal blocks, to a point back of transformer T3B.

Mount the new transformer (T7B) supplied, on the mounting plate. Solder the four wires in the cable to its terminals as follows:

BLUE	19 GAUGE	#1
BROWN	19 GAUGE	#2
YELLOW	16 GAUGE	#3
RED	16 GAUGE	#4

Remove mounting screws of transformer T3B. Mount plate, with new transformer, under left-hand mounting screws of transformer T3B (looking at front of amplifier) with spacers under right side of transformer T3B to hold unit level.

Secure the cable in place by tying it to the existing cable with strong cord.

Test the installation by applying filament power and noting that a clockwise rotation of the "FILAMENT VOLTAGE" control increases the filament voltage. Set this control so that "FILAMENT VOLTAGE" meter M1B, reads 200.

The General Radio Company makes the following recommendations for the maintenance of the Variac autotransformer T6A.

> "If the winding surface on which the brush bears becomes loaded with carbon particles, it should be cleaned with crocus cloth. Remove the loose particles with a fine brush and then clean with carbon tetrachloride or similar highly volatile cleaning agent.

"The brush should be inspected occasionally to see that it is not becoming worn. If it is allowed to wear so far that the brass holder bears on the windings, damage to the winding will result."

Orders for replacement brushes should be addressed to the General Radio Company, Cambridge, Mass. The brushes should be described as replacement parts for the Type 200CUH Variac.

CAUTION:

Filament voltage must not be applied when the brush circuit is open, as under this condition, a momentary high voltage may build up on terminals 1 and 2 of the new transformer T7B. For this reason particular care must be taken when installing the blue and brown wires attached to these terminals.

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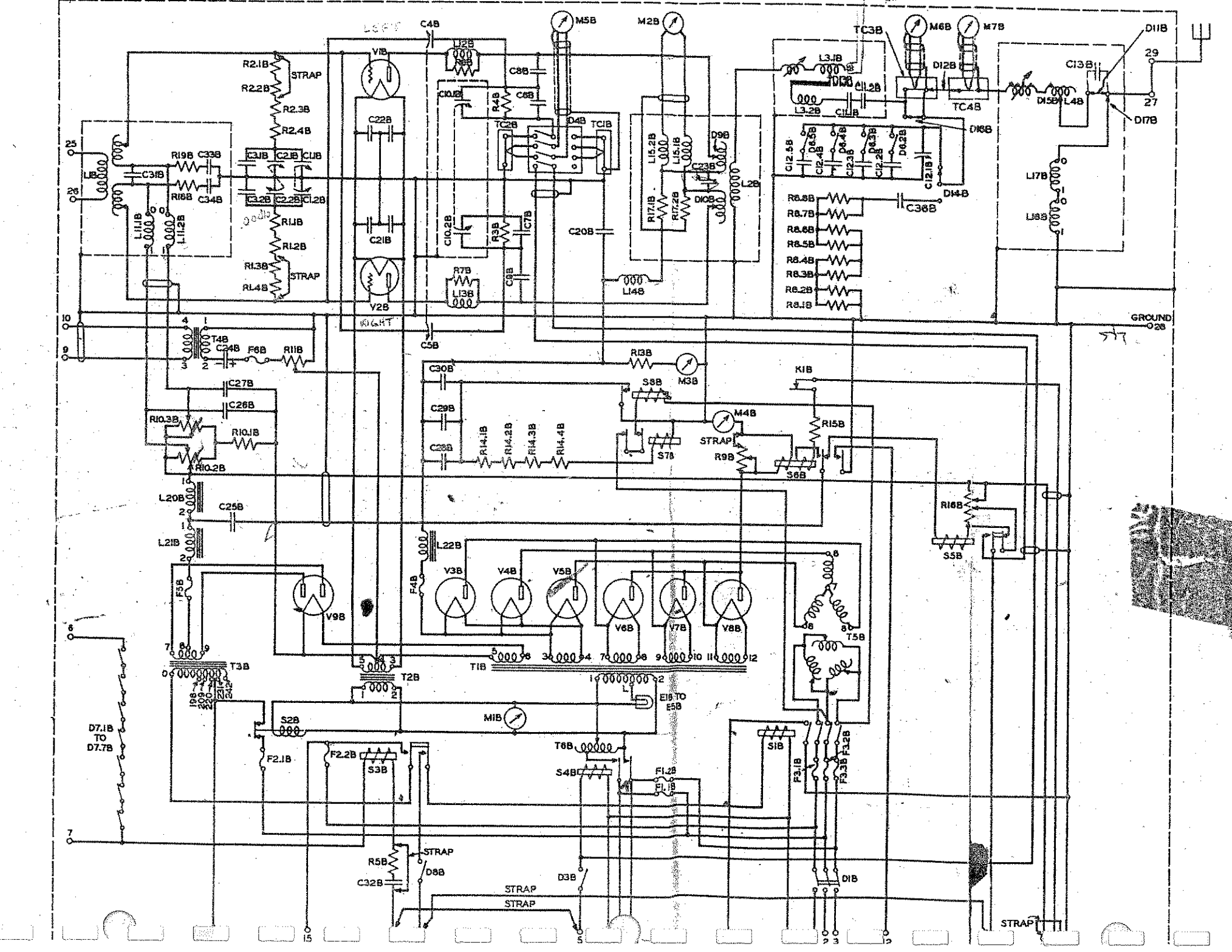

LEFT
RIGHT
V1B
V2B
M5B
M2B
M6B
M7B
M3B
M4B
M1B
TC3B
TC4B
TC1B
TC2B
D11B
D12B
D13B
D14B
D15B
D16B
D17B
D18B
D1B
D3B
D4B
D7.1B TO D7.7B
E1B TO E5B
V3B
V4B
V5B
V6B
V7B
V8B
V9B
T1B
T2B
T3B
T4B
T5B
T6B
S1B
S2B
S3B
S4B
S5B
S6B
S7B
S8B
K1B
L1B
L2B
L3.1B
L3.2B
L4B
L7B
L8B
L11.1B
L11.2B
L13B
L14B
L15.1B
L15.2B
L15.3B
L15.4B
L17B
L18B
L20B
L21B
L22B
C1B
C2B
C3B
C4B
C5B
C6B
C7B
C8B
C10B
C11B
C12B
C13B
C20B
C21B
C22B
C23B
C24B
C25B
C26B
C27B
C28B
C29B
C30B
C32B
C34B
C36B
R1.1B
R1.2B
R1.3B
R1.4B
R2.1B
R2.2B
R2.3B
R2.4B
R3B
R4B
R5B
R6.1B
R6.2B
R6.3B
R6.4B
R6.5B
R6.6B
R6.7B
R6.8B
R7B
R8B
R9B
R10.1B
R10.2B
R10.3B
R13B
R14.1B
R14.2B
R14.3B
R14.4B
R15B
R16B
R17.1B
R17.2B
R18B
R19B
F1.1B
F1.2B
F2.1B
F2.2B
F3.1B
F3.2B
F3.3B
F4B
F5B
F6B
STRAP
GROUND
25
26
27
28
29

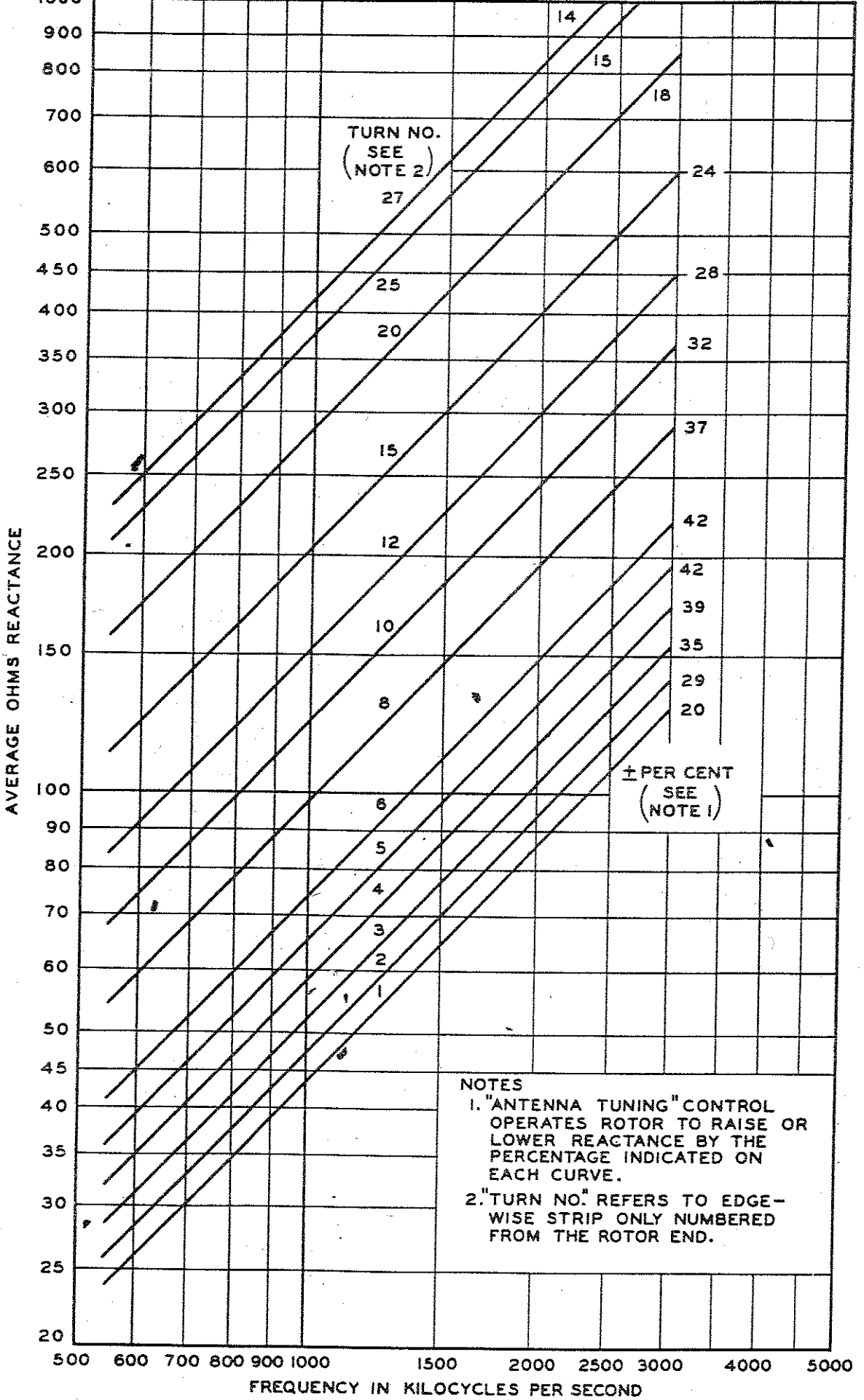
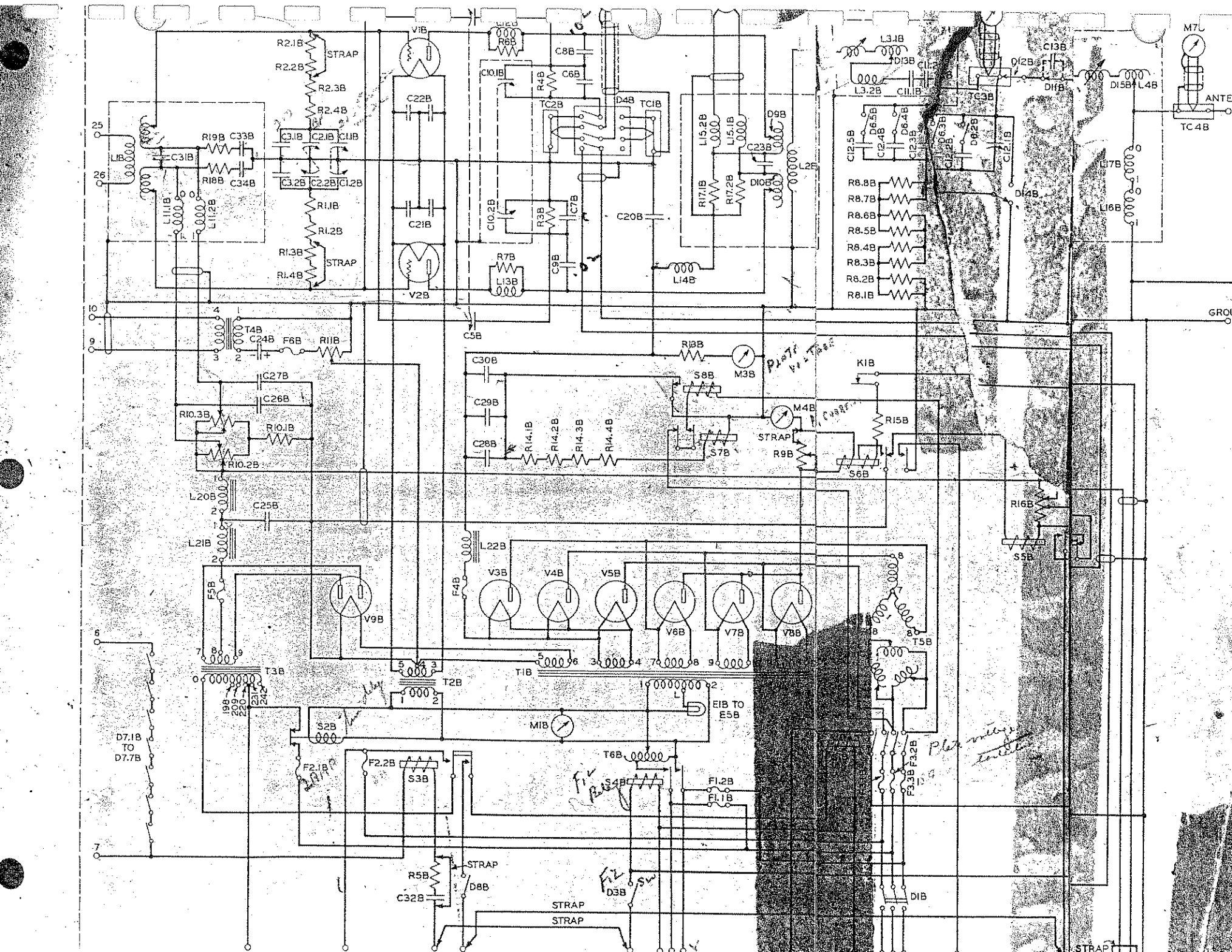

AVERAGE OHMS REACTANCE
900
800
700
600
500
450
400
350
300
250
200
150
100
90
80
70
60
50
45
40
35
30
25
20
TURN NO. (SEE NOTE 2)
14
15
18
24
28
32
37
42
42
39
35
29
20
27
25
20
15
12
10
8
6
5
4
3
2
1
± PER CENT (SEE NOTE 1)
NOTES
1. "ANTENNA TUNING" CONTROL OPERATES ROTOR TO RAISE OR LOWER REACTANCE BY THE PERCENTAGE INDICATED ON EACH CURVE.
2. "TURN NO." REFERS TO EDGE-WISE STRIP ONLY NUMBERED FROM THE ROTOR END.
500 600 700 800 900 1000 1500 2000 2500 3000 4000 5000
FREQUENCY IN KILOCYCLES PER SECOND

Fig. 6


R2.1B
STRAP
R2.2B
R2.3B
R2.4B
V1B
C22B
C21B
V2B
R19B
C33B
C3.1B
C2.1B
C1.1B
C3.2B
C2.2B
C1.2B
L1B
C3.1B
R18B
C34B
L11.1B
L11.2B
R1.1B
R1.2B
R1.3B
STRAP
R1.4B
R7B
L13B
C8B
C6B
R4B
C10.1B
TC2B
D4B
TC1B
C10.2B
R3B
C7B
C9B
L14B
C20B
L15.2B
L15.1B
C23B
D9B
L2B
R17.1B
R17.2B
D10B
L3.1B
D13B
L3.2B
C11.1B
C13B
D12B
D11B
D15B
L4B
TC3B
TC4B
ANTE
M7B
C12.5B
C12.4B
C12.3B
C12.2B
C12.1B
D6.5B
D6.4B
D6.3B
D6.2B
D14B
L17B
L16B
R8.8B
R8.7B
R8.6B
R8.5B
R8.4B
R8.3B
R8.2B
R8.1B
T4B
C24B
F6B
R11B
C5B
R13B
M3B
C30B
C29B
C28B
S8B
S7B
R14.1B
R14.2B
R14.3B
R14.4B
K1B
M4B
STRAP
R9B
R15B
S6B
R16B
S5B
C27B
C26B
R10.3B
R10.1B
R10.2B
L20B
C25B
L21B
L22B
F4B
F5B
V3B
V4B
V5B
V6B
V7B
V8B
V9B
T3B
T2B
T1B
T5B
E1B TO E5B
M1B
S2B
D7.1B TO D7.7B
F2.1B
F2.2B
S3B
T6B
S4B
F1.2B
F1.1B
F3.2B
F3.1B
R5B
C32B
D8B
STRAP
D3B
D1B
STRAP
STRAP
STRAP