TM 11-834

WAR DEPARTMENT TECHNICAL MANUAL

RADIOTELEGRAPH TRANSMITTER (PRESS WIRELESS TYPE PW-981-A)

WAR DEPARTMENT *5 FEBRUARY, 1945*

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WASHINGTON 25, D. C., 5 FEBRUARY, 1945.

TM 11-834, Radiotelegraph transmitter (Press Wireless type PW-981-A), is published for the information and guidance of all concerned.

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T/O & E 11-107 (5); 11-127 (5); 11-237 (5); 11-587 (5); 11-592 (6); 11-597 (5).

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

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LIST OF ILLUSTRATIONS

DESTRUCTION NOTICE

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

WHEN – When ordered by your commander.

HOW – 1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut — Use axes, handaxes, machetes.

3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives — Use firearms, grenades, TNT.

5. Disposal — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT – 1. Smash — Variable capacitors, tubes, relays, coils, fuses, meters, handset, speaker, and switches.

2. Cut — All wires and cables.

3. Burn — Records, logs, messages, codes, charts, all papers, books and documents.

4. Bend — Brackets, chassis, and shields.

5. Bury or scatter — Any or all of the above pieces after breaking.

DESTROY EVERYTHING

SAFETY NOTICE

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES.

DEATH ON CONTACT

MAY RESULT IF OPERATING PERSONNEL FAIL TO OBSERVE SAFETY PRECAUTIONS. THE HIGH POTENTIAL POINTS ARE INACCESSIBLE DURING NORMAL OPERATION AND SHOULD BE AVOIDED WHEN THE EQUIPMENT IS BEING SERVICED. THE PRIMARY POWER SOURCE SHOULD BE DISCONNECTED BEFORE ANY TUBE CHANGES OR SERVICING OF COMPONENT UNITS ARE ATTEMPTED.

FIRST AID FOR ELECTRIC SHOCK

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire; however, be watchful of electric flashes which may result disastrously.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breathing center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a doctor, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only,* remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. During transportation, other methods of resuscitation may be used, if the method of transportation prohibits the use of the Shaeffer prone pressure method. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing (fig. I, 1 and 2).

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such a manner that:

(1) The operator's arms and thighs are vertical while applying pressure on the small of the victim's back (fig. I, 3).

(2) The operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib.

(3) The heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim (fig. I, 1).

(4) The operator's elbows are straight and locked.

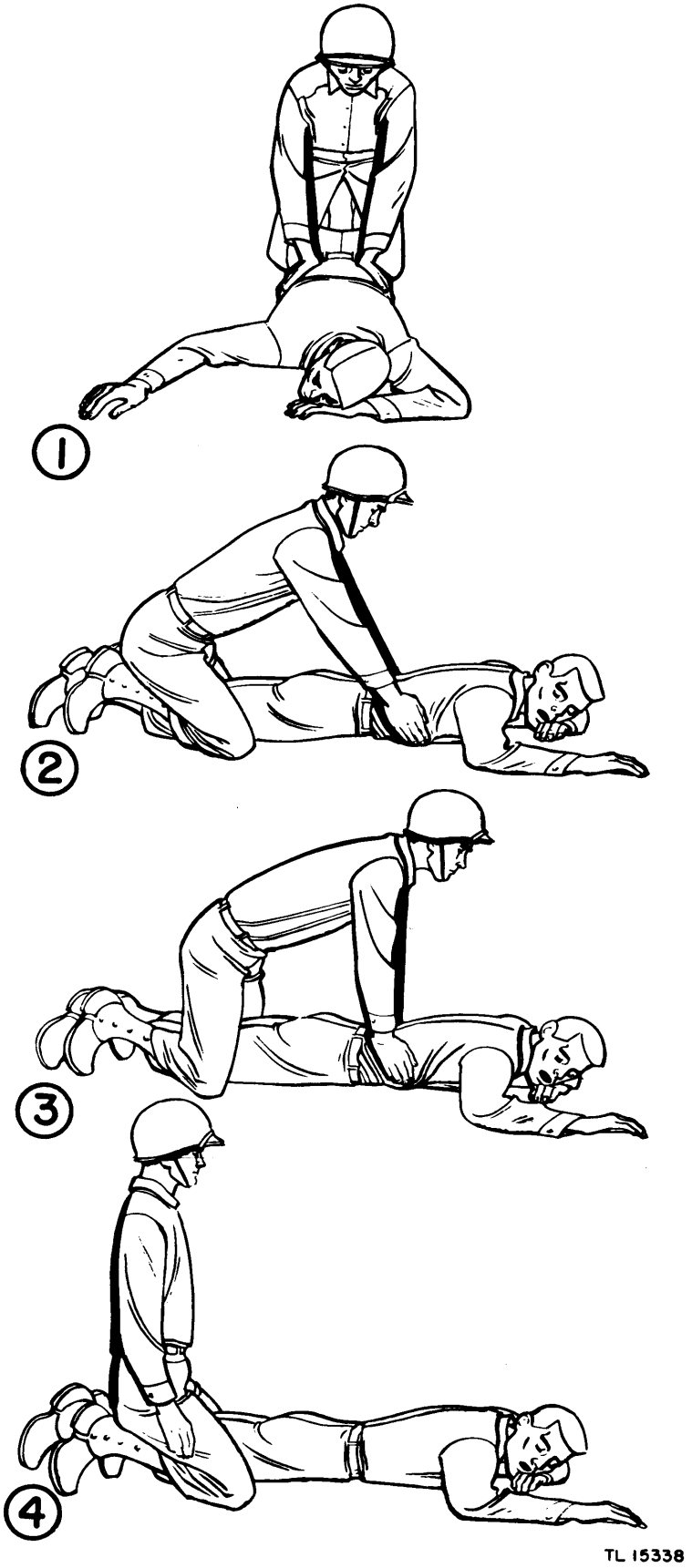

Figure I. Resuscitation Positions.

f. The resuscitation procedure is as follows:

(1) Exert downward pressure, not exceeding 60 pounds, for one second.

(2) Swing back, suddenly releasing pressure, and sit on the heels (fig. I, 4).

(3) After two seconds' rest, swing forward again positioning the hands, and apply pressure for another second (fig. I, 2 and 3).

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires one second. The release and backward swing require one second. The addition of the two-second rest makes a total of four seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, one thousand and three, one thousand and four, etc. This method of counting insures accurate timing. The exact frequency of the operating cycle of resuscitation is of utmost importance.

h. Artificial respiration should be continued without interruption until the victim regains normal breathing or until pronounced dead by a medical officer. It may be necessary to continue resuscitation for several hours. For this reason relief operators should be used if available.

METHOD OF RELIEVING OPERATOR.

The relief operator kneels beside the operator, assuming the same position on an imaginary victim, and follows the operator through three or four complete cycles. When he is sure that he has the correct rhythm, on the next forward swing of the operator the relief operator places his hands on the top of the operator's hands without applying pressure. This indicates to the operator that the relief operator is ready to take over. On the backward swing, the operator moves off the victim, to the side, and the relief operator takes the position of the operator. On the next forward swing, the operator being relieved assumes the position on an imaginary victim beside the new operator, and follows through two or three complete cycles of the new operator, or until he is sure that the new operator has the correct rhythm. The operator being relieved remains alert to take over instantly if the new operator should falter or hesitate on the cycle. During the process of relief, the original operator should count aloud, by thousands, to give the relief operator the correct timing.

INHALANT STIMULANTS.

If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostrils for comfortable breathing. Be sure that the inhalant is not held closer to the victim's nostrils and then only for short duration, one or two seconds every minute.

LIQUID STIMULANTS.

After the victim has regained consciousness, he may be given a glass of water with ½ teaspoon of aromatic spirits of ammonia added, or he may be offered hot coffee or hot tea as a stimulant. DO NOT GIVE AN UNCONSCIOUS VICTIM ANY LIQUIDS.

CAUTIONS.

a. After the victim revives, keep him lying quietly. Do not allow him to get up and walk even though he may feel that he is strong enough. Any injury which a person might have received, including electric shock, may bring about a condition of shock or fainting. This condition should be guarded against at all times. Shock is present if the victim is pale and has a cold sweat. His pulse is weak and rapid and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body, and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim may suddenly stop breathing and require additional artificial respiration. For this reason, he must be carefully watched. NEVER LEAVE A RESUSCITATED PERSON ALONE UNTIL IT IS *CERTAIN* THAT HE IS FULLY CONSCIOUS AND BREATHING NORMALLY.

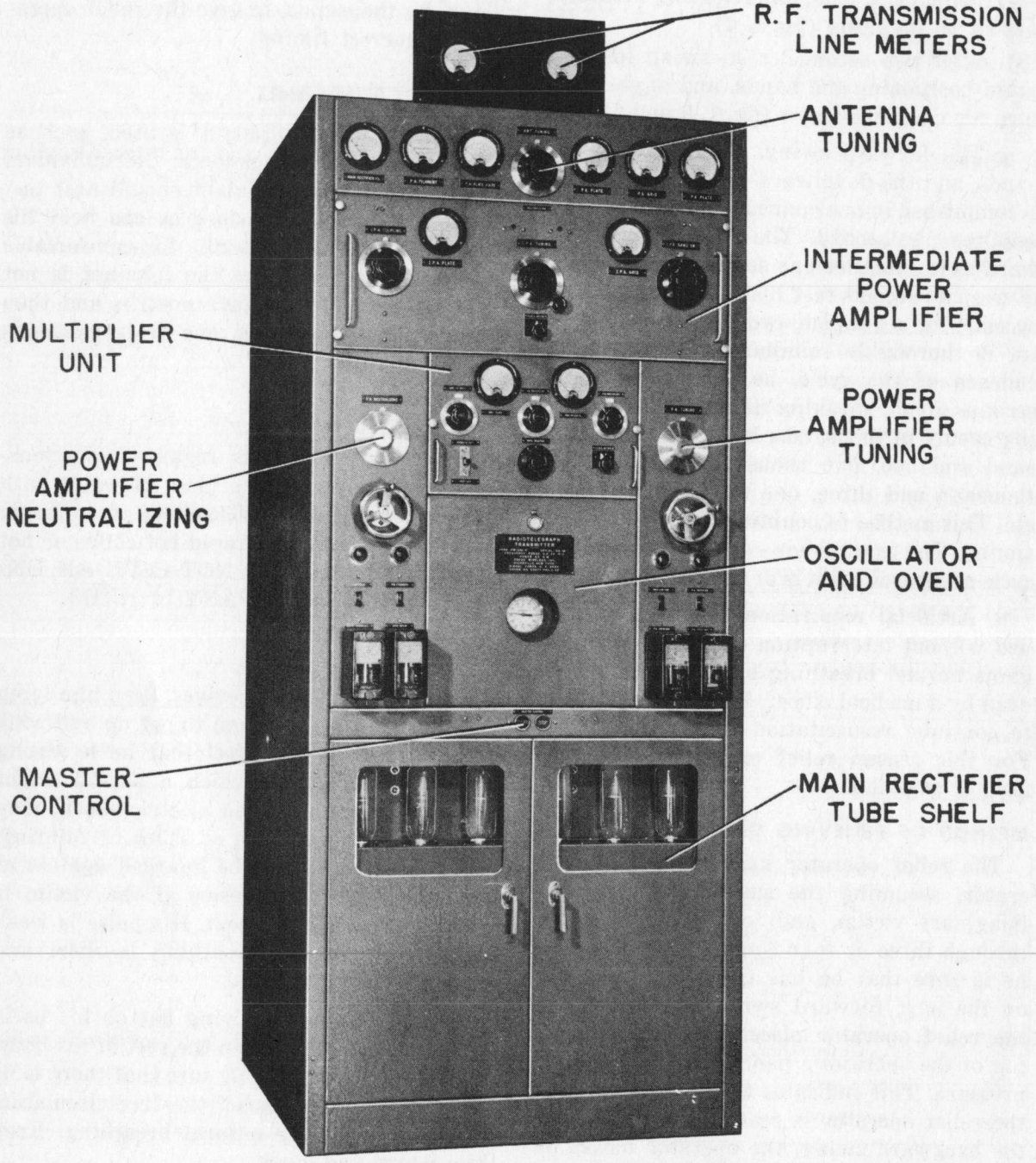

Figure 1. Radiotelegraph transmitter PW-981-A.

SECTION I
DESCRIPTION

1. PURPOSE.

Radiotelegraph transmitter (Press Wireless type PW-981-A)[1] is designed for radioteletype and telegraph operation over a frequency range of 2.5 to 23 mc (megacycles). It is capable of being keyed at speeds up to 150 words per minute (five characters per word average). The transmitter operates on a three-phase power source of 220/230 volts, 50/60 cycles. The rated carrier output of the transmitter is 2,500 watts. Power consumption is approximately 8 kw (kilowatts). The transmitter is provided with an internal frequency shifter capable of shifting the carrier 1,000 cps (cycles per second) ; however, an external frequency shifter may be used, if desired. The transmitter has provision for remote control in turning the equipment on and off, and for remote keying.

2. GENERAL.

The r-f (radio-frequency) circuit of this transmitter comprises six stages, namely: oscillator, buffer, keyed stage, multiplier, i-p-a (intermediate-power-amplifier), and p-a (power-amplifier). The output of the transmitter is designed to work into a 600- to 1,000-ohm impedance transmission line. Power is supplied by three low-voltage and one high-voltage power units contained in the cabinet.

3. DIMENSIONS AND WEIGHTS.

a. The transmitter weighs 1,717 pounds and is 77 inches high, 33 inches wide, and 36 inches deep.

b. The equipment is shipped in eight cases as follows:

Case No.	Description	Gross weight (lb)	Net weight (lb)	Volume (cu ft)	Case size (in.)
1	Transmitter.	1420	840	98.	41 x 48 x 86
2	Tank capacitor, h-f coils, shorting bars and coil bus.	162	90	7.6	20 x 22 x 30
3	Plate transformer.	369	317	4.1	18 x 19 x 22
4	Driver, oven, shifter, doubler, a-m panel.	382	155	19.4	19 x 39 x 45
5	Fil transformer, low-power voltage supply.	413	272	19.4	19 x 18 x 45
6	Set of operating tubes.	160	36	17.6	24 x 24 x 53
7	Spare tubes.	160	36	17.6	24 x 24 x 53
8	Spare parts.	260	168	13.1	18 x 30 x 42

4. MAIN COMPONENTS.

a. The main components of the transmitter are as follows:

(1) Front (fig. 22) : terminal board, main rectifier tube shelf, oven and oscillator, shifter mixer, multiplier chassis, and i-p-a chassis.

(2) Rear (fig. 23) : high-voltage power supply, low-voltage power supply, contactor panel and blower shelf, and power amplifier.

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[1] Radiotelegraph transmitter (Press Wireless type PW-981-A), the commercial nomenclature for the equipment, is used throughout this manual.

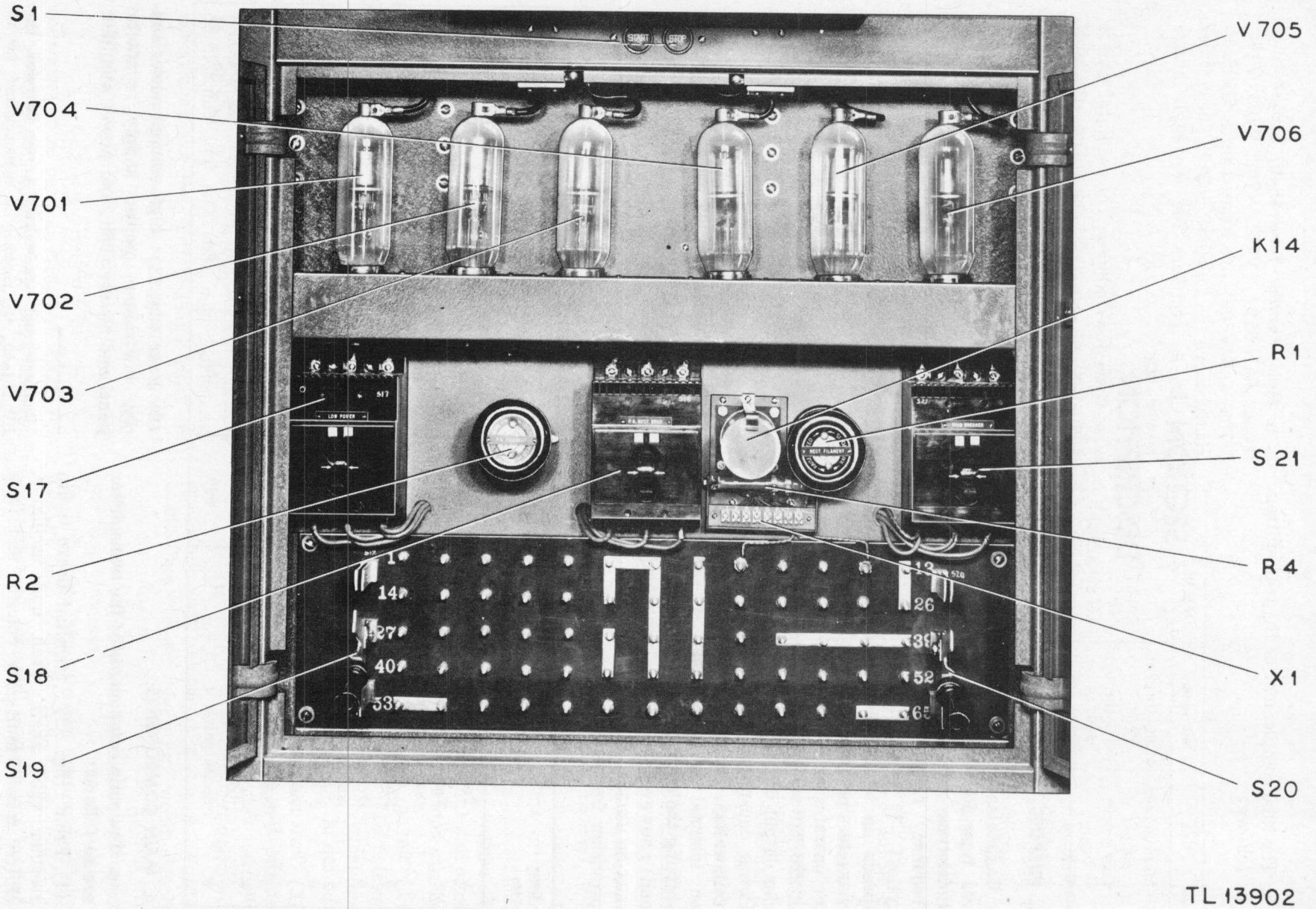

Figure 2. Main rectifier tubes and terminal board.

b. The tube complement of the transmitter is as follows:

Quan	Tube	Ref symbol	JAN No.
6	Main power supply	V701 through V706	JAN-872A
6	Low power supply	V602 through V607	JAN-866A/866
1	Voltage regulator	V601	JAN-0D3/VR-150
2	Final amplifier	V501, V502	GL8002R
1	Oven (oscillator)	V101	JAN-6SL7GT
1	Reactance	V103	JAN-6J5GT/G
1	100 Kc oscillator	V102	JAN-6N7
2	Shifter mixer	V201, V202	JAN-6L7
2	Buffer	V203	JAN-6V6GT
1	Keyed	V204	JAN-6V6GT
1	Keyer	V205	JAN-2A3
1	Resonance indicator	V206	JAN-6E5
3	Multiplier	V301 through V303	JAN-807
2	Intermediate power amplifier	V401, V402	HF100

5. MAIN FRONT COMPONENTS.

a. Terminal Board. The terminal board is mounted on the front of the transmitter, directly in front of the main power supply. The incoming a-c (alternating-current) line, the remote telegraph keying line, and the remote line for turning the transmitter on and off are connected to this terminal board.

(1) Three switches, low-power circuit breaker S17, high-voltage circuit breaker S18, and main circuit breaker S21, are mounted at the top of the terminal board (fig. 2).

(2) Two rheostats R1 and R2, also located at the top of the terminal board, control filament voltages to the power amplifier and the main rectifier.

(3) As a safety measure, two single-pole, double-throw knife switches S19 and S20 at the bottom of the terminal board, provide a grounding circuit for all high-voltage r-f components. In the OFF (horizontal) position, the high-voltage circuits are open and all high-voltage r-f components are grounded to leak off any charges that may have accumulated.

b. Main Rectifier Tube Shelf. Six rectifier Tubes JAN-872A (V701, V702, V703, V704, V705, and V706) are located on a shelf directly above the terminal board. These tubes function as rectifiers for the high-voltage power supply.

c. Oven and Oscillator. The oscillator unit is composed of a crystal-controlled oscillator and an emergency oscillator (E.O.) contained in an electrically heated, insulated oven. Access may be gained to it by opening the hinged, self-locking door located on the front of the transmitter.

(1) The temperature in the oven is maintained at 50° centigrade by thermostat S102 which is located on the upper right-hand side of the oven. The existing temperature is indicated by dial thermometer M101 visible from the front through a glass window.

(2) Receptacles for holding five different crystals are provided in the oven. A six-position selector switch S101, located on the front panel of the oven, enables the operator to select any one of the five crystals. Position E.O. indicates that an emergency oscillator is being used.

(3) A variable capacitor C103 controls the excitation of the crystal oscillator.

(4) Also located in this unit are high-frequency oscillator Tube JAN-6SL7GT (V101); low-frequency oscillator Tube JAN-6N7 (V102); Tube JAN-6J5GT/G (V103), the reactance tube for the frequency shifter circuit; reactance shift control potentiometer R105; and the 200-kc (kilocycle) oscillator tuning capacitor C115.

d. Shifter Mixer. (1) The shifter mixer is composed of the buffer-amplifier stage, keyers, and keyed stage mounted in a single removable chassis and located directly above the crystal oven unit. The four controls on the front panel of this unit are keyer plate tuning capacitor C208, shifter isolating switch S201 (two-position), teletype mark-space test switch S202, and mixer plate tuning capacitor C204.

(2) Tube JAN-6E5 is used as a resonance indicator, the "eye" being visible from the front of the panel.

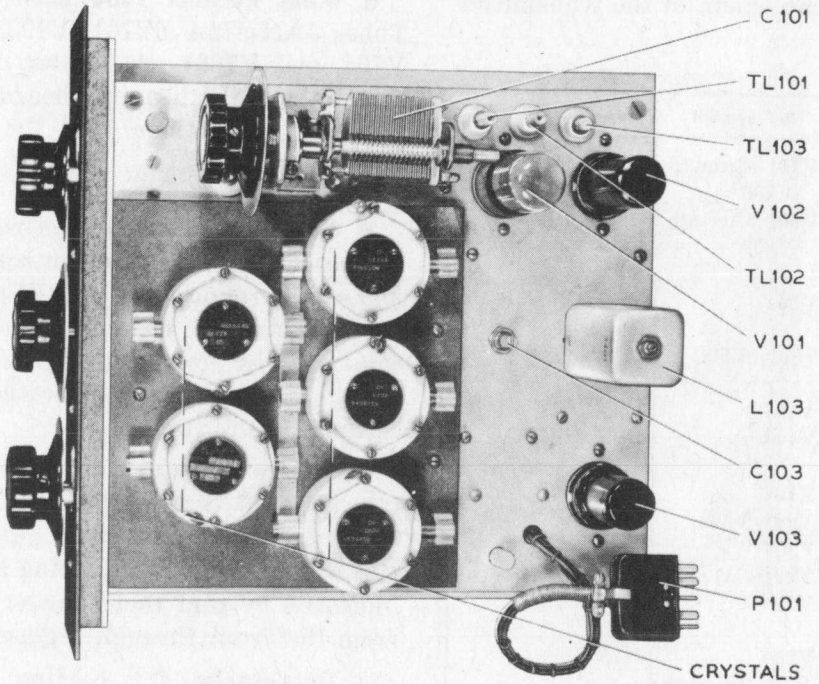

Figure 3. Crystal oscillator and emergency oscillator, top view.

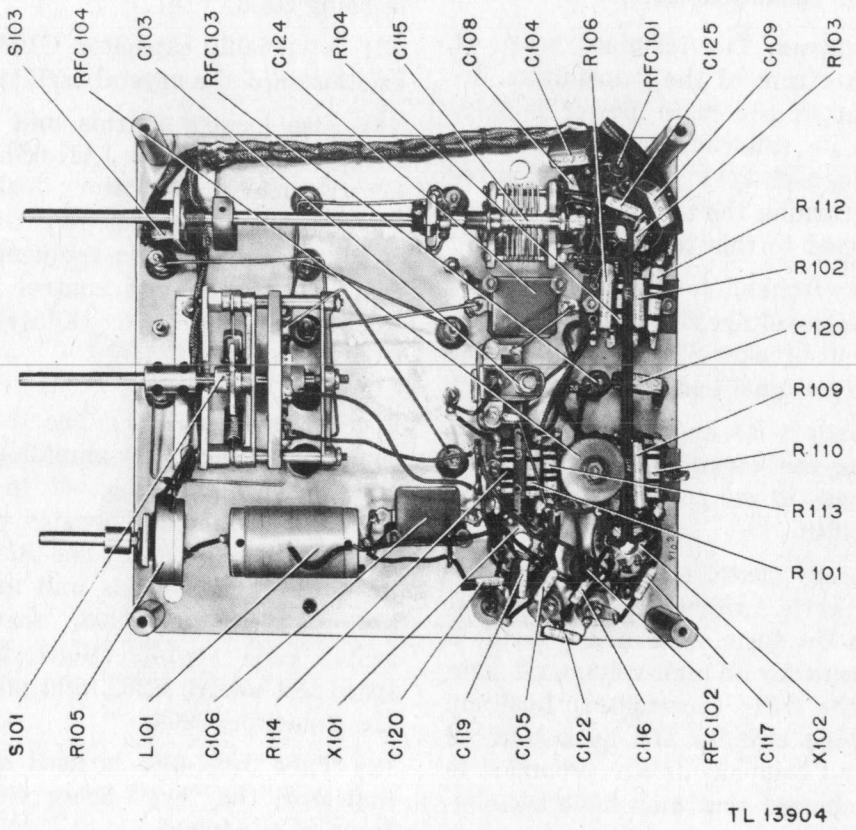

Figure 4. Crystal oscillator and emergency oscillator, bottom view.

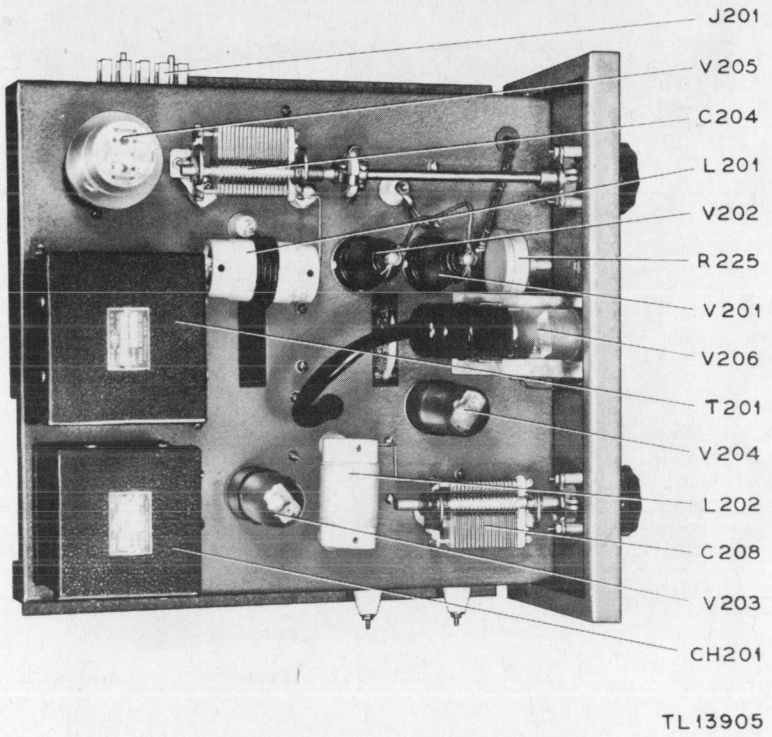

Figure 5. Shifter chassis, top view.

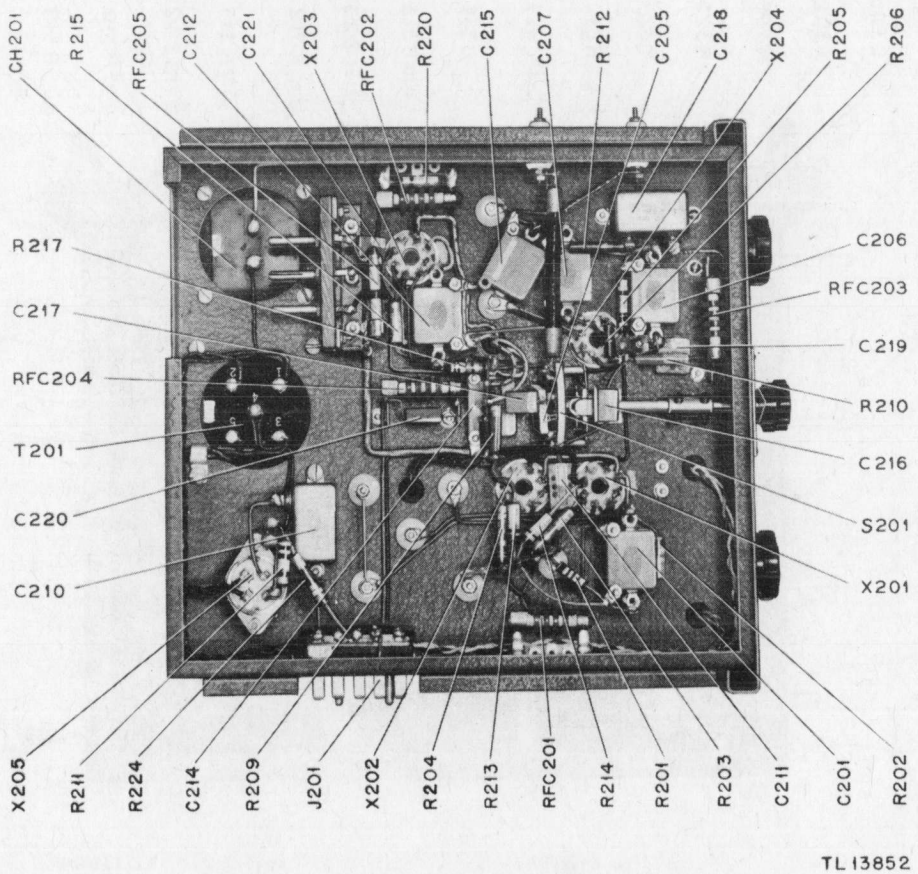

Figure 6. Shifter chassis, bottom view.

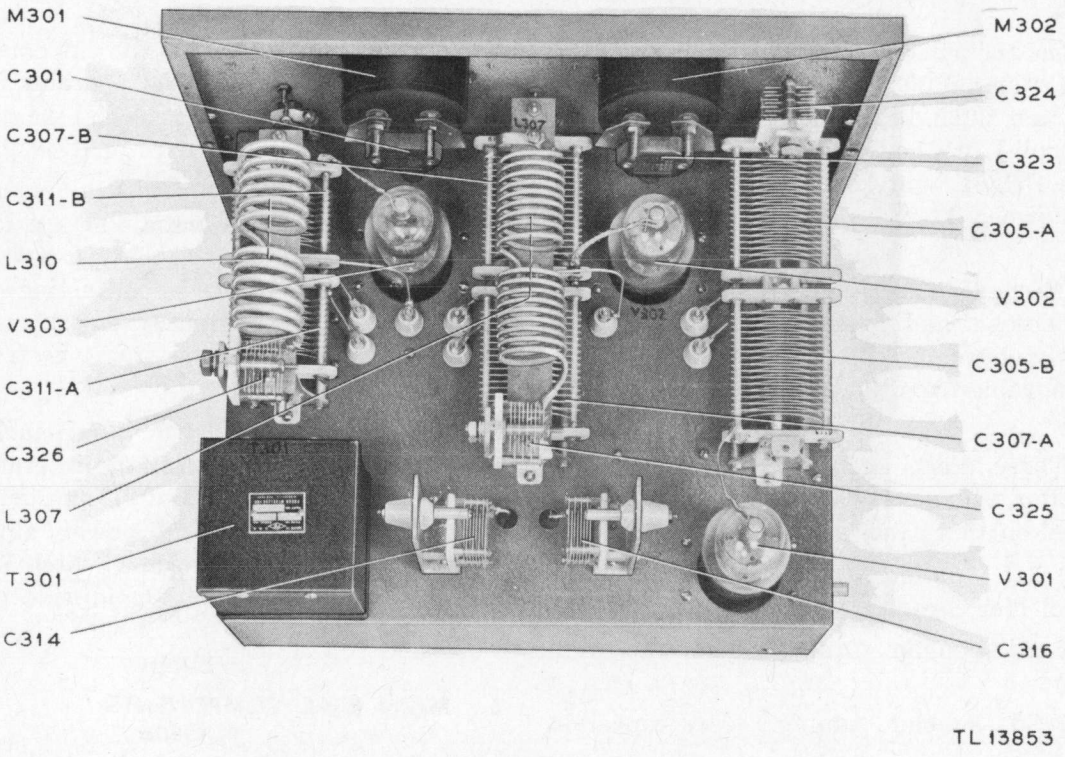

Figure 7. Frequency-multiplier chassis, top view.

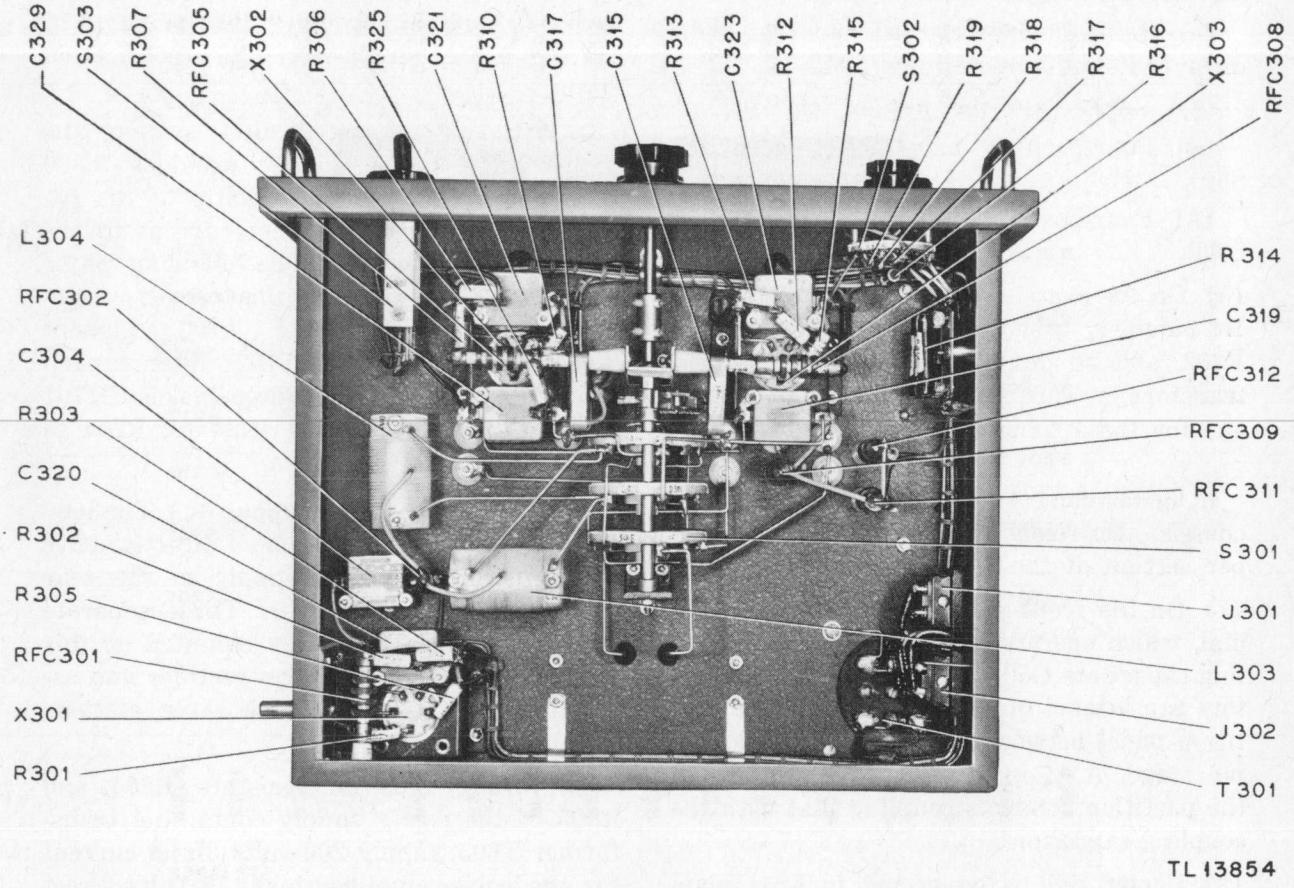

Figure 8. Frequency-multiplier chassis, bottom view.

(3) On the chassis are located buffer and keyed tubes V203 and V204, mixer tubes V201 and V202, keyer bias tube V205, mixer plate coil L201, keyer plate coil L202, keying choke CH201, and keyer bias tube filament transformer T201.

e. Multiplier Chassis. (1) The entire multiplier chassis and panel assembly is located directly above the shifter-mixer chassis, and is removable from the transmitter as a single unit.

(2) Three dials, each operating a tuning capacitor, two meters and three switches, are located on this panel as follows:

(*a*) 1st amplifier and 1st doubler tuning control (for capacitor C305).

(*b*) 2d doubler tuning (for capacitor C307).

(*c*) 3d doubler tuning (for capacitor C311).

(*d*) Oscillator-plate current indicator (100-milliampere range) M302.

(*e*) Buffer-doubler cathode current indicator (100-milliampere range) M301.

(*f*) Remote and test key switch S303.

(*g*) Four-position band selecting switch S301.

(*h*) Four-position meter selecting switch S302.

(3) On the chassis are located amplifier and 1st doubler tube V301, 2d doubler tube V302, and 3d doubler tube V303. Filament transformer T301 supplies the filament voltage for these tubes.

f. Intermediate Power Amplifier. The i-p-a chassis, also removable, is located in the upper section of the front of the transmitter.

(1) On the front panel are located coupling dial, which operates the final amplifier coupling capacitors C501 and C502. These capacitors are located directly in back of the partition panel between the i-p-a stage and the p-a stage. A ¼-inch shaft passing through the partition connects coupling dial with the coupling capacitors.

(2) Center dial is connected to i-p-a plate tuning capacitors C410A and C410B. Band switching dial is located on the extreme right of the i-p-a panel. This dial operates 6-position switch S401 which selects the proper taps on the tank coils for resonating the circuit between 2.5 and 23 mc.

(3) Capacitors C402 and C403 are located on the rear of the panel. The i-p-a stage is neutralized by properly adjusting these capacitors with a small screwdriver. This adjustment may be made from the front of the panel.

(4) Two meters located on this panel indicate the cathode current of the intermediate power amplifier (meter M401), and grid current of the intermediate power amplifier (meter M402). Meter selector switch S402 is located on the lower left-hand side of the panel.

6. MAIN REAR COMPONENTS.

a. High-voltage Power Supply. (1) The high-voltage power supply is located in the bottom section of the transmitter. Six rectifier Tubes JAN-872A (V701 through V706) are used in a three-phase, single-wye (Y) rectification circuit.

(2) With its associated filter system, the high-voltage power supply provides 3,300 volts direct current to the plates of the p-a tubes and 1,650 volts direct current to the plates of the i-p-a tubes. The following major components are used in this circuit: high-voltage plate transformer, T703; filament transformers T701 and T702; filter capacitors C701 through C704; filter chokes CH701 and CH702; and bleeder resistors, R704 to R709.

b. Low-voltage Power Supply. (1) The low-voltage power supply is located directly above the high-voltage power supply in the rear section of the transmitter. Three separate power supplies are actually mounted on this chassis, each having its own rectifier and associated filter circuit. These three sections supply the following:

(*a*) Three taps on resistors R604 and R605 of the power supply containing transformer T605, supply 200 volts direct current for the power-amplifier bias, 79 volts direct current for the i-p-a bias, and 55 volts direct

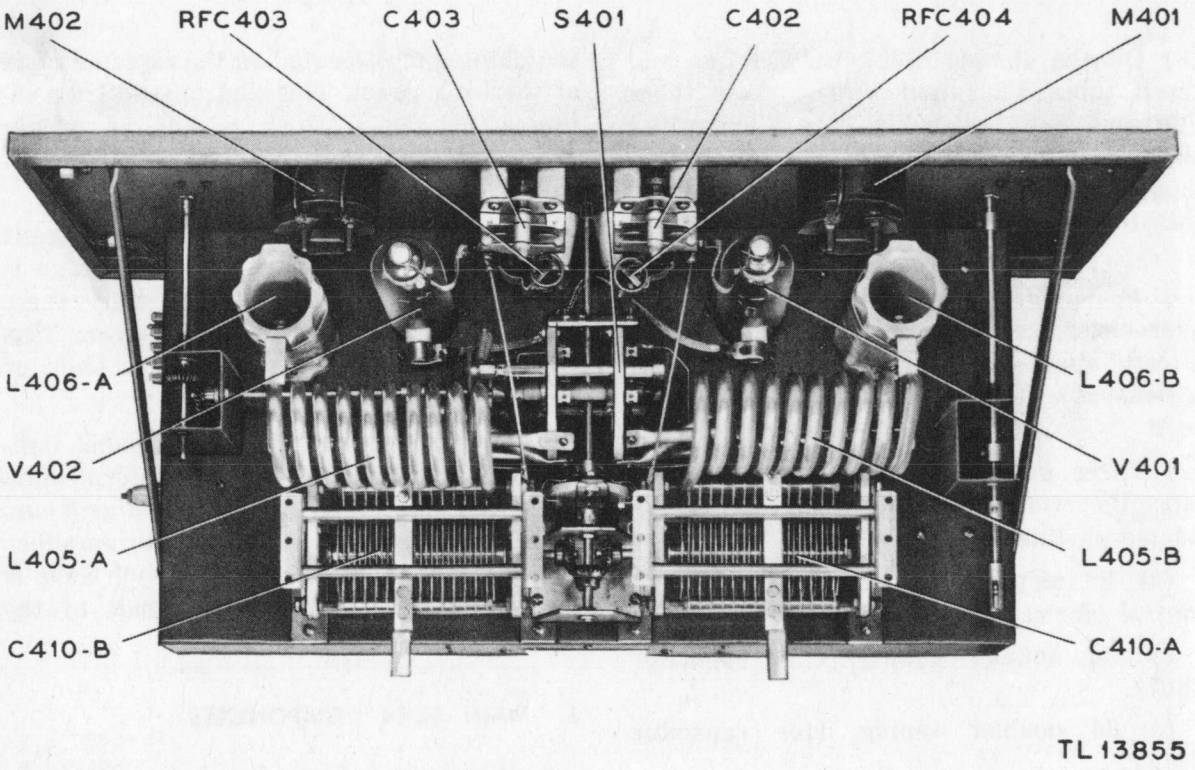

Figure 9. Intermediate-power-amplifier chassis, top view.

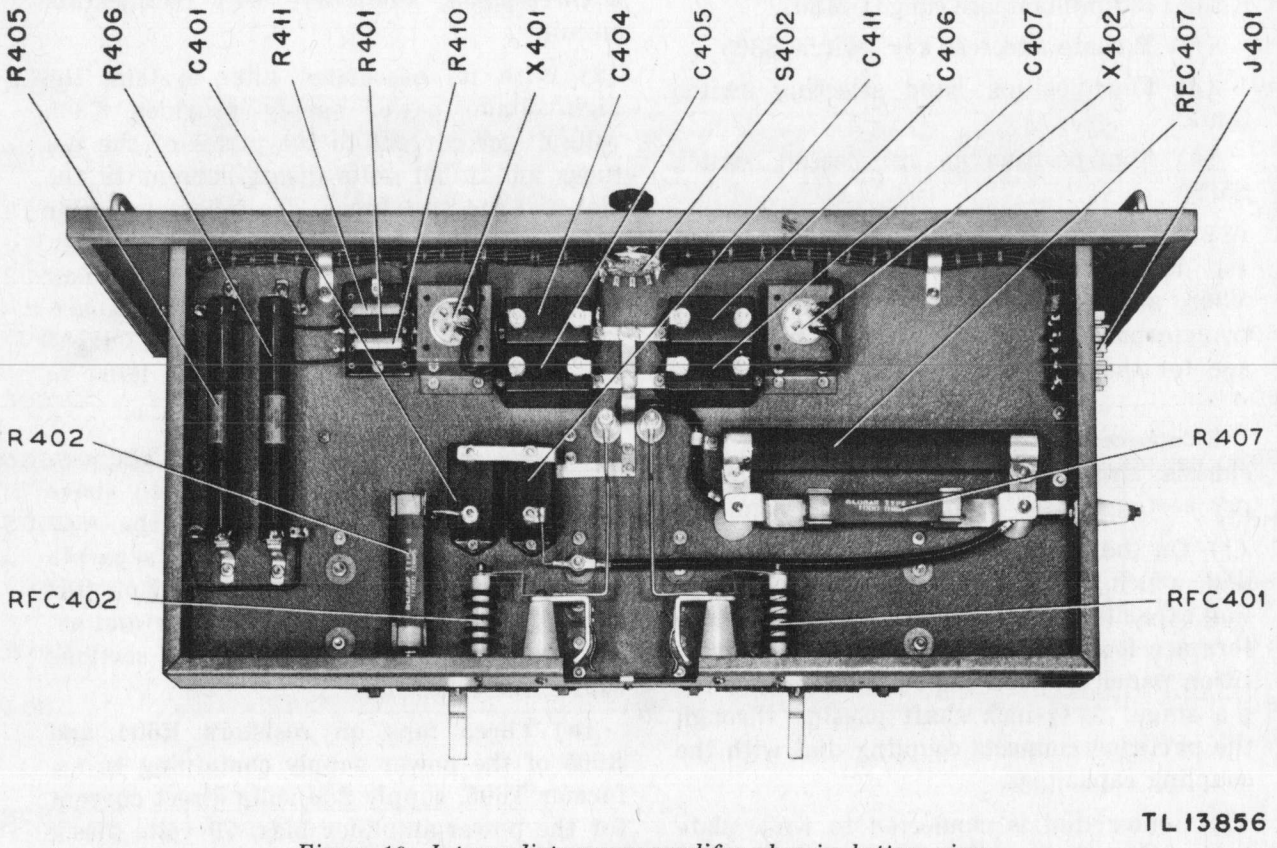

Figure 10. Intermediate-power-amplifier chassis, bottom view.

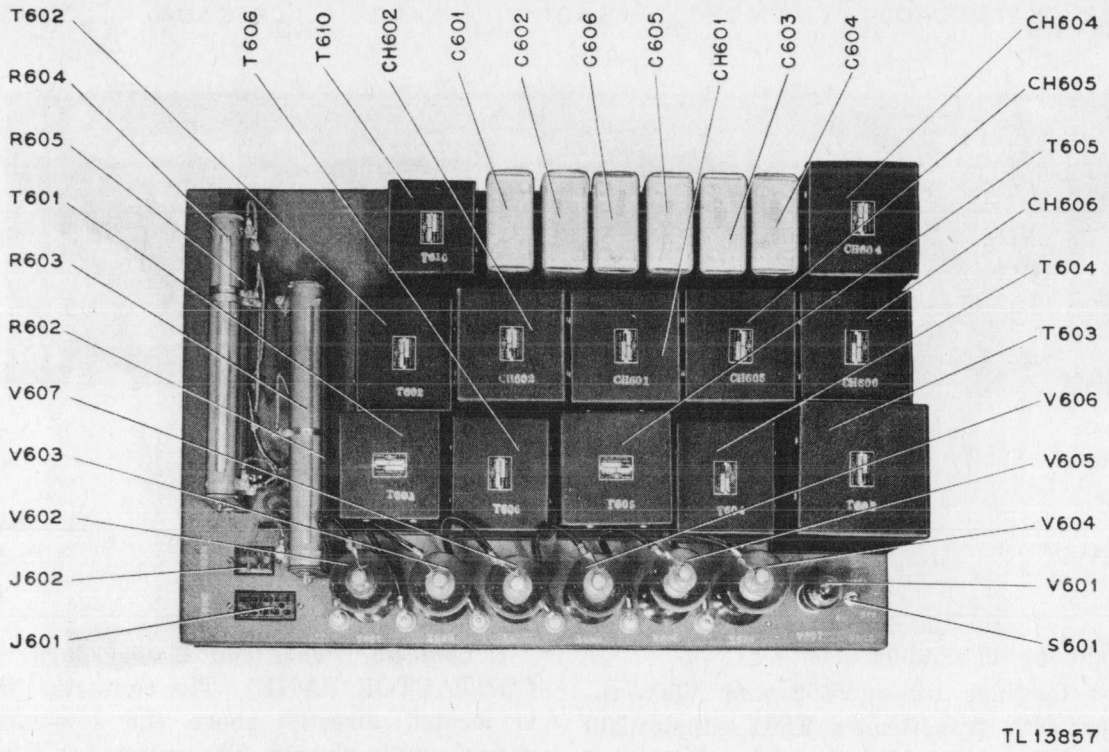

Figure 11. Low-voltage power-supply chassis, top view.

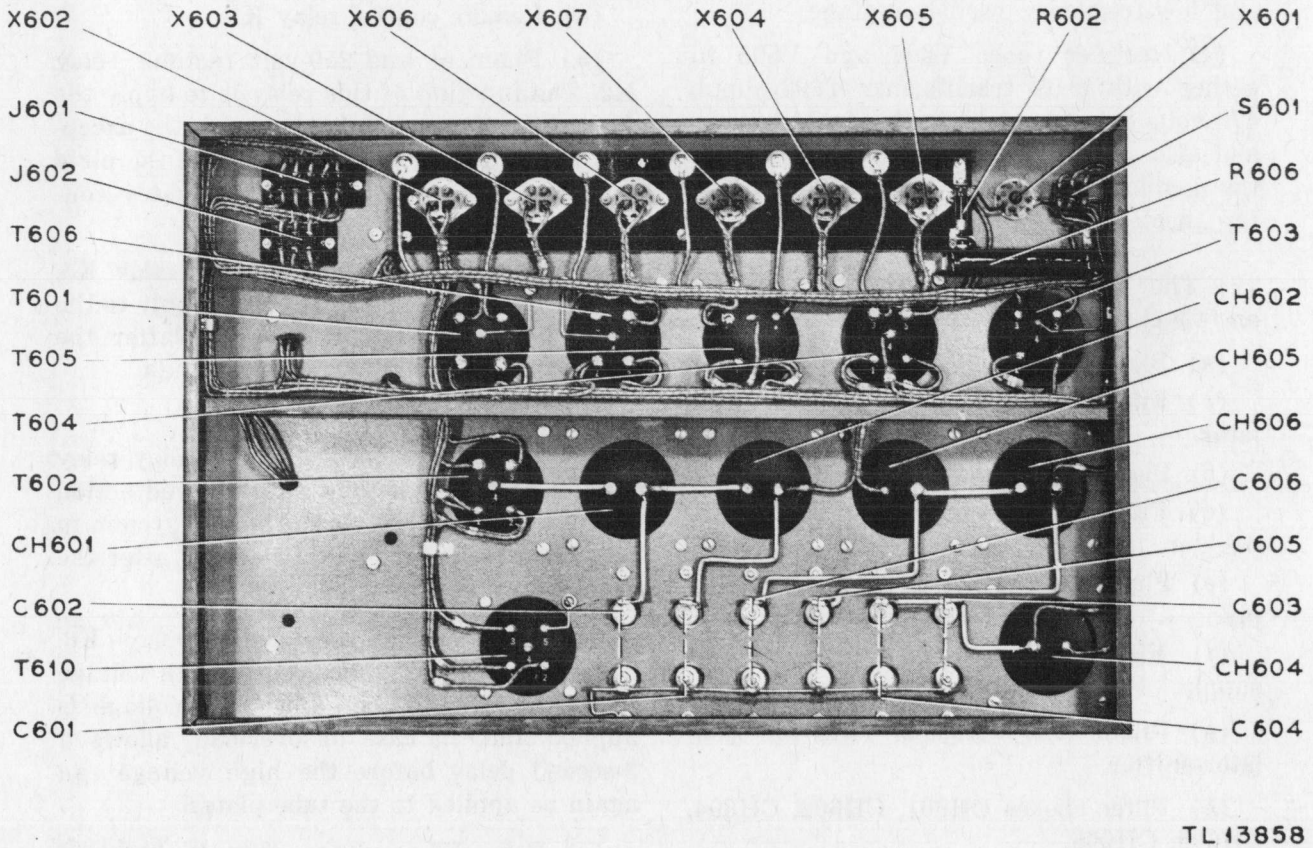

Figure 12. Low-voltage power-supply chassis, bottom view.

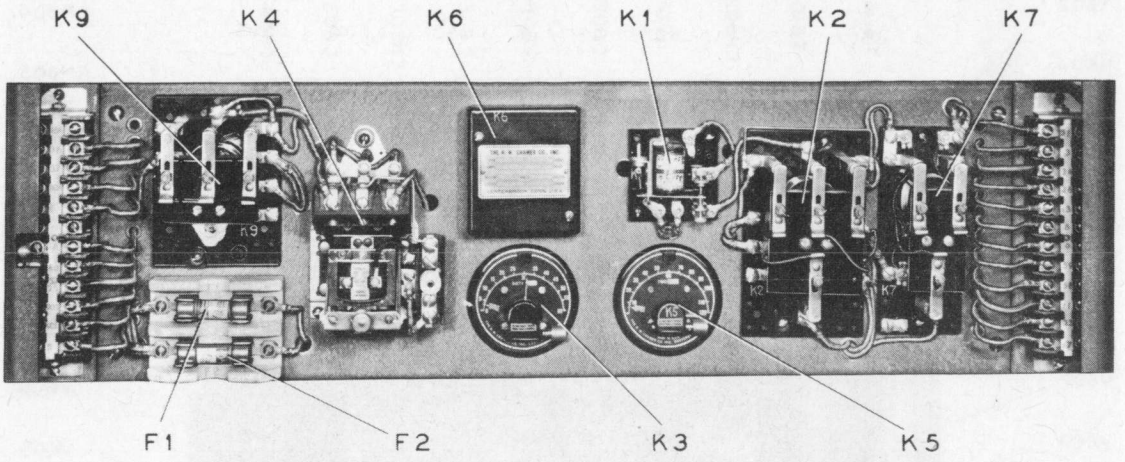

Figure 13. Contactor panel.

current for the doubler bias.

(*b*) Rectifier tubes V602 and V603 together with transformer T601 supply 250 volts direct current to the plate circuit of the mixer-buffer stage and 150 volts direct current regulated by regulator Tube JAN-OD3/VR150, to the oscillator, reactance tube and low-frequency oscillator stage.

(*c*) Rectifier tubes V604 and V605 together with plate transformer T603 supply 470 volts direct current to the doubler plates and also supply 260 volts direct current for the doubler screens and keyed stage from a tap on bleeder R603.

(2) The following components are located on this chassis:

(*a*) Plate transformer T601 for oscillator.

(*b*) Filament transformer T602 for oscillator.

(*c*) Plate transformer T603 for doubler.

(*d*) Filament transformer T604 for doubler.

(*e*) Plate transformer T605 for bias supply.

(*f*) Filament transformer T606 for bias supply.

(g) Filament transformer T610 for oscillator-shifter.

(*h*) Filter chokes CH601, CH602, CH604, CH605, CH606.

(*i*) Filter capacitors, C601 through C606.

c. Contactor Panel and Blower Shelf. (1) CONTACTOR PANEL. The contactor panel is located directly above the low-voltage power supply chassis. The entire panel, with the exception of two fuses, is composed of various types of relays and timing devices as follows:

(*a*) Remote control relay K1.

(*b*) Filament and 250-volt rectifier relay K2. The function of this relay is to apply the filament voltages to *all* tubes with the exception of the p-a tubes. It also applies the plate voltage to the oscillator and actuates contactors K3, K4, and K9.

(*c*) Thirty-second timing delay relay K3. This relay switches on the plate supply to the multiplier and bias-rectifier tubes after the filaments have been on for 30 seconds.

(*d*) Blower motor relay K4.

(*e*) Two-minute blower motor delay relay K5. This relay functions as a delayed action relay, since it maintains the blower system in operation for a period of 2 minutes after the transmitter is turned off.

(*f*) Three-second time delay relay K6. This relay delays application of high voltage to the power amplifier until bias voltage is applied and, in case of overload, allows a 3-second delay before the high voltage can again be applied to the tube plates.

(*g*) Relay K7 operates after the 3-second delay of K6 has lapsed. Immediately after K7

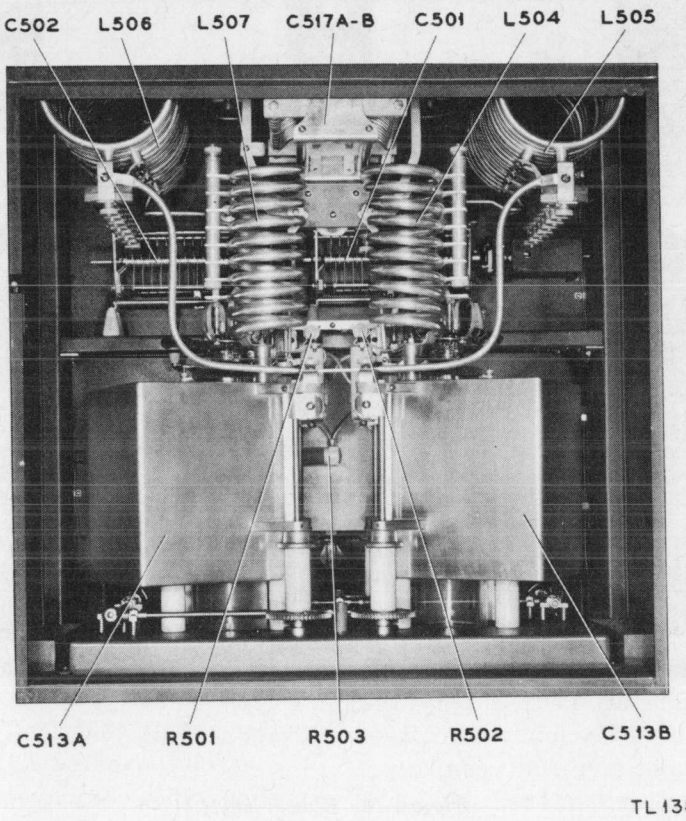

Figure 14. Power-amplifier stage.

closes, K6 returns to the OFF position. The moment it reaches the OFF position, K8 is energized.

(*h*) Relay K8 allows the voltage from the three-phase main supply line to be applied to the primary of the high-voltage plate transformer.

(*i*) Magnetic relay K9 turns p-a filaments on and off.

(2) BLOWER SHELF. The blower motor and its associated blowers are mounted on the shelf located directly behind the contactor panel (facing transmitter from the rear). Adequately filtered air is forced through the cooling fins of the p-a tubes by this blower system.

d. Power Amplifier. (1) The power amplifier comprises the upper rear half section of the cabinet. In this circuit are two p-a tubes V501 and V502, and their associated air cooling system. After circulating past the cooling fins of the p-a tubes, the exhaust air is passed out of the cabinet through the grill at the top of the transmitter.

(2) The following components are included in this section:

(*a*) P-a plate tuning capacitors C513A and C513B, and their associated tank coils L504, L505, L506, and L507.

(*b*) P-a neutralizing capacitors C505 and C506.

(*c*) P-a grid coupling capacitors C501 and C502.

(*d*) P-a filament transformers T501 and T502.

7. R-F TRANSMISSION LINE.

a. The r-f transmission line is connected to the feed-through insulators located on top of the transmitter cabinet. A transmission line of approximately 600 to 1,000 ohms impedance must be used.

b. R-f current meters M504 and M505 are also located on top of the cabinet, to be used in series with the transmission line.

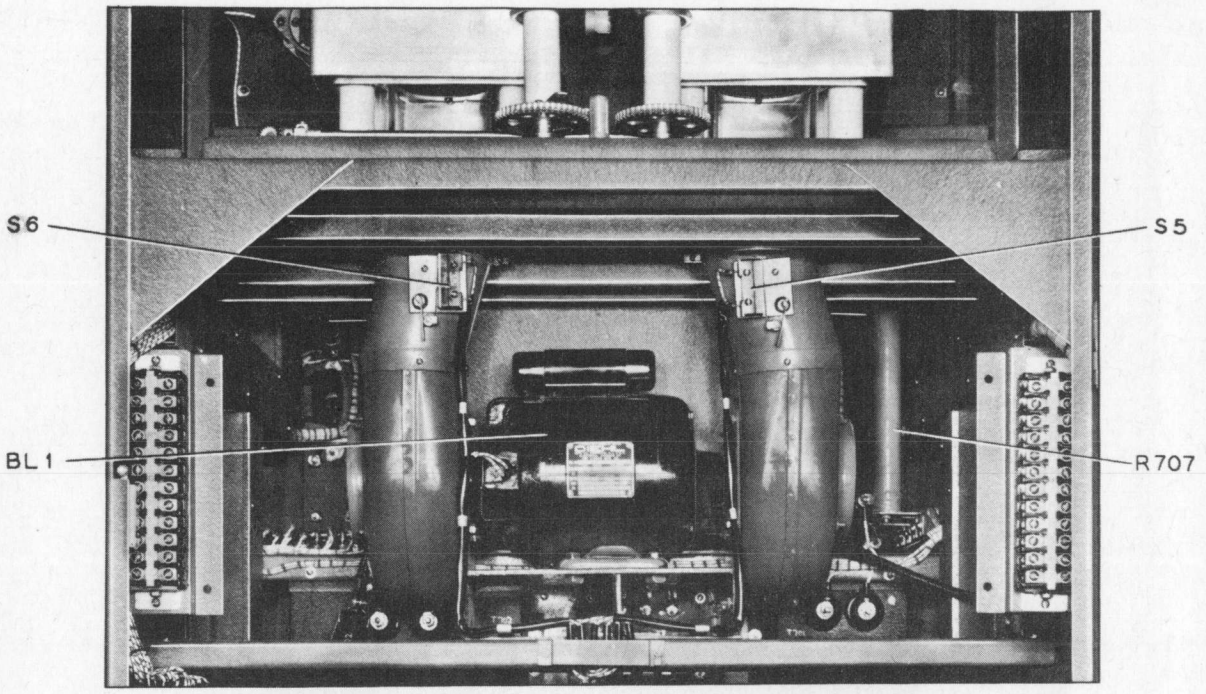

Figure 15. Blower shelf.

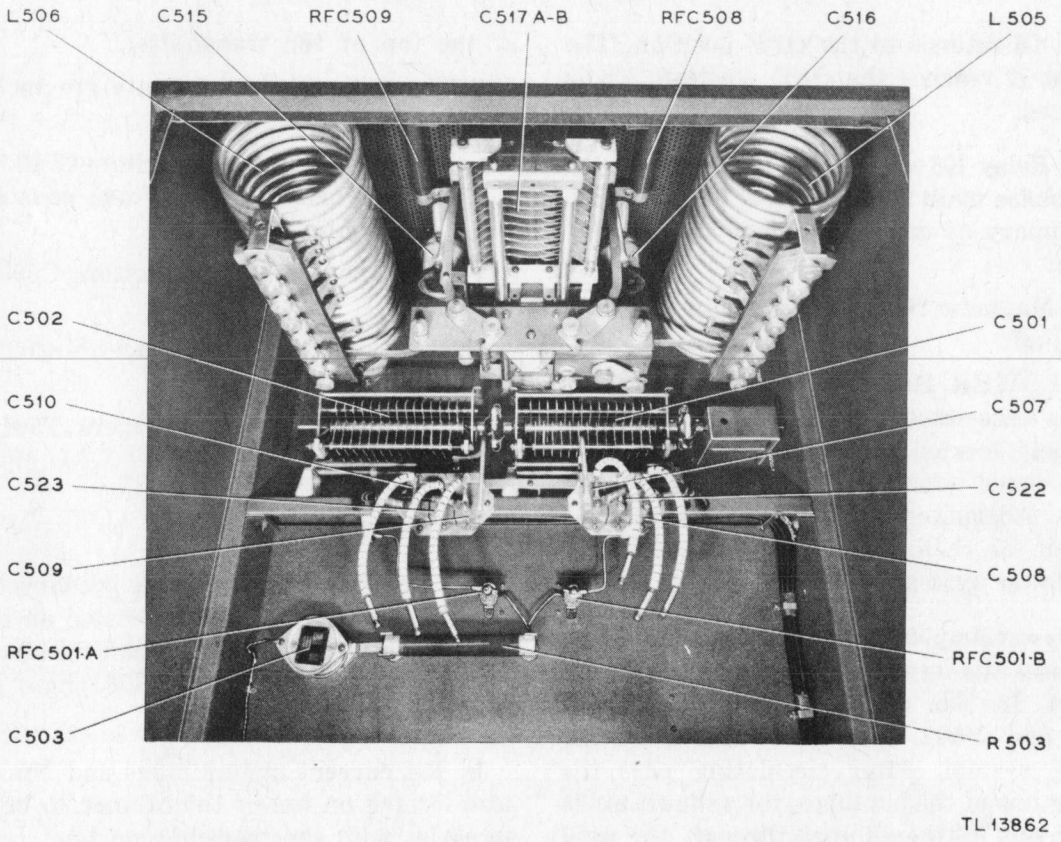

Figure 16. Power-amplifier, tank capacitor removed.

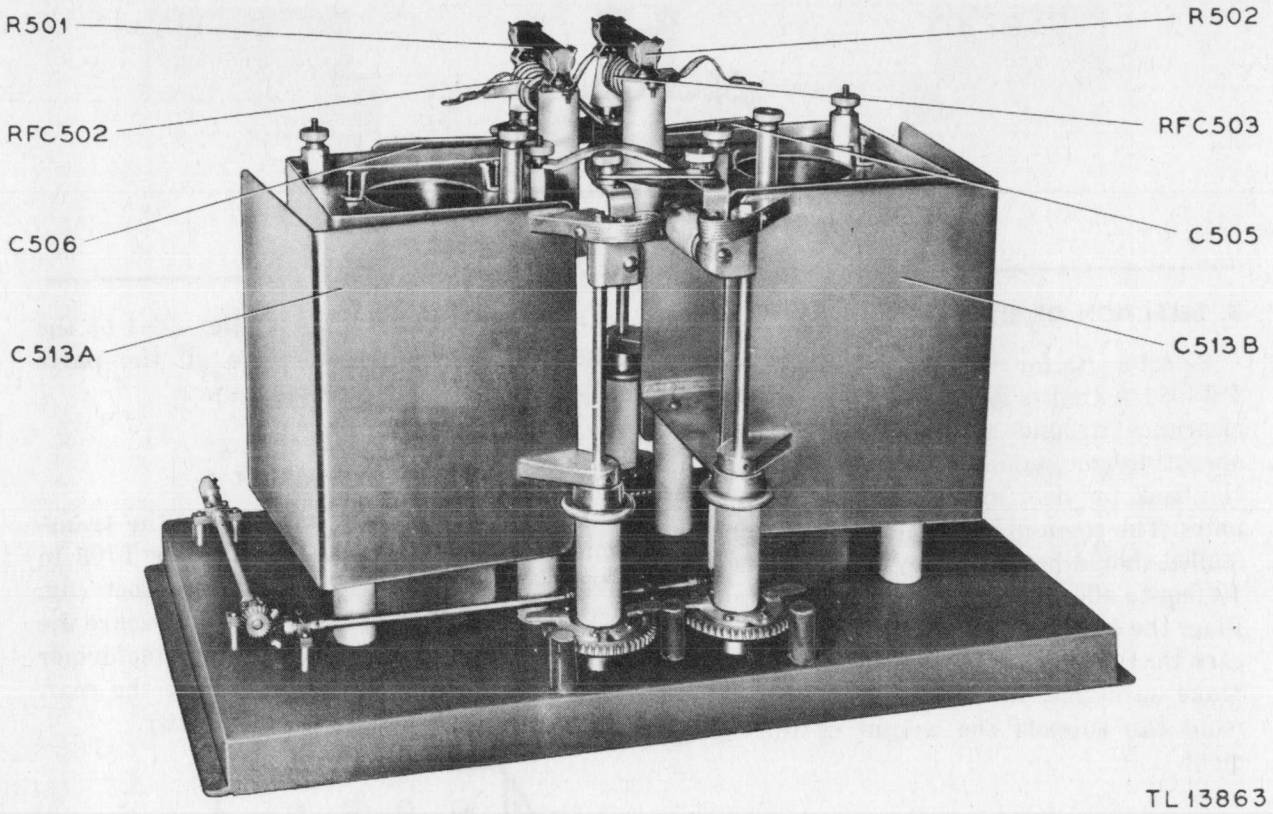

Figure 17. Power-amplifier tank capacitor assembly.

SECTION II

INSTALLATION AND OPERATION

8. SELECTION OF SITE.

Select a site for radiotelegraph transmitter PW-981-A that is large enough to give ample clearance around the transmitter for the operating personnel. Allow sufficient room at the back for door swing and for making repairs. The room in which the unit is to be installed should have a ceiling height of at least 10 feet to allow for the r-f transmission lines. Place the transmitter in a level position. Take care that it is not subjected to any vibration. Make sure that the spot selected for placement can support the weight of the equipment.

9. EXTERNAL CONNECTIONS.

Before installing the transmitter, the necessary conduit for the main a-c power line and the key line should be installed. A conduit 2 inches in diameter is sufficient to accommodate three No. 1 lead-covered cables for the three-phase, 230-volt power line between the main power board of the station and the three-phase power terminals of the transmitter. It is normally installed in or under the floor of the station. The external lines may be installed in a trench under cover plates. For emergency, where no trenches are available, the base of the transmitter is provided with an opening for 1-inch conduit to allow the input wires to run across the floor and enter the transmitter at the left side.

10. UNPACKING.

When unpacking the unit, place the case as near the final installation location as possible. *Be careful when uncrating, moving, and handling the unit to avoid damage.* Be equally careful in handling and unpacking the other cases. Some of the parts of the transmitter have been blocked in place by means of wooden supports and in some cases with padding. Remove all this excess material carefully after taking apart the sides of the wooden cases. Likewise, free all the parts that have been tied or taped up.

11. ASSEMBLY OF MAIN UNITS.

a. The first step in assembling the transmitter is to place plate transformer T703 in its position at the bottom of the cabinet (fig. 23). Use the four bolts supplied to secure the transformer in place. Install the transformer so that the primary terminals face the rear. Make the cable connections (fig. 18).

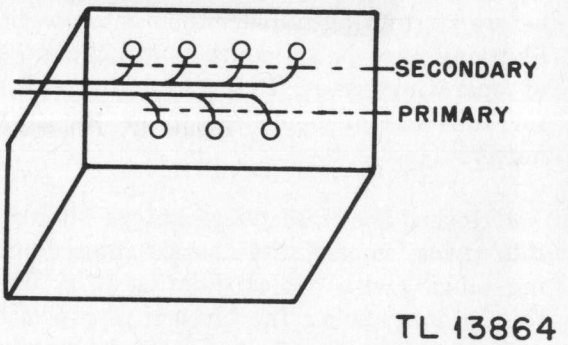

Figure 18. High-voltage plate transformer connections.

b. Slide the power-amplifier tank assembly into position and fasten it down with the four bolts supplied. With the neutralizing and plate tuning capacitors fully closed and the dials set at 100, connect the couplings on both capacitor shafts. When installing the bus bars, use figures 16 and 17, as a guide. Power-amplifier tubes are connected according to power-amplifier tube connections (fig. 19).

c. Open the door on the front of the transmitter which gives access to the crystal oven compartment. Set the crystal oven unit in place and fasten with the four screws provided. The two rails fastened to the top of the oven hold the frequency shifter unit in place. Slide the shifter into place and secure by means of the two screws.

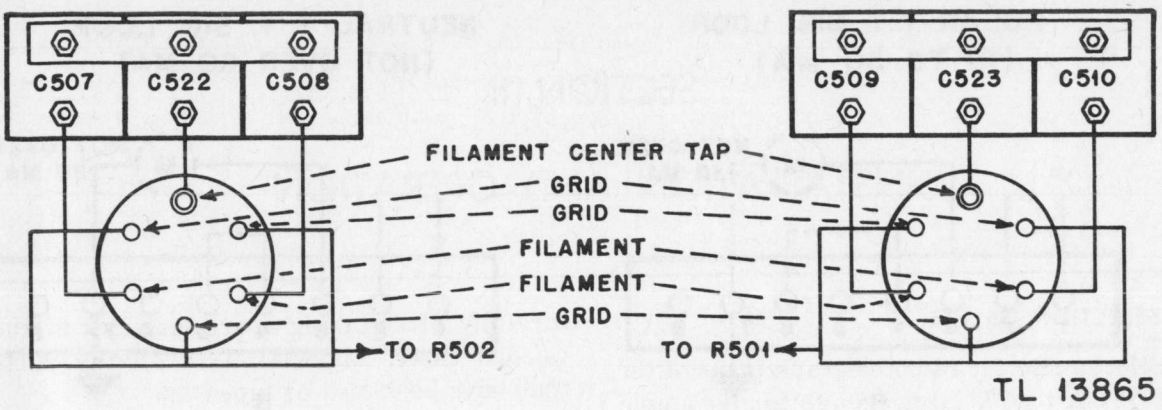

Figure 19. Power-amplifier tube connections.

d. The external frequency shifter coaxial cable lead-in and the excitation control cable are fastened to their proper terminals on the shifter chassis. Connect the two Jones plugs into their proper receptacles located on the right-hand side of the oven and shifter chassis. Insert the proper tubes in all chassis before attempting to place them into position. Shipping case No. 6 contains a complete set of operating tubes. Refer to paragraph 4*b* for tube complement line-up of the transmitter.

e. Insert the multiplier. Before sliding it into space, connect the chassis interconnecting plugs (with cables pointing up). When this is done, bring the chassis into position and secure the thumbscrews on each end of the panel. The procedure for inserting the intermediate-power-amplifier chassis is identical to that used in inserting the multiplier chassis, except that four bolts are used to hold the chassis in place.

f. Thoroughly check all components in the transmitter to see whether they have become loose or damaged. Check all tuning capacitors to see that they have not been twisted out of position and that the plates are properly spaced. Make sure all dials are tight and that the zero settings correspond with the minimum capacity position of the associated tuning capacitor *with the exception of the shifter dials.*

g. The following connections complete the installation (fig. 20) :

CAUTION: Make certain circuit breaker S21 is in the OFF position.

Terminal No.	*Procedure*
13, 26	When the remote break-in line is connected, remove the connecting link between these two terminals. Later, complete control may be maintained from a remote point.
58, 59, 60	Connect the three-phase, 220-volt, a-c line as follows: Phase A to terminal No. 58 Phase B to terminal No. 59 Phase C to terminal No. 60
51	Connect the remote line for turning the transmitter on and off to this terminal.
52	Connect the remote line for keying the transmitter for c-w (continuous-wave) and teletype operation to this terminal.
51, 54	When remote operation is required, connect the remote lines for turning the transmitter on and off to these terminals. Since relay K1 is interconnected between these two terminals within the transmitter, a 6-volt d-c source must be connected in series with the remote on-off switch and the remote line in order to energize the relay. Under this condition, the link between

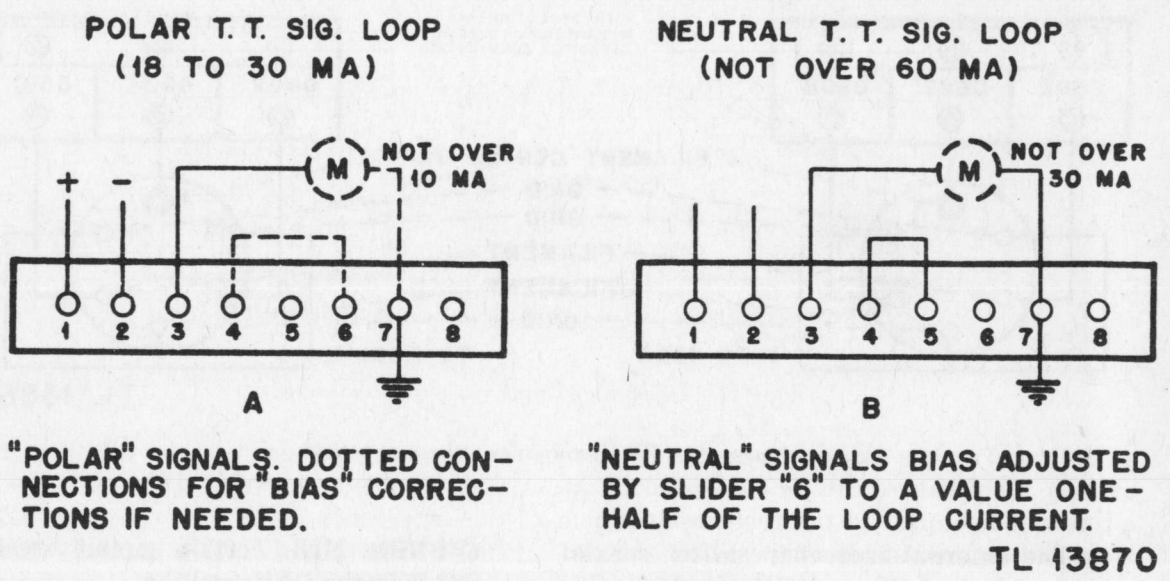

Figure 20. Remote control connections.

terminals 53 and 54 must be disconnected. If a single line and ground is to be used, connect the line to terminals 51, and connect the link between terminals 53 and 54.

12. PRELIMINARY TUNING ADJUSTMENTS.

CAUTION: When operating the transmitter at frequencies above 20 mc, be sure to remove parasitic resistors R501 and R502 located on the p-a tank assembly. Failure to do so will result in severe overheating of these resistors.

a. Before turning the transmitter on, the operator should be thoroughly familiar with all operating controls and the tuning procedure. To preset all tuning controls to their approximate settings for the desired operating frequency, refer to figure 22 and paragraph 38. Determine the proper shorting bars and selector switch settings from figures 51 and 52. The p-a tank connections are shown in figure 21.

b. For radioteletype operation, the fundamental frequency of the crystal is determined in the following manner. Divide the assigned carrier (mean transmitting) frequency by 2, 4 or 8, as shown in table A, to obtain a fundamental frequency within the normal range of the oscillator. 200 kc must then be deducted from the above result to compensate for the 200 kc beat oscillator.

EXAMPLE

Assume 11,500 kc = assigned frequency
11,500 kc ÷ 4 = 2,875 kc
2,875 kc — 200 kc = 2,675 kc
2,675 kc = crystal frequency

TABLE A

Band	Oscillator output frequency (mc)	Carrier frequency (mc)	Frequency multiplication
1	2.3 to 4.0	2.3 to 4.0	1
2	2.0 to 4.0	4.0 to 8.0	2
3	2.0 to 4.0	8.0 to 16.0	4
4	2.0 to 2.875	16.0 to 23.0	8

Note that the actual crystal frequency is 200 kc lower than the values shown in the table.

13. STARTING THE TRANSMITTER.

a. Insert the fuses in their receptacles on the contactor panel.

b. Open the bottom doors on the front of the transmitter and turn on the three circuit breakers located at the top of the terminal board.

c. Insert crystals of the proper frequency, as previously selected, in the crystal holders contained in the oven.

d. Allow sufficient time (about 2 hours) to permit the oven to attain its proper operating temperature which is approximately 50° C.,

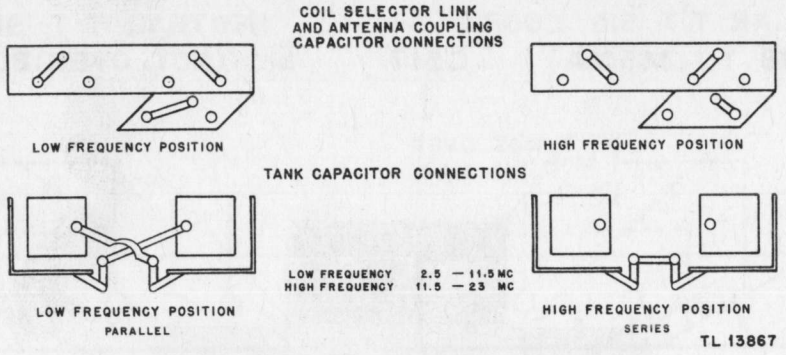

Figure 21. Antenna and tank capacitor connections.

as indicated on the dial thermometer. The operating temperature can be controlled by an adjustment coupled to the thermostat which is located on the outside of the oven.

e. Set the main RECT. FILAMENT and P.A. FILAMENT rheostats R1 & R2 to the extreme *clockwise* position.

f. Turn OFF BIAS-LOW PWR. switch S15, P.A. RECTIFIER supply switch S16, and P.A. FILAMENT switch S14.

g. Release the flags on all the overload relays. (The under voltage BIAS RELAY has no flag.)

h. Push the START button of the MASTER CONTROL to start the blower cooling system.

i. Inspect to see that all filaments with the exception of the power amplifier are on. If they have not come on, check the a-c circuit according to the schematic drawing to localize the cause.

j. Turn FREQ. SELECTOR switch S101 to the desired crystal and observe OSC PLATE meter M302. It should read approximately 1 to 1.5 ma (milliamperes), if oscillating.

k. Now turn the FREQ. SELECTOR switch to the left or right adjacent position (midway between numbers). The OSC. PLATE meter will show a reading of approximately 2.5 ma. If the meter indicates no change, oscillation is not taking place. In this event, a different crystal of the same frequency should be inserted in place of the one being used and the selector switch returned to this crystal position or another crystal position should be tried. If none is available, the emergency oscillator (position E.O. on the FREQ. SELECTOR control) must be used. When operating the E.O. position, the OSC. PLATE meter will indicate approximately 3.5 ma. A reading of approximately 5 ma indicates that the E.O. is not oscillating. The E.O. positions give readings from both triode tubes in the circuit. All the other positions give readings from only a single triode. The E.O. tuning capacitor is located inside the oscillator compartment just to the left of the crystal sockets.

l. Throw P.A. FILAMENT switch S14 on. (A green pilot light directly above the switch will come on.) P.A. FILAMENT voltage meter M2 will indicate approximately half scale. At this point, make a visual inspection to determine that the p-a filaments of the power amplifier tubes are lit.

m. Turn P.A. FILAMENTS rheostat R2 counterclockwise until the P.A. FILAMENT voltmeter reads exactly 16 volts.

n. Check to see that all doors are closed.

NOTE: Wait 30 seconds after completing the operation described in subparagraph *j* above before proceeding with the operation in subparagraph *o* below.

o. Throw on BIAS-LOW PWR. switch S15. (A green pilot light will come on when time delay relay K3 completes its cycle.) At this time, all bias supplies and the low-power supply will be on.

p. Set MULTI. SELECTOR switch S301 and the shifter control switches S201 and

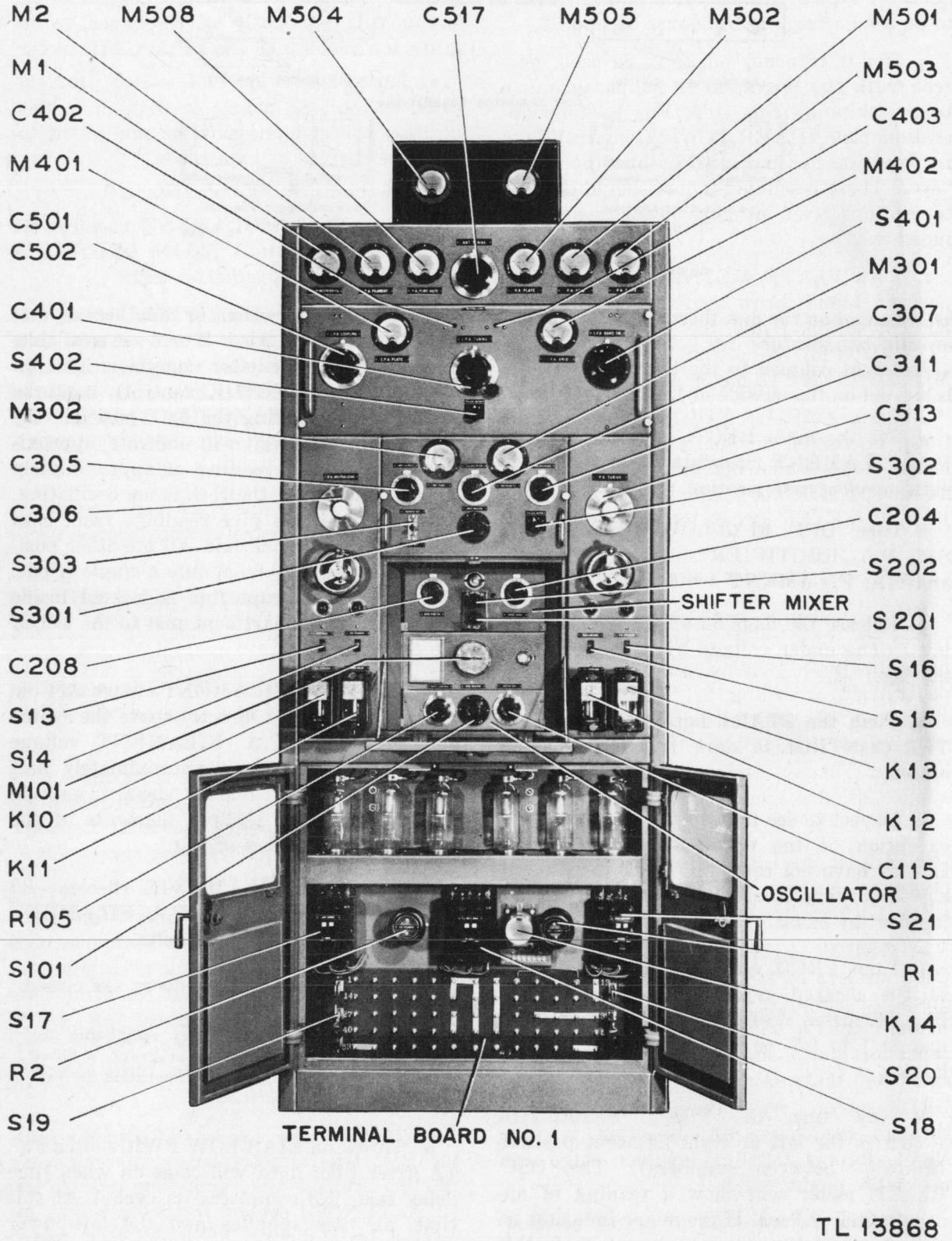

Figure 22. Radiotelegraph transmitter PW-981-A, front view.

S202 for type of transmission and frequency to be used according to figures 51 and 52.

q. If c-w transmission is to be used, proceed with the operation in subparagraph *r* below, skipping this step. For teletype operation, tune MIXER TUNING control C204 for resonance as indicated by opening of the "eye." These resonance points should be close to readings given in figure 50 for frequencies indicated.

r. Turn PLATE METER switch S302 to position 1 and throw switch S303 to TEST KEY position. Tune the KEYER-STAGE TUN. C208 for the maximum reading on the MULTIPLIER PL. meter M301.

s. Tune AMP.-1st MULT. capacitor C305 for a maximum dip on MULTIPLIER PL. meter M301. Following this operation, tune 2d and 3d MULTIPLIER, if used, changing PLATE METER switch for each tube.

14. NEUTRALIZING THE I-P-A STAGE.

The neutralizing circuit of the intermediate power amplifier is designed for wide band neutralization. If this stage is properly neutralized according to the following instructions, reneutralization will be unnecessary when shifting from one frequency to another. The p-a plate voltage need not be applied at any time when neutralizing this stage.

a. Adjust the I.P.A. TUNING control for maximum reaction as indicated by a dip on I.P.A. GRID meter M402.

b. NEUTRALIZING capacitors C402 and C403 are located at the top of the intermediate-power-amplifier panel and may be adjusted with a screwdriver. Adjust these capacitors for a minimum reaction as indicated by the minimum dip on the I.P.A. GRID meter. Rock the tuning capacitor through resonance until reaction is very slight. Retune the final doubler stage and neutralize again.

c. Throw switch S303 to center position. Close left knife switch S20 (up position) located on the terminal board. This connects the high-voltage supply to the i-p-a tube plates.

d. Set the AMP-1st MULT. control so the circuit will be slightly off resonance, to obtain a low reading on the I.P.A. GRID meter.

e. Turn PLATE METER switch S402 (located on the i-p-a panel) to position T. This position will give one half the sum of the total plate current of both tubes.

f. Set the I.P.A. COUPLING to 0.

g. Turn RECT. FILAMENT rheostat R1 counterclockwise until MAIN RECTIFIER FIL. voltmeter M1 indicates 220.

h. Throw P.A. RECTIFIER switch S16 to the on position. After 2 or 3 seconds, time delay relay K8 will close applying high voltage to the main rectifier plates, as indicated by the red pilot light lighting. The high voltage will be indicated on P.A. PLATE VOLTS meter M508.

CAUTION: Since there are high voltages at this point, be careful when proceeding with operations.

i. Throw switch S303 to TEST KEY and tune AMP.-1st MULT. until I.P.A. GRID meter indicates approximately 200 ma.

j. Tune the I.P.A. TUNING to a position that gives the greatest dip on the I.P.A. PLATE meter.

k. Increase excitation by retuning AMP.-1st MULT. to obtain a maximum indication on I.P.A. PLATE meter M401. At the same time, maintain resonance by adjusting I.P.A. TUNING for greatest dip.

l. Check for neutralization by rocking the I.P.A. TUNING dial through resonance, and noting whether maximum grid current on I.P.A. GRID meter occurs at the same time as minimum cathode current on I.P.A. PLATE meter. If it does not, readjust the NEUTRALIZING capacitors until complete neutralization is indicated.

m. Increase the I.P.A. COUPLING until the P.A. GRID meter reads approximately 200 ma and, at the same time, adjust the I.P.A. TUNING control for resonance as indicated by a dip on I.P.A. PLATE meter M401.

CAUTION: When adjusting the amount of drive to the p-a stage, do not drive

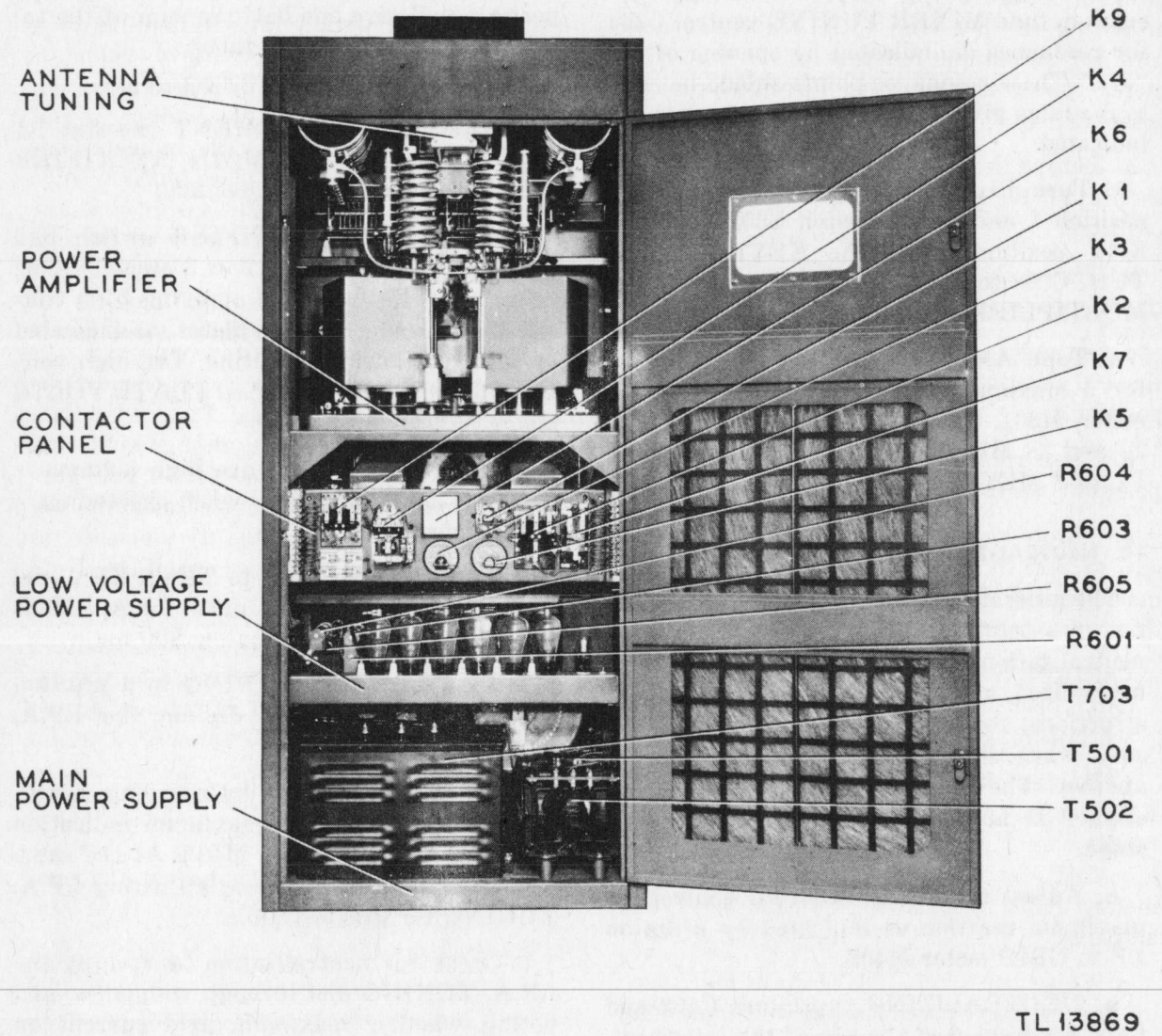

Figure 23. Radiotelegraph transmitter PW-981-A, rear view.

the grids of the p-a tubes in excess of 200 ma total.

15. TUNING THE POWER AMPLIFIER.

Before proceeding with the tuning of the power-amplifier stage, roughly neutralize by adjusting the p-a NEUTRALIZING capacitors for minimum reaction on P.A. GRID meter M501, as the P.A. TUNING dial is rotated.

a. Detune the AMP.-1st MULT. and throw the TEST KEY switch S303 to the neutral position.

b. Throw P.A. RECTIFIER switch S16 to the off position.

c. Set ANT. TUNING capacitor C517 to the 100 position. (This is the minimum load position.)

d. Close right-hand knife switch S19 (up position) on the terminal board.

e. Throw the P.A. RECTIFIER switch S16 on and wait 2 to 3 seconds for the automatic timing relay to close. After this brief delay, the high voltage will come on.

CAUTION: Never leave the test key in the down position longer than 2 to 3 seconds while tuning the power amplifier.

f. During the brief closing of the TEST KEY, adjust P.A. TUNING for minimum reading on P.A. PLATE meters and retune the AMP.-1st MULT. until the P.A. PLATE meters M502 and M503 indicate 0.4 to 0.6 amperes.

g. Close the TEST KEY again and touch up the tuning of each stage for maximum indication on the P.A. GRID meter.

h. The power amplifier is now ready for loading. The loading of this stage may be controlled by varying the ANT. TUNING dial. To *increase* the loading, decrease the dial indication. To *decrease* the loading, advance the dial to a higher indication. *Carefully* load the power amplifier to approximately 0.7 amperes while keeping the P.A. PLATE meters at a minimum by rocking the P.A. TUNING dial through resonance.

CAUTION: *DO NOT LEAVE KEY DOWN.*

i. Check the power amplifier for neutralization by rocking the P.A. TUNING dial through resonance, and note if *maximum* grid current occurs at the same time as *minimum* plate current. Slight deviation of this coincidence can be tolerated. However, if the p-a plate current fails to drop to zero when the TEST KEY is released, refer to paragraph 16 and carefully neutralize the power amplifier as indicated. Failure of the plate current to return to zero indicates oscillation which may take place on a wholly different frequency than the assigned channel. Also, keying the amplifier will be impossible.

16. NEUTRALIZING THE POWER AMPLIFIER.

Place normal loading on the power amplifier, and while rocking the P.A. TUNING control through resonance, note which side of resonance causes power-amplifier grid current to increase. Increase or decrease the p-a neutralizing capacitors directly opposite to that of the P.A. TUNING capacitors. Note the following examples:

a. If the power-amplifier tank capacitors cause the grid current to *increase* as the capacity is increased beyond resonance, adjust the P.A. NEUTRALIZING capacitors to *decrease* their capacity.

b. If the P.A. TUNING capacitors cause the power-amplifier grid current to increase with a *decrease* in capacity, adjust the neutralizing capacitors to *increase* their capacity.

c. At exact neutralization, maximum grid current and minimum plate current occur simultaneously as the P.A. TUNING capacitor is rocked through resonance.

17. TERMINAL BOARD CONNECTIONS FOR TELETYPE OPERATION.

a. Relay Circuit. The sending relay K14 is a polar type, that is, it operates one contact for one polarity of current and the other contact for the opposite direction of current. There are two windings, each having 3,200 turns and a resistance of approximately 135 ohms. Only the armature and one contact are used to control the reactance tube, causing it

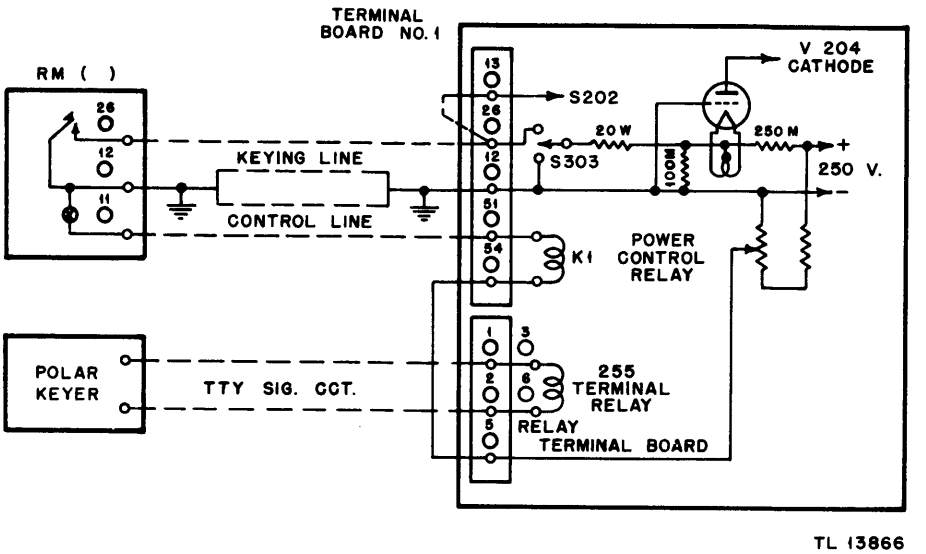

Figure 24. External relay connections.

to shift the frequency of the 200-kc oscillator (fig. 49). Referring to examples A and B, the teletype line is connected to terminals No. 1 and 2 as follows:

EXAMPLE A: Polar line (fig. 24). If the line is operated with polar signals and the current in the reversals is unequal, the signal is said to be biased. This inequality in current reversals (bias) may be corrected by a current of proper polarity equal to the unbalanced current in the line being placed through the bias winding of the relay. Connecting terminals No. 3 and 4 (the bias coil of the relay) to terminals No. 6 and 7 will connect the bias coil between ground and slider 5 on resistor R4. Adjustment of slider 5 on resistor R4 permits the proper amount of bias current to flow through the bias winding. The polarity is determined by connections from terminals No. 3 and 4 to 6 and 7; for one polarity, terminal No. 3 is connected to No. 7 and terminal No. 4 is connected to No. 6; for reverse polarity, terminal No. 3 is connected to No. 6, and No. 4 is connected to No. 7. A test tape consisting of RY's should be made and fed into the unit. With the test tape transmitting, the polarity of the connections between terminals No. 3 and 4 to No. 6 and 7 and the slider 5 are adjusted so that the receiving station reports a zero-bias condition on the transmitted signal.

EXAMPLE B: Neutral line (fig. 24). If the line is operated by neutral signals, terminals No. 3 and 4 are connected to No. 7 and 5 respectively, and the current in this circuit is adjusted to a value one-half that of the line current. If the signal is reported biased, adjust slider 6 until zero-bias is obtained.

b. External Relay or Keyer Control. When using an external relay or keyer circuit, remove the lead connecting terminal No. 7 on the relay terminal board and terminal No. 52 on terminal board No. 1. Connect the external keyer circuit to terminal No. 52. The transmitter may now be used for telegraph or teletype operation depending on the position of switch S202 on the shifter panel.

(1) The mark and space signals as sent by the loop are the same signals that exist on corresponding mark and space positions of S202. If the loop signals are reversed, reverse the loop connections on terminals No. 1 and 2.

(2) Polarity indicated on line terminals No. 1 and 2 is for mark signal.

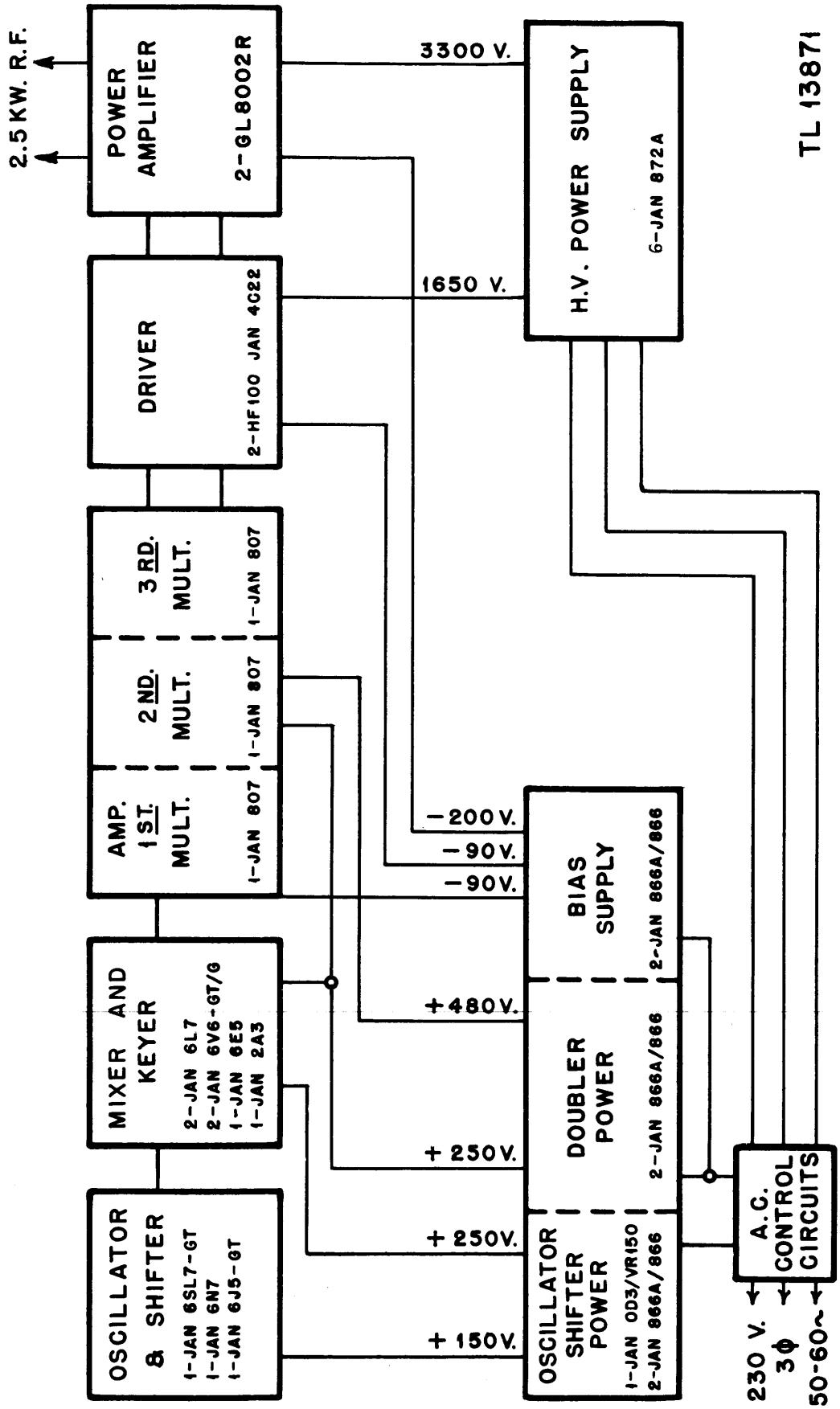

Figure 25. Radiotelegraph transmitter PW-981-A, block diagram.

SECTION III

FUNCTIONING OF PARTS

NOTE: Refer to figure 49 for the functioning of the following parts.

18. TRANSMITTER UNITS.

a. Radiotelegraph transmitter PW-981-A may be divided in eight fundamental units.

(1) Crystal oscillator and emergency oscillator.
(2) Buffer amplifier.
(3) Frequency shifter and mixer amplifier.
(4) Keyed stage.
(5) Frequency multiplier.
(6) Intermediate power amplifier.
(7) Power amplifier.
(8) Control circuits and power supply.

b. The block diagram (fig. 25) shows the electrical arrangement of the transmitter stages. The r-f oscillations generated in the oscillator pass through the buffer amplifier to the mixer. The r-f oscillations from the frequency shifter oscillator, when in use, are also fed into the mixer amplifier. The circuit continues through the keyed stage, frequency multipliers, i-p-a and p-a stages to the antenna network and transmission lines. The output circuits are designed to work into a 600- to 1000-ohm impedance transmission line.

c. The required power for operation of the transmitter is provided by four power supplies. Three single-phase, full-wave, choke-input power supplies provide the operating power for the oscillator, mixer, keyed stage, and frequency multipliers. A three-phase full-wave power supply provides the power for the intermediate and final power amplifiers.

19. CRYSTAL OSCILLATOR AND EMERGENCY OSCILLATOR.

The crystal controlled oscillator used in the transmitter is the Pierce oscillator circuit shown in the schematic diagram (fig. 26). This oscillator provides the source of the r-f oscillation to be amplified through the succeeding stages of the transmitter.

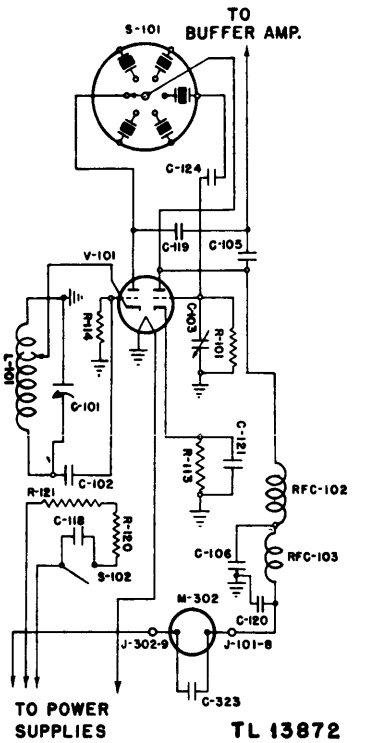

Figure 26. Crystal oscillator and emergency oscillator, schematic.

a. Crystal selector switch S101 makes it possible to select any one of five crystals for the oscillator circuit or the emergency oscillator. Twin triode Tube JAN-6SL7-GT (V101) is used in the oscillator circuit. One half of this twin triode combination functions in the Pierce crystal oscillator; the other half of the triode functions as the emergency oscillator circuit. In the Pierce oscillator circuit, an increase in the capacitance of C103 decreases the circuit reactance and results in decreased output and decreased crystal current and a slight reduction in the crystal frequency. The capacitance of capacitor C103 is set to the

correct value at the factory for crystals of normal activity appropriate to the transmitter.

b. To maintain frequency stability and prevent damage to the crystal, the plate voltage is adjusted to 150 volts and maintained constant by voltage regulator V601 in the oscillator plate supply. The grid bias on the oscillator tube controls the crystal current. This bias is obtained by means of grid leak resistor R101 and cathode bias resistor R113. To sustain oscillation, the plate circuit must have a capacitive reactance. This condition is attained by means of plate inductor RFC205 (fig. 27), whose resonant frequency is below the crystal frequency when it is parallel with the cathode to plate capacity of the oscillator tube.

c. The oscillator tube functions because of its ability to amplify in its plate circuit the voltage impressed upon its grid. A small portion of the r-f voltage in the plate circuit, properly phased, is fed back through the crystal and crystal coupling capacitor C124 into the grid, thus sustaining oscillation by supplying power to overcome the grid circuit losses. The crystal acts as the grid tank circuit, and the circuit oscillates only at the crystal frequency when normally adjusted.

d. Plate inductor RFC102 offers a high r-f impedance so that an r-f voltage is developed across the coil. This inductor together with the plate to cathode capacity of the tube, cathode bypass capacitor C121, and the plate to cathode bypass capacitor C106, form an r-f tank circuit. The r-f voltage developed across RFC102, is fed into the buffer amplifier stage through C105 and C221. The power fed back to the crystal from the plate circuit must be sufficient to sustain oscillation.

e. A direct-current path can be traced from plate supply bleeder resistor R601, through oscillator plate current meter M302 (supplied with bypass capacitor C323 to protect the meter from any parasitic r-f current), then through the plate circuit choke RFC103 (functioning with associated capacitors C120 and C106 to keep r-f current out of the plate supply), and through RFC102 to the oscillator section plate. Filament transformer T610 provides the power for the oscillator tube filament.

f. For emergency operation when crystals are not available, the crystal selector switch may be turned to the E.O. position. Plate current is thus provided to both plates of the twin triode tube since this switching arrangement connects the tube plates in parallel. The crystal oscillator will not function, because no crystal is connected in its circuit. The Hartley oscillator will now function as an emergency r-f oscillator for the transmitter. The grid tank circuit consists of inductor L101 and capacitor C101. By adjustment of this tank capacitor, the oscillator can be tuned to any frequency between 1.8 and 4 mc. The cathode is connected to the inductor at a point above ground potential. Capacitor C102 couples the tank circuit to the grid, and resistor R114 serves as the bias resistor. The r-f output is fed through coupling capacitor C119 in parallel with capacitor C105, and the r-f voltage developed across RFC102, is fed through coupling capacitor C221 to the buffer amplifier.

g. The entire oscillator unit is placed within the constant temperature oven to maintain good frequency stability. The temperature is controlled by thermostat D1 which is provided with the protective capacitor C118. Resistors R120 and R121 which are controlled by the thermostat, are connected in series across the single phase of the 220-volt, 3-phase supply, and the circuit is provided with the protective fuses F1 and F2. Oven temperature is indicated by dial thermometer M101 visible from the front through a glass window.

20. BUFFER AMPLIFIER.

In order to maintain the stability of the crystal oscillator frequency, an untuned class A buffer amplifier stage shown in the schematic diagram (fig. 27) is used between the oscillator and the succeeding stages. The buffer stage prevents variation in the plate loads caused by the interruption of the keyed stage plate current flow or adjustment of succeeding stages from affecting the plate load on the oscillator. The buffer amplifier is an extremely low-gain amplifier and at cer-

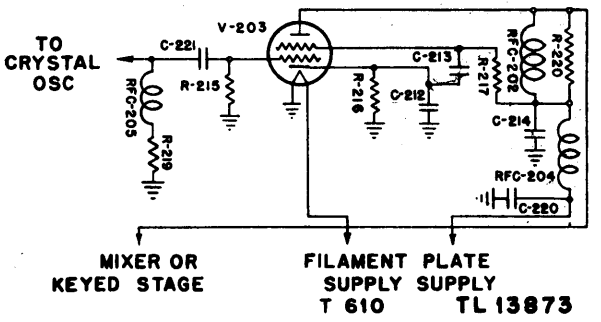

Figure 27. Buffer amplifier, schematic.

tain frequencies, may even operate at a loss.

a. This stage uses a beam tetrode Tube JAN-6V6GT and, as the circuit components are properly shielded, neutralization is unnecessary. The filament voltage is obtained from filament transformer T610. The input voltage from the oscillator stage is fed through grid coupling capacitor C221, and is developed between the grid and cathode through grid resistor R215. Because of the proximity of their cables within the transmitter, a filter consisting of RFC205 and R219, is placed in the grid lead to filter out any stray radio frequency from the 200-kc colpitts oscillator circuits. The plate r-f path is completed through plate inductor RFC202 and plate bypass capacitor C214 to ground, then through cathode bypass capacitor C212 to the cathode completing the circuit. Another filter combination RFC204 and capacitor C220 is provided for low-frequency filtering in the plate circuit. The buffer-plate shunt resistor R220 is placed across the plate inductor to maintain a flat response in the stage.

b. The screen grid of the tube is maintained at ground r-f potential, by means of screen-grid bypass C213, which couples the screen grid to the cathode. The screen-grid voltage is obtained from the d-c plate supply through the screen-grid resistor R217. A d-c plate current path may be traced from oscillator-buffer plate-supply bleeder resistor R601 to the plate, then through the tube and through cathode bias resistor R216 to ground, completing the circuit. The grid bias for the operation of the tube is obtained through biasing resistor R216. The r-f output is fed from the buffer amplifier to shifter isolation switch S201A. By means of this switch, the output may be fed into either the mixer tubes for the frequency shifter (position 1 on switch 201A and 201B) or into the keyed stage (position 2 on switch 201A and 201B). This buffer-amplifier stage requires no adjustments as it is an untuned amplifier.

21. FREQUENCY SHIFTER.

The frequency shifter unit consists of a 200-kc push-pull combination colpitts and negative-resistance oscillator V102 and its associated circuit, reactance tube V103 and its associated circuit, mixer tubes V201 and V202 and their associated circuit, and resonance indicator V206.

a. The 200-kc push-pull combination colpitts and negative-resistance oscillator shown in figure 28, uses a twin triode Tube JAN-6N7. The filament voltage for the operation of the tube is obtained from filament transformer, T610. A direct-current path may be traced from oscillator-buffer plate-supply bleeder resistor R601, to voltage regulator tube V601, through switch S103 and choke RFC101, to the oscillator plate tank circuit and the tube to ground completing the circuit. The plate tank circuit consists of the two main plate tank capacitors C112 and C113 which are provided with padder capacitor C108, and also variable capacitor C115 which enables the operator to make small adjustments in the oscillator frequency range. The reactance tube is also coupled in this tank circuit and presents a variable capacitive reactance to the circuit thus providing a means for varying the output frequency of this oscillator circuit. Plate tank inductor L103 placed in parallel with the capacitors completes the resonant circuit. Capacitors C110 and C111 are provided to complete an r-f feedback path from the plate to the grid circuits. These feedback r-f voltages are developed between grid and cathode across the two grid resistors R108 and R109. The r-f output of this 200-kc oscillator is fed through coupling capacitors C116 and C117 to the injector grids of mixer tubes V201 and V202. The resistor combination R213 and R214 acts as the injector grid resistors and together

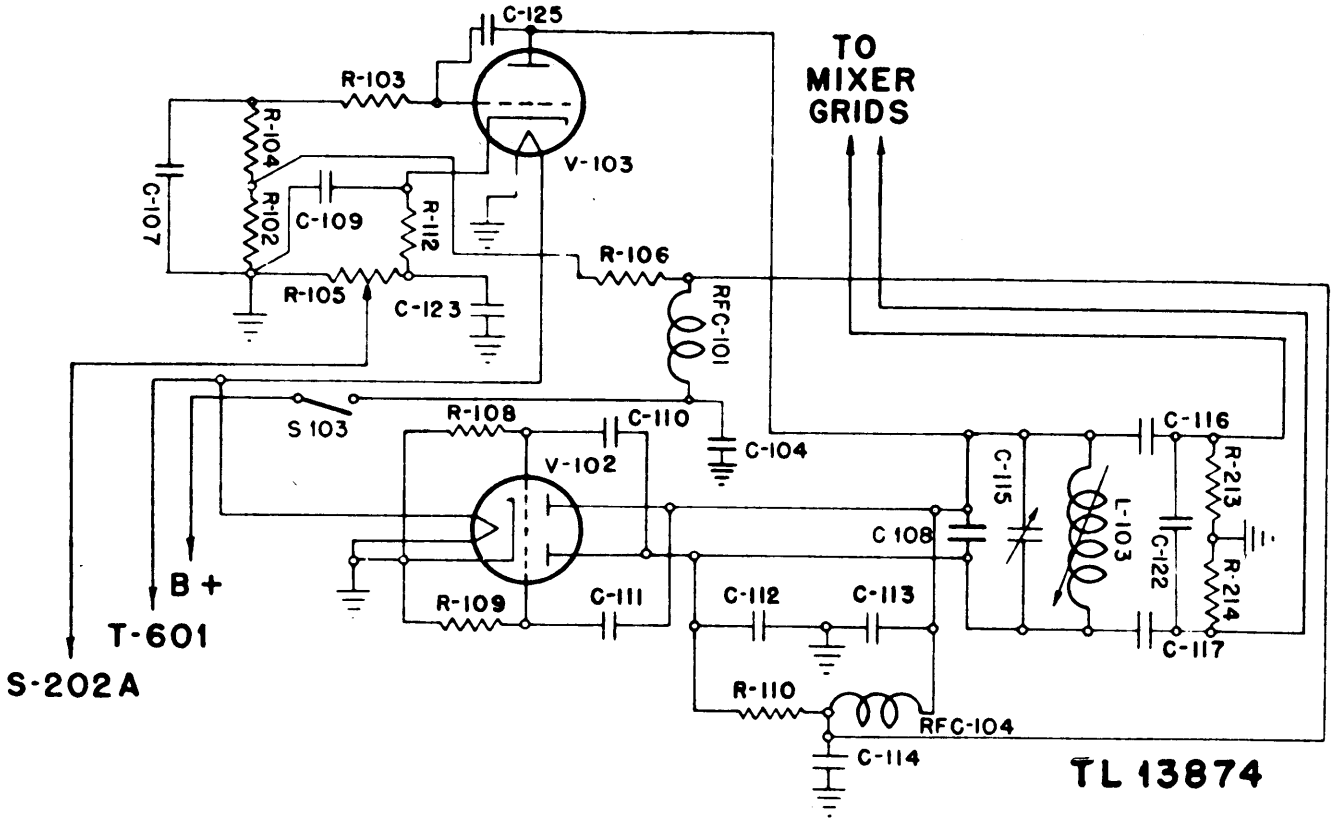

Figure 28. Reactance tube and 200-kc oscillator, schematic.

with capacitor C112 comprise a fixed load for the oscillator output.

b. Reactance tube V103 is a triode Tube JAN-6J5GT/G and acts as a variable capacitive reactance in the 200-kc oscillator-plate tank circuit. By varying the cathode bias voltage, the mutual conductance of the reactance tube is varied and the tube presents a variable capacitive reactance to the 200-kc oscillator tank circuit. As the grid bias increases with respect to cathode, the capacitive reactance presented decreases and the frequency of the oscillator goes lower. In a like manner, as the bias voltage decreases, the capacitive reactance presented to the tank increases and the oscillator frequency increases. In this manner, the reactance tube provides a controlled method for varying the output frequency of the push-pull oscillator. In the reactance tube circuit, the filament voltage is provided by filament transformer T610. The direct-current path can be traced from the oscillator-plate tank circuit through the tube and cathode resistor R112 to R105. Potentiometer R105 is the frequency shift control. When polar relay K14 closes, all or part of this resistance can be effectively shorted out, changing the reactance tube bias and thereby shifting the frequency.

c. Keying relay K14 is a polar type, that is, it closes to one contact for one polarity of current through a winding, and to the other contact for current in the other direction. When a positive voltage is on the line, the polar relay is energized in one direction, causing it to shift to the space position. This shorts all or part of R105 to ground. At the next instant, the relay is energized in the opposite direction by a negative voltage, shifting to the mark position and removing the short to ground from R105. Frequency control C115 is adjusted so that the actual operating frequencies for radioteletype are 425 cycles higher than the assigned frequency for mark signal, and R105 is adjusted to make the frequency 425 cycles lower for space signal. The frequency control on the oven panel permits variation of the 200-kc oscillator output frequency by ± 1 kc so that the tolerance of the crystal need only be held within this 1-kc range. The potentiometer in this manner controls the action of the reactance tube in its

association with the polar relay and also controls the extent of frequency shift that occurs. A maximum frequency shift of approximately 1,000 cycles may be obtained. A representative shift curve is shown in figure 53.

d. Capacitor C109 functions as an r-f bypass around the cathode bias resistor and the frequency shift potentiometer. A bypass capacitor to ground is also provided between the fixed bias resistor and the potentiometer. The static bias voltage is secured from the 150-volt plate supply through dropping resistors R106 and R102 to ground. This grid voltage is fed through resistors R104 and R103 which function in part as the grid isolating resistors to the reactance tube grid. The time constant network C107, R102, and R104, provides a means of controlling the shape of the keyed signal. Coupling capacitor C125 is provided as a path for an r-f voltage which produces a 90° phase shift from plate to grid. Thus, the tube presents to the oscillator more nearly a pure capacitive reactance. When the 200-kc oscillator is not in use, provision is made to remove the plate voltage from the V102 and V103. When C115 is turned back to zero setting, switch S103 opens the plate supply circuit. The operation of the frequency shifter circuits and the keyed stage which follows is controlled with the S202A-S202B. For c-w telegraph operation using the keyed stage, these switches are turned to position 1 and the plate voltage is removed from the 200-kc oscillator. The keyer tube bias is shorted out, and the stage functions as a class C amplifier only during this period. During this time S201A-S201B is turned to position 2. Positions 2 and 3 on this switch are provided for tuning purposes. When switch S202A-S202B is in position 2, the frequency shifter is in the SPACE position; in position 3, the frequency shifter is in the MARK position. When turned to position 4, the frequency shifter is connected to external relay K14 for shifter operation. The keyer tube bias is shorted out by switch S202B and the keyed stage functions as a class C amplifier in the transmitter except when used as a keyed stage.

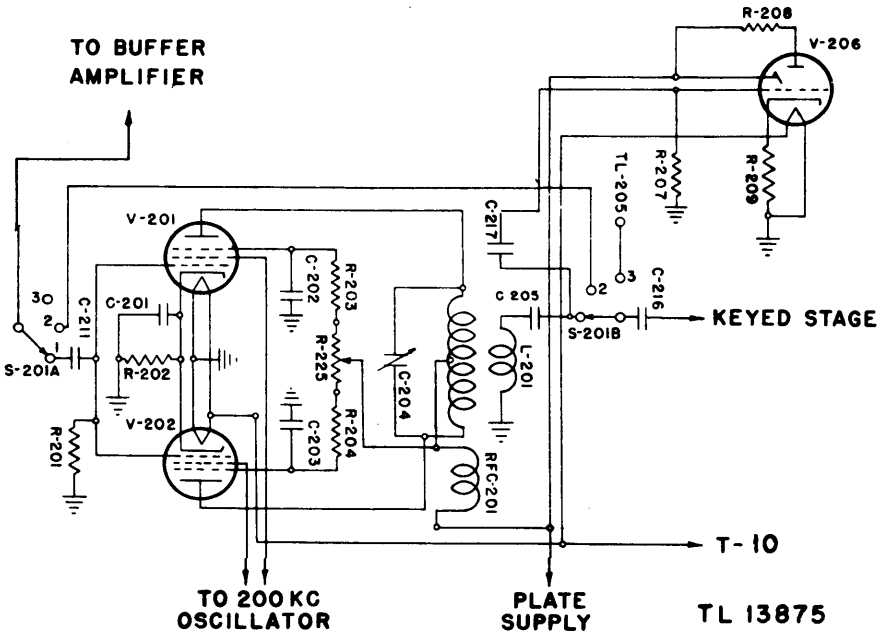

Figure 29. Mixer amplifier, schematic.

22. MIXER AMPLIFIER.

The mixer-amplifier stage (fig. 29) is provided to combine the output of the crystal oscillator and the 200-kc oscillator. The amplifier uses a pair of pentagrid mixer amplifier Tubes JAN-6L7 arranged in a push-pull circuit.

a. The filament voltage for these tubes is obtained from filament transformer T610. The d-c plate current path can be traced from oscillator-buffer power-supply bleeder resistor R601 through the choke RFC201, to the

center tap of tank inductor L201 to the tube plates. From the cathodes, the path continues through the common cathode bias resistor R202 to ground, completing the circuit. The voltages for the screen grids which completely shield the injection grids in the tubes, are secured from the same source through potentiometer R225 and screen-grid resistors R203 and R204. By means of this mixer screen balancing potentiometer, mixer screen grid voltage balance can be obtained and the crystal oscillator frequency is effectively cancelled out in the amplifier. The screen grids are maintained at ground r-f potentials by means of screen grid bypass capacitors C202 and C203. The grid bias for the two mixer tubes is secured from cathode bias resistor R202, and capacitor C201 functions as the cathode bypass capacitor.

b. The crystal-oscillator r-f output from the buffer amplifier is fed through switch S201A (position 1) and coupling capacitor C211 to the parallel control grids of the mixer amplifier. The input voltage is developed across grid resistor R201. The output of the low-frequency oscillator is fed to the injection grids of the mixer tubes. In the plate circuit of the mixer which is connected for push-pull operation, four major frequencies are present: the crystal frequency, the 200-kc oscillator frequency, a side-band frequency 200 kc lower than the crystal frequency, and a side-band frequency 200 kc higher than the crystal frequency.

c. The crystal frequency is of minor magnitude because it is fed into the mixer grids in parallel and effectively cancelled out in the balanced push-pull circuit when R225 is properly adjusted. The 200-kc oscillator frequency is not apparent because the plate tank is tuned to a much higher frequency. The two remaining frequencies are the higher and lower side-band frequencies. These are 400 kc apart and can be separated in the plate tank circuit of the mixer amplifier with the use of the dial readings for standardization. High-frequency side bands of the mixer are always selected to deliver the final output frequency. This requires that the crystal frequency be 200 kc lower than the final output frequency of the transmitter. The 200-kc oscillator frequency is adjusted so that the actual operating frequency for radioteletype will be 425 cycles higher than the assigned frequency for a mark signal, and R105 is adjusted to shift the frequency 425 cycles below the assigned frequency for a space signal. The frequency control on the front panel permits variation of these frequencies. The output voltage developed across the plate tank inductor is picked off through a secondary winding and fed through coupling capacitors C205 and S201B (position 1) to the keyed stage.

d. The resonance indicator is provided to aid in tuning and adjusting the mixer amplifier. The resonance indicator V206 is an electron-ray Tube JAN-6E5. The filament power is obtained from T610. The plate and target voltage is obtained from the mixer plate supply. R208 is the resonance indicator plate resistor. The voltage drop across R209 provides the static bias for the tube. The voltage developed across L201, the mixer tank indicator, is fed through C217 to the grid resistor R207. Resonance in the mixer is indicated by maximum spread on the indicator screen. This provides a means of adjusting screen balancing potentiometer R225 so that the crystal oscillator can be balanced out, and the mixer tank circuit tuned to the high frequency side band.

23. KEYED STAGE.

To transmit radiotelegraph signals, a means must be provided to intermittently start and stop the radio-frequency power being fed into the antenna system as the telegraph key or relay is closed and opened. This is accomplished in the c-w telegraph transmitter by means of a low-power r-f stage, keyed in the cathode circuit by a keyer tube.

a. The keyed stage shown in figure 30 is a tuned r-f amplifier operated as a class C. The stage functions to interrupt the r-f excitation fed into the first frequency multiplier. In placing the keyed stage at this point in the transmitter, a lower power level is keyed, and the succeeding stages operate only when the key is closed. The r-f voltage is fed to the grid of keyed stage tube V204 through mixer amplifier coupling capacitor C216 and keyer grid parasitic resistor R206. The input volt-

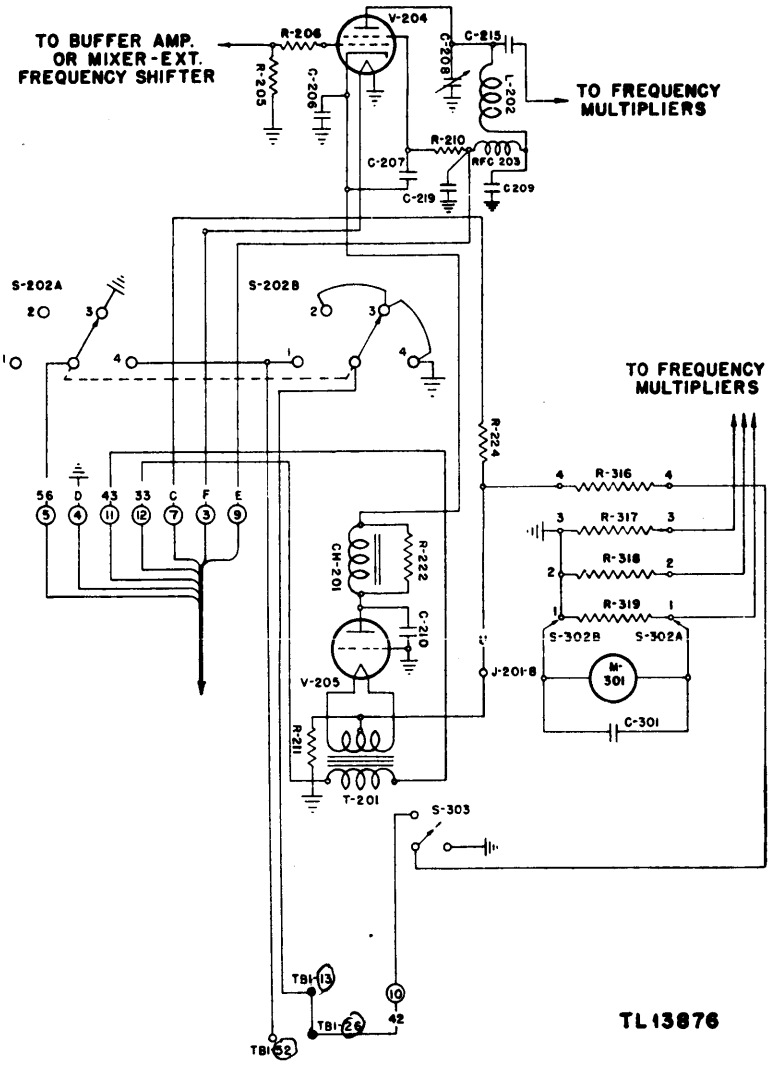

Figure 30. Keyed stage and keyer tube, schematic.

age is developed between grid and cathode across the grid leak resistor R205. By means of shifter isolation switch gang 201B (position 2), the output of the buffer amplifier may be coupled directly into the keyed stage thus isolating the frequency shifter circuits. When switch 201B is moved to position 3, an external frequency shifter can be connected into the transmitter. Whenever frequency shifter circuits are in use (position 1, S201B), the keyed stage functions as a straight class C amplifier since no keying of the shifter signal occurs.

b. The keyed stage uses a Tube JAN-6V6GT. The filament power is supplied from T610. The d-c plate current path can be traced from a tap on the keyed-stage plate-supply bleeder resistor R603 through RFC203, L202 to the tube plate. From the cathode, the circuit continues through keyer filter CH201-R222 to the plate of keyer tube V205. From the cathode, the path passes from filament transformer T201 secondary center tap through keyer bias resistor R211 to ground, completing the circuit. When the circuit is completed through R211, the current is controlled by the cut-off bias developed across keyer-tube bias resistor R211 which limits the current flow in the tube. The contacts of the telegraph key or relay are connected across this bias resistor thus shorting out the resistor and allowing plate current to flow when the relay closes or the key is

pressed. To keep the current flow through the keyer tube to a minimum value during the key-up intervals, a positive potential from the mixer plate circuit is fed through resistor R224 to the cathode. Thus the cathode during this period is at approximately the same position as the plate. When the key is closed, this voltage is removed to ground. However, resistor R224 has a high value, and the current flow through it is very small.

c. When the circuit is keyed, the circuit through resistor R316 is completed to ground removing the bias from V205. This resistance is provided to shunt the keyed stage cathode meter M301 which is inserted by means of switch S302A-S302B (position 4). A test-key switch S303 is provided for keying the transmitter during the tuning procedure. This switch can be closed to ground for tuning or for inserting switch S202A-S202B into the circuit while transmitting. Key clicks are prevented by the key click filter consisting of iron core inductor CH201 and resistor R222 connected in series with the keyer plate and capacitor C210 from the keyer plate to ground. The screen-grid voltage is obtained from the plate supply through screen grid resistor R210 and the screen grid is maintained at ground r-f potential by means of the screen bypass capacitor C207. The filter combination RFC203, C209, and C219 is placed in the plate circuit to prevent undesirable oscillations. The r-f output voltage developed across plate tank circuit C208 and L202 is fed through the coupling capacitor C215 to the frequency multiplier amplifiers.

24. FREQUENCY MULTIPLIERS.

a. The frequency multiplier stages V301, V302, and V303, shown in figure 31, are similar in design and function. These multipliers are used to increase the frequency of the transmitter to the required high value while using crystals in a lower range. The first multiplier is provided with two separate tank coils so that under certain conditions of operation, the first multiplier becomes a straight nonmultiplying class C amplifier. The frequency multiplier tank coil is normally tuned to amplify not the fundamental frequency fed into its grid but the second harmonic of the input signal frequency. To maintain efficiency, a frequency multiplier requires more bias and greater input excitation than a straight class C amplifier. By means of the frequency selector switch S301 which is a three-gang, four-position band-change switch, it is possible to use the first multiplier stage as a straight class C amplifier (position 1), or to select 1, 2, or 3 frequency multiplier stages (positions 2, 3, and 4). Note that the second and third doublers are driven from only one end of the tank coil, since each stage is a single tube. When a multiplier drives the intermediate power amplifier, however, the excitation from both halves of the multiplier tank coil is used.

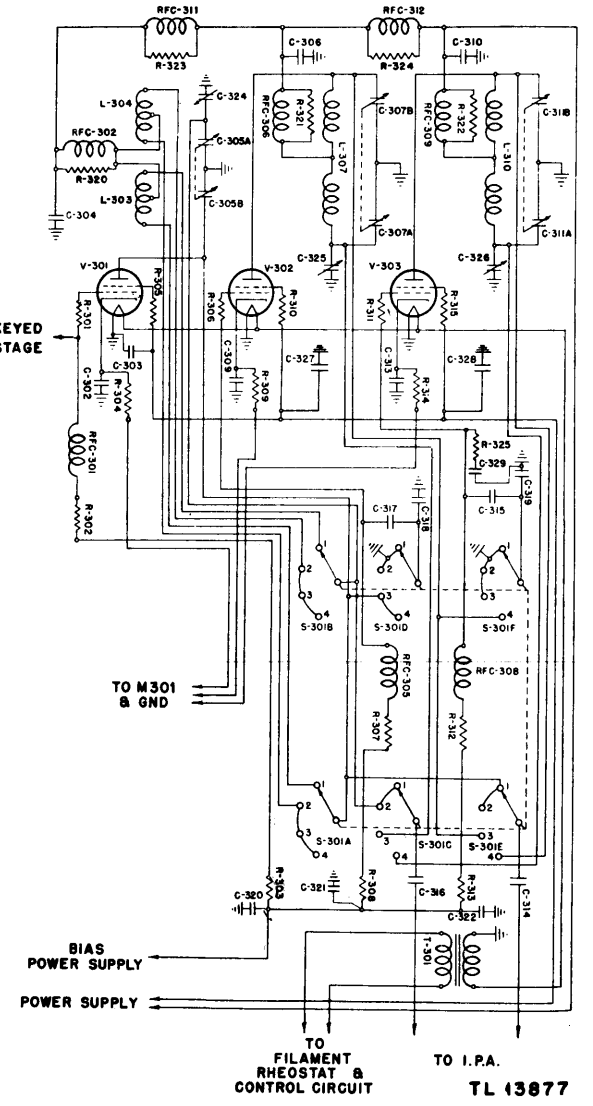

Figure 31. Frequency multipliers, schematic.

b. The first frequency multiplier uses beam tetrode Tube JAN-807 (V301). The filament voltage for this and all the multiplier amplifier tubes is obtained from filament transformer T610. A d-c plate current path can be traced from R603, the bleeder resistor for the frequency-multiplier power supply, through the choke and resistor combination RFC312-R324, RFC311-R323 (provided to remove any parasitic radio frequency from the plate supply), and through first doubler-plate filter choke RFC302 to the center tap of the plate inductor L303 or L304, depending upon the use of the amplifier. From the tank inductor, the path continues to the tube plate, cathode bias resistor R304, and through the plate grid meter shunt R317 to ground, completing the circuit.

c. By use of switch S302, the cathode meter may be inserted to measure the tube current of any of the three frequency multipliers or the keyed stage amplifier. The screen-grid voltage for all multiplier stages is obtained from R603. Resistor R305 is placed in the screen-grid circuit for the suppression of parasitic oscillations. C303 functions as the screen-grid bypass capacitor. The bias on the grid is a combination of fixed and cathode bias. The fixed bias is obtained from a tap on R604, the bias-supply bleeder resistor. Resistors R301 and R302 are provided for the suppression of parasitic oscillations in the grid circuit. The input voltage from the keyed amplifier is fed through coupling capacitor C215 and is developed across grid choke RFC301 and grid suppressor R302. The grid bypass capacitor C320 completes the grid to cathode connection. By means of band-change switch S301 (position 1), inductor L303 is connected across the plate tank capacitor C305 and the first frequency multiplier functions as a class C r-f amplifier. When inductor L304 is connected across the tank capacitor (S301, position 2) the stage functions as a frequency doubler. Capacitor C324 is provided as plate tuning compensation. The output voltage is fed into the intermediate power amplifier through coupling capacitors C316 and C314 (S301, position 1 and 2), or into the second frequency multiplier through coupling capacitor C317 (S301, position 3 and 4).

d. The maximum frequency in the first and second frequency multipliers is twice the minimum frequency. However, in the case of the third multiplier, the maximum frequency is somewhat less than double the minimum frequency due to the lower L-C ratio of this tank circuit. The grid paths are very similar in each multiplier circuit and all of these stages work on the same principle. The physical dimensions of the tank units decrease progressively from the first to the third stage. With coil L304 in position, the first multiplier covers the frequency range from 4 to 8 megacycles; the second multiplier covers the range from 8 to 16 megacycles; and the third multiplier covers the range from 16 to 23 megacycles. Extensive precautions have been taken in these stages to suppress parasitic oscillations and to filter out undesirable r-f currents which might tend to cause unstable operation.

25. INTERMEDIATE POWER AMPLIFIER (fig. 32)

a. The intermediate power amplifier or driver, which is operated as a class C, cross-neutralized, push-pull circuit (see TM 11-455) provides the excitation for the final power amplifier. The balanced r-f input energy is fed into the amplifier through coupling capacitors C314 and C316 from the frequency multiplier stage in use. The input voltage is developed across grid inductors RFC401 - RFC402 and grid bias resistor R402 between the grids and cathodes. Grid bypass capacitor C401 completes the grid to cathode r-f connection. The plate r-f path can be traced from the tube plates into the plate tank circuit consisting of reverse wound inductors L405 and L406 and split stator capacitor C410. This tank circuit can be tuned over a range from 2.5 to 23 megacycles; the frequency to be used is selected by switch S401. This switch has six positions, and is connected so that it shorts out four unused portions of each tank coil. This is done for the purpose of maintaining the best L-C ratio for the transmission and also to eliminate any possibility of power loss due to reaction between used and unused sections of the tank coil. The r-f path continues from the plate tank through i-p-a

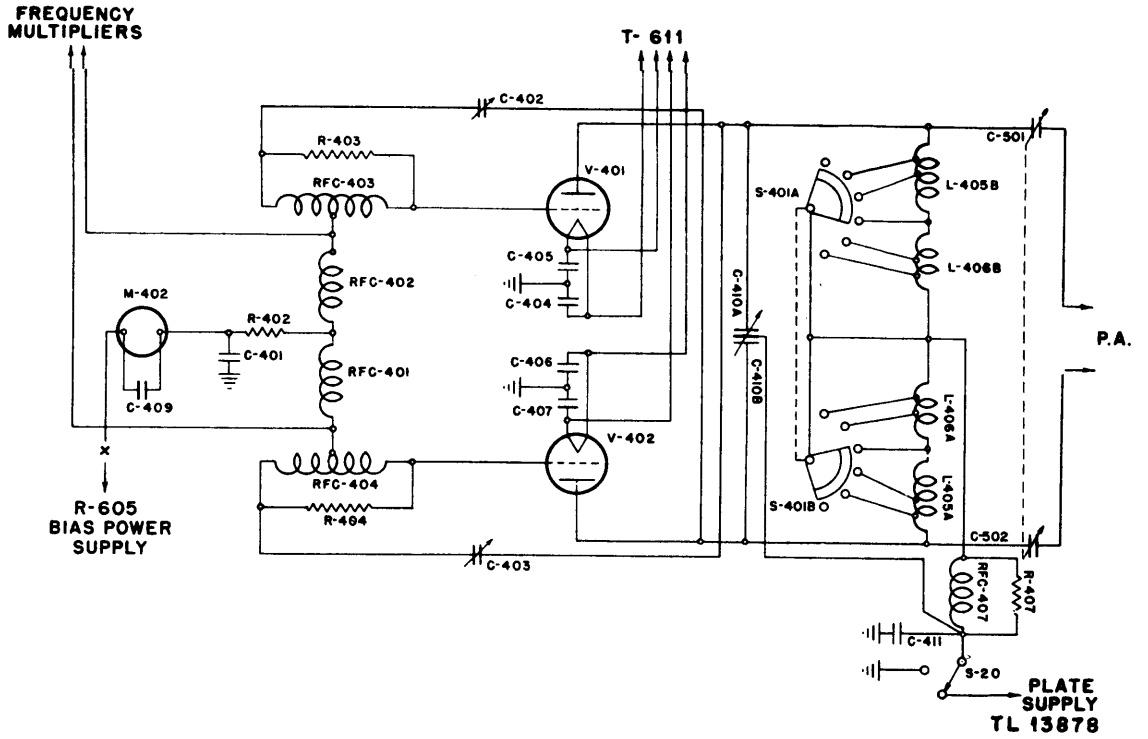

Figure 32. Intermediate power amplifier, schematic.

plate bypass capacitor C411 and through cathode bypass capacitors C404, C405, C406, and C407 completing the r-f circuit.

b. The r-f output is fed into the final power amplifier through the variable ganged coupling capacitors C501 and C502. As the output of the i-p-a stage is in excess of the power required to drive the p-a tubes, it is important that the drive of the intermediate power amplifier be kept below 200 ma. Failure to prevent current value in excess of this may shorten the life of the p-a tubes. The d-c plate current is supplied from a tap on R707 of the main power-supply bleeder resistor. The circuit can be traced from the power-supply bleeder through the plate. Disconnect switch S20 which is provided to enable the operator to remove the plate current from this single stage for purposes of neutralization and test. From here, the circuit passes through the plate parasitic oscillation suppressor RFC407-R407 to the plate tank inductor. From the tank inductor the circuit continues to tube V401, through filament transformer T611, secondary center tap, cathode bias resistor R406, cathode meter shunts R411 and R401 to ground, completing the circuit. The circuit through V402 is similar to the path from V401, it passes through the other filament transformer center tap, cathode bias resistor R405, and the cathode meter shunts R410 and R401 to ground. The i-p-a cathode meter insertion switch S402 makes it possible to measure either the plate current through V401 (position 3), the total i-p-a plate current from both tubes (position 2), or the plate current through V402 (position 1). M401 is provided with bypass capacitor C408 which presents a low impedance path around the meter for any r-f current, since the meter is designed to read direct current only.

c. The intermediate power amplifier using two HF100 tubes requires neutralization to prevent self-oscillation. This is accomplished by feeding r-f energy of the proper phase and amplitude to neutralize the r-f energy passing through the plate to grid capacitance of the tubes, through neutralizing capacitors C402 and C403, back from the plate to the grid circuit. The grid bias for the HF100 tubes is a combination of grid leak, fixed and cathode bias. The grid leak bias results from the voltage drop caused by the passage of the

rectified grid current through R402 which also functions as a parasitic oscillation suppressor. The fixed bias is secured from a tap on the bias power supply. It is fed through grid current meter M402 and R402 to the grid chokes. This fixed bias is sufficient to bias the tube beyond cut-off so that no current flows when there is no grid excitation. Bias is also secured from the voltage drop caused by the passage of the plate current through the cathode resistors and shunts. In the event of bias power-supply failure, these cathode resistors provide sufficient bias to prevent any damage to the amplifier tubes due to excessive plate current.

26. POWER AMPLIFIER.

a. The power amplifier shown in figure 33 is a straight, cross-neutralized, push-pull, r-f amplifier circuit, normally operated as class C. The input excitation power is fed from the intermediate power amplifier to the grids of the amplifier tubes, through variable coupling capacitors C501 and C502. This type of coupling permits adjustment for balance and regulation of the energy to the grids. The choke-resistor combinations RFC503-R502 and RFC502-R501 are inserted in the grid circuit for the suppression of parasitic oscillations. The input voltage is developed across grid inductors RFC501A and B, and grid bypass capacitor C503. The bias for the p-a tubes is obtained from bleeder resistor R605 of the bias power supply. The grid current is measured with grid-current meter M501 which is provided with bypass capacitor C504. In addition, cathode bias is secured through cathode resistors R505 and R506 connected in parallel in one cathode circuit, and resistors R507 and R508 connected in parallel in the other cathode circuit. The plate tank circuit consists of coils L504 or L505 and L506 or L507, and capacitors C513A and B.

b. To tune the power-amplifier tank circuit over the entire frequency range from 2.5 to 23 megacycles, a number of tank adjustments and changes must be made for each of several frequency ranges. In the tank circuit below 11.5 megacycles, inductors L505 and L506 are used with appropriate coil shorting bars for the various frequencies. At frequencies higher than 11.5 megacycles, L504 and L507 are used with their appropriate coil shorting bars. Changes in the tank coils are made with the connectors 0502 and 0503. The directions for making these connections are given in paragraph 12. In addition to the inductor adjustments, the tank capacitors may be connected either in parallel for low-frequency operation or in series for the higher frequency ranges. The power output is fed from the power amplifier into the antenna coupling network. The filament voltage for the power-amplifier tubes is secured from transformers T501 and T502. This voltage may be adjusted by voltage regulator rheostat R2, placed in the transformer primary circuit. The primary voltage is measured with voltmeter M2. A plate-current path may be traced from the bleeder resistor positive terminal of the main power-supply bleeder resistor R709 through disconnect switch S19 which is provided to enable the operator to remove the plate voltage from the power-amplifier stage for purposes of neutralization and test, through plate chokes RFC508 and RFC509, through the tank inductors in use, to the tube plates. From the cathodes, the circuit continues through the filament transformer center tap, through the cathode resistors, the d-c overload relays K12 and K13, and cathode current meters M502 and M503 to ground. Any flow of current in the p-a stage in excess of a preset value, will cause these relays to be energized, and the plate voltage will be removed from the stage. Thus, the amplifier components are protected from damage due to excessive overload currents.

c. The antenna coupling pi-network consists of two coupling coils RFC510 and RFC511 and antenna tuning capacitors C517A and B, C516, and C515, together with the power amplifier tank network. Shorting bars are used as required to vary the coil inductances of L504, L505, L506, and L507 to tune the network to the various frequencies. The network is tuned by adjusting the antenna tuning capacitors C517A and B in conjunction with plate tank capacitors 513A and B. Proper operating conditions will be indicated by a maximum r-f feeder current which is measure with antenna meters M504 and

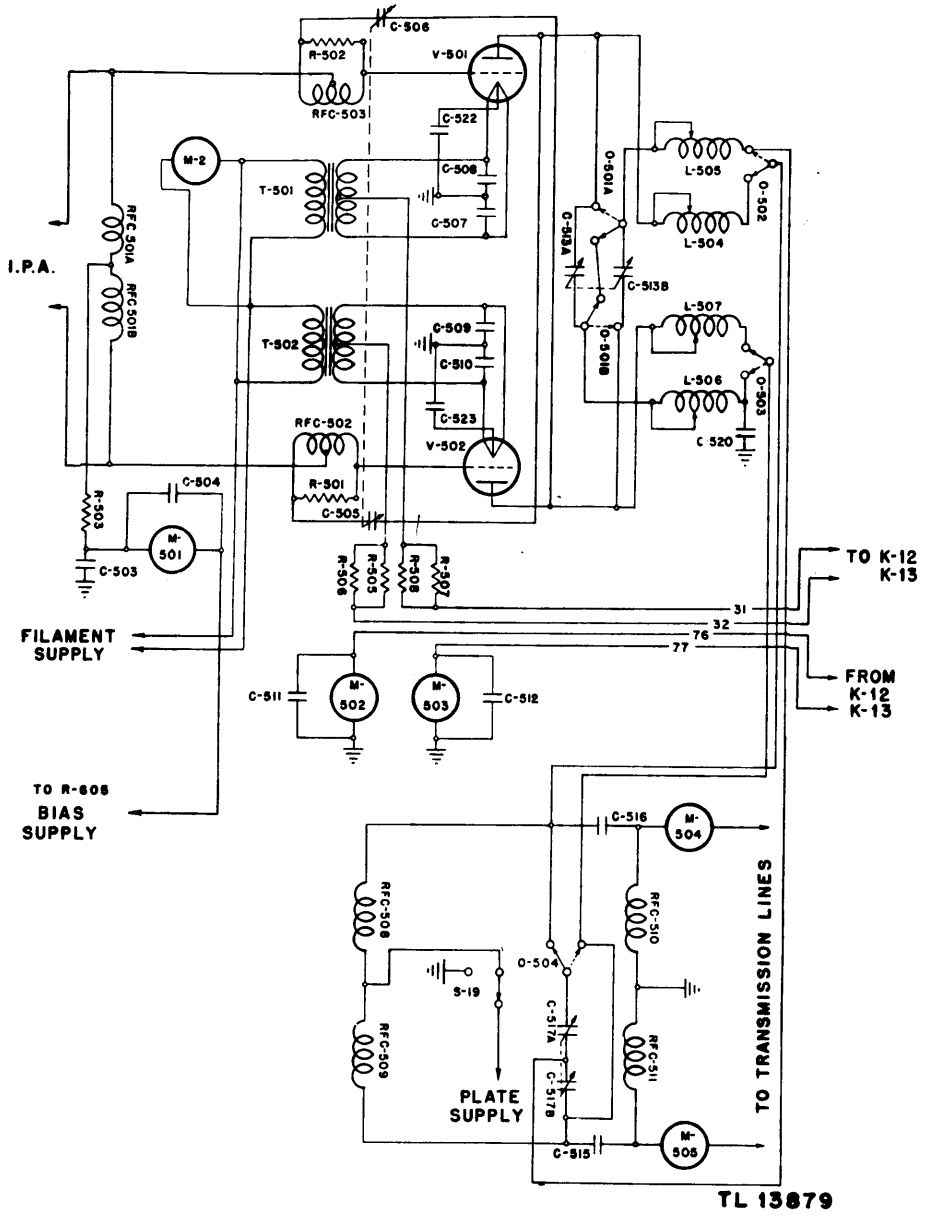

Figure 33. Power amplifier, schematic.

M505. The interaction between the coupling network and the tank circuit makes it necessary to retune the power amplifier as the network is adjusted. The antenna coupling unit is designed to work into open-wire transmission line with an impedance of approximately 600 ohms. These lines are untuned and known as nonresonant lines, and the characteristic impedance remains constant as the conductor size and spacing remains constant. The antenna network effects an impedance match between the plate circuit of the tubes and the transmission line.

27. CONTROL CIRCUIT.

The transmitter is provided with a control circuit to facilitate transmitter operation, and to protect the various components from current overloads and damage. The automatic features of the control circuit which include several time delay relays, makes it possible to control the transmitter after tuning from a remote point.

a. The three-phase, 220-volt supply line is connected to the transmitter through main circuit breaker S21. Main power supply transformer T703 is connected to the main power line through the main rectifier circuit breaker S18. The low-voltage power supplies and filament transformers are connected through circuit breaker S17. These circuit breakers protect the transmitter from overload damage. In addition to the circuit breakers, four overload relays K10, K11, K12, and K13 are provided for separate circuit protection.

b. The transmitter may be placed in operation locally by main starting switch S1. Remote control relay K1 is connected in parallel with switch S1. Connecting the control line from the control station to terminals No. 51 and 54 on terminal board No. 1, enables the operator to control the transmitter in the same manner as if he were using S1. Terminal No. 54 is normally ground through a link to terminal No. 53. In the event that the power supply used to energize K1 is above ground potential, this link must be opened. Relay K1 is a d-c sensitive relay which requires a minimum of six volts dc for operation. Actuating the coil of relay K1 or pressing the start button of S1 starts the other relays through their cycle of action to place the transmitter in operation.

c. Switches S13, S14, S15, and S16 which are normally closed for automatic operation are used for testing and tuning purposes. When switch S13, the starting circuit isolating switch, and switch S1 are closed, a circuit is completed from the main line A phase through switch S13, S-1-A (start contacts-normally open), S-1-B (stop contacts-normally closed), and filament contactor of relay K2 coil to main line B phase. This energizes the K2 coil. At the instant the K2 coil is energized, the K2 contactor in the starting circuit closes and acts as a holding contactor for the K2 coil. When K1 is used, the K1 coil is energized from a remote point, and the circuit from main line A phase through the K2 coil is completed through switch S13, the K1 contactor which closes, S-1-B, and the K2 coil. When switch S1 has been used to start the transmitter, the completed circuit may be traced from main line A phase through switch S13, holding contactor K2, K1 (normally closed when not energized), S-1-B, and K2 coil. When K1 is used from a remote position to start the transmitter, the circuit from main line A phase is completed through S13, K1 (now closed), S-1-B, and the K2 coil. When starting the transmitter with K1, the holding contactor on K2 is not used, its circuit being broken by the K1 contactor which opens as K1 coil is energized. The K1 coil must be energized continuously to keep the transmitter in operation from a remote position. Thus, using either remote or local starting, coil K2 is energized and held. To stop the transmitter from local position, S-1-B is opened, interrupting the K2 coil circuit. To stop the transmitter from a remote point, the circuit to the K1 coil is opened, interrupting the K2 coil circuit.

d. Filament contactor relay K2 has three contactors which are closed and one contactor which is open when the coil is energized. When the K2 contactor in series with K3 coil closes, the coil is energized by a complete circuit from main line A phase through K2, to main line B phase. At this instant, the circuit through R30 and I1 is also completed and I1 lights.

e. The remaining K2 closing contactor closes and completes a circuit from main line A phase through K2 (closed), K5 contactor (normally closed) and K4 coil to main line B phase. The remaining K2 contactor opens so that K5 coil is not energized. The contactor K3 is a bias contactor time-delay relay set for 30 seconds delay. After this time has elapsed, if the interlocks, overload relays, and isolating switch are functioning normally, a circuit is completed from the main line B phase, through I3 and protective resistor R31, K3 contactor, (door interlock switches) S12 to S8, bias-voltage isolating switch S15, blower interlock switches S6 and S5, power-amplifier filament isolating switch S14, through K2 contactor to an A phase connection. When K3 closes, power is supplied to plate transformers T603 and T605. This does not occur, however, until a delay period of 30 seconds has passed.

f. When K2 completes the circuit, causing blower-contactor relay coil K4 to be energized, the two blower contactors close and the blower BL1 is put in operation across the main line B and C phase. The third K4 contactor acts as a holding contactor and a circuit from A phase through K4 holding contactor, K5 contactor and K4 coil to B phase is completed until K2 is de-energized.

g. K2 is de-energized when the transmitter is stopped, and the K2 contactor normally closed completes a circuit from the main line A phase through the K4 holding contactor, K2 contactor, and K5 coil to B phase. Relay K5 is a 2-minute time-delay relay. After 2 minutes have elapsed, the K5 contactor in series with K4 coil opens and the blower stops. Thus K5 in series with K4 provides a means of continuing the action of the blowers after transmitter operation has ceased. This insures proper cooling of the p-a tubes after operation. Unless the fans are in proper operation, the blower interlocks also are present to cut off power in the transmitter.

h. When S14 is closed energizing K4, and K2 is closed, the blower action causes S5 and S6 to close. This occurs when the blower reaches normal conditions of operation. In this manner, a circuit is completed from main line A phase through filament relay K9, causing its coil to be energized. When this occurs, the K9 contactor closes, and filament power to all transmitter stages is supplied. This condition is indicated by pilot light I2, which with its protective resistor R32 is inserted in a closed circuit by the K9 contactor.

i. When K3 closes, and bias relay K11 closes, the circuit is completed from A phase through high-voltage isolating switch S16, K10, K11, K12, and K13 contactors to K7 contactor (normally closed), to K6 coil and the B phase. When main rectifier relay coil K6 is energized, a period of 4 seconds elapses, after which K6 contactor in series with K7 relay coil closes, and K7 coil is energized. This relay is the main rectifier control. One K7 contact, normally closed, now opens and the K6 relay coil is no longer energized; at the same time the normally opened K7 contact closes and acts as a holding contactor for its own coil. The normally closed K6 contactor recloses after the time delay, and the K8 main rectifier contactor is energized through a K7 contactor and this normally closed contactor. When K8 coil is energized, the K8 holding contactor closes; the K8 contactor in the A phase closes; the K8 contactor in the B phase closes; the K8 contactor in the C phase closes; and power is supplied through S18 to main rectifier transformer T703. This condition is indicated by the pilot light I4 which is connected through its protective resistor R33 across the A and C phase of the transformer supply line. The action of any of the overload relays causes K7 coil to be energized. Thus, K8 opens and the high voltage is also removed from the circuit through line 89 and the K10 coil to ground. Current in excess of the relay setting causes K10 contactor to open. The p-a overload relays are connected as shown on the schematic diagram in the p-a plate circuits completing the p-a cathode circuits to ground. An overload on these relays causes the contactors to open, interrupting the circuit of K7 relay coil circuit. K11 is the bias relay. When the bias supply is maintained at the proper values, the K11 contactor remains closed. When the current through the relay falls below a preset value, the K7 coil circuit is interrupted.

28. POWER SUPPLIES.

The power for operation of the various stages of the transmitter is obtained from four separate power supplies: the oscillator-buffer, frequency-shifter power supply; the keyed-stage and frequency-multiplier power supply; the bias power supply; and the main power supply.

a. The oscillator-buffer, frequency-shifter power supply is a full-wave choke input supply using two mercury-vapor rectifier Tubes JAN-866A (V602, and V603). The filament power is supplied by filament transformer T602 with a secondary tap (center). The plate power is obtained from plate transformer T601, the secondary of which is also center tapped. The filter network consists of chokes CH601 and CH602 and filter capac-

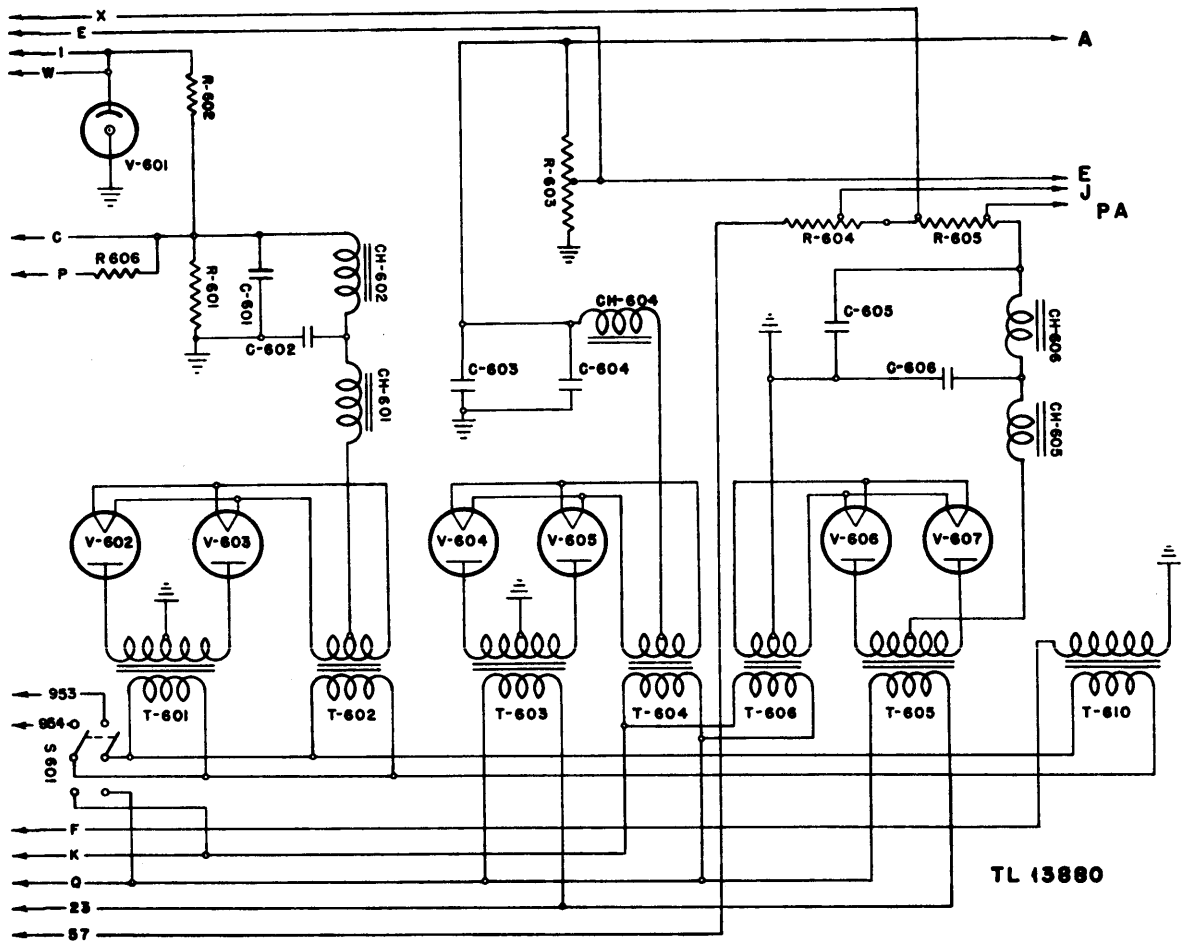

Figure 34. Low power rectifier, schematic.

itors C601 and C602. R601 functions as a bleeder resistor to maintain voltage regulation, and also to discharge the filter capacitors when the supply is shut off. The plate supply for the crystal oscillator and the 200-kc oscillator is obtained from this power supply and is controlled by voltage regulator Tube JAN-VR150-30 (V601). The high-voltage supply for the buffer amplifier and mixer amplifier are also obtained from this power supply directly from the positive terminal of the bleeder resistor. The voltage for operation of the polar relay is also obtained from this supply through resistor R606.

b. The keyed-stage and frequency-multiplier power supply is similar to the oscillator power supply. Two mercury-vapor rectifier Tubes JAN-866A/866 are used, and the filter network consists of choke CH604 and capacitors C603 and C604. Bleeder resistor R603 provides improved voltage regulation, discharges the filter capacitors when the power supply is cut off, and acts as a voltage divider to obtain lower voltages for the keyed stage and frequency-multiplier screen-grid circuit. The plate supply for the frequency multiplier stages is obtained directly from the positive terminal of resistor R603.

c. The bias power supply is similar in construction except that the positive terminal is grounded. This is because a negative potential with respect to ground is required for operating bias. Bleeder resistors R604 and R605 also function as a voltage divider to provide four different bias voltages. The bleeder resistor is connected to ground through bias relay coil K11. If the bias voltage falls below a predetermined value, the current through the relay coil is insufficient to keep the contactor in the circuit closed, and the high volt-

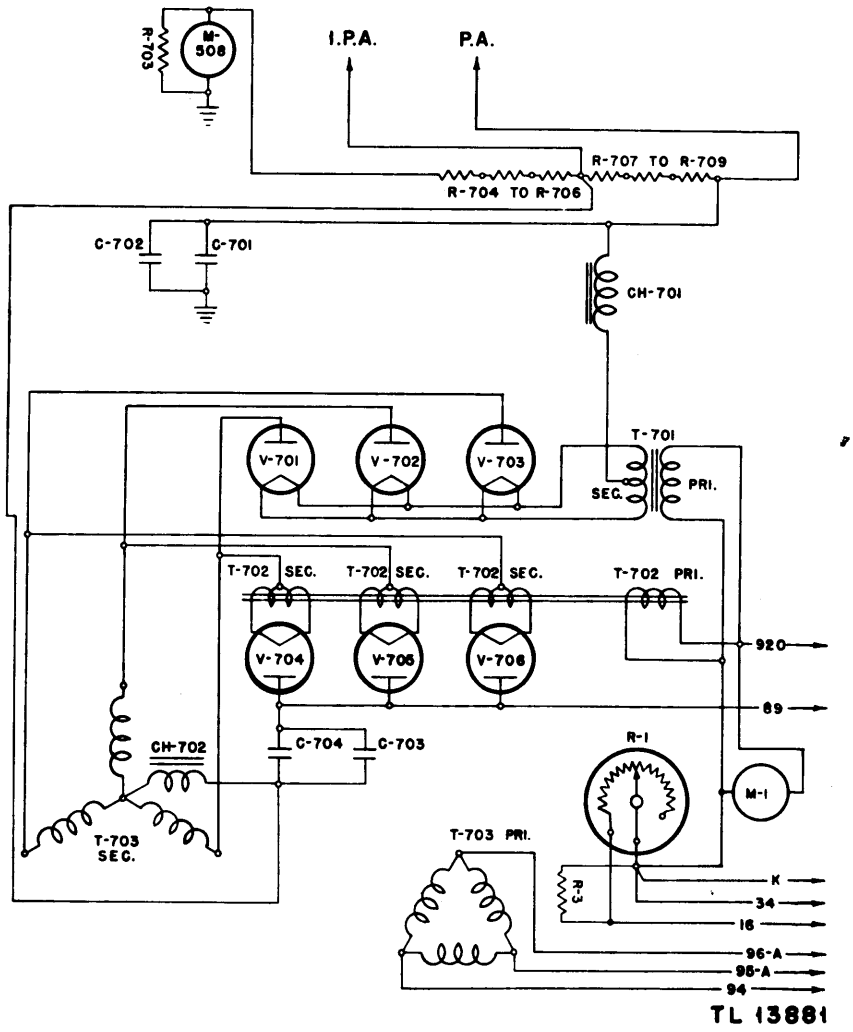

Figure 35. Main power supply, schematic.

age is removed from the various transmitter stages. In this manner, the transmitter tubes are prevented from destruction or severe damage by extreme current overloads should the bias power supply fail. The bias voltage for the operation of the frequency multiplier stages is obtained through a tap on resistor R604. The bias for the intermediate power amplifier is secured from a terminal of bleeder resistor R605, and the grid current is measured with i-p-a grid meter M402. The fixed bias for the power amplifier is obtained from another tap on resistor R605. P-a grid current is measured with meter M501.

d. The main rectifier consists of a delta-wye connected, full-wave bridge type rectifier using 6 mercury-vapor rectifier Tubes JAN-872A (V701 through V706). The filament power is obtained from two filament transformers T701 and T702. The primary input voltage to these transformers is controlled by filament rheostat R1. The secondary of T701 supplies 3 tubes in parallel connection and this winding is center tapped. Filament transformer T702 has 3 secondary windings to provide the filament power. The filter network consists of filter choke CH701 and filter capacitors C701 and C702. Bleeder resistors R704 to R709 provide better voltage regulation, act as a voltage divider for obtaining the proper i-p-a stage plate voltage, function as a bleeder to discharge the filter capacitors, and also act as a multiplier resistor for p-a plate meter M508.

SECTION IV

MAINTENANCE

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report). If Form No. 468 is not available, see TM 38-250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form No. 54 (unsatisfactory report).

29. VISUAL INSPECTION.

a. Arrange a periodic visual inspection of the transmitter while it is in operation. Check the rectifier tubes for arc-back or flashing, and immediately replace defective tubes. The plates of all frequency doublers and the first amplifier tubes should run cool and show no signs of color.

b. Check the settings of all controls against the tuning charts provided. See that all voltage and temperature meters are indicating proper values for the operating frequency being used. See that no flags are showing on any relay. If any are showing, push the reset plungers. The bias overload relay will not show a flag. The contacts are visible through the glass and should always be closed.

c. Also make a visual inspection of the transmitter when it is not operating to check all component parts. Inspect all relay and contactor contacts for corrosion and pitting caused by arcing.

30. PREVENTIVE MAINTENANCE.

a. Meaning of Preventive Maintenance. Preventive maintenance is a systematic series of operations performed at regular intervals on equipment, when turned off, to eliminate major break-downs and unwanted interruptions in service, and to keep the equipment operating at top efficiency. To understand what is meant by preventive maintenance, it is necessary to distinguish between preventive maintenance, trouble shooting, and repair. The prime function of preventive maintenance is to *prevent* break-downs and, therefore, the need for repair. On the other hand, the prime function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. It is vitally important that operators and repairmen maintain their equipment properly.

b. Description of Preventive Maint nanc Techniques.

(1) GENERAL. The actual work performed during the application of preventive maintenance is divided into six types of operation. These operations are referred to as the FITCAL system. The lettering system for the six operations are as follows:

F—Feel.
I—Inspect.
T—Tighten.
C—Clean.
A—Adjust.
L—Lubricate.

The first two operations establish the need for the other four. The selection of operations is based on a general knowledge of field conditions.

(2) FEEL. The feel operation is used most often to indicate the temperature of rotating machinery, such as blower motors, generators, etc., and to determine if electrical connections, resistors, bushings, etc., are overheated. Feeling often indicates the need for lubrication or the existence of similar defects requiring correction. Normal operating temperatures of motors will permit the hand to be held in contact with the motor or bearing case for a period of 5 seconds without discomfort. It is important that the feel operation be performed as soon as possible after shut-down and always before any other maintenance is done.

CAUTION: Normal operating temperatures of ceramic-covered resistors are extremely high. Avoid contact with these parts.

(3) INSPECT. Inspection is probably the most important operation in the preventive maintenance program. Careful observation is required. A careless observer will overlook the obscure evidences of defects and abnormalities. Slight abnormalities may not interfere with the equipment performance, but valuable time and effort can be saved if defects are corrected before they lead to major break-downs. Operating personnel must make every effort to become thoroughly familiar with the indications of normal functioning in order to be able to recognize the signs of a defective set. Inspection consists of carefully observing all parts of the equipment, noticing their color, placement, state of cleanliness, etc. Inspect for the following conditions:

(*a*) Overheating, as indicated by discoloration, blistering, or bulging of the parts or surface of the container; leakage of insulating compounds; and oxidation of metal contact surfaces.

(*b*) Placement, by observing that all leads and cabling are in their original positions.

(*c*) Cleanliness, by carefully examining all recesses in the units for accumulation of dust, especially between connecting terminals. Parts, connections, and joints should be free of dust, corrosion, and other foreign matter. In tropical and high-humidity locations, look for fungus growth and mildew.

(*d*) Tightness, by testing any connection or mounting which appears to be loose. This may be done by slightly pulling on the wire or feeling the lug or terminal screw.

(4) TIGHTEN. All mobile and portable units are subject to vibration while in transit. Other movements of equipment, caused by concussion from exploding shells or by vibration from moving vehicles, may result in loose connections which are likely to impair the operation of the set. All loose parts, especially if they are large, are definite hazards to the associated equipment. If loose parts shift or fall out of place, nearby parts may be crushed. The importance of firm mountings and connections cannot be overemphasized. Screws, bolts, and nuts should not be tightened indiscriminately, but only when they are loose. Fittings tightened beyond the pressure for which they are designed may be damaged or broken. When tightening, always use the correct tools of the proper size.

(5) CLEAN. Clean parts only when inspection shows that it is necessary. Periodic cleanings are more frequent on exposed parts than on those which are contained within cabinets. Inspection may reveal that some parts require more frequent cleaning than the schedule indicates.

(6) ADJUST. Adjustment will be made only when inspection indicates that it is required in order to maintain normal operating conditions.

(7) LUBRICATE. Lubrication refers to the application of lubricating materials to specific items of the radio set. The blower motor assembly is the main item that requires lubrication.

c. Materials Needed for Preventive Maintenance. The following materials are needed in performing preventive maintenance: small screwdriver, small adjustable wrench, small can of lubricating oil, dust cloth, flash light and mirror, crocus cloth, carbon tetrachloride, #0000 sandpaper, and burnishing tool.

31. TROUBLE SHOOTING.

The transmitter equipment normally requires very little attention if it is properly installed. Occasionally, trouble may develop. Consult the list in subparagraph *b* below to locate and repair the defect.

a. When trouble is localized to the control or a-c circuits, it must be remembered that these circuits are interconnected. Consequently, one defective part may prevent several other components from operating normally.

b. Troubles in the radio-frequency circuits may be caused by improper adjustment, defective tubes, and by defective components. A recommended procedure for correcting trouble in these circuits follows:

(1) Make certain the transmitter is properly tuned to the desired operating frequency.

(2) Check for defective tubes with a tube checker, if available. If not, a set of tubes known to be in good condition should be substituted for those in the transmitter. After this is done, substitute the original tubes, one at a time, to find the defective tube or tubes.

(3) If trouble has not been found by the foregoing methods, a defective component, such as a shorted bypass capacitor, burnt out resistor, or open circuit in wiring or plugs may be suspected. This can be remedied by making a thorough continuity check of the transmitter circuits using an ohmmeter and the wiring diagram, figure 49.

32. CONTACTORS AND RELAYS.

a. The following information will aid in localizing any relay or contactor failures.

Symptom	Cause	Remedy
1. Contactor K2 fails to operate.	1. Switch S-13 is off. Main breaker S-21, or 15-ampere breaker S-17 is off. Power line is not connected to proper terminals (No. 58, 59, and 60 at the bottom of the terminal board). Links missing from terminal board TB-1.	1. Check with figures 2, 20, and 49.
2. Contactor K2 closes but blower does not start.	2. K4 does not close.	2. Push reset plunger. Check K5; pointer and set stop should both be at 120-second position.
3. P-a overload relays K12 and K13 trip as soon as the voltage comes on.	3. Test key or remote key is closed; pa is off resonance, overloaded, or overexcited.	3. Check keys. Check p-a tuning. With the high voltage off, check bias on p-a grids.
4. Bias voltage and multiplier plate voltage do not come on at end of 30 seconds.	4. Switch S-15 may be in OFF position. Door interlocks defective.	4. Check S-15. Check door interlocks to see if they are functioning properly. Check K3. Moving pointer should be at 0 end of scale.
5. High voltage does not come on.	5. Switch S-16 is in OFF position. Main rectifier breaker S-18 is OFF. An overload relay may be open.	5. Check S-16. Check S-18. Check K10, K11, K12, and K13 to see if they are sticking.

b. To check operation of relays K6, K7, and K8, proceed as follows:

(1) Open p-a rectifier breaker S-18.

(2) Turn on p-a rectifier switch S-16.

(3) Open the rear door and block one interlock.

(4) Hold the second interlock closed with insulating material. Bias and doubler-rectifier tube should now show a blue glow.

(5) K6 should now start through its cycle. When it reaches 0, K7 will close and K6 will reset immediately. At the instant the contacts on the pointer arm of K6 close, K8 should close.

(6) If K6 and K7 operate but K8 does not close, check contacts on K6 pointer arms.

33. RELAY MAINTENANCE.

a. When inspecting relays, determine first whether a given relay is normal or abnormal.

(1) A relay is considered normal if:

(*a*) The relay assembly is free from dirt, dust, and other foreign matter.

(*b*) Contacts are not burned, pitted, or corroded.

(*c*) The contacts are lined up and correctly spaced.

(*d*) The contact springs are in good condition.

(*e*) The moving parts travel freely and function in a satisfactory manner.

(*f*) The connections to the relay are tight.

(*g*) The wire insulation is not frayed or torn.

(*h*) The relay assembly is securely mounted.

(*i*) The field coil shows no signs of overheating.

(2) Use the above check list and inspect the relays to determine abnormalities. If the contacts are not readily accessible, examine them with a flashlight and mirror.

b. Take care during inspection not to damage or misalign the relay mechanism. Check the mechanical action of the relays to make certain that the moving and stationary contacts come together in a positive manner and that they are directly in line with each other. The armature should move freely without binding or dragging. Tighten all loose connections and mounting screws, but do not apply too much force to damage the screw or to break the parts it holds. Do not start screws with their threads crossed. If a screw does not turn easily, remove it and start over again.

c. Cleaning relay contacts is a simple but delicate task. In general, relay contacts are of two varieties: hard surface and soft surface. Hard surface contacts make use of different kinds of alloys among which are palladium and elkonium. The soft surface contacts are of two kinds. Both are silver; one, solid silver and the other, silver-plated. Improper cleaning of silver-plated relay contacts will soon remove the plating and reduce their effectiveness. Solid silver contacts are not as vulnerable as silver-plated contacts, but they are made of soft material and the metal wears away at an excessive rate if carelessly cleaned.

The following list of relays are grouped according to silver plated contacts and solid silver contacts:

Solid Silver

K1, K2, K3, K5, K6, K7, K9

Silver Plated

K10, K11, K12, K13

Silver Alloy

K4

Copper Cadmium Plated

K8

Tungsten Alloy

K14

Relay contacts are of varied shapes, depending upon their size and application. In some instances, both contacts are flat; in others one contact is convex while its mate is flat. The original shape of a contact must be retained during cleaning. If burning or pitting has distorted the contact so that it must be reshaped, the original shape must be restored. It is essential that the maintenance personnel fa-

miliarize themselves with all details of the relays by examining them while they are in good condition. In this way, they will be prepared to do their work well.

(1) Before cleaning the contacts, clean the exterior of the relay with a dry or damp cloth. If it is very dirty, clean it with a cloth or brush dipped in carbon tetrachloride. Then wipe the surface with a dry cloth to remove the white deposit left by the solvent when it dries. If loose connections are found, they should be inspected. If inspection shows them to be dirty or corroded, they should be removed and cleaned, and then carefully replaced.

(2) The following information indicates how relay contacts of various types should be cleaned.

(*a*) Hard alloy contacts are cleaned, when dirty, by drawing a strip of clean wrapping paper between them while holding them together. It may be necessary, in some cases, to moisten the paper with carbon tetrachloride. A dry paper or paper strip is used for polishing. Corroded, burned or pitted contacts must be cleaned with a crocus cloth strip or a burnishing tool.

(*b*) Dirty solid silver contacts are easily cleaned with a cloth or brush dipped in carbon tetrachloride. After being cleaned, the contacts are polished with a dry cloth.

NOTE: The brown discoloration found on silver and silver-plated relay contacts is silver oxide and is a good conductor. It should be left alone unless the contacts must be cleaned for some other reason. It can be removed, at any time, with a cloth moistened with carbon tetrachloride.

Dress corroded contacts first with crocus cloth, using either the stick or the strip of material. When all of the corrosion has been removed, wipe with a clean cloth moistened with carbon tetrachloride, and polish with a piece of folded cloth. Make certain that the shape of the contacts has not been altered from the original. Resurface burned or pitted contacts, if necessary, with #0000 sandpaper, making certain that the shape of the contact is not changed. Then smooth the surface with crocus cloth. After a high polish is obtained, wipe thoroughly with clean cloth, using carbon tetrachloride when necessary. For very badly burned or pitted contacts (replacement not available), use #0000 sandpaper.

(*c*) Clean dirty silver-plated contacts with a cloth or brush dipped in carbon tetrachloride. After cleaning, polish the contacts with a dry cloth. Dress corroded contacts first with crocus cloth. The work must be done very carefully so as not to remove an excessive amount of silver plating. When all of the corrosion has been removed, polish with cloth. Make certain that the shape of the contacts has not been changed. Dress burned or pitted contacts with crocus cloth until the burned or pitted spots are removed. This may require an appreciable amount of time, but is preferable to the use of a file or sandpaper. If crocus cloth does not remove the burns or the pits, use the sandpaper tool very carefully. If the sandpaper is used, follow with crocus cloth to polish the contact, wipe thoroughly with a cloth moistened with carbon tetrachloride, and dry with a clean cloth.

CAUTION: Never use highly abrasive materials, such as emery cloth, coarse sandpaper or carborundum paper for surfacing relay contacts. They will damage the contacts.

34. ADJUSTING METERS.

Normally, all meters in radio telegraph transmitter PW-981-A should indicate zero when the equipment is turned off. If this does not occur, tap the meter case lightly with the tip of one finger. This will help the needle to overcome the slight friction which sometimes exists at the bearings preventing an otherwise normal unit from coming to rest at zero. If adjustment is needed, insert the tip of a thin screwdriver in the slotted screw head located below the meter glass, and slowly turn the adjusting screw, until the pointer is at zero. Be sure to view the meter face and pointer full on and not from either side. Avoid turning the screw too far; the needle may bend or the hair spring may be damaged. Do not make zero adjustments for several minutes after shut-downs.

35. LUBRICATION.

When lubrication is required on the radio telegraph transmitter PW-981-A, these in-

structions should be followed. Refer to key in table below for specifications of lubricants.

a. Method of Applying Special Preservative Lubricating Oil (PS). Dip the end of a No. 22 B and S gauge wire ½ inch into the lubricant, withdraw, and apply where required.

Product symbol	Nomenclature	Specification	Issuing service	Mean atmospheric temperature for use	Container size	Army Service Forces supply catalog No.
PS	Oil, Lubricating, Preservative, special	U.S. Army 2-120	Ord	Above 70° F	2-oz can	14-O-2883-992
GL	Grease, Lubricating Special	Ord. AXS 637 (Revision 1)	Ord	Above 40° F	8-oz can	14-G-1196-400
SD	Solvent, Dry-cleaning	Federal P-S-661a (Amend. 1)	QMC	Below flash point	1-gal can	51-S-4385-1

b. Control Shaft Bearings. Do not lubricate control shaft bearings unless binding occurs; otherwise apply 1 drop of special preservative lubricating oil (PS) on the shaft bearings only if rotated frequently.

c. Rotary Switches. Every 512 hours, clean rotary switch contacts with dry-cleaning solvent (SD). Lubricate detent cams if necessary, *lightly* with special lubricating grease (GL).

d. Relays. *Never apply lubricant to any part of relays.*

e. Gears. Clean gears with dry-cleaning solvent (SD) every 1,024 hours of operation. Coat gear teeth sparingly with special lubricating grease (GL).

f. Blower Motor. Apply a few drops of special preservative lubricating oil (PS) to each bearing hole every 256 hours of operation. Wipe off all excess lubricant.

g. Air Filter (Spun Glass Type). Every 64 hours remove paper frame type and clean by tapping out dust or discard when sufficient dust or dirt content require a new filter.

36. PERIODIC INSPECTION TABLE.

Make periodic inspections of the transmitter as indicated on the following chart.

Daily	Monthly	3 months
Check tubes (gas arc-back). Check fans (operation). Check relays. Check contacts. Check contactors. Clean compartments. Check meters. Check pilot lights.	Oil fan meters. Clean tuning capacitor. Brighten tube contacts. Check connections. Check oven thermostat contacts.	Oil tuning capacitor bearings. Check electrical connections. Check mechanical connections. Check tubes (refer to Manufacturer's Tube Manual).

37. VACUUM TUBE MAINTENANCE.

To obtain maximum life from tubes, it is important that they be operated within their operating limits and within 5 percent of correct filament voltages. High-voltage rectifiers, when new, should have filament voltage applied for 15 minutes before plate voltage is turned on to remove all condensed mercury from plates and to prevent arc-back.

a. Spare rectifier tubes may be prepared for immediate use by lighting the filaments for 15 minutes (no plate voltage) and storing in a rack or in an upright position. Do not allow mercury in the tube to splash over the filaments after this treatment. Handle the tubes with care.

b. It is good practice to use second sets of tubes for the transmitter and to rotate each set so that its period of activity is approximately 1,000 hours under operation.

c. When intermittent operation is anticipated and conditions permit, filament voltages can be removed during stand-by periods of two hours or more duration. If a stand-by is of less duration, the filament potentials can be lowered by reducing the voltage control. *If this is done, the operator must adjust to normal value before applying plate voltage.*

d. When the rectifier tubes reach the end of their usefulness, they usually change in color under load from a bright, greenish-blue glow to a very pale blue, and the glass envelope becomes black.

38. TYPICAL TRANSMITTER DATA.

The following chart is a typical operating check sheet for the transmitter. The dial settings and meter readings shown are typical for the operating frequencies listed.

a. Dial Settings, Meter Readings, and Other Reference Data.

Frequency	2.5	6	10	14	18	23
H-f osc dial (INSIDE OSC)	68.7	51.5	68.7	37	79.5	55.5
H-f osc Eg	6.3	6.3	6.3	6.3	6.3	6.3
H-f osc Ip (OSC. PLATE)	4.5	4.5	4.5	4.5	4.5	4.5
L-f osc Ef	6.3	6.3	6.3	6.3	6.3	6.3
L-f osc Ep	150	150	150	150	150	150
Mixer dial (MIXER TUNING)	35	50	35	62	25	46
Mixer Ef	6.3	6.3	6.3	6.3	6.3	6.3
Mixer Ep	255	255	255	255	255	255
Keyed stage dial (KEYER STAGE TUN)	65	46	65	27	76	51
Keyed stage Ef	6.3	6.3	6.3	6.3	6.3	6.3
Keyed stage Ep	225	225	225	225	225	225
Keyed stage Ip	12	12	10	12	10	14
Reactance tube Ef	6.3	6.3	6.3	6.3	6.3	6.3
Buffer Ef	6.3	6.3	6.3	6.3	6.3	6.3
Buffer Ep	225	225	225	225	225	225
Tuning eye Ef	6.3	6.3	6.3	6.3	6.3	6.3
Keyer tube Ef	2.5	2.5	2.5	2.5	2.5	2.5
Amplr dial (AMP.—1st MULT.)	58	30	52	20	68	36
Amplr Ef	6.3	6.3	6.3	6.3	6.3	6.3
Amplr Ep	500	500	500	500	500	500
Amplr Ip (MULTIPLIER PL.)	36	38	30	34	22	28
2d mult dial (2nd MULTIPLIER)			56	17	73	39
2d mult Ef	6.3	6.3	6.3	6.3	6.3	6.3
2d mult Ep	500	500	500	500	500	500
2d mult Ip (MULTIPLIER PL.)			56	56	46	50
3d mult dial (3rd MULTIPLIER)					47	10
3d mult Ip (MULTIPLIER PL.)					68	78
Mult select sw (MULTI SELECTOR)	1	2	3	3	4	4
IPA band sw (I.P.A. BAND SW.)	1	2	4	5	5	6
IPA tuning dial (I.P.A. TUNING)	76	12	39	51	21	15
IPA cplg dial (I.P.A. COUPLING)	56	56	50	39	20	13
IPA Ef	10.6	10.6	10.6	10.6	10.6	10.6
IPA Ip (1st tube)	80	70	95	125	125	125
IPA Ip (2d tube)	95	85	100	125	130	115
IPA Ip (total)	170	160	200	250	260	240
IPA Ig (I.P.A. GRID)	32	25	22	20	24	30
IPA Ep	1750	1725	1750	1725	1750	1750
IPA Ik (1st tube) (I.P.A. PLATE)	.69	.69	.70	.67	.66	.70
IPA Ik (2d tube) (I.P.A. PLATE)	.70	.71	.68	.70	.71	.71
IPA Ik (total) (I.P.A. PLATE)	1.39	1.40	1.38	1.37	1.37	1.41
PA Ef (P.A. FILAMENT)	16	16	16	16	16	16
PA Ep (P.A. PLATE VOLTS)	3500	3450	3500	3450	3500	3500

a. Dial Settings and Meter Readings and Other Reference Data (contd).

Frequency	2.5	6	10	14	18	23
PA Ek	80	80	80	80	80	80
PA Ep (plt to k)	3420	3370	3420	3370	3420	3420
PA Ig (P.A. GRID)	200	200	200	200	200	200
PA Ik (1st tube) (P.A. PLATE)	.69	.70	.72	.70	.71	.72
PA Ik (2d tube) (P.A. PLATE)	.72	.71	.70	.72	.71	.70
PA plt temp (left)	69	69	72	66	65	65
PA plt temp (rt)	62	63	62	60	60	63
PA watts dissipation (left)	630	630	735	530	495	495
PA watts dissipation (rt)	630	670	630	560	560	570
PA grid dissipation	100	100	100	100	100	100
PA watt input	4100	4050	4050	3950	4000	4150
PA watt output	2940	2850	2785	2960	3045	3085
PA eff (%)	71.7	70.5	68.5	75	76	74
I ant. (left)	2.0	2.3	1.7	2.9	2.9	2.4
I ant. (rt)	2.0	2.1	1.8	2.7	2.7	2.2
Ant. cplg c	P	P	P	S	S	S
Ant. cplg dial (ANT. TUNING)	89	48	43	50	57	33
P-a tank c	P	P	P	S	S	S
P-a tuning	92	70	85	51	86	45

b. Frequency Shift Calibration.

Calibration Frequency: 2,800 kc

Frequency (cps)	Shift Control Dial
850	80
425	50
212.5	30
106.25	18

Check	Result
Maximum shift.	1,250 cps
L-f osc shift range.	1,000 cps (approx.)
Mixer chassis switch operation.	OK
External shift operation.	OK
L-f osc drift (3-hr heat run).	230 cps

c. Three-hour Heat Run of Transmitter Operation.

Results .....

d. Relay Operation Check.

Local .....

Remote .....

SECTION V

SUPPLEMENTARY DATA

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A.

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
TM 11-834		**RADIOTELEGRAPH TRANSMITTER**, c-w; input: 220/230 v, 50- to 60-cps, 3 phase, 8 kw, output: 2.5 kw, frequency range 2.5 to 33 mc.....	PW981-A(P5)
		CONTROL CIRCUIT	
BL1	3H381-12	**BLOWER ASSEMBLY**, includes motor and two fans:.....	100(A10)
	3H3000A33-7	**MOTOR**: 1/3-hp; 3,450-rpm; 220-v; 50- to 60-cps; single-phase; shaft extends 1-3/4" each end.....	(D20)
	3H2565	**PROPELLER**: counterclockwise; for AB 100.....	(A10)
	3H2565-1	**PROPELLER**: clockwise; for AB 100.....	(A10)
E2	2Z9408.93	**BOARD**, terminal: 8-contact screw.....	8-60(J5)
	2Z9416.41	**BOARD**, terminal: 16-contact.....	CDM-16(C57)
	2Z9412.82	**BOARD**, terminal: 12-contact.....	CDM-12(C57)
S17	3H900-15-6	**BREAKER**, circuit: magnetic, 3-pole, 15 amp at 230 v.	0362-15(H6)
S18	3H900-25-3	**BREAKER**, circuit: magnetic, 3-pole, 25 amp at 230 v.	0362-25(H6)
S21	3Z9652-1.2	**BREAKER**, circuit: magnetic, 3 PST, 50 amp at 230 v.	0362-50(H6)
E5, E6	3Z1026-1	**CLIP**, fuse: bronze	60A(S36)
E18, E19, E20, E21	2Z3269-12	**COUPLING**, flexible: with hub, for C513.....	C(C2)
	6Z3856-23	**FILTER**, air: fiberglass	1(04)
	6Z3856-2/1	**ELEMENT**, filter: (for Dustop)	1(04)
F1, F2	3Z1903-1	**FUSE**, cartridge: 1 amp at 250 v.....	384-001(J1)
E1	3Z2831-3.1	**HOLDER**, fuse: block-type, (for two cartridge type fuses).....	250VDP(B7)
E3, E4	3G1000-16.3	**INSULATOR**, stand-off: conical, 2" high	A34-L2(I6)
E7, E8, E9, E10	3G1000-12	**INSULATOR**, stand-off: ceramic, conical, 1-1/2" high.....	1117-00(G1)
E11, E12, E13, E14, E37, E38, E39, E40	3G1000-8.6	**INSULATOR**, stand-off: ceramic, conical, 1" high.....	A32(I6)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
E15, E16, E17	3G1000-1.1	**INSULATOR, feedthru:** 1" long	478(B4)
E41, E42	3G1250-16.1	**INSULATOR, stand-off:** ceramic, cylindrical, 1" high	337-L-1(I6)
		INSULATOR, bead: ceramic	1117(I6)
I1, 4	2ZK5998-3	**LAMP, indicator:** red, with resistor	600(K4)
I2, 3	2ZK5998-1	**LAMP, indicator:** green, with resistor	600(K4)
M1	3F8300-28	**METER:** 300-v a-c	AO-22(G3)
M2	3F8020-6	**METER:** 0- to 20-v, a-c	AO-22(G3)
K1	2Z7585-83	**RELAY:** SPDT, d-c, sensitive	251-36(W3)
K1	2Z7585-83/2	**COIL,** relay	(W3)
K1	2Z7585-83/1	**CONTACTS,** relay	(W3)
K2	2Z7596-6	**RELAY:** 4-pole, fil contactor, 230-v, 25-amp	131-7132(W3)
K2	3C1116-5	**COIL, relay:** 230-v, 60-cps	13L13(W3)
	2Z7596-6/1	**CONTACTS, relay:** 25-amp	26126.59-1(W3)
K3	4TD1-60S	**RELAY, time-delay:** 30-second	TD1-60S(C16)
	2Z7639.1/1	**CONTACTS, relay:** 5 amp at 230 v	(C16)
K4	2Z7593-65	**RELAY:** 3-pole, normally open	709-SP(A5)
	2Z7593-65/1	**COIL, relay:** 230-v, 60-cps	RW33581(A5)
	2Z7593-65/2	**CONTACTS, relay**	35162(A5)
K5	2Z7598-33	**RELAY, time-delay:** normally closed, 120-second	TD1-120S(C16)
K6	2Z7598-35	**RELAY:** 2-pole, 0-15 second adjustment	TDSA(C16)
		COIL, relay: 230-v, 60-cps	(C16)
	2Z7598-35/1	**CONTACTS, relay:** 5 amp at 230-v	(C16)
K7	2Z7593-62	**RELAY:** 3-pole, 2 normally open, 1 normally closed	131-782(W3)
	3C1116-5	**COIL, relay**	13L13(W3)
	3H900-25-22	**CONTACTS, relay:** 25-amp	(W3)
K8	2Z7593-12	**RELAY:** 3-pole, single-throw	Dwg11774.5-2(W3)
	3C1116-2	**COIL, relay:** 120-v, a-c	18L8(W3)
	2Z3186-1	**CONTACTS, relay:** 25 amp at 220-v	11483.7-1(W3)
K9	3H900-25-16	**RELAY:** 3-pole, normally open	131-792(W3)
	3C116-5	**COIL, relay**	13L13(W3)
	3H900-25-22	**CONTACTS, relay**	(W3)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Nam of part and d scription	Mfrs part and code No.
K10, K12, K13	2Z7590-11	**RELAY:** DPST, overload	12PJC12A2(G3)
	3C1120-1	**COIL, relay:** 120-v	6174594-G2(G3)
	2Z3189-15	**CONTACTS, relay:** 1/4-amp	6174440-G1(G3)
K11	2Z7599-65	**RELAY, overload:** 0.2-0.8 amp, d-c	12PJC12A10(G3)
	2Z7599-65/1	**COIL, relay**	6174594G10(G3)
	2Z3189-15	**CONTACT, relay**	(G3)
K14	4TRY30	**RELAY, tg, polar**	255A(W5)
R1	3Z7020-2	**RESISTOR, variable:** wire-wound, 20-ohm, 335-w	62019-B(W3)
R2	3Z7004	**RESISTOR, variable:** wire-wound, 4-ohm, 14.5-amp	63009-B(W3)
R3	3Z4820-4	**RESISTOR, wire-wound:** 20-ohm, 200-w	D(W3)
R4	3Z5410.26	**RESISTOR, wire-wound:** 1,000-ohm, 50-w, 2 adj taps	50A(W3)
R30, R31, R32, R33	3Z6320-8	**RESISTOR, wire-wound:** 3,200-ohm, 10-w	1029(K4)
X1	4T6827	**SOCKET:** connecting block	18-B(W5)
S1	3Z9824-39	**SWITCH, 2-pole:** push-button, momentary, SPST	B-30(S9)
S5, S6, S8, S9, S10, S11, S12, S22	3Z9558-3	**SWITCH, sensitive:** SPST, 5 amp at 250 v	YZ-RL2(M3)
S13, S14, S15, S16	3Z9857.4-3	**SWITCH, toggle:** SPST	2971(H24)
S19, S20	3Z9817-6.2	**SWITCH, knife:** SPDT, 100 amp at 230 v	D(B11)
	3Z9558-3	**SWITCH ASSEMBLY:** blower interlock	A4-B-29(P5)

OSCILLATOR

E116	2Z9408.92	**BOARD, terminal:** 8-lug	41-34(P5)
E117	2Z9418.27	**BOARD, terminal:** 18-lug	41-35(P5)
	3G1350-109	**BRACKET, mycalex**	A4-A-510(P5)
C101	3D9250V-13	**CAPACITOR, variable:** 250-mmf	MC-909(B8)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C102, C105	3D9050-50	**CAPACITOR, mica:** 0.00005-mf, 500 v dc (working)	K-1451(S1)
C103, C115	3D9100V-9	**CAPACITOR, variable:** 100-mmf	MC-1855(B8)
C106, C107, C114, C121, C123, C124	3DKA10-218	**CAPACITOR, mica:** 0.01-mf, 600 v dc (working)	H-1110(S1)
C108, C112	3D9100-64	**CAPACITOR, mica:** 0.0001-mf, 500 v dc (working)	K-1310(S1)
C109	3DA10-21	**CAPACITOR, mica:** 0.01-mf, 300 v dc (working)	1W-351(C15)
C110, C111	3D9500-95.3	**CAPACITOR, mica:** 0.0005-mf, 500 v dc (working)	J-1350(S1)
C112, C113	3DA1-157	**CAPACITOR, mica:** 0.001-mf, 500 v dc (working)	K-1210(S1)
C116, C117	3K2510121	**CAPACITOR, mica:** 0.0001-mf, 500 v dc (working)	J-1310(S1)
C118	3DA250-21.1	**CAPACITOR, paper:** oil, 0.25-mf, 600 v dc (working)	DYR-6025(C15)
C125	3D9020-9	**CAPACITOR, mica:** 0.00002-mf, 500 v dc (working), ASA No. CM20B200J	K-1420(S1)
L101	2C6892/C11	**COIL, r-f:** tank, 86 turns, tapped at 35-1/2 turns, National XR-16 form.	15-47(P5)
L103	2C2710-5/C1	**COIL, r-f:** osc tank, 200-kc, permeability tuned	3401(S26)
RFC102	3C326-100.1	**COIL, r-f:** choke, 2.5-mh, 125-ma	R-100U(N1)
RFC104	3C368-4	**COIL, r-f:** choke, 125-mh	19-6848(M4)
J102	2Z3030-4	**CONNECTOR, male:** 10-contact	P-2410-SB(J5)
P102	2Z3071-2	**CONNECTOR, female:** 10-contact	S-2410-CCE(J5)
	2Z3289-1	**COUPLING, metal:** 1/4" shaft, 1" long	44-A-123(P5)
E108	2Z3290	**COUPLING, flexible:** insulated	A(C2)
N101	2Z3764-33	**DRIVE, dial:** 2-3/4" diam, 180°	298(C30)
N102	2Z3764.42	**DIAL:** 2-3/4" diam, 270°	710B(G9)
N103	2Z3764	**DIAL:** 2-3/4" diam, 180°	710A(G9)
N104	2Z3714-16	**DIAL:** 2-3/4", engraved bakelite, mounted on knob	PW23-30(P5)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
	3G1050-26	**INSULATOR, feedthru:** 5/8"	458(B4)
	3G1250-10.1	**INSULATOR, stand-off:** 5/8"	397-L-5/8(16)
	2Z3062-47	**JACK, r-f**	44-A-480-C(P5)
E118	2Z5822-49.1	**KNOB:** 1-1/8", for capacitor C103	S308-64-BB-40269(K6)
	3G1100-124.2	**PLATE, mycalex**	PW39B7(P5)
P101	2Z7120.3	**PLUG:** 10-contact, with clamp	P-310-CCT(J5)
R101, R104, R114	3RC31AE104K	**RESISTOR, carbon:** 100,000-ohm, 1-w	BT1(12)
R102	3RC31AE123K	**RESISTOR, carbon:** 12,000-ohm, 1-w	BT1(12)
S103	6C201C/S2	**SWITCH, toggle:** SPST, 3-amp at 250 v	8280K10(C18)
M101	6Z4251.1	**THERMOMETER:** 0-100°C, 4" stem	2Z1D(W6)
S102	2Z9488-5	**THERMOSTAT:** 330-w, 220-v	99005C(C3)
V101	2J6SL7GT	**TUBE JAN-6SL7GT**	6SL7GT(R2)
V102	2J6N7	**TUBE JAN-6N7**	6N7(R2)
V103	2J6J5	**TUBE JAN-6J5**	6J5(R2)

SHIFTER MIXER

E219, E220, E221	2Z9403.94	**BOARD, terminal:** 3-lug	1385-A(B4)
E222	2Z9401.55	**BOARD, terminal:** 1-lug	1382-B(B4)
E223	2Z9405.63	**BOARD, terminal:** 5-lug	1550(M5)
C201, C202, C203, C206, C207, C209, C212, C213, C214	3DKA10-193	**CAPACITOR, mica:** 0.01-mf, 600 v dc (working)	H-1110(S1)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C204, C208	3D9250V-13	**CAPACITOR, variable:** 250-mmf, midget type	MC-909(B8)
C205, C211	3K2510121	**CAPACITOR, mica:** 0.0001-mf, 500 v dc (working)	J-1310(S1)
C210	3DA50-39.1	**CAPACITOR, paper:** oil, 0.05-mf, 600 v dc (working)	DYR-6005(C15)
C215	3DK9050-96	**CAPACITOR, mica:** 0.00005-mf, 1,200 v dc (working)	H-2450(S1)
C216, C217	3DA1-121	**CAPACITOR, mica:** 0.001-mf, 500 v dc (working)	J-1210(S1)
C221	3D9510	**CAPACITOR, mica:** 0.00051-mf, 500 v dc (working), ASA No. CM20B511.	K-1351(S1)
E205, E206	2Z2708	**CLIP:** tube contact, 1/4"	8(N1)
CH201	3C323-SX	**COIL, a-f:** choke, 10 h at 150 ma	T-7296(A24)
L201	2C6892/C14	**COIL, r-f:** tank, 37 turns ct, 4 turns on center for coupling, National R-16 form	PW15-35(P5)
L202	2C6892/2	**COIL, r-f:** Keyer tank, 34 turns, National XR-16 form	PW15-63(P5)
RFC201, RFC202	3C362-100.1	**COIL, r-f:** choke, 2.5 mh at 125 ma, 50-ohm d-c resistance	R100U(N1)
RFC205	3C326-300.1	**COIL, r-f:** choke, 200-kc, filter, 1/4 mh at 300 ma	R300U(N1)
P201	2Z3071-2	**CONNECTOR, female:** 10-contact, with cable clamp	S-2410-CCE(J5)
J201	2Z3030-4	**CONNECTOR, male:** 10-contact, with angle bracket	P-2410-SB(J5)
E201	2Z3290	**COUPLING, flexible:** insulated, for capacitor C204	A(C2)
E202	2Z3289-1	**COUPLING:** metal	44A-123(P5)
N201, N202	2Z3764-33	**DRIVE, dial:** 2-3/4" diam 180°	298(C30)
E207, E208, E209, E210, E211, E212, E213, E214, E215, E216, E217, E218	3G1050-26	**INSULATOR, feedthru:** 5/8"	458(B4)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
E203, E204	2ZK5822-32	KNOB, indicator: 1-1/8"	S-308-64-BB-40269(K6)
R201	3RC31AE103K	RESISTOR, carbon: 10,000-ohm, 1-w	BT1(I2)
R202, R216	3RC31AE391K	RESISTOR, carbon: 400-ohm, 1-w	BT1(I2)
R203, R204, R209, R222	3RC31AE152K	RESISTOR, carbon: 1,500-ohm, 1-w	BT1(I2)
R205	3RC31AE123K	RESISTOR, carbon: 12,000-ohm, 1-w	BT-1(I2)
R206	3RC31AE511J	RESISTOR, carbon: 500-ohm, 1-w	BT-1(I2)
R207	3RC31AE514J	RESISTOR, carbon: 500,000-ohm, 1-w	BT-1(I2)
R208	3Z6801-6	RESISTOR, carbon: 1-meg, 1/4-w	(A13)
R210, R217	3RC31AE153K	RESISTOR, carbon: 15,000-ohm, 1-w	BT1(I2)
R211, R215	3RC31AE104K	RESISTOR, carbon: 100,000-ohm, 1-w	BT1(I2)
R213, R214	3RC31AE623J	RESISTOR, carbon: 60,000-ohm, 1-w	BT-1(I2)
R219	3RC20AE511J	RESISTOR, carbon: 500-ohm, 1/2-w	BT-½(I2)
R220	3RC31AE203J	RESISTOR, carbon: 20,000-ohm, 1-w	BT-1(I2)
R224	3RC31AE244J	RESISTOR, carbon: 250,000-ohm, 1-w	BT-1(I2)
R225	2Z7280-15	RESISTOR, potentiometer: wire-wound, 10,000-ohm	M-10-MP(M1)
X201, X202, X203, X204	2Z8678.34	SOCKET, tube: octal, steatite	RSS8M-(A13)
F103	3RC20AE242J	RESISTOR, carbon: 2,500-ohm, 1/2-w	BT-½(I2)
R105	2Z7280-15	RESISTOR, potentiometer: wire-wound, 10,000-ohm	M-10-MP(M1)
R106	3RC31AE513J	RESISTOR, carbon: 50,000-ohm, 1-w	BT1(I2)
R108, R109	3RC31AE753J	RESISTOR, carbon: 75,000-ohm, 1-w	BT1(I2)
R110	3RC31AE153K	RESISTOR, carbon: 15,000-ohm, 1-w	BT1(I2)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
R112	3RC31AE103K	**RESISTOR, carbon:** 10,000-ohm, 1-w	BT1(I2)
R113	3RC31AE241J	**RESISTOR, carbon:** 250-ohm, 1-w	BT1(I2)
R120, R121	2Z5016-3	**RESISTOR, heater:** 150-w, 230-v	51X335(G3)
J101	2Z8639-6	**SOCKET, 10-contact, power**	S-310-AB(J5)
X101, X102, X103	2Z8678.34	**SOCKET, tube:** octal, steatite	RSS8M(A13)
S101	3Z9825-90.11	**SWITCH, rotary:** 1-pole, 11-contact, single-section	86A(R18)
X205	2Z8674.73	**SOCKET, tube:** 4-prong, steatite	RSS4M(A13)
X206	2Z8691	**SOCKET, tube:** magic eye assembly, includes resistor R208	MEA-6(A13)
S201, S202	3Z9825-74.17	**SWITCH, rotary:** universal	2505(C4)
T201	2Z9600.15	**TRANSFORMER, filament:** pri 220-v 50- to 60-cps, sec 2.5-v 20-va	T-7026(A24)
V201, V202	2J6L7	**TUBE JAN-6L7**	6L7(R2)
V203, V204	2J6V6GT	**TUBE JAN-6V6GT**	6V6GT(R2)
V205	2J2A3	**TUBE JAN-2A3**	2A3(R2)
V206	2J6E5	**TUBE JAN-6E5**	6E5(R2)
		MULTIPLIER	
E308	2Z9410.64	**BOARD, terminal:** 10-lug	430(M5)
E317, E318, E319	2Z9402.154	**BOARD, terminal:** 2-lug	1383(B4)
E320, E321	2Z9401.56	**BOARD, terminal:** 1-lug	1382(B4)
C301	3K5510321	**CAPACITOR, mica:** 0.01-mf, 600 v dc (working)	A2-1110(S1)
C302, C303, C304, C306, C309, C310, C313, C320, C321, C323, C327, C328	3DA10-131	**CAPACITOR, mica:** 0.01-mf, 1,200 v dc (working)	H-2110(S1)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C305, C307	3D9250V-14	**CAPACITOR, variable:** dual, 250- 250-mmf	JC-1556(B8)
C311	3D9145V	**CAPACITOR, variable:** dual, 145- 145-mmf	JC-1554(B8)
C314, C316	3D9050-114	**CAPACITOR, air:** 50-mmf	E0-50-FS(C2)
C315, C317, C318, C319	3DK9050-96	**CAPACITOR, mica:** 0.00005-mf, 1,200 v dc (working)	H-2450(S1)
C323, C329	3DKA10-193	**CAPACITOR, mica:** 0.01-mf, 600 v dc (working)	H-1110(S1)
C324, C325, C326	3D9015V-25	**CAPACITOR, variable:** 15-mmf	ZT-15-AS(C2)
E305, E306, E307	2Z2724	**CLIP, tube cap:** 3/8″	24(N1)
RFC301, RFC303, RFC308	3C326-100.1	**COIL, r-f:** choke, 2.5-mh at 125 ma, 50-ohm, d-c resistance	R-100U(N1)
RFC302, RFC306, RFC309, RFC311, RFC312	3C326-300.1	**COIL, r-f:** choke, 1-mh at 300 ma, 10-ohm, d-c resistance	R-300U(N1)
L303	2C6892/C3	**COIL, r-f:** tank, 2-4-mc, 42 turns ct, National XR-16 form	PW15-55(P5)
L304	2C6892/C2	**COIL, r-f:** 4-8 mc, 22 turns ct, National XR-16 form	PW15-56(P5)
L307	2C6892/C9	**COIL, r-f:** 8-16 mc, 1/8″ copper tubing, 18 turns, ct	PW15-57(P5)
L310	2C6892/C13	**COIL, r-f:** 16-23 mc, 3/16″ copper tubing, 12 turns, ct	PW15-58(P5)
J301, J302	2Z3026-7	**CONNECTOR, male:** 6-contact, with mounting bracket	P-2406-DB(J5)
E302	2Z3289-1	**COUPLING, metal:** 1″ long x 1/2″ diam, for switch S301	44-A-123(P5)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
N301, N302, N303,	2Z3764-33	**DRIVE, dial:** 2-3/4″ diam, 180°	298(C30)
E303, E304, E309, E310, E311, E312, E313, E314, E315, E316	3G1050-26	**INSULATOR, feedthru:** 5/8″ high	458(B4)
	3G1100-132.1	**INSULATOR, coil strip:** mycalex, 8-1/4″ long x 1″ wide	44-A-504-A(P5)
	3G1100-96.4	**INSULATOR, coil strip:** mycalex, 6″ long x 1″ wide	44-A-504-B(P5)
	2Z3718.15	**KNOB, skirted:** with dial plate	PW23-31(P5)
E301	2Z5822-61	**KNOB:** with pointer, 1-1/8″ diam, for switch S302	S308-64-BB-402 69(K6)
M301	3F910-2	**METER:** 0-100 ma, d-c	D041(G3)
M302	3F902-9	**METER:** 0-20 ma, d-c	D041(G3)
	3G1100-40	**PLATE, mycalex:** for input	44-A-457(P5)
P301, P302	2Z8676.29	**PLUG:** 6 contact, with cable clamps	S-2406-CCE(J5)
	2Z3021-46	**PLUG, r-f:** output exitation	44-A-438-3(P5)
R301, R305, R306, R310, R311, R315	3RC31AE510J	**RESISTOR, carbon:** 50-ohm, 1-w	BT1(I2)
R302, R307, R312	3RC31AE102K	**RESISTOR, carbon:** 1,000-ohm, 1-w	BT1(I2)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
R303, R308, R313	3RC31AE203J	**RESISTOR, carbon:** 20,000-ohm, 1-w	BT-1(I2)
R304, R309, R314	3Z6020-98	**RESISTOR, wire-wound:** 200-ohm, 10-w	AB(I2)
R316, R317, R318, R319	3RC31AE200J	**RESISTOR, carbon:** 20-ohm, 1-w	BT-1(I2)
R320, R321, R322, R323, R324, R325	3RC31AE103K	**RESISTOR, carbon:** 10,000-ohm, 1-w	BT1(I2)
X301, X302, X303	2Z8675.13	**SOCKET, tube:** 5-prong, steatite	SS5M(A13)
S301	3Z9825-90.13	**SWITCH, rotary:** 6-pole, 4-position, 3-section	86B(R18)
S302	3Z9825-74.16	**SWITCH, rotary:** universal	2505(C4)
S303	3Z9859-25	**SWITCH:** SPDT, anti-cap	1425(F3)
T301	2Z9600.107	**TRANSFORMER, filament:** pri 215-v 60-cps, sec No. 1, 6.3-v; sec No. 2, 6.3-v 20-va	T-7290(A24)
V301, V302, V303	2J807	**TUBE JAN-807**	807(R2)
		INTERMEDIATE POWER AMPLIFIER	
E404	2Z9410.64	**BOARD, terminal:** 10-lug	430(M5)
	2Z9403.128	**BOARD, terminal:** strip	44-A-608(P5)
C401, C404, C405, C406, C407, C411	3DA2-85.1	**CAPACITOR, mica:** 0.002-mf, 3,000 v dc (working)	F2L-322(S1)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C402, C403	3D9006V-6	**CAPACITOR, variable:** 6-mmf	NA6NS(C2)
C408, C409	3K5510321	**CAPACITOR, mica:** 0.01-mf, 1,000 v dc (working)	A2-1110(S1)
C410A, C410B	3D9250V-15	**CAPACITOR, variable:** 250-mmf	BC-1605(B8)
E414, E415, E416, E417	2Z2712	**CLIP, grid:** 9/16"	12(N1)
E418, E419, E420, E421, E432, E433, E434, E435	3Z1026-1	**CLIP, fuse**	60A(S36)
L405A	2C6892/C15	**COIL, r-f:** tank, 9-1/2 turns, 3/8" copper tubing, tapped at 3, 4, and 8 turns	PW15-59B(P5)
L405B	2C6892/C10	**COIL, r-f:** tank, 9-1/2 turns, 3/8" copper tubing, tapped at 3, 4, and 8 turns	PW15-59A(P5)
L406A	2C6892/C8	**COIL, r-f:** tank, 18 turns, tapped at 10 and 15 turns, National XR-10-A form	PW15-60A(P5)
L406B	2C6892/C12	**COIL, r-f:** tank, 18 turns, tapped at 10 and 15 turns, National XR-10-A form	PW15-60B(P5)
RFC401, RFC402	3CK326-154.4	**COIL, r-f:** choke, 1-mh at 600 ma, 6-ohm d-c resistance	R-154-U(N1)
RFC403, RFC404	3C323-8Z	**COIL, r-f:** choke, 3 turns ct	PW16-3(P5)
RFC407	3C323-8Z1	**COIL, r-f:** choke, 87 turns, 1" diam, pyrex form	PW16-5A(P5)
E403	2Z3289-1	**COUPLING, m tal:** 1" long x 1/2" diam	44-A-123(P5)
J401	2Z3030-4	**CONNECTOR, male:** 10-contact, with angle bracket	P-2410-SB(J5)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
P401	2Z3071-2	**CONNECTOR, female:** 10-contact, with cable clamps	S-2410-CCE(J5)
E402	2Z3269-12	**COUPLING, flexible:** insulated	C(C2)
N401	2Z3718.31	**DIAL:** 4″ diam, 180°, direct drive	717A(G9)
N402	2Z3764.40	**DIAL:** 4″ diam, 180°, friction	23-15A(P5)
N403	2Z3714-17	**DIAL:** 4″ bakelite, mounted on knob	23-32(P5)
E405, E406, E407	3G1000-1.1	**INSULATOR, feedthru:** 1″	478(B4)
E408, E409, E410, E411	3G1880-24	**INSULATOR, stand-off:** cylindrical, 1-1/2″ high	1019-00(G1)
E412, E413, E422, E423	3G1000-12	**INSULATOR, stand-off:** conical, 1-1/2″ high	1117-00(G1)
E424, E425	3G1250-10.3	**INSULATOR, stand-off:** cylindrical 5/8″	397L-5/8(I6)
E426, E427	3G1000-16.3	**INSULATOR, stand-off:** conical, 2″ high	434-L-2(I6)
E401	2Z5822-61	**KNOB, indicator:** 1-1/8″ diam	S308-64-BB 40269(K6)
M401	3F930	**METER:** 0-300 ma, d-c	D041(G3)
M402	3F910-2	**METER:** 0-100 ma, d-c	D041(G3)
	2Z6820.33	**MOUNT, capacitor:** mycalex	44-A-458(P5)
	2Z3021-45	**PLUG,** bayonet type	44-A-573-B(P5)
R401	3Z5984-6	**RESISTOR, wire-wound:** 0.4-ohm, special	PW10-145(P5)
R402	3Z6050-76	**RESISTOR, wire-wound:** 500-ohm	B(G27)
R403, R404, R407	3Z6100-101	**RESISTOR, wire-wound:** 1,000-ohm	B(G27)
R405, R406	3Z6025-79	**RESISTOR, wide-wound:** 250-ohm, 100-w	0606(02)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
R410, R411	3RC31AE200J	**RESISTOR, carbon:** 20-ohm, 1-w	BT1(I2)
X401, X402	2Z8674.22	**SOCKET, tube:** 4-prong, steatite	SS4M(A13)
S401	3Z9825-90.12	**SWITCH:** 2-pole, 6-position, 2-section	88Dwg19A-1Spcl (R18)
S402	3Z9825-58.16	**SWITCH, rotary:** universal	2505(C4)
V401, V402	2J4C22	**TUBE JAN-4C22**	HF-100(A16)
		POWER AMPLIFIER	
C501, C502	3D9145V-2	**CAPACITOR, variable:** 145-mmf	BC-1612(B8)
C503, C515, C516	3DA5-57	**CAPACITOR, mica:** 0.005-mf, 6,000 v dc (working)	G1-625(S1)
C504, C507, C508, C509, C510, C522, C523	3DA2-85.1	**CAPACITOR, mica:** 0.002-mf, 3,000 v dc (working)	F2L-322(S1)
C505, C506	3D9040V-12	**CAPACITOR, variable:** book-type	PW11-37A(P5)
C511, C512	3K5510321	**CAPACITOR. mica:** 0.01-mf, 1,000 v dc (working)	A2-1110(S1)
C513A, C513B	3D9125V-2	**CAPACITOR, variable:** book-type	PW11-37B(P5)
C517	3D9320V-1	**CAPACITOR, variable:** dual, 320-320-mmf	GC-1817(B8)
C520	3D9100-114	**CAPACITOR, mica:** 0.0001-mf, 6,000 v dc (working)	G1-631(S1)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
E547, E548, E553, E554, E555, E556	3Z1026-1	**CLIP, fuse**	60A(S36)
L504	2C6892/C6	**COIL, r-f:** tank, 9-3/4 turns, 5″ diam x 9″ long, 1/2″ copper tubing	PW15-61A(P5)
L505	2C6892/C5	**COIL, r-f:** tank, 18-1/2 turns, tapped at 4, 6, 10, 12, 14, 15, 16, 18 turns, 6-3/4″ diam x 15″ long, 1/2″ copper tubing	PW15-62A(P5)
L506	2C6892/C4	**COIL, r-f:** tank, 18-1/2 turns, 1/2″ copper tubing, tapped at 4, 6, 10, 12, 14, 15, 16, 18 turns, 6-3/4″ diam x 15″ long	PW15-62B(P5)
L507	2C6892/C7	**COIL, r-f:** tank, 9-3/4 turns 1/2″ copper tubing, 5″ diam x 9″ long	PW15-61B(P5)
RFC501A, RFC501B	3CK326-154-4	**COIL, r-f:** choke, 1-mh at 600 ma, 6-ohm d-c resistance	R154U(N1)
RFC502, RFC503	3C323-8Z3	**COIL, r-f:** choke 5 turns, 3/16″ copper tubing	PW16-12(P5)
RFC508, RFC509, RFC510, RFC511	3C323-8G	**COIL, r-f:** choke 87 turns, No. 20 SCC on pyrex form 8-1/2″ long x 1″ diam	PW16-5(P5)
E501	2Z3269-12	**COUPLING, flexible:** insulated	C(C2)
N501	2Z3718.10	**DIAL:** 4″ diam, 180°, direct drive	717F(G9)
		FLUE, pyrex: 4″ diam, x 4″ long	(G1)
E502, E503	2ZA1350	**HANDWHEEL:** 4″ diam, 3/8″ shaft	9-23(A18)
E504, E505, E507, E508, E509, E510, E511, E512, E540, E541, E542, E543, E545, E546, E551, E552, E557, E558	3G1000-12	**INSULATOR, stand-off:** conical, 1-1/2″ high	1117-00(G1)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
E513, E514, E515, E516, E517, E520 to 537	3G1000-16.3	**INSULATOR, stand-off:** conical, 2" high	434L-2(I6)
E518, E519	3G1880-24	**INSULATOR, stand-off:** cylindrical, 1-1/4 high x 3/4" diam	1019-00(G1)
E538, E539, E549, E550	3G1350-33	**INSULATOR, feedthru:** bowl	1088-00(G1)
	3G1250-64.9	**INSULATOR, stand-off:** round, 4" long x 1-1/4" diam	1059-00(G1)
	3G1250-24.1	**INSULATOR, stand-off:** ceramic, round 1-1/2" long x 1-1/4" diam	1059-00(G1)
M501	3F950-3	**METER:** 0-500-ma, d-c	D041(G3)
M502, M503	3F100-45	**METER:** 0-1.5-amp, d-c	D041(G3)
M504, M505	3F1005-25	**METER, r-f:** 0-5-amp	D044(G3)
M508	3F905-15	**METER:** 50-ma, with 5-kv scale and external shunt	L041(G3)
R501, R502, R503	3Z6050-76	**RESISTOR, wire-wound:** 500-ohm	B(G27)
R505, R506, R507, R508	3Z6025-28	**RESISTOR, wire-wound:** 250-ohm, 200-w	0906(02)
T501, T502	2Z9600.111	**TRANSFORMER, filament:** pri 215-v, 60-cps, sec 16-v ct at 39-amp	T-7292(A24)
V501, V502	2J8002-R	**TUBE JAN-8002-R**	GL-8002-R(G3)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
		LOW VOLTAGE POWER SUPPLY	
C601, C602, C603, C604, C605, C606	3DB10-37	**CAPACITOR, oil:** 10-mf, 1,000 v dc (working)	TJU-10100(C15)
E602, E603, E604, E605, E606, E607	2Z2712	**CLIP, tube:** 9/16"	12(N1)
CH601, CH602, CH604, CH605, CH606	3C323-20D	**COIL, a-f:** choke, filter, 14-h at 250 ma, 130-ohm d-c resistance	T-7438-(A24)
J601	2Z3071-1	**CONNECTOR, female:** 10-contact, with angle bracket	S-2410-SB(J5)
J602	2Z3067-6	**CONNECTOR, female:** 6-contact, with angle bracket	S-2406-SB(J5)
P602	2Z3026-6	**CONNECTOR, male:** 6-contact, with cable clamp	P-2406-CCE(J5)
P601	2Z3030-5	**CONNECTOR, male:** 10-contact, with cable clamp	P-2410-CCE(J5)
E601, E608, E609, E610, E611, E612	3G1000-1.1	**INSULATOR, feedthru:** conical, 1"	478(B4)
R601	3Z5450.11	**RESISTOR, wire-wound:** 5,000-ohm, 200-w	D(W3)
R602	3Z6200-119	**RESISTOR, wire-wound:** 2,000-ohm, 10-w	AB(I2)
R603	3Z5510.19	**RESISTOR, wire-wound:** 10,000-ohm, 200-w	D(W3)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
R604, R605	3Z6050-148	**RESISTOR, wire-wound:** 500-ohm, 200-w, adjustable	1361(O2)
R606	3Z5475-11	**RESISTOR, wire-wound:** 7,500-ohm, 50-w	50F(W3)
X601	2Z8678.34	**SOCKET, tube:** octal, steatite	RSS8M(A13)
X602, X603, X604, X605, X606, X607	2Z8674.33	**SOCKET, tube:** 4-prong, steatite	33004(M4)
S601	3Z9853-2	**SWITCH, toggle:** DPDT	1009(B8)
T601	2Z9601.64	**TRANSFORMER, plate:** pri 230-v 60-cps, sec 600-v at 150 ma	T-7436(A24)
T602, T604, T606	2Z9600.112	**TRANSFORMER, filament:** pri 215-v 60 cps, sec 2.5-v ct, 25-va	T-7435(A24)
T603	2Z9601.63	**TRANSFORMER, plate:** pri 230-v 60-cps, sec 1160-v at 200 ma	T-7437(A24)
T605	2Z9601.66	**TRANSFORMER, plate:** pri 230-v 60-cps, sec 600-300 v at 250 ma	T-7439(A24)
T610	2Z9600.20	**TRANSFORMER, filament:** pri 215-v 60-cps, sec 6.3-v ct 20-va	T-7024(A24)
T611	2Z9600.106	**TRANSFORMER, filament:** pri 215-v 60-cps, 44-va, sec No. 1, 10.5-v at 2 amp; sec No. 2, 10.5-v at 2 amp	T-7291(A24)
V601	2JVR150-30	**TUBE JAN-VR150-30**	VR150-30(R2)
V602, V603, V604, V605, V606, V607	2J866A	**TUBE JAN-866A**	866A(R2)

MAIN RECTIFIER

C701, C702	3DB2.50020	**CAPACITOR, il:** 2-mf, 5,000 v dc (working)	TJ-50020(C15)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (c ntd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C703, C704	3DB4-65	**CAPACITOR, oil:** 4-mf, 3,000 v dc (working)	TJ-30040(C15)
E710, E711, E712, E713, E714, E715	2Z2712	**CLIP, tube:** 9/16"	12(N1)
CH701	3C323-20F	**COIL, a-f:** choke, filter, 0.25-h at 2 amp, 60-ohm d-c resistance	T-7321(A24)
CH702	3C323-20E	**COIL, a-f:** choke, filter, 3.5-h at 0.5 amp, 5,000-v test	T-7294(A24)
E701, E702, E703, E704	G1000-12	**INSULATOR, stand-off:** conical, 1-1/2" high	1177-00(G1)
E705, E706, E707, E708, E709, E716, to 724	3G1000-16.3	**INSULATOR, stand-off:** conical, 2" high	434-L-2(I6)
R703	3Z5988-4	**RESISTOR, wire-wound:** 0.8-ohm, (on mycalex form)	PW10-146(P5)
R704, R705, R706, R707, R708, R709	3Z5450.11	**RESISTOR, wire-wound:** 5,000-ohm, 200-w	D(W3)
X701, X702, X703, X704, X705, X706	2Z8759.3-1	**SOCKET, tube:** 4-prong, 50-w, porcelain	211(J4)

39. MAINTENANCE PARTS LIST FOR RADIOTELETYPE AND TELEGRAPH TRANSMITTER PW981-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
T701	2Z9600.18	**TRANSFORMER, filament:** pri 230-v 60-cps, sec 5-v at 30 amp 150-va.....	T-7030(A24)
T702	2Z9600.35	**TRANSFORMER, filament:** pri 215-v 60-cps, sec No. 1, 5 v at 10 amp; sec No. 2, 5 v at 10 amp; sec No. 3, 5 v at 10 amp.....	T-7031(A24)
T703	2Z9601.65	**TRANSFORMER, power:** pri 230 v 60-cps 3-phase delta connected, sec 3, 400 v dc at 1.7 amp, 1650 v at 0.3 amp from ct 6.5 kva wye connected	T-5378(A24)
V701, V702, V703, V704, V705, V706	2J872	**TUBE JAN-872A**	872A(A16)

40. LIST OF MANUFACTURERS.

Code	*Name*
A5	Allen-Bradley Co.
A10	American Blower Corp.
A13	American Phenolic Corp.
A16	Amperex Electronic Products, Inc.
A18	Atlas Press Co.
A24	Acme Electric Transformer Co.
B4	Birnbach Radio Co.
B8	Bud Radio Inc.
B11	Barkelew Electric Co.
C2	Allen D. Cardwell Mfg. Corp.
C4	Centralab
C15	Cornell-Dubilier Electric Corp.
C16	The R. W. Cramer Co.
C18	Cutler-Hammer Inc.
C30	Crowe Nameplate & Mfg. Co.
C57	Curtis Development Co.
D20	Diehl Mfg. Co.
F3	Federal Anti-Capacity Switch Corp.
G1	General Ceramics Co.
G3	General Electric Co.
G9	General Radio Co.
G27	Globar Corp.
H6	Heinemann Circuit Breaker Co.
H24	Hubbell Electric Co.
I2	International Resistance Co.
I6	Isolantite Inc.
J1	Jefferson Electric Co.
J4	Johnson, E. F. Co.
J5	Jones, Howard B.
K4	Kirkland Mfg. Co.
K6	Kurz-Kasch Co. Inc.
M1	Mallory, P. R. & Co.
M3	Micro Switch Corp.
M4	Millen, James Mfg. Co. Inc.
M5	Miller, J. W. Inc.
N1	National Co.
O2	Ohmite Mfg. Co.
O4	Owens-Corning Fiberglass Corp.
P5	Press Wireless Inc.
R2	RCA Mfg. Co.
R18	Radio Switches Inc.
S1	Sangamo Electric Co.
S9	Square D Co.
S26	S. W. Inductor Co.
S36	Sherman, H. B. Mfg. Co.
W3	Ward-Leonard Electric Co.
W5	Western Electric Co.

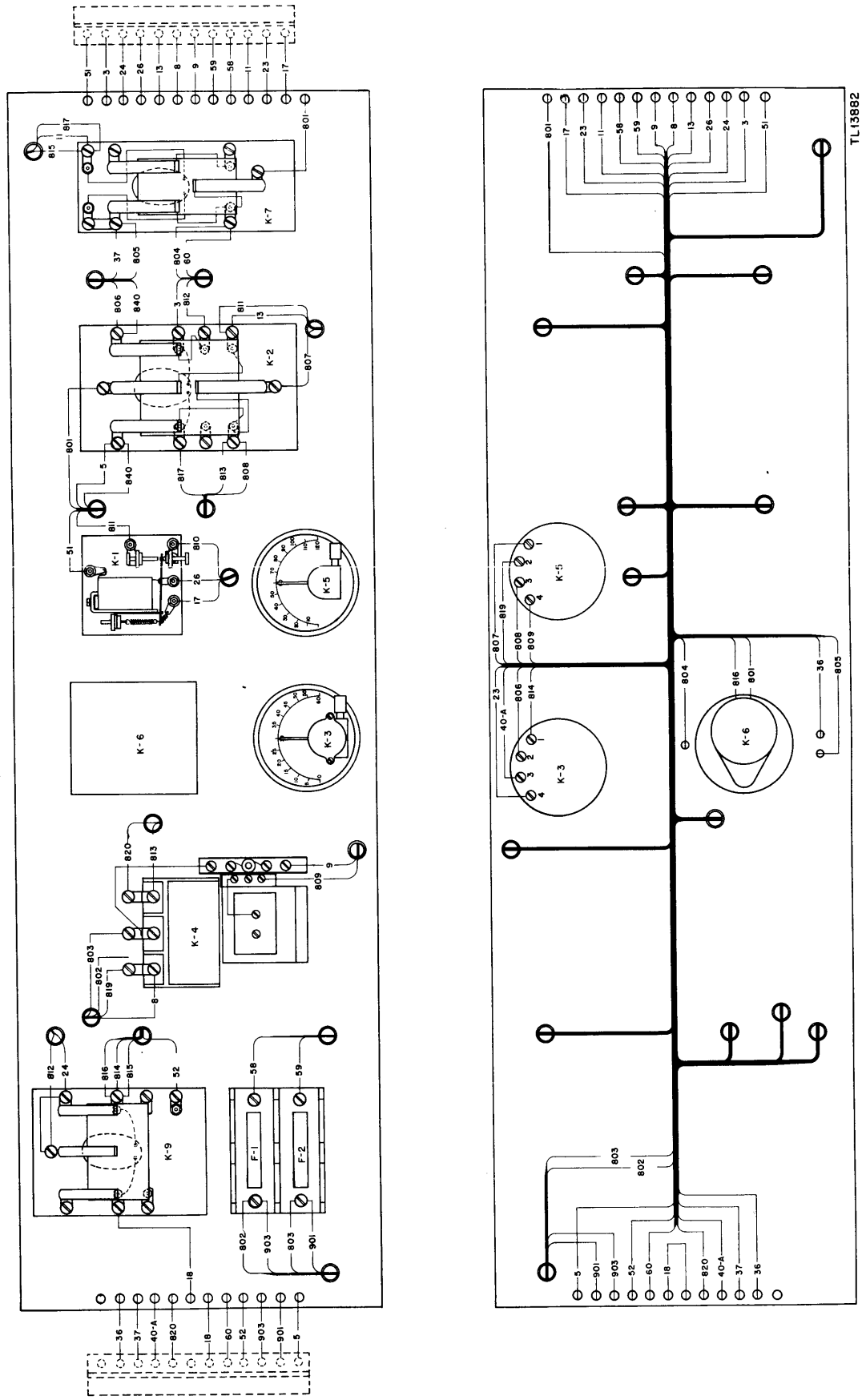

Figure 36. Contactor panel, wiring diagram.

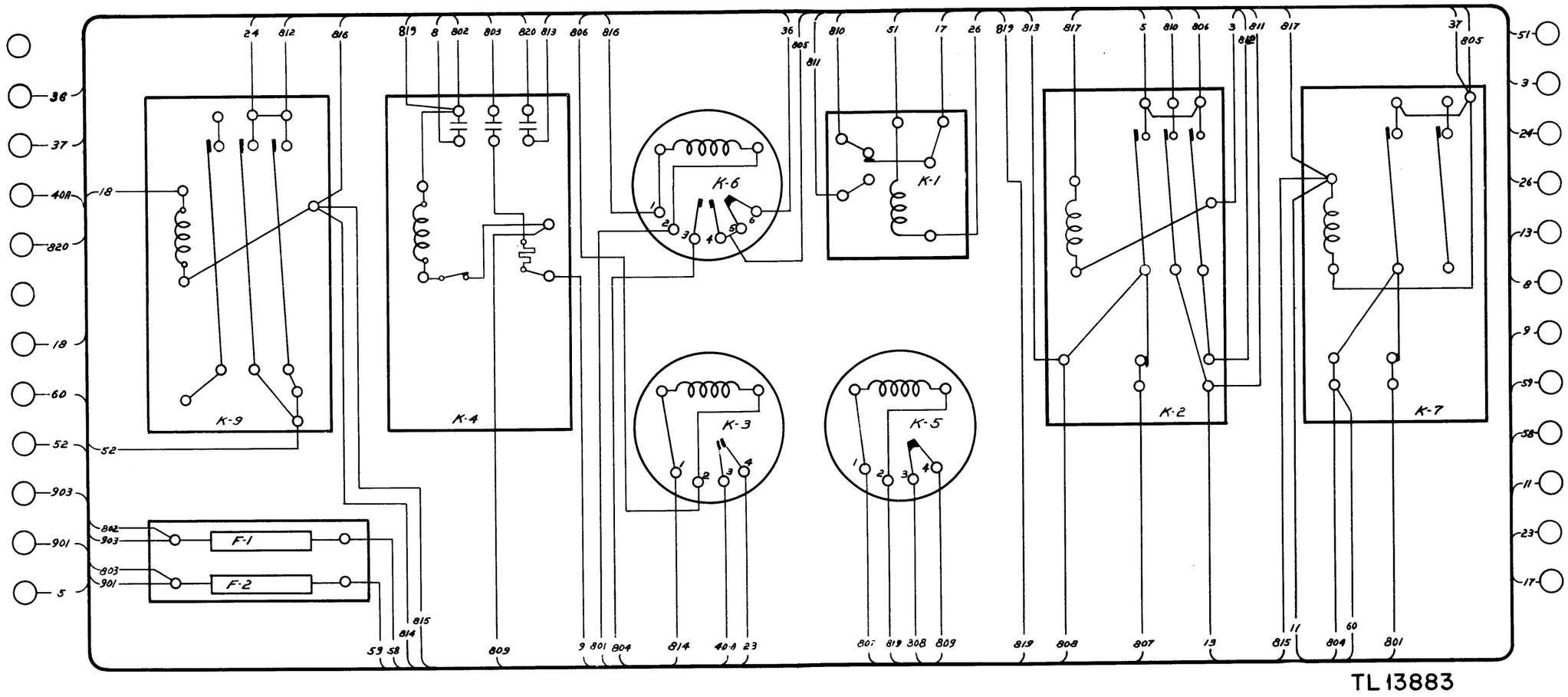

Figure 37. Contactor panel, schematic.

Component	Description
C-101	250 mmfd var
C-102	50 mmfd 500 v
C-103	100 mmfd var
C-104	.01 mfd 300 v
C-105	5 mmfd
C-106	.01 mfd 500 v
C-107	.01 mfd 600 v
C-108	.0001 mfd 500 v
C-109	.01 mfd 300 v
C-110	500 mmfd 500 v
C-111	500 mmfd 500 v
C-112	.001 mfd 500 v
C-113	.001 mfd 500 v
C-114	.01 mfd 600 v
C-115	100 mmfd var
C-116	.0001 mfd 500 v
C-117	.0001 mfd 500 v
C-118	.25 mfd 600 v
C-119	50 mmfd 500 v
C-120	.01 mfd 300 v
C-121	.01 mfd 600 v
C-122	100 mmfd 500 v
C-123	.01 mfd 600 v
C-124	.01 mfd 600 v
C-125	20 mmfd 500 v
R-101	100,000 ohms 1 w
R-102	12,000 ohms 1 w
R-103	2,500 ohms ½ w
R-104	100,000 ohms 1 w
R-105	10,000 ohms POT
R-106	50,000 ohms 1 w
R-108	75,000 ohms 1 w
R-109	75,000 ohms 1 w
R-110	15,000 ohms 1 w
R-112	10,000 ohms 1 w
R-113	250 ohms 1 w
R-114	100,000 ohms 1 w
R-120	Oven Heater
R-121	Oven Heater
L-101	H-F Osc. Coil
L-103	L-F Osc. Coil
RFC-101	2.5 MH RF Choke
RFC-102	2.5 MH RF Choke
RFC-103	2.5 MH RF Choke
RFC-104	125 MH RF Choke

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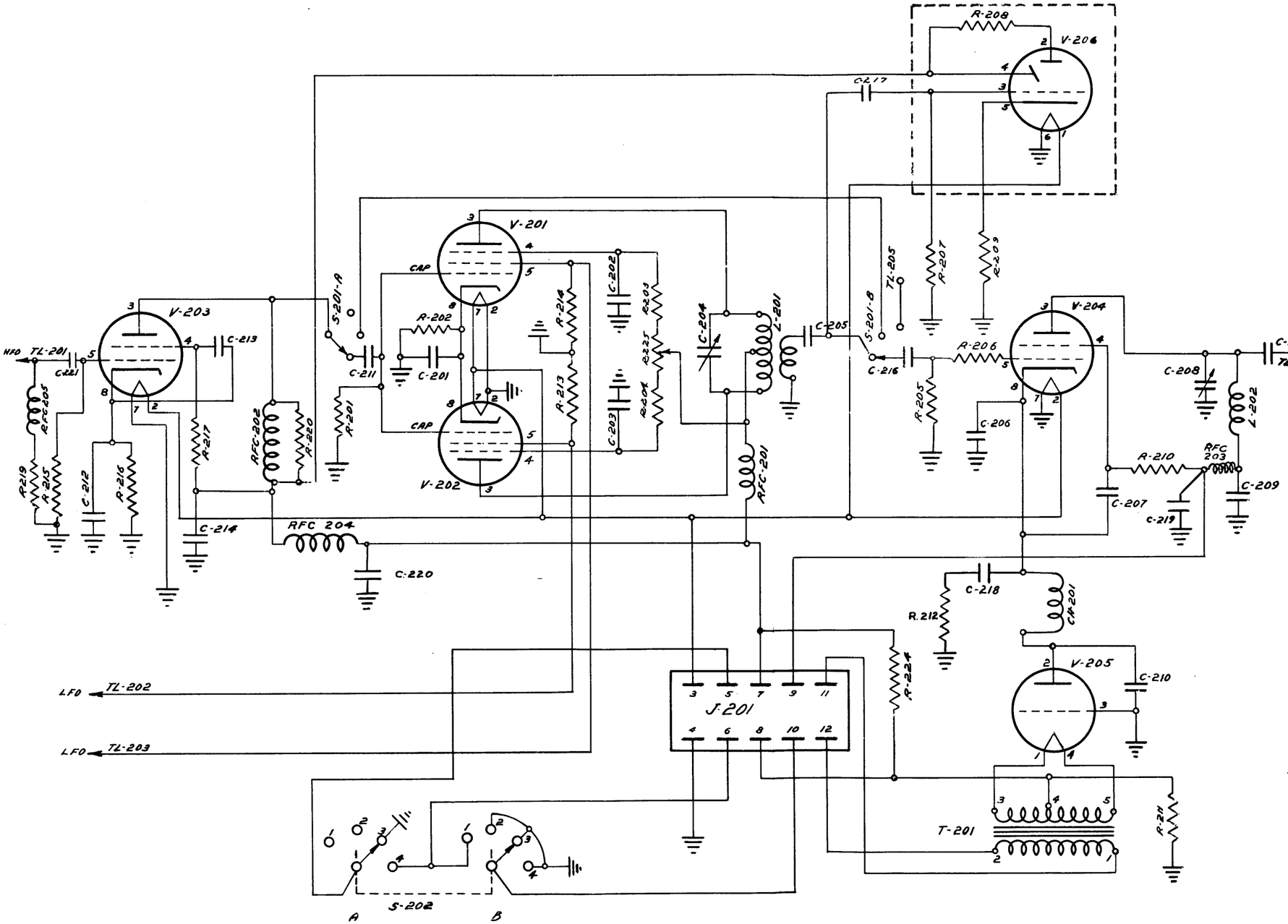
Figure 38. Oscillator and shifter, schematic.



Component	Description
R-201	10,000 ohms 1 w
R-202	1,000 ohms 1 w
R-203	1,500 ohms 1 w
R-204	1,500 ohms 1 w
R-205	12,000 ohms 1 w
R-206	500 ohms 1 w
R-207	500,000 ohms 1 w
R-209	1,500 ohms
R-210	15,000 ohms 1 w
R-211	100,000 ohms 1 w
R-212	20,000 ohms 1 w
R-213	60,000 ohms 1 w
R-214	60,000 ohms 1 w
R-215	100,000 ohms 1 w
R-216	400 ohms 1 w
R-217	15,000 ohms 1 w
R-219	500 ohms ½ w
R-220	20,000 ohms 1 w
R-222	1,500 ohms 1 w
R-225	10,000 ohms POT
R-224	250,000 ohms 1 w
C-201	.01 mfd—600 v
C-202	.01 mfd—600 v
C-203	.01 mfd—600 v
C-204	250 mmfd VAR
C-205	100 mmfd 600 v
C-206	.01 mfd 600 v
C-207	.01 mfd 600 v
C-208	250 mmfd VAR
C-209	.01 mfd—600 v
C-210	.25 mfd—600 v
C-211	100 mmfd—600 v
C-212	.01 mfd—600 v
C-213	.01 mfd—600 v
C-214	.01 mfd—600 v
C-215	50 mmfd—1200 v
C-216	.001 mfd 500 v
C-217	.001 mfd—1200 v
C-218	.25 mfd—600 v
C-219	.01 mfd 300 v
C-221	510 mmfd—500 v

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Figure 39. Mixer chassis, schematic.

Component	Description
C-329	.01 mfd—600 v
C-301	.01 mfd—600 v
C-302	.01 mfd—1200 v
C-303	.01 mfd—1200 v
C-304	.01 mfd—1200 v
C-305	250 mmfd Each Sec
C-306	.01 mfd—1200 v
C-307	250 mmfd Each Sec.
C-309	.01 mfd—1200 v
C-310	.01 mfd—1200 v
C-311	145 mmfd Each Sec.
C-313	.01 mfd—1200 v
C-314	50 mmfd air
C-315	50 mmfd 1200 v
C-316	50 mmfd air
C-317	50 mmfd 1200 v
C-318	50 mmfd 1200 v
C-319	50 mmfd 1200 v
C-320	.01 mfd—1200 v
C-321	.01 mfd—1200 v
C-322	.01 mfd—1200 v
C-323	.01 mfd—500 v
C-324	15 mmfd VAR
C-325	15 mmfd VAR
C-326	15 mmfd VAR
C-327	.01 mfd—1200 v
C-328	.01 mfd—1200 v
R-301	50 ohms 1 w
R-302	1000 ohms 1 w
R-303	20,000 ohms 1 w
R-304	200 ohms 10 w
R-306	50 ohms 1 w
R-307	1000 ohms 1 w
R-308	20,000 ohms 1 w
R-309	200 ohms 10 w
R-310	50 ohms 1 w
R-311	50 ohms 1 w
R-312	1000 ohms 1 w
R-313	20,000 ohms 1 w
R-314	200 ohms 10 w
R-315	50 ohms 1 w
R-316	20 ohms 1 w
R-317	20 ohms 1 w
R-318	20 ohms 1 w
R-319	20 ohms 1 w
R-320	10,000 ohms 1 w
R-321	10,000 ohms 1 w
R-322	10,000 ohms 1 w
R-323	10,000 ohms 1 w
R-324	10,000 ohms 1 w
R-305	50 ohms 1 w
R-325	10,000 ohms 1 w

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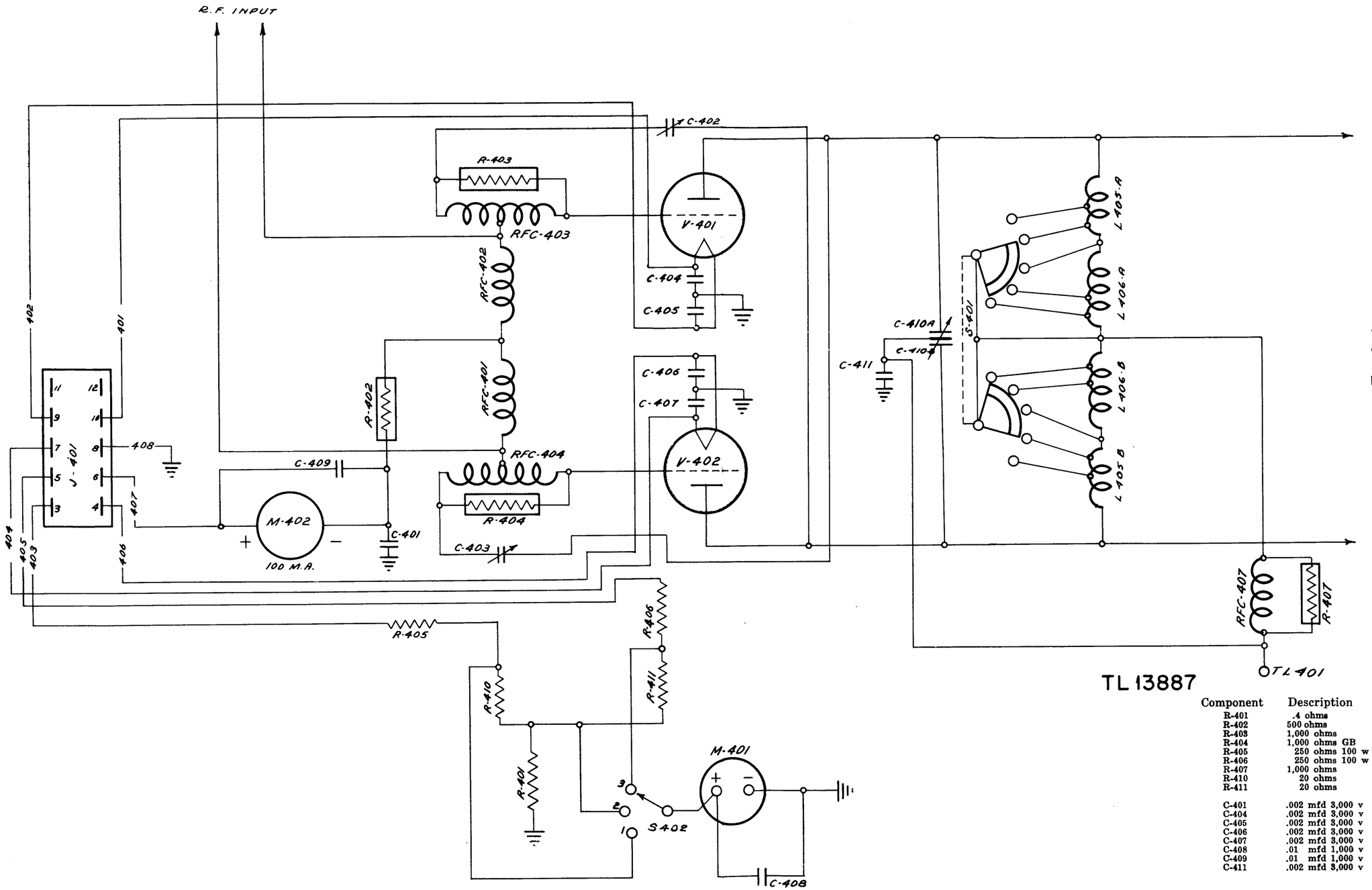
Figure 40. Frequency multiplier, schematic.



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Component	Description
R-401	.4 ohms
R-402	500 ohms
R-403	1,000 ohms
R-404	1,000 ohms GB
R-405	250 ohms 100 w
R-406	250 ohms 100 w
R-407	1,000 ohms
R-410	20 ohms
R-411	20 ohms
C-401	.002 mfd 3,000 v
C-404	.002 mfd 3,000 v
C-405	.002 mfd 3,000 v
C-406	.002 mfd 3,000 v
C-407	.002 mfd 3,000 v
C-408	.01 mfd 1,000 v
C-409	.01 mfd 1,000 v
C-411	.002 mfd 3,000 v

Figure 41. Driver, schematic.

Component	Description
R-601	5,000 ohms—200 w
R-602	2,000 ohms— 10 w
R-603	10,000 ohms—200 w
R-604	500 ohms—200 w
R-605	500 ohms—200 w
R-606	7,500 ohms— 50 w

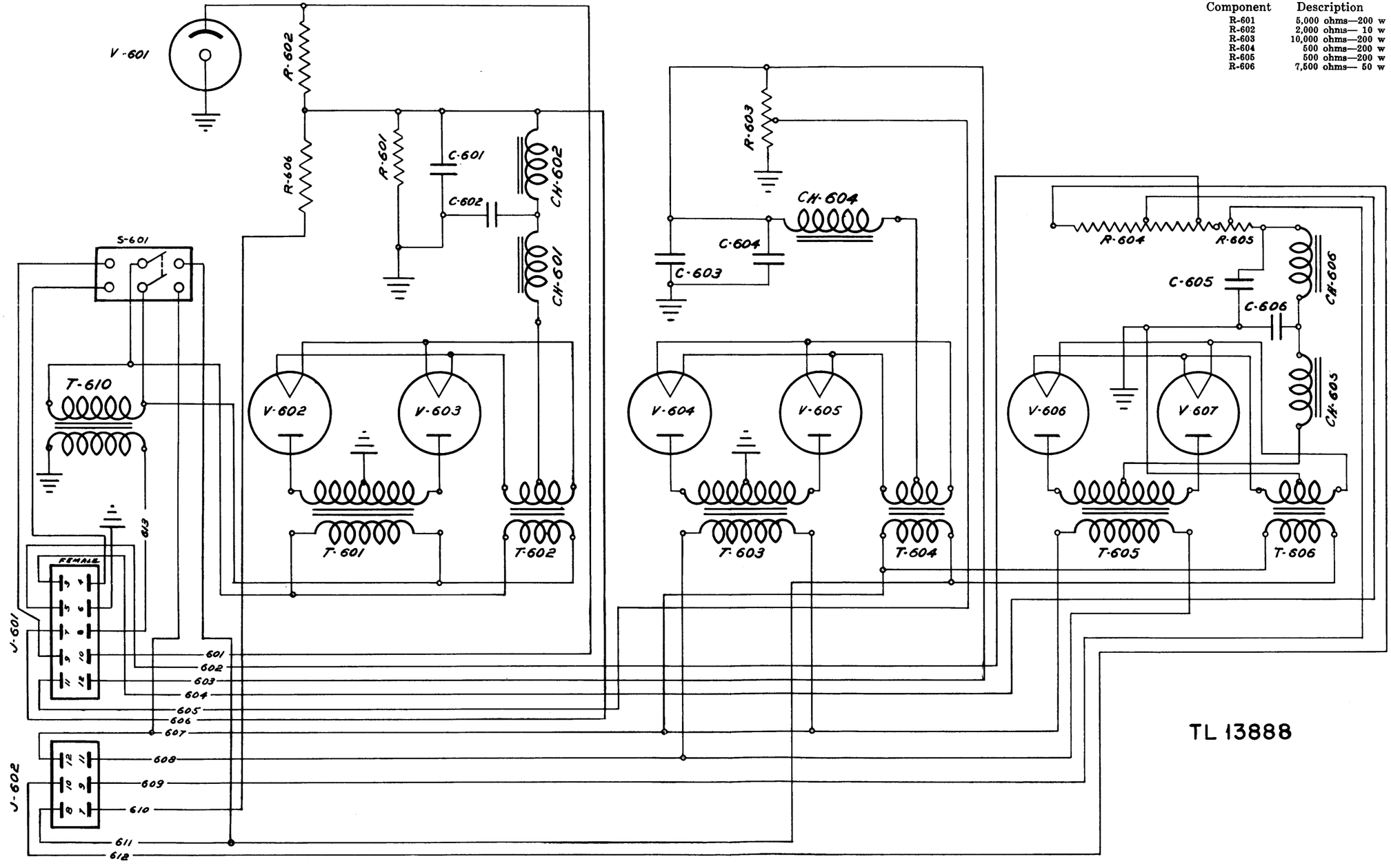


Figure 42. Low-power supply, schematic.

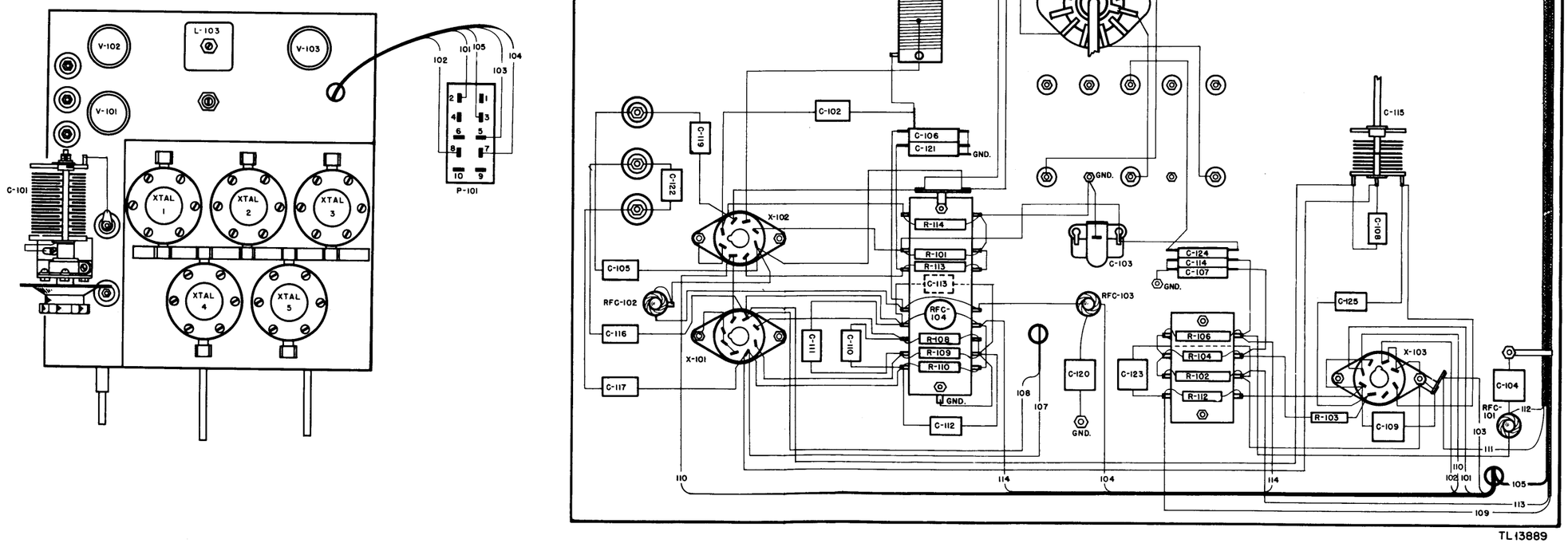
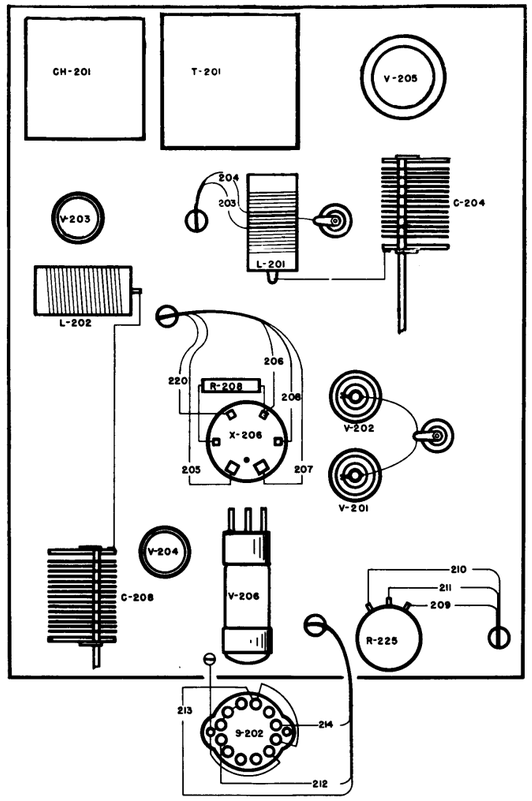


Figure 43. Oscillator, wiring diagram.



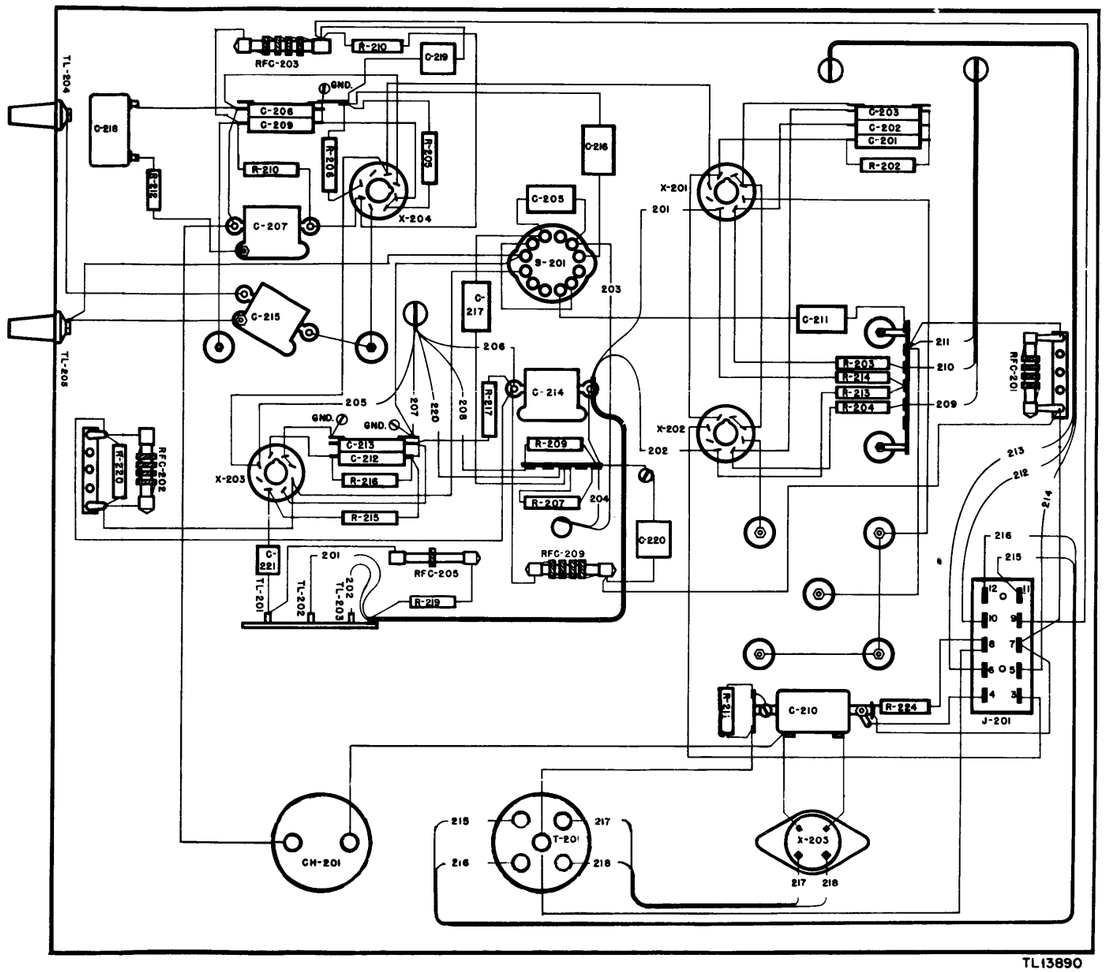


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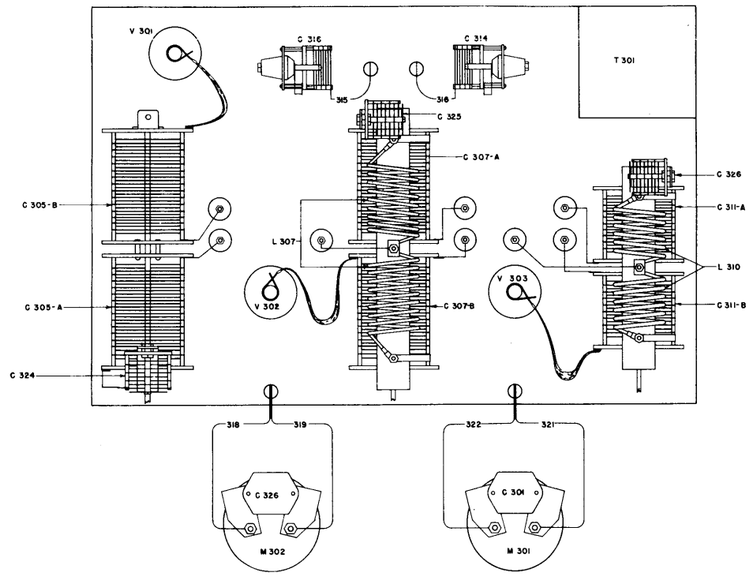
Figure 44. Mixer chassis, wiring diagram.



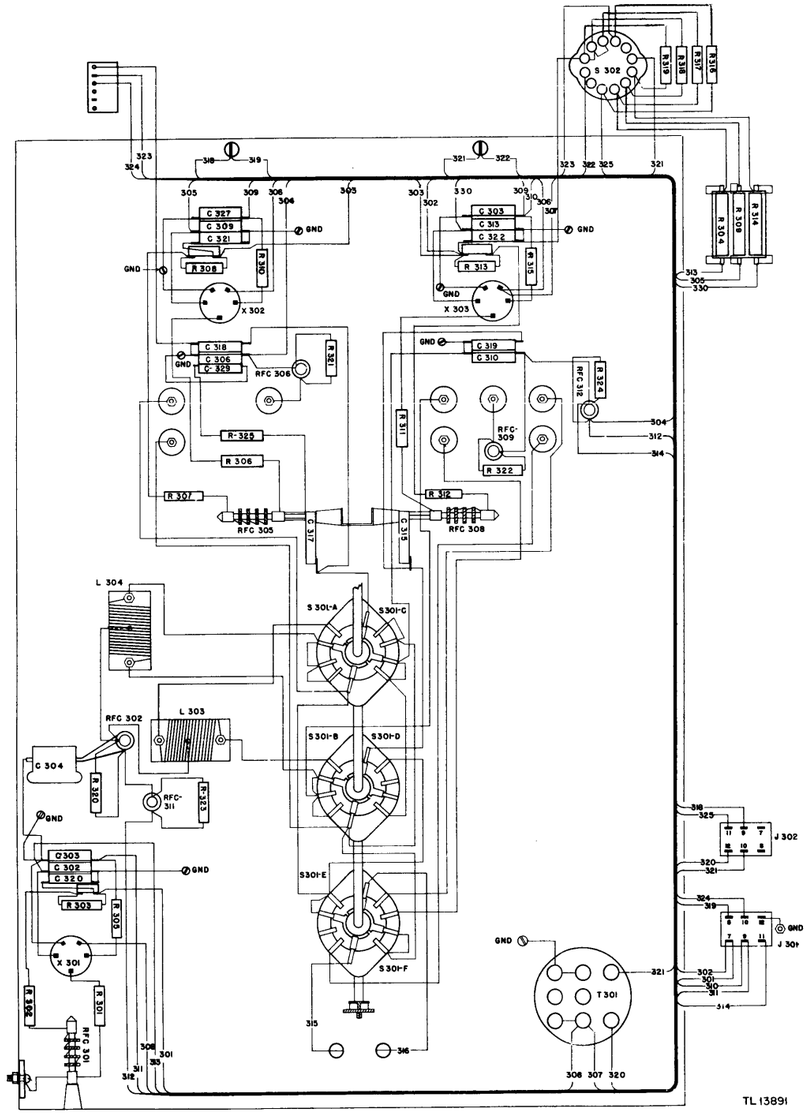
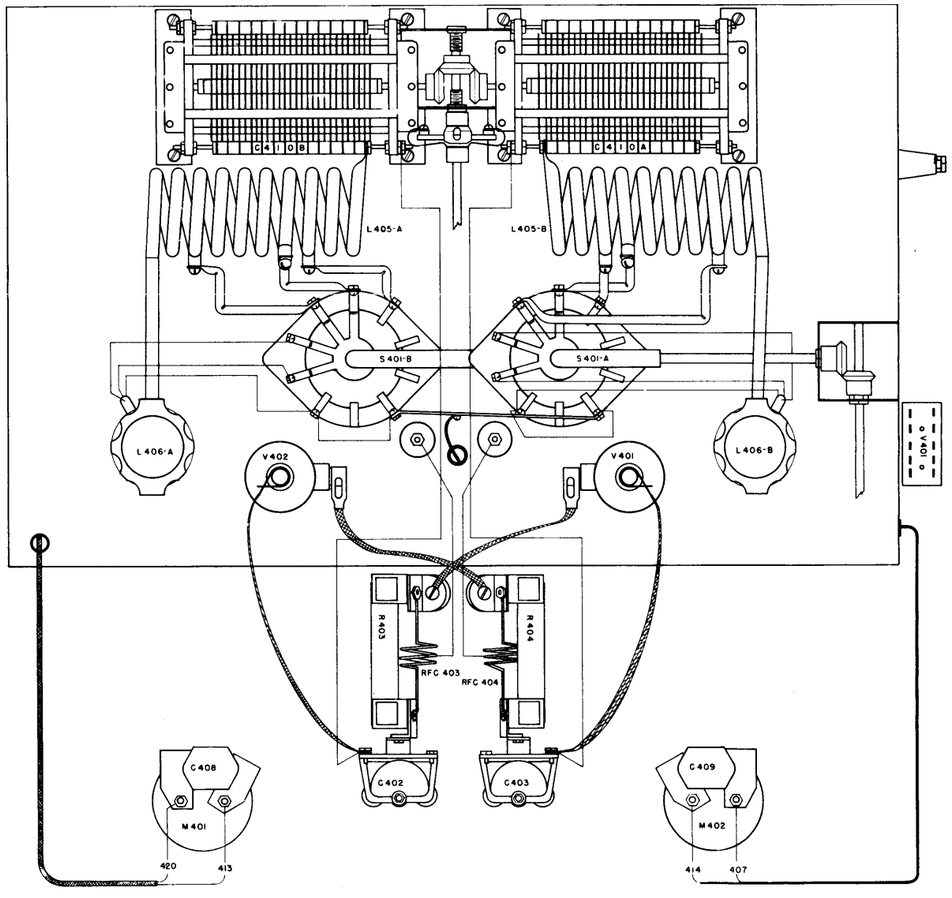


Figure 45. Frequency multiplier, wiring diagram.



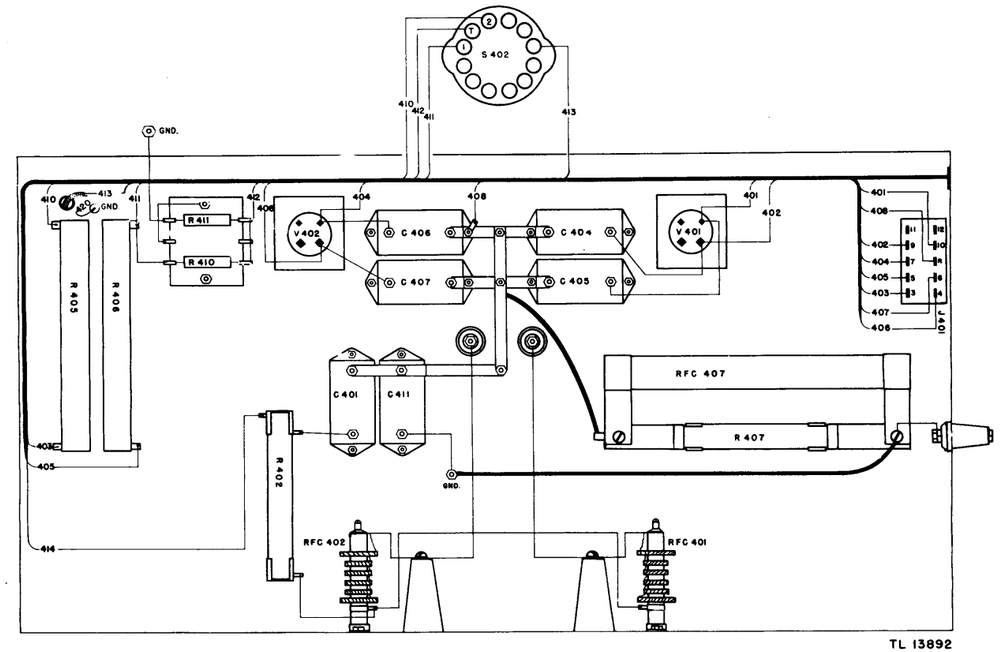
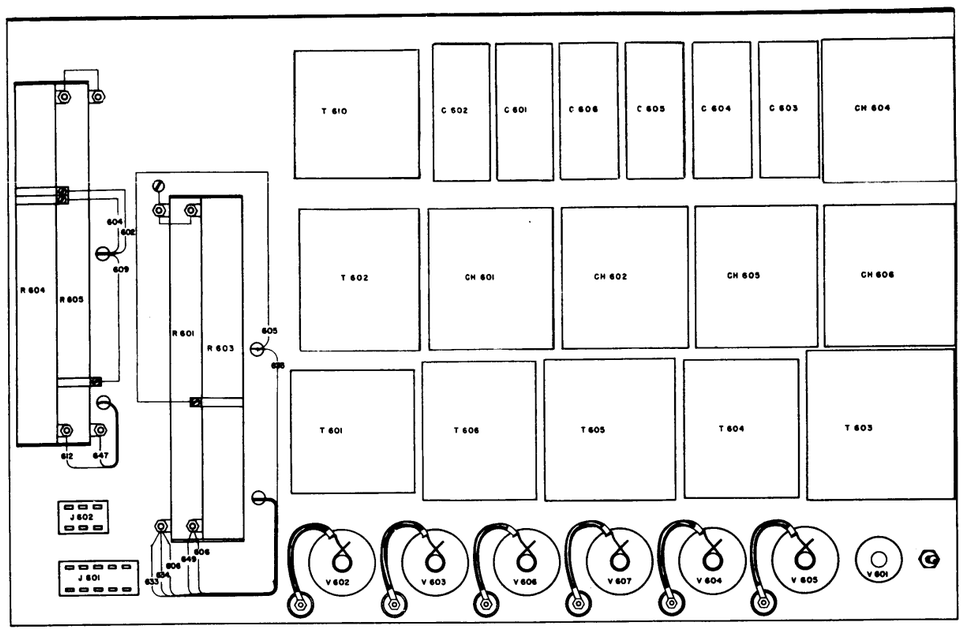


Figure 46. Driver, wiring diagram.



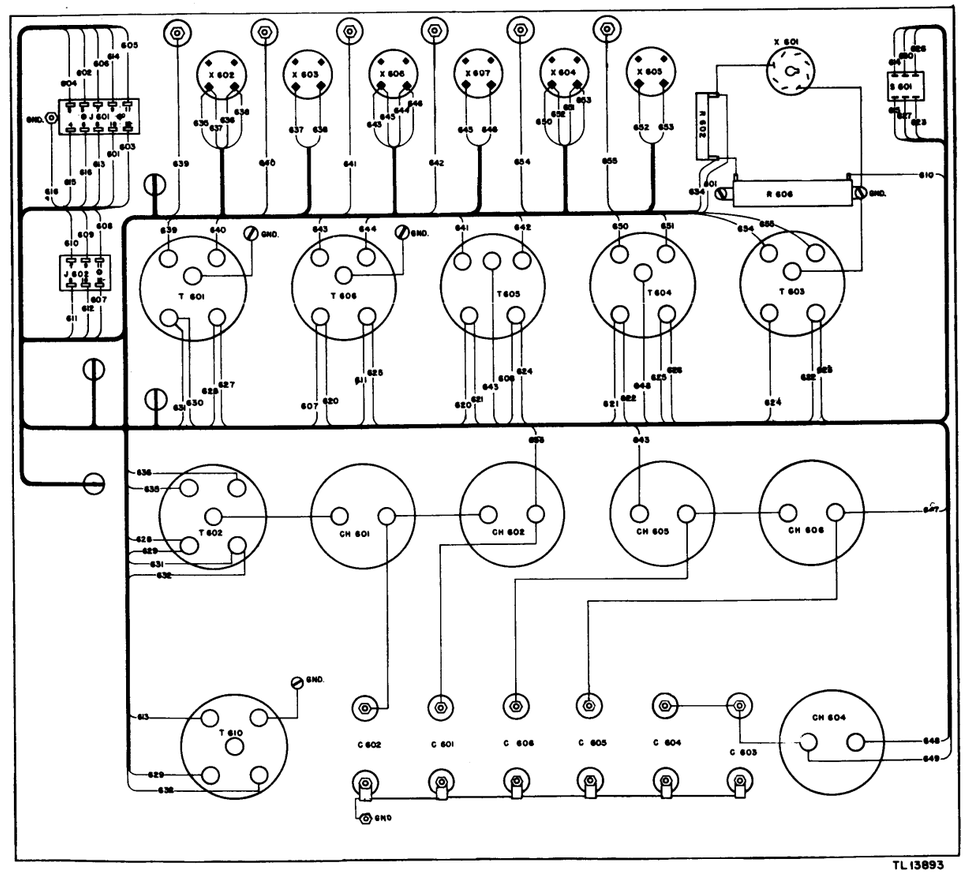


Figure 47. Low-power supply, wiring diagram.

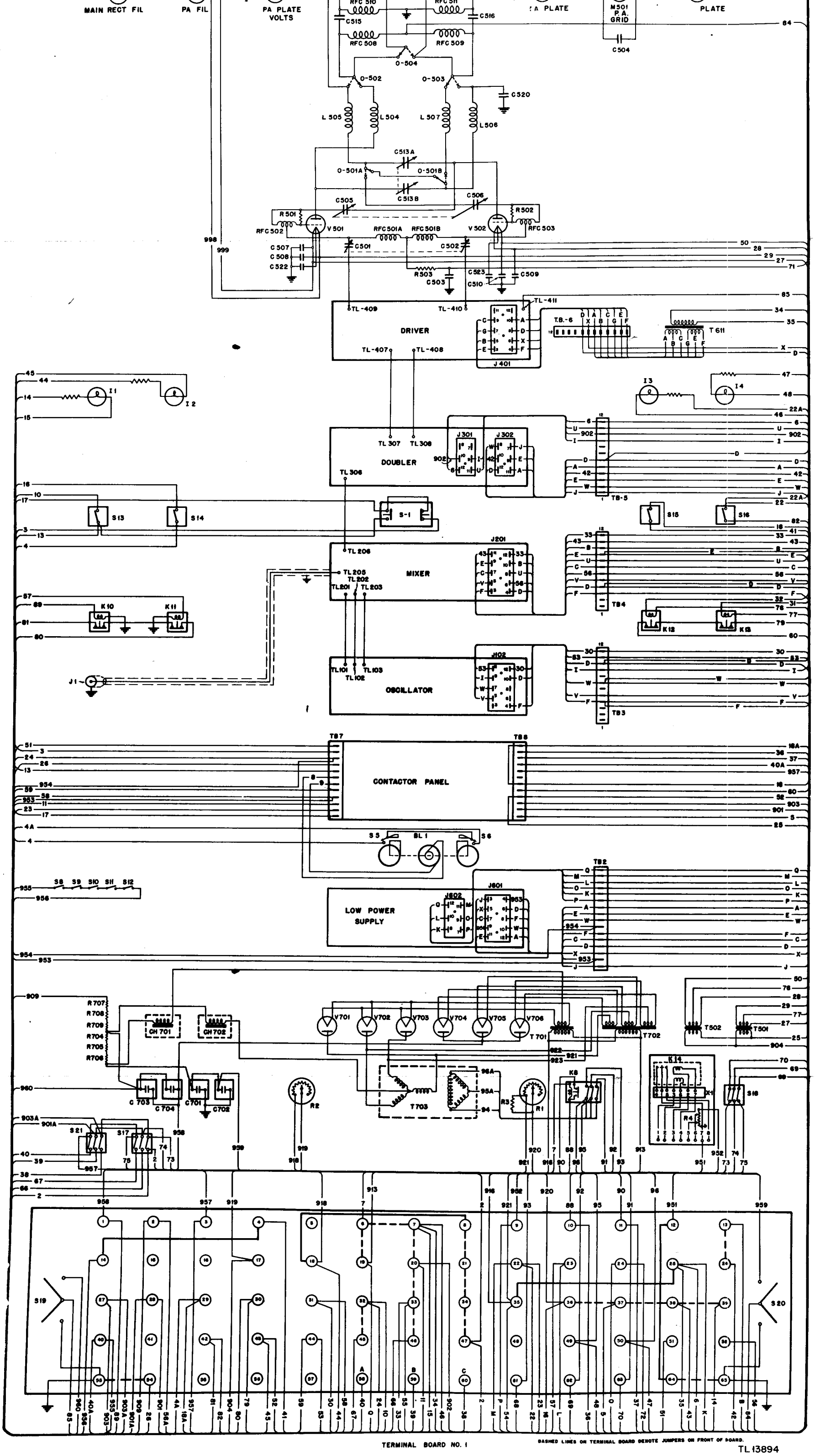


Figure 48. Cabinet wiring diagram.

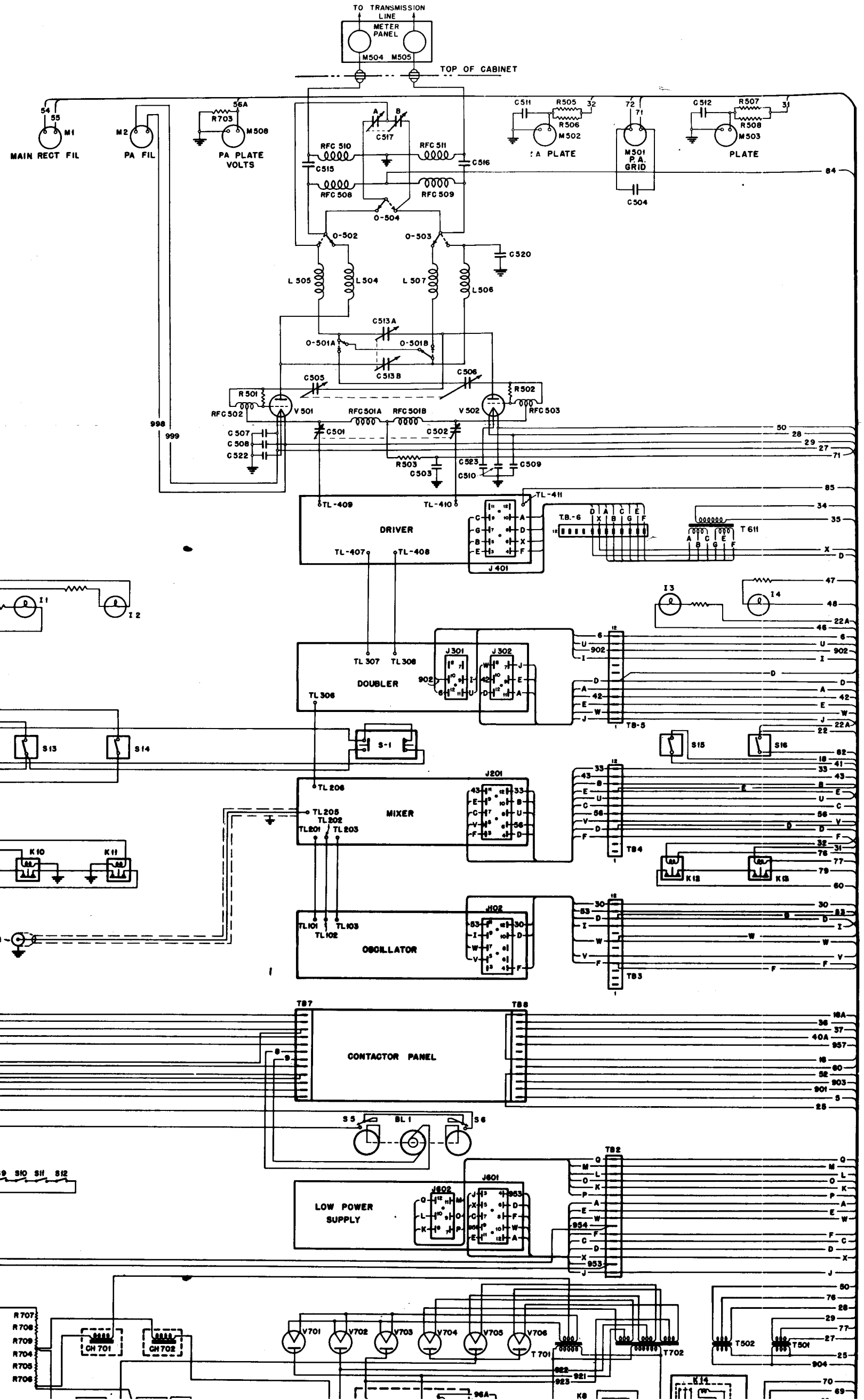
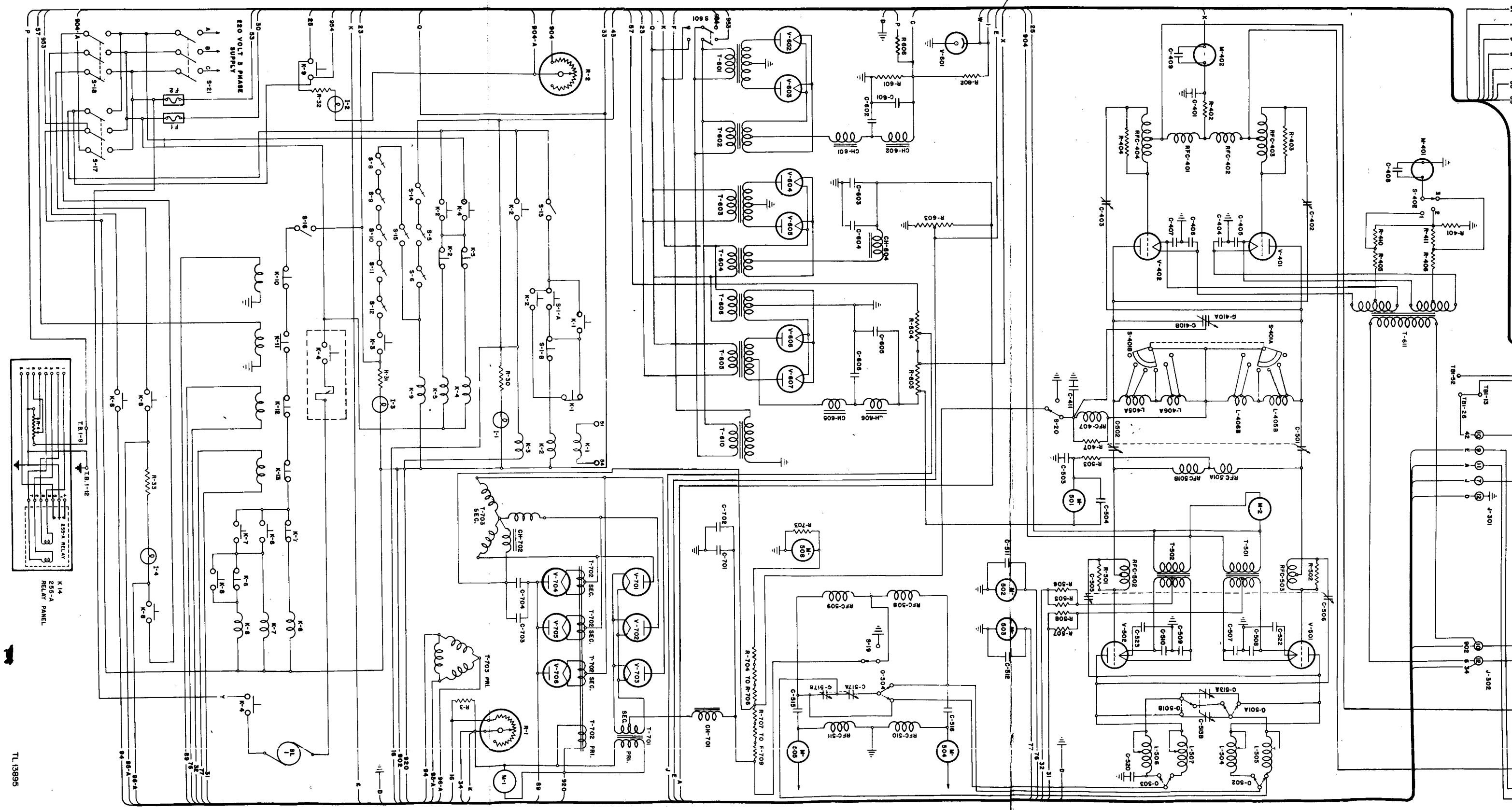

TO TRANSMISSION LINE
METER PANEL
M504 M505
TOP OF CABINET
54
55
M1
MAIN RECT FIL
M2
PA FIL
56A
R703
M508
PA PLATE VOLTS
A
B
C517
RFC 510
RFC 511
C515
C516
RFC 508
RFC 509
O-504
O-502
O-503
C520
L 505
L 504
L 507
L 506
C513A
O-501A
O-501B
C513B
C505
C506
R501
R502
RFC 502
V 501
RFC 501A
RFC 501B
V 502
RFC 503
998
999
C507
C508
C522
C501
C502
R503
C503
C523
C510
C509
C511
R505
32
R506
M502
PA PLATE
72
71
M501
P.A.
GRID
C504
C512
R507
31
R508
M503
PLATE
84
50
28
29
27
71
85
TL-411
TL-409
TL-410
DRIVER
TL-407
TL-408
J 401
T.B.-6
T 611
34
35
X
D
45
44
14
15
I 1
I 2
I 3
I 4
47
48
22A
46
6
U
902
I
D
A
42
E
W
J
TL 307
TL 308
DOUBLER
J 301
J 302
TL 306
TB-5
16
10
17
3
13
4
S 13
S 14
S-1
S15
S16
82
18
41
33
43
B
E
U
C
56
V
D
F
32
31
76
77
79
60
TL 206
TL 205
TL 202
TL201
TL 203
MIXER
J201
TB4
K12
K13
87
89
81
80
K10
K11
J1
TL101
TL 102
TL 103
OSCILLATOR
J102
TB3
30
53
51
24
26
954
959
953
11
23
17
4A
TB7
TB6
CONTACTOR PANEL
8
9
16A
36
37
40A
957
18
52
903
901
5
25
S5
BL 1
S6
S8
S9
S10
S11
S12
955
956
LOW POWER SUPPLY
J602
J601
TB2
909
R 707
R 708
R 709
R 704
R 705
R 706
CH 701
CH 702
V701
V702
V703
V704
V705
V706
T 701
T702
T502
T501
922
921
923
96A
K14
K9
904
70
69

Figure 49. Radiotelegraph transmitter PW-981-A, master schematic.



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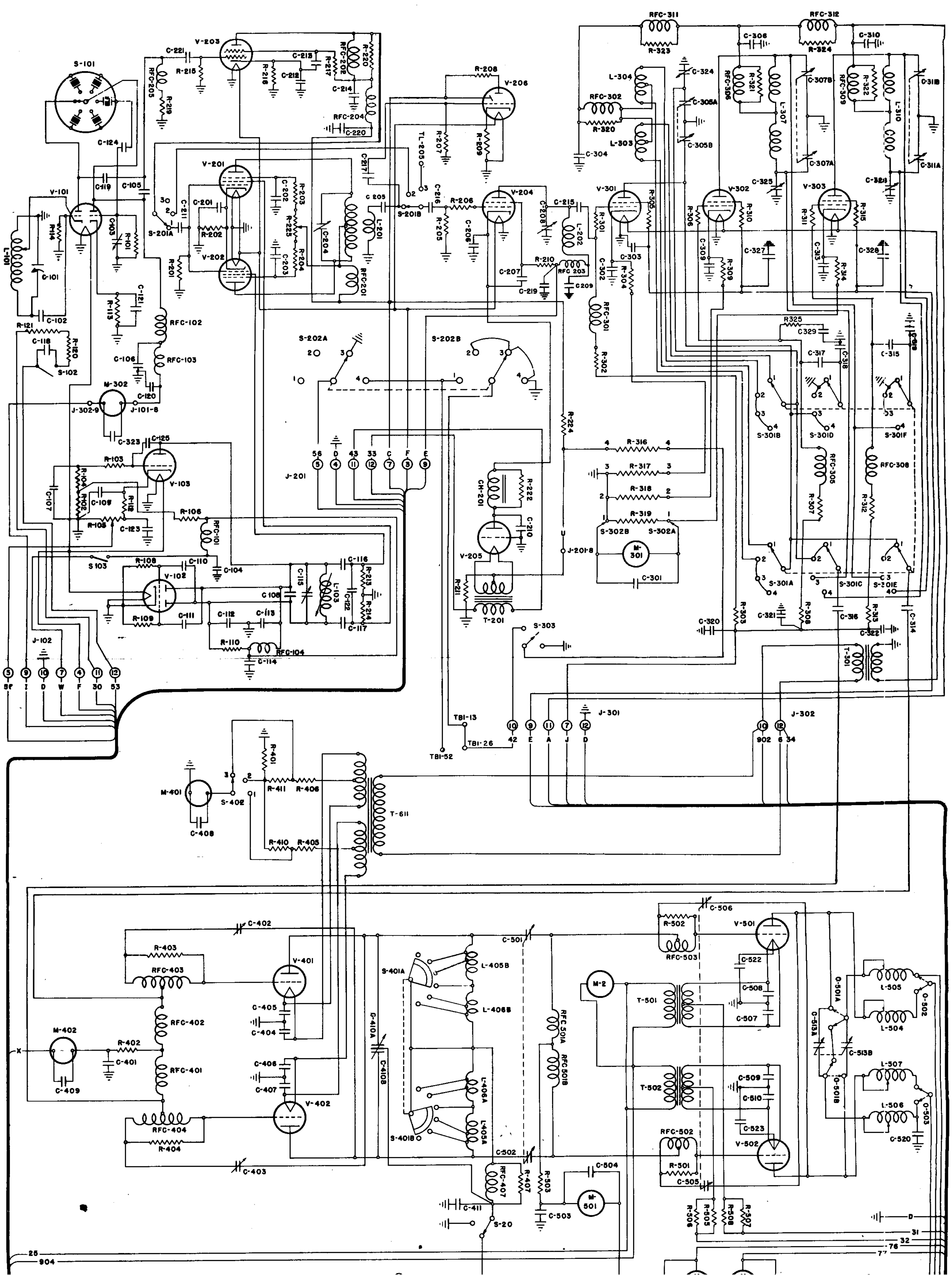
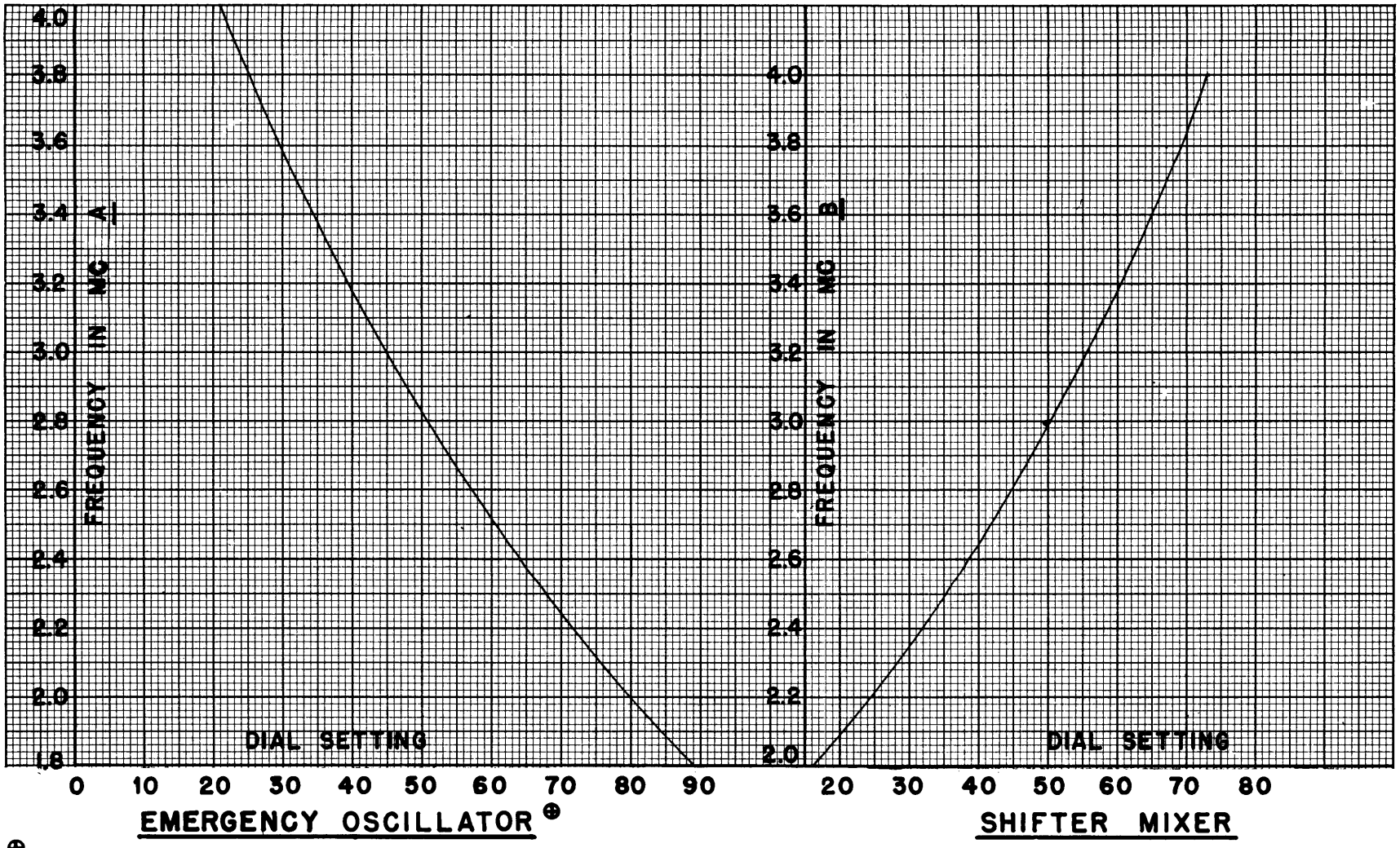

S-101
V-101
V-102
V-103
V-201
V-202
V-203
V-204
V-205
V-206
V-301
V-302
V-303
V-401
V-402
V-501
V-502
S-202A
S-202B
S-201A
S-201B
S-301A
S-301B
S-301C
S-301D
S-301E
S-301F
S-302A
S-302B
S-303
S-102
S 103
S-401A
S-401B
S-402
S-20
J-102
J-201
J-301
J-302
J-201-8
J-302-9
J-101-8
T-201
T-301
T-501
T-502
T-611
M-301
M-302
M-401
M-402
M-501
M-2
CH-201
TB1-13
TB1-26
TB1-52
TL-205
RFC-101
RFC-102
RFC-103
RFC-104
RFC-201
RFC-202
RFC-204
RFC-205
RFC-301
RFC-302
RFC-305
RFC-306
RFC-308
RFC-309
RFC-311
RFC-312
RFC-401
RFC-402
RFC-403
RFC-404
RFC-407
RFC-501A
RFC-501B
RFC-502
RFC-503
L-101
L-103
L-201
L-202
L-303
L-304
L-307
L-310
L-405A
L-405B
L-406A
L-406B
L-504
L-505
L-506
L-507



⊕ FOR TELEGRAPH OPERATION, USE FREQUENCY ORDINATE A
FOR TELETYPE OPERATION, USE FREQUENCY ORDINATE B

Figure 50. Oscillator and shifter mixer calibration curves.

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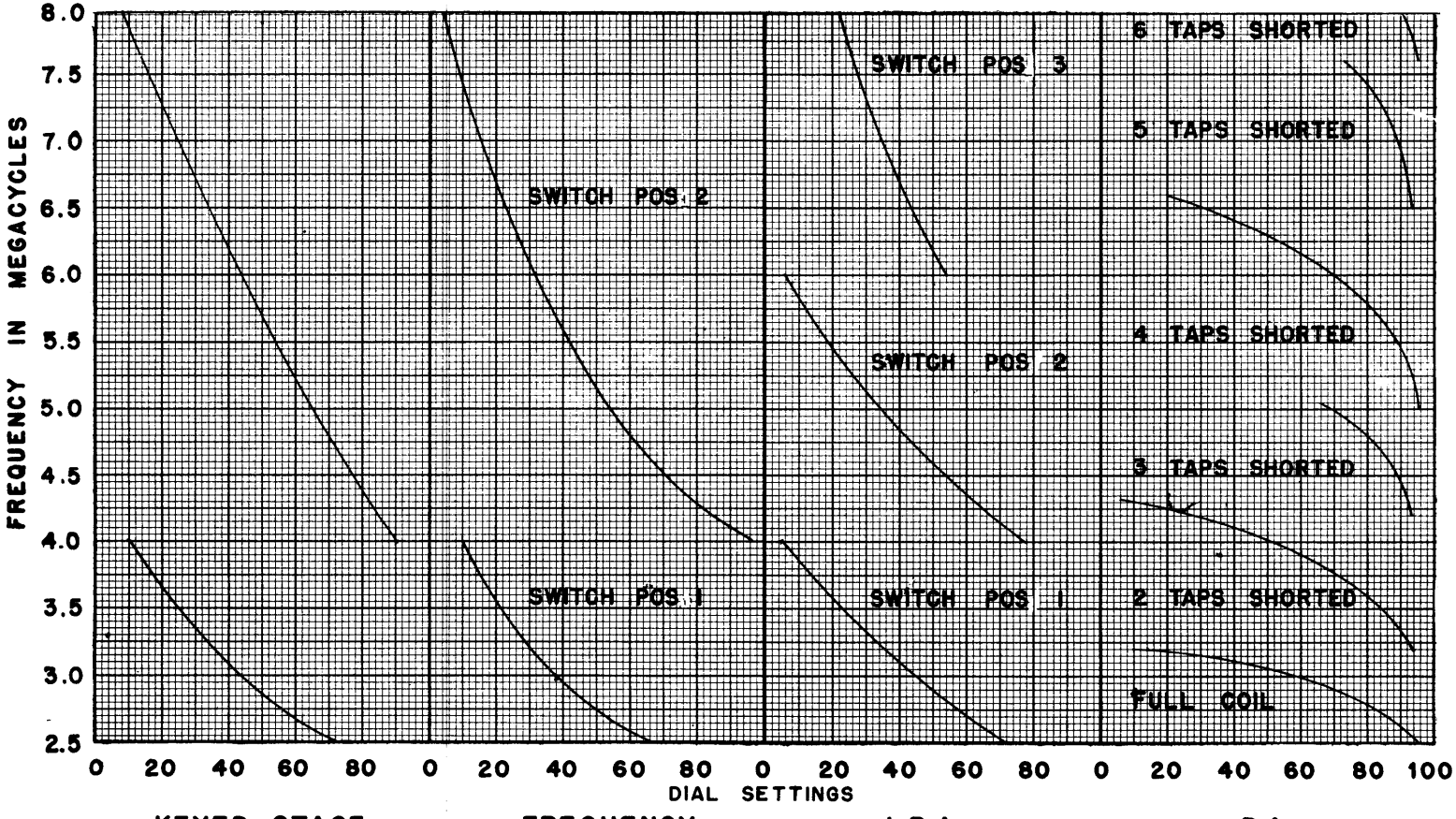

Figure 51. Transmitter calibration curves for frequencies from 2.5 to 8 megacycles.

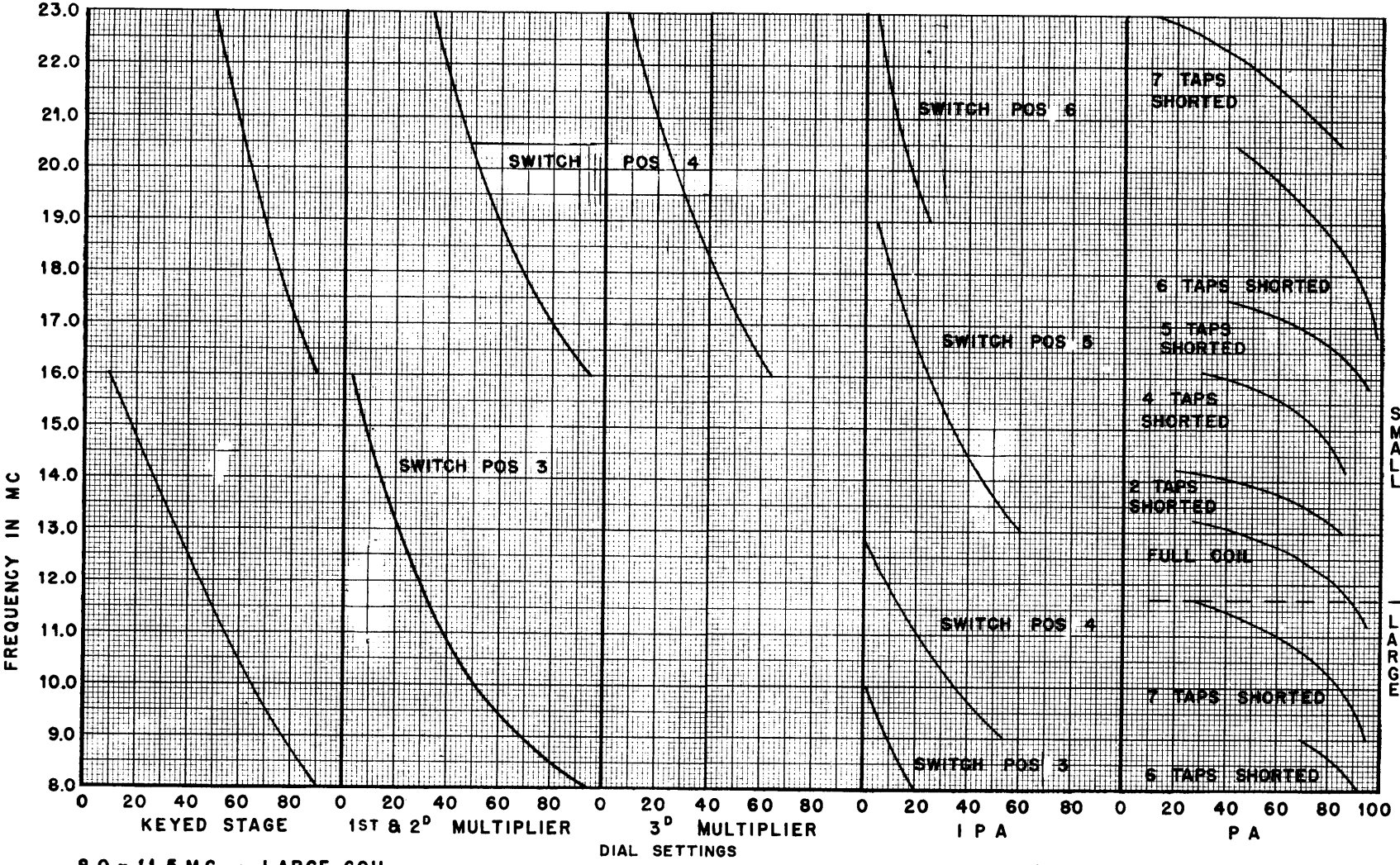

Figure 52. Transmitter calibration curves for frequencies from 8 to 23 megacycles.

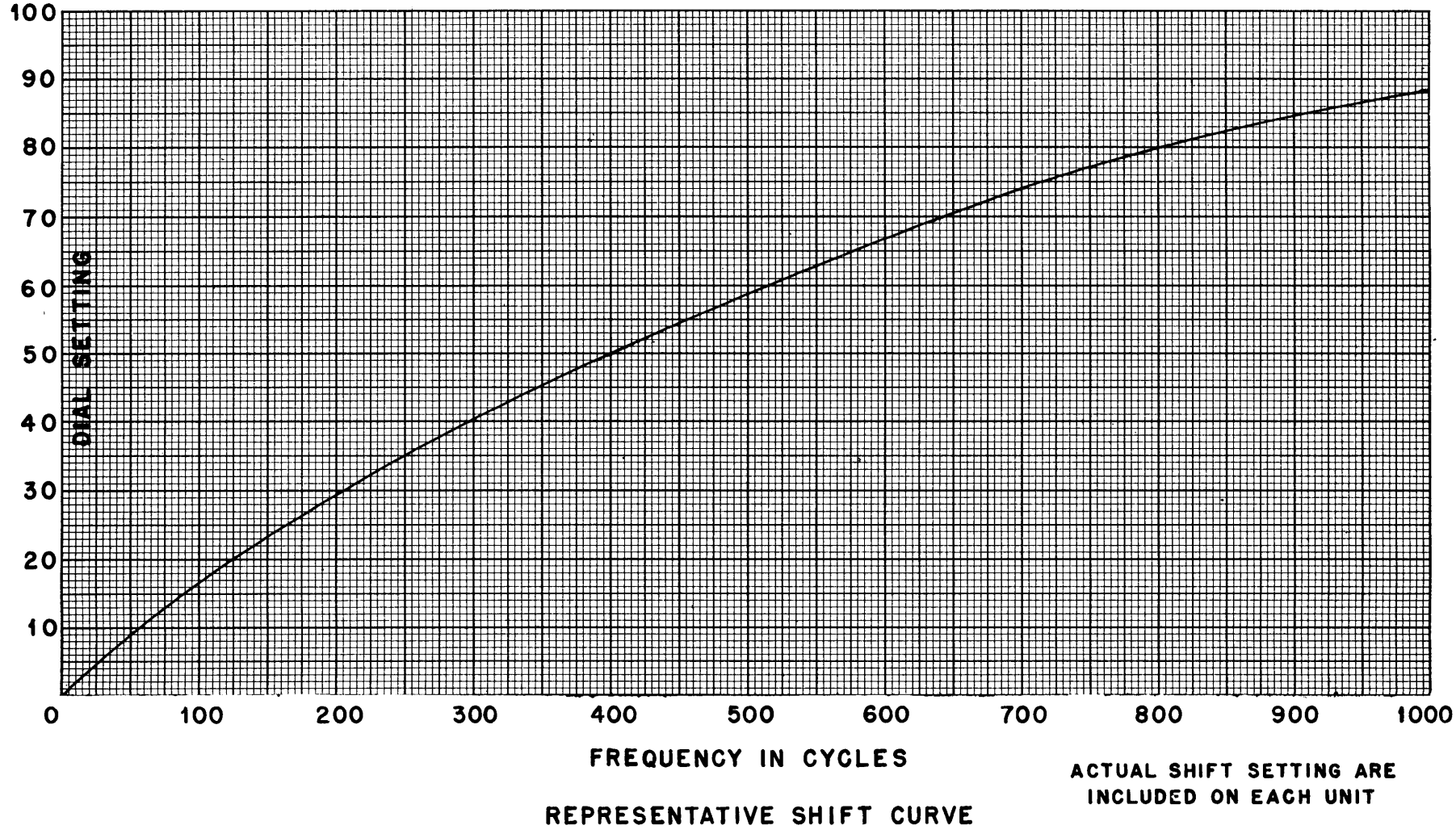

Figure 53. Frequency shift curves.

APPENDIX

SECTION VI

MOISTUREPROOFING AND FUNGIPROOFING

41. GENERAL.

The operation of Signal Corps equipment where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

b. Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

c. Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

e. Moisture provides leakage paths between battery terminals.

42. TREATMENT.

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment.

CAUTION: Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

43. STEP-BY-STEP INSTRUCTIONS FOR TREATING SHIFTER MIXER.

a. Preparation.

(1) Make all repairs and adjustments necessary for the proper operation of the equipment.

(2) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed. Thorough cleansing of the unit is necessary to prevent sealing in dirt with the lacquer. It is imperative that rust or corrosion be removed with fine sandpaper or by scraping. A solvent, such as Dry Cleaning Solvent (SD), Specification No. P-S-661a, will remove grease and oil. A blower or compressed air hose, if available, is useful for removing dust and loose dirt.

b. Disassembly.

CAUTION: Before removing any stages or component parts for tropicalization, disconnect the transmitter from the power source and short out all capacitors to make sure no charge is left in any of them.

(1) Remove the two screws at bottom of panel.

(2) Remove Jones plug on rear right side of chassis.

(3) Remove the two leads from the feed-through insulators on the left side of the chassis.

(4) Pull the shifter-mixer chassis slowly forward. (It cannot be lifted because the sides of the chassis ride in guide angles.) Some difficulty may be encountered in removing this stage for the first time since it is in a tight position.

(5) After this unit is out of the cabinet, remove the hood from the chassis by taking out the small screws holding them together.

c. Masking.

(1) Unclip Tube JAN-6E5 from its mounting and mask the glass portion.

(2) Mask the grid caps of the two Tubes JAN-6L7 (V201 and V202).

(3) Completely mask the variable capacitors on top of the chassis. Paper may be molded around these parts and held in place with masking tape.

(4) Completely mask wafer switch S202. This part should be stuffed with tissue covered with masking tape.

(5) Mask the Jones plug contacts on right side of chassis, and the three prongs at the rear of the chassis.

(6) Completely mask wafer switch S201 on bottom of chassis. Stuff with tissue and cover with masking tape.

(7) Mask the feed-through insulators on left side of chassis.

d. Drying.

(1) Place equipment in drying oven and bake for 6 hours at 140°F. Do not exceed 140°F.

(2) If wax should begin to melt on any of the components, lower baking temperature and increase baking time. For each 10° drop in baking temperature, increase baking time one hour.

e. Varnishing.

(1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec No. 71-2202, Stock No. 6G1005.3 or equal) with spray gun. Allow each coat to dry 15 to 20 minutes before applying the next coat.

(2) Inspect treated equipment and apply varnish with a brush to those portions not reached by spray gun. Be sure all components are adequately protected by varnish.

f. Reass mbly.

(1) Remove all masking tape.

(2) Clean all contacts with varnish remover, and burnish the contacts.

(3) Reassemble equipment by following disassembly instructions in reverse order.

(4) Mark cases MFP with date of treatment.

(5) Check over-all performance of equipment.

44. STEP-BY-STEP INSTRUCTIONS FOR TREATING MULTIPLIER.

a. Pr parati n. Refer to paragraph 43*a*.

b. Disass mbly.

(1) Loosen the two knurled head screws on front of panel, and pull the shelf half way out by handles.

(2) Slide the shelf to left and remove the two Jones plugs on right side of the chassis.

(3) Slide the chassis to the right so that the grid input contact will clear the side of the cabinet and prevent bumping the variable capacitor. Pull forward and clear the chassis from the cabinet.

c. Masking.

(1) Mask the glass faces of the two meters (M301 and M302) on the front of the panel to prevent varnish mist from collecting on the glass.

(2) Completely mask gang switch S301. This part may be stuffed with tissue and covered with masking tape.

(3) Mask REMOTE TEST switch S303.

(4) Completely mask each of the following variable, air-gap capacitors: C305, C307, C311, C314, C316, C324, C325, and C326. Paper should be molded around these parts and held in place with masking tape.

(5) Mask the Jones plug contacts at the rear of the chassis.

(6) Mask portion of plate meter switch S302 on the back of the front panel.

d. Drying. Refer to paragraph 43*d*.

e. Varnishing. Refer to paragraph 43*e*.

f. Reassembly. Refer to paragraph 43*f*.

45. STEP-BY-STEP INSTRUCTIONS FOR TREATING INTERMEDIATE POWER AMPLIFIER.

a. Preparation. Refer to paragraph 43*a*.

b. Disassembly.

(1) Loosen the four knurled head screws on front of panel.

(2) Pull forward by handles far enough so that the Jones plug can be removed from the right side of the chassis. Remove the Jones plug.

(3) Remove B lead from the feed-through insulator on the rear right side of the chassis.
(4) Clear the chassis from the cabinet.

c. Masking.

(1) Mask glass faces of meters M401 and M402 on the front of the panel to prevent varnish mist from collecting on glass.

(2) Mask the Jones plug contacts and the B feed-through insulator on the right side of the chassis.

(3) Completely mask two-gang band change switch S401. This part should be stuffed with tissue and covered with masking tape.

(4) Mask the variable capacitor drive gears and the band change switch drive gears.

(5) Mask variable air capacitors C402 and C403 located above the tubes.

(6) Mask the grid cap and plate leads.

(7) Be sure both tubes are firmly seated in sockets.

(8) Mask the feed-through insulator on the right side of the chassis.

d. Drying. Refer to paragraph 43*d*.

e. Varnishing. Refer to paragraph 43*e*.

f. Reassembly. Refer to paragraph 43*f*.

46. STEP-BY-STEP INSTRUCTIONS FOR TREATING CONTACTOR PANEL.

a. Preparation. Refer to paragraph 43*a*.

b. Disassembly.

(1) Disconnect all the wire leads from the two side terminal boards of the contactor panel.

(2) Take out the four screws holding the panel to the cabinet. Remove the contactor panel from the cabinet.

c. Masking. No masking is necessary, since the contactor panel is not sprayed.

d. Drying. Refer to paragraph 43*d*.

e. Varnishing. Using a brush apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec No. 71-2202, Stock No. 6G1005.3 or equal) to the wiring and relay coils only on the contactor panel. Allow each coat to dry 15 to 20 minutes before applying the next coat.

f. R ass mbly. Refer to paragraph 43*f* (omit step (1)).

47. STEP-BY-STEP INSTRUCTIONS FOR TREATING LOW-VOLTAGE POWER SUPPLY.

a. Preparation. Refer to paragraph 43*a*.

b. Disassembly.

(1) Remove the two Jones plugs from the left front corner.

(2) Slide the shelf from the chassis carefully. (The chassis is heavy.)

c. Masking.

(1) Mask the bare portions of sliding-contact wire-wound resistors R603, R604, and R605 located on the left side of chassis.

(2) Mask the plate caps of the six rectifier tubes. Be sure tubes are firmly seated in sockets.

(3) Mask six glazed ceramic insulators on top of chassis.

d. Drying. Refer to paragraph 43*d*.

e. Varnishing. Refer to paragraph 43*e*.

f. Reassembly. Refer to paragraph 43*f*.

48. STEP-BY-STEP INSTRUCTIONS FOR TREATING PARTS NOT REMOVED FROM CABINET.

a. Preparation. Refer to paragraph 43*a*.

b. Disassembly. Remove all crystals from the oscillator unit. No disassembly is necessary for the high-voltage power supply, power-amplifier assembly, and the main rectifier tube shelf.

c. Masking. No masking is necessary since the cabinet is not sprayed.

d. Drying. Dry the parts of the transmitter not removed from the cabinet by using any available means for raising the temperature within the cabinet. A string of light bulbs placed in the back of the cabinet is a suggested method. Hold temperature as near 140°F as possible for six hours.

e. Varnishing. Using a brush apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec No. 71-2202, Stock No. 6G1005.3 or equal) to all wiring and fixed connections within the

cabinet. Allow each coat to dry 15 to 20 minutes before applying the next coat.

f. R ass mbly. Refer to paragraph 43*a* (omit step (1)).

NOTE: The brown discoloration found on silver and silver-plated relay contacts is silver oxide and is a good conductor. It should be left alone unless the contacts must be cleaned for some other reason. It can be removed, at any time, with a cloth moistened with carbon tetrachloride.

NOTE: Lacquer should not be applied to any of the silver-plated parts in the power-amplifier assembly, any glazed ceramic insulators, or the contacts of the two rheostats R1 and R2. None of the parts on the front panel are to be lacquered.

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