INSTRUCTION BOOK

FREQUENCY SHIFT KEYER

TYPE 105 MODEL 4

Manufactured by

NORTHERN RADIO COMPANY
Incorporated
143-145 WEST 22nd ST., NEW YORK 11, N. Y.

INSTRUCTION BOOK

FREQUENCY SHIFT KEYER

TYPE 105 MODEL 4

Manufactured by

NORTHERN RADIO COMPANY
Incorporated
143-145 WEST 22nd ST., NEW YORK 11, N. Y.

ADDENDUM NO. 1

Pulse Shaping Circuit:

The Type 105 Model 4, Frequency Shift Keyer is equipped with the facility for shaping the DC teleprinter pulses, so that the frequency transition from "mark" to "space", or from "space to "mark" is gradual, rather than sudden. Shaping the teleprinter pulses in this way results in a reduction of the bandwidth necessary to transmit intelligence.

The pulse shaping network consists of a capacitor, C137, in association with resistors R125, R127, R136, R137 and R151. A switch, S105, permits the operation of the keying circuit with or without pulse shaping, as desired. Since the values of the pulse shaping circuit were chosen for use with 60 w.p.m. teleprinter pulses, the shaping circuit switch S105 (located at rear of chassis) should be turned to "on" only for teleprinter keying.

Additional components inserted:

Symbol	Function	Description	Mfr.	Part No.
C137	Keying Circuit pulse shaper	0.1 mfd ± 10% 200 volts paper bathtub cond.	SAN	5006-.1
S105	Shaper On-Off Switch	SPST Toggle switch	AHH	

ADDENDUM NO. 2

POSITIVE AND NEGATIVE KEYING:

The Type 105 Model 4, Frequency Shift Keyer has been modified to include provisions for either positive or negative keying (for mark). The schematic drawing has accordingly been altered to effect this change. All serial numbers of this unit have been modified to incorporate modification by the addition of the four components listed below. On Serial Numbers 34 to 60 inclusive, these components are located on the same bracket on which potentiometer R120 is mounted (See Figure 19). On all other Serial Numbers, switch S106 is mounted at rear of chassis, and resistors R153, R154, and R155 are closely associated with back of switch S106.

Symbol	Function	Description	Mfr.	Part. No.
R153	Negative Keying Bias Bleeder Resistor	390K ohms ± 5% 1/2 watt	ALB	EB 3945
R154	Negative Keying Bias Cathode Resistor	24K ohms ± 5% 1/2 watt	ALB	EB 2435
R155	Negative Keying Input Load Resistor	120K ohms ± 5% 1/2 watt	ALB	EB 1245
S106	Negative or Positive Keying Switch	DPDT Toggle switch 1 amp. 250 volts	AHH	81027 CE

ADDENDUM NO. 3

FREQUENCY RANGE MODIFICATION

1.75 MCS - 4.5 MCS

This addendum pertains only to those Northern Radio Company Frequency Shift Keyers Type 105 Model 4, which have been modified to cover the frequency range of 1.75 MCS to 4.5 MCS. The specifications (other than the frequency coverage) the schematic diagram, and all location drawings and terminal board drawings, remain unchanged.

The electrical changes constitute the replacement of transformers T101, T102 and T103. The "Mixer" and "output" Dials have been replaced with dials to cover the above frequency range.

THE ELECTRICAL PARTS LIST CHANGES FOLLOW:

Symbol	Name of Component	Description	Mfr.	Part No.
T101	Crystal Oscillator Output Transformer	Tuned Transformer, 1.55-4.3 MCS. Secondary: center tapped, inductance varied by powdered iron slug. (1/2" long x .37" dia. 6/32 thread, 1-1/2" long) Core: SCC G2	NRC NRC	A-105429-1 A-105424-1
T102	Mixer Output Transformer	Tuned Transformer: 1.75-4.5 MCS. Primary: Balanced center tapped: Secondary Center tapped: Secondary inductance varied by powdered iron slug (3/4" long x .37" dia., 6/32 thread, 1-1/2" long) Core: SCC G2	NRC NRC	A-105430-1 A-105425-1
T103	P.A. Output	Tuned RF Transformer, 1.75-4.5 MCS. Primary: 42 turns space wound. Secondary: 4 turns close wound over ground end of primary	NRC NRC	A-105431-1 A-105432-1

ADDENDUM NO. 4

F. S. - FAX OPERATION

The Frequency Shift Keyer, Type 105 Model 4, has been modified to accept "FAX" (Facsimile) operation as well as normal Frequency Shift Keying. For "FAX" operation the carrier frequency may be linearly shifted up to ± 700 cps, corresponding to a modulating voltage of approximately ± 4.2 volts.

The changes constitute the addition of the F. S. - FAX switch S107, and resistor R156. Switch S107 has been placed at the rear of the chassis. Input Terminal #8 of E1 serves for both "F.S." and "FAX" operations, selection being made by switch S107. The Schematic Diagram has been accordingly modified to incorporate these changes.

Additions to the Electrical Parts List Follow:

Symbol	Name of Component	Description	Mfr.	Part No.
R156	"FAX" input load resistor	120K ohms ± 5% 1/2 watt	ALB	EB 1245
S107	FS-FAX Input selector switch	DPDT Toggle switch 1 A. 250 V.	AHH	81027 CE

SAFETY NOTICE

This equipment employs voltages which are dangerous and may be be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

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

KEEP AWAY FROM LIVE CIRCUITS

Operating and maintenance personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions, dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties, always remove power and discharge circuits prior to touching them.

RESUSCITATION

Maintenance personnel should familiarize themselves with the rules for resuscitation found in the first aid manual.

GUARANTEE

All items of equipment and material used in the Type 105 Model 4, Frequency Shift Keyer are guaranteed against material defects, workmanship or manufacture, for a period of one year from date of installation, except that the items of equipment and material are not guaranteed for a term longer than two years from the date of shipment.

Under the terms of this Guarantee, all items which fall within the periods defined above will be replaced f.o.b. point of installation without cost to the purchaser. The Company will pay transportation charges on any defective part which it desires to have returned to its plant. If, upon examination of the defective item, the Company can show that failure was not due to any defective workmanship, material or manufacture, the Company will bill the purchaser for the cost of replacement, including transportation charges.

NORTHERN RADIO COMPANY, Incorporated
New York, New York

REPLACEMENT OF PARTS

In case a replacement is required under terms of the Guarantee, a report is requested by the Company, which should include the following information:

1. Serial number of Keyer or Power Supply
2. Date placed in Service
3. Number of hours in service, if available
4. Part and item number
5. Nature of failure and its cause.

When ordering replacement parts, not under terms of the Guarantee, the following information should be given:

1. Serial number of equipment
2. Quantity required
3. Part number from parts list.

INSTRUCTION BOOK

FREQUENCY SHIFT KEYER

Type 105 Model 4

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SUMMARY OF CHARACTERISTICS

Output Frequency Range:	2.5 to 6.7 megacycles (See Addendum No. 3)
Frequency Shift:	Adjustable from 0 to 1000 cps
Output Power:	3 watts into 50 to 75 ohms
Monitor Output:	90-120 millivolts across 50 to 75 ohms
Keying Signal:	0 volts for space (Lower) frequency and ± 15 to ± 150 volts for mark (Higher) frequency. Facsimile: (See Addendum No. 4)
Input Impedance:	120,000 ohms
Keying Speed:	150 dot cycles per second
Overall Stability:	1. 10 cycles for ambient range from 0° C. to 50° C. (mark and space frequencies) 2. 25 cycles for line voltage variation of plus or minus 10% (mark and space frequencies) 3. 2 cycles for input signal voltages from ± 15 volts to ± 150 volts (mark frequency)
Keying Bias:	Not greater than 5% at any keying speed up to 150 dot cycles per second.
Crystal Frequency:	$\frac{\text{Assigned transmitting freq.}}{\text{Transmitter multiplication factor}}$ Minus 200 KC
Crystal Holder:	Similar and equal to Bliley MC7 or Premier PL218
Crystal Sockets:	3 crystal sockets are provided with an associated switch
Power Requirements:	Frequency 50/60 cycles, voltage 115 volts plus or minus 10% or 230 volts plus or minus 10% Power Input 270 watts oven heater on, 110 watts oven heater off.
Fuses:	One 1.5 A. 250 V. 3AG Size One 2 A. 250 V. 3AG Size

Tube Complement:

	KEYER
1 - 6SN7	Crystal Oscillator - Buffer
1 - 6SN7	Frequency Shifted Oscillator
1 - 6SN7	Reactance Tube
2 - 6SA7	Modulator Amplifiers
1 - 2E26	Power Amplifier
1 - 6SN7	Keying Tube

Tube Complement: (cont'd)

POWER SUPPLY

1 - 5U4	High Voltage Rectifier
1 - 6X5GT	Bias Voltage Rectifier
1 - 0C3/VR105	Voltage Regulator
1 - 0A3/VR75	Voltage Regulator

Net Weight:

Power Supply: 23 pounds
Keyer: 35 pounds

Shipping Weight:

Power Supply) and Keyer) 115 pounds (approximately)

Dimensions:

Power Supply: 19" wide by 5¼" high by 10½" deep

Keyer: 19" wide by 10½" high by 11½" deep

Auxiliaries:

One inter-connecting cable six feet long, with spade type solder lugs. One primary power cord.

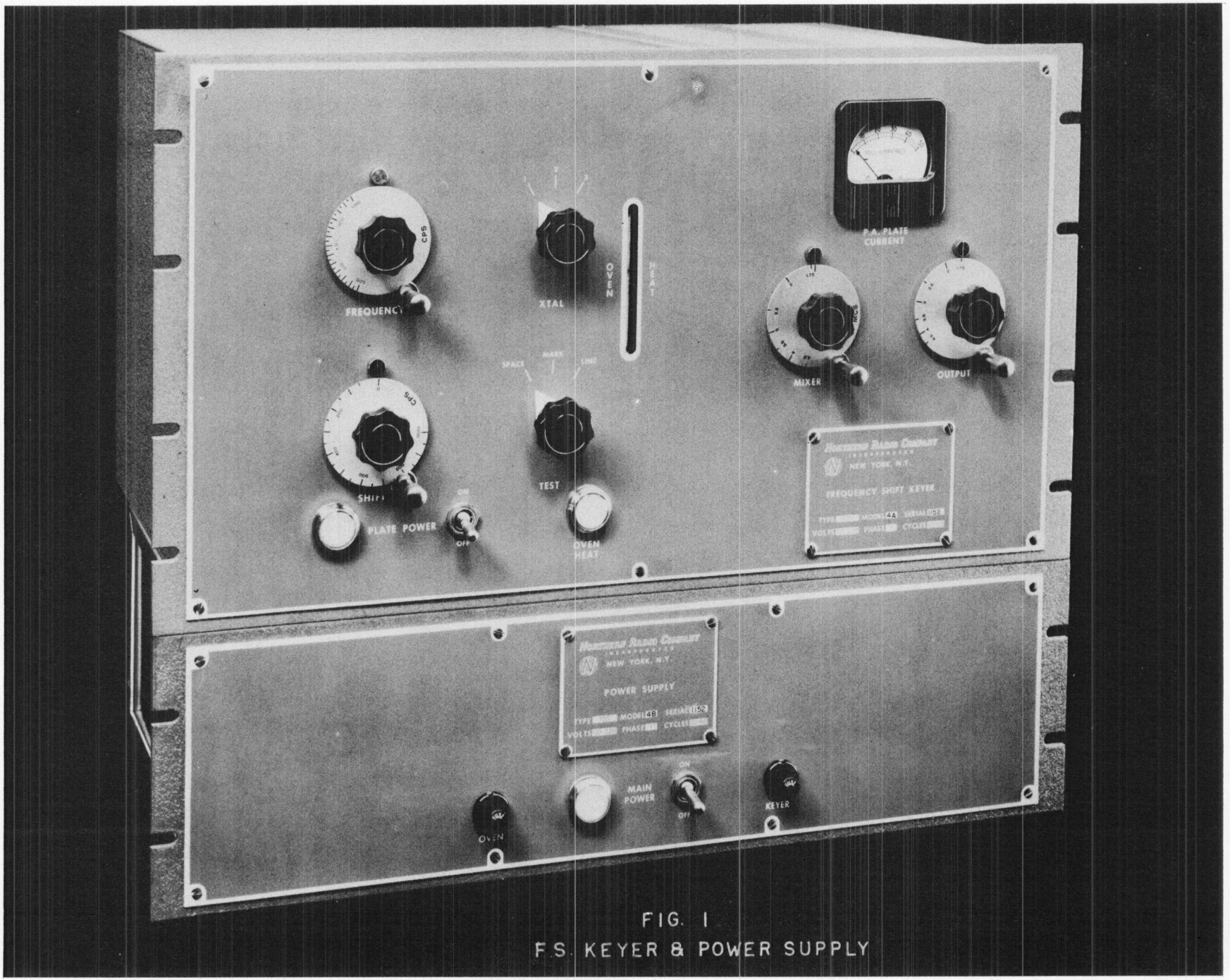


FIG. 1
F.S. KEYER & POWER SUPPLY

1. GENERAL DESCRIPTION

1-1 Purpose:

The Frequency Shift Keyer with Power Supply is a high stability radio frequency oscillator which provides a means for shifting an R. F. carrier in accordance with the variations of a D. C. input signal. This exciter replaces the crystal oscillator in a transmitter and produces "mark" and "space" carrier shift for transmission of teletype or telegraph signals. Provision is also made for Linear Facsimile or Narrow Band telephone modulation.

1-2 Construction:

1-2a Electrical Features:

The Frequency Shift Keyer is composed of five main sections: a keying circuit, reactance tube shifted oscillator, crystal oscillator, modulator, and power amplifier. A keying signal passing through the keying stage is limited in amplitude and then fed to the reactance tube oscillator where it is used to vary the frequency in accordance with the applied intelligence. This shift frequency is mixed in the modulator stage with the output from the crystal oscillator and the sum frequency is used to drive the power amplifier.

1-2b Mechanical Features:

The Frequency Shift Keyer and its associated Power Supply are designed to mount in a standard 19" cabinet or rack. The Power Supply is mounted in the same rack below the Shifter with an interconnecting cable joining the two units.

The Keyer Unit is contained in a 19" panel, 10-1/2" high. The unit is divided into two sections, on the left is an oven sections, housing both oscillators and reactance tube. The temperature of this oven is maintained at 60° C.

The keying, modulator and power amplifier stages are mounted on the RF chassis at the right of the unit. Keying input and RF output and monitor jacks are located at the rear of the RF chassis.

The separate Power Supply utilizes a 19" panel 5-1/4" high. Dust covers on both units are mounted so that they may be removed for inspection and service without necessitating removal of the units from the rack.

II. THEORY OF OPERATION

2-1 Crystal Oscillator:

The basic frequency of the Frequency Shift Keyer is derived from a crystal controlled oscillator in one triode section of type 6SN7 tube, V101. The second section of the tube is operated as a Buffer for isolation purposes. Provision is made to select any one of three output frequencies by crystal selector switch S101. This is a front panel control. The plate voltage of the oscillator tube and the temperature of the crystals are stabilized.

2-2 200 KC Oscillator:

The 6SN7, V102, is connected as a push-pull balanced oscillator operating at 200 KC at a relatively low level for stability. Coarse frequency adjustment is provided by adjusting the slug in the main tuning coil, L101; and fine variations, by a front panel control, by varying the capacity of dual air trimmer, C115, which is directly across the main tank condenser, C122 and C123. The temperature of the frequency determining elements and the plate voltage of the oscillator tube are stabilized.

2-3 Reactance Tube:

The frequency of the 200 KC oscillator is changed according to the keyed intelligence by the action of balanced reactance tube V103. The outputs of the two sections of the reactance tube are connected across the oscillator tank. The RF grid voltages of the reactance tube are derived from two phase shifting networks, C109, R109, C106 and C112, for one section and C113 and R108 for the other, so connected to the oscillator tank circuit that a phase shift slightly greater than 90^{o} is obtained relative to the voltage across each half of the oscillator tank. Accordingly, each section of the reactance tube acts as a relatively pure reactance, since the "in phase" components of reactance tube plate currents, caused by the reactance tube plate resistances, are effectively cancelled.

The first section of the reactance tube, pins 1, 2 and 3, acts as a large inductance across one side of the tank. The second section is equivalent to a small capacity across the other side. When a positive keying signal is applied to the grid of the second section, more current is drawn through this tube section and the effective capacity of the section increases, lowering oscillator frequency. This increased current increases the bias on the first tube section, decreasing its current. This in turn raises its effective inductance across the tank coil, further decreasing frequency. The adjustment is such as to make the frequency shift linear with voltage applied to the reactance tube modulated grid.

2-4 Keying Tube:

In CW or teletype operation, it is desireable to "limit" the DC pulses containing the intelligence. The purpose of limiting is to make

2-4 Keying Tube: (con't)

the keyer accept a wide range of DC step levels without affecting the magnitude of the frequency shift desired. The Keyer tube included in this equipment satisfies this point so that "space" and "mark" frequencies are independent of keying step amplitude.

With test switch S102 in space position, the first section of keyer tube V107 is cut off due to the high bias developed across cathode resistance R132. Under this condition, the second section grid is at a high DC potential, causing the tube to draw full current. It, therefore, represents a low resistance shunting R135.

R135, R136, R126 and R137 in series act as a bleeder circuit from pulse 105 volts to minus 75 volts. A small positive voltage exists at the junction of R126 and R127 under the space condition.

When the test switch is turned to "mark", the positive voltage at the grid of the first section of V107 is enough to cause this to operate fully saturated. The drop across R131, is sufficient to lower the grid voltage on the second section and cut off plate current. The voltage at the junction of R126 and R127 changes to a small negative value. The tap setting of potentiometer R126 is adjusted to equalize the positive and negative voltages under the two conditions. Keying voltage is fed to the reactance tube across the tap of R125, the front panel "shift" control.

With the test switch in "line" position, the same conditions prevail as in "space" until a keying voltage is supplied to the system, when the condition shifts to that of "mark".

2-5 Mixer Stage:

V104 and V105, both 6SA7's, comprise a balanced modulator combining the outputs from the crystal oscillator and 200 KC oscillator. To eliminate the crystal frequency from the output signal, the crystal voltage is fed in phase to the two tubes. The same output voltage appears from each side of the output transformer, T102, to ground and is therefore cancelled from plate to plate at the output of the modulator.

The output tank of the modulator is tuned to a frequency 200 KC higher than the crystal and made to track with it throughout the frequency range. Since the only undesired signal of significant amplitude is the lower sideband (400 KC below the higher sideband), good selection is not a serious problem even at the higher output frequencies. Crystal frequency elimination across T102 primary is achieved by varying the relative tube gains with R116 until they are equal. This eliminates any residual crystal frequency at T102 primary, and consequently in the Keyer output.

2-6 Power Amplifier:

The frequency shifted output carrier from the modulator is fed into the 2E26, Class B power amplifier, V106. This is a standard tuned amplifier stage employing fixed bias. Power output is varied by adjusting bias voltage by means of potentiometer, R120. Neutralization is accomplished by feeding back a portion of the output voltage in proper phase from the secondary of T103 to the 2E26 grid through C103 and C132. PA plate current is read in milliammeter N102.

2-7 Oven Thermal Control:

The temperature of the keyer oven is controlled by mercury thermostat M101 through relay K101. When the temperature at the thermostat falls below 60° C., the thermostat contacts open, causing current to flow through the coil of K101. This in turn actuates the relay, supplying power to the oven heaters and lighting neon bulb I102. When the temperature around the thermostat bulb rises above 60° C., the thermostat contacts close, short-circuiting the winding of K101. This causes the heater current to be interrupted and neon I102 goes off.

If the main thermostat, M101, or oven relay, K101, should fail, damage may be caused to the oven components due to oven overheating. This is prevented by the auxiliary thermostat, S103, which takes over control, opening the heater circuit, before the oven temperature reaches a dangerous value. When this occurs the neon bulb I102 stays on continuously, thus warning that trouble exists.

2-8 Power Supply:

The Keyer Power Supply is a standard multi-voltage supply. The high voltage rectifier V201, yields approximately 250 volts DC positive at the output of its filter for exciter plate voltage. A portion of the power from this circuit is regulated to 105 volts by R202 and V202 (0C3/VR105) and is used to supply regulated voltage to the oscillators, reactance tube and keyer circuits.

The 6X5GT, V203, and 0A3/VR75, V204, supply a regulated 75 volts negative for P. A., and keying circuit bias.

III. INSTALLATION

3-1 Unpacking and Inspection:

The Frequency Shift Keyer, Keyer Power Supply, power cord, one six-foot length of interconnecting cable, and the Instruction Book are all packed in a single shipping crate for which no unpacking information is necessary.

The individual units should be removed from the crate and placed on a convenient work bench. There the dust cover and cover plates should be removed from the power supply and keyer and each unit inspected for the following:

1. Damaged or broken components or tubes
2. Cracked or broken porcelain standoffs
3. Bent, or cracked controls, preventing free rotation
4. Tubes out of sockets
5. Connectors not fully inserted into their mates
6. Incorrect fuses in sockets

Unless visual inspection indicates definite damage to the outside of the oven, it is not advisable to open the oven section at this time. If it becomes necessary to do so, disassembly instructions given under "Maintenance" should be followed.

The Frequency Shift Keyer and Power Supply leave the factory wired for 115 V. AC., 50/60 cycles, unless otherwise instructed and marked. If 230 volt operation is desired, the unit must be modified according to "230 volt operation". If unit is to operate at 115 volts, the cover plates may be refastened to the chassis after inspection. However, the dust covers should be kept off to allow for connecting the interconnecting cable.

The Keyer and Power Supply may then be mounted in their respective places in the rack.

3-2 230 Volt Operation:

For operation from a 230 volt AC source, the following changes must be made in the units:

3-2a Power Supply:

On T201 Power Transformer (refer to Power Supply Schematic Diagram), disconnect the wires between terminals 2 and 4, and 1 and 3. Connect terminal 2 to terminal 3 on the same transformer.

This connects the power supply for 230 volt operation and places 230 volts across terminals 5 and 6 on E201.

3-2b Keyer:

Remove the inner oven assembly from the oven as explained under "Maintenance". At the bottom of the unit, just inside the middle oven box will be found TB101, protective thermostat mounting terminal board. With a pair of wire cutters, remove the wire connector from terminal 2 to 3. Of the two wires connected to terminal #1, unsolder the one coming from the cable and solder it to terminal #2. This is shown schematically on the Keyer unit Schematic Diagram.

Replace the oven assembly as explained under "Maintenance". The unit is then ready for operation with 230 volt line voltage.

3-3 Electrical Connections:

After both Keyer and Power Supply have been mounted in the cabinet, the interconnection cable between them should be connected. This can be done by following the interconnection Diagram at the rear of the Instruction Book.

On the Power Supply, the cable should be fed through the opening provided for it on the side of the chassis. On the Keyer chassis, the terminal board protective shield should be removed for wiring. It is advisable, along with the interconnecting cable, to connect the keying leads, a twisted pair, to terminals 7 and 8 of the Keyer chassis. No restriction to the impedance of the keying line is necessary, except that it should not exceed 120K ohms.

Connect the output and monitoring coaxial cables from the two jacks on the rear of the keyer chassis (J103 and J104) to their respective terminals. The cables may have a nominal impedance anywhere from 52 to 75 ohms.

Feed the power lead through the opening on the side of the Power Supply chassis to its proper jack. Then both dust covers may be replaced.

3-4 Crystals:

For ease in mounting crystals in the oven, a special crystal opening has been provided at the oven rear. Access to the crystal holders is achieved by removing the two thumb screws mounting the crystal access cover to the outer oven rear cover; removing the access cover exposes the crystals for replacement or change.

The three exposed crystal sockets are standard 3/4" spaced two pin socket for holders such as the Bliley MC7, Reeves-Hoffman RF-11 or Premier PL218.

3-4 Crystals: (con't)

The frequency of the crystal for any desired transmitter carrier frequency may be obtained from the following formula:

A.

$$F_x = \frac{F_o}{n} - 200$$

Where F_x = Crystal Frequency KCS

F_o = Assigned carrier frequency in KCS

n = Frequency multiplier in transmitter

The "Frequency" front panel control will permit a variation of ± 600 cps in output frequency to adjust for any slight errors in crystal frequency. Crystals of low temperature coefficient should be used.

After the crystals have been inserted in their sockets, the crystal access cover should be replaced on the oven.

IV. OPERATION

4-1 Introduction:

Other than tune-up and shift adjustment, routine monitoring and maintenance, there are no operating manipulations required on this equipment. A careful tune-up should be satisfactory for indefinite periods after initial warm-up. The tune-up and procedure for putting this equipment in service, are given below:

The tuning procedure consists of the following steps:

Step 1: Turn on main power switch on Keyer Power Supply and plate switch on Keyer.

Pilot lights I101 and I102 will light, and oven heat indicator I102 will go on. Temperature stability will be reached, usually within an hour after initial heat-up.

Step 2: Set "XTAL" switch to the desired crystal. Adjust "SHIFT" control to zero shift. Adjust "FREQUENCY" control for zero compensation. The "TEST SWITCH" setting is immaterial.

Step 3: Detune the "MIXER" control and adjust output level control until the P. A. plate current reads approximately 50 ma.

Step 4: Set the "MIXER" and "OUTPUT" dials to read the desired output frequency, then tune these for plate current dip.

Step 5: Set the "SHIFT" control to the desired shift, following this formula:

$$F_{cs} = \frac{F_s}{n}$$

F_x - Frequency shift at transmitter output cps

F_{cs} - Shift control setting cps

n - Multiplication in transmitter

Switch "TEST SWITCH" to Line.

This completes the tune-up unless very close limits are required for frequency and shift. Then it will be necessary to use external monitoring equipment and adjust the "FREQUENCY" and "SHIFT" controls to suit.

V. PREVENTIVE MAINTENANCE

The following procedure is recommended in maintaining this equipment:

1. Every 2000 hours of logged time, or every six months whichever is sooner, remove all tubes from their sockets and check them for defective operation.·

2. Annually, check the tube electrode potentials against the tube voltage data sheet and investigate any serious discrepancies. Also clean the chassis thoroughly by blowing out all dust and dirt and then wiping out all foreign matter. In tropical climates it may be necessary to do this more often to prevent the growth of molds and parasites within the unit.

No special selection is necessary in the event of tube replacement, nor need any circuits be readjusted. Changing 200 KC oscillator or reactance tube will yield a frequency change of less than 100 cycles, which may be corrected with the "FREQUENCY" dial on the front panel.

If correction is necessary for this change in frequency, a coarse frequency control of L101 is available, using a long thin screwdriver, through the opening located on the oven rear cover.

VI. CORRECTIVE MAINTENANCE

6-1 Possible Troubles and Corrective Measures:

6-1a Oven Heat Neon Indicator Not Cycling:

As soon as this is observed, check the oven temperature thermometer. Either the mercury will be off scale, or not showing on the scale. The two conditions are indicative of different faults.

6-1a1 Mercury Off Scale:

This can be caused either by a faulty thermostat, or a sticky relay contact.

Check the voltage across the coil of K101. If it is not zero, this indicates that the thermostat is not shorting out the relay, and is therefore faulty.

If the coil voltage is zero, release the contacts and clean them before operating unit.

6-1a2 Mercury not showing on Thermostat Scale:

Possible Causes:
- Relay coil open
- Contacts improperly adjusted
- Low power supply voltage
- Shorted thermostat M101

To isolate the cause of failure, measure the DC voltage across the coil of K101. If 10 volts or above exists here, trouble either is in an open relay coil, or is a dirty or sluggish contact. The maintenance for this is obvious.

If no DC voltage exists across the coil of K101 and full B+ voltage can be measured at terminal #4 of J102, either R139 is open or M101 is shorted. These are easily checked.

6-1b Mark and Space Frequencies not Symmetrical with Respect to Carrier.

This may indicate a dis-symmetry in either the keying circuit or the reactance tube.

Check to determine which is causing the difficulty by measuring the DC voltage at pin #7 of J101 at some large shift, first with the test switch on space; then on mark.

If the voltages are not the same (opposite polarity), adjust R126 until balance is again obtained. Then re-check shift symmetry.

6-1b Mark and Space Frequencies not Symmetrical with Respect to Carrier. (cont'd)

If the keying voltages are equal and opposite from mark to space, and the shift is still not symmetrical, adjust C112, available with a long screwdriver through a small access hole in the oven rear cover, for frequency symmetry, with keying about the mean carrier frequency.

6-1c P. A. Stage Oscillator:

Under certain conditions of no-load operation, the P. A. stage may break into oscillation if it is not properly neutralized. This situation is not serious since the oscillation disappears with drive or load. However, if the condition is noticed at any time, the following corrective procedure may be used:

Remove the "Output" coaxial cable from the Keyer and tune up at some frequency near the high end of the band with the "Output" level control adjusted for 50 ma. P. A. plate current under detuned conditions. After tuning the R. F. stages, remove the crystal from its socket and note the P.A. plate current as the "OUTPUT" know is slowly rotated about its tuning point.

If any change in meter reading is noted, the stage is not correctly neutralized. Adjust the setting of C103, accessible from the top, at the R. F. Chassis rear, until a repetition of the above procedure results in no meter reading change with change in tuning. The necessary adjustment of C103 should not be more than a few degrees.

6-1d Mixer Stage Unbalance - Crystal Frequency Observed at Output.

Adjust the P.A, "Output" control for 50 ma. P. A. plate current with R.F. stages detuned. Using any crystal near the high end of the band, tune both "MIXER" and "OUTPUT" controls for P. A. plate current dip. Then remove the 200 KC oscillator tube, V102, and tune Mixer and Output dials to 0.2 mcs below original output frequency. Adjust R116 until any remaining dip in P. A. plate current is minimized.

6-2 "MIXER" Control Alignment:

If, for any reason, the calibration of the mixer control becomes erroneous, or meter dip broad, the following steps should be taken to align the mixer stage:

1. Remove the keyer from its rack and place it on a convenient work table. Remove the dust cover and R.F. chassis bottom plate. Turn unit on its side. Connect load or dummy load to P. A. Output.

2. Adjust P. A. gain control until P. A. plate current reads 50 ma. with no drive.

6-2 "MIXER" Control Alignment: (cont'd)

3. Insert a 2.3 mcs crystal, or as close to it as possible, into a crystal socket and set both output dials to read 2.5 mcs (or crystal frequency + 0.2 mcs if another frequency is used.)

4. Adjust slugs on T101 and T102 for dip in P.A. plate current. T101 is accessible from the top of the unit, just in front of mixer tuning condenser C135. T102 is mounted horizontally on the under side of the chassis.

5. Insert a 6.5 mcs crystal, or as close to it as possible, into a crystal socket, and set both output dials to read 6.7 mcs (or crystal frequency + 0.2 mcs if another frequency crystal is used.)

6. Adjust trimmer C125, and C131 located on top of mixer condenser C135, for dip in P.A. plate current.

7. Repeat steps 4 to 7 until no further adjustment is necessary.

6-3 Oven Disassembly Instructions:

6-3a Removing Outer Oven Heat Box Assembly:

In order to inspect or replace the oven thermostat M101, or relay K101, or to reach any components mounted behind the front panel, the following procedure should be used:

1. Remove the Keyer from its position in the rack and place it on a convenient work table.

2. Loosen the two set screws holding the shaft leading into the oven to its flexible coupling on the "XTAL" switch, and one of the two set screws on the "FREQUENCY" knob.

NOTE: These coupling will be found between the oven and front panel, looking down on the equipment.

3. Rotate the "FREQUENCY" dial until the other set screw is available. Lock the dial and loosen the set screw.

4. Remove the oven cable plugs, P101 and P102.

5. Remove the four screws (two on each side of the oven assembly) and the screw holding the oven to the rear of the chassis.

6. Slide the oven assembly back.

The thermostat, relay, and other components are now readily available for inspection and service. The thermostat is removed from its

6-3a Removing Outer Oven Heat Box Assembly: (cont'd)

holder by unsoldering the two leads from the terminal board, removing its four mounting screws, and gently pulling straight out.

CAUTION: THE THERMOSTAT IS FRAGILE, HENCE MUST BE TREATED AS MUCH CARE AS ANY MERCURY THERMOMETER. WHEN REPLACING THE THERMOSTAT IN ITS CRADLE, EXTREME CARE SHOULD BE TAKEN NOT TO FORCE OR BANG THE GLASS.

6-3b Removing Inner Oven:

If it is desired to remove the inner oven, either for inspection of the oven heaters and protective thermostat, or for operation on the oven components, it is not necessary to remove the complete oven assembly, from the chassis. The oven itself may be disassembled as follows:

1. Go through Steps 1 to 3 as in 6-2a.

2. Remove the eight mounting screws around the outer periphery of the outer oven rear cover. Disengage P101, but not P102.

3. Slide off the outer oven rear cover and with it the two layers of Flintcote insulation, exposing the middle oven rear cover.

4. Remove the 11 screws around the outside edges of the middle oven rear cover attaching it to the middle oven.

5. Slide back the entire inner oven assembly which is mounted on the middle oven rear cover. This will expose the oven heaters and protective thermostat for inspection and service.

6-3c Disassembling Inner Oven:

Once the inner oven assembly has been removed from the oven, it may be opened for inspection by removing the two side plates. Ten mounting screws hold each plate rigidly to its section of the inner oven assembly. Further disassembly is obvious.

6-4 Reassembly Instructions:

Before replacing the inner sections into the oven box, it is recommended that the oven "FREQUENCY ADJUST" trimmer, C114, be closed.

The oven may then be reassembled by following a procedure which is the reverse of that used in disassembling. The frequency dial is then set so that the zero mark on the dial is one-quarter revolution from the index. The index should be on the minus side of zero.

6-4 Reassembly Instructions: (cont'd)

If this has been done carefully, the calibration of the dial will be correct. For precision setting of the dial, external monitoring methods must be used.

6-5 Emergency Operation:

If the mercury thermostat ever fails or gets broken, and it is imperative that operation be continued before a replacement is available, it is recommended that P102 be disengaged from J102 to prevent oven heat. This will result in slight loss of stability.

Another recourse available is to allow the oven to heat up until the protective thermostat goes into operation. This is not recommended due to the higher oven temperature and to the fact that there is no visual indication of this thermostat cycling.

6-6 Summary of Type Test Results:

1. FREQUENCY RANGE AND POWER OUTPUT

Output Freq. mcs	Crystal Freq. mcs	Mixer Dial Rdg.	Output Dial Rdg.	Output Power Watts
2.5	2.3	2.5	2.5	3.2
4.0	3.8	4.0	4.0	4.5
6.7	6.5	6.7	6.7	5.0

2. COMPARISON OF FREQUENCY SHIFT DIAL READING WITH ACTUAL SHIFT

Shift Dial Reading CPS	0	100	200	300	400	500	600	700	800	900	1000
Actual Shift CPS	0	106	206	303	406	509	613	713	801	893	986

3. Monitor Output Voltage:

Measured by comparison with standard generator.

104 MV RMS at 2.5 mcs.

6-6 Summary of Type Test Results: (cont'd)

4. Keying Signal Amplitude Effect on Shift.

With Shift control set to 850 cps, test key to "Line".

Keying Signal Volts	Shift cps
0	0
+9	850
+25	850
+50	850
+100	850
+150	850

5. Effect of Line Voltage on Output Frequency

With shift set for 850 cps. Varying line voltage ± 10% at 2.5 mcs output frequency.

Line Voltage	Space Freq. KCS	Mark Freq. KCS
105	2500.063	2500.0385
115	2500.068	2500.051
125	2500.071	2500.0625
Difference	*8 cps for 20% change	*24.0 cps for 20% change

*Maximum deviation encountered on group of 32 units tested by Government Agency.

6. Keying Bias Distortion

With square wave keying of 150 cps bias distortion of 3% was observed when the output keying signal from the exciter was compared with the input keying source.

7. Frequency Stability with Ambient Temperature Change.

Output Frequency 2.5 mcs. Shift adjusted to 850 cps with Test Key in Space position.

Ambient temperature change from 25° C. to 50° C., over a period of 6.5 hours. Output frequency drifted 4.5 cps.

DATE: 7-29-53 EQUIPMENT: F. S. KEYER TYPE: 105 MODEL: 4A SERIAL: PROTOTYPE 6-7

Symbol	Function	Type	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts
V101	Crystal Oscillator	6SN7GT	1-3	-8.65	2-3	86.0	4-3	0	5-3	225	6-3	8.85		
V102	200 KC Oscillator	6SN7GT	1-3	-30	2-3	90	4-3	-32	5-3	90				
V103	Reactance Tube	6SN7GT	1-8	0	2-8	90	3-8	8.3	4-8	90	5-8	90	6-8	8.6
V104	Mixer	6SA7	1-2	1.41	3-2	256	4-2	75	5-2	-4.4	6-2	1.41	8-2	-5.8
V105	Mixer	6SA7	1-2	1.41	3-2	256	4-2	81	5-2	-4.4	6-2	1.41	8-2	-4.9
V106	Power Amplifier	2E26	3-1	157	5-1	*-17.5	Plate Cap -1	265						
V107	Keyer Tube-Mark	6SN7GT	1-8	8.55	2-8	10.5	3-8	8.3	4-8	10.5	5-8	105	6-8	28.5
V107	Keyer Tube-Space	6SN7GT	1-8	0	2-8	76	3-8	6.3	4-8	76	5-8	105	6-8	76

CONTROL SETTINGS

Symbol	Function	Setting
C115	Freq. Adj.	200 KC
R125	Shift	850 cps
S101	Xtal Selector	2.3 mc Xtal
S102	Test Switch	Space
C135	Mixer	2.5 mcs
C136	Output	2.5 mcs
R120	Output Control	*

NOTE: All voltages measured with a vacuum tube DC Voltmeter.

REMARKS: All voltages taken with keying switch in Space condition, except the keyer tube voltages under Mark condition.

* R120 adjusted until voltage across pins 5 to 1 of V106 is -17.5 volts.

DATE: 7-29-53 EQUIPMENT: F. S. KEYER POWER SUPPLY TYPE: 105 MODEL: 4 SERIAL: PROTOTYPE 6-7

Symbol	Function	Type	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts
V201	Main Rectifier	5U4G	AC 4-6	752	2-gnd	298	AC 2-8	5.2						
V202	Voltage Regulator	0C3/ VR105	5-9	105										
V203	Bias Rectifier	6X5GT	AC 8-2	376	5-2	460	AC 2-7	6.6						
V204	Voltage Regulator	0A3/ VR75	2-5	-74										

NOTE: All voltages measured with a Vacuum tube DC Voltmeter, All AC measurements with 1,000 ohms/volt AC Voltmeter.

REMARKS: Unit loaded into prototype F. S. Keyer operating as indicated on its Table of Tube Socket Voltages.

VII. ELECTRICAL PARTS LIST

Sym-Bol	Function	Description	Mfr.	Part No.
C101	Crystal oscillator feedback condenser	.001 mfd ± 10% 500 volt	SAN	K 1210
C102	Crystal oscillator grid condenser	50 mmf ± 10% 500 volt silver mica	SAN	KR 1450
C103	PA neutralizing condenser	1.5-7 mmf ceramic trimmer 500 volts	ERC	TS2A
C104	Crystal oscillator buffer coupling condenser	25 mmf ± 10% 500 V. mica	SAN	K1425
C105	Crystal oscillator buffer grid condenser	10 mmf ± 10% 500 volts mica	SAN	K 1410
C106	Reactance tube quadrature condenser	30 mmf ± 5% 500 volt silver mica	SAN	RR 1430
C107	Crystal oscillator buffer plate bypass	Same as C101		
C108	Crystal oscillator buffer output coupling condenser	.01 mfd ± 20% 300 volt mica	SAN	C 06110
C109	Reactance tube coupling condenser	Same as C101		
C110	Reactance tube grid by-pass condenser	Same as C108		
C111	Reactance tube cathode bypass condenser	Same as C108		
C112	Reactance tube quadrature condenser	7-45 mmf ceramic trimmer 500 volt	ERC	TS2A
C113	Reactance tube quadrature condenser	27 mmf ± 2% 500 volt silver mica	SAN	RR 1427
C114	200 KC oscillator plate bypass	.01 mfd ± 20% 300 volt mica	SAN	C 06110
C115	200 KC oscillator frequency trimmer	Dual air trimmer, 50 mmf per section	HAM	HFD-50
C116	200 KC oscillator grid condenser	100 mmf ± 5% 500 volts silver mica	SAN	RR 1310

Symbol	Function	Description	Mfr.	Part No.
C117	Same as C116	100 mmf ± 5% 500 volts silver mica	SAN	RR 1310
C118	200 KC oscillator output coupling condenser	68 mmf ± 5% 500 volt silver mica	SAN	RR 1465
C119	Same as C118	Same as C118		
C120	200 KC oscillator output load condenser	200 mmf ± 5% 500 volt silver mica	SAN	RR1320
C121	Same as C120	Same as C120		
C122	200 KC oscillator tank condenser	2500 mmf ± 2% 500 volts silver mica	SAN	CR 1225
C123	Same as C122	Same as C122		
C124	Detector grid goupling condenser	100 mmf ± 20% 500 volts mica	SAN	K 1310
C125	Crystal frequency selector shunt trimmer	3-12 mmf ceramic trimmer 500 volts	ERC	TS2A
C126	Detector cathode bypass condenser	.01 mfd ± 20% 300 volt mica	SAN	C 06110
C127	Detector screen bypass condenser	.001 mfd ± 10% 500 volt mica	SAN	K 1210
C128	Detector screen bypass condenser	Same as C127		
C129	Detector plate bypass condenser	Same as C127		
C130	Detector output series padder	3000 mmf ± 2% 500 volts mica	SAN	C 1230
C131	Detector output shunt padder	1.5-7 mmf ceramic trimmer	ERC	TS2A
C132	PA neutralizing condenser	5 mmf ± 10% 500 volts ceramic	ERC	CC21CH
C133	PA screen bypass condenser	Same as C127		
C134	PA plate bypass condenser	Same as C127		
C135	RF detector tuning condenser condenser	2 gang air variable. Each section 250 mmf maximum	RCC	Series 17 Type C 817140

Symbol	Function	Description	Mfr.	Parts No.
C136	PA output tuning condenser	250 mmf maximum air variable	HAM	MC-250-M
C137	Keyer circuit pulse shaper	.1 mfd ± 10% 200 volt paper bathtub capacitor	SAN	5006-.1
E101	Interconnecting terminal board	8 circuit bakelite terminal board screw type binding post	HBJ	8-141-Y
I101	Power on pilot lamp	6-8 volt 250 ma. incandescent lamp bayonet base	GEC	47
I102	Oven heat pilot lamp	110 volts 1/28 watt neon lamp, bayonet base	GEC	NE 51
J101	Oven connector	8 circuit female chassis mount conn.	HBJ	S308AB
J102	Oven connector	6 circuit female chassis mount conn.	HBJ	S306AB
J103	RF power output connector	75 ohm female coaxial connector	AMP	83-1R
J104	Monitor output connector	Same as J103		
K101	Oven control relay	Sensitive DC relay Coil: 4 ma operation 3000 ohms Contacts: SPDT normally open, 2 A. 115 v.	KUR	N 21005
L101	200 KC oscillator tank inductor	500 microhenry center tapped inductor, variable by powdered iron slug	NRC	AD5A49
L102	200 KC oscillator plate	2.5 mhy RF choke single Pi	MIL	640
L103	PA plate choke	2.5 mhy RF choke with stand-off insulator mount	NAT	R100U
M101	Oven thermostat	Mercury column indicator thermostat with contact at 60° C.	PTC	VC-325
M102	PA plate current meter	P-50 ma DC milliammeter	WEI	Model 506
P101	Oven connector	8 circuit male plug with cable clamp	HBJ	P 308CCT

Symbol	Function	Description	Mfr.	Part No.
P102	Oven connector	6 circuit male plug with cable clamp	HBJ	P 306CCT
P103	RF output connector	75 ohm coaxial male cable connector	AMP	83-1SP
P104	Monitor output connector	75 ohm coaxial male cable connector	AMP	83-1SP
R101	Crystal oscillator grid risistor	100K ohms ± 10% 1/2 Watt	ALB	EB 1041
R102	Crystal oscillator plate resistor	10K ohms ± 10% 1 Watt	ALB	GB 1031
R103	Crystal oscillator plate resistor	4700 ohms ± 10% 1 Watt	ALB	GB 4721
R104	Crystal buffer cathode resistor	1000 ohms ± 10% 1/2 Watt	ALB	EB 1021
R105	200 KC oscillator plate resistor	2400 ohms ± 5% 1/2 Watt	ALB	EB 2425
R106	Reactance tube grid resistor	Same as R101		
R107	Reactance tube cathode resistor	5100 ohms ± 5% 1/2 Watt	ALB	EB 5125
R108	Reactance tube grid resistor	5800 ohms ± 1% 1/2 Watt	CCC	X-1/2
R109	Reactance tube quadrature resistor	67K ohms ± 10% 1/2 Watt	CCC	X-1/2
R110	200 KC oscillator grid resistor	100K ohms ± 5% 1/2 Watt	ALB	EB 1045
R111	Same as R110	Same as R110		
R112	Detector grid resistor	24K ohms ± 5% 1/2 Watt	ALB	EB 2435
R113	Detector grid resistor	470K ohms ± 10% 1/2 Watt	ALB	EB 4741
R114	Same as R113	Same as R113		
R115	Detector cathode resistor	100 ohms ± 10% 1/2 Watt	ALB	EB 1011
R116	Detector screen resistor	10K ohms wirewound potentiometer.	IRC	W-10,000

Symbol	Function	Description	Mfr	Part No.
R117	Detector plate resistor	4700 ohms ± 10% 1 Watt	ALB	GB 4721
R118	PA grid resistor	22K ohms ± 10% 1/2 Watt	ALB	EB 2231
R119	PA bias bleeder	2400 ohms ± 10% 1/2 Watt	ALB	EB 2421
R120	PA output control	Same as R116		
R121	PA screen resistor	22K ohms ± 10% 2 Watts	ALB	HB 2231
R122	Monitor output voltage divider	7500 ohms ± 5% 1/2 Watt	ALB	EB 7525
R123	Monitor output voltage divider	51 ohms ± 5% 1/2 Watt	ALB	EB 5105
R124	Pilot light series resistor	12 ohms ± 10% 2 Watts	ALB	HB 1201
R125	Shift control	10K ohms wirewound potentiometer 1/2" long 1/4" D.	IRC	W-10,000
R126	Shift balance control	10K ohms wirewound potentiometer 1/4" shaft	MAL	M10MP
R127	Shift control calibrator	Same as R126		
R128	Keyer grid resistor	120K ohms ± 10% 1Watt	ALB	GB 1241
R129	Keyer grid resistor	470K ohms ± 10% 1/2 Watt	ALB	EB 4741
R130	Keyer grid resistor	Same as R129		
R131	Keyer grid resistor	220K ohms ± 5% 1/2 Watt	ALB	EB 2245
R132	Keyer cathode resistor	3300 ohms ± 10% 1/2 Watt	ALB	EB 3321
R133	Keyer bias bleeder resistor	47K ohms ± 5% 1 Watt	ALB	GB 4735
R134	PA screen resistor	56K ohms ± 10% 1 Watt	ALB	GB 5631
R135	Keyer bias bleeder resistor	47K ohms ± 5% 1 Watt	ALB	GB 4735
R136	Keyer bias bleeder resistor	15K ohms ± 5% 1 Watt	ALB	GB 1535
R137	Keyer bias bleeder resistor	24K ohms ± 5% 1 Watt	ALB	GB 2435
R138	Oven pilot series resistor	100K ohms ± 10% 1/2 Watt	ALB	EB 1041
R139	Oven relay series resistor	56K ohms ± 10% 2 Watts	ALB	HB 5631

Sym-bol	Function	Description	Mfr.	Part No.
R140	Oven heater resistor	115 V. 80 ohms flat woven resistor	WJL	OW-6-CM80
R141	Same as R140	Same as R140		
R142	Same as R140	Same as R140		
R143	Same as R140	Same as R140		
R144	PA bias bleeder resistor	12K ohms ± 10% 1/2 Watt	ALB	EB 1231
R145	Detector screen resistor	10K ohms wirewound 10 Watts	WLE	10F
R146	Detector screen bleeder resistor	39K ohms ± 10% 1/2 Watt	ALB	EB 3931
R147	Reactance tube cathode resistor	430 ohms ± 5% 1/2 Watt	ALB	EB 4315
R148	Same as R147	Same as R147		
R149	Crystal buffer grid resistor	100K ohms ± 10% 1/2 Watt	ALB	EB 1041
R150	Detector screen bleeder resistor	Same as R146		
R151	Keyer output load resistor	12K ohms ± 10% 1 Watt	ALB	GB 1231
R152	PA parasitic suppressor	51 ohms ± 5% 1/2 Watt	ALB	EB 5105
R153	Negative keying bias bleeder resistor	390K ohms ± 5% 1/2 Watt	ALB	EB 3945
R154	Negative keying bias cathode resistor	24K ohms ± 5% 1/2 Watt	ALB	EB 2435
R155	Negative keying input load resistor	120K ohms ± 5% 1/2 Watt	ALB	EB 1245
R156	"FAX" Input load resistor	120K ohms ± 5% 1/2 Watt	ALB	EB 1245
S101	Crystal selector switch	2 pole: 2-5 position rotary isolantite insulation non-shorting, 1/2" shaft	CEN	2505
S102	Test switch	Same as S101, 1/2" shaft		
S103	Oven heat protection	Bi-metallic thermostat set to operate at 72 ± 2° C., Contacts normally closed 2 A. 115 V.	MIP	SU-100-L

Symbol	Function	Description	Mfr.	Part No.
S-104	Standby Switch	DPST Toggle switch 1 A. 250 V.	AHH	81024
S-106	Negative or Positive keying switch	DPDT Toggle switch 1 A. 250 volt	AHH	81027
S-107	FS-FAX input selector switch	DPDT Toggle switch 1 A. 250 volt	AHH	81027 CE
TB101	Protection thermostat mounting board	5 terminal turret terminal board	NRC	TB5A3
T101	Crystal oscillator output	Tuned transformer 2.3-6.5 mcs. Secondary inductance variable by powdered iron slug	NRC	AD5A50
T102	Detector output transformer	Tuned transformer 2.5-6.7 mcs. Balanced primary unbalance secondary. Secondary inductance variable by powdered iron slug	NRC	AD5A51
T103	PA output transformer	Tuned RF transformer	NRC	190
V101	Crystal oscillator and buffer tube	Standard	Any	6SN7GT
V102	Variable oscillator tube	Standard	Any	6SN7GT
V103	Variable oscillator reactance tube	Standard	Any	6SN7GT
V104	Mixer Tube	Standard	Any	6SA7
V105	Mixer Tube	Standard	Any	6SA7
V106	Power amplifier tube	Standard	Any	2E26
V107	Keying Tube	Standard	Any	6SN7GT
XV101	Socket for V101	8 prong octal socket with ground lugs, mica filled bakelite	CIN	9881

Symbol	Function	Description	Mfr.	Part No.
XV102	Socket for V102	Same as XV101		
XV103	Socket for V103	Same as XV101		
XV104	Socket for V104	Same as XV101		
XV105	Socket for V105	Same as XV101		
XV106	Socket for V106	Same as XV101		
XV107	Socket for V107	Same as XV101		
XI101	Socket for I101	Pilot light assembly for bayonet base pilot lamp. Red Jewel	DLA	67 BD
XI102	Socket for I102	Same as XI101 but with white jewel		
XY101	Crystal socket	Mica filled bakelite socket for crystal holder	AMP	33-2T
XY102	Same as XY101	Same as XY101		
XY103	Same as XY101	Same as XY101		

POWER SUPPLY

Symbol	Function	Description	Mfr.	Part No.
C201	Power supply filter condenser	4 mfd ± 20% 600 volt DC Dykanol	CDC	TLA 6040
C202	Same as C201	Same as C201		
C203	Same as C201	Same as C201		
C204	Same as C201	Same as C201		
C205	Power line, RF bypass condenser	0.5-0.5 mfd ± 20% 600 volt DC dual paper bathtub	SAN	5006-.5x.5
C206	Same as and part of C205	Same as and part of C205		
E201	Output terminal board	8 circuit with screw type binding posts	HBJ	8-141-Y
F201	Primary power fuse (Keyer)	Glass cartridge fuse, 1.5 A. 250 volt	LFU	3 AG
F202	Primary power fuse (Oven)	Glass cartridge fuse, 2 A. 250 volt	LFU	3 AG
I201	Primary power pilot light	6-8 volt bayonet base in candescent lamp. 250 ma.	GEC	47
J201	Primary power connector	2 circuit male recessed chassis connector	HUB	6808
L201	Power supply filter choke	7 henries 110 ma. 160 ohms DC resistance	NRC	108
L202	Same as L201	Same as L201		
P201	Power connector	2 circuit female cord connector to fit J201	HUB	7257
P202	Voltage regulator series resistor	5000 ohms ± 10% 20 watts wirewound	WLE	20F
R203	Power supply filter resistor	10K ohms ± 10% 20 watts wirewound	OHM	0215
R204	Voltage regulator series resistor	Same as R203		
R205	Power supply filter resistor	470 ohms ± 10% 2 Watts	ALB	HB 4711

Symbol	Function	Description	Mfr.	Part No.
R206	Pilot light series resistor	12 ohms ± 10% 2 Watts	ALB	HB 1201
S201	Primary power switch	DPST Toggle switch 3 A. 110 volt	AHH	81024 GB
T201	Power supply transformer	Primary: 115/230 volt 50/60 cps. Terminal 1-2-3-4 Sec. #1: 350-0-350 volt 120 ma. Terminals 9-10CT-11 Sec. #2: 5 V. 3 A. Terminals 5-6 Sec. #3: 6.3 V. 5 A. Terminals 7-8	NRC	181
V201	Main rectifier tube	Standard	Any	5U4G
V202	Voltage regulator tube	Standard	Any	OC3/VR105
V203	Bias rectifier tube	Standard	Any	6Y5GT
V204	Bias voltage regulator	Standard	Any	OA3/VR75
XV201	Socket for V201	Mica filled bakelite octal socket with ground lugs	CIN	9881
XV202	Socket for V202	Same as XV201		
XV203	Socket for V203	Same as XV201		
XV204	Socket for V204	Same as XV201		
XF201	Socket for F201	Extractor type fuse holder for glass cartridge fuse 3 AG size	LFU	1075
XF202	Socket for F202	Same as XF201		
XI201	Socket for I201	Small bayonet base pilot light assembly	DLA	67 BD

7-3

MANUFACTURERS' DESIGNATIONS LIST

AHH	Arrow-Hart & Hegeman Elec. Co.	103 Hawthorne Street Hartford, Conn.
ALB	Allen-Bradley Co.	Milwaukee, Wisconsin
AMP	American Phenolic Corp.	Empire State Bldg. New York, N. Y.
CCC	Continental Carbon Co.	13900 Lorain Avenue Cleveland 11, Ohio
CDC	Cornell-Dubilier Elec. Corp.	1000 Hamilton Blvd. So. Plainfield, New Jersey
CEN	Centralab, Inc.	900 East Keefe Avenue Milwaukee, Wisconsin
CIN	Cinch Mfg. Corp.	1026 So. Homan Avenue Chicago, Ill.
DRA	Drake Mfg. Co.	1713 W. Hubbard Street Chicago 22, Ill.
ERC	Erie Resistor Corp.	644 West 12th Street Erie, Pennsylvania
GEC	General Electric Co.	1 River Road Schenectady, New York
HAM	Hammarlund Mfg. Co.	460 West 34th Street New York, N. Y.
HBJ	Howard B. Jones Division Cinch Mfg. Corp.	1026 So. Homan Avenue Chicago, Ill.
IRC	International Resistance Co.	401 No. Broad St. Philadelphia, Penn.
LFU	Littlefuse, Inc.	1865 Miner Street Des Plaines, Ill.
MIL	J. W. Miller Co.	5917 S. Main Street Los Angeles, California
MIP	Mechanical Industries Production Co.	217 Ash Street Akron, Ohio
NAT	National Co., Inc.	61 Sherman St. Malden, Massachusetts.

NRC	Northern Radio Co., Inc.	143-145 West 22nd Street New York 11, New York
OHM	Ohmite Mfg. Co.	4835 W. Flournoy Street Chicago 44, Ill.
PHT	Philadelphia Thermometer Co.	6th and Cayuga Streets Philadelphia, Pennsylvania
RCC	Radio Condenser Corp.	Camden 3, New Jersey
RCA	Radio Corp. of America	Harrison, N. J. Tube Department
SAN	Sangamo Electric Corp.	Marion, Ill.
SCC	Stackpole Carbon Co.	St. Mary's, Pennsylvania
STA	The States Co.	19 New Park Avenue Hartford 6, Connecticut
WEI	Weston Elec. Instrument Co.	50 Church Street New York 7, N. Y.
WLE	Ward Leonard Electric Co.	31 South Street Mount Vernon, New York

FINISH

ITEM	DESCRIPTION	DWG. NO.	QUAN.	PART NO.

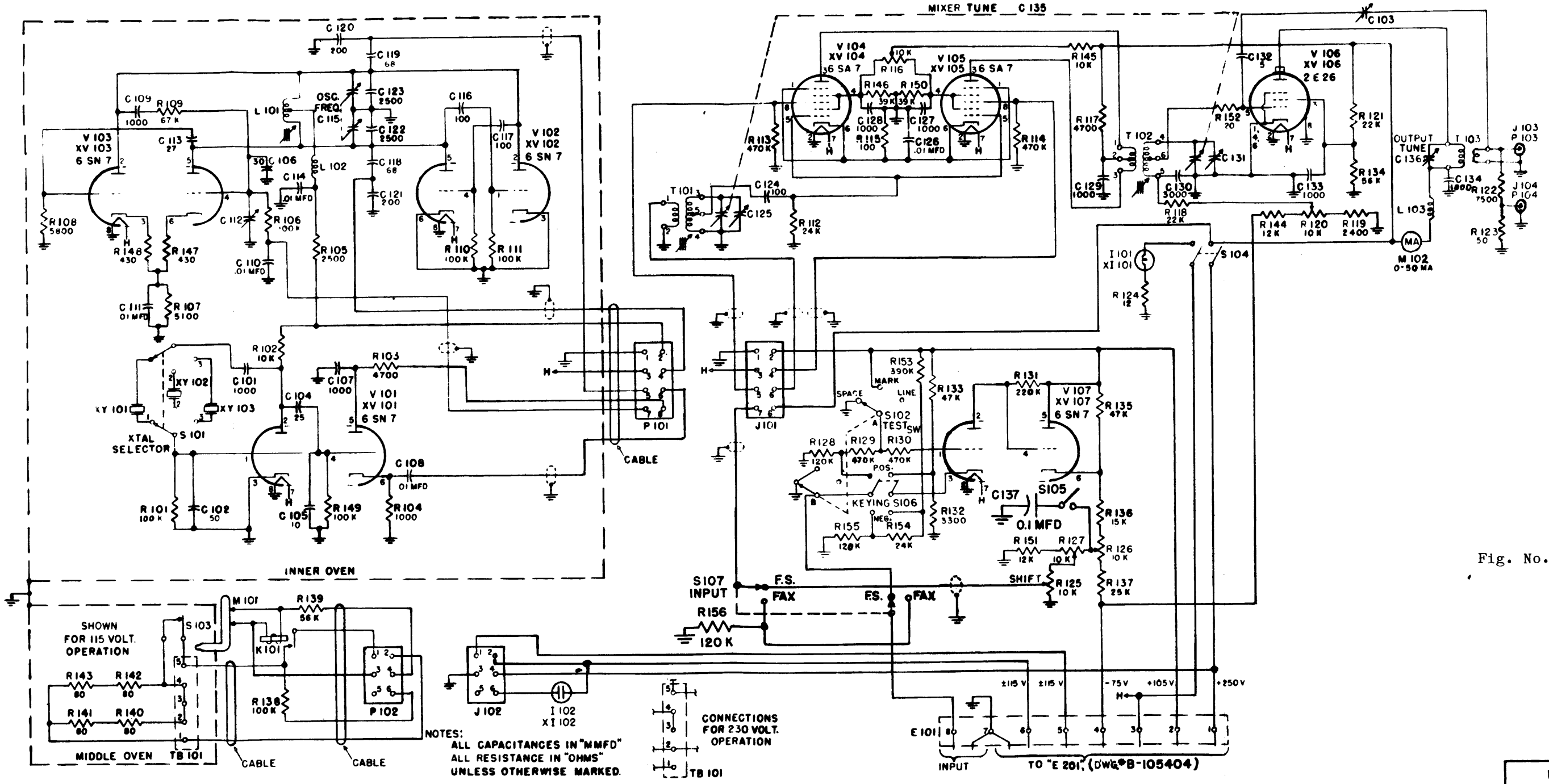


Fig. No. 2

ISSUE	DWN.	CKD.	APPR.	DATE	CHANGE
3	RA	J.m.	J.m	8-22-51	ADDED 'S107' & R'156'
2	RA	J.m.	J.m	7-24-51	ADDED 'C137' & 'S105'
1	TCR	J.m.	J.m	6-12-51	ORIG. DWG. WAS SD3C1.

MATERIAL

REFERENCE DWGS.
INDEX NO. A-105400

USED ON

TITLE
SCHEMATIC
FREQUENCY SHIFT KEYER
TYPE 105 MODEL 4A

TOLERANCE (UNLESS SPECIFIED)
FRACT. ± 1/64 DECIMAL ±.005

SCALE

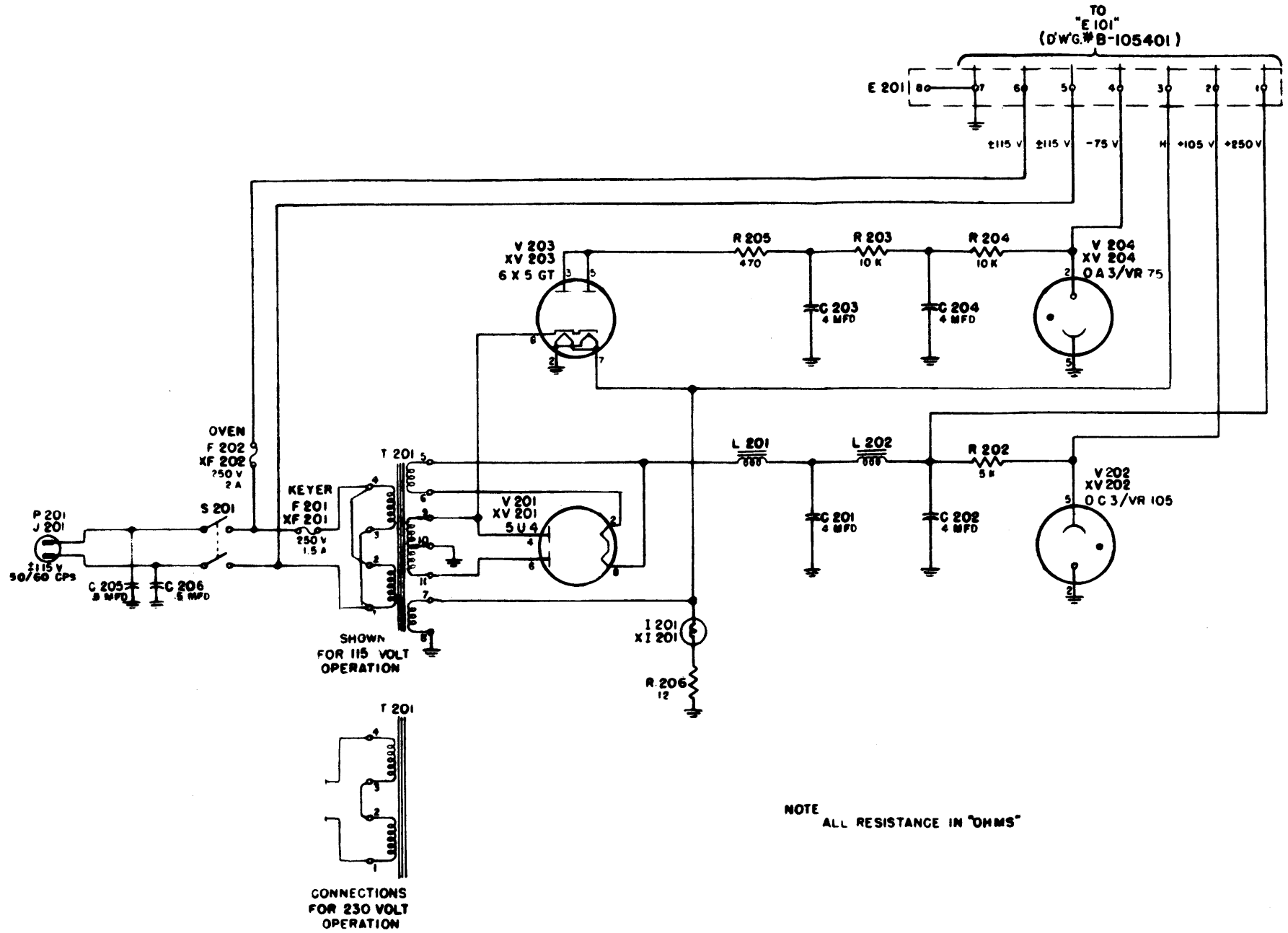
ENGR.	APPR.	DWN.	CKD.	APPR.	APPR.	DATE
L.N.		TCR	H.S.G.			12-7-49

NORTHERN RADIO COMPANY
INCORPORATED

DWG. NO. B-105401

FINISH :

ITEM	DESCRIPTION	DWG. NO.	QUAN.	PART NO.



NOTE
ALL RESISTANCE IN "OHMS"

Fig. No. 3

USED ON

ISSUE	DWN.	CKD.	APPR.	DATE	CHANGE
1	TCR	J.M.S.		6-13-51	ORIG. DWG. WAS SD 3C2

MATERIAL

SCALE

ENGR. L.N. | APPR.

REFERENCE DWGS
INDEX NO. A-105400

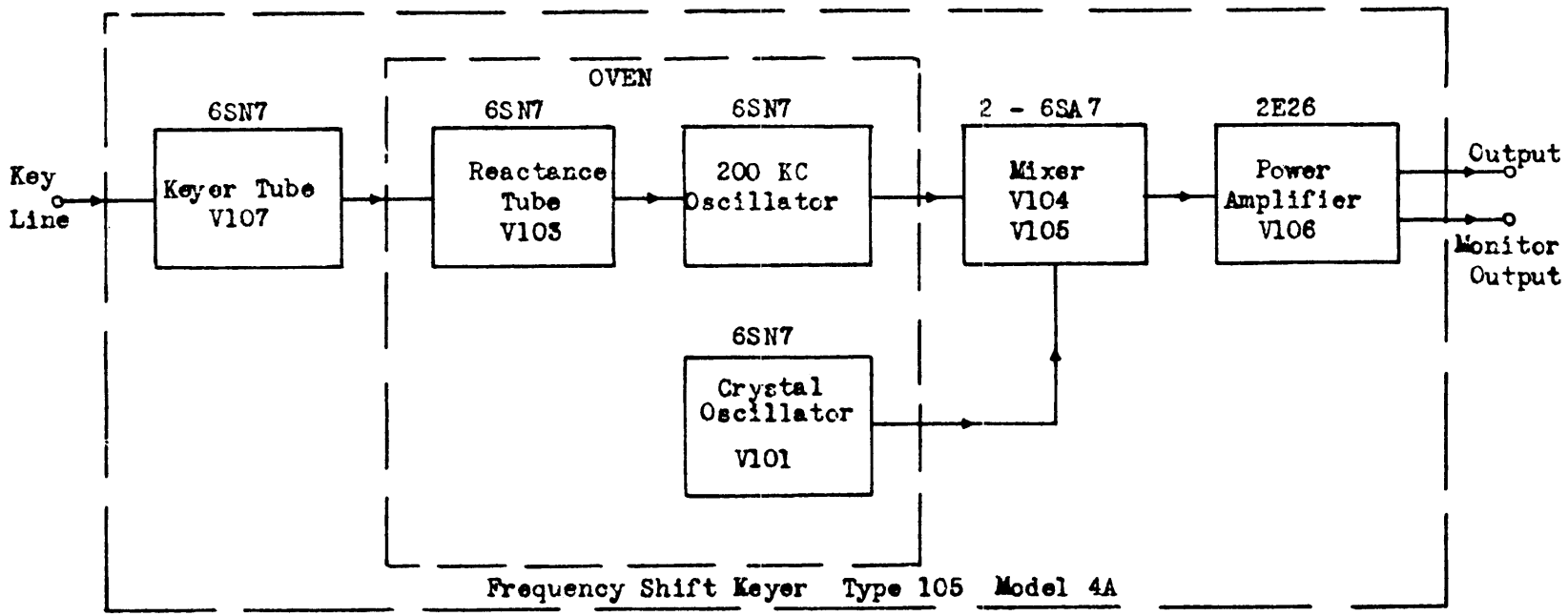
TOLERANCE (UNLESS SPECIFIED)
FRACT. ± 1/64 DECIMAL ±.005

DWN TCR | CKD | APPR. | APPR. | DATE 12-9-49

TITLE
SCHEMATIC
(POWER SUPPLY)
FREQUENCY SHIFT KEYER
TYPE 105 MODEL 4B

NORTHERN RADIO COMPANY
INCORPORATED

DWG. NO. B-105404



V201 - 5U4
V202 - OC3/VR105
V203 - 6X5GT
V204 - OA3/VR75

F S Keyer Power Supply Typ 105 Model 4B

Fig. No. 4

Block Diagram of Equipment.

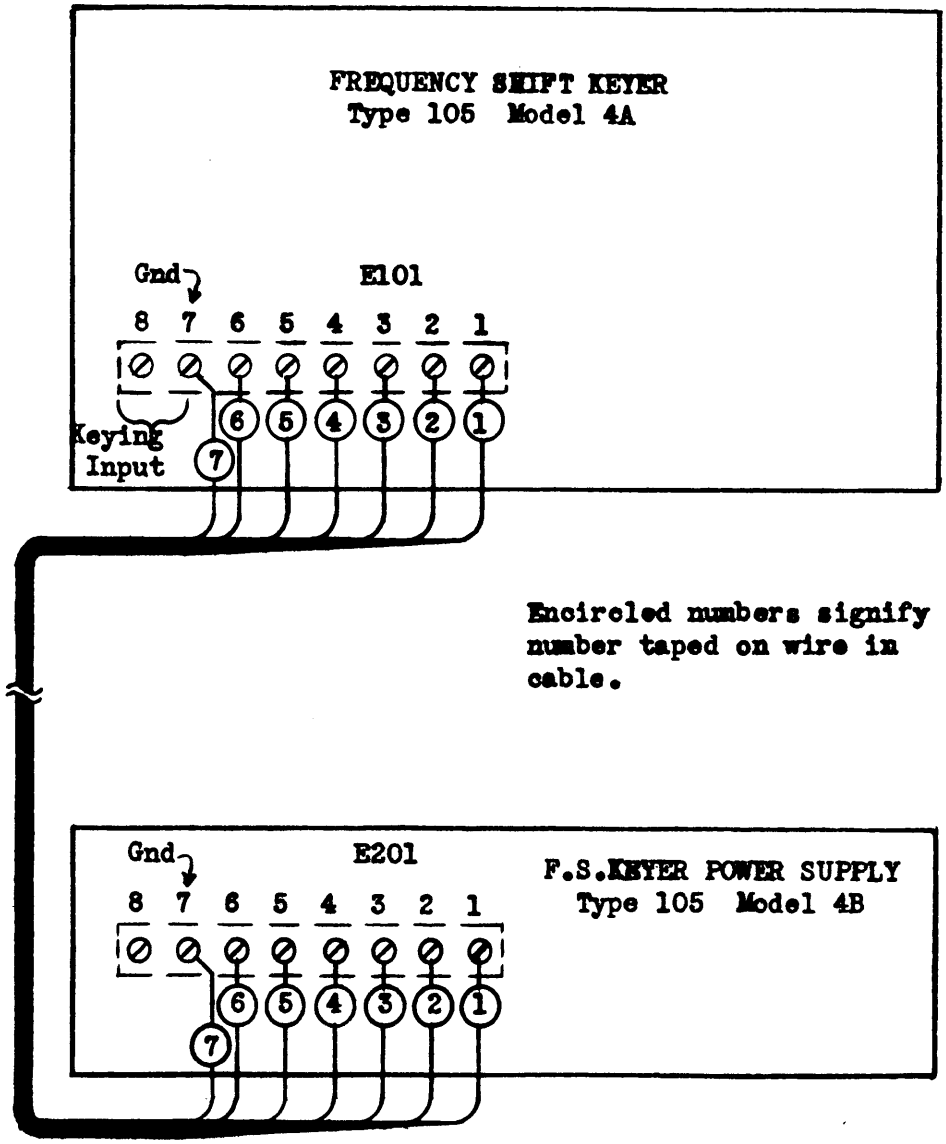


Fig. No. 5

Interconnection Diagram

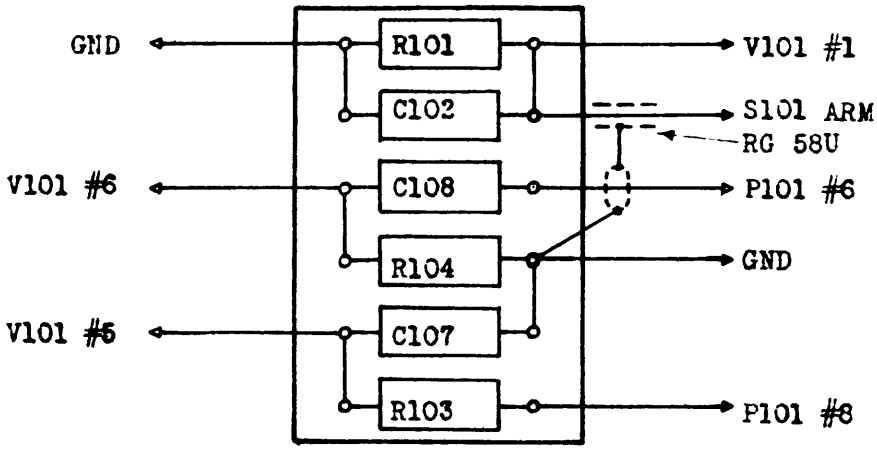


Fig. No. 6

TERMINAL BOARD #102

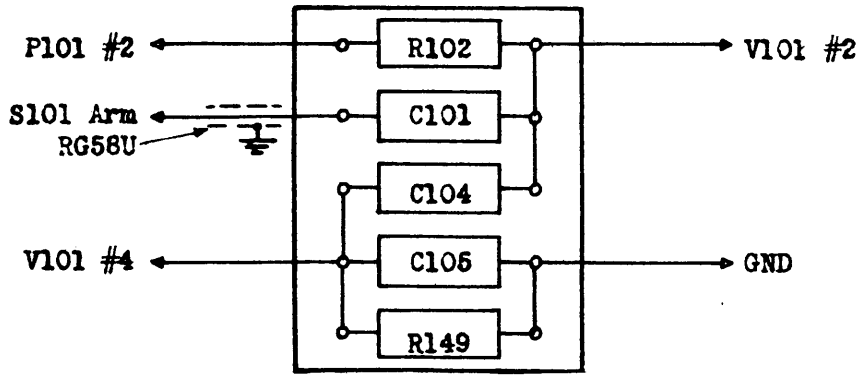


Fig. No. 7

TERMINAL BOARD #103

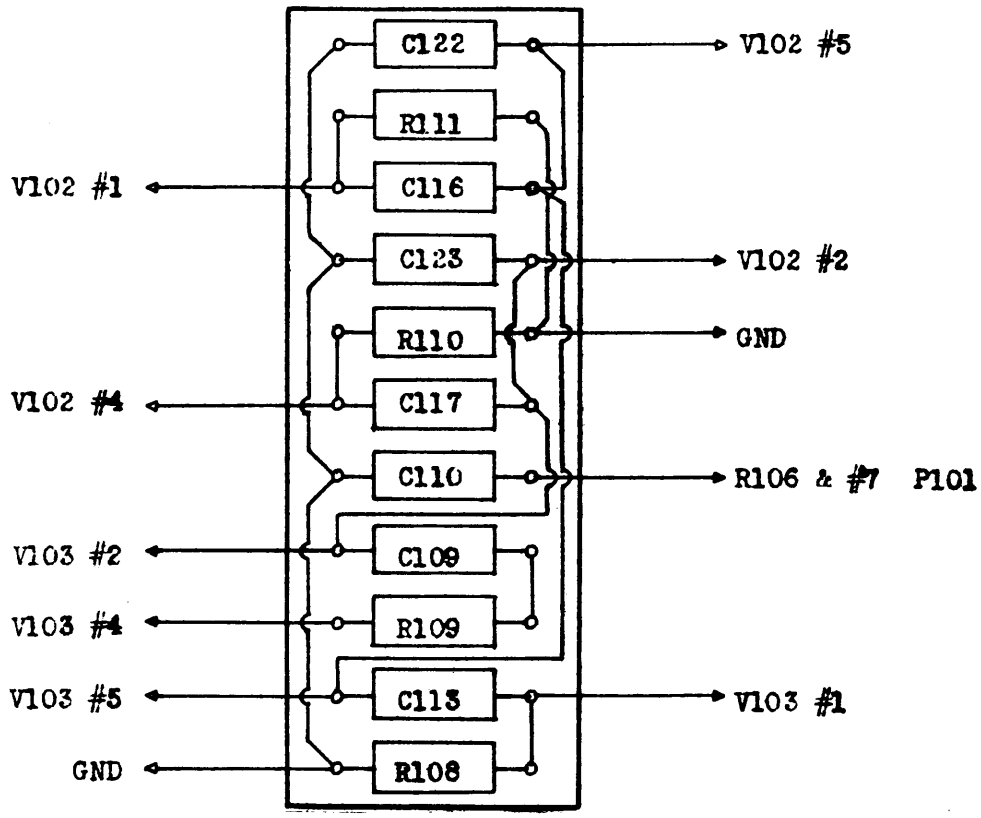


Fig. No. 8

TERMINAL BOARD #104

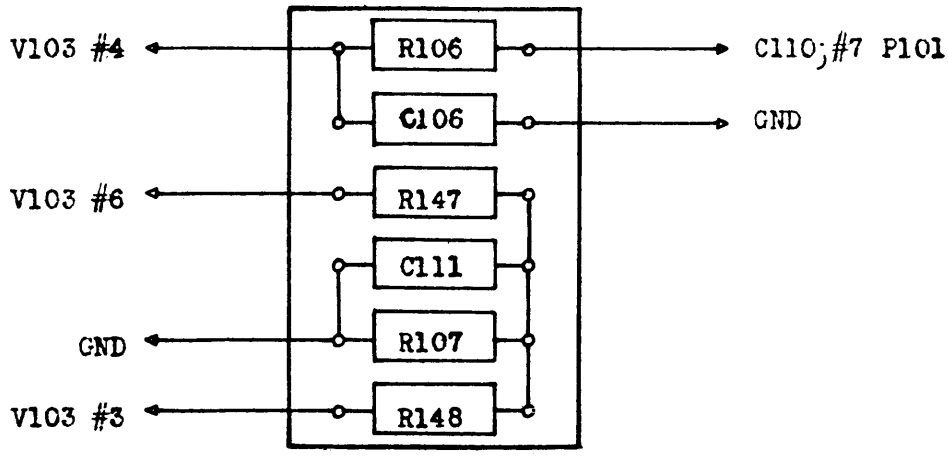


Fig. No. 9

TERMINAL BOARD #105

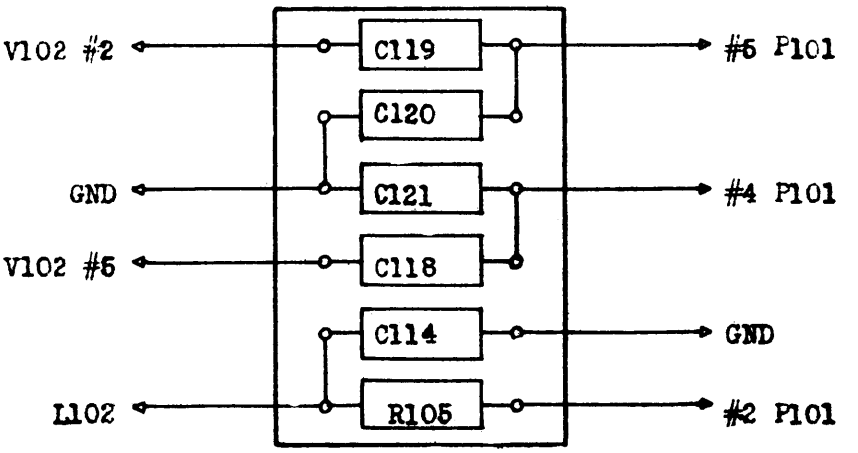


Fig. No. 10

TERMINAL BOARD #106

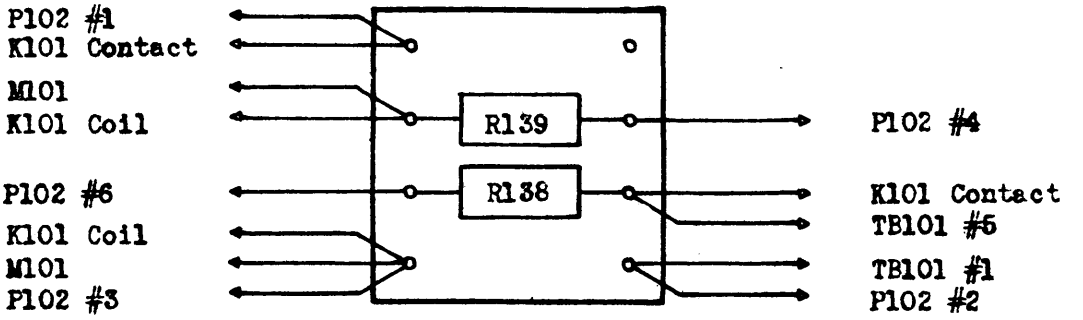


Fig. No. 11

TERMINAL BOARD #107

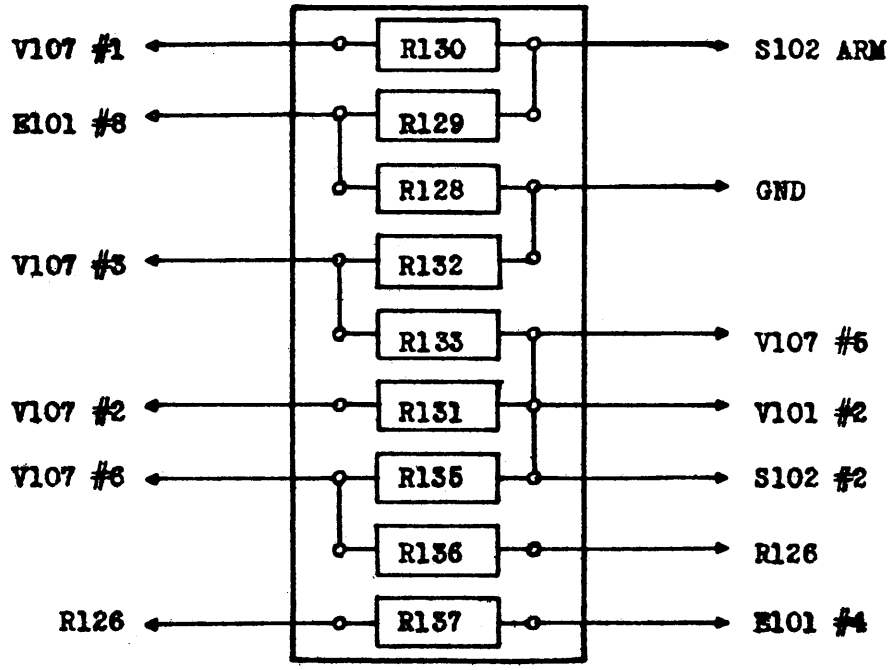


Figure No. 12

TERMINAL BOARD #108

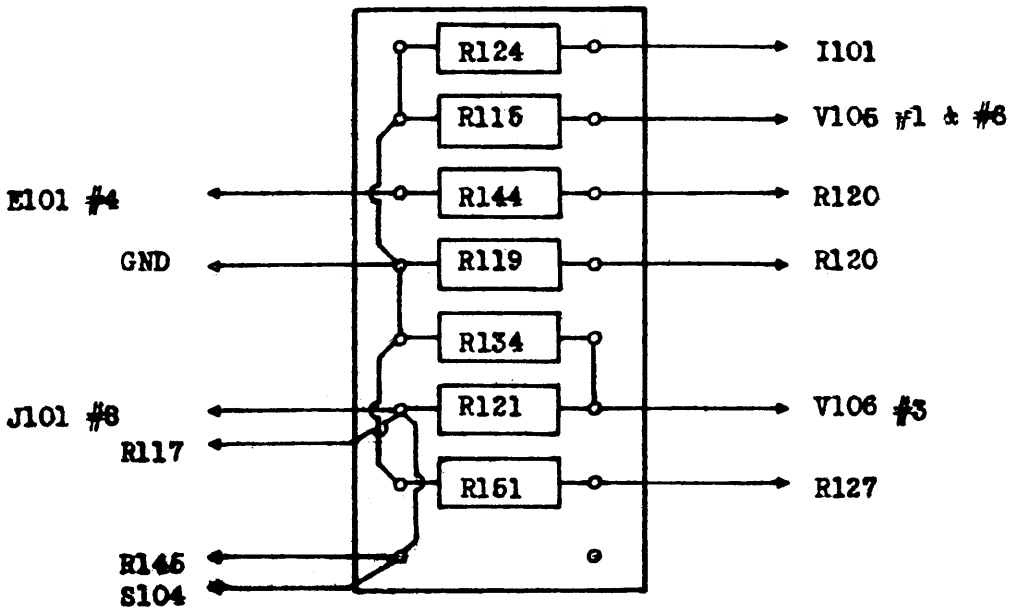


Figure No. 13

TERMINAL BOARD #109

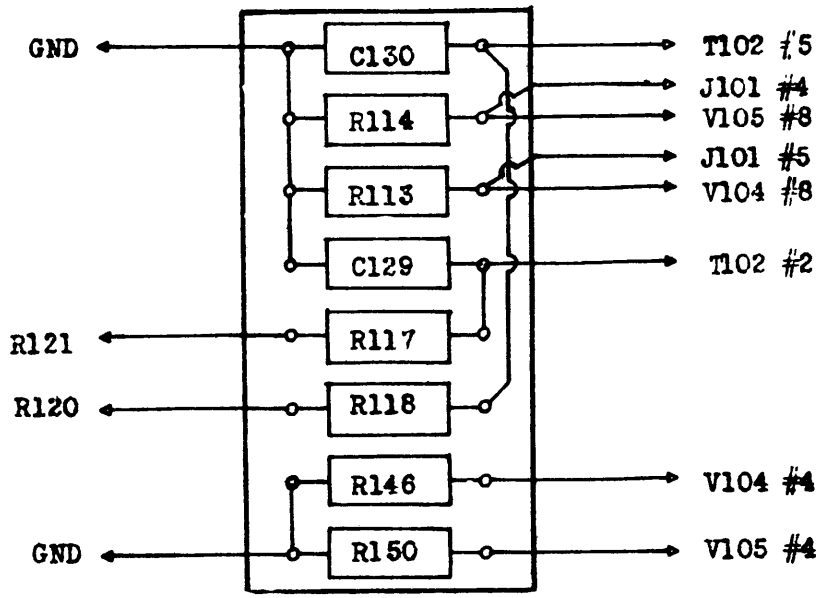


Fig. No. 14

TERMINAL BOARD #110

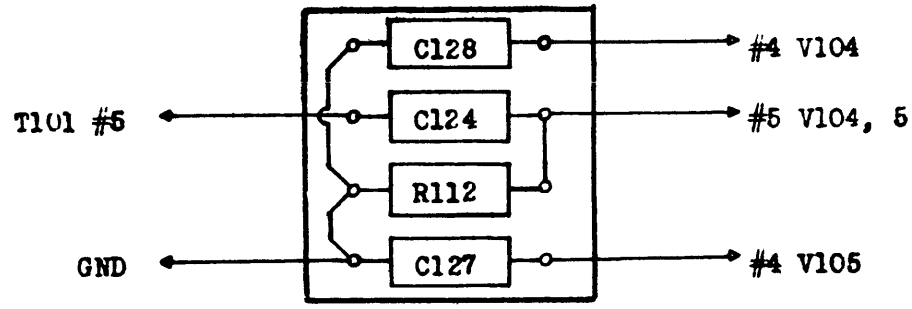


Fig. No. 15

TERMINAL BOARD #111

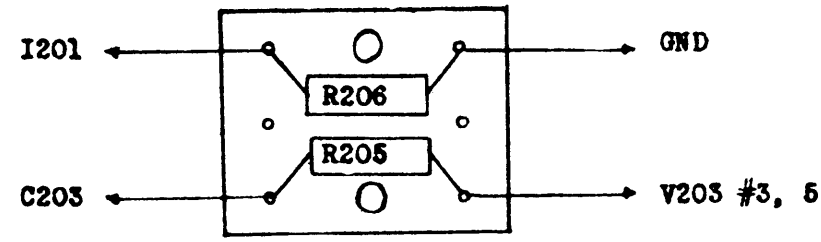


Fig. No. 16

TERMINAL BOARD #201

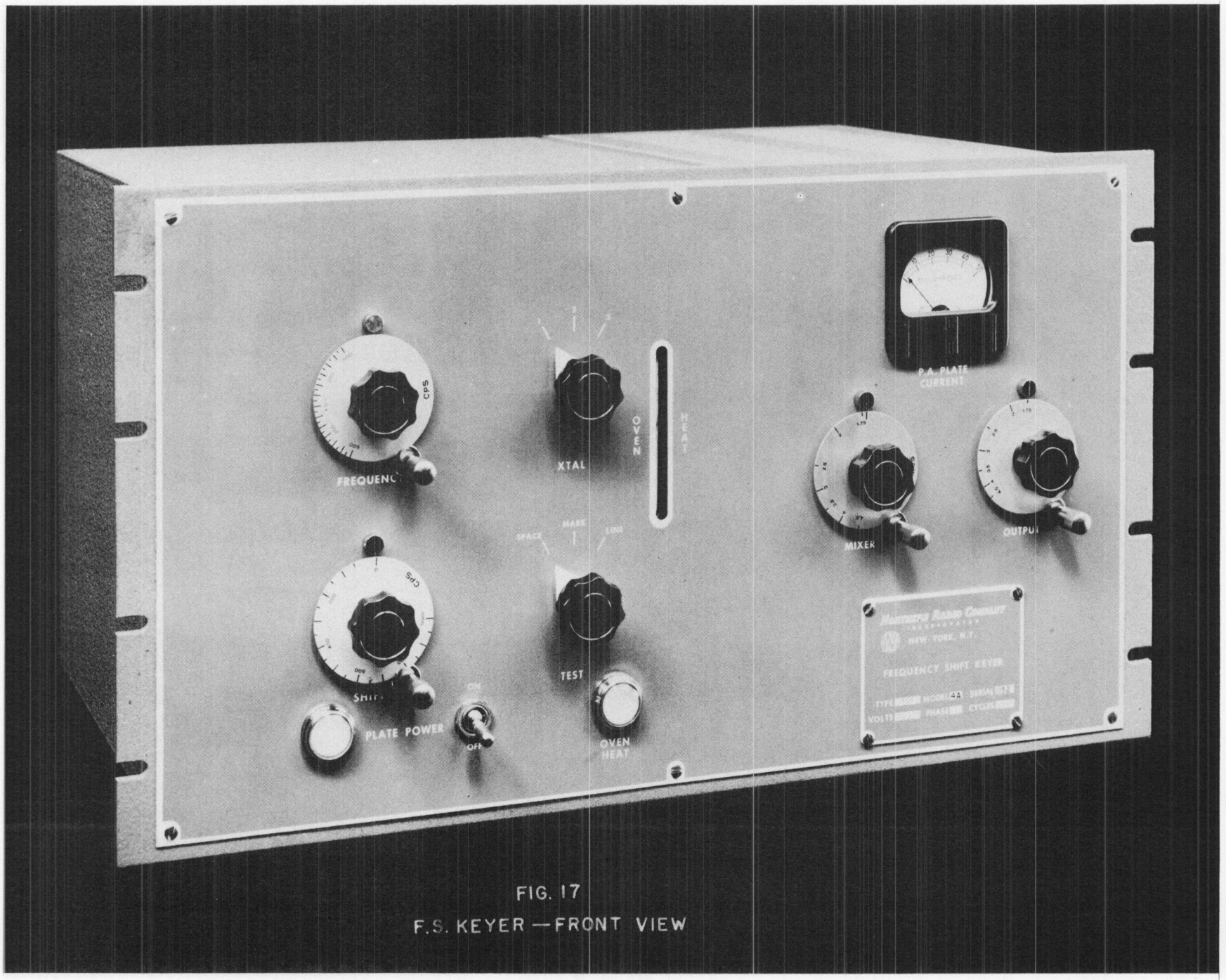


FIG. 17

F.S. KEYER — FRONT VIEW

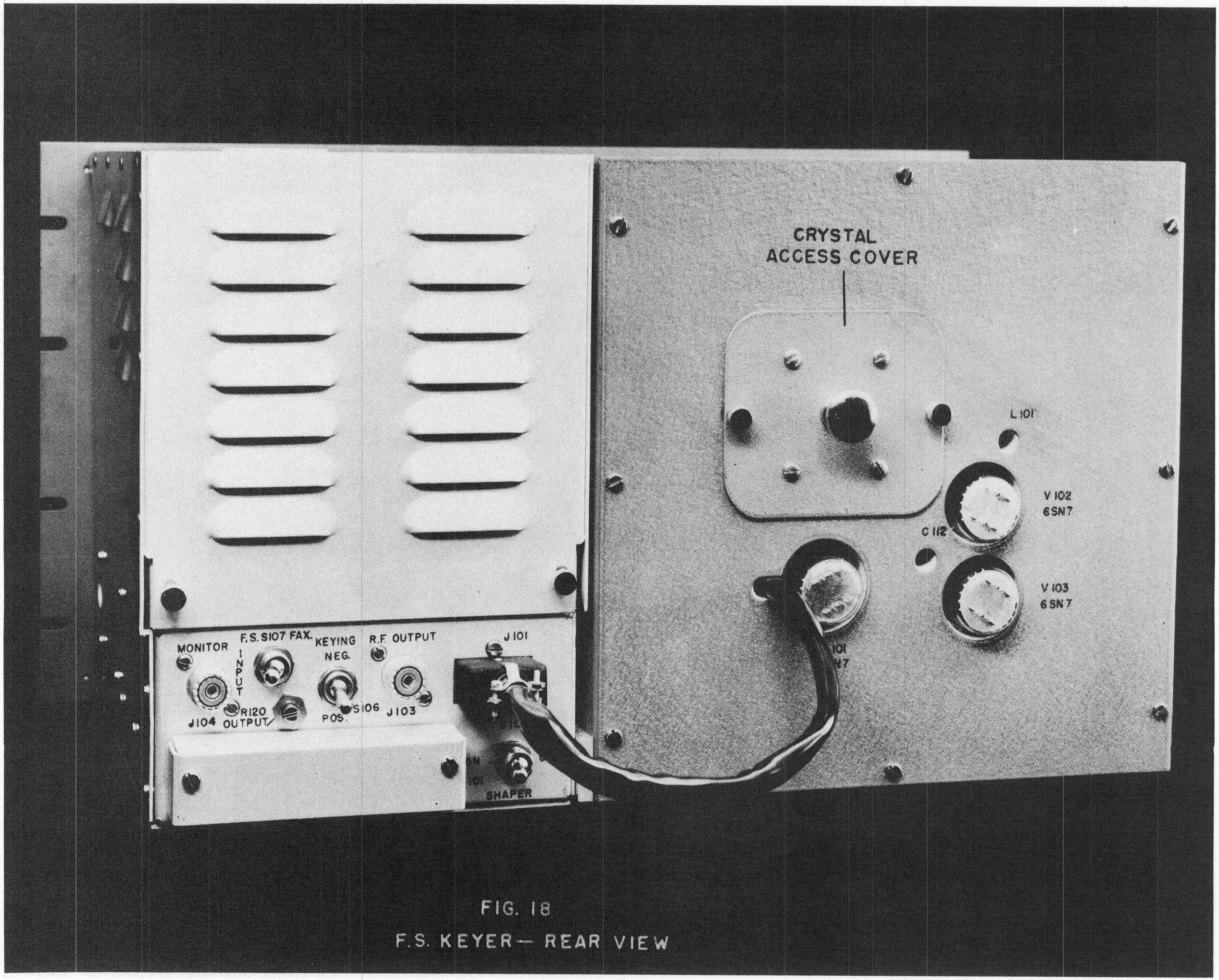


FIG. 18

F.S. KEYER— REAR VIEW

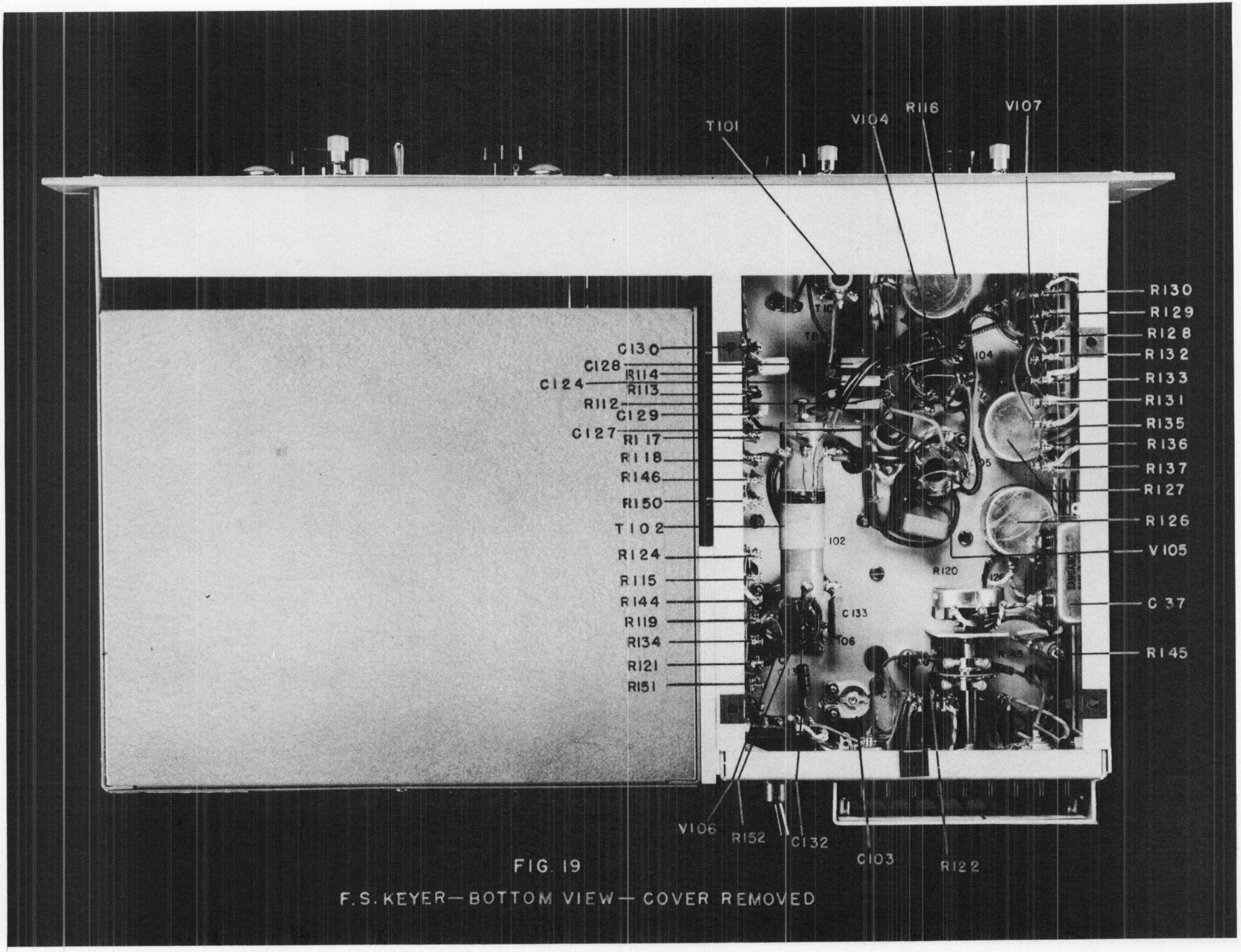


FIG. 19

F.S. KEYER—BOTTOM VIEW—COVER REMOVED

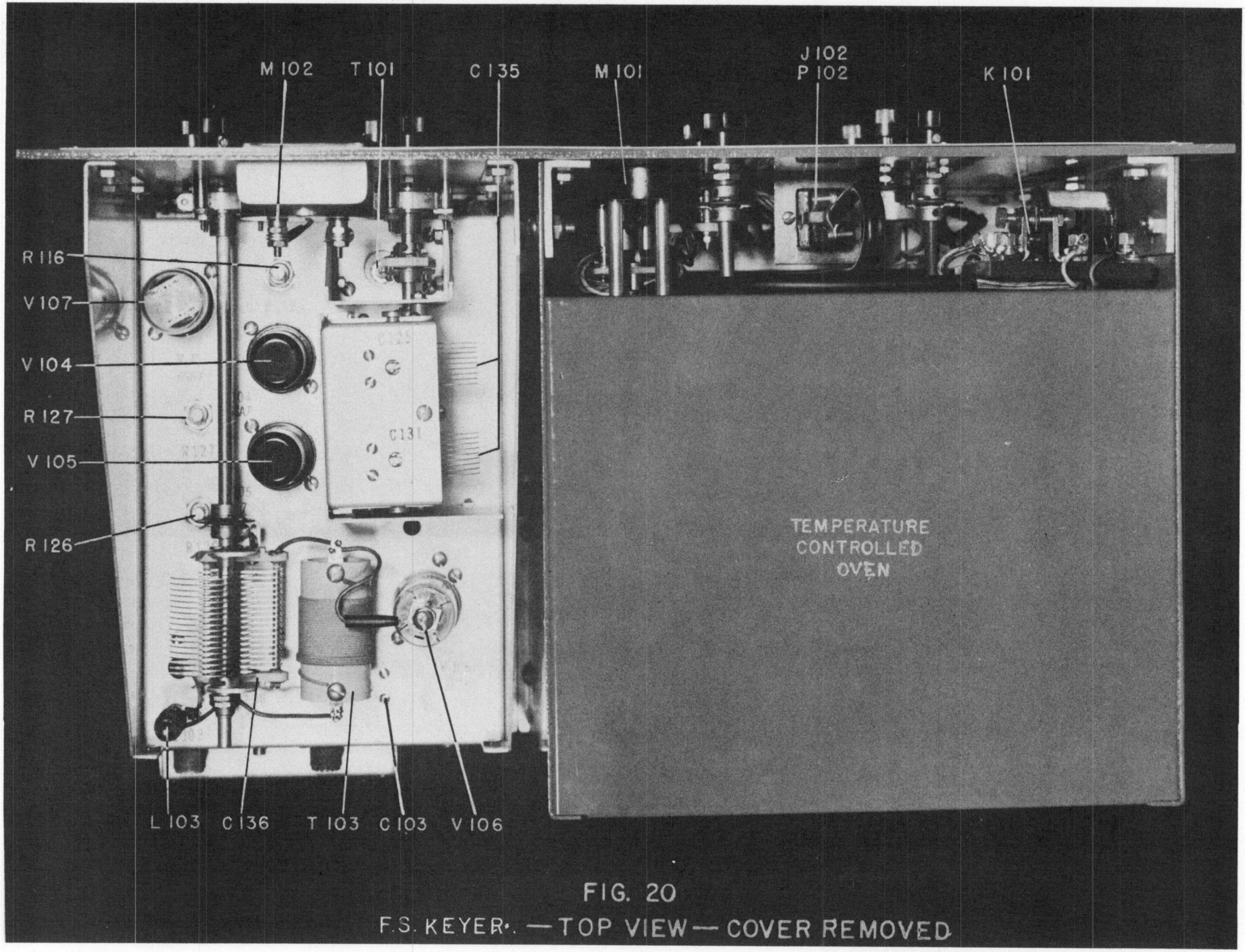


FIG. 20

F.S. KEYER. — TOP VIEW — COVER REMOVED

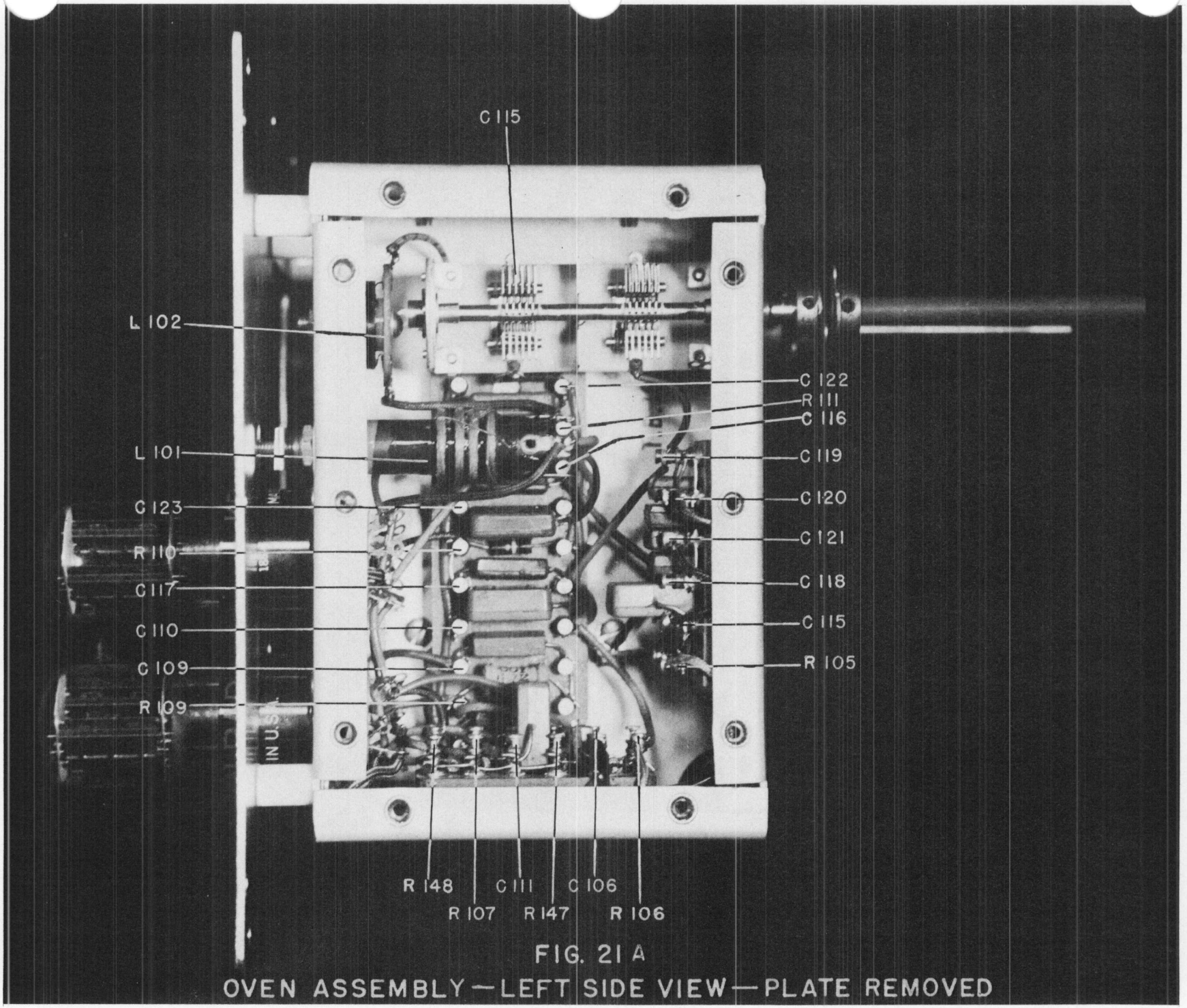


FIG. 21 A

OVEN ASSEMBLY — LEFT SIDE VIEW — PLATE REMOVED

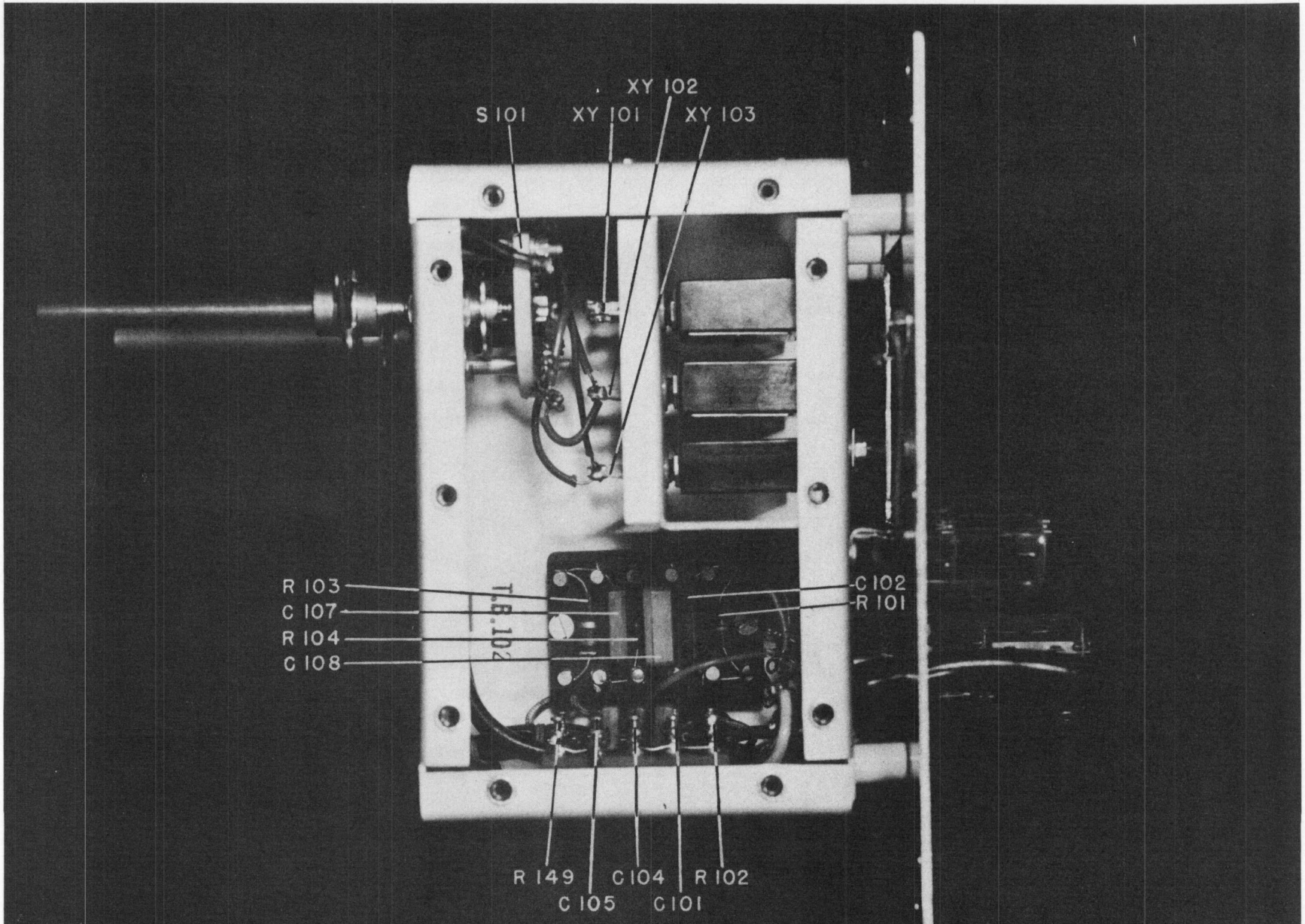


FIG. 21B
OVEN ASSEMBLY — RIGHT SIDE VIEW — PLATE REMOVED

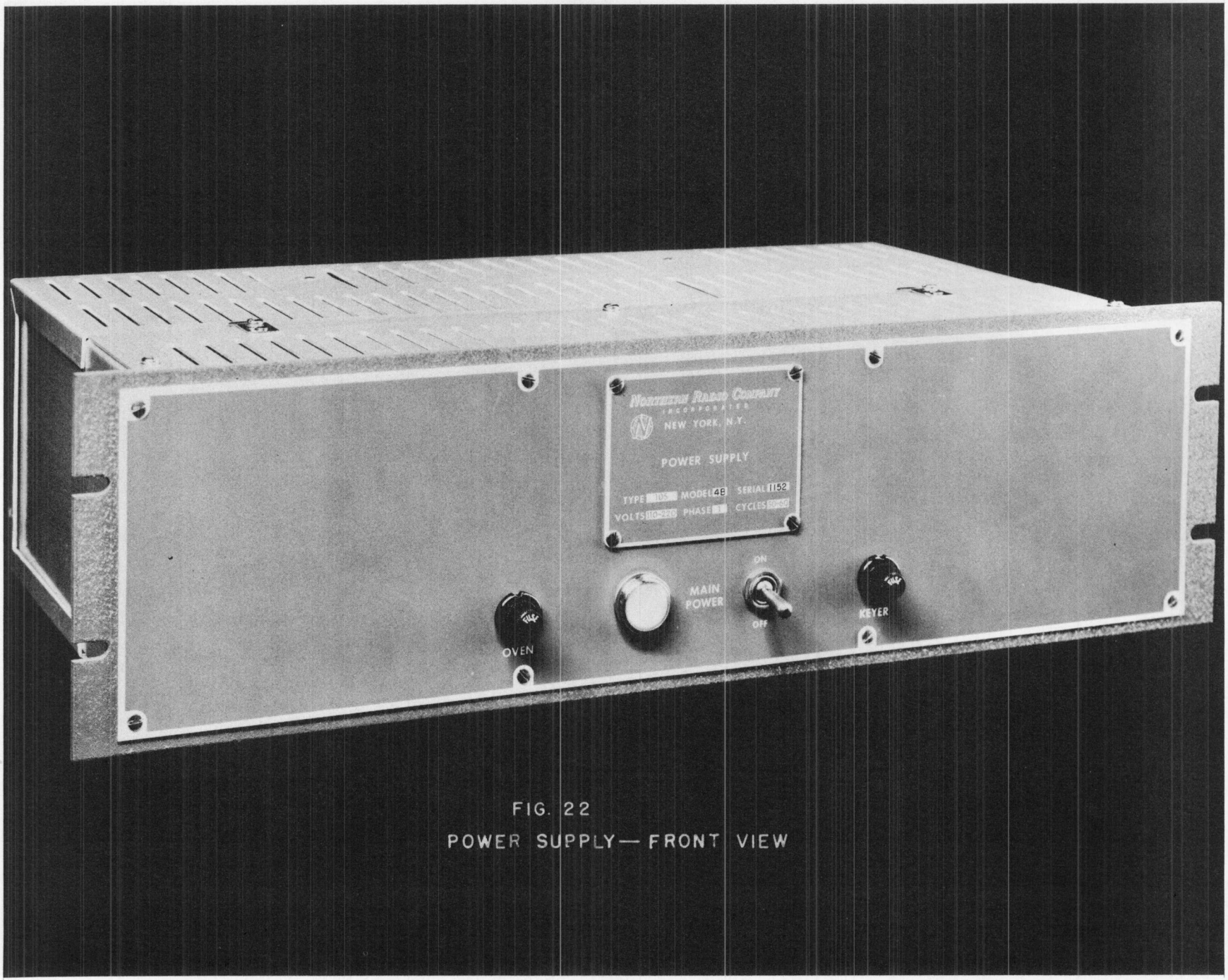


FIG. 22

POWER SUPPLY — FRONT VIEW

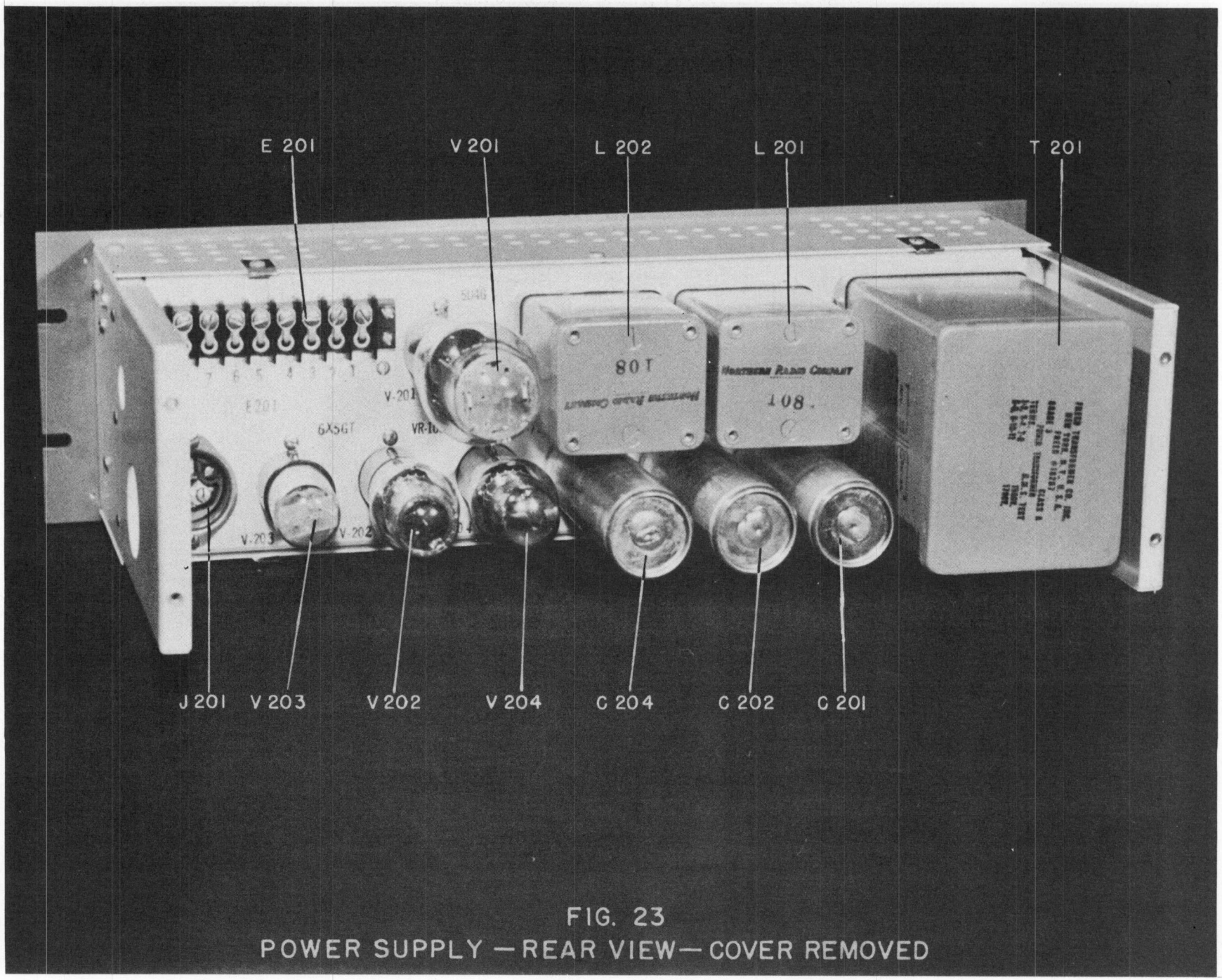


FIG. 23
POWER SUPPLY — REAR VIEW — COVER REMOVED

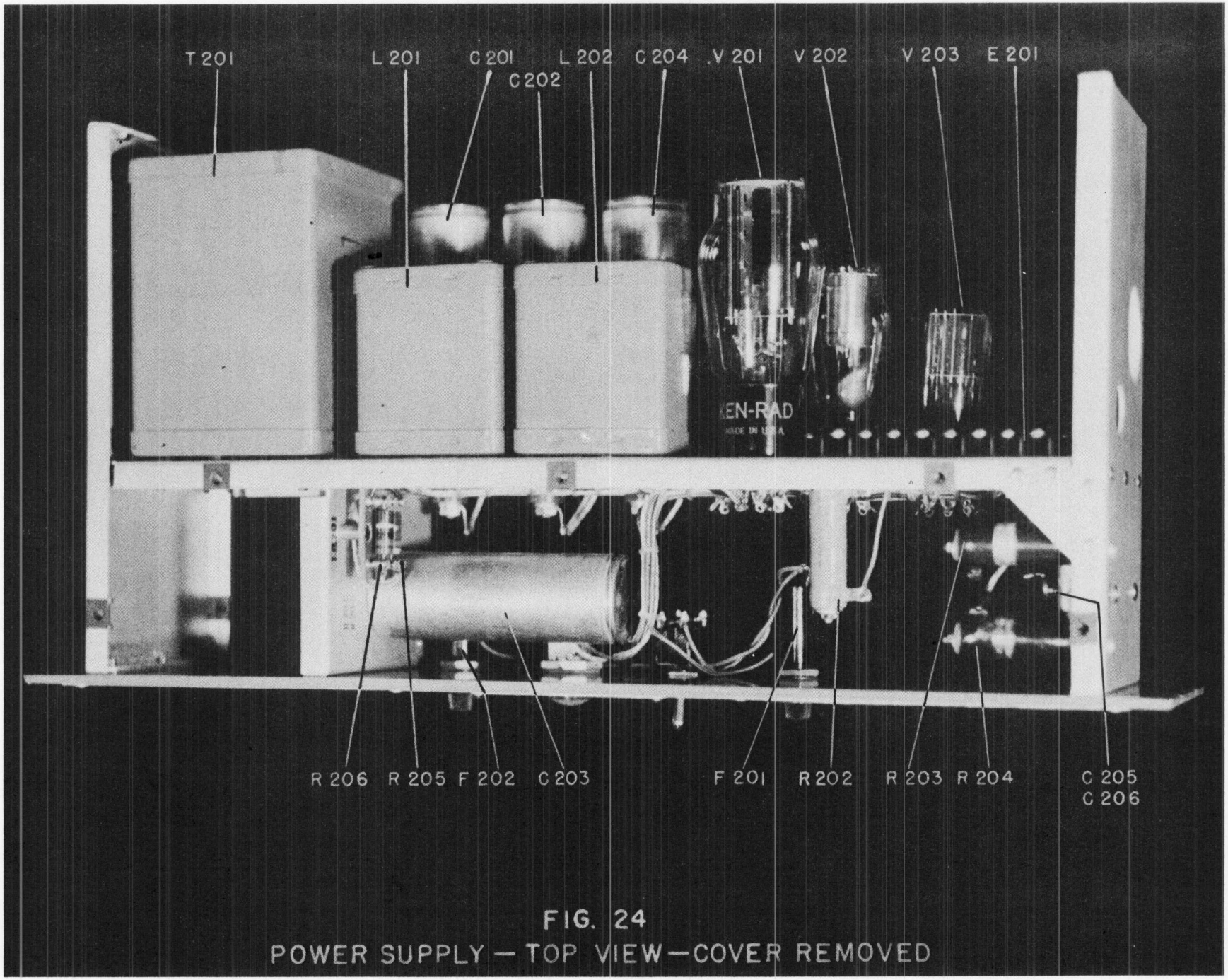


FIG. 24
POWER SUPPLY — TOP VIEW — COVER REMOVED

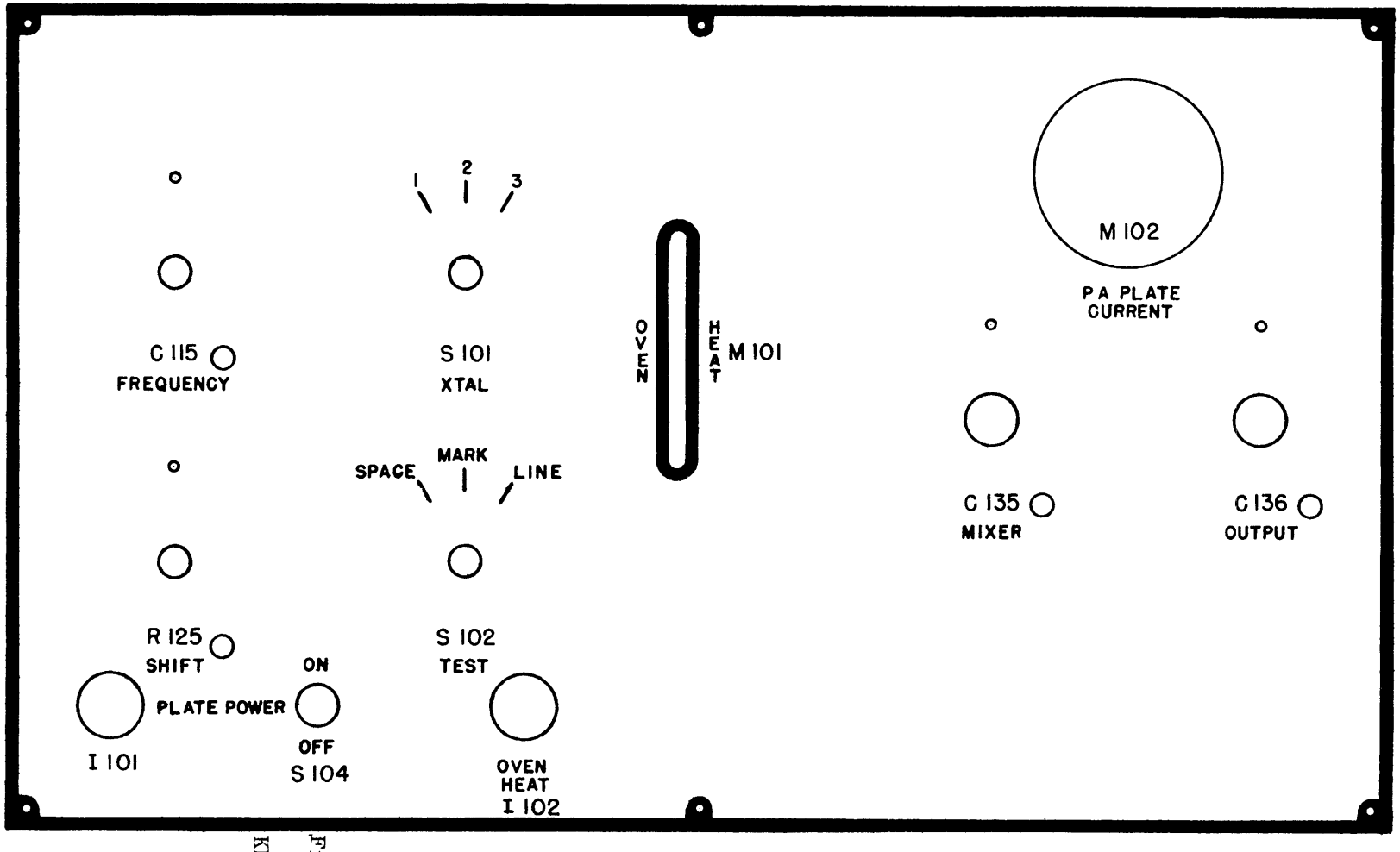


Fig. No. 25
KEYER PANEL
LAYOUT

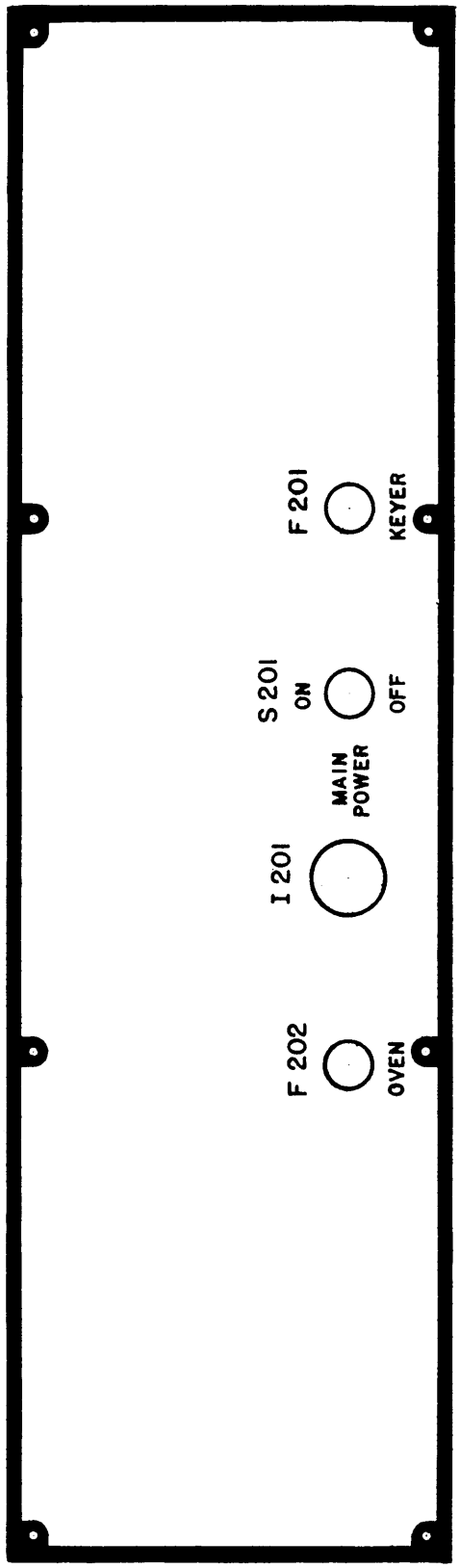


Fig. No. 26

POWER SUPPLY
PANEL LAYOUT

NOTES

NOTES

NOTES

NOTES