

J68340A TEST BAY

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1. GENERAL

1.01 This section pertains to the J68340A Test Bay. Operating principles, circuit description, and equipment features are covered. Related photographs, schematic drawings and a reference lists are included as a part of this section.

1.02 The J68340A Test Bay consists of a rolling cabinet on which are mounted the various test equipments, power supplies and control panels.

1.03 The cabinet is 7'-5-5/8" high, 33-1/4" wide, and 30-1/2" deep. A rear door provides access to the interior. Four swivel-type rubber-tread castors support the cabinet. The weight of the complete test bay is approximately 400 lbs.

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1.04 The test bay is AC operated. The power connection is made through a 3-wire plug and cord assembly. The AC power line to which the test bay is connected should be capable of supplying at least 6 amperes. When the rear door is opened, primary power is removed from the 1500 volt rectifier and from the oscilloscope. To facilitate maintenance all other voltages in the test bay are not disabled when the door is opened. The test bay is ventilated by a fan in the bottom of the cabinet.

1.05 The test bay may be specified by either of two list numbers in the equipment specification. The list 1 equipment is used at main repeater stations and at maintenance and repair centers for the TD-2 radio system. The list 2 equipment is used at auxiliary repeater stations of the TD-2 radio system. The following table lists the principle components of the list 1 and list 2 equipments:

<u>Apparatus</u>	<u>List 1</u> <u>Test Bay</u>	<u>List 2</u> <u>Test Bay</u>
J68340B Meter and Control Panel	x	x
J68340C IF Sweep Oscillator	x	
J68340D IF Detector Panel	x	x
J68340E Power Meter	x	x
J68340F Power Measuring Head	x	x
J68340K Power Supply	x	x
J68340G, L1 IF Attenuator Panel	x	
J68340G, L2 IF Attenuator Panel		x
J68340H RF Sweep Oscillator	x	x
KS-5789 1500 Volt Rectifier	x	x
J68340M 30 Cycle Switch		x
Dumont Model 2551 Oscilloscope	x	x

In addition, both the list 1 and list 2 equipments include a number of waveguide parts which are mounted on the outside of the right-hand side of the cabinet. These components connect to the RF sweep oscillator and are used to apply its output to units under test. These components are described below and may be identified in the attached photographs.

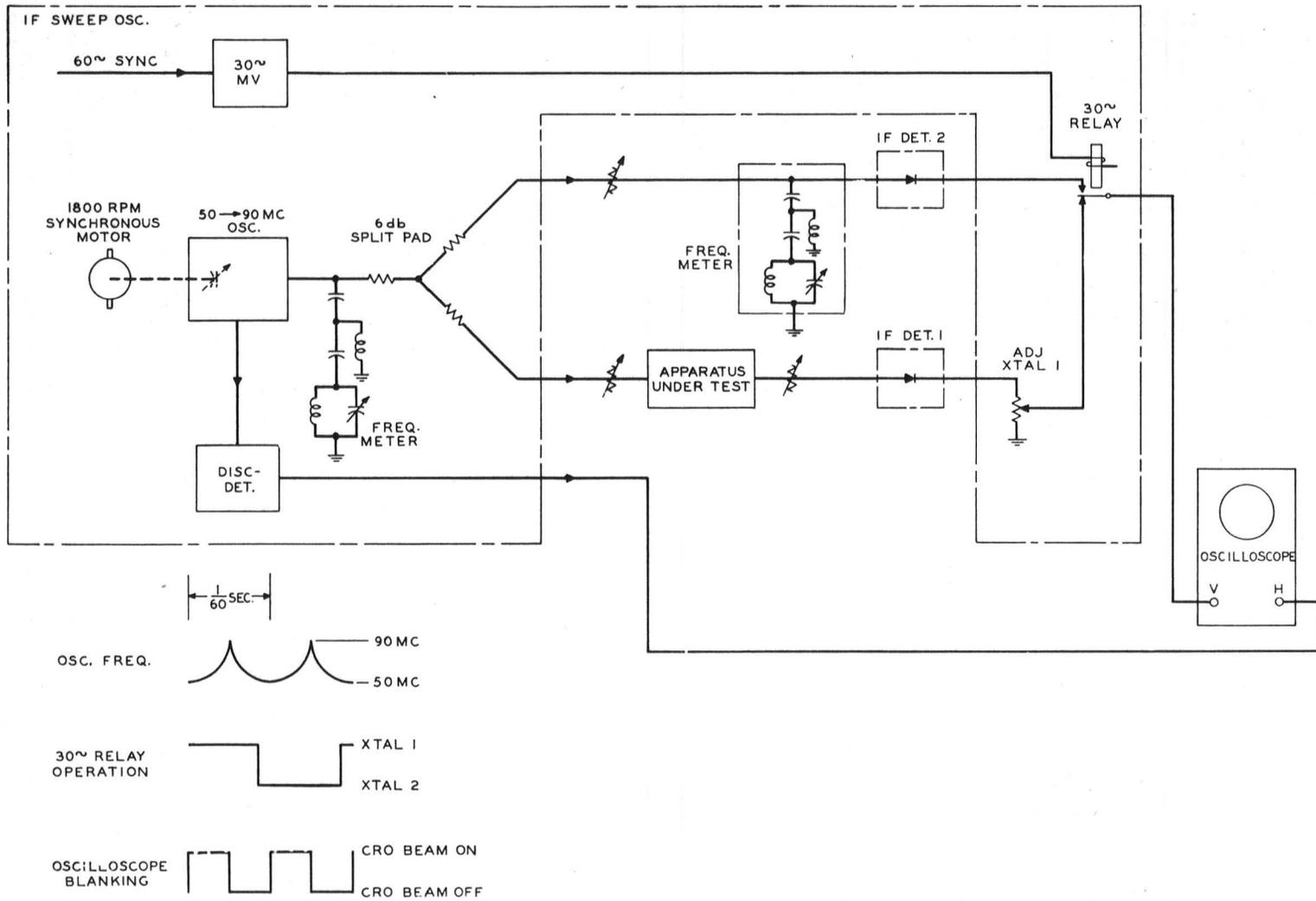


Fig. 1 - IF Sweep Frequency Transmission Measurement

2. OPERATING PRINCIPLES

(A) General

2.01 The components of the test bay are used in various combinations, and in combination with the components of the J68333A Test Bench, to repair and maintain components of the TD-2 Radio System. Specific tests are described completely in the practices for the system components in question; the following paragraphs explain the principles of operation of some of the basic tests performed with the equipment in the test bay.

(B) IF Sweep Frequency Transmission Measurements

2.02 Fig. 1 is a simplified schematic showing the use of the test bay for IF sweep frequency transmission measurements. The signal source is frequency modulated by a motor-driven variable condenser over the range from 50 to 90 MC. The variable condenser has a straight-line-capacity characteristic; the variation of frequency with time for uniform rotation is not linear. Despite the non-linear frequency sweep, the oscilloscope display includes a nearly linear horizontal frequency scale. This is accomplished by using a portion of the signal oscillator output to drive a frequency discriminator network. The rectified discriminator output is used as the horizontal deflection signal for the indicating oscilloscope, thus giving a presentation having a linear frequency scale, provided the discriminator output is linear with frequency and the signal applied to it is constant.

2.03 The signal oscillator output feeds a 6 db split pad and is used to feed two transmission circuits, a reference path and a measuring path. The reference path includes a variable attenuator and an IF crystal detector. The measuring path includes the equipment under test, level adjusting attenuators and a second IF crystal detector. The detector outputs are displayed alternately as vertical deflection of the indicating cathode ray oscilloscope. The rate of switching between detectors is synchronized with the frequency variation of the sweep oscillator so that the two traces are superimposed on the same horizontal scale. In addition, the beam of the oscilloscope is cut off or blanked for one-half of each revolution of the oscillator condenser so that retraces are eliminated. Due to persistence of vision, the oscilloscope display appears as a pair of traces, one indicating to the transmission through the reference path, the other indicating the transmission through the measuring path. If the transmission characteristics of the two paths are the same the traces may be made to coincide by adjusting the attenuators. The two traces are not necessarily

horizontal straight lines for flat transmission, since variations in oscillator output during the frequency sweep affect the outputs of both IF detectors.

2.04 The equivalent of a continuously variable attenuator of somewhat restricted range is secured by a potentiometer control (ADJ XTAL 1) in the output of one of the IF detectors. This continuously available control enables the traces to be precisely matched at any given frequency despite the finite steps of IF attenuation available.

2.05 The cathode ray oscilloscope is switched between the two IF detector outputs by a relay which is operated by a 30 cycle multivibrator circuit, which in turn is synchronized with the 60 cycle power line frequency. The oscilloscope beam is blanked by a square wave signal obtained by clipping the power line 60 cycle voltage. The blanking circuit elements are a part of the oscilloscope.

2.06 The time sequence of operation of the various parts of the circuit is indicated in Fig. 1. Phasing of the frequency sweep with respect to the oscilloscope blanking is accomplished by rotating the synchronous motor housing relative to the stator of the variable condenser. Phasing of the 30 cycle relay is adjusted by varying the grid resistors of the multivibrator circuit.

2.07 With the circuits described above, oscilloscope sensitivities of one inch per 1.0 db transmission variation are readily attained. The matching of components is such that transmission differences between the two paths excluding the circuit under test are less than 0.05 db over the frequency range from 60 to 80 MC.

2.08 A variable frequency marker in both traces is provided by a tunable broad frequency meter located ahead of the split pad in the IF sweep oscillator. In the usual test setup the reference trace is identified by a second frequency marker produced by a tunable frequency meter which is inserted ahead of the IF detector #2.

(C) RF Sweep Frequency Transmission Measurements

2.09 Fig. 2 is a simplified schematic of a set-up for RF sweep frequency transmission measurements. The measuring technique is similar to that used for IF transmission measurements described above. The J68340H RF Sweep Oscillator is used as a signal source. In this case, however, the frequency modulation is sinusoidal with time because of the construction of the oscillator as described below.

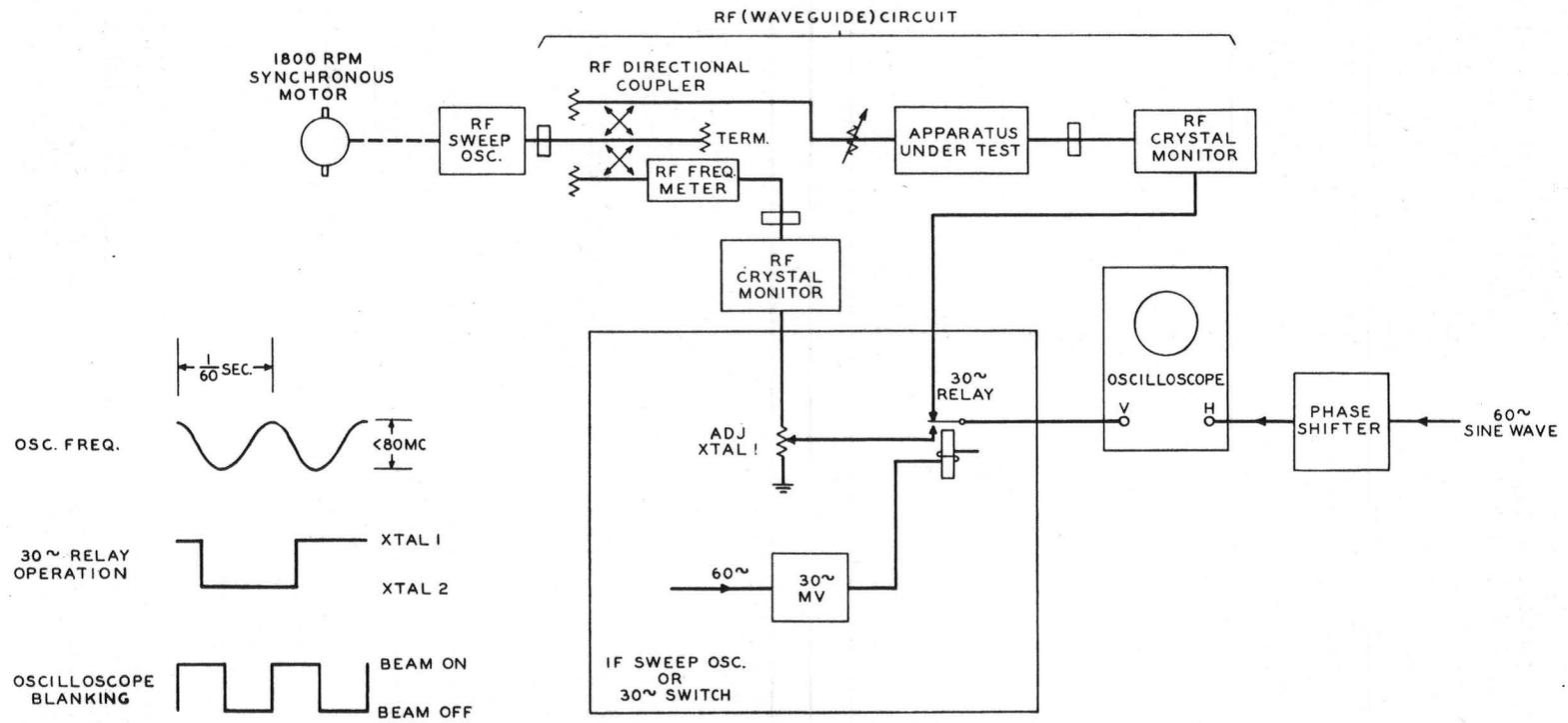


Fig. 2 - RF Sweep Frequency Transmission Measurement

The horizontal deflection signal for the oscilloscope is provided in this case by the 60 cycle power line voltage. This results in a horizontal deflection which is nearly linear with frequency. A variable phase shifter is included in the sweep circuit.

2.10 The RF sweep oscillator output is split in a double directional coupler to provide two outputs. The reference path feeds an RF detector through a tunable wave meter which provides a frequency marker. The measuring path includes level adjusting attenuators, the apparatus under test, and a second RF detector.

2.11 The oscilloscope switching circuit uses the identical elements described in conjunction with the IF measurements. These components are included as part of the IF sweep oscillator and the 30 cycle switch so that this measuring circuit may be set up with either the list 1 or list 2 test bays.

2.12 The phasing problem for this measuring circuit is similar to that for IF transmission measurements. The sweep vane of the RF sweep oscillator is rotated relative to the shaft of the sweep motor to phase the frequency sweep with the oscilloscope blanking signal. The phase of the 30 cycle relay is adjusted by varying the grid resistors of the 30 cycle multivibrator which operates the relay. The phase of the oscilloscope sweep is adjusted with the phase shifter provided.

2.13 The oscilloscope presentation is similar to that for IF transmission measurements; a pair of traces whose vertical displacement indicates transmission through the reference and measuring circuits. The horizontal displacement is nearly proportional to the instantaneous frequency of the RF sweep oscillator. Sensitivities greater than 1 inch per 1.0 db can be attained with this equipment. The relative accuracy of measurement is better than 0.05 db for a 20 MC sweep in the frequency range between 3700 and 4200 MC. This measuring technique is applicable to the transmitter-receiver bays of the TD-2 Radio System where the equipment under test may include several intermediate steps of modulation. However for this particular set up both the input and the output circuits must be at RF and in waveguide.

(D) RF-IF Sweep Frequency Transmission Measurements

2.14 Fig. 3 is a simplified schematic of the test set-up for RF-IF sweep frequency transmission measurements. These tests are used in maintaining and repairing the receiving portions of the TD-2 transmitter-receiver bays where the

input is at RF and the output is at IF frequencies. This test set up includes the RF sweep oscillator, the double directional coupler and a reference RF detector. The detector at the output of the measuring path is the IF crystal detector used for IF transmission measurements. The switching circuit is the same as described above. Since the circuit elements needed for the switching are duplicated in the IF sweep oscillator and the 30 cycle switch, these measurements may be made with either the list 1 or list 2 test bays.

(E) IF-RF Sweep Frequency Transmission Measurements

2.15 With the list 1 test bay, it is possible to make IF-RF sweep frequency transmission measurements. Such tests are required for over-all alignment of type TD-2 radio transmitters and adjustment of transmitting modulator units. The test set up for such measurements is similar to that of Fig. 1, but due to the frequency conversion which occurs in the apparatus under test, the IF detector at the output of the apparatus under test is replaced by the RF crystal monitor. The switching and phasing arrangements for such measurements are the same as those for IF sweep frequency transmission measurements described in (B) above.

(F) IF Impedance Measurements

2.16 The list 1 test bay may be used in conjunction with the J68333A Test Bench to measure and adjust the input and output impedances of IF equipment on a swept frequency basis. These tests are described in Section R90.310.

(G) RF Impedance Measurements

2.17 The list 1 test bay may be used in conjunction with the J68333A Test Bench to measure and adjust the output impedances of microwave amplifiers on a swept frequency basis. These tests are described in Section R90.310.

3. CIRCUIT DESCRIPTION

(A) J68340C IF Sweep Oscillator

3.01 General:

(1) The J68340C IF Sweep Oscillator occupies 8-3/4" of a standard 19" relay rack. The operating controls appear on the front panel; vacuum tubes and associated elements are mounted on a horizontal chassis. Because of the mercury filled relay in the 30 cycle switching circuit, the unit must be operated with the chassis within 30° of horizontal. The unit is AC operated, requiring approximately 70 watts at 115 volts, 60 cycle power is required.

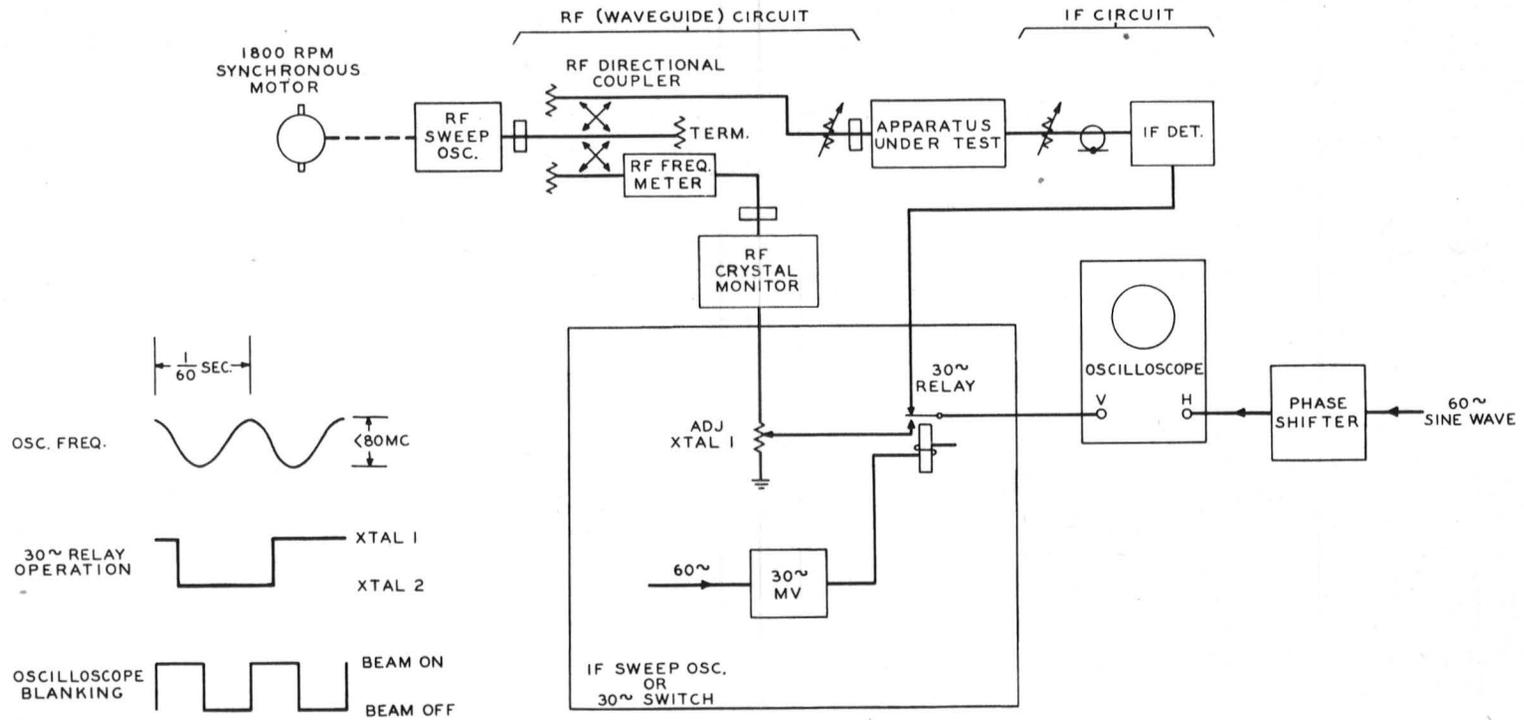


Fig. 3 - RF - IF Sweep Frequency Transmission Measurement

(2) The general operation of the IF sweep oscillator is described above. The following discussion covers the details of the components. The schematic of the IF sweep oscillator is given on SD-59383-01, supplementary page 114.

3.02 Oscillator:

(1) The oscillator circuit includes twin triode V7 and associated circuit elements. The oscillator tank circuit includes L14 and variable condenser C18 which is motor driven to provide the frequency sweep.

(2) Power is taken from the oscillator through a 1 turn pick-up coil tightly coupled to L14. The signal passes through a 3 db isolating pad (R29, R30, and R31), through the frequency meter, and through a 6 db split pad (R41, R42, and R43) to the OUT 1 and OUT 2 jacks. The level at these jacks varies from +17 to +20 dbm from unit to unit. The frequency meter used is electrically identical with that on the IF detector panel which is described in (3.10) below. An auxiliary low-level output is secured through a second one-turn coil which is loosely coupled to L14. This output drives the frequency discriminator, which in turn provides the horizontal deflection signal for the indicating oscilloscope.

(3) The main output is made approximately flat with frequency by shunting the pickup coil with a low Q series equalizer circuit which includes R55, L5, and C17. During initial testing it is necessary to adjust L5 and R55 to obtain optimum flatness.

(4) The unby-passed resistor (R27) in the plate circuit of the oscillator provides longitudinal feedback and helps to reduce even order harmonics in the oscillator output. Additional longitudinal feedback is provided by the cathode networks which include L3, R22 and C9; L4, R23 and C10. These networks are also used to maintain the heater at the same IF potential as the cathodes, thereby reducing frequency modulation due to varying heater-cathode potential.

(5) Small resistors in series with the control grids of V7 are used to suppress spurious resonance in the grid circuits.

(6) The frequency control condenser (C18) is of the "butterfly" type with the rotor mounted directly on an insulated coupling to the motor shaft.

The motor supports the condenser rotor, thereby eliminating the possibility of noise being introduced by condenser bearings and flexible couplings. The motor rotates synchronously at 1800 rpm. The condenser structure is such that two complete cycles of the frequency sweep take place for every revolution. To phase the sweep properly with respect to the power line voltage, the sweep motor assembly with the condenser rotor is turned relative to the condenser stator during line-up. A front panel dial on the condenser shaft is calibrated at 70 MC to enable the output frequency to be set at mid-band when the condenser is not rotating.

3.03 Discriminator:

(1) The discriminator furnishes a voltage proportional to the instantaneous frequency of the sweep oscillator to horizontally deflect the oscilloscope. The reactive elements of the discriminator are a pair of $1/8$ wave length (at 70 MC) type 724 coaxial cables. One of these cables is short-circuited; the other is open-circuited.

(2) The open- and short-circuited cables are driven through a pair of 75 ohm resistors (R24 and R25). The IF signal appearing across each cable is rectified in a germanium diode and the rectified outputs are subtracted to give the discriminator output voltage.

(3) At the mid-band frequency (70 MC) the impedance looking into each cable is a reactance equal in magnitude to the characteristic impedance of the cable; therefore, 0.7 of the voltage applied to the discriminator appears across each cable. At this frequency the rectifier outputs are equal, and hence their difference is zero. As the frequency decreases below mid-band, the reactance of the short-circuited cable decreases and that of the open-circuited cable increases. The rectified output of CR2 is thus greater than that of CR1. At frequencies above mid-band, the reactance of the short-circuited cable increases and that of the open-circuited cable decreases, and the rectified output of CR1 is less than that of CR2. The output of such a discriminator is thus zero at mid-band, of one polarity above mid-band and of the other polarity below mid-band. The magnitude of the output is proportional to the amount that the input frequency differs from the mid-band frequency. The sign of the output

may be reversed as desired by reversing the crystal rectifiers. In this case, the rectifiers are poled to give a positive output above mid-band.

(4) The output-frequency characteristic of such a discriminator is quite linear. The output voltage is amplified in a 2 stage amplifier (V8) before application to the horizontal input terminals of the oscilloscope.

3.04 30 Cycle Switch:

(1) As discussed above, sweep frequency transmission measurements involve the comparison of the outputs of two detectors: one in a reference transmission path and the other in the measuring path. The switch between detectors is accomplished by the relay K1 which is operated at a 30 cycle rate by a multivibrator circuit.

(2) The K1 relay transfers the vertical input circuit of the oscilloscope (Y) between the XTAL-1 and XTAL-2 jacks. The voltage applied to the XTAL-1 jack may be attenuated by the ADJ XTAL-1 control to provide fine gain adjustments as described above. Each XTAL jack provides a 1000 ohm termination for the detector associated with it.

(3) Twin triode V6 and associated elements form the 30 cycle multivibrator. The circuit is conventional; each plate is capacitively coupled to the opposite control grid. The free running rate of such a circuit is determined largely by the RC product of the coupling condensers and grid resistors. A 60 cycle synchronizing signal is injected on control grid 6 of V6 through R65. This signal is derived from the high voltage winding of the power transformer. A phase shifting network which includes R1 and C39 is included in the synchronizing circuit to compensate for the operating time of the relay K1. The multivibrator operates at half the synchronizing frequency. Although the frequency of operation is locked that with the synchronizing voltage, the phase of the output with respect to the synchronizing signal may be changed over a limited range by adjusting the free running rate of the circuit. Varying the grid resistors with the ADJ 30~ dual potentiometer adjusts the phase of the output to correlate with the oscilloscope blanking.

3.05 Slope Circuit - For IF impedance measurements it is necessary to add a signal proportional to frequency to the output of one of the IF detectors. This is accomplished by amplifying a portion of

the discriminator output and adding this signal to the signal appearing in the XTAL-2 jack. V9 is a triode amplifier associated with this circuit. The amount of signal added is controlled by the ADJ SLOPE potentiometer; the SLOPE OFF-ON switch is provided to disable this feature. The adjustment of this part of the circuit is described in detail in those parts of Section R90.310 dealing with IF impedance measurements.

3.06 Power Supply:

(1) Regulated plate power at +200 volts for the IF sweep oscillator is provided by a regulated rectifier circuit which includes V1, V2, V3, V4, and V5.

(2) V1 is a full wave rectifier with condenser input (C1). The rectifier output is applied to the plates of series regulator tubes (V2 and V3), and the regulated output voltage is taken from their cathodes.

(3) The output voltage is regulated by varying the grid bias applied to V2 and V3 to maintain constant potential at their cathodes despite load or line voltage variations.

(4) V4 is the amplifier tube for the regulator circuit. Its cathode is maintained at 105 volts above ground by the gas regulator tube, V5. A fixed percentage of the output voltage is applied to the control grid through the resistive divider which includes R16, R17 and R18. Since the cathode is at a constant potential above ground, changes in the output voltage of the regulator circuit vary the grid-cathode voltage of V4. These changes are amplified in V4 and applied to the control grids of V2 and V3 in the proper phase to maintain a constant output. The ADJ 200V control is used to set the output voltage of the rectifier circuit.

(5) The regulated 200 volt supply also furnishes plate power to the oscilloscope preamplifier which is located in the IF detector panel.

(B) J68340M 30 Cycle Switch

3.07 The 30 cycle switch includes the 30 cycle relay, the 30 cycle multivibrator and the regulated rectifier circuits of the IF sweep oscillator. The physical size of the unit is the same as the J68340C IF Sweep Oscillator. These circuits are identical with those described in 3 (A) above. Their use has been described above. A detailed schematic of the 30 cycle switch panel is given on SD-59430-01, supplementary page 119.

(C) J68340D IF Detector Panel3.08 General:

- (1) The IF detector Panel consists of several separate circuits, all mounted on a 3-1/2" by 19" panel. The schematic of the unit, SD-59384-01, is attached on supplementary page 115.
- (2) The panel contains a J68337E, L2 IF Detector, a J68337E, L3 IF Frequency Meter, a preamplifier for the oscilloscope, and a DC heater supply for the preamplifier.
- (3) Since both the detector and frequency meter are separately coded and tested items, these may be removed from the panel and replaced individually, if required.

3.09 J68337E, L2 IF Detector - The IF detector is used in IF sweep frequency transmission measurements to rectify the output of the reference path as described above.

- (1) The schematic of the detector is shown on Fig. 2 of SD-59387-01, attached on supplementary page 117. The detector is approximately 6-1/2" long and 1-1/8" square. A coaxial input jack is mounted at one end and a BNC type output connector is located near the other. In the J68340D IF Detector Panel, the IF detector is mounted on one side of the frequency meter so that the input jack is accessible through the front panel. A short cable assembly makes the detector output available at the front of the panel on a coaxial jack (DET OUT).
- (2) The input circuit of the detector is a resistive "L" pad of about 3 db loss which provides a 75 ohm termination for the line and thus improves the impedance match between the detector and the connecting circuits. The pad is followed by a variator which rectifies the signal, and a low-pass filter which removes IF frequencies from the output. The output of the detector is normally terminated by 1000 ohm resistors. These terminations are provided by connecting circuits on the IF sweep oscillator or the 30 cycle switch. With the proper termination, the detector is essentially flat with frequency over the frequency range from 60 to 80 MC for input levels ranging between -7 and +7 dbm.

3.10 J68337E, L3 IF Frequency Meter - The frequency meter is used to introduce marker pips in IF sweep frequency transmission measurements as described above.

(1) The schematic of the frequency meter is shown on Fig. 3 of SD-59387-01, attached on supplementary page 117. The unit is a small box requiring a panel mounting area of about 4-1/2" by 3-1/4" and a depth of 4-1/2". The indicating dial (calibrated in 1 MC divisions between 52 and 89 MC) is viewed through a cut-out in the panel. It is turned by the FREQ M knob which projects through the panel. Input and output coaxial jacks extend through the front of panel to the right of the dial.

(2) The input (IF IN) and output (IF OUT) jacks are connected by means of a short coaxial line. A small condenser (C7) taps a small amount of energy from the line and couples it to a variable resonant circuit consisting of C8, C9, C10, C11, and L4. This resonant circuit introduces a small sharp dip in the otherwise flat transmission characteristic between the input and output jacks. The depth of the dip produced by the resonant circuit alone would normally become deeper with increasing frequency. To reduce this effect, a compensating coil (L3) is used, which in combination with C7, causes the coupling of the resonant circuit to the line to become less with increasing frequency. With the compensation, the depth of the dip remains quite constant at about 0.2 db over the range of the frequency meter. The compensating coil (L3) is adjusted at the factory.

(3) The dial calibration is adjusted by setting L4 and C11 at the rear of the unit to make the 60 and 80 MC points exactly correct. The remainder of the scale is accurate to about ± 0.15 MC.

3.11 Preamplifier:

(1) The preamplifier provides additional gain for Y-axis deflection of the oscilloscope. It is required for certain tests where the detector output is too low to give the required deflection without additional amplification. The preamplifier is a small sub-chassis requiring a mounting area of about 3-1/4" by 4-1/4" and a depth of 7-3/4". It is located on the right-hand end of the panel. The input and output coaxial jacks extend through the front panel.

(2) The preamplifier provides about 20 db of gain. It is usually inserted between the SCOPE Y jack on either the IF sweep oscillator panel or the 30 cycle switch panel and the oscilloscope Y-axis input. The ampli-

fier is a 407A twin triode connected as a cathode-coupled amplifier. This type of circuit does not invert the polarity of the transmitted signal. Insertion of the preamplifier, therefore, does not invert the oscilloscope presentation. Since, for sweep frequency measurements the equivalent of a 30 cycle square wave must be amplified without appreciable distortion, the time constants of both input and output circuits are very large. To eliminate 60 cycle hum pick-up the heater of this tube is operated on DC. The plate supply for the preamplifier is obtained from either the IF sweep oscillator or the 30 cycle switch, depending upon the list number of the Test Bay.

3.12 DC Heater Supply

(1) The DC heater supply for the preamplifier is built on a small sub-chassis having a mounting area of 3-1/4" by 5-3/4" and a depth of 6-3/4". This is located on the left-hand end of the panel. AC power to this circuit is controlled by the PRE-AMP switch located on the Meter and Control Panel. The AC line is protected by a fuse located on the front of the IF detector panel.

(2) The voltage from a winding of T1 is rectified by a small selenium half-wave rectifier (CR1) and is filtered with the combination of C4 and R9. The resistor R8 serves to limit the condenser charging surges to a safe value. The resistor R9 is adjustable from the rear of the panel so that at the expected current drain of about 50 ma, the output voltage will be 40 volts.

(3) It should be noted that if a tube is inserted in the preamplifier with the heater supply turned on, a high surge current will flow through the heater due to the accumulated charge on C4. The heater supply should always be turned off when changing tubes to preclude burn-outs.

(D) J68340G IF Attenuator Panel (Lists 1 and 2)

3.13 The IF Attenuator Panel requires a space 9-11/16" wide by 7" high. On it are mounted push-button 75 ohm unbalanced attenuators, the number and type depending upon the list number. List 1 includes three KS-14190 and one KS-14191 attenuators, while list 2 provides one of each type.

3.14 The KS-14190 attenuator has fixed steps of 3, 4, 5, 6, and 13 db,

giving a total attenuation range of 3 to 28 db in 1 db steps. In addition, losses of 0 and 31 db are available. The five push-buttons are of the type which are pushed once for insertion and again for release. They are arranged in a single row. Input and output coaxial jacks are available from the front panel.

3.15 The KS-14191 attenuator is similar physically to the KS-14190 but has fixed steps of 5, 10, 20, 20, and 20 db, permitting 0 to 75 db loss in 5 db steps.

3.16 Maximum input power rating of either type is 0.1 watt.

(E) J68340E Power Meter

3.17 The J68340E Power Meter is used in conjunction with the J68340F RF Power Measuring Head and the J68340L IF Power Measuring Head to measure RF and IF power at various locations in the TD-2 Radio System and associated test equipment. The power meter covers a range from -10 to +6 dbm. The IF head covers the frequency range from 2 to 500 MC in a 75 ohm unbalanced coaxial circuit. The RF head covers the frequency range from 3600 to 4600 MC in waveguide. The operation of the power meter and associated RF and IF measuring heads is described in Section R70.230.

(F) J68340K Power Supply

3.18 The J68340K Power Supply supplies 6.3 V AC filament power and 180V DC regulated plate power for the J68340E Power Meter. The operation of the power supply is described in Section R70.230.

(G) J68340H RF Sweep Oscillator

3.19 The RF sweep oscillator provides a signal in the 3700-4200 MC band. This may be either a single (CW) frequency, or a frequency swept over a portion of the band.

3.20 The RF sweep oscillator mounts on a standard 19 inch panel which is 12-1/4 inches high. It projects approximately 9-1/2 inches behind the panel. The oscillator is a 402A vacuum tube mounted in a resonant cavity on the rear of the panel. Low voltage power connections are made to a terminal strip on the rear of the panel. A special high voltage socket which engages one end of the 402A electron tube is required for heater and high voltage supply for the tube. This socket and wiring are supplied as a part of the test bay local cable. The output of the oscillator appears in 2.290 by 1.145 I.D. waveguide. The output flange is behind the panel and faces the right side of the unit.

3.21 Power supply requirements for the RF sweep oscillator are as follows:

Heater: 6.3 volts, 1 ampere (1500 volts negative with respect to ground)

High voltage: 100 to 1500 volts, less than 50 ma, with both terminals ungrounded. An adjustable tap on this supply at 0 to +400 volts from the negative end is required to provide up to 8 ma for the accelerator.

3.22 The following controls are available on the front panel:

FREQUENCY - Controls the mean oscillator frequency. Dial numbers associated with this control on some models of this oscillator are reference numbers only and do not indicate frequency.

MAGNETIC SHUNT - Controls the strength of the magnetic focusing field for the 402A tube.

IMPEDANCE - Controls the impedance match between the oscillator and the output waveguide.

SWEEP-OFF-ON - Turns on and off the motor which causes the oscillator frequency to be swept over a portion of the band.

SWEEP ADJ - Controls the frequency range over which the oscillator sweeps.

CW FREQ - When pushed in and then turned, this control provides a limited adjustment of frequency when single frequency output is used.

Caution: Use CW FREQ control only when SWEEP switch is turned off.

3.23 The power supply and control circuits for the RF sweep oscillator are arranged as follows:

(1) The 402A electron tube has an indirectly heated cathode which emits an electron stream. This stream is focussed and accelerated by an accelerator, passes through holes in three discs, and ends at a collector anode. The power supply circuit supplies 6.3 volts AC for the heater, and the necessary DC potentials to maintain the electron stream. A simplified schematic of the oscillator, and of the associated power supply and control circuit is shown in Fig. 4.

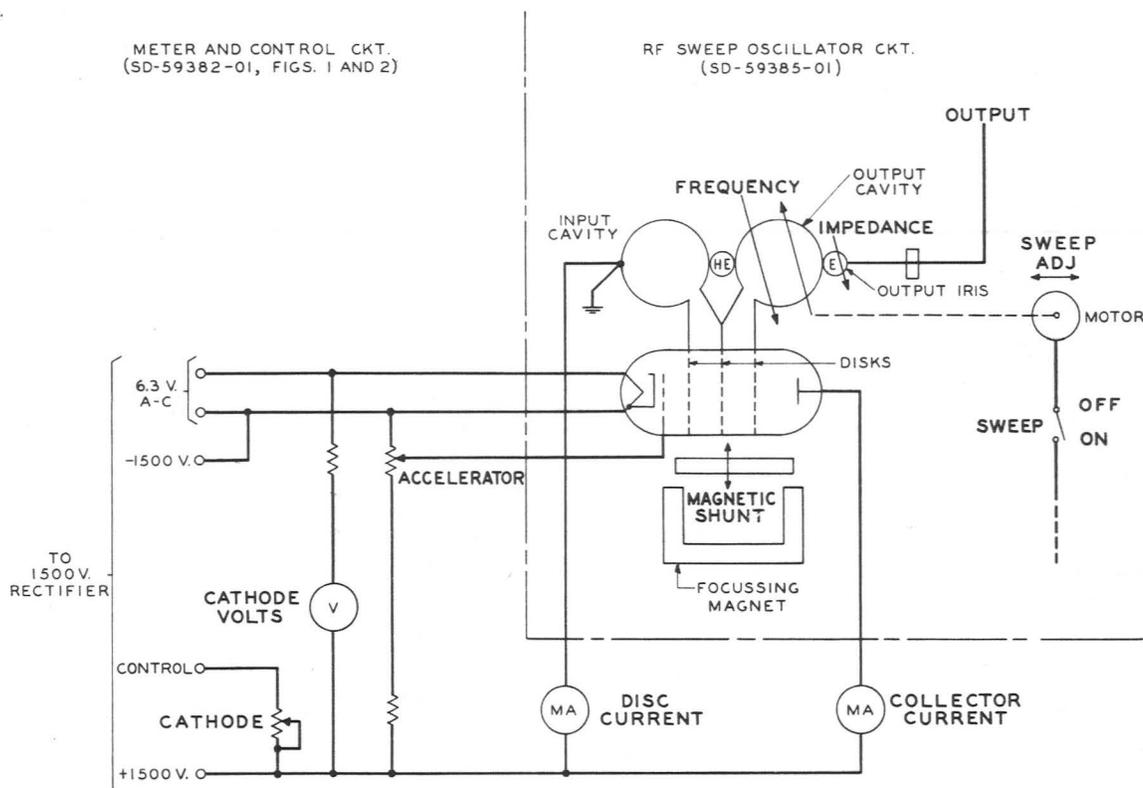


Fig. 4 - RF Sweep Oscillator - Simplified Schematic

(2) Because the discs of the 402A tube connect to the waveguide, which must be grounded both for practical reasons and to safeguard personnel, the remainder of the circuit is off ground.

(3) The negative side of the high-voltage rectifier is connected to the cathode, and the positive side to the collector through the COLLECTOR CURRENT meter.

(4) The discs are returned to the positive side of the rectifier through the DISC CURRENT meter. Since the discs are grounded, the positive side of the rectifier is grounded through this meter. Leakage or a short-circuit between either side of the rectifier and ground will result in a false reading and possibly excessive current through the DISC CURRENT meter.

(5) The voltage between the collector and the cathode is shown by the CATHODE VOLTS meter, and is adjustable by means of the CATHODE rheostat.

(6) The voltage on the accelerator is obtained from a voltage divider between the +1500 V and -1500 V leads, and is adjustable by means of the ACCELERATOR potentiometer.

(7) Heater power, at 6.3 volts AC, is also supplied by the high voltage rectifier. Since one heater lead is common to both heater and cathode, the heater supply must be about 1500 volts off ground. The heater, cathode and accelerator leads, involving hazardous voltages, appear as a leg of the bay local cable. A special high voltage socket connects these high potentials to the tube itself.

(8) A 115 volt AC supply is needed to operate two motors, one providing cooling air for the tube, and the other providing the sweep as described below. The SWEEP ON-OFF switch controls the latter motor.

3.24 A magnetic circuit for the oscillator tube is provided as follows:

(1) A permanent magnet, with pole pieces which surround the tube near either end, provides a magnetic field through the tube parallel to its axis. This field serves to focus the electron stream through the holes in the center of the discs, so that very few of the electrons strike the discs. Excessive disc current, due to improper focusing, will overheat and damage the discs.

(2) To adjust the focusing field, an adjustable magnetic shunt is pro-

vided which, as it approaches the pole pieces, causes some of the field to be diverted through the shunt, thus reducing the field at the tube. The MAGNETIC SHUNT knob on the front panel controls the position of this shunt.

3.25 The RF portion of the oscillator circuit functions as follows:

(1) Consider first the tube as shown in Fig. 4. A steady stream of electrons leaves the cathode, passes the accelerator, and approaches the discs. Assume for a moment that an alternating voltage is applied between the first and second discs. As electrons enter the space between these discs, they are alternately accelerated or retarded according to whether the second disc or the first disc is positive.

(2) By the time these electrons reach the space between the second and third discs, those which were accelerated have caught up with those which had previously been retarded, and the stream now consists of bunches of electrons. These bunches are pulses of electric current, and are therefore surrounded by a pulsing magnetic field. This field is confined by the output cavity which is connected to the second and third discs, and is accompanied by an alternating electric current in the cavity walls and an alternating voltage between the second and third discs.

(3) If some of this energy is coupled back to the input cavity, which is connected to the first and second discs, it will provide the alternating voltage which was assumed at the start, and self-sustaining oscillations will result. If the shape of one or both cavities favors oscillations of a particular frequency, then that frequency will predominate in the output.

(4) The output cavity in this oscillator is rectangular, and its size can be varied by moving two plungers into or out of its opposite ends. This is done by the FREQUENCY control on the front panel. In the absence of other effects, this controls the frequency of the oscillator.

(5) The input cavity is smaller and fixed in size. Neither the input nor the output cavity is connected to the middle disc except through a small clip. There is therefore a small opening between the input and output cavity, surrounding the middle disc. This opening provides the feedback from output to the input cavity necessary to sustain oscillation. In Fig. 4, this opening is indicated by the circle designated HE. Since the middle disc is grounded only by the small clip, a

good connection at this point is essential for proper operation.

(6) For rapid sweeping of the frequency, an additional tuning element is introduced in the output cavity. This element is a round insulating rod coated on opposite sides and across the end with a conducting material. When the conducting sides of this rod face the nearby walls of the cavity, the conducting coating by-passes part of the cavity, reducing its effective size and increasing the frequency of oscillation. When the nonconducting sides face the nearby cavity walls, the effect is much less, and the frequency lower than when the rod is in the first position.

(7) Rotating the tuning rod causes the frequency to vary in an approximately sinusoidal manner. Inserting the rod further into the cavity makes its effect greater, so that the frequency is swept over a wider range.

(8) The rod is driven by an 1800 RPM synchronous motor. Since the rod causes the frequency to change from low to high and return twice per revolution, 3600 complete sweeps per minute, or 60 per second, are produced. Since the frequency change follows a slightly different pattern increasing and decreasing, only one direction of sweep is used. The return sweep is blanked out in the oscilloscope used for observing the characteristic. The synchronous motor will lock in at four points with respect to the power line frequency. Two of these points will result in the sweep of increasing frequency being blanked, and the other two will result in the sweep of decreasing frequency being blanked. A momentary interruption of power to the sweep motor generally results in a change in the lock-in point. In using the RF sweep oscillator, the motor is momentarily turned off to produce a sweep in the desired direction.

(9) To control the frequency range over which the oscillator sweeps, the sweep motor is mounted on ways, so that it may be moved to control the degree of insertion of the tuning rod into the cavity. This movement is accomplished by the SWEEP ADJ knob.

(10) To set the oscillator for a particular single frequency, the CW FREQ control is provided. With the sweep motor off, this control may be pushed in so that it engages the sweep motor shaft. Rotation of this screwdriver control then rotates the motor shaft. This provides manual adjustment of the frequency through the range over which the tuning rod sweeps

the frequency. Engagement of this control with the sweep motor turned on may damage the mechanism.

(11) The output of the oscillator is coupled to the output waveguide through a hole in the wall of the output cavity. An adjustable iris, controlled by the IMPEDANCE knob, varies the size of this hole to control the impedance match between the cavity and the guide. In Fig. 4, this iris is indicated by the circle designated E. Adjustment of this control affects the output power, and also the variation in power over the band which is being swept.

(12) The RF sweep oscillator will supply an output of about +30 dbm (1 watt) over the frequency range of 3700 to 4200 MC. This output may be arranged to sweep over at least 70 mc, flat to ± 0.1 db.

(H) KS-5789 1500 Volt Rectifier

3.26 This unit is mounted on an 8-3/4 by 19 inch panel. It provides a high voltage supply for the RF oscillator which is adjustable from 900 to 1600 volts. It also supplies 6.3 volt AC power for the heater of the RF oscillator. The heater supply is insulated so that it may be operated as much as 1600 volts off ground. The high voltage output is controlled by an external variable resistance between the positive high voltage lead and a control lead. This control is mounted in the meter and control panel of the test bay and is designated CATHODE VOLTS. A timer in the rectifier unit delays application of the high voltage for about a minute to permit all heaters to come up to operating temperature. The schematic of this unit is ES-529617, and is given on supplementary page 120. Further information on the KS-5789 rectifier may be found in Section A301.318.

(I) J68340B Meter and Control Panel

3.27 The J68340B Meter and Control Panel occupies a vertical space of 5-1/4" on a 19" relay rack. It is the central distribution point of AC power to the units of the test bay. The schematic of the meter and control panel is given on SD-59382-01, supplementary page 118.

(1) The MAIN POWER switch controls power to all units of the test bay. The RF SWEEPER switch applies power to the 1500 volt rectifier and also to the blower and sweep motors of the RF sweep oscillator. The oscilloscope preamplifier heater supply is controlled by the PRE AMP switch. The above switches have associated indicator lamps. The other components of the test bay are controlled by switches individual to the various panels.

(2) Both sides of the AC input to the test bay are fused. A fuse is also provided for the 1500 volt rectifier and the blower and sweep motors of the RF sweep oscillator. These fuses are located at the rear of the meter and control panel. The fuse for the preamplifier heater supply is located on the IF detector panel.

(3) A 2-wire receptacle at the rear of the panel supplies power to the oscilloscope.

(4) The meter and control panel includes meters which indicate the cathode voltage, disc current and collector current of the RF sweep oscillator. A rheostat (CATHODE) controls the regulated output of the 1500 volt rectifier. There is also an accelerator voltage control for the RF sweep oscillator (ACCELERATOR).

(5) Transformer T1 applies a 60 cycle voltage of about 30 volts rms to the phase shifting network which includes R7, R8, R9, R10, and C1. The output of the phase shifter feeds the SINE SWEEP jack. The output from this jack is used for horizontal deflection of the oscilloscope for tests involving the RF sweep oscillator. The SWEEP PHASE control (R8) permits the phase of the voltage appearing at the SINE SWEEP jack to be varied. This control is used to obtain the proper phase relationship between the oscilloscope sweep and the RF oscillator sweep for RF sweep transmission measurements.

(6) The METER IN jack is terminated by the SENSITIVITY potentiometer. The XTAL CURRENT microammeter is connected between the swinger of this potentiometer and the common side, thus permitting adjustment of the proportion of the total current which flows through the meter. For maximum flexibility, the circuit elements are isolated from ground. This circuit is used principally to observe the rectified output of an IF or RF crystal detector.

(J) Waveguide Components

3.28 RF Attenuator per ED-63927-01, G2

(1) The RF Attenuator is a direct-reading, calibrated, variable waveguide attenuator, designed for the 3700 to 4200 MC band in 2.290 by 1.145 inch I.D. waveguide. It is 12-1/2 inches long.

(2) The attenuator contains a resistance vane approximately 11-1/2 inches long, mounted parallel to the narrow wall of the waveguide on sup-

porting rods spaced 3/4 of a wavelength apart, at mid-band. These rods project through the side of the waveguide and are supported by a carriage. The carriage is in turn supported by precisely-machined guide rods. A roller follower on the carriage engages a cam on a dial (calibrated in db) which controls the position of the carriage and the vane. Springs, located at the ends of the guide rods, keep the roller in contact with the cam by driving the carriage outward from the waveguide, and thus eliminate backlash.

(3) When the dial is in its zero position, the carriage is at its maximum distance from the waveguide, and it then holds the vane in contact with the narrow wall of the waveguide. In this position, the resistance vane has the least effect on transmission. As the dial is rotated toward higher attenuation settings, the vane is moved toward the center of the waveguide, where it has a greater attenuating effect.

(4) A brake is provided on the dial, and is adjustable by means of a knurled nut. The brake may be adjusted to give any desired amount of friction, or to lock the dial.

(5) The transmission characteristics of the RF attenuator are as follows:

Frequency Range - 3700 to 4200 MC
 Attenuation - Variable, 0 to 20 db
 Variation in Attenuation with Frequency - ± 0.3 db
 Readability - 0.1 db
 Reproducibility of any Setting - ± 0.1 db
 Return Loss - 33 db or greater

3.29 RF Directional Coupler per ED-63561-01, G1

(1) The physical arrangement and circuit schematic of the RF directional coupler are shown in Fig. 5. The coupler consists of a main waveguide A-B, and two secondary waveguides C-E and D-F, which are arranged at right angles to the main waveguide. The secondary guides are coupled to the main guide by means of openings in their common walls. The openings consist of pairs of crossed slots, so arranged as to control the direction of transmission between the main and secondary guides. This results in a portion of the energy traveling in the main guide from A toward B appearing in the secondary guides at C and D. Similarly, a portion of the energy traveling from B toward A will appear in the secondary guides at E and F.

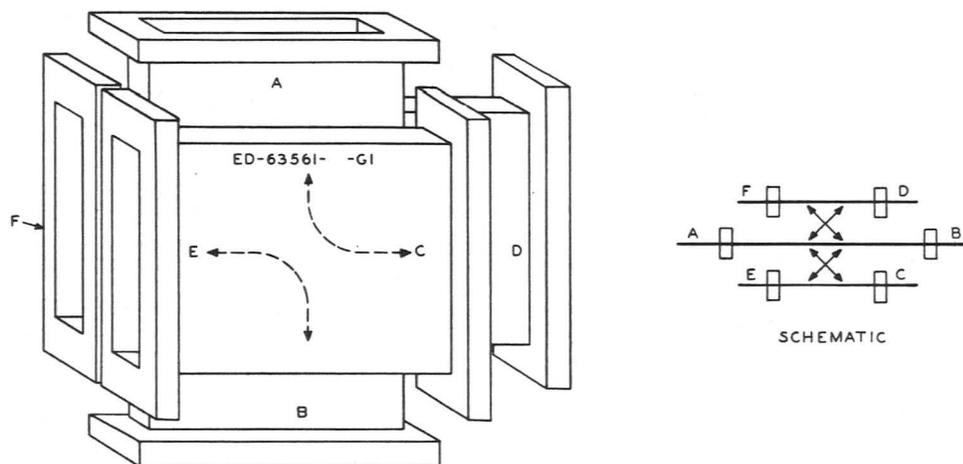


Fig. 5 - RF Directional Coupler - Schematic and Physical Arrangement

(2) The transmission loss between A and C and between A and D is stamped on the side of the coupler. This calibration assumes proper termination of each of the secondary guides. Since the coupler is symmetrical, the same losses apply between B and E, and between B and F, respectively. It will be noted that the transmission between these points is indicated by the arrows in the schematic, and by the dotted arrows in the perspective sketch. Transmission loss in the directions opposed to the arrows, as for example between A and E, is of the order of 25 db greater than the corresponding forward loss, between A and C.

(3) The RF directional coupler is used as a convenient means for obtaining several outputs from a single source. Because of the directional properties of the coupler, when the secondary guides are properly terminated, the signal in the secondary guides is relatively independent of the effects of reflections in the main guide which may be present if the main guide is not well terminated. The secondary outlets may be used, for example, for a signal to supply a reference detector, a power meter, or a circuit under test.

3.30 RF Crystal Monitor per ED-63906-01, G4:

This unit consists of a silicon varistor cartridge mounted at the end of a short coaxial line. This line is coupled into a short piece of waveguide to form a wide-band waveguide-to-coaxial transducer. Harmonics produced by the varistor are suppressed by a resonant trap consisting of a polystyrene-filled disc, inserted in the center conductor of the coaxial line between

the varistor and the waveguide. The rectified signal is tapped off this coaxial line between the harmonic trap and the waveguide. It passes through a coaxial RF trap to a jack on the side of the unit. The output is shunted internally between the trap and the jack by a 180 ohm resistor, so that when the monitor is patched into the 30 cycle switch (of IF sweep oscillator) having a 1000 ohm impedance, the resultant load on the varistor is about 150 ohms. This is the value required for the best waveguide impedance match. The varistor cartridge is readily replaceable in case of damage or overload by loosening a large knurled nut and removing a small knurled gripper which engages one end of the cartridge.

3.31 RF Frequency Meter per ED-63563-01, G1:

The RF frequency meter is a coaxial resonator, tuned by a micrometer screw arrangement, and coupled loosely to the waveguide section on which it is mounted. This coupling is such that at the frequency of resonance, about 2 to 5 per cent of the RF energy passing through the waveguide is reflected by the frequency meter. When a swept signal is transmitted through the frequency meter, a small dip in the signal will be observed at the frequency for which the meter is tuned. If a single frequency signal is used, its magnitude will be reduced by a similar amount when the frequency meter is tuned to the signal frequency.

3.32 500A Termination - This termination consists of a 4 inch piece of waveguide in which is mounted a tapered, carbon-coated dielectric vane. The shape and resistivity of the vane are such that it will absorb, without reflection, nearly all of the RF power arriving at it. The end of the waveguide beyond the vane is short circuited by a metal end-plate.

(K) DuMont Model 2551 Oscilloscope

3.33 The DuMont model 2551 oscilloscope is similar to the DuMont model 208B oscilloscope. A circuit is added to provide the option of blanking the trace during half of a 60 cycle sine wave sweep. An instruction bulletin furnished by the manufacturer is shipped with each instrument. The schematic diagram of the oscilloscope is attached on supplementary page 121.

(L) Miscellaneous Components

3.34 The miscellaneous components listed below are furnished with both the list 1 and list 2 test bays.

3.35 J68337E L2 IF Detector - This unit is electrically identical with the IF detector which is a part of the J68340D IF Detector Panel. The detector is not mounted, so that it may be connected to equipment under test with minimum length patch cords. The unit is described in par. 3.09 above.

3.36 Cable - Transducer Assembly per ED-63773-01, G1 - This unit includes two waveguide-to-coaxial transducers connected by a 10 foot length of type 726 flexible cable. The connecting cable has relatively high loss (about 10 db) to minimize the effect of reflections at the transducers. This assembly is used to connect the test bay to various RF circuits of the TD-2 transmitter-receiver bay.

3.37 Transducer per ED-63900-01, G1 - This unit is a waveguide-to-coaxial transducer. It is used in measuring the power output of the microwave generator in the TD-2 transmitter-receiver bay and in certain tests in conjunction with the J68333A Test Bench. The transducer is a short length of short circuited waveguide with a threaded fitting in the wide face. When a properly fitted coaxial cable is inserted, the energy in the waveguide is transmitted to the coaxial cable with minimum reflections at the junction.

3.38 Quick Clamps - For temporary waveguide joints in test set-ups, a number of Trico "Kliplock" No. 8 clamps are supplied, together with P-200100 alignment studs. Two of each are required for each waveguide connection.

3.39 Weston Model 779 Analyzer - This unit is a multipurpose meter for reading AC and DC voltages, DC currents and resistances. DC voltmeter resistances of both 20,000 ohms per volt and 1000 ohms

per volt are provided. Unless otherwise specified, DC voltages should be read using the 20,000 ohm per volt setting.

3.40 Cable Assemblies

(1) The following table lists the types of cable assemblies provided with the test bay:

<u>Code</u>	<u>Length</u>	<u>End Fittings</u>
ED-63941-01,G6	4'-8"	Transducer fittings, both ends
ED-63941-01,G56	3'-1"	Coaxial plug, oscilloscope connector
ED-63941-01,G65	8'-0"	BNC Plug, coaxial plug
ED-63941-01,G67	3'-6"	Coaxial plug, transducer fitting
ED-63941-01,G71	6"	Coaxial plug, both ends
ED-63941-01,G75	6"	Coaxial plug, coaxial jack

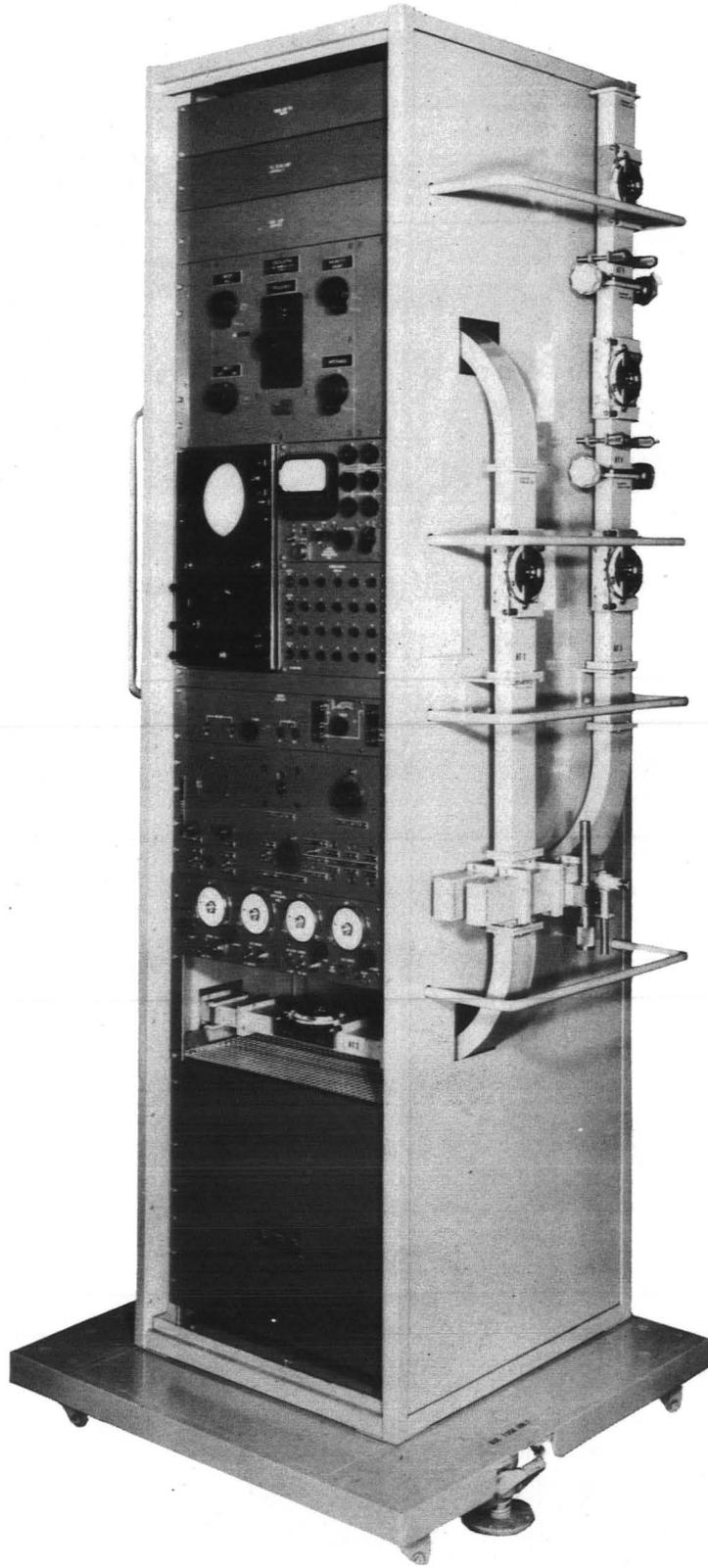
(2) In addition, P2BJ patch cords in 2' and 8' lengths are supplied.

4. PHOTOGRAPH, DRAWING, AND REFERENCE LIST4.01 Photographs (Attached)

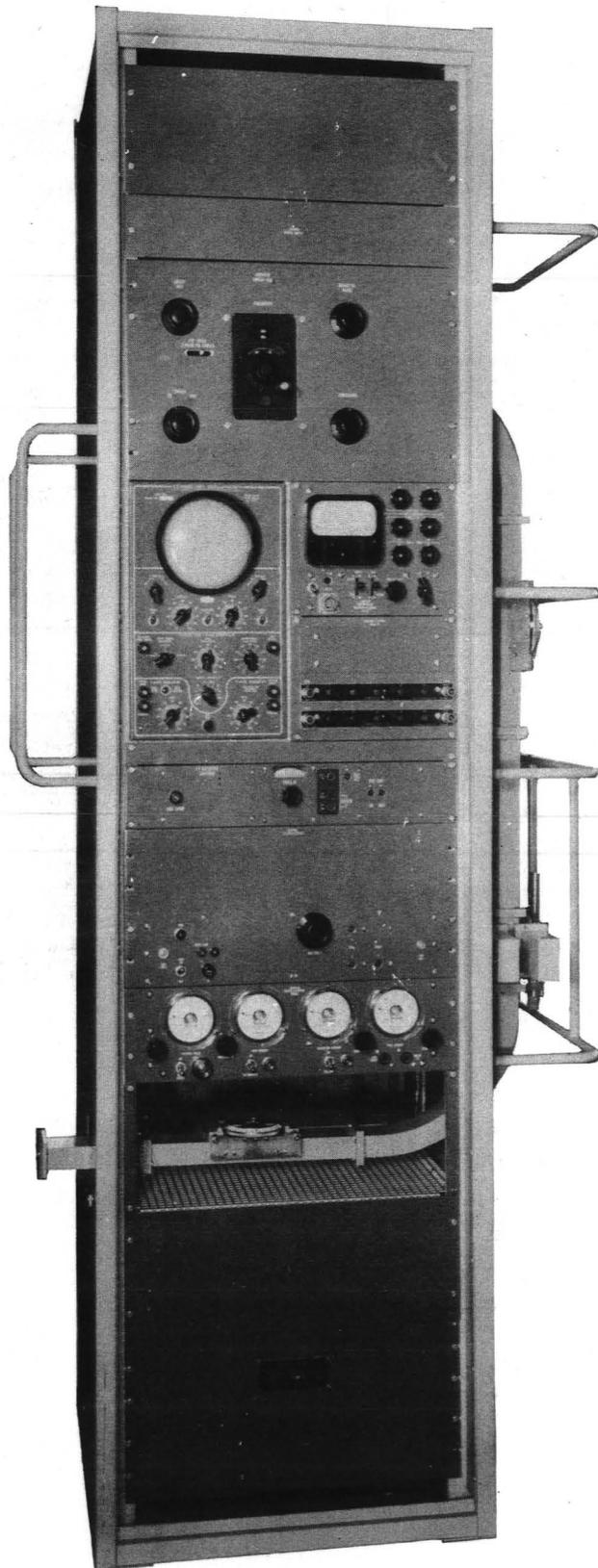
<u>Photo Desig.</u>	<u>Subject</u>	<u>Supplementary Page</u>
A	Test Bay, List 1, General View	101
B	Test Bay, List 2, General View	102
C	Meter and Control Panel, Front View	103
D	Meter and Control Panel, Rear View	104
E	IF Sweep Oscillator Panel, Front View	105
F	IF Sweep Oscillator Panel, Top View	106
G	30 Cycle Switch Panel, Front View	107
H	30 Cycle Switch Panel, Rear View	108
I	IF Detector Panel, Front View	109
J	IF Detector Panel, Rear View	110
K	RF Sweep Oscillator, Front View	111
L	RF Sweep Oscillator, Rear View	112

4.02 Drawings (Attached)

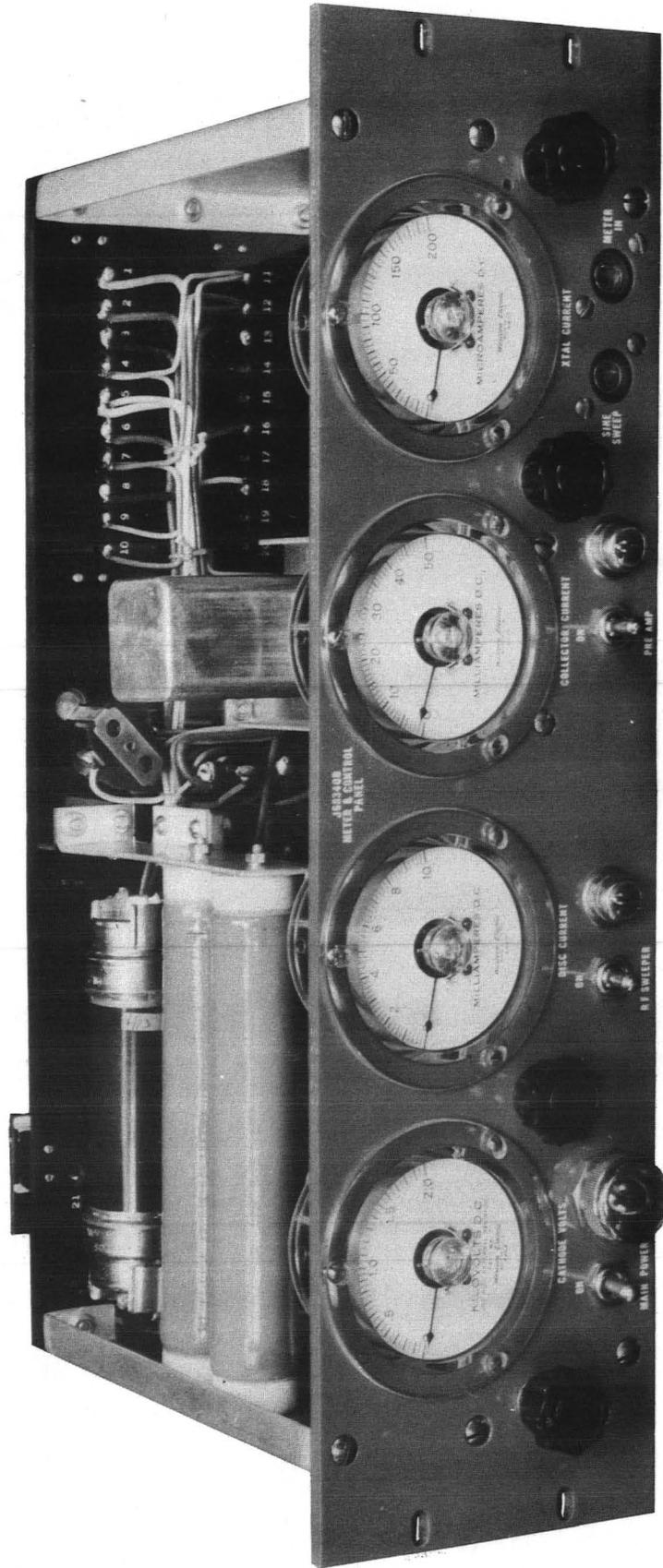
<u>Desig.</u>	<u>Subject</u>	<u>Supplementary Page</u>
SD-59382-01	Test Bay - Power Distribution Circuit	113



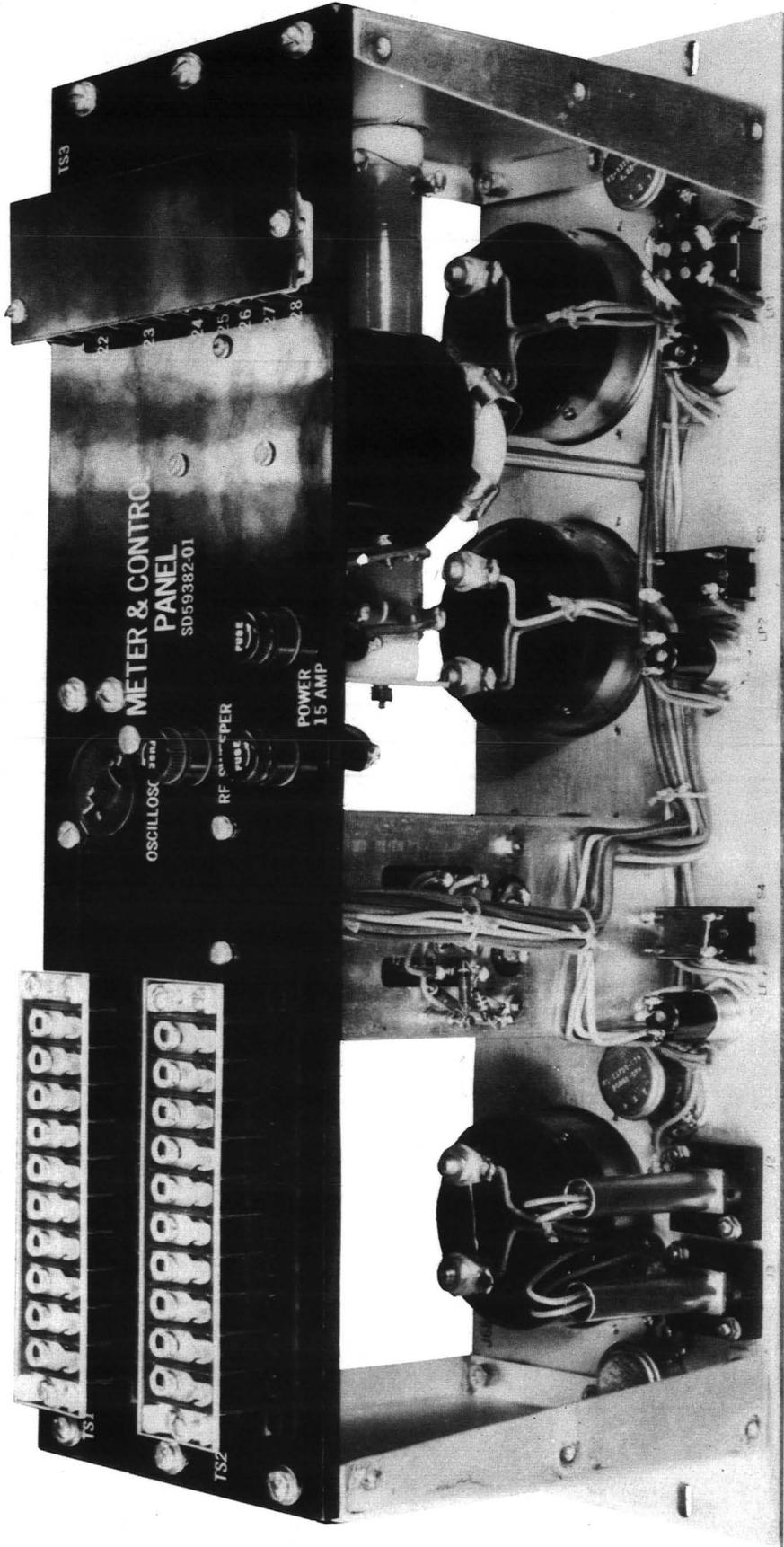
Test Bay, List 1, General View



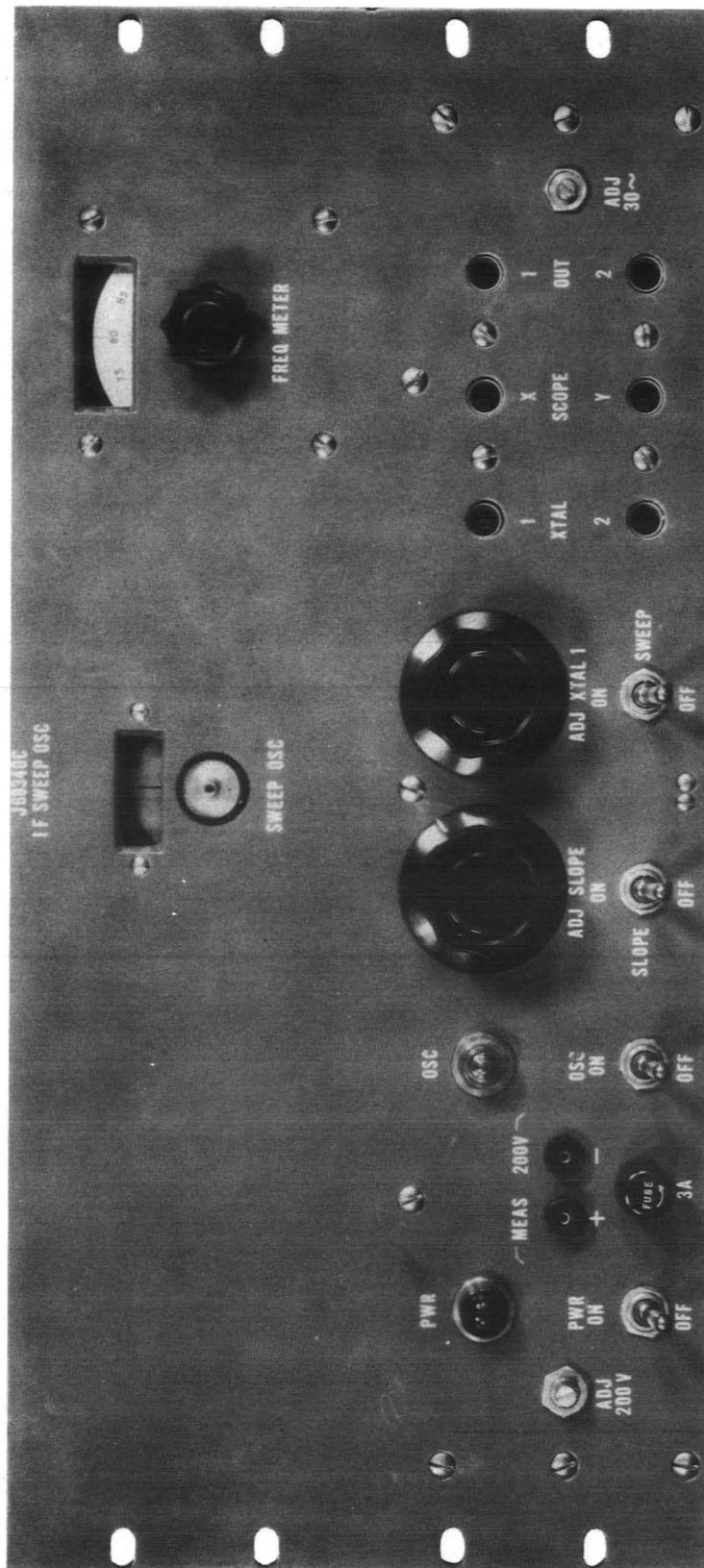
Test Bay, List 2, General View



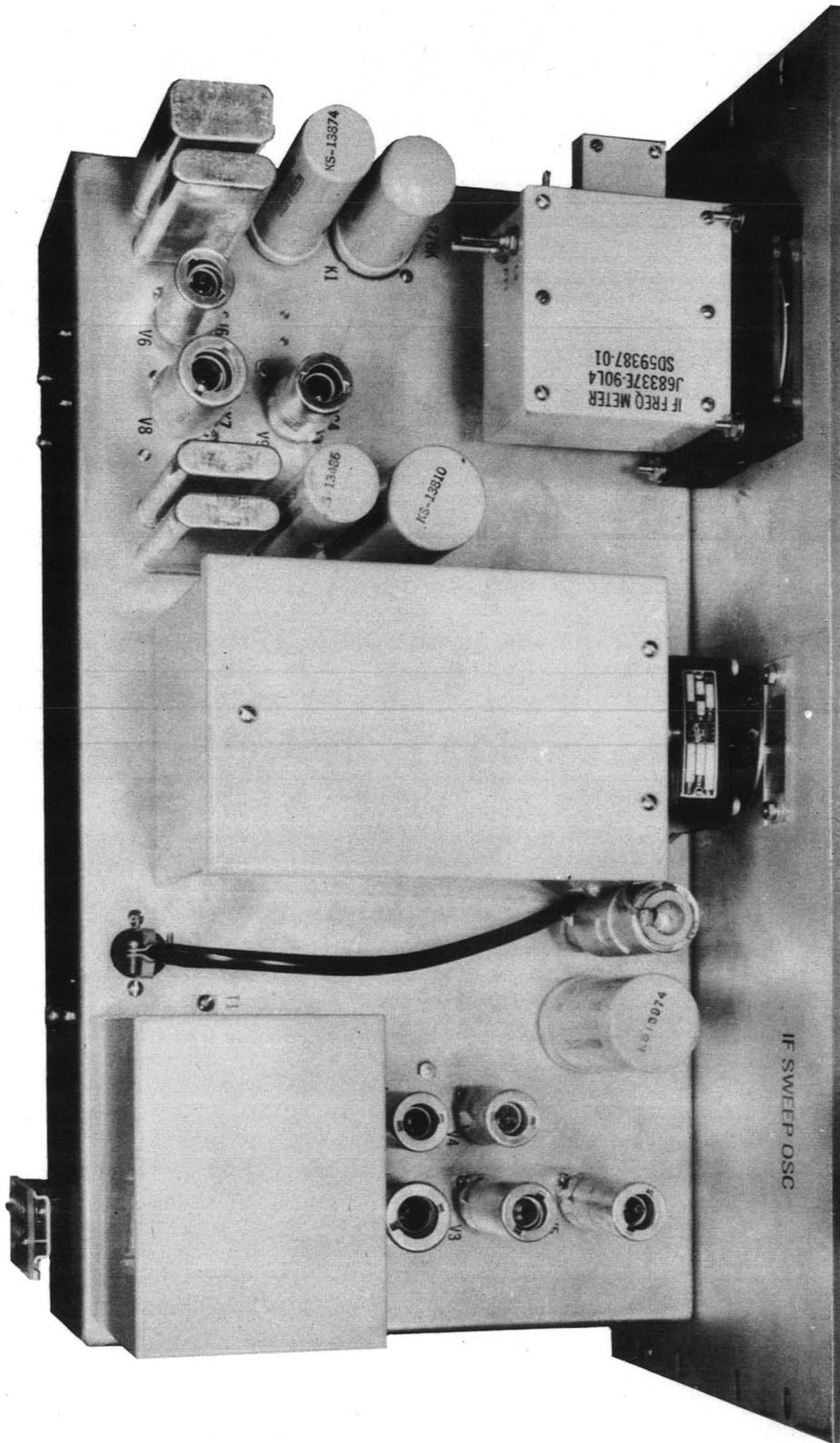
Meter and Control Panel, Front View



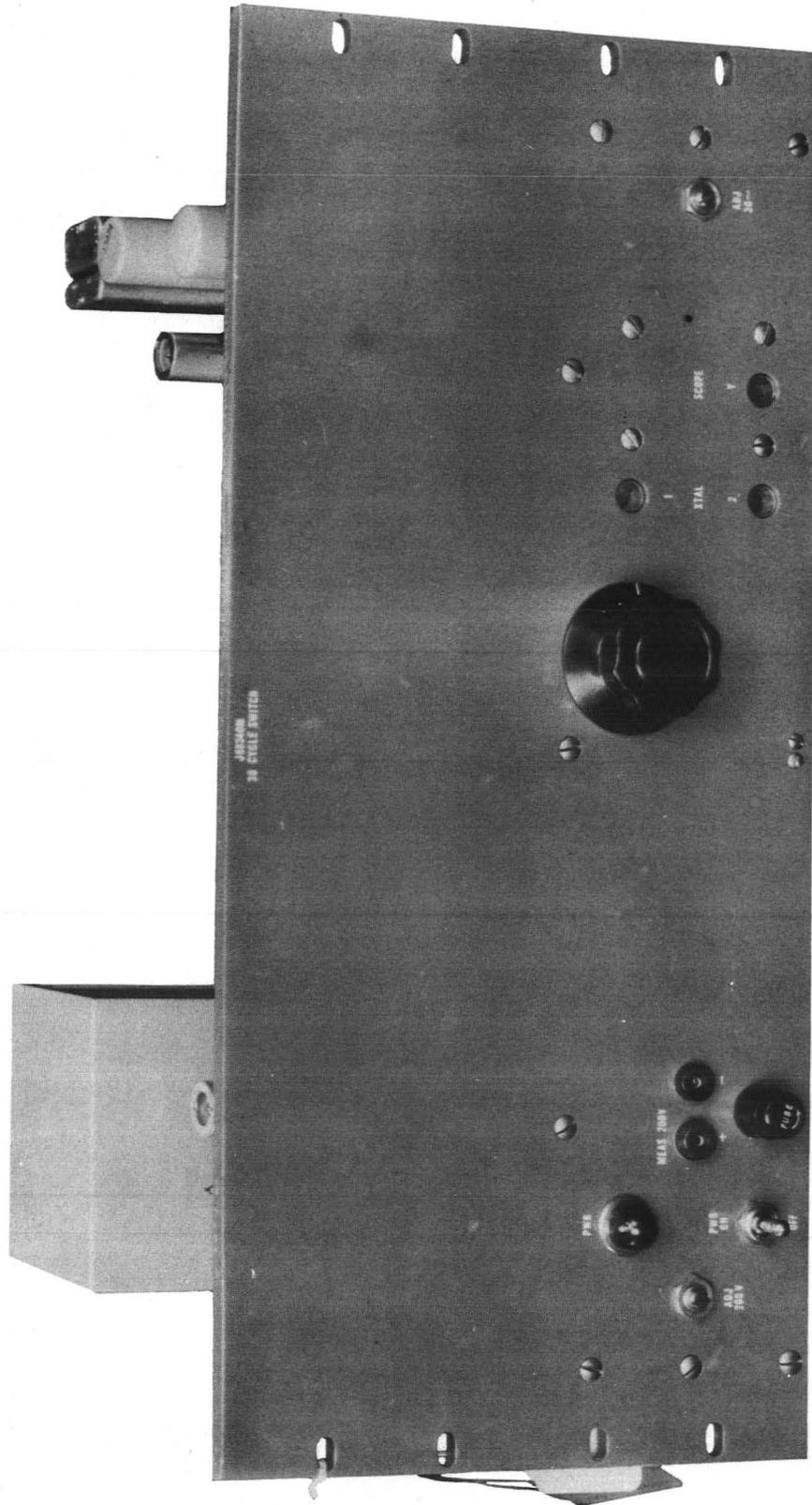
Meter and Control Panel, Rear View



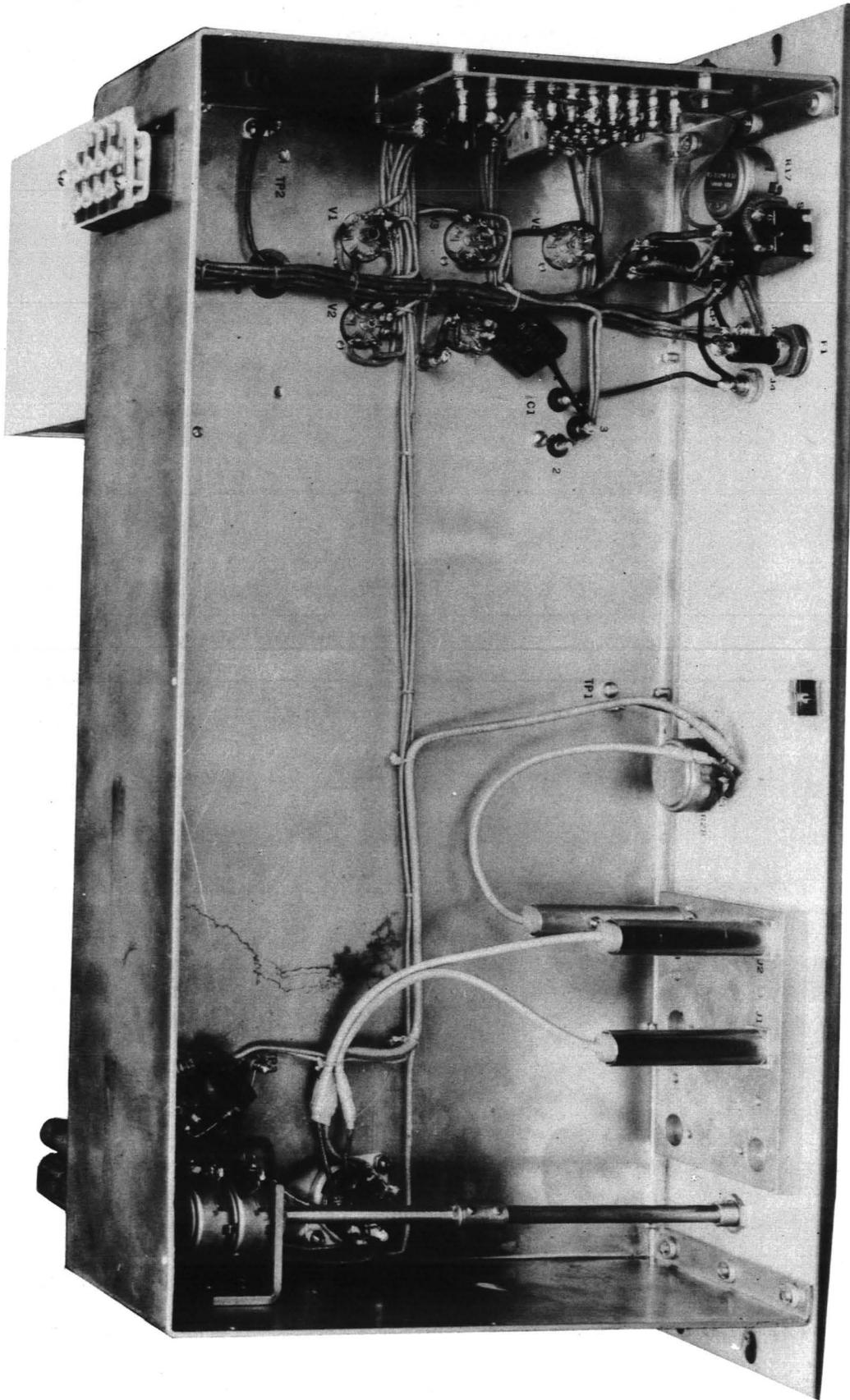
IF Sweep Oscillator Panel, Front View



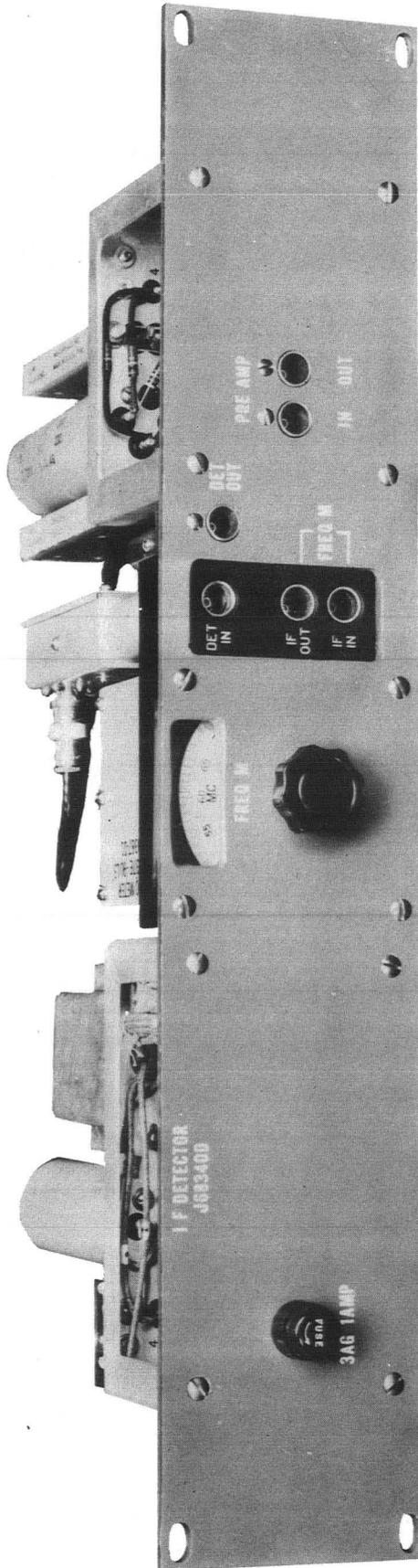
IF Sweep Oscillator Panel, Top View



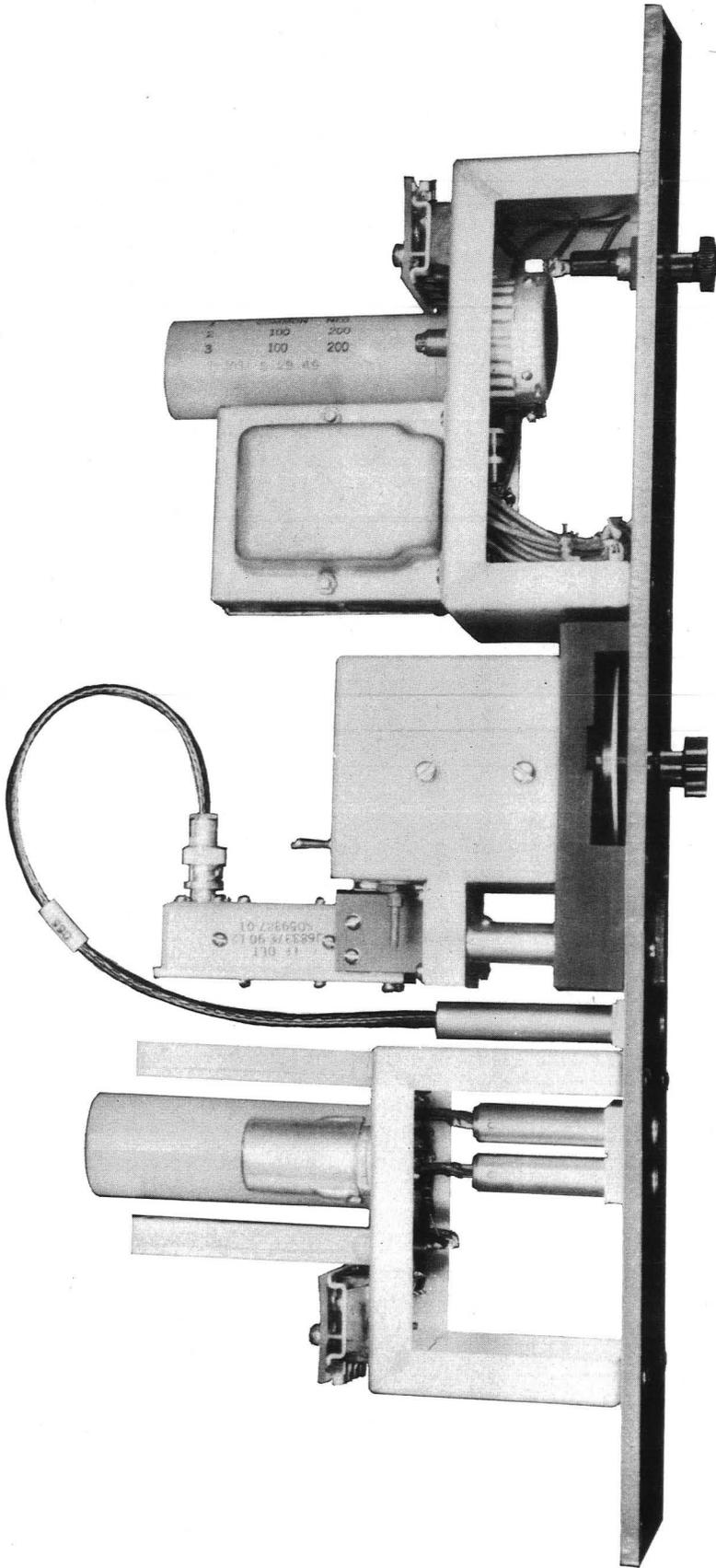
30 Cycle Switch Panel, Front View



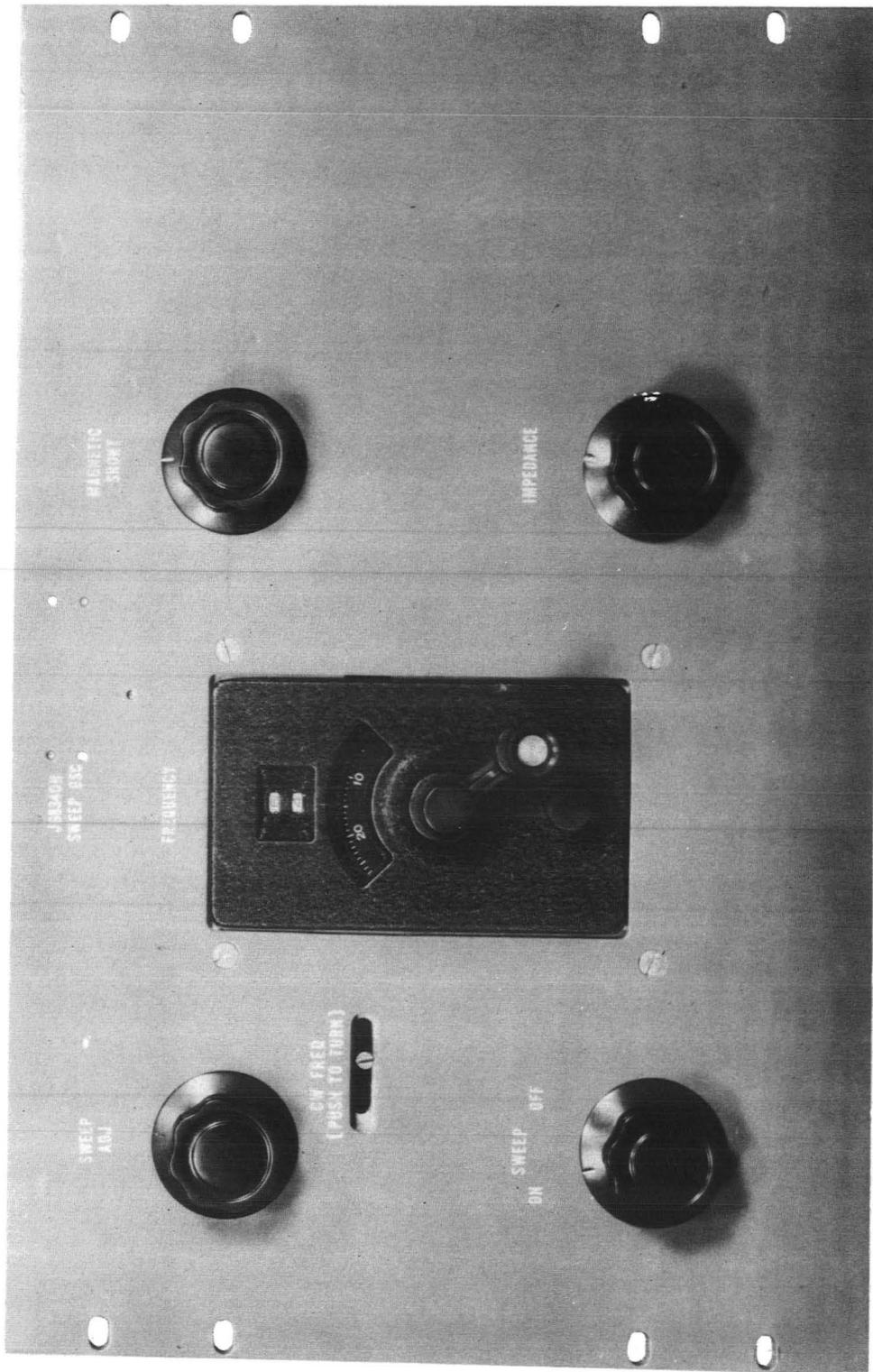
30 Cycle Switch Panel, Rear View



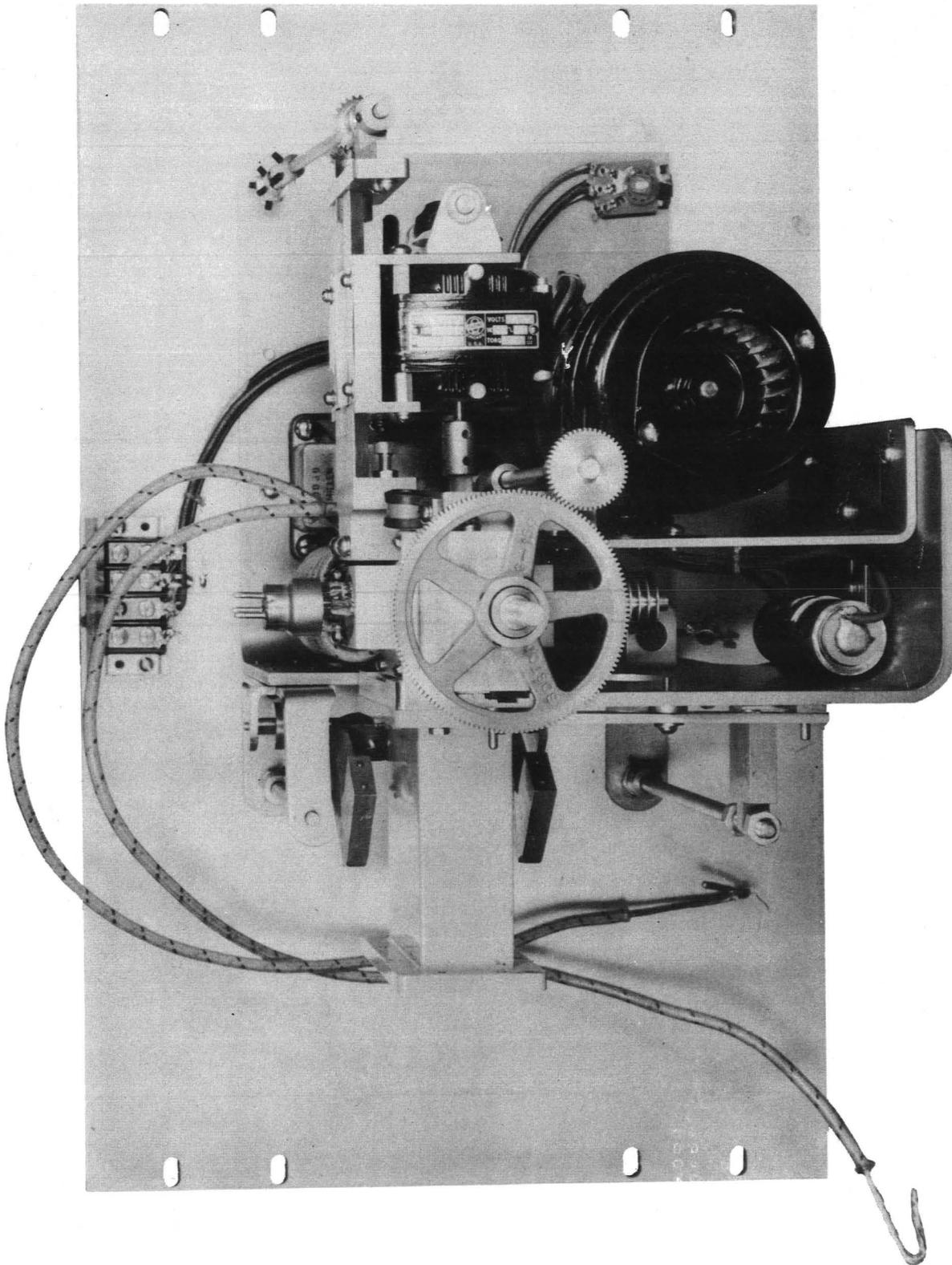
IF Detector Panel, Front View



IF Detector Panel, Rear View



RF Sweep Oscillator, Front View



RF Sweep Oscillator, Rear View

CIRCUIT NOTES:
 101. WIRE SHALL BE KS-13385, 22 GA. STRANDED, UNLESS OTHERWISE INDICATED.
 102. WHERE FIG. 4 IS NOT REQUIRED, FIG. 5 MUST BE FURNISHED.

REV.	BY	DATE	APPROVED
1	1	4-29-48	C.M.F.
2-A	2-A	7-27-48	G.M.F.
3-A	3-A	12-17-48	J.C.

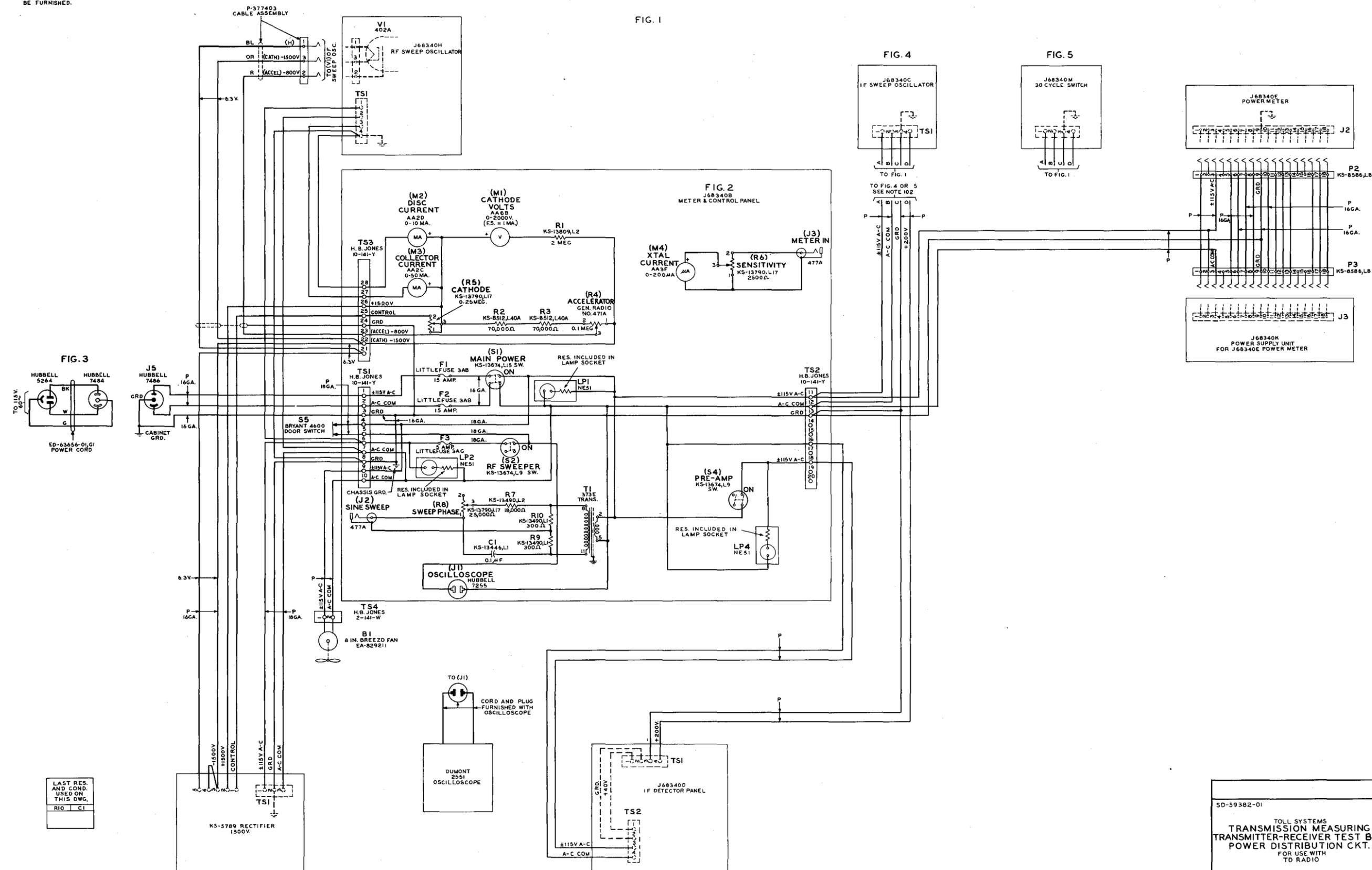


FIG. 3

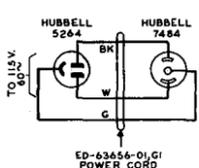


FIG. 1

FIG. 4

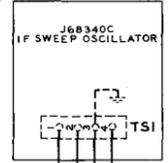


FIG. 5

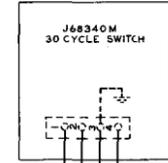
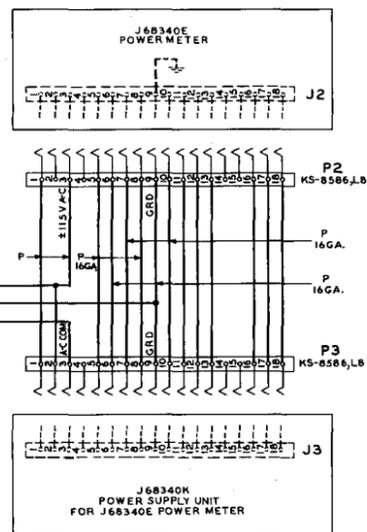
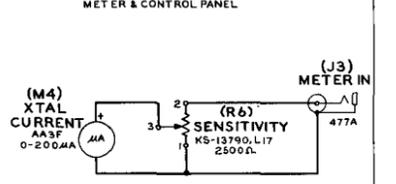


FIG. 2



LAST RES. AND COND. USED ON THIS DWG.
 RIO CI

10-58882-02

SD-59382-01

TOLL SYSTEMS
 TRANSMISSION MEASURING
 TRANSMITTER-RECEIVER TEST BAY
 POWER DISTRIBUTION CKT.
 FOR USE WITH
 TO RADIO

(PWR DIST)

BELL TELEPHONE LABORATORIES, INC.

AT&CO STANDARD

SD-59382-01

R2

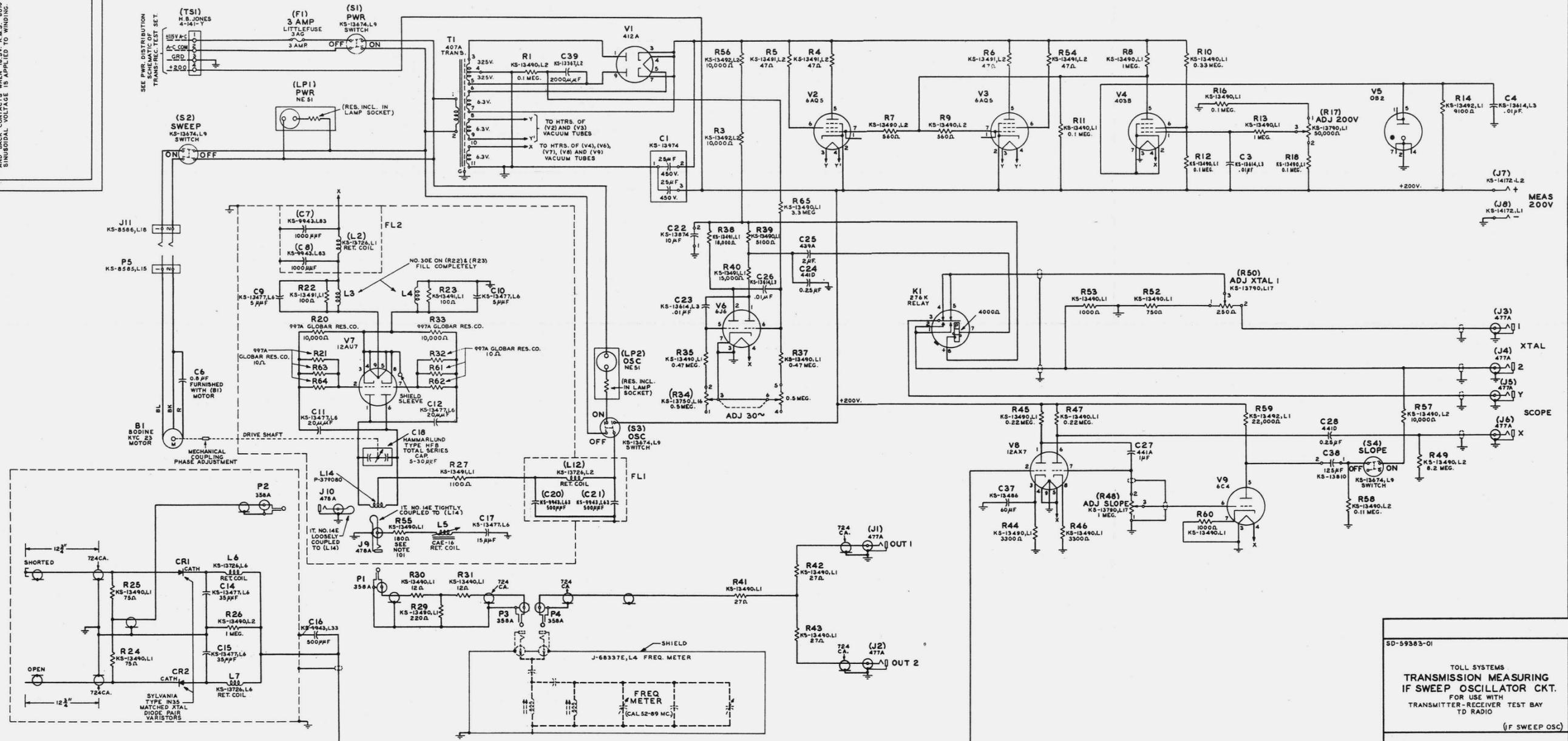
J68340A
 ED-63565-01
 ED-63568-01
 EQUIPMENT INFO.

CIRCUIT REQUIREMENTS		DIRECT CURRENT		ALTERNATE		RELAYS	
FRAMES	MEAS.	TEST	TEST	TEST	TEST	TEST	TEST
SD-59383-01	15A	15A	15A	15A	15A	15A	15A
APPROXIMATE	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
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RELAYS	15A	15A	15A	15A	15A	15A	15A
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RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A
RELAYS	15A	15A	15A	15A	15A	15A	15A

CIRCUIT NOTES:
 101. RESISTANCE (R55) MUST BE SELECTED DURING TEST TO OBTAIN MAXIMUM FLATNESS OF OUTPUT. APPROXIMATE RANGE OF VALUE REQ. MAY BE 100-300Ω. USE NEAREST NOMINAL STANDARD VALUE.

LAST RES. AND COND. USED ON THIS DWG.
 R65 C38
 R2, R15, R19, R25, R36, R51, C2, C5, C13, C19, C29 TO C36 NOT USED.

FIG. 1



10-88802-02

SD-59383-01

TOLL SYSTEMS
 TRANSMISSION MEASURING
 IF SWEEP OSCILLATOR CKT.
 FOR USE WITH
 TRANSMITTER-RECEIVER TEST BAY
 TD RADIO

(f SWEEP OSC)

BELL TELEPHONE LABORATORIES, INC.

AT&T
 STANDARD

R3

SD-59383-01

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J68340C
 ED-63591-01
 ED-63587-01
 EQUIPMENT INFO.

CIRCUIT NOTES:

101. ON INITIAL INSTALLATION, TURN POTENTIOMETER (R9) ALL THE WAY COUNTER-CLOCKWISE BEFORE APPLYING POWER. AFTER WARM-UP, ADJUST (R9) FOR 40 ± 2V. BETWEEN TERMINALS 1 AND 2 OF (TS1).

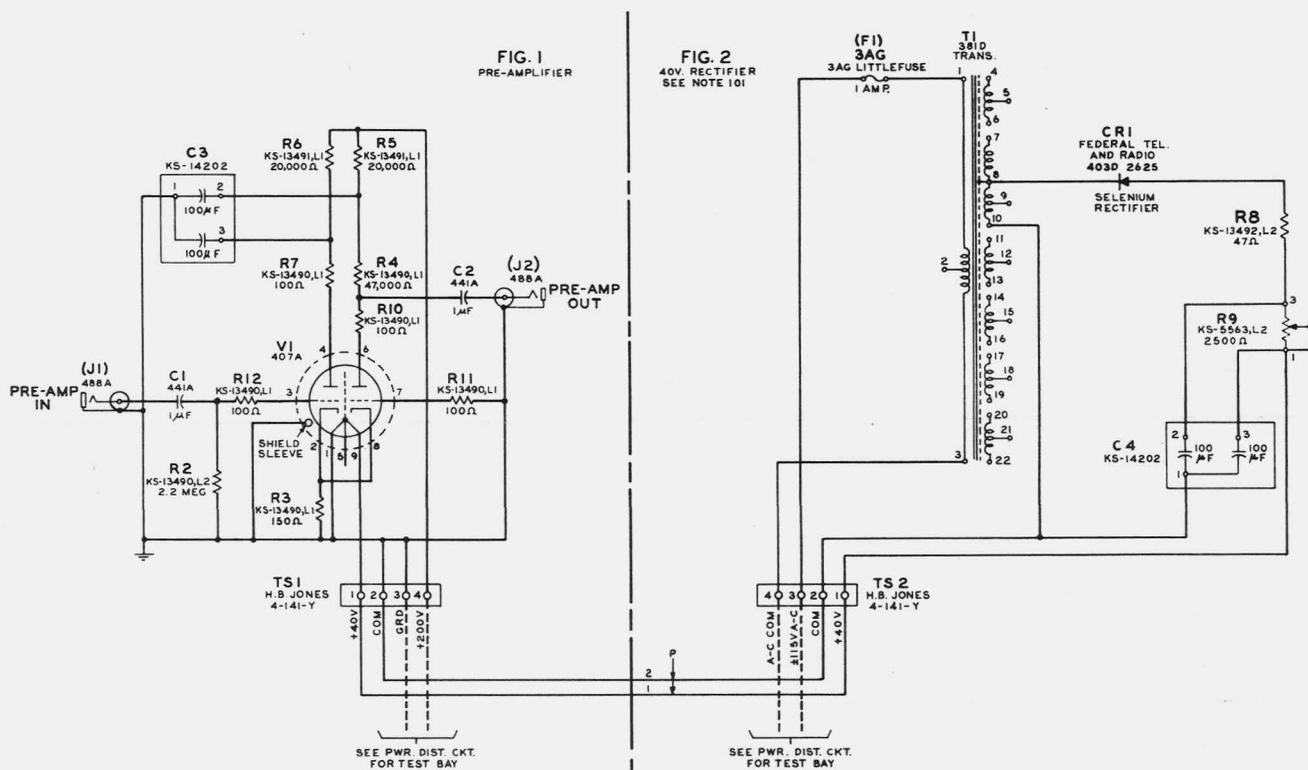


FIG. 3
IF DETECTOR CKT.
(J68337E, L2)

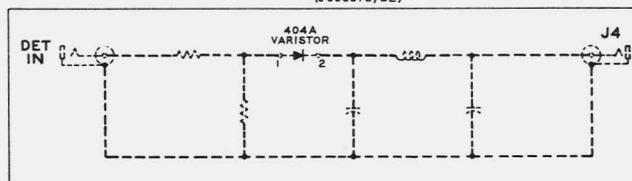


FIG. 5
IF FREQUENCY METER CKT.
(J68337E, L3)

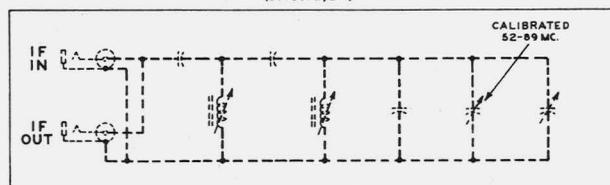
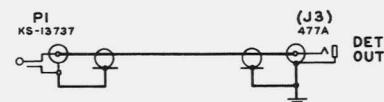


FIG. 4
ED-63591-01, G66



DWG. ISS.	C.D. ISSUE	DWG. ISS.	C.D. ISSUE	DWG. ISS.	C.D. ISSUE
1	1	1	1	1	1
DWG. ISS.	C.D. DATE	DWG. ISS.	C.D. DATE	DWG. ISS.	C.D. DATE
2-A	2-A 7-27-49	2-A	2-A 7-27-49	2-A	2-A 7-27-49
3-A	3-A 10-20-49	3-A	3-A 10-20-49	3-A	3-A 10-20-49
4-A	4-A 10-20-49	4-A	4-A 10-20-49	4-A	4-A 10-20-49
5-A	5-A 10-20-49	5-A	5-A 10-20-49	5-A	5-A 10-20-49

ED-63591-01
(DET. & FREQ. METER)
ED-63568-01
EQUIPMENT INFO.

SD-59384-01

TOLL SYSTEMS
TRANSMISSION MEASURING
IF DETECTOR PANEL CKT.
FOR USE WITH
TRANSMITTER-RECEIVER TEST BAY
TD RADIO

AT&TCO
STANDARD

SD-59384-01

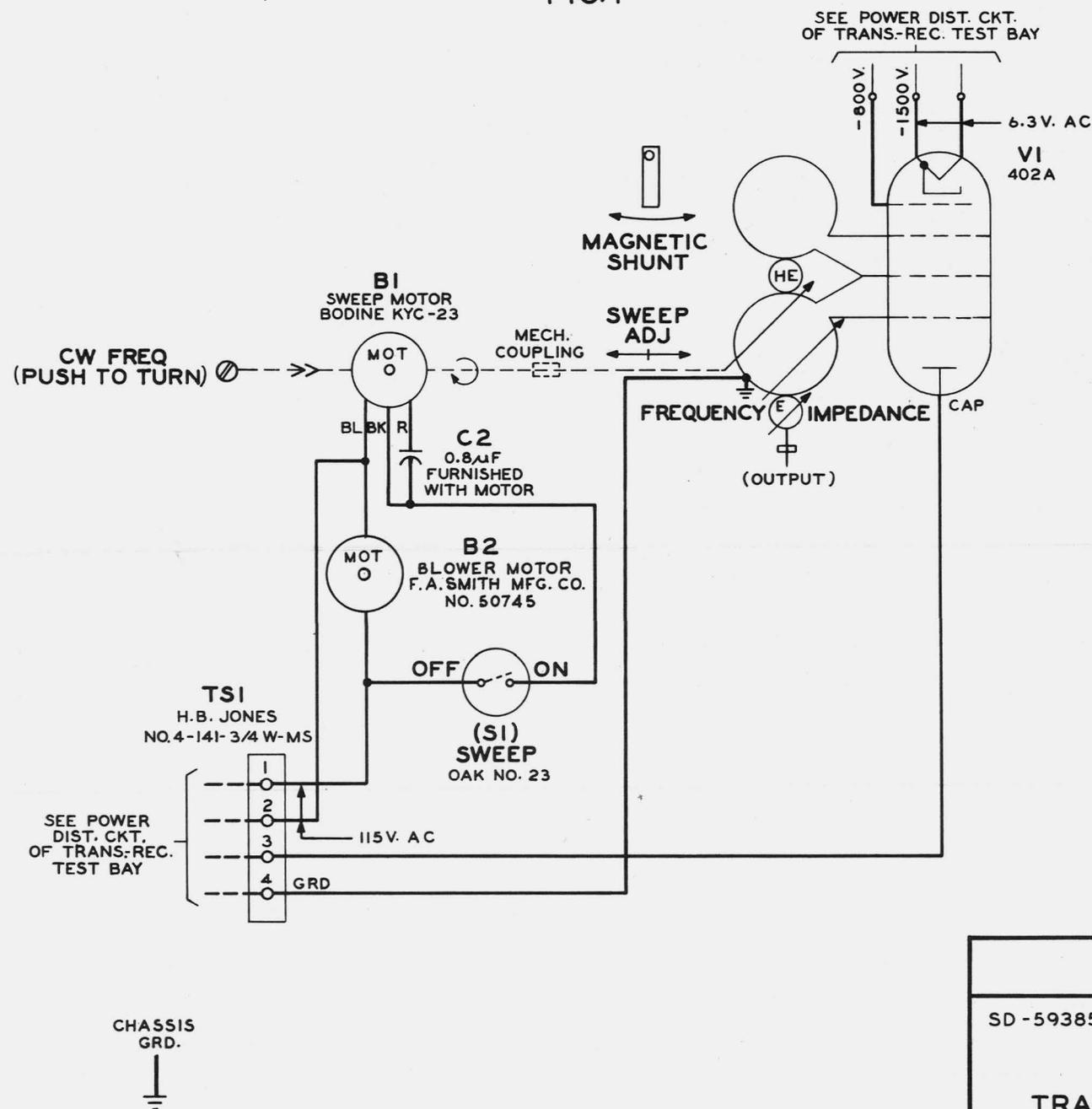
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10-4802-02

FIG. 1



DWG. ISS.	C. D. ISSUE	DWG. ISS.	C. D. ISSUE	DWG. ISS.	C. D. ISSUE
1	1				

DWG. ISS.	C. D. ISSUE	DATE ISSUED	APPROVED
2-A	2-A	7-21-49	G.N.T.K.
3-A	2-A APPI-A	12-19-49	G.N.T.K.

2-A	2-A	7-21-49	G.N.T.K.
3-A	2-A APPI-A	12-19-49	G.N.T.K.

J 68340 H
ED-63573-01
EQUIPMENT INFO.

SD-59385-01

TOLL SYSTEMS
TRANSMISSION MEASURING
RF SWEEP OSCILLATOR CKT.
FOR USE WITH
TD RADIO
TRANSMITTER-RECEIVER TEST BAY

AT & T CO
STANDARD

SD-59385-01

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10-28E02-02

FIG. 1
IF FREQUENCY METER
FOR USE WITH LINEARITY TEST SET

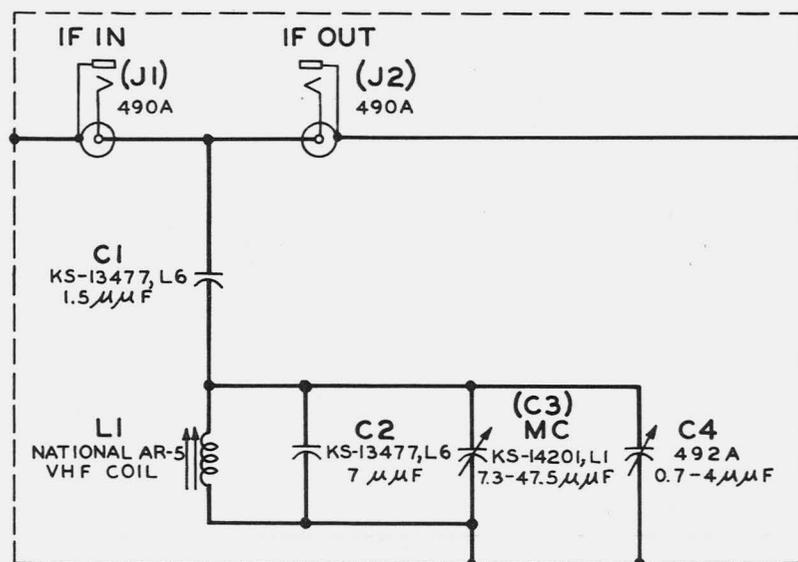
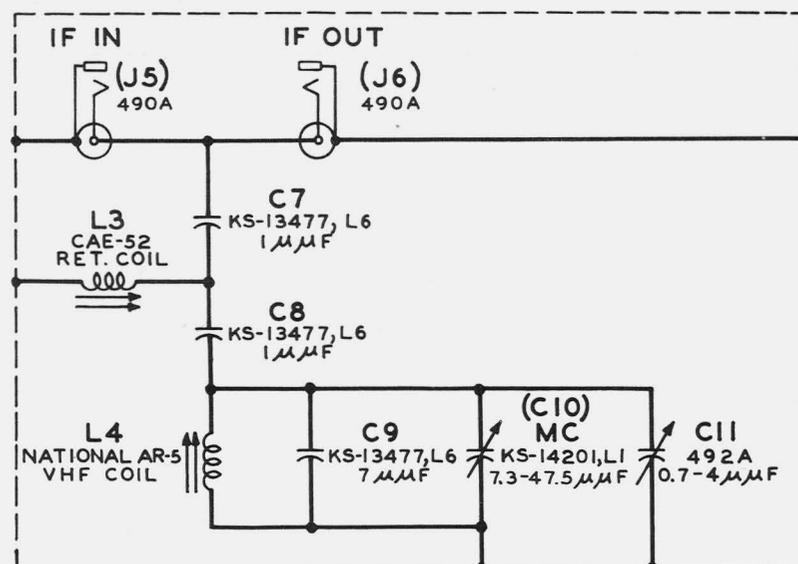


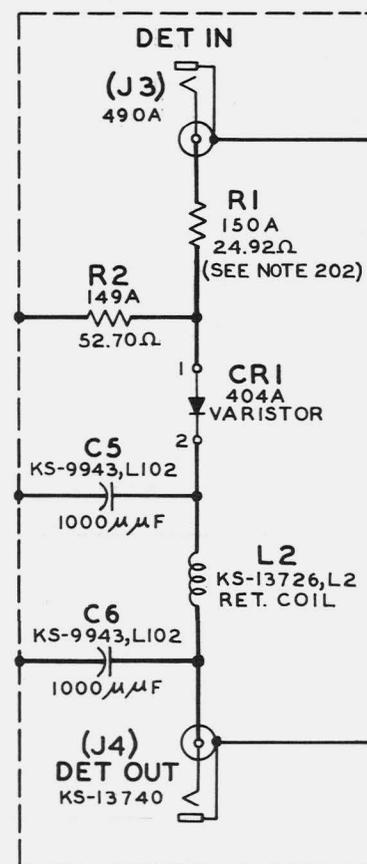
FIG. 3
IF FREQUENCY METER
FOR USE WITH TRANSMITTER-RECEIVER TEST BAY



EQUIPMENT NOTES:
201. THE PLACEMENT OF APPARATUS AND THE ARRANGEMENT OF CRITICAL WIRING MUST BE IN ACCORDANCE WITH EQUIPMENT REQUIREMENTS.

202. (R1) CONSISTS OF PART OF A 150A RESISTANCE.

FIG. 2
IF DETECTOR



DWG. ISS.	EE OR CD ISSUE	DATE ISSUED	APPROVED
1	1	3-4-49	G.N.T.K.
2-A	APP.1-A	6-20-49	G.N.T.K.
3-D	2-D	6-20-49	G.N.T.K.
4-A	2-D APP.1-A	10-3-49	G.N.T.K.

ED-63591-01
EQUIPMENT INFO.

SD-59387-01

TOLL SYSTEMS
TRANSMISSION MEASURING
IF FREQUENCY METER & IF DETECTOR CKTS.

AT&TCO
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FIGS. 1 & 3 (IF FREQ METER) FIG. 2 (IF DET)

SD-59387-01

SD-59387-01

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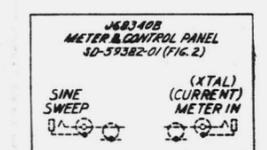
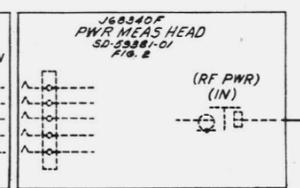
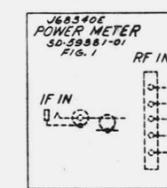
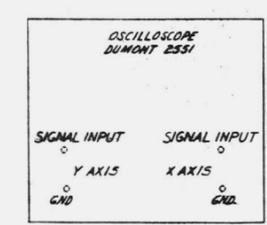
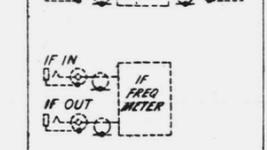
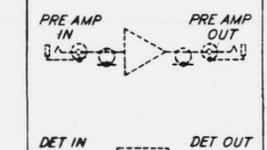
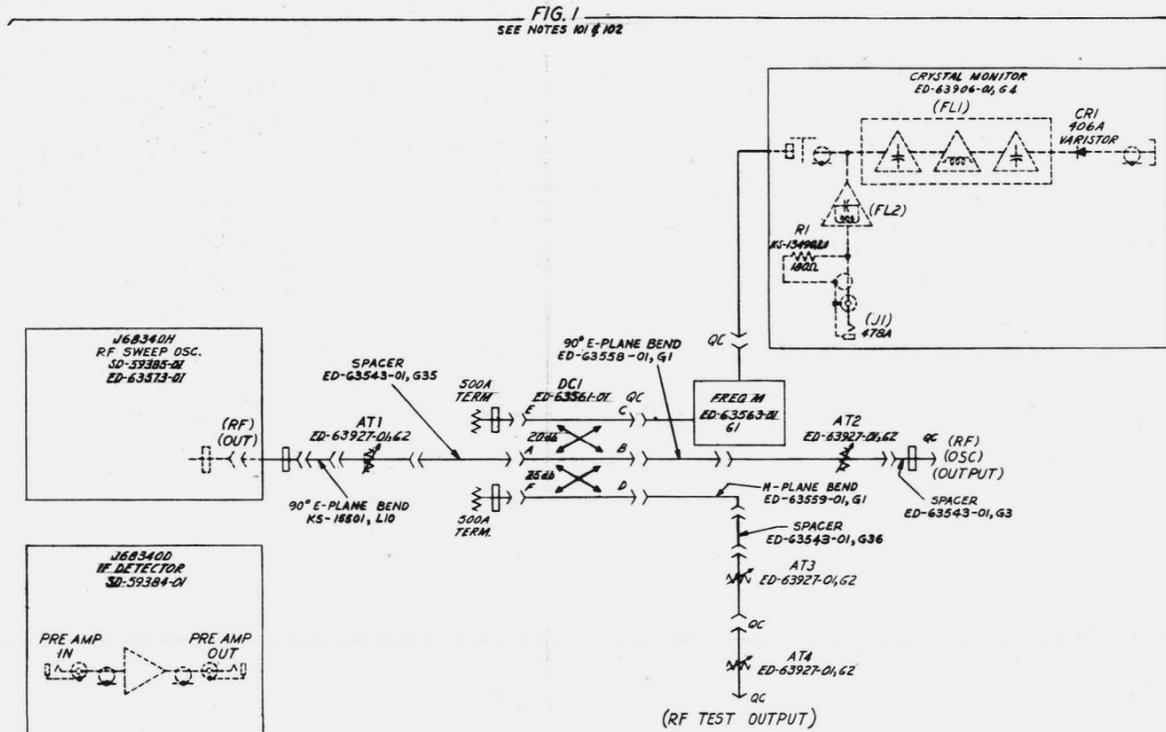
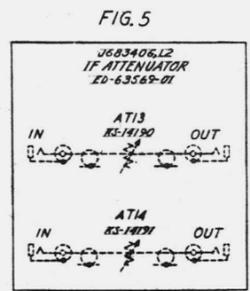
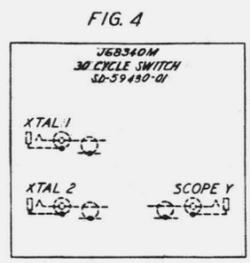
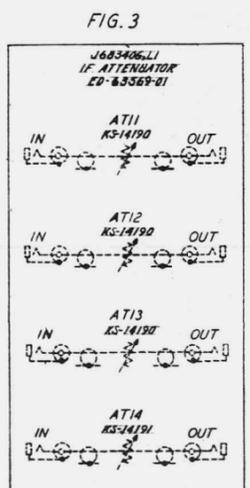
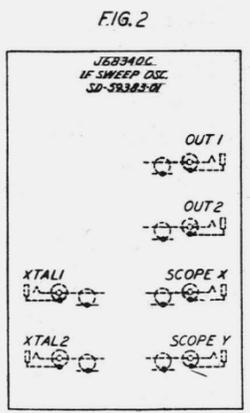
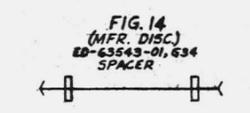
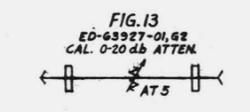
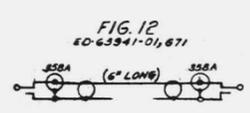
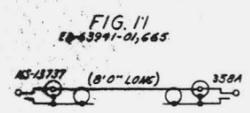
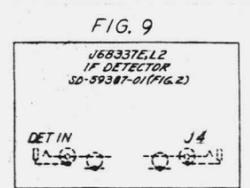
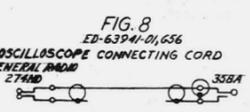
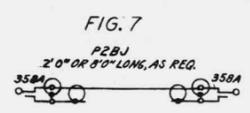
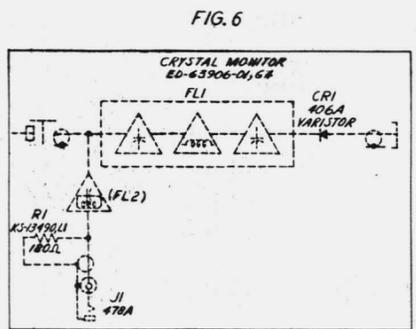
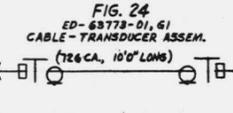
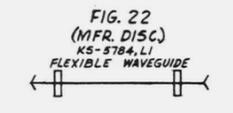
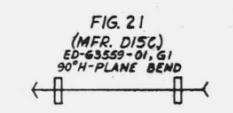
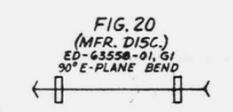
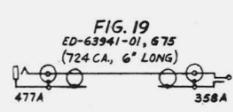
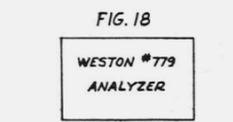
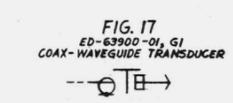
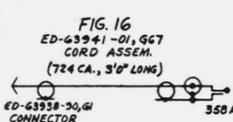
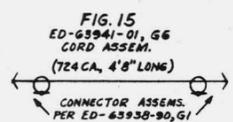
L

CIRCUIT NOTES: 101, SD-59382-01, FIG. 1 SHOWS POWER CABLES FOR CONNECTING THE EQUIPMENT SHOWN ON THIS DWG.

102. (SEE J-68340 A)

COMPONENT TO BE SUPPLIED AT:

AUXILIARY STATIONS		TERMINALS, MAIN STATIONS AND MAINTENANCE CENTERS	
QUAN.	FIG.	QUAN.	FIG.
1	1 (INCLUDING (5) PWB. 10)	1	1 (INCLUDING (2) PWB. 10)
1	4	1	2
1	5	1	3
1	6	1	6
2	12	2	12
10	7, 2'0" LONG	11	7, 2'0" LONG
4	7, 8'0" LONG	4	7, 8'0" LONG
2	8	2	8
1	9	1	9
2	10	2	10
1	11	1	11
1	13	1	13
1	14 (MFR. DISC.)	1	16 (MFR. DISC.)
1	15	1	15
1	16	1	16
1	17	1	17
1	18	1	18
1	19	1	19
20	(MFR. DISC.)	20	(MFR. DISC.)
21	(MFR. DISC.)	21	(MFR. DISC.)
22	(MFR. DISC.)	22	(MFR. DISC.)
1	23	1	23
1	24	1	24



RECORD OF FIGURES, WIRING, AND APPARATUS CHANGES

CHANGED RECORDS ON ISS.	IF JOB DO NOT SPECIFY	THIS OPTION WAS PURN.	SEE NOTE	USE IN CIRCUIT
FIGS.	FIGS.	FIGS.	FIGS.	FIGS.
3B	14, 20, 20, 21, 22 & 24	21 & 22	2, 4	14, 20, 21 & 22

10-81422-02

SD-59418-01

TOLL SYSTEMS
TD-2 RADIO

OVERALL APPLICATION SCHEMATIC
FOR TRANSMITTER-RECEIVER TEST BAY

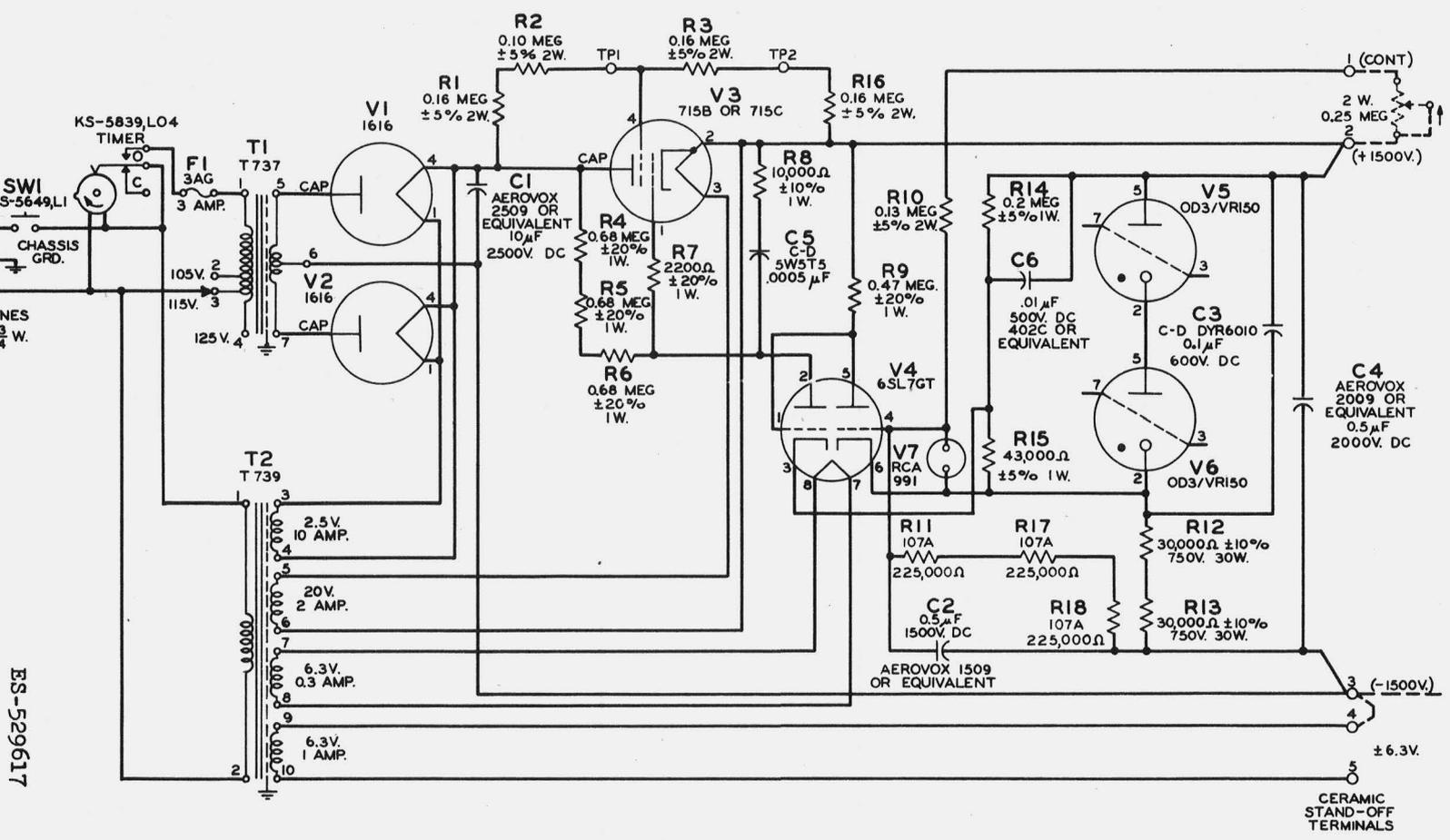
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AT&CO
STANDARD

R3

SD-59418-01

ISSUE	1	2
DATE	4-49	5-49



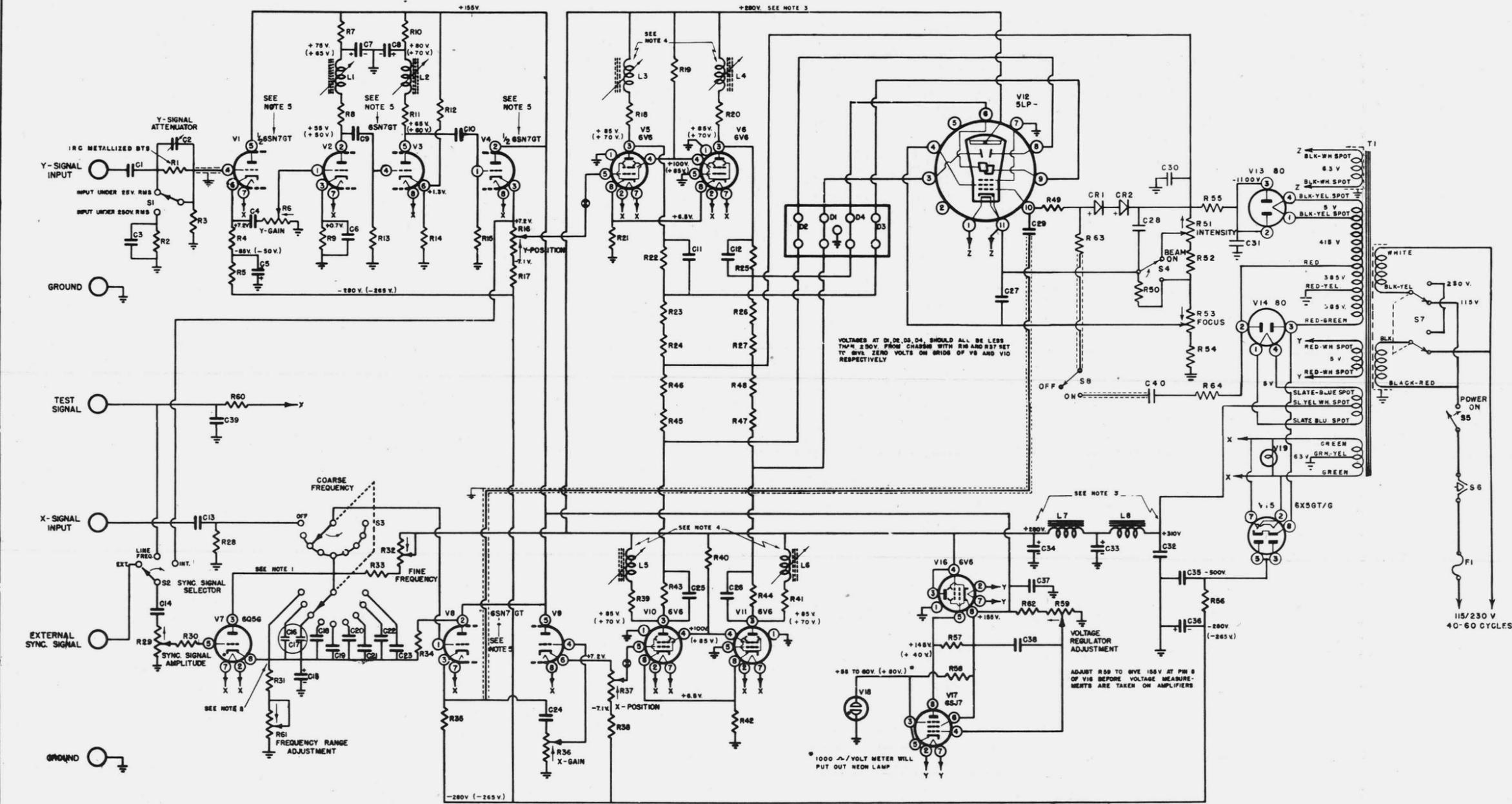
NOTES:
 1. ALL WIRING SHALL BE 16 GAUGE SOLID TINNED COPPER WIRE SLEEVED WITH IRVINGTON VARNISH CO. NO. 16 "TRANSFLEX" TUBING, EXCEPT INPUT 115V. AC LEADS WHICH SHALL BE 20 GAUGE KS-13385.

BELL TELEPHONE LABORATORIES, INC.
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KS-5789 RECTIFIER UNIT
 ELECTRON TUBE TYPE-AUTOMATIC REGULATION

ES-529617

ES-882824



COMPONENT PARTS LIST

C1	0.5µf	600V	R46	4.7meg	1W	S1	S P DT	toggle
C2	4-30µf	trimmer	R47	4.7meg	1W	S2	S P 3T	60° rotary
C3	200µf	500V	R48	4.7meg	1W	S3	D P 9 T	80° rotary
C4	5µf	200V	R49	510K	1W	S4	S P DT	toggle
C5	24µf	350V elec	R50	1meg	1/2W	S5	S P ST	toggle
C6	5100	500V	R51	100K	pot	S6	S P S.T.	Push
C7	30µf	150V elec	R52	220K	1W	S7	D P DT	Slide Switch
C8	30µf	150V elec	R53	500K	pot	S8	S P S.T.	Toggle
C7 and C8	common neg		R54	1meg	1W	T1	Power Transformer	Part No 20-92
C9	1µf	200V	R55	56K	1W	CR1	1N34	Crystal
C10	1µf	200V	R56	47K	2W	CR2	1N34	Crystal
C11	0.25µf	400V	R57	470K	1W	V1-V4	Type 6SN7GT	
C12	0.25µf	400V	R58	56K	1W	V2-V3	Type 6SN7GT	
C13	0.25µf	400V	R59	500K	pot	V5	Type 6V6	
C14	0.1µf	1000V	R60	10K	1/2W	V6	Type 6V6	
C15	25µf	50V elec	R61	1K	pot	V7	Type 6Q5G	
C16	1µf	400V	R62	470K	1W	V8-V9	Type 6SN7GT	
C17	0.2µf	400V	R63	1.2meg	1W	V10	Type 6V6	
C16-C17	common con		R64			V11	Type 6V6	
C18	0.04µf	400V				V12	Type SLP-A	
C19	0.01µf	400V				V13	Type 80	
C20	2400µf	800V				V14	Type 80	
C21	620µf	500V				V15	Type 6X5GT/G	
C22	120µf	500V				V16	Type 6V6	
C23	68µf	500V				V17	Type 6SJ7	
C24	9µf	200V				V18	Type 991 1/4 W Neon	
C25	0.25µf	400V				V19	Pilot Light No 44	
C26	0.25µf	400V					6.3V Boyonet Base	
C27	0.1µf	1000V						
C28	0.1µf	1000V						
C29	50µf	200V						
C30	0.5µf	1000V						
C31	0.5µf	1000V						
C32	1µf	1000V						
C33	16µf	450V elec						
C34	40µf	450V elec						
C35	1µf	1000V						
C36	16µf	450V elec						
C37	1µf	200V						
C38	1µf	200V						
C39	0.1µf	1000V						
C40	0.1µf	1600V						
F1	1.5 amp	fuse						
L1	1-3 mh	±5%						
L2	1-3 mh	±5%						
L3	7.5-19mh							
L4	7.5-19mh							
L5	7.5-19mh							
L6	7.5-19mh							
L7	8h	325 ohms dc						
L8	8h	325 ohms dc						
R1	2meg	1/2W ±5% MET.						
R2	240K	1/2W ±5%						
R3	2.2meg	1/2W ±5%						
R4	100K	1W						
R5	270K	1W						
R6	100K	pot						
R7	27K	1W						
R8	8.2K	1W ±5%						
R9	270 ohm	1/2W						
R10	27K	1W						
R11	8.2K	1W ±5%						
R12	5.6K	1W						
R13	1meg	1/2W						
R14	150 ohm	1/2W						
R15	1meg	1/2W						
R16	15K	pot						
R17	300K	1W ±5%						
R18	25K	10W ±5%						
R19	150K	1W						
R20	25K	10W ±5%						
R21	390 ohm	1W						
R22	680K	1W						
R23	4.7meg	1W						
R24	4.7meg	1W						
R25	680K	1W						
R26	4.7meg	1W						
R27	4.7meg	1W						
R28	4.7meg	1W						
R29	100K	1W						
R30	10K	1W						
R31	470 ohm	1/2W						
R32	5meg	pot						
R33	470K	1W						
R34	39K	1W						
R35	270K	1W						
R36	500K	pot						
R37	15K	pot						
R38	300K	1W ±5%						
R39	25K	10W ±5%						
R40	150K	1W						
R41	25K	10W ±5%						
R42	390 ohm	1W						
R43	680K	1W						
R44	680K	1W						
R45	4.7meg	1W						

NOTE 1 - APPROX. 40V. DEPENDS UPON ADJUSTMENT OF R61
 NOTE 2 - APPROX. 4V. DEPENDS UPON ADJUSTMENT OF R61
 NOTE 3 - VALUES GIVEN FOR C32-0.5µf. FOR NEWER UNITS WITH C32-1µf, INCREASE FILTER INPUT AND OUTPUT VOLTAGES APPROX. 40V.
 NOTE 4 - OLDER UNITS HAVE PEAKING COILS AND PLATE LOAD RESISTORS INTERCHANGED.
 NOTE 5 - OLDER UNITS USE 6F88 TUBES IN PLACE OF 6SN7GT TUBES, WITH SHIELDS AND SOCKET WIRING CHANGES.

VOLTAGE MEASUREMENTS ON AMPLIFIERS CONSISTING OF V5, V6 AND V10, V11 SHOULD BE MADE WITH R18 AND R37 ADJUSTED TO ZERO VOLTS AT GRID OF V5 AND V10.

D-C VOLTAGES SHOWN ARE AS MEASURED WITH AN ELECTRONIC-TYPE VOLTMETER OR ONE WITH RESISTANCE OF 20,000 OHMS/VOLT VALUES IN PARENTHESES GIVEN FOR METER OF 1000 OHMS/VOLT. WHERE VALUE IS DIFFERENT FROM ABOVE.

* 1000 Ω/VOLT METER WILL PUT OUT NEON LAMP

K = ohms x 1000 - EXAMPLE: 15K = 15,000 ohms.

ES-882824

SCHEMATIC
 CATHODE-RAY OSCILLOGRAPH

FIRST USED ON TYPE 2051	DATE 3/11/49	CHKD W. S. Smith
DRAWN J. P. White	DATE 6-1-49	
ALLEN D. MONT LABORATORIES INC	ES-882824	PASSAIC, N. J. U. S. A.

ISSUE NUMBER
 DATE
 DRAWN BY
 CHECKED BY