

J68333A TEST BENCH

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1. GENERAL

- 1.1 The J68333A Test Bench is used in conjunction with the J68340A Test Bay in repairing, aligning and maintaining various components of the TD-2 Radio System.
- 1.2 The J68333A Test Bench consists of a bench and a J68333D Cabinet. The cabinet houses the following Transmitter-Receiver units:

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- J68330G Microwave Generator
- J68330B Receiver Control Unit
- J68330M Transmitter Control Unit
- J68330H 40 MC Shifter (less 40 MC Generator)
- J68330A IF Main Amplifier

Detailed information regarding the description and operation of the above items will be found in other BSP's as indicated in the reference list at the end of this section.

1.3 The J68333D Cabinet also houses a J68333E Control Panel. Detailed information regarding the description and operating principles of the Control Panel and of the other units which are more or less associated with the Test Bench will be found in this section.

2. BENCH

2.1 The test bench is a commercial steel bench equipped with drawers and shelves for storing the test equipment components when not in use. The bench is 60 inches long, by 30 inches wide, by 34 inches high, and has a wood top. The photograph on page 101 shows a bench with the cabinet in place.

3. CABINET

3.1 The cabinet houses a number of equipment units. The photograph on page 104 shows a front view of the cabinet. Power is brought into the cabinet from the rear by a cord with a plug on the end. Air is brought into the rear on a detachable tube. The connections to the individual panels of the cabinet are by detachable plugs. Receptacles are provided on the front edges of the cabinet to which units under test may be connected by means of detachable power cords. The three control panels contain necessary controls and meters for the components under test.

4. CONTROL PANEL

4.1 All power distributed on the Test Bench passes through the Control Panel. All filament power flows through the FIL circuit breaker and two rheostats in series to the various units. The FIL voltmeter across the line on the load side of the rheostats indicates the voltage supply to the load.

4.2 The +130 volt power lead splits in the Control Panel. One branch is connected through a 1/2 ampere fuse to the AMP PWR and TEST PWR receptacles. The other branch is connected to the Receiver Control Unit.

4.3 The +250 volt power lead also splits in the Control Panel. One branch is connected through a 1/2 ampere fuse to the TEST AMP and TEST PWR receptacles. The other branch is connected to the Microwave Generator, Transmitter Control Unit and 40 MC Shifter.

4.4 There is a resistor with a variable tap (IF GAIN) to control the gain of the Test Amplifier.

4.5 There is another resistor with a variable tap (LEV ADJ) used when a Limiter Detector is being tested.

4.6 There are two meters (LIM 1 and LIM 2) used in testing a Limiter Amplifier or a Limiter Detector.

4.7 There is a switch SW CONT with two positions, A and B, used in the test of the IF Switching Amplifier.

5. AIR SUPPLY

5.1 The Air supply is to cool the 416A and 418A tubes in the test equipment and in the components under test.

6. POWER REQUIREMENTS

6.1 The unit requires 15 amperes at -12 volts DC, 0.7 amperes at +130 volts DC and 0.15 amperes at +250 volts DC.

7. IF DIRECTIONAL COUPLER

7.1 The IF Directional Coupler is a device for sampling the power traveling in each direction on a transmission line. By observing the power traveling from a signal generator toward a termination, and the power returned from the termination toward the signal generator, the amount of the reflection at the termination can be found. The difference in db between the signal supplied to a termination and the reflected signal is called the "return loss" of the termination. The better a termination matches a line, the larger will be its return loss.

Equipment Description

7.2 The IF Directional Coupler consists of a rigid brass box on which are mounted two plugs (connectors) and two jacks. The interior of this box, approximately 1/4 by 1/4 by 2-1/8 inches, serves as the outer conductor of a coaxial line. This line has two center conductors of half-round silver, supported by insulators with their flat sides facing each other. Each of these conductors is connected to a plug at

one end and a jack at the other. This connection is made with flexible leads, so that small movements of the plug and jack center conductors will not move the silver pieces. The spacing between the silver members is adjustable by means of screws, on either side of the box, which have insulators set in their ends. The insulators bear against the silver members and move toward each other as dictated by the electrical requirements of the coupler.

7.3 Access may be had to the interior of the coupler by removing four screws identified by steel-stamped dots adjacent to their heads. Removing these screws and loosening the four end screws and nuts will permit removal of a 1/4 by 1/4 by 2-1/8 inch bar which forms one side of the box.

Circuit Description

7.4 The functioning of the coupler, described with reference to SD-59419-01, is as follows:

(a) A schematic representation of the directional coupler, showing (by the arrows) the forward directions of transmission, is given in Fig. 1. An equivalent circuit, showing the internal functioning of the unit, is given in Fig. 101.

(b) The directional coupler contains two coaxial circuits, one connecting (A) and (B), the other connecting (C) and (D).

(c) The center conductors of these two circuits pass through the same shield, so that there is coupling between the circuits.

(d) If a voltage is impressed on one line, such as from (A) to (B), a smaller voltage will appear on the other line due to the capacitance between the center conductors. This voltage appears at both outlets of the second line, and has the same phase at both. This coupling is indicated by the capacitor in Fig. 101.

(e) If a current is present in one line, such as from (A) to (B), a current will be induced in the opposite direction in the other line, due to the inductive coupling of the center conductors. Voltages will thus be developed across the terminations of the second line. The voltage across one of these terminations will be of the opposite phase from the voltage across the other. Reversing the primary current will reverse the phase of both these voltages. This type of coupling is indicated by the transformer in Fig. 101.

(f) The position of each center conductor is adjustable by means of a screw. Adjustment of these screws,

designated CFLG ADJ, will adjust the capacitance between conductors. It also has a small effect on the inductive coupling. By means of this adjustment, the capacitive and inductive coupling may be adjusted until they are equal.

(g) When the coupler is adjusted for equal capacitive and inductive coupling, the voltages due to both types of coupling will add at one outlet of the second line, and cancel at the other outlet. Since the phase of the inductively coupled voltage depends on the direction of the current in the first line, the outlet at which power will appear on the second line also depends on the direction of current in the first line. This gives the coupler its directional properties.

(h) The voltages due to both types of coupling increase in proportion to the frequency of the applied signal. This results in an increase, with increasing frequency, of the power which appears at the outlet where the voltages add. The net loss between the input and this outlet for various frequencies is given in Par. 7.6.

(i) Since the voltages due to both types of coupling vary in the same way with changing frequency, the effectiveness of the cancellation which occurs at the other outlet is independent of frequency. The magnitude of the loss due to this cancellation is given in Par. 7.7.

(j) The coupler is symmetrical, so that the signal may be applied to either branch, and the forward and reflected power observed on the other branch.

Transmission Characteristics

7.5 This directional coupler is intended to work between 75 ohm impedances.

7.6 The transmission loss between branches of the coupler in the forward direction (following the arrows in Fig. 1 of SD-59419-01) is approximately 23 db at 70 MC. This loss decreases 6 db each time the frequency is doubled, or increases 6 db when the frequency is halved. The variation from 60 to 80 MC is ± 1.25 db (total 2.5 db).

7.7 The transmission loss between branches in the backward direction (opposed to the arrows in Fig. 1) is at least 40 db greater than the loss in the forward direction.

8. IF SIGNAL INSERTER

8.1 The IF Signal Inserter is a device for inserting a test signal into an interstage of an IF amplifier, in order to check transmission in the portion of the amplifier between that interstage and the output jack.

Equipment Description

8.2 The IF Signal Inserter consists of a 57 inch length of lightweight 75 ohm coaxial cable, equipped with a No. 358A plug at one end and a special connector at the other end. The special connector, approximately 1/2 inch square by 2-1/2 inches long, houses two resistors and a capacitor, and has a terminal at the end for connection to the grid terminal of an amplifier tube socket. A clip on the side of the special connector provides for grounding the body of the connector to a shield in the amplifier.

Circuit Description

8.3 The circuit is shown on SD-59420-01. It functions as follows:

(a) The GRID terminal is connected to the grid into which the signal is to be fed, and the terminal designated GROUND is connected to a suitable ground, such as a shield, as closely associated with the tube as possible.

(b) Capacitor C1 is a blocking capacitor to prevent any bias voltage on the grid from causing a direct current flow through the inserter.

(c) Resistor R2 provides a shunt from grid to ground, so as to minimize the effect on transmission of the interstage transformer which is also connected to the grid. The combination of R2, in parallel with the interstage network, gives a net impedance from grid to ground of 28 ohms.

(d) Resistor R1, in series with the 28 ohms from grid to ground, gives a total of 75 ohms to terminate the coaxial cable.

(e) The coaxial cable from the INPUT plug to resistors R1 and R2 is approximately 1/2 wavelength long at 70 MC, so that the impedance terminating the end of the cable appears at the INPUT jack, affected as little as possible by variations in the cable.

Transmission Characteristics

8.4 This circuit is designed to connect to the grid of a tube which already has connected to it a double-tuned transformer terminated in a 330 to 390 ohm resistor at the grid.

8.5 The input impedance, looking into the No. 358A plug, is 75 ohms, with a return loss of 25 db minimum from 60 to 80 MC, when the inserter is connected to an interstage as above, or to an equivalent 180 ohm resistor..

8.6 The transmission loss of the signal inserter is nominally 16 db. The loss does not vary over the 60 to 80 MC band by more than 0.2 db.

9. 50 FEET OF WAVEGUIDE

9.1 For some of the tests a waveguide transmission line about 50 feet long is needed. This waveguide is always shorted at one end. The line may consist of rigid waveguide assemblies or flexible waveguide assemblies containing KS-15501, List 20 or KS-5784, List 20.

10. FLEXIBLE WAVEGUIDE

10.1 Flexible waveguide assemblies are furnished to facilitate connection to the J68340A Test Bay and to the 50 feet of waveguide.

11. PATCH CORDS

11.1 Some of these assemblies are for use in IF circuits and others having transducers or transducer fittings in one or both ends are for use in RF circuits.

12. POWER CORDS

12.1 These assemblies are for connections to the components under test.

13. QUICK CLAMPS

13.1 Quick clamps and alignment studs offer a convenient method for holding flanges together. Each quick clamp can exert a pressure of about 200 lbs. The alignment studs to be most effective in angular alignment should be in diagonally opposite threaded holes that are farthest apart.

14. WAVEGUIDE VARIABLE ATTENUATOR (ED-63927-90)

14.1 No repairs that affect the position of the vane in the waveguide should be made to this unit. The calibration is made at the factory after the vane is assembled and is unique for that vane and the particular way in which it is mounted. A unit that is out of order should be returned for repair.

15. 1A JUNCTION

15.1 The operating principles are described in Section R90.315. No adjustments except those necessary to rotate the movable H plane connection should be made. A unit that is out of order should be returned for repair.

16. 128S PRD TERMINATION

16.1 These assemblies are used as resistive terminations to a waveguide transmission line. A unit that is out of order should be returned for repair.

17. RF CRYSTAL MONITOR (ED-63906-90)

17.1 There are two varieties used in test work. One has a resistive shunt across the output jack and the other does not. The sensitivity of the one without the shunt is greater. The operating principles are explained in Sections R90.315 and R70.205.

18. 515A FILTER

18.1 The 515A Filter is a rejection type filter used to suppress second and third harmonics of test frequencies in the 70 MC region.

19. PHOTOGRAPHS

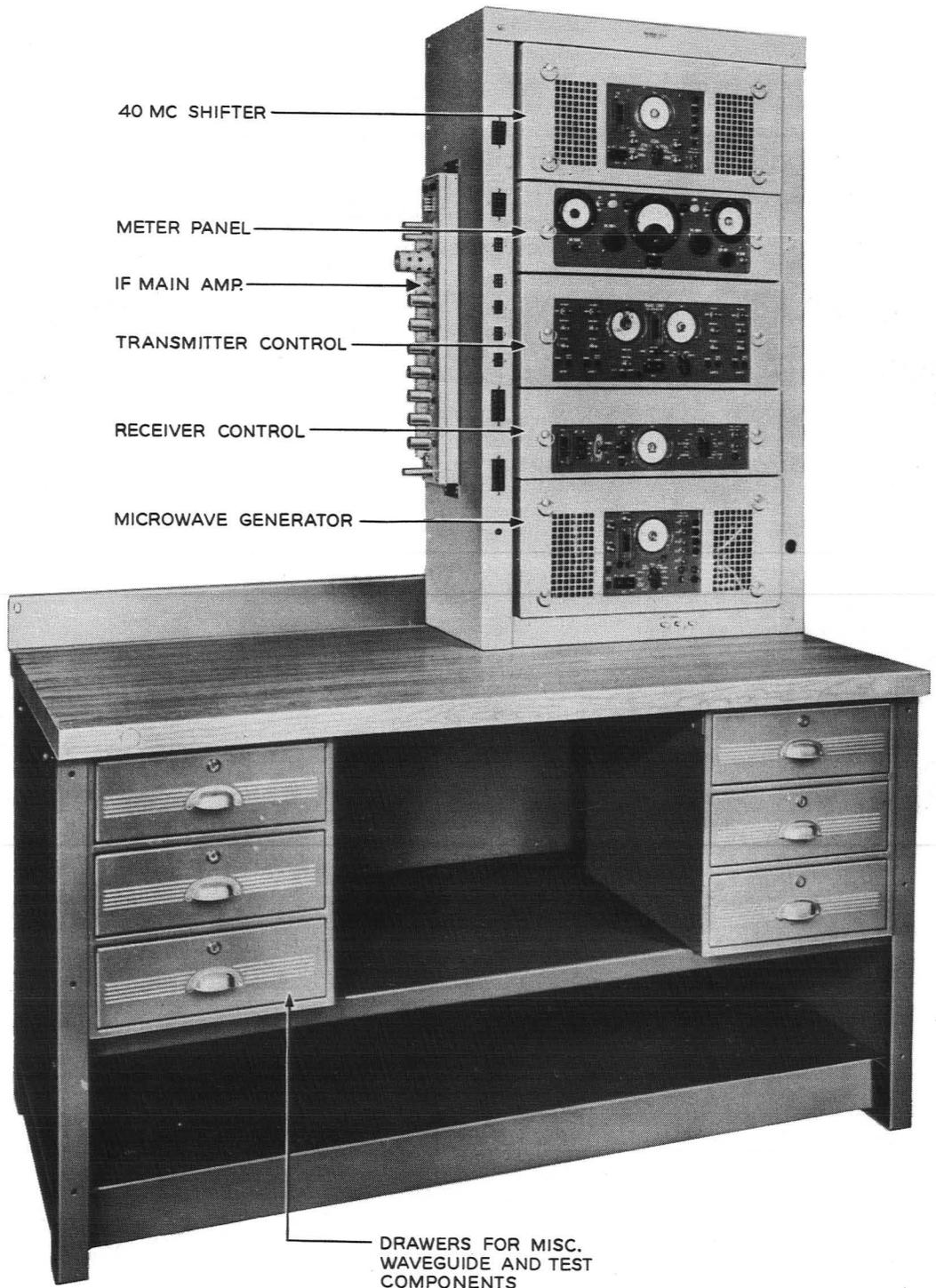
Photo Desig.	Subject	Supplementary Page
A	J68333A Test Bench	101
B	J68333B IF Signal Inserter	102
C	J68333C IF Directional Coupler	103
D	J68333D Cabinet - Front View	104
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20. DRAWINGS

Desig.	Subject	Supplementary Page
SD-59400-01	Transmitter Control Unit	108
SD-59401-01	IF Main Amplifier	109
SD-59405-01	Receiver Control Unit	110
SD-59409-011	Microwave Generator	111
SD-59410-01	40 MC Generator and Shifter Converter	112
SD-59419-01	IF Directional Coupler	113
SD-59420-01	IF Signal Inserter	114
SD-59427-012	Test Bench Power Distribution	115
SD-59427-011	Test Bench Power Distribution	116
SD-59429-01	Test Bench Control Panel	117

21. REFERENCES (not attached)

SECTION R10.305 FM Terminal Transmitter
 SECTION R20.365 FM Terminal Receiver
 SECTION R60.045 Patching and Monitoring Equipment
 SECTION R70.205 Test Bay
 SECTION R90.315 Transmitter-Receiver Bay
 SD-59436-01 Test Bench Application Schematic



40 MC SHIFTER

METER PANEL

IF MAIN AMP.

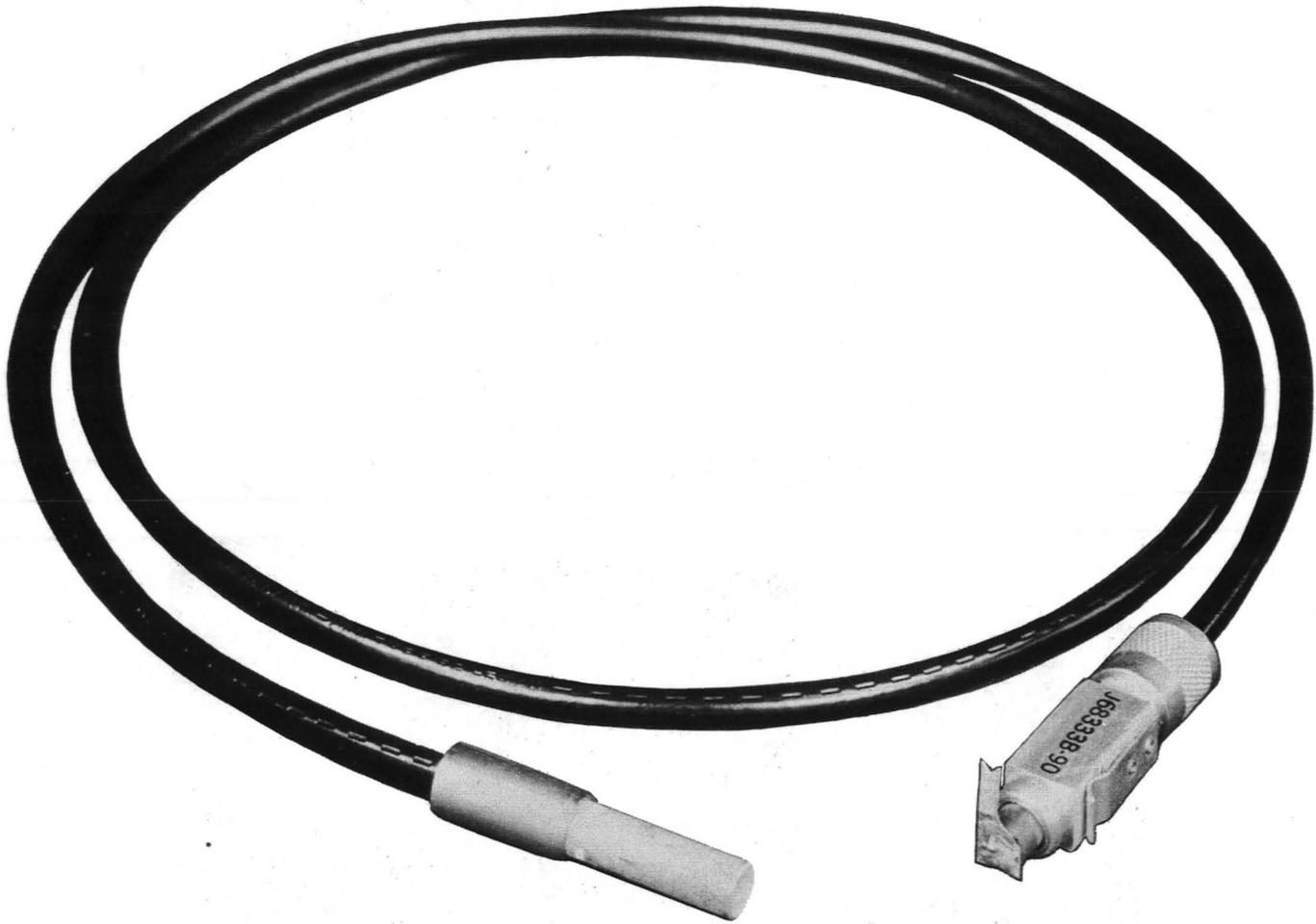
TRANSMITTER CONTROL

RECEIVER CONTROL

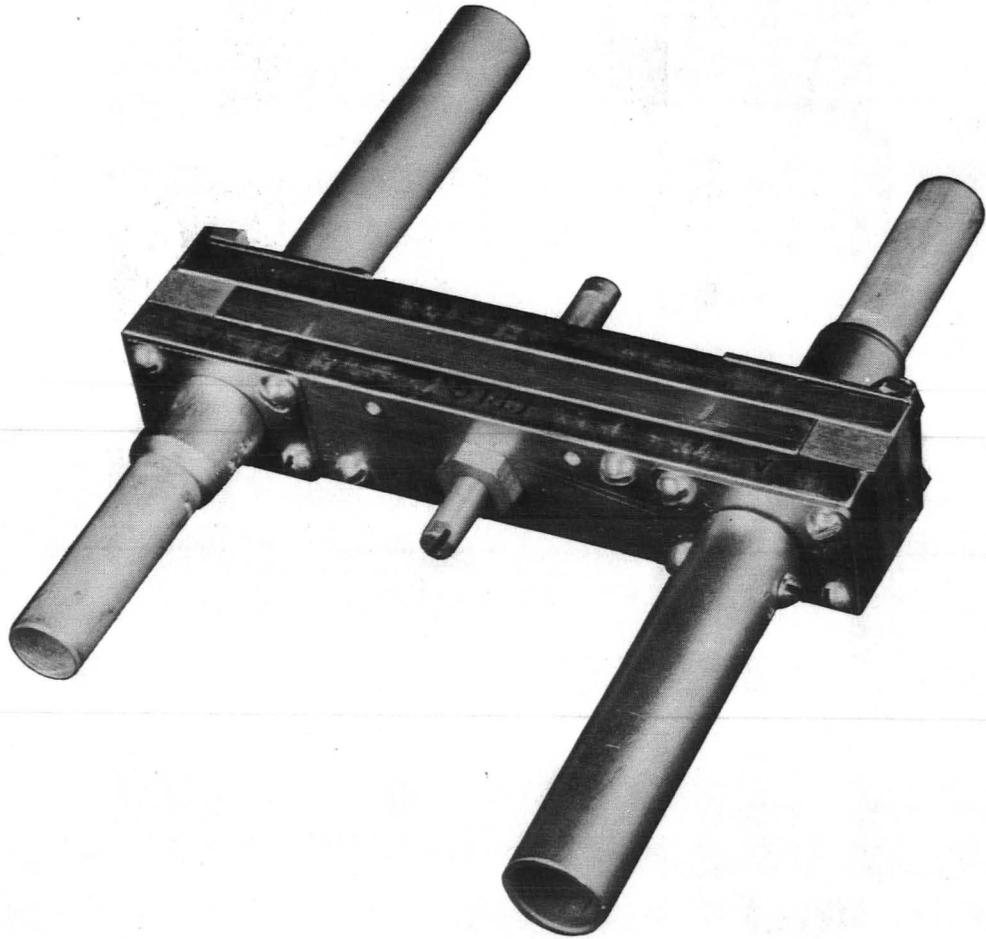
MICROWAVE GENERATOR

DRAWERS FOR MISC.
WAVEGUIDE AND TEST
COMPONENTS

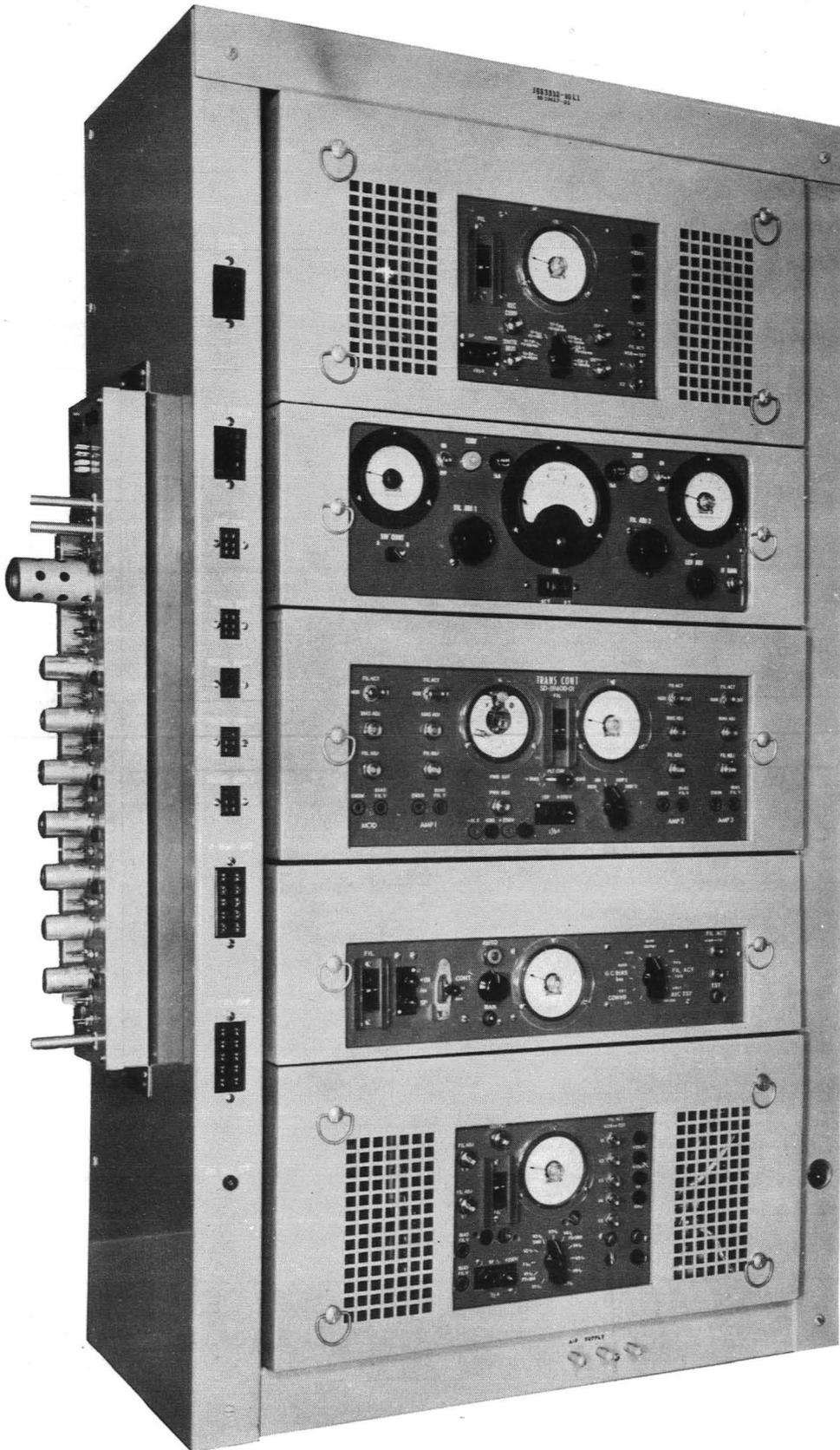
J68333A Test Bench



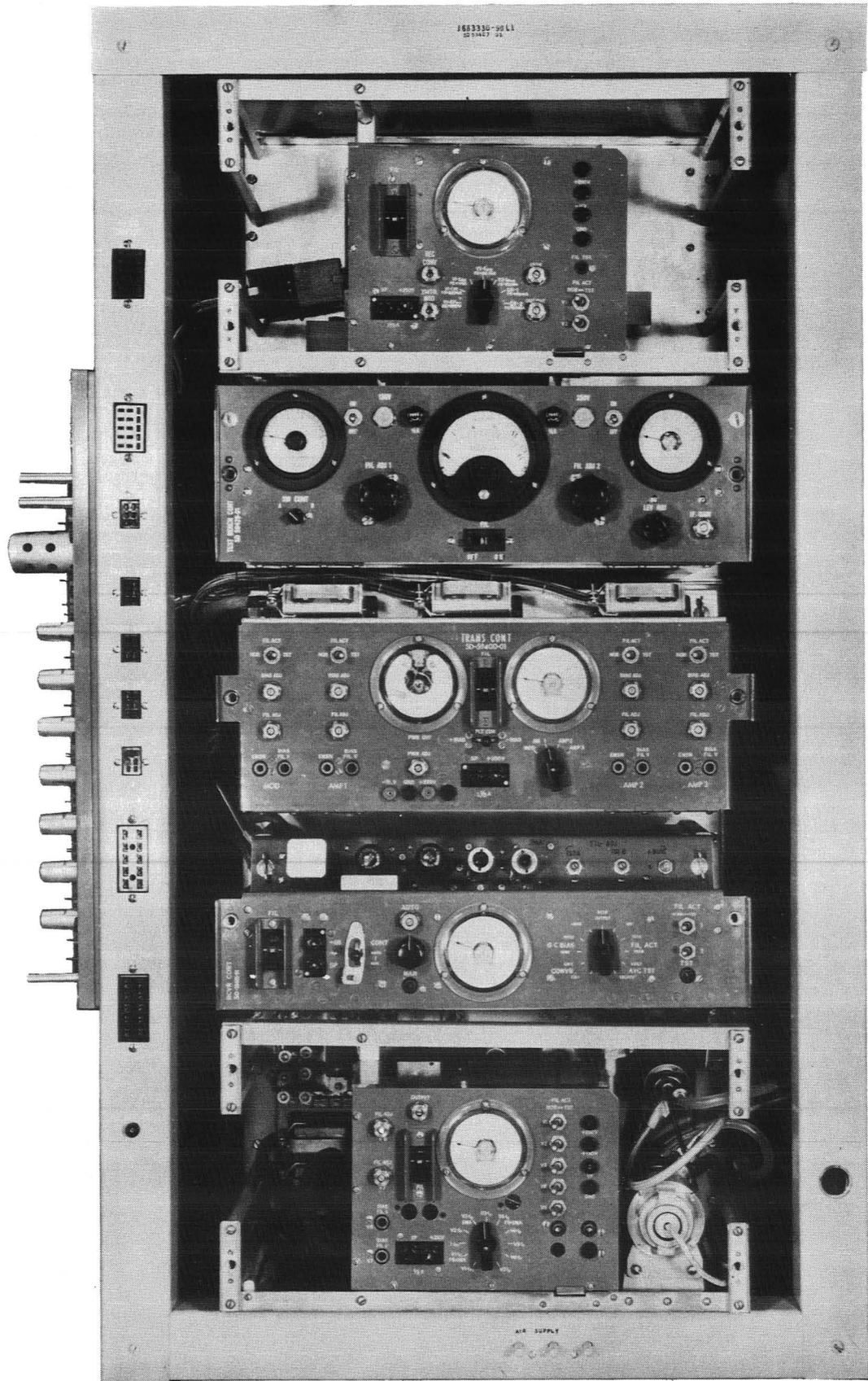
J68333B IF Signal Inserter



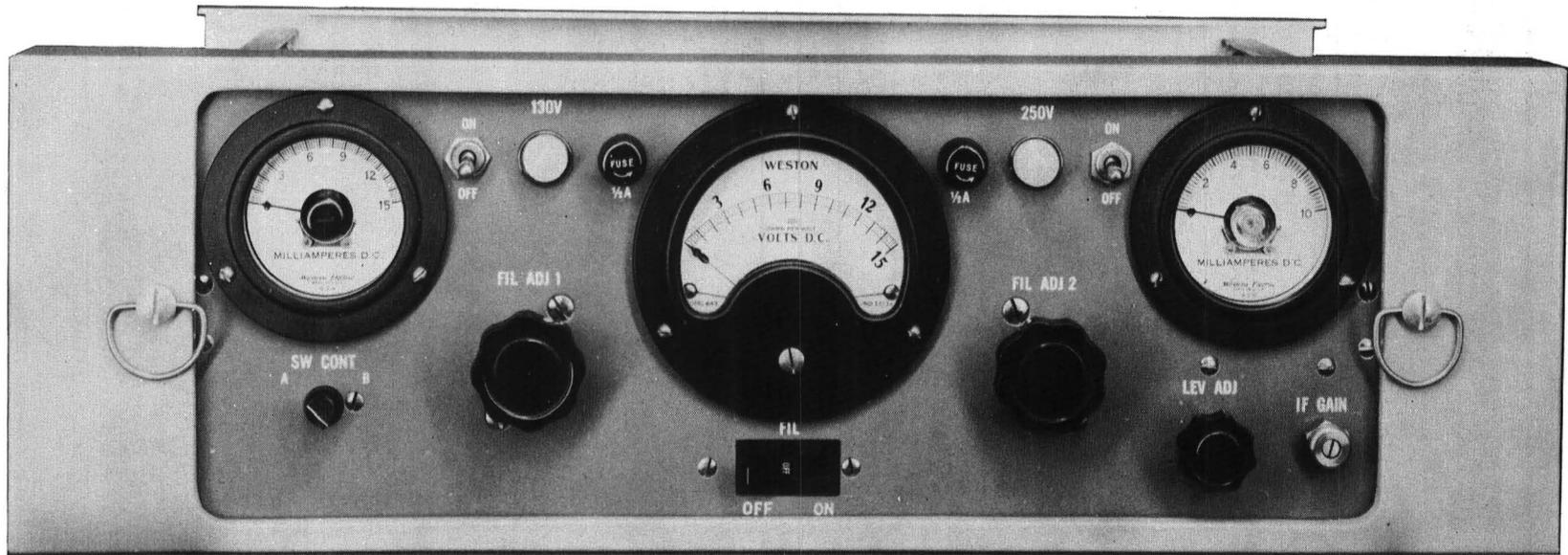
J68333C IF Directional Coupler



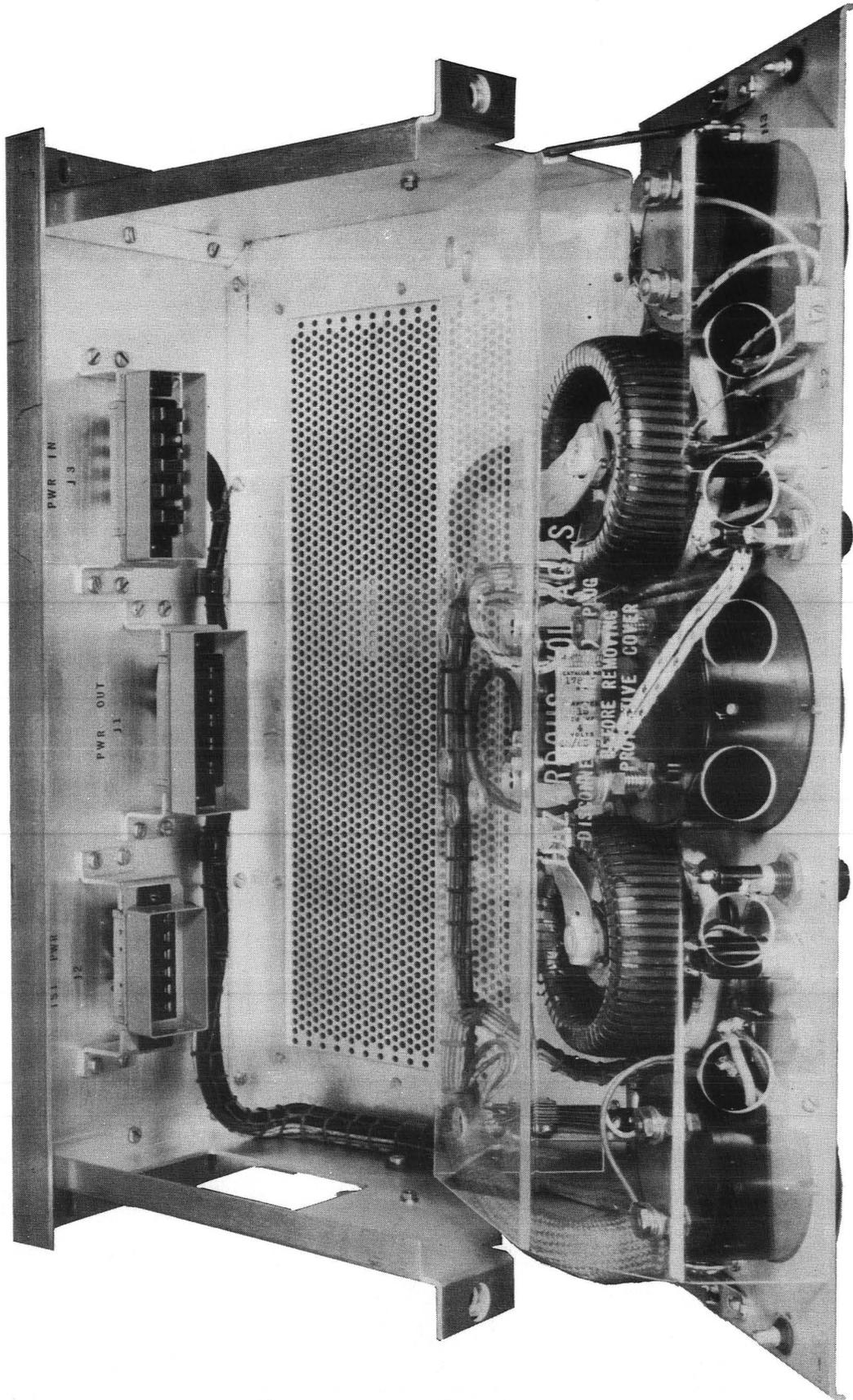
J68333D Cabinet - Front View



J68333D Cabinet - Front View - Cover Off

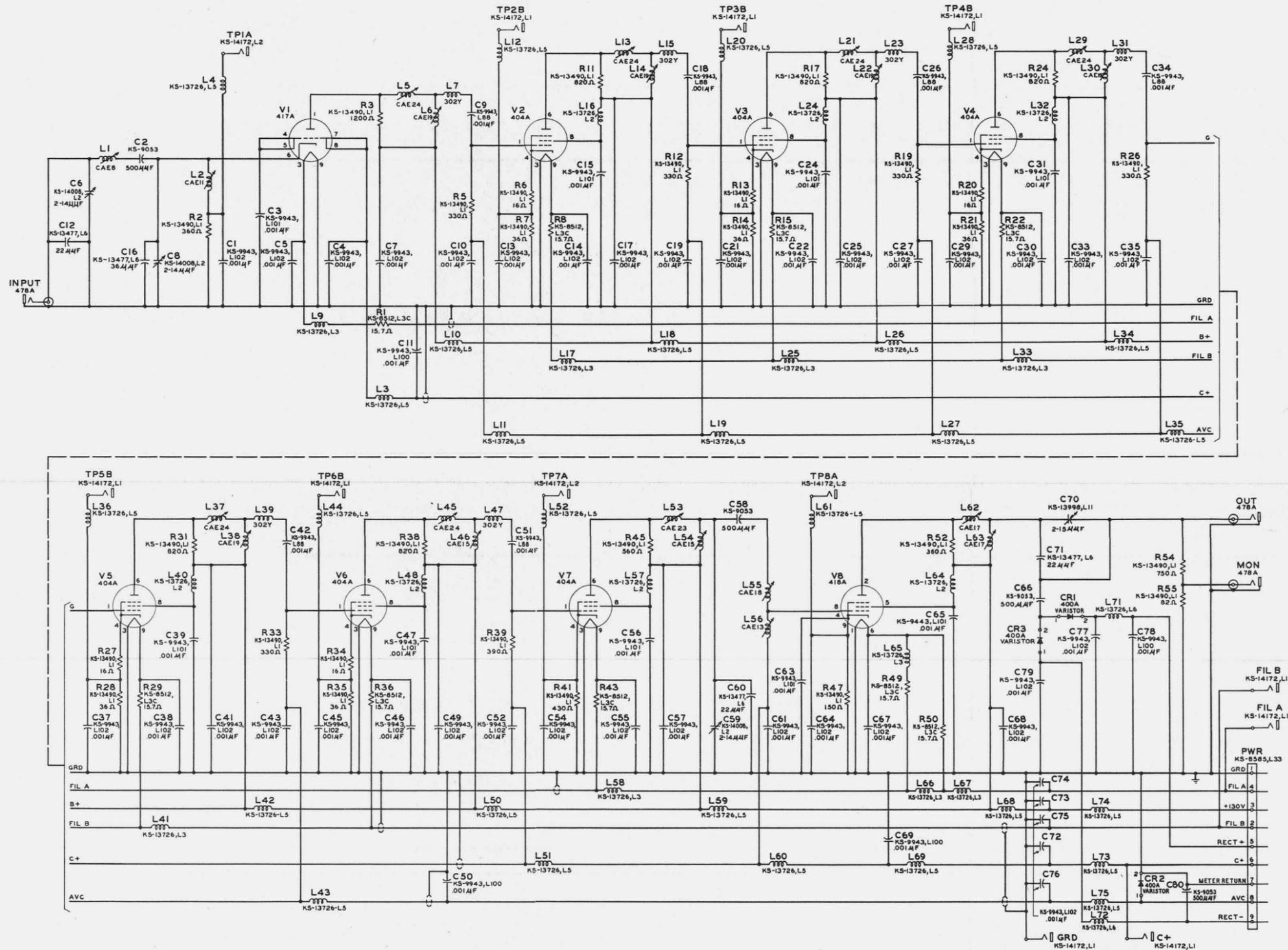


J68333E Control Panel - Front View



J68333E Control Panel - Top View

FIG. 1



REV.	NO.	DATE	APPROVED
1	1	7-7-49	G.N.T.
2	A	7-27-49	G.N.T.
3	A	5-20-49	G.N.T.
4	A	5-27-49	G.N.T.

LAST RES. COND. AND COIL USED ON THIS DWG.			
R55	C80	L75	
NOT USED			
R4, R9	C20	L8	
R10, R11	C23	L49	
R18, R23	C28	L70	
R25, R30	C30		
R32, R37	C32		
R40, R42	C36		
R44, R46	C40		
R48, R51	C44		
R53	C48		
	C53		
	C62		

⊕ CHASSIS GRD.

10-1042-02

SD-59401-01

TOLL SYSTEMS
TD RADIO
IF MAIN AMPLIFIER CKT.
(70 MC MID-BAND)

AT&CO
STANDARD

R2

(IF MAIN AMP) SD-59401-01

BELL TELEPHONE LABORATORIES, INC.

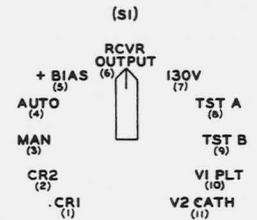
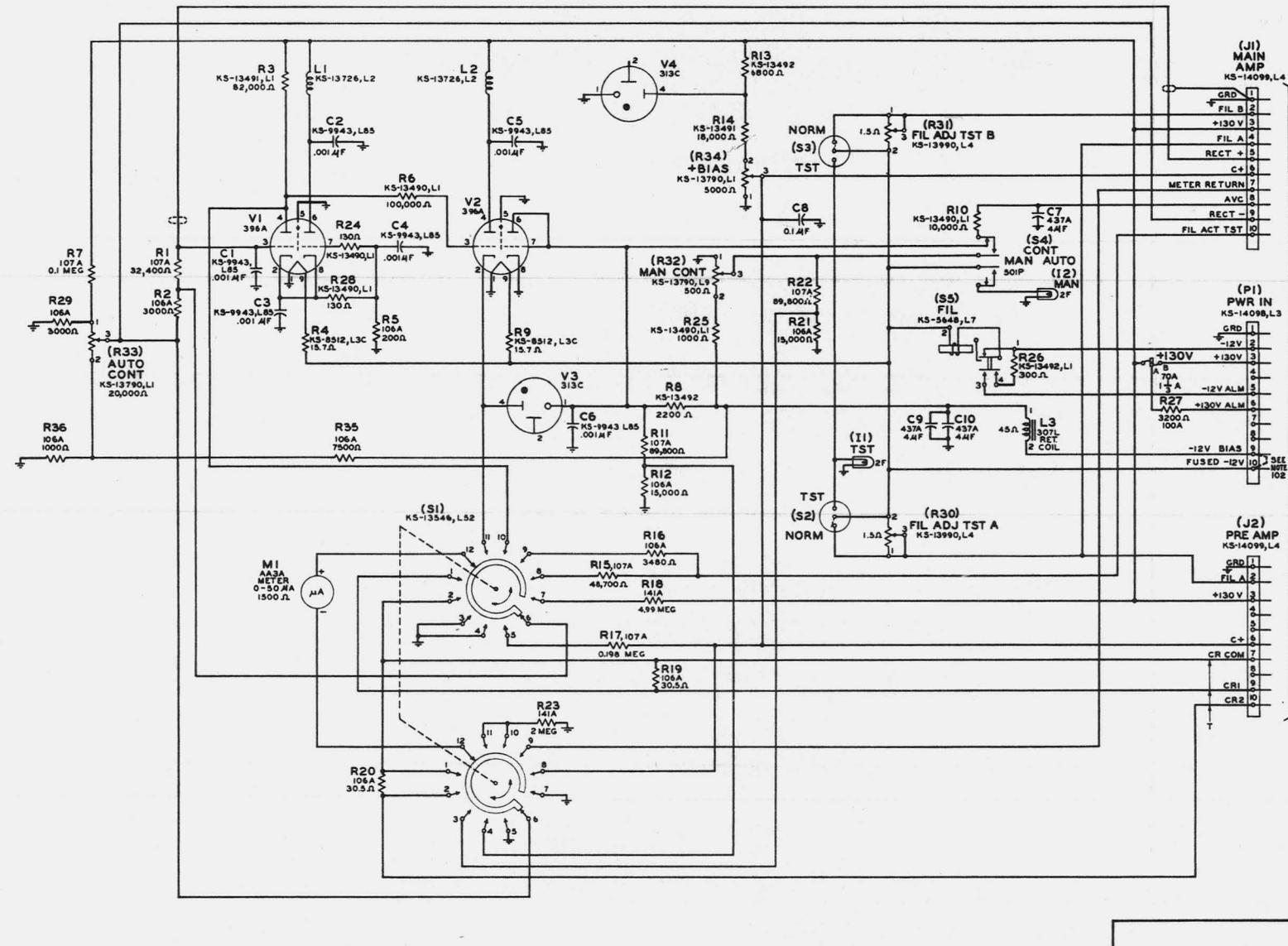
ED-63930-01
EQUIPMENT INFO.

PRINTED IN U.S.A.

CIRCUIT NOTES:
 101. REMOVING (V4) WHEN +130V SUPPLY IS CONNECTED TO THIS CKT WILL CAUSE +9V BIAS TO INCREASE AND MAY DAMAGE ASSOCIATED EQUIPMENT.
 102. PROVIDE EXTERNAL STRAP FROM TERM. 10 TO TERM. 9 OF (PWR IN) PLUG OR PROVIDE EXTERNAL -12V BIAS ON TERM. 9.

REV.	NO. OF CHG.	DATE	APPROVED
1	1	1-5-49	G.N.T.
2-A	2-A	1-17-49	G.N.T.
3-A	3-A	4-6-49	G.N.T.
4-A	3-A	5-20-49	G.N.T.

FIG. 1



LAST RES. AND COND. USED ON THIS DWG.	
R36	C10

⊥ CHASSIS GRD.

SEE APPLICATION SCHEMATIC FOR TRANSMITTER-REC. BAY

ED-53931-01 EQUIPMENT INFO.

SD-59405-01	AT&TCO STANDARD
TOLL SYSTEMS TD RADIO RECEIVER CONTROL UNIT CKT.	R1
(RCVR CONT)	SD-59405-01
BELL TELEPHONE LABORATORIES, INC.	PRINTED IN U.S.A.

10-20492-02

CIRCUIT NOTES:
 101. ALL WIRING EXCEPT DIGITAL LEADS SHOWN ABOVE THE GROUND BUS IS DI UNLESS OTHERWISE INDICATED.
 102. WHEN FIG 2 IS OMITTED THE COAXIAL CABLE OF (V5) ASSEMBLY IS CONNECTED TO (V7) ASSEMBLY.
 103. THIS CAPACITY IS FORMED BY THE ASSEMBLY OF P-255365, P-255363, AND P-255369 ASSEMBLIES.

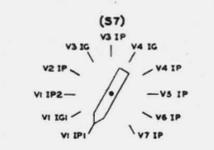
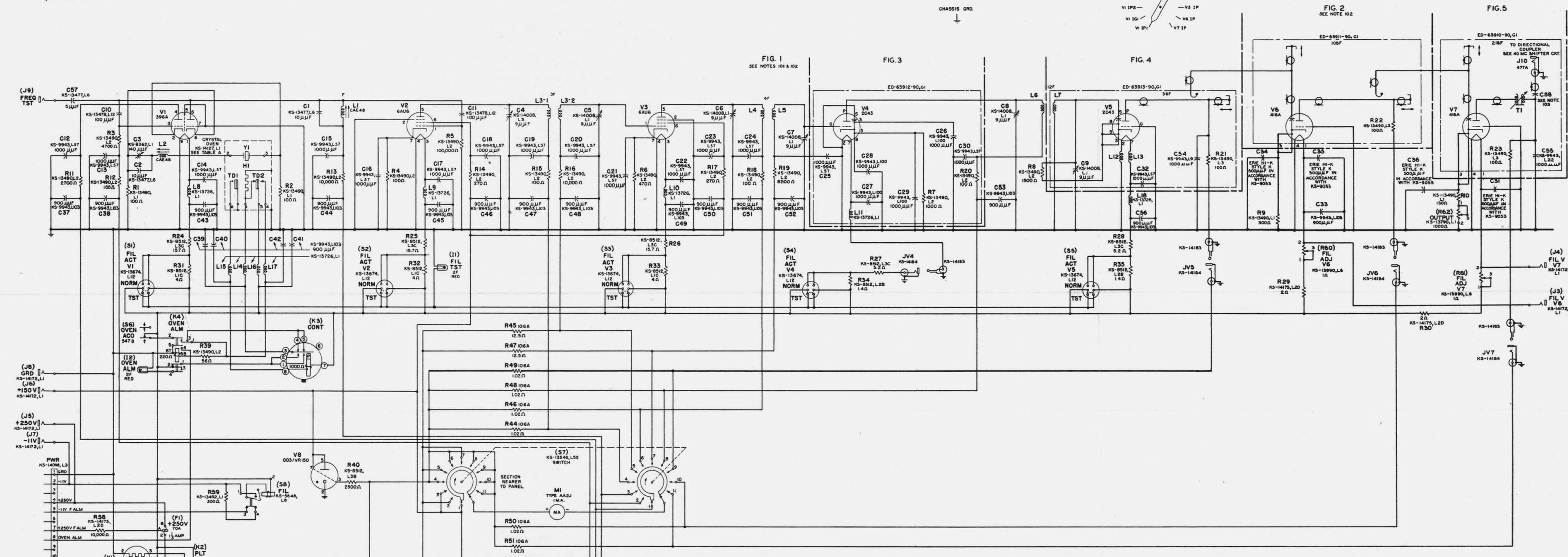


FIG. 1
SEE NOTES 101 & 102

FIG. 3
ED-63912-90,G1

FIG. 4
ED-63913-90,G1

FIG. 2
SEE NOTE 102

FIG. 5
ED-63910-90,G1

TABLE A
PROVIDE CRYSTALS AS FOLLOWS:

MW GENERATOR OUTPUT FREQ.	CRYSTAL FREQ.	CODE
3800 MC	17.59259 MC	KS-13976, L1
3820 MC	17.68518 MC	KS-13976, L1
3840 MC	17.77778 MC	KS-13976, L1
3860 MC	17.87037 MC	KS-13976, L1
3880 MC	17.96296 MC	KS-13976, L1
3900 MC	18.05556 MC	KS-13976, L1
3920 MC	18.14815 MC	KS-13976, L1
3940 MC	18.24074 MC	KS-13976, L1
3960 MC	18.33333 MC	KS-13976, L1
4020 MC	18.61111 MC	KS-13976, L1
4060 MC	18.79630 MC	KS-13976, L1
4100 MC	18.98148 MC	KS-13976, L1

LAST RES. AND COND. USED ON THIS DWG.

R62	C58
NOT USED	
R12	
R36-38	
R52-57	

OPTIONS ON THIS DWG.

FIGS.	
1-4	
5-8	
APP OR WIRING	

SD-59409-01 2 SHEETS

TOLL SYSTEMS TD RADIO MICROWAVE GENERATOR CKT.

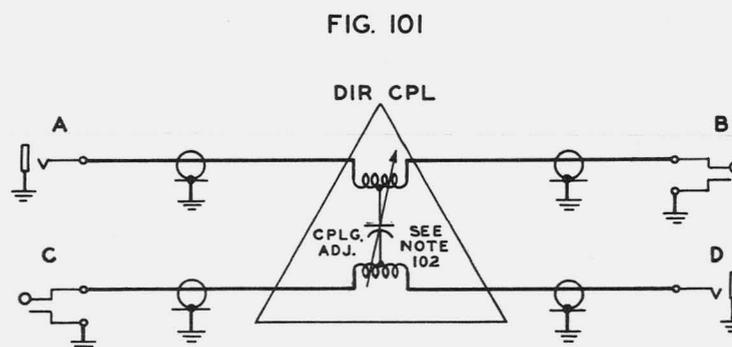
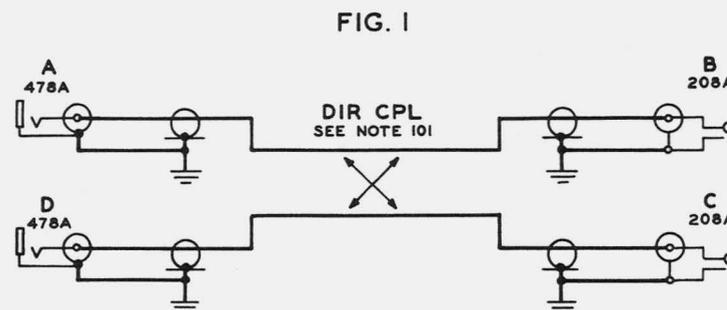
(MW GEN) SD-59409-01

BELL TELEPHONE LABORATORIES, INC. PRINTED IN U.S.A. R4

CIRCUIT NOTES:

101. FOR INTERNAL CIRCUIT CONFIGURATION, SEE FIG. 101.

102. ADJUSTMENT DESIGNATED (CPLG ADJ) CONSISTS OF TWO SCREWS WHICH SHOULD BE ADJUSTED TO MEET TEST REQUIREMENTS. WHEN MAKING ADJUSTMENTS, BOTH SCREWS SHOULD BE ROTATED SO THAT THEY PROJECT EQUAL AMOUNTS FROM THE COUPLER.



DWG. NO.	REV. OR CD. ISSUE	DATE ISSUED	APPROVED
I	I	5-17-49	G.N.T.K.

ED-63872-01
EQUIPMENT INFO.

SD-59419-01

TOLL SYSTEMS
TRANSMISSION MEASURING
IF DIRECTIONAL COUPLER CKT.

AT & T CO
STANDARD

SD-59419-01

BELL TELEPHONE LABORATORIES, INC.

PRINTED IN U.S.A.

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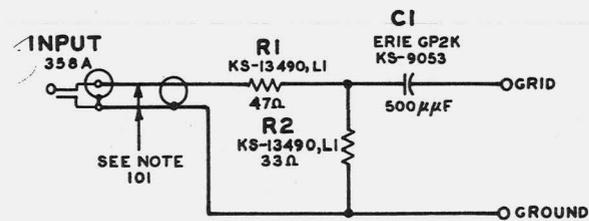
SD-59419-01

CIRCUIT NOTES:

101. THIS CABLE SHALL BE KS-13679 (RG59/U),
57 ± 1 IN. LONG.

REV. ISS.	EE OR CD ISSUE	DATE ISSUED	APPROVED
1	1	5/7/49	G.N.T.R.

FIG. 1



ED-63871-01
EQUIPMENT INFO.

SD-59420-01

TOLL SYSTEMS
TRANSMISSION MEASURING
IF SIGNAL INSERTER CKT.
FOR TD RADIO

AT&TCO
STANDARD

SD-59420-01

BELL TELEPHONE LABORATORIES, INC.

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L

10-05402-02

FIG. 1
J68330A TEST BENCH

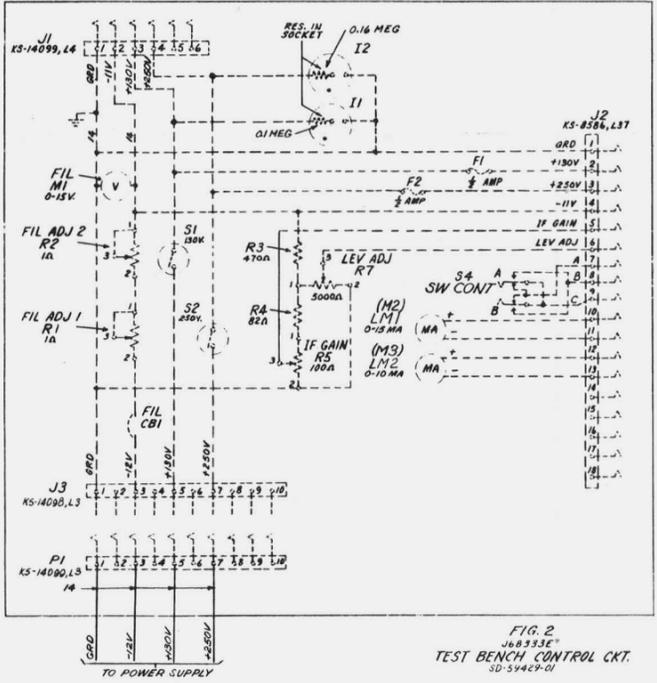
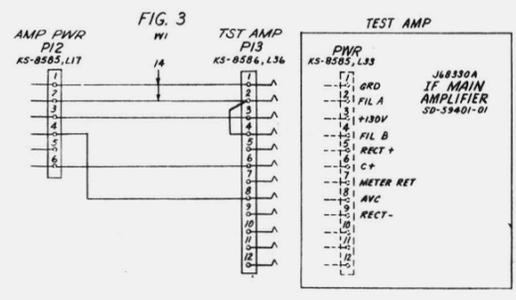
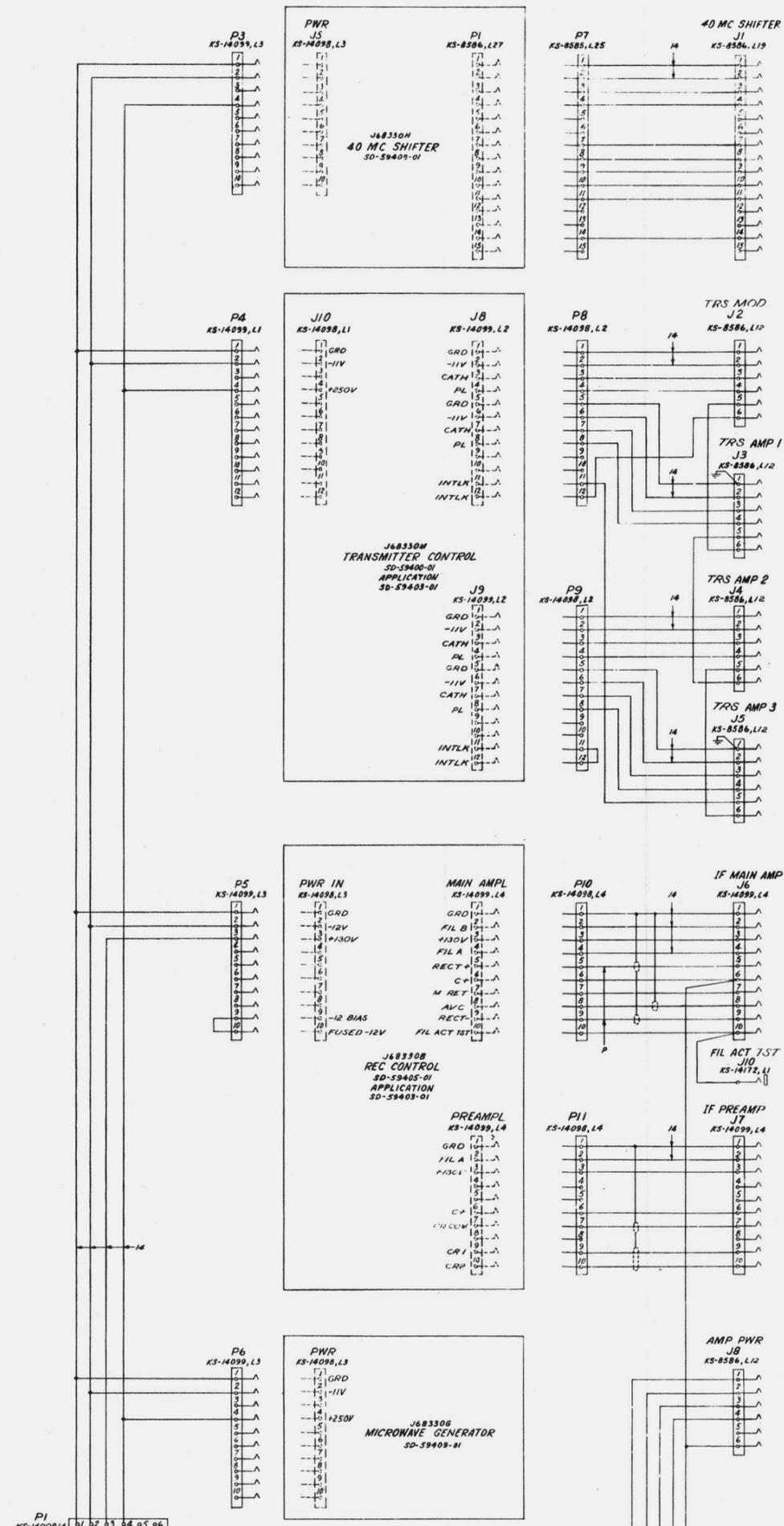
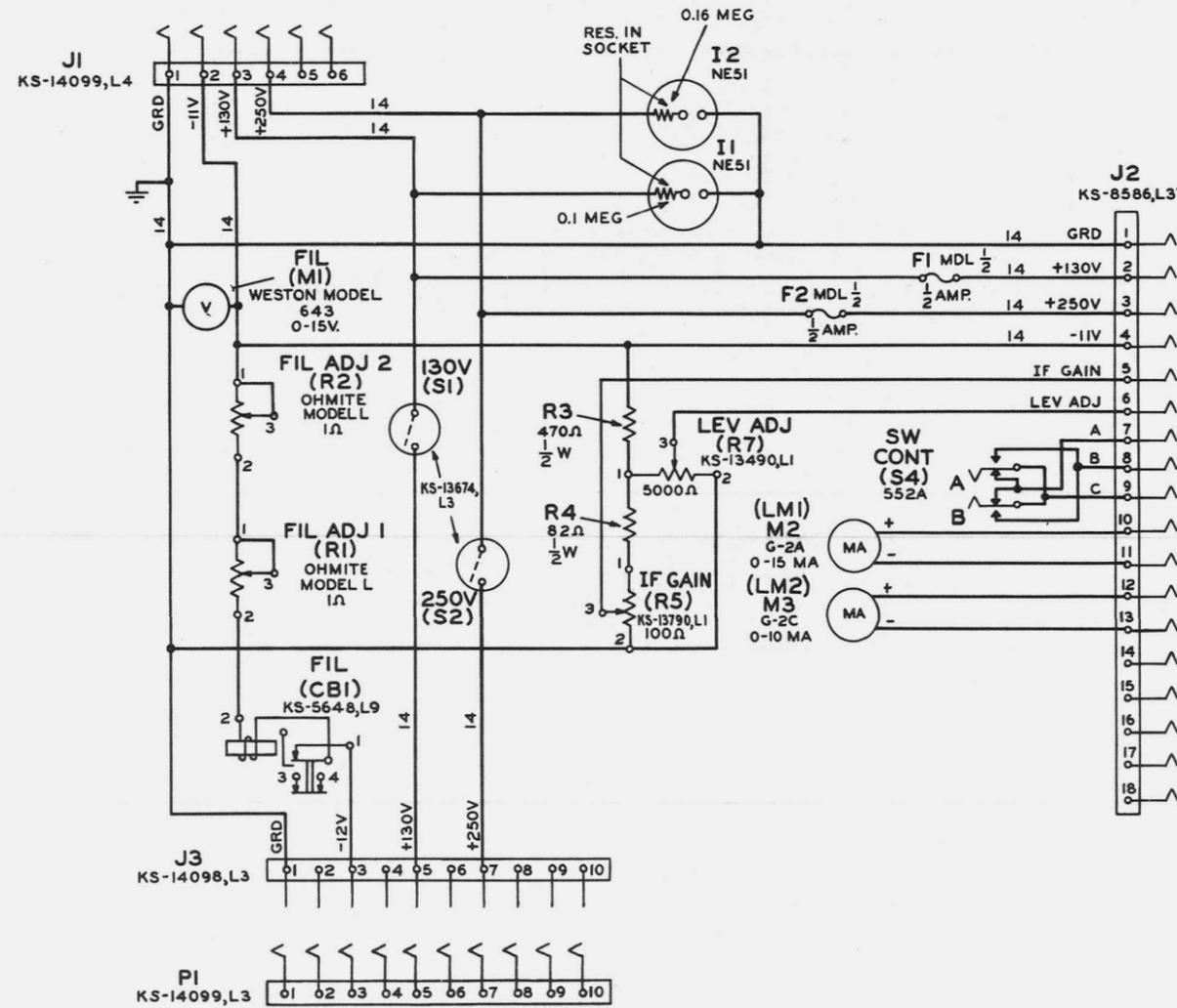


FIG. 2
TEST BENCH CONTROL CKT.

TR & RADIO
TEST BENCH
POWER DISTRIBUTION
CKT.
SD-59427-01
R3

DWG. ISS.	EE OR CD ISSUE	DATE ISSUED	APPROVED
1	1	7-27-49	G.N.T.
2-A	APP. 1-A	12-22-49	G.N.T.



⏚ CHASSIS GROUND

ED-63852-01
J68333E
EQUIPMENT INFO.

10-22452-01

SD-59429-01	AT&TCO STANDARD
TOLL SYSTEMS TD-2 RADIO TEST BENCH CONTROL CKT.	○
BELL TELEPHONE LABORATORIES, INC.	SD-59429-01
PRINTED IN U.S.A.	