

CHAPTER 2

OPERATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

8. Unpacking

a. Packaging Data. When packed for shipment, the tube tester is cushioned on all surfaces and placed within a water-resistant fiberboard box. The fiberboard box is sealed with water-resistant tape and placed within a wooden shipping box. Spare tubes, lamps, and fuses are placed in their designated positions within the tube tester (figs. 1 and 8). The technical manuals are packed within a close-fitting bag fabricated of waterproof wrapping paper. The bag is securely sealed with waterproof pressure-sensitive tape. The wooden shipping box is strapped only for intertheater shipment. A typical wooden shipping box and its contents are shown in figure 2.

- (1) The inside dimensions of a wooden shipping box that contains a tube tester is approximately $19\frac{1}{4}$ by $18\frac{1}{4}$ by $10\frac{5}{8}$ inches.
- (2) The outside volume of the tube tester packed in a wooden shipping box is 2.16 cubic feet, and weighs 60 pounds.

b. Removing Contents.

- (1) Cut and fold back the metal straps.
- (2) Remove the nails from the top with a nailpuller and remove the wooden top.
- (3) Do not attempt to pry off the top; prying may damage the equipment.
- (4) Remove the fiberboard box and cut through the three edges of the box and remove the contents.

9. Checking Unpacked Equipment

a. Check the equipment for any loss or damage that might have occurred during shipment. If the equipment has been damaged or is incomplete, refer to paragraph 2.

b. If the equipment has been used or reconditioned, see whether it has been changed by a Modification Work Order (MWO). If

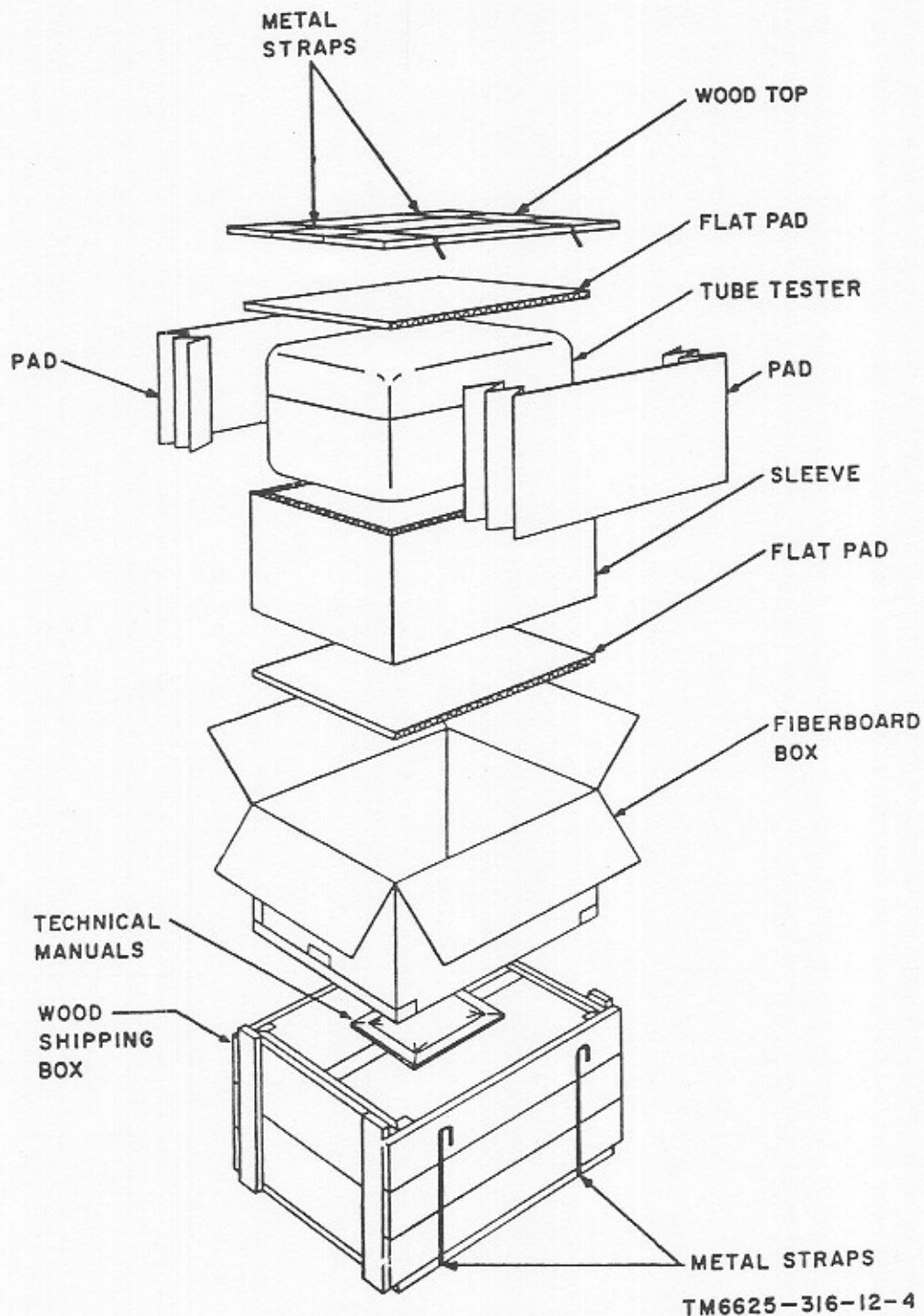


Figure 2. Typical packaging.

modified, the MWO number will appear on the front panel near the nomenclature plate.

c. Check the equipment against the packing list. When no packing list accompanies the equipment, use the table of components (par. 5a) and/or the basic issue items list (app. III) as a general check.

Section II. OPERATOR'S CONTROLS AND INDICATORS

10. Damage From Improper Settings

Improper setting of the FILAMENT RANGE switch (fig. 3) or incorrect operation of the PRESS TO TEST switches may damage the tube under test. Be sure that all the controls and switches are set properly before inserting the tube in the socket.

11. Operating Controls and Indicators

(fig. 3)

a. Controls.

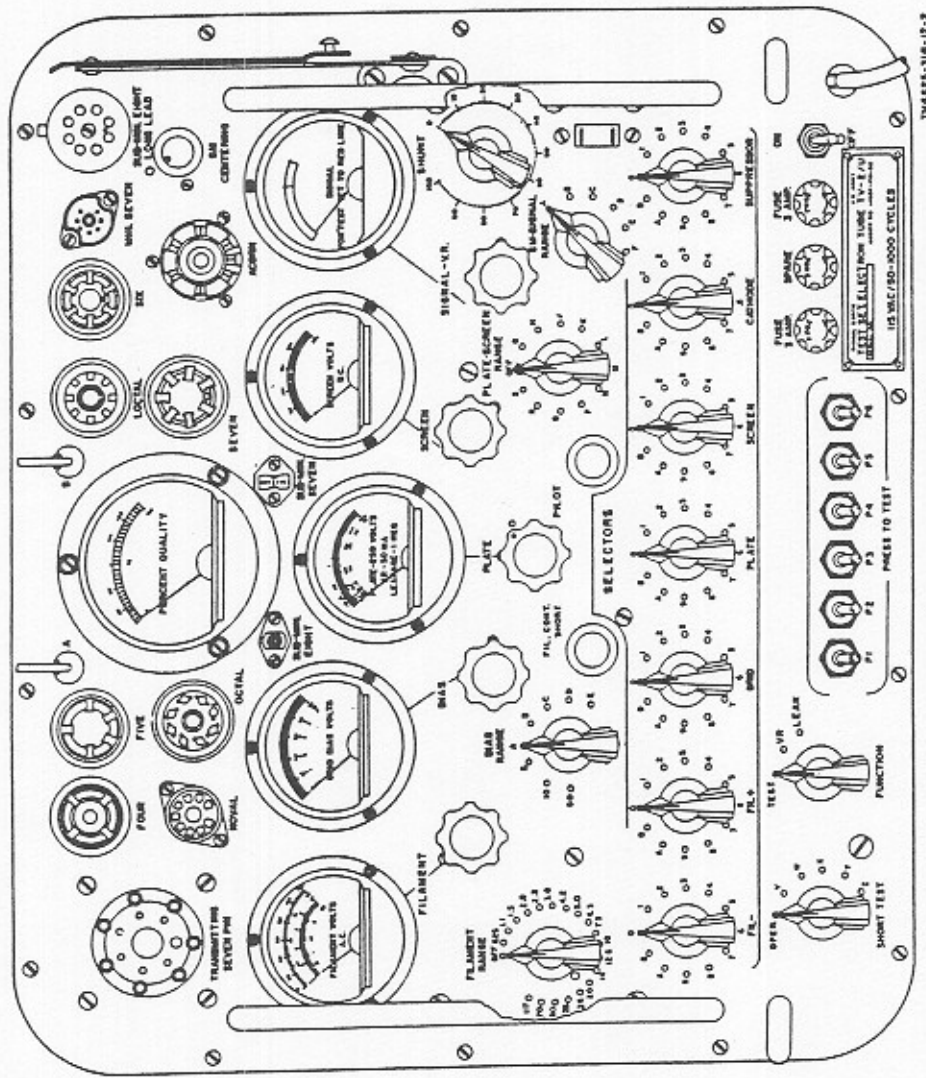
Control	Function								
ON-OFF switch ----- PRESS TO TEST (switches P1 through P6).	In ON position, applies ac power to unit. Depending on type of test selected, depressing one or more switches applies power to tube under test.								
SHORT TEST (6-position rotary switch).	In OPER. position, permits all tests except short test. By turning switch successively through positions V, W, X, Y, and Z, various tube electrodes are tested for interelement shorts.								
FUNCTION (3-position rotary switch). <i>Note.</i> On some equipments this switch is marked LEAKAGE VR.	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><i>Switch position</i></th> <th style="text-align: left; border-bottom: 1px solid black;"><i>Action</i></th> </tr> </thead> <tbody> <tr> <td>TEST-----</td> <td>Permits all types of tube tests except voltage regulator and leakage tests.</td> </tr> <tr> <td>VR-----</td> <td>Permits tests of thyratrons and voltage regulator tubes in conjunction with PRESS TO TEST P5 switch.</td> </tr> <tr> <td>LEAK-----</td> <td>Permits determining interelement leakage in megohms as indicated by PLATE meter.</td> </tr> </tbody> </table>	<i>Switch position</i>	<i>Action</i>	TEST-----	Permits all types of tube tests except voltage regulator and leakage tests.	VR-----	Permits tests of thyratrons and voltage regulator tubes in conjunction with PRESS TO TEST P5 switch.	LEAK-----	Permits determining interelement leakage in megohms as indicated by PLATE meter.
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VR-----	Permits tests of thyratrons and voltage regulator tubes in conjunction with PRESS TO TEST P5 switch.								
LEAK-----	Permits determining interelement leakage in megohms as indicated by PLATE meter.								
Seven SELECTORS switches: FIL— and FIL+ 12-position rotary switches.	Turning each of the filament switches to one of positions 1 to 9 connects filament voltage to correspondingly numbered base pin of tube under test. (0 is no connection.) Turning the switches to position A or B connects filament voltage to A or B electrical clip, respectively.								
GRID (12-position rotary switch) -	When set to one of positions 1 to 9, connects grid bias and signal voltage to correspondingly numbered base pin of tube under test. (0 is no connection.) In A or B, connects grid bias and signal voltage to A or B electrical clip.								

Control	Function						
PLATE (12-position rotary switch).	When set to one of positions 1 to 9, connects plate voltage to correspondingly numbered base pin of tube under test. (0 is no connection.) In position A or B, connects plate voltage to A or B electrical clip.						
SCREEN (12-position rotary switch).	When set to one of positions 1 to 9, connects screen voltage to correspondingly numbered base pin of tube under test. (0 is no connection.) In position A or B, connects screen voltage to A or B electrical clip.						
CATHODE (12-position rotary switch).	When set to one of positions 1 to 9, connects desired test circuit to cathode of tube under test through correspondingly numbered base pin or, in position A or B, connects through A or B electrical clip.						
SUPPRESSOR (12-position rotary switch).	When set to one of positions 1 to 9, connects desired test circuit to suppressor grid of tube under test through correspondingly numbered base pin or, in position A or B, through A or B electrical clip.						
FILAMENT RANGE (20-position rotary switch).	Selects proper filament voltage between OFF (0-volt) and 117 (117 volts ac).						
FILAMENT fine control -----	Permits fine adjustment of filament voltage applied to tube under test.						
BIAS RANGE (8-position rotary switch).	Selects 5, 10, or 50 volts fixed bias, or connects biasing resistors as required when in positions A, B, C, D, or E.						
BIAS fine control -----	Permits fine adjustment of bias voltage.						
PLATE-SCREEN RANGE (12-position rotary switch).	When in positions G, H, J, K, M, N, P, Q, R, or S, connects the proper plate and screen grid voltage to be used in the test circuit. (OFF is no connection.)						
PLATE fine control -----	Permits fine adjustment of plate voltage.						
SCREEN fine control -----	Permits fine adjustment of screen grid voltage.						
GM-SIGNAL RANGE (6-position rotary switch).	<table border="0"> <thead> <tr> <th><i>Switch position</i></th> <th><i>Action</i></th> </tr> </thead> <tbody> <tr> <td>A through E</td> <td>Connects proper ac signal voltage to grid of the tube under test.</td> </tr> <tr> <td>F</td> <td>Removes signal voltage from grid of tube under test to permit calibration of PERCENT QUALITY meter for</td> </tr> </tbody> </table>	<i>Switch position</i>	<i>Action</i>	A through E	Connects proper ac signal voltage to grid of the tube under test.	F	Removes signal voltage from grid of tube under test to permit calibration of PERCENT QUALITY meter for
<i>Switch position</i>	<i>Action</i>						
A through E	Connects proper ac signal voltage to grid of the tube under test.						
F	Removes signal voltage from grid of tube under test to permit calibration of PERCENT QUALITY meter for						

Control	Function
SIGNAL-VR control -----	<p><i>Switch position</i></p> <p><i>Action</i> performance of transconductance (GM) test.</p> <p>Permits accurate adjustment of ac signal level (indicated on the SIGNAL meter). In test of voltage-regulator tubes, permits adjustment of maximum and minimum currents through the tube (indicated on the PLATE meter).</p>
Quality SHUNT control -----	<p>When set to the position specified on the tube test data roll chart, shunts PERCENT QUALITY meter with proper resistance to perform quality (GM) test.</p>
GM CENTERING control -----	<p>With GM-SIGNAL RANGE switch in position F and the quality SHUNT control set in accordance with tube test data, permits zero calibration of the PERCENT QUALITY meter for transconductance (GM) test.</p>

b. Indicators.

Indicator	Function
PERCENT QUALITY meter ----	Indicates transconductance of amplifier tube under test.
FILAMENT VOLTS meter -----	Indicates ac filament voltage supplied to tube under test.
GRID BIAS VOLTS meter -----	Indicates grid-bias voltage supplied to tube under test.
PLATE meter -----	Indicates plate voltage supplied to tube under test.
SCREEN VOLTS meter -----	Indicates screen grid voltage supplied to tube under test.
SIGNAL meter -----	Indicates ac signal level supplied to tube under test.
PILOT lamp -----	Glow when tube tester is connected to ac power source and power ON-OFF switch is in ON position.
FIL. CONT. SHORT lamp -----	Glow to indicate short-circuited elements or filament continuity in tube under test.
<p><i>Note.</i> On some equipments this lamp is marked SHORT.</p>	



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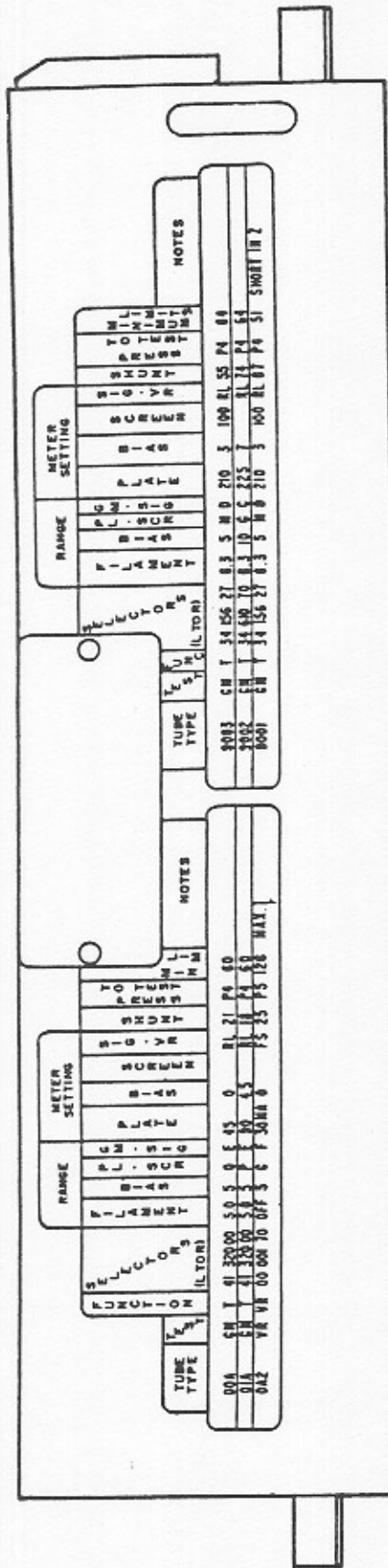
Figure 3. Test set, Electron Tube TV-2(*)/U, front panel.

12. Tube Test Data

Tube test data in roll chart form is mounted in a case inside the cover of Test Set, Electron Tube TV-2(*)/U (fig. 1). The tube test data roll chart has left- and right-hand sections. The tube types appear in ascending numerical and alphabetical order from top to bottom in the left-hand section and from bottom to top in the right-hand section. Designations on the tube test data roll chart housing (fig. 4), which appear in duplicate over both sections of the tube test data roll chart, indicate the tube type, the switches and controls of the tube tester in the order in which settings should be made, and the minimum acceptable percentage of rated transconductance as indicated on the PERCENT QUALITY meter. The information necessary to set the switches and controls for any tube type listed on the tube test data roll chart appear directly below these column headings.

Column	Description
TUBE TYPE -----	Tubes that can be tested on the TV-2(*)/U are listed in numerical and alphabetical order.
TEST -----	Indicates type of test to be performed, as follows: EM—Emission ER—Electron-ray indicator GM—Transconductance LK—Leakage TH—Thyratron VR—Voltage regulator
FUNCTION -----	Indicates setting of FUNCTION switch, as follows: L—Leakage T—Test VR—Voltage regulator
SELECTORS (L TO R) -----	Indicates setting of each selector switch, reading from left to right on the tube tester, as follows: FIL— FIL+ GRID PLATE SCREEN CATHODE SUPPRESSOR
RANGE -----	Indicates setting of range controls which correspond to following subcolumns: FILAMENT BIAS PL.-SCR GM.-SIG

Column	Description
METER SETTING -----	Indicates setting of meters, by adjusting associated fine controls, which correspond to the following subcolumns: PLATE BIAS SCREEN SIG-VR (set to redline (RL) or full scale (FS))
SHUNT -----	Indicates setting of SHUNT control.
PRESS TO TEST -----	Indicates which switch or switches, P1 through P6, should be pressed for the following tests: P1—Filament continuity and zeroing of PLATE ohmmeter for interelement leakage test. P2—Emission of diode tubes. P3—With P2 emission of multigrid tubes. P4—Transconductance. P5—Voltage regulator and thyratron tubes. P6—Gas test of amplifier tubes.
MIN LIM (left section) MINIMUM LIMITS (right section).	Indicates minimum numerical value as read on PERCENT QUALITY meter for tube under test or individual section of multipurpose tube under test.
NOTES -----	Gives special information or adjustments pertaining to tube under test.



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Figure 4. Tube test data roll chart, mounted in housing.

Section III. PRELIMINARY OPERATING PROCEDURES

13. Operating Precautions

(fig. 3)

a. Do not insert a tube into a test socket until the SELECTORS switches and the FILAMENT RANGE switch are properly adjusted (par. 16).

b. Return all controls to their safety positions (par. 15d) when the tube tester is turned off.

c. Do not prolong the testing of tubes with filaments that draw more than 3 amperes.

d. Inspect the bases of seven- and nine-pin miniature tubes for bent pins before inserting the tube into the test socket. If any pins are bent, straighten and align them by inserting the tube into the proper pin straightener (mounted on the inside of the cover of the tube tester (fig. 1)) and pressing the tube down firmly.

14. Tube Test Sockets and Test Adapters

After the controls on the tube tester have been set as directed in the tube test data roll chart (par. 12), place the tube to be tested in the proper tube test socket listed below.

a. *Tube Test Sockets* (fig. 3).

Tube test socket	Tube type tested
FOUR -----	Four-pin standard tubes.
FIVE -----	Five-pin standard tubes.
LOCTAL -----	Loctal base tubes.
SIX -----	Six-pin standard tubes.
MIN. SEVEN -----	Seven-pin miniature tubes.
SUB-MIN. EIGHT LONG LEAD -----	Eight-pin, long-lead subminiature tubes.
TRANSMITTING SEVEN PIN -----	Seven-pin transmitting tubes.
NOVAL -----	Nine-pin miniature tubes.
OCTAL -----	Octal base tubes.
SEVEN -----	Seven-pin standard tubes.
ACORN -----	Acorn tubes.
SUB-MIN. SEVEN -----	Seven-pin subminiature tubes.
SUB-MIN. EIGHT -----	Eight-pin subminiature tubes.

b. *Test Adapters*. A test adapter X13B (fig. 1) is included to provide a test socket for eight-pin, subminiature, long lead tubes. Three test adapters (fig. 5) (X3B (eight-pin octal), X7B (nine-pin noval), and X10B (seven-pin miniature)) are included with each TV-2B/U. The test adapters are installed in their corre-

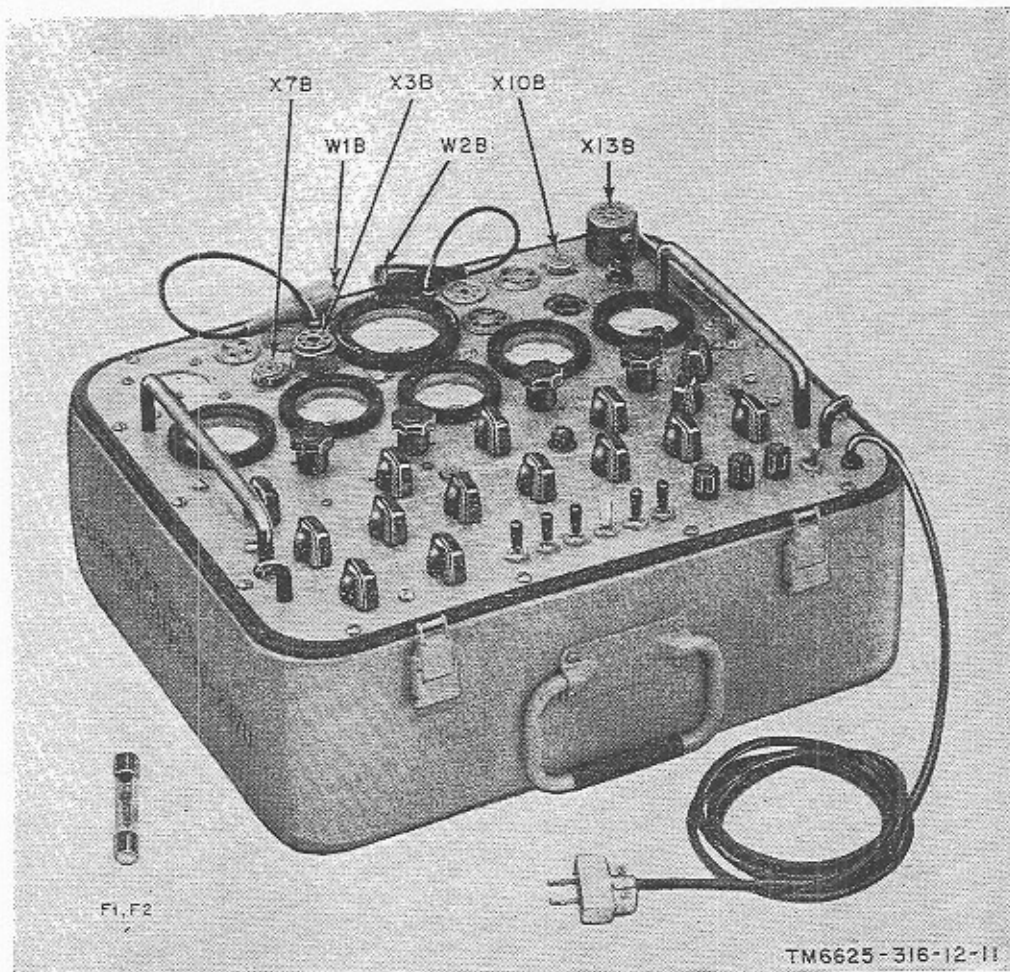


Figure 5. Panel of Test Set, Electron Tube TV-2B/U, showing location of test adapters (fuse also shown).

sponding sockets and receive the wear rather than the permanent socket. When worn so that satisfactory contact can no longer be made, the test adapters can be replaced without disconnecting the leads from their respective test socket.

15. Preliminary Starting Procedure

a. Check the voltage and frequency of the alternating current (ac) power source to be used for the operation of Test Set, Electron Tube TV-2(*)/U. The voltage must be between 103.5 and 126.5 volts ac and the frequency between 50 and 1,000 cycles per second (cps).

Cution: Never connect the TV-2(*)/U to a direct current (dc) power source.

- b. Release the latches and raise the cover of the tube tester.
- c. Remove the power cord plug from the dummy power cord

receptacle on the panel (fig. 1) and unwind the power cord from the brackets.

d. Check to see that all controls and switches are in their power cord safety positions as follows:

Switch or control	Safety position
ON-OFF -----	OFF.
SHORT TEST -----	OPER.
FUNCTION -----	TEST.
PRESS TO TEST P1, P2, P3, P4, P5, and P6.	Neutral
FIL— and FIL+ -----	0.
GRID -----	0.
PLATE -----	0.
SCREEN -----	0.
CATHODE -----	0.
SUPPRESSOR -----	0.
FILAMENT RANGE -----	OFF.
FILAMENT fine control -----	Extreme counterclockwise.
BIAS RANGE -----	50.
BIAS fine control -----	Extreme counterclockwise.
PLATE-SCREEN RANGE -----	OFF.
PLATE fine control -----	Extreme counterclockwise.
SCREEN fine control -----	Extreme counterclockwise.
SIGNAL-VR fine control -----	Extreme counterclockwise.
GM-SIGNAL RANGE -----	F.
SHUNT control -----	0.
GM CENTERING control -----	Midposition (as shown by alinement of dot on knob with that on panel).

e. Condensed operating instructions are mounted inside the cover of the tube tester (fig. 1). Revise the condensed operating instructions for GM TESTING to read as follows:

- (1) Perform all operations listed in I through IV.
- (2) Depress P4 and reset controls as shown on tube test data roll chart.
- (3) Release P4, set GM-SIGNAL RANGE control to F, and depress P4.
- (4) Set PERCENT QUALITY meter to 0 with GM CENTERING control.
- (5) Release P4 and return GM-SIGNAL RANGE control to tube test data roll chart listing.
- (6) Depress P4; if PERCENT QUALITY meter reading is above value in MIN LIM column, tube is good. Release P4.

f. Insert the power cord plug into the ac outlet.

Section IV. OPERATION UNDER USUAL CONDITIONS

16. Starting Procedure

Note. To start the equipment, first make sure the controls are set as required by the preliminary starting procedure (par. 15) and then perform procedures described in *a* through *i* below.

a. Locate the type number of the tube to be tested on the tube test data roll chart mounted inside the cover of the tube tester.

b. Set the seven SELECTORS switches to the positions given on the tube test data roll chart for the tube under test. Set the switches in the order in which they appear on the tube test data roll chart and on the tube tester panel, from left to right, starting with the FIL-SELECTORS switch on the left-hand side.

Note. The seven SELECTORS switches are interconnected electrically so that two different voltages cannot be applied to the same pin of the tube under test at the same time. Thus, by setting the SELECTORS switches in the order in which the switches are arranged on the panel, short circuits are avoided.

c. Set the FILAMENT RANGE switch to the position indicated on the tube test data roll chart.

d. Insert the tube to be tested into the proper test socket.

Caution: Be careful when inserting and removing loctal, acorn, and subminiature tubes from their sockets. Excessive force will crack the glass seals at the bases of the pins. Exert slight pressure to one side to release the lock of the LOCTAL socket. Use the pin straighteners mounted on the tube test data roll chart housing to straighten bent pins of seven- and nine-pin miniature tubes.

e. If the tube to be tested has a top cap, attach the A or B electrical clip. Directions as to which clip to use are given in the NOTES column on the tube test data roll chart unless the NOTES column is required for other data. In addition, one of the SELECTORS switches will indicate an A or B position. If the A position is designated, use the A clip; if the B position is designated, use the B clip.

f. Set the ON-OFF switch to the ON position. The PILOT lamp should glow. Allow at least 1 minute warmup time.

g. Adjust the FILAMENT fine control until the FILAMENT VOLTS meter pointer indicates the exact filament voltages specified in the RANGE column of the tube test data roll chart, unless there is a note to the contrary. In the case of a filament voltage of 0.625, 6.3, 12.6, or 117 volts, adjust the control until the meter pointer is on the red calibration line on the appropriate scale.

h. If the line voltage is low, it may not be possible to adjust the FILAMENT fine control to indicate the specified filament voltage. When this condition exists, turn the FILAMENT

RANGE switch to the next higher position, and then adjust the control until the correct voltage is indicated on the meter.

i. If the line voltage is high and it is not possible to adjust the FILAMENT fine control to indicate the specified voltage, turn the FILAMENT RANGE switch to the next lower position, and then adjust the control until the correct voltage is indicated on the meter.

17. Zero Adjustment of PERCENT QUALITY Meter

When the procedures in paragraph 16 have been completed, adjust the PERCENT QUALITY meter to zero. This adjustment should be made before testing any tube for transconductance (GM) as follows:

- a. Turn the GM-SIGNAL RANGE switch to the F position.
- b. Depress the PRESS TO TEST P4 switch to its locking position. Reset the controls to give the exact meter readings specified in the METER SETTING columns of the tube test data roll chart.
- c. Adjust the GM CENTERING control until the pointer of the PERCENT QUALITY meter is set exactly to zero on the scale.
- d. Release the P4 switch.

18. Short Test

- a. Perform the operations described in paragraphs 15 and 16.
- b. For the TV-2/U, align the dot on the PLATE fine control with the dot on the panel. For TV-2A/U and TV-2B/U, align the PLATE fine control pointer-type knob with the line index marking on the panel. This assures that the correct voltage will be applied to the short test circuit.
- c. Turn the SHORT TEST switch slowly from the OPER. position to V, W, X, Y, and Z, and back to OPER.; at the same time, tap the tube with a finger and watch the FIL. CONT. SHORT indicator lamp.

Caution: Do not tap the tubes listed below when testing for short-circuited elements. Tapping may damage the tube.

1A5GT	1LH4
1A7GT	1LN5
1C5GT	1P5GT
1G4GT	1Q5QT
1G6GT	1S4
1H5GT	1S5
1L4	1T4
1LA4	1T5GT
1LA6	1U4
1LB4	1U5
1LD5	3A4
1LE3	3A5

3A6GT
3B7
3D6
3LF4

3Q4
3Q5QT
3S4
3V4

d. If the lamp burns continuously or glows during tapping in any one of the five positions of the SHORT TEST switch, the tube contains short-circuited electrodes. Discard the tube unless an exception is noted on the tube test data roll chart.

e. Disregard a momentary flash of the FIL. CONT. SHORT indicator lamp while the SHORT TEST switch is being moved from one position to the next. This flashing usually is caused by the charging of a capacitor in the test circuit.

Note. Some tubes *normally* test as shorted when the SHORT TEST switch is in certain positions. Before discarding a tube that shows a short, check the tube test data roll chart NOTES column for information on normal short indications.

f. When the test is completed, set the ON-OFF switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15d).

19. Interelement Leakage Test

Follow the test procedure in *a* through *e* below to determine the interelement leakage (LK) in megohms between electrodes of the tube under test.

a. Perform the operations described in paragraphs 15 and 16.

b. Operate the FUNCTION switch to the LEAK position. This position connects the PLATE meter into the circuit to serve as an ohmmeter for this test only.

c. Set the ohmmeter (PLATE meter) to zero as follows:

- (1) Operate the SHORT TEST switch to the V position.
- (2) Turn the PLATE fine control to its maximum counter-clockwise position.
- (3) Depress the PRESS TO TEST P1 switch.
- (4) With the P1 switch held in its depressed position, adjust the PLATE fine control until the pointer of the PLATE meter indicates zero (250 on center scale) on the ohmmeter (top) scale.
- (5) Release the P1 switch.

d. Operate the SHORT TEST switch slowly from the OPER. position to positions V, W, X, Y, and Z; at the same time, watch for a deflection of the PLATE meter pointer.

- (1) An open circuit or infinite leakage between elements will produce no deflection of the PLATE meter pointer.
- (2) A short circuit between two elements will produce a full-scale deflection of the PLATE meter pointer.

Note. Where the NOTES column indicates a short circuit, full-scale deflection will appear at those settings.

- (3) Read intermediate leakage values on the resistance scale of the PLATE meter. The amount of leakage is indicated in megohms.

e. When the test is completed, set the ON-OFF switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15*d*).

20. Filament Continuity Test

a. Perform the operations in paragraphs 15 and 16.

b. If the filament continuity test is the only test to be made, set only the FIL— and the FIL+ SELECTORS switches as indicated in the tube test data roll chart. Leave the remaining SELECTORS switches in their safety positions (par. 15*d*).

c. Operate the SHORT TEST switch to the V position. For the TV-2/U, align the dot on the PLATE fine control with the dot on the panel. For the TV-2A/U, and TV-2B/U, align the line marking on the PLATE fine control with the line marking on the panel.

d. Depress the PRESS TO TEST P1 switch.

- (1) If the FIL. CONT. SHORT lamp glows, the filament is good.
- (2) If the FIL. CONT. SHORT lamp does not glow, the filament is open. Discard the tube.

Note. Occasionally a filament will show continuity when cold, but will open when it warms up. If this condition is suspected, set the FILAMENT RANGE switch to the normal voltage for the tube under test, let the tube warm up for several minutes, and repeat the test.

21. Transconductance Test

a. Perform the operations described in paragraphs 15 and 16.

b. Operate the FUNCTION switch to the TEST position.

c. Operate the PLATE-SCREEN RANGE switch to the position specified on the tube test data roll chart.

Warning: Do not touch the top cap of a tube under test after plate voltage has been applied.

d. Adjust the PLATE and SCREEN fine controls until the PLATE and SCREEN VOLTS meters indicate the exact voltages specified on the tube test data roll chart. Red calibration marks on both meters facilitate this adjustment.

e. Set the BIAS RANGE switch to the voltage or position specified on the tube test data roll chart.

f. Adjust the BIAS fine control until the GRID BIAS VOLTS meter indicates the exact grid-bias voltage specified on the chart.

g. If the bias voltage indication is over 80 percent of full scale at a low plate voltage setting, it may be difficult to obtain the required bias voltage. In such a case, use the next higher setting of the BIAS RANGE switch.

h. Operate the quality SHUNT control to the number given on the tube test data roll chart.

i. Adjust the PERCENT QUALITY meter to zero (par. 17).

j. Operate the GM-SIGNAL RANGE switch to the position specified for the quality test.

k. Adjust the SIGNAL-V.R. fine control until the pointer of the SIGNAL meter is on the red line.

l. Depress the PRESS TO TEST P4 switch to its locking position.

m. Read the percent quality for the tube under test on the PERCENT QUALITY meter.

(1) If the reading is below the minimum limit indicated on the tube test data roll chart, discard the tube.

(2) If the reading borders on the minimum limit, the tube may be usable but should be replaced soon.

(3) If the PERCENT QUALITY meter indication is beyond full scale, the tube may be gassy. Perform the gas test (par. 22).

n. Release the P4 switch.

Note. A multisection tube may be listed several times on the tube test data roll chart. If this is the case, reset the SELECTORS switches for each listing in the tube test data roll chart. Repeat the short test and the transconductance test for each new setting.

o. When a test is completed, set the ON-OFF switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15d).

22. Gas Test

Use the following procedures to determine whether an amplifier

tube contains excessive gas. When testing a multisection tube, make the gas test on an amplifier section; it does not apply to diode sections or to rectifiers.

a. Perform the operations in paragraphs 15 and 16.

b. Operate the FUNCTION switch to the TEST position.

c. Operate the PLATE-SCREEN RANGE switch to the position specified on the tube test data roll chart.

Warning: Do not touch the top cap of a tube under test after plate voltage has been applied.

d. Adjust the PLATE and SCREEN fine controls until the PLATE and SCREEN VOLTS meters indicate the exact voltages specified on the tube test data roll chart. Red calibration marks on the scales of both meters facilitate this adjustment.

e. Operate the BIAS RANGE switch to the voltage or position specified on the tube test data roll chart.

f. Adjust the BIAS fine control until the GRID BIAS VOLTS meter indicates the specified voltage.

g. Set the quality SHUNT control to the number given on the tube test data roll chart, and adjust the PERCENT QUALITY meter to zero (par. 17).

h. Operate the GM-SIGNAL RANGE switch to the position specified for the quality test.

i. Adjust the SIGNAL-V.R. fine control until the pointer of the SIGNAL VOLTS meter is on the red line.

j. Depress the PRESS TO TEST P4 switch to its locking position.

k. Depress and hold down the PRESS TO TEST P6 switch. Depressing the P6 switch may cause the PERCENT QUALITY meter pointer to move upward or downward on the scale. If the pointer moves more than three scale divisions in either direction, the tube contains too much gas for satisfactory operation.

Note. Some tubes develop gas after they have been in operation for a period of time. When this is suspected to be the case, let the tube remain under test with operating potentials applied for several minutes before making the gas test.

l. When the test is completed, set the ON-OFF switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15d).

23. Emission Test

Use the following procedure to test the emission (EM) of rectifier tubes, diode detectors, and multielement tubes.

- a. Perform the operations described in paragraphs 15 and 16.
- b. Operate the FUNCTION switch to the TEST position.
- c. Set the PLATE-SCREEN RANGE switch to the position specified on the tube test data roll chart.
- d. Adjust the PLATE fine control until the PLATE meter indicates the exact voltage specified on the tube test data roll chart. Red calibration marks on the meter scales facilitate this adjustment.
- e. Operate the quality SHUNT control to the number specified on the tube test data roll chart.
- f. Operate the GM-SIGNAL RANGE switch to the position noted on the tube test data roll chart.
- g. For the TV-2/U, align the dot on the knob of the GM CENTERING control with the dot on the panel. For the TV-2A/U and TV-2B/U, align the line marking on the GM CENTERING knob with the line marking on the panel.
- h. If the tube under test is a diode, hold down the PRESS TO TEST P2 switch. If the tube under test is a multigrid tube, hold down *both* the P2 and P3 switches.
- i. Read the PERCENT QUALITY meter. If the indication is below the minimum limit given on the tube test data roll chart, discard the tube. Tubes that border on the minimum limit may be usable but should be replaced soon.

Note. When testing some diodes, the PERCENT QUALITY meter will deflect off scale. This is a normal condition when the emission of the tube is far in excess of that required by tube specifications. If the need for balancing such a diode is present, reduce the setting of the quality SHUNT control until the PERCENT QUALITY meter reads 100. Observe the new shunt setting and use this setting to compare diodes of the same type.

- j. When the test is completed, set the ON-OFF switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15d).

24. Voltage Regulator and Gas Rectifier Test

Use the following procedure to test the voltage regulator (VR) and gas rectifier tubes under minimum and maximum load conditions. The regulating ability of the tube is computed from the test results. For testing thyratron tubes, refer to paragraph 26.

- a. Perform the operations described in paragraphs 15 and 16. Set the FILAMENT RANGE and BIAS RANGE switches to the positions indicated in the tube test data roll chart.
- b. Set the PLATE-SCREEN RANGE switch to the position specified on the tube test data roll chart.

c. Set the quality SHUNT control to the number specified on the tube test data roll chart.

d. Set the FUNCTION switch to the VR position.

e. Turn the SIGNAL-V.R. and the BIAS fine controls to their extreme counterclockwise (zero) positions.

f. Depress and hold down the PRESS TO TEST P5 switch. Note the current through the tube as indicated on the PLATE meter and note the reading of the PERCENT QUALITY meter.

g. With the P5 switch held in its operated position, adjust the SIGNAL-V.R., PLATE, and SCREEN fine controls until the VR-50 MA scale of the PLATE meter indicates the minimum load current through the tube as specified on the tube test data roll chart. Note the reading of the PERCENT QUALITY meter.

h. With the PRESS TO TEST P5 switch still held in its operated position, adjust the SIGNAL-V.R. fine control until the VR-50 MA scale of the PLATE meter indicates the maximum load current specified on the chart. Note the reading of the PERCENT QUALITY meter.

i. Determine the regulating ability of a tube by taking the difference between the maximum and minimum load currents through the tube as read on the PERCENT QUALITY meter. If the difference between the two readings is greater than the maximum difference indicated on the tube test data roll chart, discard the tube.

Note. A quality SHUNT control setting of 50 is specified for many voltage regulator tubes. When so specified, the reading on the PERCENT QUALITY meter indicates directly the voltage drop across the tube under test. The difference between the voltage drop at minimum and maximum load currents as read on the PERCENT QUALITY meter then is equal to the regulating ability of the tube in *volts*.

j. When the test is completed, set the ON-OFF power switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15d).

25. Procedure for Reading Plate Current (Less Than 50 Milliamperes) of Triode Tubes

a. Perform the operations indicated in paragraphs 15 and 16.

b. Set all SELECTORS switches as indicated on the tube test data roll chart with the exception of the PLATE and SCREEN SELECTORS switches.

c. Set the PLATE selector switch to the 0 position.

d. Set the SCREEN SELECTORS switch to the position design-

nated for the PLATE SELECTORS switch on the tube test data roll chart.

e. Set the GM-SIGNAL RANGE switch to the F position.

f. Adjust the SCREEN fine control until the voltage specified on the tube test data roll chart for the PLATE meter is indicated on the SCREEN VOLTS meter.

Note. It may be necessary to set the PLATE-SCREEN RANGE switch to a new setting, moving the switch in a counterclockwise direction, so that the SCREEN VOLTS meter can indicate the voltage specified for the PLATE meter.

g. Adjust all other fine controls as required on the tube test data roll chart for the tube under test.

h. Turn the SIGNAL-V.R. fine control to its maximum counterclockwise position.

i. Set the FUNCTION switch to the VR position.

j. Set the quality SHUNT control to 0.

k. Depress the PRESS TO TEST P5 switch. Be sure the proper voltages for the tube being tested appear on all other meters. Note the reading on the 0- to 50-milliamper (ma) scale on the PLATE meter.

l. Release the PRESS TO TEST P5 switch.

m. When the test is completed, set the ON-OFF power switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15d).

26. Thyatron Test

Use the following procedure to determine the *firing potential* of thyatron (TH) tubes. Thyatrons are also called gas triodes or grid glow tubes. The firing potential may be defined as the grid voltage at which the tube begins to conduct.

a. Perform the operations indicated in paragraphs 15 and 18.

b. Set the FUNCTION switch to the VR position.

c. Set the PLATE-SCREEN RANGE switch to the position specified on the tube test data roll chart.

d. Set the quality SHUNT control to the number specified on the tube test data roll chart.

e. Set the SIGNAL-V.R. fine control to its extreme clockwise (maximum) position.

f. Depress and hold down the PRESS TO TEST P5 switch. Note the current through the tube as indicated on the PLATE meter, and note the reading of the PERCENT QUALITY meter.

g. Adjust the SCREEN fine control until the SCREEN VOLTS meter indicates the voltage specified on the tube test data roll chart (par. 12).

h. Set the BIAS fine control to its extreme clockwise (maximum) position.

i. With the PRESS TO TEST P5 switch held in its operated position, gradually reduce the bias voltage by adjusting the BIAS fine control until the tube strikes its firing potential. The firing potential is indicated by a sudden increase in load current shown on the PLATE meter and by a sudden decrease on the PERCENT QUALITY meter.

Note. The tube will not conduct (as indicated by an increase in load current shown by the PLATE meter) until the critical grid-bias voltage is reached. For example, for a type 2D21W or type 2050W tube, the bias voltage at which conduction occurs should be between 1.5 and 3.0 volts.

j. The voltage at which the tube strikes is read on the GRID BIAS VOLTS meter. Record the grid voltage at the instant and at the point that the pointer starts to deflect. This is the striking voltage of the tube under test. Repeat the test to confirm the reading. Minimum limits for striking voltages of thyratrons are given on the tube test data roll chart.

k. When the test is completed, set the ON-OFF power switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15*d*).

27. Electron-Ray Indicator Test

There are two types of electron-ray (ER) indicator tubes that can be tested with the TV-2(*)/U. Type 6U5 and similar tubes have a triode section and a single indicator (one shadow). Type 6AF6 and similar tubes have no triode section, but have twin indicators (dual shadow). Follow the procedure below to check the opening and closing action of the eyes only. Indicators with triode sections also must be tested for emission (*i* below).

a. Perform the operations indicated in paragraphs 15 and 16.

b. Operate the FUNCTION switch to the TEST position.

c. Operate the PLATE-SCREEN RANGE switch to the position specified on the tube test data roll chart.

d. Adjust the PLATE and SCREEN fine controls until the exact voltages specified on the tube test data roll chart are indicated on the corresponding meters.

e. Depress the PRESS TO TEST P4 switch. If the tube is a single indicator, the indicator should be closed; if the tube is a twin-indicator tube, such as the 6AD6 or 6AF6, indicator No. 1 should be closed and indicator No. 2 should be open.

- f.* Release the PRESS TO TEST P4 switch.
- g.* For twin-indicator tubes, operate the SCREEN and SUPPRESSOR SELECTORS switches to the positions specified in the second line of the tube test data roll chart.
- h.* Again depress the PRESS TO TEST P4 switch. If the tube is good, the indicator now should be open, or, in the case of twin-indicator tubes, indicator No. 1 should be open and indicator No. 2 should be closed.
- i.* Perform an emission test on the triode of electron-ray indicators with triode sections, such as 6U5 (par. 23). The control settings for the emission test are specified in the third entry of the same tube on the tube test data roll chart (par. 12).

28. Ballast Tube Test

Test ballast tubes as follows:

- a.* Perform the operations indicated in paragraph 15.
- b.* Operate the FIL-SELECTORS switch to the position specified in the tube test data roll chart for the tube under test. All other switches and controls should be in their safety positions (par. 15*d*).
- c.* Insert the ballast tube into the appropriate socket.
- d.* Turn the ON-OFF power switch to the ON position.
- e.* Turn the SHORT TEST switch to the V position.
- f.* Depress and hold down the PRESS TO TEST P1 switch. Operate the FIL+ SELECTORS switch to each of the positions specified in the tube test data roll chart. The FIL.-CONT. SHORT lamp should glow in every position noted. If it does not, discard the ballast tube.
- g.* Repeat the procedures indicated in *b* through *f* above for each listing of the tube.

29. Indicator Lamp Test

To check an indicator lamp or other lamps with miniature bayonet or screw-type bases, proceed as follows:

- a.* OPERATE THE FIL- SELECTORS switch to position 2.
- b.* Operate the FIL+ SELECTORS switch to position 7.
- c.* Operate the FILAMENT RANGE switch to the correct voltage for the lamp under test. This voltage usually is marked on the lamp base.
- d.* Operate the ON-OFF power switch to the ON position.
- e.* Adjust the FILAMENT fine control until the FILAMENT VOLTS meter indicates the exact voltage specified for the lamp.

f. Insert and hold the lamp in the center of the SEVEN socket. If the lamp is good, it will light with normal brilliancy.

Caution: Do not test glowlamps with the TV-2(*)/U unless these lamps are supplied with a current-limiting series resistor.

g. When the test is completed, operate the ON-OFF power switch to the OFF position and return the FIL— and FIL+ SELECTORS switches, the FILAMENT RANGE switch, and the FILAMENT fine control to their safety positions (par. 15d).

30. Complete Tube Test

As an example of a complete tube test, assume a 6SQ7 tube is to be tested. The 6SQ7 tube is a twin-diode high-mu triode used as a combined detector, amplifier, and automatic voltage control tube in radio receivers. It has an eight-pin octal base. Rotate the tube test data roll chart until the 6SQ7 appears in the TUBE TYPE column in the left-hand window of the tube test data roll chart housing. In addition to tests for short circuits, interelement leakage, and filament continuity, note that this tube must be tested *three* times: to test the transconductance of the triode section, to measure the emission of diode No. 1, and to measure the emission of diode No. 2. In addition, the gas content of the tube must be checked.

a. *Preparation.* Adjust the tube test data roll chart so the first line on which 6SQ7 appears is in the center of the window between the horizontal red lines. Refer to the column headings marked on the tube test data roll chart housing and proceed as follows:

- (1) Perform the operations described in paragraph 15.
- (2) Set the FUNCTION switch to TEST (T).
- (3) Set the SELECTORS switches to the positions indicated in the SELECTORS (L TO R) column on the tube test data roll chart and in the order indicated:
 - (a) FIL— to 7.
 - (b) FIL+ to 8.
 - (c) GRID to 2.
 - (d) PLATE to 6.
 - (e) SCREEN to 0.
 - (f) CATHODE to 3.
 - (g) SUPPRESSOR to 0.
- (4) Set the FILAMENT RANGE switch to the 6.3 position.
- (5) Insert the 6SQ7 tube into the OCTAL test socket.
- (6) Set the ON-OFF switch to the ON position and allow a 1-minute warmup.

- (7) Adjust the FILAMENT fine control until the FILAMENT VOLTS meter needle indicates 6.3 volts.

b. *Short Test.* To perform the short test (par. 18) on the 6SQ7 tube, proceed as follows:

- (1) For the TV-2/U, align the dot on the PLATE fine control with the dot on the panel. For the TV-2A/U and TV-2B/U, align the PLATE fine control pointer-type knob with the line index marking on the panel.
- (2) Turn the SHORT TEST switch slowly from the OPER. position to V, W, X, Y, and Z, and back to OPER.; at the same time, tap the tube with a finger and watch the FIL. CONT. SHORT indicator lamp.
- (3) If the lamp glows continuously or glows during tapping in any of the five positions of the SHORT TEST switch, the tube contains a short circuit. Discard the tube. If there is no short circuit, proceed with the next test.

c. *Interelement Leakage Test.* To perform the test for interelement leakage (par. 19) on the 6SQ7 tube, proceed as follows:

- (1) Set the FUNCTION switch to the LEAK position.
- (2) Set the PLATE meter, which is functioning as an ohmmeter for this test, to zero (par. 19c).
- (3) Turn the SHORT TEST switch slowly from the OPER. position to V, W, X, Y, and Z; at the same time watch for a deflection of the PLATE meter pointer.
- (4) An open circuit or zero leakage between elements will produce no deflection of the PLATE meter pointer. A short circuit between elements will produce a full-scale deflection of the pointer. Read intermediate values on the resistance scale of the PLATE meter. If there is no leakage, proceed with the next test.
- (5) Set the FUNCTION switch to the TEST position.

d. *Filament Continuity Test.* Proceed as outlined below to determine whether the filament of the 6SQ7 tube is open (par. 20). The FIL— and FIL+ SELECTORS switches are set as indicated in the tube test data roll chart, at 7 and 8, respectively.

- (1) Set the SHORT TEST switch to the V position.
- (2) Depress the PRESS TO TEST P1 switch.
- (3) If the FIL. CONT. SHORT lamp glows, the filament is good. If the lamp does not glow, the filament is open. Discard the tube. If the filament is good, however, proceed to test the transconductance of the triode section.
- (4) Set the SHORT TEST switch to OPER.

e. Measurement of Transconductance. To test the transconductance of the triode section of the 6SQ7 tube, proceed as outlined below. The FUNCTION switch and all SELECTORS switches are set as in *a* (2) through (7) above.

- (1) Set the PLATE-SCREEN RANGE switch to the J position.
- (2) Adjust the PLATE fine control until the PLATE meter indicates 225 volts.
- (3) Set the BIAS RANGE switch to the 5 position.
- (4) Adjust the BIAS fine control until the GRID BIAS VOLTS meter indicates 2 volts.
- (5) Turn the SHUNT control to 90.
- (6) Adjust the PERCENT QUALITY meter to zero (par. 17).
- (7) Set the GM-SIGNAL RANGE switch to D.
- (8) Adjust the SIGNAL-V.R. control until the SIGNAL meter pointer is on the red line.
- (9) Depress the PRESS TO TEST P2 switch to its locking position. Read the percent quality of the 6SQ7 tube on the PERCENT QUALITY meter. If the reading is below the minimum limit of 25, discard the tube; if it borders on 25, the tube may be used but should be replaced soon. If the meter pointer is beyond full scale, test the tube for gas.

f. Test for Excessive Gas. To test the tube for gas, proceed as outlined below. The FUNCTION switch and all SELECTORS switches and range switches are set as in *e* above, and the FILAMENT VOLTS meter indicates 6.3 volts.

- (1) Depress the PRESS TO TEST P2 switch to its locking position.
- (2) Depress and hold down the PRESS TO TEST P6 switch. If the pointer of the PERCENT QUALITY meter remains at 25 or near 25, the tube does not contain excessive gas. If the pointer moves more than three scale divisions in either direction, however, the tube contains too much gas for satisfactory operation.

g. Measurement of Emission (Diode No. 1). To measure the emission of diode No. 1, adjust the tube test data roll chart so the second line on which the 6SQ7 tube appears is between the horizontal red lines. The FUNCTION switch, all SELECTORS switches except the PLATE switch, and the PLATE-SCREEN

RANGE switch are set as in *a*(2) through (4) above, and the FILAMENT VOLTS meter indicates 6.3 volts.

- (1) Set the PLATE switch to the 5 position.
- (2) Set the PLATE-SCREEN RANGE switch to the S position.
- (3) Adjust the PLATE fine control until the PLATE meter indicates 20 volts ac.
- (4) Turn the quality SHUNT control to 90.
- (5) Set the GM-SIGNAL RANGE switch to the A position.
- (6) For the TV-2/U, align the dot on the knob of the GM CENTERING control with the dot on the panel. For the TV-2A/U and TV-2B/U, align the line marking on the GM CENTERING control with the line marking on the panel.
- (7) Depress the PRESS TO TEST P2 switch and read the PERCENT QUALITY meter. If the indication is less than the minimum limit of 25, discard the tube. If the indication is satisfactory, measure the emission of diode No. 2.

h. Measurement of Emission (Diode No. 2). To measure the emission of diode No. 2, adjust the tube test data roll chart so the third line on which the 6SQ7 tube appears is between the horizontal red lines. The FUNCTION switch, all SELECTORS switches except the PLATE switch are set as in *g* above, and the FILAMENT VOLTS meter indicates 6.3 volts.

- (1) Set the PLATE switch to the 4 position.
- (2) With the PLATE-SCREEN RANGE switch on S, adjust the PLATE fine control until the PLATE meter indicates 20 volts ac.
- (3) The quality SHUNT control remains on 90.
- (4) The GM-SIGNAL RANGE switch remains on S.
- (5) For the TV-2/U, align the dot on the knob of the GM CENTERING control with the dot on the panel. For the TV-2A/U and TV-2B/U, align the line marking on the GM CENTERING control with the line marking on the panel.
- (6) Depress the PRESS TO TEST P2 switch and read the PERCENT QUALITY meter. If the indication is less than the minimum of 25, discard the tube. If the indication is satisfactory, the tube is good.

31. Stopping Procedure

- a.* Set the ON-OFF switch to the OFF position.
- b.* Remove the tube from the test socket.
- c.* Return all controls to their safety positions (par. 15*d*).
- d.* Remove the power cord from the power source, wind the power cord around the brackets on the panel, and insert the plug into the dummy power cord receptacle (fig. 1). Close the cover of the case, and latch the luggage-type fasteners.