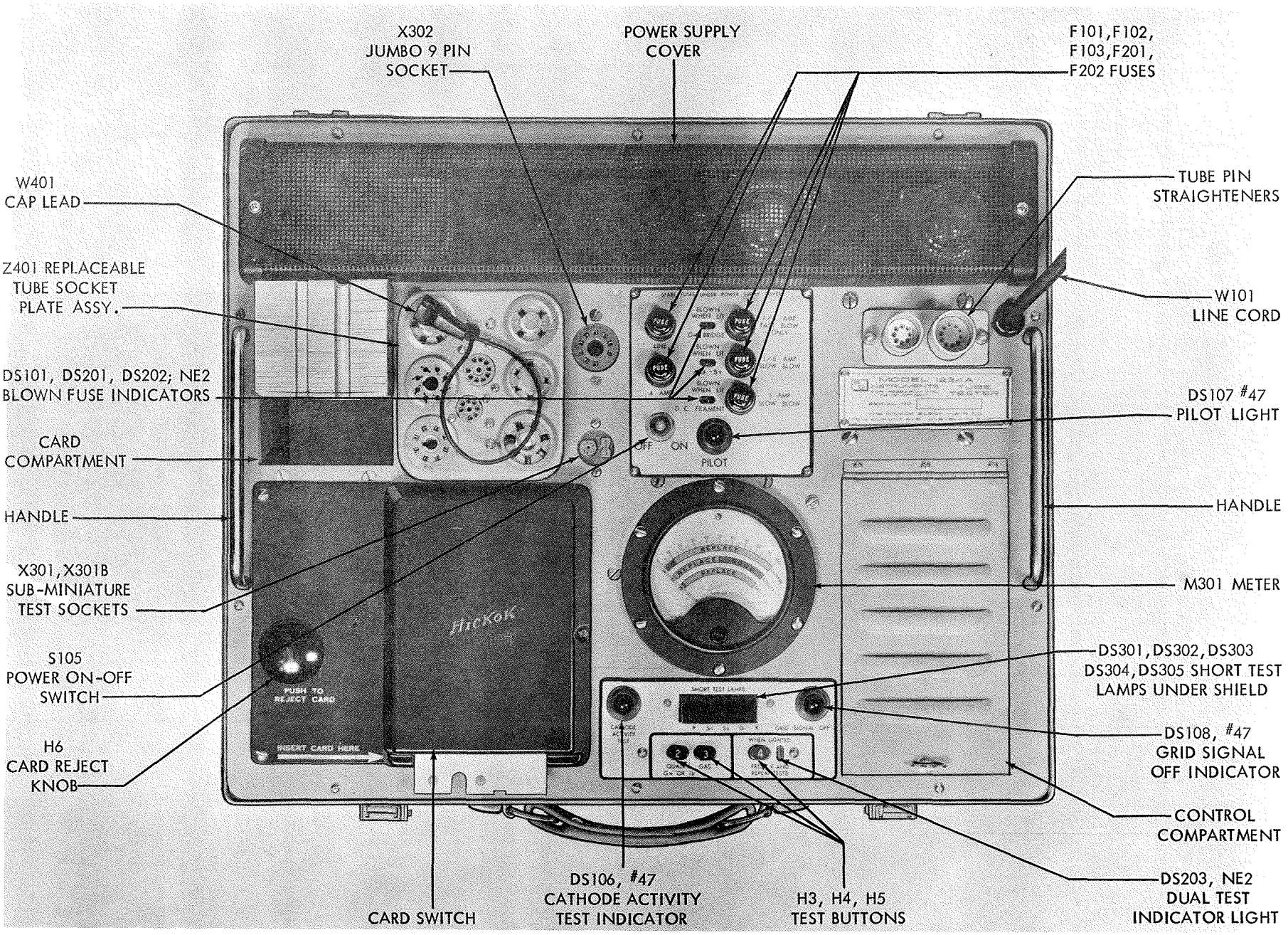

Figure 2. Identification of Controls and Components

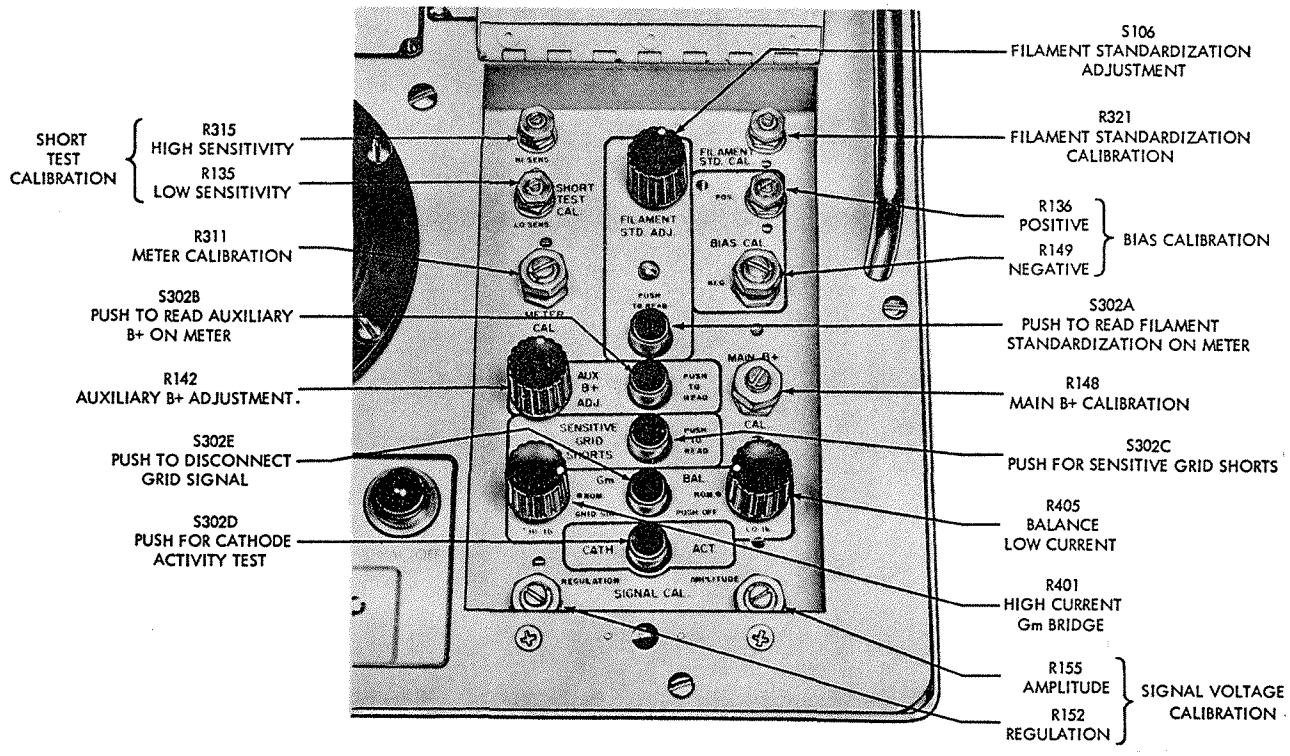

Figure 3 - Auxiliary Compartment

C. Auxiliary Compartment

2.13 A hinged panel covers a group of auxiliary controls which are used for special tests and for calibration of the set.

2.14 Two of these controls marked SIGNAL CAL. are used with special test cards for adjusting the REGULATION and AMPLITUDE of the signal voltage.

2.15 A push button marked CATH ACT is used for making cathode activity tests. When this button is pressed the filament voltage is reduced 10 percent. Results of the test are read as a change in reading on the numerical meter scale. As a warning to the operator, when the CATH ACT button is pressed, a lamp on the main panel is lighted.

2.16 A push button and two potentiometers are used for balancing the Gm bridge circuit under actual tube operating current for any Gm test. When the button is pressed it removes the grid signal and allows a zero balance to be made with one potentiometer or the other depending on whether the tube under test is passing HI or LO plate current. A lamp on the main panel is lighted when this adjustment is being made.

2.17 A button labeled SENSITIVE GRID SHORTS is used for checking grid to cathode shorts at a sensitivity much higher than the normal tests. The results of this test are observed on the short test lamps.

2.18 Certain special tests require the use of a continuously adjustable auxiliary power supply. By pressing the PUSH TO READ button the meter is used to monitor the voltage of the auxiliary power supply. This voltage may be adjusted by the use of the potentiometer labelled AUX B+ ADJ.

2.19 The rest of the potentiometer controls, marked MAIN B+ CAL, BIAS CAL NEG. BIAS CAL POS, FILAMENT STD CAL, METER CAL, SHORT TEST CAL, HI SENS, SHORT TEST CAL LO SENS, are calibration controls and are adjusted by the use of special calibration cards and a calibration cell, as covered in the section on routine calibration and also the maintenance section of this book.

2.20 The line voltage to the tester may vary over a wide range. All circuits in the tester are electronically regulated except the filament supply. To correct for this, a button is pressed and the FILAMENT STD ADJ switch is rotated until the meter reads midscale.

D. Program Cards

2.21 The circuitry in the tester which is to be utilized is selected by a pre-punched card. These cards are made of a tough vinyl plastic material.

2.22 The card switch in the tester has 186 single pole single throw switches. These are arranged in 17 rows with 11 switches in each row. The vinyl card is used to push the switches closed and therefore the absence of a hole in the card is required to actuate a switch.

2.23 The tube numbers are printed in color on the tabs of the cards. For convenience in the filing system the tube number is also printed at the edge of the card.

2.24 The cards are arranged in alpha-numerical order in the test compartment. A special card is provided to be used as a marker when a card is removed for use.

2.25 A pack of calibration cards is supplied for use in routine calibration of this equipment. Another pack of cards is included for use in trouble shooting and complete calibration.

2.26 A pack of printed blank cards and a hand punch are provided so that additional tube test cards may be punched as new tubes are developed. Torn, broken or unserviceable cards may be replaced or duplicated with the hand punch and blank cards.

3. CALIBRATION

3.01 General. The tester is equipped with self-calibrating features which include calibration controls located in the auxiliary control compartment and corresponding calibration code cards. The calibration procedures are divided into two parts, Routine Calibration, listed below, and Complete Calibration, listed in the Maintenance Section.

3.02 Routine Calibration is quickly performed using the proper calibration cards and does not require external test equipment. It should be performed upon initial installation, and weekly thereafter.

3.03 Complete Calibration is also performed with the use of special calibration cards, however, additional test equipment is required for some of the checks.

3.04 The complete calibration may be performed at the time of installation, (in addition to Routine Calibration noted above), and should be checked monthly and whenever trouble is suspected or maintenance work has been performed.

3.05 Routine Calibration Procedure.

a. Turn tester on and allow it to warm up for 25 minutes. Check that the meter is reading zero. If necessary, re-adjust the mechanical zero adjust so that the needle knife-edge rests over the zero line.

b. Select the Routine Calibration Cards, #1 through #10, from the tester case cover.

3.06 Meter Check.

a. Insert calibration card #1, METER, into the switch. Plug the calibration cell into the octal test socket, see figure 4. (The calibration cell is normally stored in the cover of the tube tester.) The left short lamp will glow.

b. Press button #2 for check of meter microamp cal. The meter should read within ± 1 division of the figure written in the top blank on the calibration cell cover. If the reading is out of tolerance the meter should be checked against a meter standard for 50 μamp indication at mid-scale. If the error is significant, the meter should be repaired or replaced.

c. Hold down button #2 and press button #4 to check meter millivolt sensitivity. The meter should read within ± 1 division of the figure written in the bottom blank on the calibration cell cover. If the reading is out of tolerance, adjust the "METER CAL" control for proper reading.

NOTE: Routine Calibration Controls are located in the auxiliary control compartment. If the control has a locking nut, its setting should be rechecked after the nut is tightened.

IMPORTANT: To insure accuracy the calibration cell E1 should be returned to an authorized repair facility for check or replacement at least once every 12 months.

3.07 Short Test Sensitivities.

DURING THE FOLLOWING FOUR TESTS (CARDS #2 THRU #5) LEAVE THE CALIBRATING CELL IN THE OCTAL SOCKET. DO NOT PRESS ANY BUTTONS.

a. Insert Calibration Card #2, SHORTS 2 MEG NO-GO. Observe that no short lamps are lighted. If any lamps are glowing adjust "LO SENS" short test control to just extinguish all lamps.

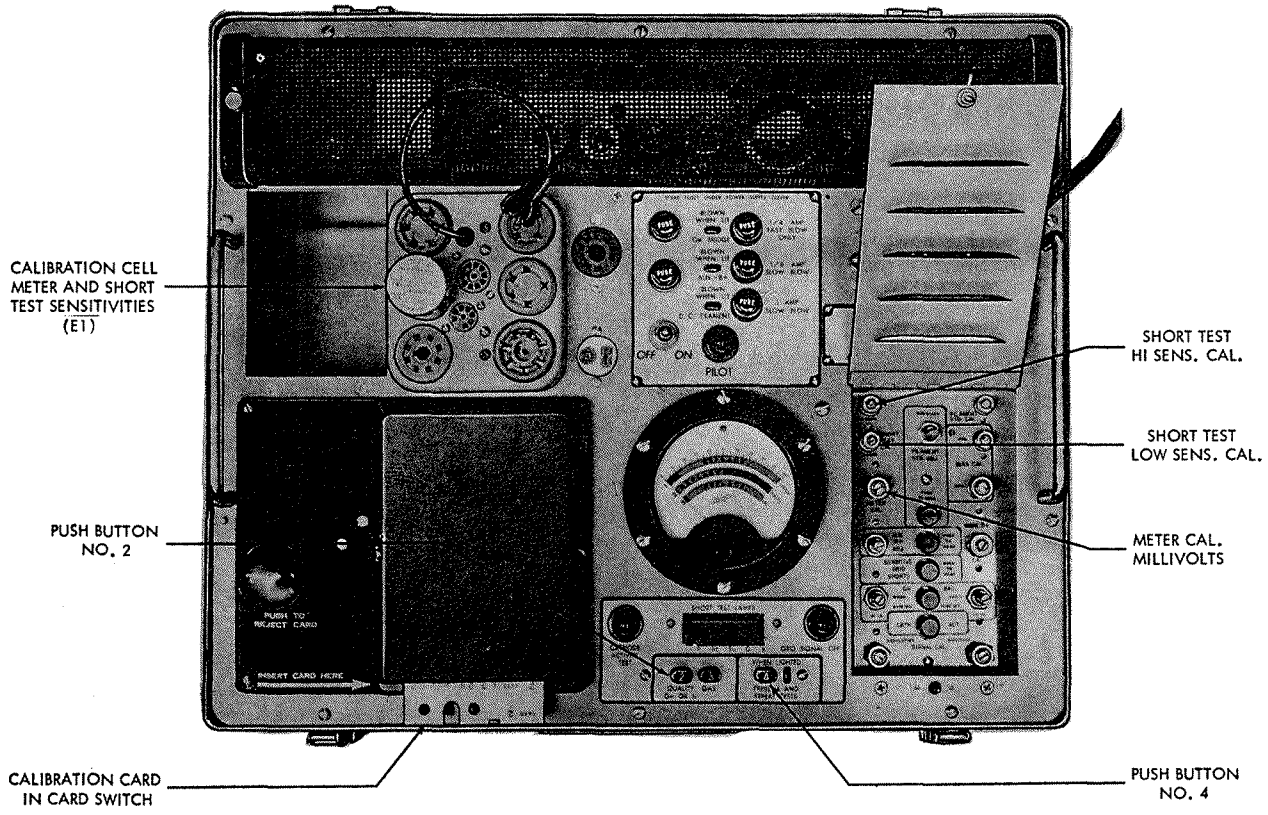

Figure 4 - Meter Sensitivity

b. Insert Card #3, SHORTS 1 MEG GO. The left four lamps should glow. If they are not glowing re-adjust the "LO SENS" control until they glow with Card #3 and are extinguished with Card #2, as listed above.

c. Insert Card #4, SHORT 20 MEG NO-GO. Press SENSITIVE GRID SHORTS button located in the Auxiliary Compartment (See Figure No. 3). No short lamps should glow. (If any are lighted adjust the "HI SENS" control).

d. Insert Card #5, SHORT 10 MEG GO. Press SENSITIVE GRID SHORTS button located in the Auxiliary Compartment (See Figure No. 3). The number 4 lamp only (counting left to right) should glow.

NOTE: The Lamp may flicker or glow dimly as compared to the "LO SENS" short indication. If the number four lamp is not glowing re-adjust the "HI SENS" control until it glows with card #5 and is extinguished with card #4, as before.

REMOVE CALIBRATION CELL FROM OCTAL SOCKET.

3.08 Bias Calibration.

a. Insert Card #6, FIXED BIAS CAL NEG. No short lamps should glow. Press button #2. Meter should read half scale. If reading is other than half scale, adjust "BIAS CAL NEG" control for proper indication.

b. Insert Card #7, FIXED BIAS CAL POS. Short lamps 1 and 2 should glow. Press button #2. Meter should read half scale. If another reading is obtained, adjust "BIAS CAL POS" control.

3.09 Main B+ Power Supply Calibration.

a. Insert Card #8, MAIN B PLUS CAL. Short Lamps 1, 2, 3 and 5 should glow. Press button #2. The meter should read half scale. If meter reading is not proper, adjust MAIN B+ CAL for correct indication.

3.10 Gm Bridge Balance.

Check that the white dots on the Gm BAL HI Ib and LO Ib knobs are in line with the associated dots labeled NOM (Nominal) on the panel.

a. Insert Card #9, GM BAL LOW IB. Press button #2. Meter should read zero, +5 divisions or minus the equivalent of 5 divisions. If the reading is out of tolerance the LO Ib control may be adjusted for a zero reading and the knob re-set on the control shaft to properly align the dots.

NOTE: The balance adjustments are somewhat subject to temperature variation and the tester should be completely warmed up prior to these adjustments.

b. Insert Card #10, GM BAL HI IB. Press button #2. The meter should read zero, + 5 divisions or minus the equivalent of 5 divisions. If the reading is out of tolerance the HI Ib control may be adjusted in manner noted for LO Ib above.

4. OPERATION

A. Normal

4.01 Before operating this set the calibration procedure, as outlined in Section 3.0 should be followed.

4.02 The tester is equipped with a three-conductor power cord, one wire of which is chassis ground. It should be plugged into a 105-125 volt 50 to 400 cycle outlet having a building ground.

4.03 Open the auxiliary compartment trap door and check for the following to be in the NOM position:

FILAMENT STD. ADJ. knob
GM BAL - 2 knobs. GRID SIG. button should be up, no red light at GRID SIGNAL OFF lamp.
CATH ACT - Button up and no red light at CATHODE ACTIVITY TEST lamp.

All other controls in this compartment should be left as is.

4.04 Turn on the tester and allow it to warm up for 5 or 10 minutes. This tester may be left on for extended periods without harm. Some heat will be noted from the ventilated section at the rear but this is normal.

4.05 Press PUSH TO REJECT CARD knob down until it locks and remove the non-test card from the switch. This card is used to keep the switch pins in place during the shipment and should be inserted before transporting the tester.

4.06 Plug the tube to be tested into its proper socket. Pin straighteners are supplied for 7 and 9 pin miniature tubes and should be used before these tubes are plugged in.

4.07 The tester is shipped with calibration cards and handpunch cards in its case. Cards for tubes are obtained separately. It is important that cards be kept in their proper order. A yellow plastic flag is provided to be used as a bookmark when cards are removed. It is expected that different locations may want to add more markers to separate card groups or to intermix card groups in the tester case. However, this should be done with care so that other operators will not be confused. Probably it would be best to use the tester a few months before any refiling is done.

4.08 Select the proper card (or cards) for the tube to be tested. Insert the selected card into the slot in the card switch until the card switch is actuated. This is indicated when the PUSH TO REJECT CARD knob pops up.

NOTE: The card will operate the tester only when it is inserted properly, that is, when the printing is up and toward the operator. Never put paper or objects other than program cards into the card switch as they may jam the switch contacts. If the overload relay shuts off the tester when the program card actuates the card switch, check to make sure that the proper card is being used or if the tube under test has a direct interelectrode short.

Once the card switch has been actuated the tube under test is automatically subjected to an interelement shorts test and a heater to cathode leakage test. A blinking or steady glow of any of the short test lamps is an indication of an interelement short. If the short test lamps remain dark, no interelement shorts exist within the tube under test. If an interelement short exists between two or more elements, the short test lamp or lamps connected between these elements will remain dark and the remaining lamps will light. The abbreviations for the tube elements are located on the panel just below the short test hood so that the neon lamps are between them, making it possible to determine what elements are shorted. For example, if all the lamps were lighted except the right hand one it would indicate a grid to cathode short. If only the left hand

lamp is lighted it indicates a plate to cathode short. Heater to cathode shorts are indicated as leakage currents on the number 1 meter scale. If the meter reads above the green area the tube should be replaced. A direct heater to cathode short would cause the meter to go full scale.

4.09 The tube is now ready for the QUALITY test. This may be for transconductance, emission, plate current, voltage drop, etc., depending on the type of tube being tested. Push the number 2 button and read the number 2 meter scale which tells whether or not the tube is good. The actual Gm or milliampere reading can be interpreted with the aid of the TUBE TEST CONDITIONS booklet which is shipped with the tester. When the number 2 button is pressed the numerical meter scale may be read as a percentage of full scale. By referring to the booklet for the full scale reading the actual Gm can be determined. For example, if a tube read 70 and the booklet listed its full scale reading as 6800 umhos, the actual reading would be 70% of 6800 or 4760 umhos. Of course the reading for rectifiers and diodes would be interpreted in milliamperes instead of micromhos.

4.10 The tube may be checked for gas by pressing the number 3 button and reading the number 3 meter scale. The number 2 button also goes down when 3 is pressed.

4.11 If a tube such as a dual diode or dual triode which has two identical sections is being tested, the neon lamp next to the number 4 button will light. This lamp tells the operator that he may check both sections with one card. To do this the operator checks the tube for shorts, leakage, quality and gas which takes care of one section. He then holds down button 4 and repeats the checks for shorts, leakage, quality and gas on the second section.

4.12 Some tubes require more than one card. For example, a tube having dual diode sections and a triode section would have two cards, one for the triode and one to be used with button 4 for checking the diodes. If the two diode sections were not alike the tube would take three cards and the lamp by button 4 would not light. Some tubes have more than one card so that special tests may be made. Commercial voltage regulator tubes have four cards. The first card is an instruction card. The second card is for the dark current test or the point just below firing when the tube is at the maximum leakage point. Button 2 is pressed for this test but leakage is still read on the number 1 meter scale. Card 3 is the low current test. It flows minimum current through the tube and measures the voltage across the tube. Card 4 is the high current test. It flows maximum current through the tube and measures the voltage across the tube. The difference between the readings with cards 3 and 4 indicates the regulation ability of the tube. The closer the readings, the better the regulation.

B. Auxiliary Tests

4.13 As seen from the foregoing paragraphs the normal testing procedure is extremely simple. All that is necessary is to insert the card, check shorts and leakage and then press two buttons and take readings. However, there are other tests which can be made. Controls for these are located in the auxiliary compartment. This compartment has been described in paragraphs 2 and 3 in detail. For testing tubes the only controls used are the five push buttons and the four knobs associated with them. Actually two of these (FILAMENT STD. ADJ. and Gm BAL.) are not really tests but are controls to obtain more accurate test results.

4.14 The FILAMENT STD. ADJ. controls the primary side of the filament transformer. It is used to compensate for variations in line voltage and for variations caused by tubes having large filament currents. For all tubes the white dot on the knob may be aligned with the dot labelled NOM. and left there. However, when the operator wishes to obtain very accurate tests the filament voltage may be standardized for every tube. To do this the PUSH TO READ button is held down and the knob is rotated until the meter reads as close to 50 as possible. When the operator has finished testing tubes, he should restore the knob to NOM.

4.15 The complete adjustment of the Gm bridge balancing controls is described in 3.0. To obtain the most accurate results, the balance should be checked every time a tube is tested for Gm. To do this press button 2 and the GRID SIG. button. The GRID SIGNAL OFF lamp on the tester panel will light. Adjust the LO Ib or HI Ib knob until the meter reads as near zero as pos-

sible. Most tubes require the adjustment of the LO Ib knob, however, tubes that draw heavy plate current require the adjustment of the HI Ib knob. After completing the check, restore the GRID SIG. button to normal by pressing any black button in the auxiliary compartment. When the operator is finished testing he should return both balance knobs to their NOM. positions.

4.16 The cathode activity test is used as an indication of the amount of useful life remaining in the tube. By reducing the filament voltage ten percent and allowing the cathode to cool off slightly the ability of the cathode as an emitter of electrons can be estimated. This test is made in conjunction with the normal quality test. After the tube has warmed up button 2 is pressed and the test meter is read on scale 2; also the numerical reading on the 0-100 scale is noted. The CATH. ACT. button is then locked down. A red light on the tester panel comes on. After a wait of about 1-1/2 minutes button 2 is again pressed and the reading taken on the numerical scale. The tube should be rejected if this reading differs from the normal reading by more than 10 percent or if the reading drops into the red area on scale 2. After this test the button should be restored to normal by pressing any black push button in the auxiliary compartment.

4.17 It is often desirable to check tubes for shorts between grid and cathode at a sensitivity greater than normal. This is especially true for tubes used in oscilloscopes and television sets. To make this check merely press the SENSITIVE GRID SHORTS button and note carefully if any of the shorts lamps light.

4.18 The remaining control in the auxiliary compartment is the auxiliary B+ adjustment. This control varies the voltage of the auxiliary regulated supply. This supply is only used on special test cards such as for Western Electric cold cathode and voltage regulator tubes.

C. Hand Punch Card System

4.19 The Hickok hand punch card system consists of fifty printed blank cards, and one steel hand punch. Additional cards may be ordered under the Hickok Part No. 3122-80.

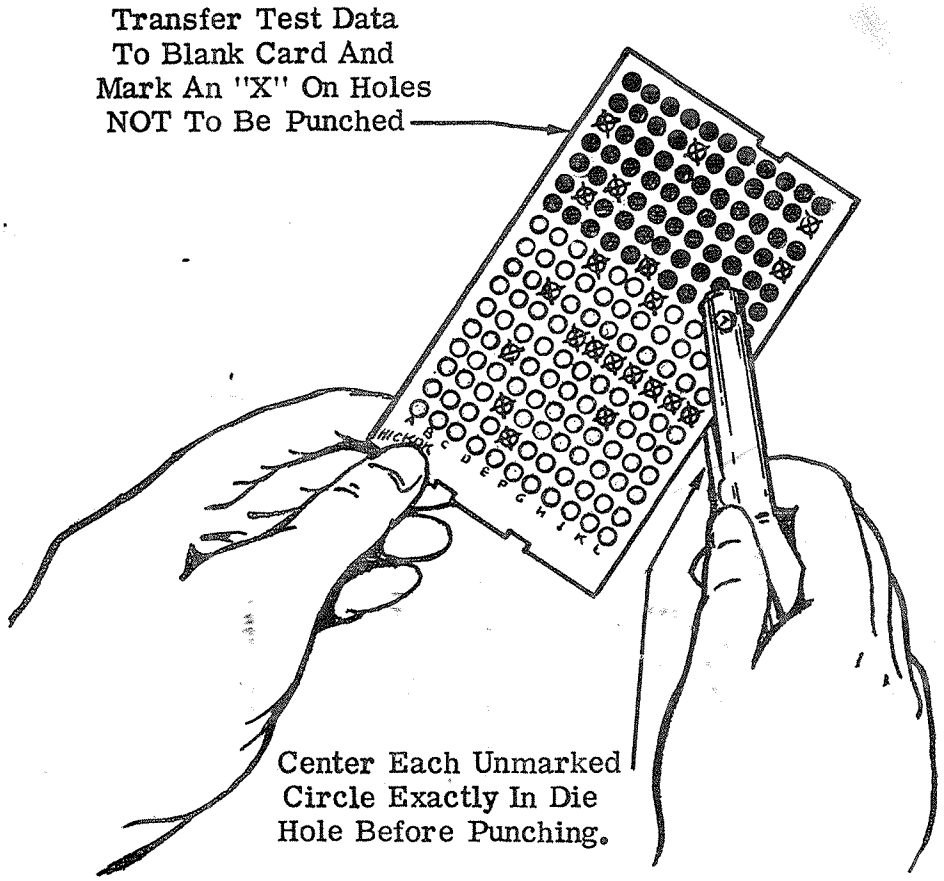

Figure 5 - Punching New or Replacement Tube Test Code Cards

4.20 Preparation of Cards: The Hickok CARDMATIC switch is designed so the unpunched areas in a test card close the contacts. Therefore, all the circles are punched in the card except the ones that close circuit switches.

a. Transfer the test data to the blank card and mark an "X" on the circles not to be punched.

b. A convenient way to locate the correct circles on the card is to find the desired lettered row and mark the circles that are not to be punched in that lettered row.

4.21 Punching the Card: Locate the unmarked circle exactly in the die hole of the hand punch and punch the hole.

4.22 Replacing Broken Cards:

a. Place the parts of the broken card over a blank card and mark the holes to be punched.

b. Center the marked circles in the die hole of the hand punch and punch the holes.

5. CIRCUIT

A. Circuit Theory

5.01 Previous testers have checked tubes with circuits which were fixed in nature. When a tube having characteristics different from any other was developed it was necessary to test it on a compromise type circuit. In this tube tester an effort has been made to include enough separate circuits so that by interconnecting them, nearly any tube may be tested for nearly any condition. The feature which makes this possible is the card switch with its 186 contacts. This switch may be thought of as a group of patch cords to interconnect a group of laboratory components. This group of components contains the following:

1. 1% R box - high current
2. 1/4% meter
3. 1% meter shunt system
4. Black box - direct reading Gm
5. Fixed bias supply - 1%
6. Regulated B+ supplies
7. AC supplies
8. Decade filament supplies
9. Regulated signal
10. A group of capacitors
11. Unregulated B+ Supply

5.02 The card switch connects these components in nearly any configuration rather than following a fixed circuit pattern. Its functions are mainly as follows:

It applies the properly established voltages to the various pins of the tube sockets.
It chooses a high wattage decade resistance from 0 to 70,000 ohms, in 10 ohm steps
It places certain fixed capacitors into the desired point in the circuits
It puts the Gm bridge into the proper point of the circuit
It connects the regulated signal of 222 millivolts
It chooses half-scale meter shunts capable of resolving at mid-scale, Gm's of 250 to 13,000 micromhos in 50 micromho steps; 250 to 64,000 micromhos in 250 micromho steps; currents from 50 to 2600 microamps in 10 microamp steps; and from 1 to 255 milliamps in one milliamp steps; or voltages from 5 to 260 volts in one volt steps.
It places the meter and its shunts at the proper point of the test circuit.