

**M9B METER**  
**(PORTABLE VOLT-OHM-MILLIAMMETER**  
**DESCRIPTION AND APPLICATION**

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1. GENERAL

1.01 This Section describes the Western Electric Company M9B Meter (portable volt-ohm-milliammeter), includes instructions for its use and methods for replacement of parts. The information is also generally applicable to the D-166852 Meter.

1.02 The M9B Meter is a small portable multi-meter designed for general maintenance use for the measurement of a-c and d-c voltages, d-c current, and resistance. Five voltage scale ranges are provided, both a-c and d-c, from 0-3 to 0-300 volts, with a sensitivity of 2000 ohms per volt on all scales. Three d-c current ranges are provided from 0-150 milliamperes to 0-15 amperes, and four resistance measuring scale ranges from 0-1000 ohms to 0-1,000,000 ohms.

1.03 A special double-pointer meter movement provides unusual legibility of scales; the linear voltage and current scale markings are grouped in the upper semicircle of the meter face, and the nonlinear resistance scale is located under the pointer sweep on the lower semicircle of the meter face. The wide angle sweep (150 degrees) of the pointer adds to the legibility of the scales. A nonglare, hardened glass window is used. All circuit connections are made to positive contact pin jacks. Fig. 1 shows a face view of the M9B Meter.

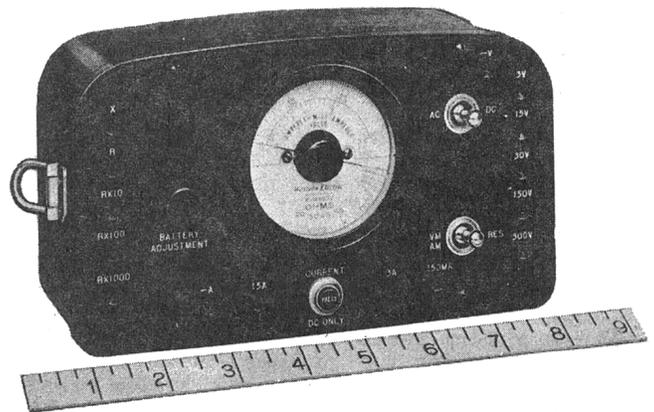


Fig. 1 - M9B Meter - face View

1.04 The M9B Meter is furnished with a pair of KS-9290 test pick leads, a pair of KS-9291 test clip leads and a KS-9308 carrying strap. A 4-1/2-volt battery (par. 2.08) is required for use in the meter. The meter is equipped with "D" loops for attaching a neck carrying strap (KS-9308). A fibre carrying case (KS-9307) is available for carrying the meter and test leads. (See Figs. 2 and 3.) The M9B Meter is similar to the Western Electric Company D-166852 Volt-ohm-milliammeter which was recently developed for maintenance use with carrier, central office, and telegraph equipments.

2. CIRCUIT AND EQUIPMENT FEATURES(A) M9B Meter

2.01 A schematic of the M9B Meter is shown in Fig. 4. The scale ranges provided are as follows:

Voltmeter Ranges A-C or D-C (2000 Ohms Per Volt)	Ammeter Ranges D-C Only	Ohmmeter Ranges
0-3 volts	0-150 milliamp.	0-1000 ohms
0-15 volts	0-3 amp.	0-10,000 ohms
0-30 volts	0-15 amp.	0-100,000 ohms
0-150 volts		0-1,000,000 ohms
0-300 volts		

The accuracy of the meter is  $\pm 2$  per cent. of full scale for d-c and  $\pm 5$  per cent. of full scale for a-c measurements; for resistance measurements, the accuracy is  $\pm 2$  per cent. at one-half the pointer travel, i.e., at "40" on the OHMS scale.

2.02 The meter movement is of a relatively sensitive type, requiring 100 microamperes of current to obtain full-scale deflection, and is combined with suitable series and shunting resistances to provide for the direct current, the a-c and d-c voltage, and the resistance ranges tabulated in Paragraph 2.01. In the voltmeter condition, on all scales, a-c and d-c, the internal resistance (sensitivity) of the meter is 2000 ohms per volt.

2.03 The dial (Fig. 5) is circular, with the current and voltage scales on the upper half of the dial and the nonlinear resistance scale on the lower half. The double-ended pointer is pivoted at the center. One end of the pointer travels over the upper scales; the other end of the pointer sweeps over the lower scale. This provides a complete separation of the nonuniform resistance measuring scale from the markings for the current and voltage measuring scales, which makes the scales easier to read than the conventional type meter which has all scales grouped under one pointer. The pointer swings from zero on the left, to full scale on the right, on all scales. Instead of the conventional arc of 90 degrees, the pointers swing through a 150-degree arc from zero to full-scale readings. The outside scales are approximately 2-3/4" long.

2.04 A face view of the volt-ohm-milliammeter is shown in Fig. 1. All the connections to the meter are made by means of pin jacks. Connections for resistance measurements (X and R jacks) are on the left side of the panel; those for voltage measurements (V jacks) are located on the right side of the panel and current measuring (A and MA jacks) are located along the lower part of the panel.

2.05 A copper-oxide rectifier in the meter provides means for using the d-c meter movement for measuring a-c voltage. Operation of the AC-DC toggle switch at the right of the meter dial cuts the rectifier into the circuit for a-c voltage measurements or eliminates it for all d-c measurements, including resistance.

2.06 Two toggle switches located to the right of the meter and designated AC-DC, and AM - RES, together set up the internal connections which are required for each type of use; that is, as either an a-c or d-c voltmeter, as a d-c ammeter, or as a resistance measuring device.

2.07 A quick-acting push-to-read switch (with its push-button marked PRESS) is provided to connect the meter movement across the internal d-c measuring shunts which are associated with the -A, 15A, 3A, and 150MA jacks. The meter movement is only connected to read current while this switch is depressed.

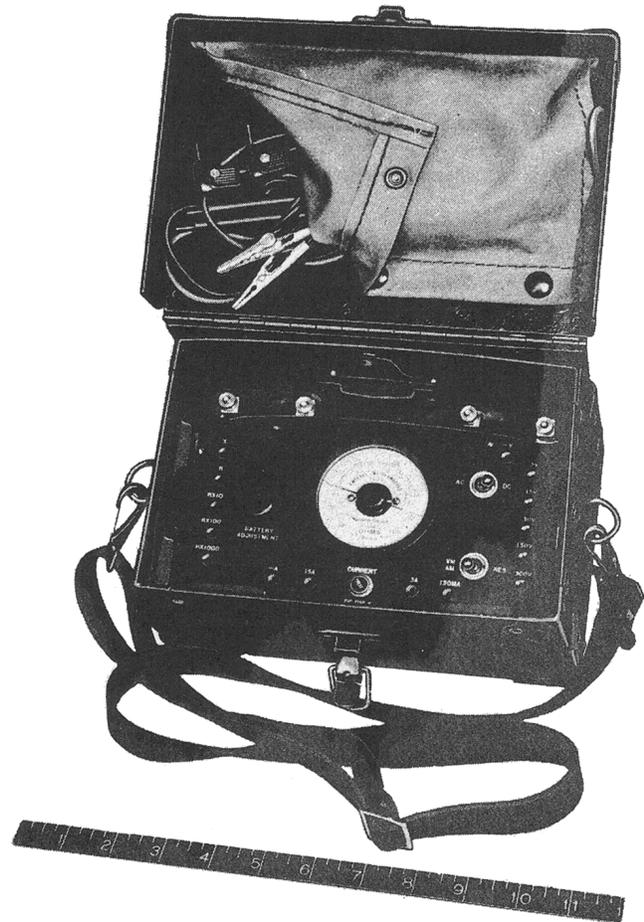


Fig. 2 - M9B Meter in Carrying Case - Cover Open

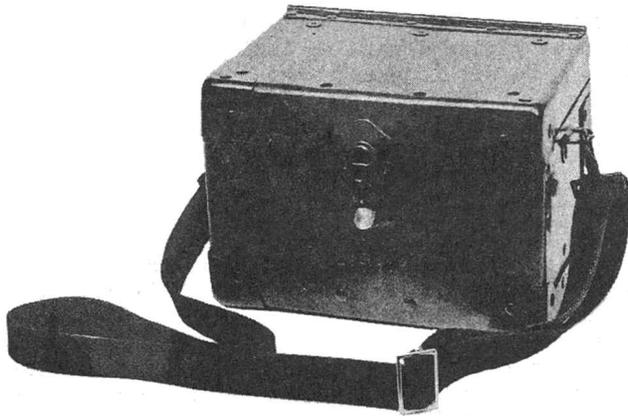


Fig. 3 - KS-9307 Carrying Case with KS-9308 Carrying Strap

2.08 A 4-1/2-volt battery is required for use in the meter. The battery mounts in a bracket inside the meter case. Any one of the following batteries may be used:

Bright Star	03-17S
Eveready	781
Burgess	5360
Ray-O-Vac	531R
Bond	317

2.09 The knob BATTERY ADJUSTMENT controls a rheostat which adjusts the "zero" setting portion of the resistance measuring circuit. This setting varies with the voltage and condition of the 4-1/2-volt dry cell battery.

(B) Test Leads, Carrying Strap, and Carrying Case

2.10 The test leads supplied with the meter are equipped with pin terminals at one end for connection to the meter jacks. One pair of test leads (KS-9291) is equipped at the other end with test picks, the other pair (KS-9290) with test clips. The test picks are 7-1/2" long and consist of a slender hard rubber handle with a pick extending approximately 1/2" from the end. The test clips are narrow, alligator-type clips.

2.11 The KS-9308 carrying strap is available for use with the M9B Meter. This strap (Figs. 2 and 3) is equipped on each end with a harness snap and is adjustable as to length by means of a sliding buckle. The strap is intended to attach to the metal "D" loop on the sides of the instrument, and to be used as a neck strap to support the meter so as to leave both hands of the tester free for making test connections; or the strap may be attached to the KS-9307 carrying case and used in the same way.

2.12 The KS-9307 carrying case may be obtained for use with this meter. This fibre case (Figs. 2 and 3) is arranged with a hinged top, inside of which a snap-fastened fabric flap provides a place for storing the test leads (Fig. 2). There is a "D" ring on each side of the case to which the KS-9308 carrying strap may be attached. The case is so designed that

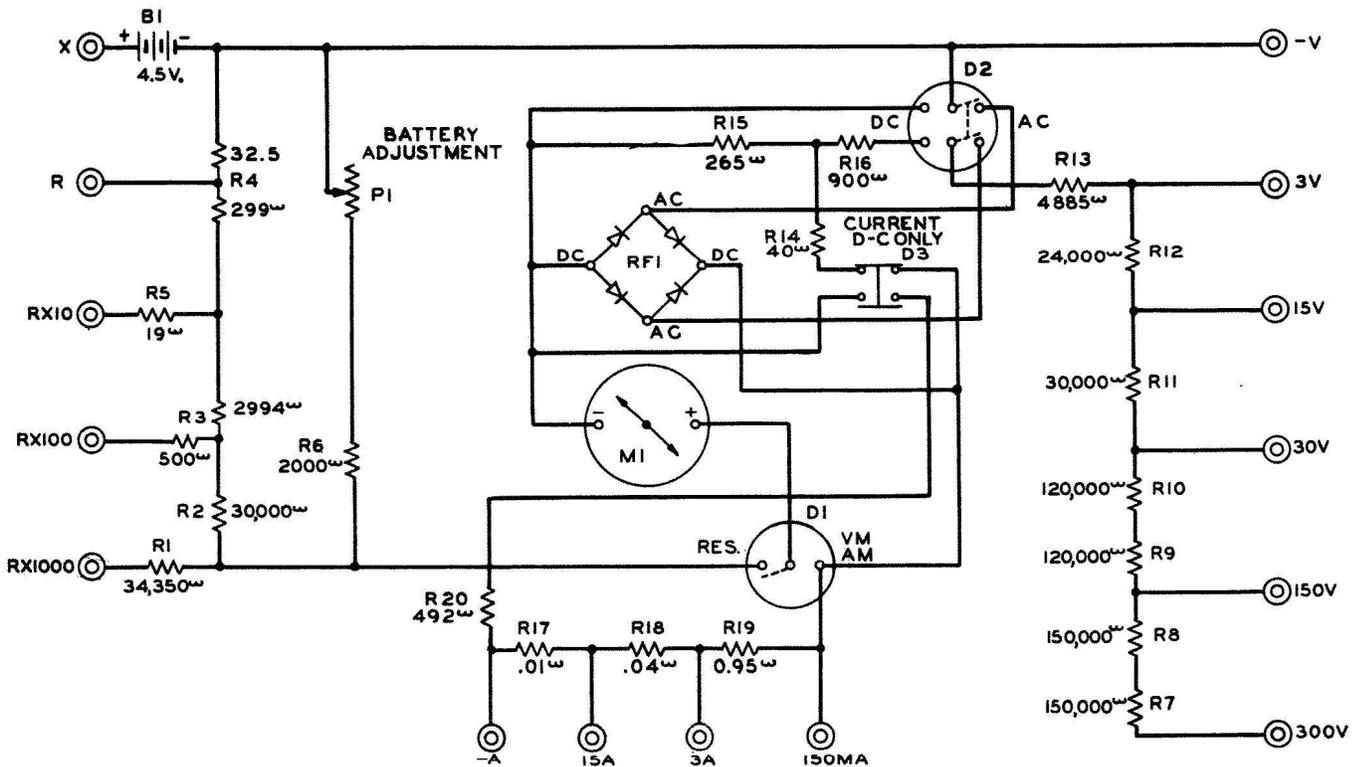


Fig. 4 - Schematic Diagram of M9B Meter Circuit

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when the lid is open the meter can be used without removing it from the case. A simple clamping device holds the meter securely in position in the case, cushioned between sponge rubber blocks on sides, end, and bottom. There is room for two spare dry batteries inside the carrying case, in the space between the hinged side of the case and the meter; one may be placed on each side of the meter clamping device.

2.13 The dimensions and weights of the M9B Meter and associated equipment are as follows:

Name	Dimensions (In.)			Wt. Lbs.
	Length	Width	Depth	
M9B Meter	8	4-1/4	3-1/2	3.25
KS-9290 Test Leads (pair)	50 (ea)			0.18
KS-9291 Test Leads (pair)	50 (ea)			0.06
KS-9308 Carrying Strap	40	1	-	0.18
KS-9307 Carrying Case	8-1/2	6	6	3.4

**3. OPERATION**

(A) Precautions

3.01 In order to avoid damage to the meter, the following precautions should be observed. Do not connect resistance measuring jacks (X and R) to a circuit which includes a source of either d-c or a-c power, since it may damage the meter movement and the meter resistances. This is particularly important with regard to a-c power, because the alternating current entering the meter through the resistance measuring jacks (X and R) will not give a meter deflection and therefore might

destroy either the meter coil or a resistance without giving a warning indication on the meter. Do not connect the current measuring jacks (-A, 15A, 3A, and 150MA) to a circuit in which the current is greater than 15 amperes d-c; do not connect into an a-c circuit.

(B) Preparation

3.02 Before making direct current or a-c or d-c voltage measurements, check that the upper pointer of the meter lines up exactly with the zero mark of the upper scales, (which also sets the lower pointer at the (infinity) mark of the resistance measuring scale). The zero position of the pointers can be adjusted by turning the slotted bakelite button in the center of the meter glass with a screwdriver or small coin.

(C) Scales

3.03 Two scales, inner and outer, appear on the top half of the meter face. A single scale for resistance measuring, calibrated in ohms is on the lower half. Fig. 5 shows the meter scales in detail.

3.04 The inner scale (with red markings) on the upper half of the dial is for reading a-c voltages in the 0-3-volt range. This separate scale is necessary because a nonuniform movement of the meter pointer is produced when a-c voltage within this low range is measured.

3.05 The outer scale is used for all other voltage measurements both a-c and d-c and for direct-current measurements. It has 75 equal divisions with every fifth division a long mark. It is marked with black figures at each 25 divisions, as follows:

50	100	150
100	200	300

The outer scale divisions and markings have the following values for current and voltage measurements:

When Measuring	Connected to Jacks	Current or Voltage Value for Top Pointer at			Scale Value Each Division	
		50 100	100 200	150 300	Short Lines	Long Lines
Direct Current	-A and 150MA	0.050 amp.	0.100 amp.	0.150 amp.	0.002 amp.	0.010 amp.
	-A and 3A	1.0 amp.	2.0 amp.	3.0 amp.	0.04 amp.	0.2 amp.
	-A and 15A	5.0 amp.	10.0 amp.	15.0 amp.	0.2 amp.	1.0 amp.
Voltage* D-C Only	-V and 3V	1 volt	2 volts	3 volts	0.04 volt	0.2 volt
Voltage A-C or D-C	-V and 15V	5 volts	10 volts	15 volts	0.2 volt	1 volt
	-V and 30V	10 volts	20 volts	30 volts	0.4 volt	2 volts
	-V and 150V	50 volts	100 volts	150 volts	2.0 volts	10 volts
	-V and 300V	100 volts	200 volts	300 volts	4.0 volts	20 volts
Voltage* A-C Only	-V and 3V	Use top pointer and RED scale				

\* For measuring a-c voltages when connected to the -V and 3V jacks, see Paragraph 3.04.

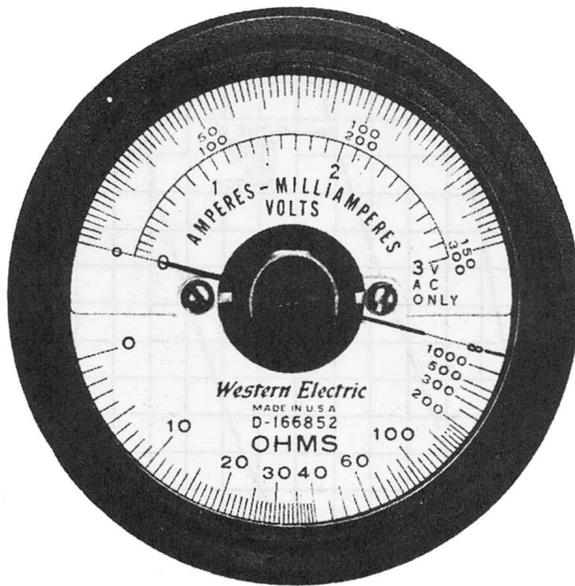


Fig. 5 - M9B Meter - Face View

3.06 The resistance scale (lower half of the dial (Fig. 5)) is read directly in ohms if the test cords are connected to X and R (0-1000-ohm scale). If the test cords are connected at X and Rx10, the scale reading should be multiplied by ten; if the connections are at X and Rx100 multiply the scale reading by 100; if connections are at X and Rx1000, multiply the scale reading by 1000.

#### (D) Voltage Measurements

3.07 In measuring d-c voltage, set the upper toggle switch at its DC position; in measuring a-c voltage, set this switch at its AC position. Set the lower toggle switch at its <sup>VM</sup> position. Make connections to the -V pin jack and to the 300V, 150V, 30V, 15V, or 3V pin jack depending on the amount of voltage to be measured. In measuring d-c voltage connect the -V pin jack to the negative side of the circuit being checked.

Caution: If the approximate voltage is not known, start with the 300V jack, and if the reading is less than 150 volts, change the connection from the 300V jack to the 150V jack. If the reading is less than 30 volts, change the connection from the 150V jack to the 30V jack. Likewise, if the reading is less than 15 volts or less than 3 volts, change the connection to the 15V or 3V jack, respectively.

#### (E) Current Measurements

3.08 Direct current only can be measured. When direct current is to be measured set the upper toggle switch at its DC position and the lower toggle switch at its <sup>VM</sup> position.  
AM

Connect the negative side of the circuit to the -A pin jack and the positive side of the circuit to the 15A, 3A, or 150MA jack depending on the amount of current to be measured.

Caution: If the approximate amount of current is unknown, start with the 15A jack. Current will flow through the meter shunts, but not through the meter movement, as soon as connection through these pin jacks is made. Push down the CURRENT DC ONLY button marked PRESS to read the meter. This permits current to flow through the meter movement. If the meter indication is less than 3 amperes, connect to the 3A pin jack, and if it is less than 150 milliamperes, connect to the 150MA pin jack.

#### (F) Resistance Measurements

3.09 When resistance is to be measured, set the upper toggle switch at its DC position, and the lower toggle switch at its RES position. Connect one test cord to the X pin jack, and the other test cord to either the R, Rx10, Rx100, or Rx1000 jack depending on the value of the resistance to be measured. Short-circuit the test cords and turn the BATTERY ADJUSTMENT knob until a zero reading is obtained on the ohms scale. This adjustment is necessary to calibrate the meter circuit to the exact voltage and condition of the dry-cell battery. When a zero adjustment can no longer be obtained within the range of the BATTERY ADJUSTMENT knob, the battery of the meter is no longer in suitable condition and should be replaced (Paragraph 4.03). Connect the test cords to the circuit to be measured and read the resistance scale of the meter.

3.10 The resistance scale is not uniform, and the pointer moves farther for a particular value of resistance change when over the left side of the scale than when over the right side of the scale. Therefore, greater accuracy of reading results when the scale is selected which as far as possible keeps the pointer near the middle range of its swing. The following table suggests the most favorable connections to the meter for various ranges of resistance values to be measured.

Resistance - Ohms	Meter Jack Connections
0-200	X and R
100-2000	X and Rx10
1000-20,000	X and Rx100
10,000-1,000,000	X and Rx1000

3.11 When making resistance measurements the drain on the 4-1/2-volt test battery is different for connections to each pair of jacks (i.e., X and R, X and Rx10, X and Rx100, or X and Rx1000). This may, especially with a used

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battery, cause the zero setting to need a different BATTERY ADJUSTMENT knob position for each resistance measuring scale range. Therefore, when accuracy of the measurement is important, it is desirable to check the zero setting (by short-circuiting the test leads) each time the scale connection to the meter jacks is changed. Also, when connected to the X and R jacks, the current drain is relatively heavy, and it may be desirable to recheck the zero setting from time to time while using this scale range. The meter is accurate for resistance measurements within  $\pm 2$  per cent. at mid-swing of the pointer. The current drains at zero reading on the ohms scale, for each test lead connection, are approximately as follows:

Test Lead Connection	Current - Milliampères
X and R	129.5
X and Rx10	12.95
X and Rx100	1.3
X and Rx1000	0.13

3.12 If a 4.5-volt battery of a suitable size is not available, any 4.5-volt battery can be connected externally for making resistance measurements. If this external 4.5-volt battery differs appreciably as to its internal resistance, from the types of batteries normally used in the meter, the accuracy of the lower resistance scales may be slightly decreased.

3.13 To use an external battery, connect the negative terminal of the battery to the -V terminal of the meter. Connect the positive terminal of the battery to one side of the circuit whose resistance is to be measured. Connect the other side of the resistance to the proper pin jack for the scale required (Rx10, Rx100, or Rx1000).

(G) Capacitance Measurements

3.14 The following Paragraphs (3.15 through 3.21) cover the use of the M9B Meter for measuring capacitance by the ballistic kick method of testing. By this method, the meter may be used to make capacitance measurements within the limits of approximately 0.1 mf to 200 mf, with a reasonable degree of accuracy.

3.15 General Method. In measuring capacitance, the resistance measuring portion of the M9B Meter circuit is used, with the test leads connected to the X and Rx1000 pin jacks for the lower capacitance values or to the X and Rx100 pin jacks for higher values. The maximum swing of the pointer at the instant of connection to the capacitor is read on the 0-150 scale on the upper part of the meter dial. This scale reading is then converted into capacitance in microfarads by use of the curves in Fig. 6 or 7. Several repetitions of the swing generally are required for

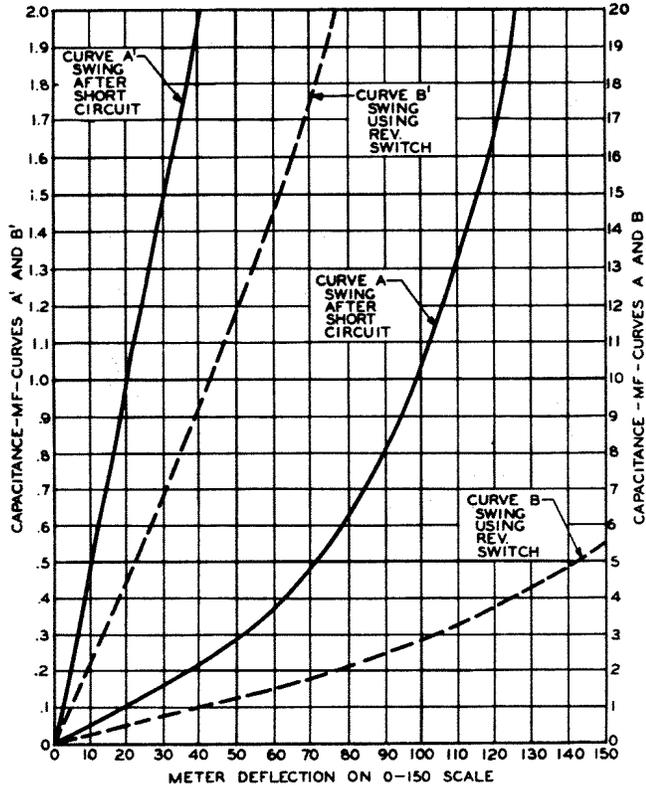


Fig. 6 - Capacitance Measurement - Smaller Values - Using X and Rx1000 Jacks

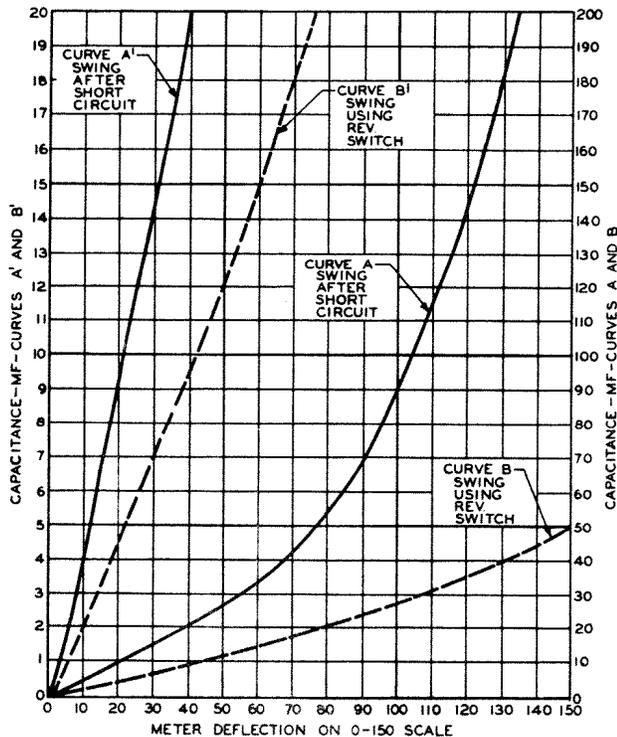


Fig. 7 - Capacitance Measurement - Larger Values - Using X and Rx100 Jacks

accurate reading. The test may be made by either of two methods; by short-circuiting the capacitor to fully discharge it and then making connection to the meter; or, by reversing the polarity of the connections from the meter to the capacitor, without intermediate discharge of the capacitor. The latter method requires the use of an auxiliary switch inserted in the connections between the meter and capacitor as shown in Fig. 9. When the short-circuiting method is followed, no auxiliary switch is required; however, if desired, a switch may be used in the test leads to discharge the capacitor and then reconnect it to the meter, in order to simplify the procedure (see Fig. 8). The reversing switch method, covered in Paragraph 3.18, should not be used for electrolytic capacitors, since a single polarity should be used when testing this type of capacitor; that is, the (+) or X terminal of the meter should always connect to the (+) terminal of the capacitor. When using the reversing method, the magnitude of the pointer swing is approximately double that obtained after shorting the capacitor. The dotted curves B and B' in Figs. 6 and 7 are provided for use when the reversing switch is employed, and solid curves A and A' when the short-circuiting switch is used.

3.16 The table below summarizes the connections which may be used for various values of capacitance, and the curves which are applicable for the testing procedure used. The A' and B' curves in both Figs. 6 and 7 correspond to the lower portions of the A and B curves respectively, but are plotted on a larger scale for easier and more accurate reading of the smaller values of capacitance. It is therefore preferable to use curves A' or B' if the pointer swing is low enough to be read on them.

3.17 Electrolytic Capacitors. Before measuring the capacitance of electrolytic capacitors which have not been in service for an extended period, the film should be restored by connecting the capacitor to a d-c voltage approximating the normal working voltage of the capacitor, in series with a lamp, for about 30 minutes. If a capacitor is tested in the circuit, and there are any shunting paths around the capacitor, at least one terminal should be disconnected before proceeding.

3.18 Procedure. The following procedure for measuring capacitance is to be followed when neither a short-circuiting switch nor a reversing switch is to be used. When a short-circuiting switch or a reversing switch is used, the procedure given below is modified as covered in Paragraph 3.20 or 3.21.

- (1) For higher capacitance measurements, use the X and Rx100 pin jacks; for lower capacitance measurements, use the X and Rx1000 pin jacks (see Paragraph 3.16).
- (2) Set the meter switches to their DC and RES positions, connect the test cords to the meter jacks to be used and adjust the setting of the BATTERY ADJUSTMENT knob for zero reading on the resistance scale (as covered in Paragraph 3.09).
- (3) Connect the test lead from the X pin jack to one terminal of the capacitor (if the capacitor is electrolytic, connect this lead to the positive terminal).
- (4) With the other test lead disconnected from the meter, connect its clip end to the other capacitor terminal (negative, if capacitor is electrolytic).
- (5) Then, quickly insert the other terminal of this test lead into the Rx100 or the Rx1000 pin jack, at the same time watching the meter needle to determine its maximum swing. If this connection is not made quickly a full swing of the pointer will not be obtained.
- (6) Read the maximum swing on the 0-150 (upper) scale and convert the reading to microfarads by use of the solid curves A or A' in Fig. 6 or 7; use Fig. 6 for connections to the X and Rx1000 jacks; use Fig. 7 for X and Rx100 connections.
- (7) To repeat the test, remove the lead from the meter Rx100 or the Rx1000 jack, touch it to the capacitor to short-circuit and discharge it, then repeat the connection to meter, as in Items (5) and (6) above.

Capacitance Range	Pin Jack Connectors	Fig.	Applicable Curve	
			Short Cct. Method-Solid Curve	Rev. Sw. Method-Dotted Curve
0.1 to 2.0 mf	X and Rx1000	6	A'	B'
2.0 to 20 mf	(X and Rx1000 or X and Rx100)	6	A	B
		7	A'	B'
20 to 200 mf	X and Rx100	7	A	B

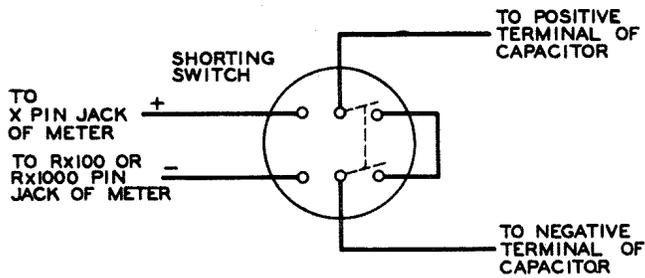


Fig. 8 - Wiring of Shorting Switch

### 3.19 Procedure Using Short-circuiting Switch.

For greater convenience in making capacitance measurements, a switch may be used to short-circuit the terminals of the capacitor before each test. A quick-acting DPDT toggle switch may be used for this purpose, wired as shown in Fig. 8. After the switch is connected to the meter jacks and to the capacitor as indicated in Fig. 8, operate the switch quickly from its short-circuit position to charge the capacitor, the charging current producing the meter pointer swing; then restore the switch to its short-circuit position to discharge the capacitor. If repetition of the swing is desired, it may be obtained by repeated operation of the switch. Otherwise, the method described in Paragraph 3.18 is followed, using the solid curves (A or A') in Fig. 6 or 7.

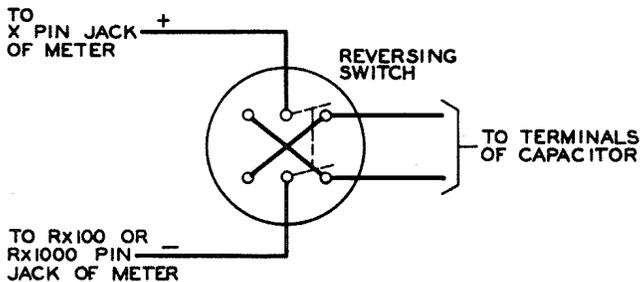


Fig. 9 - Wiring of Reversing Switch

### 3.20 Procedure Using Reversing Switch.

If desired, a reversing switch may be used with the test leads in place of the shorting switch described in Paragraph 3.19. Fig. 9 shows a snap-action double-pole double-throw toggle switch wired as a reversing switch and indicates the connections to the meter and to the capacitor. After these connections have been made, operation of the switch to either position reverses the polarity of the voltage applied to the capacitor by the meter and produces a swing of the meter pointer. Repetitions of the swing may be obtained by operating the switch back and forth until the maximum swing is ascertained. The reading obtained by this method is converted to microfarads by using the dotted curves (B or B') in Fig. 6 or 7.

Since the effective change in voltage across the capacitor when using a reversing switch is twice that obtained when using the uni-polarity short-circuiting switch, the resulting swing of the pointer is approximately doubled for a given value of capacity.

3.21 Leakage Resistance of Electrolytic Capacitors. In measuring capacitance as covered in the preceding paragraphs, the meter needle should return to 0 after the initial swing. In checking electrolytic capacitors, the needle, after its swing, will not return entirely to zero but generally will stabilize at some value above zero, depending upon how completely the film of the capacitor is formed and on its leakage resistance. The amount of leakage resistance in ohms can be read on the ohms scale in the usual manner, i.e., as 100 or 1000 times the actual reading on the meter, depending upon the meter scale used. In using the M9B Meter to measure the leakage of capacitors, a low voltage (4.5 volts) is applied, as compared to the usual operating voltages. Therefore, this test, in general, imposes a less severe condition than the service voltages to which the capacitor is normally connected. Leakage resistance at the low voltage at which the test is made should generally be 100,000 ohms or greater, for capacitors in good condition. The amount of leakage which can be tolerated depends upon the circuit usage of the capacitor. Leakage current, of course, is converted into heat loss in the capacitor, and when appreciable, may hasten the deterioration and failure of the capacitor.

## 4. MAINTENANCE

### (A) Voltage Accuracy

4.01 No regular routine accuracy tests are required but it is recommended that the d-c voltmeter be occasionally checked against a voltmeter of known accuracy. The permissible error is 2 per cent. of full scale, at any point on a scale.

4.02 The a-c voltmeter may be occasionally checked against a voltmeter of known accuracy. The permissible error is 5 per cent. of full scale at any point on the scale.

### (B) Battery Replacement

4.03 The battery should be replaced when it is impossible to adjust the meter pointer to the zero ohms mark when the test leads connected to the X and Rx100 jacks are short-circuited (Paragraph 3.09), or when frequent adjustment of the BATTERY ADJUSTMENT knob is required when measuring resistance. If desired, the voltage of the battery may be measured without removing it from the meter as follows:

- (1) Arrange the meter for d-c voltage measurement.

(2) Connect one test lead to the X pin jack and the other test lead to the 15V pin jack.

(3) Short-circuit the test leads and read the battery voltage on the 0-15 volt scale.

4.04 When replacement of the battery is required, use one of the following 4-1/2 volt batteries which have suitable characteristics and the proper type terminals for use in the meter.

Bright Star	03-17S
Eveready	— 781
Burgess	5360
Ray-O-Vac	531R
Bond	317

4.05 The lower portion of the meter casing is removable from the meter top panel by loosening the four screws which are located on the face of the panel near the edges. The battery slides into a bracket formed to fit the battery and mounted on the rear of the meter housing. The leads to the battery are equipped with spade terminals to fit under the screw terminals of the battery. The RED lead connects to the positive (+) terminal of the battery.

4.06 A coating of nonfluid oil (New York and New Jersey Lubricant Co. No. K-000) is applied to the edges of the casing and panel which fit together, in order to provide a moisture seal. Care should be taken not to wipe off this oil when the case is opened, so that the seal can be maintained when the casing is put back together. A rubber gasket may be provided on some meters in place of the oil or may be obtained if preferred. (Part 6.)

4.07 The screws holding the casing and panel together are 6-32 (.138-32), 5/8" long, oval-head machine screws.

## 5. REPAIR

### (A) General

5.01 The replacement of parts in the field, other than replacement of the battery, is not recommended, since the calibration of the meter may be affected by variations in replacement parts. If, however, parts are removed or replaced for any reason, the following instructions should be carefully followed.

5.02 All apparatus parts are attached to the underside of the top panel of the meter (Fig. 10). This panel may be removed by taking out the four screws which attach it to the meter case. The edges of the panel and case may be coated with oil, or a rubber gasket may be provided in order to moisture-seal the meter. If a coating of oil is used, take care not to wipe it off when removing the top panel or making repairs. The oil used for this purpose and the rubber gasket are listed in Part 6.

5.03 Identification of Leads. If it is necessary to remove parts from the meter for replacement or to remove leads or parts in order to gain access to a defective part, make a record of the connections removed and of the location of any part removed, in order that the connections and parts can be correctly replaced.

5.04 Electrical Connections. When replacing internal wiring, clip the leads as close as possible for satisfactory connection. Take care to use only enough solder to make a secure

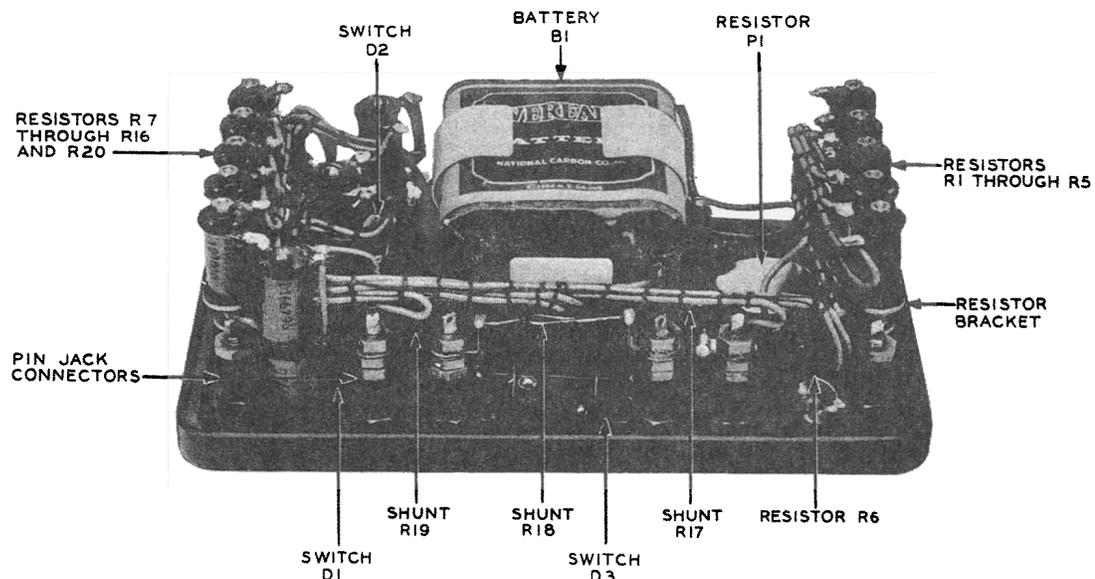


Fig. 10 - Location of Parts of M9B Meter

connection. Do not heat the terminal or connection more than necessary to avoid possible damage to resistors, rectifier, etc.

Caution: Never change the location of parts or wiring leads. Such a change may necessitate complete recalibration of the meter. Never change the length of wiring leads. Use No. 22 gauge wire. Moisture-resistant wire, Western Electric Company D-142203, No. 22 gauge, solid or stranded, or KS-9819 wire is used in wiring the meter; this or its equivalent should be used for repairs.

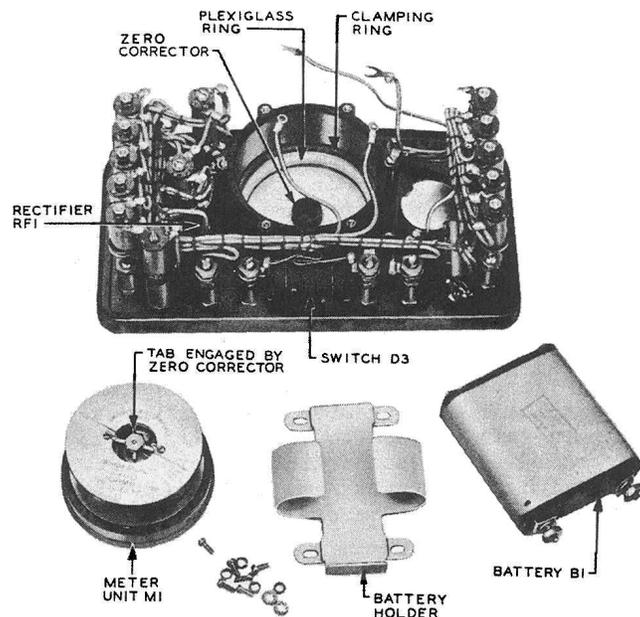


Fig. 11 - Location of Parts of M9B Meter - Battery Holder and Meter Unit Removed

5.05 Replacement of Parts. In replacing parts, take care to replace all parts in the same manner as originally installed. Be particularly careful to replace the phenol-fibre insulating washers and bushings correctly.

#### (B) Meter Unit

5.06 The meter unit is housed within a cylindrical phenol-plastic wall which is part of the top panel (Fig. 11). If it is necessary to remove the meter unit, it must be handled with care, and particular care must be taken when replacing the unit in its housing as covered by Item (6) below. Instructions for removing and replacing the meter unit follow:

- (1) Disconnect the leads from the battery and slide the battery from its holder.

- (2) Remove the battery holder by removing the screws which attach it to the meter unit housing.

- (3) Loosen the two screws which fasten the spring clips and turn the clips clear of the meter unit.

- (4) Note the color of the lead attached to each of the meter terminals on the rear of the meter unit. Disconnect these leads by removing the terminal screws.

- (5) Place the palm of the hand over the meter unit and turn the panel face upward so that the meter unit slides out into the hand.

- (6) Before replacing the meter unit in the housing, carefully note the position of the turned-up brass tab close to the center of the meter assembly which determines the zero setting of the pointer (Fig. 11). This brass tab must be engaged by one of the small slots in the zero corrector which is mounted in the center of the glass meter window. Holding the meter unit face upward in the palm of the hand, carefully slide the meter panel housing down over it in such a way that the relative position of the brass tab and the engaging slot of the zero corrector will be approximately right; then when almost fully in place, carefully turn the meter unit in the housing until the pointer adjusting tab slides into the slot in the zero corrector. If the meter unit face is not lined up straight in the shell, carefully rotate the meter unit in order to position the dial properly, keeping the brass tab and zero corrector engaged. Use care in performing this operation since serious damage may be done to the meter unit by careless or rough handling.

- (7) Holding the meter unit in place, turn the panel face down; reposition the spring clips; replace the meter unit terminal leads, the battery holder, and the battery.

- (8) Replace the panel on the casing, place on a level surface, and adjust the zero reading of the pointers by turning the zero corrector with a screwdriver or small coin.

#### (C) Meter Glass and Zero Corrector

5.07 The meter glass is moisture-sealed to the meter case by caulking between the outer rim of the glass and the case. A light-colored plexiglass ring, within the cylindrical meter unit housing, is held against the window

by a forced-in brass clamping ring. If it is necessary to replace the glass window and zero corrector assembly, proceed as follows:

- (1) Remove the meter unit as covered by Paragraph 5.06 above.
- (2) Using a thin-bladed screwdriver, pry the brass clamping ring away from the inside of the meter unit housing at one point, bending the brass away sufficiently so that long-nose pliers can be inserted to grip it.
- (3) Grasp the bent part of the brass ring with the pliers and remove the ring.
- (4) Turn panel face upward so that the plexiglass ring will slide out.
- (5) From the top of the panel, pry the glass away from the case by inserting a small screwdriver blade or knife blade. Carefully scrape the old caulk from the case.
- (6) Reassembling, seal the glass to the meter case with Hallemite No. 770 caulk mixed with 3 per cent. litharge. If Hallemite caulk is not available, use G.E.Co. Glyptal mixed with enough talc to give it body. Wipe off any excess before it sets.

(7) The clamping ring may sometimes be used again if carefully reshaped with pliers, or a new ring may be used. Push the clamping ring down evenly until it rests firmly against the plexiglass ring. A wooden block, if available, may be used to force the clamping ring in.

(8) Replace the meter unit and adjust the zero reading as covered in Paragraph 5.06, Item (5) through (7) above.

(D) Pin Jacks

5.08 The pin jack assemblies are screwed into drillings in the underside of the top panel. Each pin jack (Fig. 12) consists principally of the outer shell which screws into the panel, the pin jack body, a lock nut, and lock washer. Two lengths of pin jacks are used. Additional washers and nuts are added to the stem of the longer jacks for connecting wires, lugs, etc., as required. A pin jack, if taken

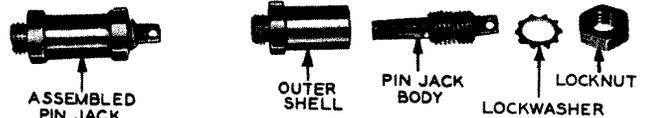
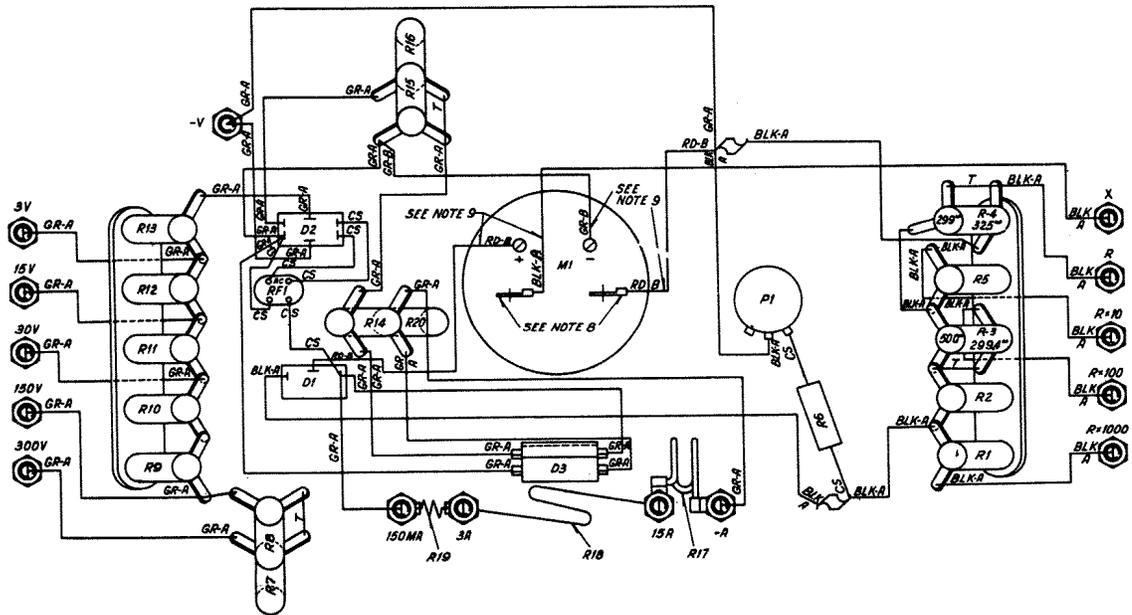


Fig. 12 - Pin Jack Assembly and Parts



- Notes:
1. Wires designated "A" shall be per Spec. KS-9819 #22 AWG Solid Conductor.
  2. Wires designated "B" shall be per Spec. KS-9819 #22 AWG Stranded Conductor.
  3. Wires designated "C" shall be furnished with apparatus.
  4. Wires designated "T" shall be #22 AWG Bare Tinned Copper.
  5. Wires designated "S" shall be covered with No. 17 Varnish Tubing per LRM 186.
  6. All soldering shall be in accordance with Spec. KS-512 Method E, using Solder #13, Flux No. 2.
  7. All connections to be mechanically secure before soldering.
  8. Battery leads shall be arranged so that cord tips do not come into contact with any electrical connections.
  9. No. 11 Varnished Tubing per LRM 186, approx. 1/2 in. long shall be assembled over the ends of these leads and soldered connections.

Fig. 13 - M9B Meter - Wiring Diagram

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apart for repair or inspection, must be carefully reassembled as follows:

- (1) Screw the pin jack into the shell as far as it will go; then back it off a little (not over 1/4 turn).
- (2) Place the lock washer and lock nut on the protruding end of the pin jack and screw the lock nut down to hold the pin jack in place. Use care that the inner part is not turned from the position described in Item (1) above when the lock nut is tightened. If the tips of the inner jack "bottom," they will not grip properly when the pin terminal of the test load is inserted.
- (3) If pin jacks do not grip tightly, the slotted ends of the tips of the pin jack body may be adjusted using pliers at the time that the pin jack is disassembled.
- (4) It is unnecessary to remove the outer shell from the panel in order to inspect the body of the jack. Do not remove the jacks from the panel unnecessarily, as the bushing threads may be damaged by doing this repeatedly or carelessly.

**6. REPLACEMENT PARTS**

6.01 The following is a list of the more readily replaceable parts of the M9B Meter:

<u>Part</u>	<u>Manufacturer and No.</u>
Battery, 4-1/2 volts.	Bright Star 03-17S, Eveready 781, Burgess 5360, Bond 317 or Ray-O-Vac 531R

<u>Part</u>	<u>Manufacturer and No.</u>
Gasket, rubber; for use between top panel and case.	W. E. Co. BA-109230
Meter Unit Assembly (meter movement, scale plates and pointers).	W. E. Co. P-480532
Oil, nonfluid; for moisture-sealing top panel to case.	N. Y. and N. J. Lubricant Co. #K-000
Pin Jack (longer size)	W. E. Co. P-480657
Potentiometer (battery adjustment)	Allen-Bradley J-U1032-Pl4048-4
Resistor; for replacing R-4; may require slight modification of resis- tance of secondary wind- ing to obtain accurate readings on 0-1000-ohm scale.	W. E. Co. D-166804, with secondary wind- ing of 33.5 ohms
Zero Corrector Assembly (zero cor- rector mounted in hardened glass me- ter window)	W. E. Co. P-285979