

35 TYPE TEST SETS

1. GENERAL

1.01 This section describes the Nos. 35C, 35D and 35F test sets used for testing and adjusting relays and other apparatus. Typical testing circuits are also described and the apparatus arrangements are shown for the application of the sets to different kinds of circuit arrangements.

1.02 This section is reissued principally to include information concerning the No. 35F test set, per J947L4B, and to include additional typical circuit arrangements.

1.03 The Nos. 35C, 35D and 35F sets are used for testing and adjusting apparatus on a direct current flow basis. The No. 35D and No. 35F sets can in addition be used in testing and adjusting apparatus on a d-c voltage basis and in measuring external d-c voltages.

2. GENERAL DESCRIPTION OF CIRCUIT AND APPARATUS

No. 35C Test Set

2.01 The No. 35C test set is a testing device by means of which the current to an external circuit can be regulated and is used primarily for making electrical checks of relays and other apparatus for which current flow requirements are specified.

2.02 The principal elements of the set consist of a milliammeter in series with an adjustable resistance for regulating the amount of the current. In addition to these elements, there are keys and switches for setting up the required circuit arrangements, and jacks and binding posts for supplying battery and ground to the set and for connecting the test circuit to the apparatus under test.

2.03 The apparatus is housed in a wooden box with a removable cover. The over-all dimensions of the box proper, with the cover in place, are 11" x 8-7/16" x 6-1/8". The set is equipped with a strap to hold the box in place on a ladder and a carrying handle. Four rubber feet (not shown in Fig. 17) are provided on the side of the set equipped with jacks and binding posts. A circuit label is provided on the inside surface of the cover.

2.04 The switching apparatus which is exposed to view when the lid of the box is removed, is shown in Fig. 17. Two rheostats are

mounted in the rear of the box, and in front of these is a panel which mounts the milliammeter, miscellaneous keys, switches, etc. The circuit arrangement is shown in Fig. 18.

2.05 The milliammeter is a model No. 267 Weston instrument per KS-2777 having 3 ranges, 0-.015, 0-.075 and 0-.750 ampere, and is equipped with a knife edge needle and a mirror. The scale of the meter has an inner and an outer band of lines, each of which contains 75 lines. These two bands of lines are located with respect to each other so that each line in one band of lines bisects the space between two adjacent lines in the other band of lines. Hence for the 0-.015 ampere range the distance between two adjacent lines, that is, one line on the outer band and the next line on the inner band, will represent .015 ampere divided by 150 or .0001 ampere. In like manner the distance between two adjacent lines for the 0-.075 range will be .0005 ampere, and for the 0-.750 range .005 ampere. The change of ranges is made by the key designated MIL-AMPS, the designations 15, 75 and 750 indicating the position of the key for each scale range. This key is non-locking in the position designated 15 and 75 so as to safeguard the instrument as much as possible against excessive current flow.

2.06 Referring to the test circuit, Fig. 18, it will be noted that one side of the milliammeter is connected to the black rheostat, which is equipped with four slides; that is, the test set is arranged so that four different and independent current flow values may be set up at one time. Two of these slides are wired directly through telegraph keys 1 and 2 to slides of the red rheostat and the other two are connected through other resistances, external jacks and telegraph keys 3 and 4 to the other two slides of the red rheostat. The slides are numbered 1, 2, 3 and 4 to indicate with which telegraph key each is associated. Each telegraph key is equipped with a short-circuiting switch so that, if desired, a steady current can be maintained while setting the rheostats. It is also possible to use a combination of keys to meet certain specified conditions. For example, a release current flow value may be set up on one of the keys and the short-circuiting switch for this key should be operated while an operating current flow value is set up on one of the other keys.

- 2.07 The two rheostats are mounted end to end at the rear of the panel. The long rheostat equipped with the black slides is of the slide wire coil type having a minimum of 1150 ohms resistance with approximately 2 ohms per turn. The short rheostat equipped with the red slides is a drum made up of an assembly of circular insulated contact rings which are connected to spool resistances of 1000 ohms each, giving a range of 0 to 28,000 ohms in 1000-ohm steps.
- 2.08 Each of the circuits through telegraph keys 3 and 4 passes through a series of 38-type resistances totaling 500,000 ohms and the normally closed contacts of a cutoff jack through which the circuit may be connected to a remote control key or other external circuit, as, for example, some machine controlled interrupter. The resistances can be cut out by means of a series of single pole, double throw knife type switches. Each switch has a designation for each position which indicates the amount of resistance in the circuit. The front set of three switches designated 3 is associated with telegraph key 3 and the back set of switches designated 4 is associated with telegraph key 4.
- 2.09 In addition to the knife switches just mentioned there is a knife switch designated G which is effective only when the BAT & GRD CO key is operated. If the latter key is operated and the G switch is open, a metallic circuit is closed through the milliammeter, but if the G switch is operated toward the position marked GRD, ground is connected to one side of the milliammeter. Another knife switch, designated L, is provided to control the sleeve condition of the T&R jack and is used primarily in the testing of supervisory relays. With this switch normal there is a 500-ohm resistance in the sleeve circuit. When the switch is operated in the direction marked 10, a 10-ohm resistance is placed in parallel with the 500 ohms and when operated in the direction marked 500 & LAMP a local circuit is closed through the signal lamp. The signal lamp can be connected in the circuit in various ways to indicate contact closure.
- 2.10 The reverse key, designated REV, is used to reverse the leads to the apparatus under test by reversing the tip and ring leads of the T&R jack.
- 2.11 Each of the leads to the milliammeter and rheostat is equipped with a fuse. On the later sets, these fuses are No. 24D, 3/4 ampere, whereas previously they were No. 24B, 1/2 ampere. These fuses are mounted on the panel in the rear of the milliammeter so as to be readily replaceable.
- 2.12 Connection to the test set is made through the jacks and binding posts shown in Fig. 17. The jacks are grouped under two designations, TEST and SIGNAL. Except for the two jacks designated EXT KEY, either jack under each designation can be used interchangeably, depending upon the type of plug employed, the top row taking the 310-type and the bottom the 309-type plug. The EXT KEY jacks each take the 310-type plug.
- Note: The No. 309 and No. 310 replaced the No. 109 and No. 110 plugs, respectively.
- 2.13 The EXT KEY jacks are designated 3R and 4W. The numbers 3 and 4 indicate with which telegraph key each jack is associated and the R and W designations are provided to enable the maintenanceman to properly associate the red and white plugs of the 32C test set cord which is used for external control. The white plug should be inserted in the 4W jack and the red plug in the 3R jack.
- 2.14 The S jack is provided, primarily, for testing cutoff relays in subscriber line circuits and sleeve relays in cord circuits when the tests are made from the front of the switchboard.
- No. 35D Test Set
- 2.15 The No. 35D test set retains all the circuit features of the No. 35C set in precisely the same form as regards circuit arrangements and designations. In this way all maintenance instructions covering the No. 35C set will apply without change to the No. 35D set. Certain new circuit features, principally the ability to read voltage, have been added and the equipment arrangements have been improved, as described in the following paragraphs. The detailed circuit arrangement is shown on Drawing SD-96003-01. The essential features of the circuit are shown on Fig. 20 of the section.
- 2.16 The type and general arrangement of the keys, switches, jacks, rheostats, etc., is the same as for the No. 35C set. The housing employed and the mounting of the apparatus within the set, however, are entirely different.
- 2.17 The No. 35D set employs the "B1" size aluminum alloy casing and is equipped with an aluminum alloy removable cover. Two aluminum bars are provided on the front of the casing to act as feet when the set is placed on its side. As in the case of the No. 35C set, a carrying handle and ladder strap are provided, and a circuit label is attached to the inner

surface of the cover. A name plate, inscribed No. 35D TEST SET J94714A, is provided on one end of the set. The over-all dimensions of the set proper, with the cover in place are 12-1/16" x 9-7/16" x 6". The weight of the set is approximately 16 pounds, a decrease of about one pound over the No. 35C set. The top and front views of the set showing the arrangement of the external apparatus are shown in Fig. 19.

2.18 The apparatus is mounted on the top panel or on mounting plates attached to the panel. When the panel is removed from the casing the apparatus becomes readily accessible for maintenance.

2.19 The location of the apparatus on the top panel of the No. 35D test set is the same as that for the No. 35C test set except that on the No. 35D set the lamp has been removed from the key mounting position in front of the BAT & GRD CO key and placed between the lever type keys and the meter. In place of the lamp is mounted an additional key designated VM at the rear and 3MA at the front, for use with the meter as noted below. The scale change key previously designated MIL-AMPS, and with the three positions from front to rear marked 75, 750 and 15, respectively, has had added to it, as shown in Fig. 19, the designation VOLTS and the positional markings 75, 300 and 15. The old designation 15 has been changed to 15(3). These new designations are for use when the set is employed to make voltage readings or when using the 3 milliamper scale.

2.20 In addition to the binding posts provided on the No. 35C set, the No. 35D set has a binding post connected to the sleeve of the TEST BAT & GRD jack and designated S1. By strapping this binding post to the L1 binding post the sleeve of a cord connected to the TEST BAT & GRD jack can be connected to the sleeve of the TEST T&R jack. This path is through the 10-ohm resistance with the L switch operated to the 10 position.

2.21 The meter provided is a model No. 267 Weston volt-milliammeter per KS-7436, which with its associated circuit provides for the making of voltage readings as well as milliamper readings. The voltage ranges are 0 to 15, 0 to 75, 0 to 300. As a milliammeter a range of 0 to .003 ampere is provided in addition to the 0 to .015, 0 to .075, and 0 to .750 ampere ranges provided for the No. 35C test set.

2.22 The meter scale itself has, like that of the No. 35C test set, an inner and outer band of 75 lines. The inner lines bisect the spaces between the outer lines thus producing in effect a 150-line scale. Three series of

range designations are provided. The inner scale is designated 0 to 3, the middle scale is designated 0 to 15, and the outer scale is marked 0 to 75. For the 0 to 750 milliamper range the outer scale readings are multiplied by 10 and for the 0 to 300-volt range the inner scale readings are multiplied by 100. The scales to be used and the multiplying factors are indicated in the table below. This information is also shown on the circuit label provided on the inside of the test set cover.

<u>Milliamperes</u>	<u>Scale</u>
0 to 750	Outer scale x 10
0 to 75	Outer scale
0 to 15	Middle scale
0 to 3	Inner scale
<u>Volts</u>	<u>Scale</u>
0 to 300	Inner scale x 100
0 to 75	Outer scale
0 to 15	Middle scale

2.23 When the set is used as a milliammeter the selection of the 15, 75, and 750 milliamper ranges is made in the same way as for the No. 35C set. An additional key position, designated 3MA, is provided to set up the circuit for the 0 to 3 milliamper range. In order for this key position to be effective, however, the 15(3) key must also be operated. This is to guard against possible damage to the meter which might occur if the scale were controlled by a single key. When using the 3 milliamper range each scale line represents .02 milliamper.

2.24 The key position designated VM provides for changing the circuit setup to read voltage instead of current. With this key operated, the voltage ranges desired can be selected by operating the scale change key to the 15, 75 or 300 position, respectively. The operation of the scale change key changes the value of a multiplier resistance in series with the .003 ampere winding of the meter.

2.25 When the VM key is operated, the voltmeter is connected in the circuit in either of two ways, depending upon whether the BAT & GRD CO key is normal or operated. If the latter key is normal, the negative side of the voltmeter is connected through normally closed contacts of the REV key to the tip of the T&R jack and the positive side of the instrument is connected through normally closed contacts of the REV key to the ring of the T&R jack. If the BAT & GRD CO key is operated the positive side of the instrument is connected in the same manner, but the negative side is connected to the battery lead of the BAT & GRD jack.

2.26 Under this arrangement, if the proper connections are established to the set for reading milliamperes, the voltage applied to the apparatus under test can be determined by merely operating the VM key. The scale change key should also be operated, in addition, for the smaller values of voltage.

No. 35F Test Set

2.27 The No. 35F test set replaces the No. 35D set. The principal differences between the No. 35F and the No. 35D sets are that the No. 35F test set makes use of the Western Electric Company D9A meter in place of the Weston meter per KS-7436 in the No. 35D set and also uses 107A resistances associated with the telegraph keys 3 and 4 in place of the 38-type used in the No. 35D set. The knife switches described in 2.08 and 2.09 have been replaced by toggle type switches on the No. 35F test sets.

2.28 The description of the No. 35D set in 2.15 to 2.26, inclusive, and all maintenance instructions apply without change to the No. 35F test set and the apparatus arrangement and circuit arrangement for the No. 35F set is shown in Figs. 21 and 22.

3. TYPICAL TEST ARRANGEMENTS

35 Type Test Set Used as Milliammeter

3.01 Figs. 1 to 8 show typical test arrangements which can be obtained with the No. 35C test set for use in reading current. These figures apply to the 35D and 35F test sets also, except that the detailed arrangement of the wiring at the BAT & GRD CO key is slightly

different. The figures show how the connections are made and which keys must be operated for each arrangement. The dotted wiring in each case indicates the part of the test set wiring which is not used. It should be understood, however, that other test arrangements are possible using the various jacks, binding posts and test cords in different combinations. If connection is made to the contacts or winding terminals of a relay, the 2W17A cord equipped with the proper connecting tools may be used. Where a winding of a polarized relay or other apparatus is connected directly to the terminals of a jack, use an appropriate cord and plug inserted into that jack for connecting the relay to a test set. If the relay is in the tip or ring of a cord circuit, the cord can be inserted directly in the T&R jack. If the relay is connected to the sleeve, the cord can be connected to the S jack. Battery and ground can be supplied to the test set by patching from a battery supply jack to the TEST BAT & GRD jack or, if battery supply jacks are not available, the 2W17A cord equipped with the proper connecting tools may be used to pick up battery and ground at the most convenient place. Battery and ground may also be supplied by plugging a common battery switchboard cord directly into the TEST BAT & GRD jack. In dial offices having battery connected to tip and ground to sleeve of battery supply jacks, use the 2P10B cord; connect the end with the 309 type plug to the test set.

3.02 Fig. 1 shows the test arrangement where the relay has neither battery nor ground connected to its winding. The current through the relay may be reversed by operating the REV key. This is a necessary requirement when testing polarized relays.

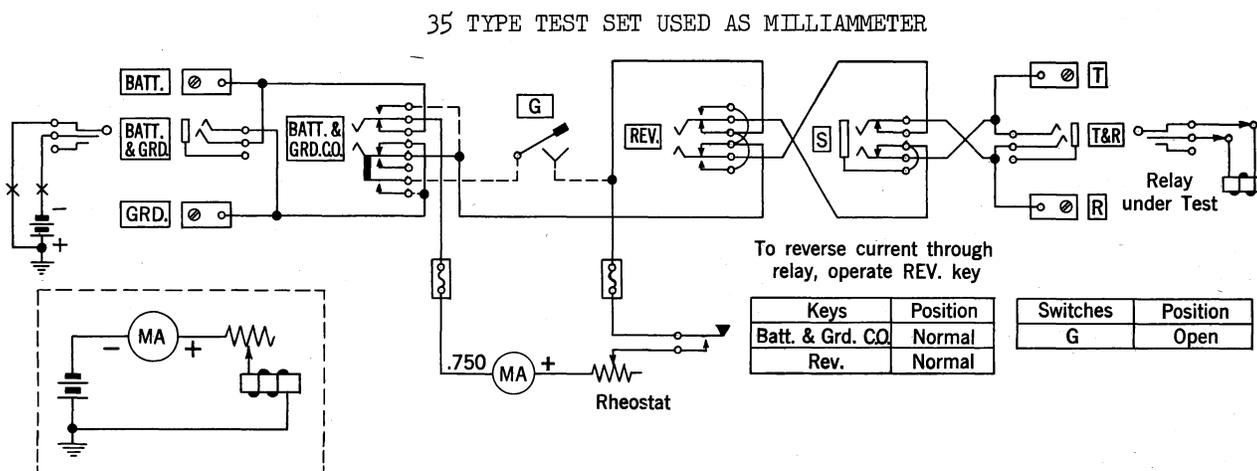


Fig. 1 - Neither Battery nor Ground on Relay Winding

"B/G" (Battery and Ground) Application

3.03 Fig. 2 shows the test arrangement where one side of the winding of the relay is grounded. It should be noted that the REV key must be normal if the tip of the patching cord is connected to the relay or operated if the ring is connected to the relay.

3.04 Fig. 3 shows the test arrangement where one side of the winding of the relay is connected to battery. It should be noted that the REV key must be normal if the ring of the patching cord is connected to the relay or operated if the tip is connected to the relay.

3.05 A modification of test arrangements 2 and 3 consists in employing the unused conductor of the patching cord to pick up battery

or ground as required, and then using the test arrangement shown in Fig. 4.

3.06 Fig. 4 shows the test arrangement for a relay with both battery and ground connected to it. Where positive battery is connected to the relay the REV key must be operated.

3.07 Fig. 5 shows the test arrangement where one side of the relay winding is connected to positive battery. It should be noted that the REV key must be normal if the relay winding is connected to the tip of the patching cord or operated if it is connected to the ring, and that ground must be connected to the ring of the BAT & GRD jack of the test set.

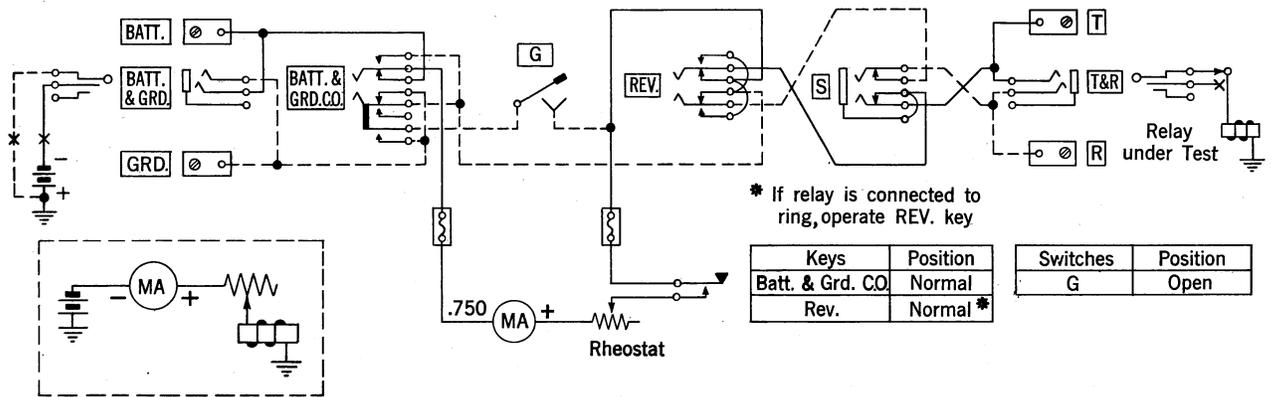


Fig. 2 - Ground on Relay Winding

"BATT" (Battery) Application

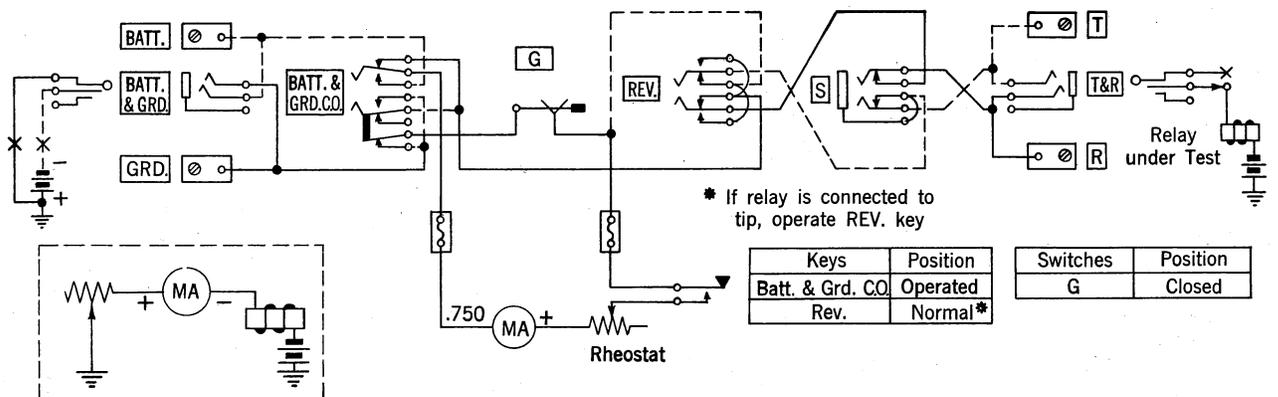


Fig. 3 - Battery on Relay Winding

"GRD" (Ground) Application

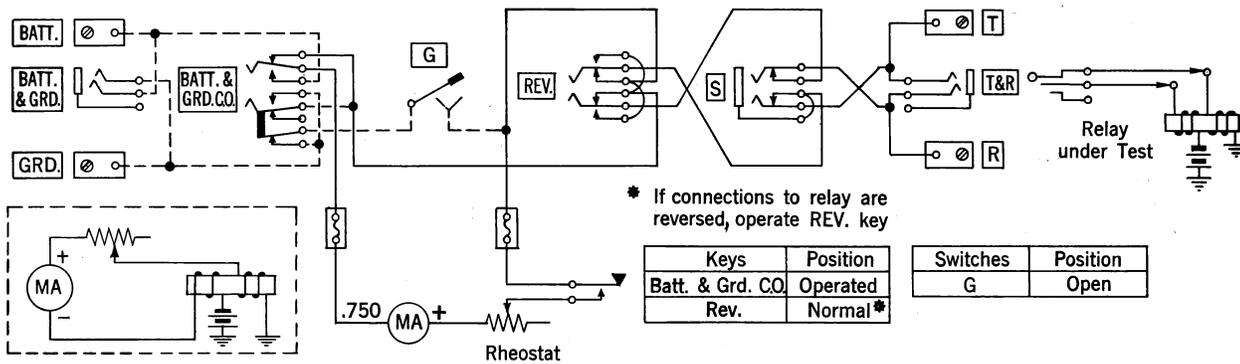


Fig. 4 - Battery and Ground on Relay Winding

"M" (Metallic) Application

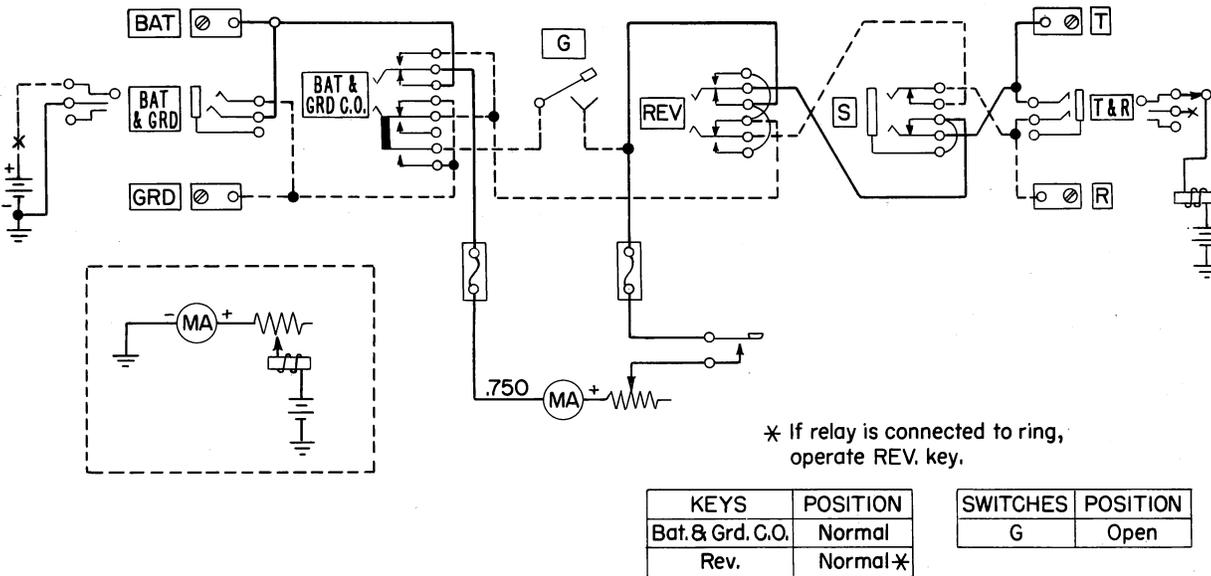


Fig. 5 - Positive Battery on Relay Winding

"-GRD" (Negative Ground) Application Where Positive Battery Is Used

3.08 Fig. 6 shows the test arrangement where one side of the relay is connected to ground and positive battery is supplied by the test set. In this case it should be noted that with the REV key normal the relay winding must be connected to the ring of the patching cord or if the relay winding is connected to the tip, the REV key must be operated. It should also be noted that the positive battery must be connected to the tip of the BAT & GRD jack of the test set.

3.09 Fig. 7 shows the test arrangement where one side of the relay is permanently connected to 24V battery (negative). This arrangement is used to apply a soak to the relay in the reverse direction to the operating current. The change in the direction of current flow through the relay is obtained by operating, in the order named, first the REV key and second the BAT & GRD CO key. It should be noted that if the BAT & GRD CO were operated first, or alone, a reverse full soak circuit condition exists.

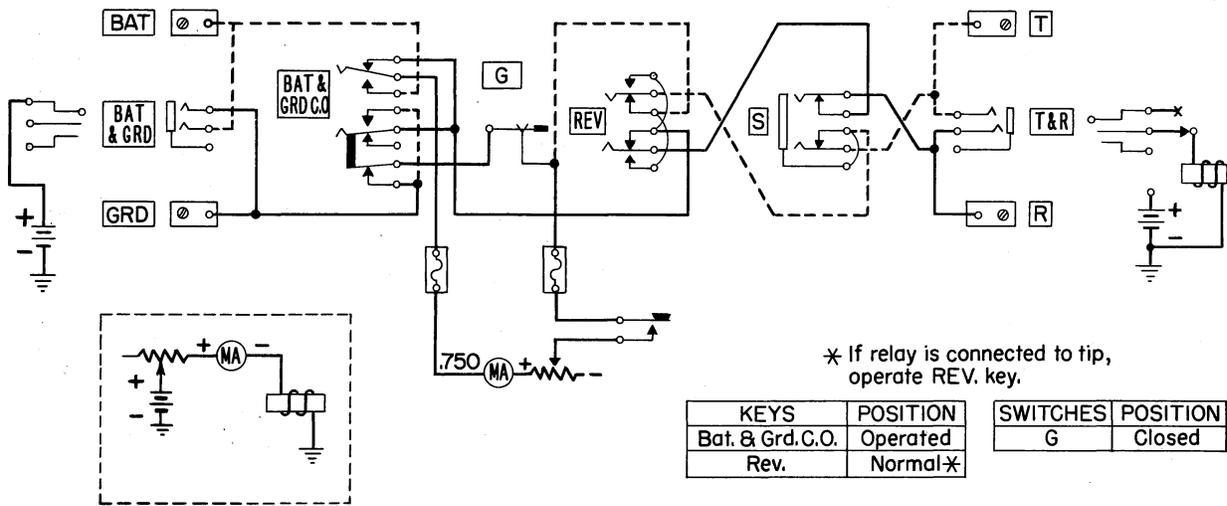


Fig. 6 - Ground on Relay Winding Where Positive Battery Is Used

"BATT" (Positive Battery) Application

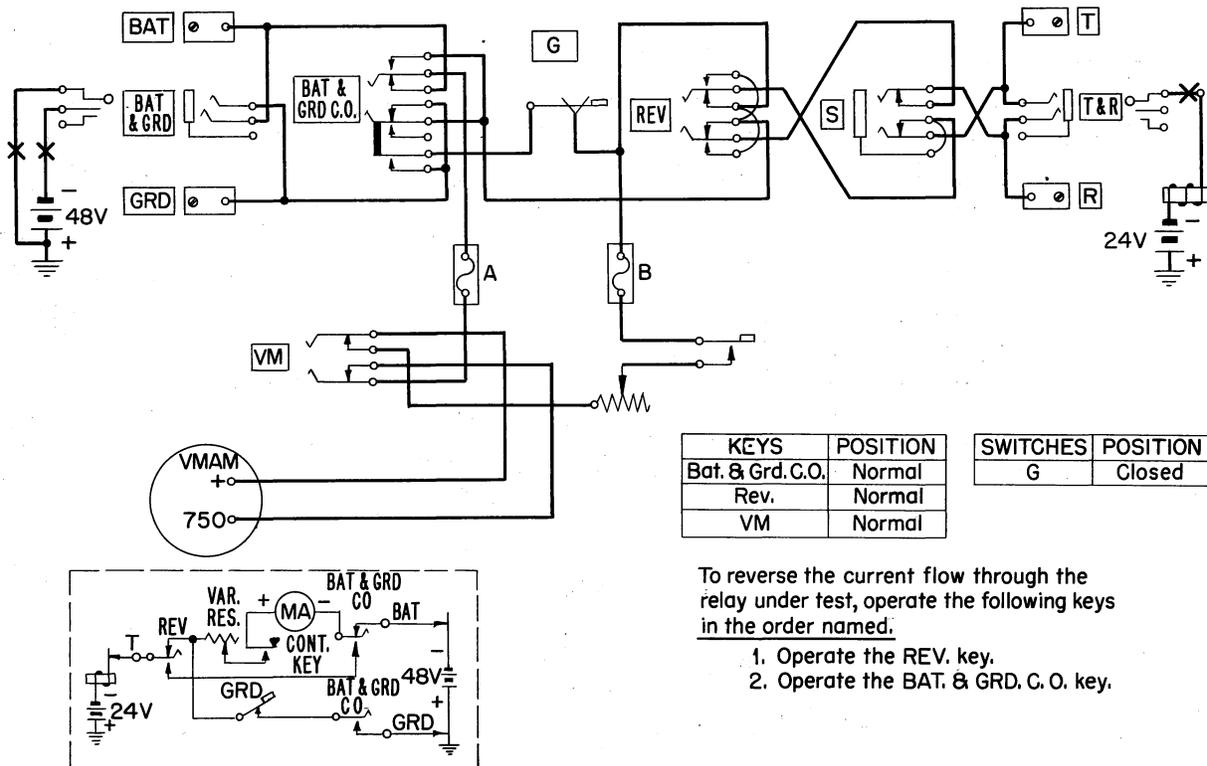


Fig. 7 - 24V Permanently Connected to the Relay

"ABG" (Alternate Battery and Ground) Application

3.10 Fig. 8 shows the test arrangement for non-grounded battery generally used where a relay is wired in the circuit in such a manner that one side of its winding is connected to a commonly wired lead which would have to be removed or opened at the fuse panel to permit making current flow tests. The non-grounded battery may be positive or negative as required by connecting the BAT lead of the test box to the positive or negative side of the battery as desired.

3.11 Fig. 9 shows a typical arrangement for using the lamp signal to indicate contact closure. Because of the flexibility of this feature, other arrangements are possible, and in each particular case the most convenient one should be used. The 10 and 500-ohm resistances associated with the L switch have been provided to approximate the sleeve condition of various cord circuits. The 10-ohm value was chosen for testing "A" cord supervisory relays, since ground is usually supplied through the tip of another "A" cord, in which case the normal 34-ohm sleeve is approximated.

35-Type Test Sets - Voltage Applications

3.12 The No. 35D and No. 35F test sets can be used as voltmeters in two different ways; one in applying voltage requirements to relays or other apparatus, the other in reading the value of an external voltage.

3.13 Figs. 10 to 13 show typical test arrangements where the No. 35D or No. 35F test sets are used in applying voltage requirements. The external connections and the setting of the keys and switches for Figs. 10 to 12 are the same as when current measurements are made as shown in Figs. 1 to 3, respectively, except that the VM key is also operated. Under these conditions the resistance slides and switches are effective in adjusting the voltage applied to the apparatus being checked. The applied voltage is then shown directly by the meter. The figures 10 to 12 also include brief circuit arrangements as applied to the No. 35C test set using an external voltmeter.

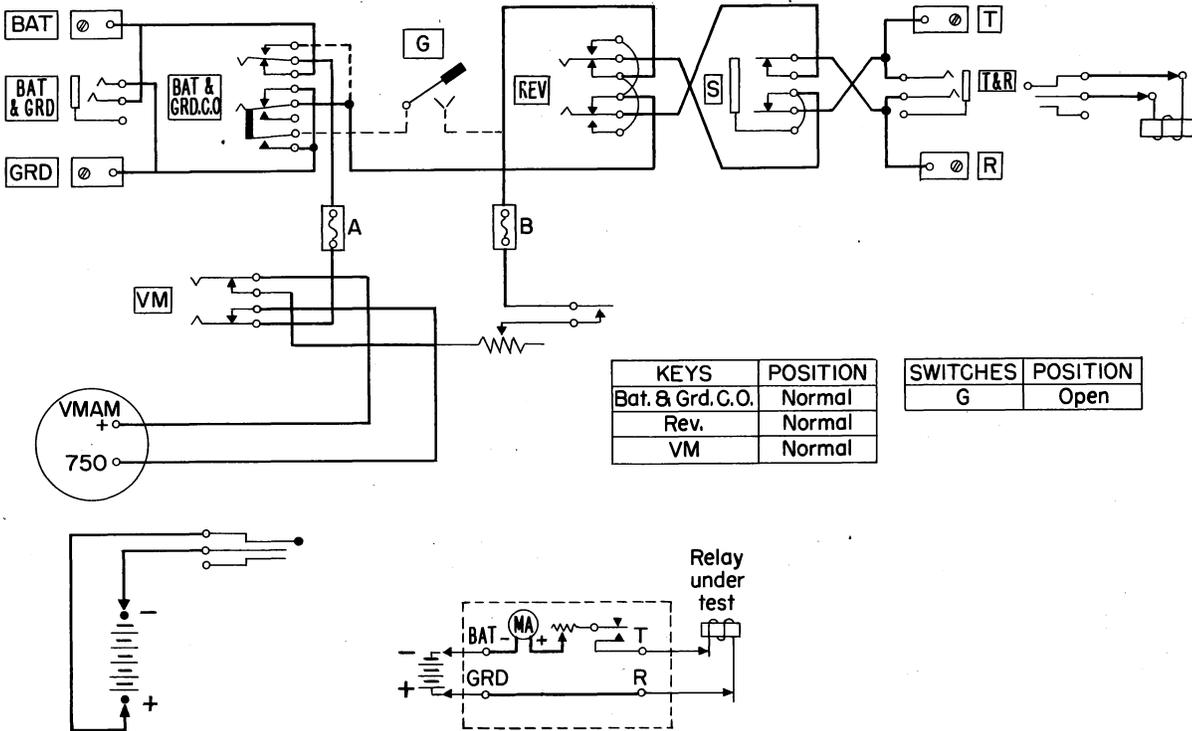
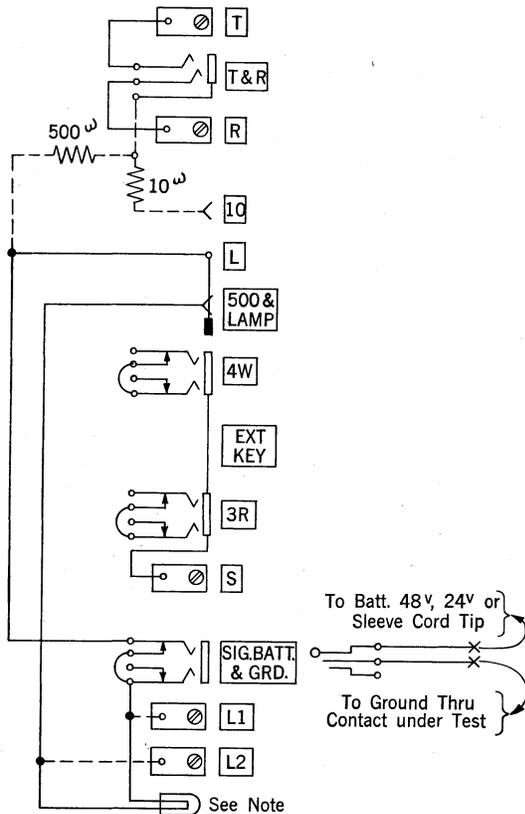


Fig. 8 - "NGB" (Non-Grounded Battery) Application



NOTE:
Choose type of lamp to be used in accordance with the following:-

Voltage across lamp	Type of lamp
12	2-F
24	2-G
48	2-T

Fig. 9 - Using Lamp Signal to Indicate Contact Closure

3.14 Fig. 13 shows the circuit arrangements for using auxiliary batteries to facilitate providing the required voltages across the circuit so they may either aid or oppose the office battery voltage.

3.15 Fig. 14 shows the test arrangements when it is desired to read the voltage of an external source. The source of voltage to be measured is connected to the TEST T&R jack normally with the negative side connected to the tip and the positive side connected to ring. If the polarity is reversed with respect to tip and ring, it will be necessary to operate the reverse key to pole the meter in the proper direction.

3.16 Fig. 15 shows the test arrangements when it is desired to read the voltage of an external source with a specified load condition as, for instance, in checking that the voltage of a dry cell battery does not fall below a specified amount with a certain drain on the battery for a designated time. The procedures under this condition are covered under 4. METHOD OF OPERATION.

3.17 The resistance of the set when used as a voltmeter is approximately 100,000 ohms for the 300-volt scale, 25,000 ohms for the 75-volt scale and 5000 ohms for the 15-volt scale. Thus the nominal rating is 333 ohms per volt.

4. METHOD OF OPERATION

4.01 The first step in the use of the test set consists in ascertaining what test arrangement is most suitable for the particular apparatus under test. After making sure that all of the short-circuiting switches of the telegraph keys are open and the slides of both rheostats are in their extreme right position, the test set can be patched and the keys and switches operated as required by the test arrangement to be used. These precautions should be observed in order to avoid injuring the meter.

4.02 The short-circuiting switch of one of the telegraph keys should be operated and the corresponding slides moved until the desired current or voltage is obtained. Care should be taken not to operate the VOLTS-MIL-AMPS key until the reading of the meter indicates that the current or voltage is less than the full scale reading of the range to which transfer is to be made. After the proper value of current or voltage has been set up the short-circuiting switch should be restored and the desired condition can be applied as required by depressing the proper telegraph key.

4.03 The minimum current for which circuits 1 and 2 can be used is slightly less than .002 ampere on 48 volts or .001 ampere on 24 volts. For lower current values it is necessary to use circuits 3 and 4 with which are associated the additional resistances controlled by the knife switches designated 3 and 4. The maximum resistance of the rheostat should be in the circuit before operating these knife switches so as to guard as much as possible against injury to the meter.

4.04 In applying voltage requirements there may be conditions involving apparatus of relatively low resistance with comparatively low voltage requirement values where the

desired voltage reading can not be obtained with the variable resistance units provided in circuits 1 and 2. In such instances it will be necessary to use circuit 3 or 4 and add additional resistance controlled by the knife switches 3 and 4.

4.05 When using the No. 35D or No. 35F test set as a voltmeter care should be exercised that the scale change key is in its normal position whenever the VM key is restored to normal in order to avoid possible damage to the meter.

4.06 A reasonable amount of care should be exercised in adjusting the sliders of the 35D and 35F test sets in applying voltage requirements to avoid currents of such magnitude as to operate the test set fuse. If the sliders are moved to the left only to the point where the specified voltage value is observed on the meter, the current will ordinarily be

well within the capacity of the fuse. However, if the sliders are moved still further to the left to the extent that the observed voltage is close to the voltage value of the current supply, the total resistance may be low enough for the fuse to operate. This condition can, of course, exist only when the apparatus being adjusted becomes short-circuited or is of relatively low resistance.

4.07 When manual remote control is desired the 32C test set should be patched to jacks 3R and 4W. When mechanical remote control is desired one of these jacks should be patched to the jack wired to the mechanical controlling device. Wherever possible the current value should be adjusted with the external controlling device in the circuit.

4.08 Fig. 16 shows the cord and plug assemblies ordinarily used with the test sets. Other arrangements are of advantage in special cases.

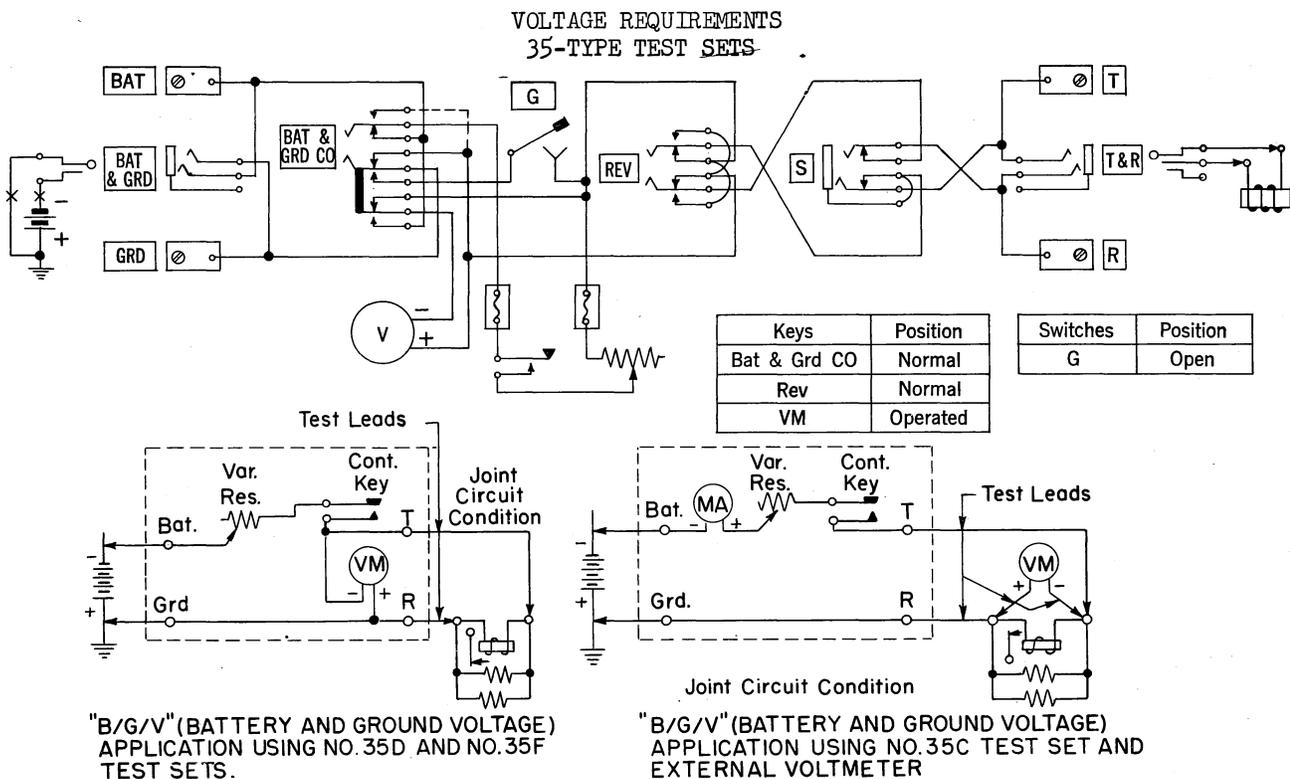


Fig. 10 - Neither Battery nor Ground on Relay Winding

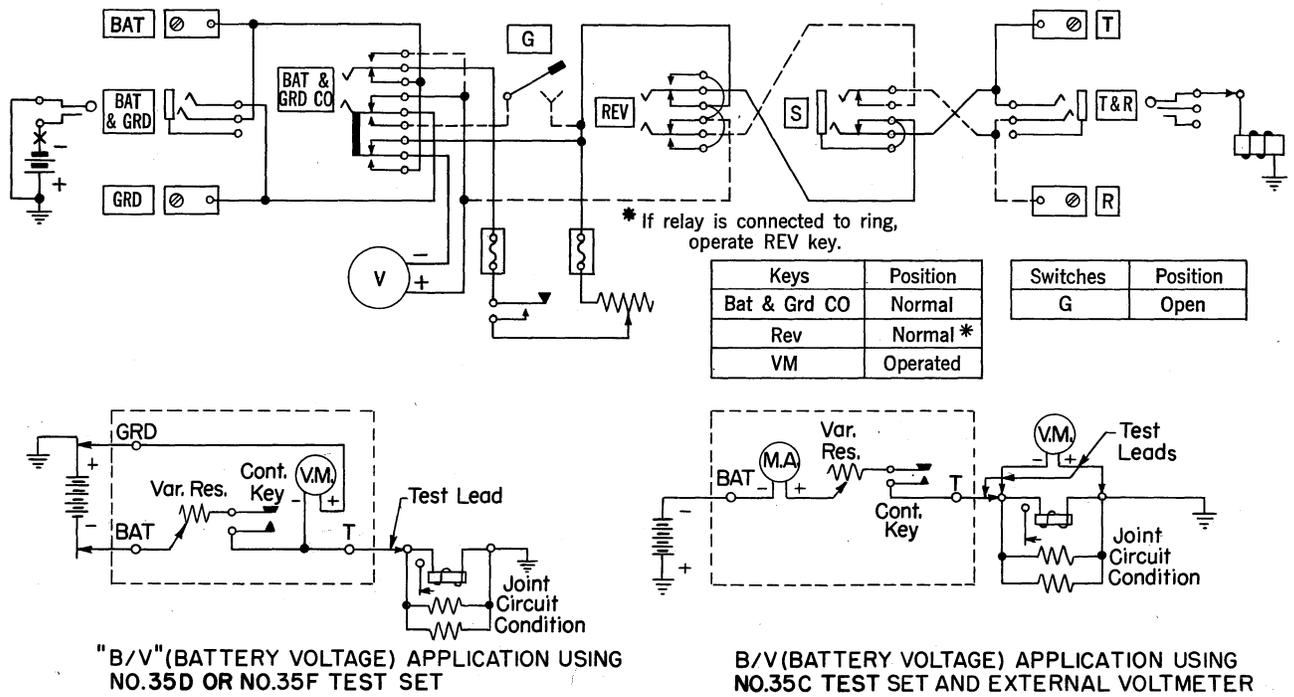


Fig. 11 - Ground on Relay Winding

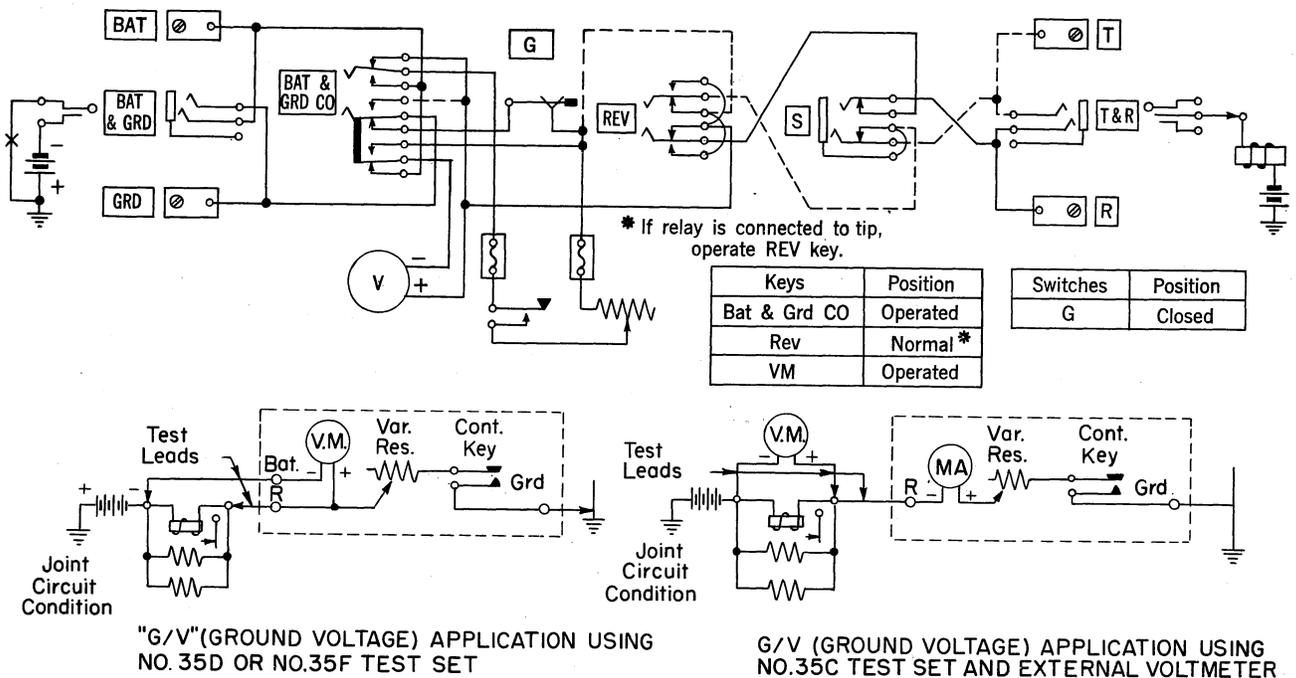


Fig. 12 - Battery on Relay Winding

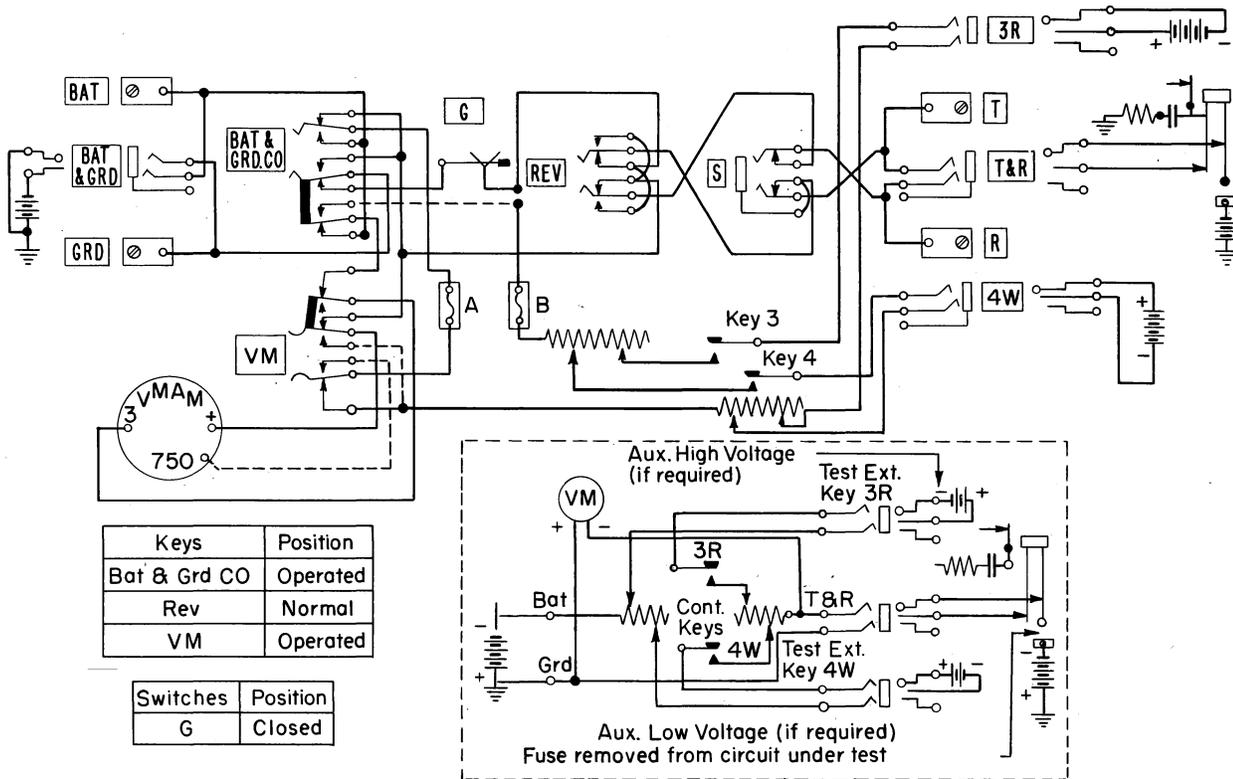


Fig. 13 - "F/V" (Fuse Voltage) Application Using No. 35D or No. 35F Test Set with Fuse Removed from Circuit Under Test

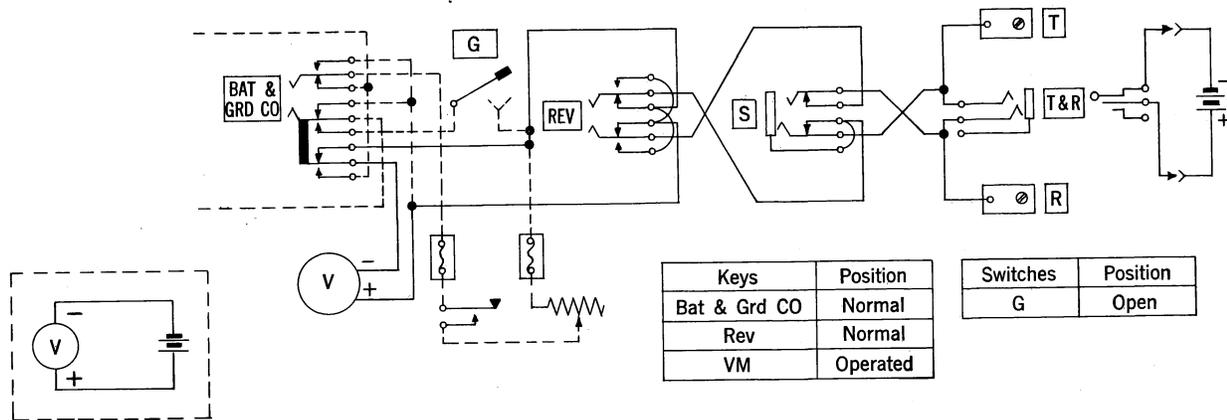


Fig. 14 - Measurement of External Voltages - No. 35D or No. 35F Test Set

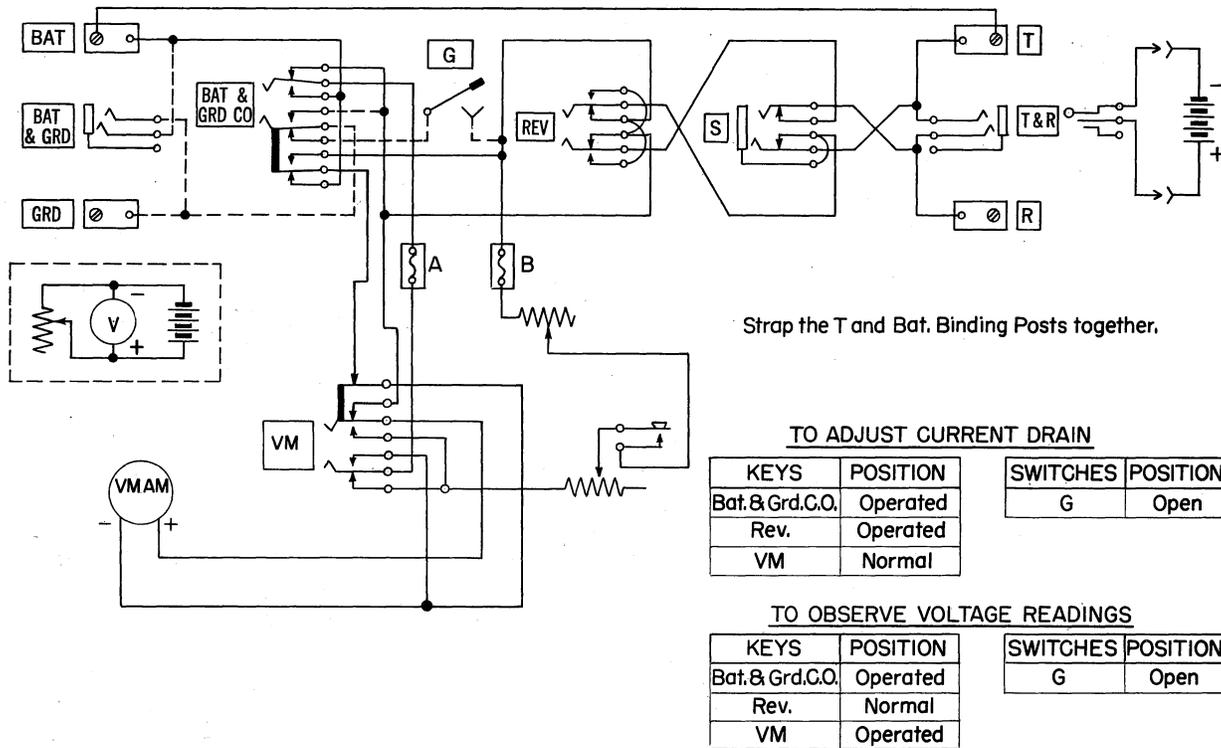


Fig. 15 - Measurement of Dry Cell Voltages with Resistance Load Applied by Test Set - No. 35D or No. 35F Test Set

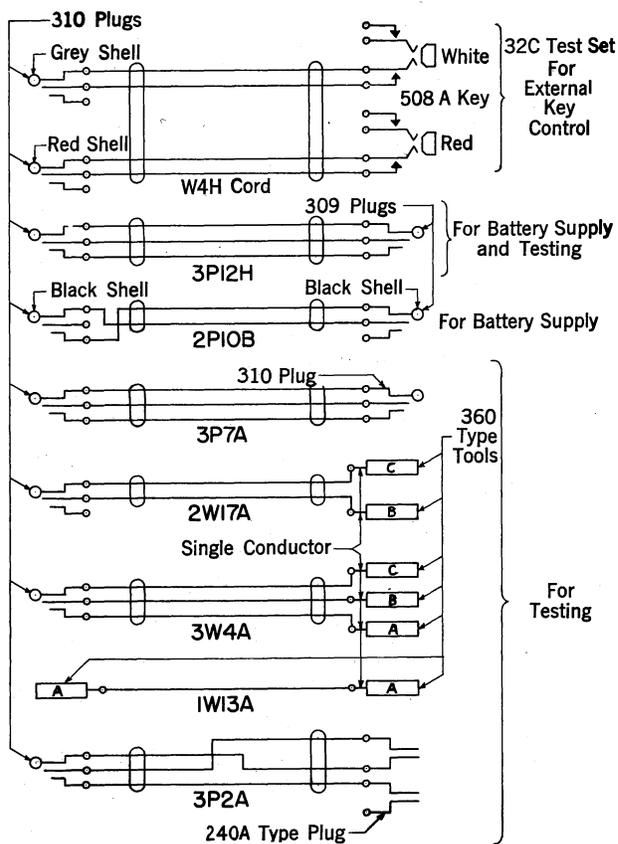


Fig. 16 - Cords Used with No. 35-Type Test Sets

4.09 ^{see addendum} The No. 360-type tool shown in Fig. 11 is designed for connecting the cords to various other tools used in making connection with apparatus contacts and terminals, and is provided with a colored sleeve to indicate the cord conductor with which it is used.

Code	Conductor	Color
360A	Sleeve	Red
360B	Ring	Black
360C	Tip	White

4.10 The following tools have been made available for association with the 360-type tools of the cords noted, principally for the uses indicated. Certain details relative to these tools, together with information concerning additional tools which may be made available subsequently, are covered in other sections of this division.

(a) 357 tool; for making connection to sequence switch and other apparatus springs.

(b) 361B tool; for making connection to windings of E, R and similar type relays, from the front of the relay.

- (c) 364 tool; spade terminal for making connection to screw terminals, binding posts, etc.
- (d) 365 tool; suspender clip type of connector for general usage.
- (e) 387A tool; for making connection at 111-type cutoff relays to the windings of the associated line relay.
- (f) 411A tool; a test pick connector for general usage.
- (g) 419A tool; a spring clip for use in making connections to various types of apparatus springs and terminals.
- (h) 428A tool; for making connection to windings of 89, 111, 149 and various other relays, from the front of the relay.
- (i) KS-6278 tool; a suspender clip type of connector, narrower than the No. 365 tool, for use where close clearances between apparatus terminals are encountered.
- (j) 509A tool; for making connections to the windings of U and Y type relays.
- (k) 547A tool; for connecting to the windings of 245, 254 and similar type relays, 300-type switches and No. 1 and No. 2 timers.
- (l) 548A tool; for connecting to 300-type and similar switches.
- (m) 607A tool; (Replaces the R-2736 winding connector) for connecting to the windings of U, Y, UA and UB type relays.

Determining Resistance Values with No. 35D and No. 35F Test Sets

4.11 The No. 35D and No. 35F test sets afford an easy means of determining the value of the resistance of a piece of apparatus. Under one of the circuit arrangements shown in Fig. 1, 2 or 3, a convenient value of current can be set up through the apparatus and then by operating the VM key the corresponding voltage at the apparatus terminals is determined. The resistance can then be obtained in accordance with Ohm's law, i.e., the resistance in ohms equals the voltage divided by the current in amperes. This method should be sufficiently accurate to be satisfactory for checking the values of resistance when the limits are not closer than $\pm 5\%$.

Use of the 35-Type Test Set as a Variable Resistance

4.12 The 35-type test set can be used in setting up a predetermined value of resistance for testing purposes in cases where the test value involves limits of not closer than $\pm 5\%$ as covered in Section A304.015.

Measurement of Dry Cell Battery Voltages with a Specified Current Drain

4.13 When it is desired to determine the voltage of a dry cell battery with a specified current drain on the battery, circuit arrangements are set up as shown in Fig. 15, using the No. 35D or No. 35F test set.

4.14 If the condition of load for the battery is specified in terms of resistance instead of current, it is first necessary to determine the corresponding current. This can be done by obtaining the approximate "open circuit" voltage of the battery and then applying Ohm's law, using the resistance value specified, that is, the current in amperes equals the voltage divided by the resistance in ohms. The desired open circuit voltage will be indicated on the meter if, with conditions established as shown in Fig. 15 and with all sliders to the extreme right, one of the telegraph keys is depressed. There is some slight load on the battery at this time due to the current flowing through the voltmeter, but the reading observed will be satisfactory for the purpose desired.

4.15 The required current drain condition as specified or as determined above, is established by restoring the VM key to normal, operating the REV key and then operating one of the telegraph keys, and moving the associated sliders to the left until the proper current is indicated by the meter. It is desirable to maintain the circuit for as short a time as possible in setting up the current to avoid unnecessary drain on the battery.

4.16 After the desired setting of the sliders for the proper current drain is obtained the REV key is restored and the VM key is re-operated. This changes the circuit setup so that the meter will read the voltage across the terminals of the battery. The value of the resistance connected across the battery under control of the telegraph key is not changed sufficiently by the operation of the VM key to affect the results obtained.

4.17 The telegraph key can then be reclosed to apply the load for any specified time interval, during which the battery voltage will be observed on the meter.

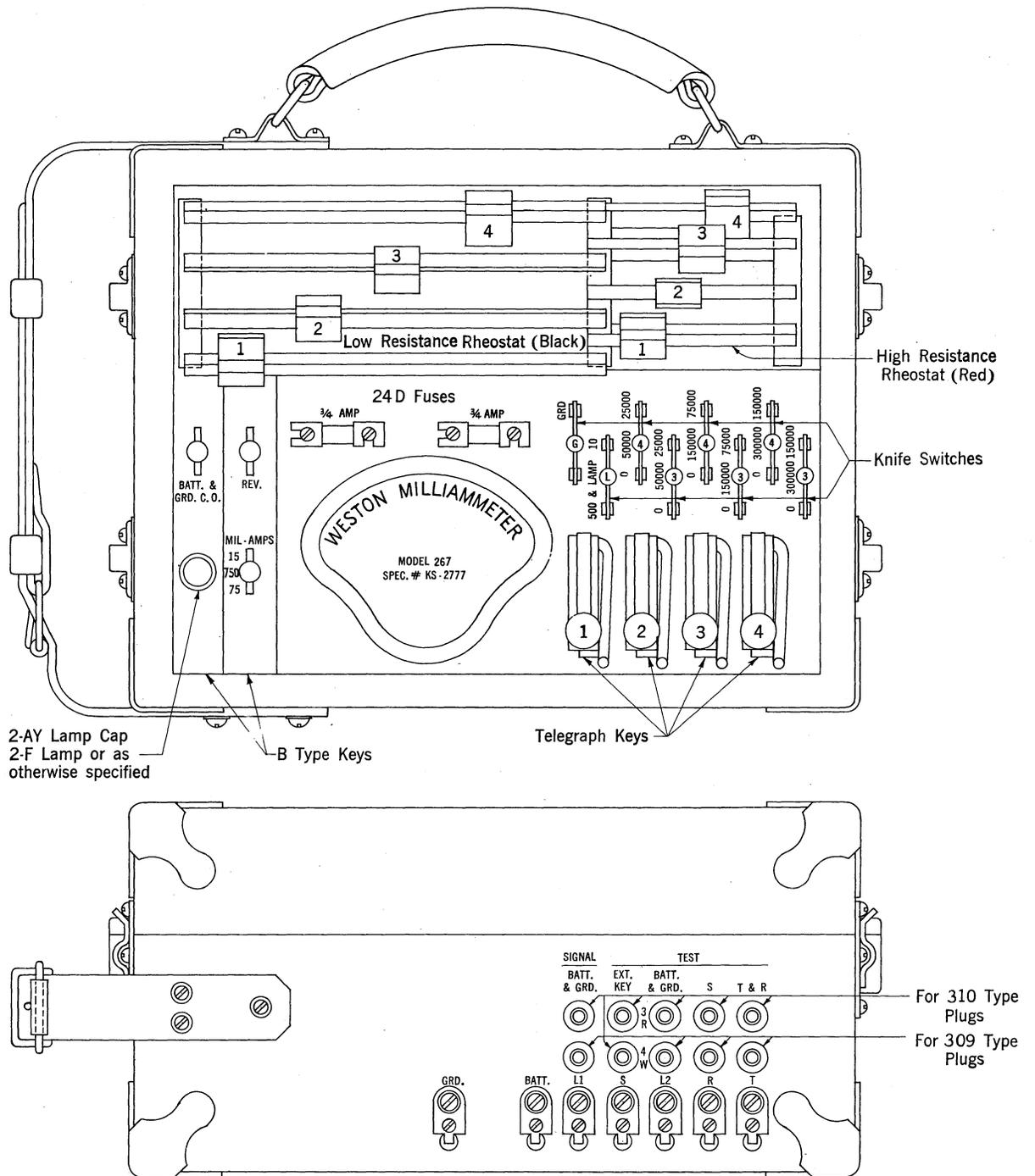
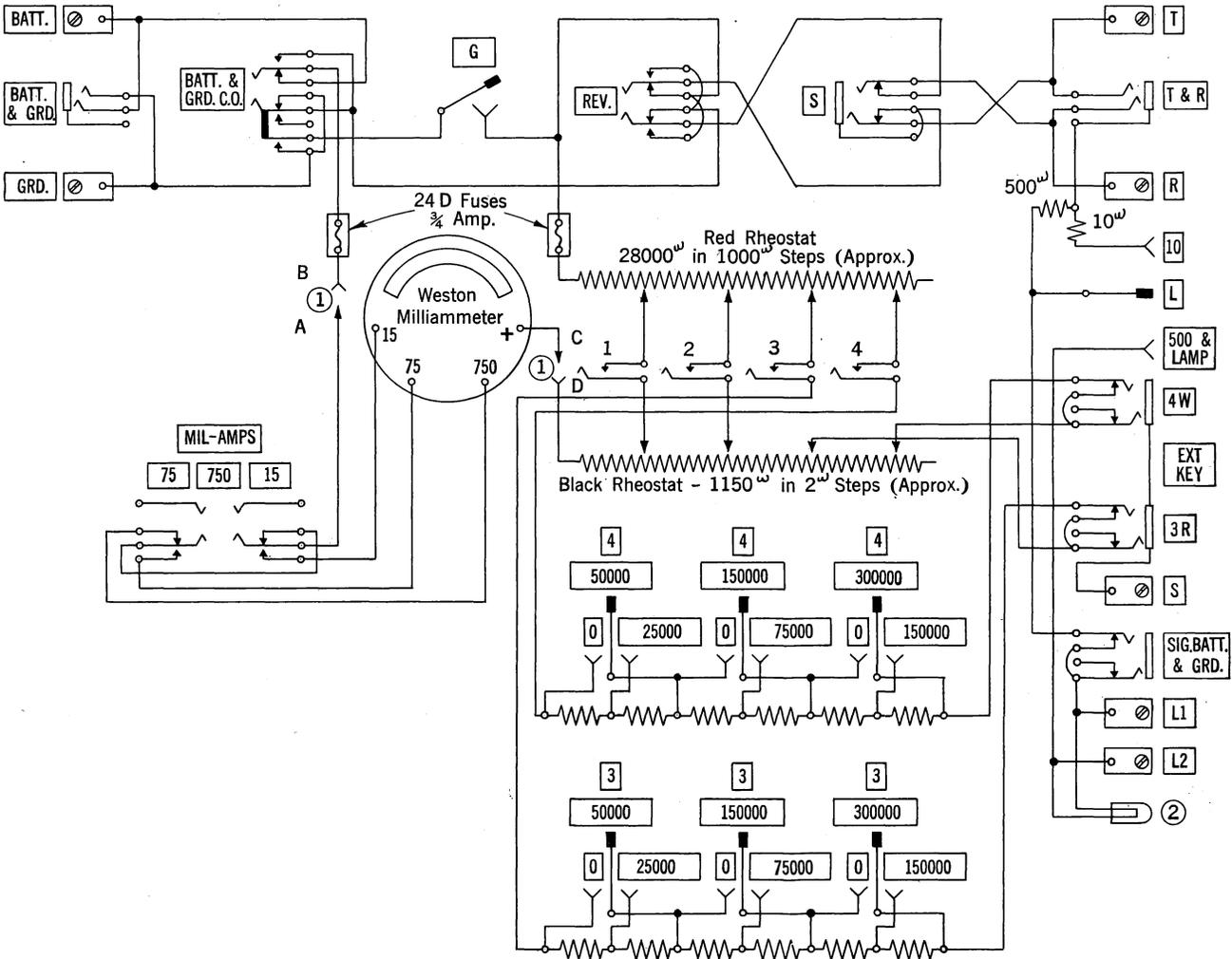


Fig. 17 - No. 35C Test Set - Apparatus Arrangement



NOTES

① The Milliammeter is wired in the set as shown. This arrangement is that required for use in offices having POSITIVE side of battery grounded. For use in offices having NEGATIVE side of battery grounded reverse connections to Milliammeter by connecting A to D and B to C.

② This lamp may be used to indicate contact closure. Choose type of lamp to be used in accordance with the following:

Voltage across lamp	Type of lamp
12	2F
24	2G
48	2T

Fig. 18 - No. 35C Test Set - Circuit Arrangement

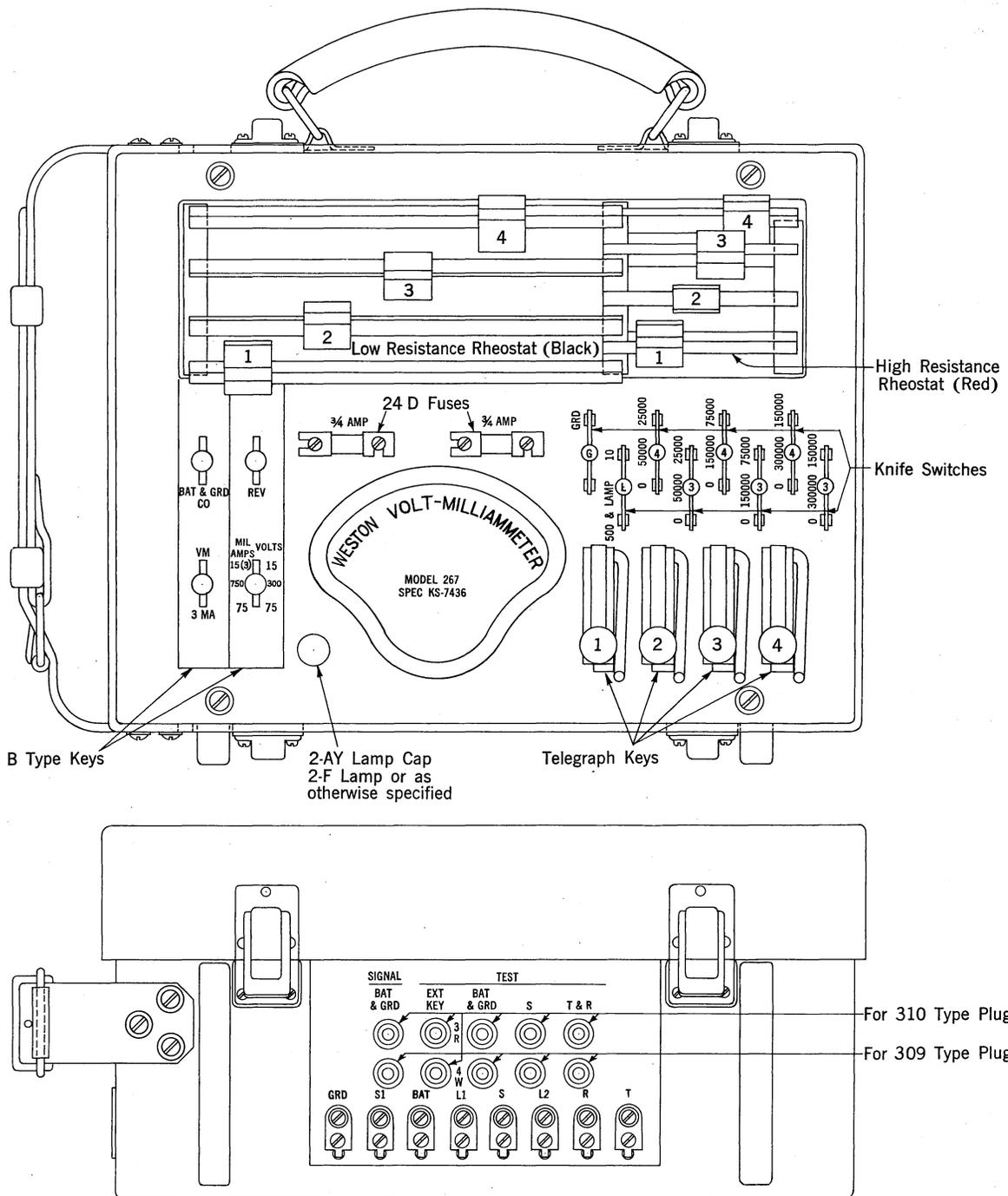
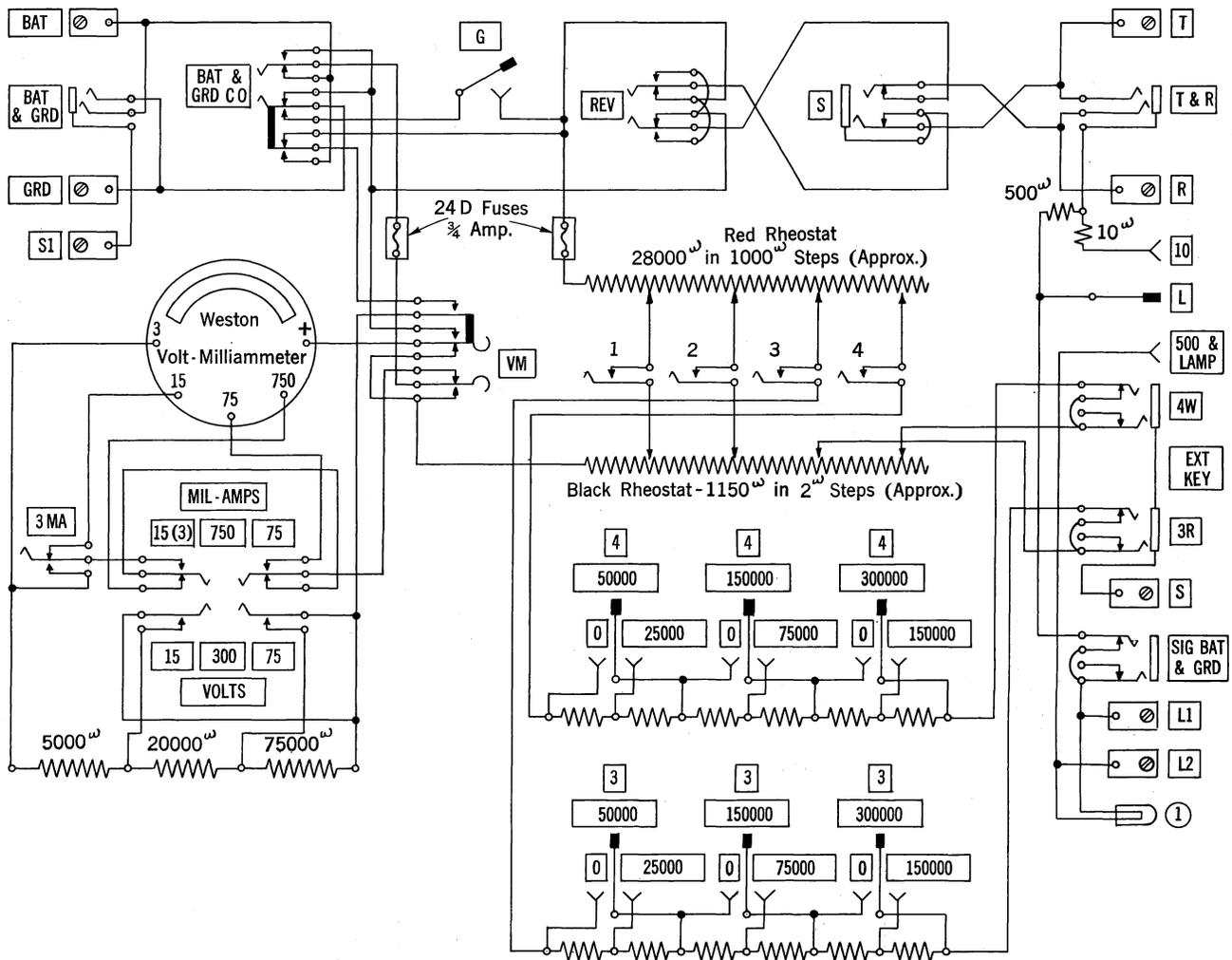


Fig. 19 - No. 35D Test Set - Apparatus Arrangement

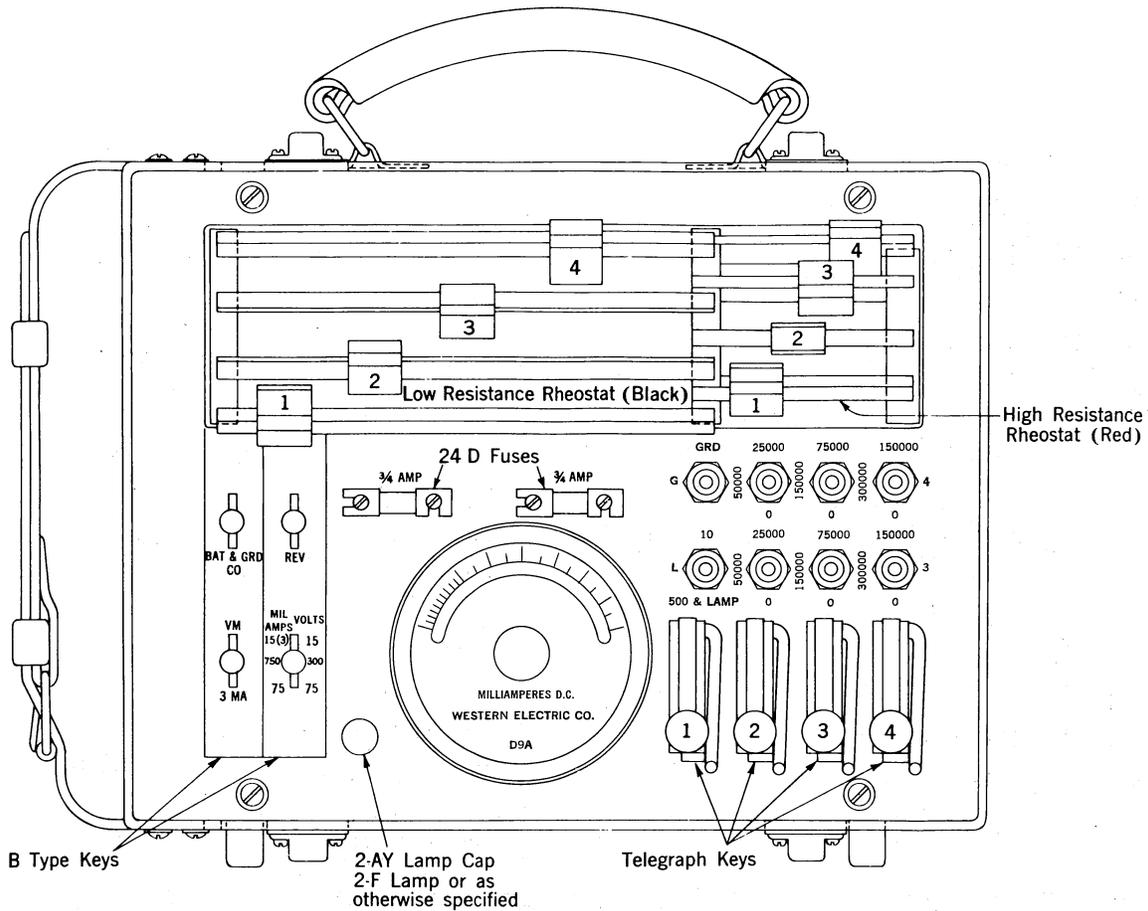


NOTE

① This lamp may be used to indicate contact closure. Choose type of lamp to be used in accordance with the following:

Voltage across lamp	Type of lamp
12	2F
24	2G
48	2T

Fig. 20 - No. 35D Test Set - Circuit Arrangement



B Type Keys
 2-AY Lamp Cap
 2-F Lamp or as
 otherwise specified

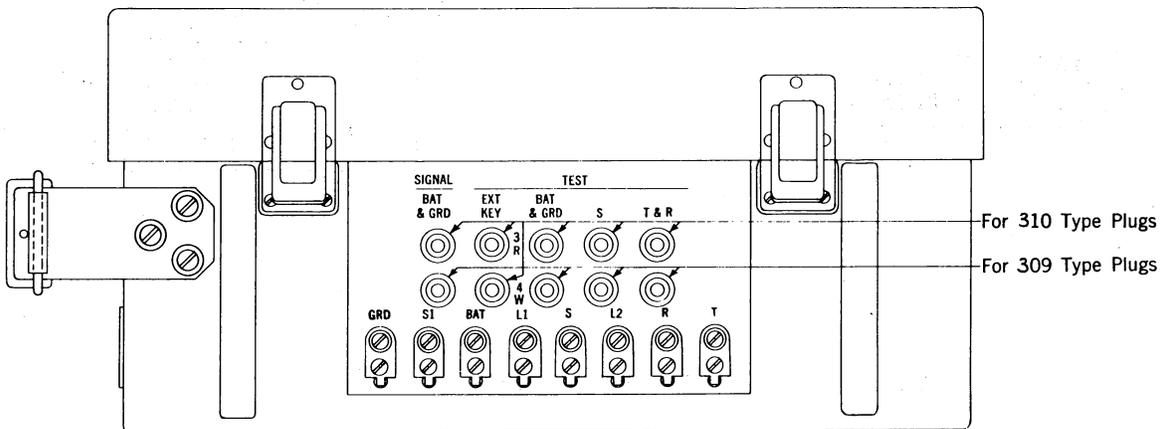


Fig. 21 - No. 35F Test Set - Apparatus Arrangement

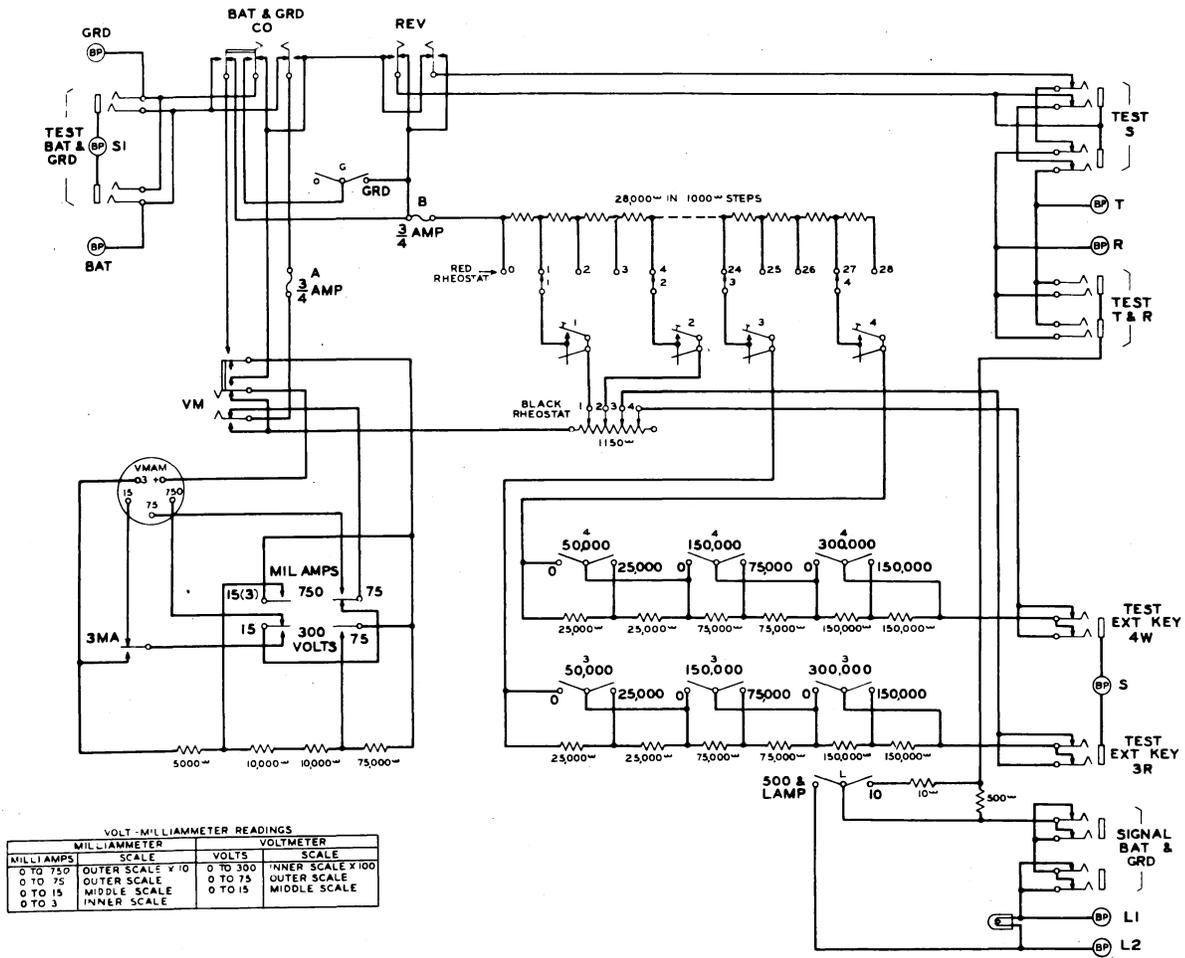


Fig. 22 - No. 35F Test Set - Circuit Arrangement