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METHOD OF OPERATION
WHEATSTONE BRIDGE CIRCUIT
Local Test Desk - Full Mechanical Power Driven System.

GENERAL DESCRIPTION

1. This circuit is used with the primary and secondary testing cord circuit at a local test desk, for locating and determining the extent of trouble on a line. It is provided with keys to enable the testing operator to make the Varley and Murray loop tests in addition to the usual battery and galvanometer key.

2. In order to increase the usefulness of the Varley and Murray loop tests it is often desirable to extend the grounded side of the battery to some point outside of the office, for instance in locating a short circuit. This is accomplished by means of the Wheatstone bridge cord and the reverse (REV) key.

3. The principal measurements and tests which can be made with this circuit are as follows:-

(A) SIMPLE RESISTANCE MEASUREMENTS.
(B) GROUND RESISTANCE MEASUREMENTS.
(C) VARLEY LOOP TEST
(D) MURRAY LOOP TEST
(E) LOCATION OF SHORT CIRCUITS OR CROSSES.

4. From the resistance values obtained by the above tests, the location of a trouble may be determined from tabulated data of distances or by comparison with the resistance of a good line of known size and length.

DETAILED DESCRIPTION

OPERATION

(A) SIMPLE RESISTANCE MEASUREMENTS.

5. To measure the loop resistance of a line, the plug of the testing cord (not shown) is inserted in a jack connected to the line under test and the tip and ring of the line are short circuited at the distant end. The "W.B. & V.L." and "L" keys are then operated and the ration dial set. The operation of the "W.B. & V.L." key disconnects the volt milliammeter from the test circuit and connects the test circuit and the 100 volt testing battery to the Bridge. The operation of the "L" key disconnects the ground from the testing battery and connects the formerly grounded side of the battery to the tip side of the test circuit. The "B &G" key of the Bridge is then depressed and the rheostat arms varied until a balance is obtained and the galvanometer shows no deflection. The ".1" and "B & G" keys are then operated (increasing the resistance of the galvanometer shunt) until a balance is obtained by manipulating the rheostat arms as before. The "OPEN" and "B & G" keys are now depressed until a balance is again obtained by

varying the rheostat arms as before. The unknown resistance "X" may then be calculated by means of the following formula:-

Where "R" = rheostat resistance.
" "X" = resistance of loop
" "A" = ratio dial setting
X = AR

(B) GROUNDED RESISTANCE MEASUREMENTS

6. This test is made in a similar manner to that described for (A), with the "G" key (shown in the testing cord circuit) operated. After obtaining a balance, the unknown resistance "X" may be calculated from the following formula:-

Where "A" = ratio dial setting
" "R" = rheostat resistance
" "X" = resistance to ground
X = AR

NOTE:- This test should be made only under favorable circumstances as it is not reliable if earth potential exists or if ground has any appreciable resistance.

(C) VARLEY LOOP TEST (LOCATION OF GROUNDS)

7. To make a Varley loop test the faulty and good wires are joined at the distant end of the line and the loop resistance measured as described under (A). The "L" key is then released, the "W.B. & V.L." key being held operated, and the ration dial is set and the rheostat dials of the "Bridge varied until a galvanometer balance is obtained. The "B & G" and ".1" keys of the Bridge are then depressed and the rheostat dials varied until a galvanometer balance is again obtained. After obtaining a galvanometer balance with the "B & G" and ".1" keys depressed, the "B & G" and "OPEN" keys are depressed and a balance obtained by varying the rheostat dials as before.

8. The resistance "X" in ohms to the fault may be calculated by means of the following formula:-

Where "L" = total resistance of loop.
" "X" = resistance to the fault
" "A" = ratio dial reading
" "R" = rheostat reading
$X = \frac{L - AR}{A + 1}$

(D) MURRAY LOOP TEST (LOCATION OF GROUNDS)

9. To determine the resistance in ohms to a fault by means of the Murray Loop test, the loop resistance of the pair of wires under test is determined as explained under (A). The "L" key is then released, and the ratio dial is set at M-1,000 with the "W. B. & V.L.", "ML" and "B & G" keys operated and the rheostat arms are varied until a balance is obtained.

10. After a galvanometer balance is obtained with the "B & G" and the "OPEN" keys depressed, the resistance "X" to the fault may be calculated by means of the following formula:-

Where "X" = resistance to the fault
" "L" = resistance of loop
" M-1000 = ratio dial reading
" "R" = rheostat reading
" $X = \frac{R}{1000 + R} L$

(E) LOCATION OF SHORT CIRCUITS OR CROSSES (VARLEY OR MURRAY LOOP TEST)

11. To determine the resistance in ohms to a short circuit or cross between a pair of wires, (regardless of the resistance), a good wire of equal resistance is connected to one of the faulty wires at the distant end of the line and the loop resistance of the good and faulty wires is determined as described under (A).

12. The plug of the Wheatstone bridge cord is then inserted in a test jack connected to the faulty wire, operating the E184 relay. The operation of the E184 relay, the "REV". key being normal, disconnects ground from the testing battery and connects the testing battery to the ring of the Wheatstone bridge cord. The proper keys are then operated for making the Varley or Murray loop test and the location of the fault determined as described above for grounds. If the ring side of the faulty wire has been connected to the good conductor at the distant end of the line, it will be necessary to operate the "REV" key. The "REV" key is associated with the Wheatstone bridge cord to enable the testing operator to connect the testing battery to either the tip or ring side of the Wheatstone bridge cord.

13. When the plug of the Wheatstone bridge cord is removed from the test jack, the E184 relay releases and the circuit is restored to normal.

CIRCUIT REQUIREMENTS

	OPERATE			NON-OPERATE			RELEASE
E184	Test	.070	amp.	Test	.020	amp.	
	Readj.	.030	amp.	Readj.	.022	amp.	

ENG.--CAL-VL.
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CHK' D.-WHL.

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