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METHOD OF OPERATION
CORD CIRCUIT
Voltmeter Test - Trouble Desk - Power Driven Machine Switching System.

GENERAL DESCRIPTION

1. This circuit is used at a trouble desk for testing troubles on subscribers' lines, which due to failure or troubles, may be held up on senders. It is also used for testing outgoing trunks, directly, or in conjunction with the test cord and sender circuits (not shown). The Test cord (Sender Mon.) located at the sender monitor's position is for the purpose of connecting the voltmeter test circuit to the subscriber's line through the sender monitor's jack. The cord (Outgoing Trunk Cord Test Board) located at the outgoing trunk test desk is used for connecting the test circuit directly with an outgoing trunk.

2. The testing key equipment of the voltmeter testing circuit is as follows:-

1. A TEST key for connecting this circuit with the test cord circuit.

2. A sender monitor (SEN. MON.) key used to connect the voltmeter test circuit through the sender monitor's jack for testing subscriber's lines. If the plug of the test cord at the sender monitor's position is inserted in assender monitor jack which connects with the subscriber lines through the sender circuit the SM relay is operated by the operation of the (SEN. MON.) key. The SM relay operated connects the tip and ring of the sender monitor's cord to the contacts of the (SEN. MON.) key. Should the sender monitor operator by mistake insert the plug of the test cord in a plugging up line jack which connects with the final multiple, the SM relay will not operate, due to the low resistance ground on the sleeve of this plugging up line jack. This feature eliminates the possibility, to charge falsely on an incoming call.

3. A make busy key (MB) used in connecting with the test cord located at the outgoing trunk test desk for testing outgoing trunks without first making selection. If the plug of the outgoing trunk test cord is inserted in the test jack of a non-busy outgoing trunk and the MB key is operated, the C-1 relay operated and connects the tip and ring of the trunk through to the test keys. If the outgoing trunk under test is busy, the C-1 relay will not operate due to the busy ground connection on the sleeve of the jack. In either case the green lamp is lighted by the operation of the MB key. With the MB key operated and the C-1 relay normal the red and green lamps both light as an indication that the trunk is busy.

4. A no-test key (NOT) used short circuit the contact of the CI relay when it is desired to test an outgoing trunk regardless of a busy condition.

5. A ringing key (RING) for connecting ringing current to the line under test.

6. A reversing key (REV) used to reverse the top and the ring sides of the line with respect to the testing apparatus.

7. A grounding key (G), used to ground one side of the line under test and used in conjunction with other keys to connect the voltmeter to ground when desired.

8. A talking key (T.V.M.) used to connect the test desk telephone circuit to the test cord and supplies talking battery to stations through the sender monitor's cord. The 203-A relay is bridged across the test circuit for supervisory purposes.

9. A foreign potential key (FEMF) used for measuring foreign potentials.

10. A voltmeter reversing key (VM.REV.) for reversing the voltmeter with respect to the line when the foreign potential key is operated.

11. A scale change key for connecting the various voltmeter scales in the circuit.

(a) With this key normal, the 120 V. scale of the voltmeter is connected in series with the 100 volt testing battery. (b) With the key in the 20,000 ohm position, the 24 V. 1.2 M.A scale of the voltmeter is connected in series with the 20 volt testing battery to the testing circuit. (c) With the key in the 1000 ohm position, the 24 V. 24 M.A. scale of the voltmeter is connected in series with the 20 volt testing battery in the circuit.

12. An ammeter key (AM) used to connect the 480 M.A. scale of the voltmeter in series with the 60 ohm external resistance and 24 volt battery in the testing circuit.

3. THE VARIOUS OPERATIONS AND TESTS THAT MAY BE ACCOMPLISHED BY MEANS OF THIS CIRCUIT ARE AS FOLLOWS:

1. TALKING TO A SUBSCRIBER

2. RINGING

3. TESTS FOR GROUND

4. TESTS FOR SHORT CIRCUITS AND RESISTANCE TESTS

5. CONTINUITY TEST

6. BALLISTIC TEST

7. FOREIGN BATTERY TEST

4. The methods to be employed in performing these various tests and operations are briefly outlined as follows:-

1. TALKING TO A SUBSCRIBER

5. Talking connections may be established by the operation of the T.V.M. key over each of the three test cords (one not shown). The supervisory lamp (white) is lighted when the (T.V.M.) key is operated and is extinguished by the operation of the L or the 203-A relay. With the circuit established over the cord located at the sender monitor's position, the SM-1 relay is operated by the operation of the SEND. MON. key and connects talking battery to the line under test through the contacts of the (T.V.M.). The L relay is operated in series with the station set under test. When the circuit is established over either the test cord located in the test and sender circuits or the outgoing trunk test cord, the 203-A relay is bridged across the repeating coil and is operated by reverse battery and ground, from the distant office with the receiver removed from the switchhook at the called station. When the receiver is replaced on the switchhook, the L or 203-A relay as the case may be, is released, in turn relighting the supervisory lamp, as a disconnect signal. When the (T.V.M.) key is restored to normal the lamp is extinguished.

2. RINGING

6. The circuit is equipped with a ringing key for connecting ringing current to the line under test. The ringing key when operated connects ringing current to the ring of the cord and ground to the tip. When used in connection with a reverse key, the above conditions are transposed.

3. TESTS FOR GROUND

7. To test for a ground on the ring side, using the 120 V, scale of the voltmeter, all keys are normal other than the key which connects the test cord to be used. The 100 volt testing battery is connected to the ring of the cord in series with the voltmeter. The voltmeter should give little or no deflection, ff the line is clear. In the event of a ground its resistance may be determined as explained under "Tests for Short Circuits and Resistance". To test the tip side, operate the reverse key and proceed as above.

4. TEST FOR SHORT CIRCUITS AND RESISTANCES

(a) With the voltmeter scale of the voltameter.

8. Tests for short circuits may be made by operating the G key. If the line is short and if free from ground the voltmeter needle will show a deflection which will be unchanged when the reverse key is operated. The smaller the resistance of the short circuited line, the greater will be the deflection. In all cases the voltmeter reading bears the same ratio to the voltmeter resistance, as the difference between its reading and the test battery voltage bears to the external resistance. The line resistance may be calculated by dividing the difference between the testing battery voltage and the voltage reading by the voltmeter reading and multiplying this quotient by the resistance of the voltmeter coil; for example, if the voltmeter coil has a resistance of 100,000 ohm and the testing battery is 100 volts with a reading of 40 volts obtained on the line, the resistance of this is $\frac{100 - 40 \times 100,000}{40}$ ohms = 150,000 ohms.

9. The voltameter has four different scale windings each of different resistance: namely 100,000 ohms, 20,000 ohms, 1,000 ohms, and less than 10 ohms. The first three scales are arranged to read volts while the fourth is arranged to read in miliamperes. To measure a high resistance loop cross or ground, the 100 volt testing battery is used. On account of the high resistance of the 100 volt winding of the voltmeter, the needle will be deflected at a greater difference than it would in the case of the 20 volt testing battery where used, thereby giving a larger deflection and a more accurate reading. For measuring smaller resistances, the other scales and windings are used. If the resistance scale most nearly equals in resistance to be measured is used, the measurements are more accurate. The milliammeter scale is best adapted for measuring resistances of less than 500 ohms.

(b) With the milliammeter scale of the voltameter.

10. To make the milliammeter test of a ground on the ring of the line, operate the AM key. If a ground on the tip side of the line is to be measured, operate also the reverse key. To make a milliammeter test on a metallic circuit operate the AM and G keys.

5. CONTINUITY TESTS

11. Continuity tests are made in the same manner as tests for short circuits. In the case of lines equipped with standard common battery sets, no permanent deflection will occur unless the receiver is removed from the switchhook at the subscriber's station. If it is not convenient to have the receiver removed, a fairly satisfactory test of continuity may be made by operating the reverse key back and forth. This will permit a momentary deflection of the voltmeter needle, due to the charge and discharge of the condenser of the line is continuous. Tests for continuity should always be preceded by the test for ground.

6. BALLISTIC CAPACITY TEST

12. This test is made to determine approximately the capacities of the line and condensers. To make a ballistic test, the G key and the reverse key are operated, the latter key should be operated both ways in synchronism with the movements of the voltmeter needle, as the capacity in the circuit under test charges and discharges.

7. FOREIGN BATTERY TEST

13. To test for foreign grounded negative battery over the ring side of lines the (F.E.M.F.) key and G keys are operated.

14. To test for foreign grounded positive battery over the ring side of lines the (F.E.M.F.), (V.M.REV) and (G) keys are operated.

15. Tests for foreign grounded batteries on the tip side of the line are made with the reverse key operated. Tests are made for foreign metallic battery having its negative side connected to the ring side of the line by operating the (F.E.M.F.) key. By operating the (V.M.REV.) key foreign metallic battery having its positive side connected to the ring side is tested.

CIRCUIT REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
E250 (SM-1)	Test. .031 amp. Readj. .023 amp.	Test .017 amp. Readj. .018 amp.	
E267 (C-1)	Test .045 amp. Readj. .035 amp.	Test .0228 amp. Readj. .024 amp.	
E543 (SM)	Test .012 amp. Readj. .007 amp.		Test .0005 amp. Readj. .001 amp.
Spl. B33 D-24558 (L)	After a soak of approximately .3 amp. Test .020 amp. Readj. .015 amp.		After a soak of approximately .3 amp. Test .0047 amp. Readj. .005 amp.

203-A

MECHANICAL REQUIREMENTS

(a) Armature travel .015" to .020".
(b) Armature must move freely in bearings.
(c) There must be follow in the contact springs.
(d) There shall be .005" air gap between the hard rubber bridge and the swinging spring.

ELECTRICAL REQUIREMENTS

Test .004 amp.
Readj. .0024 amp.

On open circuit:

ELECTRICAL REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
206-C	After a soak of approximately .020 amp. in the opposite direction to operating current. Test .0028 amp. Readj. .0026 amp.		On open circuit. After a soak of approximately .020 amp. in the same direction as operating current. Adjust Biasing spring to meet release requirements.

ENG.--JVM-BH.
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CHK'D.--RAP.

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