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COMMON SYSTEMS
SENDER MAKE BUSY FRAME
TEST CIRCUIT
FOR USE IN PANEL
AND NO. 1 CROSSBAR OFFICES
SERVED BY A CENTRAL "A" SWITCHBOARD

CHANGES

B. Changes in Apparatus

B.1 Added

1 221A, 432-ohm PT Resistor, option K
1 221A, 432-ohm PR Resistor, option K

D. Description of Changes

D.1 The PT and PR resistors, shown as option K, are added in series with the T and R leads in Fig. F to attenuate the level of the tone from the timer circuit. Adding these resistors reduces crosstalk which causes interference in data circuits. Option K replaces option L which is Mfr Disc. Option L was formerly a part of Fig. F and was not shown.

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is for use at the sender make-busy frame in offices served by a central "A" board. It is arranged for testing subscriber lines on calls routed to permanent-signal holding trunks, and for testing coin lines on calls that cannot be released by the coin control supervisory circuit.

SECTION II - DETAILED DESCRIPTION

1. CIRCUIT OPERATION

TALKING

1.01 When the test jack T of this circuit is connected to a permanent-signal holding trunk or district coin control circuit with the patching cord, the SL relay operates from ground on the sleeve and lights the S lamp. The T key operated, (a) supplies ground for operating the T relay, (b) opens the path to the testing and G keys, and (c) connects the transformer battery to the tip and ring of the test jack. The T relay operated, supplies ground on the ST lead and transfers the operator telephone circuit from the T1 and R1 leads to the 2 and 5 terminals of the transformer for talking. If the receiver is off the switchhook at the subscriber station, the S relay operates and extinguishes the S lamp by opening the ground at its back contact, and prepares a path for operating the H relay under control of the H key. When the receiver is placed on the switchhook at the subscriber station, the S relay releases and lights the S lamp.

HOWLER APPLICATION - FIG. E.

1.02 With a subscriber line connected to a permanent-signal holding trunk and the receiver not on the switchhook, a signal will appear on the frame. The test man then connects the particular trunk to the test jack by means of the patching cord. If a test of the line indicates a receiver off the switchhook, the H key is operated to apply the howler tone in the following manner: the S relay (Fig. A) or relays S

and SB (Fig. B) operate from the subscriber loop. Relay S with Fig. A or Fig. B, R wiring, or relay SB with Fig. B, S wiring operated, operates relay H, which locks through its own contacts and H key to the operating ground. The H relay operated, (a) closes a circuit through the F and G leads to start the Howler Circuit off-normal and (b) closes the C and D leads through to No. 2 and 5 terminals of the transformer for transmitting the howler tone. The closure of the leads supplying the start ground to the Howler Circuit causes battery to be placed on the A and B leads, which flashes the H lamp and operates the H1 relay, respectively. The H1 relay operated on its P winding, locks through its S winding to ground at the H key. An interrupter in the Howler Circuit operates a stepper switch which supplies graduated howler tone to the C and D leads inducing it over the tip and ring to the subscriber line. This tone and the flashing lamp will continue to the end of the cycle unless the receiver is replaced on the switchhook or the H key is restored to normal. At the end of the cycle the H lamp changes from flashing to steady. The H1 relay, however, will remain operated until the stepper switch of the Howler Circuit returns to normal. With S wiring when the receiver at the subscriber station is placed on the switchhook, relay SB will release, placing ground on the sleeve of the connecting jack for disconnection of the permanent-signal holding trunk from the subscriber line. If the receiver at the subscriber station is placed on the switchhook and immediately removed again before the H key is restored to normal, the howler tone will not be reapplied unless the H key is restored and then reoperated. With the H relay released, the tone leads are disconnected from the transformer and operator telephone set, and the start ground circuit opened to the Howler Circuit. This causes battery to be removed from the A lead and the H lamp to be extinguished. When the stepper switch of the Howler Circuit has returned to normal, battery will be removed from the B lead and the H1 relay will release if the H key has been restored to normal. In order to repeat the howler tone, it is necessary to release and reoperate the H key after having noted that the H lamp is extinguished.

RECEIVER OFF-HOOK TONE APPLICATION - FIG. F

1.03 With a subscriber line connected to a permanent-signal trunk and the receiver not on the switchhook, a signal will appear on the frame. The test man then connects the particular trunk to the test jack by means of a patching cord. If a test of the line indicates a receiver off the switchhook, the ROHT key is operated to apply the receiver off-hook tone and announcement in the following manner. The S relay (Fig. A) or relays S and SB (Fig. B) operate from the subscriber loop. Relay S with Fig. A or Fig. B, R wiring, or relay SB with Fig. B, S wiring operated, operates relay H which in turn operates the H2 relay. The H and H2 relays operated, (a) close ground to the ST lead to the Timer Circuit which starts and times the application of the receiver off-hook tone, (b) close the T- and R-leads to the 2 and 5 terminals of the transformer for transmitting the receiver off-hook tone, (c) flash the ROHT lamp during the time the receiver off-hook tone is applied. At the end of the timed interval, the Timer Circuit grounds the EC lead which operates the H1 relay releasing the H and H2 relays which remove the ground from the ST lead to the Timer Circuit and opens the T- and R-leads to the Timer Circuit. The H1 relay locks to ground through the SB relay operated, and the ROHT lamp changes from flashing to steady. If the receiver is placed on the switchhook at any time during the cycle or afterwards while the ROHT key is operated, the H, H1, and H2 relays will be released and the ROHT lamp will be extinguished. With S wiring when the receiver at the subscriber station is placed on the switchhook, relay SB will release placing ground on the sleeve of the connecting jack for disconnection of the permanent-signal holding trunk from the subscriber line. In order to repeat the ROHT cycle, it is necessary to release and reoperate the ROHT key.

COIN CONTROL

1.04 When the coin control or supervisory circuit fails to collect or return a coin, a signal will appear at the sender make-busy frame. When the patching cord is inserted in the coin control jack and the T jack of the test circuit, ground from the sleeve of the coin control or supervisory circuit through the winding of a relay operates the SL relay and lights the S lamp.

A. Coin Collect

1.05 An attempt to collect the coin is brought about by operating the CC key, which operates the CN relay, disconnecting the transformer battery from the circuit. Positive or negative coin current, as required, is connected to the tip (M option) or tip and ring (N option) of the test jack through the operated CC key and winding of the C relay and C lamp. The C relay operates over the tip of the subscriber line through the coin magnet to ground and lights the CN lamp. When the CC key is released, the CN and CC relays release, extinguishing the CN lamp.

B. Coin Return

1.06 An attempt to return the coin is brought about by operating the CR key which operates the CN relay, disconnecting the transformer battery from the circuit. Positive or negative coin current, as required, is connected to the tip (M option) or tip and ring (N option) of

the test jack through the operated CR key and winding of the R relay and R lamp. The R relay operates over the tip of the subscriber line through the coin magnet to ground and lights the CN lamp. When the CR key is released, the CN and R relays release, extinguishing the CN lamp. The CN relay is slow in releasing in order to provide a path for the discharge of the coin magnet through resistor A and capacitor P to ground when the CC or CR key is restored to normal. When the CC or CR key is operated, ground is removed from the ST lead to disconnect the telephone circuit and reduce the possibility of clicks.

RINGING

1.07 When the (±) key is operated with the REV and RG keys normal, ringing current is applied to the ring and ground to the tip of a subscriber line. With the (±) and REV keys operated and the RG key normal, ringing current is connected to the tip and ground to the ring of a subscriber line. In testing lines arranged for two-party full selective, or four-party semiselective ringing, it may be desirable to open the ringing ground in the test circuit in cases where the receiver may be off the switchhook. The operation of the RG key will remove the ground from the test circuit and permit ringing the subscriber bell under the above conditions. The ST ground is opened every time the (±) key is operated, for the same reason as described when the CC or CR key is operated.

VOLTMETER TEST FOR SHORT-CIRCUITS

1.08 In testing for a short-circuit the G key must be operated. If the line is short-circuited, the voltmeter needle will show a constant deflection when the REV key is operated and restored. With the milliammeter connected to the line and the G key restored to normal if the meter returns to 0, it indicates that the line is short-circuited.

VOLTMETER TEST FOR GROUNDS

1.09 With the REV and G keys normal, the circuit is set up to test for grounds on the ring; with the REV key operated and G key normal, the circuit is set up to test for grounds on the tip. The value of the resistance to ground may be computed by multiplying the difference between the test-battery voltage and the voltmeter reading, by the resistance in series with the voltmeter and dividing by the voltmeter reading. With no keys operated, the 100-volt test battery through 100,000-ohm resistance and the meter is connected to the ring of the test circuit. With the 20,000-ohm or 1,000-ohm scale change key operated, 20-volt test battery through 20,000-ohm or 1,000-ohm resistance, respectively, is connected to the ring of the test circuit. For the most accurate results, the voltmeter combination should be used which has a resistance most nearly equal to the resistance being measured. The milliammeter may be used in measuring the resistance over the tip or ring, in which case the REV key is used in the same manner as for making voltmeter tests.

CONTINUITY TEST

1.10 When making this test, the G key is operated. If the line is equipped with a common battery subscriber set having a capacitor in series with the bell, no appreciable permanent deflection will occur unless the receiver at the station is removed from the switchhook. If it is not convenient to have the receiver removed, a satisfactory test may be made by operating the REV key quickly back and forth. This will give a deflection of the voltmeter needle due to the charge and discharge of the capacitor in the subscriber set. If the needle does not return to 0 after each operation of the REV key, it indicates trouble or line-leak. Tests for ground should always precede the test for continuity.

CONTINUITY TEST OF SUBSCRIBER LINES EQUIPPED WITH COLD CATHODE TUBE-TYPE SUBSCRIBER SETS

1.11 Continuity tests of subscriber lines equipped with cold cathode tubes are make by operating key -STA or +STA. The operation of these keys causes negative or positive coin potential, local test desk test battery or the test battery supply circuit potential to be connected through the 100,000-ohm voltmeter shunted by 8,000-ohm resistors D and E to the ring of the line. With the -STA key operated, the negative potential on the ring of the line will cause the control gaps of the tubes in the subscriber sets connected to the ring of the line to break down and the voltmeter needle to deflect slightly. If there is a negative station on the ring of the line, there will be a flow of current through its ringer and consequently the deflection of the voltmeter needle will be greater than would be the case with no negative station connected to the ring. Similar conditions apply if the +STA key is operated in checking for positive stations. Connections on the tip of the line are checked by the operation of the REV key as well as the -STA or +STA key. Where -STA, +STA key is provided, the voltage of the negative and positive voltage supply can be checked by the operation of the -STA or +STA key and then the RV REV key.

VOLTMETER TEST FOR FOREIGN BATTERY

1.12 To test for foreign battery on a line the FEMF key is operated, which disconnects the test battery from the meter and connects the meter to ground in series with the ring side. If the polarity is

such as to give a positive reading, it indicates the voltage of a negative battery which is grounded. If the polarity is such as to give a negative reading, the VM REV key should be operated. This will reverse the meter with respect to the line and indicates the voltage of a positive battery which is grounded. Tests for foreign grounded battery on the tip side of the line are made as previously described but with the REV key operated.

BALLISTIC CAPACITY TEST

1.13 This test is to determine the approximate capacity of the line, the total capacity of capacitors connected to a line and to detect an open. To test a line for grounded capacity the G key is operated; then after the needle comes to rest the REV key is operated several times. This causes a deflection proportional to the capacity on the ring side when the REV key is normal, and proportional to the capacity on the tip side when the REV key is operated.

MILLIAMMETER TEST

1.14 When making a milliammeter test the AM key is operated. If a ground on the ring side is to be measured the REV key should be normal. To measure a ground on the tip side the REV key should be operated. If a metallic test is to be made the AM and G keys should be operated. The milliammeter scale is best adapted for measuring resistances less than 500 ohms.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The maximum external circuit resistance for subscriber supervision is Fig. A, 750 ohms, Fig. B, 1500 ohms with a minimum line insulation resistance of 10,000 ohms.

1.02 The rated external sleeve resistance for the SL relay is 34 ohms.

1.03 The rated maximum external resistance for coin operation with 110-volt coin battery and ±20 volt earth potential is 2140 ohms.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 This circuit is designed to perform the following functions.

3.02 Arranged to connect to a jack of a permanent-signal holding trunk or to a coin control supervisory circuit by means of a patching cord.

3.03 Supplies talking battery and ground through a transformer to the calling subscriber by the operation of a key which also connects the telephone circuit to the opposite side of the transformer if the (±) key and CN relay are normal If either the key or relay is operated, ground is removed from the ST lead, disconnecting the telephone set.

3.04 Records supervision from the calling subscriber.

3.05 Arranged for ringing on the tip or ring of subscriber lines.

3.06 Lights a lamp if the sleeve of the test jack is connected to ground.

3.07 Arranged to collect or return coins and light the pilot lamp when the coin current is applied to the line. When option M is provided, coin potential is applied on the tip lead only. When N is provided, coin potential is applied to both tip and ring leads.

3.08 Arranged to apply howler tone to a subscriber line if the receiver is not on the switchhook: Fig. E.

3.09 Lights a lamp steadily as long as the Howler Circuit is off-normal, but flashes this lamp until the end of the tone cycle.

3.10 Arranged to automatically disconnect the permanent signal holding trunk from the subscriber line when the receiver is placed on the switchhook after howler tone is applied. (Fig. B only.)

3.11 Arranged to prevent the reapplication of howler tone if the subscriber places the receiver on the switchhook and removes it again before the howler key is restored to normal.

3.12 Arranged to remove ringing ground when ringing to external ground is required.

3.13 Arranged for voltmeter testing.

3.14 With the meter connected to the tip or ring of the test jack, the following tests may be made.

(a) Test for grounds.

(b) Test for short-circuits.

(c) Test for continuity.

(d) Voltmeter test for foreign potential.

(e) Ballistic test for capacity.

(f) Milliammeter test for low resistance.

(g) Fig. C. The volt-milliammeter is provided with three scales to be used with external resistances, the proper

values being obtained by connecting to the various terminals designated A, B, C, D, E, F, and N. The resistances are connected to give the following readings.

TABLE A

Terminal	Volts	MA	External Resistance Values
A-N	0-150	1.5	100,000
B-N	0-30	1.5	20,000
E-N	0-30	30	1,000
F-N		375	Less than 1
Fig. D			

A milliammeter is provided with three scales and is connected to provide volt-milliammeter test conditions as follows.

TABLE B

Test Conditions		
Volts	MA	Ohms
0-120	1.2	100,000
0-24	1.2	20,000
0-24	24	1,000
0-300 ma	300	3

Normally 100 volts connected to the meter through 100,000 ohms is the combination used for measuring a high-resistance ground or insulation resistance on a line. By operating the 20,000-ohm key, the 100-volt battery and 100,000-ohm resistance, Fig. C, or the 100,000-ohm winding of the meter, Fig. D, are disconnected and 20 volts is connected to the meter through 20,000 ohms. This combination may be used for measuring smaller resistances which could not be accurately determined with the high potential and high resistance. By operating the 1,000-ohm key, the 100-volt battery and 100,000-ohm resistance, Fig. C, or the 100,000-ohm winding of the meter, Fig. D, are disconnected and 20-volt battery through 1,000 ohms is connected to the meter. With Fig. D the operation of the 1,000-ohm key also connects the A 1053-ohm resistor across the (-) and 24-volt terminals of the meter. This combination may be used for obtaining greater accuracy in measuring low resistances, short-circuited capacitors and sticky relays in subscriber sets. The milliammeter is used with a low resistance and shunt for making resistance measurements or current-flow tests by operating the AM key. This key disconnects the meter from the test battery and connects it normally to the ring side of the test circuit in series with 96 ohms and 24-volt central office battery. The B and C resistors are provided in series with the meter to protect it on maximum current flow, and to give the same ratio of deflection for current readings as for voltage readings on the 150-volt or 120-volt scale.

(h) Continuity test for tube-type subscriber lines.

3.15 Arranged to apply receiver off-hook tone to a subscriber line if the receiver is not on the switchhook.

4. CONNECTING CIRCUITS

(a) Howler Circuit - SD-90057-01.

(b) Permanent Signal Holding Trunk for Sender Make-Busy Frames - SD-21696-01.

(c) Selector Circuit - Line Finder and District Coin Control Circuit - SD-21631-01.

(d) Telephone Circuit for Sender Make-Busy Frame - SD-21707-01.

(e) Test Circuit Local Test Desk No. 14.

(f) Test Circuit for 20-Volt, 100-Volt, 116-Volt and 200-Volt Battery - SD-96120-01.

(g) Timer Circuit, 5A Timer - SD-99304-01.

(h) Miscellaneous Circuit for Miscellaneous Interrupter Frame - SD-21666-01, SD-21667-01.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 See revised 3.07 in Section III.

D. Description of Changes

D.1 Options M and N are added to Fig. 1. Option N was previously part of Fig. 1. Option M applies coin potential on tip lead of the line where dial-tone-first operation is applicable. Option N applies coin potential to both tip and ring leads.

D.2 Circuit Note 122 is added.