PANEL SYSTEM
SENDER MAKE BUSY FRAME
TEST CIRCUIT
FOR USE IN OFFICES SERVED BY A
CENTRAL "A" SWITCHBOARD

CHANGES

B. CHANGES IN APPARATUS

B.1	Superseded	Superseded By	Added
	4 - 8E Resistance lamps	4 - 12LOR13L resistance lamps	P3F cord (3P12E)
	1 - 8B Resistance lamp	1 - 12BOR13B resistance lamp	101ED resistance Fig. D
	KS-6563 volt milliammeter and multiplier	KS-8271 volt milliammeter	

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The resistance lamps (VM), (-STA), (+STA), (C) and (R) are shown as 8, 12 or 13 type and reference made to note 113 which is added.

D.2 The volt milliammeter (MAM) and multiplier are removed from main Fig. and shown in Fig. C rated "Mfr. Disc.". Fig. D and note 114 covering the change are added.

D.3 The KS specification number of the meter in Fig. C is added to note 107 and note 115 is added for the meter in Fig. D.

D.4 The main Fig. is designated Fig. 1 and the connecting information at Figs. A and B changed from "To main Fig." to "To Fig. 1."

D.5 The patching cord for use in crossbar offices is added and the code and assembly number replacing the "J" Spec. number added for the cord for use in panel offices. Prior to Issue 6-D the information at the patching cords was as follows: "Patch to permanent signal trunk or to district coin control circuit."

D.6 The cross connections have been changed.

All other headings under "Changes", no change.

1. PURPOSE OF CIRCUIT

1.1 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.

2. WORKING LIMITS

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

2.2 The rated external sleeve resistance for the (SL) relay is 34 ohms.

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

3. FUNCTIONS

3.01 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.

3.02 Supplies talking battery and ground through a repeating coil to the calling subscriber by the operation of a key which also connects the telephone circuit to the opposite side of the repeating coil 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.

3.03 Records supervision from the calling subscriber.

3.04 Arranged for ringing on the tip or ring of subscribers' lines.

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

3.06 Arranged to collect or return coins and light the pilot lamp when the coin current is applied to the line.

3.07 Arranged to apply howler tone to a subscriber line if the receiver is not on the switchhook.

3.08 Lights a lamp steadily as long as the howler circuit is off normal, but flashes this lamp until the end of the tone cycle.

3.09 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.

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

3.11 Arranged for voltmeter testing.

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

3.111 Test for grounds.

3.112 Test for short-circuits.

3.113 Test for continuity.

3.114 Voltmeter test for foreign potential.

3.115 Ballistic test for capacity.

3.116 Milliammeter test for low resistance.

3.117 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:

A-N	0-150 volts	1.5 MA	100,000 ohms
B-N	0-30 volts	1.5 MA	20,000 ohms
E-N	0-30 volts	30 MA	1,000 ohms
F-N		375 MA	less than 1 ohm

Fig. D

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

0-120 volts	1.2 MA	100,000 ohms
0-24 volts	1.2 MA	20,000 ohms
0-24 volts	24 MA	1,000 ohms
0-300 MA	300 MA	3 ohms

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 resistance across the (-) and (24V.) terminals of the meter. This combination may be used for obtaining greater accuracy in measuring low resistances, short-circuited condensers 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) & (C) resistances 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 V or 120 V scale.

3.118 Continuity test for tube type subscriber lines.

4. CONNECTING CIRCUITS

4.1 Howler circuit.

4.2 Permanent signal holding trunk for sender make busy frame.

4.3 Selector circuit - Line finder and district coin control circuit.

4.4 Telephone circuit for sender make busy frame.

4.5 Test circuit local test desk #14.

4.6 Test circuit for 20 V., 100 V., 116 V. and 200 V. battery.

DESCRIPTION OF OPERATION

5. CIRCUIT OPERATION

5.01 Talking

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 repeating coil battery to the tip and ring of the test jack. The (T) relay operated, supplies ground on the "ST" lead and transfers the operator's telephone circuit from the "T1" and "R1" leads to the 2 and 5 terminals of the repeating coil for talking. If the receiver is off the switchhook at the subscriber's 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's station the (S) relay releases and lights the (S) lamp.

5.02 Howler Application

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 operates from the subscriber's loop. Ground from the armature of the (S) relay through the contacts of the (H) key and (H1) relay operates relay (H), which locks through its own contacts and (H) key to ground at the (S) relay. 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 repeat coil 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 supplied 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. If the receiver at the subscriber's 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 repeating coil and operator's 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.

5.03 Coin Control

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.

5.031 Coin Collect

An attempt to collect the coin is brought about by operating the (CC) key, which operates the (CN) relay, disconnecting the repeat coil battery from the circuit. Positive or negative coin current (as required) is connected to the tip and ring 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.

5.032 Coin Return

An attempt to return the coin is brought about by operating the (CR) key which operates the (CN) relay, disconnecting the repeat coil battery from the circuit. Positive or negative coin current (as required) is connected to the tip and ring 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 resistance (A) and condenser (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.

5.04 Ringing

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 semi-selective 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's bell under the above conditions. The "ST" ground is opened every time the (±) key is operated, for the same reason as described in paragraph 5.03 when the (CC) or (CR) key is operated.

5.05 Voltmeter Test for Short-Circuits

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.

5.06 Voltmeter Test for Grounds

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 ohms 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 thru 20,000 ohms or 1,000 ohms 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.

5.07 Continuity Test

When making this test, the (G) key is operated. If the line is equipped with a common battery subscriber's set

having a condenser 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 condenser in the subscriber's set. If the needle does not return to zero after each operation of the (REV) key it indicates trouble or line leak. Tests for ground should always precede the test for continuity.

5.08 Continuity Test of Subscriber Lines Equipped with Cold Cathode Tube Type Subscriber Sets

Continuity tests of subscriber lines equipped with cold cathode tubes are made 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 thru the 100,000 ohm voltmeter shunted by 8,000 ohms resistances (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 thru 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 (VM REV) key.

5.09 Voltmeter Test for Foreign Battery

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 above but with the (REV) key operated.

5.10 Ballistic Capacity Test

This test is to determine the approximate capacity of the line, the total capacity of condensers 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.

5.11 Milliammeter Test

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.

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