

PANEL SYSTEM  
51 TYPE DIAL TESTER CIRCUIT  
FOR USE WITH RINGER TEST CIRCUIT  
AND LOCAL TEST DESK

CHANGES

B. CHANGES IN APPARATUS

B.1 Superseded

Superseded BY

Message Fig. 4;	14LH, Option "P"
Registers: 12E,	(A&M Only)
Option "Q"	14F, Option "N"
Fig. 5;	14LL, Option "K"
12C,	(A&M Only)
Option "M"	14K, Option "J"

Only) or Options "N" and "J" respectively.  
Options "P" and "K" are furnished with  
adapters for mounting on old equipment.

D.2 Note 124 is rated "Mfr. Disc."

D.3 Note 132 is added to cover these  
changes.

D.4 Added options are added to the  
Options Used Table.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Options "Q" and "M" are designated  
and rated "Mfr. Disc." and are super-  
seded by Options "P" and "K" resp. (A&M

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2314-BSP-CGM-GH



PANEL SYSTEM  
22 TYPE DIAL TESTER CIRCUIT  
FOR USE WITH RINGER TEST CIRCUIT  
AND LOCAL TEST DESK

CHANGES

B. CHANGES IN APPARATUS

B.1 Superseded

Superseded BY

Messages V.R. 5;  
Registers: 132  
Option "P" 14P, Option "M"  
V.R. 5;  
130  
Option "M" 14K, Option "J"  
14L, Option "K"  
(A&M Only)  
14P, Option "M"  
(A&M Only)  
14L, Option "P"

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Options "J" and "M" are designated  
and rated "Mr. Disc." and are super-  
seded by Options "P" and "K" resp. (A&M)

D.4 Added options are added to the  
Options Used Table.

D.3 Note 132 is added to cover these  
changes.

D.2 Note 134 is rated "Mr. Disc."

Only) or Options "M" and "J" respectively.  
Options "P" and "K" are furnished with  
adapters for mounting on old equipment.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2314-BSP-COM-CH



PANEL SYSTEM  
51 TYPE DIAL TESTER CIRCUIT  
FOR USE WITH RINGER TEST CIRCUIT  
AND LOCAL TEST DESK

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 This circuit is arranged to disconnect if any digit other than "0" is dialed when making the dial speed test.

B. CHANGES IN APPARATUS

Superseded	Superseded By
1 R79 (TD) Relay	1 R94 (TD) Relay
4 R183 (AD, HM, TD1,R) Relays	4 R1207 (AD,HM, TD1,R) Relays
1 R1267 (ST) Relay	1 R1378 (ST) Relay
1 E386 (RN) Relay	1 E1931 (RN) Relay
1 E446 (MG) Relay	1 E1695 (MG) Relay
2 E600 (HR,LR) Relays	1 E598 (HR,LR) Relay
1 E654 (D) Relay	1 E199 (D) Relay
1 E727 (C) Relay	1 E462 (C) Relay
1 E966 (RT) Relay	1 E1883 (RT) Relay
1 E1843 (RS) Relay	1 E935 (RS) Relay
1 E6269 Relay (SA)	1 E1684 Relay (SA)
1 E6434 Relay (SW)	1 E6427 Relay (SW)
1 149CG Relay (SR1)	1 149AR Relay (SR)
1 R986 Relay (RL)	1 R1240 Relay (RL)
1 E799 Relay (T1)	1 E1620 Relay (T1)

B.2 Added

- 1 R245 Relay (T2)
- 1 E1142 Relay (T3)

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Figure D and "R" and "T" options are added to permit the circuit to disconnect if any digit other than "0" is dialed when making the dial speed test.

D.2 The original circuit prior to this change is shown as Figure C and S and U options rated manufacture discontinued.

D.3 Notes 130 and 131 are added to designate the use of Figures C, D and "R", "S", "T" and "U" options.

D.4 The connecting information for the leads of Figure L is changed and note 203 is added to permit strapping of spare bank terminals of the LF selector to the working terminals to reduce the hunting time of the LF selector.

D.5 Note 123 is revised to include a reference to "280 Type relays" in the statement covering the 239 Type pulsing relays.

All other headings under changes, no change.

1. PURPOSE OF CIRCUIT

1.1 To test the speed of subscriber's and operator's dials.

1.2 To test for bell tapping from dial pulses.

1.3 Connection is made with this circuit either directly from the local test desk; or from the station under test by means of a ringer test circuit.

1.4 When this circuit is in a condition to test the speed of a dial, dial tone is connected to the line.

1.5 Distinctive tones are connected to the line indicating the condition of the dial: Slow, OK or fast.

2. WORKING LIMITS

2.1 When 10 P.P.S. dials are used with "Y" wiring and apparatus, maximum external circuit loop resistance 1500 ohms, minimum insulation resistance of test trunk 60,000 ohms, minimum insulation resistance of subs. or operators' loop, 10,000 ohms.

2.2 When 10 P.P.S. dials are used with "X" wiring, maximum external circuit loop resistance 1000 ohms, minimum insulation resistance of subs. or operators' loop 10,000 ohms (no test trunk used).

2.3 When 20 P.P.S. dials are used with "Y" wiring and apparatus, maximum external circuit loop resistance 1100 ohms, minimum insulation resistance of test trunk 60,000 ohms minimum insulation resistance of subs. or operators' loop 15,000 ohms.

2.4 When 20 P.P.S. dials are used with "X" wiring, maximum external circuit loop resistance 350 ohms minimum insulation resistance of subs. or operators' loop 15,000 ohms.



### 3. FUNCTIONS

3.1 Where more than one of these circuits is installed, they may be arranged in a common group or in two sub-groups, with a common start relay per group when arranged in a common group, or one start relay per sub-group when arranged in two sub-groups. The sub-group arrangement is intended to be used where the total number of "Ringer test circuits" and test desk positions associated with the Dial tester circuits exceed 22 and functions so that all "Ringer test circuits" can be served by both sub-groups of Dial tester circuits; however, the sub-groups are divided between the local test desk positions.

3.2 This circuit is associated with a subscriber station through ringer test circuit or through the local test desk. Four different dial testing conditions are established depending upon the setting of the register switch in the ringer test circuit, or upon which key is operated at the local test desk. These testing conditions are to determine whether the speed of a dial falls within one of the following ranges: low speed dial test limits, low speed dial readjust limits, high speed dial test limits, high speed dial readjust limits. One of three distinctive tones will be connected to the line on each test as follows: one tone if the speed of the dial is within the required limits; another tone if the speed of the dial is below the slow limit; another tone if the speed of the dial is above the fast limit.

3.3 Repeat tests may be made by means of the keys at the local test desk. When the station under test is connected to the dial tester by means of the ringer test circuit, repeat tests may be made by dialing a certain one digit code.

3.4 While testing dial, the subscriber's ringer can be observed for bell tapping. The pulsing circuit is arranged to apply as severe condition as is used in service.

### 4. CONNECTING CIRCUITS

4.1 This circuit associates itself with the local test desk secondary test circuit SD-90497-01 or with the ringer test circuit, SD-21094-01.

4.2 Miscellaneous and auxiliary alarm circuit for floor alarm board of miscellaneous alarm circuit, SD-21203-01, ES-226189.

4.3 Tone power circuit or miscellaneous tone circuit.

4.4 Power ringing circuit, SD-90429-03.

4.5 Audible and visual alarm circuit. SD-96188-01.

### DESCRIPTION OF OPERATION

#### 5. APPARATUS AND FUNCTIONS

##### 5.01 Gravity Pendulum

The time measuring device is composed of a gravity pendulum to which is attached a (Contact Arm) for making contact with a commutator. The release of this arm is controlled by a magnet mounted on the pendulum which when energized, holds the (Contact Arm) as part of the swinging element and when deenergized, allows the (Contact Arm) to make contact with the commutator. The (Contact Arm) is so pivoted that when released and in contact with the commutator, the pendulum can still swing. The commutator is divided into insulated segments so spaced that the pendulum, in swinging freely in the direction of the arrow from its start position when opposite the particular division will have been in motion for a time period equivalent to that required for nine pulses at the pulsing rate corresponding to the test and readjust requirements for low and high speed dials. The commutator divisions are so designed that the (Contact Arm) will not remain on the division point. The pendulum is controlled by the (Reset) solenoid and the (Hold) and (Trip) magnets, the functions of which are indicated by their names. The (Trip Contacts) are provided so that in case the pulse rate of a dial is slower than that provided for by the range of the commutator mechanical (Trip Contacts) will be operated, causing the (Contact Arm) to release. Two keys are provided for manual control of the pendulum for the purpose of calibration.

##### 5.02 (PC) "Pulse Control" Selector

This is a 206 type selector switch. It is used to control the setting of the 51 type dial tester and as a register advances under control of dial pulses. The following table indicates the function of the advancement from its various positions for both test desk calls and calls routed through the ringer test circuit.

#### TEST DESK CALL POS.

N	Normal
1	Awtg. (HL) relay
2	Awtg. (TR) relay
3	Awtg. (AD) relay
4	Dial Tone Awtg. Dial



TEST DESK CALL  
POS. (Cont'd)

- 5 Dialing Awtg. Dial
- 6 Dialing Awtg. Dial
- 7 Dialing Awtg. Dial
- 8 Dialing Awtg. Dial
- 9 Dialing Awtg. Dial
- 10 Dialing Awtg. Dial
- 11 Dialing Awtg. Dial
- 12 Dialing Awtg. Dial  
oper. (Tl) relay
- 13 Dialing Awtg. Dial; Rel. (Trip) magnet
- 14 OK or TBL. Tone Awtg. restore.
- 15 Pass by return to nor.
- 16 Pass by return to nor.
- 17 Pass by return to nor.
- 18 Pass by return to nor.
- 19 Pass by return to nor.
- 20 Oper. (RL) relay
- 21 Pass by return to nor.

RINGER TEST CALL  
POS.

- N Normal
- 1 Awtg. (HL) relay
- 2 Awtg. (TR) relay
- 3 Awtg. (AD) relay
- 4 Dial Tone Awtg. Dial
- 5 Dialing Awtg. Dial
- 6 Dialing Awtg. Dial
- 7 Dialing Awtg. Dial
- 8 Dialing Awtg. Dial
- 9 Dialing Awtg. Dial
- 10 Dialing Awtg. Dial
- 11 Dialing Awtg. Dial
- 12 Dialing Awtg. Dial oper. (Tl) relay
- 13 Dialing Awtg. Dial; Rel. (Trip) magnet
- 14 OK or TBL. Tone Awtg. dial or disc
- 15 Pass by
- 16 Dial 2 - Retest
- 17 Dial 3 - Readjust
- 18 Dial 4 - Retest
- 19 Dial 5 - Readjust
- 20 Opr. (RL) relay
- 21 Pass by return to nor.

## 5.03 (LF) Connecting Selector

This is a 206 type selector switch used as a line finder switch. Ground on the common start lead operates the (ST) relay which causes all idle connector selectors to rotate. The selector is caused to rotate under control of a relay which prevents overstepping. With battery on the hunt terminal, the hunt relays (H) and (H1) operate causing the selector to stop and the (CO) relay to operate, connecting the ringer test circuit or local test desk position through to the 51 type dial test circuit. In case of simultaneous selections not more than one set of hunt relays can operate, thus preventing double connections.

## 5.04 (AL) "Alarm" Selector

This is a 206 type selector switch. It is in the timing circuit which is common to both dial testers and ringer test circuits.

## 5.05 (DT) Lamp

At the relay rack, lights when the associated dial tester has been off normal for more than a certain length of time.

## 5.06 (DT) Message Register

Scores each time a connection is established with a dial tester.

## 5.07 Make Busy Jack

A make busy jack is provided for each dial test circuit. When a plug is inserted into this jack, three circuits are opened:

- (a) First, the start circuit to prevent the connection selector from rotating.
- (b) Second, the hunting circuit to prevent making the line busy on which the selector might be resting.
- (c) Third, the operating path for the (CT1) relay, to prevent interference.

## 5.08 Pulsing Circuit

A standard pulsing circuit is used. The (L) or pulsing relay, from its back contact and by aid of the (PH) (pulse help) relay controls the advance of the selector. The slow release (SR) and (SR1) relays are controlled directly or indirectly from make contact of the (L) relay and indicate that the circuit is being held at the dial station. (SV) relay, which is under control of (SR) or (SR1) relay, depending on "X" or "Y" wiring, is provided to guard against breaking down a connection due to make contact closures of the (L) relay of very short duration. The (RA) relay is in the pulse control selector circuit and operates in series with the selector. The (SW) relay is used as a transfer relay to make possible the use of the (PH) relay as an aid in the self-interrupted operation of the pulse control selector as well as in the pulse help feature. The pulsing path is through the break contact of the (RL) relay. The latter operates at terminal 20 in the event that, through error a digit should be dialed which may carry the (PC) stepper beyond the normal terminal. The (RL) relay operated, opens the pulsing path and will



permit the stepper to advance from normal to terminal 4 by way of the initial path.

### 5.09 Calibration Device

Two keys are provided for manual control when it is desired to check the oscillation of the pendulum. When making such a test, the circuit will be made busy in the regular manner. The operation of the (B) key will move the (Trip Contacts) to one side and cause the circuit to be set ready for a test. The operation of the (A) key will release the pendulum allowing it to swing freely. The release of the two keys restores the circuit to normal.

## 6. CIRCUIT OPERATION

### 6.1 Call Through Ringer Test Circuit

#### 6.11 Hunting

When a dial tester circuit is required by a ringer test circuit, ground is connected to (ST) lead operating (ST) or (R) relay, the (ST) relay is common to six dial tester circuits, or to a sub-group. If there are more than six dial tester circuits and sub-grouping is not required, there will be more than one (ST) relay which is common to a group and all the (ST) relays of the same group will operate in parallel. The operation of (R) relay will operate the (ST) relays of both sub-groups. This causes the connector switches of the idle dial tester circuits to hunt in the following manner for a terminal on (HG) lead to which battery through a 150 ohm resistance is connected. Ground from the (ST) relay causes (F) relay to operate which closes the same ground through its make contacts to operate (LF) stepping magnet. When (LF) stepping magnet operates, the circuit to (F) relay is broken and (F) relay releases, opening the circuit to (LF) stepping magnet and (LF) selector advances one step. (F) relay is slow operating to prevent the selector stepping off an idle terminal. When the selector reaches a terminal which has a low resistance battery connected to (HG) lead (H) relay operates and short-circuits its high resistance winding, causing an increase of current which operates (H1) relay, (H1) relay operated, removes the ground for operating (F) relay and the selector, causing it to stop hunting and operates (CT) relay.

#### 6.12 Connecting Through

The (CT) relay operated, cuts through the "SP" lead to (MG) and (P) relays, prepares path for operating (LR) or (HR) relay, and operates (DT) register and (CT1) relay. (CT1) relay operated, closes its locking path and operates (CO) and (Z)

relays. (CO) relay operated, opens the circuit to (LF) selector closes through "HL", "SP", "T" and "R" leads and part of a series circuit to (BY) relay. (Z) relay operated closes through, (TD) lead and starts the timing circuit as described in paragraph 6.4. A bridge across the "T" and "R" leads in the ringer test circuit operates the (L) relay. (L) relay operated, operates (SR) relay through (SR) arc of (PC) selector switch. With Y wiring (SR) relay operated, operates (SR1) relay in turn operating (SV) relay, with X wiring the (SR) relay operates the (SV) relay which operates (ON) relay through the normal terminal of (BS) arc of (PC) selector switch. (ON) relay operated, operates (G) and (G1) relays. (G) and (G1) relays operated, connect ground to the off-normal ground leads and battery to the off-normal battery leads. (CT1) relay locks to the off-normal ground. As (TD) lead does not extend through to the ringer test circuit (TD) relay does not operate. Ground through the break contacts of (RN) and (TD) relays is connected to "HL" lead. This causes a relay in the ringer test circuit to operate which in turn disconnects the battery from "HG" lead and disconnects ground from "ST" lead. Battery disconnected from "HG" lead, releases (H) and (H1) relays in turn releasing (CT) relay. Ground disconnected from "ST" lead, releases (R) and (ST) relay, stopping the hunting connector switches of the other dial tester circuits. (CT) relay released opens the initial circuit to the (MG), (P), (LR) and (HR) relays. By the operation and release of (CT) relay, (DT) message register is operated and released, scoring one call.

Depending upon the setting of the register in the ringer test circuit, the "SP" lead will be open or connected to either ground through 5000 ohms resistance, 48 volt battery or direct ground. With the "SP" lead open the marginal (MG) and polarized (P) relays are not operated and the commutator segments are grouped for indicating the speed condition of a low speed dial within its test limits. "SP" lead connected to ground through 5000 ohms operates the (P) relay. The (MG) relay does not receive sufficient current to operate due to the high resistance in the circuit. (P) relay operated operates (LR) relay which groups the commutator segments for indicating the speed condition of a low speed dial within its readjust limits. 48 volt battery connected to the "SP" lead operates (MG) relay but the (P) relay does not operate under this condition since the current flow is in the reversed direction. (MG) relay operated, operates (SP) relay which groups the commutator segments for indicating the speed condition of a high



speed dial within its test limits. Direct ground connected to the "SP" lead operates both (MG) and (P) relays. (MG) relay operated, operates (SP) relay. (P) relay operated, operates (HR) relay over a lead transferred from the winding of the (LR) relay by the

operation of (SP) relay. (LR) or (HR) relays lock to the off-normal ground through the break contacts of (TD) and (RT) relays. This locking circuit is provided because the operating path is only closed for a short time. See following table:

Table showing condition of leads for different tests:

Type of Dial	Application	Condition on "SP" Lead	Relays Operated
Low Speed	Test	Open	None
Low Speed	Readjust	Grd. Through 5000 ohms	(P) and (LR)
High Speed	Test	48V Bat.	(MG) and (SP)
High Speed	Readjust	Grd.	(MG), (P) and (SP) and (HR)

### 6.13 Setting of the Pendulum

#### 6.131 Selector Normal

When (G) relay operated, the battery connected to the off-normal battery lead through the break contact of (RN) relay and the normal terminal of (RN) arc of (PC) selector switch and the break contact of (PC) selector, operates (PH) relay, energizing (PC) selector which opens the circuit to (PH) relay, releasing it and (PC) selector switch steps to position 1. The battery on the off-normal battery lead to ground through dial tone contacts of dial tester also operates (AD) relay. (AD) relay operated, in turn operates (FS), (OK) or (SL) relay depending upon the commutator segment that the contact arm happens to be resting on. The operation of these relays performs no useful function at this time.

#### 6.132 Selector Position 1 - Awaiting (HL) Relay

In position 1 (HM) relay operates from ground on (GS) arc. (HM) relay operated, locks to the off-normal ground through the break contact of (DT) relay and operates, (HL) relay through its "S" winding. (HL) relay operated, locks through its "P" winding in series with the hold magnet of the 51 type dial tester from battery through the make contacts of (L) relay, and connects battery to terminal of (RN) arc stepping the (PC) selector switch one position from position 1 to position 2.

#### 6.133 Selector Position 2 - Awaiting (TR) Relay

In position 2, (RS) relay operates from ground on (GS) arc. (RS) relay

operated, operates the (RESET) solenoid of the 51 type dial tester. The reset arm moves under control of the (RESET) solenoid breaking the (Dial Tone Contacts), releasing (AD) relay in turn removing battery from the windings of (FS), (OK) and (SL) relays releasing any one that may be operated. Further movement of the reset arm moves the pendulum and (Contact Arm) to the extremity of their swing and places them under control of the (Hold) magnet. When the reset arm has reached its fully operated position the (Solenoid Control Contact) will be closed, operating (TR) relay through the "S" winding. (TR) relay operated, operates (TF) and (TC) relays and locks in series with the (TRIP) magnet and the "P" winding through the break contact of (T) relay to the off-normal battery. The (TRIP) magnet holds the trip arm to the pendulum. The operation of (TC) relay connects battery to terminal 2 of (RN) arc, stepping (PC) selector switch one position, from position 2 to position 3.

#### 6.134 Selector Position 3 - Awaiting (AD) Relay

As (PC) selector switch advances from position 2 to position 3 the circuit through (RS) relay is opened. When (RS) relay is released, the circuit to the (RESET) solenoid is broken and the reset arm will return to its normal position. The (Solenoid Control Contacts) are opened. When the reset arm is in its normal position the (Dial Tone Contact) are closed operating (AD) relay. (AD) relay operated, connects battery to 3 terminal of the (RN) arc, stepping (PC) selector switch one position from position 3 to position 4. (AD) relay operated, also connects battery to the windings of (FS), (OK) and (SL) relays.



#### 6.14 Selector Position 4 - Dial Tone Awaiting Dial

As (PC) selector switch advances from position 3 to position 4, the control of (SR) relay is changed from the make contact of (L) relay to the make contact of (HL) relay. In position 4, (DT) relay operates from ground on (GS) arc. (DT) relay operated operates (SW) relay and releases (HM) relay which in turn breaks the operating circuit of (HL) relay, leaving (HL) relay and the (Hold) magnet held under control of the make contact of (L) relay. (SW) relay operated locks through the break contacts of (RT), (RR), (T3) and (RN) relays, closes the tone lead to the "P" winding of (BAL) repeating coil, connects (PH) relay in parallel with (PC) stepping magnet, and arranges the (PC) stepping magnet under control of the break contact of (L) relay. A tone through the "P" winding of the (BAL) repeating coil induces a tone in the "S" winding which is audible at the station under test. This tone is the regular dial tone except when "W" wiring and apparatus is used, and is the signal that the central office apparatus is set for the dial test. Zero should then be dialed. When "W" apparatus is used (DT-1) condenser is wired in parallel with (DT) condenser to give a much louder dial tone so as to prevent fraudulent use of the circuit by the subscriber, and this feature is special for New York Telephone Co.

#### 6.15 Advance of Dial Pulses

6.151 Position 4 to Position 5 - (L) relay should follow the dial pulses. On the first release of (L) relay, (HL) relay and the (Hold) magnet release. The release of the (Hold) magnet permits the pendulum to start its swing. Battery through the break contact of (L) relay is connected through the winding of (RA) relay in series with the winding of (PC) stepping magnet to ground also through the make contact of (SW) relay and the break contact of (PC) stepping magnet through the winding of (PH) relay to ground. (RA) and (PH) relays operate and (PC) stepping magnet is energized. (PH) relay operated, holds battery connected through the winding of (RA) relay and through the (PC) stepping magnet, and its own winding in parallel. This is to insure the advance of (PC) selector switch even if the break contact closure of the (L) relay is very brief. (PH) relay operated, also holds the circuit for (SR) relay closed. When the stepping magnet opens its contact (PH) relay releases and provided (L) relay has reoperated, (PC) selector switch advances one step to position 5. (DT) relay releases as (PC) selector switch leaves position 4, opening the dial tone circuit.

6.152 Position 5 to Position 11 - In position 5, (SR) relay is again under control of the make contact of (L) relay. The advance from one position to the next is as above described.

#### 6.153 Position 12 - Operation of (T1)

Relay - In position 12 (SR) relay is under control of (TF) relay, and (T1) relay operates from ground on (GS) arc. (T1) relay operated, locks to the off-normal ground through the make contact of (TR) relay and opens the circuit to (TF) relay. (TF) relay being slow releasing will hold (SR) relay operated while the switch is in position 12, under normal conditions. (T1) relay operated also closed an auxiliary locking circuit for (TR) relay under control of the make contact of (L) relay.

#### 6.154 Position 13 - Release of Trip

Magnet - (SR) relay is under control of (TC) relay in position 13, (TC) relay being under control of (TR) relay. In position 13 (T) relay operates, opening the locking circuit of (TR) relay to the off-normal battery, leaving (TR) relay and the trip magnet under control of the make contact of (L) relay. (TR) relay will remain operated as long as (L) relay is operated. On the release of (L) relay at the beginning of the tenth pulse, (TR) relay releases and the (Trip) magnet is released. The release of (TR) relay releases (T1) relay and prevents the circuit to the (Trip) magnet being again closed, the (TR) relay also releases (TC) relay placing (SR) relay under control of the make contact of (L) relay. The release of the (Trip) magnet allows the (Contact Arm) to come in contact with the commutator at a distance from the starting position proportional to the time required by the dial in sending 9 and a fraction pulses. As before explained, the grouping of the commutator segments is dependent upon the test being made. The (Contact Arm) coming in contact with a commutator segment stops its swing and supplies ground for operating one of the signal relays (FS), (OK), or (SL) depending upon the speed of the dial and the particular test being made.

The (Trip) magnet is so arranged that when (B) key is not operated its circuit will be broken when the pendulum reaches the extremity of its swing. If the speed of a dial is so slow that the pendulum reaches the extremity of its swing before the start of the tenth pulse the opening of this circuit will release the (Trip) magnet and (TR) relay. (TR) relay released, in turn releases (TC) relay, placing (SR) relay directly under control of the make contact of (L) relay in positions 12 and 13. The (Contact Arm) will make contact with the last segment of



the commutator which is permanently wired to (SL) relay which will operate causing the slowly interrupted tone to be sent out indicating that the dial speed is too slow. At the completion of the tenth pulse, the (PC) selector switch will step from position 13 to position 14 releasing (T) relay.

#### 6.16 Position 14 - O.K. or Trouble Tone

In position 14 (DT) relay operates from ground on (GS) arc, connecting ground to the "P" winding of the (BAL) repeating coil for completing the tone circuit. Either (SL), (OK) or (FS) relay will be operated and a tone will be closed through the "P" winding of the (BAL) repeating coil. This will induce a tone in the "S" winding of the (BAL) coil which is audible at the station under test. If (SL) relay is operated a slowly interrupted tone will be applied indicating that the dial speed is slower than the low speed limit of the particular test being made. If (OK) relay is operated from the commutator segment of the dial tester an audible ringing tone will be applied indicating that the dial speed is within the limits of the particular test being made. If (FS) relay is operated, a rapidly interrupted tone will be applied, indicating that the dial speed is faster than the high speed limit of the particular test being made. When (SL) or (FS) relay operates the (OK) relay will follow the interrupter closures to produce the slow or fast tone.

#### 6.17 Reset for Repeat Test

In order to make a repeat test, a single digit, either 2, 3, 4, or 5 is dialed at any time after the O.K. or trouble tone is audible. 2 or 4 is dialed if it is desired to test the dial within its test limits and 3 or 5 if it is desired to test the dial within its readjust limits. The range of the dial, either high speed or low speed, will remain the same on repeat tests as on the initial test. The dial pulses causes the (PC) selector switch to advance in the same manner as when zero was dialed. (RA) relay will be operated at the beginning of the train of pulses, but will release at the end of the train. Should 2 or 4 be dialed, (PC) selector switch will be stepped to position 16 or 18 and when (RA) relay releases, (RT) relay will be operated opening the locking circuit for (HR) and (LR) relays, releasing them if operated, and opening the locking circuit of (SW) relay which releases. Should 3 or 5 be dialed, (PC) selector switch will be stepped to position 17 or 19 and when (RA) relay releases, (RR) relay will be operated connecting ground through the break contact of (SP) relay, operating (LR) relay if (SP)

relay is normal or connecting ground through the make contact of (SP) relay, operating (HR) relay if (SP) relay is operated. The operation of (RR) relay also opens the locking circuit of (SW) relay which releases. (RR) relay is slow in releasing because the (HR) or (LR) operating circuit must be closed long enough to close locking circuit of (HR) or (LR) relay. (SW) relay released advances (PC) selector switch under control of (PH) relay and its own break contact, the advancing circuit is from battery on terminals 5 to 21 of (RN) arc. The (PC) selector switch is advanced to normal. As (PC) selector switch leaves position 14, (DT) relay releases. In position 20 (RL) relay operates from ground on (GS) arc, and locks under control of (AD) relay. In the normal position, (ON) relay is held operated under control of (SV) relay, and (G) relay being operated (PC) switch is stepped to position 1; the operation from this point on being the same as before described, the pendulum being reset and (PC) switch advancing to position 4. (RL) relay releases when (AD) relay releases.

#### 6.18 Disconnection

With (PC) selector switch in position 14, if the station under test disconnects (L) relay releases in turn releasing (SR) relay, in turn releasing (SR1) relay when "Y" app. is used in turn releasing (SV) relay, in turn operating (RN) relay. (RN) relay operated, locks to the off-normal ground and opens the "R" and "HL" leads releasing the ringer test circuit. The operation of (RN) relay also releases (SW) relay. The release of (SW) relay, advances (PC) selector switch under control of (PH) relay and its own break contact, the advancing circuit is from battery on terminals 5 to 21 of (RN) arc. Thus the (PC) selector switch is advanced to normal. As (PC) selector switch leaves position 14, (DT) relay releases. In position 20, (RL) relay operates from ground on (GS) arc, and locks under control of (AD) relay. As (PC) selector switch leaves position 21, the circuit for (ON) relay is broken. It releases, in turn releasing (G) and (G1) relays. (G) and (G1) relays released, release (RN), (CT1), (CO), (Z) and all other relays which may be operated from the off-normal battery and ground leads, and the circuit is normal.

#### 6.19 Early Release

##### 6.191 Normal Position

In case the 51 type dial tester circuit is selected and immediately released, the (L) relay may not have been operated



a sufficient length of time to move the (PC) selector switch from the normal position.

#### 6.192 Positions 1, 2 or 3

If the calling station disconnects with the (PC) selector switch in positions 1, 2 or 3 (L) relay will release, in turn releasing (SR) in turn releasing (SR1) when "Y" app. is used in turn releasing (SV) relays, in turn operating (RN) relay. (RN) relay operated, locks to the off-normal ground and opens the "R" and "HL" leads releasing the ringer test circuit and opens the operating circuit of (SW) relay. The operation of the circuit will proceed in the regular manner in positions 1, 2 and 3 of (PC) selector switch. In position 4, (SW) relay will not operate and (PC) selector switch will be stepped to position 5 from battery through the break contact of (SV) relay and (RN) arc. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal.

#### 6.193 Position 4

If the called station disconnects with (PC) selector switch in position 4, (L) relay releases energizing (PC) stepping magnet, (HL) relay will release in turn releasing (SR) relay in turn releasing (SR1) relay in turn releasing (SV) relay, in turn operating (RN) relay which locks to the off-normal ground, and opens the "R" and "HL" leads, releasing the ringer test circuit, and releases (SW) relay. (SW) relay released, opens the circuit to (PC) stepping magnet which releases, stepping (PC) selector switch to position 5. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal.

#### 6.194 Positions 5 to 11 (Figure C and "S" and "U" Options)

If 1 to 7 digits are dialed, (PC) selector switch will advance to a corresponding position between 5 and 11. When the station under test disconnects, (L) relay releases in turn releasing (SR) relay, in turn releasing (SR1) relay in turn releasing (SV) relay, in turn operating (RN) relay. (RN) relay locks to the off-normal ground, and opens the "R" and "HL" leads, releasing the ringer test circuit, and releases (SW) relay. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal.

#### 6.195 Positions 5 to 11 (Figure D and "R" and "T" Options)

If 1 to 7 digits are dialed, the (PC) selector switch will advance to a corresponding position between 5 and 11. At the end of the train of dial pulses, the (RA) relay will release and the (T3) relay will operate to battery on the normal contacts of the (RA) relay. The operation of the (T3) relay will cause the (SW) relay to release. Battery through the normal contacts of the (SW) relay and through terminals 5 to 21 of the (RN) arc, steps the (PC) selector switch to normal.

#### 6.196 Position 12 (Figure C and "S" and "U" Options)

If 8 is dialed (PC) selector switch will step to position 12. In position 12 (SR) relay is under control of (TF) relay, but as the operating circuit of (TF) relay is broken in position 12 by the operation of (T1) relay, (TF) relay will release. When the pendulum reaches the end of its swing the (Trip Contact) should open, releasing the (Trip) magnet and (TR) relay, in turn releasing (TC) relay. (TC) relay released, places (SR) relay under control of the make contact of (L) relay. When the station under test disconnects, (L) relay releases in turn releasing (SR) relay, in turn releasing (SR1) relay when "Y" apparatus is used in turn releasing (SV) relay in turn operating (RN) relay. (RN) relay locks to the off-normal ground and opens the "R" and "HL" leads releasing the ringer test circuit, and releases (SW) relay. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal.

Should (SV) relay release before the (Trip Contacts) are opened or should the pendulum fail to make a complete swing and fail to open the (Trip Contacts), the circuit for (SR) relay will remain open when (TF) relay releases and (SR) relay will release in turn releasing (SR1) relay when "Y" apparatus is used in turn releasing (SV) relay, in turn operating (RN) relay. This circuit and the ringer test circuit will be restored to normal as before described, even though the calling station has not disconnected.

#### 6.197 Position 12 (Figure D and "R" and "T" Options)

If 8 digits are dialed, the (PC) selector will step to position 12. At the end of the eighth dial pulse the (RA) relay



will release. Ground on the (GS) arc of the (PC) switch will operate the (T1) and (T3) relays. The operation of the (T3) relay will cause the (SW) relay to release. Battery through the normal contacts of the (SW) relay through terminals 12 to 21 of the (RN) arc steps the (PC) selector switch to normal.

#### 6.198 Position 13 (Figure C and "S" and "U" Options)

If 9 is dialed, (PC) selector switch will step to position 13. (SR) relay is held operated through the make contact of (TC) relay. When the pendulum reaches the end of its swing, the (Trip Contacts) should open, releasing the (Trip) magnet and (TR) relay in turn releasing (TC) relay. (TC) relay released, places (SR) relay under control of the make contact of (L) relay. When the station under test disconnects, (L) relay releases in turn releasing (SR) relay in turn releasing (SR1) relay, when "Y" apparatus is used in turn releasing (SV) relay, in turn operating (RN) relay. Should the pendulum fail to make a complete swing and fail to open the (Trip Contacts), (SR) relay will remain held through the make contact of (TC) relay to battery and when the station under test disconnects (L) relay releases in turn releasing (TR) relay, in turn releasing (TC) relay, in turn releasing (SR) relay, in turn releasing (SR1) relay when "Y" apparatus is used in turn, releasing (SV) relay in turn operating (RN) relay. (RN) relay locks to the off-normal ground and opens the "R" and "HL" leads releasing the ringer test circuit and releases (SW) relay. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal.

#### 6.199 Position 13 (Figure D and "R" and "T" Options)

If 9 digits are dialed the (PC) selector switch will step to position 13. At the end of the ninth dial pulse, the (RA) relay will release. Ground on the (GS) arc of the (PC) switch will operate the (T) relay. The (T) relay will operate the (T2) relay which in turn will operate the (T3) relay. The operation of the (T3) relay will cause the (SW) relay to release. Battery through the normal contacts of the (SW) relay, and through terminals 13 to 21 of the (RN) arc steps the selector switch to normal.

### 6.2 Call Through Local Test Desk

#### 6.201 Hunting

When a dial tester circuit is required by an operator at the local test desk, a key at the local test desk is

operated connecting ground to (ST) lead operating (ST) relay, which is common to six dial tester circuits in a group or sub-group. If there are more than six dial tester circuits and sub-grouping is not required, there will be more than one (ST) relay common to a group and all the (ST) relays will operate in parallel. This causes the connector switches of the idle dial tester circuits to hunt in the following manner for a terminal on (HG) lead to which battery through a 150 ohm resistance is connected. Ground from the (ST) relay causes the (F) relay to operate which closes the same ground through its make contact to operate (LF) stepping magnet. When (LF) stepping magnet operates the circuit to (F) relay is broken and (F) relay releases, opening the circuit to (LF) stepping magnet and (LF) selector advances one step. (F) relay is slow operating to prevent the selector stepping off an idle terminal. When the selector reaches a terminal which has a low resistance battery connected to (HG) lead (H) relay operates and short circuits its high resistance winding, causing an increase of current which operates (H1) relay. (H1) relay operated, removes the ground for operating (F) relay and the selector, causing it to stop hunting and operates (CT) relay.

#### Connecting Through

When the (CT) relay operated, it closes the "SP" lead to (MG) and (P) relays, prepares path for operating (LR) or (HR) relays, operates (DT) register and (CT1) relay. (CT1) relay operated, closes its locking path and operates (CO) and (Z) relays. (CO) relay operated opens the circuit to (LF) selector closes through "HL", "SP", "T" and "R" leads and part of a series circuit for operating (BY) relay. (Z) relay operated closes through (TD) lead and starts timing circuit as described in paragraph 6.4. Ground from the key circuit of the test desk over (TD) lead operates (TD) relay and a relay at the local test desk. This latter relay operated removes the ground from (ST) lead, releasing (ST) relay, stopping the hunting connector switches of the other dial tester circuit and releasing (CT) relay. When (TD) relay operated (TD1) relay operated in a local circuit when "Y" wiring is used closing a circuit to be described later. By the operation and release of (CT) relay (DT) message register is operated and released, scoring one call. The operation of the relay at the local test desk also removes battery from "HG" lead, releasing (H) and (H1) relays. (TD) relay operated, operates (TD1) relay when "Y" wiring is used which operates (CT1) relay. When "X" wiring is used the above path is closed by the operation of (TD) relay. The (TD) relay also



prepares a path for operating (LR) or (HR) relay after (CT) relay releases, opens the locking path of (LR) and (HR) relays, prepares a path for operating a relay at the local test desk over "HL" lead and provides a locking path for (CT1) relay. When a test key at the local test desk is operated, "R" lead is grounded over the subscriber loop operating (L) relay. (L) relay operated operates (SR) relay through (SR) arc of (PC) selector switch. (SR) relay operated, operates (SR1) relay when "Y" wiring is used in turn operating (SY) relay which operates (ON) relay through the normal terminals of (BS) arc of (PC) selector switch. (ON) relay operated, operates (G) and (G1) relays, (G) and (G1) relays when operated connect ground to off-normal ground leads and battery to off-normal battery leads. (CT1) relay locks to the off-normal ground lead.

#### 6.202 Class of Test

The dial tester circuit may be associated with either a low or high speed dial and either test or readjust conditions may be imposed. Distinction between these different conditions is made as follows: "SP" lead will be either open or connected to ground through 5000 ohms, 48 volt battery or direct ground. With "SP" lead open the (MG) and (P) relays are not operated

and the commutator segments are grouped for indicating the speed condition of a low speed dial within its test limits. "SP" lead connected to ground through 5000 ohms operates the (P) relay. The (MG) relay does not receive sufficient current to operate due to the high resistance in the circuit. (P) relay operated operates (LR) relay which groups the commutator segments for indicating the speed condition of a low speed dial within its readjust limits. 48 volt battery connected to the "SP" lead operates (MG) relay but the (P) relay does not operate under this condition since the current flow is in the reverse direction. (MG) relay operated, operates (SP) relay which groups the commutator segments for indicating the speed condition of a high speed dial within its test limits. Direct ground connected to the "SP" lead operates both (MG) and (P) relays. (MG) relay operated, operates (SP) relay. (P) relay operated, operates (HR) relay over a lead transferred from the winding of the (LR) relay by the operation of the (SP) relay. With the (SP) and (HR) relays operated commutator segments are grouped for indicating a speed condition of a high speed dial within its readjust limits, See following table.

Table showing condition of leads and relays for different tests:

Type of Dial	Application	Condition on "SP" Lead	Relays Operated
Low Speed	Test	Open	None
Low Speed	Readjust	Grd. through 5000 ohms	(P) and (LR)
High Speed	Test	48V. Bat.	(MG) and (SP)
High Speed	Readjust	Grd.	(MG), (P), (SP) and (HR)

#### 6.203 Setting of the Pendulum

##### 6.2031 Selector Normal

When (G) relay operated the battery connected to the off-normal battery lead through the break contact of (RN) relay and the normal terminal of (RN) arc of (PC) selector switch and the break contact of the (PC) selector operates (PH) relay, which energizes (PC) selector which opens the circuit to (PH) relay releasing it, and (PC) selector switch steps to position 1. The battery on the off-normal battery lead also operates (AD) relay. (AD) relay operated, in turn operates (FS), (OK) or (SL) relay depending upon the commutator segment that the (Contact Arm) happens to be resting on. The operation of these relays performs no useful function at this time.

##### 6.2032 Selector Position 1 - Awaiting (HL) Relay

In position 1 (HM) relay operates from ground on (GS) arc. (HM) relay operated, locks to the off-normal ground through the break contact of (DT) relay and operates (HL) relay through its "S" winding. (HL) relay operated, locks through its "P" winding in series with the hold magnet of the 51 type dial tester from battery through the make contact of (L) relay and connects battery to terminal 1 of (RN) arc stepping the (PC) selector switch one position from position 1 to position 2.

##### 6.2033 Selector Position 2 - Awaiting (TR) Relay

In position 2, (RS) relay operates from ground on (GS) arc. (RS) relay



operated, operates the reset solenoid of the 51 type dial tester. The reset arm moves under control of the (RESET) solenoid breaking the (Dial Tone Contact) releasing (AD) relay in turn removing battery from the windings of (FS), (OK) and (SL) relays, releasing any one that may be operated. Further movement of the reset arm moves the pendulum and (Contact Arm) to the extremity of their swing and places them under control of the (Hold) magnet. When the reset arm has reached its fully operated position the (Solenoid Control Contacts) will be closed, operating (TR) relay, through the "S" winding (TR) relay operated, operates (TF) and (TC) relays and locks in series with the trip magnet and the "P" winding through the break contact of (T) relay to the off-normal battery. The (Trip) magnet holds the (Contact Arm) to the pendulum. The operation of (TC) relay connects battery to terminal 2 of (RN) arc, stepping (PC) selector switch one position, from position 2 to position 3.

#### 6.2034 Selector Position 3 - Awaiting (AD) Relay

As (PC) selector switch advances from position 2 to position 3 the circuit through (RS) relay is opened. When (RS) relay is released, the circuit to the (RESET) solenoid is broken and the reset arm will return to its normal position. When the reset arm is in its normal position the (Dial Tone Contacts) are closed operating (AD) relay. (AD) relay operated, connects battery to terminal 3 of (RN) arc, stepping (PC) selector switch one position from position 3 to position 4. (AD) relay operated, also connects battery to the windings of (FS), (OK) and (SL) relays.

#### 6.204 Selector Position 4 - Dial Tone Awaiting Dial

As (PC) selector switch advances from position 3 to position 4, the control of (SR) relay is changed from the make contact of (L) relay to the make contact of (HL) relay. In position 4, (DT) relay operates from ground on (GS) arc. (DT) relay operated, connects battery through (H) resistance to "HL" lead to close the monitoring circuit at the local test desk, the (DT) relay also operates (SW) relay and releases (HM) relay in turn breaking the operating circuit of (HL) relay, leaving (HL) relay and the hold magnet held under control of the make contact of (L) relay. (SW) relay operated, locks through the break contacts of (RT) and (RR) relays, closes the tone lead to the "P" winding of (BAL) repeating coil, connects (PH) relay in parallel with (PC) stepping magnet, and arranges the (PC) stepping magnet under control of the break contact of (L) relay. A tone through the

"P" winding of the (BAL) repeating coil induces a tone in the "S" winding which is audible at the station under test and at the test desk telephone circuit. This tone is the regular dial tone except when "W" wiring and apparatus is used and is the signal that the central office apparatus is set for the dial test. Zero should then be dialed.

#### 6.205 Advance on Dial Pulses

6.2051 Position 4 to Position 5 - (L) relay should follow the dial pulses. On the first release of (L) relay, (HL) relay and the (Hold) magnet release. The release of the (Hold) magnet permits the pendulum to start its swing. The release of (HL) relay disconnects the battery from "HL" lead causing the monitoring circuit at the local test desk to be opened. The purpose of this is to prevent dialing from pulsing into the telephone receiver of the attendant at the test desk and to remove the capacity bridge which might interfere with pulsing. Battery through the break contact of (L) relay is connected through the winding of (RA) relay in series with the winding of (PC) stepping magnet to ground also through the make contact of (SW) relay and the break contact of (PC) stepping magnet through the winding of (PH) relay to ground. (RA) and (PH) relays operate and (PC) stepping magnet is energized. (PH) relay operated, holds battery connected through the winding of (RA) relay and through the (PC) stepping magnet, and its own winding in parallel. This is to insure the advance of (PC) selector switch even if the break contact closure of the (L) relay is very brief. (PH) relay operated, also holds the circuit for (SR) relay closed. When the stepping magnet opens its contact, (PH) relay releases and provided (L) relay has reoperated, (PC) selector switch advances one step to position 5. (DT) relay releases as (PC) selector switch leaves position 4, opening the dial tone circuit.

#### 6.2052 Position 5 to Position 11

In position 5, (SR) relay is again under control of the make contact of (L) relay. The advance from one position to the next is as above described.

#### 6.2053 Position 12 - Operation of (T1) Relay

In position 12 (SR) relay is under control of (TF) relay and (T1) relay operates from ground on (GS) arc. (T1) relay operated, locks to the off-normal ground through the make contact of (TR) relay and opens the circuit to (TF) relay. (TF) relay being slow releasing will hold (SR)



relay operated while the switch is in position 12, under normal conditions. (T1) relay operated also closes an auxiliary locking circuit for (TR) relay under control of the make contact of (L) relay.

#### 6.2054 Position 13 - Release of Trip Magnet

(SR) relay is under control of (TC) relay in position 13, (TC) relay being under control of (TR) relay. In position 13 (T) relay operates, opening the locking circuit of (TR) relay to the off-normal battery, leaving (TR) relay and the trip magnet under control of the make contact of (L) relay. (TR) relay will remain operated as long as (L) relay is operated. On the release of (L) relay at the beginning of the tenth pulse, (TR) relay releases and the (Trip) magnet is released. The release of (TR) relay releases (T1) relay and prevents the circuit to the (Trip) magnet being again closed, the (TR) relay also releases (TC) relay placing (SR) relay under control of the make contact of (L) relay. The release of the (Trip) magnet allows the Contact Arm to come in contact with the commutator at a distance from the starting position proportional to the time required by the dial in sending 9 and a fraction pulses. As before explained the grouping of the commutator segments is dependent upon the test being made. The (Contact Arm) coming in contact with a commutator segment stops its swing and supplies ground for operating one of the signal relays (FS), (OK) or (SL), depending upon the particular test being made. The (Trip) magnet is so arranged that when (B) key is not operated its circuit will be broken when the pendulum reaches the extremity of its swing. If the speed of a dial is so slow that the pendulum reaches the extremity of its swing before the start of the tenth pulse the opening of this circuit will release the (Trip) magnet and (TR) relay. (TR) relay released in turn releases (TC) relay, placing (SR) relay directly under control of the make contact of (L) relay in position 12 and 13. The trip arm will make contact with the last segment of the commutator which is permanently wired to (SL) relay which will operate causing the slowly interrupted tone to be sent out indicating that the dial speed is too slow.

At the completion of the tenth pulse, the (PC) selector switch will step from position 13 to position 14, releasing (T) relay.

#### 6.206 Position 14 - O.K. or Trouble Tone

In position 14 (DT) relay operates from ground on (GS) arc, connecting ground to the "P" winding of the (BAL) repeating

coil for completing the tone circuit and connecting battery through (C) resistance to "HL" lead to close the monitoring circuit at the test desk.

When the cable between a P.B.X. subscriber and the dial tester, is more than 800 ohms the (PC) selector may take an extra step, therefore a circuit is provided with "Y" wiring and apparatus from position 15 of (GS) arc, (PC) selector through contacts of (TD1) relay to operate (DT) relay.

Either (SL), (OK) or (FS) relay will be operated and a tone will be closed through the "P" winding of the (BAL) repeating coil. This will induce a tone in the "S" winding of the (BAL) coil which is audible at the station under test and at the test desk telephone circuit. If (SL) relay is operated, a slowly interrupted tone will be applied indicating that the dial speed is slower than the low speed limit of the particular test being made. If (OK) relay is operated, from the commutator segment of the dial tester, an audible ringing tone will be applied, indicating that the dial speed is within the limits of the particular test being made. If (FS) relay is operated, a rapidly interrupted tone will be applied indicating that the dial speed is faster than the high speed limit of the particular test being made. When (SL) or (FS) relay operated the (OK) relay will follow the interrupter closures to produce the slow or fast tone.

#### 6.207 Restoring to Normal

With (PC) selector switch in position 14, the station under test disconnecting or restoring the test key to normal will open "R" lead releasing (L) relay in turn releasing (SR) relay in turn releasing (SR1) relay where "Y" apparatus is used in turn releasing (SV) relay. (SV) relay released, operates (RN) relay which locks to the off-normal ground, opens "R" lead and releases (SW) relay. The release of (SW) relay advances (PC) selector switch under control of (PH) relay and its own break contact. The advancing circuit is from battery on terminals 5 to 21 of (RN) arc. The (PC) selector switch is advanced to normal. As (PC) selector switch leaves position 14 where "X" wiring is used, or position 14 and 15 where "Y" wiring is used, (DT) relay releases disconnecting the battery through (C) resistance from (HL) lead causing the monitoring circuit at the test desk to be opened. In position 20 (RL) relay operates from ground on (GS) arc and locks under control of (AD) relay. As (PC) selector switch leaves position 21 the circuit for (ON) relay is broken, it releases in turn releasing (G) relay. (G) relay released, removes battery from the



off-normal battery leads releasing (AD) relay in turn releasing (RL) relay and (FS), (OK) or (SL) relay and removes ground from the off-normal ground lead releasing (RN) relay. If the test key was released, the "SP" lead will be open and the (MG), (P), (SP), (LR) or (HR) relays if operated will release.

#### 6.208 Repeat Test

With the circuit in this condition, if the station under test again connects and if a test key at the test desk is operated, the ring conductor is again closed through, operating (L) relay, in turn operating (SR) relay in turn operating (SR1) relay, where "Y" apparatus is used in turn operating (SV) relay, in turn operating (ON) relay in turn operating (G) relay and (PC) selector switch is advanced and the 51 type dial tester is set for a test in the same manner as before described. The same test key as operated for the first test or a different test key may be operated and the test will be made accordingly.

#### 6.209 Disconnection

With the circuit restored to normal after a test, restoring (DIAL TEST) key to normal will open "TD" lead, releasing (TD) relay in turn releasing (TD1) relay where "Y" apparatus is used and (CT1), (CO) and (Z) relays and the circuit is normal.

#### 6.210 Early Release

##### 6.2101 Normal Position

In case the 51 type dial tester circuit is selected but (DIAL TEST) key is restored to normal before a test key is operated (L) relay will not operate and (PC) selector switch will not move out of the normal position. When (DIAL TEST) key is restored to normal (TD) relay and (TD1) relay when "Y" wiring is used, releases in turn releasing (CT1) and (CO) relays and the circuit is normal.

##### 6.2102 Positions 1, 2 or 3

If the station under test disconnects or the test key is restored to normal with (PC) selector switch in positions 1, 2 or 3 (L) relay will release in turn releasing (SR) relay in turn releasing (SR1) relay in turn releasing (SV) relay, in turn operating (RN) relay. (RN) relay operated, locks to the off-normal ground, opens "R" lead and opens the operating circuit of (SW) relay. The operation of the circuit will proceed in the regular manner in positions 1, 2 and 3 of (PC) selector switch. In position 4, (SW) relay will not operate and (PC) selector switch will be stepped to

position 5 from battery through the break contact of (SV) relay and (RN) arc. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal. (TD) relay and (TD1) relay when "Y" wiring is used, remain operated, provided (DIAL TEST), (LSDT) or (HSDT) key at the local test desk remains operated.

##### 6.2103 Position 4

If the station under test disconnects or the test key is restored to normal with (PC) selector switch in position 4, (L) relay releases energizing (PC) stepping magnet, (HL) relay will release in turn releasing (SR) relay in turn releasing (SR1) relay where "Y" apparatus is used, in turn releasing (SV) relay, in turn operating (R) relay which locks to the off-normal ground, opens "R" lead and releases (SW) relay. (SW) relay released opens the circuit to (PC) stepping magnet which releases, stepping (PC) selector switch to position 5. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal. (TD) relay and (TD1) relay when "Y" wiring is used, remain operated, provided (DIAL TEST), (LSDT) or (HSDT) key at the local test desk remains operated.

##### 6.2104 Positions 5 to 11 (Figure C and "S" and "U" Options)

If 1 to 7 digits are dialed (PC) selector switch will advance to a corresponding position between 5 and 11. When the station under test disconnects or the test key is restored to normal (L) relay releases in turn releasing (SR) relay in turn releasing (SR1) relay where "Y" apparatus is used in turn releasing (SV) relay in turn operating (RN) relay. (RN) relay locks to the off-normal ground, opens "R" lead and releases (SW) relay. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal. (TD) relay and (TD1) relay when "Y" wiring is used remain operated, provided (DIAL TEST), (LSDT) or (HSDT) key at the local test desk remains operated.

##### 6.2105 Positions 5 to 11 (Figure D and "R" and "T" Options)

If one to seven digits are dialed, the (PC) selector switch will advance to a corresponding position between 5 and 11. At the end of the train of dial pulses, the (RA) relay will release. Ground on the (GS) arc of the (PC) switch will operate the (T3) relay which in turn will cause the (SW) relay to release. Battery through the normal contacts of the (SW)



relay through terminals 5 to 21 of the (RN) arc steps the (PC) selector switch to normal.

#### 6.2106 Position 12 (Figure C and " " and " " Options)

If 8 is dialed (PC) selector switch will step to position 12. In position 12 (SR) relay is under control of (TF) relay, but as the operating circuit of (TF) relay is broken in position 12 by the operation of (T1) relay, (TF) relay will release. When the pendulum reaches the end of its swing the (Trip Contacts) should open, releasing (TC) relay. (TC) relay released places (SR) relay under control of the make contact of (L) relay. When the station under test disconnects or the test key is restored to normal (L) relay releases in turn releasing (SR) relay in turn releasing (SR1) where "Y" apparatus is used in turn releasing (SV) relay in turn operating (RN) relay. (RN) relay locks to the off-normal ground, opens "R" lead and releases (SW) relay. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal. (TD) relay and (TD1) relay when "Y" wiring is used remain operated, provided (DIAL TEST), (LSDT) or (HSDT) key at the local test desk remains operated. If the test key is still operated and the station under test has not disconnected (PC) selector switch will advance to position 4 in the regular manner.

Should (SV) relay release before the (Trip Contacts) are opened or should the pendulum fail to make a complete swing and fail to open the (Trip Contacts) the circuit for (SR) relay will remain open when (TF) relay releases and (SR) relay will release in turn releasing (SV) relay in turn operating (RN) relay and the circuit will be restored to normal as before described even though the calling station has not disconnected, or the test key has not been restored to normal.

#### 6.2107 Position 12 (Figure D and "R" and "T" Options)

If 8 digits are dialed, the (PC) selector switch will step to position 12. At the end of the eighth pulse, the (RA) relay will release. Ground on the (GS) arc of the (PC) selector switch will operate the (T1) and (T3) relays. The operation of the (T3) relay will cause the (SW) relay to release. Battery through the normal contacts of the (SW) relay and through terminals 12 to 21 of the (RN) arc steps the (PC) selector switch to normal. The (TD) relay when "X" wiring is used or the (TD) and (TD1) relays when "Y" wiring is used will remain operated provided the (DIAL

TEST), (LSDT) or (HSDT) key at the local test desk remains operated. If the test key is still operated and the station under test has not disconnected, the (PC) selector switch will advance to position 4 in the regular manner.

#### 6.2108 Position 13

If 9 is dialed, (PC) selector switch will step to position 13, (SR) relay is held operated through the make contact of (TC) relay. When the pendulum reaches the end of its swing, the (Trip Contacts) should open, releasing the (TRIP) magnet and (TR) relay, in turn releasing (TC) relay. (TC) relay released, places (SR) relay under control of the make contact of (L) relay. When the station under test disconnects or the test key is restored to normal (L) relay releases in turn releasing (SR) relay in turn releasing (SR1) relay where "Y" apparatus is used, in turn releasing (SV) relay in turn operating (RN) relay. Should the pendulum fail to make a complete swing and fail to open the (TRIP CONTACTS), (SR) relay will remain held through the make contact of (TC) relay to battery and when the station under test disconnects (L) relay releases in turn releasing (SR) relay in turn releasing (SR1) relay where "Y" apparatus is used in turn releasing (SV) relay in turn operating (RN) relay. (RN) relay locks to the off-normal ground, opens "R" lead and releases (SW) relay. Battery through the break contact of (SW) relay and terminals 5 to 21 of (RN) arc steps (PC) selector switch to normal. (TD) relay and (TD1) relay when "Y" wiring is used remain operated, provided (DIAL TEST), (LSDT) or (HSDT) key at the local test desk remains operated.

#### 6.3 Make Busy Jack

Each circuit is provided with a make busy jack. The insertion of a plug in this jack opens the hunting lead, thus preventing any circuit upon which the selector might be resting from being held busy. Second opens the start circuit, preventing the selector from hunting. Third, removes the ground for operating the (CT1) relay, preventing interference with the circuit upon which the selector might be resting. Fourth, closes a link in the chain circuit for operating (BY) relay. A plug may be inserted in (MB) jack while the circuit is busy. The circuit is so arranged that this will not interfere with the test in progress but will hold the circuit busy when it is released.

#### 6.4 Timing and Alarm Feature

When (Z) relay operates ground is connected to the common lead "INT", "A" and



"B" leads are closed through to (ZA) and (ZB) relays and locking circuits are prepared for (ZA), (ZB) and (AL) relays.

When "INT" lead is grounded by a dial tester circuit or by a ringer test circuit, the common timing circuit will function in the following manner. When "F" contact of "AL" interrupter closes, (C) relay operates. When "B" contact of "AL" interrupter closes, (SA) relay operates, holding ground on "INT" lead and operating (AL) stepping magnet. When "B" contact opens, (SA) relay releases, releasing (AL) stepping magnet advancing (AL) selector switch one step. (AL) selector switch will advance in this manner as long as "INT" lead is grounded. When (AL) switch steps on to a position where "D" lead is grounded through 2 arc, (SA) relay will operate through the break contact of (AL) selector. (SA) relay operated, operates (AL) stepping magnet, releasing (SA) relay in turn releasing (AL) stepping magnet advancing (AL) selector switch independently of the interrupter. When (AL) selector switch is on a terminal where "A" lead is connected to a terminal of 4 arc, battery is connected to "A" lead while (C) relay is operated. Similarly when (AL) selector switch is on a terminal where "B" lead is connected to a terminal of 4 arc, battery is connected to "B" lead while (C) relay is operated, and when (AL) selector switch is on a terminal where "C" lead is connected to a terminal of 4 arc, battery is connected to "C" lead while (C) relay is operated. Battery is thus connected to "A" lead for a short time and then after a definite length of time, battery is connected to "B" lead for a short time, then after the same definite length of time battery is connected to "A" lead and so forth. Battery is connected to "C" lead for a short time approximately one minute after it is connected to "A" lead and one minute after it is connected to "B" lead. The interval between the time when battery is connected to "A" lead and the time when battery is connected to "B" lead depends upon the connections of "A" and "B" leads as shown in the table under Circuit Notes.

Assume that after (Z) relay operates, battery is connected to "B" lead before it is connected to "A" lead. When battery is connected to "B" lead, (ZB) relay operates and locks under control of (Z) relay. Approximately one minute later, battery is connected to "C" lead but "C" lead is open as (ZA) relay is not operated. A definite time after battery is connected to (B) lead, battery is connected to "A" lead, operating (ZA) relay, which locks under control of (Z) relay. Approximately one minute later, battery is connected to "C" lead

operating (AL) relay. (AL) relay operated, locks under control of (ZA) relay, lights (DT) lamp at the relay rack and closes a circuit to light a lamp at the floor alarm board where figure A is used, or where figure B is used connects ground to the audible and visual alarm circuit over the "F" and "A" leads.

The timing circuit is common to the ringer test circuits as well as to the dial testers and is so arranged that when a dial tester is associated with a ringer test circuit, and the circuits are held for more than the allowed time, the ringer test circuit is automatically disconnected and the dial tester is released at least one minute before (DT) lamp would light. Thus on calls from the ringer test circuit (DT) lamp will only light in case of failure to restore to normal. On calls from the test desk, the individual (DT) lamp at the relay rack will light and the circuit to light a lamp at the floor alarm board will be closed if the dial tester is held over a certain length of time. This time varies between a definite minimum and maximum depending upon the position of (AL) selector when the call is started. The maximum time is approximately one minute less than twice the minimum time.

(Z) relay operated under control of (CT1) relay and whenever (CT1) relay releases (Z) relay releases and releases any of the relays (ZA), (ZB) or (AL) which may be operated.

When figure 6 is used in place of figure 2, the operation is as above described except that the one minute period referred to becomes two minutes.

When the timing circuit shown on the "Ringer test circuit" is used instead of figure 2, the operation of figure 1 is as above described except that the one minute period referred to becomes two minutes.

#### 6.5 Calibration Check

Before proceeding with calibration, the circuit must be made busy in the regular manner. The calibration of the pendulum is checked by noting the number of oscillations in a given length of time. A window is provided for observing the pendulum oscillations. Two keys are provided for controlling the pendulum. The operation of the (B) key transfers the control of the (HOLD) magnet to the (A) key and closes a circuit from ground through the (B) resistance for operating the (L) relay. The operation of the (L) relay causes the circuit to advance to position 4 of (PC) selector switch



resetting the pendulum in the regular manner as before explained. The operation of the (B) key also moves the (Trip Contacts) out of the path of the pendulum. When the pendulum is set, the operation of the (A) key trips the pendulum by transferring the holding circuit for the (HL) relay from the (HOLD) magnet to the ground at the key. This allows the pendulum to oscillate freely. Upon completion of the check, the circuit is returned to normal by restoring the (A) and (B) keys.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3040-NL-CGM

## 6.6 All Dial Testers Busy Lamps

If all the dial testers circuits are busy, a chain circuit will be closed through the make contact of the (CO) relays or the make contacts of the (MB) jacks to operate (BY) relay. (BY) relay operated closes a circuit to lamps at positions of the test desk arranged to use 51 type dial tester circuits.