

TOLL SYSTEMS  
SIGNALING  
TELEVISION ORDER WIRE CIRCUIT

CHANGES

D. Description of Changes

- D.1 In Fig. 2, option ZY is added to ensure a current path for leads A or AU in case of failure of lamp L when only one Fig. 2 is used.
- D.2 Note 102 is expanded to include option ZY.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 4124-JHJ-RL

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TOLL SYSTEMS  
SIGNALING  
TELEVISION ORDER WIRE CIRCUIT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 Fig. 37 is added.
- D.2 Fig. 10 is changed to remove G1 type filter and to add "ZP" and "ZQ" options which allows dial to be used with the SS1 Selective Signaling Order Wire Circuit.
- D.3 Fig. 101 is changed to show addition to Fig. 37 and new dial connection.
- D.4 Fig. 37 and "ZP" and "ZQ" options are added to the Options Used table.
- D.5 Fig. 102 modified to reflect changes.
- D.6 Information Note 306 is added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2177-WAH-EGS-JW

TOLL SYSTEMS  
SIGNALING  
TELEVISION ORDER WIRE CIRCUIT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 Figs. 51, 56, 57 & 58 are rated Mfr. Disc. and are superseded by Figs. 66, 67, 68, 69, 70, 71, 72 and 36.
- D.2 Note 101 addition of (M) battery & fuse.
- D.3 Note 102, change in Fig. 5, under (Quantity).  
Note 102, change in Fig. 11, under (Quantity).  
Note 102, change in Fig. 13, under (Quantity).  
Note 102, addition of Fig. 36, under (Feature & Option).  
Note 102, addition under (Feature & Option) when Fig. 3 is assoc. with Fig. 36 for ZX option.
- D.4 Note 104, addition of 10D.
- D.5 Note 304, change to show that Fig. 1 is provided at the audio patch bay or other first position & Fig. 5 is provided for a control position only.
- D.6 (Option Used table), change Line 10 to Fig. 36, and Line 20 to ZX option.
- D.7 Designation changes on Sheet 1 for the 7 keys.
- D.8 Addition to Ckt. Req. Tables on Page 3 for (M) relay.
- D.9 Changes & additions in the following figures; Figs. 1, 5, 22, 23, 25, 64 and 102.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

- 1.1 This circuit was developed to provide telephone order circuit arrangements for use with the television networks.

2. WORKING LIMITS

- 2.1 (RU) Relay Fig. 15  
Max. Cond. Loop Res. 4000 ohms.

3. FUNCTIONS

- 3.01 To provide a talking and signaling circuit between various television operating centers.

3.02 To provide selective calling of any control position at any operating center by operating a push-button, when sequence signaling is provided. When 1000 cycle or 20 cycle signaling is provided, selective calling is provided by code ringing.

3.03 To provide a lockout circuit which prevents more than one attendant from securing control of the common Sequence Sending Circuit in the operating center at a time.

3.04 To provide an audible and visual call signal at the audio patch bay as well as at the particular control position being called or at a Toll Test Board when so arranged.

3.05 To provide means for releasing locked-in audible and visual call signals at the audio patch bay and control position, when the call is answered at either location or a Toll Test Board when so arranged.

3.06 To provide means for connecting to two way automatic trunks, 20 cycle ringdown lines and PBX extensions.

3.07 To provide means for the attendants at the audio patch bay and at one or more control positions to talk on the same television order circuit at the same time. This feature is also provided on the automatic trunks, ringdown lines, and PBX extensions.

3.08 To provide a relay for automatically transferring the television order circuit drop from the telephone set to the Sequence Sending Circuit when a push-button in the key set is operated.

3.09 To provide a lamp in the key set to indicate that the second signaling tone is being transmitted after a push-button has been operated.

3.10 To provide a key for switching from the regular Sequence Sending Circuit to the spare.

3.11 To provide arrangements for associating local circuits with a television order circuit.

3.12 To provide means for connecting a telephone set balancing network for each position connected to the television order circuit, on circuits using Sequence Signaling.

3.13 To provide means for preventing a television order circuit from being left without a termination when the key associated with a local circuit is also operated.

3.14 To provide a key for operating a relay arranged to connect two television order circuits together.

3.15 To provide a key for extending audible and visual signals from the Television Operating Center to the Toll Test Board, so that incoming calls may be answered at the Toll Test Board during periods when the Television Operating Center is unattended.

#### 4. CONNECTING CIRCUITS

When this circuit is listed on a keysheet, the connecting information thereon is to be followed.

4.01 Application Schematic-Television Order Circuits - SD-56205-01.

4.02 Sequence Sending Circuit - SD-56113-01.

4.03 Sequence Receiving Circuit - SD-56114-01.

4.04 Telephone Order Wire Circuit - 2 way Ringdown - SD-95440-01.

4.05 No. 740B, 740C and 740D PBX - Line Circuits - (Typical) - SD-66126-01.

4.06 Two way Automatic Trunk Circuit - SD-55348-01.

4.07 Telephone Order Wire Circuit, 1000 Cycle Ringdown Signaling - SD-55574-01.

4.08 Terminal and Intermediate, 20 Cycle D-C Signaling Circuits - SD-55194-01.

4.09 20 Cycle D-C and D-C 20 Cycle, Terminal and Intermed. Sig. Ckt. - SD-55560-01.

4.10 Cut-off Relay Circuit - SD-55393-01.

4.11 V1 Telephone Repeater Application Schematic - SD-64903-01.

4.12 1000 Cycle Ringer Oscillator - SD-64419-01.

4.13 Line and Balancing, 4 Wire Terminating Circuit - SD-64304-01.

4.14 Audible and Visual Signals

4.141 Auxiliary Signal Circuit - SD-63842-01.

4.142 Auxiliary Signal and Night Alarm Circuit - SD-55039-01.

4.15 Two Way Two Wire Automatic Trunk Circuit - SD-95405-01.

4.16 Local Station Line Circuit - SD-95409-01.

4.17 Multi-station Line Circuit - SD-55647-01.

4.18 Trunk Jack Circuits at Toll Test Boards.

4.181 TT Bd. No. 4, 5 or 18B - SD-62805-01.

4.182 TT Bd. No. 16, 17B or 18B or Test and Control Bd. No. 8 - SD-64545-01.

4.183 TT Bd. No. 17C.

4.19 Test Board Cord and Position Circuits.

4.191 TT Bd. No. 5.

(a) Voltmeter, Testing, and Connecting Cord Circuit - SD-63688-01.

4.192 Test and Control Bd. No. 8

(a) Testing and Connecting Cord Ckt. - SD-64159-01.

(b) Testing Cord for Non-Mult. Bd. - SD-62961-01.

4.193 TT Bd. No. 17B

(a) Cord Ckt. - SD-64613-01.

(b) Position and Tel. Ckt. - SD-64616-01.

4.194 TT Bd. No. 17C

(a) Cord Ckt. - SD-68092-01.

(b) Position Ckt. - SD-66353-01.

4.195 TT Bd. No. 18B

(a) Primary Test Ckt. - SD-55031-01.

(b) Secondary Cord Ckt. - SD-55033-01.

(c) Secondary Position Ckt. - SD-55034-01.

#### 5. DESCRIPTION OF OPERATION

##### General

There are three general types of television operating centers. These are:

1. Offices with an audio patch bay and one or more control positions equipped with both intercity order circuits and local circuits.

2. Offices with only an audio patch bay equipped with both intercity order circuits and local circuits.

3. Offices with only an audio patch bay equipped with only local circuits.

This circuit is arranged to provide order circuit facilities in any of the above offices. Not all the facilities may be provided in a particular office but those that are provided appear usually at the audio patch bay. Then, if control positions are required, multiple appearances at those locations are provided. Then, if unattended period answering is required, transfer of the visual and audible signals, and multiple answering is provided at Toll Test boards.

In the circuit description that follows, it has been assumed that multiples of each facility under discussion have been provided at the control positions, and at Toll Test Boards. If this is not the case in a particular office, the multiple reference is to be disregarded.

There are two general types of circuits for which arrangements are provided by this circuit.

1. TVOC

Order circuits used on an intercity basis between operating centers and designated as (TVOC).

2. Local Circuits

Automatic trunks, ringdown lines and PBX extensions one end of which terminates at a television operating center and which are referred to as local circuits.

5.1 Television Order Circuit (TVOC) Arrangements for Intercity Use Between Television Operating Centers

The television order circuit drop at a television operating center appears on keys usually at the audio patch bay. Multiple keys are provided at the control positions where monitoring facilities for the audio and video television channels are located. If unattended period answering is required, transfer of the visual and audible signals, and multiple answering is provided at Toll Test Board.

The (TVOC) talk keys are shown in Figs. 3, 17, 22, 24, and 26. The key in Fig. 17 may also be used for two Local Circuits; the trunk to a Subset and the Two Way Ringdown-Telephone Order Wire Circuit.

The "F" lead which is connected through all the above (TVOC) keys functions to prevent accidental operation of the dial from disturbing transmission when the telephone circuit is connected to a television order circuit.

The contacts associated with the transmission path on the various local circuit talk keys (associated with the same telephone circuit) are connected in a series chain. Thus, those keys nearest the telephone circuit have a higher "preference". When operated, succeeding keys are disconnected from the telephone circuit. When television order circuits (TVOC's) are provided, the local circuits can be divided into two groups; those assigned for connection to the TVOC's (LC-1) and those not so assigned (LC-2). The talk keys associated with circuits in the (LC-2) group are placed nearest the telephone circuits.

The (TVOC) talk keys are also wired in a series chain similar to the method used for local circuits. However, the first (TVOC) talk key connects into the series chain of (LC-1) and (LC-2) keys at a point between the two groups mentioned above, via the "T1-R1" leads. (See Fig. 102). Thus, the transmission path (with all keys normal) leaves the telephone circuit, goes through the (LC-2) keys and then splits through the (LC-1) and TVOC groups in parallel. From this, it can be seen that the operation of an (LC-2) key will disconnect the telephone circuit from the (TVOC) and (LC-1) groups. In this event, ground is also removed from the "BR" lead circuit associated with the (TVOC) talk keys, in order to release the associated (SW), (B), (C) or (K) relays. This places terminations furnished by the Television Order Wire Circuit - Application Schematic, by the 1000 Cycle Ringdown-Telephone Order Wire Circuit, by Fig. 24 or by Fig. 26 on these TVOC's in place of the telephone circuit. This is important since the proper termination must be present on the "T" and "R" leads whenever the "BR" lead is grounded on all circuits except the Two Way Ringdown-Telephone Order Wire Circuit.

The circuit is also arranged to prevent a (TVOC) key with higher preference from leaving a TVOC associated with a lower preference key without a termination, if one is required. The ground associated with the "BR" leads is also run through a series chain on the (TVOC) keys. Thus, if a higher preference (TVOC) key is operated, ground is removed from the "BR" leads associated with lower preference keys, releasing their (SW), (B), (C) or (K) relays. This places terminations, furnished by the above circuits on these TVOC's, in place of the telephone circuit.

The order circuit associated with Fig. 17 does not require a termination when idle. However, the "BR" lead chain passes through contacts on this key when it is used as a TVOC. This is necessary since operation of this key will remove the telephone circuit of Fig. 12 or 35 from a TVOC associated with the succeeding (TVOC) key.

The "BR" lead ground comes from a make contact of the "R" jack in Fig. 1 so that the TVOC will revert to the idle condition if the telephone set is removed from the Tel. Set jacks with a talk left operated.

If the operating center is unattended, and answering incoming calls at the TT Bd is required, the transfer key (TB) Fig. 30, is turned to operate the (TB) relay Fig. 29, which extends the "L" leads to the TT Bd. Trunk Jack Circuits. When a two way RD TEL OW circuit uses option "A" in Fig. 14, the lamp relay (L1) Fig. 34 is provided. When an incoming call connects battery over the "L" lead Fig. 29 to the Trunk Jack Circuit the lamp and alarm signals at the TT Bd. operate. To answer the signal, a test cord at the TT Bd. is inserted in the jack associated with the signal and the (SL-) relay of Figs. 31, 32, or 33 operates to connect ground to the leads "F", "K", "C", "S" or "BR" as needed and opens the "A" lead when associated with a TVOC talk key (sequence signaling) Fig. 3. The transmission path is closed by direct wiring to the TT Bd. Trunk Jack Circuit except in the case of the TT Bd. No. 17C in which case it is connected through Fig. 33.

Reference to audible and visual signals means either the Auxiliary Signal Circuit SD-63842-01, or the Auxiliary Signal and Night Alarm Circuit SD-55039-01.

#### 5.11 TVOC with Sequence Signaling

##### 5.111 General

This circuit is arranged to operate with the standard line equipment used on four-wire toll order circuits. Signaling is accomplished by modulating a 1600 cycle carrier first with one frequency and then with another. The modulating frequencies are in the audio range.

The television order circuit arrangements are shown in Figs. 1 to 8 inclusive and, in Fig. 11. A telephone circuit with telephone sets and jacks is provided by Figs. 12 or 35 and 13, which are common to both the TVOC and the local circuit arrangements. Contact protection has been provided on all relays primarily to prevent interference in the audio and video television channels.

##### 5.112 Outgoing Call From Audio Patch Bay or From Control Position

To originate a call the (TVOC) key of Fig. 3 is operated to the TALK position. This operates the associated (SW-) relay of the Television Order Wire Circuit-Application Schematic closing the transmission path from the telephone circuit in Fig. 12 or 35 through to the order circuit. After listening and challenging on the order circuit to

determine that it is idle, signaling may be started. If one telephone circuit is provided, only the appropriate push-button in the key set of Fig. 11 need be operated. If two telephone circuits are provided with one keyset, Fig. 4 is provided. The particular (TC1) or (TC2) key must be held operated during signaling that associates the output of the sequence sending circuit with the particular telephone circuit to which the television order circuit has been connected.

A Fig. 6 is associated with each keyset. When a push-button of the keyset is pressed, one of the contacts on the push-button operates the (L) relay of Fig. 6 over the "L2" and "G" leads in Fig. 6, the "L1" and "L2" leads in Fig. 3, and the "L1" leads in Fig. 4, if provided. The (L) relay, in operating, connects the "S1" and "S2" leads from the (S) relay of Fig. 7 through the depressed push-button to two of the six leads of Fig. 11 designated "F2" to "F7". The (L) relay also removes battery from the (D) relay in Fig. 6, which is slow in releasing, closes the output of the sending circuit to its back contacts and operates the (TR) relay in Fig. 1. Relay (TR), in operating, disconnects the telephone circuit from the order circuit drop and connects the drop to relay (D) in Fig. 6. When relay (D) releases, the output of the Sequence Sending Circuit will be connected to the order circuit. Due to the (A) and (B) resistances, the signaling tones will be heard.

A frequency control relay in the sending circuit is connected to each of the "F2" to "F7" leads. Ground from the (S) relay in Fig. 7 is connected to one of the two particular "F2" to "F7" leads previously selected, operating one of the relays in the sending circuit. This applies the desired modulating frequency to the 1600 cycle carrier and the first signal is ready to be transmitted over the order circuit. The slow-release characteristic of the (D) relay in Fig. 6 allows time for this sequence of events to be completed before releasing.

The (D) relay, on releasing, removes ground from the (S) relay in Fig. 7. This relay will remain operated for a minimum of approximately 300 milliseconds during which time the 1600 cycle carrier and first modulating frequency are sent out on the toll circuit. When the (S) relay releases, ground is removed from the first of the two selected "F2" to "F7" leads, releasing its associated frequency control relay in the sending circuit, and is connected to the other selected lead lighting the (SIG) lamp.

The frequency control relay in the sending circuit associated with this lead then operates, changing the modulating frequency, and the second signal goes out on

the order circuit. This signal will stay on until the push-button is released. The button should be held depressed for about 0.3 seconds after the (SIG) lamp lights.

When the push-button is released, the (L) relay in Fig. 6 and the second frequency control relay in the sending circuit release. The (L) relay, in releasing, removes the output of the sending circuit from the line, removes the ground on the "S2" lead from the push-button contacts and reoperates the (D) relay in Fig. 6. Relay (L), in releasing, also releases the (TR) relay in Fig. 1 which reconnects the telephone circuit in Fig. 12 or 35 to the order circuit. Relay (D) in reoperating, extinguishes the keyset (SIG) lamp and reoperates relay (S) in Fig. 7. If Fig. 4 is provided, the (TC1) or (TC2) key is released at the end of the signaling period.

#### 5.113 Incoming Call

When a signal of the proper code is received from a distant operating center, the Sequence Receiving Circuit operates. A ground is placed on one of the "SG" leads and on the "CSG" lead for a time approximately equal to the time the push-button in the distant station is depressed. The "CSG" lead operates audible and visual signals at the audio patch bay, while the "SG" leads perform this function at the control positions.

Ground on the "CSG" lead operates relay (R) in Fig. 1. Relay (R) locks to ground furnished through a series chain of break contacts on each (TVOC) key that is associated with the same TVOC. Operation of relay (R) causes the audible and visual signals of the associated Fig. 2 at the audio patch bay to function.

Ground on one of the "SG" leads operates relay (A) in Fig. 5 associated with the control position. Relay (A) locks to ground over the same path as relay (R) in Fig. 1, operates the audible and visual signals in the associated Fig. 2 to function.

The call may be answered at the audio patch bay or at the control position by operating the (TVOC) key in Fig. 3. In either case the series chain which furnishes locking ground for the (R) and (A) relays in Figs. 1 and 5 is opened, releasing both relays. This releases the locked-in audible and visual signals at both the control position and the audio patch bay. Operation of the (TVOC) key also grounds the "BR" lead which operates the associated (SW-) relay of the Television Order Wire Circuit-Application Schematic. This closes the transmission path from the telephone circuit in Fig. 12 or 35 to the order circuit.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, as described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32, or 33 opening the "A" lead, extinguishing the visual and silencing the audible signals. The operation of the (SL-) relay also grounded the "BR" lead which operates the (SW-) relay of the Television Order Wire Circuit-Application Schematic. This closes the transmission path to the TT Bd. trunk jack.

#### 5.114 Additional Circuit Features

##### 1. Lockout Circuit (Fig. 6)

A Fig. 6 is furnished for each key-set, Fig. 11, to prevent more than one attendant from using the common Sequence Sending Circuit in the operating center at a time. The (2T-3T) contacts on the (L) relays are connected in series via the "G" leads. Contact (2T) on the first (L) relay is connected to ground (S option), but no connection is made to (3T) on the last (L) relay. The (2B-1B) contacts are also connected in series, with battery on the last (1B) contact (R option) and no connection on the first (2B) contact. With this arrangement, any (L) relay that operates will remove ground from the operating path of succeeding (L) relays and battery from preceding ones. This allows only one (L) relay to remain operated at a time. On simultaneous operation of two push-buttons in different key sets, some slight hunting may be evident, but one (L) relay will gain control and maintain all others released. The slow-release characteristic of the (D) relay in Fig. 6 prevents any disturbance on the toll line due to this effect.

##### 2. Delay Circuit (Fig. 6)

The (D) relay in Fig. 6 connects the television order circuit drop to the output of the Sequence Sending Circuit through contacts on relay (TR) in Fig. 1 and relay (L) in Fig. 6. Relay (D) operates as outlined in 5.112. The (D) relay also applies ground to the "LP" lead which lights a lamp in the associated Key set (See 5.112). The (4B-5B) contacts of all (D) relays are connected in series. The (4B) contact on the last (D) relay is connected to ground (R option), while the (5B) contact on the first (D) relay is connected to relay (S) in Fig. 7. Thus any one of the (D) relays releasing will start the release of relay (S).

Relay (D) in Fig. 6 is slow-release in order to allow time for the frequency

control relay in the Sequence Sending Circuit to operate when a push-button is depressed, before sending the first tone out on the order circuit. In addition, it prevents any disturbance from reaching the order circuit due to slight hunting of the lockout relays in Fig. 6 when push-buttons in more than one key set are operated simultaneously.

There is another reason for making the (D) relay slow-release. Assume that a push-button in one key set is depressed. Then its associated (L) relay in Fig. 6 is operated, the (D) relay in Fig. 6 is released, and while the second part of the signal is going out, the (S) relay in Fig. 7 is released. If a push-button in a second key set is now depressed, nothing happens until the first is released. Then, however, the second (L) relay will operate as soon as the first push-button releases. Since, at this instant, the (S) relay in Fig. 7 may still be released, the second (D) relay should remain operated until the first (D) relay and the (S) relay have re-operated. The slow-release characteristic of the (D) relay, therefore, maintains the series connection to ground on the "C" lead to insure reoperation of relay (S) in Fig. 7.

3. Television Order Circuit Talk Key (Fig. 3)

The (TVOC) key in Fig. 3 is arranged to connect the telephone circuit in Fig. 12 or 35 to only one order circuit at a time and to prevent the order circuits from being connected together.

The circuit is arranged to connect an additional telephone set balancing network for each position connected to the TVOC. The "BR" lead from each position is connected to a separate (SW-) relay shown on the Television Order Wire Circuit-Application Schematic. When a position is equipped with two telephone circuits, the "BR" leads from the two talk keys associated with the same TVOC are connected together. Thus, the same (SW-) relay is operated regardless of which key is thrown.

4. Key Set Guard Feature (In Fig. 3)

The operating path for the (L) relay in Fig. 6 is connected through make contacts on the (TVOC) key in Fig. 3 over the "L1" and "L2" leads. This prevents operation of the (L) relay, unless the (TVOC) key is operated, when a push-button in the key set is depressed. Thus, accidental operation of a push-button cannot interfere with the use of the common Sequence Sending Circuit by another attendant elsewhere in the operating center. The (L) relay operating path is also connected through contacts on the (TC1) and (TC2) keys in Fig. 4, when provided. Thus, either the (TC1) or

(TC2) key or a key per Fig. 11 may be operated first, when originating a call.

5. Sending Circuit Transfer Key (Fig. 8)

Fig. 8 provides a key for transferring from the regular Sequence Sending Circuit to a spare in the event of trouble in the former.

5.12 TVOC with 1000 Cycle Ringdown Signaling

5.121 General

This circuit can be arranged in two general ways. If connection is made to the Telephone Order Wire Circuit - 1000 cycle Ringdown Signaling (SD-55574-01, Fig. 22 is provided. Fig. 21 is also provided when locking audible and visual signals are specified. When the above order wire circuit is not used, then Figs. 23 and 24, or 25 and 26, are required and function directly with the 1000 cycle signaling equipment. Figs. 23 and 24 are provided when the signaling equipment is arranged for DC signaling over the "SG" leads. Figs. 25 and 26 are provided when the signaling equipment is arranged for 20 cycle signaling.

Regardless of which arrangement is used, the lamp in Fig. 2 and the telephone circuit, jacks and telephone sets of Figs. 12 or 35 and 13 are also required.

5.122 Outgoing Call From Audio Patch Bay or From Control Positions

When Fig. 22 is provided, a call is originated by operating the (TVOC) key to the TALK position. Ground is then connected to the "BR" lead. This operates the (SW) or (SWA) relay in the Application Schematic-Television Order Wire Circuits which closes the transmission path through to the order circuit. If the "BR" lead connects to the 1000 Cycle Ringdown-Telephone O.W. Circuit, ground on this lead operates the (B) relay removing a termination from the order circuit transmission path. After listening and challenging to determine that the order circuit is idle, signaling may be started by operating the (TVOC) key to the RING position. Ground is then connected to lead "SS" operating relay (R) in the order wire circuit to send a signal out on the order circuit. When the key is restored to the TALK position, relay (R) releases, removing the signal from the order circuit. The circuit is now again in the talking condition.

If code ringing is used, the (TVOC) key is operated to the RING position the proper number of times.

Fig. 21 is provided when code ringing is not required and provides means for

locking in the audible and visual signals. This relay operates when the (TVOCD) key is operated to TALK, but performs no function on originating calls.

When Figs. 23 and 24 are provided, a call is originated following the same procedure for determining that the order circuit is idle as outlined above. In this case, when the (TVOCB) key per Fig. 24 is operated to TALK, relay (C) in Fig. 23 operates removing the termination in Fig. 23 from the line. To transmit a signal, the (TVOCB) key is operated to the RING position. This connects battery to the "SG" lead causing the connecting circuit to place a signal on the order circuit. During the time the (TVOCB) key of Fig. 24 is in the RING position, relay (C) of Fig. 23 is released restoring the termination on the line.

Code ringing, if used, is accomplished by operating the (TVOCB) key to the RING position the proper number of times. At the end of the signaling interval, the (TVOCB) key is restored to the TALK position, reoperating relay (C) and thereby restoring the circuit to the talking condition.

When Figs. 25 and 26 are provided, the same procedure for originating a call is followed as outlined for Figs. 23 and 24. In this case the (K) relay in Fig. 25 performs the same functions and operates the same way as relay (C) in Fig. 23. However, when the (TVOCC) key is operated to the RING position, 20 cycle ringing current is connected to the signaling equipment instead of battery, as was the case in Fig. 24.

#### 5.123 Incoming Call At Audio Patch Bay or At Control Positions

Upon receipt of an incoming call when Fig. 22 is provided, the audible and visual signals in Fig. 2 function. These signals will lock in only if Fig. 21 is provided. This figure provides locking ground over the "J" lead to the 1000 Cycle Ringdown-Telephone Order Wire Circuit. To answer the call, the (TVOCD) key in Fig. 22 is operated to the TALK position, closing the transmission path to the order circuit in the same manner as described under 5.122 for Outgoing Calls. Relay (L) also operates, if provided, removing the locking ground from the 1000 Cycle Ringdown Order Wire Circuit. This extinguishes the lamp and silences the audible signal.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, as described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack

of the TT Bd. The sleeve operates the (SL-) relay in Fig. 31, 32, or 33, grounding the "F" and "BR" leads. Option (ZV) in Fig. 33 is provided, to furnish ground for the "F" lead, to Fig. 21. The "F" lead grounded operates the (L) relay in Fig. 21, if provided, removing the locking ground from the 1000 cycle RD Order Wire circuit. This extinguishes the visual and silences the audible signals. The "BR" lead grounded operates the (B) relay of the TEL OW 1000 Cycle RD ckt. removing the termination from the (T3 and R3) leads. The transmission path to the TT Bd. trunk jack is closed.

When Figs. 23 and 24 are provided, an incoming signal causes battery to be placed on the "SG" lead of Fig. 24 operating relay (B) in Fig. 23. If option (ZB) is provided relay (B) locks under control of relay (C) in Fig. 23, causing the audible and visual signals in Fig. 2 to function. If option (ZB) is not provided, the audible and visual signals do not lock in. The call is answered by operating the (TVOCB) key in Fig. 24 to the TALK position. This operates relay (C) in Fig. 23 removing a termination from the transmission path, and, if option (ZB) is provided, releases relay (B) in Fig. 23.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32, or 33 grounding the "BR" lead. The "BR" lead operates the (C) relay in Fig. 23 removing the termination from the transmission "T" and "R" leads, and if option (ZB) in Fig. 23 is provided, releases relay (B) in Fig. 23 extinguishing the visual and silencing the audible signals. The transmission path to the TT Bd. trunk jack is closed over the "T1" and "R1" leads.

When Figs. 25 and 26 are provided, an incoming call causes the signaling equipment to connect 20 cycle ringing current to the "T" and "R" leads of Fig. 26. This current operates the (J) relay in Fig. 25 which operates the (H) relay. Relay (H), in operating, causes the audible and visual signals in Fig. 2 to function. If option (ZB) is provided, relay (H) in Fig. 25 locks under control of relay (K). Option (ZB) is not provided if code ringing is required.

To answer the call, the (TVOCC) key in Fig. 26 is operated to the TALK position. Ground is then connected to lead "BR" which operates relay (K) in Fig. 25. Relay (K), in operating, removes the termination from the transmission path and

releases relay (H) in Fig. 25, if option (ZB) was provided. This extinguishes the visual and silences the audible signals.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, as described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32 or 33 grounding the "BR" lead. The "BR" lead operates the (K) relay in Fig. 25. Relay (K), in operating, removes the termination from the "T" and "R" leads and releases relay (H) in Fig. 25 if option (ZB) is provided. This extinguishes the visual and silences the audible signals. The transmission path to the TT Bd. trunk jack is closed over leads "T1" and "R1".

### 5.13 TVOC with 20 Cycle Ringdown Signaling

#### 5.131 General

Either of two general arrangements may be used to provide a 20 Cycle Ringdown Television Order circuit. If the Two Way Ringdown-Telephone Order Wire Circuit is to be used as a TVOC, Fig. 17 is provided with Fig. 20. When the above order wire circuit is not used, then Figs. 23 and 24 or 25 and 26 are required and function directly with the 20 cycle signaling equipment. Figs. 23 and 24 are provided when the signaling equipment is arranged for DC signaling over the "SG" leads. Figs. 25 and 26 are provided when the signaling equipment is arranged for 20 cycle signaling.

When Fig. 17 is provided for use as a TVOC the (ZA) option is not provided. This option is only involved when Fig. 17 functions with a local circuit in group assigned for connection to a TVOC.

The lamp in Fig. 2 and the telephone circuit, jacks and telephone sets of Figs. 12 or 35 and 13 are required for either arrangement.

#### 5.132 Outgoing Call From Audio Patch Bay or From Control Positions

When Fig. 17 is provided for use as a TVOC, the (TVOC) key and associated circuits function as outlined in 5.212 for local circuit use.

If Figs. 23 and 24, or 25 and 26 are provided, these figures function as outlined under 5.122 for 1000 cycle signaling TVOC's, but are associated with signaling equipment which functions on 20 cycle signals on the order circuit.

#### 5.133 Incoming Calls At Audio Patch Bay or At Control Positions

Fig. 17 and associated circuits, when provided for use as a TVOC, function as outlined in 5.213 for local circuit use.

When Figs. 23 and 24, or 25 and 26, are provided, these figures function as outlined under 5.123 for 1000 cycle signaling TVOC's.

### 5.2 Local Circuits

#### 5.21 Ringdown Lines (RD)

##### 5.211 General

The ringdown lines terminate on keys while the trunk circuits are provided as part of the Two Way Ringdown-Telephone Order Wire Circuit SD-95440-01 and described in CD-95440-01. The associated talk and ring key (RD) is shown in Fig. 17, the line lamp in Fig. 14, the telephone circuit in Fig. 12 or 35 and the telephone sets and jacks in Fig. 13. The ringing supply lamp in Fig. 20 is also provided. Option (ZA) is provided on each Fig. 17 when used for a local circuit in the group assigned for connection to a TVOC (LC-1).

##### 5.212 Outgoing Call From Audio Patch Bay or From Control Positions

To originate a call, the (RD) key in Fig. 17 is first operated to the TALK position. This grounds the "C" lead operating the (C) relay in the Two Way Ringdown Telephone Order Wire Circuit which conditions the transmission path for talking. After listening and challenging to determine that the line is idle, the key may be operated to the RING position. This connects 20 cycle ringing current to the line. The key is then returned to the TALK position. (If code ringing is used, the (RD) key is operated to the RING position, from normal the appropriate number of times.) When operated to the TALK position, the (RD) key connects the telephone circuit in Fig. 12 to the ringdown line.

##### 5.213 Incoming Call At Audio Patch Bay or At Control Position

Upon receipt of an incoming call, the trunk circuit of SD-95440-01 functions to connect ground (A option) or battery (B option) to the "L" lead in Fig. 14 causing the audible and visual signals to function. To answer the call, the (RD) key in Fig. 17 is operated to the TALK position. This grounds the "C" lead in Fig. 17 operating the (C) relay in the trunk circuit of the Two Way Ringdown-Telephone Order Wire Circuit. The (C) relay in operating, extinguishes the visual and silences the audible signals in Fig. 14 and conditions the line for talking.

The (A) option in Fig. 14 is provided when the audible signal is non-locking and the visual signal is locking. (B) option is provided when the audible and visual signals are either both locking or both non-locking. When option (B) is provided this relay is connected in series with the lamp and operates whenever the line lamp lights.

If unattended period answering at the Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, as described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32 or 33 grounding the "K" or "C" lead in Fig. 17. The grounded "K" or "C" lead operates the (C) relay in the trunk circuit of the two way RD TEL OW ckt. extinguishing the visual and silencing the audible signals. The transmission path to the TT Bd. trunk jack is closed over the "T" and "R" leads.

## 5.22 PBX or Central Office Line

### 5.221 General

This circuit provides one or more PBX or Central Office lines in the operating center, which appear initially at the audio patch bay. Multiple appearances are provided at the control positions. Contact protection is provided on the (G) relay and on the dial pulsing contacts primarily to prevent interference in the audio and video television channels.

The PBX and Central Office line arrangements are shown in Figs. 15 and 16, using the telephone circuit of Fig. 12 or 35, the jacks and telephone sets in Fig. 13, and contacts of the (TVOC) keys in Figs. 3, 17, 22, 24, and 26. The line lamp in Fig. 14 (B option) also functions with this circuit. The keys in Fig. 16 are designated PBX when used on the PBX lines and CO when used on the Central Office Lines.

Option (ZJ) in Fig. 12 or option "ZO" in Fig. 35 is provided when the dialing circuit in Fig. 9 is not provided.

Option (Z) is provided in each Fig. 16 when there are no TVOC's in the operating center.

### 5.222 Outgoing Call From Audio Patch Bay or From Control Positions

To originate a call, the (PBX) (or CO) key in Fig. 16 is operated to the TALK position. This associates the telephone circuit in Fig. 12 or 35 and the dialing circuit and dial in Figs. 9 and 10

with the desired line. The (A) retard coil in Fig. 9 is connected across the line, operating the line relay in the PBX or Central Office. If this circuit is associated with a dial PBX or Central Office, the dial is then operated in the usual manner. The "F" lead connecting to Figs. 3, 17, 22, 24 and 26 requires that the TVOC keys therein be restored to normal before dialing (See 5.1).

When the dial is moved off-normal, ground through the dial off-normal contacts operates relay (E) in Fig. 9 which operates relay (F) in Fig. 9. Relay (E) disconnects the tip lead of the telephone circuit to reduce dialing clicks and short circuits the retard coil (A). Relay (F) disconnects the "ring" lead of the telephone circuit. The release of the dial breaks the circuit periodically to operate the dial equipment in the PBX or central office. When the dial has returned to its normal position, relay (E) releases, in turn releasing relay (F). During the interval between the release of relay (E) and relay (F), resistance (B) is held bridged across the retard coil (A). If the retard coil was suddenly introduced in place of the short across the tip and ring, the current would drop to a low value for a short interval. This is due to the high initial impedance of the coil to a sudden surge of current through it. This might result in a false pulse. By bridging resistance (B) across the coil, this effect is reduced and the possibility of sending a false pulse is avoided.

When the (PBX) (or CO) key in Fig. 16 is operated to the TALK position, the busy lamp in Fig. 28 lights at all other appearances of the same line to indicate that the line is in use. If the attendant wishes to hold the connection, the (PBX) (or CO) key in Fig. 16 is operated to the HOLD position. This will light the busy lamp in Fig. 28 at the position originating the call and will maintain the busy lamps lighted at all other appearances of this same line. The (PBX) (or CO) key may then be restored to normal.

### 5.223 Incoming Call At Audio Patch Bay or At Control Positions

When ringing current is placed on the line to this circuit from the PBX or Central office, the (RU) relay in Fig. 15 operates, in turn operating relay (G). Relay (G) connects battery to the "L" lead which causes the audible and visual signals to function on Fig. 14. The (G) relay locks to local ground.

To answer the call, the (PBX) (or CO) key in Fig. 16 is operated to the TALK position. This connects the telephone circuit in Fig. 12 or 35 to the line shunts down the (G) relay in Fig. 15, extinguishing

the visual and silencing the audible signals. If the attendant wishes to hold the connection, the (PBX) (or CO) key is operated to the HOLD position, the 50 ohm (D) resistance in Fig. 15 is hunted, across the line and the telephone circuit in Fig. 12 or 35 is then available for use on the other circuits, after the (PBX) (or CO) key is restored from the TALK position to normal.

Disconnection is obtained by restoring the (PBX) (or CO) key from the TALK position to normal.

The busy lamp in Fig. 28 functions as outlined in 5.222 above when answering or holding the connection.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call as described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack at the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32, or 33 grounding the "BR" lead. The grounded "BR" lead shunts down the (G) relay in Fig. 15 extinguishing the visual and silencing the audible signals. The transmission path of the TT Bd. trunk jack is closed over the "T" and "R" leads.

Option (ZW) in Fig. 33 is provided as a holding path for answering on Sta. Line Ckt. at PBX, or Cent. Off. Sub. Line Ckt., when Fig. 33 is associated with Fig. 15.

#### 5.23 Two Way Automatic Trunk To or Between Bays, Frames or Racks (ATB)

##### 5.231 General

The trunk circuit itself is shown on SD-55348-01. It is terminated in a key and lamp at the audio patch bay with multiplied keys and similar lamps at the control positions.

The talk key for the automatic trunk in Fig. 19, the line lamp in Fig. 14 (E option) and the telephone circuit equipment in Figs. 12 or 35 and 13 are also provided.

#### 5.232 Outgoing Call From Audio Patch Bay or From Control Positions

To originate a call, the ATB key in Fig. 19 is operated to the TALK position. This lights the line lamp in Fig. 14 at the position originating the call and operates the buzzer control relay in the Auxiliary Signal Circuit, actuating the buzzer. The (A) relay in the trunk circuit shown on SD-55348-01 also operates on ground placed on lead "S". This relay, in operating,

signals the other end of the circuit. When the attendant at the other end answers, the (B) relay in the trunk circuit operates. This removes battery from the "L" lead which extinguishes the visual and silences the audible signals in Fig. 14.

Disconnection is accomplished by restoring the (ATB) key in Fig. 19 to normal. This removes ground from lead "S" which releases relay (A) in the trunk circuit. Relay (A) in releasing, reconnects battery to the "L" lead. The visual and audible signals function in Fig. 14 until the operator at the other end also disconnects.

#### 5.233 Incoming Call At Audio Patch Bay or At Control Positions

An incoming call causes the trunk circuit on SD-55348-01 to function, placing battery on the "L" lead in Fig. 19. This causes the audible and visual signals in Fig. 14 to function. To answer the call, the (ATB) key in Fig. 19 is operated to the TALK position. This grounds the "S" lead and operates the (A) relay in the trunk circuit. Relay (A), in operating, removes battery from the "L" lead extinguishing the visual and silencing the audible signals. At the position answering the call, when the (ATB) key was operated to the TALK position it extinguishes the visual and silences the audible signal.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32, or 33 grounding the "s" lead. The "s" lead operates the (A) relay in the Two Way Automatic Trunk circuit which removes battery from the "L" lead in Fig. 19 extinguishing the visual and silencing the audible signals. The transmission path to the TT Bd. trunk jack is closed over the "T" and "R" leads.

#### 5.24 Two Way - Two Wire Automatic Trunk (ATA)

##### 5.241 General

The Two Way - Two Wire Automatic Trunk is terminated in a key and lamp at the audio patch bay with multiplied keys and lamps at the control positions. The talk key is provided by Fig. 18, the line lamp by Fig. 14 and the telephone circuit, telephone sets and jacks by Figs. 12 or 35 and 13.

#### 5.242 Outgoing Call From Audio Patch Bay or Control Positions

To originate a call, the (ATA) key in Fig. 18 is operated to the TALK position.

This grounds the "K" lead, operating relay (K) shown on the trunk circuit SD-95405-01. Relay (K) operates relay (K1), also in the trunk circuit, which signals the distant end.

#### 5.243 Incoming Call At Audio Patch Bay or At Control Positions

When a call is received, the (A) and (A1) relays in the trunk circuit SD-95405-01 operate. This connects battery to the "L" lead in Fig. 14 and causes the audible and visual signals to function. To answer the call, the (ATA) key in Fig. 18 is operated to the TALK position. This grounds the "K" lead in Fig. 18 operating relay (K) and, in turn, relay (K1) in the trunk circuit. Relay (K1) in operating, extinguishes the visual and silences the audible signals in Fig. 14.

If unattended period answering at a Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, described above, caused the audible and visual signals to function, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32, or 33 grounding the "K" lead in Fig. 18 which operates the (K) relay and in turn the (K1) relay in the Two Way - Two Wire Automatic Trunk circuit. Relay (K1) in operating extinguishes the visual and silences the audible signals. The transmission path to the TT Bd. trunk jack is closed over the "T" and "R" leads.

Disconnection is obtained by restoring the (ATA) key in Fig. 18 to normal. This releases relay (K) in the trunk circuit. When the other end disconnects, the (A), (A1) and (K) relays in the trunk also release restoring the circuit to normal.

#### 5.25 Local Station Line Circuit (LS)

##### 5.251 General

The local station line circuit is terminated in a key and lamp at the audio patch bay with multiplied keys and lamps at the control positions. The other end of the trunk is terminated in a subscriber set. The local station line circuit is shown on SD-95409-01. Fig. 17 provides a TALK and RING key, (LS) and Figs. 12 or 35 and 13 provide the telephone circuit, telephone sets and jacks. The line lamp in Fig. 14 and the ringing supply lamp in Fig. 20 are also provided.

The circuit is arranged to signal automatically toward the operating center when the handset is removed from the subscriber set. Ringing current (20 cycles)

is applied to the line at the operating center when signaling out to the subscriber set.

Option (ZA) is provided on each Fig. 17 when Fig. 17 is associated with a trunk to a subset and no TVOC's are provided in the office. If TVOC's are provided, all Figs. 17 associated with a trunk to a subset are placed in the group not assigned for connection to the TVOC (LC-2).

#### 5.252 Outgoing Call From Audio Patch Bay or From Control Positions

To originate a call, the (LS) key in Fig. 17 is operated to the TALK position. This grounds the "K" lead in Fig. 17 and operates the (CO) relay in the Local Station Line Circuit. However, this relay performs no function at this time. After listening and challenging to determine that the circuit is idle, the key may be operated to the RING position. The "K" lead is again grounded and 20 cycle ringing current is connected to the line. Ground on lead "K" again operates relay (CO) which conditions the Line Circuit for signaling.

At the end of the ringing interval, the (LS) key is restored to the TALK position. This removes the 20 cycle ringing current from the line and reconnects ground to the "K" lead, reoperating relay (CO) in the Line Circuit.

#### 5.253 Incoming Call At Audio Patch or At Control Positions

When a call is received, battery is placed on the "L" lead in Fig. 14 by the Local Station Line Circuit. This causes the audible and visual signals to function in Fig. 14.

To answer the call, the (LS) key in Fig. 17 is operated to the TALK position. Ground is then connected to the "K" lead which operates relay (CO) in the local Station Line Circuit. Relay (CO), in operating, extinguishes the visual and silences the audible signals by removing battery from the "L" lead.

If unattended period answering at the Toll Test Board is required, the (TB) key in Fig. 30 is turned, operating the (TB) relay in Fig. 29. When an incoming call, described above, caused the audible and visual signals to function in Fig. 14, similar signals occur at the TT Bd. The call is answered by inserting a test cord in the trunk jack of the TT Bd. The sleeve operates the (SL-) relay in Figs. 31, 32, or 33 grounding the "K" lead which operates the (CO) relay in the local Station Line Ckt. Relay (CO) in operating extinguishes the visual and silences the audible signals by removing battery from the

"L" lead. The transmission path to the TT Bd. trunk jack is closed over the "T" and "R" leads.

Disconnection is obtained by restoring the (LS) key to normal.

5.3 Key For Controlling Ckt. Arranged to Interconnect Two TVOC's

The (C) key in Fig. 27, when operated connects ground to the "A" lead. This operates the (SL-) relay (provided by the Multistation Line Circuit SD-55647-01) which connects two Television Order Circuits together. The (G) lamp lights whenever the (C) key is operated and functions as a guard lamp.

5.4 Information Figures

5.41 Fig. 101 shows a typical circuit layout in an office equipped with local circuits only. Although only one local circuit of each type has been shown, any number may be provided on a particular job. It is also possible to omit any of the local circuits, if desired. The keys associated with the various facilities may be arranged in any order.

5.42 Fig. 102 shows a typical circuit layout in an office equipped with both local circuits and intercity television

order circuits. Except for the TVOC with Sequence Signaling, only one facility of each type has been shown. However, any number may be provided. When a second telephone circuit is provided at a position, the associated keys are multiplied to those associated with the first. Keys associated with other positions are also connected in multiple. (Exceptions to this are the "A" leads of Fig. 3, the "SQ" leads of Fig. 24 and the "T-R" leads of Fig. 26.)

5.43 Fig. 103 shows the control arrangements for the Sequence Sending Circuit. Figs. 7 and 8 are common for the office while one Fig. 6 is provided for each position. Fig. 8 is provided only when a spare Sequence Sending Circuit is furnished.

5.44 Fig. 104 shows a typical layout of the "L" lead transfer to Toll Test Boards. Fig. 105 shows a similar layout of the "I" lead transfer where battery is furnished on the "A" or "AU" leads of the Auxiliary Signal Ckt., or the Auxiliary Signal and Night Alarm Ckt.

5.45 Fig. 106 shows a typical layout of connections to Toll Test Boards Nos. 4, 5, 16, 17B, 18B and Test and Control Board No. 8 for answering incoming calls only. Fig. 107 is a similar layout for connections to Toll Test Board No. 17C.

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