

# PANEL SYSTEMS <br> INCOMING SEIECTOR CIRCUIT <br> KEY PUTSING OR KEY INDICATOR <br> FROM LONG DISTANCE OFFICE <br> FOUR PARTY SEMISELECTIVE RINGING <br> FOR USE IN GROUND CUT-OFF RELAY OFFICES 

## CHANGES

## A. Changed and Added Functions

A. 1 Provision is made for interrupted tone as the all paths busy signal.
B. Changes in Apparatus
B. 1 SUPERSEDED

SUPERSEDED BY
11A Lamp ( $T$ ),
11B Lamp ( $T$ ), F1g. A
11D and 11L Multiple

Fig. A
IlN Multiple Brushes, Fig. 1 Brush,

ZK Option D-89195 Fig. 1 ZL Option D-180075 Sequence Switch, Sequence Switch, Fig. 1
B. 2 ADDED

400E Diode (L), ZN Option
$2 \mu f$ Capacitor (OF), ZJ Option
D. Description of Changes
D. 1 Option ZJ wiring and capacitor are added at contacts of the OF intermupter and replace ZI wiring which is rated Mfr Disc. The ZL option switch, which is added replaces the $Z K$ option switch to provide the proper cuttings on the $C$ and $D$ cams to connect paths busy tone instead of flash on overflow.
D. 2 A $2 N$ option $400 E$ diode is added in series with the primary winding of the $L$ relay to prevent surges from the up-drive magnet from falsely operating the $L$ relay during trunk hunting. Option $Z N$ replaces option $Z M$ wiring which is rated Mfr Disc.
D. 3 The llD and llL multiple brushes are rated Mfr Disc. and are superseded by the llN multiple brush which is added.
D. 4 The 11A lamp is rated Mrr Disc. and is superseded by the llB lamp which is added.
D. 5 Circuit Notes 130 through 133 are added.
F. Changes in CD Sections
F. 1 Under 3. FUNCTIONS, change 3.19 to read:
3.19 Retransmits line busy flash or transmits line busy tone in case called
line is busy.
F.2 In 22. OVERFLOW, the last two sentences should be changed to read:
If $Z I$ and $Z K$ options are furnished, in position 16, incerrupted ground under control of the D relay is connected to the Sl relay primary winding, thereby flashing the toll supervisory lamp in the toll opscator cord circuit. If ZJ and ZL optior.s are furnished, in position 16, interrupted tone, through contacts of interrupter CF , capacitor $O F$, and cams $C$ and D is connected to the ring lead of the toll operator cord circuit as an overflow signal. When the toll operator removes the plug fror.: the jack, the A relay releases and the circuit functions as described in 19.
F. 3 In 24. TELL-TALE, the last sentence should be changed to read:

If ZI and ZK options are furnished, in position 16, interrupted ground is supplied through cam C operating the Sl relay and providing a flashing signal to the toll operator. If ZJ and ZL options are furnished, interrupted tone is connected to the ring lead of the toll operator cord circuit as described in 22.

> F. 4 In 25. DISCONNECTION UNDER LINE BUSY, ALL PATHS BUSY OR TELL-TALE CONDITION, after the first sentence, add the following subtitle: $\frac{\text { A. Flashing Signal Returned on Line Busy, }}{\text { Paths Busy,or Tell-Tale }}$
F. 5 In 25., after the last sentence, add the following:
B. Tone Signal Returned on Line Buey, Paths Busy, or Tell-Tale
The $S$ and $S l$ relays are not operated. The A relay is totally under control of the loop at the switchboard and when this loop is opened, the A relay releases and the circuit restores to normal as described in 19.

BELL TELEPHONE LABORATORIES, INCORPORATED

PANEL SYSTEM<br>INCOMING SELECTOR CIRCUIT<br>KEY PULSING OR KEY INDICATOR<br>FROM LONG DISTANCE OFFICE<br>FOUR PARTY SEMISELECTIVE RINGING<br>FOR USE IN GROUND CUT-OFF RELAY OFFICES

## Changes

## A. CHANGED AND ADDED FUNCTIONS

A.l Provision to indicate a busy condition to Traffic Usage Recorder circuit, when the switch is off normal, is added optionally.

## D. DESCRIPTION OF CIRCUIT CHANGES

## D. 1 Option "ZH" is added for connection to the Traffic Usage Recorder cir- <br> cuit. Option "ZG" is designațed.

D. 2 Options "ZH" and "ZG" are added to the Options Used table.
D. 3 In Note 109, information Figs. 201 and 102 are designated, and Fig. 101,
is rated"Mfr. Disc." for this circuit. This
is in accordance with signaling arrangements that have been standardized for the direct distance dialing program.
D. 4 Notes 128 and 129 are added.
D. 5 Cross connection Fig. 1 K is changed to cover Options "ZG" and "ZH".

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT
1.1 This circuit is for use in establishing connections between toll operatore and subscribers in panel dial office areas.

## 2. WORKING LIMITS

2.1 The maximum external circuit loop for the L relay is 1460 ohms not to include more than 12 miles of cable, with a minimum leak of 30,000 ohms.
2.2 The maximum external circuit loop for the A relay is 4.375 ohms with minimum leak resistance of 30,000 ohms. The minimum external resistance for key indicator circuits is 17,500 ohms.
2.3 The maximum subscriber's external circuit loop is 1400 ohms for the Bl59
S relay and 1500 ohms for the G88 S relay with minimum insulation resistance, 10,000 ohms.
2.4 Maximum external circuit resistance at minimum 21 volt battery from tip of circuit to called trunk is 297 ohms for the S relay, "Y" wiring, and 2150 ohms for the TD relay, "X" wiring.
2.5 Maximum external circuit resistance over ring to the busy back circuit is 756 ohms.
2.6 Maximum external circuit loop for ringing from distant office is as follows:

| Min. Volt. | Frequency | $\begin{gathered} \text { \#19 } \\ \text { Cable } \end{gathered}$ | $\begin{gathered} \# 22 \\ \text { Cable } \end{gathered}$ | $\begin{gathered} \# 24 \\ \text { Cable } \end{gathered}$ | Open Wire |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 5 | 16-2/3V | 2100w | 2200 | 2300 | 2400 |
| 95 | 16-2/3V | 3000w | 3300 | 3500 | 3700 |
| 95 | 20V | 3300w | 3700 | 3900 | 4200 |

2.7 The maximum earth potential at called station is 20 V positive and 10V negative for the B159 S relay and 20 V positive and 15 V negative for the G88 S relay when operating with coin lines.

### 2.8 Maximum Subscriber Tripping Range

| Relay | Ringing <br> $\mathrm{a}-\mathrm{c}$ | 20~ |
| :--- | :--- | :--- | :--- | :--- |
| d-c |  |  | | RINGING |
| :---: |
| INTERVAL |
| Loop |$\quad$| Silent |
| :---: |
| Interval |
| Loop |

## 3. FUNCTIONS

3.1 This circuit is used in establishing connections between key indicator or key pulsing equipment in the toll office and final selectors. Its functions are as follows:
3.01 Recognizes selection.
3.02 Makes brush selection.
3.03 Trips the selected brush.
3.04 Makes group selection.
3.05 Selects and centers the multiple brushes on the terminals of the first idle trunk.
3.06 Grounds the sleeve terminal of the selected trunk as soon as it is seized.
3.07 Prepares for final selection.
3.08 Recognizes the completion of final selections and sends a reverse bat-
tery signal to the sender circuit.
3.09 Recognizes trunk closure at the originating end.
3.10 Signals the called subscriber under control of the toll operator.
3.11 Rerings PBX stations under control of toll operator.
3.12 Transmits ringing induction to the toll operator.
3.13 Opens the ringing circuit when the receiver is removed from the switchhook at the called subscriber's station.
3.14 Furnishes talking battery to the called subscriber's station as soon as the ringing circuit is opened and until the connection is released.
3.15 Signals the operator when the called subscriber removes the receiver from the switchhook.
3.16 Signals the operator when the called subscriber replaces the receiver on the switchhook.
3.17 Furnishes repeating coil and condenser transmission of toll grade quality during the time the calling and called stations are connected.
3.18 Returns the elevator to normal, resets the multiple brushes and advances the sequence switch to normal when the incoming selector is released by the operator at the distant end.
3.19 Retransmits line busy flash in case called line is busy.
3.20 Registers each advance of the sequence switch from normal.
3.21 If all of the trunks in the selected group are busy when the selector hunts for an idle trunk, the elevator stops on the top set of terminals (known as the overflow terminals) and functions as, follows: (a) signals the sender that an overflow condition exists, (b) recogolses trunk closure,
(c) registers the overflow condition, (d) transmits an overflow signal to the operator, (e) returns the elevator to normal. Rests the brushes and advances the switch to normal when released by the operator.
3.22 When the elevator travels to the top of the bank on a trouble condition (tell-tale) the circuit functions as fol-
lows: (a) releases the up-drive magnet,
(b) signals the sender as on an overflow condition, (c) recognizes trunk closure, (d) returns the elevator to normal when released by the operator.
3.23 Returns to normal if the switch is moved off normal manually.
3.24 Recognizes a wipe-out condition as soon as the switch enters the ringing position, opens the ringing circuit, returns the elevator to normal, resets the brushes and returns to normal.
3.25 Arranged for an optional locked in disconnect feature for use with key pulsing circuits.
3.26 Indicates an idle condition to the "Group Busy Register Circuit" whenever the switch is in the normal position.
3.27 Indicate a busy condition to the Traffic Usage Recorder whenever the switch is off normal.
3.28 Transmits a tone to the intercepting operator at the "A" switchboard when the TD relay and associated equipment is used.
3.29 Arranged to remove the tone from the tip of the trunk by the operation of the $S$ relay when the TD relay and associated equipment is used.
4. CONNECTING CIRCUITS

This circuit will function with the following circuits:
4.01 Final selector circuits with line relay in final.
4.02 No. 3 toll outgoing trunk circuits.
4.03 Key Pulsing link and sender circuits.
4.04 Toll key indicator link and sender circuits.
4.05 No. 3 and Key Pulsing toll cord circuits.
4.06 Coin Circuit.
4.07 Miscellaneous register circuit.
4.08 Blank incoming trunk circuit.
4.09 Traffic Usage Recorder Circuit, SD-95738-01.

### 4.10 Trunk Circuit from Toll Switching System No. 4, 4A or 4M - SD-68326-01.

## DESCRIPTION OF OPERATION

## 5. TRUNK SEIZURE


#### Abstract

When this trunk is selected by a key indicator link circuit at the toll office, the trunk number is displayed at the key indicator position and the plug of a toll cord is inserted in the jack of the outgoing trunk multiple. When this trunk is selected by the operator at the key pulsing office, the cord is inserted into the jack of the outgoing trunk multiple. When at least one digit of the line number has been written up, the fundanental circuit is closed thru in the sender, operating the incoming L relay. The L relay when operated, locks over the fundamental circuit and advances the switch to position 2.


## 6. BRUSH SELECTION

With the switch in position 2 ground from the L relay operates the UP magnet. As the selector moves upward carrying the commutator brushes over the commutator segments, ground is intermittently connected to the tip side of the fundamental circuit from the "A" commutator brush and segments, holding the L relay operated and successively short-circuiting the stepping relay in the associated sender circuit, thereby permitting its release and reoperation until the proper brush has been selected. When a sufficient number of impulses have been sent back to satisfy the sender the fundamental circuit is opened releasing the L relay. The L relay released, opens the circuit through the UP magnet which stops the upward movement of the selector and advances the switch to position 3.

## 7. GROUP SELECTION

With the switch in position 3, the trip magnet operates. In position 3, the L relay is again operated and locks through the fundamental circuit advancing the switch to position 4. In position 4 the UP magnet is again operated, and with the trip magnet energized, it causes the previously selected set of brushes to trip as the selector moves upward for group selection.

The "B" commutator is connected to the fundamental circuit and the operation is the same as described for brush selection. After a sufficient number of impulses have been sent back to satisfy the sender for group selection, the fundamental
circuit is opened. The $L$ relay then releases, releasing the UP magnet and causing the switch to advance to position 5. In position 5, the L relay operates through winding "P" advancing the switch to position 6 where a circuit is closed for energizing the UP magnet for trunk hunting.

## 8. TRUNK HUNTING

If the first trunk of a group in which the selector is hunting is busy the L relay is held operated over the circuit from battery through winding "S" to ground on the sleeve terminal of the busy trunk. With the L relay operated, the circuit through the UP magnet is maintained and the selector travels upward until an idle trunk is found. When the idle trunk is found, the holding circuit through winding " $S$ " of the $L$ relay is opened but the relay remains operated due to a circuit from ground through the "C" commutator brush to battery through winding "P" of the L relay. When the circuit through the "C" commutator is opened, the L relay releases, in turn opening the circuit through the UP magnet which steps the selector brushes on the terminals of the selected trunk and removing ground from the "C" commutator thus preventing the reoperation of the L relay when the selector settles back on the terminals. The release of the L relay in position 6 connects ground from cams $N$ and $E$ to the sleeve terminal of the trunk thus holding the selected final trunk busy while the ground on the back contact advances the switch to position 7. When the switch enters position $63 / 4$ and until it reackes position 15 l/4 the selected final trunk is held busy to all other hunting incoming circuits by ground through cam "E".

## 9. SELECTION BEYOND - INCOMING ADVANCE

With the switch in position 7 the L relay operates from a circuit thru winding "P" and cams "I" and "E" to ground. The L relay operated, advances the switch to position 8 and locks to ground on the ring terminal of the final selector circuit. With the switch in position 8 the fundamental circuit is closed through cam "F" to the final selector and ground is closed to the fundamental circuit and trunk through cam "D" and front contact of the L relay for selections beyond. When the selections beyond have been completed, the final circuit advances disconnecting ground from the ring terminal and thereby releasing the $L$ relay which advances the switch to position 9. With the switch in position 9, the L relay operates in a circuit through winding "P" cam "D" the fundamental circuit, cam "J" to ground on cam "I". The direction of current over the fundamental circuit, being reversed, causes the associated key indicator or key pulsing sender to function.

The L relay operated advances the switch to position ll. As the switch advances out of position 10, the circuit through the L relay is opened at cam "D", releasing the relay. Should the L relay release in position 10, due to trunk opening, the switch will still advance to position 11 , but
through the back contact of the relay.

## 10. TRUNK CLOSURE


#### Abstract

With the switch in position ll, a circuit is closed from battery and ground through the windings of the A relay, the contacts of the Sl relay, resis. B and C if provided and through the repeating coil to the trunk circuit. If the trunk circuit terminates in a key indicator office, the closure occurs in the toll operators cord circuit or in the outgoing trunk circuit. If the trunk circuit terminates in a key pulsing office, the closure occurs in the associated sender circuit. In either case the A relay receives an operating path by means of a trunk closure at the originating end. The operation of the A relay operates the D and Dl relays, the latter in turn operates the L relay. The L relay operated, advances the switch to position 12 and a circuit through cams $L$ and $B$ advances it to position 13. The D and D1 relays are made slow to release to prevent premature disconnection on momentary openings of the contacts of the A relay. As the switch leaves 11-3,4 the locking path of the $L$ relay is opened at cam E.


If the trunk circuit terminates in an "Inward" position at the key pulsing of fice, the direct current closure at the send:r is of short duration - just long enough to reg. the bat. and grd. condition of the incoming circuit and probably not long enough to operate the A, D and D1 relays. This closure is immediately followed by a timed interval of ringing current which operates the R2 relay. The operation of the R2 relay operates the R3 and Sl relays. The Sl relay causes the A relay to operate which in turn operates the D, D1 and L relays as described above, moving the switch into position 12. If the trunk circuit terminates in an "Outward" position at the key pulsing office the direct current trunk closure is of long enough duration to permit the A, D and D1 relays to operate.

If the incoming is arranged to function with a key pulsing toll office the ground on the A relay winding is placed under control of the slow release Dl relay after the sequence switch moves out of position 11 in order to obtain a locked in disconnect feature.

## 11. RINGING CALLED STATION

When Option " $\mathcal{Q N}^{\prime}$ is used, the circuit operation provides far connection of ringing
supply to the ring conductor toward the final selector for signaling the called station.

Option "K" is provided when ringing supply is to be connected to the tip conductor toward the final selector for signaling the called station. This arrangement may be used when it is desired to increase the number of subscriber stations on existing lines without the addition of final terminals. This will be accomplished by the use of an additional office code and incoming selectors arranged to connect ringing supply to the tip conductor toward the final selectcrs, thereby permitting reaching the same final terminal number by dialing either office code but signaling a station on the opposite side of the line. Such an arrangement will permit providing a maximum of 4 stations per line but using the final selectors common to two groups of incoming selectors each of which are associated with a separate office code.

## 12. RINGING LINES IN TRJNK GROUP "On OR "2" - ONE RING CODE (K OR Q OPTION)

If the called number is reached by a final trunk located in either group 0 or 2 of the incoming frame, the sequence switch will stay in position 13. If the trunk terminates in an inward position at the key pulsing office, the Rl relay will operate immediately in position 13 provided the ringing trunk closure has occurred. If the trunk terminates in an outward position at the key pulsing office or in a key indicator office, the toll operator will delay ringing to await the lighting of the toll cord supervisory lamp which occurs in position 11 of the incoming for key indicator trunks and a little later for key pulsing circuits. When the operator rings the R2 relay is operated in turn operating the Sl relay which while operated will hold the A relay in a local circuit. The operation of the R2 relay also operates the R3 relay which locks under control of the $R$ relay. The R3 relay operates the Rl relay from ground on normal contact of the L relay. The Rl relay operated locks under control of the $R$ relay and connects ringing current thru the 2 sec. ring. 4 sec . silent int. of the ringing machine to the line. Ringing on the opposite side is accomplished by reversing the cross-connections at the distributing frames or as descrited in par. 11. During the ringing period an audible ringing tone is transmitted to the toll operater thru condenser $A$ and winding, of the repeating coil.

## 13. RINGING LINES IN TRUNK GROUP NON OR "2" - TWO RING CODE (J OPTION)

When Option "J" is used the circuit operates as described in paragraph 12 except that relay Rl operates under control
of the PU interrupter connecuing ringing current through the Ring " 2 " interrupter of the ringing machine to the line. This permits increasing the number of subscriber stations on existing lines, without changing the final selectors.
14. RINGGING LINES IN TRUNK GROUP "l" OR
"3" - TWO RING CODE (K OR Q OPTION)

If the called number is reached by a final trunk located in either group 1 or 3 on the incoming frame, the sequence switch will not stop in position 13 as the L relay will be held operated to ground through the "P" commutator, after the lockinf circuit throush cam "E" opens the position $113 / 4$, and the switch will advance to position 14, where closure thru cam "L" advances it to position 15. As the switch passes through position 14 the $L$ relay releases. When the R2 relay operates, which may occur while the switch is in or advancing from position ll, the Sl and R3 relays operate. The R3 relay locks under control of the R relay. The Rl relay operates under control of the PU interrupter and locks under control of the $R$ relay. The Rl relay when operated connects ringing current through the Ring "2" interrupter of the ringing machine to the line.

When "S" wiring and apparatus are furnished, the operation of the R2 relay when the operator rings, also operates the R4 relay, which opens the repeating coil windings and thereby prevents ringing current from the toll operator's cord, from passing thru the repeating coil and ringing the wrong party's bell before the Rl relay operates on closure of the PU interrupter.

## 15. RINGING LINES IN TRUNK GROUP "l" OR "3n - ONE RING CODE (J OPTION)

When Option "J" is used the circuit operates as described in paragraph 14 except that relay Rl is operated from ground thru contact on the $L$ relay connecting ringing current through the Ring "l" interrupter of the ringing machine to the line. This permits increasing- the number of subscriber stations on existing lines without changing the final selectors.

## 16. CALLED PARTY ANSWERS - "Y" WIRING

When the receiver at the called station is removed from the switchhook, the R relay operates over the called subscriber's loop. The operation of the $R$ relay releases the R3 and Rl relays. The Rl relay released, closes the tip and ring of the final trunk through the windings of the repeating coil to the S relay which operates. The operation of the S relay operates the SI and RC relays. The RC relay places the Rl relay under control of the ringing key in the toll operator's cord circuit for use when ringing on PBX lines. The RC relay is made slow in
releasing to prevent its release during the time that its holding circuit is being transferred from the contacts of the R1 relay to the contacts of the $S$ relay on recall to a PBX under which condition the $S$ relay must reoperate. I'he operation of the S1 relay disconnects battery and fround from the tip and ring of the trunk circuit extinguishing the supervisory lamp in the cord circuit and provides a local holding circuit for the A relay when the receiver is off the switchhook at the called station. When "X" wiring is used the operation is the same as explained above except that the 'CD relay operates in series with the S relay but is short-circuited when the RC relay operates. This momentary operation of the TD relay serves no useful purpose.

## 17. CALLS TC IN'TERCEPTING OPERATOR

When this circuit is used in an office equipped with a panel "A" switchboard arranged for the completion of intercepted calls, TD and TC relays and associated equipment is used. Under this condition when a call is answered by the intercepting operator relay TD will operate to battery in the cord circuit and provide closure of the tone circuit thereby providing a distinctive tone to indicate to the intercepting operator that a toll call has been intercepted. When the cord circuit tone key is operated the battery condition on the tip is changed to a bridge condition across tip and ring thereby causing operation of the $S$ relay and in turn the RC relay in this circuit. Operation of the RC relay will close a shortcircuit around the TD relay causing it to release and will also open the tone lead to disconnect it from the tip conductor without awaiting the release of the I'D relay. Operation of the $S$ relay causes operation of the Sl relay which provides supervision to the toll operator as describer in the preceding paragraph.

The operation of relay $T D$ as just described will cause operation of relay TC. Relay TC operated will close the tone circuit to the tip conductor, short-circuit windings 1 to 2 and 5 to 6 of the repeating coil and open the circuit to condenser $B$. This arrangement is provided to prevent falso closure of tone toward the toll office which might impair transmission over the associated toll line prior to answer of the called subscriber should the TD relay operate falsely as a result of earth potential at the substation with a coin in the box or as a result of calling certain types of PBX over trunks with a high resistance to 48 V battery.

Should the associated "A" swi.tchboard circuits not be arranged for the completion of intercepted calls the TD relay and associated apparatus is not used. Under this condition when the intercepting operator answers the call a cord circuit condition of
battery on the tip conductor will cause operation of the $S$ relay in this circuit and thereby provide supervision to the toll operator as previously.described.

## 18. RERING PBX

When ringing current is connected to the trunk at the toll office to recall a substation of a PBX, the R2 relay operates, in turn operating the Rl relay through the make contacts of the RC relay. The operation of the Rl relay connects continuous ringing current to the called line.

## 19. DISCCNNECTION

When the receiver at the called station is replaced on the switchhook while the switch is in talking position 13 or 15, the $S$ relay releases in turn releasing the SI and RC relays. The SI relay released connects battery and ground thru the A relay to the trunk to operate the supervisory relay in the toll cord or outgoing trunk circuit thereby again requiring the A relay to hold over the trunk. When the plug of the toll cord is removed from the jack, the A relay is released, causing the release of the D and Dl relays which in turn causes the operation of the L relay through cam P. The release of the Dl relay when the circuit is arranged to operate with a key pulsing office discannects ground from the A relay thereby producing a locked in disconnect. The operation of the L relay causes the switch to advance to position 8. In position 18 the down magnet is operated from ground through cams "E" and "G", returning the elevator to normal where ground closure through the "Y" commutator advances the switch to position 1 , opening the circuit to the down magnet. Battery and ground are connected to the trunk during the travel to position 18 if the circuit is arranged for operation with key indicator system to hold the outgoing trunk circuit at the toll office. The trip magnet is operated in positions $17 / 18$ to prevent snagging of the brushes as the selector is being restored to normal. When the switch reaches position 18, battery and ground are disconnected from the trunk thereby releasing the outgoing trunk circuit at the toll office. In position 18 ground is connected to the tip and ring of the trunk to discharge the cable pairs.

## 20. 'rOLL OPERATOR DISCONNECTS

Should the key indicator toll operator disconnect before the called subscriber, the outgoing trunk of the key indicator toll system will function and the trunk will be held busy until the receiver is replaced on the switchhook at the called station. When this occurs the circuit will return to normal as explained in paragraph 19. In the case of operation with key pulsing circuits
a withdrawal of the plug causes disconnection as described in paragraph 19 after the A relay has again been applied to the trunk.

## 21. KEY INDICATOR TOLL OPERATOR FAILS TO

 PICK UP ASSIGNED TRUNKShould the key indicator toll operator fail to insert a plug in the outgoing end of this circuit, the key indicator circuits, after a predetermined period will release, which will cause a short circuit to be closed across the trunk during the release time of slow to release relays. This closure causes the A relay in this circuit to operate as described in paragraph 10. When the short circuit is removed, the A relay will release and the circuit will then function as described in "Disconnection" under paragraph 19. In the case of operation with key pulsing circuits this condition is not possible as the trunk is selected before the desired number is written up on the position keys.

## 22. OVERFLOW

When the selector is trunk hunting in position 6 and all the trunks of the group are busy, the elevator travels to the top of the group where the brushes make contact with the overflow terminals. The holding circuit through the L relay is opened at the sleeve terminal releasing the $L$ relay and advancing the switch to position 7. In position 7 the L relay operates to ground through cams "I" and "E", thereby advancing the switch to position 8 . The L relay releases in position 8 , the $R$ lead to the final being open and advances the switch to position 9 where the L relay is operated over the fundamental circuit advancing the switch to position 1l. In position 11 the A relay is operated over the trunk loop as in trunk closure in turn operating the $D$ and D1 relays and thereby causing the L relay to operate and advance the switch to position 12 where a circuit through cams $L$ and $B$ advances it to position 13. In position 13 ground from the $Z$ commutator advances the switch to position 16. In position 16 interrupter ground under control of the $D$ relay is connected to the S-1 relay through its "Pn winding thereby flashing the toll supervisory lamp in the toll operator's cord circuit. When the toll operator removes the plug from the jack, the A relay releases and the circuit functions the same as described in paragraph 19.

## 23. OPERATION OF OVERFLOW REGISTER

When the switch reaches position 12 with the selector resting on the overflow terminals of any group when "Q" Option is used, ground thru the C resistance lamp, the S relay and winding $3-4$ of the repeating coll issupplied to the tip commutator brush and
overflow terminal operating the overflow register which is connected to the tip terminal of all frames serving the same group of finals.
24. TELL-TALE

Should the selector travel to the top of the frame during selections the switch advances to position 9 from'ground through the $\mathbb{X}$ commutator. In position 9 the $L$ relay is operated over the fundamental circuit and advances the switch to position li.. The A relay operates in position 11 operating the D relay which in turn causes the operation of the L relay. The operation of the L relay advances the switch to position 12 where closure through cams "L" and "B" advances it to position 13. In position 13 ground through the "X" commutator advances the switch to position 16. In position 16 interrupted ground is supplied through cam L operating the $\mathrm{S}-1$ relay and providing a flashing signal to the toll operator as described in paragraph 22.
25. DISCONNECTION UNDER LINE BUSY, ALL PATHS BUSY OR TELL-TALE CONDITIONS

When the plug is removed from the jack at the toll board as result of line busy, all paths busy or tell-tale conditions the release of the incoming will occur in the following manner:
(a) On disconnect under line busy condition When the S relay releases during the open period of the busy back interrupter, the $S-1, A$ and $D$ relays will release. The release of the D relay will disconnect ground from the armature of the $S$ relay thereby preventing the reoperation of the $S-1, A$ and $D$ relays when the $S$ relay again operates during the next closed period of the busy back interrupter. The release of the D and Dl relays will cause the operation of the $L$ relay causing the selector to return to normal as described in paragraph 19.
(b) On disconnect under all paths busy or telil-tale conditions with the switch in position 16, when interrupter OF opens releasing the S-l relay, the A and D relays will release. The release of the $D$ relay will disconnect ground from the interrupter contact thereby preventing the reoperation of the $S-1, A$ and D relays when the next closure of the interrupter contacts occurs. The release of the D and Dl relays will cause the return of the selector to noritil as described above.

## 26. SELECTOR GROUP REGISTER

When the switch advances through position $9 / 4$ on all calls, ground is closed through cams I, J and F for operating the selector group register thereby indicating the number of calls handled by all selectors in the group during a specified time.

## 27. GROUP BUSY REGISTERS OR TRAFFIC USAGE RECORDER

## Option "ZG"

The group busy register operates every time all the trunks in a particular group are busy simultaneously. When any selector in a particular group is in position 1 , ground is connected over lead "PBR" to the group busy register circuit. However, when all the selectors in a particular group are busy, ground is removed from lead "PBR", releasing a normally operated relay, thereby causing the group busy register to operate.

Option "ZH"
Whenever a selector is busy ground is removed from lead "PB", thus indicating a busy condition to the Traffic Usage Recorder.

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## CHANGF.S

## A. CHANGED AND ADDED FUNCTIONS

A. 1 Provision to indicate a busy condition to Traffic Usage Recorder circuit, when the switch is off normal, is added optionally.
D. DESCRIPTION OF CIRCUIT CHANGES
D. 1 Option "ZH" is added for connection to the Traffic Usage Recorder circuit. Option "ZG" is designated.
D. 2 Options "ZH" and "ZG" are added to the Options Used table.
D. 3 In Note 109, information Figs. 101 and 102 are designated, and Fig. 101, is rated"Mfr. Disc." for this circuit. This is in accordance with signaling arrangements that have been standardized for the direct distance dialing program.
D. 4 Notes 128 and 129 are added.
D. 5 Cross connection Fig. lK is changed to cover Options "ZG" and "ZH".

All other headings under Changes, no change.

## 1. PURPOSE OF CIRCUIT

1.1 This circuit is for use in establish-
ing connections between toll operatore and subscribers in panel dial office areas.

## 2. WORKING LIMITS

2.1 The maximum external circuit loop for the L relay is 1460 ohms not to include more than 12 miles of cable, with a minimum leak of 30,000 ohms.
2.2 The maximum external circuit loop for the A relay is 4.375 ohms with minimum leak resistance of 30,000 ohms. The minimum external resistance for key indicator circuits is 17,500 ohms.
2.3 The maximum subscriber's external circuit loop is 1400 ohms for the B159 $S$ relay and 1500 ohms for the 688 S relay with minimum insulation resistance, 10,000 ohms.
2.4 Maximum external circuit resistance
at minimum 21 volt battery from tip of circuit to called trunk is 297 ohms for the S relay, "Y" wiring, and 2150 ohms for the TD relay, "X" wiring.
2.5 Maximum external circuit resistance over ring to the busy back circuit
is 756 ohms.
2.6 Maximum external circuit loop for ringing from distant office is as follows:

| Min. |  |  |  |  |  |
| :---: | :--- | :---: | :---: | :---: | :---: |
| Volt. | Fre- <br> quency | \#19 <br> Cable | \#22 <br> Cable | $\# 24$ <br> Cable | Open <br> Wire |
| 75 | $16-2 / 3 V$ | $2100 \omega$ | 2200 | 2300 | 2400 |
| 95 | $16-2 / 3 V$ | $3000 \omega$ | 3300 | 3500 | 3700 |
| 95 | 20 V | $3300 \omega$ | 3700 | 3900 | 4200 |

2.7 The maximum earth potential at called station is 20 V positive and 10V negative for the B159 S relay and 20 V positive and 15 V negative for the $688 \mathrm{~S} \mathrm{re-}$ lay when operating with coin lines.

### 2.8 Maximum Subscriber Tripping Range



## 3. FUNCTIONS

3.1 This circuit is used in establishing connections between key indicator or key pulsing equipment in the toll office and final selectors. Its functions are as follows:
3.01 Recognizes selection.
3.02 Makes brush selection.
3.03 Trips the selected brush.
3.04 Makes group selection.
3.05 Selects and centers the multiple brushes on the terminals of the first idle trunk.
3.06 Grounds the sleeve terminal of the selected trunk as soon as it is seized.
3.07 Prepares for final selection.
3.08 Recognizes the completion of final selections and sends a reverse bat-
tery signal to the sender circuit.
3.09 Recognizes trunk closure at the originating end.
3.10 Signals the called subscriber under control of the toll operator.
3.11 Rerings PBX stations under control of toll. operator.
3.12 Transmits ringing induction to the toll operator.
3.13 Opens the ringing circuit when the receiver is removed from the switchhook at the called subscriber's station.
3.14 Furnishes talking battery to the called subscriber's station as soon as the ringing circuit is opened and until the connection is released.
3.15 Signals the operator when the called subscriber removes the receiver from the switchhook.
3.16 Signals the operator when the called subscriber replaces the receiver on the switchhook.
3.17 Furnishes repeating coil and condenser transmission of toll grade quality during the time the calling and called stations are connected.
3.18 Returns the elevator to normal, resets the multiple brushes and advances the sequence switch to normal when the incoming selector is released by the operator at the distant end.
3.19 Retransmits line busy flash in case called line is busy.
3.20 Registers each advance of the sequence switch from normal.
3.21 If all of the trunks in the selected group are busy when the selector hunts for an idle trunk, the elevator stops on the top set of terminals (known as the overflow terminals) and functions as follows: (a) signals the sender that an overflow condition exists, (b) recognizes trunk closure,
(c) registers the overflow condition, (d) transmits an overflow signal to the operator, (e) returns the elevator to normal. Rests the brushes and advances the switch to normal when released by the operator.
3.22 When the elevator travels to the top of the bank on a trouble condition (tell-tale) the circuit functions as follows: (a) releases the up-drive magnet, (b) signals the sender as on an overflow condition, (c) recognizes trunk closure,
(d) returns the elevator to normal when released by the operator.
3.23 Returns to normal if the switch is moved off normal manually.
3.24 Recognizes a wipe-out condition as soon as the switch enters the ringing position, opens the ringing circuit, returns the elevator to normal, resets the brushes and returns to normal.
3.25 Arranged for an optional locked in disconnect feature for use with key pulsing circuits.
3.26 Indicates an idle condition to the "Group Busy Register Circuit" whenever the switch is in the normal position.
3.27 Indicate a busy condition to the Traffic Usage Recorder whenever the switch is off normal.
3.28 Transmits a tone to the intercepting operator at the "A" switchboard when the TD relay and associated equipment is used.
3.29 Arranged to remove the tone from the tip of the trunk by the operation of the $S$ relay when the TD relay and associated equipment is used.

## 4. CONNECTING CIRCUITS

This circuit will function with the following circuits:
4.01 Final selector circuits with line relay in final.
4.02 No. 3 toll outgoing trunk circuits.
4.03 Key Pulsing link and sender circuits.
4.04 Toll key indicator link and sender circuits.
4.05 No. 3 and Key Pulsing toll cord circuits.
4.06 Coin Circuit.
4.07 Miscellaneous register circuit.
4.08 Blank incoming trunk circuit.
4.09 Traffic Usage Recorder Circuit, SD-95738-01.
4.10 Trunk Circuit from Toll Switching System No. 4, 4A or 4M - SD-68326-01.

## DESCRIPTION OF OPERATION

## 5. TRUNK SEIZURE

When this trunk is selected by a key indicator link circuit at the toll office, the trunk number is displayed at the key indicator position and the plug of a toll cord is inserted in the jack of the outgoing trunk multiple. When this trunk is selected by the operator at the key pulsing office, the cord is inserted into the jack of the outgoing trunk multiple. When at least one digit of the line number has been written up, the fundamental circuit is closed thru in the sender, operating the incoming L relay. The L relay when operated, locks. over the fundamental circuit and advances the switch to position 2.

## 6. BRUSH SELECTION

With the switch in position 2 ground from the L relay operates the UP magnet. As the selector moves upward carrying the commutator brushes over the commutator segments, ground is intermittently connected to the tip side of the fundamental circuit from the "A" commutator brush and segments, holding the L relay operated and successively short-circuiting the stepping relay in the associated sender circuit, thereby permitting its release and reoperation until the proper brush has been selected. When a sufficient number of impulses have been sent back to satisfy the sender the fundamental circuit is opened releasing the L relay. The L relay released, opens the circuit through the UP magnet which stops the upward movement of the selector and advances the switch to position 3.

## 7. GROUP SELECTION

With the switch in position 3, the trip magnet operates. In position 3, the L relay is again operated and locks through the fundamental circuit advancing the switch to position 4 . In position 4 the UP magnet is again operated, and with the trip magnet energized, it causes the previously selected set of brushes to trip as the selector moves upward for group selection.

The "B" commutator is connected to the fundamental circuit and the operation is the same as described for brush selection. After a sufficient number of impulses have been sent back to satisfy the sender for group selection, the fundamental
circuit is opened. The L relay then releases, releasing the UP magnet and causing the switch to advance to position 5. In position 5, the L relay operates through winding "P" advancing the switch to position 6 where a circuit is closed for energizing the UP magnet for trunk hunting.

## 8. TRUNK HUNTING

If the first trunk of a group in which the selector is hunting is busy the L relay is held operated over the circuit from battery through winding " $S$ " to ground on the sleeve terminal of the busy trunk. With the L relay operated, the circuit through the UP magnet is maintained and the selector travels upward until an idle trunk is found. When the idle trunk is found, the holding circuit through winding "S" of the $L$ relay is opened but the relay remains operated due to a circuit from ground through the "C" commutator brush to battery through winding "P" of the L relay. When the circuit through the "C" commutator is opened, the L relay releases, in turn opening the circuit through the UP magnet which steps the selector brushes on the terminals of the selected trunk and removing ground from the "C" commutator thus preventing the reoperation of the L relay when the selector settles back on the terminals. The release of the L relay in position 6 connects ground from cams $N$ and E to the sleeve terminal of the trunk thus holding the selected final trunk busy while the ground on the back contact advances the switch to position 7. When the switch enters position $63 / 4$ and until it reackes position $151 / 4$ the selected final trunk is held busy to all other hunting incoming circuits by ground through cam "E".

## 9. SELECTION BEYOND - INCOMING ADVANCE

With the switch in position 7 the L relay operates from a circuit thru winding "P" and cams "I" and "E" to ground. The L relay operated, advances the switch to position 8 and locks to ground on the ring terminal of the final selector circuit. With the switch in position 8 the fundamental circuit is closed through cam "F" to the final selector and ground is closed to the fundamental circuit and trunk through cam "D" and front contact of the L relay for selections beyond. When the selections beyond have been completed, the final circuit advances disconnecting $\mathrm{g}_{\mathrm{r}}$ ound from the ring terminal and thereby releasing the $L$ relay which advances the switch to position 9. With the switch in position 9, the L relay operates in a circuit through winding "P" cam "D" the fundamental circuit, cam "J" to ground on cam "I". The direction of current over the fundamental circuit, being reversed, causes the associated key indir cator or key pulsing sender to function.

The L relay operated advances the switch to position ll. As the switch advances out of position 10, the circuit through the L relay is opened at cam "D", releasing the relay. Should the L relay release in position 10, due to trunk opening, the switch will still advance to position ll, but through the back contact of the relay.

## 10. TRUNK CLOSURE

With the switch in position ll, a circuit is closed from battery and ground through the windings of the A relay, the contacts of the Sl relay, resis. B and C if provided and through the repeating coil to the trunk circuit. If the trunk circuit terminates in a key indicator office, the closure occurs in the toll operators cord circuit or in the outgoing trunk circuit. If the trunk circuit terminates in a key pulsing office, the closure occurs in the associated sender circuit. In either case the A relay receives an operating path by means of a trunk closure at the originating end. The operation of the A relay operates the D and Dl relays, the latter in turn operates the L relay. The L relay operated, advances the switch to position 12 and a circuit through cams $L$ and $B$ advances it to position 13. The D and Dl relays are made slow to release to prevent premature disconnection on momentary openings of the contacts of the A relay. As the switch leaves ll-3/4 the locking path of the L relay is opened at cam E.

If the trunk circuit terminates in an "Inward" position at the key pulsing office, the direct current closure at the sender is of short duration - just long enough to reg. the bat. and grd. condition of the incoming circuit and probably not long enough to operate the A, D and Dl relays. This closure is immediately followed by a timed interval of ringing current which operates the R2 relay. The operation of the R2 relay operates the R3 and Sl relays. The Sl relay causes the A relay to operate which in turn operates the D, Dl and $L$ relays as described above, moving the switch into position 12. If the trunk circuit terminates in an "Outward" position at the key pulsing office the direct current trunk closure is of long enough duration to permit the A, D and Dl relays to operate.

If the incoming is arranged to function with a key pulsing toll office the ground on the A relay winding is placed under control of the slow release Dl relay after the sequence switch moves out of position 11 in order to obtain a locked in disconnect feature.
11. RINGING CALLED STATION

When Option "Q" is used, the circuit operation provides for connection of ringing
supply to the ring conductor toward the final selector for signaling the called station.

Option "K" is provided when ringing supply is to be connected to the tip conductor toward the final selector for signaling the called station. This arrangement may be used when it is desired to increase the number of subscriber stations on existing lines without the addition of final terminals. This will be accomplished by the use of an additional office code and incoming selectors arranged to connect ringing supply to the tip conductor toward the final selectcrs, thereby permitting reaching the same final terminal number by dialing either office code but signaling a station on the opposite side of the line. Such an arrangement will permit providing a maximum of 4 stations per line but using the final selectors common totwo groups of incoming selectors each of which are associated with a separate office code.

## 12. RINGING LINES IN TRJNK GROUP "O" OR "2" - ONE RING CODE (K OR Q OPTION)

If the called number is reached by a final trunk located in either group 0 or 2 of the incoming frame, the sequence switch will stay in position 13. If the trunk terminates in an inward position at the key pulsing office, the Rl relay will operate immediately in position 13 provided the ringing trunk closure has occurred. If the trunk terminates in an outward position at the key pulsing office or in a key indicator office, the toll operator will delay ringing to await the lighting of the toll cord supervisory lamp which occurs in position 11 of the incoming for key indicator trunks and a little later for key pulsing circuits. When the operator rings the R2 relay is operated in turn operating the Sl relay which while operated will hold the A relay in a local circuit. The operation of the R2 relay also operates the R3 relay which locks under control of the $R$ relay. The R3 relay operates the Rl relay from ground on normal contact of the L relay. The Rl relay operated locks under control of the $R$ relay and connects ringing current thru the 2 sec . ring. 4 sec . silent int. of the ringing machine to the line. Ringing on the opposite side is accomplished by reversing the cross-connections at the distributing frames or as descrited in par. ll. During the ringing period an audible ringing tone is transmitted to the toll operater thru condenser A and winding, of the repeating coil.

## 13. RINGING LINES IN TRUNK GROUP "O" OR "2" - TWO RING CODE (J OPTION)

When Option "J" is used the circuit operates as described in paragraph 12 except that relay Rl operates under control
of the PU interrupter connecting ringing current through the Ring "2" interrupter of the ringing machine to the line. This permits increasing the number of subscriber stations on existing lines, without changing the final selectors.

## 14. RINGING LINES IN TRUNK GROUP "l" OR "3" - TWO RING CODE (K OR Q OPTION)

If the called number is reached by a final trunk located in either group l or 3 on the incoming frame, the sequence switch will not stop in position 13 as the L relay will be held operated to ground through the "P" commutator, after the locking circuit through cam "E" opens the position ll $3 / 4$, and the switch will advance to position l4, where closure thru cam "L" advances it to position l5. As the switch passes through position 14 the L relay releases. When the R2 relay operates, which may occur while the switch is in or advancing from position 11 , the Sl and R3 relays operate. The R3 relay locks under control of the R relay. The Rl relay operates under control of the PU interrupter and locks under control of the $R$ relay. The Rl relay when operated connects ringing current through the Ring " 2 " interrupter of the ringing machine to the line.

When "S" wiring and apparatus are furnished, the operation of the R2 relay when the operator rings, also operates the R4 relay, which opens the repeating coil windings and thereby prevents ringing current from the toll operator's cord, from passing thru the repeating coil and ringing the wrong party's bell before the Rl relay operates on closure of the PU interrupter.

## 15. RINGING LINES IN TRUNK GROUP "l" OR "3" - ONE RING CODE (J OPTION)

When Option "J" is used the circuit operates as described in paragraph 14 except that relay R1 is operated from ground thru contact on the $L$ relay connecting ringing current through the Ring "l" interrupter of the ringing machine to the line. This permits increasing- the number of subscriber stations on existing lines without changing the final selectors.

## 16. CALLED PARTY ANSWERS - "Y" WIRING

When the receiver at the called station is removed from the switchhook, the $R$ relay operates over the called subscriber's loop. The operation of the $R$ relay releases the R3 and R1 relays. The Rl relay released, closes the tip and ring of the final trunk through the windings of the repeating coil to the S relay which operates. The operation of the S relay operates the SI and RC relays. The RC relay places the Rl relay under control of the ringing key in the toll operator's cord circuit for use when ringing on PBX lines. The RC relay is made slow in
releasing to prevent its release during the time that its holding circuit is being transferred from the contacts of the Rl relay to the contacts of the $S$ relay on recall to a PBX under which condition the S relay must reoperate. The operation of the Sl relay disconnects battery and ground from the tip and ring of the trunk circuit extinguishing the supervisory lamp in the cord circuit and provides a local holding circuit for the A relay when the receiver is off the switchhook at the called station. When "X" wiring is used the operation is the same as explained above except that the TD relay operates in series with the $S$ relay but is short-circuited when the RC relay operates. This momentary operation of the TD relay serves no useful purpose.

## 17. CALLS TC INTERCEPTING OPERATOR

When this circuit is used in an office equipped with a panel "A" switchboard arranged for the completion of intercepted calls, TD and TC relays and associated equipment is used. Under this condition when a call is answered by the intercepting operator relay TD will operate to battery in the cord circuit and provide closure of the tone circuit thereby providing a distinctive tone to indicate to the intercepting operator that a toll call has been intercepted. When the cord circuit tone key is operated the battery condition on the tip is changed to a bridge condition across tip and ring thereby causing operation of the $S$ relay and in turn the RC relay in this circuit. Operation of the RC relay will close a short circuit around the TD relay causing it to release and will also open the tone lead to disconnect it from the tip conductor without awaiting the release of the I'D relay. Operation of the $S$ relay causes operation of the Sl relay which provides supervision to the toll operator as describer in the preceding paragraph.

The operation of relay $T D$ as just described will cause operation of relay TC. Relay TC operated will close the tone circuit to the tip conductor, short-circuit windings 1 to 2 and 5 to 6 of the repeating coil and open the circuit to condenser $B$. This arrangement is provided to prevent fals closure of tone toward the toll. office which might impair transmission over the associated toll line prior to answer of the called subscriber should the TD relay operate falsely as a result of earth potential at the substation with a coin in the box or as a result of calling certain types of PBX over trunks with a high resistance to 48 V battery.

Should the associated "A" switchboard circuits not be arranged for the completion of intercepted calls the TD relay and associated apparatus is not used. Under this condition when the intercepting operator answers the call a cord circuit condition of
battery on the tip conductor will cause operation of the $S$ relay in this circuit and thereby provide supervision to the toll operator as previously..described.

## 18. RERING PBX

When ringing current is connected to the trunk at the toll office to recall a substation of a PBX, the R2 relay operates, in turn operating the Rl relay through the make contacts of the RC relay. The operation of the Rl relay connects continuous ringing current to the called line.

## 19. DISCCNNECTION

When the receiver at the called station is replaced on the switchhook while the switch is in talking position 13 or 15, the $S$ relay releases in turn releasing the Sl and RC relays. The Sl relay released connects battery and ground thru the A relay to the trunk to operate the supervisory relay in the toll cord or outgoing trunk circuit thereby again requiring the A relay to hold over the trunk. When the plug of the toll cord is removed from the jack, the A relay is released, causing the release of the D and Dl relays which in turn causes the operation of the L relay through cam P. The release of the Dl relay when the circuit is arranged to operate with a key pulsing office disconnects ground from the A relay thereby producing a locked in disconnect. The operation of the L relay causes the switch to advance to position 8. In position 18 the down magnet is operated from ground through cams "E" and "G", returning the elevator to normal where ground closure through the "Y" commutator advances the switch to position l, opening the circuit to the down magnet. Battery and ground are connected to the trunk during the travel to position 18 if the circuit is arranged for operation with key indicator system to hold the outgoing trunk circuit at the toll office. The trip magnet is operated in positions $17 / 18$ to prevent snagging of the brushes as the selector is being restored to normal. When the switch reaches position 18, battery and ground are disconnected from the trunk thereby releasing the outgoing trunk circuit at the toll office. In position 18 ground is connected to the tip and ring of the trunk to discharge the cable pairs.

## 20. TOLL OPERATOR DISCONNECTS

Should the key indicator toll operator disconnect before the called subscriber, the outgoing trunk of the key indicator toll system will function and the trunk will be held busy until the receiver is replaced on the switchhook at the called station. When this occurs the circuit will return to normal as explained in paragraph 19. In the case of operation with key pulsing circuits
a withdrawal of the plug causes disconnection as described in paragraph 19 after the A relay has again been applied to the trunk.

## 21. KEY INDICATOR TOLL OPERATOR FAILS TO

 PICK UP ASSIGNED TRUNKShould the key indicator toll operator fail to insert a plug in the outgoing end of this circuit, the key indicator circuits, after a predetermined period will release, which will cause a short circuit to be closed across the trunk during the release time of slow to release relays. This closure causes the A relay in this circuit to operate as described in paragraph 10. When the short circuit is removed, the A relay will release and the circuit will then function as described in "Disconnection" under paragraph 19. In the case of operation with key pulsing circuits this condition is not possible as the trunk is selected before the desired number is written up on the position keys.

## 22. OVERFLOW

When the selector is trunk hunting in position 6 and all the trunks of the group are busy, the elevator travels to the top of the group where the brushes make contact with the overflow terminals. The holding circuit through the L relay is opened at the sleeve terminal releasing the L relay and advancing the switch to position 7. In position 7 the L relay operates to ground through cams "I" and "E", thereby advancing the switch to position 8. The L relay roleases in position 8 , the $R$ lead to the final being open and advances the switch to position 9 where the L relay is operated over the fundamental circuit advancing the switch to position ll. In position 11 the A relay is operated over the trunk loop as in trunk closure in turn operating the $D$ and Dl relays and thereby causing the L relay to operate and advance the switch to position 12 where a circuit through cams $L$ and $B$ advances it to position 13. In position 13 ground from the $Z$ commutator advances the switch to position 16. In position 16 interrupter ground under control of the D relay is connected to the S-l relay through its "P" winding thereby flashing the toll supervisory lamp in the toll operator's cord circuit. When the toll operator removes the plug from the jack, the A relay releases and the circuit functions the same as described in paragraph 19.

## 23. OPERATION OF OVERFLOW REGISTER

[^0] issupplied to the tip commutator brush and
overflow terminal operating the overflow register which is connected to the tip terminal of all frames serving the same group of finals.


#### Abstract

24. TELL-TALE

Should the selector travel to the top of the frame during selections the switch advances to position 9 from ground through the $X$ commutator. In position 9 the $L$ relay is operated over the fundamental circuit and advances the switch to position li.. The A relay operates in position $l l$ operating the D relay which in turn causes the operation of the L relay. The operation of the L relay advances the switch to position 12 where closure through cams "L" and "B" advances it to position 13. In position 13 ground through the "X" commutator advances the switch to position 16. In position 16 interrupted ground is supplied through cam L operating the S-I relay and providing a flashing signal to the toll operator as described in paragraph 22.


## 25. DISCONNECTION UNDER LINE BUSY, ALL PATHS BUSY OR TELL-TALE CONDITIONS

[^1](b) On disconnect. under all paths busy or tell-tale conditions with the switch in position 16, when interrupter OF opens releasing the S-1 relay, the A and D relays will release. The release of the $D$ relay will disconnect ground from the interrupter contact thereby preventing the reoperation of the S-1, A and D relays when the next closure of the interrupter contacts occurs. The release of the D and Dl relays will cause the return of the selector to normal as described above.

## 26. SELECTOR GROUP REGISTER

When the switch advances through position 9 3/4 on all calls, ground is closed through cams I, J and F for operating the selector group register thereby indicating the number of calls handled by all selectors in the group during a specified time.

## 27. GROUP BUSY REGISTERS OR TRAFFIC USAGE RECORDER

## Option "ZG"

The group busy register operates every time all the trunks in a particular group are busy simultaneously. When any selector in a particular group is in position 1 , ground is connected over lead "PBR" to the group busy register circuit. However, when all the selectors in a particular group are busy, ground is removed from lead "PBR", releasing a normally operated relay, thereby causing the group busy register to operate.
Option "ZH"

Whenever a selector is busy ground is removed from lead "PB", thus indicating a busy condition to the Traffic Usage Recorder.

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DEPT. 2325-SW-EWO-JL


[^0]:    When the switch reaches position 12 with the selector resting on the overflow terminals of any group when "Q" Option is used, ground thru the C resistance lamp, the S relay and winding 3-4 of the repeating coil

[^1]:    When the plug is removed from the jack at the toll board as result of line busy, all paths busy or tell-tale conditions the release of the incoming will occur in the following manner:
    (a) On disconnect under line busy condition When the $S$ relay releases during the open period of the busy back interrupter, the $S-1, A$ and $D$ relays will release. The release of the $D$ relay will disconnect ground from the armature of the $S$ relay thereby preventing the reoperation of the S-l, A and D relays when the S relay again operates during the next closed period of the busy back interrupter. The release of the D and Dl relays will cause the operation of the $L$ relay causing the selector to return to normal as described in paragraph 19.

