PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM TOLL SWITCHING SYSTEM NO. 4 INDIVIDUAL, 2 OR 4 PARTY SELECTIVE OR 4 PARTY SEMI-SELECTIVE RINGING GROUND CUT-OFF RELAY OFFICE

CHANGES
B. Changes in Apparatus
B. $1 \frac{\text { Superseded }}{\substack{\text { IlA Resistance } \\ \text { Lamp }}} \quad \frac{\text { Superseded By }}{\substack{\text { llB Resistance } \\ \text { Lamp }}}$
D. Description of Changes
D. 1 The "Mfr Disc." llA resistance lamp is superseded by the llB resistance lamp.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 6261-RP-AFB-EZ

Printed in U. S. A.

PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM TOLL SWITCHING SYSTEM NO. 4 INDIVIDUAL, 2 OR 4 PARTY SELECTIVE OR 4 PARTY SEMI-SELECTIVE RINGING GROUND CUT-OFF RELAY OFFICE

## CHANGES

D. DESCRIPTION OF CHANGES
D. 1 YK option is added in Fig. A to provide ringing in position 14 instead of position 12. This allows the circuit to function properly with 8 A announcement trunks.
D. 2 YJ option provides the existing arrangement.
D. 3 YJ and YK options are added in the Option Used Table.
D. 4 Circuit Note 119 is added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2364-WMS-JEM

PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM TOLL SWITCHING SYSTEM NO. 4
INDIVIDUAL, 2- OR 4-PARTY SELECTIVE
OR 4-PARTY SEMI-SEJECTIVE RINGING GROUND CUTOFF RELAY OFFICE

## CHANGES

B. CHANGES IN APPARATUS
B. 1 Superseded

11L Multiple Brush
Superseded by
IIN Multiple Brush
B. 2 Added:

D 420G Diode "YG" Option
I 400E Diode "YI" Option
D. DESCRIPTION OF CHANGES
D. 1 "YG" option is added to provide additional slow release characteristic to the D relay in order to hold over the A relay release and reoperation during $S l$ relay operation or release.
D. 2 " $G$ " option is added to prevent surges from the updrive magnet from falsely operating the $L$ relay.
D. 3 The 11L multiple brush is rated Mrr Disc. and is superseded by the IlN multiple brush to reduce transmisision noise and
eliminate distortion of the brush tips due to snagging.
All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2364-WMS-JEM

PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM TOLL SWITCHING SYSTEM NO. 4 INDIVIDUAL 2 OR 4 PARTY SELECTIVE OR 4 PARTY SEMI-SELECTIVE RINGING GROUND CUT-OFF RELAY OFFICE
B. CHANGES IN APPARATUS
B. 1 Removed

Fig. 2
1-B1111 (TD) Relay
1-E1715 (TC) Relay
1-0.1 M.F. (T) Capacitor
C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS
C. 1 Adjustment "A" for relay (TD) is
designated and rated "Mfr. Disc." and is superseded by adjustment "B."
D. DESCRIPTION OF CIRCUIT CHANGES
D. 1 Fig. 2 is rated "Mfr. Disc." ,
D. 2 The following is removed from Note 102:

Toll Identifying Tone At "A"Bd. Bequired Fig. 2 Nat rieq. Mig. 3
D. 3 This change is added to Note 103 for record purposes.

All other headings, no change.
bell telbphone laboratories, inc.

DEPT. 3040-BSP-CGY-CH

PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM TOLL SWITCHING SYSTEM NO. 4
INDIVIDUAL 2 OR 4 PARTY SELECTIVE OR 4 PARTY SEMI-SELECTIVE RINGING

GROUND CUT-OFF RELAY OFFICE

## CHANGES

B. CHANGES IN APPARATUS
B. 1 Added
120CS Rep. Coil (YC opt.)
120DS Rep. Coil (YD opt.)
3J Commutator (YF opt.)
B. 2 Superseded
B415 Relay
B403 "
B144 "
E6176 "
E545 "
D. DESCRIPTION OF CIRCUIT CHANGES
D. 1 Notes 116,117 and 118 are added.
D. 2 The use of the $\mathrm{B} 415, \mathrm{~B} 403, \mathrm{Bl} 44$,

E6176 and E545 relays are super: seded by the B392, E859 and E572 relays to show realistic ratings for obsolescent apparatus.
D. 3 Circuit Note 104 is revised to in-
clude l20CS (YC option) and l20DS (YB option) Rep. coils.
Superseded
B392 Relay
n
n
E859
E5
E572
n . ,

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3360-WKS_CGM-Z1
D. 4 Note 102 is revised to specify use of the 3A commutator (YD option) with $50 \%$ Party Line Ringing and the 3J commutator ( F option) with $25 \%$ Party Line Ringing. Use of Fig. $G$ is specified when Free Line Circuits are used in office. Use of Fig. $H$ is apecified when Free Iine Circuits are not used in office.

> D. 5 Note 103 is revised to show relays and options YD, YE, YF, YB \& YC.
> D. 6 Fig. $G$ was formerly rated "A\&M only".
> D. 7 Options YB, YC, YD, YE and YF are added to options used table.
E. CHANGES IN TRANSMISSION REQUIREMENIS
E. 1 Data for the 120CS and 120DS Rep. Coils is added to Transmission Test Requirements Table.

> All other headings, no change.

PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM TOLL SWITCHING SYSTEM NO. 4 INDIVIDUAL, 2 OR 4 PARTY SELECTIVE OR 4 PARTY SEMI-SELLECTIVE RINGING GROUND CUT-OFF RELAY OFFICE

## CHANGES

## B. Changes in apparatus

## B. 1 Added

(A) resistance, 100,000 ohms per KS-13490, LI ("IA" option).
C. CHANGES IN CIRCUIT REQUIREMENTS OTHER-THAN THOSE APPLYING TO ADDED OR REMDVED APPARATUS
C. 1 " $\mathrm{SS}_{4}-\mathrm{L}^{\prime \prime}$ is added in the Block or Insulate columin for the (L) relay.
D. DESCRIPTION OF CIRCUIT CHANGES
D. 1 The (A) resistance is connected across the tip and ring when "YA" wiring is furnished. This resistance is provided to discharge the trunk conductors between selections and thus prevent the possibility of false operation of the sender stepping relay on final units selection when the final selectors are equipped with a 3M or 3G commutator and the cable exceeds 6 miles as covered in PEM 1917.
D. 2 Circuit Note 115 is added explaining the use of "YA" option.
D. 3 Reference to "IA" option is added to note 103 and the options used
table.

## D. 4 In the table for working limits 50,000 ohms is added for the trunk min. ins. res.

All other headings, no change.

## 2. WORKING LIMITS

2.1 The maximum external circuit loop
for selections shall not exceed
1488 ohms resistance and shall not include more than 12 miles of cable.
2.2 The maximum external circuit loop resistance for trunk supervision is 7540 ohms.
2.3. The minimum trunk insulation resistance is 30,000 ohms with "FA" option not provided. When "YA" option is provided the minimum trunis insulation resistance is 50,000 ohms.
2.4 The maximum external circuit loop resistance for subscriber supervision is 1500 ohms.
2.5 The minimum subscriber line insulation resistance is 10,000 ohms.

### 2.6 Tripping ranges:

The maximum subscriber tripping range is as follows:

| Tripping Relay | A-C <br> Voltage | $\begin{aligned} & \text { Silent } \\ & \text { Int. } \\ & \text { Voltage } \end{aligned}$ | Hange <br> Ringing <br> Interval | Sileñt Interval | Earth Pot. | $\begin{aligned} & \text { Sub. } \\ & \text { Set } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 114AK | 95-110 | 46-52 | 450w | 7300 |  |  |
| 114 AK | 95-103 | 46-52 | 800w | 730\% |  |  |
| 114 AK | $84-88$ | 46-52 | 13500 | 800w |  |  |
| 114BL | 72-80 | 60-75 | 970w | 850w |  |  |
| 114 KA | 84-88 | 46-52 | 1000w or 1500w | 1000w or 1500w |  |  |
| 114 KA | 84-888 | 46-52 | 1000w | 1000\% | $\pm 15 \mathrm{~V}$ | TUBE |
| 114KA | 84-88 | 46-52 | 1500w | 1500\% | $\pm 5 \mathrm{~V}$ | TUBE |

BELL TELEPHONE LABORATORIES, INC.

## CHANGES

A. CHANCED AND AUDED FUNCTTONS
A. 1 This circuit has beer changed to orovide for connections of
ringing sumoly to the tip side of t.e. final terminal to permit increasing the number of subscriber stations without the addition of final terminals.

## B. CHANGES IN APPARATUS

$$
\begin{array}{cc}
\text { B. } 1 & \text { Replaced } \\
& \text { Seq. Sw. A, D-159894 } \\
& \text { "M" option } \\
& \text { Seq. Sw. B, D-159895 "ZQ" option } \\
& D-159893 \text { "K" opticn } \\
&
\end{array}
$$

Replaced By (Special)

$$
\begin{aligned}
& \mathrm{D}-17838 l_{1} \text { "ZV" option } \\
& \mathrm{D}-178385 \text { "ZW" ontion } \\
& \mathrm{D}-178383 \text { "ZX" ontion } \\
& \mathrm{D}-17838 \text { ? "ZV" option }
\end{aligned}
$$

## D. DESCRIPTION OF CIRCLIT CHÂNGES

## D. 1 Option "ZU" and "ZV", "ZW", "ZX" <br> or "ZY" have been added to ar-

 range for connection of ringing current to the tip side and ringing ground to the ring side toward the final terminal.D. 2 Option "ZZ" is added to permit
circuits that have been modified to orcvide ringing on the tip sjde to be converted to provide ringing on the ring side without changing the secuence switch.
D. 3 "ZT" option shows the orjginal arrangement to provide ringing on the ring side.
D.1. The searence switch legend is extended to show "ZV", "ZW", "ZX" and "ZY" ontions.
D. 5 Circuit note 103 and the cntions used table are extended to refer to options "ZT", "ZU", "ZV", "ZW", "ZX", "ZY" and "ZZ".
D. 6 Circuit notes 113 and 114 are added.
D. 7 The fusing information for the ringing lead formerly was 1-1/3 amp.

All other headings under "Changes", no change.

## 1. PURPOSE OF CIPCUIT

### 1.1 This circuit is for use in the

 completion of calls from crossbar toll to subscribers in oanel office areas.2. WCRKING LIMITS
2.1 The maximum external circuit loop for selections shall not exceed
14888 ohms resistance and shall not include more than 12 miles of cable.
2.2 The maximum external circuit loop resistance for trunk supervision is ? 540 ohms.
2.3 The minimum trunk insulatinn resistance is 30,000 ohms.
2.4 The maximum external circuit loop resistance for subscriber sumervjsion is 1500 ohms.
2.5 The minimum sibscriber line insulation resistance $i=10,000$ ohms.
2.6 Trioping ranges:

The maximum subscriber tripoing range is as follows:

|  |  | Silent |  | Range |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tripping Relay | $\begin{gathered} \text { A-C } \\ \text { Voltage } \end{gathered}$ | Int. <br> Voltage | Ringing <br> Interval |  | Silent Interval | Earth Pot. | Subset |
| 114 AK | 95-110 | 46-52 | $450 \%$ |  | 730w |  |  |
| 114 AK | 95-103 | 46-5? | 800w |  | 730w |  |  |
| 114 AK | 84-88 | 46-52 | 1350w |  | 800w |  |  |
| 214 ${ }^{\text {BL }}$ | 72-80 | 60-75 | 9700 |  | 850w |  |  |
| 114 KA | 84-88 | 46-52 | 1000w or 1500w |  | 1000w or 1500\% |  |  |
| 114 KA | 84-88 | 46-52 | 1000w |  | 1000w | $\pm 15 \mathrm{~V}$ | TUBE |
| 214 KA | 84-88 | 46-52 | 1500w |  | 1500w | $\pm 5 \mathrm{~V}$ | TURE |

## 3. FUNCTIONS

3.0. 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 in the selected group.
3.06 Grounds the sleeve terminal of the selected trunk as a busy indication as soon as it is seized and maintains the condition until the switch advances beyond the talking position.
3.07 Closes the "T" lead of the incoming trunk to the "T" lead of the final selector and connects ground to the "R" lead of the incoming trunk during the time the final selector is making selections.
3.02 Recognizes the completion of final selections and signals the sender that all selections have been completed.
3.09 Recognizes trunk closure from the toll outgoing trunk circuit.
3.10 Transmits audible ringing tone to the calling subscriber while the called subscriber is being signalled with machine ringing current.
3.11 Opens the ringing circuit when the receiver is removed from the switchhook at the called station or when the toll trunk releases this circuit.
3.12 Furnishes talking battery to the called station from the time
when the ringing circuit is opened until the connection is released.
3.13 Signals the originating toll operator when the called subscriber removes the receiver from the switchhook on answer and when the receiver is replaced on the switchhook on disconnect.
3. 14 Furnishes renentine coil and condenser transmission during the time the calling and called stations are connected.
3.15 Returns the elevator to normal, resets the miltiple brushes, and advances the sequence switch to normal when released by disconnect of the toll trunk.
3.16 Registers each revolution of the sequence switch.
3.17 If all of the trunks in the selected group are busy when the selector hunts for an idle trunk, the elevator stops on the too set of terminals in the group (known as the overflow terminals) and the selector functions as follows:
(a) Signals the toll sender that an overflow condition exists thereby cacsing the associated trunk circuit to transmit an overflow flash toward the originating toll operator.
(b) Recognizes trunt closure.
(c) Registers the overflow condition.
(d) Returns to normal when released by the toll trunk circuit.
3.15 When the elevator travels to the top of the frame on a trouble condition (telltale) the circuit functions as follows:
(c: Release the UP-drive magnet.
(b) Signals the sender as on an overflow condition.
(c) Recognizes trunk closure.
(d) Returns to normal, when rejeased by the toll trunk circuit.
3.19 Returns to norral if the switch is advanced off normal marially.
3.?0 Transmits a line busy flash and tone toward the toll office when the called line is busy.

$$
x^{\prime}-4037 x
$$

3.21 Provjdes for giving a tone sisnal to the "A" swbd. operator on intercepted calls to indicate trey are from toll.

### 3.22 Provides a charging circui+ for condenser ( $P$ ) before trunk <br> closure nccurs.

## 4. CONNECTING CIRCUJTS

When this circuit is shown on a key sheet, the connecting information thereon is to be followed.

This circuit functions with:
4.1 Toll key pulsing sender circuits. SD-58018-01 (Typical)
4.? Trunk circuit from toll switching system \#4. SD-68011-01 (Typical)
4.3 Final selector circuit arranged to onerate wj.th ground on cut off
relay. ES-239664 (Tynical)
4.4 Trunk circuits for blank incoming multiple. ES-24003? (Tvpical)
4.5 Wiscellaneous register circuit. SD-20141-01
4.6 Standard test circuits for testing incoming selectors. SD-20042-('I
(Tynical)

## DESCRIPTICN OF OPERATION

## 5. SEIZURE

When the associated toll trunk is selected by a crossbar marker and the assocjated sender is ready for selections the (L) relay nperates over the fundamental circuit in series with the "stepning relay" of the sender and advances the sequence switch to position ?.

## 6. BRUSH SELLCTION

With the switch in rosition 2, the UP-drive magnet operates, causing the selector to move upward for hrush selfction. As the selector moves upward, carrying the commutator brushes over the commutator segments, the A seements and brush intormittently connect grecund to the tin side of the fundamental circuit, altfrnately closing and onening a short circuit around the stenning relay of the sender circuit, thus releasing and rermitting the reoperation of the step. ning relay. when sufficient imnulses have been sent back to satisfy the sender for this selection, the fundamenta] circuit is opened by the sender, releasing the (L) relay, and consequent, J.y opening the circuit, through the JP magnet; which stops the upward movement
of the selector, and the switcts advances to position 3 where a circuit is closed for nopating the TRIP magnet.

## 7. GREUP Sidection

When the fundarienta] circuit is arain c? osed in the sender, the (L) relay operates, advancing the switch to position 4. The UP magnet is acain npereted and the selector moves unward for Eroup selection trinoing the oreviously selected brush. As the selector moves upward the B commutator segments and brush intermittently connect ground to the tin side of the fundamental circuit, ajternately closing and opening a short circuit, around the steroing relay of the sender circuit, thereby releasing and permitting the reoberetion of the stepning relay, until sufficient impulses have been sent bect to satisfy the sender. The fundemental circuit is then orened by the sender; releasing the (L) rolay which onens the circuit, through the UP maonet, stonning the upward movement of the selector, advencing the switch to nosition 5, As the switch leaves nosition 4 the TRIP magnet releases.

## 玉. TridNK MUPIJNG

In position 5, the (L) relay operates through its secnndary winding, acivancing the switch to nosition 6 . If the first trunk in the group is idle when the switch advances trom position 5 the (L) relay releases, connecting ground thr" cam $P$ to the ' $S$ terminal of the trunk to hold the trunk busy and arvancing the switch to nosition 7. If the first trunk of the rroun is busy when the switch enters position 6, the (L) relay holds onereted through its trimary windine from ground on the $S$ terminal and the UP magnet onerates, causine the selector to move upward. When an idle trunk is found the holding circuit through the orimary winding of the (I.) $r$ lay is opened, biut the ( $\bar{L}, r e-$ lay does not release immediately because of a circuit closed throurh the "C" commutator brish and segment. The adjustment of the "C" comnutator brush with relation to the tripord sleeve multiple brish, is such that it dofs not break contact with the "C" commutator segment until slishtly after the holding circuit throuph the nrimary winding of the (I) relay is opened, by the slefve brush leaving the busy trrinal end makirf. contact with the sleeve trminal of the idle trunk. The ( I ) relav and the UP magnet therefore remain operatad and the selectur continurs to travel upward until the "C" commutator brush breaks contact with the metal segment. At this time the brushes are slightly above the center of the selector terminels and a holding pawl enters the not, ch in the

$$
c-4037 x
$$

Page 3
rack attached to the brush support rod. With the circuit to ground trru the "C" commutator opened, the (L) relay releases, disconnecting ground from the commutator feed bar " ${ }^{\prime}$ " and releasing the UP magnet. The selector ther drops back upon the holding pawl, thus centering the brushes on the line terminals. During trunk hunting, ground is connocted to the "G" commitator through cam C and the front contact of the (L) relay. This is to orevent the reoperation of the ( $L$ ) relay, by the closing of a circuit from ground throngh the "C" comm'גtatior brush and segment as the selector drnos ints place. The release of the (I) relay advances the switch to nosition ?.

## 9. SELecticin Beyond

In oosition 7, the (L) relay operates through its primary winding, advancing the switch to position 8, where the (L) relay holds over the ring side of the trunk to ground in the final seiector. The tip of the fundamental is closed through cem F from the final trunk to the sender and ground throngh the contect of the (L) relay is connected to the ring in order to complete the fundamental circuit.

## 10. Incoming advaince

After selection beyond "Final Selectinn" has been completed, the final selector functions and disconnects ground from the ring conductor, cellising the release of the (L) relay which advances the switch to rosition 9 . The (I) relay reonerates in position 9 over the findamental circuat. This time the direction of the current over the tip and ring of the fundamental circuit is reversed and causes the sender to function and prepares for dismissal.

Tre (L) relay operated, advances the switch through nosition 10, releasing the (L) relay. The a cam also provides a path for advancing the switch to positicn 11.

## 11. TRIINK CLOSUKE

With this switch in posjtion ll, battery and Jround clceure is orovided thry the (A) relay to the trunk which. will cause the toll sender to function and in turn cause the associated outcoine trunk circuit to clase thr': the pclarized relay bridge, after which the sender will release. The (A) relay in this circuit, will operate thru the sender bridge and will te held operated thru the bricide in the toll trunk circuit. The (A) rolay operated will cause oneration of the (D) relay which will nperate the (L) rolay advencing the switch to nosition 1.2. The (L) relay locks operated in positicn 11 to insure advance of tre switch on abandoned cejl.ls.
17. RINGING
12.1 renera?
hen ont,ions "允T" And "Y", M:" "ZQ" or "ZK" or "ZZ" and "ZV", "Zir", "ZX" or "ZY" are used, the circiit creration nrovives for connection of ringing sunnly to rine conductor towar the fina? selector for dirnaling the called station.

Ontions "לU", and "ZV", "rt", "Zy." or "¿Y" Ere nrovided whom rineing sumply is to be connected to tr: tip conductor to ard the final selfector for signeling the called station. This arranofrent may be used when it is desired to increese the number of sibscriber stations rithout the addition ff final terminals. This will be accomplished by the use of an additional (Theorctical) office coce with its incoming selectors arranged to connect ringins suprily to the tir conductor toward the final selectors. The same final terminal con be rfached by dialing either office conde but signaling a station on onposite sicies of the jine. Such en arrangement will nermit, nrovicine a maximum of twn stations rer rinal terminal by using the final selectors common to two groues of incoming selectres, aech of which is associated with a semarate office core.

### 12.2. Inrivivucl or Two Party Selective Pjneing <br> When irure a for this type of

 rincint is nrovired the seruenco switch will stor in nosition 1 ? where interrubted machine ringing is connected thru the winding of the (R) relay and contacts of the (L) relay to the subscribers line to ring the bell at, the called station. Alldible ringing tone is provicied to the calling party thrı cam $G$ concenser ( $A$ ) and the rentatine coil windings as an incication that ringing current is connected to the called line.
### 12.3 Four Party Semi Selective Ringing

12.31 When figure $R$ for this tyoe of ringing is nroviced and the statinn cflled is to be sjonaled with the cne rine code, the "P" commutator circuit will be open and the (P) relay will not onerate. Under this condition the serucnce switch will. stcf in position 1.2 where interrupted machine ringing with a two second rine duration will be annected thru the winding of the " R " relay and contects of the ( I ) relay to the subscribers line to ring the bell at the called stetion.
12.32 When the station called to be he signaled with the two ring code ground will be closed them the "P" commutator oderating the (P) reley in rositions 10 to 19 1/4. Wi.th the (P)

$$
\begin{gathered}
c-4<309 x \\
4
\end{gathered}
$$

relar operated the sequence switch will advance thri position 12 to 13 and the ringing circujt will be held open to prevent a false ring while the switch is advancing thru nosition 12, a circuit from ground thru cams 0 and $B$ will cause advance of the switch from position 13 to 14 and when ground closure from the pick up circuit thru contacts of the operated (I.) relay nccurs, the (P) relay will onerate indicating that the ringing power circuit is in a condition to provide a full cycle of ringing to the subscribers line. Tre (r) relay will lock onerated under control of the operated (L) relay and will close interrupted machine ringing with two one second rings thru the winding of relay $(R)$ to the subscribers line to ring the bell at the called station. Thile ringing supily is corrected to the line linder either the one ring or t,wo ring conditions audible ringing tone will be provided to the calling narty t'iru cam G, condenser (A) and the repeating coil windings as an indication that the bell at the called station is being rung. Under the twr, rine condition when the called subscriber answers the (R) relay will corerate and cause release of relay (L) which will in turn cause release of relay (D). Release of relay (J.) will cause tie circuit operation as described in par. 13.

## 1?.4 Four Party Selective Ringing <br> With this operation figures $C$ or D are provided and the circuit will function as follows:

12.41 When the station called is to be signalled with superimposed current the circuit to the "?" commutat,or will be open and the (P) relay will not operate causing the swit,ch to stop in onsition 12 where sip. ringing thru relay ( $R$ ) and contacts of the onereted (L) relay will te connected to the subscriber line t.c signal the called station.

## 1?.42 When the desired station is to

 be rung with + superimnosed current the circuit to the P commutator is closed which will carse operation of the ( P ) relay in positions 10 to 12 1/4. The (P) relay onereted will cause advance of the switch to posi+ion 13 and open the circuit to the ringing sunnly to prevent a false rine while the switch is advancing thr'i nosition 12. The $(P)$ relay will release when the switch advances from position 12 1/4. Advance of the switch from position 13 to 14 vill occur from ground closures thru cars 0 and $P$. In position 14, + superimpcsed machine ringing thru the winding of relay ( $R$ ) and contacts of the(L) relay is closed to the subscribers line to signal the called station. Wher the called stat:on is sipnalled with either - or + ringing suonly audible ringing tone is nrovided to the calling subscriber thru condenser (A) cam $G$ and the reneating coil windings as explained in caragranh l2.2.

## 1?. TALKING

When the receiver is removed from the switchhork at the called station, the (R) relay will operete and cause release of the (L) relay. The (L) reley released will under all conditions excent 4 narty ringing with the two rine cone, disconnect the rinping circuit and the ( $a$ ) rejay from the line celusing it to release. For the two ring condition release of relay (I) will ceuse release of relay ( $P$ ) which will disconnect the ringing circuit and (R) relay from the line. Release of the (I.) relay will cause advance of the switch to nosition 15. In nosition $143 / 4$ to 1.5 the (L) relay will again cperate thm: windince $S$ and will cause advance of the swit.ch to position 16 . Fron posjition $143 / 4$ to 16 Talking battery and ground thru relay $S$ and the repeating coil windinfs ere connected to the subscribers line and the (5! relay will onerate. Operation of the (S) relay will carlse eneration of relay ( $S l$ ) which vill reverse the battery and ground connections from the (fi) relay to the trunk, therehy transritting a subscribers answer indicetion to the distant toll operator.
14. KIMUPA TO MAD mL

Then the receiver is renlaced on the switchhonk at the called station, the ( $(\mathbb{0})$ relay releases, releasing the (BI) relay. The release of the (Si) relay again reverses the battery and ground connected to the incoming trunk for sinervisory purposes. When the holding bridge in the toll trunk is onened, $t^{\text {he }} \in(A)$ relfy relfases, releasing the (D) relay. The (D) rejay released releases the (L) relay and onens the circuit from the ground wincing of the $(A)$ relay to the trunk to prevent interference by reseizing during return to normal. The release of the (L) relay advances the switch to position 18 where the DOWN mapnet operates, causing the selector to move downward. When the selector reaches normal, ground through the $Y$ commutetor brush and segment, advances the switch to nosition 1, thus releasing the DOWN magnet. The TRIP magnet is energized in nositions $1^{7}$ $1 / 2$ to 18 to mrevent snageing the multinle brusk on the trip fingers when the el evator is returning to normal.
15. OVERFLOW

If all of the trunks in the selfected group test bisy while trink huntine in
posjtion 6 , the selector will continue upward יntil the multiple brush contacts with the too set of terminals in the groun, known as the cverflow terminals. The sleeve commutator bar is onen at overflow to prevent grounding the sleeve terminal of the multinle bank. while the switch is moving out of trunk hunting position. The (I,) relay releases when this t三rminal is reached and advances the switch out of nosition 6 . In position 7 the (I.) relay reoperates, advancing the switch to positinn 8 where it a zein releases, because the ring terminal is not connected to a final groind, advencing the switch to nosition 9. Reverse battery is connerted to the funda$m \div n t=1$ circuit as previously described, but since the sender has not yet made final selections, it is recrenized by the sender as an overflow condition which causes the sender to dismiss and the toll outgoing trunk to provide the normal trusk closure bridge condition. The incomiñ (L) relay operates as in normal operation and causes advance of the switch to nosition 1l. The incoming (A) relay then operates thry the toll trunk supervisory bridge as in nermal oneration, operating the (D) and (I) relays and thereby advancinc the switch to position 1h. Ground c] osure thr: the $Z$ commutator serment will advance the switch to nosition 17. As the switch advances thru nositinns ? $2 / 16$ rround closure to the tip conducter. will canse oneration of the nverf'ow ref.. ister. :hen the holdine bridse in the tcll trunk is onened, the $(A)$ (D) and (I) rolays w:ll release advancine the switch to nosition 18. In this noition tre down drive magnet onerates causing return of the elevator to normal and advance of the switch to rosition 1 as described in nar. 14.

## 16. TELL-TALE

If the selector travels upward to the ton of the frame, known as "telltale" mosition, in any of the up-drive mositions, ground through the $X$ commitetor and brush advances the switch to the next nosition. In position 3, the (L) relay operates over the funciamental circuit, advancing the switch to position $l_{4}$, where the $X$ commutator advances the switch to position 5. The (L) relay operates again, advancing the switch to position 6, ground through the i. commitator brush and segment, advancing the switch to position 7. The (L) relay operates as before, advancing the switch to nosition 8, the $X$ commutator advancing the switch to nosition 9. The overflow signal. is sent back to the sender which disconnects causing the toll trunk
to provide trunk closure and advance of the incoming selector switch to position 12. In this nosition around closure thru the $X$ commutator serment will cause advance of the switch to nnsition 17 and return to normal is described for the overflow condition.

## 17. SHLUCTCR GEOUP REFISTTR

As the semence swjtioh advences thry Dosition 10 ground is connscted to leed "G?" to the selector group refister in order to record all of the calls which are cornloted throuph a groin of truntis.

## 1.? Intracirtej CaLle

When this circuit is l:sed in an office eoviphed with a nanel "h" switchbnerd arranfed for the comoletion of intercepted calls, the (TD) and (TC) relays and assncieted ecujoment showm in Fig. 2 is used. Under this condition when a call ju answered by the intercenting operator relay (TL) will operate to battery controlled from the cord circuit and will cause operation $n f$ relay (TC). Relay (TC) onereted will close the tone circuit to the tir conductor t.herrby nrovidinf a tone $t c$ indicate to the intercerting onerator that a tcll call has been intercentid. The (TC) $r \in l a y$ oneroted rill ense chert circuit windings 3 to 4 and 7 to 8 of the repeatinc coil and open the circuit to concenser ( c ). This arranocment is nrovided to orevent false closure of tone toward the toll orfice which mioht imnair transmission over +r: associated toll line pricr to answer of the called subscriber should the (Ti) rejay operate falsely as a result of farth petential at the substation with a coin in the box or in connection with ial. type P.B.X. switchboards. ihen the tone key at the "A" onsition is onerated the battery concition on the tip is changed to a bridge condition across tin and ring thereby cavsing oneration of the (3) relay and in turn the (S1) relay in this circuit. Then Fig. E or F is nrevicied, the oneration of the (SJ) relay will close a short circuit arcund the (TV) relay cousing it to release and in turn release the (TC) relay. When Fig. G or $H$ is nrovided, the operation of the (Sl) relay will short circutt and then onen the operating path of the (TD) reliy causing it to release and in turn release the (TC) relay. Release of the (TC) reley will disconnect. the tone ckt. and $r$ store the reneating coil circuit to the talking condition. operation of the (SI) rflay also orovines

furnished and when the intercerting oreretor answers the call a cord circuit condition of battery on the tip conductor will cause operation of the (3) relay in this circuit and thereby provide supervision to the toll operator as nreviously describ: to.

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DEPT. 3340-JWT-FAK-KM



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