PANEL SYSTEMS
LiNOULING SELCCTOR CIRCUIT DIALING
FROSE MANUAL OR STEP-BY-STEP OFFICE
ARRANGED TO ABSORB ONE OFFICE CODE DIGIT
WHEN REQUIRED AND WITH ARRANGEMENT FOR INITIAL KEY INDICATOR OPERATION
FOUR PARTY SEMI-SELECTIVE RINGING
FOR USE IN GROUND CUT-OFF REIAY OFFICES

CHANGES

## A. CHANGED AND ADDED FUNCTIONS

## A.l This circuit has been changed to

 provide for using two ring ringing current for groups 0 and 2 and one ring ringing current for groups 1 and 3, to permit increasing the number of subscriver stations on existing lines without changing the final selectors.D. DESCRIPTION OF CIRCUIT CHANGES
D. 1 Option "S" has been added to change wiring at the $C, S$ and $U$ cams and
the (I) relay to close the pickup lead for connecting 2 ring ringing current when relay (I) is normal, to ring groups 0 and 2 with $\&$ ring current, and to close 1 ring ringing current when relay
(I) is operated, to ring groups 1 and 3. The original connection has been designated "V" or "T" option. Circuit note 123 has been added to specify the use of "S" option.

All other headings under "CHANGES," no change.

## 1. PURPOSE OF CIRCUIT

$$
\begin{aligned}
& 1.1 \text { This circuit is used to connect a } \\
& \text { subscriber in a manual office to } \\
& \text { a subscriber in a panel office by means } \\
& \text { of dialing or key indicator operation } \\
& \text { or to connect a subscriber in a step- } \\
& \text { by-step office to a subscriber in a } \\
& \text { panel office. }
\end{aligned}
$$

## 2. WORKING LIMITS

2.1 The maximum external resistance for trunk supervision to a key indicator office is 1390 ohms for 24 volts, 2200 ohms for 38 volts and 2875 ohms for 48 volts at the key indicator office. When the B73 or B361 relay is used for the A relay, the maximum external resistance for trunk supervision is 1200 ohms for 24 volts.
2. 2 The maximum external circuit resistance for trunk supervision to a manual dialing office or to a step-by-step office is 2450 ohms.
2.3 The minimum insulation resis tance for any trunk is 30,000 ohms.
2.4 The maximum external circuit resistance for pulsing to a key indicator office is 1100 ohms.
2.5 The maximum external circuit loop resistance dial pulsing range
from step-by-step or manual office is 1300 ohms with 10 pps dial when Fig. D is used.
2.6 The maximum external circuit loop resistance dial pulsing range
from a manual office when Fig. G is used is 3300 ohms or 3,000 ohms trunk conductor resistance with 10 to 20 pps dial.
2.7 The maximum external resistance for subscriber's supervision is 750 ohms with "E" wiring and 1500 ohms with "TF ${ }^{\prime \prime}$ wiring.
2.8 The minimum insulation resistance for subscriber's supervision and ringing is 10,000 ohms.
2.9 The tripping ranges are as follows:
A-C A-C Ringing Silent
Relay Voltage voltage Interval Interval

| 114 AK | $95-103$ | $16-19$ | $800 \omega$ | $730 \omega$ |
| :--- | :--- | :--- | ---: | ---: |
| 114 AK | $84-88$ | $46-52$ | $1350 \omega$ | $800 \omega$ |
| 114 KA | $84-88$ | $46-52$ | $1000 \omega$ | $1000 \omega$ |
|  |  |  | or | or |
|  |  |  | $1500 \omega$ | $1500 \omega$ |

## 3. FUNCTIONS

3.01 When operated with a manual dialing or step-by-step office this circuit receives and registers the thousand digit even though the circuit has not completely returned to normal.
3.02 When operated in conjunction with step-by-step office this incoming is arranged to absorb the last code digit.
3.03 When arranged for dialing this circuit hunts for and seizes the first idle sender, immediately after being seized at the originating end
when used with manual "A" operators and after beginning of dialing into this circuit when used with step-by-step.
3.04 Makes the seized sender busy to other sender selectors.
3.05 Transfers the Thousands registration to the sender and prepares a circuit to permit the registration of the remaining digits in the sender.
3.06 Selects the proper brush and group under control of the local dialing sender or the distant key indicator sender depending upon the cirouit arrangements.
3.07 Hunts for an idie final selector.
3.08 Makes the final selector busy to other incoming selectors immediately upon seizure.
3.09 Prepares for final selections.
3.10 Recognizes the completion of final selections and signals the sender that all selections are completed.
3.11 When arranged for dialing, recognizes the acknowledgement by the sender of the "completion of the final selection" signal.
3.12 Recognizes trunk closure at the distant office.
3.13 Closes machine ringing of the proper kind to the line to ring the bell at the called subscriver's station.
3.14 Transmits an audible ringing signal to the originating subscriber.
3.15 Trips the machine ringing when the receiver is removed from the switchhook at the called station.
3.16 Recognizes an abandoned call condition when sequence switch is in the ringing position and discontinues the ringing of the called subscriber.
3. 17 Furnishes tal king battery to the called subscriber after ringing
is tripped.
3.18 Signals the originating end when the called subscriber removes the receiver from the swi tohhook.
3.19 Signals the originating end when the called subscriber replaces the receiver on the switchhook.
3.20 Returns elevator and oircuit to normal when released by the distant end.
3.21 Registers each advance of the sequence switch from normal.
3.22 If all trunks in the selected group are busy the selector stops on the top set of terminals (overflow terminals) and functions as follows:
(a) Advances to reverse Dattery position and sends a sender dismissal signal.
(b) Recognizes trunk closure.
(c) Provides a flashing signal to the manual key indicat or operator or dialing manual operator if dialing over similar trunks from step-by-step offic es is not anticipated. For all other conditions gives only on "all paths busy" tone.
(d) Returns to normal when released at the originating end.
3.23 When the elevator travels to the top of the frame (telltale) on a trouble condition the circuit functions the same as described under "overflow." (See Paragraph 22.)
3.24 Returns to normal if sequence switch is moved off normal menually.
3.25 Transmits a line busy signal to the calling end.
3.26 This circuit grounds a lead to the time alarm circuit to give an alarm if the switoh remains too long in positions $1,2,4,6,8,11$ and if the called subscriber has hung up, in position 14.
3.27 Provides for operating a regis ter when all trunks in the group are busy when arranged for initial key indicator operation.

## 4. CONNECTING CIRCUITS

4.01 Dialing Incoming Sender.
4.02 Final Selector Circuit of the Ground Cut-Off System.
4.03 Outgoing Trunk Circuit at manual office.
4.04 Outgoing Repeater Circuit at Step-by-Step office.
4.05 Key Indicator Sender Circuit.
4.06 Key Indicator Outgoing Trunk Circuit.
4.07 Key Indicator Link Circuit.
4.08 Miscellaneous Register Circuit.
4.09 Seleotor Time Alarm Circuit.
4.10 Miscellaneous Tone and Interrupter Circuit.

## DESCRIPTION OF OPERATION

## 5. CALL FROM STEP-BY-STEP AUTOMATIC

 OFFICE OR MANUAL DIALING OPERATORThese calls are handled by means of apparatus in Figures $1,2, B$ and $D$ and with the use of mN" wiring. When a step-by-step selector seizes the incoming end of this circuit, or a distant "A" operator inserts the plug of a cord cirouit into the outgoing trunk jack, the PLS relay operates, in turn operating the REL relay. In the case of step-by-step operation the first digit received may be the last digit of the office code. If this is the case the $U$ and $V$ relays are normal otherwise where the first digit is the "thousands" digit whether dialed by a step-by-step subscriber or a manuel operator, the $U$ and V relays must be blocked operated if they are provided or are omitted in accordance with "Z" wiring. Assume that the first digit received is the last of fice code digit. The PLS relay releases and reoper ates following the oreak and make of the dial. Upon the release of the PLS relay, a circuit is closed to ground on its armature, the make contact of the REL relay, break contact of the TR relay, winding of the ADV relay, through the back contact of the $V$ relay, the $15-0 \mathrm{hm}$ resistance and the winding of the w relay to 52.5 ohms to battery. The B relay operates in parallel with the 52.5 -ohan resistance and the relay $W$ to ground over the same path, and furnishes an additional holding ground to prevent the REL relay from releasing. The ADV relay is slow to release and does not follow the make and break of the PLS relay, but remains operated until the dialing of the digit is completed. The operation of the ADV relay operates the U relay and places a ground on the non-inductive winding of the TR relay which at this time serves no useful purpose. When the dialing of the digit is completed the PLS relay remains operated and the ADV relay releases, permitting the operation of the $\nabla$ relay which looks in series with the U relay under control of the REL relay.

This circuit is now in the same condition as if the first digit to be received were a "thousands" digit. The operation and release of the PLS relay under the control of the dial causes the ADV relay to operate the $B$ relay and TH selector to follow the pulses of the

PLS relay. The B relay operating under control of the break contact of the TH selector, furnishes additional hola ing ground for the REL relay and also reinforces the ground impulses from the armature of the PLS relay thus insuring the operation of the TH selector magnet.

Should dialing from manual offl ce only be anticipated, Figure ${ }^{\prime \prime}{ }^{\prime \prime}$ may be provided, in which case the operation will be as described when Figure "D" is used.

## 6. HUNTING SENDER

The U relay operated, at the beginning of dialing the first digit into this circuit, operates the T relay through its secondary winding. Should the U relay be olocked operated or "Z" wiring provided the $T$ relay will operate under control of the PLS relay. The $T$ relay operated, operates the p-1 relay and locks to ground through its primary winding on the test brush of the sender selector if the brush is resting on the terminal of a busy sender. The p-l relay locks up under the control of the REL relay, grounds the lead to the Selector Time Alarm Circuit and with the aid of the $T$ relay steps the sender selector brushes until an idle sender is found. When an idle sender is found, the holding cireuit of the $T$ relay is opened in the sender, releasing the $T$ relay. The T relay released, operates the CI relay and connects ground to the (TEST) brush, making the associated sender test busy to all other hunting sender selectors. The CI relay operated, closes the (CI) lead to the winding of the CI-2 relay and closes the (I), (REG), (FR) and (FT) leads to the sender.

## 7. THOUSANDS REGISTRATION

Assume the dial is operated to transmit thousands digit 8 , the PLS relay releases and reoperates a corresponding number of times. Upon the release of the PLS relay, the (TH) selector magnet, operates. Upon the reoperation of the PLS relay, the energizing circuit of the (TH) selector magnet is opened, releasing the magnet, which steps the brush assembly of the switch to terminal l. With the brush assembly resting on terminal 1, ground is connected through the \#2 brush and arc of the (TH) selector to one winding of the TR relay, but this relay does not operate due to ground being applied to the other side of the winding through the make contact of the ADV relay. Upon the subsequent release and reoperation of the PLS relay, the energizing oirouit for the (TH) selector magnet is opened and closed, in turn
stepping the brushes of the switch to a terminal, corresponding to the thousands digit dialed. After the last pulse has been transmitted to the (TH) selector magnet, the PLS relay reoperates, releasing the $B$ and $A D V$ relays. The release of the ADV relay removes the short-circuit from the primery windings of the TR relay, which operates to ground on the \#2 arc of the (TH) selector. The operation of the TR relay: (a) transfers the impulse lead to the sender over lead (I), (b) connects battery to terminals of arc (4), (5) and (6) of the (TH) selector in order to set the register relays in the sender over leads (FR), ( FT ) and ( REG ), (c) opens the circuit through the B relay.

## 8. HUNDREDS, TENS AND UNITS REGISTRATION

When the first pulse of the hundreds digit is received in the incoming circuit the PLS relay releases, sending a grounded impulse to the sender circuits over impulse lead (I) to an arrangement similar to the "thousands" register of the inooming circuit. With the operation in the sender of the relay corresponding to the ( $A D V$ ) of the incoming, the sender sequence switch moves all normal. From position 2 until the sender returns to normal, ground is connected to the (CI) lead operating the CI-2 relay. The operation of the CI-2 relay (a) closes the (REG) lead to the make contact of the PLS relay, (b) transfers the (FR) lead to the contact of the CI-I relay, (c) transfers the (FT) lead to the "L" cam and (d) operates the CI-1 relay. The (FR) lead is placed under control of the CI-I relay to prevent false operation of the stepper relay in the sender by delaying the application of ground from cam "M". The operation of the CI-1 relay, holds the TR relay operated, permits the $L$ relay to operate over the fundamental leads to the sender, and returns the (TH) selector to normal by connecting ground through the \#l arc to the selector magnet. The L relay operated locks to the fundamental circuit and advances the switch to position 2 to begin selections. Meanwhile the pulses of the remaining digits are being registered in the sender independently of selections and the "pulse held "relay of the sender helpd to hold the REL relay operated during pulsing by connecting ground to the (REG) lead.

## 9. BRUSH SELECTION

In position 2 , the UP magnet is operated for brush selection. As the selector moves upward in position 2 , carrying the commutator brushes over the commutator segments, the "A" segment and brush intermittently connects ground to the tip side of the fundamental
circuit, through cams $K$ and $L$, holding the L relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting reoperation until the proper brush has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the I relay. The release of the $L$ relay opens the circuit through the UP magnet, stopping the upward movement of the selector, and also closes a circuit from ground on its armature and break contact, cam $B$ to battery through the $R$ magnet, advanoing the switch to position 3. With the switch in position 3, the TRIP magnet operated to ground on cam N. In position 3 , the $L$ relay again operates and locks, advancing the switch to position 4 for group selection.

## 10. GROUP SELECTION

With the switch in position 4, the UP magnet again operates, moving the selector upward for group selection. The TRIP magnet, being operated, causes the previously selected set of brushes to trip as the selector moves upward. As the selector moves upward for group selection, carrying the commutator brushes over the commutator segments, the "B" segment and brush intermittently connects ground to the tip side of the fundamental circuit through cam L, holding the L relay operated but successively short-circuiting the stepping relay in the associated sender eircuit, thus releasing and permitting its ro operation, until the proper group has been selected. When sufficient 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, stopping the upward movement of the selector, and advancing the switch to position 5. The L relay operates on its secondary winding and advances the switch to position 6. If the first trunk of the selector group is idle, the L relay releases as the switch leaves position 5 and makes the trunk busy to other hunting selectors by applying ground through its back contact.

## 11. TRUNK HUNTING

Should the first trunk of the group in which the selector is hunting be busy, the L relay is held operated through its primary winding, to ground on the $s$ terminal of the busy trunk. During the period the $L$ relay is held operated, due to the busy condition, the UP magnet is energized and the selector travels upward until an ide trunk is found. When an idle trunk is found, the cirouit through the primary winding of the

L relay is opened, but the $L$ relay does not release immediately, due to a oircuit being closed from ground on the C commutator brush and segment through cam E to battery through the secondary winding of the L relay. The selector therefore continues to travel up until the circuit through the C oommutator brush and segment is opened, releasing the L relay. The L relay released, opens the circuit through the UP magnet stopping the upward movement of the selector, removes the ground from the "C" commutator, makes the selected trunk busy to other hunting selectors by placing ground on the sleeve terminal through the back contact of the L relay and advances the switch to position 7 . The ground to the $C$ comrnutator in position 6 is placed under control of the L relay to prevent its reoperation when the selector settles back on the terminals of the selected trunk.

When the switch enters position 6-3/4, the selected final trunk is held busy to all other hunting selectors by ground being connected to the $S$ terminal of the trunk through cam N. With the switoh in position 7, the L relay operates through its primary winding, advancing the switch to position 8.

## 12. SELECTION BEYOND

When the switch leaves position 7, the looking oircuit through the L relay is transferred from ground on cam $N$, to ground in the final selector oircuit through cam $G$ and the ring side of the final trunk. In position 8 , the tip side of the fundamental circuit is closed to the tip terminal of the selected final trunk for selection beyond, by means of the contacts of cam F, make contact of the CI- 2 relay, brush 4 of the sender selector switch, over the FT lead, through the associated sender circuit, back over the FR lead, brush 5, make contact of the CI-2 relay, to ground through the make contact of the L relay. The L relay in the associated final operates and the final elevator travels up for final brush selections. The "A" commutator of the final sends back pulses to satisfy the associated sender. When the sender is satisfied the fundamental circuit is opened and the final advances to the await sender position for final tens selections. Final tens and final units selections are made in a similar manner. When the final selections are completed the final advances and removes ground from the ring conductor, releasing the L relay which advances the incoming sequence switch to position 9 .

## 13. INCOMING ADVANCE

In position 9 the primary winding of the $L$ relay is connected to the $r$ ing side of the fundamental circuit to $t$ he sender. The L relay operates on its primary winding and locks on secondary winding, moving the sequence switch to position 10. The ourrent through the fundamental circuit being reversed, the overflow relay in the sender operates causing the advance of the sender. In the case of a dialing sender, the $I$ relay remains operated in position 10 until the sender sequence switch has advanced and broken the fundamental oircuit, releasing the $L$ relay and therefore advancing the incoming to position 11. In case of key indicator operation the incoming is wired per m" wiring and the sequence switch moves to position ll, without waiting for a fundamental opening. Position 10 in this case is used to give extra time for the operation of the sender relays.

## 14. SENDER DISMISSAL AND TRUNK CLOSURE

In position ll the TRl relay operates from ground on the CI-1 relay, disconnecting the PLS relay from the trunk to the originating end and connecting the trunk to the windings of the A relay. The A relay operates over the tip and ring conductors of the trunk operating in turn the Dl relay or D and Dl relays. The operation of the Dl relay, permits the L relay to operate on it $s$ primary and look on its secondary wi nding to ground on cam $N$, and furnishes a looking ground for the TRI relay. The operation of the L relay advances the sequence switch to position 12 where the $L$ relay looks under control of the tripping relay R. Meanwhile the release of the PLS relay causes the release of the REL relay and in turn the Pl relay, and the $U$ and $V$ relays if electrically operated. The release of the Pl relay removes Eround from the $T$ lead permitting the sender to return to normal, and releases the CI relay which in turn releases the CI-2 relay. The CI- 2 releases the CI-1 which permits the (TR) to release, thus returning the digit registration and sender selector portion of the circuit to normal.

## 15. RINGING CALLED STATION

When option ${ }^{\prime \prime}{ }^{\prime \prime}$ 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 "T" 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 additions 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 inal selectors, thereby permitting ringing 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 inal selectors common to two groups of incoming selectors each of which are associated with a separate ofilce code.
16. RINGINGONLE RING CODE FOR GROUPS "O" AND "2" ( $V$ OR T OPTION)
If the called line is reached by a final selector trunk located in group "On or "2" of the incoming frame, the $P$ commutator will not be grounded and the I relay therefore will not operate. One ring ringing current from cam 0 will be connected to the called line through the normal contact of the I relay, the winding of the $R$ relay, cam $R$ and the front contact of the L relay. Ringing on the opposite side is accomplished by reversing the cross-connections at the distributing frame or as described in par. 15. During the ringing interval, tone is sent back to the originating end by means of condenser (A) and winding of the repeating coil. If a disconnection occurs during the ringing interval the A, $D_{9}$ and $D I$ relays release. The DI reo lay released causes the release of the $L$ relay thus disconnecting ringing current from the called subscriber's line.
17. RINGING TWO RING CODi POR GROUPSMO" AND "2" (S OPTION)
Where option "S" is used the circuit operates as described in paragraph 18 ex cept that relay $I$ is not operated, and pickup ground operates the PU relay, connecting two ring ringing current to the called line with relay I normal. This permits increasing the number of subsoriber stations on existing lines without changing the final selectors.
18. RINGING TWO RING CODE FOR GROUPS "l" AND "3n (V OR T OPTION)
If the called line is reached by a final selector trunk located in eroups "I" and "3" of the incoming frame, the P commutator brush will rest on a grounded segment and the I relay will operate in position 10 and stay operated until position 12. In position 12 pick up ground through the pick-up lamp, cam $U$, front contacts of the I relay and cam S operates the PU relay which looks under control of the R relay. The operation of the PU relay connects the M.R. "Ring
$2^{\prime \prime}$ ringing current through the winding of the R relay to the called subscris ber's line. Ringing is controlled and tone is sent back to the originating end during the ringing interval as desoribed in Paragraph 15 \& 16 。

## 18A. RINGING = INDIVIDUAL \& TWO PAR'IY SKLIECTIVE ("X" WIRING \& APPARATUS OMI TTED)

With the "P" commutator not cone nected, (X wiring) the switch advances to position 12 with the I relay nonoperated. $M R$ RI ringing current will be connected to the called subscriber's line and the circuit will function in the same manner as described in Par. 15 \& 16.
19. RINGING - ONR RING CODR FOR GROUPS "1" AND ${ }^{n \prime \prime}$ (S OPTION)

When option "S" is used, the circuit operates as described in Par. 18 except that relay PU is not operated, and one ring ringing current is connected to the called line when relay I is operated. This permits increasing the number of subscriber stations on existing lines without changing the final selectors.

## 20. CALITBD PARTY ANSWERS

When the recelver at the called station is removed from the switchhook, the $R$ relay operates, opening the locking circuit through the inner winding of the I relay, which releases. The R relay is not necessarily slow acting but is designed to be less responsive to alternating than to direct current. The release of the L relay removes the ringing current, from the ring of the final trunk, releases the $R$ relay, advances the switch to position 14 and connects repeating coil battery by means of the back contact of the I relay to the ring side of the final conductor. position is is a passby to permit an overlap of talking battery to the called subscriber at cail $G$, thus preventing clicks.

## 21. TALKING

In position 14 , the $S$ relay operates over the called subscriber's line and causes the operation of the I relay. The I relay operates, reverses the direction of the current over the tip and ring of the incoming trunk, operating a polarized relay in the out trunk circuit, causing the relay to function. If the call is from a manual office, the reversal of the current operates a polarized relay in the trunk which causes the operator's supervisory lamp to be extinguished.
22. DISC ONNECTION

When the receiver at the called station is replaced on the switchhook, the $S$ relay releases, in turn releasing the I relay. The I relay released, reverses the direction of the current over the tip and ring of the incoming trunk. When the calling subscriber disconnects the step-by-step selector circuit functions causing the release of the A relay. In the case of calls from a manual office, the release of the I relay causes the operator's supervisory lamp to light as a disconnect signal. When the operator disconnects the A relay releases. The release of the $A$ relay in either case opens the circuit through the $D$ relay, which in turn releases the Dl relay. The Dl relay released, releases the TRI relay and advances the switch to position 16. In position 16, the DOWN manget is operated. When the selector reaches its normal position, the "r" commutator brush and segment advances the switch to normal. The TRl relay releases, disconnects the A relay from the trunk circuit and connects the trunk to the PLS relay. If the circuit is seized for a new call the registration of the desired nurber can proceed without waiting for the sequence switch to return to normal.

## 23. CALIED LINE BUSY

If the called line is busy the switch advances to position 12 as described in Paragraphs 13 and 14. In position 12 the R relay is operated from 24-volt battery through a resistance in the final circuit, over the ring of the final trunk, contacts of cam $G$, make contact of the L relay, lower contacts of the $R$, winding of the $R$ relay, to the ringing lead. The switch is advanced to position 14 as described in Paragraph 16. In position 14 , when the circuit. is us used in a step-by-step area intermittent tone is sent back from the final circuit over the ring of the final trunk causing an induced tone to be transmitted back to the calling subscriber or to the originating operator at the manual office. When disconnection takes place at the manual office or calline automatic substation, the switch is advanced to normal as described in
Par. 22. If operation from manual offices only is expected the associated final selector causes operation and release of the $S$ relay and thereby transmitting a line busy flash to the originating operator.

## 24. OVERFLOW

Should all trunks in any particular group be busy, the selector while trunk hunting (in position 6) travels to the top of the group and rests on the overflow terminals. As the sleeve of the
overflow terminals is open, the L relay releases, advancing the switch to position 7. In position 7, the L relay operates through its primary winding. The L relay operated advences the switch to position 8. In position 8 , the ring terminals being open the L relay releases, advancing the switch to position 9. With the switch in position 9, the L relay operates through its primary winding over the fundamental circuit to ground. The L relay operated advances the switch as described in Paragraph 13. In position 11 , the A relay operates over the incoming trunk, operating the $D$ and Dl relays which in turn operates the L relay. The L relay operated, advances the switch to position 12. In position 12, ground on the (Z) commutator brush and segment advances the switch to position 15. In position 15, a busy tone is sent back to the step-by-step subscriber or to the operator at the menual offioe. In the case of a trunk from a Key Indicator "A" operator or a dialing "A" operator in an area requiring a flashing signal the $S$ relay is alternately operated and released from ground through cam (J) and interrupter lead PB, thereby intormittently shunting the $12,000-0 h m$ winding of the A relay or reversing the battery polarity toward the distant of fioe and thereby flashing the "A" operator's supervisory lamp. When disconnection takes place at the distant end, the A relay releases. The A rel ay released, releases the Dl or the $D$ and Dl relays. The Dl relay released, advances the switch to position 16. From this point on the switch is advanced to normal as described in Paragraph 22. When "Z" wiring is provided the ground for the Dl relay is opened when the relay releases thereby preventing reoperation should the A relay reoperate from a surge condition.

## 25. TELL TALE

Should the selector brush travel to the top of the bank during selecti on, ground on the (X) commutator brush and segment advances the switch to positiion 9. In position 9, the L relay operates over the fundamental oircuit, advancing the switch as described in Paragraph 13. If the sender sequence switch has not reached position 6 the sender will block and the incoming will remain in position l0. Otherwise the sender breaks the fundamental and the incoming advances. In position 11, the A relay operates over the incoming trunk, operating the D and Dl relays which in turn operates the L relay. The L rel ay operated, advances the switch to position l2. The "X" commutator brush and segment then advances the switch to position 15. The operation is the same as under "Overflow".
26. EARLY DISC ONNECT

## (A) BEFORE OR IMMEDIATELY AFTER THE THOUSANDS DIGIT HAS BEEN DIALED

Should disconnection take place at this time, the PIS relay releases, in turn releasing the REL relay. The release of the REL relay releases the P-I relay and the $U$ and $V$ relays is provided and electrically operated and also connects ground through its back contact and \#3 arc of the (TH) selector to the winding of the CI-1 relay to battery, operating the CI-l relay. The operation of the CI-l relay on its primary causes the stepper magnet to return the (TH) selector to normal. The CI-l relay releases when the (TH) selector reaches normal. The release of the plelay releases the CI relay and also opens the (T) lead to the sender circuit returning the sender to normal. In this case, the incoming sequence switch has not as yet been advanced off-normal.
(B) AFTER THE HUNDREDS DIGIT HAS BEEN DIALED AND SELECTIONS STARTED

Should disconnections take place at this time, the incoming having moved off-normal, the PLS relay releases, in turn releasing the REL relay. The REL relay released, releases the P-l relay and the $U$ and $V$ relays if electrically operated. The release of the P-l relay opens the ( $T$ ) lead to the sender causing it to return to normal and releases the CI relay which releases in turn the CI- 2 relay. The CI- 2 relay released, releases the CI-1 relay. The release of the CI-1 relay connects ground to cam C advancing the sequence switch to position l2. In position l2, the $L$ relay is normal due to the fact that the circuit over the $T$ and $R$ to the A relay is open and the switch is advanced by the back contact of the $L$ relay to position 14. In position 14 , the Dl relay being normal, the back contact of the Dl relay advances the switch to position l6. From this position the return to normal feature is the same as explained in Paragraph 22. If the final selector was moved offnormal, the ground is removed in position

15-1/4 from the "S" lead to the final circuit releasing the final circuit which returns to norinal.

## 27. OPERATION OF INCOMING IN CONNECTION WITH KEY INDICATOR MANUAL OFFICE

These calls are handled with apparatus in figures $l$ and ( $A$ ) and the " $M$ " wiring. When this circuit is seized at the key indicator office and the fundamental circuit is closed in the key indicator sender, the I relay operates on its primary winding through carns $K$ and $L$, over the tip conductor through the associated sender back over the ring conductor, compensating resistance to ground on cain M. The L relay operated, locks and advances the switch to position 2. As the switch leaves position 1 ground is removed from the "PBR" lead to the Misc. Reg. Ckt. When all trunks in the group are off-normal ground is completely removed from this lead and registration takes place thus obtaining a record when all trunks are busy. Selections take place as described above except that the associated sem er instead of being located in the same office is at the manual key indicator office. Trunk hunting is accomplished the same as for the dialing incoming circuit. Incoming advance takes place similarly except as noted in the paragraph on incoming advances. (Par. 13.)

In position 11 the A relay operates to 24-38 or 48 volts at the originating end, through both windings in series. The A relay operated the circuit functions as described in paragraphs on "Trunk Closure", "Ringing" and "Called Party Answers" except that the apparatus mentioned and shown in figure 2 is not equipped and does not function. In the talking position the operation of the $S$ relay short-circuits the high resistance winding of the A relay permitting the supervisory relay in the associated cord circuit to operate and extinguish the cord lamp signal. The circuit from this point functions as described previously for dialing incomings except for the functions of the apparatus in figure 2.

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