

This Method of Operation was prepared from Issue 14 of Drawing ST-51012-01.

METHOD OF OPERATION
SENDER CIRCUIT

"A" position Sender and Link Circuit - Frame - Unit Type - Panel Machine
Switching System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This sender circuit is used at a machine switching "A" switch-
board for completing calls originated by a subscriber for points not
appearing on the subscriber's district frame.

2. WORKING LIMITS

2.1 The use of this circuit is limited by the working limits of the
(TG), (STP) and (OFL) relays in regard to loop and leak.

2.11 (TG) Relay - Bl67 on R.C.I. and Operator Calls

Maximum external circuit loop resistance		
(Tandem R.C.I. (operate) -		4,640 ohms
(Direct R.C.I. -		3,682 ohms
Minimum resistance trunk leak -		30,000 ohms

2.12 On Mechanical Class Calls

Maximum external circuit loop resistance		2,300 ohms
Minimum battery (operate) -		45 volts
Minimum external circuit loop resistance		
(non-operate) -		1,845 ohms
Maximum battery(non-operate) -		25 volts
Minimum leak resistance -		30,000 ohms

2.2 (STP) Relay - 207-A

Maximum circuit loop resistance -		2,900 ohms
Minimum leak resistance -		30,000 ohms
(3200 ohms with improved incomings) -		
The loop shall not include more than 20 miles of 19 gauge cable - (30 miles with improved incomings)		

(19 Pages, Page 2)

Issue 2 BT 51012-01

April 19, 1927.

Replacing all previous
issues.

2.3 (OFL) Relay - 206-U

Maximum compensated external circuit loop resistance	3,140 ohms
Minimum trunk leak resistance	30,000 ohms

OPERATION

3. PRINCIPAL FUNCTIONS

The principal functions of this circuit are as follows:-

- 3.1 To record the setting of the operated keys in the key and key control circuit.
- 3.2 To determine, (a) the class of call, (b) compensating resistance to be used.
- 3.3 To control all selections.
- 3.4 To transmit relay call indicator pulses on all tandem and R.C.I. calls.
- 3.5 To automatically wipe out (return to normal) when a call is abandoned.

4. CONNECTING CIRCUITS

This sender circuit functions with:

- 4.1 Panel machine switching three digit suburban key and key control circuits.
- 4.2 Panel machine switching suburban sender selector and allotter circuits.
- 4.3 Panel machine switching "A" cord and district circuits.
- 4.4 All trunk circuits selected by the district selector to manual and panel machine switching offices.

DESCRIPTION OF OPERATION

5. INDEX

5.01 Sender selected

Paragraph

6

	<u>Paragraph</u>
5.02 Registrations	7
Route	7.1
Tandem Hundreds and Incoming Brush	7.2
Tandem Tens and Incoming Brush	7.3
Tandem Units and Incoming Group	7.4
Final Brush, Incoming Group and Stations	7.5
Final Tens and Station	7.6
Final Units	7.7
5.03 Setting of Route Switch	8
5.04 Direct Machine Switching Call - 48 Volt Test	
Non-Loaded District Brush Selection	9
District Group Selection	10
First Office Test	11
First Office Brush Selection	12
First Office Group Selection	13
Second Office Test	14
Second Office Brush and Group Selection	15
Trunk Test	16
Incoming Brush Selection	17
Incoming Group Selection	18
Final Brush Selection	19
Final Tens Selection	20
Final Units Selection	21
Incoming Advance	22
Talking Selection	23
Return to Normal	24
5.05 Direct Machine Switching Call - 48 Volt Test Loaded	25
5.06 Toll and Desk and Straightforward Toll Tandem Manual Calls	26
5.07 R.C.I. Direct	
5.071 Sender Advance	27
5.072 Trunk Guard Test	28
5.073 Sending R.C.I. Pulses	29
5.08 Local Area	

(19 Pages, Page 4)
Issue 2 BT 51012-01
April 19, 1927.
Replacing all previous
issues.

	<u>Paragraph</u>
5.081 Operation of Keys	30
5.082 Sending R.C.I. Pulses	31
5.09 R.C.I. and Machine Switching Tandem Calls - 24 Volt Test	32
5.1 Miscellaneous	
5.2 Skip Office	33
5.3 Delayed Wipe-out	34
5.4 Overflow	
5.41 District	35
5.42 Office	36
5.43 Office on Manual and Manual or Switching Tandem	37
5.44 Incoming	38
5.45 Final	39
5.5 Splitting Counting Relays	40
6. <u>SENDER SELECTED</u>	

When the plug of the cord and district circuit is inserted in the jack of a line, ground is connected to the (ST) and (Hold) leads of the sender selector and allotter circuit and removed from the (HTG) lead. The sender selector and cord finder function, selecting an idle sender and finding the cord, respectively. The (S) relay in the register control circuit operates holding the sender busy to hunting selectors. When the sender selector and allotter circuit switch enter position 3, the (MO) relay in the register control circuit operates. The (MO) relay operated, advances the R-1 switch to position 2. When the sender enters position 2/18 the sender busy lamp lights ("M" wiring) under control of the sender busy lamp gong key.

7. REGISTRATIONS

Registrations take place over leads (A), (B), (C), (PT) and (FR) which are closed through from the register control circuit to the key and key control circuit.

7.1 Route Registration

For route registration ((R-1) in position 2) lead A is connected to ground through a high or low resistance in the key control circuit, causing the operation or non-operation of the (R-2) relay. The (R-1) and (R-3) relays are connected to battery through a low or high resistance in the key control circuit over lead B, causing the operation of the (R-3) relay and the operation or non-operation of the (R-1) relay. The (R-4) relay and the (A) relay are connected in series to low or high resistance in the key control circuit over lead C, causing the operation of the (A) relay and the operation or non-operation of the (R-4) relay. The FT lead is open or connected to direct ground in the key control circuit, causing the non-operation or operation of the (R-5) relay. The FR lead is open or connected to direct ground, causing the non-operation or operation of the (R-6) relay. The following table indicates the setting of the R-6 switch for the various route keys.

~~A-R-1~~
 A-R-2
 B-R-1 R-3
 C R-4-A
 FT-R-5
 FR-R-6

<u>Route Key Operated</u>	<u>Sequence Switch Position</u>
0 to 4 inc.	2 or 11
5 to 9 inc.	3 or 12
10 to 14 inc.	4 or 13
15 to 19 inc.	5 or 14
20 to 24 inc.	6 or 15
25 to 29 inc.	7 or 16
30 to 34 inc.	8 or 17
34 to 39 inc.	9 or 18

The switch is moved into the position corresponding to the key operated by the setting of the route relays ((R-1) to (R-6) inc.). The (A) relay in the register control circuit advances the (R-1) switch to position 3. The register relays operated, lock until the (R-1) switch leaves position 9.

7.2 Tandem Hundreds and Incoming Brush Registration

In position 3 of the (R-1) switch, tandem hundreds and incoming brush registrations takes place. All leads are now connected to the opposite polarity of battery from that used in position 2. Lead (A) is open, or connected to battery through high or low resistance, causing the non-operation of the (H-1) and (H-3) relays, the non-operation of the (H-1) relay and the operation of the

H1 & H3
 operate over
 A lead
 H-2 over
 B lead
 H4 & B
 operate over
 FR

(19 Pages, Page 6)

Issue 2 BT 51012-01

April 19, 1927.

Replacing all previous issues.

(H-3) relay, or the operation of the (H-1) and (H-3) relays. Lead B is connected to low or high resistance, causing the operation or non-operation of the (H-2) relay. The FR lead is connected to battery through low or high resistance, causing the operation or non-operation of the (H-4) relay and the operation of the (B) relay. The (C) lead is open or connected to direct ground, causing the non-operation or operation of the (IB-2) relay. The (B) relay operated, advances the (R-1) switch to position 4.

7.3 Tandem Tens and Incoming Brush Registration

In position 4, the polarity of the registering leads is again reversed for tandem tens and incoming brush registration. Lead ADV is connected to ground through low or high resistance, causing the operation or non-operation of the (T-2) relay. Lead SC is connected to low battery, high battery or is open, causing the operation or non-operation of the (T-1) and the operation of the (T-3) relays. Lead (C) is connected to battery through low or high resistance, operating or non-operating the (T-4) relay and the operation of the (A) relay. The (FR) lead is (a) open, connected to (b) 955 ohm ground or (c) to direct ground, causing the non-operation of the (IB-1) and (IB-3) relays or the non-operation of the (IB-1) relay and the operation of the (IB-3) relay or the operation of the (IB-1) and (IB-3) relays. The (A) relay operated, advances the (R-1) switch to position 5. All register relays operated, lock until the switch leaves position 9.

7.4 Tandem Units and Incoming Group Registration

In position 5, the polarity of the battery on the leads is again reversed for tandem units and part of incoming group registration. Lead is open, or connected to battery through high or low resistance, causing the non-operation of the (U-1) and (U-3) relays, or operation of the (U-3) relay and the non-operation of the (U-1) relay, or the operation of the (U-1) and (U-3) relays. Lead SC is connected to ground through high or low resistance, causing the non-operation or operation of the (U-2) relay. Lead C is connected to direct ground or open, causing the operation or non-operation of the (IGT) relay. Lead FR is connected to battery through low or high resistance, causing the operation of the (B) relay and the operation or non-operation of the (U-4) relay. The (B) relay operated, advances the (R-1) switch to position 6. Lead (FT) is open during this registration.

7.5 Final Brush, Incoming Group and Stations Registration

In position 6 of the (R-1) switch final brush, the remainder of incoming group, and stations registrations take place. Lead ADV is connected through low or high resistance to ground, causing the operation or non-operation of the (FB-2) relay. The SC lead is connected to low battery, high battery or is open, operating or non-operating the (FB-1) and (FB-3) relays. Lead C is connected to battery through a low or high resistance, operating the (A) relay and operating or non-operating the (IGH) relay. Lead FR is connected to direct ground, ground through 955 ohms or is open, causing (a) the operation of (STA-1) and (STA-3) relays, (b) the operation of the (STA-3) relay alone or (c) the non-operation of both the (STA-1) and (STA-3) relays. The (A) relay operated, advances the switch to position 7. All operated register relays lock. When the switch leaves position 6, the (A) relay releases.

7.6 Final Tens and Station Registration

In position 7 of the R-1 switch final tens and the completion of stations registrations take place. Lead ADV is connected to battery through low or high resistance or is open, operating or non-operating the (FT-1) and (FT-3) relays. Lead SC is connected to ground through low or high resistance, operating or non-operating the (FT-2) relay. Lead C is open or connected to direct ground, non-operating or operating (STA-2) relay. FR lead is connected to battery through low or high resistance, operating or non-operating the (FT-4) relay and operating the (B) relay. The (B) relay operated, advances the switch to position 8. All operated register relays lock. The (B) relay releases as the switch leaves position 7.

7.7 Final Units Registration

In position 8, final units registration takes place. Lead ADV is connected to ground through low or high resistance, causing the operation or non-operation of the (FU-2) relay. Lead (SC) is (a) connected to battery through low or high resistance, causing the operation of the (FU-3) and the operation or non-operation of the (FU-1) relay, or (b) is open, causing the non-operation of both the (FU-1) and (FU-3) relays. Lead C is connected to battery through low or high resistance, causing the operation of the (A) relay and the operation or non-operation of the (FU-4) relay. The (A) relay operated advances the switch to position 9. All operated register relays hold until the switch leaves position 9. The (A) relay releases in position 8.

(19 Pages, Page 8)
Issue 2 BT 51012-01
April 19, 1927.
Replacing all previous
issues.

8. SETTING OF ROUTINE SWITCH - (R-1) IN POSITION 3)

At the completion of route registration when the R-1 switch advances to position 3, the R-6 magnet is energized. If the (R-5) relay is operated and the (R-6) relay non-operated, the switch advances to position 4. If the (R-6) relay is operated and the (R-5) non-operated, the switch advances to position 6. If both relays are operated, the switch advances to position 8. The (R-4) relay operated, advances the switch to the next odd numbered position in each case. The (C-1) relay remains operated as long as the R-6 magnet is energized. When the (C-1) relay releases, the routing selector rotating magnets operate causing the selectors to function. The selectors rotate until the terminal on the hunting bank, which is grounded through the contacts of the (R-1) and (R-2) and (R-3) relays is reached. When this terminal is reached, the (TS-1) and (TS-2) relays are operated.

(NOTE:- Two relays are necessary to take care of slip, i.e. in case one selector should reach terminal before the other). The (TS-1) and (TS-2) relays operated, (a) advance the class switch R-4 according to the class of call, (b) advance the sender switch R-3 to position 2.

DIRECT MACHINE SWITCHING CALL - 48 VOLT TEST NON-LOADED

9. DISTRICT BRUSH SELECTION - R-1 IN POSITION 9, R-3 IN POSITION 2, R-4 IN POSITION 4

Upon the completion of registrations and the setting of the route switch, the sender functions for district brush selection over the FT lead. As the elevator in the district circuit ascends, ground from commutator A intermittently short-circuits the (STP) relay which releases. Each release of the (STP) relay operates a prime counting relay. When sufficient pulses have been sent back to satisfy the sender, the (FO') and (BO') relays operate. The (FO') relay operated, advances the R-3 switch to position 3. The (BO') relay operated, opens the fundamental circuit. The switch is advanced to position 4 by ground on the A cam.

10. DISTRICT GROUP SELECTION

With the sender switch in position 4, the fundamental circuit is again closed. The (L) relay in the district again operates and advances the district switch to position 6. District group selection now takes place in a manner similar to brush selection as described in paragraph 9. The first counting relay operated is now controlled by the cross-connection to the (RS-1) DG arc of the route switch. When sufficient pulses have been sent back from the district circuit to satisfy the sender, the (BO') and (FO') relays operate. The (BO') relay operated,

opens the fundamental circuit, preventing the operation of the (STP) relay. The (FO') relay operated, advances the R-3 switch to position 5.

11. FIRST OFFICE TEST

With the R-3 switch in position 5, ground on the J cam advances the R-2 switch to position 2. With the R-2 switch in position 2, the (R-3) switch in position 5 and the class switch in position 4 first office test is made. The (TG) relay operates over the tip and ring. Should the office selector be off-normal when seized by the district selector, the (TG) relay does not operate, thus preventing the sender from functioning until the selected trunk reaches the normal position. The (TG) relay operated, operates the (TG-2) relay. The (TG-2) relay operated, operates the (TG-1) relay. The (TG-1) relay operated, advances the (R-2) switch to position 3.

12. FIRST OFFICE BRUSH SELECTION - R-2 IN POSITION 3, R-3 IN POSITION 5, R-4 IN POSITION 4

With the R-2 switch in position 3, the sender control, sender and class circuits function for first office brush selection. Which counting relay will operate first is determined by the setting of the A arc of rotary switch 2 RS-2. The (STP) relay is intermittently short-circuited by ground on the A commutator in the office selector. The (STP) relay released, removes the short circuit from the winding of the prime counting relay. The prime relay operated connects ground to the winding of the next counting relay. With the (D) counting relay operated, the (STP) relay released, operates the (BO') and (FO') relays. The (BO') relay operated, opens the fundamental circuit, preventing the operation of the (STP) relay. The (FO') relay operated, advances the R-2 switch to position 4. Ground on the A cam advances the switch to position 5.

13. FIRST OFFICE GROUP SELECTION

With the (R-2) switch in position 5, the sender control and sender circuits function for first office group selection in a manner similar to that described in paragraph 12 for office brush selection, except that the A commutator is replaced by the B commutator. The (BO') relay operated, again opens the fundamental circuit. The (FO') relay operated, advances the R-2 switch to position 6. Ground on the A cam advances the switch to position 7.

14. SECOND OFFICE TEST

With the R-2 switch in position 7, the sender and sender control circuits function for second office test in a manner similar to that described in paragraph 11 for first office test. The (TG-1) relay operated, advances the R-2 switch to position 8.

(19 Pages, Page 10)

Issue 2 BT 51012-01

April 19, 1927.

Replacing all previous issues.

15. SECOND OFFICE BRUSH AND GROUP SELECTIONS

In positions 8 and 10 of the R-2 switch, second office brush and office group selections are made. The sender and sender control circuits function as described in paragraphs 12 and 13 respectively. The selection made in each case is determined by the setting of the A arc of the RS-2 switch for brush and by the C arc of the RS-2 switch for group selections. When the (FO') relay operates at the end of second office group selection, the R-2 switch is advanced to position 11. Ground on the T cam of the R-4 switch advances the R-2 switch to position 12 for this class of call. The A cam advances the switch to position 13.

16. TRUNK TEST

As the R-2 switch enters position 10-3/4 to 13, ground on cam F advances the R-3 switch to position 6. With the (R-2) switch in position 11 and R-3 in position 6, trunk test is made. The (TG) relay operates, in turn operating the (TG-2) relay. The (TG-2) relay operated, operates the (TG-1) relay. The (TG-1) relay operated, advances the R-3 switch to position 7. Ground on the T cam of the R-4 switch advances the (R-3) switch to position 8 for this class of call. If the selector is off-normal, the (TG) relay does not operate until it reaches normal, when the circuit functions as described.

17. INCOMING BRUSH SELECTION - R-1 IN POSITION 9, R-2 IN POSITION 13, R-3 IN POSITION 8, R-4 IN POSITION 4

With the R-3 switch in position 8, the sender circuit functions for incoming brush selection. Which incoming brush is selected will be determined by the setting of the (IB) relays. (Example: If (IB-1) and (IB-3) relays are operated and (IB-2) relay is not operated, counting relay (4) will be the first to operate). Ground from the A commutator of the incoming selector intermittently short-circuits the (STP) relay. The (STP) relay released, operates the prime relay which operates the next succeeding counting relay. When sufficient pulses have been sent from the incoming selector to satisfy the sender the (FO') and (BO') relays operate. The (BO') relay operated, opens the fundamental circuit, preventing the operation of the (STP) relay and releasing the line relay in the incoming selector. The (FO') relay operated, advances the R-3 switch to position 9, ground on the (A) cam advancing it to position 10. As the switch leaves position 8-1/4 the counting relays release.

18. INCOMING GROUP SELECTION

With the R-3 switch in position 10, the sender circuit functions for incoming group selection. The group selected is determined by the setting of the (IGH) and (IGT) relays. (Example: Group 3 is selected when both relays are operated). When sufficient pulses have been transmitted to satisfy the sender the (FO') and (BO') relays operate and function as described in paragraph 17. The switch is advanced to position 12.

19. FINAL BRUSH SELECTION

With the R-3 switch in position 12, the sender functions for final brush selection in a manner similar to that described for incoming brush selection, in paragraph 17. Which counting relay operates first is determined by the setting of the (FB) relays. (Example: If the (FB-1), (FB-2) and (FB-3) relays are all operated, the (3) counting relay operates first, selecting final brush 3). When sufficient pulses have been sent to satisfy the sender circuit the (FO') and (BO') relays function and the R-3 switch is advanced to position 13, ground on the A cam advancing it to position 14.

20. FINAL TENS SELECTION

With the (R-3) switch in position 14, the circuit functions for final tens selection in a manner similar to that described for incoming brush selection in paragraph 17. The selection in this case is determined by the setting of the (FT) relays. The (FO') relay operated at the end of selection advances the switch to position 15 and the A cam advances it to position 16.

21. FINAL UNITS SELECTION

In position 16, the sender functions for final units selection in a manner similar to that described for incoming group selection in paragraph 18, except that the election is now determined by the setting of the (FU) relays. The (FO') relay operated, advances the R-3 switch to position 17.

22. INCOMING ADVANCE

When the (R-3) switch enters position 17, ground on the (J) cam advances the switch to position 14. When the incoming selector enters position 9, reverse battery over the fundamental circuit operates the (OFL) and (STP) relays. The (OFL) relay operated, holds through its 1000 ohm winding. The (OFL) and (STP) relays operated, operates the (O) counting

(19 Pages, Page 12)
Issue 2 BT 51012-01
April 19, 1927.
Replacing all previous
issues.

relay. When the incoming advances out of position 9, the (STP) relay releases in turn operating the (BO') and (FO') relays. The (BO') relay operated, opens the fundamental circuit. The (FO') relay operated, advances the R-2 switch to position 15. Ground on cam F of the R-2 switch advances the R-2 switch to position 16.

23. TALKING SELECTION

With the R-2 switch in position 16, a circuit is closed from battery in the district selector through the district line relay and the (STP) relay in the sender circuit. The (STP) relay operated, operates the (O) relay. When the (STP) relay releases due to being short-circuited, the (FO') and (BO') relays operate. The (FO') relay operated, performs no function at this time. The (BO') relay operated, opens the fundamental circuit, causing the district to stop in the required position, (in this case 12).

24. RETURN TO NORMAL

When talking selection has been completed in the district circuit, the district line relay releases. The line relay released, releases the (H) and (H-1) relays in the sender selector and allotter circuit. The release of these relays opens the ADV, SC, FT and FR leads and advances the sender selector switch. As the switch advances, ground is removed from the HTG lead. The (S) relay in the register control circuit releases. The short circuit being removed from its inductive winding, the (S-1) relay operates. The (S-1) relay operated, connects ground through its 80 ohm winding to the HTG lead as a busy condition. Should a sender selector be hunting at this time, the ground through the 80 ohm winding causes it to pass by the sender and the (S-1) relay to be held operated until the brush has left its HTG terminal. The (S) relay released, advances the R-1 switch to position 18. As the R-1 switch enters position 10 ground on the C cam advances the R-2, R-3, R-4 and R-6 switches to normal with the aid of the A cams of the respective switches. With the above switches in position 1, ground from the Q cam of the R-6 switch advances the R-1 switch to normal. As the R-1 switch leaves position 9, all operated register relays release.

DIRECT MACHINE SWITCHING CALL - 48 VOLT TEST LOADED

25. GENERAL

On this class of call the sender circuit functions as described for direct machine switching call, 48 volt test non-loaded, with the following exceptions:

- 25.1 The class switch is set in position 5 instead of in position 4, but in the same manner as described under the previous call.
- 25.2 Talking selection requires two pulses from the district selector operating counting relays (I), (I'), (O), (FO') and (BO').

26. TOLL AND DESK AND STRAIGHTFORWARD TOLL TANDEM MANUAL CALLS

All calls which do not require numerical selection are included in this class. For a call of this class only the route and start keys are operated. The circuit functions in the same manner as described for route registration. The routing switch rotates until it finds ground on the terminal corresponding to the operated route key. The class switch is advanced to position 2 or 3. Up to the completion of office selection, the circuit functions in the same manner as described in paragraph 9 to 15 inclusive. With the R-2 switch in position 11, ground on cam T of R-4 switch advances it to position 12, the A cam advancing it to position 13. As the R-2 switch passes through position 10-3/4 to 13, ground on the G2 cam advances the R-3 switch to position 6. The (TG-1) relay operated at the end of trunk test advances the R-3 switch to position 7. Ground on cam R of the class circuit operates the (O), (BO') and (FO') relays. The (FO') relay operated, advances the R-2 switch to position 15. With the R-2 switch in position 15, ground on the ADV lead advances the district out of the selection beyond position. As the district advances, it connects ground to lead SC operating the (STP) and (TR) relays. The (STP) relay operated, advances the R-2 switch to position 16. In position 16 of the R-2 switch, talking selection in the district is made. For "Toll and Desk Non-Loaded" calls, the 2 counting relay is the first to operate. For "Toll and Desk Loaded" "YA" wiring, calls the 3 counting relay operates first, for "Straightforward Toll Tandem Manual" "XA" wiring calls the 0 counting relay operates first. The circuit functions for talking selection in the same manner as described in paragraph 23. When sufficient pulses have been sent back from the district to satisfy the sender, the (FO') and (BO') relays operate. The (BO') relay operated, opens the fundamental circuit, causing the district to stop in the required position. The (FO') relay operated at this time performs no function. From this point on, the circuit functions in the same manner as described in paragraph 24, "Return to Normal".

R.C.I. DIRECT

27. ADVANCE

On R.C.I. calls to manual offices, the circuit functions in the same

(19 Pages, Page 14)
Issue 2 BT 51012-01
April 19, 1927.
Replacing all previous
issues.

manner as described for direct machine switching call up to position 11 of the R-2 and position 5 of the R-3 switches. The class switch is set in position 6 or 7. As the class switch advances, the (T) relay operates. When the class switch stops advancing, the (T) relay releases. The (T) relay released, advances the R-3 switch to position 6.

28. TRUNK GUARD TEST - R-1 IN POSITION 9, R-2 IN POSITION 11, R-3 IN POSITION 6, R-4 IN POSITION 6/7

With the R-1 switch in position 9, the R-2 switch in position 11, the R-3 switch in position 6 and the R-4 switch in position 6 or 7, trunk guard test is made in the same manner as for a direct machine switching call except that the (TG) relay is bridged across the (FT) and (FR) leads without the A resistance. The (TG) relay operated, operates the (TG-2) relay. The (TG-2) relay operated, operates the (TG-1) relay. The (TG-1) relay operated, advances the R-2 switch to position 7. The sender does not function further until the assignment key in the R.C.I. trunk at the manual board is operated. The assignment key operated, releases the (TG) relay. The (TG) relay released, releases the (TG-1) and (TG-2) relays. The (TG-1) and (TG-2) relays released, connect the (FT) and (FR) leads through from the district to the call indicator impulser cams. The (TG-1) relay operated, also operates the (DWO) relay. The (FP) relay operates when the R-2 switch enters position 6 3/4 to 7. The (DWO) and (FP) relays operated, advance the R-5 switch through one complete revolution from position 1 to position 1. When making trunk test a 2 MF "TG" condenser and 18-BA "H" resistance are connected in series across the winding of the (TG) relay to absorb an inductive kick when the (TG) relay releases.

29. SENDING R.C.I. PULSES

(NOTE:- The routing switch circuit is arranged for (P), (Q), (Z) and (L) wiring so that it may be used with all R.C.I. trunks whether or not they are arranged for universal pulsing.) The continuous advance of the impulser switch through one full revolution sends pulses over the fundamental circuit, operating the proper combination of relays at the terminating R.C.I. offices for displaying the number called, before the manual "B" operator or is registered in a Full Mechanical Tandem or Local Tandem sender. The pulses are sent under the control of the operated register relays in the following order: Tandem (when used), stations, thousands, hundreds, tens, units. As the R-5 switch leaves position 9-1/4, the (FP) relay releases, transferring the fundamental circuit to cams L and K of the R-5 switch. As the R-6 switch

advances to position 1, the R-2 switch is advanced to position 12 by ground on the L cam of the R-3 switch and to position 13 by the A cam. As the R-2 switch passes through position 12 to 12-1/2, battery and ground are connected to the tip and ring of the pulsing circuit as an additional pulse. This pulse is used to advance the two wire office selector if it is included in the routing. If the apparatus at the manual office is arranged for this pulse, it will be necessary to send it in all cases whether or not the two wire office selector is used. When "Y" wiring is provided and the apparatus in the manual office is arranged to function without the additional pulse, the sender control switch R-2 may be advanced to position 15 before the sender moves from position 5. As the R-2 switch leaves position 20-3/4, the fundamental circuit is opened, preventing further pulsing. As the (R-2) switch enters position 13, the (O), (FO') and (BO') relays operate. The (FO') relay operated, advances the R-2 switch to position 15. The (O) and (BO') relays perform no useful function at this time. The (O), (BO') and (FO') relays release as the R-2 switch advances to position 15. In position 15, ground on the (F) cam advances the district to talking selection. The circuit functions for talking selection and returns to normal in the same manner as described for direct machine switching call, paragraphs 23 and 24.

LOCAL AREA - MACHINE SWITCHING TANDEM CALLS

30. OPERATION OF KEYS

This class of call includes (a) calls where the record is transferred from the operator's sender to a register sender in the same or in a distant office, the completion of selection being controlled by the register sender, (b) calls which originate at a special "A" position for local points not appearing on the district frame and are completed through a tandem district which is associated with a common group of register sender. On these calls it is necessary to operate the tandem keys in addition to the route and numerical keys.

31. SENDING R.C.I. PULSES

When the setting of the keys has been recorded in the register control circuit and the routing switch has been set, the class switch is advanced to position 10 or 11 (according to whether the call is non-loaded or loaded). The circuit functions for district and office

(19 Pages, Page 16)
Issue 2 BT 51012-01
April 19, 1927.
Replacing all previous
issues.

selections in the same manner as described in paragraphs 9 to 15 inclusive. With the R-1, R-2, R-3 and R-4 switches in position 9, 13, 6 and 8 respectively, the tandem relay operates. The tandem relay operated (a) locks, (b) operates the (FP) relay, (c) closes circuits through from the contacts of the (H), (T) and (U) relays. The (FP) relay operated, advances the (R-5) switch to position 2, the B cam advancing it to position 9. Trunk guard test is made in the same manner as described in paragraph 28, except that the control switch R-2 is in position 13 instead of 11. The (TG-1) relay operated, advances the R-3 switch to position 7. Upon the completion of the trunk test, the distant district circuit selects an idle register sender and opens the fundamental circuit, releasing the (TG) relay. The (TG) relay released, releases the (TG-1) and (TG-2) relays. The (TG-1) relay released, advances the R-5 switch from position 9 to position 1, sending out the required pulses according to the setting of the (A), (T) and (U) relays. Impulses for stations, thousands, hundreds, tens and units are sent out while the R-5 switch makes the second revolution. The register sender upon receiving the last pulse, advances the tandem district. The district advanced, connects reverse battery to the FT and FR leads in a manner similar to that on incoming advance. As the R-5 switch advances to position 1, at the end of the second revolution the R-2 switch advances to position 14. From this point on, the circuit functions as described in paragraphs 22, 23 and 24, the 0 counting relay operating for talking selections.

R.C.I. AND MECHANICAL TANDEM 24 VOLT TEST

32. The operation of the circuit for this class of call is the same as for R.C.I. direct, described in paragraphs 27, 28 and 29, except that the R-5 switch is set in position 9 before the pulses are sent out and the tandem relay operates, functioning in the same manner as described in paragraph 31, the R-4 switch is advanced to position 10 or 11. For talking selections, the (O) relay operates for non-loaded talking and the 1 relay operated for loaded talking.

MISCELLANEOUS

33. SKIP OFFICE

On calls not requiring office selections for completion, the circuit functions as described in paragraphs 9 and 10. Ground on the first OB arc of the RS-2 selector operates the (SO) relay which causes the R-2 switch to advance to position 13 immediately. Should it be desired to skip only second office selections the circuit functions as

described in paragraphs 9, 10, 11, 12, 13. Ground on the second OB arc of RS-2 selector advances the R-2 switch to position 13. This is accomplished in the following manner. The (SO) relay operates in position 1 of the R-2 switch. The (SO) relay operated, (a) advances the R-2 switch to position 6, the A cam advancing it to position 7, (b) operates the (O), (FO') and (BO') relays. As the R-2 switch leaves position 5, the (SO) relay releases but reoperates as the switch moves into position 5 3/4 /7. The (SO) relay operated, locks, advancing the R-2 switch to position 10, the A cam advancing it to position 11, ground on cam T-4 advancing the R-2 switch to position 12. From this point on, the circuit functions as described in paragraphs 16 to 24 inclusive.

34. DELAYED WIPE-OUT

When the plug of the "Cord and District Circuit" is withdrawn from the jack before final units selection has taken place, the district advances and closes a circuit over lead SC, operating the (DWO) relay. The (DWO) relay operated, (a) holds, (b) opens the fundamental circuit, preventing final units selection, which is usually made through the break contacts of the (DWO) relay. With the final units selection lead opened, the counting relays cannot function and the selector travels to tell-tale. The circuit functions from this point on as described below in paragraph.

55. DISTRICT OVERFLOW - R-1 IN POSITION 9, R-2 IN POSITION 1, R-3 IN POSITION 8, R-4 IN POSITION 2 TO 12 INC.

When the district goes to overflow the release of the (L) relay advances the district to position 9. In position 9, ground on the SC lead advances the district to position 10. In position 10, the Z commutator advances the switch to position 11. In position 11, ground on the S cam of the district advances the switch to position 17. In position 17, the district releases the sender. The sender selector returns to normal opening the FT, HTG, PR, ADV and SC leads. As the sender selector advances to normal, ground is removed from the HTG lead, releasing the (S) relay in the register control circuit. The (S) relay released, removes the short-circuit from the inductive winding of the (S-1) relay which now operates and holds. The (S-1) relay operated, connects ground through its 80 ohm winding to the HTG lead as a busy condition as described in paragraph 24. The (S) relay released, also advances the R-1 switch to position 18. As the R-1 switch enters position 10, ground on the F-1 cam advances the R-3, R-4, R-5 and R-6 switches to normal. With the R-2, R-3, R-4, R-5 and R-6 switches in normal, a circuit is closed, advancing the R-1 switch to normal. As the R-1 switch enters position 10, all operated register relays release.

(19 Pages, Page 18)
Issue 2 BT 51012-01
April 19, 1927.
Replacing all previous
issues.

36. OFFICE OVERFLOW - R-1 IN POSITION 9, R-2 IN POSITION 8, R-3 IN POSITION 5, R-4 IN POSITION 2 TO 11 INC., R-5 IN POSITION 1

When the office circuit goes to overflow it is advanced to position 11. Reverse battery is sent over the fundamental circuit in position 11, operating the (OFL) and (STP) relays in the sender circuit. The (OFL) relay operated, locks and operates the (OFL-1) and (OFL-2) relays. The (OFL-1) relay operated, (a) locks to ground on cam M-3, (b) connects the talking selection leads to the 4 counting relays, (c) operates the (O) counting relay. The (OFL-2) relay operated, (a) locks to ground on cam (G-2), (b) operates the (TG-1) relay, (c) closes a circuit advancing the R-2 switch to position 8, the A cam advancing it to position 7. The (TG-1) relay operated, advances the R-2 switch to position 8, ground on the (OFL-2) relay advancing it to 9 and ground on the A cam advancing it to position 10. As the R-2 switch leaves position 8, the (BO') and (FO') relays operate. The (FO') relay operated, advances the R-2 switch to position 11. As the R-2 switch advances to position 11, ground on G-2 cam advances the R-3 switch to position 6, ground on the T-4 cam advances the R-2 switch to position 12, the A cam advancing it to position 13. With the R-3 switch in position 6, ground on cam N-3 advances the switch to position 7 and immediately to 8. In position 8, the (O), (FO') and (BO') relays operate. The (O), (FO') and (BO') relays operated, hold until the R-3 switch advances to position 17. The (FO') relay operated, advances the R-3 switch to position 17. On all other calls than "direct machine switching" the R-2 switch advances to position 14 from ground on the make contact of the (FO') relay in position 7/8 of the R-2 switch. On direct machine switching calls, the R-2 switch does not advance from position 13 until the R-3 switch enters position 17. In position 17 of the R-3 switch, ground on the J-3 cam advances the R-2 switch to position 14, ground on the contact of the (FO') relay operated, advancing the switch to position 15. The advance of the district operates the (STP) relay. The (STP) relay operated, advances the R-2 switch to position 16. In position 16 of the R-2 switch, talking selection is made and as the (OFL-1) relay operates, the district advances to the overflow position. From this point on, the circuit functions in the same manner as described in paragraph 24, "Return to Normal".

37. OFFICE OVERFLOW ON MANUAL, AND MANUAL OR MECHANICAL TANDEM

An office selector may go to overflow with the R-2 switch in position 11 or 13 and the sender in position 6 on calls from manual, manual tandem or mechanical tandem calls. In this case, the (TG) and (OFL) relays are bridged across the line to the trunk guard test position.

The (TG) relay operated, operates the (TG-2) relay which in turn operates the (TG-1) relay. The (OFL) relay operated, operates the (OFL-1) and (OFL-2) relays. The (OFL-2) relay operated, operates the (SO) relay. The (SO) relay operated, advances the (R-2) switch out of position 13. As the R-2 switch leaves position 13-1/4, the (FO') and (BO') relays operate. The (FO') relay operated, advances the R-2 switch to position 15. The district is advanced and talking selection is made as previously described.

38. INCOMING OVERFLOW

Should an incoming selector go to overflow with the sender in position 12 and the sender control switch in position 13, the (STP), (OFL), (OFL-1) and (OFL-2) relays operate. The (STP) relay operated, operates the (O) counting relay. When the incoming selector advances, the (STP) relay releases, operating the (FO') and (BO') relays. The (FO') relay operated, advances the (R-3) switch to position 17. When the R-2 switch advances to position 16, the district is advanced, talking selection is made and the circuit returns to normal as described in paragraph 24.

39. FINAL TELL-TALE

When the final selector goes to tell-tale, reversed battery over the fundamental circuit operates the (OFL) and (STP) relays. The (OFL) relay operated, operates the (OFL-1) and (OFL-2) relays. The (OFL-1) and (OFL-2) relays operated, lock. The (OFL-1) relay operated, operates the (O) counting relay. The final circuit continues to advance and connects ground to the FT lead, releasing the (STP) relay. The (STP) relay released, operates the (BO') and (FO') relays. The (FO') relay operated, advances the R-3 switch to position 17. As the R-3 switch advances to position 17, ground on the (J-3) cam advances the R-2 switch to position 14, the (FO') relay operated, advancing it to position 15. With the R-2 switch in position 15 the (O), (FO') and (BO') relays release and ground on the (Q-1) cam over the ADV lead advances the district. The district advanced, ground is removed from the hold lead, restoring the circuit to normal as described under "Restoring to Normal" paragraph 24.

40. SPLITTING COUNTING RELAYS

Whenever a counting relay above (4) is to be operated, the (TR) relay operates. The (TR) relay operated, transfers the pulsing circuit from the contacts of the (1) relay to the corresponding contact of the (5) relay. This eliminates extensive cross connection.

ENG: F.S.G.
April 19, 1927.
BMS

CHK'D. BY: D.C.W.

APP'D. BY: E. R. COOKE
S.C.E.