Sender Trans. 1-6

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Western Electric Company, Inc.,
Equipment Engineering Branch, Hawthorne.

Issue 2 - BT-502305.
Appendix #3.
October 29, 1923. (*)

This appendix was prepared from T-502305 Issue 35.

METHOD OF OPERATION
SCHEMATIC

Sender Circuit - Subscribers - 2 Digit Office Code - Panel Machine Switching System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

No change.

2. WORKING LIMITS

No change.

OPERATION

3. PRINCIPAL FUNCTIONS

No change.

4. CONNECTING CIRCUITS

No change.

DESCRIPTION OF OPERATION

5. No change.

Cancel appendices 1 & 2.

Cancel Circuit requirements covered on pages 38 to 47 inclusive.

ENG: I.M.W.
11/2/23
F.G.H.

CHK'D.--BY: J.I.

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Issue 2 - BT-502305.
Appendix 2.
March 29, 1923.

METHOD OF OPERATION
SENDER CIRCUIT
Subscriber's Two-Digit Office Code - Power Driven Machine Switching System.

This appendix was prepared from issue 28 of drawing T-502305.

The following requirements for the E1483 relay (MSL-1) shall be added:

Code	Desig.	Spec. #	SK No.	Cont Press	Arm. Trvl.	Test For	Test Amps.	Readj. Amps.	Conn GRD	Test Set Prep
E1483	(MSL-1)	X-70037	15	20	.015	0	.040	.018	RU(MSL-1)	G

Under the test notes for the 206-AK relay (CT-4) in appendix 1 to issue 2 note 9 shall be changed to read as follows:-

> "9 - Before applying the current flow requirements to the primary winding, connect 48 volt battery to the #3 contact of the (CT-4) relay and to the 1-T spring of the (CT-3) relay".

ENG.--EOP-BO. 8/20/23. CHK'D.--ANB-CWP. APPROVED - J.L. DOW - G.M.L.

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Western Electric Company, Inc.,
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METHOD OF OPERATION
SENDER CIRCUIT

Subscribers' - Schematic Two Digit Office Code - Power Driven Machine Switching System.

This Appendix was prepared from issue 25 of T-502305.

The requirements for the 206-AK relay (CT-4) shall be changed to read as follows:

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

MECHANICAL REQUIREMENTS

206-AK	SPTC. NUMBER	SKETCH NUMBER
(CT-4)	X-70055	3

DIRECT CURRENT FLOW REQUIREMENTS

Test Wdg.	Test For	Test Amps.	Readj. Amps.
P	O	.017	.016
P	NO	.0125	.0136
S	O	.040	.038
T	H	.020	.019
T	H	.053	.050

CIRCUIT PREPARATION
TEST CLIP DATA

Test Wdg.	Block	Conn. Bat.	Conn. GRD.	Test Set Prep.	See Test Note	Remarks
P			1B (CT-3)	G	9/4/17	
P			1B (CT-3)	G	9/17	
S		2B (CC)	3T (CT-3)	B/G	17	
T		-	-	-	-	C
T	(CT-7)O	-	1T (CT-3)	G	10/17	D

Test Notes:

4 (a) Total contact travel .004".

(b) The biasing spring shall be tensioned against the armature with sufficient force to meet the non-operate requirement.

Test Notes:

9 Before applying the current flow requirements to the primary winding, connect 48 volt battery to the #3 contact of the (CT-4) relay and to the 1B spring of the (CT-3) relay.

10 Before applying the joint hold current flow requirements to the tertiary winding, connect 48 volt battery to the #3 contact of the (CT-4) relay. While establishing the joint hold current flow values in the test set, the (CT-4) relay should be held operated on its primary winding by grounding the 1B spring of the (CT-3) relay. In order to get the (CT-4) relay armature in its operated position before testing for the hold on its tertiary winding, it will be necessary to operate it on its primary winding by momentarily grounding the 1B spring of the (CT-3) relay.

17 Special requirements to meet circuit conditions which are (a) maximum subscribers' loop 750 ohms, (b) earth potential 17 volts negative, 18 volts positive and (c) minimum subscribers' line leak 10,000 ohms.

Remarks:

C - Requirements for relay winding alone.

D - Joint circuit requirements for parallel circuit combination of (CT-4), (CT-3) and (CT-1) relays.

Western Electric Company, Inc.,
Engineering Dept.,
New York.

Issue 2 - BT-502305.
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METHOD OF OPERATION
SENDER CIRCUIT

Subscriber's - Schematic Two Digit Office Code - Power Driven Machine Switching System.

This Method of Operation was prepared from issue 26 of drawing T-502305.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is for use in controlling the establishment of a connection through mechanical selectors under direct control of a machine switching subscriber.

2. WORKING LIMITS

2.1 Minimum trunk leak 30,000 ohms.

2.2 Maximum external trunk loop to 24 volt R.C.I. offices - 6500 ohms.

2.3 Maximum external trunk loop to office, incoming or final selectors - 2300 ohms.

2.4 Maximum subscriber's line loop (non-coin) - 1000 ohms or earth potential maximum. 18 volts positive to 18 volts negative.

2.5 Maximum subscriber's line loop (coin) - 750 ohms or earth potential maximum 18 volts positive to 17 volts negative.

2.6 On all R.C.I. class calls, minimum trunk loop for selection beyond office - 900 ohms.

3. PRINCIPAL FUNCTIONS

The principal functions of the sender are:

3.1 To receive and register the pulses dialed by a calling subscriber.

3.2 To translate these pulses from the decimal system as dialed, into the proper settings on the registers and translator for making the necessary selections on the panel type selectors.

3.3 To set up by means of the class register, the circuit conditions for completing the call to the particular class of office in which the called station terminates as for example, a manual or a machine switching office.

3.4 To control the selections on the various selectors as required to complete the connection.

3.5 To translate the register settings into the proper pulses to set up the required number on the call indicator, if the called station is in a manual office.

3.6 To collect the coin on completed calls from coin box stations or to return the coil if the call is not completed or is for a station to which free service is given.

3.7 To give a suitable alarm after a predetermined length of time in case the completion of a call is blocked at any point in its progress.

3.8 To set up a release condition in the sender and the district circuit in case the call is abandoned by the calling subscriber during the time selections are being made.

3.9 To give a signal to the sender monitor at the trouble desk in case the call is blocked due to improper dialing or failure of the equipment during the time selections are being made.

3.10 The sender is made up of the following divisions:

3.101 CLASS CIRCUIT By means of which the class of call to be made is determined. The setting taken by the class switch causes the sender to add or to omit certain of its operations as required for the completion of the connection.

3.102 REGISTER CONTROL CIRCUIT Controls the connection of the sender to a district selector; controls the closure of the fundamental circuit during selections and controls the disconnection of the sender.

3.103 REGISTER AND TRANSLATOR CIRCUIT The office code dial pulses take settings corresponding to the number of pulses dialed. The setting of the office code registers gives complete information to the sender for selecting a trunk to the office containing the called station. That is, for setting the class register to give the necessary circuit combinations for the class of the desired office and for making the proper brush and group selections on the district and office frame and for choosing an outgoing trunk to the called office.

3.104 NUMBERS REGISTER CIRCUIT The numerical and station dial pulses take settings corresponding to the number

of pulses dialed. The setting of the numerical registers controls incoming and final selections or controls the R.C.I. pulses depending upon the class of office in which the called station is located.

3.105 SENDER CIRCUIT Consisting of the stepping relay and counting relays for controlling district, office, incoming and final selections. The counting relays to be used for district and office selections are determined by cross connections from the district brush, district group, office brush and office group arcs of the translator. The counting relays to be used for incoming brush, incoming group, final brush, final tens and final units and if required station designations are determined by wiring from the numerical and stations register arcs of the translator.

3.106 CALL INDICATOR IMPULSER CIRCUIT The impulser sequence switch sends out to the control circuit of the call indicator equipment at the manual office a series of pulses, the sequence of which is under control of the sender numerical registers, to operate the call indicator lamp relays that cause the number of the called subscriber's number to be displayed before an operator.

3.107 SENDER MONITOR AND TIME MEASURE ALARM CIRCUIT For the purpose of giving a signal to a sender monitor when any condition in the sender circuit remains unchanged for a length of time predetermined by the circuit. Associated with the time measure alarm circuit is a coin circuit used for monitoring on coin and non-coin lines and for the refund or collection of coin.

4. CONNECTING CIRCUITS This sender will function with:

4.1 Any standard district selector.

4.2 Any standard office selector.

4.3 Any standard incoming selector.

4.4 Any standard final selector.

4.5 Any standard R.C.I. trunk to a manual office.

4.6 Any standard outgoing trunk to an operator's position.

4.7 Associated cord circuits at trouble desk.

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INDEX

REGULAR MECHANICAL CALL USING OFFICE SELECTOR - NON-COIN

REGULAR MECHANICAL CALL USING OFFICE SELECTOR - COIN

MISCELLANEOUS

DETAILED DESCRIPTION

REGULAR MECHANICAL CALLS USING OFFICE SELECTOR - NON-COIN ("X" WIRING)

SENDER SELECTED

5. With the sender control switch in position 1, battery is connected through the winding of the T relay to the multiple test terminal of the associated district sender selector (not shown). When a hunting sender selector selects and connects to the tip (T), ring (R), test, fundamental tip (FT), sender control (SC), fundamental ring (FR), terminals of this circuit, it connects ground to the test terminal, operating the T relay. The T relay operated, (a) is held operated from ground on the test lead, (b) operates the ON relay and (c) operates the SLR relay under the control of the L, RLS, ST and ST-1 relays.

6. When the sender is selected, the associated district advances to the "awaiting sender" position, in which position a circuit is closed from battery, over lead SC, through both windings of the SC relay, to ground operating the SC relay. The operation of the ON relay, (a) closes a circuit from ground to operate the SB relay, (b) prepares in part a circuit for operating the T-1 relay, (c) closes a circuit from ground on its make contact, (X wiring), normal terminal (terminal 22) and M-2 brush, to battery through the break contact and winding of the MS relay, operating the MS relay. The operation of the SB relay, (a) opens the operating circuit to the MB relay so that this sender cannot be made busy by a make busy plug, (b) closes in part a chain circuit to the "all senders busy" register, (c) closes in part a circuit to light the sender busy lamp when the sender busy key is operated, and (d) closes a circuit from battery through the non-inductive winding of the T-1 relay in parallel with battery through the winding of the T relay, through the 80 ohm winding of the T-1 relay, to ground on the armature of the MB relay.

7. The T-1 relay does not operate at this time, as its inductive winding is short circuited by the ground on the test lead. The MS relay operated, functions as described under "Time Measure and Alarm". The operation of the SC relay opens the circuit through the SLR relay. The SLR relay is slow to release and the call has not been abandoned or the sender seized to collect or return a coin, the L relay operates before the SLR relay releases. Circuit battery through the primary winding of the L relay, (X wiring), MSL relay normal, R lead, through the associated district, line finder and subscriber's line circuits (not shown) T lead, MSL relay normal, to ground through the outer winding of the 66-A repeating coil. The operation of the L relay closes a circuit from battery through the winding of the SLR relay, to ground, thus holding the SLR relay operated.

8. If the call is abandoned or the sender has been seized to collect or return a coin, the L relay does not operate and the SLR relay releases, causing the sender to function, as described for an abandoned call in paragraphs 41 to 43 or as described in paragraph 59 if seized.

for the purpose of collecting or refunding the coin. The operation of the L relay also closes a circuit from ground, T and L relays operated, SC-1 relay normal, SC relay operated, winding of the SC-1 relay, to battery, operating the SC-1 relay. The SC-1 relay locks to ground on the T relay. The operation of the SC-1 relay (a) advances the sender control switch to position 2, and (b) closes a circuit to operate the RLS relay. The operation of the RLS relay closes a circuit from ground through the RC-4 brush and normal terminal, 25 ohm winding of the 66-A repeating coil, 1/2 m.f. condenser to battery on the lead "To Tone Circuits". A tone is thus induced in the 500 ohm winding of the 66-A repeating coil and transmitted to the calling station as an indication that the office apparatus is ready for the operation of the dial.

9. When the sender control switch enters position 1 3/4, ground is connected to the upper outer contact of control cam T through the winding of the ON relay, holding the ON relay operated until the sender control switch advances from position 6.

SETTING REGISTERS

10. The operation of the dial at the calling station, alternately releases and reoperates the L relay, in synchronism with the impulses in each digit dialed. The SLR relay is slow to release and remains operated while the entire number is being dialed. The first release of the L relay closes a circuit from ground, T relay operated, L relay released, RLS relay operated, windings of the RA relay, RC-6 brush and N terminal, to battery through two paths in parallel. One of these paths is traced through the normal PP relay winding of the A magnet, through the 44-E resistance and one winding of the ON-2 relay in parallel, to battery, operating the RA relay, the A magnet, and ON-2 relay. The other path is traced through the A magnet normal, strapped terminals of arc A-1, lead A, arc RC-5, normal terminal and brush, sender control cam F, winding of the PH relay, PP relay normal to battery operating the PH relay. The RA relay is slow in releasing and remains operated until all digits are dialed.

11. The operation of the RA relay closes a circuit from ground on the RLS relay to operate the RC magnet. The PH relay is fast in operating and when operated closes the register stepping magnet circuit to an additional ground on its left armature and locks to ground until the A magnet operates, to insure stepping of the register, if for any reason the impulses of the L relay are not of sufficient duration to operate the A magnet. The operation of the PH relay also closes a circuit from ground on its right armature to battery through the winding of the SLR relay and holds this relay operated during the pulsing period.

12. When the A register magnet operates, after the L relay releases it opens the circuit through the PH relay. The PH relay releases opening the circuit through the A magnet. The ON-2 relay and the A magnet release and the A register brush assembly is advanved to terminal 1. Each time the L relay releases and reoperates, the A register magnet and the A relay operate and release and the A register brush assembly is advanced one step. Upon the completion of the series of impulses, corresponding to the first

digit of the office code, the RA relay and ON-2 relays release. The release of the RA relay opens the circuit in which the RC magnet is energized, releasing the magnet, stepping the RC brush assembly to terminal 1. The number 1 is not used as a digit of the office code and therefore two or more impulses are received for the first digit dialed and the A register does not stop on terminal 1 except in the case of a preliminary impulse as described later in paragraph 45.

13. The sender is now ready to receive impulses for the second digit of the office code. The L relay again alternately releases and reoperates, responding to the impulses from the dial. The RA, PH and ON-2 relays, and the B register magnet operate and release stepping the B register in a manner similar to that in which the "A" register was set, except, the pulsing circuit from ground through the L and PH relays operated is through the winding of the B register magnet and terminal 1 of the RC-6 arc, instead of the "A" register magnet, and the circuit in which the PH relay operates, passes through terminal 1 of the RC-5 arc, lead B, and strapped terminals of the B-1 arc, instead of the normal terminal of the RC-5 arc and lead A. The RC magnet is energized when the RA relay operates, and when the RA relay releases upon completion of the series of impulses corresponding to the second digit of the number dialed, the RC magnet releases, stepping the RC brush assembly to terminal 2. The register control switch is now in position to direct the next series of impulses from the L relay to the thousands register. The TH, H, T and U registers are set in a similar manner to that described for the A and B registers. On all calls for which the H register is set in positions 5 to 9 inclusive, the IG relay operates whereby the 1 counting relay is connected to the even numbered terminal of arc TH-6 for incoming group selections instead of the 0 counting relay and where the 3 counting relay is connected to the odd numbered terminals of the TH-6 arc instead of the 2 counting relay.

TRANSLATION

14. When the brushes of the RC switch advance to terminal 2 after setting the "A" register, a circuit is closed to operate the ST relay from battery, winding and break contact of the ST relay, terminal 2 and arc RC-4 brush, to ground at the RLS relay. The ST relay operated, (a) locks in position 2 through its make contact, cam 0 to ground on the RLS relay operated, (b) closes a circuit from ground on its armature through the windings of the ROT-1 and ROT-2 magnets to battery, operating the magnets, thus rotating the power driven translator and (c) connects ground from the RLS relay operated, the SSR relay normal, the ST relay operated, A-5 brush and terminal, to one of the B register brushes and terminal through the cross connections to the translator arc T1-S and T2-S.

15. When the translator brush assembly advances to the particular terminal to which this ground is connected the circuit is extended through the TR relay operated or normal, to battery through the windings of the TS-1 and TS-2 relays and to battery through the windings of the STOP-1 and STOP-2 magnets. The TR relay operates if the A register is set in position 3, 5, 7 or 9 thereby transmitting the hunting lead from the arc with terminals numbered 1 to 22 to the arc with terminals numbered 23 to 44. The TS-1 and TS-2 relays and the STOP-1 and STOP-2 magnets operate in this circuit and lock to ground on the ST relay. The operation of the TS-1 and TS-2 relays,

(a) closes another locking circuit for the ST relay, from ground on the armature of the TS-1 relay, through the lower contacts of sender control ca, C, to battery through the make contact and winding of the ST relay, (b) closes a circuit from ground on the armature and make contact of the TS-1 and TS-2 relays operated, sender cam C, to battery through the winding of the R-2 magnet, advancing the sender switch to position 2, (c) closes a circuit from ground on the TS-1 and TS-2 relays, sender control cam B, to battery through the R-1 magnet, advancing the sender control switch to position 3.

16. NOTE: Each power driven translator consists of one 202-C selector and two ten 10-C lamps. It has a capacity of forty-four sets of terminals, each bank consisting of twenty-two sets. The two banks are mounted on the translator frame parallel to each other with the terminals in alignment with the springs of the brush assemblies of the selector. The 202-C selector is composed of a rotary magnet (ROT), a STOP magnet and two step by step brush assemblies, which are clamped to a rotary shaft in the magnet end of which is fastened a metal driving disc. The brushes are single ended the bridging type and on one assembly are set 180° from the brushes on the other assembly, so that the brushes of only one assembly can make contact with the terminals at any one time. The driving disc is actuated by the ROT. magnet, which operates in a circuit through the break contact of the STOP magnet. The disc is provided with a notched rim, the notches of which serve to stop and hold the selector with the brush assemblies centered on the terminals. The armature of the STOP magnet is provided at its end with a projecting pawl, which is of sufficient size to engage any of the notches in the rim of the disc, thus providing a positive mechanical stop for the rotary unit when the STOP magnet is operated. Normally, the armature pawl does not touch the rim of the disc at any point. The circuit is arranged so that the stop magnet operates when the hunting disc of either assembly makes contact with the desired terminal. As the hunting brushes (T1-S and T2-S) are mounted to make contact brush slightly in advance of the other brushes, the STOP magnet is operated, before the corresponding notch in the rim of the disc is under the armature pawl, causing the pawl to rest on the rim of the disc between two complete notches. The ROT. magnet, therefore remains operated and the disc continues to rotate until the armature pawl drops into the next notch which is associated with the desired row of terminals. When the pawl enters the notch, the contact springs associated with the STOP magnet are opened, thereby opening the circuit through the winding of the ROT. magnet. The STOP magnet remains operating during the progress of selection.

17. Assume for this class of call, that the translator stops in a position in which the T1-CL brush is resting on the contacts of the terminal to which the class set lead C is connected. The circuit is then closed from battery through the R-3 magnet and the CL relay in parallel, cam C, lead C, terminal and T2-CL brush, OT relay normal to ground at the TS-2 relay operated, advancing the class switch to position 7 or 18 and operating the CL relay. The operation of the CL relay prevents the operation of the relays in the impulse circuit during the advance of the class switch. The CL relay releases when the switch advances beyond position 6 or 17.

DISTRICT SELECTION

18. With the sender control switch in position 3, and the sender switch in position 2, the fundamental circuit is closed for brush selection. This circuit is from battery through the district line relay, over lead FT, S and ADV relays normal, sender control cam S, upper outer and lower inner contacts of sender cam N, windings of the OFL relay, BO relay normal, windings of the STP relay, 1000 ohms resistance, lower inner and upper outer contacts of sender control cam J, to ground on sender cam I. The OFL relay does not operate at this time, as it is of the polarized type, unless one of the selectors goes to overflow, at which time the battery through its winding is in the reversed direction. The district L, and STP relays operated, cause the selector to move upward and close a circuit in which one of the counting relays, operates. For this call, it is assumed that 2 counting relay is the first to be operated. The circuit for operating 2 counting relay is from battery at sender control cam X, winding of the 2 counting relay, 2' counting relay normal, lead 2, terminal and T-2 DB brush, sender cams V and U, sender control cam N, LA relay normal, sender cam L, STP relay operated to ground on sender cam I. The operation of 2 counting relay closes a circuit through its windings and the winding of the 2' counting relay in series from ground through sender cam J. The 2' counting relay does not operate at this time however, as it is short circuited by ground on cam I under control of the STP relay. As the district selector moves upward for brush selection, ground is connected to the tip side of the fundamental circuit, each time the A commutator brush makes contact with one of the metal segments in the "A" commutator. This ground short circuits the winding of the STP relay, causing it to release. The release of the STP relay removes the short circuit from the winding of the 2' counting relay. The 2' counting relay now operates and the 2 counting relay holds in the circuit described above. The operation of the 2' counting relay transfers the pulsing circuit through its make contact, to the 1 counting relay, ready for the next impulse.

19. The district selector continues to move upward and each operation and release of the STP relay causes one set of counting relays to be operated.

20. The number of counting relays to be operated for a given selection is determined by connecting the counting relay terminals to the terminals of the translator arc as specified by the Telephone Company, so that the desired counting relay will be connected to the terminal on which the T1-DB and T2-DB brush of the translator shall be resting. When the STP relay releases after the operation of O counting relay, the short circuit to ground on cam I is removed from the winding of the FO and BO relays. The

O counting relay holds, and the FO and BO relays operate in parallel to ground on cam J. The operation of the BO relay opens the fundamental circuit thus stopping the up-drive of the district selector and causing the district switch to advance. The operation of the FO relay, closes a circuit in which the sender switch is advanced to position 3. This circuit is from ground on the armature of the FO relay, IA relay normal, sender control cam I, sender cam C, to battery through the R-2 magnet. The A cam advances the switch to position 4. As the sender switch advances from position 2, the counting relays release, since the circuit through their windings is opened at cam I. With the sender switch in position 4, the 1000 ohm non-inductive winding of the SC relay is short circuited from ground on the sender cam J, reducing the resistance to ground on lead SC, causing the operation of the CH relay in the district. When district group selection and trunk hunting have been completed, it is necessary that the district CH relay reoperate, in order to advance the district switch to the selection beyond position.

NOTE: In order to prolong the life of the stepping relay contacts, the direction of current flow through these contacts is reversed for each successive selection by means of the cuttings on sender cams L and I.

21. With the sender switch in position 4, the fundamental circuit is again closed, for district group selection, as described for district brush selection. The circuit for operating the counting relays is from ground at the lower outer contact of cam I, STP relay operated, cam L, IA relay normal, sender control cam N, sender cams U and V, the T2-DG brush and terminal, and cross connection lead to battery through the proper counting relay. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate as described for brush selection. The operation of the BO relay opens the fundamental circuit, advancing the district to its trunk hunting position. Having selected an idle trunk, the district advances to selection beyond. The operation of the FO relay closes a circuit from ground on its armature, IA relay normal, sender control cam I, sender cam C to battery through the R magnet, advancing the sender switch to position 5. The A cam advances the switch to position 6. The counting relays release when the switch advances from position 4.

OFFICE TEST AND SELECTIONS

22. With the sender switch in position 5, a circuit is closed from battery through one winding of the office line relay, over lead FT, S and ADV. relays normal, top inner contact of sender control cam S, 14,500 ohms resistance, sender cam O, winding of the TG, OFL and STP relays, BO relay normal, top inner contact of sender cam X, sender control cam M, compensating resistance and OFF-T1 brush and arc compensating resistance, (0-1200 ohms) sender control cam V, ADV-1 relay normal, over lead FR, to ground in the office circuit. The TG relay operates, operating the TG-1 relay. The operation of the TG-1 relay, operates the CI relay which is held operated through its make contacts, sender cam Y, sender control cam T to ground. The sender R magnet energizes from battery, top inner contact of cam B, operated CI

relay, sender control cam U to ground advancing the sender switch to position 7. As the switch breaks position 6 the fundamental circuit is opened at sender cam O releasing the TG and TG-1 relays. As the switch breaks position 6 1/4 at sender cam Y, the CI relay releases opening the energizing circuit of the sender R magnet, stopping the sender switch in position 7. The switch advances to position 8 from ground on the IA relay. While the switch is advancing to position 7, a circuit is closed from battery, sender control cam X, 500 ohms resistance, sender cams M and N, winding of the OFL relay, BO relay normal, windings of the STP relay, 1000 ohms resistance to ground on sender cam H. The STP relay operates and immediately releases as the switch advances from position 7. This condition soaks the STP relay.

23. In position 8, the fundamental circuit is again closed for office brush selection. This circuit is traced the same as for office test with the exception that it passes through the upper outer and lower contacts of sender cam N instead of through the 14,500 ohms resistance and winding of the TG relay. Ground from the segments of the office A commutator intermittently short circuit the STP relay alternately releasing and reoperating it. The counting relay circuit is the same as described for District Brush Selection, except that it is now closed through the lower outer contacts of cams L and I, upper inner contacts of cam V, terminal and T2-0B brush. When sufficient impulses have been received to satisfy the sender, the BO and FO relay operate. The operation of the BO relay opens the fundamental circuit, stopping the updrive of the office selector and advancing the office switch. The operation of the FO relay advances the sender switch to position 9, the A cam advancing it to position 10. The counting relays release when the switch advances from position 8.

24. With the sender switch in position 10, the fundamental circuit is closed and office group selection is made in the same manner as the office brush selection, except that the circuit to operate the counting relays is through the upper outer contacts of cams I and L, lower inner contact of cam U, terminal and T2-0G brush. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate. The operation of the BO relay opens the fundamental circuit and the operation of the FO relay advances the sender switch to position 11, the A cam advancing it to position 12. The counting relays release when the switch advances from position 10.

INCOMING TEST AND SELECTIONS

25. When the sender switch advances through positions 11 and 12, the S relay operates if the TF and H registers have not yet advanced from normal. CIRCUIT: Battery, through its winding, DWO relay normal, sender cam F, cam I, terminal 3 and RC-4 brush, to ground on the make contact of the RLS relay. The operation of the S relay opens the fundamental circuit, thus preventing the operation of the TG relay for incoming test.

26. When the thousands and hundreds digits have been dialed, the RC switch advances to terminal 4, releasing the S relay. The release of the S relay closes a circuit from battery through one winding of the incoming L relay, over lead FT, and through the windings of the TC relay as described

for office tests except that it is closed through the lower contacts of sender cam X and compensating resistance brush T-1. (Beyond Office). The TG relay operates operating the TG-1 relay. The TG-1 relay operated, operates the CI relay. The operation of the CI relay closes a circuit through the upper inner contact of sender cam B, CI relay operated, sender control cam U to ground advancing the sender switch to position 13, the A cam advancing the switch to position 14. As the switch advances from position 12, the T and TG-1 relays release. As the switch breaks position 12 1/4 the CI relay releases.

27. With the sender switch in position 14, the fundamental circuit is closed for incoming brush selection. The circuit is from battery through the winding of the line relay in the incoming circuit, over lead F?, S and ADV relays normal, inner contacts of cam S, class cam O, sender cam N, winding of the OFL relay, BO relay normal, windings of the STP relay, sender cam X, T-1 brush and terminal, compensating resistance, lower contacts of sender control cam V, ADV-1 relay normal, over lead FR to ground in the incoming circuit. Incoming and office selections are similar except that in the former the circuit for operating the counting relays is closed through the upper contacts of cam U, terminal and TH-3 brush.

28. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate. The operation of the BO relay opens the fundamental circuit and the operation of the FO relay advances the sender switch to position 15 releasing the counting relays. The sender switch is advanced to position 16 in a circuit from battery through the R-2 magnet to ground through cam C and break contact of the IA relay. While the switch is advancing through position 15, the STP relay operates as similarly described with the switch advanced in position 7.

29. With the sender switch in position 16, the fundamental circuit is closed, and incoming group selection is made in the same manner as described for incoming brush selection except that the counting relay circuit is closed through the lower outer contact of cam U, TH-6 brush and terminal and the IG relay normal. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate. The operation of the BO relay opens the fundamental circuit and the operation of the FO relay advances the sender switch to position 17 releasing the counting relays. The sender switch is advanced to position 17, from ground operated FO relay, normal IA relay, sender control cam I, sender cam C, R magnet to battery. The A cam advances the switch to position 18.

30. As the sender switch advances through position 17 to position 18, a circuit is closed from battery through the sender control R magnet, cam B, sender cam D, to ground at class cam F, advancing the sender control cam switch to position 4. As the sender control switch enters position 4, ground on the upper inner contact of the sender control cam F maintains a short circuit on the outer winding of the BC relay following the removal of ground through the lower inner contact of sender cam J, which occurs when the sender switch advances from position 18.

FINAL SELECTIONS

31. With the sender switch in position 18, the fundamental circuit is closed, for final brush selection from battery through one winding of the final L relay, over lead FT, S and ADV relays normal, top outer contact of sender control cam S, sender cam N, windings of the OFL relay, BO relay normal, windings of the STP relay, top outer contact of sender cam X, sender control cam M, COMP. RES. T-1 brush and terminal, (beyond office), compensating resistance, control cam V, ADV-1 relay normal, lead FR to ground in the incoming circuit. Final brush selection is made in the same manner as incoming brush selection, except that the operating circuit for the counting relays is through the upper outer contacts of sender cams L and I, STP relay operated, IA relay normal, sender control cam N, sender cam S, H-6 terminal and brush, over one of the counting relay cross connection leads, winding of the counting relay to battery at sender control of cam X. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate. The operation of the BO relay opens the fundamental circuit and the operation of the FO relay advances the sender switch to position 1 releasing the counting relays. As the switch enters position 1 on the second revolution, a circuit is closed from battery, through the winding of the sender switch R magnet, cam C, TS-2 and TS-1 relays operated, to ground advancing the sender switch to position 2.

32. As the sender switch advances through position 1 to position 2, the S relay operates if the T register has not yet advanced from normal, from battery, winding, DWO relay normal, sender cam F, control cam P, terminal 4 and RC-4 brush, to ground at the operated RLS relay. The operation of the S relay opens the fundamental circuit, thus preventing the operation of the STP relay for final tens selection, until the tens digit has been dialed. The RC switch then advances to terminal 5, releasing the S relay. The release of the S relay closes the fundamental circuit for final tens selection. Final tens selection is made in a similar manner as final brush selection, except that the counting relays operate through sender cam S and the T-3 terminal and brush. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate, opening the fundamental circuit and advancing the sender switch to position 3. The A cam advances the switch to position 4. The counting relays release as the switch advances from position 2.

33. As the sender switch advances through position 3 to position 4, the S relay operates if the U register has not been advanced from normal, CIRCUIT: DWO relay normal, sender cam F, lower contacts of control cam K, terminal 5 and RC-4 brush, to ground at the operated RLS relay. The operation of the S relay opens the fundamental circuit, preventing the operation of the STP relay for final units selection until the units digit has been dialed. The RC switch is then advanced to terminal 6, closing a circuit from battery through the primary winding of the ON-2 relay and a 58 ohm resistance in parallel winding and break contact of the RC magnet, RC-2 brush and strapped terminals 2 to 8 inclusive, class cam F, strapped terminals and brushes of the U-2, H-2 and TF-2 arcs, terminal and T1-SD brush, RA relay normal, RLS relay operated to ground. The RC magnet alternately operates and releases in this circuit, thereby stepping the RC brush assembly to terminal 9. The S relay releases when the RC switch advances from terminal 5, closing the fundamental circuit for final units selection. Final units selection is made in the same manner as final brush selection, except that the circuit for operating the counting relays

passes through the lower inner contact of cam S, DMP relay normal, U-3 terminal and brush. When sufficient impulses have been received to satisfy the sender, the BO and FO relays operate, opening the fundamental circuit and advancing the sender switch to position 5. The counting relays release when the switch advances from position 4. The A cam advances the switch to position 6.

INCOMING ADVANCE AND TALKING SELECTION

34. With the sender switch in position 6, a circuit is closed from battery through the incoming line relay, over the ring of the fundamental circuit, the ADV-1 relay normal, control cam V, compensating resistance, COMP. RES. T-1 (Beyond Office) terminal and brush, control cam M, sender cam X, windings of the STP relay, BO relay normal, winding of the OFL relay, sender cam N, control cam S, ADV and S relays normal, lead FT to ground in the incoming circuit. The current flow in this circuit is in the proper direction to operate both the ST and OFL relays. The OFL relay operated, locks through its 6400 ohm winding, cam K, to ground on its make contact. The operation of the OFL relay also closes a circuit from ground on its make contact, to battery through the winding of the IA relay. The IA relay operated, operates the zero counting relay. CIRCUIT: Ground, sender cam I, STP relay operated, sender cam L, IA relay operated, 0 lead, to battery at control cam X, through the winding of the 0 relay. The closing of the fundamental circuit to operate the STP and OFL relays, advances the incoming sequence switch, thereby opening the fundamental circuit and when the STP relay releases, the BO and FO relays operate in parallel. The operation of the FO relay operates the ADV. and ADV-1 relays. CIRCUIT: Ground on the armature of the FO relay, IA relay operated, sender control cam Q, M-4 brush and strapped terminals 17 and 22, to battery through the windings of the ADV. and ADV-1 relays, which are held operated to ground at sender control cam T. The operation of the ADV-1 relay opens the FR lead, energizes the sender control R magnet advancing the sender control switch to position 5 and energizes the sender R magnet advancing the sender switch to position 7 releasing the OFL relay in turn releasing the IA relay.

35. The STP relay operates in position 7 and the sender switch advances to position 8 from ground at the IA relay normal and cam C. The operation of the ADV. relay, disconnects ground from the SC lead, releasing the district line relay advancing the district, thus opening the dialing leads to the sender and releasing the sender L relay. The release of the sender L relay releases the SLR and RLS relay, closing a circuit from battery through the inner winding of the district L relay, lead FT, S relay normal, ADV. relay operated, cams M and N, windings of the OFL relay, BO relay normal, windings of the STP relay, 1000 ohms resistance, sender control cam J, terminal 9 of RC-1 brush to ground on the SLR relay normal. The STP relay operates operating the zero counting relay from battery, sender control cam X, winding of the 0 counting relay, lead 0, terminal and T-1 TALK. SEL. brush, OV relay normal, sender control cam N, IA relay normal, sender cam L, STP relay operated, to ground on cam I. As the district advances to its talking position, it connects ground to the tip side of the fundamental circuit, thereby short circuiting and releasing the STP relay in the sender. The STP relay alternately releases and reoperates until the 0, BO and FO relays are operated. The operation of the BO relay opens the fundamental circuit, releasing the district L relay, thus stopping the district switch in the

proper talking position for this class of call. The operation of the FO relay closes a circuit from ground on its armature, IA relay, normal control cam I, to battery through the sender control R magnet, advancing the sender control switch to position 6. The release of the district L relay disconnects ground from the test lead. With the control switch in position 6, the sender switch is advanced to normal from battery through the R magnet cam C to ground at control cam U.

RESETTING REGISTERS

36. When the sender control switch enters position 3 after the setting of the translator as described in paragraph 16, a circuit is closed from ground on the armature of the CL relay normal, class cams N, sender control cams G and H, A-1 brush and terminal 9, contact and winding of the A magnet, to battery through a 44-E resistance and secondary winding of the ON-2 relay in parallel. The A magnet and ON-2 magnet operate and the A register is stepped to terminal 11. A circuit is closed from ground on control cam N, through the B magnet, stepping the B register to terminal 11 in the same manner. The ON-2 relay releases as the A and B registers step to terminal 11.

37. When the sender control switch enters position 4 for incoming group selection as described in paragraph 30, a circuit is closed from ground on the armature of the CL relay, class cam N, control cam R and sender cam D, control cams G and H, A-1 and B-1 brushes and 11 terminals, outer contacts of sender control cam E, TH-1 brush and strapped terminals, through the contact and winding ot the TH magnet, to battery through the secondary winding of the ON-1 relay and 44-E resistance in parallel. The TH magnet and ON-1 relay operate, stepping the TH register to terminal 11. This circuit is extended through the H magnet, stepping the H register to termonal 11. As the sender control switch enters position 5 for incoming advance as described in paragraph 34, the T and U registers, (SH, ST, and SU registers, when used) are returned to normal in like manner. The circuit from ground at the CL relay as traced above is extended through terminal 11 of the H-1 arc, sender control cam E to arc T-1. When the T register is stepped to terminal 11, the U register is stepped.

RETURN TO NORMAL

38. When ground is removed from the test lead by the release of the district L relay, as described in paragraph 35, the T-1 relay operates in the circuit described in paragraphed 6. The T-1 relay operated, (a) locks through both windings in series to ground on its armature, (b) releases the T relay, and (c) connects ground to the test lead through its 80 ohm winding, causing the test terminal of the sender selector to test busy. The release of the T relay closes a circuit from ground on its armature, terminal 9 and RC-2 brush, break contact and winding of the RC magnet, to battery through the 44-E resistance and winding of the ON-2 relay in parallel, stepping the RC switch to terminal 10.

39. With all the registers normal a circuit is closed from battery through the 44-E resistance and winding of the ON-2 relay in parallel, break contact and winding of the RC magnet, RC-2 brush and 10 terminal, 11 terminals and brushes of the SH-1, U-1, and T-1 registers, outer contacts of sender

control cam F, 11 terminals and brushes of the H-1 and TH-1 registers, outer contacts of sender control cam E, 11 terminals and brushes of the B-1 and A-1 registers control cams H and G, sender cam D, sender control cam E, class cam N, normal CL relay to ground stepping the RC register to terminal 11 releasing the ON-2 relay. With the RC brush on terminal 10, a circuit is closed from battery through the winding of the sender control R magnet, cam B, 11 terminal and brush of the RC-1 arc, to ground on the armature of the SLR relay, advancing the sender control switch to position 6.

40. The sender R magnet energizes from battery winding, lower inner contact of cam C, sender control cam U to ground advancing the sender switch to normal. The advance of the sender switch to position 1, closes a circuit from battery through the sender control R magnet, control cam C, impulser cam Y, cam Q, 11 terminal and RC-1 brush, to ground on the SLR relay normal, advancing the sender control switch to its next normal position. When the sender control switch advances from position 6 to normal, the ON relay releases if all the switches and registers are in their normal positions. The release of the ON relay releases the SB relay. The release of the SB relay releases the T-1 relay thus removing the busy condition (ground) from the test lead. The class switch does not advance to normal, but remains in whatever position it was set.

ABANDONED CALLS

41. If the receiver is replaced on the switchhook before district selection and trunk hunting are completed, the sender L relay fails to operate or release if already operated, causing the release of the SLR relay. The release of the SLR relay, (a) prevents the operation of or releases the RLS relay, (b) operates the DWO relay through cam W, SLR relay normal, SC relay operated, RLS and L relays normal to ground on the armature of the T relay operated, and (c) closes a circuit from ground on the SLR relay normal, RC-1 brush and strapped terminals 1 to 8 inclusive, break contact and winding of the RC magnet to battery through the 44-E resistance and primary winding of the ON-2 relay in parallel, stepping the RC switch to terminal 9. The DWO relay operated, (a) locks to ground at the T relay operated, (b) connects ground on its armature and through its make contact to lead SC, short circuiting the 500 ohm winding of the SC relay, releasing the sender SC relay and the district D relay. The district then returns to normal, disconnecting ground from the REST lead releasing the T relay. The release of the T relay, (a) releases the DWO and SC-1 relays, (b) closes a circuit from battery through the primary winding of the ON-2 relay and 44-E resistance in multiple, winding and back contact of the RC magnet, RC-2 brush and terminal 9, to ground on the T relay normal, advancing the RC switch to terminal 10. The sender control R magnet energizes from battery, winding, bottom inner contact of cam C, normal T relay to ground, advancing the switch to position 5. When the sender control switch enters position 5, and until it advances again from normal, the circuit is closed from ground through control cam H, advancing all off-normal registers and the RC switch to normal as described in paragraph 39. With the RC switch normal, the sender control switch advances to position 6, from battery through the R magnet, bottom inner contact of cam C, 11 terminal and RC-1 brush, to ground at the SLR relay normal. With the sender control

switch in position 6, return to normal is made as in paragraph 40.

42. If the call is abandoned without dialing after the L and RIS relays are operated, the release of the L relay closes a circuit through the winding of the A register magnet as described in paragraph 14 before the RIS relay releases. The release of the RIS relay opens the circuit through the winding of the A register magnet, stepping the A register to terminal 1. The PP relay operates as described in paragraph 114 but as the RIS relay has released, the PP relay also releases thus closing a circuit in which the A register is returned to normal as described in paragraph 37.

43. When a call is abandoned and its associated district selector has advanced for selection beyond position, the DVO relay operates as described in paragraph 41 but all selections up to and including talking selection must be made before the sender and district can return to normal. Office test and selections are completed as described under this heading (1.05) in paragraphs 22 to 24 inclusive. The operation of the DVO relay connects the O counting relay to cam V for incoming brush and incoming group selection and to cam T for final brush and tens selection, the counting relay circuits otherwise being as described in paragraphs 25 to 35 inclusive. The counting relay circuit is open for final units selection, allowing the final selector to go to tell tale. Incoming advance, talking selection, resetting registers and return to normal completed as described in paragraphs 34 to 40 inclusive.

TIME MEASURE AND ALARM (X AND J WIRING.)

44. During the progress of the call, the time measure and alarm circuit functions to indicate a permanent signal, partial dialing or stuck sender condition. When the MS relay operates as described in paragraph 10 it locks through its make contact to the same ground. When the 152-E interrupter contacts are closed, the STP magnet is energized from battery winding, make contact of the 152-E interrupter, normal terminal 22 and M-5 brush, MS relay operated, TMA and MSL relays normal to ground. When the interrupter opens this circuit, the STP magnet releases, stepping the time measure and alarm switch to terminal 1. When the interrupter contacts again close, the STP magnet is energized, through terminal 1 and M-5 brush and when the circuit is opened, the STP magnet releases, stepping the switch to terminal 2. The switch is then stepped to terminal 3 by the closing and opening of the 152-E interrupter contacts. If the register control switch has not been advanced from normal, the time measure switch cannot step from terminal 3. A circuit is closed from battery through the sender monitor lamp (green), terminal 3 and M-5 brush, MS relay operated, TMA and MSL relays normal, to ground, lighting the lamp to indicate a permanent signal condition. Ground at the armature of the normal MSL relay is connected through the TMA and the MSL relays normal, the M-6 brush and terminal 3 to the "Miscellaneous Auxiliary Signal Circuit."

45. If the RC switch has stepped off normal, the TMA relay operates from battery through its winding, M-3 brush and strapped terminals 1 to 5 inclusive strapped terminals 1 to 8 inclusive and RC-3 brush, the SSR relay normal, to ground on the armature of the operated RIS relay. The operation of the TMA relay closes a circuit from battery through the winding and break

contact of the STP magnet, TMA relay operated, to ground as described for operating the TMA relay. The time measure switch is thereby stepped to terminal 6, independently of the interrupter releasing the TMA relay.

46. A circuit is again closed through the interrupter, strapped terminals 6 to 8 inclusive and M-5 brush, stepping the switch to terminal 9. If at this time the RC switch has not advanced to terminal 9, the time measure switch cannot leave terminal 9 and the green sender lamp flashes in unison with the contacts of the 149-F interrupter, terminal 9 and M-5 brush to indicate an unfinished dialing condition. Ground is connected to terminal 9 and M-6 brush and the lead S to the miscellaneous "Auxiliary Signal Circuit", as described for terminal 3.

47. If the RC switch has been stepped to terminal 9, the TMA relay operates through the M-3 brush and strapped terminals 6 to 11 inclusive terminal 9 and RC-3 brush, SSR relay normal, RLS relay operated to ground. The operation of the TMA relay closes a circuit through the STP magnet stepping the time measure switch to terminal 12, independently of the interrupter. The lamp stops flashing when the switch steps from terminal 9. The SKS relay not being operated for a direct mechanical call, the TMA relay does not release as the switch steps from terminal 11, but holds in a circuit from battery through its winding, M-3 brush and strapped terminal 12 to 16 inclusive, to ground through the SKS and MSL relays normal. With the TMA relay operated, the STP magnet operates and releases, stepping the time measure switch to terminal 17.

48. The TMA relay releases as the switch steps from terminal 16. The STP magnet circuit is closed through the 152-E interrupter, strapped terminals 17 to 19 inclusive and M-5 brush, stepping the switch to terminal 20. If the sender has not returned to normal when the switch steps to terminal 20, ground is connected through terminal 20 and the M-6 brush to the lead "To Miscellaneous Auxiliary Signal Circuit" as described for terminal 3, and the green sender lamp flashes in a circuit through the break contacts of the SKS relay, 149 type interrupter, terminal 20 and M-5 brush, to indicate a stuck sender. When the sender returns to normal, the release of the ON relay releases the MS relay. The release of the MS relay at this or any other time, closes a circuit from battery through the TMA relay strapped terminals and M-1 brush, to ground through the MS relay normal. The TMA relay operated, closes the STP magnet circuit to the same ground, stepping the switch to terminal 22 or normal.

REGULAR MECHANICAL CALLS USING OFFICE SELECTOR - COIN (Y WIRING)

OPERATION OF TIME MEASURE CIRCUIT

49. The registers are set and translation and selection are made as described for a non-coin call, except that the dialing circuit as traced in paragrapg 11 is from the T lead, MSL, C-1, CT-7 and Ct-2 relays normal, winding of the repeating coil to ground and from the R lead MSL, C-1, CT-7 and CT-2 relays normal, winding of the L relay to battery and also the time measure and alarm circuit makes a preliminary coin test. When the MS relay operates as described in paragraph 6, it locks to the operating ground. When the interrupter contacts close, the STP magnet is energized through a circuit

and its winding, make contact of the 152-E interrupter, terminal 22 (N terminal) and M-5 brush, the TMA relay normal, the MS relay operated, to ground at the C and MSL-1 relays normal. When the interrupter opens this circuit, the STP magnet releases, stepping the time measure switch to terminal 1. The switch is stepped to terminal 3 under control of the interrupter. If the RC switch has not been stepped off normal when the time measure switch steps to terminal 3, a circuit is closed from battery through the sender monitor lamp, (green), the CT-1 and C-2 relays normal, terminal 3 and M-5 brush, TMA relay normal, MS relay operated, to ground at the C and MSL-1 relays normal, lighting the lamp to indicate a permanent signal condition. Ground is connected through the M-6 brush and terminal 3, the TMA and MSL-1 relays normal. "To The Miscellaneous Auxiliary Signal Circuit". If the RC switch has stepped off normal, the TLA relay operates through strapped terminals N to 4 and M-3 brush and the switch steps to terminal 5 independently of the interrupter in a similar manner, to the operation of the TMA relay and the advance of the non-coin switch to terminal 5 as described in paragraph 45. The TLA relay releases, when the switch advances from position 4.

50. The STP magnet circuit is closed through the 152-E interrupter, strapped terminals 5 to 7 inclusive and M-5 brush to ground as for terminal 1, stepping the switch to terminal 8. If at this time the RC switch has not advanced to position 9, the time measure switch cannot advance from position 8 and the green sender lamp flasges to indicate an unfinished dialing condition from battery, through the lamp, CT-1 and C-2 relays normal, 149-F interrupter contacts, terminal 8 and M-5 brush, TLA relay normal, MS relay operated, to ground at the C and MSL-1 relays normal. The TMA relay operates with the RC switch on terminal 9 from battery, through its winding, M-3 brush and strapped terminals 5 to 8 inclusive, terminal 9 and RC-3 brush, to ground at the operated RLS relay. The operation of the TMA relay closes a circuit through its make contact, from batteryythrough the STP magnet to the same ground on the armature of the RLS relay, stepping the time measure switch to terminal 9. The TMA relay is held operated as the time measure switch steps from terminal 8 from battery, through its winding, M-3 brush and strapped terminals 9 to 12 inclusive, the SKS and C relays normal, to ground at the MSL-1 relay, thereby stepping the time measure switch to position 13 terminal releasing the TMA relay.

51. The CT-1 and CT-2 relays operate from ground at the operated ON relay, M-2 brush and strapped terminals 13 to 17, normal C-5, SKS and CT relays, dividing beyond this point into two paths, one through the break contact of the CT-7 relay, winding of the CT-2 relay to battery and the other through the break contact of the CT-3 relay, winding of the CT-1 relay to battery. At this time the winding of the CT-3 relay and 1000 ohm winding of the CT-4 relays are short circuited. The CT-1 relay operated operates the TMA relay from battery, M-3 brush and terminal 13, operated CT-1 relay, normal MSL-1 relay to ground. The TLA relay operated, energizes the STP magnet stepping the time measure switch to terminal 14 releasing the TLA relay.

PRELIMINARY COIN TEST

52. The time measure switch steps from terminal 14 to 17 under control of the 152-E interrupter in a circuit through strapped terminals 14 to 16 inclusive and M-5 brush. The operation of the CT-2 relay, (a) operates the CB relay from battery, winding operated CT-2 relay, terminal 14 and brush of arc M-6 to ground and is held operated as the time measure switch steps from terminal 14 from battery, winding, operated CT-2 relay, operated CB relay, normal C-3 relay, strapped terminals 13 to 17 and brush of M-2 arc, operated ON relay to ground, (b) disconnects the dialing circuit from the L relay and the 66-A repeating coil, (c) closes a circuit from battery through the winding of the L relay, the CT-2 relay operated, 800 ohm non-inductive winding of the MSL relay to ground on the armature of the operated RIS relay, thereby holding the L relay operated. The CB relay operated closes a circuit from 48 volt battery through the 18-BA resistance, CB relay operated, 1000 ohm winding of the CT-9 relay, CT-3 relay normal, CT-2 relay operated, CT-7, C-1 and MSL relays normal, over the lead T to the subscriber's line, and from 110 volts coin battery, operated CB relay 18-BA resistance (b), 950 ohm winding of the CT-9 relay, CT-3 relay normal, CT-2 relay operated, CT-7, C-1 and MSL relays normal, over lead R to the subscriber's line. The CT-9 relay operates if a coin has been deposited but does not operate on a 10,000 ohm leak.

53. The CT-9 relay locks through its 950 ohm winding through strapped terminals 13 to 17 inclusive and the M-2 brush to ground at the operated ON relay. The operation of the CT-9 relay closes a circuit from 48 volt battery at the CT-9 relay operated, winding of the CT-3 relay to the CN, SKS and C-3 relays normal, to ground at the operated ON relay through the strapped terminals 13 to 17 inclusive and the M-2 brush, operating the CT-3 relay. The operation of the CT-3 relay, (a) opens the circuit from 48 volt battery through the 1,000 ohm winding of the CT-9 relay and 110 volts battery through the 950 ohm winding of the CT-9 relay, (b) closes a circuit from 110 volt battery, CB relay operated, 1500 ohm winding of the CT-4 relay, CT-3 and CT-2 relays operated, CT-7, C-1 and MSL relays normal, lead R and (d) closes a circuit from ground, operated ON relay, strapped terminals 13 to 17 and brush of arc M-2, normal C-3, SKS and CN relays, break contact of the CT-4 relay, 350 ohm winding of the CT-4 relay, CT-3 and CT-2 relays operated, CT-7, C-1 and MSL relays normal to lead R, short circuiting 48 volt battery at the operated CT-9 relay through the 18-BH resistance to one winding terminal of the 350 ohm winding of the CT-4 relay. The operation of the CT-3 relay also opens the circuit through the winding of the CT-1 relay but the CT-1 relay is slow to release and does not release until the CT-4 relay has had time to operate. The CT-4 relay operates if there is solid ground on the line, thereby closing a circuit through the winding of the CT-1 relay preventing its release. The CT-4 relay does not operate if the resistance to ground on the subscriber's line, is that of the coin collect magnet, and the CT-1 relay releases.

54. If the time measure switch enters position 17 before the CT-1 relay releases, due either to the failure of the CT-9 relay to operate or to the operation of the CT-4 relay, the red coin lamp flashes in a circuit through the CT-1 relay operated C-2 relay normal, contacts of the 149-F interrupter, terminal 17 and M-5 brush, TA relay normal, MS relay operated, C relay operated to ground on the MSL-1 relays normal. Under these conditions, the S relay operates when the sender switch enters position 3 for final tens selection from battery through its winding, SA relay normal, sender cam F, top outer of control cam A

to ground at the CT-1 relay operated. The operation of the S relay opens the fundamental circuit, preventing final units selection and the sender is released by the sender monitor operator as described in paragraph 120. With the time measure switch in position 17 and the TMA relay normal, ground is connected from the M-6 brush and terminal 17, TMA and MSL-1 relays normal, to the "Miscellaneous Auxiliary Signal Circuit."

55. The release of the CT-1 relay, if the coin has been deposited, closes a circuit from battery, winding of the TMA relay, M-3 brush and strapped terminals 14 to 17 inclusive, CT-1 relay normal, to ground at the MSL-1 relay normal, operating the TMA relay. The operation of the TMA relay energizes the STP magnet, stepping the time measure switch to terminal 18 releasing the TMA, CT-2, CT-3 and CT-9 relays.

56. The time measure switch is stepped from terminal 18 to terminal 21 by the operation of the STP magnet in a circuit through the contacts of the 152-E interrupter, strapped terminals 18 to 20 of the M-5 brush, TMA relay normal, MS relay operated, to ground through the C and MSL-1 relays normal.

57. If the sender has not returned to normal when the switch steps to terminal 21, ground is connected through terminal 21 and M-5 brush to the "Miscellaneous Auxiliary Signal Circuit." The green sender lamp flashes in a circuit through the contacts of the 149-H interrupter, terminal 21 and M-5 brush, indicating a stuck sender. When the sender returns to normal, the release of the SB relay releases the MS relay. The release of the MS relay at this, or at any other time, closes a circuit from battery through the winding of the TMA relay, strapped terminals, and M-1 brush to ground at the MS relay. The TMA relay operated, energizes the STP magnet, stepping the switch to terminal 22 releasing the TMA relay.

58. Calls originating at coin stations for which no charge is made, (free routes) the CN relay operates at the completion of translation from battery, secondary winding, lead 1 or 2, terminal and T-1 - SKO brush, control cam E, to ground at cam U. The CN relay operated, locks through its continuity contacts. The time measure and alarm switch will function as described in the preceding paragraphs, until it steps to terminal 13 for a preliminary coin test. The CT-1 and CT-2 relays do not operate, but the TMA relay operates from battery, winding, M-3 brush and terminal 13, CN relay operated, SKS and C-3 relays normal, strapped terminals 13 to 17 inclusive and M-2 brush, to ground at the CN relay. The operation of the TMA relay energizes the STP magnet, stepping the switch to terminal 14. The TMA relay is held operated through the M-3 brush and strapped terminals 14 to 17 inclusive, CT-1 relay normal, to ground on the armature of the MSL-1 relay, stepping the switch to terminal 18, releasing the TMA relay. From this point, the operation is as described in paragraphs 56 and 57.

COIN COLLECT AND RETURN

59. When the receiver is replaced on the switchhook at the calling station, the district selector selects an idle sender for the purpose of collecting or returning the coin. The T, CN, SB, MS, SC and SC-1 relays operate as described under Sender Selected (1.01), paragraph 10. If the charge relay in the district is operated, ground is connected over lead FR, ADV-1 relay normal, sender control cam V, to battery through the [illegible]

the CC relay, operating the CC relay. The operation of the CC relay operates the DWO relay from battery, winding, CC relay operated to ground on the FR lead. The DWO relay operated, locks to the same ground. The C-3 relay operates from battery, both windings and make contact, normal ADV, C and SSR relays, operated DWO relay to ground and is held operated through its continuity contacts to the same ground. The C relay operates from battery, primary winding MS relay operated, terminal 22 and M-1 brush, MS and C-3 relays operated, normal ADV, and SSR relays normal, to ground on the armature of the DWO relay operated. The C relay operated, locks through its secondary winding through its continuity contacts to ground at the DWO relay and operates the TMA relay, from battery, winding, terminal 22 and M-4 brush, C relay operated, to ground at the normal MSL-1 relay. The operation of the TMA relay closes a circuit from battery through the winding and back contact of the STP magnet and the TMA relay operated to ground at the normal MSL-1 relay, stepping the switch to terminal 2. The TMA relay is held operated through strapped terminals 2 to 8 stepping the switch to terminal 9 releasing the TMS relay.

60. The C-1 relay operates from battery, winding, strapped terminals 9 to 12 inclusive and M-4 brush, C relay operated, to ground at the normal MSL-1 relay. The operation of the C-1 relay operates the CB and C2 relays. The operation of the CB relay closes a circuit from positive coin battery CB relay operated, winding of the CT-5 relay, CC and C-1 relays operated, MSL relay normal to the tip and ring of the line. The CT-5 relay operates if there is a coin in the coin box, operating the CT-6 relay which is held operated through its make contact, C-3 relay operated, SSR relay normal to ground at the operated DWO relay. The operation of the CT-6 relay opens the circuit which gives an alarm during final coin test as described in paragraph 65.

61. The operation of the C-2 relay closes a circuit from battery, winding of the STP magnet, the C-2 relay operated, contacts of the 149-F interrupter, C-2 relay operated, strapped terminals and brush of arc M-2, ON relay operated to ground. As the interrupter makes and breaks contact, the switch steps to terminal 13. As the switch steps from terminal 12, the C-1 relay releases, releasing the CB and C-2 relays. The C-1 relay is held operated through terminal 12 for the purpose of holding a circuit to ground through the 2 m.f. condenser and 1200 ohms resistance until the coin magnet in the coin box has had time to discharge thus protecting the multiple bank. The release of the C-2 relay opens the circuit through the STP magnet, stopping the switch on terminal 13.

62. If the coin is to be returned, the charge relay in the district selector circuit does not connect ground to the FR lead and the CC relay does not operate but the time measure and sender circuits function, as described in the preceding paragraph, except that negative coin battery is connected to the tip and ring of the line through the CB relay operated, CC relay normal, C-1 relay operated and the MSL-1 relay normal. The switch steps to terminal 13 as described in the preceding paragraph.

FINAL COIN TEST

63. The CT-7 relay operates from battery, winding the C relay operated strapped terminals 17 to 13 and brush of arc M-2, operated ON relay to ground.

The operation of the CT-7 relay connects battery through the windings of the CT-8 relay, to the tip and ring side of the line. If the coin has not been collected or returned by this time, or if either side of the line is grounded in some other way, the differentially wound relay CT-8 operates, operating the CT-1 relay. The CT-1 relay operated, operates the TMA relay, through the M-3 brush and terminal 13 the CT-1 relay operated, to ground at the normal MSL-1 relay.

64. The time measure switch steps from terminal 13 to terminal 14 in a circuit through the STP magnet, contacts of the 149-H interrupter, CT-7 relay operated, terminal 13 and M-4 brush, C relay operated, to ground at the MSL-1 relay. The operation of the TMA relay (in case the CT-1 relay operates) also closes the circuit in which the STP magnet operates, stepping the switch from terminal 13 to terminal 14. The TMA relay operates, (or holds if already operated) through strapped terminals 14 to 16 inclusive and M-4 brush C relay operated, to ground on the armature of the MSL-1 relay, stepping the switch to terminal 7 releasing the TMA relay. If operated, the CT-1 relay prevents the advance of the switch from terminal 17. If the coin has not been collected by the time terminal 17 is reached and with the CC relay operated, a circuit is closed from battery, through the red coin lamp, CT-1 relay operated, contacts of the 149-H interrupter, terminal 17 and M-4 brush, C relay operated, to ground at the MSL-1 relay. The lamp flashes in this circuit, indicating that the coin has not been collected, or that there is some other ground on the line.

65. If the coin should have been returned, and there is a ground on the line the CC relay being normal, the red coin lamp lights permanently in a circuit through the CT-1 relay operated, CC relay normal, terminal 17 and M-4 brush to ground at the MSL-1 relay.

66. If, when coin collect battery was connected to the line in paragraph 60, the CT-5 and CT-6 relays did not operate, the CT-8 relay does not operate as in paragraph 63. The CT-1 relay operates from battery, winding, CC relay operated, CT-6 relay normal, C relay operated to ground through strapped terminals 17 to 13 and M-2 brush. In any case the operation of the CT-1 relay prevents the switch from stepping beyond terminal 17, the red lamp flashing or lighting as above described.

RETURN TO NORMAL

67. In case the coin has been properly collected returned, and the line is clear, the CT-1 relay is not operated and the TMS relay holds through terminals 17 to 14 and brush of arc M-3, CT-1 relay normal, to ground on the armature of the MSL-1 relay, stepping the switch to terminal 18 releasing the TMS relay. The CT-7 relay also releases as the switch steps from terminal 17. The time measure switch steps to terminal 21 as described in paragraph 56 giving a stuck sender alarm as described in paragraph 57 if the sender has not by this time returned to normal.

68. When the time measure switch "makes" terminal 18, ground is connected from the armature of the operated ON relay, M-2 brush and strapped terminals 18 to 21 inclusive, C relay operated, ADV relay normal to lead SC, releasing the D relay in the district, advancing the district to normal. As the district advances to normal ground is disconnected from lead FR, releasing the CC relay, and from the TMS lead, allowing the CT-1 relay to operate and the

T relay to release as described in paragraph 38. The release of the T relay releases the ON, SB, MS, SC-1, and DWO relays. The release of the DWO relay releases the C and C-3 relays and the CT-8 relay if operated. The release of the MS relay steps the time measure switch to terminal 22 releasing the T-1 relay.

CALLS TO MECHANICAL A.B.X.

69. For this class of call, the sender functions as described in paragraphs 5 to 33 inclusive, except that the SH, ST and SU registers are set in a similar manner to the setting of the other numerical registers. The RC switch, instead of advancing from position 6 to position 9, as described in paragraph 33, advances one step when the RA relay releases, after the setting of the station registers in a similar manner to its advance from normal to position 6.

70. With the translation completed, a circuit is closed through the top outer contact of class cam B, lead L, terminal and brush of the T2-CL translator arc, operating the CL relay and advancing the class switch to position 8. As the sender switch advances through position 5, the S relay operates, if the RC switch does not advance from position 8, indicating that the station register has not been set. This circuit is from battery, winding of the S relay, DWO relay normal, sender cam G, class cam G, control cam D, strapped terminals 6 to 8 inclusive and RC-4 brush to ground on the RIS relay operated. The operation of the S relay opens the fundamental circuit, preventing the operation of the STP relay for station hundreds selection.

71. When the station registers have been set, the RC switch steps to terminal 9 and the S relay releases, closing the fundamental circuit. Stations hundreds selection then takes place instead of incoming advance. The STP relay operates in the fundamental circuit for station hundreds, tens and units selections, closing circuits, to operate the proper counting relays from ground at sender cam I, STP relay operated, cam L, IA relay normal, control cam N, sender cam S and contacts of cam T, through the station hundreds, tens and units register arcs to the proper counting relays for the station hundreds, tens and units selections respectively. At the completion of each selection, the BO and FO relays operate, opening the fundamental circuit. The operation of the FO relay in position 6, advances the sender switch to position 7 from ground, FO relay operated, IA relay normal, control cam I, sender cam B to battery through the sender R magnet. In position 7, the STP relay operates as described in paragraph 22. The switch then advances to position 8 from ground through the IA relay normal and sender cam C.

72. The operation of the FO relay in positions 8 and 10 advances the switch to positions 10 and 12 respectively as described for position 6 with the help of cam A. In position 12, incoming advance is made as described in paragraphs 34, except that the operation of the ADV-1 relay advances the sender switch to position 15, instead of to position 7 releasing the BO, FO and IA relays. The STP relay operates as in position 7, and the sender switch advances to position 16 in a circuit through sender cam C to ground at the normal IA relay. Talking selection is completed, registers reset, and the sender circuit returned to normal as described in paragraphs 35 to 40 inclusive.

CALL TO ZERO OPERATOR AND ONE DIGIT CODES

73. On calls from a coin station to a zero operator or other one

digit code operators, the sender circuit functions as described in paragraphs 5 to 12 inclusive setting the A register in position 10 for the zero operator. With the RC switch in position 1, and the A register in position 10, (or any other position corresponding to a one digit code), a circuit is closed from battery through the winding and break contact of the RC magnet, RC-2 brush and terminal 1, terminal 10 and A-4 brush, RA relay normal, to ground on the armature of the RLS relay operated, stepping the RC switch to terminal 2 operating the ST relay.

74. When translation takes place, the switch steps to terminal 3, and the sender advances to position 2, as described in paragraph 14 to 17 inclusive. The terminals for one digit codes on the hunting arcs are connected directly to the terminals of arc A-3. The CL relay operates and the class switch is advanced to position 10 through class cam B, over lead F to the contact of the T2-TL translator arc. The CL relay releases as the class switch breaks position 9, and the RC switch is advanced from position 2 to position 9 from battery through the winding and break contact of the RC magnet, RC-2 brush and strapped terminals 2 to 8 inclusive, class cam H, CL relay normal, control cam O, to ground at the operated TS-1 relay.

75. District group and brush selections are made, the district selecting a trunk to the zero operator or other one digit code operator or station, and the sender advances to position 6, as described in paragraphs 18 to 21 inclusive. For this class of call, the CN relay operates as soon as the translator is set, from battery secondary winding and break contact terminal and brush of the T1-SKO arc, control cam E, to ground at control cam U and locks through its continuity contacts to the same ground. The operation of the CN relay holds the BO and FO relays after operating in position 4 until the sender switch advances from position 10, in a circuit through the sender cam R, CN relay operated, over lead 3, terminal and brush, of arc T1-SLO inner contacts of control cam E, to ground at control cam U. The TG, TG-1 and CI relays operate as described in paragraph 22, except that battery is connected to one winding of the L relay in the trunk circuit to zero operator, instead of the L relay of an office selector.

76. With the aid of cam A the sender advances from position 6 to position 12, in a circuit through cam C, control cam I, the IA relay normal, to ground at the operated FO relay. The TG, TG-1, and CI relays release as the switch advances from position 6. In position 12, the TG, TG-1, and CI relays operate and the switch advances to position 14, as described in paragraph 26. In position 14 the ADV and ADV-1 relays operate from battery, windings in parallel CT-6 and C-3 relays normal, class cam P, sender cam R, IA relay normal, to ground at sender cam J. The operation of the ADV-1 relay advances the control switch to position 5 through cam C, and advances the sender switch to position 15 through sender cam B. The sender switch advances to position 16 through cam C. The operation of the ADV relay disconnects ground from lead SC allowing the district L relay to release and advance the distirct, thus opening the dialing leads to the sender, releasing the sender L relay. The release of the sender L relay releases the SLR and RLS relays, operating the STP relay, and causing talking selection to be made as described in paragraphs 34 and 35 with the switch in position 8. The operation of the FO relay, closes a circuit in which the sender control switch advances to position 6. From this point on the registers are reset and the sender returns to normal as described in paragraph 68 inclusive.

77. On calls from a non-coin station to zero operator, or other one digit code operator, the sender functions as described in the preceding paragraphs, except that the counting relays hold in position 4 until the sender switch advances beyond position 10 through sender cam R, lead 2, terminal and brush of the T1-SKO translator arc.

CALL TO THREE DIGIT OPERATOR

78. On calls to long distance, information, complaint, repair Commercial Department, or other special operator, three digits are dialed. The sender is selected, registers are set and translation is made as described in paragraphs 5 to 17 inclusive. Only the first two digits are required to complete selections. The CL relay operates and the class switch advances to position 11 through cam D, over lead C to the T2-CL translator arc. The CL relay releases when the class switch advances from position 10, and the RC switch is then advanced from position 2 to position 9, as described in paragraph 74. From this point on the sender functions as described under "Call to Zero Operator" in paragraphs 73 to 77 inclusive.

CALL TO RESTRICTED ZONE

79. If a number is dialed which should be obtained by a toll operator, or if office code digits are dialed for which there is no office, the sender is selected, the registers are set, and translation made as described in paragraphs 5 to 17 inclusive. The CL relay operates and the class switch advances to position 9, through the upper inner contact of class cam D, over lead D to the T2-CL translator arc. The CL relay releases as the switch advances from position 8, and the RC switch is then advanced from position 2 to position 9, and the sender functions as described under "Call to Zero Operator" in paragraphs 74 to 76 inclusive.

CALL VIA R.C.I. TRUNKS

DIRECT RELAY CALL INDICATOR - NUMBER LESS THAN 10,000

80. When a call to a manual station is made via direct R.C.I. the sender is selected and the registers are set as described in paragraphs 5 to 13 inclusive except that the SH register is also set if the station is on a party line, the RC switch being advanced to terminal 7. If the party line is in a party line office with less than 10,000 lines, the RC switch is stepped from terminal 7 to terminal 9 from battery, winding and break contact of the RC magnet, RC-2 brush, and strapped terminals 2 to 8 inclusive, lower terminals of class H, strapped terminals 1 to 0 inclusive and the SH-6 brush, lead 1, terminal and T1-SD brush, RA relay, normal to ground at the RLS relay operated.

81. If this party line is in a party line office with more than 10,000 lines and the first digit is 1 the RC switch is advanced from position 7 to position 9 through the RC-2 brush and terminals, lower terminals of class cam H, strapped terminals 1 to 0 inclusive and the SH-6 brush, strapped terminal 1 to 9 inclusive and H-4 brush, terminal 1 and TH-4 brush, over lead 2, to the T1-SD arc. (Numbers whose first two digits are 10 will always be private lines).

82. If this party line is in a party line office with more than 10,000

lines, and the first digit is not 1, the RC switch is advanced, as just described except that the circuit to ground over lead 2 passes through strapped terminals 2 to 10 inclusive and the TH-4 brush. If the line is a private line in a private line office (either with more than 9999 or less than 10,000 line) the SH register is not set and the RC switch is stepped from terminal 6 to terminal 9, after sufficient time has elasped for the dialing of a station digit, as described below in paragraph 94.

83. If the line is a private line in a private line office with less than 10,000 lines, the RC switch is strapped from terminal 6 to terminal 9, through the RC-2 brush and terminals, class cam H, strapped terminals 1 to 0 inclusive and U-2 brush, over lead S, to the T1-SD translator arc.

84. If the line is a private line in a private line office with more than 9999 lines, and the first digit is 1 and the second digit is not zero, the RC switch is stepped from terminal 6 to terminal 9 through the RC-2 brush and terminals, lower contacts of class cam H, strapped terminals 1 to 0 inclusive and U-2 brush, terminals 1 to 9 inclusive and H-2 brush, terminal 1 and TH-2 brush, over lead 4, to the T1-SD translator arc. If the line is a private line in a private line office with more than 9999 lines, and the first digit is not 1, the RC switch is stepped as just described, except that the circuit to ground over lead 4 passes through strapped terminals 2 to 0 inclusive and the TH-2 brush. If the line is a private line office with more than 9999 lines and the first two digits are 10, a fifth digit not being dialed, the SH register is not advanced, and the RC switch is again advanced from terminal 6 to terminal 9 after sufficient time has elapsed for the dialing of a fifth digit, as described below under "Time Measure and Alarm" in paragraphs 75 to 77 inclusive. Translation is made as described in paragraphs 14 to 17 inclusive, except that the CL relay operates and the class switch advances to position 2, (or 13), through the upper outer contact of class cam C, over lead A, to the T2-CL translator arc. The CL relay releases when the switch advances from position 1, (or 12).

85. District and office selections are made and the sender switch advances to position 12 as described in paragraphs 18 to 24 inclusive. The S relay operates and functions as described in paragraph 25, if the RC switch has not advanced to position 4. With the sender switch in position 12, a circuit is closed from battery at the manual office, over the fundamental tip, S and ADV relays normal, control cam S, class cam O, sender cam O, windings of the TG, STP, and OFL relays, the BO relay normal, sender cam X, "COMP. RES. T-1 BEYOND OFF", translator brush, compensating resistance, control cam V, ADV-1 normal, over lead FR to ground in the manual office. The TG relay operates in this circuit causing the operation of the TG-1 and CI relays. The operation of the CI relay advances the sender switch to position 14, and during this advance the fundamental circuit is closed through the TG relay holding operated the TG-1 and CI relays and short circuiting the 14, 500 ohms resistance. This is traced through class cam O, the CI relay operated, and sender cam O. The guard lamp associated with the trunk at the RCI position lights.

86. With the switch in position 14, the TG relay remains operated until the distant operator depresses the display key associated with the lighted guard lamp. The release of the CL relay operates, the D relay from battery, winding, class cam E, CL relay normal, to ground at sender cam E. The D relay locks, until the impulse switch advances beyond position 9 1/2 through its make contact,

impulser cam D, class cam M, to ground through control cam U. The operation of the D relay closes a circuit in which the FP relay operates. The operation of the D relay also closes a circuit through the D relay operated, and impulser cam C, in which the impulser switch advances from position 1, ground on cam B advancing it to position 9. With the impulser switch in position 9, when the display key is depressed the TG relay releases, releasing the TG-1 and CI relays. The release of the CI relay closes the tip and ring sides of the fundamental circuit through its break contacts, sender cams Q and P, class cams J and L, to the contacts of the impulser switch cams.

87. The release of the CI relay also closes a circuit through impulser cam C, FP relay operated, class cam K, CI relay normal, to ground at sender cam H, advancing the impulser switch from position 9 to position 10. The B cam advances the switch to position 1. The D relay releases when the switch advances beyond position 9 1/2. The FP relay holds, after the D relay releases, through its make contact, impulser cam D, class cam M, to ground at control cam U. For the second time the impulser switch is advanced from position 1 to position 2 in the same circuit as from position 9 to position 10, the B cam advancing the switch to position 9. As the switch advances beyond position 2 1/2 in the second revolution, the FP relay releases. The switch is advanced from position 9 to 10 in a circuit through impulser cam C, to ground through the D relay normal, the B cam advancing the switch to normal. During the rotation of the impulser switch R.C.I. impulses are sent out to the manual office by connecting battery and ground to the tip and ring of the fundamental circuit, through the contacts of the impulser switch cams, for the purpose of operating that combination of relays in the manual office which will cause the called number to be displayed at the R.C.I. position.

88. The order in which those impulses are sent, is, stations, thousands, hundreds, tens and units. Four circuit conditions are established for each digit or letter displayed. Each one of these circuit conditions may be such as to send no impulse, to send a heavy negative impulse, or a light negative impulse. For example, to display station W, the following four circuit conditions are set up in the order named, (1) while the impulser switch advances from position 9 to position 9 1/2 an open circuit exists, (2) while the switch advances from position 10 to position 10 1/2 a heavy negative impulse is transmitted from battery through the 52.5 ohm resistance, impulser cam T, impulser cam Q, terminal 9 and SH-4 brush, class cam Q, impulser cam M, TAN relay normal, RIS relay operated, impulser cams G and H, FP relay operated, over the ringside of the fundamental circuit, back over the tip side, FP relay operated, impulser cam F, to ground through impulser I, (3) while the impulser switch advances from position 11 to position 11 1/2 an open circuit exists, (4) while the switch advances from position 12 to position 12 1/2 a light negative impulse is transmitted, from battery through the 3500 ohm resistance, impulser cams G and H, FP relay operated, over the ringside of the fundamental circuit back over the tip side, FP relay operated, impulser cam F, to ground through impulser cam I. In case the station is not on a party line, the first and third conditions are open circuits, and the second and fourth conditions cause light negative impulses to be transmitted, whereby the digit zero is displayed at the R.C.I. office to indicate that there is no party designation required.

89. Circuit conditions are established for transmitting impulses,

through the contacts of the impulser switch cams, for the thousands digit in positions 13, 14, 15, and 16, for the hundreds digits in position 17, 18, 19 and 20, for the tens digits in positions 1, 2, 3, and 4 and for the units digits in position 5, 6, 7 and 8. The switch advances from position 8 1/2 to 11 in the second revolution with the fundamental circuit open. While the switch advances from position 11 to position 12 1/2 a heavy positive impulse is transmitted from battery through the 52.5 ohm resistance, impulser cam Q, FP relay normal, class cam J, over the tip side of the fundamental circuit, back over the ringside, FP relay normal, to ground through cam I. This is to provide for the operation of a polarized relay in a proposed distant two wire office selector, in order to advance this selector, (such a selector is not yet designed).

90. As the impulser switch is advanced from position 13 to position 1, a circuit is closed, in which the ADV and ADV-1 relays operate, through impulser cam E, FP relay normal, class cam K, CI relay normal, to ground at sender cam H. The operation of the ADV relay advances the district selector, following which talking selection, resetting registers, and return to normal take place as described in paragraphs 35 to 40 inclusive.

TANDEM RELAY CALL INDICATOR - NUMBERS LESS THAN 10,000

91. On a call to a manual station via tandem R.C.I. whose number is less than 10,000, the circuit operates as described in the preceding paragraphs ip to the point where the display key is operated at the R.C.I. office, except (a) that the CL relay operates and the class switch is advanced to position 5, (or position 16) in a circuit through class cam C and lead B, to the T2-CL translator arc. The CL relay releases when the switch advances from position 4 (or position 15), (b) that the impulser switch is not advanced from normal until after the display key is operated, and (c) the TAN relay operates when the CL relay releases, in place of the D relay, causing the operation of the FP relay. The circuit in which the TAN relay operates, is from battery, winding, class cam E, break contact of the CL relay, to ground at sender cam H. The TAN relay locks until the switch advances beyond position 9 1/2 through impulser cam D, class cam M, to ground at control cam U.

92. When the display key is operated, the TG and TG-1, and CI relays release, closing a circuit in which the impulser switch advances, with the aid of cam B, from position 1 to position 9. This circuit is through impulser cam C, the FP relay operated, class cam K, CI relay normal, to ground at sender cam H. The impulser switch is advanced with the aid of cam B from position 9 to position 1 and again from position 1 to position 9 in the same circuit. The TAN relay releases when the switch advances beyond position 9 1/2, but the FP relay holds as described in the paragraph 87 until the switch advances from position 2 1/2 of the second revolution. The switch advances from position 9 to position 1 in a circuit through impulser cam C, to ground at the D relay normal. The release of the FP relay prevents the advance of the switch from normal a third time. Each manual office which is tandem to the originating office is assigned a tandem code number by means of which the particular office called is identified by the tandem operator. Impulses are transmitted over the tandem R.C.I. trunk for displaying the tandem code number in addition to those for displaying the called number. The order in which the impulses are transmitted is tandem tens, tandem units, stations, thousands, hundreds, tens and units.

93. During the advance of the impulser switch from position 1 to position 4 inclusive, four circuit conditions are established for tandem tens, according to the setting of the A register (arc A-5), as required. The impulses for tandem units are transmitted during the advance from position 5 to position 8 inclusive, according to the setting of the B register (arc B-5). The impulses for stations, thousands, hundreds, tens and units digits are transmitted, talking selection, resetting registers and sender returns are all completed as described in paragraphs 89 and 90.

OPERATING OF THE TIME MEASURE AND ALARM CIRCUIT ON R.C.I. CALLS

94. The non-coin time measure and alarm circuit functions as described for Time Measure and Alarm paragraph 44, with the following exceptions: When the register control switch enters position 6, indicating that the fourth digit of the number has been dialed, the SKS relay operates from battery, winding class cam C, control cam D strapped terminals 6 to 8 inclusive and RC-4 brush, to ground at the RIS relay operated. If the time measure switch has stepped from terminal 5, but not beyond terminal 11, the TMA relay operates stepping the time measure switch to terminal 12. The TMA relay releases as the switch steps from terminal 11 if the SKS relay has not by this time been released. The SKS relay does not release unless the RC switch has stepped to terminal 9.

95. On terminal 11 with the SKS relay operated, a circuit is closed from battery through the STP magnet, SKS magnet, SKS relay operated, contacts of the 149-H interrupter, strapped terminals, 12 to 15 inclusive and M-5 brush, MS relay operated to ground through the TMA and MSL relays normal, advancing the switch one step each time the interrupter makes and breaks contact. When the switch makes terminal 16, sufficient time for the dialing of the stations digit has elapsed.

96. In case the stations digit is dialed before the time measure switch makes terminal 16, the SH register advances stepping the RC switch to terminal 9 as described in paragraph 80. In case the stations digit has not been dialed when the time measure switch steps to terminal 16, the RC switch is stepped to terminal 9 through the RC-2 brush and strapped terminals 2 to 8 inclusive, through terminal 16 and the M-5 brush, MS relay operated, to ground at the TMA and MSL relays normal. In either case the SKS relay releases, the time measure circuit continues to function as described for Time Measure and Alarm paragraphs 44 to 48.

97. The coin sender time measure and alarm circuit functions as described in paragraph 49 with the following exceptions: the SKS relay operates as described in paragraph 94. If the time measure switch has stepped from terminal 4, but not beyond terminal 8, when the SKS relay operates, a circuit is closed in which the TMA relay operates, through the M-5 brush and strapped terminals 5 to 8 inclusive, the SKS relay operated, to ground through C and MSL-1 relays normal. The operation of the TMA relay closes a circuit through the STP magnet and the TMA relay operated, stepping the switch to terminal 9. The TMA relay releases when the switch advances from terminal 8 if the SKS relay has not by that time released. The SKS relay does not release unless the RC switch has stepped to terminal 9, with the SKS relay operated, a circuit is closed from battery, winding of the STP magnet, contacts of the 149-H interrupter, SKS relay operated, strapped terminals 9 to 12 inclusive and M-5 brush, TMA relay normal, MS relay operated, to ground through the C and MSL-1 relays normal, advancing the switch one step each time the interrupter makes and breaks contact.

98. When the switch makes terminal 13, time sufficient for the dialing of the station's digit has elapsed. In case the stations digit has been dialed before the time measure switch enters position 13, the RC switch has stepped to terminal 9 as described in paragraph 80. If the stations digit has not been dialed when the time measure switch makes terminal 13, the RC switch is stepped to terminal 9 through the RC-2 brush and strapped terminals 2 to 8 inclusive, terminal 13 and the M-5 brush, break contact of the TMA relay, MS relay operated, to ground at the C and MSL-1 relays normal.

99. In either case the SKS relay releases when the RC switch steps from terminal 8. With the SKS relay released, the time measure switch continues to function as described in paragraphs 51 to 58 inclusive.

DIRECT AND TANDEM R.C.I. - NUMBERS MORE THAN 9999

100. On a call to a manual station via either direct or tandem R.C.I. for a number greater than 9999, the sender functions as described for "Direct Relay Call Indicator" and as described for "Tandem Relay Call Indicator" with the following exceptions. For numbers more than 9999 the dialing of the fifth digit sets the SH register and steps the RC switch to terminal 7. If the station is in an office with no party lines, the advance of the SH register closes a circuit from battery, winding of the OT relay, strapped terminals 1 to 0 inclusive and SH-2 brush, 0 terminal and H-2 brush, terminal 1 and TH-2 brush, lead 4, terminal and T1-SD brush, the RA relay normal, to ground on the armature of the RLS relay operated, operating the OT relay.

101. If the station is in an office with party lines, the advance of the SH register closes a circuit to ground through the winding of the OT relay, and T1-SD translator terminal and brush, as just described, except that it passes through terminal 0 and the H-4 brush, terminal 1 and the TH-4 brush, and over lead 2. The OT relay locks to ground on the armature of the TS-2 relay operated. The operation of the OT relay in either case closes a circuit from battery through the windings of the CL relay and class switch R magnet in parallel, class cam D, OT relay operated, to ground on the armature of the TS -2 relay operated, advancing the class switch one step to position 3, 6, 14, or 17 as the case may be and operating the CL relay. The CL relay releases when the class switch advances.

102. The advance of the class switch closes a circuit in which the RC switch is advanced from position 7 to position 9. This circuit is from battery 44-E resistance and winding of the ON-2 relay in multiple break contact of the RC magnet through the RC-2 brush and strapped terminals 2 to 8 inclusive, class cam H, CL relay normal, control cam C, to ground at the TS-1 relay operated. The advance of the class switch causes impulses for the first numerical digit to be transmitted first on a direct R.C.I. call, and to be transmitted immediately following the impulses for office code on a tandem R.C.I. call, instead of impulses as would normally be controlled by the setting of the SH register.

103. The circuit conditions necessary for displaying digit 1 as controlled by the setting of the TH register, and established in positions 9, 10, 11, and 12 of the impulser switch, for the digit 0 as controlled by the setting of the H register, in positions 13, 14, 15 and 16, for the

hundreds digit as controlled by the setting of the tens register, in positions 17, 18, 19 and 20, for the tens digit, as controlled by the setting of the units register in positions 1, 2, 3, and 4 and for the units digit as controlled by the setting of the SH register, (arc SH-5) in positions, 5, 6, 7, and 8.

MISCELLANEOUS

OVERFLOW CONDITIONS

DISTRICT SELECTOR

104. With the sender switch in position 3 and the control switch in position 3, should the district selector go to the overflow position during trunk hunting, the pulsing circuit is opened when the district advance from the "Selection Beyond" position, causing the release of the sender B, SLP, and RLS relays. The release of the SLR relay advances the RC switch to position 9 as described in paragraph 41 if not already advanced to that position. As the district switch continues to advance to the overflow position ground is removed from the lead TEST causing the operation of the T-1 relay and the release of the T relay. In position 9 a circuit is closed from ground through the T relay normal, terminal 9 and RC-2 brush, to battery through the RC magnet, advancing the RC switch to position 0.

105. With the RC switch in position 0 a circuit is closed from battery, through the sender control R magnet, cam C, terminal 0 and RC-1 brush, to ground at the SLR relay normal, advancing the sender control switch to position 5. As the control switch advances from position 3 to position 5, the registers are reset as described under this heading in paragraphs 36 and 37. With all registers normal the RC switch advances to normal causing the sender control switch and the sender switch to return to normal as described in paragraphs 39 and 40.

OFFICE SELECTOR

106. Should the office selector go to overflow during trunk hunting, on a call to a mechanical office, reverse battery is connected to the fundamental circuit, when the sender switch enters position 12, "Trunk Test". The TG and CI relays operate and the sender switch advances to position 14 as described in paragraph 26, except that the current is in the opposite direction. In position 14 the fundamental circuit is again closed through the STP and OFL relays, as described in paragraph 27 except that the current flows in the opposite direction, operating both the STP and OFL relays. The OFL relay operated, locks through its 6400 ohm winding, to ground on its armature through the lower contacts of cam K.

107. The operation of the OFL relay closes a circuit in which the IA and OV relays operate. The circuit in which the OV relay operates is from battery, winding, control cam I and sender cam K, to ground through the OFL relay operated. The OV relay locks to ground through control cam T. The operation of the OV relay closes a holding circuit through the winding of the CI relay, OV relay operated, to ground at control cam T. The operation of the IA relay connects the lead from the C counting relay, through the IA relay

operated, contacts of cam L, STP relay operated, to ground through cam I, operating the O counting relay. The operation of the I4 relay closes a circuit from battery through the winding of the sender control switch magnets, cam D, cam C, OV relay operated, to ground through cam N, advancing the control switch to position 4.

108. In position 4 the ADV and ADV-1 relays operate through control cam Q, to the same ground, and lock through the ADV relay operated, to ground through cam T. The operation of the ADV relay, (a) opens the FR lead, releasing the STP relay and thus causing the operation of the BO and RO relays, (b) closes a circuit through control cam C, advancing the control switch to position 5, and (c) closes a circuit from ground on its left armature, through sender cam B, advancing the sender switch to position 15. The operation of the ADV relay opens the SC lead, releasing the SC relay and causing the advance of the district. The advance of the district releases the sender L relay. The release of the L relay releases the SLR and HRD relays. When the switch advanced from position 14, the ORL, I4, O, BO, and RO relays release. In position 15 a circuit is closed from the STP and ORL relays, as described in paragraph 22 to insure the release of the ORL relay. With the I4 relay released, the sender advances to position 16, as described in paragraph 28.

109. In position 16 a circuit is closed from battery through the district L relay, over lead FT, in which the STP relay operates. When the STP relay operates in this circuit, it closes a circuit from battery through the winding of the 3 counting relay, lead C, OV relay operated, control cam N, I4 relay normal, sender cam L, STP relay operated to ground at cam I.

110. As the district switch advances, the STP relay is intermittently short circuited by ground in the district connected to lead FT, thereby causing the alternate release and operation of the STP relay until the BO and RO relays operate. The operation of the BO relay opens the fundamental circuit, releasing the district L relay, stepping the district in the overflow position. The operation from this point on as described in paragraphs 104 and 105.

111. Should the office selector go to overflow on an R.C.I. call, the operation is as just described, except that the operation of the TC and CI relays in positions 12 and 14 shunts the 40-K resistance, in order to operate the marginal polarized relay in the distant two wire office selector, if used.

INCOMING SELECTOR

112. Should the incoming selector go to overflow, with the sender in position 18 and the control switch in position 4, the fundamental circuit is closed from battery and ground in the incoming circuit through the STP and ORL relays in the sender as described for final brush selection in paragraph 31, except that the flow of current is in the opposite direction. The ORL and incoming L relays operate in addition to the STP relay, advancing the incoming to the awaiting trunk closure position. (The polarized relay in the distant two wire office, if used, also operates in this circuit, advancing the selector, from the "Selection Beyond" position). The CHL relay, operated, locks through cam K to ground. The I4 relay operates to the same ground.

113. The OV relay operates through cam E, control cam L, sender cam K, to ground through the make contact of the OFL relay. The CI relay operates, and the OV relay locks in a circuit through the OV relay operated, to ground through cam T. The operation of the IA relay closes a circuit in which the O counting relay operates, as described in paragraph 106. The advance of the incoming selector opens the fundamental circuit, releasing the STP relay and causing the operation of the BO and FO relays. The operation of the FO relay closes a circuit, in which the ADV and ADV-1 relays operate, through control cam Q, IA and BO relays operated, to ground. The operation of the ADV-1 relay opens the FR lead, and advances the control switch to position 5. The operation of the ADV relay opens the SC lead, releasing the SC relay, causing the advance of the district selector.

114. The advance of the district selector releases the sender L relay causing the release of the SLR and RLS relays. The operation of the ADV-1 relay advances the sender switch to position 8. The OFL, IA, O, BO, and FO relays release when the switch advances from position 18. In position 8 a circuit is closed from battery through the district L relay, over lead FT, in which the STP relay operates as described in paragraph 57. The counting relays are operated and the district advanced to the overflow position, as described in paragraphs 106 and 107. The operation from this point on is as described in paragraphs 104 and 105.

PRELIMINARY PULSE

115. Should one preliminary pulse be transmitted over the pulsing circuit before dialing, due to accidental dialing or any other temporary open circuit, the A register is advanced to terminal 1, closing a circuit in which the PP relay operates, from battery, RA relay normal, 1000 ohm winding of the PP relay, terminal 1 and A-4 brush, RA relay normal, to ground at the RLS relay operated. The RC magnet and the ON-2 relay hold in a circuit through terminal 1 and A-6 brush, SSR relay normal, to ground at the RLS relay operated, thus preventing the advance of the RC switch from normal. With the PP relay operated, when the L relay next releases, a circuit is closed from battery through the secondary winding of the ON-1 relay in parallel with the 58 ohm resistance, 15 ohm winding and make contact of the PP relay, normal terminal and RC-6 brush, winding of the RA relay, RLS relay operated, L relay normal to ground at the T relay operated, operating the RA relay opening the circuit through the 1000 ohm winding of the PP relay. The PP relay holds through its 15 ohm winding until the L relay reoperates. The RA relay holds during the series of impulses corresponding to the first digit.

116. The PP relay releases when the L relay operates after the receipt of the first impulse of the series closing the circuit through the A register magnet, as described in paragraph 10. The second pulse of the series then advances the A register from terminal 1 to terminal 2, and from this point on the circuit functions in the regular manner. If there is only one pulse a second time, the release of the RA relay closes a circuit through the 1000 ohm winding of the PP relay, as before described, and ON-2 relay and RC magnet remain energized, preventing the advance of the RC switch. This operation is repeated until more than one pulse is received.

RELEASE OF SENDER FROM PERMANENT SIGNAL CONDITIONS

117. If the sender monitor lamp lights to indicate a permanent signal condition as described in paragraphs 44 to 48 for a non-coin sender, the plug of the monitor operator's cord is inserted in test jack T, operating the MSL relay from battery on the sleeve of the cord. The operation of the MSL relay disconnects the tip and ring of the line from the sender L relay, and connects its non-inductive winding across the L relay to hold it operated to prevent a false disconnect. The line is then connected to the tip and ring of the cord circuit.

118. To release the sender the plug of the cord is inserted in and immediately removed from jack MB, operating the SSR relay. The operation of the SSR relay closes a locking circuit to ground at the T relay operated, and closes a circuit from ground, RIS and SSR relays operated, terminal of the RC-2 brush, to battery through the winding of the RC magnet, advancing the RC switch to terminal 2. The ST relay operates and locks as described in paragraph 14. The translator rotates until the hunting brush finds the terminal on the T1-S arc, to which ground from the RIS and SSR relays operated is connected over lead B. The TS-1 and TS-2 relays operate and the translator is stopped in a position in which the SSA relay operates from battery, winding, terminal and contact of the T2-CL arc, to ground at the OT relay normal and the TS-2 relay operated. The SSA relay operated closes a circuit, in which the CL relay operates, and in which the class switch advances to position 10. The TS-1 and TS-2 relays, operated, function as described in paragraph 15.

119. When the CL relay releases as the switch advances from position 9 and the RC switch advances from position 2 to position 9, as described in paragraph 74. The setting of the translator causes district and office selector to be made, such that the line is connected to a "permanent signal trunk" to the trouble desk. From this point on the operation of the sender circuit is as described under "Call To Zero Operator". When the MS relay releases the TMA relay operates from battery, its winding, strapped terminals 1 to 21 inclusive and M-1 brush, to ground at the MS relay normal. The operation of the TMA relay closes a circuit from battery through the winding and break contact of the stepping magnet, TMA relay operated, to the same ground advancing the time measure switch to normal. The TMA relay releases when the switch advances from position 21.

120. For a permanent signal condition as described in paragraph 54 for a coin sender, the MSL-1 relay operates and functions as described for the MSL relay in paragraph 117. In releasing the sender the SSR relay operates and locks and the RC switch advances to position 2 as described in paragraph 118. The ST relay operates, translation is completed, the SSA relay operates, and the class switch is advanced to position 10, as described in paragraph 118. The CL relay also operates as described, thereby preventing the operation of the CT-1 and CT-2 relays when the time measure switch advances to normal. The RC switch advances from position 2 to position 9 as described in paragraph 74. A trunk at the trouble desk is selected as described in paragraph 75.

RELEASE OF STUCK SENDER

121. In case the sender monitor lamp lights to indicate a partial dialing condition or a stuck sender condition, as described in paragraphs 44 to 48 for a non-coin sender, or as described in paragraph 54 for a coin sender, the plug of the monitoring operator's cord is inserted in test jack T, operating the MSL relay. If translation has not been completed, the sender is released as described but if translation has been completed, the SSA relay does not operate. If incoming advance has not been completed, the sender control switch will then be in position 3 or position 4, and when the SSR relay operates as described in paragraph 118, the DWO relay operates through its winding, control cam W, SSR relay operated, SSA relay normal, to ground at control cam U. The DWO relay locks to ground on the armature of the T relay operated. The operation of the DWO relay short circuits the winding of, and therefore releases, the SC relay, and causes the release of the district D relay.

122. District group selection should have been completed before the D relay releases, but if the district returns to normal immediately, causing the release of the L, RLS and SLR relay. If district group selection has been completed when the district D relay releases, office test, office selections, trunk test and incoming selection takes place as described in paragraph 43. Incoming advance and talking selection then takes place advancing the district and thereby releasing the L, RLS, and SLR relays.

123. If incoming advance has already been completed when the SSA relay operates, the DWO relay does not operate since the control switch is then in position 5 and the L, RLS, and SLR relays will have released when the district advanced from the "selection beyond" position. In each case the release of the SLR relay advances the RC switch to position 9, as described in paragraph 41. "Resetting the register" and "return to normal" are completed as described in paragraphs 36 to 40.

124. On a call from a coin station the operation is as described in the preceding paragraph except that the associated district circuit reselects a sender for the purpose of returning the coin. If at this time the receiver has been replaced on the switchhook, the coin is returned as described in paragraph 59 to 62. If the receiver has not been replaced on the switchhook and the subscriber does not dial another number the sender functions as described under "Preliminary Pulse" routing the call to a trunk in the permanent signal group, or returning to normal as described in preceding paragraph 123.

REGISTER OR SWITCH OFF NORMAL

125. Should any register be moved off normal, while the sender is idle, the ON-1 and ON-2 relays operate in series with the stepping magnet of the register which is off normal, as described under "Resetting Registers" advancing them to normal. The operation of the ON-1 and ON-2 relays operates the ON relay. The operation of the ON relay operates the SB and MS relays. The operation of the SB relay operates the T-1 relay, thereby connecting ground through its 80 ohm winding to the test lead in order to make the sender test busy.

126. When the registers are all returned to normal, the ON relay releases, releasing the SB and MS relays. The release of the SB relay releases the T relay, thereby removing ground from the test lead. The release of the MS relay causes the time measure switch to return to normal.

127. Should any one of the sequence switches, except the class switch, be moved off normal, the ON relay operates, causing the operation of the SB, MS and T-1 relays as just described. The sender control switch advances to position 5 from ground on the armature and through the SLR relay normal, RC-1 brush and terminals O and N, control cam C to battery through the winding of the RC-1 magnet, and to position 6, in the same circuit, except that it passes through cam B instead of cam C. With the sender control switch in position 6 all the other sequence switches advance to normal as described in paragraph 40.

SKIP OFFICE

128. On non-coin calls which do not require an office selector, a circuit is closed, in position 4 to 10 inclusive of the sender switch, to hold the counting relays operated while ground from the armature and make contact of the FO relay advances the sender switch to position 12, with the aid of cam A. The circuit for holding the counting relays operated is from battery through their windings, sender cam R, lead 2, terminal and TL-SKO brush, control cam E, to ground at cam U. When the sender switch advances from position 10, the counting relays release, and the call is completed as described in paragraphs 25 to 40. On coin calls which do not require an office selector, and which do not require the collection of a coin (free route), the circuit for holding the counting relays operated passes through lead 3 and the CN relay operated, otherwise it is as just described for non-coin calls.

MAKE BUSY

129. When necessary to work on any of the sender apparatus, a plug with its tip and ring strapped is inserted in the MB jack at the monitoring position, operating the MB relay in a circuit to ground on the ring spring of jack MB. The operation of the MB relay connects ground to the test terminals of the sender selector, causing the sender to test busy, and partially closing the sender busy lamp, at the alarm board. Should the motors for driving the sender switches stop, ground is connected to the lead "To Motor Stop Alarm Circuit" operating the MB relay, causing the sender to function as above described.

HEAT AND SPARK PROTECTION

130. The 44-A, E and G resistances are for the purpose of protecting the apparatus against heating on account of the low resistance of the register magnets and other apparatus. The 0.5 MF condensers are used in series with the various resistances to protect the relay and register contacts from excessive sparking.

READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

SEE SPECIFICATION X-70087 FOR EXPLANATION OF FORM.

APPARATUS	SPEC.NO.	APPARATUS	SPEC.NO.	APPARATUS	SPEC.NO.
B18 Sequence Switch	X-70026*	200-K Selector	X-71120*	149-F Interrupter	X-70018
B19 Sequence Switch	X-70126	200-T Selector	X-71111	149-H Interrupter	X-70018
B20 Sequence Switch	X-70026*	200-U Selector	X-71118	152-C Interrupter	X-70018
B21 Sequence Switch	X-70126	1202-C Selector	X-71218	152-E Interrupter	X-70018
	X-70026*		X-70018		
	X-70126				

RELAYS		MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.				CIRCUIT PREPARATION		TEST SEE	
CODE DESIG.	NUMBER	SPEC. NUMBER	SKETCH	CONT. ARM. PRESS.	TEST TRVL.	TEST WDG.	AFTER SOAK					
178-AD	(RA)	X-70069	C	15		0	.9					
						R	.9					
176-AF	(SLR)	X-70069	C	15		0						
						R						
206-G	(TF)	X-70055	3		P/T	0	-.023	.011	.010	SS3-P(R2)	SS1-N(R2) B/G	3/4/8 B
					P/T	R	.023	O.C.	O.C.	SS3-P(R2)	SS1-N(R2) B/G	3
					S	H		.0067	.0064		SS2-K(R2) G	3
206-AK	(CT-4)	X-70055	3		P	0		.017	.016		1B(CT-3) G	10/17
					P	NO		.0125	.0135		1B(CT-3) G	4/9
					S	0		.040	.038	1B(CB)	3P(CT-3) B/G	9/17
					T	P		.020	.019		G	9/10 C
					T	H		.0275	.026	(CT-7) O (CT-3)NO	1T(CT-3) G	9/10 D
207-A	(SM)	X-70075	M			0		.011	.0105	SS3-P(R2)	SS1-X(R2) B/G	3/5 E
						NO		.009	.0095	SS3-P(R2)	SS1-X(R2) B/G	3
208-B	(1')	X-70076	H			0		.016	.015	(R1)2 (1) NO	1 (1) G	3/6
						NO		.016	.015	(R1)2 (1) NO	1 (1) G	3/14

208-B (2' to 9' incl.) See test note #13.

OPER. NOT BR BACK CONT. NON OPER

TEST 0 .125 .085 .059
READ TP .115 .090 .063
ARMATURE TRAVEL. .090

READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION		TEST SET	TEST PREP	NOTE	REMARKS
CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL.	TEST WDG.	TEST FOR	AFTER SOAK AMPS.	READJ. AMPS.	S.S. POS.	BLOCK CONN.	TEST CLIP BAT. CONN.	GRD.			
208-C	(BO) (FO)	X-70076	H				0	.0125	.012					3/6		C
							NO	.0105	.011					3		C
							0	.025	.024	(R1)2	(0)NO	IT(IA)	G	3/14		F
							NO	.021	.022	(R1)2	(C)NO	IT(IA)	G	3/14		F
208-G	(C)	X-70076	L				0	.016	.015	(R1)2		IT(IA)	G	3/6		G
							NO	.013	.014	(R1)2		IT(IA)	G	3/14		G
208-G	(1)	X-70076					0	.016	.015	(R1)2		3 (1')	G	3/6		G
							NO	.013	.014	(R1)2		3 (1')	G	3/14		G
208-G	(2-9 incl.)	See Test Note 16.														
B167	(TG)	X-70056	1				0	.0022	.0021		SS1-O(R2)	SS3-P(R2)	B/	3		H
							NO	.0016	.0017		SS1-O(R2)	SS3-P(R2)	B/	3		
B217	(CT-8)	X-70056				P	0	.0078				3T(CT-7)	G	17		U
						P	NO	.0045				3T(CT-7)	G	17		U
						S	0	.0073	.0069			3B(CT-7)	G	17		U
						S	NO	.0052	.0055			3B(CT-7)	G	17		U
B310	(CT-5)	X-70056					0	.050	.046		1T(CB)	5T(CC)	B/G	17		
							NO	.033	.035		1T(CB)	5T(CC)	B/G	17		
E367	(TMA)	X-70037	10/2	20	.015		0	.020	.012		(STP.M.)0	RU(TMA)	G			
E371	(TR)	X-70037	3	20	.020		0	.020	.013			RU(TR)	G			
E428	(CT-3)	X-70037	7/3	20	.020		0	.020	.016				M			C
							0	.064	.051		RL(CT-3)	RU(CT-3)	M			I

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION		TEST SEE	
		SPEC.	SWITCH	CONT.	ARM.	TEST	TEST AFTER	TEST	READJ	S.S.	TEST CLIP DATA		SLT	TEST REMARKS
CODE	DESIG.	NUMBER	NUMBER	PRESS.	TRVL	WDG.	FOR	SOAK	AMPS.	AMPS.	POS.	BLOCK	CONT.DAT.	CONT.GRD.	PREP	NOTE
E429	(IG)	X-70037	3	20	.020		0		.020	.013			RU(IG)	G		
E429	(SKS)	X-70037	3	20	.020		0		.020	.013			RU(SKS)	G		
E528	(SSR)	X-70037	8/11	20	.020		0		.041	.022						C
							0		.063	.034			RU(SSR)	G	18	J
E539	(SSA)	X-70037	2/1	20	.015		0		.020	.010			RU(SSA)	G		
E572	(MB)	X-70037	8/3	20	.020		0		.020	.016			RU(MB)	G	19	K
E589	(CT-7)	X-70037	8/7	20	.020		0		.040	.023			RU(CT-7)	G		
E591	(CL)	X-70037	15/3	20	.020		0		.020	.016						C
									.228	.183		SS(R-3)	RU(CL)	G		L
E594	(TAN)	X-70037	11/14	20	.035		0		.020	.016			RU(TAN)	G		M
E625	(T)	X-70037	9/3	20	.035		0		.020	.016		(ON)NO	RU(T)	G		
E659	(TG-1)	X-70037	1	20	.015		0		.026	.024			RU(TG-1)	G		
E696	(MS)	X-70037	9/8	Spl.	.035		0		.021	.020			RU(MS)	G	20	
							R		.0028	.003			RU(MS)	G		
E742	(ADV-1)	X-70037	11/2	20	.015		0		.020	.013						C
							0		.049	.032			RU(ADV-1)	G	21	N
E827	(L)	X-70037	3	Spl.	.020	P	0		.014	.0135			RU(L)	G	3/20	0
						P	NO		.0115	.012			RU(L)	G	22/23	P
E828	(PH)	X-70037		Spl.	.015		0		.010	.0095			RU(PH)	G	3/20	
							NO		.006	.0065			RU(PH)	G	3/20	

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.				CIRCUIT PREPARATION		TEST SET	TEST SEE REMARKS
CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	WDG. TEST FOR	TEST AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	TEST CLIP DATA BLOCK CONN.	BAT. CONN.	CRD. PREP	NOTE
E879	(CB)	X-70037	11	20	.015	0		.020	.017			RU(CB)	G	3	
E879	(TS-1)	X-70037	11	20	.015	0		.020	.017						C
						0		.195	.166		(Stop-1)0	RU(TS-1)	G		Q
E879	(TS-2)	X-70037	11	20	.015	0		.020	.017						C
						0		.195	.166		(Stop-2)0	RU(TS-2)	G		R
E895	(MS)	X-70037	10/14	20	.035	0		.039	.016			RU(MS)	G		
E904	(RLS)	X-70037	23/8	20	.030	0		.041	.031			RU(RLS)	G		
E1026	(OV)	X-70037	23/8	20	.030	0		.041	.031			RU(OV)	G		
E1084	(SSR)	X-70037	24/23	20	.030	0		.041	.030						C
						0		.064	.047			RU(SSR)	G	18	S
E1085	(ADV)	X-70037	10/3	20	.020	0		.020	.015						C
						0		.043	.032			RU(ADV)	G	21	T
E1088	(MSL)	X-70037	8	Spl.	.020	P 0		.024	.022		RL(MSL)		Bat.		U
						NO		.011	.012		RL(MSL)		Bat.		U
E1104	(IA)	X-70037	24/7	20	.025	0		.026	.024			RU(IA)	G	3	
E1107	(TMA)	X-70037	15/10	20	.015	0		.020	.016			RU(TMA)	G	24	
E1109	(MSL)	X-70037	7	20	.020	0		.022	.024			RU(MSL)	G		
E1111	(FP)	X-70037	24/8	20	.025	0		.041	.027			RU(FP)			
E1138	(OT)	X-70037	3/1	20	.020	0		.038	.017			RU(OT)	G		

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION		TEST SEE	
		SPEC.	SKETCH	CONT. ARM.		TEST	TEST AFTER SOAK	TEST AMPS.	READJ. AMPS.	S.S. POS.	TEST CLIP BLOCK CONN.	BAT. CONN.	GRD.	SET PREP	TEST NOTE	REMARKS
E1165	(DWO)	X-70037	26/35	20	.030		0	.027	.023			RU(DWO)	G			
E1167	(ON-1)	X-70037	1	20	.015	P	0	.040	.018							V
						P	0	.572	.258			RU(ON-1)	G			W
						S	0	.040	.018							X
						S	0	.572	.258			LL(ON-1)	G			Y
E1167	(ON-2)	X-70037	1	20	.015	P	0	.040	.018							V
						P	0	.572	.258			RU(ON-2)	G			Z
						S	0	.040	.018							X
						S	0	.572	.258			LL(ON-2)	G			A-1
E1168	(ON)	X-70037	11/10	20	.015		0	.020	.017			RU(ON)	G			
E1168	(SB)	X-70037	11/10	20	.015		0	.020	.017		(MB) 0	RU (SB)	G			
E1189	(P-1)	X-70037	2/1	20	.015	P/S	0	.033	.031						3	C
							0	.0342	.0324		(P) NO RL(P-1)		Bat.	3/15		B-1
E1258	(C-1)	X-70037	8	20	.020		0	.027	.023		(C-2)NO	RU(C-1)	G			
E1258	(CT-2)	X-70037	8	20	.020		0	.027	.023		(CT-7) 0	RU(CT-2)	G			
E1259	(D)	X-70037	9	20	.020		0	.027	.023			RU(D)	G			C-1
E1263	(CT-1)	X-70037	8/3	20	.020		0	.039	.037		(CT-3) 0	RU(CT-1)	G			
E1259	(ST)	X-70037	23/12	20	.035		0	.027	.023		(Stop Mag.)0	RU(ST)	G			
E1296	(ST)	X-70037	9/11	20	.035		0	.027	.020			RU(SC-1)	G	26		D-1
							0	.027	.020		(CC)NO	RU(SC-1)	G	26		E-1
							0	.059	.051			RU(SC-1)	G	26		F-1
							0	.059	.051		(CC)NO	RU(SC-1)	G	26		G-1

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION		TEST SEE		
		SPEC.	SKETCH CONT.	ARM.	TEST	TEST	AFTER TEST	READJ	S.S.	TEST CLIP DAT		SET	TEST	REMARKS
CODE	DESIG.	NUMBER	NUMBER	PRESS.	TRVL	WDG.	FOR SOAK	AMPS.	AMPS.	POS.	BLOCK COIN.	BAT.	CONN.	GRD.	PREP	NOTE
E1453	(S)	X-70037	2	20	.015		0	.020	.007			RU(S)	G			
E1507	(RLS)	X-70037	8/11	20	.020		0	.027	.020			RU(RLS)	G			
E1594	(SKS)	X-70037	10/3	20	.020		0	.020	.015			RU(SKS)	G			0
E1759	(CT-9)	X-70037	1	Spl.	.015	P	0	.0107	.0102		RU(CT-9)	RU(CT-9)	B/G	17/20		U
						P	NO	.0069	.0073		RL(CT-9)	RU(CT-9)	B/G	17/22		U
						S	0	.0215	.0204	(HSL-1)0	LU(CT-9)	LL(CT-9)	B/G	17/22		U
E1767	(CS)	X-70037	3/1	20	.020	P/S	0	.017	.016		RL(SC)		Bat.	3		
E1949	(C-2)	X-70037	23/7	20	.030		0	.028	.024			RU(C-2)	G			
E1982	(PP)	X-70037	3	20	.020	P	0	.118	.112			RU(PP)	G	3		
						S	0	.037	.035			LL(PP)	G	3		
E6023	(CN)	X-70037	9/3	20	.035	P	0	.041	.031			RU(CN)	G			
						S	0	.041	.031			LL(CN)				
E6037	(CI)	X-70037	26/24	20	.030		0	.041	.033			RU(CI)	G			
E6050	(CT-6)	X-70037	10	20	.015	P	0	.041	.029							C
						P	0	.072	.051			RU(CT-6)	G	7		H-1
						S	0	.041	.029			LL(CT-6)	G			
E6052	(C)	X-70037	24/23	20	.030	P	0	.058	.054			RU(C)	G			
						S	H	.058	.035			LL(C)	G			
E6055	(C-3)	X-70037	26/12	20	.035	P	0	.029	.027			RU(C-3)	G			
E6066	(ADV)	X-70037	7/10	20	.020		0	.027	.016				G			C
								.049	.029			RU(ADV)	G			T

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS	MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION			TEST SEE	
	SPEC.	SKETCH	CONT. ARM.		TEST	TEST AFTER	TEST	READJ.	S.S.	TEST CLIP DATA			SET	TEST
CODE DESIG.	NUMBER	NUMBER	PRESS.	TRVL.	WDG.	FOR SOAK	AMPS.	AMPS.	POS.	BLOCK	CONN.	BAT. CONN.	GRD.	PREP NOTE	REMARKS
E6089 (CC)	X-70037	26/7	20	.030		0	.119	.063							C
						0	.149	.079		(DWO)NO	RU(CC)		G	12	I-1
E6133 (FF)	X-70037	31	Spl.	.015		0	.010	.0095			RU(FF)		G	3/11	
						NO	.006	.0064			RU(FF)		G	3/11	

TEST NOTES:

1. - (a) Before making any tests or readjustments the sender should be made busy by inserting a make busy plug in the (MB) jack.
   (b) All sequence switches and selectors should be normal at all times during tests or readjustments unless otherwise specified.
2. Normally closed contact-minimum 15 grams.
3. Special requirements to insure fast operation.
4. (a) Total contact travel .004".
   (b) The biasing spring shall be tensioned against the armature with sufficient force to meet the release or non-operate requirement.
5. (a) Armature gap .013" to .014".
   (b) Contact gap .003" to .004".
6. (a) Armature gap .015" ± .002".
   (b) Contact gap min. .004" max. .007".
   (c) The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.
7. Strap 1-B and 2-B spring terminals of (CT-6) relay.
8. A negative sign (-) preceding a current value means that this current shall flow in the direction opposite to the direction of the operating current.
9. Requirements to meet special circuit conditions.
10. Before applying current flow requirements for Primary winding connect 48 volt battery direct to RL winding terminal of Primary winding of (CT-4) relay.

READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

RELAYS	MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.				CIRCUIT PREPARATION			TEST SEE	
CODE DESIG.	SPEC. NUMBER	SKETCH CONT. NUMBER	ARM. PRESS.	TEST TRVL	TEST VDG.	AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	TEST BLOCK	CLIP CONN.	DATA BAT.	SET CONN.	TEST REMARKS PREP NOTE

TEST NOTES: (Continued)

11. - (a) Maximum subscribers line loop of 350 ohms.
(b) Minimum leak resistance of 20000 ohms.
12. Strap 4-B and 3-B spring terminals of (CC) relay.
13. The requirements for the 208-B relays (2' to 9' incl.) are the same as for 208-B relay (1') and are tested and readjusted in a manner similar to the 208-B relay (1').
14. Insulate SS1-C (R1)
15. Strap 1T and 2T spring terminals of (T-1) relay connect ground direct to (RU) winding terminal of (T-1) relay.
16. The requirements for the 208-G relays (2 to 9 incl.) are the same as for the 208-G relay (1) and are tested and readjusted in a similar manner to the 208-G relay (1).
17. (a) Minimum subscribers line loop 750 ohms.
(b) Earth potential 17 volts negative, 18 volts positive.
(c) Minimum line leak 10000 ohms.
18. Strap 1-B and 2-B spring terminals of SSR relay and remove make busy plug from M.B. jack.
19. Strap 1-B and 2-B spring terminal of (FT) relay.
20. No definite contact pressure specified.
21. Insulate SS3-B-R-2.
22. Armature need not touch the core when operated.
23. The L relay should always be readjusted and tested with its secondary winding connected to Battery thru a .5 mf. condenser as shown in the circuit.
24. Insulate the break contact of the (M) step magnet.

READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.				CIRCUIT PREPARATION			TEST SEE	
		SPEC.	SKETCH	CONT. ARM.	TEST	TEST AFTER	TEST	READJ.	S.S.	TEST CLIP DATA			SET	TEST
CODE	DESIG.	NUMBER	NUMBER	PRESS.	TRVL.	WDG.	FOR	SOAK	AMPS.	AMPS.	POS.	BLOCK CONN.	BAT. CONN.	GRD. PREP	NOTE	REMARKS

REMARKS:

A. Insulate 3T (F)
B. Maximum external loop - 2300 ohms.
C. Req. for relay winding alone.
D. Req. for cct. comb. of (T) wdg. (CT-4) and (CT-3) relays and 18-BH Res.
E. Max. Ext. Cct. loop 3100 ohms.
F. Req. for Cct. combination of (BO) and (FO') relays.
G. Insulate SSI - JR2.
H. Max. Ext. Cct. loop 2500 ohms (mechanical) - 6800 ohms (R.C.I.)
I. Req. for cct. combination of (CT-3) relay and #18-BH resistance.
J. Req. for cct. combination of (SSR) and (ON) relays.
K. Insulate Spring 2T (T-1)
L. Req. for cct. combination of (CL) relay and (R-3) magnet.
M. Insulate SS-2-D-R-4.
N. Req. for cct. combination of (ADV) and (ADV-1) relays.
O. Max. Ext. cct. loop 1000 ohms.
P. Min. line leak 10000 ohms.
Q. Req. for cct. comb. of (TS-1) rel. and (Stop-1) magnet.
R. Req. for cct. comb. of (TS-2) relay and (Stop-2) magnet.
S. Req. for cct. comb. of (SSR) and (ON) relays.
T. Req. for cct. comb. of (ADV) and (ADV-1) relays.
U. Special Req. to meet circuit conditions.
V. Req. for Prim. Wdg. alone.
W. Req. for cct. comb. of Prim. Wdg. of (ON-1) relay & #44-E Res.
X. Req. for Secondary winding alone.
Y. Req. for Cct. Comb. of Secondary wdg. of (ON-1) relay and #44-E Res.
Z. Req. for Cct. Comb. of Primary Wdg. of (ON-2) relay and #44-E Res.

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS	MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.			CIRCUIT PREPARATION			TEST SEE	
CODE DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. ARM. PRESS.	TEST TRVL.	TEST WDG.	TEST AFTER SOAK	READJ. S.S. AMPS.	TEST AMPS.	POS.	CLIP DATA BLOCK CONN.	SET BAT. CONN.	TEST GRD.	PREP NOTE	REMARKS

REMARKS: (Continued)

A-1 - Req. for Cct. Comb. of Secondary wdg. of (ON-2) relay and #44-E Res.
B-1 Req. for Cct. Comb. of (T-1) and (T) relays.
C-1 Insulate SS4 - DR4 and SS2 - CR4.
D-1 "X" wiring Req. for relay wdg. alone.
E-1 "Y" wiring Req. for relay wdg. alone.
F-1 "X" wiring Req. for Cct. comb. of (SC-1) and (SLR) relays.
G-1 "Y" wiring Req. for Cct. comb. of (SC-1) and (SLR) relays.
H-1 Req. for cct. comb. of (CT-6) and (C-3) relays.
I-1 Req. for cct. comb. of (CC) relay and (DWO) relays.