

STEP-BY-STEP SYSTEMS  
NO. 1 OR 350A  
CONNECTOR CIRCUIT  
LOCAL LEVEL HUNTING  
SELECTIVE AND SEMISELECTIVE RINGING

## CHANGES

## B. CHANGES IN APPARATUS

B.1 Superseded                      Superseded By  
H Relay 222DH (ZI      H Relay 305A (ZU  
Option) and H            Option)  
Relay D179726 (ZJ  
Option)

## D. DESCRIPTION OF CIRCUIT CHANGES

D.1 In Circuit Note 113, under column headed PROV where Options ZJ, ZP and ZQ are referred to, Option ZH is added. Reference to this option was omitted on Issue 27-D.

D.2 The rating of Options ZH, ZN, ZP and ZQ is changed from Provisional to Standard.

D.3 Options ZI, ZJ and ZF are rated Manufactured Discontinued.

D.4 Options ZK, ZL, ZO, ZS and ZT are added and recorded in Notes 113 and 114 and Options Used Table.

D.5 Reference to Option ZU is shown in Note 113 and Options Used table.

D.6 Equipment Note 204 is added.

## DEVELOPMENT

## 1. PURPOSE OF CIRCUIT

1.1 To make the final connection to a PBX trunk in a group of over ten trunks in a step-by-step dial systems.

## 2. WORKING LIMITS

LIMITS ARE FOR SINGLE OFFICE AREAS  
FOR MULTIOFFICE AREAS, AND FOR OPERATOR PULSING, SEE  
KEYSHEETS

Type of Dial or Adj.	45V. Min.					48V. Min.				
	Pulsing from Sub.			Called Sta. Supv.		Pulsing from Sub.			Called Sta. Supv.	
	2,4 or 5	6	7	Adj.A	Adj.B	2,4 or 5	6	7	Adj.A	Adj.B
Max. Ext.Ckt. Loop*	750w	1200w	1100w	1000w	1400w	850w	1500w	1400w	1115w	1500w
Max. Ext.Ckt. Loop**	850w	1400w	1300w	1000w	1400w	1000w	1500w	1500w	1115w	1500w
Max. Ext.Ckt. Loop***	1000w	1400w	1400w	1000w	1400w	1115w	1500w	1500w	1115w	1500w
Min. Ins. Res.	15,000w			15,000w		15,000w			15,000w	

\*When Using 1000w Loop - Leak B in Pulsing Test Set  
\*\*When Using 1200w Loop - Leak A in Pulsing Test Set  
\*\*\*When Using 1400w Loop - Leak A in Pulsing Test Set

## Tripping Range

Type of Ring and District	Ringing Interval Voltage		Silent Interval Voltage	Code of (F) Relay	Option	Rating	Max. Ext. Ckt. Loop For Tripping		
	No. 1	No. 350A					Adj. "A"	Adj. "B"	Adj. "C"
AC-DC	84-88 <sup>(1)</sup> AC	72-88 OR	45-52	222DG	E	Std. (1)	1030w	-	1400w
	& 45-52 DC	84-88 AC & 45-52 DC	48-52	222DG	E	Std. (1)	1115w	-	1500w
Sup. Tube ±5V. E.P.	84-88 <sup>(1)</sup> AC	72-88 OR	45-52	222DG	E	Std. (1)	1030w	-	1400w
	& 37-40(3) DC	84-88 AC & 37-40(3) DC	48-52 60-75	222DG 222DJ	E F	Std. (1) A&M MD	1115w - -	- 1500w 1500w	1500w - -
Sup. In- verted 42A and Tube	84-88 <sup>(1)</sup> AC	72-88 OR	45-52	222DG	E	Std. (1)	1030w	-	1400w
	& 37-40(3) DC	84-88 AC & 37-40(3) DC	48-52 60-75	222DG 222DJ	E F	Std. (1) A&M MD	1115w - -	- 1500w 1500w	1500w - -
Sup. 42A, Inv. 42A, and Tube	76-80 <sup>(2)</sup> AC	72-88 OR	45-52	222DG	E	Std. (1)	1030w	-	1400w
	& 42-46 DC	84-88 AC & 37-40 DC	48-52 60-75	222DG 222DJ	E F	Std. (1) A&M MD	1115w - -	- 1500w 1500w	1500w - -

(1) 72-88 AC & 80-88 AC are A&M in No. 1.

(2) 64-80 AC & 72-80 AC are also A&M in No. 1.

(3) 64-80, 72-80, or 76-80 AC & 42-46 DC are also A&M in No. 1 & 350A.

## OPERATION

## 3. FUNCTION

3.01 To return ground on the sleeve for holding the preceding switches and place a busy potential on the sleeve of the calling line.

3.02 To record either the first digit dialed or only the first pulse of any first digit by means of a recording switch and to ground a segment of the commutator.

3.03 To automatically step the switch shaft up to the level corresponding to the grounded commutator segment.

3.04 To automatically select an idle trunk in the level corresponding to the grounded commutator segment or to step the switch to the tenth rotary step if all the trunks on a level or in a group are busy.

3.05 To automatically release the switch when the tenth rotary step is reached if the wipers have not tested all the trunks in the group.

3.06 To advance the recording switch one step on release from tenth rotary step if all the trunks in a group have not been tested.

3.07 To again automatically step switch up and around on subsequent bank levels until either an idle trunk is found or all trunks in the group have been tested.

3.08 To return a busy tone to calling station when all trunks in the group are busy.

3.09 To ground the sleeve of the called line for the purpose of operating the line circuit cutoff relay and placing a busy potential on the sleeve.

3.10 To ring the called station and supply ringing tone to the calling station.

3.11 To trip ringing when the called party answers.

3.12 To connect the tip and ring of the talking circuit through from the calling station to the called station.

3.13 To furnish talking battery to both the calling and the called stations.

3.14 To reverse battery over the talking conductors to the calling station when the called station answers, if required.

3.15 To bring in an alarm after a pre-determined time if the called party hangs up receiver and the calling party does not.



- 3.16 To release all switches except the connector and bring in an alarm after a predetermined time, if calling party hangs up receiver and called party does not when "W" wiring is used.
- 3.17 To release when the calling station hangs up the receiver when "W" wiring is omitted.
- 3.18 To operate a register on calls finding all trunks busy for one PBX group at a time in any connector group.
- 3.19 To operate the peg count register once for each call.
- 3.20 To provide means for removing ground from the "S" wiper when the trunk hunting feature is being tested.
- 3.21 To start level hunting only when the units digit is received.
- 3.22 To restore the called line to service after a predetermined interval when the called party disconnected but the calling party failed to disconnect.
- 3.23 To provide a means of cross-connection to the recording switch so that any connector can be arranged to hunt over any group of ten trunks first.
- 3.24 To provide for level hunting over the entire group regardless of the digit dialed when a PBX utilizes entire connector group of trunks.

#### 4. CONNECTING CIRCUITS

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

- 4.01 Selector Bank Multiple Circuit - SD-32123-01.
- 4.02 Self tor Circuit - SD-30200-01\*, SD-30976-01\*.
- 4.03 Incoming Selector Circuit - SD-32077-01\*.
- 4.04 Connector Bank Multiple Circuit - SD-32128-01.
- 4.05 Switch Trouble Alarm Circuit - SD-32045-01.
- 4.06 Test Circuit - SD-90469-02\*.
- 4.07 Traffic Register Circuit - SD-30896-01.
- 4.08 Intercepting Trunk Circuit - SD-31337-01\*.

- 4.09 Connector Alternating Relay Circuit - SD-32063-01.
- 4.10 Subscriber's Line Circuit - SD-32133-01\*.
- 4.11 Machine Intercept Trunk Circuit - SD-32202-01.

\*Typical

#### DETAILED DESCRIPTION

##### 5. SEIZURE AND DIALING (OPTIONS ZE AND ZK OR ZL AND ZS - SWITCH STARTS HUNTING AFTER THE FIRST OR TENS DIGIT)

When this switch is seized by a selector, A operates over the subscriber's loop which in turn operates B. B is slow to release and remains operated during dialing. B operating returns ground over the incoming sleeve lead to hold the preceding switches, opens the release circuit, prepares the circuit for the operation of C and the recording switch rotary magnet when "ZA" wiring is provided, and prepares a circuit for holding Z and H. A follows the pulsing of the first digit, and with ZA option, the recorder switch steps to the terminal corresponding to this digit and C operates and remains operated until the completion of this digit when it releases. With ZB option, ZA omitted, the Rec. Sw. does not follow the pulsing A relay but steps to the first terminal when C operates without regard to the digit dialed. The Rec. Sw. operating operates the R.O.N. Rec. Sw. springs which prepare a path for releasing the Rec. Sw. C releasing operates Z and G. Z operating opens the circuit to C, and RLS magnet. G operating causes a switch to start hunting.

##### 6. SEIZURE AND DIALING (OPTIONS ZK, ZO AND ZT OR ZH, ZL AND ZO - SWITCH DOES NOT START HUNTING UNTIL THE COMPLETION OF THE UNITS DIGIT)

When this circuit is seized A operates operating B. B is slow to release and remains operated during dialing. B operating returns ground over the incoming sleeve lead to hold the preceding switches, opens the release circuit, operates H, prepares the circuit for the operation of C and the recording switch rotary magnet when ZA option is provided and prepares the circuit for holding Z and H. H operated opens the hunting circuit. When the first digit is received A follows the pulses and with ZA option steps the Rec. Sw. C operates and remains operating during pulsing, and with ZG option steps the Rec. Sw. to the first terminal without regard to the digit dialed. At the end of



the digit C releases operating Z which locks to ground through springs on B and R.O.N. Rec. Sw. and opens the operating circuit for H. C operates during the dialing of the next or units digit and releases H. At the completion of this digit C releases and closes the hunting circuit.

## 7. TRUNK HUNTING

The recording switch wiper #2 has placed a ground on the recording bank contact. This bank contact is cross-connected to a commutator segment corresponding to the connector bank level which it is desired to have the connector wipers hunt over first. On the release of C, G is operated on its secondary winding. This operates the vertical magnet, a back contact of which opens the circuit to G allowing it to release. This allows the vertical magnet to release and again closes the circuit for operating G. This operation continues until the vertical brush makes contact with grounded commutator segment. Ground from this segment prevents G from releasing and also operates E sufficiently to close contacts two and three. This energizes the 1180-ohm winding and the relay then fully operates. To preclude the snagging of wipers on the first rotary step due to wipers vibrating after shaft is stopped on the selected level, E is made slow in operating to allow some time for the wipers to settle before the rotary magnet is operated. The operation of E transfers the stepping circuit from the vertical to the rotary magnet. The stepping of the rotary magnet continues until the (S) wiper reaches an idle terminal to which battery is supplied through the cutoff relay of the line circuit. This battery prevents the operation of G as the current through the primary winding is opposing that of the secondary winding. The battery supplied through the cutoff relay also operates H over its primary winding sufficiently to close contact one and two. The secondary winding is then energized and the relay fully operates. The marginal adjustment of H is such that it will not operate when two connectors test the same line simultaneously. If an idle terminal is not found in the first bank level the switch on reaching the tenth bank terminal operates the tenth rotary step spring and a circuit is then established through wiper number one of the recording switch to the release magnet. This energizes the release magnet and restores the switch shaft to its normal position. On the operation of the release magnet the recording switch rotary magnet is energized thus stepping the recording switch wipers to the next bank terminal. When the shaft reaches its normal position the V.O.N. springs operate allowing the release magnet to release and also opens the circuit to G

so as to prevent its operation before the release of E. On the release of E, the circuit is again in a position for trunk hunting as described before and continues this operation until either an idle trunk is found or if all trunks are busy the wipers are stepped to the tenth rotary step on the last level of the group. On the last level of the group, the recording switch bank terminal is not connected to the release common lead, therefore, the switch will not release. The tenth rotary springs being operated, a busy tone is supplied to the ring side of the line.

## 8. RINGING THE CALLED STATION

On the operation of H, positive or negative superimposed ringing is applied to the called line through the break contacts and the 200-ohm winding of F and a ringing tone is supplied to the calling station through the .04 mf capacitor (A). When the called station answers F operates to close contact springs one and two, due to the current in the 200-ohm winding. The 1300-ohm winding being energized on the closure of contacts one and two, fully operates the relay and it remains operated until the switch releases. The operation of this relay connects the talking capacitors through to the D which supplies talking battery to the called station. The called and the calling stations are now connected through the 2 mf condensers in the tip and ring leads. Under this condition, if called station presents a bridge across the tip and ring, D operates and reverses the battery over the tip and ring conductors to the calling station. D also prepares a circuit for giving the supervisory alarms.

## 9. RELEASE OF THE CONNECTOR WHEN THE CALLED PARTY DISCONNECTS FIRST WITH W, ZE AND ZK OPTIONS OR W, ZK, ZO AND ZT OPTIONS

If the called station disconnects first, D releases and when the calling station disconnects A and B release and close a circuit for energizing the release magnet of the recording switch. Ground is also removed from the sleeve allowing the preceding switches to restore to normal. H and Z which were held operated through the contacts of B will release. The release of Z energizes the release magnet and restores the switch shaft to its normal position. With ZE option, the release of Z also allows F to release. With ZO option, F releases when B releases.

## 10. RELEASE OF PRECEDING SWITCHES WHEN THE CALLED PARTY DISCONNECTS LAST WITH W, ZE AND ZK OPTIONS OR W, ZK, ZO AND ZT OPTIONS

If the calling party disconnects before the called party, D remains operated



and through its front contact holds H and Z thus maintaining the circuit for holding D energized as long as the called party does not disconnect. When the calling station disconnects, A releases and closes the circuit for operating C through the A resistance. The release of A opens the circuit for B. The operation of C removes one ground from the "S" lead. B releasing allows the preceding switches to release and releases C. On the release of C the sleeve lead is again grounded from a make contact on D. This places a busy ground on the "S" lead until the connector is released by the disconnect of the called party. The (A) resistance causes the C to release more quickly so as to decrease the unguarded interval on the "S" lead.

#### 11. RELEASE OF SWITCH WITH ZE AND ZK OPTIONS OR ZK, ZO AND ZT OPTIONS PROVIDED AND W OPTION OMITTED

When W option is omitted the release of the connector is under the control of the calling station. The switch will release as described under paragraph 9 except that the D may or may not be operated depending upon whether or not the called party had disconnected.

#### 12. AUTOMATIC DISCONNECT (OPTIONS ZL AND ZS OR ZH, ZL AND ZO WITH OPTION ZP)

When the called party releases first, D releases and closes a path from direct ground with ZP option through the heater of the thermal relay on H, F operated, R.O.N. operated, through the winding of the release magnet of the recorder switch to RLS battery. Under this condition the thermal relay starts to heat but the release magnet does not operate. After a predetermined interval, the bimetallic springs of the thermal relay close and shunt the 100 ohms heater. The recorder release magnet operates and opens the R.O.N. spring. When the R.O.N. springs open, Z and H release and with ZO option removes ground from the sleeve to release the preceding switches. With ZS option, Z releasing removes ground from the sleeve and releases relay F. When the loop is opened, releasing A and B, the RLS magnet operates and releases the connector switch. With ZO option F does not release until B releases. When Z releases with F operated, ground from the still operated springs of the thermal relay operates the RLS magnet releasing the switch. When the loop is opened, A and B release, releasing F.

#### 12.1 Automatic Disconnect (Options ZL and ZS or ZH, ZL and ZO with Option ZQ)

The automatic disconnect feature is the same as described in paragraph 12

except that the ground which controls this feature is supplied from the intercept trunk. If the intercept trunk is busy the ground is removed disabling the automatic disconnect feature.

#### 13. SUPERVISORY #1, ZK OPTION

If the called station disconnects before the calling station a circuit is closed through the back contacts of D and a front contact of F for operating the supervisory signal.

#### 14. SUPERVISORY #2

If the called station remains on the line after the calling station has disconnected with "W" wiring, D remains operated and upon release of A and B a circuit is closed through the front contact of D and back contacts of B and A for operating a supervisory signal. When "W" wiring is omitted, the supervisory #2 is not used.

#### 15. OVERFLOW REGISTER

Provision is made for recording the number of attempted calls into a certain group during the time that all trunks are busy. When it is desired to register these calls the (RLS) bank terminal corresponding to the last lead in group is connected to terminal (B). This operates the overflow register whenever the recording switch wiper is on this terminal and the connector goes to the tenth rotary step with G operated due to all the trunks being busy.

#### 16. PEG COUNT REGISTER

Provision is made for operating a peg count register once on every call through a back contact of Z and vertical off-normal springs.

#### 17. TEST JACK

Springs three and four of test jack may be used to make the switch busy to incoming calls when it is out of order. Springs one and two may be used for making local tests on this switch to cause it to function in the same manner as described for an originating call. The make-busy feature of the test jack is also duplicated by the removal of the switch from its jack since shelf jack springs #9 and #11 are arranged to place ground on the "S" lead upon the removal of the switch.

#### 18. CONTACT PROTECTION

The condenser and resistance unit (B) reduces sparking at the contacts of F when this relay operates. The units (C) and (C1) reduce sparking at the contacts which open the stepping magnet circuits.

19. CROSS-CONNECTIONS TO RECORDING SWITCH

The #2 recording bank terminals of the recording switch are arranged from bank #2 so that they can be connected to any commutator segment. Terminals 1 to 0 of the 12-point release bank block are arranged so that they can be connected to the release common lead, to the overflow register lead "B" or left disconnected. The purpose of this is so that in large trunk groups which require several levels in the connector banks, each individual connector can

be arranged for any preference in respect to testing the various levels of the connector multiple bank in which the trunks of this group are located.

20. SLEEVE CUTOFF JACK

The sleeve cutoff jack affords a means of opening the "S" wiper so that when trunk hunting tests are being made, the subscriber's lines on the banks of the connectors over which the wipers rotate will not be affected.

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