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2000 and SE.50 Type Group Selectors - ETP 0258

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2000 AND SE.50 TYPE GROUP SELECTORS

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1. INTRODUCTION.

1.1 In the technical training publication "Internal Trunking", it was shown that to extend the range of a step-by-step exchange beyond 100 lines, it is necessary to add one or more additional switching stages. These additional stages - group selector stages - direct the setting up of the call, each selector stage in turn responding to one digit of the dialled number until the call is finally directed to the final selector associated with the group of lines (100 or 200, depending upon the selector type) containing the desired number.

1.2 The main functions of a bimotional group selector are:-

- To step vertically under the control of the appropriate dialled digit.
- To "cut in" (rotate horizontally) to the bank contacts of the dialled level and select a free circuit to the next selector stage.
- To remain in the "switched through" condition for the duration of the call.
- To release itself at the end of the call.

1.3 The 2000 type selector became the standard bimotional switching mechanism for Australia during the 1930's. Since that time, earlier varieties of bimotional selector have been commonly referred to as pre-2000 type equipment.

Shortly after 1950 the SE.50 type of bimotional equipment was introduced into the Australian network. The SE.50 mechanism occupies the same mounting as the 2000 type, and group selectors of both types can work side by side in the same shelf. The principle of the 2000 type mechanism is described in Paper 1 of Telephony 4, and the SE.50 type mechanism is described in the publication "SE.50 Type Selector Mechanism".

1.4 This publication lists the general operational functions of group selectors and describes the main features of the circuit operation of both the 2000 and SE.50 type group selectors.

1.5 While reading the circuit descriptions in this publication, you should study the small explanatory diagrams included with the text and relate them to the complete circuits attached. Also attached is a chart or operational diagram which outlines the sequence of operation of the selector relays and magnets.

2. OPERATIONAL FUNCTIONS.

2.1 The main operational functions of the SE.50 and 2000 type group selectors are:-

(a) When the loop is extended from the previous selector,

- Returns earth on the private to hold and guard the connection.
- Provides dial tone when used as a first selector.
- On first and incoming selectors, provides a P.G. alarm should the selector be held for longer than 6 minutes without dialling.

(b) Steps vertically under the control of the pulses received.

(c) "Cuts in" (Steps horizontally) on the level reached at the end of the vertical pulses, hunts for and seizes the first free outlet in the level. Two outlets are tested at each rotary step - one in the lower bank (odd) and one in the upper bank (even).

(d) Switches the calling loop through to the selected outlet.

- If both upper and lower outlets are free, the odd outlet (lower bank) is selected.

(e) After switching, maintains a holding earth on the private for a time sufficient to permit an earth to be returned on the private from the selector or circuit connected to the seized outlet.

(f) *SE.50 only. Steps off an outlet which fails to return an earth on the P wire.*

(g) Maintains the selector in the "switched through" condition until release conditions are applied. (This is normally at the end of the call when earth is removed from the P wire).

(h) Releases itself when release conditions are applied.

- Provides a guarding circuit for itself during release.
- Provides a release alarm should the selector fail to release due to a mechanical defect.
- In the event of release after no progress or all outlets busy, provides a release unguard period to allow the simultaneous release of all previous selectors.

(i) When all outlets on the dialled level are busy

- the selector steps to the 11th rotary contact and operates 11th step 'S' mechanically operated springs.
- busy tone is transmitted to the calling subscriber.
- the overflow meter is operated.

2.2 Two additional facilities provided by the SE.50 type group selector are "pre-busying" and "junction guard".

- Pre-busying. When a selector required for maintenance is in use on a call, the technician, by transferring a link in the test jack, can prevent the switch from being taken for another call, while still allowing all the previous switches to release in the normal way at the end of the call.

- Junction guard. During release, the negative lead to the selector is opened. If the switch is an incoming selector this indicates a busy condition on the junction if the repeater relay set at the originating exchange is equipped for back busying.

3. 2000 TYPE GROUP SELECTOR (CE 65).

3.1 LOOP SEIZURE. When the calling loop is extended from the previous selector on the positive and negative wires of the selected trunk, the loop operates the A relay of the group selector (Fig. 1). Test jacks 3 and 4 permit a maintenance technician to monitor a call or to loop a selector for testing purposes.

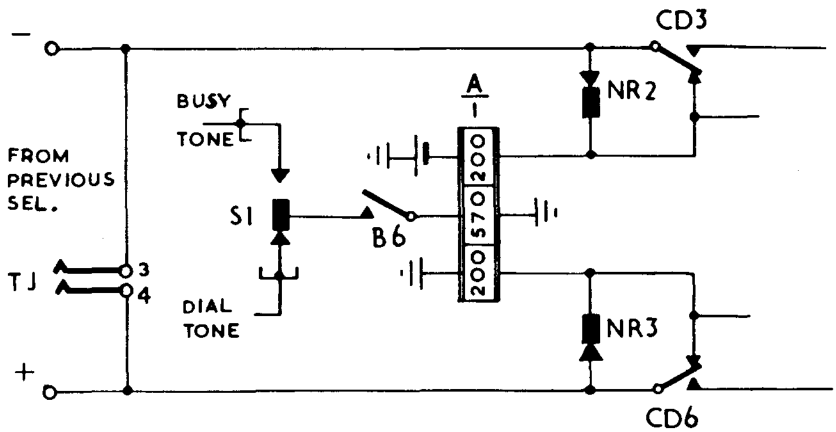


FIG. 1. LOOP SEIZURE.

3.2 GUARDING AND HOLDING. When a selector is seized, it is essential that an earth potential is quickly applied to the incoming private wire. Application of this earth causes the selector to test busy to other testing circuits. It is also fed back to the previous selector of this call to hold the switching relay operated.

For normal selectors, earth is applied to the private by B3 contact after A1 extends the earth from CD5 to operate the B relay (Fig. 2). This means that there is the combined operate lags of relays A and B before the guarding and holding earth is applied. In the case of subscriber's uniselector circuits connected to long lines, there is a possibility of the switching relay releasing before a holding earth is returned from B3. For this reason, selectors used as first selectors may be strapped between U8 and U9. With this strapping added, earth from CD5 is applied to the private immediately relay A operates, and it is then reinforced by earth from contacts B1 and B3. The earth from CD5 is disconnected when relay CD is operated on its 700 ohm winding by contact B2.

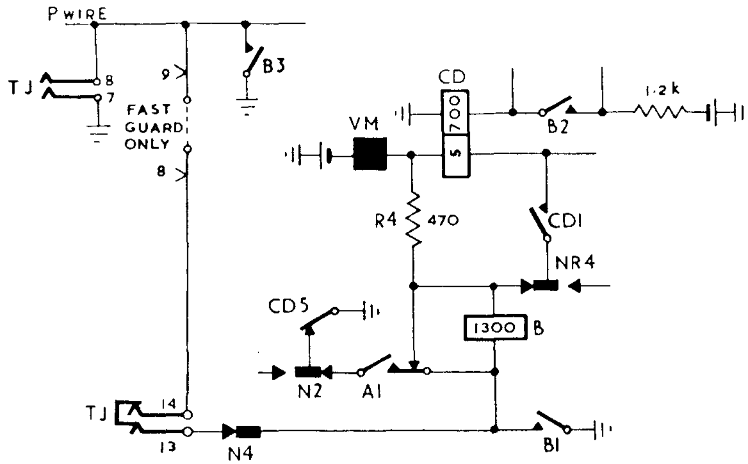


FIG. 2. GUARD AND PULSING PREPARATION.

When it is necessary to busy a selector strapped for the fast guard feature, it is most important that the test link is transferred from TJ 13/14 to TJ 7/8. Opening the circuit at TJ 13/14 prevents a current drain via resistor R4 and the vertical magnet.

3.3 DIAL TONE TO CALLER. When the selector is a first selector, contact B6 (Fig. 1) connects dial tone to the 570 ohm winding of relay A. The tone is induced from this winding into the two 200 ohm windings and so to the caller. If the selector is not a first selector, the dial tone connection is replaced by earth.

3.4 P.G. SUPERVISORY. When contact A1 operates relay B, contact B3, as well as applying earth to the private, also extends earth via B4 contact and a supervisory lamp to a P.G. delayed alarm circuit. The supervisory lamp on the switch lights, and if the switch remains looped for 6 minutes without any vertical stepping, an alarm condition is given. If the switch is stepped vertically, N springs are operated, the lamp is extinguished and the alarm condition is removed (Fig. 3). In many exchanges this alarm is disconnected except for certain specified periods.

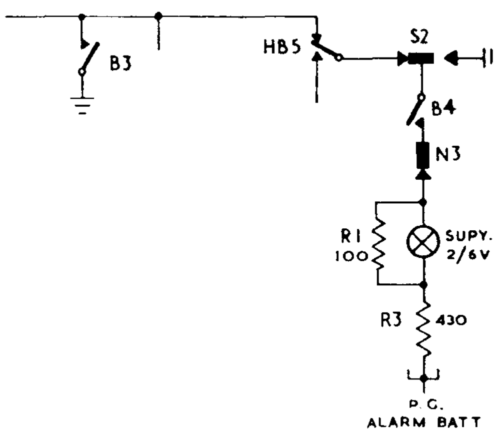
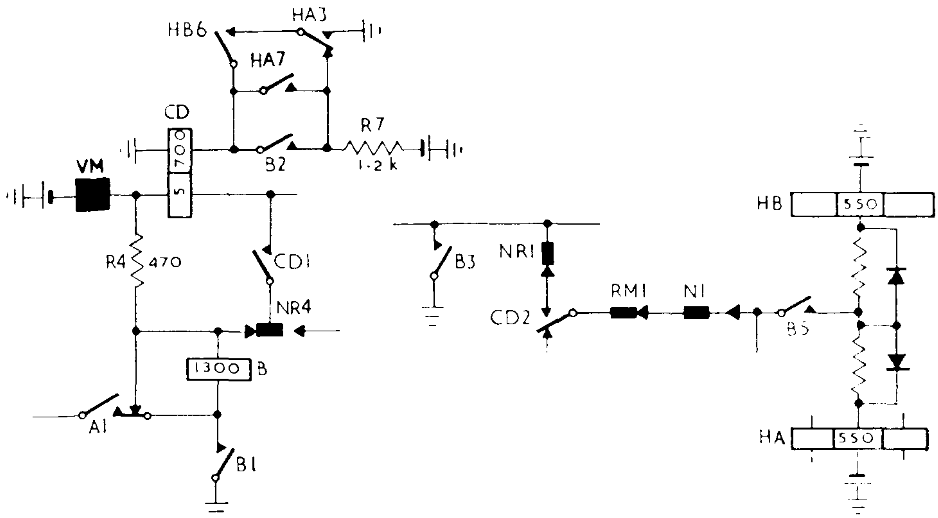


FIG. 3. P.G. SUPERVISORY ALARM.

3.5 VERTICAL PULSING. When the selector is first seized, contact A1 operates relay B to the battery behind the vertical magnet. The vertical magnet does not operate in series with B. Relay B holds via B1 and at B2 operates relay CD on its 700 ohm winding. CD1 prepares a low resistance operating circuit for the vertical magnet and CD2 prepares a circuit for relays HA and HB (Fig. 4).



(a) (b)

FIG. 4. VERTICAL PULSING.

When the caller dials the digit appropriate to this rank of switching, relay A releases with each pulse and the A1 contact short circuits relay B, allowing sufficient current to flow to completely operate the vertical magnet. Relay B is short circuited each time the A1 contact restores and is re-energised each time A1 operates. The B relay holds during pulsing because of the slow release effect caused by the inductive current circulating in its short circuited winding.

The vertical magnet is energised each time A1 contact short circuits relay B, and releases each time the resistance of the B relay is included in series with the magnet. The wiper carriage is raised a number of steps according to the digit dialled. At the first vertical step, the vertical off-normal (N) springs operate and N1 operates relays HA and HB on their 550 ohm windings. Contacts HA3 and HB6 short circuit the 700 ohm winding of relay CD. Relay CD remains operated during the pulse train as it receives a high value current pulse through the 5 ohm winding each time the vertical magnet is operated, and the magnetic flux is maintained by the effect of the short-circuited 700 ohm winding.

Relay CD releases, after a delay period, at the end of the pulse train as the A relay is held operated by the calling loop and the current through the 5 ohm winding of CD in series with relay B and the vertical magnet is not sufficient to hold relay CD operated.

3.6 SUMMARY OF FLUX BEHAVIOUR DURING PULSING. Before pulsing commences, relays A, B and CD are all operated and the vertical magnet is energised to a slight degree by the current through the magnet in series with relay B. As the vertical magnet normally operates on current values approximating 1A, and the current through relay B is in the region of 40mA, the vertical magnet flux is at this stage only slight.

During pulsing, the A relay releases at each break period of the dial. The A1 contact short circuits relay B so that the flux commences to fall in relay B. At the same time the vertical magnet is energised and relay CD receives a high value pulse through its 5 ohm winding, causing a build up of the flux in relay CD.

When the A relay re-operates at each make period of the dial, relay B is energised again and the flux value of relay CD falls, while the vertical magnet releases.

If the operate and release times of relay A are in accordance with the dial ratios, the pulsing circuit relays will perform satisfactorily. A longer than normal operated time for relay A could result in relay CD releasing, which results in the selector switching to the wrong level. A longer than normal released time for relay A could result in relay B releasing and causing the selector to release.

3.7 AUTOMATIC CUT-IN. At the end of the vertical pulse train, relay CD releases slowly and at CD4 operates the rotary magnet from earth at B3 via operated HB and HA contacts and the rotary interrupter springs (Fig. 5). The rotary magnet steps the wipers to the first contact of the dialled level.

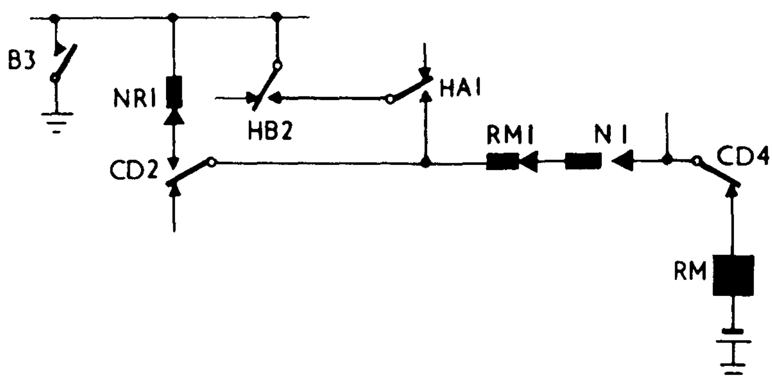


FIG. 5. AUTOMATIC CUT-IN.

3.8 200 OUTLETS-BANKS ASSEMBLY. Figs. 1, 2 and 3 in the paper "Internal Trunking" show the make up of bimotional selector banks. The standard 2000 type group selector is a 200 outlet selector, which means that each level has an availability of 20 circuits or trunks. To obtain this availability, the group selector is associated with three 220 point banks. The lower bank contains the positive and negative connections for the "odd" numbered outlets on each level -10 circuits numbered 1,3,5.......19; the middle bank contains the positive and negative connections for the even numbered outlets 2,4,6.......20, while the upper bank contains the private wire connections for both line groups. This enables the group selector to test simultaneously via the private or top set of wipers the condition or potential existing on one odd and even private contact.

3.9 OUTLET TESTING-CUT DRIVE PRINCIPLE. The method of outlet testing used on 2000 type group selectors employs a system known as the "cut-drive" principle. When the selector "cuts in" at the end of the vertical stepping, a self interrupted drive circuit for the rotary magnet is completed via operated HA and HB contacts and the rotary magnet interrupter springs. Once this circuit is established, it is maintained until it is "cut" by the release of either HA or HB relay when a free outlet is tested.

As the rotary magnet steps the wipers to the first contact, the rotary interrupter springs open the circuit to the rotary magnet and also to the operate windings (550 ohms) of the HA and HB relays (Fig. 6). During the period that the rotary magnet is releasing, the HA and HB relays test with their 400 ohm windings the condition on the private contacts of that pair of odd and even circuits. When both the odd and even circuits are busy, there is an earth potential on each private contact which will hold operated the HA and HB relays. When the rotary magnet and its interrupter springs restore, the self interrupted rotary circuit is once more completed, and the wipers are stepped to the next set of contacts. This action is repeated if the next odd and even circuits are both busy.

When either the odd or even circuit is free, there is no earth potential on the private contact, the associated HA or HB relay releases, and the drive circuit is opened at the HA or HB contact.

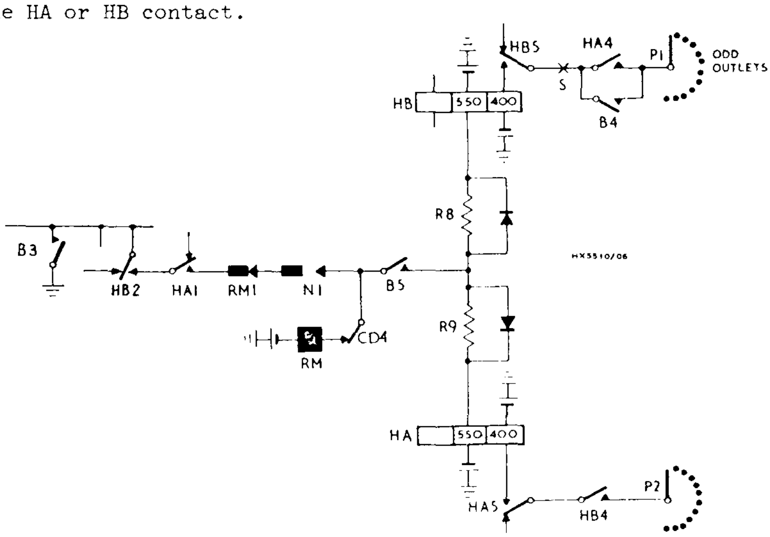


FIG. 6. OUTLET TESTING.

3.10 OUTLET TESTING-ODD FREE, EVEN BUSY. While the selector is testing over busy contacts, relays HA and HB remain operated and the self interrupted rotary drive is maintained. When a free odd outlet is encountered, absence of earth on the P1 wiper allows relay HB to release. HB2 cuts the rotary drive circuit to prevent any further stepping. Earth from B3 via HB5 normal is extended via the P1 wiper to busy the free outlet. HB4 releases relay HA and HB6 and HA4 remove the short circuit from the 700 ohm winding of relay CD (fig. 7). Relay CD operates and at CD1 re-operates relay HA on its 1500 ohm winding. CD3 and CD6 disconnect relay A and together with contacts HA2 and HA6 extend the calling loop to the selected outlet. HA7 prepares a circuit to hold relay CD after B2 restores. A1 contact short circuits relay B which releases slowly. During the slow release of relay B, the seized circuit returns an earth on the private to hold relay HA. For the remainder of the call, relay HA remains operated on its 1500 ohm winding and contact HA7 holds relay CD operated on its 700 ohm winding.

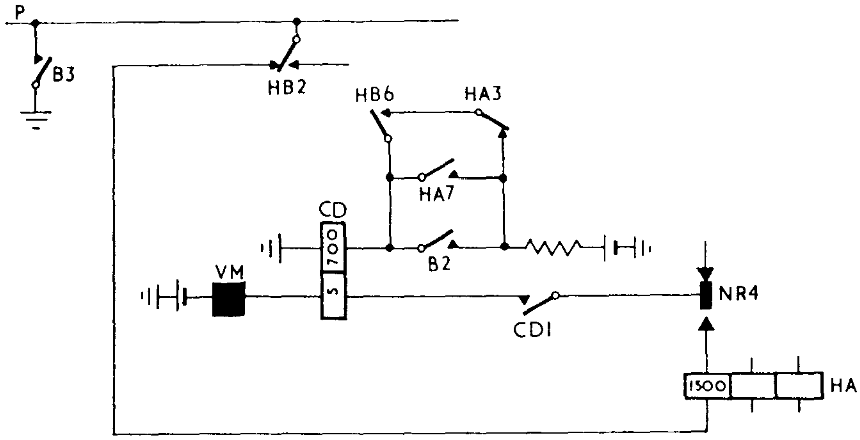


FIG. 7. ODD OUTLET FREE - RE-OPERATION OF HA.

3.11 BOTH OUTLETS FREE. When both odd and even circuits test free, HA and HB relays both release and a guarding earth from B3 is applied via HB5 normal and B4 operated contacts to busy the odd outlet. Relay CD operates, HA re-operates and the call is switched to the odd outlet as described in para. 3.10.

3.12 EVEN OUTLET FREE – ODD BUSY. The pair of contacts is tested with relays HA and HB operated. If the even outlet is free, there is no earth at the P2 wiper, relay HA releases and at HA1 cuts the rotary drive circuit. If the odd outlet is busy, relay HB remains operated on its 400 ohm winding via B4 contact and the P1 wiper to the earth at the busy odd contact.

When HA relay releases, HA5 extends earth from B3 to guard the seized outlet, and HA3 operates relay CD by removing the short circuit from the 700 ohm winding. When relay CD re-operates, relay HB holds on its 1500 ohm winding from battery via the vertical magnet, 5 ohm winding of CD, CD1 and NR4 to earth on the P wire from B3 via HB2 operated and HA1 normal. Contacts CD3, CD6 and HB1, HB3 switch the calling loop through to the selected even outlet. Relay A releases and at A1 short circuits relay B which releases slowly. During the slow release of relay B, the next selector is seized and earth is returned on the private of the selected even outlet to maintain relay HB operated on its 1500 ohm winding. Contact HB6 maintains relay CD operated on its 700 ohm winding. HB7 prepares a circuit for the operation of a test bell when a test link is inserted in TJ9 and 10. This circuit allows a technician to determine whether a call is connected to the lower bank (odd outlet, HA operated) or to the upper bank (even outlet, HB operated) without removing the switch cover (Fig. 8).

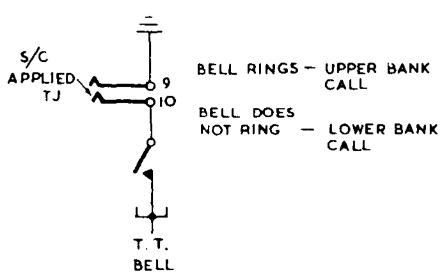


FIG. 8. USE OF TRUNK TEST BELL.

3.13 THROUGH CONDITIONS. Figs. 9 and 10 show the respective through conditions when switched to an odd or an even outlet. In each case, one of the switching relays (HA or HB) is held operated on its 1500 ohm winding by earth fed back on the private wire from the selector connected to the seized outlet. Contacts of the operated switching relay hold the 700 ohm winding.

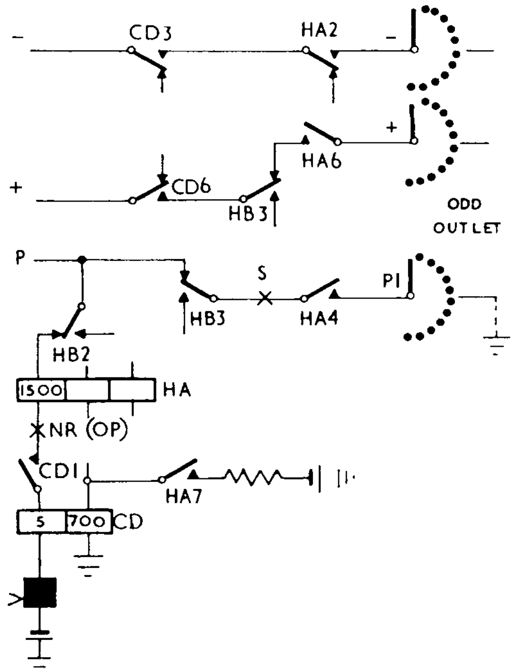


FIG. 9. THROUGH CONDITIONS - ODD OUTLET.

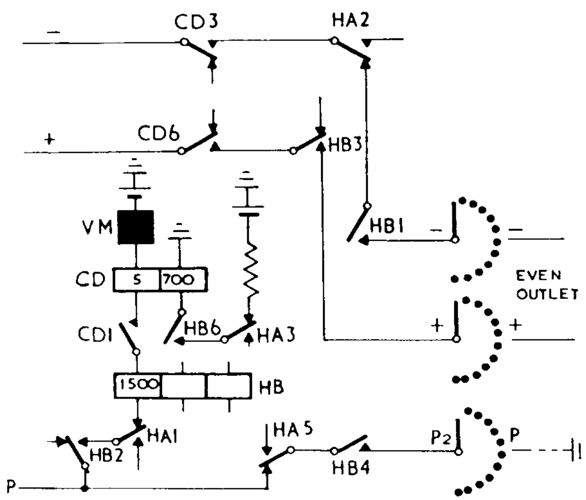


FIG. 10. THROUGH CONDITIONS - EVEN OUTLET.

3.14 ALL OUTLETS BUSY. When all outlets on a dialled level are busy, relays HA and HB remain operated and the rotary drive is maintained until eleven rotary steps are taken, when the 11th step or S springs operate. As the eleventh contacts are not connected to working trunks, there is normally no earth on the P contacts and relays HA and HB both release, cutting the rotary drive circuit. Relays CD and HA re-operate as described in para. 3.11 and the caller is switched to the odd bank. At each switch, the 11th positive and negative contacts on all levels of the odd bank are commoned and wired back via U jacks 4 and 7 to the A relay. Because of this wiring, the calling loop is still connected to the A relay and earth from B3 holds relay HA operated. Fig. 11 shows the conditions while the caller is receiving busy tone.

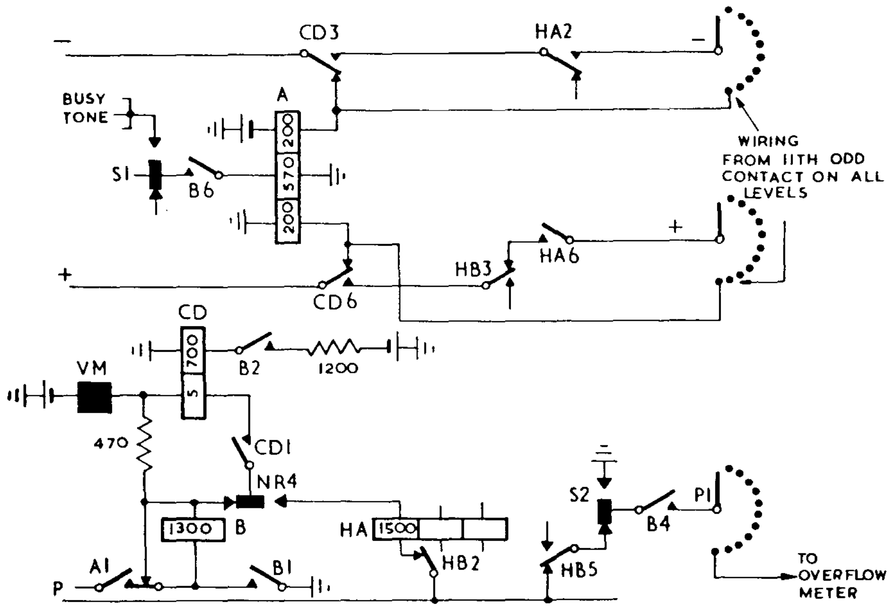


FIG. 11. ALL OUTLETS BUSY CONDITION.

3.15 RELEASE OF CONNECTION. The 2000 type group selector releases by rotating to the 12th step, where it falls to below the first level and rotates backwards under spring tension to the normal position. The release after a normal call occurs when the holding earth is removed from the P wire by the switch ahead. The switching relay HA or HB releases, followed by the release of relay CD. Contact CD4 completes a self drive circuit for the rotary magnet from the release alarm earth via TJ 11/12, B7, rotary interrupters DM1 and vertical off-normals N1. The switch drives to the 12th step, where it falls and restores as previously described. When the carriage reaches the normal position, the N1 contacts open the release circuit. If, due to some mechanical defect, the carriage does not restore to normal within 9 seconds of the release circuit being completed, a release alarm is given. During the release of the selector, there is a guarding earth connected to the incoming private wire via CD5 and N2. This earth is removed at N2 when the switch fully restores to normal. However, there is an unguarded period from the time that the earth is first removed from the P wire by the switch ahead until the release of HA (or HB) followed by relay CD. The total unguard period, consisting of the combined release lags of these two relays, is approximately 20 milliseconds. If the switch is seized during the unguarded period, the release circuit is still maintained, and the switch restores normally. Relay B cannot be re-operated until the switch is fully restored, as its operating path is via N2 normal.

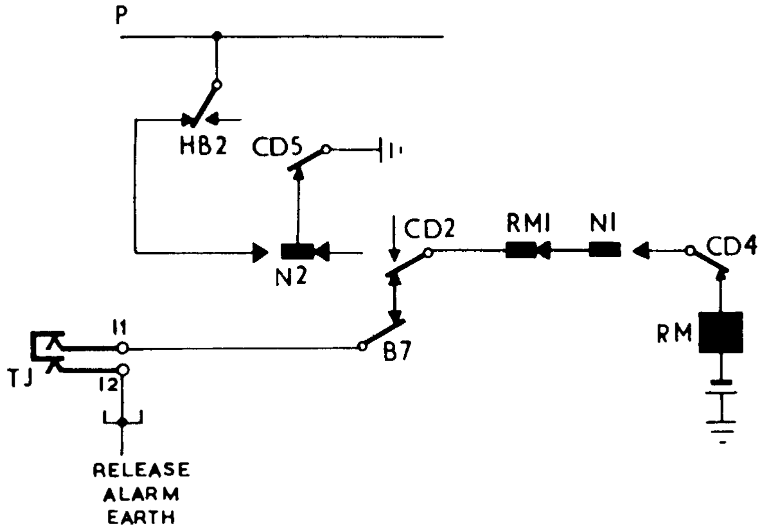


FIG. 12. RELEASE CIRCUIT.

When the release takes place from the "all outlets busy" condition, the earth on the private and the holding of the HA relay is from contact B3, and not from any earth returned from a switch ahead. When the caller replaces the handset, relay A releases and A1 short circuits relay B which releases slowly. Contact B3 removes the earth from the incoming private and releases relay HA, which in turn releases relay CD. During the combined release lags of relays HA and CD, earth is removed from the incoming private to allow the release of holding relays in any previous selectors used on the call. The remainder of the release is the same as for a normal call.

3.16 EFFECT OF FAULTY (OPEN) OUTLET. If the seized outlet is open on the positive, negative or private wire, no earth will be returned on the P wire. When relay B releases, the switching relay will release and in turn release relay CD, completing the release circuit as described in para. 3.15. Contacts CD3 and CD6 re-connect the A relay across the calling loop. A relay re-operates, but relay B cannot operate until the switch restores completely to normal. The release of relay B removes earth from the incoming private and releases all of the previous switches, so that the call is lost.

NOTES

4. SE.50 TYPE GROUP SELECTOR (CE 11030).

4.1 The following description is based upon drawing CE-11030, but it can be equally applied to the selector to drawing CE-900, as there are only minor differences between the two circuits.

4.2 SEIZURE. When the calling loop is extended from the previous selector, relay A operates, A1 operates relay B from battery behind the vertical magnet to earth at N5 and B7 operates relay CD on its 600 ohm winding from earth at NR3 (Fig. 13). On first and incoming selectors the switch supervisory lamp lights from earth at B1 or N5 via CD2 operated contact. A guarding earth is normally applied to the incoming private wire by B3, but if a fast guard is required U8 and U9 may be strapped, allowing earth from N5 to be applied to the private wire immediately the A1 contact operates. On first selectors, contact CD4 connects dial tone to the 570 ohm winding of relay A, where it is induced into the two 200 ohm windings and so to the calling line.

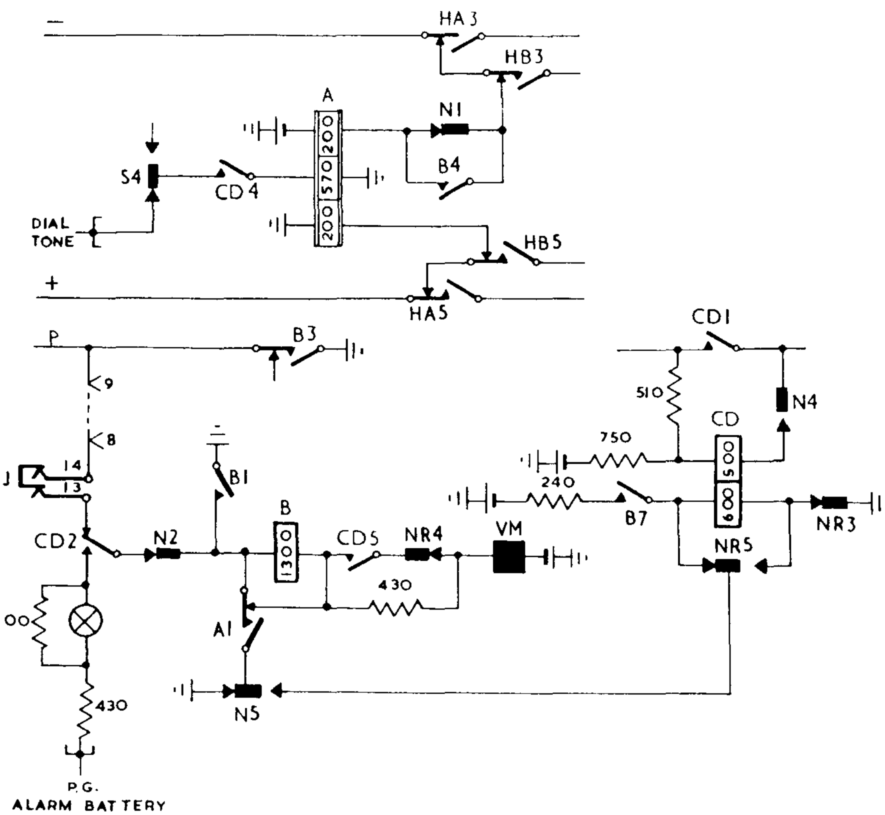


FIG. 13. SEIZURE.

4.3 VERTICAL STEPPING. Before pulsing commences, relays A, B and CD are operated. Relay CD is operated on its 600 ohm winding and a 510 ohm shunt path around the 500 ohm winding is prepared at CD1. Contact CD5 prepares the vertical magnet pulsing circuit by short circuiting the 430 ohm resistor in series with relay B. Fig. 14 shows a simplified version of the vertical pulsing circuit. When pulses are received, the A relay releases at each break and re-operates each time the loop circuit is remade. Each time the A relay releases, contact A1 short circuits relay B and operates the vertical magnet from earth at B1. When the A relay re-operates, the short circuit is removed from relay B which is energised again in series with the vertical magnet. The additional resistance of relay B causes the vertical magnet to release each time relay B is connected in series. At the first vertical step the vertical off normal (N) springs place a shunt across the 500 ohm winding of relay CD (N4) and connect an intermittent short circuiting earth via A1 operated for the 600 ohm winding (N5). After the first vertical step, the 500 ohm winding of CD is shunted for the remainder of the pulse train and the 600 ohm winding is short circuited each time relay A operates. Relays B and CD both hold during vertical stepping.

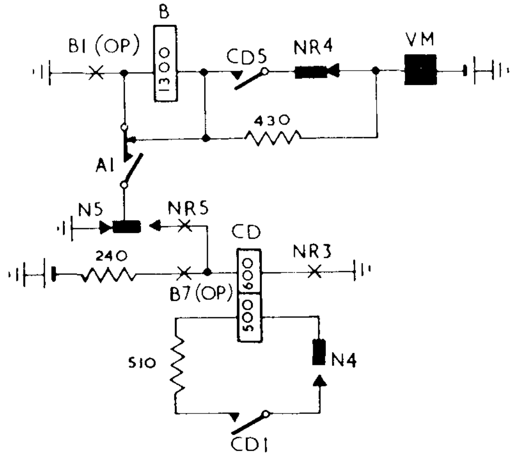


FIG. 14. SIMPLIFIED VERTICAL PULSING CIRCUIT.

4.4 ROTARY "CUT-IN". At the end of the vertical pulse train, relay A remains operated, relay B is held in series with the vertical magnet and relay CD releases after a delay period of 90-135 milliseconds. Contact CD3 extends the magnet alarm earth to operate the rotary magnet, moving the wipers to the first row of bank contacts on the dialled level.

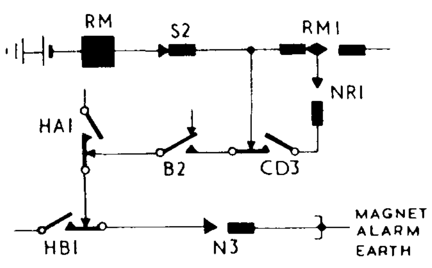


FIG. 15. ROTARY CUT-IN.

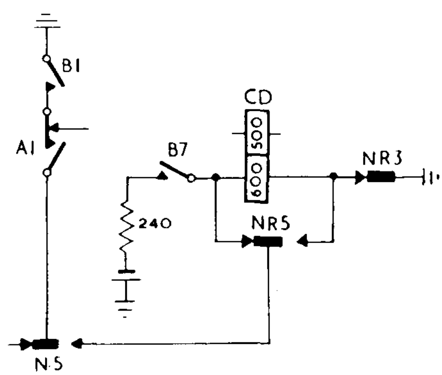


FIG. 16. RE-OPERATION OF CD.

4.5 RE-OPERATION OF RELAY CD. At the first rotary step, rotary off-normal (NR) springs operate. At NR5, the earth via B1 and A1 which was previously short circuiting relay CD now re-operates CD on its 600 ohm winding.

4.6 CUT-DRIVE PRINCIPLE. When NR1 and CD3 operate at the first rotary step, a self-interrupted rotary drive circuit from the magnet alarm earth via HB1 and HA1 contacts is established. The rotary interrupter springs operate when the rotary magnet armature is almost fully operated and restore when the magnet is almost fully released. Each time RM1 springs are operated, the magnet alarm earth is extended to the 85 ohm windings of both HA and HB relays. The opposite side of each winding has a negative potential connected and tests via the P1 and P2 wipers the condition on the private contacts. While both odd and even private contacts are busy, the busying earth potential shunts the HA and HB relays and prevents their operation. The drive circuit is maintained and when the interrupter springs restore the rotary magnet is operated and steps the wipers to the next contact. The drive continues until a free outlet is found. On a free outlet there is no shunting earth and HA or HB relay (or both) operates from the magnet alarm earth to negative potential via a 390 ohm resistor. The rotary drive circuit is "cut" at either HA1 or HB1 (Fig. 17). Earth from CD7 operated is extended via HA2 or HB2 to guard the seized outlet.

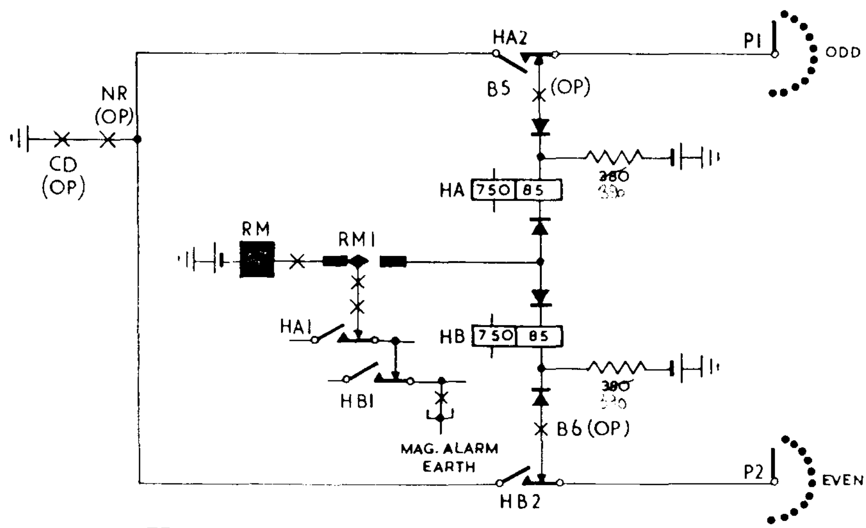


FIG. 17. CUT-DRIVE PRINCIPLE - SE.50 SELECTOR.

4.7 ODD OUTLET FREE, EVEN OUTLET BUSY. During the first rotary step, NR springs re-operate relay CD. The rotary magnet operating earth is transferred via CD3 and NR1 to the rotary interrupter springs RM1. During the period that the RM1 springs are operated, relays HA and HB test the P1 and P2 outlets via the 85 ohm windings. As the even outlet is assumed busy, earth on the P2 contact short circuits relay HB and prevents its operation. If the odd contact is free, there is no short circuiting earth and relay HA operates on its 85 ohm winding from the magnet alarm earth to negative behind the 390 ohm resistor. The rotary magnet drive circuit is disconnected at HA1, the HA relay holds on its 750 ohm winding via HA4, and the negative, positive and private wires are extended to the selected outlet via HA3, HA5 and HA2 respectively. The calling loop is extended through to next selector. Relay A in the switched selector releases and at A1 releases relays CD and B. During the slow release of these relays contact B3 maintains an earth on the incoming private and CD7 holds relay HA. A guarding and holding earth is returned on the private wire from the next selector to hold this and previous selectors after the final release of relays B and CD. When contact CD6 restores, an additional resistance of 2000 ohms is inserted in the holding circuit of relay HA. This reduces the holding current to approx. 20mA and ensures a fast release at the end of the call. During conversation, the only relay operated is relay HA. Fig. 18 shows the switched through condition.

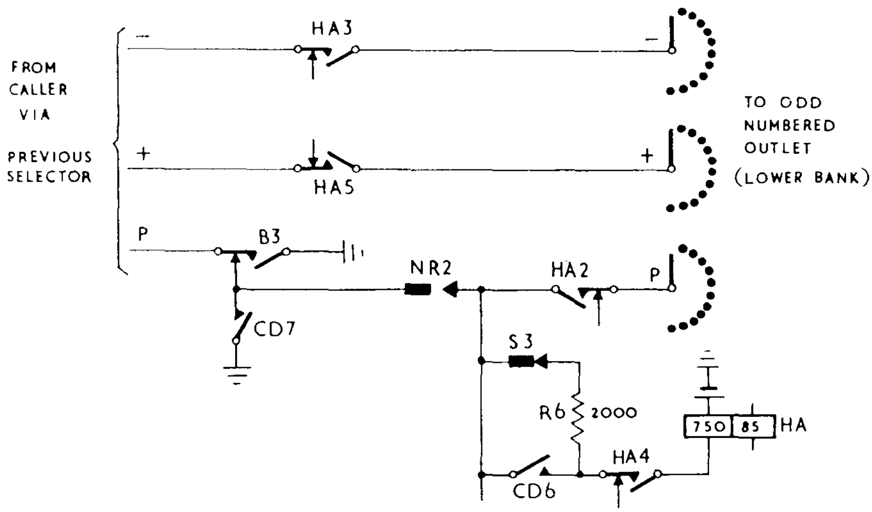


FIG. 18. THROUGH CONDITION - ODD OUTLET SELECTED.

4.8 EVEN OUTLET FREE, ODD OUTLET BUSY. The outlet testing circuit is prepared as described in para. 4.7. If the odd outlet is busy, the 85 ohm winding of HA is short circuited and relay HA does not operate. If the even outlet is free, the alarm earth via the operated interrupter springs operates relay HB on its 85 ohm winding. Relay HB holds on its 750 ohm winding via HB4, disconnects the rotary magnet operating earth at HB1 and switches the negative, positive and private wires through to the selected outlet via HB3, HB5 and HB2 respectively. Relay A releases, followed by CD and B. An earth is returned on the private wire from the next selector during the release time of relays B and CD. After the release of relay CD, a 2000 ohm resistor is included in the hold circuit of relay HB in the same manner as shown for the odd outlet in Fig. 18.

4.9 BOTH OUTLETS FREE. Relay HA and HB both operate on their 85 ohm windings. As the holding circuit for relay HB is opened at HA4, relay HB releases. Relay HA remains operated on its 750 ohm winding and the call is switched to the odd outlet as described in para. 4.7.

4.10 "STEP-ON" FROM FAULTY OUTLET. If an earth is not returned on the P wire of a seized outlet the switching relay (HA or HB) is released at CD7 after the 40-80mS release lag of relay CD. This is a much shorter release lag than that obtained at the end of the vertical stepping as on this occasion the 600 ohm winding is not short-circuited and the principal delaying feature is the 510 ohm shunt across the 500 ohm winding of CD. The restoration of contacts CD3 and HA1 (or HB1) re-operates the rotary magnet and the wipers are stepped to the next set of contacts. Relay A, which was placed back across the circuit by the release of the switching relay, re-operates to the calling loop and at A1 extends earth from the still operated B1 contact to operate relay CD on its 600 ohm winding. Contact CD3 transfers the magnet earth via RM1 operated so that relays HA and HB can re-commence testing outlets in the usual manner.

4.11 ALL OUTLETS BUSY. When all outlets on the dialled level are busy, the selector steps to the 11th rotary step and operates "S" springs. S1 applies an earth to the overflow meter, S2 opens the rotary magnet drive circuit, S3 opens the hold circuit via 2000 ohms for the switching relays and S4 applies busy tone to the 570 ohm winding of relay A. HB operates on its 85 ohm winding and holds on its 750 ohm winding via HB4 and CD6 to earth at CD7. HB3 and HB5 disconnect relay A, which at A1 releases relay CD after a release lag of 40-80mS. Relay HB is released by CD contacts and places relay A back across the line to re-operate to the calling loop. A1 re-operates relay CD on its 600 ohm winding. Busy tone is induced from the 570 ohm winding of relay A into the two 200 ohm windings and fed to the caller. During the time that the caller is receiving busy tone relays A, B and CD are held operated. Fig. 19 shows the conditions while the caller is receiving busy tone.

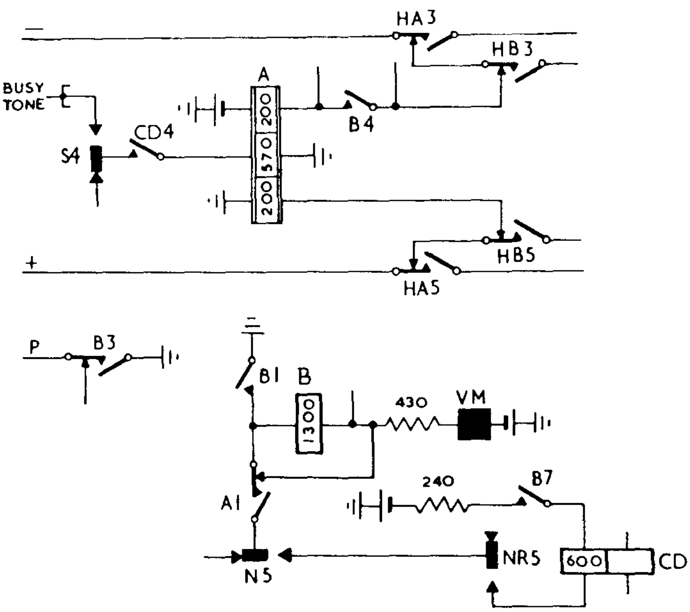


FIG. 19. CALLER RECEIVES BUSY TONE - ALL OUTLETS BUSY.

4.12 RELEASE FROM NORMAL CALL. The release of the selector after the completion of a matured call is initiated by the removal of the holding earth from the P wire of the selected outlet. The switching relay HA or HB releases and disconnects the negative, positive and private incoming wires from the outlet. HA1 or HB1 extends the magnet alarm earth to operate relay CD on its 500 ohm winding. CD1 applies the magnet alarm earth to operate the release magnet and CD7 applies a guarding earth to the private during the release of the selector. Relay CD is shunted by CD1, but the delay effect of this shunt enables relay CD to hold operated during the selector release.

When the selector has fully restored, N3 disconnects the magnet alarm earth and N4 removes the shunt from the 500 ohm winding of CD so that it can release quickly. The incoming selector private wire is unguarded from the time that the holding earth is removed from the P wire until earth is re-applied by CD7. This unguard period represents the release of the switching relay HA or HB followed by the operation of relay CD.

If the circuit is seized during the unguard period, relay A cannot operate as the negative line is opened at N1. This feature also supplies a junction guard if the selector is an incoming selector and the repeater relay set at the originating exchange is fitted with back busying facilities. Fig. 20 shows the release conditions after a matured call.

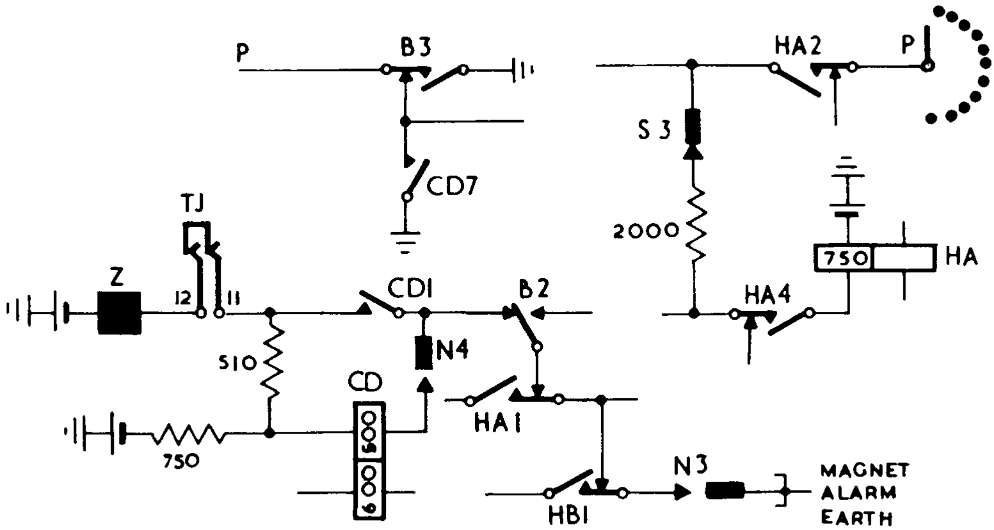


FIG. 20. RELEASE CONDITIONS.

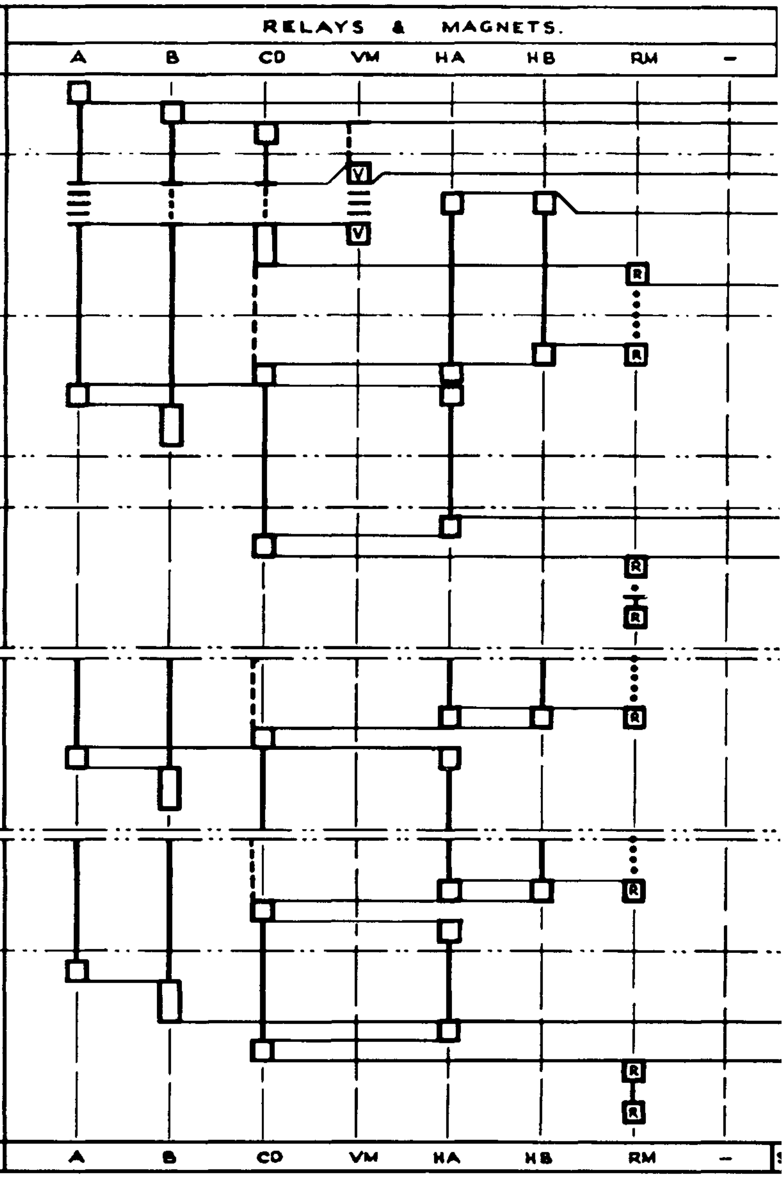
4.13 RELEASE FROM ALL OUTLETS BUSY CONDITION. While the caller is receiving busy tone after an all outlets busy condition, relays A, B and CD are operated. When the calling subscribers handset is restored, relay A releases and A1 contact short circuits relay B and opens the circuit to the 600 ohm winding of CD. Earth is removed from the incoming private at B3 to allow all preceding selectors to release. B2 connects the magnet alarm earth to the 500 ohm winding of relay CD. Because the two windings of CD are reverse connected, the flux in CD must completely restore to zero and then build up in the reverse direction to operate relay CD on its 500 ohm winding. CD1 extends the magnet earth to operate the release magnet and CD7 applies earth to re-guard the incoming private.

4.14 RELEASE ALARM. If, due to a mechanical defect, the selector does not release when release conditions are applied, a release alarm is given after a 9 second delay period.

4.15 PRE-BUSYING. When the selector is required for maintenance and a call is in progress, a technician may "pre-busy" the selector by removing the release link from between test jacks 11 and 12 and inserting it between test jacks 10 and 11.

At the end of the call, when the switching relay releases, the magnet alarm earth does not operate the release magnet, but is diverted to test jack 10 and operates the T.T. bell. Relay CD operates on its 500 ohm winding from the magnet alarm earth and at CD7 places a guarding earth on the incoming P wire. All other previous selectors release when the holding earth is first removed from the private at the conclusion of the call. The release alarm is given after 9 seconds to ensure prompt attention.

	OPERATION.
1.	LOOP EXTENDED FROM PREVIOUS SELECTOR.
2	IMPULSING. AND ROTARY CUT IN & SEARCH.
3	FREE OUTLET, LOWER.
	CONVERSATION PERIOD.
4	RELEASE, COMPLETION OF CALL.
5	FREE OUTLET, UPPER & LOWER. (ALTERNATIVE TO 3 ABOVE.)
6	ALL OUTLETS BUSY, UPPER & LOWER. (ALTERNATIVE TO 3 ABOVE).
7	RELEASE AFTER ALL OUTLETS BUSY.



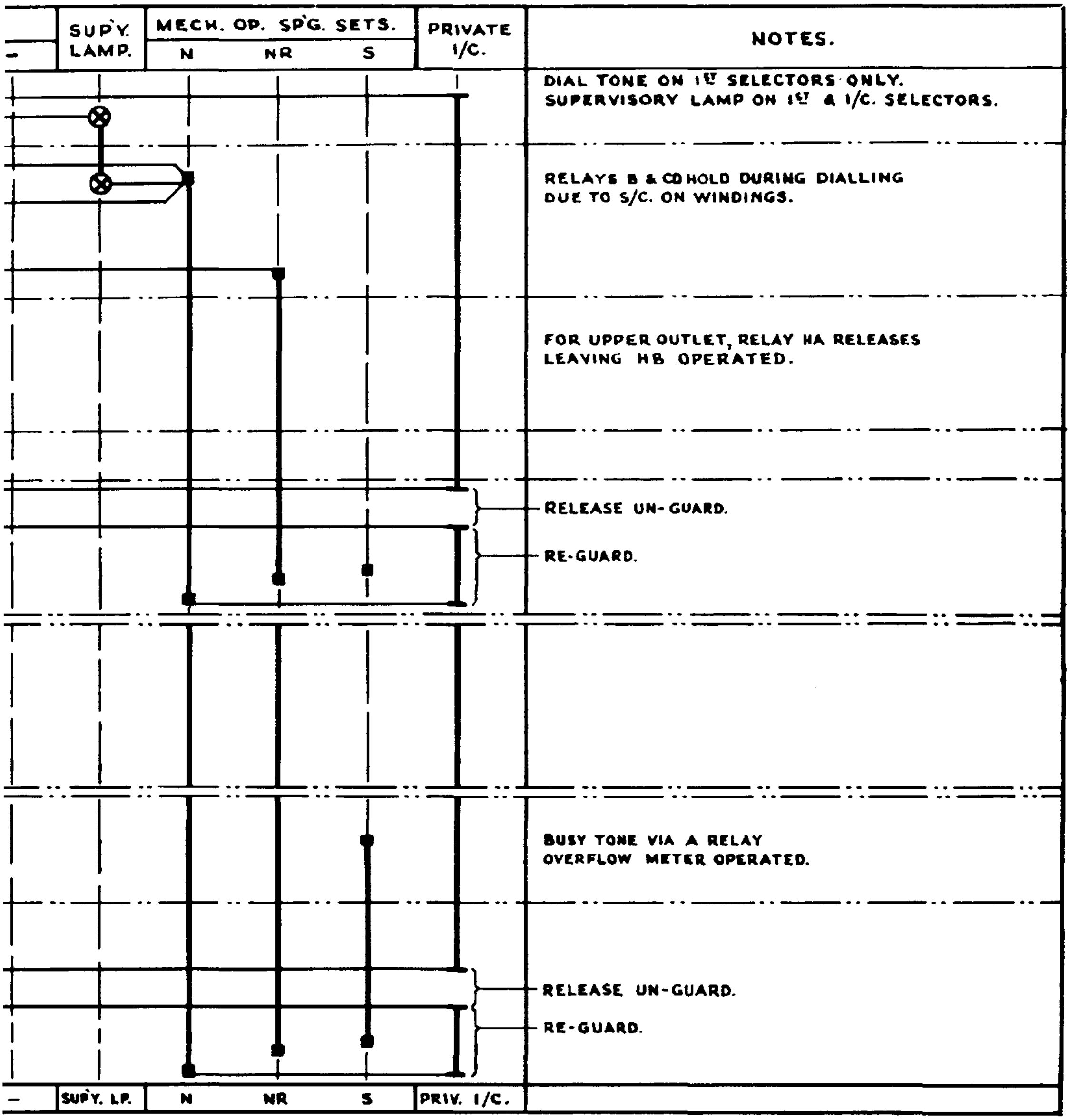
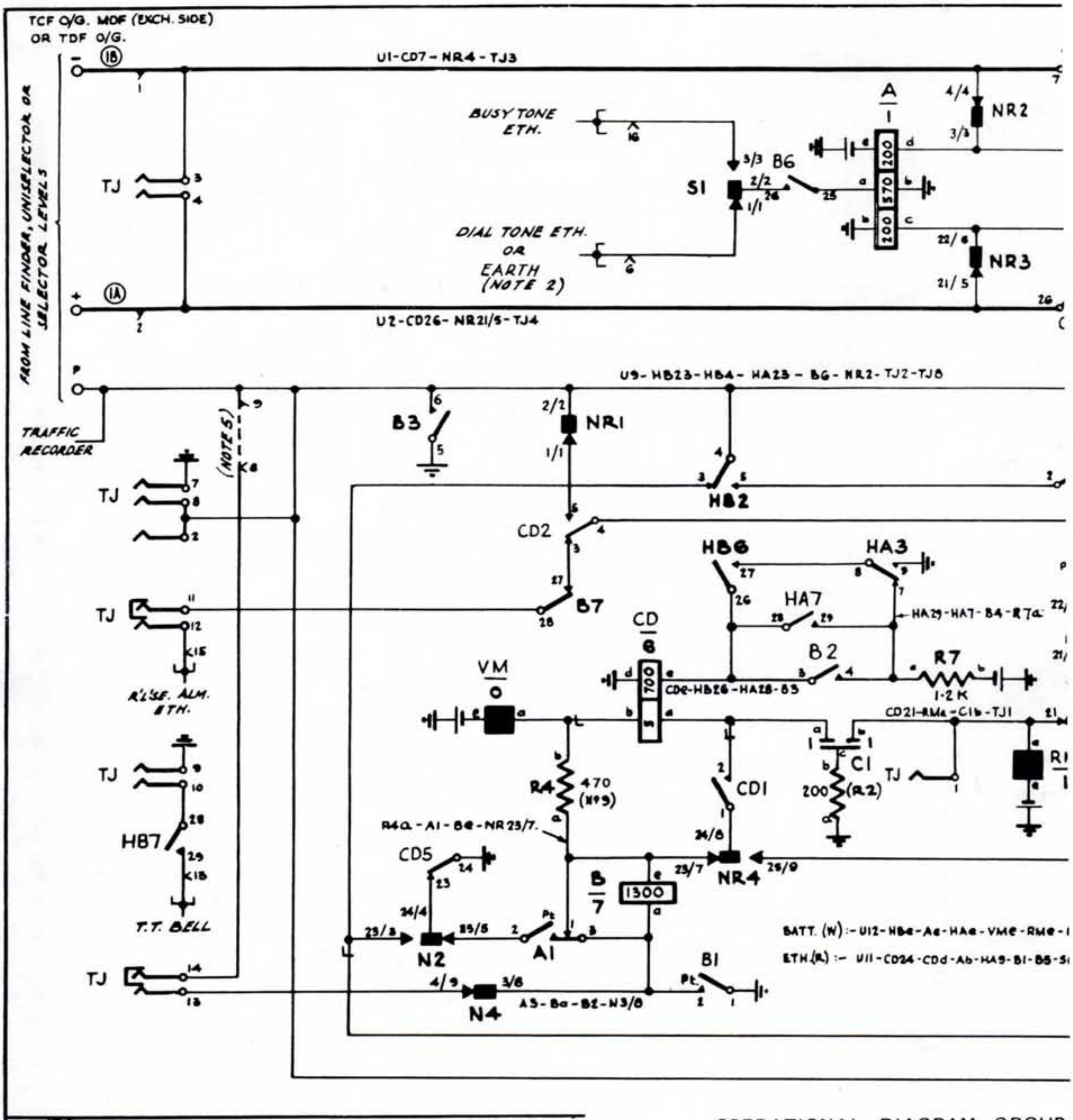
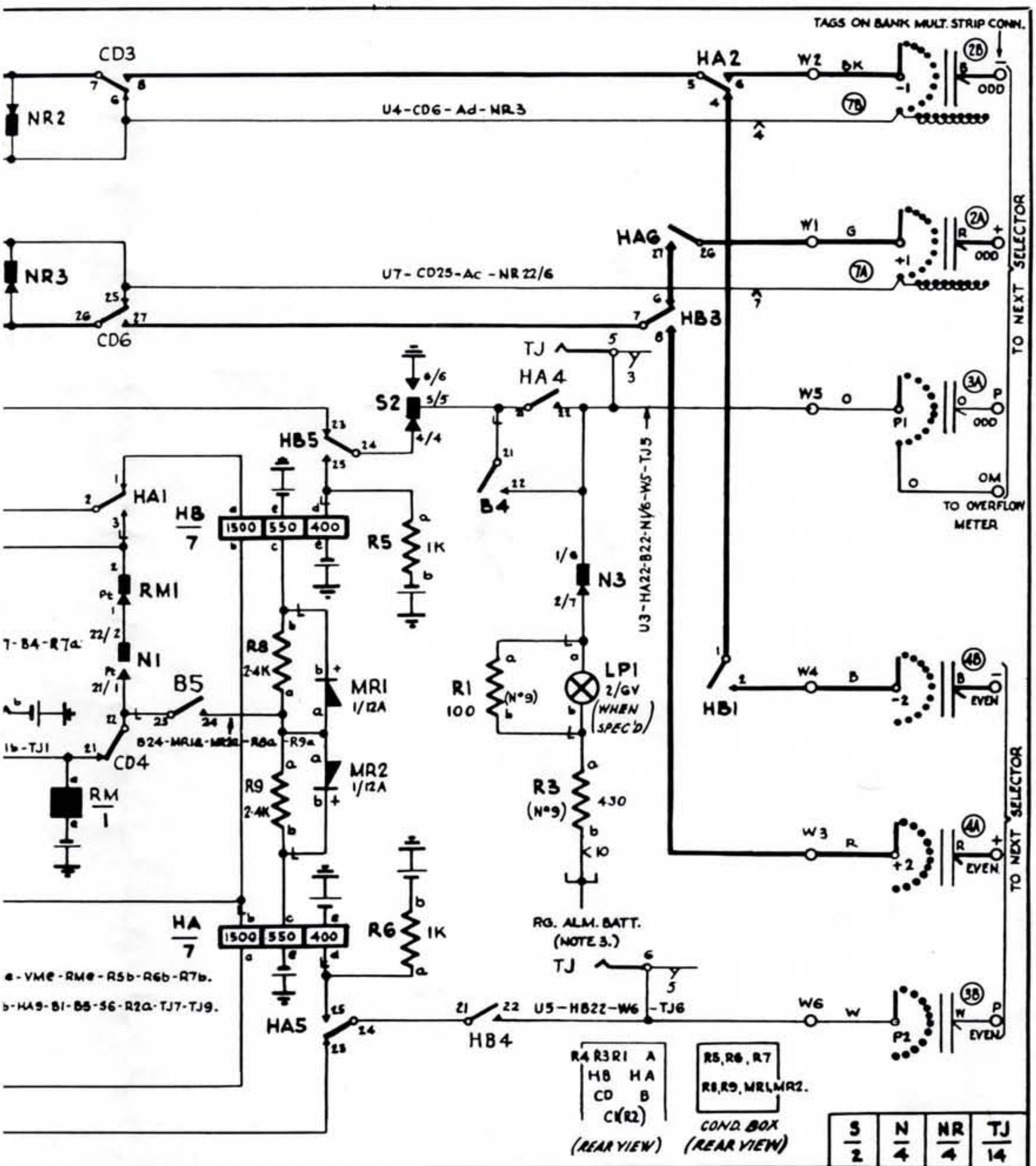


FIG. 21. OPERATIONAL DIAGRAM
GROUP SELECTOR (2000 TYPE).

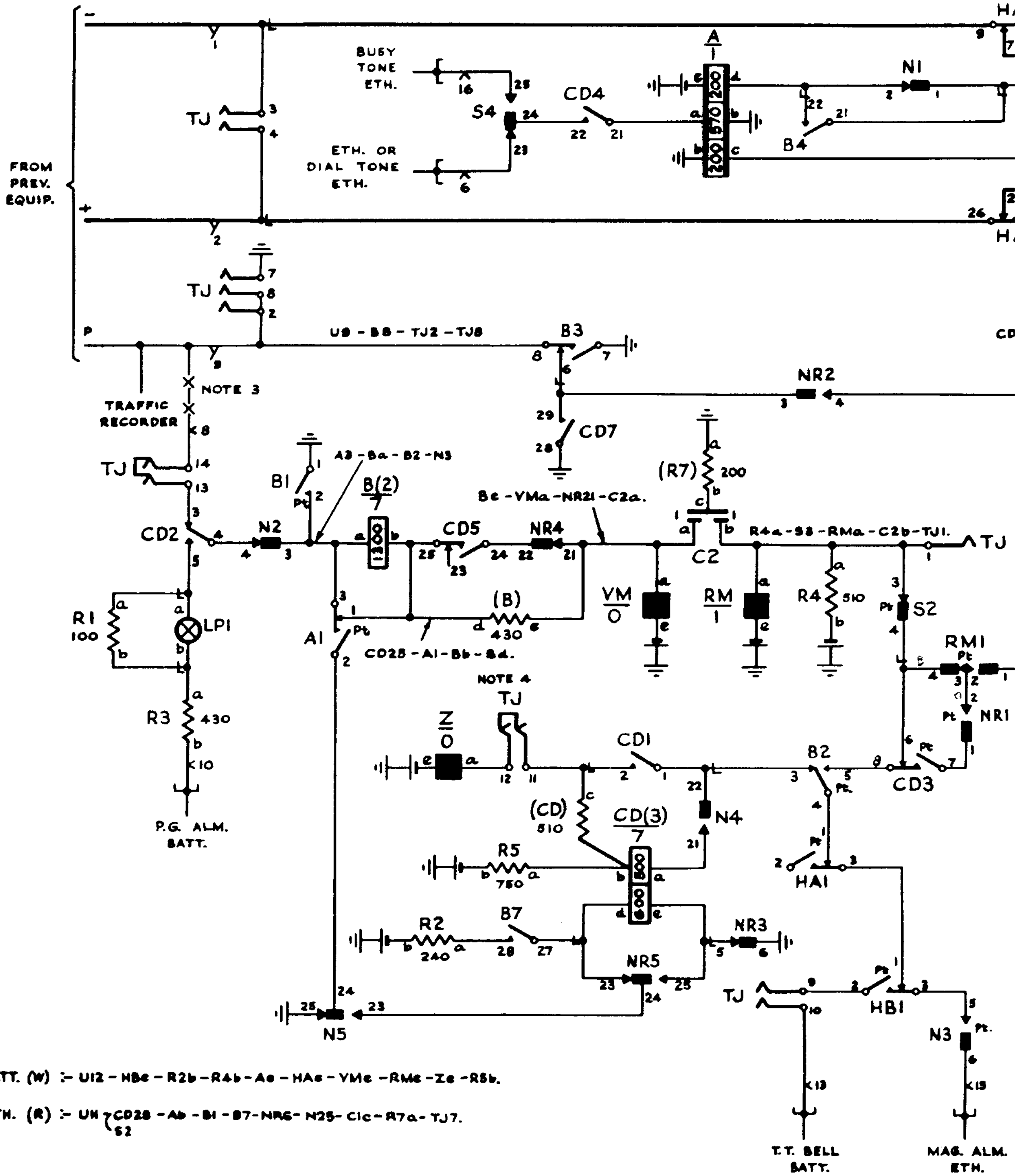


OPERATIONAL DIAGRAM GROUP



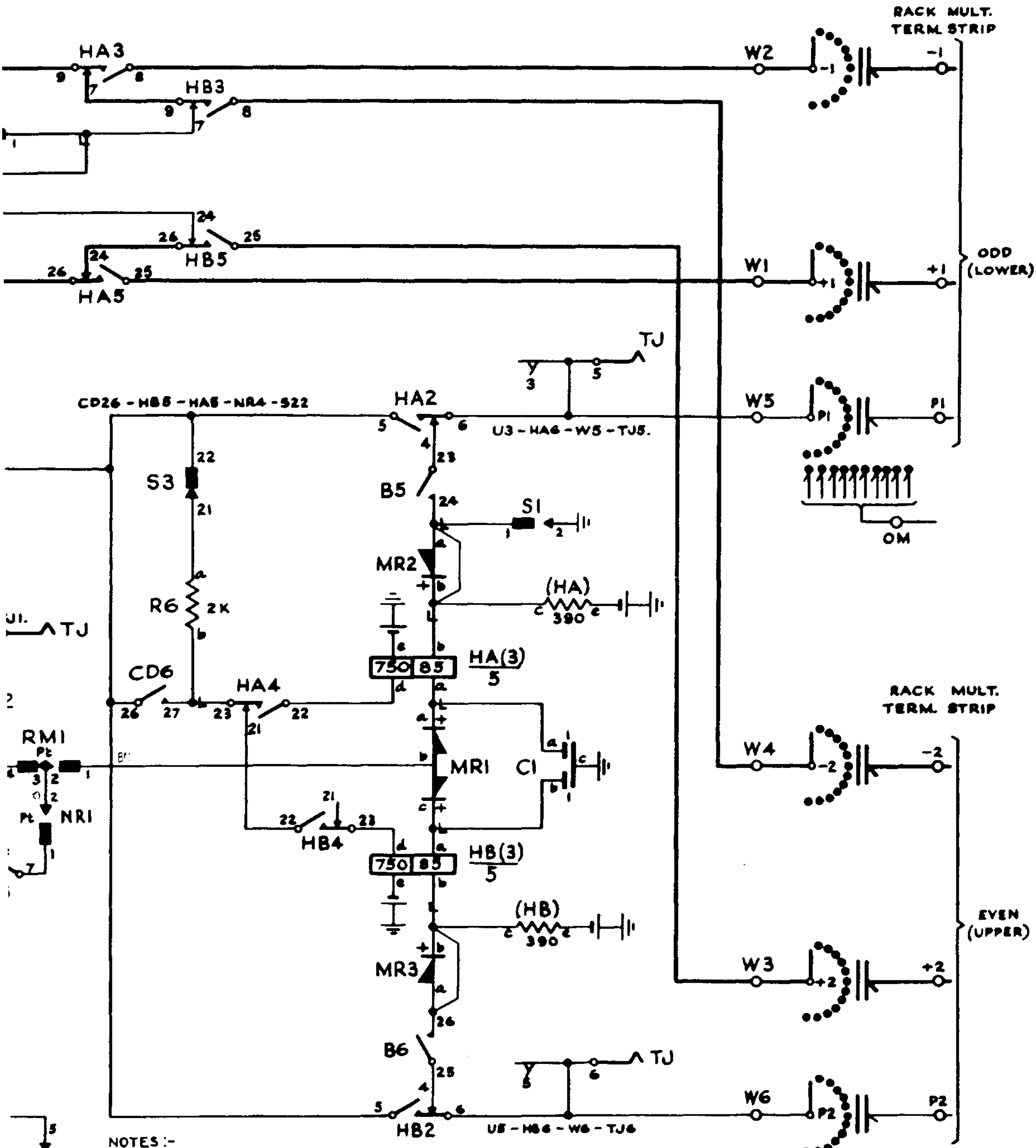
M GROUP SELECTOR (2000 TYPE)

FIG. 22. 2000 TYPE GROUP SELECTOR.



BATT. (W) :- U12 - HBe - R2b - R4b - Ae - HAe - VMe - RMe - Ze - R5b.

ETH. (R) :- U11 { CD28 / S2 } - Ab - B1 - B7 - NR6 - N25 - C1c - R7a - TJ7.



NOTES :-

1. FUSING :- 3·0A PER 20 SELECTORS .
2. SHELF JACKS U9 & U11 TO MAKE CONTACT WHEN SELECTOR IS REMOVED.
3. STRAP SHELF JACKS U8 & U9 ON LOCAL FIRST SELECTORS IN UNISELECTOR EXCHANGES FOR FAST GUARD.
4. TO BUSY AFTER COMPLETION OF CALL, REMOVE LINK FROM TJ11 & 12 & INSERT IN TJ10 & 11.
5. ~~WIRING UNSTANDARD TO ALLOW EASIER CONVERSION TO BATTERY TESTING.~~
6. SOME SELECTORS HAVE 'HA' & 'HB' RELAY CODE 35039.
7. SOME SELECTORS HAVE MR2, MR3 & S1 REMOVED.

FIG. 23. SE.50 TYPE GROUP SELECTOR.
END OF PAPER