SE.50 TYPE GROUP SELECTOR
200 OUTLETS DRAWING CE.11030

1. GENERAL.

1.1 This E.I. describes the functions, and design features of an SE.50 type Group Selector - 200 Outlets to which Drawing CE.11030 Sheet 1 Issue 1 refers.

1.2 It may be used as a first, incoming or intermediate selector and may also be converted to test for battery.

2. OPERATIONAL FUNCTIONS.

2.1 The main operational functions are as follows -

(i) Loop extended from the previous selector

(a) Returns earth on the private to hold and guard the connection.

(b) Provides dial tone when used as a 1st selector.

(c) On 1st and incoming selectors, provides a P.G. alarm should the selector be held for longer than 6 minutes without dialling.

(ii) Vertical impulsing, rotary cut-in and search

(a) Steps vertically under the control of impulses received.

(b) Cuts in on the level reached and, if the first two outlets are busy, hunts for and seizes the first free outlet in the level.

(c) Tests two outlets at each rotary step.

(iii) Switching to a free outlet, lower or upper

(a) Switches the calling line through to the seized outlet, relay HA operating if lower (odd) outlet is free and relay HB if upper (even) outlet is free.

(b) If both upper and lower outlets are free, switches the calling line through to the lower outlet, relay HA taking preference over relay HB.

(c) Keeps a holding earth on the private for a time sufficient for an earth to be returned from the seized selector.

(d) Steps off an outlet which fails to return an earth on the P wire.

(iv) Release after a call

(a) Releases when the release condition is applied.

(b) Provides a release alarm should the selector fail to release due to a mechanical defect.

(v) All Outlets busy, upper and lower (alternative to (iii) above)

(a) Selector steps to 11th row contacts and operates S springs.

(b) Busy tone transmitted to the calling subscriber.

(c) Overflow meter operates.

(vi) Release after no progress or all outlets busy

(a) Provides a release unguard period to allow the simultaneous release of previous selectors.

3. SPECIAL FEATURES.

3.1 The following distinctive features have been incorporated in the design of this circuit -

(i) Step-off-open Trunk. This facility is provided to eliminate no progress calls and "drop-outs" which may be caused by an open circuit negative, positive or private wire, and by the non-latch condition which may occur with 2000 type mechanism.

(ii) Fast Switching. By using a single stage cut through a fast connection to the next selector is obtained.

(iii) Magnet Alarms. Both the rotary and release magnet are operated from a common magnet alarm earth so that, if a mechanical failure causes the permanent energisation of either of these magnets an alarm will be given.

(iv) Current Drain Reduction. Only one relay is held after cut through on a normal call and the current drain of the switch is 19 mA in this condition. The 2000 type group selector has a current drain of 58 mA under a similar condition. The cumulative effect of the saving of approximately 39 mA per T.U. per group selector rank in a large exchange is considerable.

(v) Re-guard. The re-guard earth is applied by relay CD. This eliminates the intermittent earth which occurred with earlier circuits, when the wiper carriage bounced at the end of its vertical drop.

(vi) Overflow Meter Registration. A pulse type circuit is incorporated to ensure accuracy in recording overflows. Previously, in periods of very heavy traffic, many overflow registrations were masked by the continuous occupancy of the 11th step contacts.

(vii) Selector Pre-busying. This condition, which may be applied during the period of conversation, prevents the selector from being taken into further use on completion of the existing call. When the release condition is applied an audible alarm by the T.T. bell is given, and the selector may be removed from service.

(viii) Battery Testing.

(a) The selector may be converted to battery testing by a simple circuit modification. The 390 ohm non-inductive windings of relays HA and HB are disconnected. Rectifiers MR2 and MR3 are short circuited.

(b) The circuit, when arranged for earth testing, will operate reliably into a succeeding rank equipped with battery test-in resistors, whereas the existing standard 2000 type circuit or its equivalent is unreliable and tends to pass idle trunks.

(ix) Less Sparking of Wiper-to-Bank Contacts. During rotary search the testing wipers interrupt a current of approximatelt 110 mA via a non-inductive circuit. This will considerably reduce the arcing and sparking and consequent wear of bank contacts.

(x) No Nickel Iron-Cored relays are used.

(xi) Wiring Simplification. No special bank wiring is required from the 11th row negative and positive contacts to U jacks to hold relay A on overflow calls as in the case of the 2000 type and equivalent circuits. This feature gives a greater similarity of final selector multiple and group selector multiple wiring, with consequent simplification in manufacture.

(xii) Fewer Relays Operated Under Overflow Condition. On an overflow call three relays are held, namely, A, B and CD, whereas in the 2000 type selector four relays are held, namely, A, B, CD and HA.

(xiii) Release Unguard. Circuit irregularities, due to an intruding selector switching-in during the release guard, are eliminated. With the 2000 type group selector, drop-out and stop-on-busy troubles result from switching to a releasing train of selectors during the release unguard period.

(xiv) Sparking on the Switching Relay. Sparking across the contacts during cut-through is minimised due to the lower impedance of relay A when the 570 ohm winding is short-circuited. (See Paragraph 6.1.)

(xv) Relay Coil Winding. For ease of manufacture, the use of fine winding wire has been avoided in the design of the relays.

(xvi) Back-guarding. Provision is made for back-guarding to a distant exchange when this selector is used on junctions equipped with auto-to-auto repeaters with this facility. Relay A is unable to reoperate until the selector is completely normal as its circuit is interrupted on the negative side at N1.

4. RELAY FUNCTIONS.

4.1 Relay A - Impulsing, battery and tone feed..
Relay B - Guarding and holding.
Relay CD - Completion of impulse train, rotary drive control, step-off-open trunk control and re-guard.

Relay HA)
Relay HB) - Drive tripping and switching.

5. CIRCUIT OPERATION.

5.1 When the selector is seized, relay A operates and, in turn, operates relay B which operates relay CD. On 1st and incoming selectors the supervisory lamp glows. A1 applies the fast guard to the incoming private when the selector is preceded by a uniselector.

5.2 Dialling commences and the selector is stepped vertically, whereupon the N springs operate. During vertical stepping relays B and CD hold. Relay B holds by virtue of the short-circuit applied across the relay winding during the "break" period of each impulse, and relay CD holds because of the 510 ohm shunt across its 500 ohm winding together with the short-circuited 600 ohm winding.

5.3 At the conclusion of impulsing, relay A remains operated and relay CD releases in 90-135 mS. Magnet alarm earth via N3, HB1, HA1, B2, CD3 and S2 operates the rotary magnet, moving the wipers to the first row of bank contacts. At NR5, the earth previosuly short-circuiting relay CD now establishes an operate path. In reoperating, relay CD transfers the rotary magnet operating earth to the testing relays via the interrupter springs RM1, which are in their operated condition. During the period that the RM1 springs are operated, relays HA and HB test the first P1 and P2 outlets via their 85 ohm windings. If both outlets are busy neither HA nor HB operate. The rotary magnet then releases and the self-drive circuit via the interrupter is established. The search continues until a free outlet, which allows relay HA or HB (or both) to operate, is found. The rotary drive circuit is disconnected and the appropriate switching relay is held to the forward private wire by earth at CD7. If relays HA and HB both operate, indicating that both outlets are free, relay HA takes control and releases relay HB. The negative, positive and private wires are extended and relay A releases followed by relays CD and B. Relay HA (or HB) holds via 2000 ohms during the conversation period. All other relays are released so that the current drain, and the surge voltage which occurs on releases, are reduced.

5.4 If the seized selector fails to return an earth on the P wire, the switching relay releases when relay CD releases, approximately 40 to 80 mS after cut-through rotary magnet is then re-energised and the wipers moved to the next outlet. Relay A will be re-operated followed by relay CD which transfers the magnet operating earth circuit to relays HA and HB to test the outlets. Thus the rotary search conditions are re-established and the search continues until a free outlet is found. It is essential for relay CD to release in 40 to 80 mS to ensure the satisfactory operation of the "step-off-open" feature. After cut-through to the next selector, relay B on releasing connects the forward private through to the incoming side.

5.5 If no outlets are available the selector steps to the eleventh row contact, busy tone is fed to the calling subscriber and an earth pulse operates the overflow meter. Pulse registration of the overflow meter is achieved by the re-application of the switching relay test circuit to the private wire. Relay HA operates and holds via CD6 and CD7, and releases relay A. Relay CD releases in 40 to 80 mS followed by relay HA. Relay A reoperates followed by relay CD so that relays A, B and CD are held under the control of the calling subscriber. If an earth is already present on the 11th row contact, as may be the case when 2000 type group selectors are in the same rank, relay HA cannot operate and no overflow metering pulse is given. Also, under this condition, rectifier MR2 is short-circuited by S1 to prevent damage by excessive current flow if the selector remains too long on the 11th step.

5.6 Release from a matured call is initiated by the removal of the holding earth from the P wire on the seized outlet. Relay HA (or HB) releases and the speaking pair is disconnected , whilst relay CD operates on its 500 ohm winding, and provides the reguard earth until the selector restores to its normal position. The negative line is open-circuited to prevent operation of relay A until the selector has fully restored, and to provide junction guard at the originating exchange if repeaters with back-busying facilities are used.

5.7 Release from the all-outlets-busy condition is initiated when the calling subscriber restores. Relay A releases followed by relays CD and B. The private is unguarded, allowing the release of previous selectors until relay CD reoperates to provide the reguard.

5.8 When, for maintenance reasons, the selector is required by the maintenance officer and a call is in progress, the release link may be removed from test jacks 11 and 12 and inserted in test jacks 10 and 11. The release magnet is not energised when the release condition is applied, but relay CD operates and prevents the selector from being taken into service on another call. All other selectors in use on the particular call release in the normal manner. The T.T. bell is operated and, after the 9 seconds delay period, the release alarm. The operations of the alarm circuit ensures prompt attention which is important when the selector concerned is connected to an incoming junction.

6. DESIGN FEATURES.

6.1 Relay A. The 570 ohm winding of this relay is connected either to a low impedance source (dial tone or busy tone) or directly earthed to prevent crosstalk, and the surge voltage, which would otherwise be of the order of 1,200 to 1,400 volts under short-line unquenched dialling conditions, is reduced to safe limits.

6.2 Relay B . This relay is designed to hold with a dialling ratio as low as 20% make 12 impulses per second on a 1,200 ohm line. The release time must be at least 130 mS.

6.3 Relay CD.

(i) This relay normally operates on the 600 ohm winding which is designed to have short-time constant to ensure -

(a) rapid operation when the selector is seized;

(b) maximum growth of flux in the short time available after the first rotary step to the time cut-through occurs on one of the first outlets, so that the release time of the relay will not be adversely affected. When the selector seizes an outlet, an earth is fed forward for the release time of relays A and CD which, for an outlet on the first step, may be as low as 50 mS. However, the maximum time required for the operation of the relays A and B in the selector or repeater ahead is 35 mS under the worst conditions, so that an adequate margin of safety exists.

(ii) The 600 ohm winding is full short-circuited and the 500 ohm winding is partially short-circuited to achieve the necessary release time at conclusion of the impulse train. After the first operation of the rotary magnet it depends on the shunted 500 ohm winding to achieve the shorter release time of 40-80 mS necessary for the step-off-open trunk feature.

(iii) On release from the 11th step, relay CD releases and then immediately reoperates. Therefore, to ensure an adequate release unguard period the 500 ohm winding is reverse connected. The flux must then collapse to zero before building up in the reverse direction to reoperate the relay.

(iv) The 510 ohm resistance in parallel with the 500 ohm winding of this relay is only connected after its operation so that -

(a) The speed of operation on the 600 ohm winding is unaffected.

(b) The speed of operation during the release of the selector is unaffected by a permanently connected shunt. When the selector reaches the normal position the relay releases quickly due to the disconnection of the shunt by the N springs. This prevents, on incoming selectors, any momentary energisation of the vertical magnet due to bunching of A1 should the selector be seized at the instant of release. The release time is still of sufficient duration to mask the effect of any wiper carriage bounce on the incoming P wire.

(v) The 750 ohm resistance in series with the 500 ohm winding on the relay is required to reduce the current drain to a value which is insufficient to hold the shelf alarm relay (RA) when the test link is removed from T11-T12 while isolating a faulty switch which has failed to release.

6.4 <u>Relays HA and HB</u>.

(i) These relays are designed to operate within 8 to 9 mS under static circuit conditions. Under dynamic test conditions the HA and HB relays should not operate on a 200 ohm earth on the first two outlets (1st step) but should operate to any subsequent outlet on which a 700 ohm earth is present. In actual practice it is not necessary for a group selector to pass outlets busied with a private resistance in excess of 100 ohms, as this condition is never encountered. The subscriber's uniselector, which has a similar test circuit, does not step satisfactorily over a high resistance private circuit, and will stop-on-busy quite readily with a private resistance of this order.

(ii) The spring-set loading on each of these relays consists of five "K" units and, with the short-time constant of the operating winding, a high speed of operation is ensured.

(iii) After cut-through an additional resistance of 2000 ohms is inserted to reduce the holding current to 19 mA and to ensure a fast release at the conclusion of the call. An open circuit period of 5 to 6 mS is sufficient to release the holding relay. The reduced holding current and the 2000 ohm resistor have the effect of considerably reducing -

(a) The surge voltage on the private wire.

(b) The coupling between the holding relays of the various selectors, as the presence of a single slow release or shunted relay on the P wire effects the release of all holding relays.

(iv) The operation of relays HA and HB as a means of arresting the rotary search is used in preference to the release of these relays for the reasons that -

(a) A single stage cut-through is possible.

(b) Only one relay is held throughout the duration of the call.

(v) Immunity from stop-on-busy is achieved by the slightly slower response time of these relays when compared to a conventional 2000 type selector or equivalent circuit.

6.5 Capacitor C1. The adjustment of the drive tripping and holding contacts of either the HA relays is not critical, due to the provision of capacitor C1. The capacitor is discharged when the rotary interrupter contacts are operated and the HA and HB relays are testing their respective outlets. When a free outlet is encountered the effective testing time is extended slightly while the capacitor charges in series with the operating windings of the testing relays after the toggle has restored or HA4 (HB4) has opened.

6.6 Rectifiers.

(i) The 1/6A rectifiers prevent the earth potential behind the 85 ohm windings of the HA and HB relays from holding a releasing switch train, should the selector be testing an outlet on which a release unguard commences.

(ii) The 2P/24A rectifiers are utilised to -

(a) Prevent positive battery from operating the testing relays.

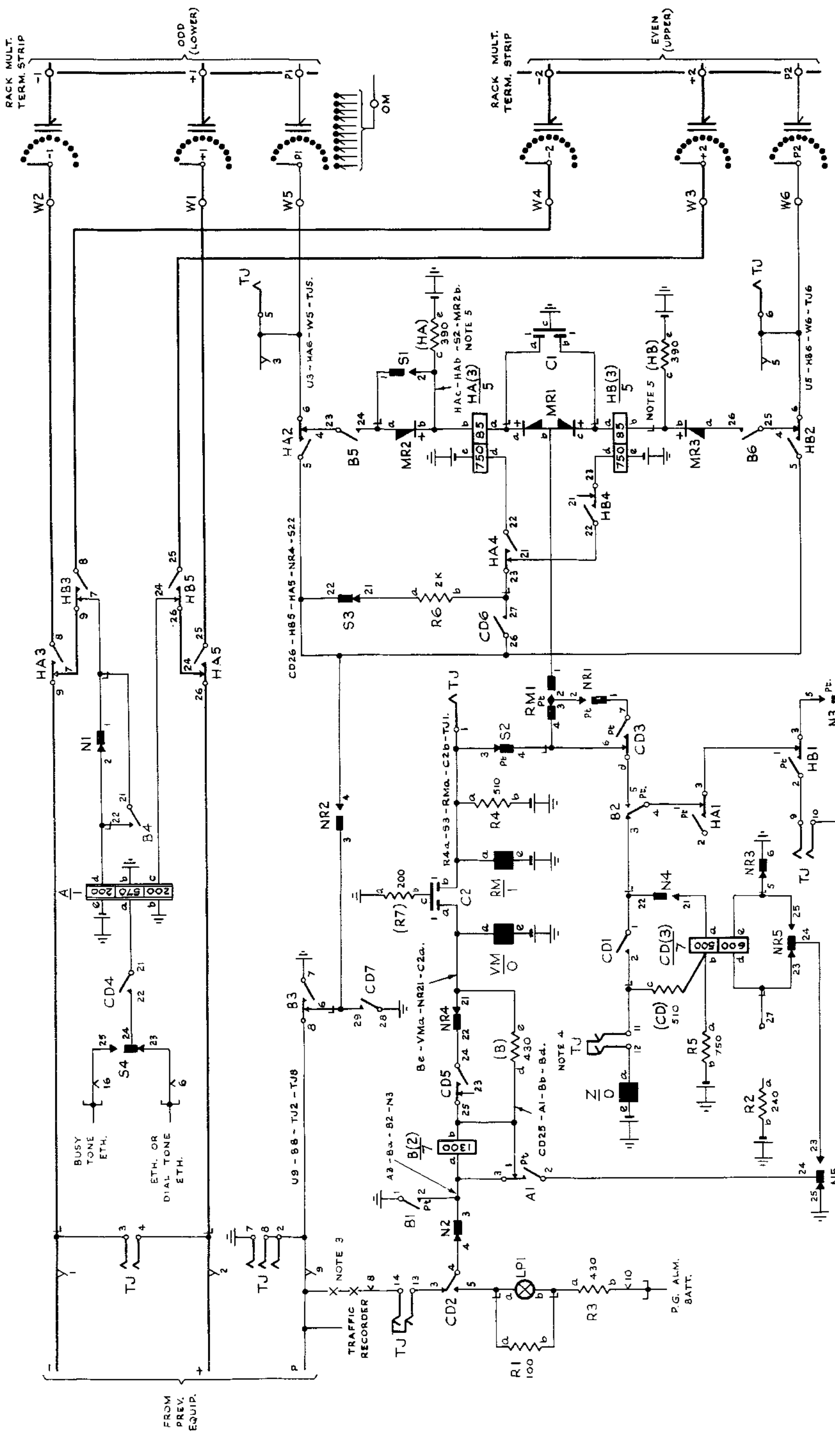
(b) Provide a non-linear resistance to greatly increase the range of non-operate to operate current in the test windings of relays HA and HB when testing over high resistance busy outlets.

Rectifier elements type 1/12A do not provide sufficient non-linearity and do not affect the range of current values in the testing windings of relays HA and HB.

6.7 Rotary Magnet Shunt. The provision of the 510 ohm shunt in parallel with the rotary magnet slightly decreases the rotary search speed to ensure that the rotary detent functions correctly.

6.8 Relay Coils. Relays A, HA and HB must be fitted with S.R.B.P. front cheeks, but Relays B and CD may be fitted with copper front cheeks.

6.9 Rotary Off-normal Contact Unit NR2. With the selector busied, this prevents relays HA and HB locking to the private wire, while they are being adjusted by the maintenance technician.



NOTES
1. FUSING :- 3·0A PER 20 SELRS.
2. SHELF JACKS U9 & U11 TO MAKE CONTACT WHEN SELR. IS REMOVED.
3. STRAP SHELF JACKS U8 & U9 WHEN FAST GUARD IS REQ'D.
4. TO BUSY AFTER COMPLETION OF CALL, REMOVE LINK FROM TU11 & 12 & INSERT IN TJ10 & 11.
5. WIRING UNSTANDARD TO ALLOW EASIER CONVERSION TO BATTERY TESTING

BATT. (W) :- U12 - HB2 - R2b - R4b - Ae - HAe - VMe - RMe - Ze - R5b.

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

RELAY	CODE
A	37236
B	35011
CD	35012
HA	35013
HB	35013

N	NR	S	TJ
5	5	4	14

GROUP SELECTOR 200 OUTLET S.E. 50 TYPE. DRAWING C.E. 1103

FIG. 1.

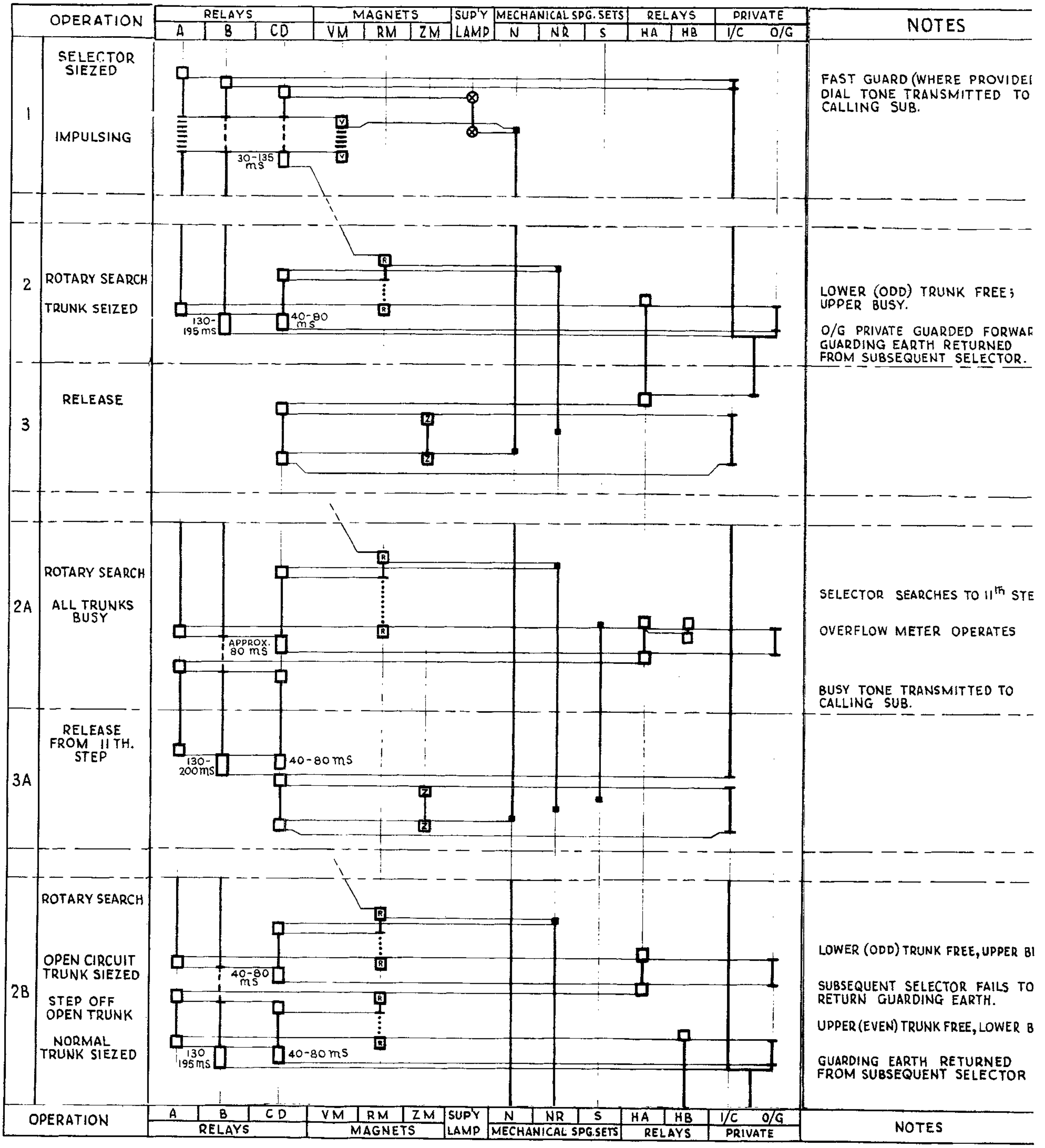

OPERATION
RELAYS
A
B
CD
MAGNETS
VM
RM
ZM
SUP'Y LAMP
MECHANICAL SPG. SETS
N
NR
S
RELAYS
HA
HB
PRIVATE
I/C
O/G
NOTES
1
SELECTOR SIEZED
IMPULSING
30-135 mS
FAST GUARD (WHERE PROVIDED
DIAL TONE TRANSMITTED TO CALLING SUB.
2
ROTARY SEARCH
TRUNK SEIZED
130-195 ms
40-80 ms
LOWER (ODD) TRUNK FREE; UPPER BUSY.
O/G PRIVATE GUARDED FORWAR
GUARDING EARTH RETURNED FROM SUBSEQUENT SELECTOR.
3
RELEASE
2A
ROTARY SEARCH
ALL TRUNKS BUSY
APPROX. 80 mS
SELECTOR SEARCHES TO 11th STE
OVERFLOW METER OPERATES
BUSY TONE TRANSMITTED TO CALLING SUB.
3A
RELEASE FROM 11 TH. STEP
130-200 mS
40-80 mS
2B
ROTARY SEARCH
OPEN CIRCUIT TRUNK SIEZED
40-80 mS
STEP OFF OPEN TRUNK
NORMAL TRUNK SIEZED
130 195 mS
40-80 mS
LOWER (ODD) TRUNK FREE, UPPER B
SUBSEQUENT SELECTOR FAILS TO RETURN GUARDING EARTH.
UPPER (EVEN) TRUNK FREE, LOWER B
GUARDING EARTH RETURNED FROM SUBSEQUENT SELECTOR

FIG. 2.

E N D.