

DIAGRAM NOTES (ISSUE 1)

concerning

GBW.13900

titled

U.A.X. NZ.13 FINAL-SELECTOR 2-10 TYPEGENERAL.

The circuit shows a 100 outlet final selector with P.B.X. groups of 2-10 lines as provided at a U.A.X. NZ.13.

The following diagrams should be considered in conjunction with this circuit.

GBW.13910 Subscriber's Line Finder &
Control Relay Set.

GBW.13890 Group Selector.

FACILITY SCHEDULE.

Provision is made for:-

- .1 Access to a total multiple of 100 lines including P.B.X. groups.
- .2 Holding the preceding apparatus in the chain of connections.
- .3 Vertical stepping under the control of the first train of impulses received.
- .4 Rotary stepping under the control of the second train of impulses received.
- .5 Testing the first line of a P.B.X. group and should it be busy, automatically search for a free line over the remainder of the group.
- .6 Direct access to be given (providing it is free) to any number other than the first of a P.B.X. group.
- .7 Transmission of busy tone to the caller if all lines in a P.B.X. group are busy, or if a particular number dialled is busy.
- .8 Applying ringing conditions to the called subscriber's line and returning ringing tone to calling party.
- .9 The transmission of metering and supervisory signals to the calling party when the called party answers.
- .10 Night service facilities on any line of a P.B.X. group other than the first.
- .11 Guarding the circuit against intrusion during the progress and release of a call.
- .12 A transmission and current feeding bridge for calling and called parties lines.
- .13 Trunk offering on calls from toll switchboard.
- .14 Forced release to be applied (under time pulse control) to the circuit when (a) CSH conditions are encountered, (b) when the call originates via a faulty parent exchange junction i.e., earth or battery contact.
- .15 Selector to be automatically busied and alarm to be given if the wiper carriage remains off-normal after release.

CIRCUIT OUTLINE.

The selector wiper carriage steps vertically under control of the "tens" digit to the level represented by that digit. After the inter-train pause the wiper carriage is rotated under the control of the "units" digit and the wipers stop at the bank contact appropriate to that digit. The called subscriber's line is then tested and if it is free, ringing current is applied to the line, and ringing tone is returned to the caller. When the called party answers the ringing is tripped, supervisory and metering conditions are returned to the caller. If busy conditions are encountered, busy tone is returned to the caller. On a call made to a P.B.X. group the first line being free, the operation of the circuit is as already described, but if the first line is busy, hunt start conditions are set up and rotary search continues until either a free line is found or the last line of the group is reached. Further rotary stepping is prevented and busy tone is returned to the caller. In the case of a Parent Exchange call, a resistance positive battery is connected to the M wire to operate relay TO, contacts of which remove a short-circuit from the coils of relay OC. Trunk offering is effected by the operator earthing the junction loop by operating her ringing key. This unbalance operates the differential relay OC. Subsequent circuit operation gives access to the wanted subscriber. Under CSH conditions the circuit is forced released, under the control of the time pulse circuit.

1. CIRCUIT DETAIL.Selector seized

Relay A operates to a loop on the incoming negative and positive lines.

A1 operates relay B.

Relay B operating

B1 prepares circuit for the operation of vertical magnet and common holding circuit of relays E, F, H and HR etc. (see also Design Details for Relay CD).

B2 prepares testing-in circuit for relay HS. See also Design Details.

B3 connects guarding and holding earth to incoming P wire.

B4 prepares testing-in circuit of relay H. See also Design Details.

B5 operates relay CD.

B6 disconnects release alarm earth circuit.

Relay CD operating

CD1 prepares circuit for operation of vertical magnet in series with 5 ohms winding of relay CD.

CD2)

CD3) see Design Details.

CD4)

CD5) see later under "P.B.X. Call".

2. IMPULSING.(a) "Tens" train of impulses.

Relay A releases during the break period of the impulse.

A1 short-circuits relay B (to provide its slow to release feature) holds relay CD via its 5 ohms winding and energises the vertical magnet.

During impulsing relays B and CD hold. The selector wiper carriage steps vertically to the level determined by the number of impulses received.

N springs, (mechanical off-normal springs) operate when the wiper carriage is stepped off-normal.

- N1 disconnects R1 150 ohms resistance battery from P wire independently of B3.
- N2 prepares operating circuit of rotary magnet.
- N3 short-circuits 700 ohms winding of relay CD (to provide slow release feature).

Relay A holds at conclusion of impulse train.

- A1 holds relay B and disconnects holding circuit of relay CD which releases slowly.

Relay CD releasing

- CD3 completes circuit for operation of relay E in series with vertical magnet.
- CD1)
- CD2) perform no useful function
- CD4) at this stage.
- CD5)

Relay E operating

- E1 prepares holding circuit for relay E during rotary stepping.
- E2 disconnects vertical stepping circuit and prepares rotary magnet circuit.
- E3 see later under "Called Subscriber Answers".
- E4)
- E5) see Design Details.
- E6 break contact removes short-circuit from 700 ohms winding of relay CD which operates. Make contact prepares a circuit for short-circuiting relay CD when NR3 operates.

Relay CD operating

- CD1 prepares rotary magnet circuit.
- CD2 perform no useful function at this stage.
- CD3 completes holding circuit of relay E to vertical magnet circuit independently of NR2.
- CD4)
- CD5) perform no useful function at this stage.

(b) "Units" train of impulses.

Relay A responding to "units" train of impulses

- A1 repeats the impulses to the rotary magnet.

Relays B and CD hold during impulsing. Wiper carriage is rotated to the bank contact corresponding to the "units" digit dialled.

The mechanical normal rotary springs (NR) operate when the wiper carriage is rotated off-normal.

- NR1 applies earth to the P-wire independently of D3.
- NR2 disconnects original operating circuit of relay E and prevents it holding to vertical magnet when CD3 releases.
- NR3 short-circuits the 700 ohms winding of relay CD and prepares an operating circuit for relay G. (See Ordinary line busy).

At the end of the "units" train of impulses:-

- Relay A is held by the calling loop
- A1 releases relay CD.

3. CALL TO AN ORDINARY LINE.

Relay CD releasing after elapse of slow release period
 CD2 connects earth to the 900 ohm coil of relay H to test the line via the P1 wiper.
 CD3 disconnects circuit of relay E, which releases slowly.
 CD1)
 CD4) perform no useful function at this stage.
 CD5)

(a) Line free

Relay H operates in series with called subscribers relay K via P1 wiper.

H1) prepare circuit for connection of relay D
 H2) to subscriber's line to provide transmitter current and called subscriber answer signal.
 H3 guards the called subscriber's line circuit and holds his relay K, and shunts operating winding of relay H.
 H4 operates relay HR.
 H5 disconnects rotary magnet stepping circuit and prepares circuit for the operation of relay E.
 H6 holds relay H to B1 earth.

Relay HR operating

HR1 prepares circuit for extension of ringing to called subscriber's line.
 HR2 extends ringing return lead to positive line.
 HR3 prepares an operating circuit for relay J (see E4 released).
 HR4)
 HR6) see later under "Trunk Offering".
 HR5 prepares a locking circuit for relay F.

Relay E released by CD3

E1 prevents premature re-operation of relay E when CD3 re-operates.
 E2 further disconnects rotary impulsing circuit (H5 operated).
 E3 see later under J2.
 E4 operates relay J.
 E5 see "Design Details".
 E6 removes short-circuit from 700 ohms winding of relay CD which then re-operates.

Relay J operating

J1 connects ringing to called subscriber's line via 300 ohms winding of relay F.
 J2 prepares meter circuit.
 J3 connects ring tone to 570 ohms winding of relay A and the tone is then transmitted to calling party.
 J4 applies earth to Ringing Machine Start lead to start ringing vibrator in common equipment.

Relay CD operated by E6

CD1 performs no useful function at this stage.
 CD2 prepares for the connection of the release alarm earth to U15 by operating the release relay in the miscellaneous equipment.
 CD3 prepares a circuit for the re-operation of relay E by D1 when the called subscriber answers.
 CD4)
 CD5) performs no useful function at this stage.

(b) Called subscriber answers.Relay F operates to called subscriber's loop

- F1 see later under "Trunk Offering".
 F2) disconnect ringing circuit and extend subscriber's
 F3) loop to operate relay D and to complete
 transmission bridge.
 F4 'x' removes short-circuit from 400 ohms winding of
 relay F to hold it to B1 earth (See also Design
 Details).
 F5 prepares operate circuit of relay TM (see Forced
 Release under CSH conditions).
 F6 disconnects ring tone.
 F7 see Design Details.

Relay D operating

- D1 operates relay E.
 D3 disconnects operate circuit of relay TM (see
 Forced Release under CSH conditions).
 D2) reverse the potential applied to the incoming line
 D4) to provide a supervisory or metering signal.

Relay E operating

- E1 holds relay E independently of D1.
 E2)
 E5) perform no useful function at this stage.
 E6)
 E3 applies YA 150 ohms resistance battery to meter wire
 (during the slow release of relay J) to operate the
 subscriber's meter.
 E4 disconnects relay J, which releases slowly.

Relay J releasing

- J1)
 J3) perform no useful function at this stage.
 J2 disconnects battery from meter wire.
 J4 disconnects earth from Ring Machine Start common
 to prevent unnecessary running of common equipment
 ringing vibrator etc.

The connection between the calling and called parties is now complete and conversation can take place.

Relays held at this stage are:- A, B, CD, D, E, F, H and HR.

(c) Ordinary line busy.

On completion of units digit, relay H tests P1 wire during the slow release of relay E. If the line is busy relay H fails to operate due to absence of battery potential from called subscriber's K relay.

Relay E released by CD3

- E1 prevents re-operation of relay E when CD3 re-operates.
 E4 operates relay G.
 E6 removes short-circuit from 700 ohms winding of relay CD
 which re-operates.
 E2)
 E3) perform no useful function at this stage.
 E5)

Relay CD operating

- CD2 disconnects the testing-in circuit of relay H and
 prepares the release relay circuit.

CD1)
 CD3)
 CD4) perform no useful function at this stage.
 CD5)

Relay G operated by E4.

G1 connects earth to Ring Machine Start common to operate common equipment and so provide busy tone.
 G2 prevents stepping of rotary magnet.
 G3 ineffective at this stage.
 G4 see later under "P.B.X. Call".
 G5 connects "busy tone" earth to 570 ohms winding of relay A, and hence busy tone to calling line during tone periods.

At this stage busy tone is being returned to calling line and the following relays are held:- A, B, CD and G.

4. P.B.X. Call.

A 200 ohms resistance battery is connected to the P2 bank contact of the 1st line of a P.B.X. group, and earth to that of the last line of the group.

(a) First line free.

The circuit functions as previously described for a call to an ordinary free line, except that after the release of relay CD and whilst relay H is being offered to the P1 wiper CD5 operates relay HS to the 200 ohms resistance battery via the P2 wiper. CD3 releases relay E. Subsequently E6 allows relay CD to re-operate and at CD5 release relay HS. The operation and release of relay HS serves no useful purpose.

(b) First line busy.

In this case relay HS operates as previously described but relay H does not operate.

Relay HS operated by CD5

HS1 prepares rotary magnet circuit.
 HS2 see Design Details.
 HS3 prepares operate circuit of relay G, see also Design Details.
 HS4 holds relay HS via its 450 ohms winding independently of the P2 wiper condition.
 HS5 connects one winding of relay G in series with 900 ohms winding of relay H to the P1 wiper.
 HS6 see Design Details.

Relay E released by CD3

E4 prepares in conjunction with HS3 an operate circuit for relay G.
 E6 removes short-circuit from 700 ohms winding of relay CD which then re-operates.
 E1)
 E2)
 E3) perform no useful function at this stage.
 E5)

Relay CD operating

CD2 removes short-circuit from relay G. Relays H and G are connected in series to P1 wiper.
 CD4 energises the rotary magnet.

CD1)
 CD3) perform no useful function at this stage.
 CD5)

Rotary Magnet RM operates and steps the wipers to the next line (intermediate)

RM1 operates relay G.

Relay G operating

G1 connects earth to ringing machine start common
 G2 releases rotary magnet.
 G3 leaves relay A dependent upon TM3.
 G4 disconnects holding circuit of relay HS (slow to release).
 G5 performs no useful function at this stage.

(c) Intermediate line free.

When the wipers step to the intermediate line, relays H and G are applied in series to the P1 wiper. If the line is free, relay H operates and relay G holds to battery via the subscriber K relay.

Rotary Magnet RM released by G2.

RM1 disconnects operating coil of relay G, leaving it dependent upon its holding circuit.

Relay H operating

H1)
 H2) prepare operate circuit for relay D. and
 H3 short circuits operate winding of relay H/hold winding of relay G. Relay G releases and relay H holds via its 1000 ohms winding. H3 also busies the P1 wire.
 H4 operates relay HR.
 H5 ineffective at this stage.

Relay HR operating

HR1) prepares circuit for extension of ringing to called
 HR2) subscriber's line.
 HR3 prepares an operate circuit for relay J.
 HR4 ineffective at present.
 HR5 prepares a locking circuit for relay F.
 HR6 ineffective at present.

Relay G releasing

G1)
 G2) perform no useful function at this stage.
 G3)
 G4 disconnects hold circuit of relay HS, which releases slowly.
 G5 prepares a ring tone circuit.

Relay HS releasing.

HS1)
 HS2)
 HS3) perform no useful function at this stage.
 HS4)
 HS5)
 HS6 completes the circuit for relay J which operates.

Ringing and metering function as previously described.

(d) Intermediate line busy.

Relay H does not operate. Relay G releases.

Relay G releasing

G1)
G5) perform no useful function at this stage.
G3)
G4 re-establishes hold circuit of relay HS.
G2 re-operates the rotary magnet.

Rotary magnet operates and steps wipers to next line.

RM1 operates relay G.

Relay H tests on P1 wire of third line, (assume this is last line)
then:-

(e) Last line busy.

On the last line earth is permanently connected to P2 bank contact and Relay H does not operate, but relay G holds over its operating winding via the P2 earth and 2000 ohms resistor R6.

Relay G holding

G1 maintains earth on Ring M/C Start wire.
G2 disconnects rotary magnet circuit.
G3 prepares forced release circuit. (See C.S.H. condition),
G4 releases relay HS.
G5 prepares circuit for connection of busy tone to line.

Relay HS releasing

HS1)
HS4) perform no useful function at this stage.
HS6)
HS2 connects busy tone earth to 570 ohms winding of relay
A.
HS3 completes holding circuit of relay G to B1 earth.
HS5 disconnects testing-in circuit of relays H and G
(in series), from the P1 wiper.

Busy tone is returned to the caller.
Relays held at this stage are:- A, B, CD and G.

5. CALL FROM PARENT EXCHANGE.

The conditions are similar to those for an ordinary subscriber, except that a low resistance positive battery is connected to the M-wire via the incoming junction equipment, to operate relay TO to H3 earth.

Relay TO operating

TO1 holds relay TO to B3 earth.
TO2) remove short circuits from the windings of
TO3) relay OC, so preparing it for the trunk offering
signal from Parent Exchange.
TO4'Y' disconnects operating circuit of relay TO from
M-wire, and disconnects positive battery. The "Y"
action of TO4 prevents interaction between it and
TO1.

6. TRUNK OFFERING.

The Parent Exchange operator to obtain connection to the busy subscriber operates the "ringing" key, thus earthing the loop and unbalancing the current through windings of relay OC (differential relay), which then operates.

Relays held at this stage:- A, B, CD, G and TO.

Relay OC operating

OC1 removes short circuit from 400 ohms winding of relay F which operates to earth at H3.

Relay F operating

F1 operates relay HR.
 F2) prepare to connect operator to wanted
 F3) subscriber when HR1 and HR2 operate.
 F4'x' removes short-circuit from holding coil of relay F.
 F5 performs no useful function at this stage.
 F6 disconnects ring tone circuit to prevent the tones from being fed to the A relay when J3 operates and G5 releases.
 F7 see "Design Details".

Relay HR operating

HR1) complete speaking path to wanted
 HR2) subscriber.
 HR3 releases relay G and operates relay J.
 HR4 offers relay H to P-wire in readiness for when the wanted subscriber clears.
 HR5 prepares holding circuit for relay F on subsequent release of relay OC.
 HR6 operates relay D over one winding to R1 resistance battery.

Relay J operating

J1)
 J2) perform no useful function at this stage.
 J4)
 J3 prepares to extend ring tone to relay A when F6 releases later.

Relay G released by HR3

G1 leaves Ring M/C Start dependent upon J4.
 G2)
 G4) perform no useful function at this stage.
 G3 restores normal earth condition to relay A.
 G5 disconnects busy tone earth from relay A and prepares to extend ring tone to operator when F6 releases later.

Relay D operated by HR6

D1) perform no useful function at this stage
 D3)
 D2) return supervisory condition to
 D4) operator and release relay OC.

Relay OC releasing

OC1 holds relay F to B1 earth.

Operator now offers trunk call to subscriber.

(a) Subscriber accepts trunk call.

When subscriber clears battery is connected to P1 wiper from the K relay of his line circuit, and relay H operates.

Relay H operating

- H1 connects one winding of relay D to the subscriber's -ve line.
- H2 releases relay D and at the same time connects the other winding of relay D to subscriber's +ve line.
- H3 guards P1 wire.
- H4 provides hold circuit for relay HR independently of F1.
- H5 prepares circuit for relay E.
- H6 holds relay H.

Relay D releasing

- D1) perform no useful function at this stage.
- D3)
- D2) return supervisory clear to operator and
- D4) restore relay OC to the line.

(b) Operator rings subscriber.

Operator momentarily operates ringing key and relay OC re-operates.

Relay OC operating

- OC1 releases relay F.

Relay F releasing

- F1)
- F4) perform no useful function at this stage.
- F5)
- F2) extend ringing and ring
- F3) return to line.
- F6 connects ring tone to 570 ohms winding of relay A and thence to line and operator.
- F7 performs no useful function at this stage.

The remainder of the circuit operation is similar to that already described when called subscriber answers on a call to an ordinary line.

7. RELEASE FROM AN UNANSWERED CALL.

Relays held at this stage:- A, B, CD, H, HR and J. (Also relay TO if call is from Parent Exchange).

Calling party clears and relay A releases.

Relay A releasing

- A1 releases relay B.

Relay B releasing

- B1 releases relays H, HR, and J.
- B2)
- B4) perform no useful function at this stage.
- B3 disconnects NR1 earth from selector level P-wire to effect early release of preceding equipment. At the same time the circuit is busied against seizure by the disconnection of the R1 150 resistance battery at N1 operated.
- B5 releases relay CD (and relay TO if call is from Parent Exchange).
- B6 prepares the Selector release circuit.

Relay HR releasing

- HR1) disconnect ringing current and ring return from
- HR2) called subscriber's line.

HR3 ineffective at this stage.
 HR4 see "Design Details".
 HR5 performs no useful function at this stage.
 HR6 disconnects a possible operate circuit for relay D to R1 resistance battery.

Relay H released by B1

H1)
 H2) perform no useful function at this stage.
 H4)
 H3 removes busy condition from the subscriber's line circuit and releases relay K.
 H5 completes rotary magnet self-drive circuit. Wiper carriage is rotated to 12th rotary position which is clear of the bank. NR springs restore. The rotary interrupter break spring is prevented from breaking by mechanical adjustment until the wiper carriage restores to normal.
 H6 performs no useful function at this stage.

The selector restores to normal.

Relay CD released by B5

CD2 disconnects release alarm relay circuit.
 CD1)
 CD3) perform no useful function at this stage.
 CD4)
 CD5)

Relay J released by B1.

J1)
 J2) performs no useful function at this stage.
 J3 disconnects ring tone from relay A.
 J4 disconnects earth from Ring M/C start common.

N Springs restore to normal when wiper carriage comes to rest on normal level.

N1 reconnects R1 resistance battery to P-wire to remove busy conditions from the selector in readiness for the next call.
 N2 releases rotary magnet.
 N3 performs no useful function at this stage.

(a) Release from an answered call (called party on line)

Relays held prior to release:- A, B, CD, D, E, F, H and HR.
 Calling party clears and relay A releases.

Relay A releasing

A1 short circuits relay B, which releases.

Relay B releasing

B1 releases relays E, F, H and HR.
 B2)
 B4) perform no useful function at this stage.
 B3 removes earth at NR1 made from selector P-wire to effect release of preceding equipment. At the same time the circuit is busied against seizure by disconnection of R1 battery at N1 operated.
 B5 disconnects relay CD 700 ohm winding)
 (and relay T0 if operated).)
 B6 connects release alarm earth via E2)
 (not yet released) to relay CD 50)
 ohm winding, R2 battery.)

NOTE.- The momentary opposing flux in the two windings causes relay CD to release.

Relay HR releasing

- HR1)
- HR2) release relay D.
- HR4) see "Design Details".
- HR3)
- HR5) perform no useful function at this stage.
- HR6)

Relay D releasing

- D1) performs no useful function at this stage.
- D2) restore normal polarity to negative
- D4) and positive lines.
- D3) extends earth to TP start and operates relay TM.

Relay H releasing

- H1)
- H2)
- H4) perform no useful function at this stage.
- H6)
- H3) removes busy condition from subscriber's line circuit.
- H5) completes rotary magnet self-drive circuit. Wiper carriage is stepped to 12th rotary position clear of bank.

Relay TM operating

- TM1)
- TM2) perform no useful function at this stage.
- TM3)
- TM4) extends earth over TP Hold common and disconnects TP Start.

Relay F releasing

- F1)
- F2)
- F3) perform no useful function at this stage.
- F4)
- F6)
- F7)
- F5) releases relay TM and removes earth from TP Hold common.

Relay E releasing

- E1)
- E3)
- E4) perform no useful function at this stage.
- E5)
- E6)
- E2)

Relay TM releasing

- TM1)
- TM2) perform no useful function at this stage.
- TM3)
- TM4)

Relay CD releasing

- CD1)
- CD3) perform no useful function at this stage.
- CD4)
- CD5)
- CD2) releases Release Alarm Relay.

The selector is now restored to normal.

(b) Release from a busy call (ordinary line).

Calling party clears and relay A releases.

Relay A releasing

A1 releases relay B.

Relay B releasing

B1 releases relay G.

B2) perform no useful function at this stage.

B4)

B3 disconnects the selector level P-wire to effect an early release of preceding equipment and to busy the incoming P-wire until N1 remakes when selector restores to normal.

B5 releases relay CD.

B6 prepares release circuit.

Relay CD releasing

CD1)

CD3) perform no useful function at this stage.

CD4)

CD5)

CD2 disconnects release relay circuit.

Relay G releasing

G1 disconnects earth from Ring M/C start common.

G2 completes rotary magnet self-drive circuit.

G3 restores earth to relay A in readiness for next call.

G4 performs no useful function at this stage.

G5 disconnects busy tone from relay A.

The selector restores to normal.

8. FORCED RELEASE (by time pulse) under:-

(a) C.S.H. condition

Relays held prior to release:- A, B, CD, D, E, F, H and HR.

The called subscriber clearing first, relay D releases.

Relay D releasing

D1)

D2) perform no useful function at this stage.

D4)

D3 connects relay TM to TP start common, relay TM operates.

Relay TM operating

TM1) ensure that relay A releases when relay G

TM3) operates later.

TM2 completes operating circuit for relay G to earth applied on TP release common.

TM4 connects relay TM to TP hold common and disconnects it from "start" common.

Relay G operating

G1)

G4) perform no useful function at this stage.

G5)

G2 disconnects rotary self-drive circuit.

G3 releases relay A.

Relay A releasing

A1 releases relay B.

Relay B releasing

B1 releases relays E, F, H and HR.
 B2) perform no useful function at this stage.
 B4)
 B3 disconnects earth from selector P-wire to effect early release of preceding equipment. At the same time the circuit is busied against seizure by the disconnection of R1 battery at N1 operated.
 B5 releases relay CD.
 B6 prepares selector release circuit.

Relay CD releasing

CD1)
 CD2)
 CD3) perform no useful function at this stage.
 CD4)
 CD5)

Relay HR releasing

HR1)
 HR2) disconnect negative and positive wires.
 HR4 see "Design Details"
 HR3) perform no useful function at this stage.
 HR5)
 HR6 disconnects a possible operate circuit for relay D on release of relay H.

Relay H releasing

H1)
 H2)
 H4) perform no useful function at this stage.
 H6)
 H3 removes busy condition from subscriber's line circuit.
 H5 prepares rotary magnet self-drive circuit.

Relay E releasing

E1)
 E2)
 E3) perform no useful function at this stage.
 E4)
 E5)
 E6)

Relay F releasing

F1)
 F2)
 F3) perform no useful function at this stage.
 F4)
 F6)
 F7)
 F5 releases relay TM.

Relay TM releasing

TM1)
 TM3) perform no useful function at this stage.
 TM4)
 TM2 releases relay G.

Relay G releasing

G1)
G3)
G4) perform no useful function at this stage.
G5)
G2 completes rotary self-drive circuit and selector restores to normal.

N1 guards selector until it restores to normal.

(b) Faulty (earth or battery connected) parent junction.

Selector is seized and relays A, B, CD, TO and OC operate, due to line fault conditions.

Relay OC operating

OC1 operates relay F.

Relay F operating

F1)
F2)
F3) perform no useful function at this stage.
F4)
F6)
F7)
F5 disconnects holding earth from preceding equipment and completes circuit for Time Pulse equipment.

The release of the Group Selector switching relay releases relays A and OC. Relays B, CD, F and TO release. The release of A1 gives one impulse to the vertical magnet and B6 completes release of the selector, by completing the rotary self-drive circuit.

9. RELEASE ALARM.

If the selector fails to release due to mechanical defect, N2 completes alarm circuit and N1 guards the circuit against seizure.

10. P.B.X. "NIGHT SERVICE" CALLS.

As "hunt start" conditions only apply when first line of a P.B.X. group is dialled, then night service facilities can be given on any P.B.X. line other than the first.

11. DESIGN DETAILS.

(a) The reasons for the use of slow to release relays are as follows:-

Relay B to enable it to retain during impulsing. The slow release feature is obtained by the short circuit applied by the break contact of A1 during impulsing.

Relay CD to enable it to retain during impulsing. The slow release feature is obtained by short circuit applied by B1 (TL) to the 700 ohms winding.

Relay E to allow relay H sufficient time to operate when testing a free single line on the first line of a P.B.X. group.

Relay G see Design Details for resistor R7.

Relay HS to cover the operation and release of relay G during P.B.X. "hunting".

Relay J to ensure satisfactory operation of calling subscriber's meter when called subscriber answers.

(b) The reasons for the use of slow to operate relays:-

Relay E to ensure complete saturation thus providing sufficient release lag to hold it during the changeover of CD3 at the end of vertical impulsing.

Relay F to ensure that it is fully fluxed (either in the ringing or silent periods) before it operates.

(c) Rectifiers are used for the following reasons:-

MR1 prevents operation of relay TO by negative battery conditions on the M-wire.

MR2 prevents shunting of vertical and rotary magnets by resistor R2 during impulsing.

(d) Special features of:-

Relay OC is differentially connected i.e., operates only on current difference in the windings.

Resistor R6 prevents a feed-back of full earth to P2 wiper from CD5 via rotary interrupter springs RM1 when these are operated during P.B.X. hunting, which would assimilate last line conditions to other hunting selectors.

Resistor R7 Provides the slow release feature of relay G to overcome the following fault:- If the first line of a P.B.X. group is busy relay HS operates but not relay H. Relay E releases, E4 prepares operate circuit for relay G and E6 re-operates relay CD. CD4 operates the rotary magnet which steps the wipers to the next free line. RM1 operating completes circuit of relay G. G2 releases the rotary magnet, and RM1 releasing disconnects the operating circuit of relay G. Relays H and G are offered to P1 wiper in series to the subscriber's relay K. Relay H should operate and relay G hold in series with relay K. However, owing to the high inductance of the series circuit relay H is slow in operating and relay G hold current rises slowly. If relay G were to fail to hold long enough to ensure that relay H operated before relay G released, a false operation of the rotary magnet, via G2 and H5, would result.

(e) Relay contacts not fully explained previously:-

B2 prevents the operation of relay HS should the selector wipers alight on the first line of a P.B.X. group during rotary release.

B4 prevents the operation of relay H (during rotary release) when passing over disengaged subscriber's lines.

CD2 prevents the operation of relay H (during rotary stepping) when passing over disengaged subscribers lines under the control of the units digit.

CD3 break contact guards against the operation of relay E during vertical stepping, as subsequent impulses after the operation of relay E would be directed to the rotary magnet.

CD4 prevents the premature operation of rotary magnet (when the first line of a P.B.X. group has been dialled) before the release of relay E and the re-operation of relay CD. Relay HS operating at HS1 would operate the rotary magnet and earth via HS1 and rotary interrupters operated would operate relay G. G2 would release the rotary magnet and RM1 would release relay G. G2 releasing would operate the rotary magnet again. These two operations of the rotary magnet would step the wipers to the third line of the P.B.X. group.

- E4 prevents the operation of relay G on the first rotary step. The operation of relay G would cause the transmission of busy tone to the caller and at G2 would prevent further rotary stepping. If, after completion of dialling the line is free, the calling party would be connected to a wrong number.
- E5 prevents an earth feed to the P2 wiper during rotary stepping to avoid the possibility of busy being given to a caller on another selector on the first line of a P.B.X. group.
- F4"x" is made an "x" action to ensure that a satisfactory hold circuit is established for relay F via its 400 ohms winding, before disconnecting its operating circuit at F2 and F3.
- F7 prevents an inter action between relays CD and E, when "called subscriber" answers, due to D1 operating relay E, E6 releasing relay CD and CD3 releasing relay E. F7 operated prevents release of relay CD.
- G4 ensures that relay HS is held until relay G releases when switching to a P.B.X. line other than the first. This sequence ensures the correct functioning of HS2.
- H1) normal, disconnect relay D from the transmission bridge
H2) condensers to prevent them adversely effecting the selector impulsing performance.
- HR4 has two functions (a) completes operating circuit for relay H under trunk offering conditions and (b) in conjunction with H3 overcomes a difficulty giving rise to irregular rotary stepping during release from an answered call (calling party clearing first). This irregular release was due to the difference in release lags of relays H and HR. H2 releasing before HR6, completed a circuit for the re-operation of relay D to R1 resistance battery. D2 and D4 reversed the negative and positive lines and discharged the subscriber's telephone condenser through the coils of relay A. Relay A operated and remained operated long enough to allow relay B to re-operate. Then B6 disconnected the rotary drive circuit thus interrupting the release. B1 re-operated relay HR during the slow release of F1 and the cycle was repeated. The position of HR4 ensures that relay HR will always release before relay H and thus prevent re-operation of relay D.
- HS6 see Design Detail for J1.
- HS2 disconnects busy tone from tone coil of relay A during rotary hunting on calls to P.B.X. lines when relay G holds in series with relay H to a free line of P.B.X. group other than the first.
- HS3 operated, prepares operate circuit of relay G if first line of P.B.X. group is busy. Released, maintains relay G when last line of a P.B.X. group is busy.
- J1 provides a ringing delay period to allow sufficient time for relay K in the subscriber's line circuit to operate and remove relay L from the line to prevent premature ringtrip. This delay is achieved by the slow release of E4 and HS6 respectively on calls to single lines and P.B.X. lines thus delaying the operation of relay J.

END.