

DIAGRAM NOTES (ISSUE 3)

concerning

GBW. 16660 (ISSUE 3)

titled

FINAL SELECTOR ORDINARY

U.A.X. NZ13

An explanation of the above circuitry is covered under the following headings:

1. GENERAL.
2. FACILITIES.
3. OUTLINE CIRCUIT OPERATION.
4. CIRCUIT DETAIL.

Called subscriber answering, relays F and D operate and conversation may proceed.

Called subscriber clears, relay D releases and starts the timed release circuit. If the timed release circuit matures, relay B is shunted out and releases causing the selector to home. If the called subscriber's line is engaged relay H and thus HR do not operate.

Thus on completion of rotary search relay E releases and Busy Tone is fed back via relay A to the calling subscriber's line.

Should a Manual Operator find the line engaged, then the Operator operates the Trunk Offer key on the Manual Board which applies an unbalance on the line to operate relay OC, as relay TO has been operated via operator access batt on the M lead of the selector. Relay OC operating causes relays F and HR to operate and switch in to the busy line to enable the operator to offer the trunk call to the required subscriber.

#### 4. CIRCUIT DETAIL.

Contacts not mentioned are ineffective at that stage. The selector is seized via the -ve and +ve leads (U1 and U2) once the circuit has tested in and found the 'P' lead free, i.e. 150 ohm batt on the P lead.

The loop via the selector levels and U1 and U2 causes relay A to operate.

##### Relay A operating,

A1 removes s/c off B relay coil and completes the operate path for relay B (Eth, A1, 130OB, MR2, R1, Batt.).

##### Relay B operating,

B1 prepares hold path for relay B.  
B2 completes operate path for relay CD (Eth, B2, 700CD, R6, Batt.).  
B3 further disconnects release alarm earth common.  
B4 prepares H relay test circuit.  
B5 removes test batt potential and replaces it with a guarding eth.

##### Relay CD operating,

CD1 prepares vertical stepping circuit.  
CD2 prepares E relay operate path.  
CD3 extends eth to 'release alarm relay battery'.

##### Calling subscriber dials first digit

##### Relay A pulses to dialled train,

The break period of the pulse causes A relay to release.

##### Relay A released,

A1 completes the operate path for the vertical magnet which causes the wiper carriage to step vertically (Eth, B2, A1, CD1, 5CD, E3, NR3, VM, Batt.).

## 1. GENERAL.

The diagram GBW. 16660 shows the circuit of a final selector which receives the penultimate and final digit of a subscriber's number. The selector is provided for use in a UAX13 exchange.

## 2. FACILITIES.

Provision is made for:

- (a) Testing battery condition on 'P' lead.
- (b) Guarding the selector once seized, from intrusion.
- (c) Battery feed to calling subscriber's instrument.
- (d) Transmission Bridge.
- (e) Ring tone to calling subscriber.
- (f) Busy tone to indicate to the calling subscriber the state of called subscriber's line.
- (g) Acceptance of the penultimate and final digit of subscriber's number.
- (h) Ringing supply to called subscriber's instrument.
- (i) Trunk Offering.
- (j) Timed pulse release.
- (k) Alarm should the selector fail to restore to normal.
- (l) Battery feed to called subscriber's instrument.
- (m) Ringing machine start.

## 3. OUTLINE CIRCUIT OPERATION.

Seizure of this selector is via the levels of preceding group selector.

The seizure of the circuit is achieved by looping the incoming -ve and +ve leads.

Relay A operates followed by relay B. Relay CD is pre-energised via its 700 ohm winding and operates. Relay A pulses to first pulse train which steps the vertical magnet via the 5 ohm winding of relay CD to the required level. On completion of vertical stepping relay CD releases and relay E operates via the vertical magnet circuit. This prepares the rotary magnet circuit.

Relay A pulses to the final dialled digit and the wiper carriage rotates into the bank assembly. Mechanical springs NR operate and put a start earth out to the ringing machine. The P1 wiper tests the called subscriber's line circuit and if free relay H operates which in turn operates relay HR. Ringing is applied to the called subscriber's telephone via the -ve and +ve selector wipers and subscriber's line.

Relays B and CD hold during pulsing. Relay B holds due to the s/c across its coil introduced by the release of A1 and CD holds due to the s/c - Eth, 700CD, E2, NR4, N3, B1, Eth.

The first vertical step of the wiper carriage the N springs operate.

N springs operated,

N1 disconnects 150 ohm test batt to TJ13 and 14.  
N2 prepares rotary release circuit.  
N3 completes shunt path across 700CD coil.

On completion of first pulse train relay CD releases.

CD relay releasing,

CD1 disconnects path to vertical magnet.  
CD2 completes operate path for E relay (Eth, B1, N3, 1500E, CD2, NR3, VM, Batt.).  
CD3 removes eth off 'release alarm relay battery' common.

Relay E operating,

E1 prepares hold path for E relay.  
E2 takes shunt off R6 to permit relay CD to operate.  
E3 prepares rotary magnet stepping circuit.  
E4 spare.  
E5 prepares busy tone circuit.

Relay CD operates,

CD1 prepares rotary magnet stepping circuit.  
CD2 disconnects the original operate path for E relay but relay E holds via E1-CD2.  
CD3 extends eth to 'release alarm relay batt'.

Calling Subscriber dials final digit

Relay A pulses and causes the rotary magnet to step to rotate the wiper carriage into the bank (Eth, B1, A1, CD1, 5CD, E3, N2, H2, RM, Batt.).

Relay CD holds to the pulsing via the rotary magnet.

The first rotary step causes the NR springset to operate.

NR springsets operated,

NR1 provides alternative guard eth to P lead via B5.  
NR2 prepares the circuit for possible application of ring tone or busy tone via tone winding of relay A.  
NR3 disconnects the original operate path for vertical magnet and for relay E.  
NR4 completes path for shunting eth to R6 to ensure release of relay CD on completion of dialling, also extends eth to 'ring machine start batt' lead.

Dialling ceases

Relay CD releases, (slowly)

- CD1 disconnects circuit to rotary magnet.
- CD2 disconnects hold path for relay E which releases.
- CD3 removes eth off 'release alarm relay batt' common and completes test circuit to H relay which, if the subscriber's line circuit is free operates to the line circuit K relay via 'P' lead and selector bank (Eth, CD3, B4, 900H, wiper P1, etc.).

Relay E on releasing (slowly) at E2 disconnects the short circuit on R6 battery - hence relay CD re-operates and at CD2 prepares a re-operator path for relay E. CD3 disconnects the test circuit via relay H, etc.

Called Subscriber free

Relay H operates, (Eth, CD3, B4, 900H, P1 wiper to batt via subscriber's 1300 ohm K relay to batt.).

- H1 completes operate path for relay HR which operates.
- H2 further prepares operate path for relay E.
- H3 completes hold path for relay H via 'de' winding.
- H4) prepare operate hold path
- H5) for relay D.
- H6 provides a guard eth forward on the P1 wiper lead.

Relay HR operating,

- HR2) extend ringing via F relay on the -ve wiper and ring return
- HR5) batt via the +ve wiper and bank to called subscriber's line once E relay has released.
- HR3 connects interrupted ring tone to the tone winding of relay A.
- HR4 prepares hold path for F relay via its 400 ohm coil.
- HR7 spare.

Ringing is now extended to the called subscriber's line to ring the subscriber's instrument bell.

Called subscriber answers

Subscriber lifts handset which loops the +ve and -ve wires.

Relay F operates, via its 300 ohm winding and holds via its 400 ohm winding.

Relay F operating,

- F1 provides alternative hold path for HR relay.
- F2) disconnect ringing and ring return batt to the subscriber's
- F3) line and replace it with batt feeding relay D which operates to the called party's loop.
- F4 removes s/c off the hold winding of relay F.
- F5 prepares time pulse circuit to relay TM.
- F6 removes eth off 'Ringing machine start lead'.
- F7 disconnects Ring tone from the A relay tone winding.

Relay D operating,

- D1 completes re-operate path for relay E (Eth, B1, N3, 1500E, CD2, D1, H2, RM, Batt.).
- D2) reverse potential to incoming +ve and -ve
- D4) leads for supervisory purposes.
- D3 disconnects eth to time pulse start lead.

Conversation may now proceed between called and calling parties.  
Relays operated - A, B, CD, E, F, H, HR.

Called Subscriber Busy

Call proceeds to the point of relay H switching. If the subscriber's line is 'busy' an eth is applied to the P1 bank contact. Thus when the testing condition is applied to P1 bank contact via the P1 wiper, Eth, CD3, B4, 900H, P1 wiper relay H does not operate. Then when E relay releases (slowly) Busy tone eth is applied to the A relay tone winding via E5 & HR3.

The calling subscriber receives Busy tone. (Relay operated: A, B, CD).

Trunk Offering

Operator access to the final selector is marked by the presence of a +ve battery on the M wire - operating relay TO (+ve batt, M wire, TO4, MR3, 200TO, H6, Eth).

TO relay operating,

- TO1 provides hold path for TO relay via 'de' winding.
- TA2) remove s/c off.
- TO3) OC relay windings.
- TO4 disconnects original operate path of TO relay.

The call otherwise proceeds as for an ordinary call - as outlined previously. If however the operator receives busy tone, she momentarily operates her ring key which results in the application of an unbalance to the incoming +ve and -ve wires - relay OC operates.

Relay OC operating,

- OC1 Operates relay F (Eth, H6, OC1, 400F, R2, Batt).

Relay F operating,

- F1 completes operate path for relay HR.
- F2) prepare to extend the transmission bridge through
- F3) to the wanted subscriber.
- F5 prepares time pulse start circuit.
- F6 removes eth off 'Ringing Machine start' lead.
- F7 Further disconnects "Int. Ring Tone Eth" lead prior to the operation of relay HR.

Relay HR operating,

- HR1 prepares H relay operate circuit
- HR2) complete the speaking circuit through
- HR5) the transmission bridge.

HR4 prepares hold path for F relay when OC relay releases.  
HR6 completes operate path for relay D (Eth, RB1, 75D, HR6, R4, Batt.).  
HR7 spare.

Relay D operating,

D1 prepares re-operating path for relay E (Eth, B1, N3, 1500E, CD2, D1, H2, RM, Batt.).  
D2) reverse potential to incoming +ve and -ve wires for  
D4) supervisory purposes.  
D3 disconnects eth to time pulse start lead.

The operator 'offers' the call to the required subscriber. If the subscriber accepts the call, then the connection is cleared and the eth is removed off the 'P1' lead to permit the H relay to switch to the now free condition of a 1300 ohm batt (from the subscriber's K relay) on the P1 lead.

Relay H operating,

H1 provides holding path for relay HR - alternative to that via F1.  
H2 prepares later operate path for relay E (As relay E operate lag is greater than relay D release lag the former is not immediately operated).  
H3 completes hold path for relay H via 'd-e' winding.  
H4,5 release relay D (called sub. has replaced handset).  
H6 provides guard eth to P1 wiper lead.

Relay D releasing,

D2,4 restore incoming +ve and -ve lead polarity to normal which results in the lighting of the operator's calling cord supervisory lamp.

The operator again momentarily operates her ring key and relay OC operates - releasing relay F at OC1. Relay F released applies ringing current to the called subs line and returns Int Ring Tone to the operator, etc. The call now proceeds as for a normal call with relays F, D and E operating on called sub answer.

Time Pulse Release (Forced Release)

Should the calling subscriber hold after the called subscriber has cleared, the circuit is set up to complete the time pulse release circuit thus: Eth, D3, F5, 1000TM, Time Pulse Start Lead, Batt. Relay TM operates.

Relay TM operating,

TM1 holds TM relay via TP Hold and disconnects TP start.  
TM2 prepares s/c release of relay B.

If this condition prevails, then on the arrival of the eth on the TP release lead the R1 batt is shunted by the full eth to release relay B and thus release the final selector.

### Called Subscriber releases

The restoring of the called subscriber's instrument removes the loop off the outgoing +ve and -ve leads. Relay D releases.

#### Relay D releasing,

- D2) restore potential on the incoming.
- D4) +ve and -ve leads.
- D3 extends eth to time pulse start lead.

As the selector is designed for 'calling subscriber' hold, nothing further happens until either the selector is time pulse released or the calling subscriber restores.

### Calling subscriber 'clears'

#### Relay A releases,

- A1 s/c releases relay B.

#### Relay B releasing,

- B1 releases relays E-H-F & HR.
- B2 releases CD (and TO if operated) relays.
- B3 completes homing path for selector (Eth, U15, TJ11-12, B3, RM1, E6, N2, H2, RM, Batt.).
- B4 removes eth via 900H off the P1 wiper.
- B5 removes guard eth off the P lead.

The wiper carriage is restored to home position and the N springs operate.

#### N springsets operating,

- N1 restores the 150 ohm test batt to the P lead.
- N2 breaks the rotary drive circuit as the wiper carriage reaches the 'home Position'.

### 5. DESIGN DETAILS.

1. MR1 diode is provided to prevent eth feed back onto the 'TP release' lead.
2. MR2 diode prevents the 150R1 from slugging the vertical and rotary magnet during dialling.
3. MR3 diode is provided to ensure that TO relay will only operate to positive batt signal.
4. MR4 diode prevents eth being fed forward to the 'ringing machine start' lead.
5. MR5 diode prevents feed back from the 'ringing machine start' lead.



6. Relay TO<sup>4</sup> spring combination is adjusted to ensure that TO<sup>1</sup> springset makes before TO<sup>4</sup> spring combination breaks.
7. C3+R5 provide a spark quench unit for the rotary and vertical magnets (RM and VM).
8. RB1 is an iron wire barretter and limits the current to the subscriber's instrument.
9. Relay A has 3 nickel iron sleeves fitted on the iron coil core. This increases the impedance of the relay coils at speech frequencies - due to 'skin effect'.
10. Relay CC (operator control) is differentially connected such that it will only operate to line unbalance which is the 'trunk offer' signal.
11. Relay springset E7 is provided at this point of the circuit, to ensure that relay K, of the called subscriber's line, is operated before ringing is applied to the line.
12. Relay F is designed to 'trip' the ringing should the called subscriber answer in the 'silent' period.
13. TJ1 to 14 are provided for maintenance purposes.
14. The 'N' springs operate on the first vertical step and restore just prior to the wiper carriage restoring home. The NR springs operate on the first rotary step and restore on the wiper carriage reaching the '12th' rotary step.
15. Relay CD is pre-energised on its 'de' winding to ensure that the relay will hold on its 'ab' winding during pulsing.
16. TO<sup>4</sup> 'y' contact set is provided to ensure that the relay TO self locking circuit is completed before in initial operate circuit via TO<sup>4</sup> is disconnected.

END OF DIAGRAM NOTES