

DIAGRAM NOTES (ISSUE I)

Concerning

GBW 14400

titled

U.A.X. N.Z. 13

FINAL SELECTOR CIRCUIT FOR 5-PARTY LINES

1. GENERAL

The diagram shows the circuit arrangement of the equipment used for the Final Selector circuit for 5-party lines with loop dialling telephones at a U.A.X. N.Z. 13 M unit.

The diagram should be considered in conjunction with the following diagram or its equivalent:-

GBW 13760 Ringing Codes circuit.

2. FACILITY SCHEDULE

Provision is made for -

- (a) Access to a multiple of 20 party lines with up to 5 parties on each.
- (b) Rotary stepping under the control of the first impulse train received, and then "self-stepping" to the start contact of either of the two sets of ten lines, as determined by the discriminating relays, following the receipt of the first impulse train.
- (c) Rotary stepping under the control of the second impulse train received, to the required line contacts.
- (d) Testing the required line for free or busy condition.
- (e) Returning ring tone or busy tone to the caller as required.
- (f) Applying ringing current to the called line if free, in the form of one of the five ringing codes available. Discrimination of the first impulse train received being used to choose the required code.
- (g) The transmission of metering and supervisory signals to the calling party when required.
- (h) Guarding the circuit against intrusion during the progress and release of a call.
- (i) Trunk offering on calls from a parent manual exchange.

- (j) A transmission bridge between the calling and the called parties' lines.
- (k) The circuit to respond to loop signalling conditions, and transmit simplex earth signalling conditions to the called line.
- (l) Calling party release or first party release conditions on local calls (see note 7 on the diagram) and calling party release on calls over an incoming junction to the U.A.X. 13.
- (m) Forced release to be applied (under time pulse control), when -
 - (a) the selector is seized and dialling is delayed (P.G.)
 - (b) C.S.H. conditions are encountered on incoming junction calls or on local calls when calling party release is effective (see note 7 on the diagram.)

3. CIRCUIT DESCRIPTION

Outline

A Final Selector is designed to receive two digits.

The first digit selects the required ringing code and determines which of the two groups of ten lines is required. The required ringing code is stored by a set of relays, and the Final Selector wipers move automatically to the beginning of whichever set of line contacts is required, as determined by the first digit repeated to the selector.

The second digit then causes the selector wipers to step to the contacts corresponding to the required line.

If the line is busy, the call is not connected and busy tone is returned to the caller.

If the line is free, the line circuit is seized and ringing current is applied to the line in a manner corresponding to the pre-determined code. When the called subscriber answers, ringing current is cut off and the call is connected through.

Trunk offering facilities are available to an operator at a parent manual board.

Either first party or calling party release is effective on local calls (see note 7 on the drawing, and calling party release is effective on calls over an incoming junction to the U.A.X. 13.

Forced release is initiated in the event of an uncompleted call or a C.S.H. condition being sustained.

Detail

Seizure (by local selector).

The incoming selector switches to the R1 marking battery on the P wire, and its calling loop is extended to energise relay A.

- Relay A operating to the loop across the incoming line wires
- A1 operates relay B.
- Relay B operating,
- B1 prepares a general operating earth.
- B2 extends earth at contact DB8 via contact HR2, wiper FS1 on the home contact and contacts W5 and E2 to operate relay CD on its d-e winding. It also disconnects the FS t.j. spring, preventing the insertion of a test link stepping the FS switch.
- B3 prepares an operate circuit for relay E.
- B4 disconnects part of the final selector homing circuit.
- B5 prepares the impulsing circuit for the FS switch magnet.
- B6 disconnects the marking battery from and connects earth to the incoming P wire in order to hold the previous equipment.
- Relay CD operating,
- CD1 further prepares the FS switch magnet impulsing circuit.
- CD2 has no useful function at this stage.
- CD3 extends earth at contact B1 via contacts E4 and FD3 to operate relay CA.
- CD4 further disconnects the marking battery from the incoming P wire.
- CD5 connects earth at contact FD5 to the time pulse relay TM, preparing to force the release of the selector if the caller fails to dial within 60 to 260 secs (see par. 8 - forced release.)
- Relay CA operating,
- CA1) &) have no useful function at this stage.
- CA2)

- CA3 disconnects part of the FS switch magnet "step-on" circuit.
- CA4 prepares the digit discriminating circuit.
- CA5 disconnects the operate circuit of relay E.
- CA6)
&) have no useful function at this stage.
- CA7)
- CA8 also prepares the digit discriminating circuit.

The circuit is now ready to receive the first impulse train ("tens" digit).

Dialling the tens digit.

- Relay A responding to the "tens" impulse train,
 - A1 repeats the impulses to the FS switch magnet in series with the a-b winding of relay CD.

The wipers rotate to the position corresponding to the digit dialled. When wiper FS1 moves off the home contact the d-e winding of relay CD is disconnected. Relay CD still holds owing to the impulses passing through the a-b winding and to the slow release slug.

At the end of the "tens" impulse train -

- Relay A is held by the calling loop,
 - A1 releases relay CD (slow-to-release) and holds relay B which, being slow-to-release, held during impulsing.
- Relay CD releasing at the end of its slow release period,
 - CD1 disconnects the FS switch impulsing circuit.
 - CD2 has no useful function at this stage.
 - CD3 releases relay CA (slow-to-release) and operates one or more of the digit discriminating relays, W, X, Y and Z, depending upon the position of the FS switch wipers (see below).
 - CD4 has no useful function at this stage.
 - CD5 disconnects the "priming" earth from the time pulse relay TM.

For ease of description, two examples will now be given to indicate the sequence of operations involved for a tens digit in the 5 to 9 group, and a tens digit in the 1 to 4 and 0 group. The operations when other digits are dialled may then be readily inferred.

(a) Tens Digit 8 (2 impulses)

When relay CD releases at the end of the "tens" impulse train, the FS switch wipers will be resting on position 2. Earth at contact B1 extended via contacts E⁴, FD³ and CD³ will therefore operate relay Y via wiper FS7 during the release period of relay CA.

Relay Y operating,

Y1 holds relay Y to earth at contact B1

Y2 connects ringing code conductor "M" via contact X2 to contact PM2.

Y3)

&) have no useful function at this stage.

Y4)

Relay CA releasing at the end of its slow release period,

CA1 has no useful function at this stage.

CA2 prepares the operate circuit for the ring code relay PM.

CA³ extends earth at contact DB⁸ via contact HR2, wiper FS1 on bank contact No. 2, contact W⁶ and the FS d.m. springs to energise the FS switch magnet.

CA⁴ disconnects the operate circuits of the discriminating relays.

CA⁵ prepares an operate circuit for relay E.

CA⁶)

& have no useful function at this stage.

CA⁷)

CA⁸ also disconnects the operate circuits of the discriminating relays.

The FS switch wipers are stepped by self-interruption of the magnet circuit until position No. 6 is reached. The magnet circuit is then broken at wiper FS1 and earth at contact DB⁸ is instead extended via contacts B³, W⁴ and CA⁵ to operate relay E on its a-b winding.

Relay E operating,

E1 prepares a hold circuit for relay E on its d-e winding,

E2 operates relay CD to earth at contact DB⁸ via contact HR2, wiper FS1 on bank contact No. 6 and contacts B³, W⁴ and CA⁵.

- E3 operates relay TL on a call from the parent exchange (see par. 6)
- E4 prepares an operate circuit for relay FD.
- E5 further disconnects the busy tone circuit against the operation of contact FD4.
- Relay CD operating,
 - CD1 prepares the impulsing circuit for the FS switch magnet.
 - CD2 holds relay E to earth at contact E1.
 - CD3 prepares an operate circuit for relay CA.
 - CD4 has no useful function at this stage.
 - CD5 "Re-primed" the time-pulse release relay TM.

The circuit is now ready to receive the second digit.

(b) Tens Digit 1 (9 impulses).

When relay CD releases at the end of the "tens" impulse train, the FS switch wipers will be resting on position 9. Earth at contact B1 extended via contacts E4, FD3 and CD3 will then operate relay W via wiper FS6, and relays X and Y via wiper FS7, during the release period of relay CA.

- Relay W operating,
 - W1 holds relay W to earth at contact B1.
 - W2 prepares the drive circuit for the FS switch magnet.
 - W3 prepares a circuit for relay E from bank contact No. 17 of the FS1 bank.
 - W4 has no useful function at this stage.
 - W5) prevent the operation of the FS switch magnet or
 - &) relay CD should the second digit be 1, 2 or 0
 - W6) (see below).
- Relay X operating, (at the same time as relay W)
 - X1 holds relay X to earth at contact B1.
 - X2 prepares to connect ringing code conductor "A" to contact PM2.

- Relay Y operating (at the same time as relays W and XO,
- Y1 holds relay Y to earth at contact B1.
- Y2 has no useful function at this stage.
- Y3 connects ringing code conductor "A" to contact PM2.
- Relay CA releasing at the end of its slow release period,
- CA1 has no useful function at this stage.
- CA2 prepares an operate circuit for the ring code relay PM.
- CA3 extends earth at contact DB8 via contacts HR2, wiper FS1 on bank contact No. 9, contact W2 and the FS d.m. springs to energise the FS switch magnet.
- CA4 disconnects the operating circuits of the discriminating relays.
- CA5)
- CA6) have no useful function at this stage.
- &)
- CA7)
- CA8 also disconnects the operating circuits of the discriminating relays.

The FS switch wipers are stepped by self-interruption of the magnet circuit until position 17 is reached. The magnet circuit is then broken at wiper FS1 and earth at contact DB8 is instead extended via contact W3 to operate relay E.

- Relay E operating,
- E1 prepares a hold circuit for relay E.
- E2 operates relay CD to earth at contact DB8 via contact HR2, wiper FS1 on bank contact No. 17 and contact W3.
- E3 operates relay TL on a call from the Parent exchange (see par. 6)
- E4 prepares an operate circuit for relay FD.
- E5 further disconnects the busy tone circuit against the operation of contact Fd4.
- Relay CD operating,

- CD1 prepares the impulsing circuit for the FS switch magnet.
- CD2 holds relay E to earth at contact E1.
- CD3 prepares an operate circuit for relay CA.
- CD4 has no useful function at this stage.
- CD5 "re-primed" the time-pulse relay TM.

The circuit is now ready to receive the second digit.

When the other "tens" digits are dialled, the discriminating relays operate as follows:-

<u>Tens digit.</u>	<u>Relay(s) Operated.</u>	<u>Ringing Code.</u>
9	X	R
8	Y	M
7	Z	D
6	X&Y	A
5	X&Z	S
4	W&X	R
3	W&Y	M
2	W&Z	D
1	W, X&Y	A
0	W, X&Z	S

It will be seen that relay W is always operated when a digit in the 1 to 4 and 0 group is dialled, causing the selector wipers to "drive" to position 17. When a digit in the 5 to 9 groups is dialled, relay W does not operate, so the selector wipers drive to position 6.

Dialling the Units Digit

For ease of explanation, it will be assumed that the units digit 2 (8 impulses) will be dialled after a tens digit 1 (9 impulses). Relays W, X & Y will be operated to prepare the "A" ringing code, and the FS switch wipers will be resting on position 17.

The operation of the circuit for other numbers is similar, except that (a) the ringing code may differ, or (b) the other group of lines may be required. The operation in these case can be readily followed from the subsequent description. The bank contacts selected by the "tens" and "units" digits are shown in the table on the diagram.

- Relay A responding to the "units" impulse train,
- A1 repeats the impulses to the FS switch magnet in series with the a-b winding of relay CD.

The wipers rotate to the position corresponding to the digit dialled (position 0 in this case). When wiper FS1 moves off bank contact No. 17 the d-e winding of relay CD is disconnected. Relay CD still holds owing to the impulses passing through the a-b winding and to the slow release slug.

When wiper FS5 moves on to bank contact No. 18, relay FD operates to earth at contact B1 via contact E4.

Relay FD operating,

 FD1 holds relay FD to earth at contact B1.

 FD2 prepares an operate circuit for the testing relay H.

 FD3 prepares an operate circuit for relay CA.

 FD4 prepares the busy tone circuit.

 FD5 disconnects the time-pulse relay TM and earths the machine start wire via contact DB7.

At the end of the "units" impulse train:

Relay A is held by the calling loop,

 A1 disconnects relay CD (slow-to-release) and holds relay B.

Relay CD releasing at the end of its slow release period,

 CD1 disconnects the FS switch magnet impulsing circuit.

 CD2 disconnects relay E (slow-to-release) and earths tag "d" of the testing relay H.

 CD3)

 CD4)

 &) have no useful function at this stage.

 CD5)

The called line is now "tested" during the release lag period of relay E.

Relay H operates to battery on the P wire of the free line circuit and to earth at contact E1.

 H1 energises relay HR in series with the a-b winding of relay H, which holds.

 H2 earths the line circuit P wire.

 H3 prepares an operate circuit for relay DA

 H4 completes a circuit to energise relay PM when the next ringing code start pulse (earth) occurs.

H5 connects relay D to the - line wire.
H6 connects relay F to the + line wire.

Relay HR operating,

HR1)
HR2)
&) have no useful function at this stage.
HR3)

HR4 connects the outgoing - line wire to relay D via contact PM3.
HR5 connects the outgoing + line wire to relay F via contact PM4.
HR6 returns interrupted ring-tone to the caller.
HR7 further earths the incoming P wire against the operation of contact DB2.

Relay E releasing at the end of its slow release period,

E1)
E2)
&) have no useful function at this stage.
E3)

E4 further prepares an operate circuit for relay CA.
E5 has no useful function at this stage.

Relay PM operating when the next ring code start pulse occurs,

PM1 holds relay PM for the duration of the ring code hold pulse.
PM2 connects relay AC to ring code conductor "A"
PM3 connects the - line wire to cont. ring eth. via contact AC1.
PM4 connects the + line wire to ring return battery via resistance R4 or to cont. ring eth. via contact AC1 (see note 4 on the diagram.)

Relay AC responding to the ringing code earth pulses,
AC1 when operated connects cont. ring eth. to the line wire (or wires - see note 4 on diagram).

Relay PM restoring at the end of the ring code hold pulse,
PM1 disconnects the ring code hold lead.

- PM2 disconnects relay AC from the ringing code conductor.
 - PM3 re-connects the - line wire to the transmission bridge and relay D.
 - PM4 re-connects the + line wire to the transmission bridge and relay F.
- Relay PM then remains unoperated for 2.4 secs. until the next ring code start pulse occurs. The code ringing cycle then repeats until the called party answers.

The called party answers

The called party lifts the handset and completes the loop. During the next unoperated period of relay PM, relays D and F operate to the loop, via contacts PM3 and H5 and PM4 and H6 respectively.

- Relay D operating,
 - D1 operates relay DR.
 - D2 provides an alternative holding circuit for relays H and HR.
- Relay DR operating,
 - DR1) Reverse the polarity of the battery feed to the
 - &) calling line for supervisory purposes and disconnect
 - DR2) relay OC from the circuit.
 - DR3 prepares a holding circuit for relay DA.
 - DR4 connects tag "d" of relay DA to earth at contact H3.
 - DR5 has no useful function at this stage (see contact F1 below).
- Relay F operating, (at the same time as relay D)
 - F1 operates relay CA to earth at contact B1 via contacts E4, FD3 and OC1.
- Relay CA operating,
 - CA1 has no useful function at this stage.
 - CA2 disconnects the ringing code start lead.
 - CA3)
 - CA4) have no useful function at this stage.
 - &)
 - CA5)

- CA6 disconnects ring tone.
- CA7)
&) have no useful function at this stage.
- CA8)

The call is now established and conversation may proceed.

Metering

When the next S pulse (battery) occurs relay DA operates on its d-e winding to earth at contact H3 via contacts DR4 and DB5.

- Relay DA operating,
 - DA1 holds relay DA on its a-c winding to battery via resistance R5.
 - DA2 prepares a holding circuit for relays H and HR (either party release)
 - DA3 prepares the Z pulse circuit for the operation of relay DB.
 - DA4 prepares the metering battery circuit.
 - DA5 further connects earth to the machine start lead against the operation of contact DB7.
- Relay DB operating on its d-e winding in series with the a-b winding of relay DA when the next Z pulse (battery) occurs,
 - DB1 removes the short circuit from the a-b winding of relay DB, which holds to earth at contact B1.
 - DB2 disconnects its earth from the P wire (see Release, par. 7 (ii)).
 - DB3 connects the metering battery to the M wire (see Note 8 on drawing)
 - DB4 completes an alternative holding circuit for relays H and HR, preventing release by the called party during the metering period when first party re-lease is effective.
 - DB5 disconnects the S pulse operating circuit of relay DA.

- DB6 disconnects the a-c winding of relay DA leaving it holding in series with the d-e winding of relay DB, to the Z pulse.
- DB7 disconnects earth at contact FD5 from the machine start lead.
- DB8 has no useful function at this stage.
- Relay DA releasing at the end of the Z pulse (4 secs.)
- DA1 further disconnects the a-c winding of relay DA.
- DA2 disconnects the alternative holding circuit for relays H and HR.
- DA3 disconnects the Z pulse holding circuit.
- DA4 disconnects the metering battery from the M wire.
- DA5 disconnects its earth from the machine start lead.

Called Line Engaged.

When the called line is engaged earth instead of battery is connected to the line circuit P wire and relay H is unable to operate.

- Relay E restoring at the end of its release lag period,
 - E1)
 - E2)
 - E3) have no useful function at this stage.
 - &)
 - E4)
- E5 returns busy tone to the calling party.

The caller must then restore and try the call again later (excepting an operator at the parent manual board - see par. 6.)

Trunk Offering

The trunk offering facility is made available to operators at the parent exchange manual board by relay TL, which must only be operated on incoming junction calls to the U.A.X., otherwise it would be possible for the trunk-offering facility to be exercised by U.A.X. subscribers having an earth on one of the line wires. Relay TL is operated by positive battery sent forward over the M wire from the incoming junction relay set (see U.A.X. circuits). The rectifier MR1 prevents operation to a normal (negative) battery.

Prior to the receipt of the units digit, relay TL is operated by contact E3 making (see par. 2),

Relay TL operating,

 TL1 holds relay TL to earth at contact B1.

 TL2)
 &) disconnect the short-circuits from the windings
 TL3) of relay OC.

 TL4 disconnects the TL relay operate circuit (to prevent
 draining of the positive battery.)

 TL5 short-circuits contact D2 (to give "manual hold" on
 either party release.)

When the operator makes a call and encounters an engaged line, busy tone is returned as in par. 5 above. The operator may then make a connection by momentarily operating the ring key, thereby momentarily earthing one line wire. This causes relay OC (which has two windings wound in opposition and is normally unoperated) to operate momentarily.

Relay OC operating,

 OC1 extends earth at contact B1 via contacts E⁴ and
 FD³ to energise the d-e winding of relay HR.

Relay HR operating,

 HR1 holds relay HR to earth at contact B1 via contact
 TL5, so that relay OC may release without effect.

 HR2 energises relay D to earth at contact DB⁸ via contact
 H5.

 HR3 provides a testing earth for relay H when the called
 line becomes free.

 HR4)
 &) establish a speech circuit in parallel with the
 HR5) existing conversation.

 HR6 disconnects busy tone and connects ring tone.

Relay D operating,

 D1 operates relay DR.

 D2 has no useful function at this stage.

Relay DR operating,

 DR1) disconnect relay OC from the circuit and reverse
 &) the battery potential to line, causing the operator's
 DR2) supervisory lamp to be extinguished.

DR3)
&) have no useful function at this stage.
DR4)

DR5 extends earth at contact B1 via contact E4,
FD3 and OC1 to operate relay CA.

Relay CA operating,

CA1 provides an additional holding circuit for relay CA,
against the release of contact DR5.

CA2 disconnects the ring code start circuit.

CA3)
CA4)
&) have no useful function at this stage.
CA5)

CA6 disconnects ring tone.

CA7)
&) have no useful function at this stage.
CA8)

The operator now offers the call. If it is accepted,
the called party is told to restore the handset.

When the called line thus becomes free, relay H is energised.

Relay H operating,

H1 provides a holding circuit for relays H and HR.

H2 earths the line circuit P wire.

H3 has no useful function at this stage.

H4 prepares the operate circuit for relay PM (ring
code start).

H5 connects relay D to the - line wire, and causes it
to release.

H6 connects relay F to the + line wire.

Relay D releasing,

D1 releases relay DR.

Relay DR releasing,

- DR1) again reverse line polarity (thus causing the
- &) operator's lamp to glow) and reconnect relay
- DR2) OC in circuit.

- DR3)
- DR4)
- &) have no useful function at this stage.
- DR5)

The operator may now ring the called party by operating the ring call key again momentarily.

Relay OC operating momentarily,

- OC1 disconnects relay CA.

Relay CA releasing,

- CA1 disconnects the holding circuit so that relay OC can restore without effect.
- CA2 completes the ring code start circuit.
- CA3)
- CA4)
- &) have no useful function at this stage.
- CA5)
- CA6 connects earth to the machine start lead.
- CA8 has no useful function at this stage.

Relays PM and AC then operate as in par. 4 and ring the called party, who answers as already described.

The call is held by the manual operator, as contact TL5 by-passes contact D2 (see Release, par. 7.) If the called subscriber hangs up, the operator can re-call by again operating the ring key.

Release

Relay TL is only operated during an incoming junction (manual) call. At the end of an automatic call, the selector is released by the first party to hang up (first party release) or by the calling party (see note 7 on the diagram.). On manual calls, however, calling party release only is effective (due to contact TL5.). A.C.S.H. alarm is not required owing to the P.G. lock-out facility at the line circuit, and time pulse release (see par. 8 below).

(a) Calling party releases

- Relay A is released by the calling party breaking the line loop,
- A1 disconnects relay B (slow-to-release).
- Relay B releases at the end of its slow release period.
- B1 releases relays CA, DB, FD, H, HR, F (when HR releases) TL (if used) and those discriminating relays which have been used (W, X, Y and Z).

It will now be seen that there is a direct connexion from every contact, except No. 0 of the FS1 bank, to the FS switch magnet via the FS d.m. springs.

Contacts DB8 and HR2 restoring connect earth to wiper FS1, causing the FS switch magnet to be energised and "step" the wipers to the home position (No. 0).

When wiper FS8 returns to the home contact (and only then) the marking battery is restored to the incoming P wire, and the circuit is ready for another call.

(b) Called Party releases

When the called party hangs up, relays D, F and DR are released.

If calling party release is effective (see note 7 on the diagram) contact DR4 restoring extends earth at contact H3 via contacts CA7 to tag "a" of relay TM and primes the forced release circuit. No further action takes place until the calling party hangs up or forced release is effected. (see par. 8)

If first party release is effective (jack points 3 and 4 are not strapped) contact D2 restoring, releases relays H and HR. Contact HR7 disconnects the earth from the incoming P wire, causing the preceding equipment to release and so disconnect relay A. The release then proceeds as in (i)

Forced Release

Forced release is initiated under the following conditions -

- (a) When the calling party fails to complete dialling within a reasonable time after seizing the selector. Contact CD5 extends earth at contact FD5 to tag "a" of relay TM.

- (b) Under C.S.H. conditions. Contact DR⁴ restoring extends earth at contact H3 to tag "a" of relay TM via contact CA 7.

If a "time pulse start" pulse occurs when tag "a" of relay TM is earthed relay TM operates.

Relay TM operating.

TM1 enables relay TM to hold to the "time pulse hold" pulse.

TM2 connects the time pulse release lead to relay B.

If the "forced release" condition continues for a further 60 secs. (i.e., relay TM is held by earth on tag "a") then the "release" pulse (earth) occurring will short-circuit relay B, causing it to release. Release of the whole circuit then occurs as in par. 7 above.

4. CIRCUIT NOTES.

- (a) Relay A.

Made high impedance to speech currents to prevent them leaking to battery.

- (b) Relay B.

Made slow-to-release to enable it to hold during impulsing of relay A.

- (c) Relay CA.

Made slow-to-release to ensure operation of the digit discriminating relays during dialling of the "tens" digit.

- (d) Relay CD.

Made slow-to-release to enable it to hold on its a-b winding during impulsing of relay A.

- (e) Relay E

Made slow-to-release to prevent disconnexion of the "testing" earth at contact E1 before relay H has had time to operate.

(f) Relays F and D.

Made high impedance to speech currents to prevent them leaking to battery.

(g) Rectifier MR1.

Prevents operation of relay TL to a normal (negative) battery.

(h) Rectifier MR2.

Increases the release lag of relay B to enable it to hold more satisfactorily during impulsing of relay A.

(i) Rectifier MR3.

Prevents the ring code hold earth being extended to the common ring code start lead when relay PM is operated.

END

