POST OFFICE TELECOMMUNICATIONS HEADQUARTERS

Level 0

DIAGRAM NOTES AT 60444G

SPECIFICATION T 60444

OUTGOING RELAY-SET. GSC REGISTER AND ASSISTANCE TRAFFIC

UAX NOS. 12, 13 AND 14

SIGNALLING SYSTEM DC NO. 2

2000 TYPE

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1. GENERAL

The diagram shows the circuit connexions of an outgoing relay-set used at a UAX Nos. 12, 13 and 14 to control assistance and register traffic to the group switching centre on junctions employing Signalling System DC No. 2. The circuit can cater for four differing UAX and GSC conditions as shown in schedule form in paragraph 3.2.

The relay-set may be installed at an exchange prior to the introduction of STD in which case the strapping arrangements shown in paragraph 3.4 must be observed.

As laid down in TI PLANNING AND WORKS A5 F1152 this equipment can be connected to a line with an overall signalling path characteristic of up to 76000 μF ohms, but to meet the d.c. signalling requirements the loop resistance must not exceed 5200 ohms.

The following diagrams or their equivalents should be considered in conjunction with this diagram:-

AT 61469 COIN AND FEE CHECKING CIRCUIT.

AT 60451 INCOMING RELAY-SET FROM UAX NOS. 12, 13 AND 14. GSC SIGNALLING SYSTEM DC NO. 2.

AT 60443 OUTGOING RELAY-SET TO GROUP SWITCHING CENTRE. UAX NOS. 12, 13, 14. SIGNALLING SYSTEM DC NO. 2.

AT 60455 AUXILIARY RELAY-SET. GSC AND ASSISTANCE TRAFFIC UAX NO. 13. SIGNALLING SYSTEM DC NO. 2.

AT 60446 INCOMING RELAY-SET. SSDC NO. 2.

AT 60447 INCOMING RELAY-SET WITH LINEFINDER ACCESS AND TKO. UAX NO. 12. SSDC NO. 2.

AT 60448 BOTHWAY SWITCHING RELAY-SET. SSDC NO. 2.

AT 60078 ROUTINE TEST UNBARRING CONTROL. UAX NO. 13. (VIA AT 4082 FIG. 28).

AT 60105 ROUTINE TEST UNBARRING CONTROL. UAX NO. 14. (VIA AT 60107 FIG. 4).

2. FACILITY SCHEDULE

Provision is made for:-

2.1 Dual access from group selector levels 0 and 1 by separate path of entry in order to differentiate between trunk and assistance traffic respectively.

2.2 Battery testing from the preceding selector level P wire.

2.3 Transformer type transmission bridge.

2.4 Conversion of loop disconnect pulses to current reversal pulses.

2.5 Temporary storage of the digits received from the subscriber's dial.

2.6 An associated junction hunter to search for a free GSC junction or a free GSC level 9 junction when:- (a) the relay-set is seized via level 0, or (b) the relay-set is seized via level 1, by an ordinary subscriber, providing the first digit received is permitted or (c) the relay-set is seized via level 1, by a coin box subscriber providing that either (i) the first received digits are 00 (prepayment coin box dialling 100 for assistance) or (ii) the first digit received is permitted (pay on answer coin box). /(i) and (ii) are alternative and are predetermined by circuit strapping/. The maximum hunting time of the junction hunter not to exceed 500 ms.

2.7 Transmission of busy tone to the caller if all the outgoing junctions are busy and the operation of the overflow meter.

2.8 On connexion to a free junction and after a delay of 100 ms, generation and transmission of digits as follows:- (a) Seizure via level 1 - generation of digit 1 (ordinary caller), (b) Seizure via level 1 - either (i) generation and transmission of digits 11 with an inter-digital pause of 750 ms minimum (prepayment coin box), or (ii) generation and transmission of digit 1 (pay on answer coin box). /(i) and (ii) are alternative and are predetermined by circuit strapping/. (c) Seizure via level 0 - generation and transmission of digit 0 (ordinary caller), (d) Seizure via level 0 - either (i) generation and transmission of digits 11 with an inter-digital pause of 750 ms minimum (prepayment coin box dialling 0 for assistance), or (ii) generation and transmission of digit 0 (pay on answer coin box). /(i) and (ii) are alternatives and are predetermined by circuit strapping/.

2.9 Following facility 2.8 (a) or 2.8 /(b) (ii)/ transmission after an inter-digital pause of 750 ms minimum, of the stored digits, with inter-digital pauses of 750 ms minimum.

2.10 Following facility 2.8 (c) or 2.8 /(d) (ii)/ transmission after an inter-digital pause of 750 ms minimum of a discriminating digit of numerical value 2 or 4 or 6 if the caller is an ordinary subscriber, or 1 or 3 or 5 if the call is from a coin box. This facility is optional and is provided by pulse sender strapping arrangements.

2.11 Following facility 2.10 on an 0 level call, transmission of the stored digits with inter-digital pauses of 400 ms minimum.

2.12 Manual hold on non-metered calls.

2.13 Forward recall under manual hold conditions.

2.14 Regeneration of a coin and fee checking signal to the preceding equipment when call is originated from a coin box.

2.15 The connexion of a single metering pulse to the M wire to operate the caller's meter on receipt of an answering supervisory signal-earth on the incoming positive wire.

2.16 Prevention of switch-hook flashing or continued dialling by the caller, after receipt of the first metering signal or the first CFC signal, from interfering with receipt of subsequent metering signals or the transmission of pay tone respectively.

2.17 Transmission of NU tone to the caller if the first digit received on a level 1 call is a barred digit.

2.18 Transmission of NU tone to the caller if the relay-set is seized by a call routed over an incoming junction to the UAX to prevent fraudulent access to either the group switching centre register or the assistance operator.

2.19 Forced release of the circuit under time pulse control for the following conditions:-

(a) Seizure without subsequent dialling (PG) on level 1 or level 0 calls.

(b) All junctions engaged.

(c) Call from an inter-dialling exchange except for operators' routine test calls.

(d) A barred code call via level 1.

2.20 A release alarm should the regenerator (mechanical), the pulse sender or the junction hunter fail to return to normal following a call.

2.21 Busying the circuit should the regenerator, the pulse sender or the junction hunter be left off-normal following a previous call.

2.22 Operator routine test.

2.23 Recording of ineffective 0 level calls at the GSC.

2.24 Traffic recorder access lead.

2.25 Signalled sequence release on directly connected junction.

2.26 Busying the incoming P wire when directly connected outgoing junction is disconnected.

3. CIRCUIT DESCRIPTION

3.1 Location

Location of the components on the diagram can be found by referring to the component grid reference on Sheet 1 of the diagram and then to the relevant vertical grid.

3.2 Outline

This circuit, comprising two relay-sets, caters for both trunk and assistance traffic routed via levels 0 and 1 respectively of the group selector. The first digit dialled by the subscriber is regenerated and transmitted by the pulse sender, the remaining dialled digits being stored (and counted in some cases) and then retransmitted via the regenerator following the pulse sender transmission. By circuit strapping the pulse sender is able to transmit (i) routing digits other than those dialled and (ii) CCB discriminating digits.

By additional strappings the circuit can cater for the following UAX or group switching centre conditions:-

(a) STD - UAX with prepayment coin boxes dialling 100 for assistance

Level 0 CB - barred on VMB of group selectors.

Level 0 ORD - generate 02 or 04 or 06 (representing charge group 1 or 2 or 3).

Level 1 CB - after receipt of 00 generate 11.

Level 1 ORD - generate 1.

(b) STD - UAX with prepayment coin boxes dialling 0 for assistance

Level 0 CB - generate 11.

Level 0 ORD - generate 02 or 04 or 06 (representing charge group 1 or 2 or 3).

Level 1 CB - barred on VMB of group selectors.

Level 1 ORD - generate 1.

(c) STD - UAX with pay on answer coin boxes dialling 100 for assistance

Level 0 CB - generate 01 or 03 or 05.)
Level 0 ORD - generate 02 or 04 or 06.) (representing charge group 1 or 2 or 3.)

Level 1 CB - generate 1.

Level 1 ORD - generate 1.

3.2.1 Level 0 Call (Trunk traffic)

The relay-set is seized by a loop extended via the preceding equipment to operate relay A. The subsequent operation of relays BB and PU prepare to reverse the potential of the outgoing negative and positive wires to form the seizure signal to the distant incoming relay-set.

The trains of pulses from the calling party's dial are received and stored on the regenerator and, on receipt of the first digit (second digit dialled) the junction hunter searches for a free junction.

Prior to switching to a free outlet, a current flows through the 6-4 winding of relays D and FC from earth at resistor R18 in such a direction as to hold spring 12 of contacts D1 and FC1 in contact with spring 10.

On switching to a free outlet, reversed polarity is connected to the outgoing negative and positive wires to seize the distant incoming equipment. Relay H in operating disconnects the earth at resistor R18 but replaces it with a signalling earth from the incoming relay-set. When the relay-set at the distant end is fully seized this signalling earth is disconnected and consequently relay D changes over under the influence of the current flowing in its bias winding. Spring 12 of contact D1 therefore breaks with spring 10 and makes with spring 11. (Relay FC at this stage is unaffected).

After a suitable delay (to allow adequate seizure time for the distant equipment) the pulse sender transmits the predetermined digits (ORD or CCB) by pulsing relay PU via the pulse sender arcs PS5 and PS6, contact PU2 reversing the polarity of the outgoing negative and positive wires to form the pulses to the distant incoming A relay.

When the pulse sender ceases transmitting, the regenerator sends the stored digits, relay PU in this case being under the control of the regenerator 67% break loop disconnect pulses.

When the called party answers, metering signals are received in the form of periodic connections of earth on the outgoing negative and positive wires. Relay D responds to these signals and consequently metering conditions are connected to the M wire to control the calling party's meter.

3.2.2 Level 1 (Assistance traffic)

On seizure from the selector level 1 outlet, relays WS and A operate in series.

When the relay-set receives the second dialled digit (or the 2nd and 3rd digits on calls from a prepayment coin box) the digits are steered into a discriminator by a contact of relay WS. The digits are also stored in the regenerator.

When the digits represent a barred code, the caller receives NU tone and the relay-set is force-released under time pulse control should the caller hold on to the call.

When the digits represent a permitted code, the junction hunter searches for a free outlet to the GSC.

Prior to switching to a free outlet, a current flows through one winding of relays D and FC from earth at resistor R18 in such a direction as to hold spring 12 of contacts D1 and FC1 in contact with spring 10.

On switching to a free outlet, reversed polarity is connected to the outgoing negative and positive wires to seize the distant incoming relay-set. Relay H in operating disconnects the earth at resistor R18 but replaces it with a signalling earth from the distant incoming relay-set. When the relay-set at the GSC is fully seized, this signalling earth is disconnected and consequently relay D changes over under the influence of the current flowing in its bias winding. Spring 12 of contact D1 therefore breaks with spring 10 and makes with spring 11 (Relay FC at this stage is unaffected).

After a suitable delay period (to allow adequate seizure time for the distant equipment) the pulse sender transmits the predetermined routing digits 1 or 11 (11 where prepayment coin boxes are fitted). These digits are transmitted in the form of reversals of polarity to the outgoing negative and positive wires by relay PU which at this stage is under the control of contact PG2.

When the pulse sender ceases transmission, the regenerator sends the stored digits, relay PU in this case being under the control of the regenerator 67% break loop disconnect pulses.

When the operator answers (100 calls) a coin and fee checking signal is connected to the junction by the distant incoming relay-set in the form of a negative battery pulse of approximately 250 ms duration. On receipt of this signal, polarised relay FC operates resulting in the repetition of the coin and fee checking signal to the preceding equipment if the call originated from a coin box. On calls originated from pre-payment coin boxes, the coin and fee checking signal is ineffective but on calls from pay-on-answer coin box subscribers, it results in the return of pay tone to the answering operator. To establish speech conditions the operator operates and releases the RING key which initiates a further coin and fee checking signal similar to that just described.

A second operation of the RING key results in the transmission of another coin and fee checking signal to the preceding equipment to effect the opening of the coin slots in the coin box mechanism.

Should the calling subscriber clear before the operator, manual hold conditions are set up by the re-connexion of the signalling earth at the distant incoming relay-set to bring about the change-over of relay D. Contact D1 holds relay BD and hence relays BB and BC to provide the necessary manual hold condition to the preceding selector train.

Single fee metering has been provided on level 1 calls where required to cater for services requiring this facility (eg 123).

3.2.3 Functions of straps

Strap No. 7 — Used at UAX No. 13 and 14 with pay on answer coin box to provide metering battery on the M wire.

Strap No. 8 — Used at:-

(i) UAX No. 12 with pay on answer coin box and in association with contact CB2 and strap No. 10 to provide metering battery or earth on the M lead.

(ii) UAX No. 12, 13 and 14, with prepayment coin box and in association with contact CB2 to provide battery on the M lead for ordinary subscribers.

Straps No. 9 — Used at UAX No. 12, 13 and 14 with prepayment coin box where CCB subscribers dial 0 only for assistance to provide the following facilities:-

(i) In association with contact CB3 operates relay CO to suppress both regenerator and counting discrimination circuit.

(ii) In association with contact CB5 operates relay BB in order to hunt for and find a free junction on seizure of the relay-set.

(iii) In association with contact CB1 provides a manual hold earth on the P wire for the preceding selector.

Strap No. 10 — See Strap No. 8 paragraph (i).

Straps No. 11 — Used at UAX No. 12, 13 and 14 with prepayment coin box where CCB subscribers dial 100 for assistance to provide the following facilities:-

(i) In association with contact CB3 operates relay CO to suppress the regenerator thus avoiding the necessity to provide digit absorbing equipment at the GSC.

(ii) Short-circuits contact CO5 to retain the digit counting discrimination facility.

Straps No. 12 — Used at UAX No. 14 only to provide (i) 3 minute time-pulse forced release from PG conditions to prevent tapping line faults via level 1 of the GSC from holding the circuit busy for long periods. (ii) the correct testing-in battery conditions on the P wire.

Straps No. 13 — Used at UAX No. 12 and 13 (i) to complete normal time-pulse circuits and (ii) to provide the correct testing-in battery conditions on the P wire.

Straps No. 14 — Used at UAX No. 13 and 14 where direct connexion to a junction is required. The strap avoids the necessity of providing a junction hunter as the alternative choice junction can be made available by a cross in the cabling of levels 1 and 0 of the group selectors.

Straps No. 15 — Used at UAX No. 12 and 13 where a junction hunter is provided. In association with a routine tester it provides a continuity test of junction hunter wiper to bank contact on the positive wire. The strap between U77-U79 provides a circuit for current to flow in the 6-4 winding of relay D opposing and exceeding that in the bias winding so that spring 12 of contact D1 is held against spring 10 when the relay-set is idle.

Straps No. 16 — Enable the junction hunter to home without interruption at contact HX1, if manually stepped off-normal in the directly-connected junction case where the junction hunter is fitted but not used, ie where straps No. 14 are also provided.

3.3 Detail

3.3.1 General

In considering this circuit it should be borne in mind that relays D and FC are side-stable polarized relays. Their windings are connected so that a current flowing from the higher number tag of a winding to the lower number tag tends to move contact D1 and FC1 lever springs from the higher number spring to the lower number spring. Thus a current flowing from tag 6 to tag 4 (current being assumed to flow from earth to battery) causes spring 12 to move from spring 11 to spring 10 or, if already in contact with spring 10, to be held there. In consequence of this, relays D and FC are not affected by currents flowing in the line which have a complete metallic path, but are affected by line currents which have earth as a return path. The former currents will be referred to as "loop currents" and the latter as "earth currents".

Circuit free condition (where junction hunter is fitted)

While this relay-set is idle, earth is connected to the outgoing positive wire by contact H6. This causes an earth current to flow:-

(a) in the 6-4 winding of relay D, the magnetic effect of which exceeds the effect of the current flowing from tag 7 to tag 9 of the bias winding, by an amount sufficient to ensure that at contact D1 spring 12 makes contact with spring 10.

(b) in the 6-4 winding of relay FC, the magnetic effect of which assists the effect of the current flowing from tag 9 to tag 7 of the bias winding to ensure that, at contact FC1 spring 12 makes contact with spring 10.

Circuit free condition (relay-set directly connected to junction)

A similar condition exists on the D and FC relays as that described in the previous paragraph except that the earth current flowing in the 6-4 windings of these relays is due to the connexion of earth to the centre point of the transmission bridge in the distant incoming relay-set.

The following circuit functions are described:-

3.3.2 Level 0 trunk call from ordinary and CCB subscribers.

3.3.3 Level 1 call (assistance and manual board services).

3.3.4 Assistance call by a CCB subscriber dialling 0 only where prepayment coin boxes are fitted.

3.3.5 Assistance call from a CCB subscriber dialling 100 where prepayment coin boxes are fitted.

3.3.6 Incoming call from an inter-dialling exchange via selector level 1 or 0.

3.3.7 Forced release of relay-set under time-pulse control.

3.3.8 Operators routine test of junction.

3.3.9 Recording of ineffective calls at the GSC.

3.4 Use of relay-set under pre-STD conditions.

3.3.2 Level 0 trunk call from ordinary and CCB (pay on answer type) subscribers

3.3.2.1 Seizure

The relay-set is seized by a loop extended via the preceding selector level 0 to operate relay A. Relay CB also operates for a call from a CCB subscriber, see section 3.3.2.9.

Relay A operating,
A1 operates relay B and prepares to short circuit relay CD independently of the earth at contact BD1.
A2 is ineffective at this stage.

Relay B operating,

- B1 holds relay B independently of contact A1 and short-circuits relay CD.
- B2 disconnects the testing-in battery from, and connects a busying earth to, the incoming P wire.
- B3 is ineffective at this stage.
- B4 operates relay BA.
- B5 operates relay PU.
- B6 prepares an operate circuit for relay CD.

Relay PU operating,

- PU1 connects the start condition to the alarm delay equipment via relay TP.
- PU2 prepares to connect reversed polarity to the outgoing negative and positive wires.

Relay BA operating at contact B4,

- BA1 short circuits resistor R1 to prepare the pulsing circuit to the regenerator Receive Element.
- BA2 operates the release relay (UAX 12 and 13) which provides the release alarm earth to this circuit.
- BA3 operates relay BD.
- BA4 prepares the circuit for the regenerator Transmit Element.
- BA5 is ineffective at this stage.
- BA6 prevents a premature homing circuit for the pulse sender.
- BA7 prepares the operating circuit for relay ST.

Relay BD operating,

- BD1 prepares the operating circuit for relay CD.
- BD2 prepares a hold circuit for relays CO and EF.
- BD3 prepares an operating circuit for relay DD.
- BD4 prepares an operating circuit for relay EF should all the junction outlets on arc JH2 be engaged.
- BD5 operates relays IP and STA and prepares the operating circuit for BB.

Relay IP operating,

- IP1 operates relay IS.

Relay IS operating,

- IS1 maintains earth on the release relay lead independently of contact BA2.
- IS2 prevents premature operation of the Transmit Element.
- IS3 prevents premature operation of relay ST.
- IS4) short circuit the secondary windings of
- IS5) transformer T1.
- IS6 holds relay STA independently of contact BD5.
- IS7 further disconnects the testing-in battery circuit.

Relay STA operating at contact BD5,

- STA1) connect capacitors C9 and C10 across the secondary
- STA2) winding of transformer T1.
- STA4 prevents a premature operating circuit for relay J.

3.3.2.2 Dialling and digit storage

Relay A responds to loop-disconnect pulses received over the incoming negative and positive wires.

Relay A — pulsing,
A1 — short circuits relay B which holds during pulsing and operates relay CD. Contact A1 also pulses the Receive Element.
A2 — is ineffective at this stage.

Relay CD — operating,
CD1 — operates the regenerator Mark Element.
CD2 — operates relay CA.
CD3 — see Design Details.

Mark Element — operation of the regenerator Mark Element prevents relay BY from operating to regenerator U point 3.

Relay CA — operating at contact CD2.
CA1 — is ineffective at this stage.
CA2 — operates relay BB.
CA3 — is ineffective at this stage.

Relay BB — operating,
BB1 — prepares the M wire metering circuit.
BB2 — disconnects the start condition from the alarm delay equipment.
BB3 — prepares an operating circuit for relay CO if the calling party should clear at this stage.
BB4 — operates relay BC.
BB5) BB6) — connect reversed polarity to the outgoing negative and positive wires.
Where a junction hunter is fitted, contact BB6 in connecting earth to resistor R15 causes relay D to changeover under control of the bias winding. Where the relay-set is directly connected to a line, contact D1 is held with spring 12 in contact with spring 10 by the current flowing in the 3-1 winding opposing and exceeding that in the bias winding until the distant incoming relay is seized.
BB7 — holds relay BB independently of contact CA2.
BB8 — prepares the operating circuit for relay J.

Contact D1 — changing over spring 12 making contact with spring 11 operates relay DB.

Relay DB — operating,
DB5 — connects earth to the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.
All other contacts of relay DB are ineffective at this stage.

Relay BC — operating slowly (see Design Details),
BC1 — is ineffective at this stage.
BC2 — prepares the holding circuit for relay CD independently of contact B6.
BC3 — holds relay BC independently of contact EF3 and disconnects earth from the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.
BC4 — connects busy tone to contact EF4.
BC5 — completes the self drive circuit for the junction hunter drive magnet. Where the junction hunter is not required, contact BC5 operates relays H and HX.
BC6 — connects one winding of relay HX to the P wiper where a junction hunter is required.
BC7 — prepares the outgoing negative wire circuit.

Relay A responds to the dialled pulses operating the Receive Element during each break period and releasing it during each make period. Whilst pulses are being stored in the regenerator an earth appears on regenerator U point 8, but is ineffective at this stage.

At the end of the pulse train relay CD releases.

Relay CD releasing,
- CD1 releases the regenerator Mark Element.
- CD2 releases relay CA.
- CD3 see Design Details.

On release of the regenerator Mark Element earth appears on regenerator U point 3 and relay BY operates.

Relay BY operating,
- BY1 ensures the testing-in battery cannot be reconnected to the incoming P wire if the regenerator fails to restore to normal.
- BY2 holds relay BY independently of the earth from regenerator U point 3.
- BY3 prepares the operating circuit for relay DK.
- BY4 prepares a circuit to connect the release alarm earth (Fig. 3 Mechanical Regenerator) or earth (Fig. 4 Electronic Regenerator) to the regenerator Transmit Element.

Relay CA releasing slowly at contact CD2.

All CA contacts are ineffective at this stage.

3.3.2.3 Junction hunting

With the operation of contact BC5 in the previous paragraph earth is connected to the junction hunter drive magnet via contact HX1 and the JHdm springs to start the JH uniselector hunting for a free outlet.

The hunter continues driving until a free outlet is found or, should all outlets be busy, drives to outlet 12 or 25 (outlet 25 if the availability is 20).

3.3.2.4 All junctions busy

When the P wiper, arc JH2, steps to contact 12 or 25 relay HX operates to battery at resistor R19 and relay EF operates in series with relay HX when contact CD3 releases at the end of the pulse train.

Relay HX operating,
- HX1 cuts the drive circuit to the junction hunter magnet and operates relay H in series with the hold winding of relay HX.

Relay H operating,
- H1) H2) H3) are ineffective at this stage.
- H4 connects earth to the overflow meter lead.
- H5 is ineffective at this stage.
- H6 disconnects earth from the 6-4 windings of relays D and FC. (Relay D has already changed over by the operation of contact BB6 above).
- H7 releases relay IP and leaves relay STA holding on its second winding.

Relay EF operating,
EF1 connects the start conditions to the alarm delay equipment via the winding of relay TP.
EF2 operates relay CO.
EF3 is ineffective at this stage.
EF4 connects busy tone to the calling party.
EF5 is ineffective at this stage.
EF6 disconnects an operate circuit for relay ST.
EF7 holds relay EF to earth at contact BD2.

Relay CO operating,
CO1 prevents subsequent pulses of contact A1 from pulsing the regenerator by introducing resistor R1 into the operate circuit of the regenerator Receive Element.
CO2 further disconnects the testing-in battery circuit.
CO3 locks relay CO to earth at contact BD2.
CO4 prepares a hold circuit for relay PR should forced release conditions materialise. The break contact prevents the operation of the regenerator Mark Element under the same conditions.
CO7 short circuits the 200Ω winding of relay WS (see Design Details).

Other CO contacts are ineffective at this stage.

Relay IP releasing at contact H7,
IP1 releases relay IS.

Relay IS releasing slowly,
IS4) disconnect the short-circuits from the secondary windings of
IS5) transformer T1.
IS6 releases relay STA.

Other IS contacts are ineffective at this stage.

Relay STA releasing,
STA1) disconnect capacitors C9 and C10 from the secondary windings of
STA2) of transformer T1.
STA4 operates relay J.

Relay J operating.

All J contacts are ineffective at this stage.

The relay-set remains held in this condition until the calling party clears or the relay-set is force-released under control of the time-pulse at contact EF1 (see paragraph 3.3.7.2).

3.3.2.5 Junction free

Relays held at this stage:- A, B, BA, BB, BC, BD, BY, DB, IP, PU, IS, STA and spring 12 of contact D1 in contact with spring 11.

When the P wiper, arc JH2, steps to a free outlet relay HX operates to the testing-in battery of the junction equipment.

Relay HX operating,
HX1 cuts the drive circuit to the junction hunter magnet and operates relay H in series with the hold winding of relay HX.

Relay H operating,
H1 connects earth to the release relay lead (see Design Details).
H2 prepares the operating circuit for relay ST.
H3) H4) disconnect the junction hunter homing circuit.
H5 connects the outgoing negative wire to the junction.
H6 disconnects earth at resistor R18 from relay D and connects relay D to the outgoing positive wire of the junction.
H7 releases relay IP, prepares a hold circuit for relay RG and leaves relay STA held on its second winding by contact IS6.

The operation of contacts H5 and H6 also connect a reversed polarity to the junction to seize the distant incoming relay-set while the operation of contact H6 in disconnecting the earth at resistor R18 replaces it by the signalling earth on the outgoing positive and negative wires maintained by the distant incoming relay-set. Relay D changes over as a current now flows in the 3-1 winding whilst the distant incoming relay-set is being seized.

Contact D1 changing over,
spring 12, breaking contact with spring 11 and making contact with spring 10, disconnects the hold circuit for relay DB (see Design Details relay DB).

The complete seizure of the incoming relay-set brings about the disconnexion of the signalling earth so that, there is now a loop current via windings 4-6 and 3-1 via relay D so that the current in the 7-9 bias winding causes contact D1 to change over.

Contact D1 changing over,
spring 12, breaking contact with spring 10 and making contact with spring 11, holds relay DB.

Relay IP releasing slowly at contact H7,
IP1 releases relay IS.

Relay IS releasing slowly,
IS1) IS2) are ineffective at this stage.
IS3 operates relay ST.
IS4) IS5) disconnect the short circuits from the secondary windings of transformer T1.
IS6 disconnects the hold circuit for relay STA which is held by the subsequent operation of contact ST8.
IS7 is ineffective at this stage.

3.3.2.6 Pulse sending

Relay ST operating slowly (see Design Details),
ST1 is ineffective at this stage.
ST2 reoperates relay IS.
ST3 disconnects the pulse sender homing circuit.
ST4 energizes relay PG and connects earth to the pulse sender control arc PS5.
ST5 short circuits contact IS3.
ST6) ST7) are ineffective at this stage.
ST8 holds relay STA.

Relay IS operating,
- IS1 is ineffective at this stage.
- IS2 prevents the premature operation of the regenerator Transmit Element.
- IS3 is ineffective at this stage.
- IS4) short circuit the secondary windings of
- IS5) transformer T1.
- IS6 holds relay STA independently of contact ST8.
- IS7 is ineffective at this stage.

Relay PG operating slowly (see Design Details),
- PG1 disconnects relay PG and operates the pulse sender magnet PS.
- PG2 releases relay PU.

Relay PU releasing,
- PU1 is ineffective at this stage.
- PU2 reverses the direction of the loop current flowing in the line giving a break pulse to the distant incoming selector.

Relay PG releasing slowly at contact PG1,
- PG1 releases magnet PS and the pulse sender wipers are stepped from bank contact 1 to bank contact 2. Relay PG is re-energized.
- PG2 reoperates relay PU.

Relay PU operating,
- PU1 is ineffective at this stage.
- PU2 reverses the direction of the loop current in the line to terminate the first break pulse to the distant incoming selector.

Relay PG operating and releasing steps the pulse sender wipers and relay PU transmits reversals of potential to the distant incoming relay-set until the PS5 wiper steps to a bank contact wired to terminal IT.

On the contacts wired to the IT terminal, earth at contact RT4 holds relay PU so that the pulsing of contact PG2 is nullified and hence no pulses are received by the distant incoming relay-set at this stage.

When the PS5 wiper again steps to an unwired bank contact, earth at contact ST4 is removed from relay PU and once more contact PG2 pulses relay PU which transmits reversals of potential to the incoming relay-set at contact PU2.

When wiper PS5 steps to the bank outlet wired to terminal RG, relay RG operates.

Relay RG operating,
- RG1 prepares to operate the regenerator Transmit Element.
- RG2 releases relay IS.
- RG3 prepares to home the pulse sender PS.
- RG4 releases relay ST.
- RG5) prevent further operation of relay PG.
- RG6)
- RG7 holds relay RG on its second winding.

Relay ST releasing,
ST1 is ineffective at this stage.
ST2 prevents an operating circuit for relay IS on cleardown when relay RG releases.
ST3 homes the pulse sender PS.
ST7 removes the short circuit from contact B5.
ST8 leaves relay STA held by contact IS6.

Other ST contacts are ineffective at this stage.

The pulse sender self drives to its home contact.

Relay IS releasing slowly at contact RG2,
IS1 is ineffective at this stage.
IS2 operates the regenerator Transmit Element see paragraph 3.3.2.7 below).
IS3 is ineffective at this stage.
IS4) disconnect the short circuits from the secondary windings of
IS5) transformer T1.
IS6 disconnects the holding circuit for relay STA which is held on the subsequent operation of contact DK3.
IS7 is ineffective at this stage.

The relay-set now transmits the digit(s) stored in the regenerator.

3.3.2.7 Regenerator transmits stored digits

The pulse sender having transmitted the predetermined digits, the trains of pulses stored in the regenerator are now transmitted when contact IS2 above operates and subsequently releases Transmit Element.

Operation of the regenerator Transmit Element removes the earth from regenerator U point 5 and allows relay DK to operate.

Relay DK operating slowly (see Design Details),
DK1 disconnects the supervisory lamp, (Fig. 5 mechanical regenerator).
DK2 operates relay IS.
DK3 holds relay STA.

Relay IS operating,
IS1 is ineffective at this stage.
IS2 releases the Transmit Element.
IS3 is ineffective at this stage.
IS4) short-circuit the secondary windings of transformer T1.
IS5)
IS6 holds relay STA independently of contact DK3.
IS7 is ineffective at this stage.

Transmit Element releasing, transmits 67% break loop disconnect pulses, to release and re-operate relay PU, from regenerator U points 6 and 12. Earth pulses are also transmitted to the 600 ohm winding of relay DK.

Transmit Element Output release of the Transmit Element connects earth from regenerator U point 5 to relay DK to short circuit it. Relay DK holds during pulse transmission due to the earth pulses from regenerator U point 2.

Relay PU releasing,
PU1 is ineffective at this stage.
PU2 reverses the direction of the loop current flowing in the line giving a break pulse to the distant incoming selector.

Relay PU operating,
PU1 is ineffective at this stage.
PU2 reverses the direction of the loop current in the line to terminate the break pulse to the distant incoming selector.

The remainder of the pulse train is transmitted as above. At the end of the pulse train earth is removed from regenerator U point 2 allowing relay DK to release.

Relay DK releasing slowly,
DK1 is ineffective at this stage.
DK2 releases relay IS.
DK3 leaves relay STA held by contact IS6.

Relay IS releasing slowly,
IS2 operates the Transmit Element.
IS4) disconnect the short-circuits from the secondary windings of
IS5) transformer T1.
IS6 releases relay STA.

Other IS contacts are ineffective at this stage.

Relay STA releasing slowly,
STA1) short circuit capacitors C9 and C10 (see Design Details).
STA2)
STA4 operates relay J.

Relay J operating,
J1 is ineffective at this stage.
J2 holds relay J independently of contact D1.
J3 prepares the operating circuit for relay DD.

The preceding circuit operation is repeated for each transmission of a stored pulse train. During long intertrain pauses of the subscriber's dial relay BY may release when the regenerator is empty as the earths on regenerator U points 3 and 8 disappear until a subsequent train of pulses is received when relay BY is re-operated and retransmission of the pulse train commences.

When the final pulse train has been transmitted, the off normal earth is removed from regenerator U point 8, the Mark Element earth is removed from regenerator U point 3 and relay BY releases.

Relay BY releasing,
BY1 prepares the testing-in battery circuit.
BY2 is ineffective at this stage.
BY3 disconnects battery from the regenerator U point 5 and relay DK.
BY4 disconnects the release alarm earth (Fig. 3 Mechanical Regenerator) or earth (Fig. 4 Electronic Regenerator) from the Transmit Element, and supervisory lamp element (Fig. 5). Contact BY4 also releases relay IS.

Relay DK releasing at the regenerator U point 2.
DK3 leaves relay STA held by contact IS6.

Other DK contacts are ineffective at this stage.

Relay IS releasing slowly at contact BY4,
IS4) disconnect the short-circuits from the secondary
IS5) windings of transformer T1.
IS6 releases relay STA.

Other IS contacts are ineffective at this stage.

The release of relay STA and operation of relay J is identical to that described above.

3.3.2.8 Called subscriber answers

Relays held at this stage:- A, B, BA, BB, BC, BD, H, HX, DB, J, RG and PU.

When the called subscriber answers, the distant incoming relay-set connects an earth pulse to line as an answering signal. This completes a circuit for an earth current to flow in the 3-1 winding of relay D which causes contact D1 to change over.

Contact D1 changing over,
spring 12, breaking contact with spring 11 and making contact with spring 10, operates relay DD.

Relay DD operating slowly (see Design Details),
DD1 connects earth to the P wire to hold the relay-set during the meter pulse cycle should the calling party flash or clear and release relay B at this stage.
DD2 connects the metering condition to the M wire.
DD3 releases relay J.
DD4 holds relay DD independently of contact D1 to prevent release of that relay should the called party flash at this stage.
DD5 operates relay CO.
DD6 operates relay DA.
DD7 removes the short circuit from one winding of relay DD.

Relay DA operating,
DA1 disconnects contact CA1 from the operate circuit of relay DD to ensure that should the calling party clear in face of a subsequent meter pulse, the operate circuit for relay DD is not disconnected at contact CA1.
DA2 holds relay BA independently of contact B4 (see Design Details).
DA3 holds relay DA independently of contact DD6.
DA4) render the line signalling conditions independent
DA5) of contact PU2. Contact DA4 also disconnects earth from resistor R15 to reduce current drain.
DA6 holds relay DB (see Design Details relay DB).

Relay CO operating,
CO1 prevents flashing of contact A1 operating the Receive Element.
CO2 further disconnects the testing-in battery circuit.
CO3 holds relay CO.
CO4 prevents subsequent operation of contact CD1 operating the Mark Element.
CO7 short circuits the 200 ohm winding of relay WS (see Design Details).

Other CO contacts are ineffective at this stage.

At the end of the metering period, earth is disconnected from line by the distant incoming relay-set. The earth current is thus replaced by a loop current and causes contact D1 to change over.

Contact D1 changing over,
spring 12 breaking contact with spring 10 leaves relay DD held under the control of contact J2, and making with spring 11 prepares the reoperate circuit for relay J.

Relay J releasing slowly at contact DD3,
J1 is ineffective at this stage.
J2 releases relay DD.
J3 disconnects the relay DD operating circuit (see Design Details).

Relay DD releasing,
DD1 disconnects an earth from the P wire.
DD2 disconnects the metering condition from the M wire.
DD3 reoperates relay J to earth at contact D1.
DD4 prepares a hold circuit for relay J independently of contact D1.
DD5) DD6) are ineffective at this stage.
DD7 restores the short-circuit to one winding of relay DD.

Relay J operating,
J1 is ineffective at this stage.
J2 prepares a locking circuit for relay DD.
J3 prepares the reoperate circuit for relay DD.

Answer conditions are now set up and the circuit is prepared for the receipt of further meter pulses.

3.3.2.9 Level 0 call from a CCB (pay on answer) subscriber

The circuit description is similar to that described in the previous paragraphs except that relay CB is operated on seizure by negative battery extended via the M wire.

Relay CB operating,
CB1 is ineffective at this stage (see paragraph 3.3.3.13).
CB2 in a UAX No. 12 changes over the metering condition from battery to earth.
CB3 holds relay CB to earth at contact BD2.
CB4 is ineffective at this stage (see paragraph 3.3.3.13).
CB5 is ineffective at this stage (see paragraph 3.3.4).
CB6 changes over the pulse sender control arc from PS5 to PS6. Where the group switching centre requires CCB discrimination an alternative identifying code will be transmitted. See the pulse sender strapping schedule of the diagram.
CB7 is ineffective on calls from level 0.

3.3.2.10 Release from an answered call (working in conjunction with a junction hunter)

Relays held at this stage:- A, B, BA, BB, BC, BD, H, HX, DB, J, RG, CO, PU and DA.

The disconnexion of the loop from the incoming negative and positive wires when the calling party clears releases relay A.

Relay A releasing,
A1 releases relay B and operates relay CD.
A2 is ineffective at this stage.

Relay CD operating,
CD1 is ineffective at this stage.
CD2 operates relay CA.

Relay CA operating,

All CA contacts are ineffective at this stage.

Relay B releasing slowly at contact A1,
B1 prevents the operation of relay B (short circuit via contacts MH1 and CO1) should the calling party recall at this stage.
B2 prepares to connect the testing-in battery to the P wire and releases the preceding selector.
B3 is ineffective at this stage.
B4 releases relay DA.
B5 releases relay PU.
B6 is ineffective at this stage.

Relay PU releasing,
PU1 is ineffective at this stage.
PU2 prepares to connect earth to the outgoing negative wire.

Relay DA releasing,
DA1 is ineffective at this stage.
DA2 releases relay BA.
DA3 is ineffective at this stage.
DA4) restore the normal potentials to the outgoing negative and
DA5) positive wires to provide a forward clearing signal to the distant incoming relay-set.
DA6 transfers the hold circuit for relay DB to contact D1.

Relay BA releasing slowly,
BA2 holds relay CO independently of contact BD2.
BA3 releases relay BD.
BA5 disconnects arc PS3 from the PS drive magnet (see Design Details).
BA7 disconnects the relay ST operating circuit (see Design Details).

Other BA contacts are ineffective at this stage.

Relay BD releasing slowly,
BD1 releases relay CD.
BD2 is ineffective at this stage.
BD3 disconnects an operating circuit for relay MH (see Design Details).
BD4 is ineffective at this stage.
BD5 releases relays RG and BB.

Relay RG releasing,

All contacts of this relay are ineffective at this stage.

Relay CD releasing slowly at contact BD1,
CD1 ensures the Mark Element is not operated when relay CO releases.
CD2 releases relay CA.

Relay BB releasing at contact BD5,
BB1 connects relay CB to the M wire.
BB2 is ineffective at this stage.
BB3 releases relay CO.
BB4 releases relay BC.
BB5 disconnects earth at contact PU2 from battery at resistor R16.
BB6) are ineffective at this stage.
BB7)
BB8 releases relay J.

Relay CO releasing slowly,
CO1 disconnects the short circuit from relay B.
CO2 prepares to connect the testing-in battery to the P wire.
CO6 restores relay EF to the M wire.

Other CO contacts are ineffective at this stage.

Relay CA releasing slowly at contact CD1,

All CA contacts are ineffective at this stage.

Relay BC releasing slowly at contact BB4,
BC3 connects earth to the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.
BC5 releases relays H and HX and prepares the homing circuit for the junction hunter.
BC6 releases relay SK in the associated level 9 relay-set.
BC7 disconnects the negative wire.

Other BC contacts are ineffective at this stage.

Relay HX releasing,
HX1 prepares the uniselector JH homing circuit.

Relay H releasing,
H1) are ineffective at this stage.
H2)
H3) self drive the junction hunter to its home position.
H4)
H5 is ineffective at this stage.
H6 disconnects the outgoing positive wire from, and connects earth to the 6 to 4 winding of relay D. This earth current flowing from tag 6 to tag 4 of the line winding or relay D causes contact D1 to change over.
H7 is ineffective at this stage.

Relay J releasing slowly at contact BB8,
J1 prepares to connect the testing-in battery to the P wire.

Other J contacts are ineffective at this stage.

Contact D1 changing over (see contact H6 above),
spring 12 breaking with spring 11 releases relay DB.

Relay DB releasing,
DB1 prepares to connect the testing-in battery to the P wire.
DB2 disconnects earth from the release relay.
DB3) are ineffective at this stage.
DB4)
DB5 disconnects earth from the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.

Uniselector JH on a home contact (see contacts H3 and H4 above),
wiper JH5 restores the testing-in battery to the P wire.

All other wipers are ineffective at this stage.

All relays have now released and the relay-set is free to accept a further call.

3.3.2.11 Release from an answered call (junction hunter not provided

When the relay-set is connected directly to a junction, contacts BC7, H5, H6 and HX1 are short-circuited, the junction hunter is not provided, and the strap between resistor R18 and contact H6 is not fitted.

The cleardown of the relay-set is similar to that described in paragraph 3.3.2.10 except that the contacts mentioned above are ineffective during the call and relay D changes over when the equipment at the GSC has completely cleared down.

Relays D and DB function as described in paragraph 3.3.2.10 except that contact DB1 connects the testing-in battery to the P wire.

3.3.3 Level 1 call (assistance and manual board services) from ordinary and CCB (pay on answer type) subscribers

3.3.3.1 Seizure

The relay-set is seized by a loop extended via the selector level 1 to operate relay A. Relay WS also operates or partially operates, via one winding. Should the relay only partially operate, the early make contact WS2 fully operates the relay when contact B3 operates. For a CCB subscriber, relay CB will also operate to the battery on the M wire (see also section 3.3.3.13).

Relay A operating,
A1 operates relay B and prepares to short-circuit relay CD independently of earth at contact BD1.
A2 prepares a circuit for stepping the PS magnet.

Relay B operating,
B1 holds relay B independently of contact A1.
B2 disconnects the testing-in battery from, and connects earth to, the P wire.
B3 fully operates relay WS and holds the relay independently of its operate winding.
B4 operates relay BA.
B5 operates relay PU.
B6 prepares an operate circuit for relay CD.

Relay PU operating,

PU1 connects the start condition to the alarm delay equipment via relay TP.

PU2 prepares to connect reversed polarity to the outgoing negative and positive wires.

Relay WS operating,

WS1 prepares to connect earth to the P wire should manual hold conditions be subsequently set up.

WS2 operates relay WA.

WS3 prepares the coin and fee checking signalling circuit.

WS4 ensures that relay J is not held by contact D1 and prepares the operating circuit for relay J.

WS5 ensures that relay DD cannot operate until relay DB releases on calls where an answering supervisory signal is received.

Relay BA operating at contact B4,

BA1 short circuits resistor R1 to prepare the pulsing circuit to the Receive Element.

BA2 operates the release relay which provides the release alarm earth to this relay-set.

BA3 operates relay BD.

BA4 prepares the circuit for the Transmit Element.

BA5 prepares the circuit for stepping the PS magnet.

BA6 prevents a premature homing circuit for the pulse sender.

BA7 prepares the operating circuit for relay ST.

Relay WA operating at contact WS2,

WA1 short circuits the operate winding of relay WS.

WA2 makes the control of the junction hunter start circuit (the operation of relay BC) dependent on the operation of contact DC1 (allowed code dialled).

WA3 disconnects relay IP from contact BD5.

WA4 ensures relay IS is only operated by contact IP1.

WA5 prepares to connect earth to the PS3 wiper.

WA6) change over the pulse sender control PS7 and PS8 arcs from
WA7) level 0 to level 1 routing digits.

Relay BD operating at contact BA3.

BD1 prepares the operating circuit for relay CD.

BD2 prepares hold circuits for relays WA, WS, CO and EF independently of contact B3.

BD3)
BD4) are ineffective at this stage.

BD5 connects earth to the PS3 wiper, prepares the operating circuit for relay BB and operates relay STA.

Relay STA operating,

STA1) connect capacitors C9 and C10 across the secondary windings of
STA2) transformer T1.

STA4 prevents a premature operating circuit for relay J.

3.3.3.2 Dialling, digit discrimination and digit storage

Relay A responds to the loop-disconnect pulses received on the incoming negative and positive wires.

Relay A pulsing,

A1 short-circuits relay B which holds during pulsing and operates relay CD. Contact A1 also pulses the Receive Element.

A2 pulses the PS magnet whose wipers are stepped to the appropriate bank outlet.

Relay CD operating,
CD1 operates the Mark Element.
CD2 operates relay CA.
CD3 see Design Details.

Operation of the Mark Element, see contact CD1 above, removes the Mark Element earth from U point 3 and prevents operation of relay BY.

Relay CA operating at contact CD2,
CA1 is ineffective at this stage.
CA2 operates relay BB.
CA3 disconnects earth from the PS3 wiper.

Relay BB operating,
BB1 is ineffective at this stage.
BB2 disconnects the start condition from the alarm delay equipment.
BB3 is ineffective at this stage.
BB4 prepares the operating circuit for relay BC.
BB5) connects reversed polarity to the outgoing negative and positive
BB6) wires. Where a junction hunter is fitted, contact BB6 in short-circuiting resistor R15 causes relay D to changeover under control of its bias winding. Where a junction hunter is not fitted, contact D1 is held with spring 12 in contact with spring 10 by the current in its 3-1 winding opposing and exceeding that in the bias winding, until the distant incoming relay-set is seized.
BB7 holds relay BB.
BB8 prepares the operating circuit for relay J.

Contact D1 changing over,
spring 12 making contact with spring 11 operates relay DB.

Relay DB operating,
DB1)
DB2) are ineffective at this stage.
DB3)
DB4 prevents a premature operating circuit for relay DD on calls where an answering supervisory signal is received.
DB5 connects earth to the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.

Relay A operating and releasing to the dialled pulses steps the wipers of uniselector PS to an outlet corresponding to the digit dialled.

Similarly, the regenerator Receive Element is pulsed to store the digit dialled in readiness for its transmission if the call is allowed.

Whilst pulses are being stored in the regenerator an earth appears on regenerator U point 8, but is ineffective at this stage. Relays B and CD remain operated during the pulse train.

At the end of the pulse train relay CD releases.

3.3.3.3 Reception of a barred code

The outlets of arcs PS3 and PS4 corresponding to a barred digit are wired to the EF terminal.

At the end of the pulse train relay CD releases.

Relay CD releasing,
- CD1 releases the Mark Element.
- CD2 releases relay CA.
- CD3 see Design Details.

On release of the regenerator Mark Element earth appears on regenerator U point 3 and relay BY operates.

Relay BY operating,
- BY1 disconnects the testing in battery.
- BY2 holds relay BY independently of the earth from regenerator U point 3.
- BY3 prepares the operating circuit for relay DK.
- BY4 prepares a circuit to connect the release alarm earth (Fig. 3 Mechanical Regenerator) or earth (Fig. 4 Electronic Regenerator) to the regenerator Transmit Element.

Relay CA releasing,
- CA1) CA2) are ineffective at this stage.
- CA3 connects earth at contact BD5 via contacts DC4, H2, WA5 to arc PS3 to operate relay EF.

Relay EF operating,
- EF1 connects the start condition to the alarm delay equipment via relay TP.
- EF2 operates relay CO.
- EF3 prevents the operation of relay BC.
- EF4 connects NU tone to the calling party.
- EF5 disconnects the operating circuit of the PS magnet.
- EF6 is ineffective at this stage.
- EF7 holds relay EF to earth at contact BD2.

Relay CO operating,
- CO1 prevents subsequent pulses from contact A1 stepping the regenerator.
- CO2 further disconnects the testing-in battery circuit.
- CO3 holds relay CO to earth at contact BD2.

Other CO contacts are ineffective at this stage.

The relay-set remains in this condition until the calling party clears or until it is forced released under control of the alarm delay equipment (see paragraph 3.3.7.3).

3.3.3.4 Reception of a permitted code

The outlets of arcs PS3 and PS4 corresponding to a permitted digit are wired to the DC terminal.

At the end of the pulse train, relay CD releases.

Relay CD releasing,
- CD1 releases the Mark Element.
- CD2 releases relay CA.
- CD3 see Design Details.

On release of the regenerator Mark Element earth appears on regenerator U point 3 and relay BY operates.

Relay BY operating,

BY1 ensures the testing-in battery is not connected to the P wire if the regenerator fails to restore to normal.

BY2 holds relay BY.

BY3 prepares the operating circuit for relay DK.

BY4 extends the release alarm earth (Fig. 3 Mechanical Regenerator) or earth (Fig. 4 Electronic Regenerator) to the regenerator Transmit Element.

Relay CA releasing at contact CD2,

CA1)
CA2) are ineffective at this stage.

CA3 connects earth at contact BD5 via contacts DC4, H2, WA5 to wiper PS3 to operate relay DC.

Relay DC operating,

DC1 operates relay BC.

DC2 holds relay DC while the pulse sender uniselector is off normal.

DC3 completes the homing circuit for the pulse sender.

DC4 disconnects the operate circuit for relay DC and prevents an operate circuit for relay ST should contact H2 operate before the pulse sender homes.

DC5 holds relay DC when the pulse sender has homed.

DC6 prevents a false operating circuit for relay EF (see Design Details).

Relay BC operating,

BC1 connects earth to the P wire should manual hold conditions be subsequently set up.

BC2 prepares the holding circuit for relay CD.

BC3 holds relay BC independently of the earth at contact EF3 and disconnects earth from the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.

BC4 is ineffective at this stage unless all junctions are subsequently found to be engaged.

BC5 connects earth to the junction hunter drive magnet to self-drive the uniselector to a free outlet. Where the junction hunter is not required, contact BC5 operates relays H and HX.

BC6 prepares the operating circuit for relay HX where the junction hunter is required.

BC7 prepares the outgoing negative wire circuit.

The junction hunter steps until a free outlet is found or until the wipers step to outlet 12 or 25 (outlet 25 if the availability is 20).

3.3.3.5 Junction free

Relay HX operates to the testing-in battery of the junction equipment.

Relay HX operating,

HX1 disconnects the junction hunter drive circuit and operates relay H.

Relay H operating,
H1 is ineffective at this stage.
H2 prepares the operating circuit for relay ST.
H3) disconnect the junction hunter homing circuit.
H4)
H5 connects the outgoing negative wire to the junction.
H6 disconnects earth at resistor R18 from relay D and connects relay D to the outgoing positive wire of the junction.
H7 releases relay DC, prepares the hold circuit for relay RG and disconnects the original operating circuit for relay STA which holds on the subsequent operation of contact ST8.

Relay DC releasing,
DC4 operates relay ST.

Other DC contacts are ineffective at this stage.

The operation of contacts H5 and H6 above also connect a reversed polarity to the outgoing negative and positive wires to seize the distant incoming relay-set while the operation of contact H6 in disconnecting the earth at resistor R18 replaces it by the signalling earth on the outgoing positive and negative wires maintained by the distant incoming relay-set. Relay D changes over as a current now flows in the 3-1 winding while the distant incoming relay-set is being seized.

Contact D1 changing over,
spring 12 breaking contact with spring 11 and making contact with spring 10 disconnects the hold circuit for relay DB (see Design Details - relay DB).

The complete seizure of the incoming relay-set brings about the disconnexion of the signalling earth. As an earth current no longer flows, the current in the 7-9 bias winding of relay D causes contact D1 to change over.

Contact D1 changing over,
spring 12 making contact with spring 11 holds relay DB.

3.3.3.6 Pulse sending

Relay ST operating at contact DC4,
ST1 is ineffective at this stage.
ST2 operates relay IP.
ST3 disconnects the pulse sender homing circuit.
ST4 energizes relay PG and connects earth to PS7 wiper to prevent the pulsing of relay PU when contact PG2 subsequently pulses. This provides a seizure time for the distant equipment during the first two pulses of the pulse sender.
ST5 holds relay ST independently of contact IS3.
ST6 disconnects the pulse sender wipers PS3 or PS4 during the pulsing period.
ST7 is ineffective at this stage.
ST8 holds relay STA (previously disconnected by contact H7 operating).

Relay IP operating,
IP1 operates relay IS.

Relay IS operating,
- IS2 prevents the premature operation of the Transmit Element.
- IS4) connect short-circuits across the secondary windings
- IS5) of transformer T1.
- IS6 holds relay STA independently of contact ST8.

Other IS contacts are ineffective at this stage.

Relay PG operating slowly at contact ST4,
- PG1 disconnects relay PG and operates the PS magnet.
- PG2 is ineffective at this stage as it is short circuited by the earth from the PS7 wiper via the IT terminal.

Relay PG releasing slowly,
- PG1 energizes relay PG and releases magnet PS.
- PG2 is ineffective at this stage.

The pulse sender wipers step under the control of relay PG but no pulses are transmitted to line while the sender is stepping over the first two contacts. On stepping off contact 2 on to contact 3, earth from contact ST4 via wiper PS7 is disconnected as the next outlet has been left disconnected.

Relay PG operating slowly,
- PG1 disconnects relay PG and operates the PS magnet.
- PG2 releases relay PU.

Relay PU releasing,
- PU1 is ineffective at this stage.
- PU2 reverses the direction of the loop current flowing in the line giving a break pulse to the distant incoming selector.

Relay PG releasing slowly,
- PG1 energizes relay PG and steps the PS wipers to the next outlet.
- PG2 operates relay PU.

Relay PU operating,
- PU1 is ineffective at this stage.
- PU2 reverses the direction of the loop current flowing in the line to terminate the first break pulse to the distant incoming selector.

Relay PG and PU functioning as described above transmit the pre-determined digits to line.

After the routing code has been transmitted, the next wired bank outlet operates relay RG from earth at contact ST4 via contacts CB6, WA6 and the pulse sender wiper PS7.

Relay RG operating,
- RG1 prepares to operate the Transmit Element.
- RG2 releases relay IP.
- RG3 prepares to home the pulse sender.
- RG4 releases relay ST.
- RG5) prevent further operation or
- RG6) relay PG.
- RG7 holds relay RG on its second winding.

Relay ST releasing slowly,
ST2 prevents an operating circuit for relay IP on cleardown when relay RG releases.
ST3 homes the pulse sender.
ST4 disconnects the operating circuit for relay RG.
ST7 removes the short circuit from contact B5.
ST8 leaves relay STA held by contact IS6.

Other ST contacts are ineffective at this stage.

The pulse sender self-drives to its home contact.

Relay IP releasing slowly at contact RG2,
IP1 releases relay IS.

Relay IS releasing slowly,
IS2 operates the Transmit Element.
IS4) remove the short-circuits from the secondary windings of
IS5) transformer T1.
IS6 disconnects the hold circuit for relay STA which is held by the subsequent operation of contact DK3.

Other IS contacts are ineffective at this stage.

The relay-set now transmits the digit(s) stored in the regenerator.

3.3.3.7 Regenerator transmits stored digits

Relay PU, having transmitted the predetermined pulse sender digits, now transmits the digits stored in the regenerator under the control of the regenerator. Contact IS2 releasing operates the Transmit Element. Operation of the regenerator Transmit Element removes the earth from regenerator U point 5 and allows relay DK to operate.

Relay DK operating,
DK1 disconnects the supervisory lamp (Fig. 5 Mechanical Regenerator).
DK2 reoperates relay IP.
DK3 holds relay STA.

Relay IP operating,
IP1 operates relay IS.

Relay IS operating,
IS2 releases the Transmit Element.
IS4) short circuit the secondary windings of transformer T1.
IS5)
IS6 leaves relay STA held by contact DK3.

Other IS contacts are ineffective at this stage.

Transmit Element releasing, transmits 67% break loop disconnect pulses to release and reoperate relay PU, from regenerator U points 6 and 12. Earth pulses are also transmitted to the 600 ohm winding of relay DK.

Transmit Element Output release of the Transmit Element connects earth from regenerator U point 5 to relay DK to short-circuit it. Relay DK holds during pulse transmission due to the earth pulses from regenerator U point 2.

Relay PU releasing,
PU1 is ineffective at this stage.
PU2 reverses the direction of the loop current flowing in the line giving a break pulse to the distant incoming relay-set.

Relay PU operating,
PU1 is ineffective at this stage.
PU2 reverses the direction of the loop current in the line to terminate the break pulse to the distant incoming relay-set.

The remainder of the pulse train is transmitted as above. At the end of the pulse train earth is removed from regenerator U point 2 allowing relay DK to release.

Relay DK releasing slowly,
DK1 is ineffective at this stage.
DK2 releases relay IP.
DK3 leaves relay STA held by contact IS6.

Relay IP releasing slowly,
IP1 releases relay IS.

Relay IS releasing slowly,
IS2 operates the Transmit Element.
IS4) disconnect the short-circuits from the secondary windings
IS5) of transformer T1.
IS6 releases relay STA.

Other IS contacts are ineffective at this stage.

Relay STA releasing slowly (see Design Details),
STA1) disconnect capacitors C9 and C10 from the secondary windings
STA2) of transformer T1.
STA4 operates relay J.

Relay J operating,
J1 is ineffective at this stage.
J2 holds relay J via contacts DD3 and DD4.
J3 prepares the operating circuit for relay DD where the metering facility is required.

The preceding circuit operation is repeated for each transmission of a stored pulse. During long inter-train pauses of the subscriber's dial relay BY may release when the regenerator is empty as the earths on regenerator U points 3 and 8 disappear until a subsequent train is received when relay BY is operated and transmission of the pulse train commences.

When the final train has been transmitted, the off normal earth is removed from regenerator U points 3 and 8, relay BY releases, also the earth is removed from regenerator U point 2 and relay DK is released.

Relay BY releasing,
BY1 prepares the testing-in battery circuit.
BY2 is ineffective at this stage.
BY3 disconnects battery from the regenerator U point 5.
BY4 releases relay IP.

Relay DK releasing,

All DK contacts are ineffective at this stage.

Relay IP releasing slowly at contact BY4,
IP1 releases relay IS.

Relay IS releasing slowly,
IS4) disconnect the short-circuits from the secondary windings of
IS5) of transformer T1.
IS6 releases relay STA.

Other IS contacts are ineffective at this stage.

The circuit description of the release of relay STA and the operation of relay J is identical to that described above.

3.3.3.8 Operator answers (See also paragraph 3.3.3.13)

Relays held at this stage:- A, B, BA, BB, BC, BD, H, HX, DB, J, RG, PU, WA and WS.

When the operator answers, the distant incoming relay-set connects a coin and fee checking signalling pulse of negative battery to line. This completes a circuit for an earth current to flow in the 4-6 winding of relay FC which causes contact FC1 to change over. Relay D remains unaffected.

Contact FC1 changing over,
spring 12 making contact with spring 11 operates relay CO.

Relay CO operating,
CO1 prevents any subsequent flashing of contact A1 from operating the Receive Element.
CO2 further disconnects the testing-in battery circuit.
CO3 holds relay CO.
CO4 prevents any subsequent operation of contact CD1 energizing the Mark Element.
CO5) are ineffective at this stage.
CO6)

When the coin and fee checking signal is disconnected from the outgoing line by the distant incoming relay-set, the earth current no longer flows and the bias winding of relay FC causes contact FC1 to change over. Relay D remains unaffected.

Contact FC1 changing over,
spring 12 breaking contact from spring 11 is ineffective at this stage.

3.3.3.9 Manual hold

Relays held prior to manual hold:- A, B, BA, BB, BC, BD, CO, H, HX, DB, J, RG, WA, WS and PU.

When the calling party clears, the loop is disconnected from the incoming negative and positive wires to release relay A.

Relay A releasing,
A1 releases relay B and operates relay CD.
A2 is ineffective at this stage.

Relay CD operating,
CD1 is ineffective at this stage.
CD2 operates relay CA.

Relay CA operating,
CA1 prevents false operation of relay DD and prepares the operating circuit for relay MH when contact D1 subsequently changes over.

Other CA contacts are ineffective at this stage.

Relay B releasing,
B2 leaves the holding earth to the preceding selector maintained by contact BC1.
B4 releases relay BA.
B5 releases relay PU.
B6 leaves relay CD holding to contact BC2.

Other B contacts are ineffective at this stage.

Relay PU releasing,
PU1 is ineffective at this stage.
PU2 reverses the outgoing line polarity to release relay A in the distant incoming relay-set.

Relay BA releasing slowly at contact B4,
BA3 disconnects the operate circuit for relay BD and prepares the operating circuit for relay MH.

Other BA contacts are ineffective at this stage.

A manual hold condition is now established in the distant incoming relay-set which connects a signalling earth to the line. This completes a circuit for an earth current to flow in the 6-4 winding of relay D which causes contact D1 to change over.

Contact D1 changing over,
spring 12 breaking contact with spring 11 and making contact with spring 10 holds relay BD and operates relay MH. Relay BD in holding, holds relays BB and BC so preventing cleardown of the relay-set and preceding selector train.

Relay MH operating,
MH1 removes the short circuit from relay B in preparation for a subsequent recall condition if required.
MH2 releases relay CD and prepares the circuit for operating relay B should the calling party recall.
MH3 holds relay DB.
MH4 holds relay CA independently of contact CD2.

Relay CD releasing,

All CD contacts are ineffective at this stage.

Manual hold conditions have now been established and the relay-set remains in this condition until either the calling party recalls or the operator clears down the connexion.

3.3.3.10 Recall from manual hold

The loop reconnected to the incoming negative and positive wires when the calling party recalls, operates relay A.

Relay A operating,
A1 operates relay B.
A2 is ineffective at this stage.

Relay B operating,
B1 holds relay B independently of contact A1.
B4 operates relay BA.
B5 operates relay PU.

Other B contacts are ineffective at this stage.

Relay PU operating,
PU1 is ineffective at this stage.
PU2 connects a reversal of polarity to the outgoing negative and positive wires.

Relay BA operating at contact B4,
BA3 releases relay MH and holds relay BD independently of contact D1.

Other BA contacts are ineffective at this stage.

The operation of contact PU2 brings about the disconnexion of the manual hold signal by the incoming relay-set.

On the disconnexion of earth by the distant equipment, the earth current no longer flows in the line winding of relay D and hence the current in the 7-9 bias winding causes relay D to change over.

Contact D1 changing over,
spring 12 breaking contact with spring 10 and making contact with spring 11 leaves relay BD holding to earth at contact BA3 and holds relay DB independently of contact MH3.

Relay MH releasing slowly at contact BA3,
MH1 prepares a short circuit path for relay B.
MH2 prepares an operating circuit for relay CD.
MH3 leaves relay DB holding to earth at contact D1.
MH4 releases relay CA.

Relay CA releasing,

All CA contacts are ineffective at this stage.

3.3.3.11 Operator clears from manual hold

Relays held at this stage:- BB, BC, BD, H, HX, DB, J, RG, WA, WS, CO, CA and MH.

The operator clearing results in the disconnexion of the signalling earth from line by the distant incoming relay-set. As an earth current no longer flows, the current in the bias winding of relay D causes contact D1 to change over.

Contact D1 changing over,
spring 12 breaking contact with spring 10 and making contact with spring 11 releases relays MH and BD and holds relay DB.

Relay BD releasing,
BD1 prevents the operation of relay CD when contact MH2 releases.
BD2 is ineffective at this stage.
BD3 disconnects the operating circuit for relay MH to prevent its reoperation should contact D1 change over before relay J releases.
BD4 is ineffective at this stage.
BD5 releases relays RG and BB.

Relay MH releasing at contact D1,
MH1)
MH2) are ineffective at this stage.
MH3 leaves relay DB holding to earth at contact D1.
MH4 releases relay CA.

Relay RG releasing at contact BD5,

All RG contacts are ineffective at this stage.

Relay CA releasing at contact MH3,

All contacts are ineffective at this stage.

Relay BB releasing at contact BD5,
BB1 restores relay CB to the M wire.
BB3 releases relays CO, WA and WS.
BB4 releases relay BC.
BB8 releases relay J.

Other BB contacts are ineffective at this stage.

Relay CO releasing,
CO2 prepares to connect the testing-in battery to the P wire.
CO6 connects relay EF to the M wire.

Other CO contacts are ineffective at this stage.

Relay WA releasing at contact BB3,

All WA contacts are ineffective at this stage.

Relay WS releasing at contact BB3,
WS1 disconnects earth from the P wire to release the preceding selector.

All other WS contacts are ineffective at this stage.

Relay BC releasing at contact BB4,
BC3 connects earth to the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.
BC5 releases relays H and HX.
BC6 releases relay SK in the associated level 9 relay-set (if junction hunter is used).
BC7 disconnects the outgoing negative wire.

Other BC contacts are ineffective at this stage.

The release of relays J, H, HX and BC and the changeover of contact D1 and release of relay DB is identical to that described in paragraph 3.3.2.10 commencing with the release of relay J.

3.3.3.12 Level 1 call to service requiring single fee metering

The "Seizure" of the relay-set, "Dialling", "Reception of a permitted code", "Junction hunting", "Pulse sending" and "Regenerator transmitting stored digits" is identical to that described in previous paragraphs commencing with paragraph 3.3.3.1.

Relays held prior to the receipt of the answering supervisory signal:- A, B, BA, BB, BC, BD, H, HX, DB, J, RG, PU, WA and WS.

When the distant incoming equipment switches to the service requiring the single fee metering facility, the distant incoming relay-set connects earth to line as an answering signal. This completes a circuit for an earth current to flow in the 3-1 winding of relay D which causes contact D1 to change over.

Contact D1 changing over,
spring 12 breaking contact with spring 11 and making contact with spring 10 releases relay DB and prepares the operating circuit for relay DD.

Relay DB releasing slowly (see Design Details),
DB1)
DB2) are ineffective at this stage.
DB3)
DB4 operates relay DD.

Relay DD operating slowly,
DD1 connects earth to the P wire to hold the relay-set during the meter pulse should the calling party flash or clear at this stage.
DD2 connects a metering condition to the M wire.
DD3 releases relay J.
DD4 holds relay DD independently of contact D1 to prevent release of that relay should the called party flash at this stage.
DD5 operates relay CO.
DD6 operates relay DA.
DD7 removes the short circuit from relay DD.

Relay DA operating,
DA1 is ineffective on level 1 single fee metering calls.
DA2 holds relay BA (see Design Details).
DA3 holds relay DA independently of contact DD6.
DA4) render the line signalling conditions independent of
DA5) contact PU2.
DA6 operates relay DB.

Relay CO operating at contact DD5,
CO1 prevents flashing of contact A1 stepping the uniselector.
CO2 further disconnects the testing-in battery.
CO3 holds relay CO.
CO4 prevents subsequent operation of contact CD1 operating the Mark Element.

Other CO contacts are ineffective at this stage.

Relay DB operating,
DB1 further disconnects the testing-in battery from the P wire.
DB2 connects earth to the release relay independently of contact BA2.

Other DB contacts are ineffective at this stage.

Relay J releasing slowly at contact DD3,
J1 prepares to connect the testing-in battery to the P wire.
J2 releases relay DD.
J3 is ineffective at this stage.

Relay DD releasing,
DD2 disconnects the metering condition from the M wire.

Other DD contacts are ineffective at this stage.

3.3.3.13 Level 1 call from a CCB subscriber

The circuit description is the same as that described in the previous paragraphs except that on seizure relay CB is operated by negative battery via the M wire.

Relay CB operating,
- CB1 is ineffective on this type of call.
- CB2 prepares the metering circuit.
- CB3 holds relay CB to earth at contact BD2.
- CB4 prepares an operate circuit for relay PB,
- CB5 is ineffective on this type of call.
- CB6 changes over the pulse sender control arcs from PS7 to PS8 (used where prepayment boxes are fitted, see pulse sender strapping schedule on diagram).
- CB7 changes over the pulse sender discriminating arcs from PS3 to PS4.

When the operator answers, the distant incoming relay-set connects a coin and fee checking signalling pulse of negative battery to line. This completes a circuit for an earth current to flow in the 4-6 winding of relay FC which causes contact FC1 to change over. Relay D remains unaffected.

Contact FC1 changing over,
spring 12 making contact with spring 11 operates relays CO and PB.

Relay PB operating,
- PB1 is ineffective.
- PB2 disconnects battery from the incoming negative wire.
- PB3 disconnects earth from, and connects positive battery to, the incoming positive wire to repeat, in conjunction with contact PB2, the coin and fee checking signal to the preceding coin and fee checking relay-set.
- PB4x holds relay A to prevent its release during repetition of the CFC signal.

The positive battery transmitted on the positive wire causes the preceding coin and fee checking relay-set to transmit pay tone to the operator thus indicating that the call originated from a call office. (This tone cannot be heard by the calling party).

When the coin and fee checking signal is disconnected from the outgoing line by the distant incoming relay-set, the earth current no longer flows and the bias winding of relay FC causes contact FC1 to change over. Relay D remains unaffected.

Contact FC1 changing over,
spring 12 breaking contact from spring 11 releases relay PB.

Relay PB releasing,
- PB1 is ineffective.
- PB2 restores battery to the incoming negative wire.
- PB3 disconnects positive battery from, and restores earth to, the incoming positive wire. This terminates the CFC signal to the preceding equipment.
- PB4x leaves relay A holding to the calling party's loop.

To remove the pay tone, the operator momentarily operates her ring key so transmitting another CFC signal as described above. On receipt of this signal the preceding CFC relay-set disconnects pay tone.

The operator now speaks to the calling party and when required the operator is able to open the coin slots in the call office coin-box by again sending a CFC signal as described above.

3.3.4 Assistance call by a CCB subscriber dialling "0" only where prepayment coin boxes are fitted (see Note 5 on diagram)

3.3.4.1 Seizure

Relay A operates to the calling party's loop via the group selector level 0 outlet. Relay CB operates via the M wire to negative battery.

Relay A operating,
- A1 operates relay B.
- A2 is ineffective on this type of call.

Relay CB operating via the M wire,
- CB1 prepares the circuit for connecting a manual hold earth to the P wire.
- CB2 is ineffective on this type of call.
- CB3 prepares to hold relay CB on its second winding and prepares to operate relay CO.
- CB4 prepares to operate relay PB.
- CB5 prepares to operate relay BB.
- CB6 changes over the pulse sender control arc from PS5 to PS6.
- CB7 is ineffective at this stage.

Relay B operating,
- B1 holds relay B independently of contact A1.
- B2 disconnects the testing-in battery from, and connects earth to, the incoming P wire.
- B3 holds relay CB on its second winding and operates relay CO via contact CB3.
- B4 operates relay BA.
- B5 operates relay PU.
- B6 prepares an operate circuit for relay CD.

Relay PU operating,
- PU1 connects the start condition to the alarm delay equipment via relay TP.
- PU2 prepares to connect reversed polarity to the outgoing negative and positive wires.

Relay BA operating at contact B4,
- BA2 operates the release relay.
- BA3 operates relay BD.
- BA6 prevents a premature homing circuit for the pulse sender.
- BA7 prepares the operate circuit for relay ST.

Other BA contacts are ineffective at this stage.

Relay CO operating to earth at contact B3 via contact CB3,
CO1 disconnects the pulsing circuit to the Receive Element.
CO2 further disconnects the testing-in battery circuit.
CO3 holds relay CO.
CO4 disconnects the operate circuit for the Mark Element.
CO5 is ineffective on this type of call.
CO6 disconnects relay EF from the M wire.

Relay BD operating at contact BA3,
BD1 prepares the operating circuit for relay CD.
BD2 holds relays CB and CO independently of contact B3.
BD3 prepares an operating circuit for relay MH and a holding circuit for relay BD when manual hold conditions are set up.
BD4 prepares the operating circuit for relay EF.
BD5 operates relay IP (via contacts H7, DC5 and WA3), relay BB via contact CB5 and relay STA via contact H7.

Relay STA operating,
STA1) connect capacitors C9 and C10 across the secondary windings
STA2) of transformer T1.
STA4 prevents a premature operating circuit for relay J.

Relay IP operating at contact BD5,
IP1 operates relay IS.

Relay IS operating,
IS1 is ineffective at this stage.
IS2 is ineffective on this type of call.
IS3 disconnects the operating circuit for relay ST.
IS4) short circuit the secondary windings of
IS5) transformer T1.
IS6 holds relay STA on its second winding.
IS7 is ineffective at this stage.

Relay BB operating at contact BD5,
BB1 leaves the hold circuit for relay CB dependent on contact CB3.
BB2 disconnects the start condition from the alarm delay equipment.
BB3 is ineffective at this stage.
BB4 operates relay BC.
BB5) connect reversed polarity to the outgoing negative and
BB6) positive wires. Where a junction hunter is fitted, contact BB6 in short circuiting resistor R15 causes relay D to change over. Where directly connected to line, relay D is held with spring 12 in contact with spring 10 by the current flowing in the 3-1 winding opposing and exceeding that in the bias winding, until the distant incoming relay-set is seized.
BB7 is ineffective at this stage.
BB8 prepares the operating circuit for relay J.

Contact D1 changing over spring 12 making contact with spring 11 operates relay DB.

Relay DB operating,

All DB contacts are ineffective at this stage.

Relay BC operating at contact BB4,
- BC1 connects earth to the P wire independently of contact B2.
- BC2 prepares the operating circuit for relay CD should manual hold conditions be subsequently established.
- BC3 holds relay BC independently of contact EF3.
- BC4 connects busy tone to contact EF4.
- BC5 completes the self drive circuit for the junction hunter drive magnet.
- BC6 connects one winding of relay HX to the outgoing P wire.
- BC7 prepares the outgoing negative wire circuit.

3.3.4.2 Junction free

With the operation of contact BC5 in the preceding paragraph, earth is connected to the junction hunter drive magnet via contact HX1 and the JHdm springs to start the JH uniselector hunting for a free outlet.

When the P wiper JH2 steps to a free outlet, relay HX operates to the testing-in battery of the junction.

Relay HX operating,
- HX1 cuts the drive circuit to the junction hunter magnet and operates relay H in series with the hold winding of relay HX.

Relay H operating,
- H1 is ineffective at this stage.
- H2 prepares the operating circuit for relay ST.
- H3) H4) disconnect the junction hunter homing circuit.
- H5 connects the outgoing negative wire to the junction.
- H6 disconnects earth at resistor R18 from relay D and connects relay D to the outgoing positive wire of the junction.
- H7 releases relay IP, prepares a hold circuit for relay RG and leaves relay STA held by contact IS6 on its second winding.

The operation of contacts H5 and H6 also connect a reversed polarity to the junction to seize the distant incoming relay-set, whilst the operation of contact H6 in disconnecting the earth at resistor R18 replaces it by the signalling earth on the outgoing positive and negative wires maintained by the distant incoming relay-set. Relay D changes over as a current now flows in the 3-1 winding whilst the distant incoming relay-set is being seized.

Contact D1 changing over,
spring 12 breaking contact with spring 11 disconnects the hold circuit for relay DB (see Design Details - relay DB).

The complete seizure of the incoming relay-set brings about the disconnexion of the signalling earth. As an earth current no longer flows, the current in the 7-9 bias winding of relay D causes contact D1 to change over.

Contact D1 changing over,
spring 12, breaking contact with spring 10 and making contact with spring 11 holds relay DB.

Relay IP releasing slowly at contact H7,
- IP1 releases relay IS.

Relay IS releasing slowly,
IS3 operates relay ST.
IS4) disconnect the short circuits from the secondary windings of
IS5) transformer T1.
IS6 disconnects the hold circuit for relay STA which is held by the subsequent operation of contact ST8.

Other IS contacts are ineffective at this stage.

3.3.4.3 Pulse sending

Relay ST operating slowly,
ST1 is ineffective at this stage.
ST2 reoperates relay IS.
ST3 disconnects the pulse sender homing circuit.
ST4 energizes relay PG and connects earth to PS6 wiper to prevent the pulsing of relay PU when relay PG subsequently pulses. This provides a seizure time for the distant equipment during the first two pulses of the pulse sender.
ST5 holds relay ST independently of contact IS3.
ST6 is ineffective on this type of call.
ST7 is ineffective at this stage.
ST8 holds relay STA.

Relay IS operating,
IS2 is ineffective on this type of call.
IS4) connect a short-circuit to the secondary windings of
IS5) transformer T1.
IS6 holds relay STA independently of contact ST8.

Other IS contacts are ineffective at this stage.

Relay PG operating at contact ST4,
PG1 disconnects relay PG and operates the PS magnet.
PG2 is ineffective at this stage as it is short circuited by the earth from the PS6 wiper via the IT terminal.

Relay PG releasing slowly,
PG1 re-energizes relay PG and releases magnet PS.
PG2 is ineffective at this stage.

The pulse sender wipers step under the control of relay PG but no pulses are transmitted to line while the sender is stepping over the first two contacts. On stepping off contact 2 on to contact 3, earth from contact ST4 via wiper PS6 is disconnected as the next outlet has been left disconnected.

Relay PG operating slowly,
PG1 disconnects relay PG and operates the PS magnet.
PG2 releases relay PU.

Relay PU releasing,
PU1 is ineffective at this stage.
PU2 reverses the direction of the loop current flowing in the line giving a break pulse to the distant incoming selector.

Relay PG releasing slowly,
PG1 energizes relay PG and steps the pulse sender PS to the next outlet.
PG2 operates relay PU.

Relay PU operating,
PU1 is ineffective at this stage.
PU2 reverses the direction of the loop current flowing in the line to terminate the first break pulse to the distant incoming relay-set.

Relays PG and PU functioning as described above transmit the predetermined digits to line. When wiper PS6 steps to the group of outlets wired to the IT terminal, earth at contact ST4 short circuits contact PG2 to provide an inter digital pause. The routing code for a CCB subscriber assistance call is 11. After the routing codes have been transmitted the next wired bank outlet operates relay RG from earth at contact ST4 via contacts CB6, WA7 and arc PS6.

Relay RG operating,
RG1 is ineffective on this type of call.
RG2 releases relay IS.
RG3 prepares the homing circuit for the pulse sender.
RG4 releases relay ST.
RG5) prevent the reoperation of relay PG.
RG6)
RG7 holds relay RG.

Relay ST releasing slowly,
ST1 is ineffective on this type of call.
ST2 is ineffective at this stage.
ST3 completes the homing circuit for the pulse sender.
ST4 disconnects earth from arc PS6.
ST5 is ineffective at this stage.
ST6) are ineffective on this type of call.
ST7)
ST8)

Relay IS releasing slowly at contact RG2,
IS4) disconnect the short-circuits from the secondary windings of
IS5) transformer T1.
IS6 releases relay STA.

Other IS contacts are ineffective at this stage.

Relay STA releasing,
STA1) short circuit capacitors C9 and C10
STA2) (see Design Details).
STA4 operates relay J.

Relay J operating,
J1 is ineffective at this stage.
J2 holds relay J independently of contact D1.
J3 prepares the operating circuit for relay DD.

The pulse sender self-drives to its home contact, wiper PS2 preparing to connect the testing-in battery to the P wiper when the uniselector is on contact 1.

3.3.4.4 Operator Answer, Manual hold, recall from manual hold and release from manual hold

The circuit description is similar to that described in paragraphs 3.3.3.8, 3.3.3.9, 3.3.3.10 and 3.3.3.11 except that the manual hold earth to the incoming P wire in this case is provided via contact CB1.

3.3.5 Assistance call from a CCB subscriber dialling 100 where prepayment coin boxes are fitted. (Note 5 on diagram)

The circuit description is similar to that described in paragraph 3.3.3 with the following exceptions:-

(a) the permitted code dialled into the relay-set must be 00 only as shown by the typical strapping on arc PS4 of the pulse sender.

(b) the regenerator circuit is disconnected, therefore the digits 00 are not stored and transmitted, obviating the need for a digit absorbing relay-set in the GSC.

(c) the pulse sender control arc PS8 is strapped to transmit the digits 11 as shown by the typical strapping on the diagram.

The main circuit differences are as follows:-

3.3.5.1 Seizure

Contact CB3 operates relay CO via strap No. 11.

Relay CO operating,
- CO1 disconnects the pulsing circuit of the Receive Element.
- CO2 further disconnects the testing-in battery circuit.
- CO3 holds relay CO.
- CO4 disconnects the Mark Element.
- CO5 is short circuited by strap No. 11 to maintain the pulse sending circuit.
- CO6 is ineffective on this type of call.

3.3.5.2 Dialling and digit discrimination

The circuit description is similar to that described in paragraph 3.3.3.2 with the exception that there is no digit storage by the regenerator.

3.3.5.3 Reception of a barred code

The circuit description is similar to that described in paragraph 3.3.3.3 with the exception that all codes other than 00 are barred as shown by the typical strapping on pulse sender control arc PS4.

3.3.5.4 Reception of the permitted code 00

The circuit description is similar to that described in paragraph 3.3.3.4 omitting reference to storage by the regenerator.

3.3.5.5 Pulse sending

The circuit description is similar to that described in paragraph 3.3.3.6 except that the pulse sender control arc PS8 is strapped to transmit code 11.

The subscriber receives ring tone from the GSC.

3.3.5.6 The operator answers

Ring tone is removed when the operator answers.

Although a coin and fee checking signal is also transmitted by the incoming relay-set at the GSC it is ineffective on this type of call.

3.3.5.7 Manual hold, recall and release from manual hold

The circuit description is similar to that described in paragraphs 3.3.3.9, 3.3.3.10 and 3.3.3.11.

3.3.6 Incoming call from an inter-dialling exchange via selector level 1 or 0

3.3.6.1 Seizure

Relay A operates to the loop extended via the preceding selector level and relay EF operates to positive battery connected to the M wire by the preceding equipment. On level 1 calls, relays WS and WA also operate but their contacts are ineffective.

Relay A operating,
- A1 operates relay B.
- A2 is ineffective on this type of call.

Relay EF operating to the positive battery via the M lead,
- EF1 prepares to connect the start condition to the alarm delay equipment independently of contact BB2.
- EF2 prepares the operating circuit for relay CO.
- EF3 prevents the operation of relay BC when relay BB operates. This ensures that the junction hunter does not hunt for a free outlet on this type of call.
- EF4 connects NU tone to the calling party.
- EF5 disconnects the pulse sender counting and sending circuits.
- EF6 disconnects the operating circuit for relay ST.
- EF7 prepares a holding circuit for relay EF.

Relay B operating at contact A1,
- B1 holds relay B independently of contact A1.
- B2 disconnects the testing-in battery from, and connects earth to, the incoming P wire.
- B3 operates relay CO via contact EF2 and holds relay EF on its second winding.
- B4 operates relay BA.
- B5 operates relay PU.
- B6 prepares an operate circuit for relay CD.

Relay PU operating,
- PU1 connects the start condition to the alarm delay equipment via relay TP.
- PU2 is ineffective on this type of call.

Relay CO operating,
- CO1 prevents subsequent pulsing from operating the Receive Element.
- CO2 further disconnects the testing-in battery circuit.
- CO3 holds relay CO.
- CO4 prevents the subsequent operation of relay CD from operating the Mark Element. It also prepares a hold circuit for relay PR.
- CO5 is ineffective at this stage.
- CO6 prevents positive battery current drain and leaves relay EF holding on its other winding to earth at contact B3.
- CO7 short circuits the 200Ω winding of relay WS (see Design Details).

Relay BA operating at contact B4,
BA2 connects earth to the release relay lead.
BA3 operates relay BD.

Other BA contacts are ineffective at this stage.

Relay BD operating,
BD1 prepares the operating circuit for relay CD.
BD5 operates relay IP (level 0 call only) and relay STA.

Other BD contacts are ineffective at this stage.

Relay STA operating,
STA1) connect capacitors C9 and C10 across transformer T1.
STA2)
STA4 prevents the premature operation of relay J.

Relay IP operating at contact BD5.
IP1 operates relay IS.

Relay IS operating,
IS4) short-circuit the secondary windings of
IS5) transformer T1.
IS6 holds relay STA on its second winding.

Other IS contacts are ineffective at this stage.

3.3.6.2 Dialling

Should the calling party continue to dial in the face of NU tone, relay A releases to the first break pulse.

Relay A pulsing,
A1 operates relay CD.
A2 is ineffective on this type of call.

Relay CD operating on the first break pulse,
CD1 is ineffective at this stage.
CD2 operates relay CA.

Relay CA operating,
CA1) are ineffective at this stage.
CA3)
CA2 operates relay BB.

Relay BB operating,
BB6 short circuits the 4-6 winding of relay D (where junction hunter is fitted) which changes over.

Other BB contacts are ineffective at this stage.

Contact D1 changing over,
spring 12 making contact with spring 11 operates relay DB.

Relay DB operating,
DB5 connects earth to the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.

All other DB contacts are ineffective at this stage.

At the end of the pulse train, relay A remains operated and relay CD releases.

Relay CD releasing,
CD1 is ineffective at this stage.
CD2 releases relay CA.

Relay CA releasing,

All CA contacts are ineffective at this stage.

3.3.6.3 Release of the relay-set by the caller

Relays held at this stage:- A, B, BA, BB, BD, CO, DB, EF, STA, PU and on level 0 call IP and IS and on a level 1 call WA and WS.

When the calling party clears relay A releases.

Relay A releasing,
A1 releases relay B and operates relay CD.
A2 is ineffective on this type of call.

Relay CD operating,
CD1 is ineffective at this stage.
CD2 operates relay CA.

Relay CA operating,

All CA contacts are ineffective at this stage.

Relay B releasing slowly at contact A1,
B1 is ineffective at this stage.
B2 disconnects earth from the P wire and prepares the testing-in battery circuit.
B3 is ineffective at this stage.
B4 releases relay BA.
B5 releases relay PU.
B6 releases relay CD.

Relay PU releasing,
PU1 disconnects earth from the alarm delay equipment.
PU2 disconnects the short circuit from the 6-4 winding of relay D (where junction hunter is fitted) which changes over.

Contact D1 changing over,
spring 12 breaking contact with spring 11 releases relay DB.

Relay DB releasing,
DB1 prepares to connect the testing-in battery to the P wire.
DB5 disconnects earth from the alarm delay equipment lead in a UAX No. 14, or junction busying alarm in a UAX No. 13.

Other DB contacts are ineffective at this stage.

Relay CD releasing at contact B6,
CD1 is ineffective at this stage.
CD2 releases relay CA.

Relay CA releasing,

All CA contacts are ineffective at this stage.

Relay BA releasing slowly at contact B4,
BA2 holds relays CO and EF via contact BB3.
BA3 releases relay BD.

Other BA contacts are ineffective at this stage.

Relay BD releasing slowly,
BD5 releases relays IP (level 0 call), BB and STA.

Other BD contacts are ineffective at this stage.

Relay STA releasing,
STA1) short circuit capacitors C9 and C10.
STA2)

Other STA contacts are ineffective at this stage.

Relay BB releasing at contact BD5,
BB3 releases relays CO, EF, and on level 1 calls relays WA and WS.

All other contacts of relay BB are ineffective at this stage.

Relay IP releasing slowly at contact BD5,
IP1 releases relay IS.

Relay IS releasing slowly,
IS4) remove the short circuits from the secondary windings of
IS5) transformer T1.

Other IS contacts are ineffective at this stage.

Relay EF)
) releasing at contact BB3,
Relay WA)
)
Relay WS)

All contacts of these relays are ineffective at this stage.

Relay CO releasing slowly at contact BB3,
CO1 connects the testing-in battery to the P wire.

Other CO contacts are ineffective at this stage.

All relays have now released and the relay-set is free to accept a further call.

3.3.7 Forced release of the relay-set under time pulse control

Forced release of the relay-set is provided under the following circuit conditions should the calling party hold on to the call:-

3.3.7.1 Seizure without subsequent dialling (PG) via level 1 or 0.

3.3.7.2 All junctions busy.

3.3.7.3 Barred code dialled (level 1).

3.3.7.4 Call from an inter-dialling exchange via level 1 or 0.

The above conditions will now be described:-

3.3.7.1 Seizure without subsequent dialling (PG) via level 1 or 0

The seizure of the relay-set to establish the PG conditions is similar to that described in paragraph 3.3.2.1.

Relays held at this stage:- A, B, BA, BD, PU, STA and on level 0 call IP and IS and on level 1 call WA and WS.

In seizing the relay-set the operation of contact PU1 connects earth (UAX No. 12 and 13) or battery (UAX No. 14) to the alarm delay equipment via relay TP.

Relay TP operating to the time pulse,
- TP1 holds relay TP to earth (UAX No. 14) or to battery via the time pulse hold lead (UAX No. 12 or 13).
- TP2 connects earth to the time pulse hold lead (UAX No. 14).
- TP3 connects relay PR to the time pulse release lead (UAX No. 12 or 13) or the Z lead (UAX No. 14).

Relay PR operating to earth from the alarm delay equipment,
- PR1 disconnects earth at contact B2 from the incoming P wire so releasing the preceding selector.
- PR2 prepares a hold circuit for relay PR on its second winding.
- PR3 operates relay CO and disconnects the operate circuit for relay CA (see Design Details).

Relay CO operating,
- CO1 prevents energization of the Receive Element when contact A1 subsequently releases.
- CO2 further disconnects the testing-in battery circuit.
- CO3 holds relay CO to earth at contact BD2.
- CO4 prepares a hold circuit for relay PR and on its break contact prevents energization of the Mark Element when contact CD1 subsequently operates.

Other CO contacts are ineffective at this stage.

The disconnexion of earth from the P wire at contact PR1 releases the preceding selector to bring about the release of relay A in this relay-set.

Relay A releasing,
- A1 operates relay CD and releases relay B.
- A2 is ineffective at this stage.

Relay CD operating,
- CD1 holds relay PR on its second winding (see Design Details).
- CD2 is ineffective at this stage.

Relay B releasing slowly,
- B4 releases relay BA.
- B5 releases relay PU.
- B6 releases relay CD.

Other B contacts are ineffective at this stage.

Relay PU releasing,
- PU1 disconnects the start condition from the alarm delay equipment to release relay TP.
- PU2 is ineffective at this stage.

Relay TP releasing,
TP1 is ineffective at this stage.
TP2 disconnects earth from the ST lead (UAX No. 14).
TP3 leaves relay PR holding on its second winding.

Relay CD releasing at contact B6,
CD1 releases relay PR.
CD2 is ineffective at this stage.

Relay PR releasing,
PR1 prepares to connect the testing-in battery to the P wire.

Other PR contacts are ineffective at this stage.

Relay BA releasing slowly at contact B4,
BA3 releases relay BD.

Other BA contacts are ineffective at this stage.

Relay BD releasing slowly at contact BA3,
BD2 releases relay CO, and on level 1 calls relays WA and WS.
BD5 releases relay IP (level 0 call) and relay STA.

Other BD contacts are ineffective at this stage.

Relay WS)
) releasing (level 1 call only),
Relay WA)

All contacts of these relays are ineffective at this stage.

Relay IP releasing slowly, (level 0 call only),
IP1 releases relay IS.

Relay STA releasing slowly at contact BD5,
STA1)
STA2) short-circuit capacitors C9 and C10.

Other STA contacts are ineffective at this stage.

Relay CO releasing slowly at contact BD5 (see Design Details),
CO2 prepares to connect the testing-in battery to the P wire.
CO6 restores relay EF to the M wire.

Other CO contacts are ineffective at this stage.

Relay IS releasing slowly at contact IP1,
IS4) disconnect the short-circuits from the secondary windings
IS5) of transformer T1.
IS7 connects the testing-in battery to the P wire.

Other IS contacts are ineffective at this stage.

All relays have now released and the relay-set is free to accept a further call.

3.3.7.2 Forced release from "all junctions busy" condition

The seizure of the relay-set, digit storage, junction hunting and all junctions busy condition are described in paragraphs 3.3.2.1 to paragraphs 3.3.2.4 respectively.

Relays held at this stage:- A, B, BA, PU, BB, BC, BD, BY, H, HX, EF, CO, DB, J and relays WS and WA on a level 1 call.

The operation of relay EF connects the start condition to the alarm delay equipment via relay TP to operate that relay to the time-pulse.

Relay TP operating,
- TP1 holds relay TP to earth (UAX No. 14) or to battery via the time pulse hold lead (UAX No. 12 or 13).
- TP2 connects earth to the time-pulse hold lead (UAX No. 14).
- TP3 connects relay PR to the time-pulse release lead (UAX No. 12 or 13) or the Z lead (UAX No. 14).

Relay PR operating,
- PR1 disconnects the holding earth from the incoming P wire to release the preceding selector.
- PR2 prepares to hold relay PR on its second winding.
- PR3 disconnects the operating circuit for relay CA.

The disconnection of earth from the P wire at contact PR1 releases the preceding selector to bring about the release of relay A in this relay-set.

Relay A releasing,
- A1 operates relay CD and releases relay B.
- A2 is ineffective at this stage.

Relay CD operating,
- CD1 holds relay PR on its second winding.
- CD2 is ineffective at this stage.

Relay B releasing slowly at contact A1,
- B2 prepares to connect the testing-in battery to the P wire.
- B4 releases relay BA.
- B5 releases relay PU.

Other B contacts are ineffective at this stage.

Relay PU releasing,
- PU1 disconnects the start condition from the alarm delay equipment to release relay TP.
- PU2 is ineffective at this stage.

Relay TP releasing,
- TP3 leaves relay PR held to earth at contact CD1.

Other TP contacts are ineffective at this stage.

Relay BA releasing slowly at contact B4,
- BA3 releases relay BD.
- BA4 operates the Transmit Element to enable the regenerator to transmit the stored pulses.

Other BA contacts are ineffective at this stage.

Operation of the regenerator Transmit Element removes the earth from regenerator U point 5 and allows relay DK to operate to battery at resistor R5.

Relay DK operating slowly,
- DK1 releases the Transmit Element.
- DK2 operates relay IP (level 1 call) or IS level 0 call.
- DK3 is ineffective at this stage.

Relay IP operating,
IP1 operates relay IS.

Relay IS operating,
IS4)
IS5) short-circuit the secondary windings of transformer T1.

Other IS contacts are ineffective as the stored pulses are to be transmitted without inter train pauses.

Transmit Element releasing at contact DK1, transmits 67% break loop disconnect pulses from regenerator U points 6 and 12. These are ineffective as the operate circuit for relay PU is disconnected at contact B5.

Transmit Element Output release of the Transmit Element connects earth to U point 5 to short circuit relay DK leaving it holding on its second winding due to earth pulses from regenerator U point 2.

The remainder of the pulse train is transmitted as described above without intertrain pauses until all the trains have been transmitted, when the regenerator is empty and the off normal earth is disconnected thus releasing relay BY. Also the earth is removed from regenerator U point 2 to release relay DK.

Relay BY releasing,
BY1 prepares the testing-in battery circuit.
BY2 is ineffective at this stage.
BY3 disconnects battery from the regenerator U point 5 and relay DK.
BY4 disconnects the release alarm earth from the Transmit Element and supervisory lamp element. Contact BY4 also releases relay IP on level 1 call or relay IS on level 0 call.

Relay DK releasing,

All DK contacts are ineffective at this stage.

While the pulses are being transmitted the relay-set is also clearing down but does not affect the circuit arrangement described above.

Relay BD releasing slowly at contact BA3,
BD1 releases relay CD.
BD2 is ineffective at this stage.
BD3 disconnects an operating circuit for relay MH (see Design Details).
BD4 releases relay HX.
BD5 releases relay BB.

Relay HX releasing,
HX1 releases relay H and prepares the homing circuit for the junction hunter.

Relay H releasing slowly,
H3)
H4) prepares the homing circuit for the junction hunter.
H5 disconnects the outgoing positive wire.
H6 connects earth to the line winding of relay D. Relay D changes over.

Other H contacts are ineffective at this stage.

Contact D1 changing over,
spring 12 breaking contact with spring 11 and making contact with spring 10 leaves relays DB and J holding to earth at contact J2 (on level 0 call). On level 1 call relays DB and J release.

Relay BB releasing at contact BD5,
BB4 releases relay BC.
BB8 releases relay J.

Other BB contacts are ineffective at this stage.

Relay CD releasing slowly at contact BD1,
CD1 releases relay PR.
CD2 is ineffective at this stage.

Relay PR releasing,
PR1 prepares to connect the testing-in battery to the P wire.
PR2 is ineffective at this stage.
PR3 releases relays CO, EF and on a level 1 call, relays WA and WS.

Relay EF releasing,
EF4 disconnects NU tone from the bridge.

Other EF contacts are ineffective at this stage.

Relay WA)
) releasing at contact PR3,
Relay WS)

All contacts of these two relays are ineffective at this stage.

Relay CO releasing slowly at contact PR3,
CO2 prepares to connect the testing-in battery to the P wire.

Other CO contacts are ineffective at this stage.

Relay J releasing slowly at contact BB8,
J1 prepares to connect the testing-in battery to the P wire.
J2 releases relay DB.
J3 is ineffective at this stage.

Relay DB releasing,
DB1 prepares to connect the testing-in battery to the P wire.

Other DB contacts are ineffective at this stage.

Relay BC releasing slowly at contact BB4,
BC5 drives the junction hunter to its home contact.

Other BC contacts are ineffective at this stage.

Relay IP releasing at contact BY4,
IP1 releases relay IS.

Relay IS releasing slowly,

All IS contacts are ineffective at this stage.

When the junction hunter reaches its home contact wiper JH5 connects the testing-in battery to the P wire.

3.3.7.3 Forced release from "reception of barred code via level 1"

The seizure of the relay-set, discrimination, digit storage and reception of a barred code are described in paragraph 3.3.3.1 to paragraph 3.3.3.3 respectively.

Should the subscriber continue to hold on to the relay-set, forced release conditions are set up when relay TP operates to the alarm delay equipment.

Forced release conditions are established and the relay-set clears down, the circuit description being similar to that described in paragraph 3.3.7.2 "Forced release from all junctions busy" except that in this case relays BC, H and HX are not operated and on the release of contact DB5 the pulse sender self-drives to its home contact via arc PS1.

3.3.7.4 Forced release of call from interdialling exchange via levels 1 or 0

The seizure of the relay-set and dialling are described in paragraphs 3.3.6.1 and 3.3.6.2.

Relays held at this stage:- A, B, BA, BD, PU, CO, DB, EF, STA and BB (relays WS and WA on level 1 call, and relays IP and IS on level 0 call) and spring 12 of contact D1 in contact with spring 11.

Should the calling party continue to hold the relay-set, relay TP operates to the time-pulse (UAX No. 12 or 13) or the S pulse (UAX No. 14).

Relay TP operating,
- TP1 holds relay TP to earth (UAX No. 14) or to battery via the time pulse hold lead (UAX No. 12 or 13).
- TP2 connects earth to the time-pulse lead (UAX No. 14).
- TP3 connects relay PR to the time-pulse release lead (UAX No. 12 or 13) or to the Z lead (UAX No. 14).

Relay PR operating,
- PR1 disconnects the holding earth from the incoming P wire to release the preceding selector.
- PR2 prepares to hold relay PR on its second winding.
- PR3 disconnects the operating circuit for relay CA and provides another hold circuit for relay CO.

The disconnexion of earth from the P wire at contact PR1 releases the preceding selector to bring about the release of relay A in this relay-set.

Relay A releasing,
- A1 operates relay CD and releases relay B.
- A2 is ineffective at this stage.

Relay CD operating,
- CD1 provides an alternative hold circuit for relay PR.
- CD2 is ineffective at this stage.

Relay B releasing,
B1 is ineffective at this stage.
B2 prepares to connect the testing-in battery to the P wire.
B3 is ineffective at this stage.
B4 releases relay BA.
B5 releases relay PU.
B6 releases relay CD.

Relay CD releasing,
CD1 releases relay PR.
CD2 is ineffective at this stage.

Relay PU releasing at contact B5,
PU1 releases relay TP.
PU2 disconnects earth from the 4-6 winding of relay D which changes over under the control of its bias winding.

Contact D1 changing over,
spring 12 breaking with apring 11 releases relay DB.

Relay DB releasing,
DB5 disconnects earth from the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.

All other DB contacts are ineffective at this stage.

Relay BA releasing,
BA3 releases relay BD.

Other BA contacts are ineffective at this stage.

Relay TP releasing at contact PU1,

All TP contacts are ineffective at this stage.

Relay BD releasing slowly at contact BA3,
BD5 releases relays BB and STA, and on level 0 call, relay IP.

Other BD contacts are ineffective at this stage.

Relay PR releasing at contact CD1,
PR1 prepares to connect the testing-in battery to the P wire.

Other PR contacts are ineffective at this stage.

Relay BB releasing at contact BD5,
BB3 releases relays CO, EF and on level 1 calls relays WA and WS.

Other BB contacts are ineffective at this stage.

Relay WA)
) releasing (level 1 calls),
Relay WS)

All contacts of these two relays are ineffective at this stage.

Relay EF releasing,
EF4 disconnects NU tone from the bridge.

Other EF contacts are ineffective at this stage.

Relay CO releasing slowly at contact BB3,
CO2 prepares to connect the testing-in battery to the P wire.

Other CO contacts are ineffective at this stage.

Relay STA releasing at contact BD5,
STA1)
STA2) short circuit capacitors C9 and C10.

Other STA contacts are ineffective at this stage.

Relay IP releasing slowly at contact BD5 (level 0 calls),
IP1 releases relay IS.

Relay IS releasing,
IS4)
IS5) remove the short-circuits from the secondary windings of transformer T1.
IS7 connects the testing-in battery to the P wire.

Other IS contacts are ineffective at this stage.

All relays have now released and the relay-set is free to accept a further call.

3.3.8 Operators routine test of junction (see Note 10 on diagram)

To effect a junction routine call, the operator dials a selected final selector number which brings about the removal of earth from shelf jack U point 110 (via the tone check and routine test unbarring circuit) to unbar this circuit to inter-dialling calls by ensuring that relay EF cannot be operated from the M wire.

The operator is now able to use the circuit as described in paragraph 3.3.3.

3.3.9 Recording of ineffective calls from level 0

Traffic meters at the GSC record both effective and ineffective calls from ordinary and CCB subscribers.

If therefore the subscriber clears down after dialling two or more digits of the code the relay-set is arranged to:-

(i) release the preceding equipment,

(ii) remain held until the pulse sender has finished transmitting the routing code digits necessary for the call to reach the GSC register translator.

The seizure, dialling, digit storage, junction hunting and pulse sending is described in paragraphs 3.3.2.1, 3.3.2.2, 3.3.2.3, 3.3.2.4 and 3.3.2.6 respectively.

3.3.10 Release from an ineffective call when a Mechanical Regenerator is provided

Relays held at this stage:- A, B, BA, BB, BC, BD, BY, H, HX, DB, PU, ST and STA.

Should the calling subscriber clear after dialling two or more digits relay A releases.

Relay A releasing,
A1 operates relay CD, operates the Receive Element and releases relay B.
A2 is ineffective at this stage.

Relay CD operating,
CD1 operates the Mark Element.
CD2 operates relay CA.
CD3 see Design Details.

Mark Element Output is ineffective at this stage,

Relay CA operating,

All CA contacts are ineffective at this stage.

Relay B releasing slowly at contact A1,
B1 releases the Receive Element.
B2 releases the preceding equipment.
B3 is ineffective at this stage.
B4 leaves relay BA holding to earth at contact ST1.
B5 leaves relay PU under the control of contact ST7.
B6 is ineffective at this stage.

The release of contact B1 in releasing the Receive Element causes the regenerator to store one pulse.

Whilst the circuit operations described above are proceeding, the pulse sender is transmitting the predetermined code as described in paragraph 3.3.2.6 with the result that when the code has been transmitted relay RG operates (as described in paragraph 3.3.2.6) and releases relay ST.

Relay ST releasing,
ST1 releases relay BA.
ST2 is ineffective at this stage.
ST3 homes the pulse sender PS.
ST7 releases relay PU.
ST8 releases relay STA.

Other ST contacts are ineffective at this stage.

Relay PU releasing,
PU1 is ineffective at this stage.
PU2 reverses the potentials of the outgoing negative and positive wires to form the forward clearing signal to the incoming relay-set.

Relay BA releasing slowly at contact ST1,
BA1 removes the short circuit from resistor R1.
BA2 operates relay CO via contact BB3.
BA3 releases relay BD.
BA4 operates the Transmit Element.

Other BA contacts are ineffective at this stage.

Relay CO operating,
CO1 is ineffective at this stage.
CO2 further disconnects the testing-in battery from the P wire.
CO3 holds relay CO.
CO4 releases the Mark Element to store the pulse given to the regenerator when the calling party clears.

Other CO contacts are ineffective at this stage.

Mark Element Output is ineffective at this stage as BY is operated due to the digits dialled by the calling party.

Transmit Element Output allows relay DK to operate by disconnecting the short circuit to earth at regenerator U point 5 from its 250 ohm winding.

Relay DK operating,
DK1 releases the Transmit Element.
DK2 operates relay IS.
DK3 is ineffective at this stage.

Relay IS operating,
IS4)
IS5) short circuit the secondary windings of transformer T1.

Other IS contacts are ineffective at this stage.

Transmit Element releasing, transmits the first pulse train stored in the regenerator. The pulses are ineffective as the operate circuit for relay PU is disconnected at contacts B5 and ST7.

Transmit Element Output On release of the Transmit Element, earth appears on regenerator U point 5 to short circuit one winding of relay DK to make it dependent on pulsing earth from regenerator U point 2.

Relay STA releasing at contact ST8;
STA1)
STA2) short circuit capacitors C9 and C10.
STA4 operates relay J.

Relay J operating,
J2 holds relay J.

Other J contacts are ineffective at this stage.

This sequence continues until the regenerator is empty when the removal of earth from regenerator U point 8 releases relay BY and the removal of pulsing earth from regenerator U point 2 releases relay DK.

Relay BD releasing slowly at contact BA3,
BD1 releases relay CD.
BD5 releases relays RG and BB.

Other BD contacts are ineffective at this stage.

Relay RG releasing,

All RG contacts are ineffective at this stage.

Relay BB releasing,
BB3 releases relay CO.
BB4 releases relay BC.
BB8 releases relay J.

Other BB contacts are ineffective at this stage.

Relay CD releasing at contact BD1,
CD1 is ineffective at this stage.
CD2 releases relay CA.

Relay CO releasing at contact BB3,
CO2 prepares to connect the testing-in battery to the P wire.

Other CO contacts are ineffective at this stage.

Relay BC releasing at contact BB4,
BC3 connects earth to the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.
BC5 prepares to home the junction hunter.
BC6 releases relay HX.

Other BC contacts are ineffective at this stage.

Relay HX releasing,
HX1 releases relay H and prepares to home the junction hunter.

Relay H releasing slowly,
H1 disconnects earth from the release relay lead.
H3) home the junction hunter providing the pulse sender is on its
H4) home contact.
H6 reconnects earth to the 6 to 4 winding of relay D to cause relay D to change over.

Other H contacts are ineffective at this stage.

Contact D1 changing over,
spring 12 breaking contact with spring 11 releases relay DB.

Relay BY releasing at disconnexion of earth from regenerator U point 8.
BY4 releases relay IS.

Other BY contacts are ineffective at this stage.

Relay DK releasing by removal of pulsing earth from regenerator U point 2.

All DK contacts are ineffective at this stage.

Relay CA releasing at contact CD2,

Other CA contacts are ineffective at this stage.

Relay DB releasing at contact D1,
DB1 prepares to connect the testing-in battery to the P wire.
DB5 disconnects earth from the alarm delay equipment lead in a UAX No. 14 or junction busying alarm in a UAX No. 13.

Other DB contacts are ineffective at this stage.

Relay IS releasing at contact DK2,
IS1 disconnects earth from the release relay.
IS4) disconnect the short-circuits from the secondary windings of
IS5) transformer T1.
IS7 prepares to connect the testing-in battery to the P wire.

Other IS contacts are ineffective at this stage.

Relay J releasing slowly at contact BB8,
J1 prepares to connect the testing-in battery to the P wire.

Other J contacts are ineffective at this stage.

When the junction hunter arrives at a home contact, wiper JH5 connects the testing-in battery to the P wire.

All relays have now released and the relay-set is free to accept a further call.

3.3.11 Release from an ineffective call when an Electronic Regenerator is provided

The release sequence is similar to that given in paragraph 3.3.10 except that when relay BA releases, BA1 restores regenerator to idle state. Relay BY releases as do other relays in sequence.

3.4 Use of relay-set under pre-STD conditions

To permit this relay-set to be installed at an exchange prior to the introduction of STD working the following shelf jack U points are strapped together:- U29-U31, U65-U67 and as metering will not be required under these conditions it must be ensured that no straps exist between X9-X10 and X10-X11. Shelf jack U point 73 should also be connected to earth. To ensure an operation of relay CB a strap should be connected across the break action of contact BB1.

When STD working is introduced the straps should be removed and the earth removed from U73.

3.4.1 UAX ordinary subscriber dials 0 for assistance

As a result of the straps mentioned above (paragraph 3.4) relays CO and BB operate on seizure of the relay-set.

Relay CO operating,
CO1 ensures that any unwanted digits that may be dialled do not step the regenerator.
CO2 disconnects the testing-in battery independently of contact B2.
CO3 is ineffective due to the strap between U29-31.
CO4 disconnects the operating circuit for the Mark Element.
CO5) are ineffective at this stage.
CO6)
CO7 short circuits the 200Ω winding of relay WS (see Design Details).

Relay BB operating at contact BD5.

- BB1 is ineffective on this type of call as the metering conditions have been disconnected from contact DD2.
- BB2 disconnects the alarm delay equipment
- BB3 is ineffective at this stage.
- BB4 operates relay BC.
- BB5) prepare to connect reversed polarity to the outgoing negative
- BB6) and positive wires.
- BB7 is ineffective due to the strap between U65-67.
- BB8 prepares the operating circuit for relay J.

Relay BC operating,

- BC1 connects earth to the P wire (U73 connected to earth) independently of contact B2, to provide manual hold conditions should manual hold be subsequently set up.
- BC2 prepares the operating circuit for relay CD under manual hold conditions.
- BC3 is ineffective as contacts WA2 and EF3 remain normal.
- BC4 is ineffective on this type of call.
- BC5 completes a self drive circuit for the junction hunter. Where a junction hunter is not fitted contact BC5 operates relays H and HX.
- BC6 connects relay HX to the junction hunter P wire.
- BC7 prepares the outgoing negative wire circuit.

The circuit operation now continues as described in paragraph 3.3.2.5 and the sending of the digits by the pulse sender to route the call to a manual board or to a "dial 100" announcement is similar to that described in paragraph 3.3.2.6.

3.4.2 UAX CCB subscriber dials 0 for assistance

When a CCB subscriber dials 0 for assistance, relay CB operates on seizure of the relay-set to a negative battery on the M wire as described in paragraph 3.3.3.13 and relay CO operates as described in paragraph 3.4.1 above. The pulse sender sends the digits 11 as for STD working.

3.4.3 UAX ordinary subscriber dials 100 for assistance

On seizure of the relay-set, relays WS and WA operate as described in paragraph 3.3.3.1 and relay CO operates as described in paragraph 3.4.1 above. The digits 00 are counted on the PS arcs 3 or 4 and with the operation of relay DC the pulse sender transmits the digits to route the call to a manual board.

4. DESIGN DETAILS

The following relays have been made slow to release:-

Relay B)
Relay CD) when short circuited by contact A1 to hold during pulsing.

Relay BA)
Relay BD) the combined release lags of these two relays ensure that when setting up manual hold conditions relay D changes over and holds relay BD before relay BD releases.

Relay CO on forced release from PG conditions from level 1 ensures that the testing-in battery to the incoming P wire is not reconnected until relays WS and WA have released.

Relay DK — by short circuit via the U point 5 to ensure that it holds during the transmission of a pulse train from the regenerator. In conjunction with relays IP and IS the release lag also provides the inter-train pause period between regenerator transmitted pulse trains.

Relay H — to ensure relay HX releases before relay H on cleardown so preventing an interaction between relays H and HX via contacts H3 and H4 and HX1.

Relay IP) Relay IS) — in conjunction with relay DK provides the regenerator inter-train pause period.

Relay J — controls the length of the meter pulse connected to the M wire by contact DD2.

Relay MH — ensures that spring 12 of contact D1 breaks from spring 10 on recall from manual hold before relays MH and CA release so preventing a false operate circuit for relay DD.

Relay STA — to ensure it does not release whilst waiting the operation of contact ST8 after its hold circuit has been disconnected by contact IS6.

The following relays have been made slow to operate:-

Relay BC) Relay ST) — on level 0 calls with a subscriber's short inter-train pause (eg a call from a PBX) to provide a fluxing period for relays IP and IS so ensuring an adequate release lag for these relays. This delay is required to give the distant equipment at the GSC sufficient seizure time before receiving the predetermined code from this relay-set.

Relay DB — to ensure this relay remains unaffected if contact D1 momentarily operates during the seizure of the relay-set. The release lag ensures that it does not release when contact D1 changes over and contact DA6 operates when the called party answers. The release lag also ensures that the relay does not release when contact D1 changes over to contact 10 and back to contact 11 when the junction hunter switches the relay-set through to the distant incoming relay-set.

Relay DD — by means of a short circuit at contact DD7 to provide the recognition period for the called subscriber answering signal and subsequently to provide the recognition period for periodic meter pulses received over the junction. Once operated the short circuit is disconnected to prevent relay DD releasing slowly thus ensuring at contact DD3 that the operating circuit for relay J is restored as quickly as possible to prepare for the receipt of the next periodic meter pulse over the junction.

Relay DK — to provide adequate operation of the Transmit Element if the release of the relay-set occurs with trains of pulses stored in the regenerator (ie contact BA4 normal).

Relays with special requirements:-

Relay D)
Relay FC) see paragraph 3.3.1 "General".

Relay PG is a self interacting relay which, in conjunction with capacitor C8 pulses at 10 pps with an operate lag of 33.3 ms (due to its windings acting in opposition) and a release lag of 66.6 ms (due to its windings acting in series aiding).

Contacts not previously fully explained:-

Contact BA5 prevents the release alarm earth locking up relay DC and the PS magnet and short-circuiting the PSdm springs should relay DC be manually operated and the PS magnet pushed off normal when the relay-set is idle (release alarm earth, DC3, BA6, PSdm, ST6, EF5, CA3, CB7, PS3 straps DC terminal and DC2 to the PSdm springs).

Contact BA7 on level 0 calls, under seizure and release conditions, prevents the operation of relay ST which would start the pulse sender sending the predetermined digit during the release of relays BA and BD.

Contact BD3 ensures that relay MH is not operated if the distant incoming relay-set clears down and changes over relay D before relay J has released.

Contact CD1 by holding relay PR, ensures that contact CD2 releases before contact PR3, so preventing the operation of relays CA, BB etc. and hence inhibiting the operation of the JH magnet.

Contact CD3 when all junction hunter outlets are busy, it prevents the release of the Mark Element during the receipt of a pulse train, by delaying the operation of relay EF, and consequently CO until the inter-digital pause.

Contact CO7 prevents overhearing from level 1 input leads during a level 0 call by short circuiting the 200Ω winding of relay WS, so restoring the line to balance.

Contact DA2 holds relay BA during a meter pulse to ensure false manual hold conditions are not established should the calling party clear during the metering cycle. By delaying the release of relay BA, time is given to the incoming relay-set to bring about the change over of contact D1 (spring 12 moves to spring 11) before contact BA3 releases.

Contact DC6 prevents a false operation of relay EF whilst the pulse sender is homing when relay DC operates. (Release alarm earth, DC3 operated, PSdm, ST6, CO5, BA5, CA3, PS3 arc and strap to relay EF).

Contact H1 ensures that on cleardown, earth is maintained on the release relay lead independently of contact BA2. If contact BA2 disconnected the earth a condition might arise where earth was disconnected from the release alarm lead before the junction hunter had homed.

Contact J3 prevents a manual lock up of relays BD and CA.

Contact PR3 — break, prevents the operation of relay CA where forced release has been set up from a PG condition and hence prevents the unnecessary operation of relay BC and hunting by the junction hunter.

Contact STA1)
Contact STA2) — in conjunction with capacitors C9 and C10 absorbs switching clicks following regenerator transmission.

Rectifier MR5 — prevents relay FC responding to certain switching surges during the setting up of a call.

Relay Timing Information — To ensure satisfactory operation of the circuit the lags of the timed relays should be within the limits shown in the table below, excepting those marked NC which are not critical for the operation of the circuit but will not normally be exceeded. All times are in milliseconds.

Relay	Release lag		Operate lag	
	Min.	Max.	Min.	Max.
B (by short circuit)	150	225		
BA	150	225 NC		
BC			50	75 NC
BD	200	300		
CD (by short circuit)	100	150		
CO	150	225 NC		
DB			50	75 NC
DK (short circuit winding)	200	300		
H	100	150 NC		
IP	350	475 NC		
IS	180	270 NC		
J	200	350		
MH	250	350 NC		
ST			50	75 NC
STA	150	225		

The relay-set has been designed to work in conjunction with the following common services:-

UAX No. 12

Busy tone	to Diagram AT 60131
NU "	" " " "
Time-pulse hold)	
" " start)	" " AT 60048 Fig. 1
" " release)	
Release alarm earth	" " " " " "
Release relay	" " " " " "
DC converter (pos. bat.)	" " AT 60239
Pulse supply and monitoring)	
relay-set for local call)	
timing (including Routine-test)	
unbarring control))	" " AT 60054 Fig. 1
	(via AT 60047 Fig. 5)

UAX No. 13

Time-pulse hold	to Diagram AT 5406 Fig. 2
" " start	" " " " " "
" " release	" " " " " "
Release alarm earth	" " AT 4082 Fig. 22
" relay	" " " "
Busy tone earth	" " AT 60131
NU tone	" " " "
Positive battery	" " AT 4082 Fig. 10
Routine-test unbarring control	" " AT 60078 Fig. 2
	(via " AT 4082 Fig. 28)

UAX No. 14

Busy tone earth	to Diagram AT 4161 Fig. 1
NU " "	" " " " " "
Positive battery	" " " " " "
Release Alarm earth	" " " " Fig. 2
Alarm delay equipment	" " AT 4117 Fig. 2
Pulse supply and monitoring)	
relay-set for local call)	
timing (including Routine-test)	
unbarring control))	" " AT 60105 Fig. 1
	(via " AT 60107 Fig. 4)
Junction busying alarm	to " " " Fig. 5

5. HISTORY

Date	Dgm. Suffix	D.N. Issue	Amendment
December 1967	Open	1	-
May 1970	A	1	CD relay element changed to permit possible use of electronic solid state regenerator. Contact BC3 changed and contact DB5 provided to give 6 minute delay alarm facilities in a UAX No. 14 or junction busying alarm in a UAX No. 13. Test jack spring 20 moved to U point 109 and strap 15 between U points 107 and 109 removed to prevent RT relay interaction. Positive battery fusing arrangements changed to 0.5 A fuse per relay-set. Contact PG2 rearranged and contact STA3 made spare to prevent false operations of relay PG. Provided U116 and strapping between U114 and U116 to prevent the junction hunters of directly connected circuits hunting when all the circuits via the junction hunter multiple are engaged.
October 1970	B	1	Junction hunter availability increased to 20. Note 16 amended.
June 1971	C	1	Resistors R13 and R14 changed to preferred values. Contact CD3 moved.
November 1972	D	-	Junction hunter availability made optional. Note 18 added. Notes 10 and 13 amended. Specification not reissued.
November 1972	E	1	Note 1 amended.
July 1975	F	-	Editorial changes to permit use of alternative type of pulse regenerator. Figs. 3, 4 and 5 and Notes 19, 20 and 21 added. Notes 1, 2 and 8 amended etc. Redrawn Diagram and Specification not reissued.
July 1975	G	1	Contact DB3 made spare for new work. MR6 and 7 added. Note 22 added.

END OF DIAGRAM NOTES

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