ZZ 29.7.69 (H)

POST OFFICE TELECOMMUNICATIONS HEADQUARTERS

DIAGRAM NOTES AT 60075B

SPECIFICATION T 60075

OUTGOING CIRCUIT WITH BOTHWAY SWITCHING

TO G.S.C.

U.A.X. NOS. 13 and 14

1. GENERAL

This diagram shows the circuit of a 2000 type relay set used at a U.A.X. No. 13 or 14 for terminating an outgoing junction employing loop-disconnect pulsing.

The circuit is intended primarily for use at exchanges having pay on answer C.C.B. lines but can also be used at exchanges having pre-payment C.C.B. lines.

When used on a bothway basis incoming calls are switched via this relay set to the associated incoming equipment.

It is suitable for terminating a junction having a signalling loop resistance of up to 2000 ohms.

The following typical diagrams, or their equivalent, should be considered in conjunction with this diagram:-

AT 60068	GROUP SELECTOR. U.A.X. NO. 13.
AT 60093	FIRST GROUP SELECTOR. U.A.X. NO. 14.
AT 60077	LOCAL CALL TIMING CIRCUIT. U.A.X. NO. 13.
AT 60104	LOCAL CALL TIMING CIRCUIT. U.A.X. NO. 14.
AT 60083	OUTGOING RELAY SET. G.S.C. REGISTER AND ASSISTANCE TRAFFIC. U.A.Xs NOS. 12, 13 and 14.
AT 60087	DISCRIMINATOR FOR LINKED NUMBERING SCHEME. U.A.X. NO. 13.
AT 60665	COIN AND FEE CHECKING CIRCUIT.
AT 4064	INCOMING JUNCTION FROM PARENT, DEPENDENT MANUAL OR NON DEPENDENT EXCHANGE WITH DIRECT CONNEXION TO 1st SELECTOR. U.A.X. NO. 14.
AT 5518	INCOMING JUNCTION FROM PARENT, DEPENDENT MANUAL OR NON DEPENDENT EXCHANGE WITH DIRECT CONNEXION TO 1st SELECTOR. U.A.X. NO. 13.
AT 60079	C.C.B. SUBSCRIBERS LINE CIRCUIT AND LINEFINDER (25 OR 50 POINT) U.A.Xs NOS. 12, 13 and 14.

2. FACILITY SCHEDULE

Provision is made for:-

2.1 Working over a junction of up to 2000 ohms loop resistance.

2.2 Unidirectional outgoing working, or bothway working in conjunction with an incoming equipment.

2.3 Access on battery tested basis from the preceding selector or via linked numbering scheme discriminator (U.A.X. 13 only).

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2.4 Joint access on a battery tested basis with an outgoing register assistance relay set.

2.5 A transformer type transmission bridge with ballast resistor feed to the calling subscriber's instrument.

2.6 Reception of loop-disconnect pulses via the preceding group selector and repetition of the pulsing signals to the junction.

2.7 Transmitting speech, tones and supervisory signals.

2.8 Dialling codes 911 to 910 and 92 to 90 to be individually allowed or barred according to straps on cross connexion field.
(N.B. The first digit of the dial code being used to gain access to this relay set).

2.9 N.U. tone to be returned to the caller and the forward connexion cleared when a barred code is recognised (including an initial train of eleven or more pulses).

2.10 The connexion of a single negative battery meter pulse to the M wire when the called party answers a call for which metering is appropriate.

2.11 Satellite type manual hold when the calling subscriber clears from a connexion which returns a manual hold condition.

2.12 Forward recall under manual hold conditions.

2.13 Guarding the selector level and junction hunter banks and holding the preceding equipment when the junction is in use for an outgoing call via this relay set.

2.14 Guarding the selector level and junction hunter banks when the junction is in use for:-

(a) an incoming call via this relay set.

(b) an outgoing call via the outgoing register and assistance relay set.

2.15 Guarding the circuit against seizure for a further outgoing call during the maximum release period of the distant exchange equipment following release by the calling party.

2.16 Permitting the routing of an incoming call as soon as the distant exchange equipment has released following release by the calling party or as a result of facility 2.9.

2.17 (U.A.X. No. 13 only) Junction busying by disconnexion of the line to the G.S.C., where the circuit is unidirectional.

2.18 (U.A.X. No. 13 only) Forced release of the circuit in the following circumstances:-

(i) Seizure without subsequent dialling (P.G. condition).

(ii) 'Called subscriber held' condition.

2.19 Busying the circuit from the associated M.D.F. busying strip.

3. CIRCUIT DESCRIPTION

3.1 Outline

If, in describing the operation or release of a relay any contact is not mentioned, it should be assumed that it performs no useful function at that stage.

This circuit caters for ordinary and 'pay on answer' coin box subscribers, and extends calls via the G.S.C. by loop-disconnect pulsing,

the first one or two digits also being repeated to the counting uniselector which permits or bars the call. Metering via the local call timing equipment is effected on receipt of a reversal of line polarity when the called subscriber answers. Manual hold is required on certain switchboard services, but to avoid counting all the received digits, the subscriber's line equipment and selectors are held momentarily when the caller clears from any outgoing call, followed by the release of the equipment unless manual hold conditions have been detected in the meantime. Precautions are taken to ensure the complete release of the connexion if the caller clears but quickly recalls. This is done by preventing relay BD from reoperating on recall unless the counting uniselector and discriminating relays have restored to normal or manual hold conditions obtain.

Incoming calls are routed through this equipment to an incoming group selector via an incoming relay set.

Junctions from the U.A.X. to the G.S.C. are shared by the relay set carrying G.S.C. register and assistance traffic. The latter contains a junction hunter whose battery testing P wire condition is controlled by this circuit.

3.2 Location

Relays, relay contacts etc., can be located by using the grid reference shown on the right hand side of the diagram.

3.3 Detail

The following operational details are described:-

Seizure via level 9 (UAX No. 14) or via discriminator (UAX No. 13)	par.	3.3.1
Dialling a permitted code, 2 to 0	"	3.3.2
Dialling a permitted code 11 to 10	"	3.3.3
Dialling a barred code	"	3.3.4
Pulses in excess of 10	"	3.3.5
Called subscriber answers	"	3.3.6
Release from an answered call, caller clears first	"	3.3.7
Release from an answered call, called subscriber clears first	"	3.3.8
Release from busy tone or an unanswered call	"	3.3.9
Release from a barred call	"	3.3.10
Manual hold	"	3.3.11
Forced release of circuit under time pulse control	"	3.3.12
Outgoing call from S.T.D. junction hunter	"	3.3.13
Incoming call	"	3.3.14
Junction busying	"	3.3.15
Routine testing	"	3.3.16

3.3.1 Seizure via level 9 (UAX No. 14) or via discriminator (UAX No. 13)

When the relay set is seized, relay A operates to a loop connected to the incoming negative and positive wires from the preceding equipment.

Relay A operating,
- A1 operates relay B.
- A2 prepares to extend a loop via diode D2, to the junction.

Relay B operating,
- B1 prepares the metering circuit (see Design Details).
- B2 disconnects the testing in battery from, and connects earth to the selector level P wire to hold the preceding equipment and busy the selector level access.
- B3 completes a hold circuit for relay B to cover the transit time of contact A1 during pulsing.
- B4 operates relay BD to earth via the home contact of uniselector arc CS3.
- B5 operates relays HJ and MD and prepares the operating circuits for relays DA, DD, J, MA and NU.

Relay BD operating,
- BD1 prepares the operating circuit for relay CD.
- BD2 prepares a hold circuit for relay BD independently of the home contact of arc CS3.
- BD3 connects earth to the traffic recorder lead.
- BD4 prepares the pulsing loop (see Design Details).
- BD5 prepares the time pulse release circuit (U.A.X. No. 13 only).
- BD6 prepares to extend the calling loop to junction.
- BD7 disconnects the junction hunter P1 wire to busy the outlet.

Relay HJ operating at contact B5,
- HJ1 connects an alternative holding and guarding earth to the selector level P wire.
- HJ3 prepares a holding circuit independently of contact B5.
- HJ4 operates relay SK.
- HJ5) HJ6) extend the calling loop to line to seize the distant equipment (and release relay BG in the case of a unidirectional junction at a U.A.X. No. 13).

Relay MD operating at contact B5,
- MD2 prepares the operating circuit for relay J.
- MD3 completes a holding circuit for relay MD independently of contact J4.
- MD4 prevents the premature operation of relay DD.

Relay SK operating at contact HJ4,
- SK1 short circuits test jacks 7 and 8 (see Deisgn Details).
- SK2 connects earth to the P wire associated with the M.D.F. busying strip.

3.3.2 Dialling a permitted code 2 to 0

The calling subscriber dials a permitted code, e.g. digit 2.

Relay A responding to the loop-disconnect pulses received over the selector level negative and positive wires,
- A1 operates relay CD, energises the CS uniselector magnet and short circuits relay B which holds during pulsing.
- A2 repeats the pulses to the distant exchange.

Relay CD operating and holding during pulsing,
- CD1 short circuits relay DE to prevent the surges induced in the secondary winding of transformer T1 during pulsing from momentarily operating relay DE.
- CD2 short circuits the secondary winding of transformer T1 to provide a non-inductive pulsing loop.
- CD4 disconnects the testing-in battery from the digit counting uniselector wiper CS1.
- CD5 operates relay CA.

Relay CA operating,
- CA1 prepares the operating circuit for relay J.

At the end of the pulse train relay A remains operated.

Relay A operated,
- A1 maintains relay B operated, disconnects the CS uniselector magnet to complete the stepping of the wipers and short-circuits relay CD which releases.
- A2 maintains the loop to the outgoing negative and positive wires.

Relay CD releasing slowly (see Design Details).
- CD1 disconnects a short-circuit from relay DE.
- CD2 disconnects the short-circuit from T1 secondary.
- CD3 operates relay J.
- CD4 reconnects the testing-in battery to the CS1 uniselector wiper. Since digit 2 is assumed to be a permitted code, terminal SCA1 is strapped to terminal MA, and relay MA operates.
- CD5 releases relay CA.

Relay MA — operating,
- MA1 prevents the CS uniselector wipers being stepped by subsequent dialled digits.
- MA2 completes a holding circuit for relay MA and isolates terminal MA.
- MA3 disconnects the operate circuit for relay NU to prevent its possible operation via arc CS2 when contact J3 operates.

Relay J — operating slowly at contact CD3 (see Design Details),
- J1 prepares the metering circuit.
- J2 completes an alternative holding circuit for relay J and prepares the operating circuit for relay DA.
- J4 short circuits the make element of contact DE1 (see Design Details).

Relay CA — releasing slowly at contact CD5 (see Design Details),
- CA1 disconnects the operating circuit for relay J which continues to hold via contact J2.

On completion of dialling RING TONE, BUSY TONE or NU TONE is returned from the distant exchange and the following relays are held operated:- A, B, BD, HJ, J, MA, MD and SK.

3.3.3 Dialling a permitted code 11 to 10

The calling subscribers dials a permitted code, e.g. 14 and on dialling the first digit '1' relay A responds to the loop-disconnect pulse.

Relay A — releasing,
- A1 operates relay CD, energises the CS uniselector magnet and short circuits relay B which holds during pulsing.
- A2 repeats the pulses to the distant exchange.

Relay CD — operating and holding during pulsing,
- CD1 short circuits relay DE to prevent the surges induced in the secondary winding of transformer T1 during pulsing from momentarily operating relay DE.
- CD2 short circuits the secondary winding of transformer T1 to provide a non-inductive pulsing loop.
- CD4 disconnects the testing-in battery from the digit counting uniselector wipers.
- CD5 operates relay CA.

Relay CA — operating,
- CA1 prepares the operating circuit for relay J.

At the end of the first pulse train relay A remains operated.

Relay A — operated,
- A1 maintains relay B operated, disconnects the CS uniselector magnet to step the wipers and short-circuits relay CD which releases.
- A2 maintains the loop to the outgoing negative and positive wires.

Relay CD — releasing slowly (see Design Details),
- CD1 disconnects a short circuit from relay DE.
- CD2 disconnects the short-circuit from T1 secondary.
- CD3 operates relay J.
- CD5 releases relay CA.

Relay J — operating slowly (see Design Details),
- J1 prepares the metering circuit.
- J2 completes an alternative holding circuit for relay J and prepares the operating circuit for relay DA.
- J3 switches the testing-in battery from wiper CS1 to wiper CS2 in preparation for the second digit.
- J4 short-circuits the make element of contact DE1 (see Design Details).

Relay CA releasing slowly at contact CD5 (see Design Details),
CA1 disconnects the operating circuit for relay J which continues to hold via contact J2.

Relay A responding to the second train of dialled pulses, in this case the digit 4.

Relay A responding to the loop-disconnect pulses,
A1 operates relay CD, steps the CS uniselector and short circuits relay B which holds during pulsing.
A2 repeats the pulses to the distant exchange.

Relay CD operating and holding during pulsing,
CD1 short circuits relay DE to prevent the surges induced in the secondary winding of transformer T1 during pulsing from momentarily operating relay DE.
CD2 short circuits the secondary wonding of transformer T1 to provide a non-inductive pulsing loop.
CD4 disconnects the testing battery from the digit counting uniselector wiper CS2.
CD5 operates relay CA.

Relay CA operating, all contacts of the relay are ineffective at this stage.

At the end of the pulse train relay A remains operated.

Relay A operated,
A1 maintains relay B operated, and short circuits relay CD which releases.
A2 maintains the loop to the outgoing negative and positive wires.

Relay CD releasing slowly (see Design Details),
CD1 disconnects the short circuit from relay DE.
CD2 disconnects the short-circuit from T1 secondary.
CD4 reconnects the testing-in battery to the CS2 uniselector wiper. Since digit 4 is assumed to be a permitted code, terminal SCA29 is strapped to terminal MA, and relay MA operates.
CD5 releases relay CA.

Relay MA operating,
MA1 prevents the CS uniselector wipers being stepped by subsequent dialled digits.
MA2 completes the holding circuit for relay MA and isolates terminal MA.
MA3 disconnects the operate circuit for relay NU.

Relay CA releasing at contact CD5, all contacts of this relay are ineffective at this stage.

On completion of dialling RING TONE, BUSY TONE or NU TONE is returned from the distant exchange and the following relays are held operated:-
A, B, BD, HJ, J, MA, MD and SK.

3.3.4 Dialling a barred code

The calling subscriber dials a barred code, e.g digit 0. The circuit operation is the same as that previously described under para. 3.3.2 up to the point where relay CD releases at the end of the pulse train:-

Relay CD releasing slowly (see Design Details),
CD1 disconnects a short circuit from relay DE.
CD2 disconnects the short-circuit from T1 secondary.
CD3 operates relay J.
CD4 reconnects the testing-in battery to the CS1 uniselector wiper. Since digit 0 is assumed to be a barred code, terminal SCA8 is strapped to terminal NU, and relay NU operates.
CD5 releases relay CA.

Relay NU operating,
- NU1 connects NU tone to the calling subscriber via the tone winding of transformer T1.
- NU2 prevents the CS uniselector wipers being stepped by subsequent dialled digits.
- NU3 disconnects the operate circuit for relay MA to prevent its possible operation via arc CS2 when contact J3 operates.
- NU4 completes a holding circuit for relay NU and isolates terminal NU.
- NU5 releases relay HJ.

Relay J operating slowly at contact CD3 (see Design Details),
- J2 completes an alternative holding circuit for relay J.

Relay HJ releasing slowly at contact NU5,
- HJ1 disconnects the alternative holding earth from the selector level outlet.
- HJ2 prepares the CS uniselector homing circuit.
- HJ3 disconnects the short-circuit from contact B5 to ensure early release of relays J, MD and NU during subsequent clear down.
- HJ4 releases relay SK.
- HJ5) HJ6) release the equipment at the G.S.C.

Relay CA releasing slowly at contact CD5, all contacts of this relay are ineffective at this stage.

Relay SK releasing slowly at contact HJ4,
- SK1 prepares to connect the testing-in battery to the junction hunter and selector level P wires.
- SK2 disconnects the earth from the P wire associated with the M.D.F. busying strip.
- SK3) SK4) connect the incoming equipment to junction, thereby enabling an incoming call to mature.

3.3.5 Pulses in excess of 10

If for any reason a continuous train of pulses exceeding 10 is received, the CS uniselector wipers are stepped, and when the last outlet is reached, relay NU is operated from earth at contact CD4 via wiper CS1 and bank contact 11.

Relay NU operating,
- NU1 connects NU tone to the transmission bridge via the tone winding of transformer T1.
- NU2 prevents the CS uniselector from being stepped off the last outlet by subsequent pulses.
- NU3 disconnects the operate circuit for relay MA.
- NU4 completes a holding circuit for relay NU and isolates terminal NU.
- NU5 releases relay HJ.

When pulsing eventually ceases, relay CD releases.

Relay CD releasing slowly,
- CD3 operates relay J.
- CD5 operates relay CA.

The remainder of this circuit description is as given in the previous para. 3.3.4 starting at the point where relay J is operated.

3.3.6 Called subscriber answers

When the called party answers, the battery and earth potentials on the outgoing negative and positive wires are reversed and relay DE, which hitherto has been shunted by diode D2 (see Design Details), operates.

Relay DE operating,
- DE1 releases relay MD and prepares an operating circuit for relay DD.

Relay MD — releasing slowly (see Design Details),
- MD1 connects a short circuit across contact DD2 (see Design Details).
- MD3 prevents the reoperation of relay MD should the called subscriber flash at this stage.
- MD4 operates relay DD.

Relay DD — operating,
- DD1 connects the metering battery, via resistor R1, to the M wire to operate the calling subscriber's meter.
- DD3) DD4) reverse the potentials of the incoming negative and positive wires for supervisory purposes.
- DD5 completes the operating circuit for relay DA and releases relay J.
- DD6 short-circuits contact A2, to ensure that when relay A releases momentarily during the changeover of contacts DD3 and 4, the release of contact A2 is masked by contact DD6.
- DD7 prevents the misoperation of relay TM on the subsequent release of relay J.

Relay DA — operating.
- DA1 ensures that relay DE is not short circuited should relay CD operate due to relay A releasing momentarily when contacts DD3 and 4 change-over.
- DA2 prevents an irregular reoperate circuit for relay BD should the caller flash with the called subscriber on the line.
- DA3 short-circuits contacts A2 and DD6 to ensure that when the calling party clears an interaction is not set up between relays A, DE and DD.
- DA4 completes a holding circuit for relay DA independently of contacts DD5 and J2.
- DA5 disconnects the pulsing loop independently of contact CD2 to prevent subsequent operations of contact CD2 from short-circuiting the outgoing negative and positive wires.
- DA6 prevents the reoperation of relay MD on the subsequent release of relay J.

Relay J — releasing slowly at contact DD5 (see Design Details),
- J1 disconnects the metering battery from the M wire.

Speech conditions are now established.

The following relays are held operated at this stage:-

A, B, BD, DE, DD, HJ, MA and SK.

3.3.7 Release from an answered call, calling subscriber clears first

Relays held operated prior to release:- A, B, BD, DE, DA, DD, HJ MA and SK. Disconnexion of the calling party's loop releases relay A.

Relay A — releasing,
- A1 transfers a short circuit from relay CD to relay B. Relay CD operates and relay B releases.

Relay CD — operating,
- CD5 operates relay CA.

Relay CA — operating,
- CA2 completes a holding circuit for relays DA, DD, MA and HJ independently of contact B5, to delay the release of the preceding selector long enough for manual hold conditions to be detected if present.

Relay B — releasing slowly at contact A1 (see Design Details),
- B2 disconnects the short circuit from contact HJ1.
- B3 disconnects the earth from diode D1.
- B4 releases relay BD.
- B5 disconnects the short circuit from contacts CA2 and HJ3.

Relay BD releasing,
- BD1 releases relay CD.
- BD2 prepares the CS uniselector homing circuit.
- BD3 disconnects the earth from the traffic recorder lead.
- BD6 disconnects the forward junction loop to release relay DE and the equipment in the distant exchange.
- BD7 reconnects the junction hunter P1 wire.

Relay DE releasing,
- DE1 releases relay DD.

Relay DD releasing,
- DD3) DD4) restore the normal potentials to the selector level negative and positive wires.

Relay CD releasing slowly at contact BD1 (see Design Details),
- CD5 releases relay CA.

Relay CA releasing slowly (see Design Details),
- CA2 releases relays MA, HJ and DA.

Relay MA releasing, all contacts at this stage are ineffective.

Relay HJ releasing slowly at contact CA2 (see Design Details),
- HJ1 disconnects earth from the selector level P wire to release the preceding equipment.
- HJ2 completes the homing circuit for uniselector CS.
- HJ4 releases relay SK.
- HJ5) HJ6) prepare the reconnexion of the junction negative and positive wires to the incoming equipment.

Relay DA releasing slowly at contact CA2 (see Design Details),
- DA3 disconnects the short-circuit from contact A2.

Relay SK releasing slowly at contact HJ4 (see Design Details),
- SK1 reconnects the testing-in battery to the junction hunter and selector level P wires.
- SK2 disconnects earth from the P wire associated with the M.D.F. busying strip.
- SK3) SK4) reconnect the junction negative and positive wires to the incoming equipment.

All relays have now released and the circuit is free for further calls.

3.3.8 Release from an answered call, called subscriber clears first

Relays held operated prior to release:- A, B, BD, DE, DA, DD, HJ, MA and SK.

The circuit operation is similar to that described above under par. 3.3.7 except that relays DE and DD are released as follows:-

When the called subscriber clears, the potentials of the outgoing negative and positive wires are reversed and relay DE releases.

Relay DE releasing,
- DE1 releases relay DD.

Relay DD releasing,
- DD3) DD4) restore the normal potentials to the selector negative and positive wires for supervisory purposes.
- DD7 connects earth via relay TM to the TP start lead to start the time pulse circuit.

When the calling party clears, the release of the circuit is initiated by the disconnexion of the loop from the selector level negative and positive wires and the circuit functions as described under para. 3.3.7.

3.3.9 Release from busy tone, or an unanswered call

Relays held operated prior to release:- A, B, BD, HJ, J, MA, MD and SK.

Disconnexion of the calling party's loop releases relay A.

Relay A — releasing,
- A1 transfers a short circuit from relay CD to relay B. Relay CD operates and relay B releases.
- A2 disconnects the forward junction loop to release the distant exchange equipment.

Relay CD — operating,
- CD5 operates relay CA.

Relay CA — operating,
- CA2 completes a holding circuit for relays HJ, J, MA and MD independently of contact B5.

Relay B — releasing slowly at contact A1 (see Design Details),
- B2 disconnects the short circuit from contact HJ1.
- B3 disconnects the earth from diode D1.
- B4 releases relay BD.
- B5 disconnects the short circuit from contact CA2.

Relay BD — releasing,
- BD1 released relay CD.
- BD2 prepares the CS uniselector homing circuit.
- BD3 disconnects the earth from the traffic recorder lead.
- BD7 reconnects the junction hunter P1 wire.

Relay CD — releasing slowly (see Design Details),
- CD5 releases relay CA.

Relay CA — releasing slowly (see Design Details),
- CA2 releases relays MA, HJ, J and MD.

Relay MA — releasing, all contacts are ineffective at this stage.

Relay HJ — releasing slowly at contact CA2 (see Design Details),
- HJ1 disconnects earth from the selector level P wire to release the preceding equipment.
- HJ2 completes the homing circuit for uniselector CS.
- HJ4 releases relay SK.
- HJ5) HJ6) prepare the reconnexion of the junction negative and positive wires to the incoming equipment.

Relay J — releasing slowly at contact CA2, all contacts of this relay are ineffective at this stage.

Relay MD — releasing slowly at contact CA2, all contacts of this relay are ineffective at this stage.

Relay SK — releasing slowly at contact HJ4 (see Design Details),
- SK1 reconnects the testing-in battery to the junction hunter and selector level P wires.
- SK2 disconnects earth from the P wire associated with the M.D.F. busying strip.
- SK3) SK4) reconnect the junction negative and positive wires to the incoming equipment.

All relays have now released and the circuit is free for further calls.

3.3.10 Release from a barred call

Relays held operated prior to release:- A, B, BD, J, MD and NU.

Disconnexion of the calling party's loop releases relay A.

Relay A — releasing,
A1 — transfers a short circuit for relay CD to relay B. Relay CD operates and relay B releases.

Relay CD — operating,
CD5 — operates relay CA.

Relay CA — operating, all contacts of this relay are ineffective at this stage.

Relay B — releasing slowly at contact A1,
B2 — disconnects earth from the selector level P wire to release the preceding equipment.
B3 — disconnects earth from diode D1.
B4 — releases relay BD.
B5 — releases relays NU, J, AND MD.

Relay BD — releasing,
BD1 — releases relay CD.
BD2 — completes the CS uniselector homing circuit.
BD3 — disconnects the earth from the traffic recorder lead.
BD7 — reconnects the junction hunter P1 wire.

Relay NU — releasing at contact B5,
NU1 — disconnects NU tone from the tone winding of transformer T1.

Relay CD — releasing slowly at contact BD1,
CD5 — releases relay CA.

Relay J — releasing slowly at contact B5, all contacts of this relay are ineffective at this stage.

Relay MD — releasing slowly at contact B5, all contacts of this relay are ineffective at this stage.

Relay CA — releasing slowly at contact CD5,
CA3 — reconnects the testing-in battery to the junction hunter and selector level P wires.

All relays have now been released and the circuit is free for further calls.

3.3.11 Manual Hold

Relays held operated prior to release:- A, B, BD, HJ, J, MA, MD and SK.

On those switchboards providing a manual hold facility no reversal is returned to the U.A.X. from G.S.C. when the operator answers the call.

(a) Disconnexion of the calling party's loop releases relay A

Relay A — releasing,
A1 — transfers a short circuit from relay CD to relay B. Relay CD operates and relay B releases.
A2 — disconnects the outgoing junction loop, thus signalling a clear condition to the distant equipment.

Relay CD — operating,
CD1 — short-circuits relay DE.
CD5 — operates relay CA.

Relay CA — operating,
CA2 — completes a holding circuit for relays HJ, J, MA and MD independently of contact B5.

Relay B releasing slowly at contact A1 (see Design Details),
B2 disconnects the short circuit from contact HJ1.
B3 disconnects the earth from diode D1.
B4 releases relay BD.
B5 disconnects the short circuit from contacts CA2 and HJ3

Relay BD releasing,
BD1 releases relay CD.
BD2 prepares the CS uniselector homing circuit.
BD3 disconnects the earth from the traffic recorder lead.
BD6 operates relay MH to the manual hold battery returned on the positive junction wire from the G.S.C.

Relay MH operating,
MH1 prepares a reoperating circuit for relay BD should the calling party recall.
MH2 disconnects the original operating circuit for relay CA and completes an alternative holding circuit for this relay.

Relay CD releasing slowly at contact BD1, all contacts of this relay are ineffective at this stage.

The circuit remains inthis condition until the calling subscriber recalls or the operator releases the circuit.

(b) Recall from manual hold

Relays held operated at this stage:- CA, HJ, J, MA, MD, MH and SK.

If the calling subscriber recalls, relay A operates to the calling loop.

Relay A operating,
A1 reoperates relay B.
A2 prepares to complete the junction loop.

Relay B reoperting,
B2 connects a holding earth to the selector level P wire independently of contacts HJ1.
B3 completes an independent holding circuit for relay B.
B4 reoperates relay BD.
B5 completes an independent holding circuit for relays HJ, J, MA and MD.

Relay BD reoperting,
BD1 prepares an operating circuit for relay CD.
BD2 completes an independent holding circuit for relay BD.
BD3 reconnects earth to the traffic recorder.
BD6 releases relay MH and completes the junction loop to the G.S.C.

Relay MH releasing slowly (see Design Details),
MH2 releases relay CA.

Relay CA releasing,
CA2 disconnects the short circuit from contact B5.

Recall is complete and conversation may proceed.

(c) Release from manual hold

Relays held operated at this stage:- CA, HJ, J, MA, MD, MH and SK.

If the subscriber does not recall, the operator clears the connexion by withdrawing the answering plug. Relay MH releases.

Relay MH releasing,
MH2 releases relay CA.

Further release of the circuit is now similar to that described under para. 3.3.9 commencing at the point where relay CA is released.

All relays have now released and the circuit is free for further calls.

3.3.12 Forced release of circuit under time pulse control - (applicable to U.A.X. No. 13 only)

Forced release of the circuit is effected under time pulse control when:-

(a) the circuit and junction are seized but dialled pulses are not received.

(b) The circuit and junction are held after the called subscriber has answered and cleared.

In each case relay TM operates in series with relay TA in the time pulse circuit.

Relay TM operating (see Design Details),
TM1 prepares a circuit for:-

(a) operating relay DD and holding relay MD in the case where the circuit is seized and no further dialling takes place.

(b) operating relays MD and DD in the case where the called subscriber has answered and cleard.

TM2 holds relay TM.

After a period of 1 to 2 minutes, if the PG or CSH condition persists, earth is connected to the time pulse release lead which permits relays DD and MD to be operated simultaneously via contact TM1.

Contact DD2) operated simultaneously disconnect earth from the selector
Contact MD1) level P wire to release the preceding equipment, this relay set and the junction.

3.3.13 Outgoing call from S.T.D. junction hunter

Where S.T.D. traffic and level 9 traffic share the same group of junctions to the G.S.C. a searching junction hunter tests in to 150 ohms battery via resistor R5 and arc CS1 in parallel with relay SK which operates. The earth potential from the junction hunter P1 wire also busies the selector level P wire.

Relay SK operating slowly (see Design Details),
SK1 holds relay SK and reduces battery power consumption by disconnecting resistor R5.
SK2 busies the P wire associated with the M.D.F. busying strip.
SK3) extends the S.T.D. call to the junction.
SK4)

3.3.14 Incoming call

The seizure of the incoming equipment causes the incoming P1 wire to be earthed, operating relay CA. This also applies if an incoming call arrives while a caller, who has dialled a spare or barred code, is holding the equipment while receiving NU tone.

Relay CA operating,
CA3 busies the selector level and junction hunter P wires.

3.3.15 Junction busying (U.A.X. No. 13 outgoing unidirectional circuit only)

In the idle state relay BG is connected across the junction negative and positive wires and remains permanently operated by the line potentials supplied by the distant incoming relay set. The circuit may be busied by the release of relay BG due to one of the following conditons:-

(a) disconnexion of the line at the distant exchange.
(b) interruption of the idle line current by a fault condition.
(c) wrongful reversal of the negative and positive line connexions.

Relay BG releasing slowly (see Design Details),
BG1 connects earth to the busying alarm relay.
BG2 connects earth to the M.D.F. P-wire and operates relay CA.

Relay CA operating,
CA3 busies the selector level and junction hunter P wires by disconnecting the testing-in battery fed via resistor R5.

3.3.16 Routine testing

Insertion of the tester plug into the relay set test jack connects earth to test jack spring 22 to operate relay RT.

Relay RT operating,
RT1 connects earth to the selector level P wire to busy access via level 9.
RT2 prevents the operation of the junction busying alarm relay (U.A.X. No. 13 unidirectional circuit only).
RT3) RT4) disconnect the junction negative and positive wires.
RT5 connects earth to the junction hunter P wire to busy access via selector levels 1 or 0.

4. DESIGN DETAILS

4.1 Relay timing information

To ensure satisfactory operation of the circuit, the lags of the timed relays should under the appropriate circuit conditions, be within the limits shown in the table, excepting those marked N.C. 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	150	225			By short-circuit
CA	250	350 NC			
CD	120	180			By short-circuit
DA	200	300 NC			
HJ	130	200 NC			
J	200	300 NC	55	85 NC	
MD	250	375 NC			
MH	100	200 NC			By shunt diode
SK	250	350 NC	80	130 NC	
TM	60	90 NC			

4.2 Relays with special features

Relay DE — is designed to include a release current test to avoid an excessive release lag under supervisory conditions due to the slugging effect of diode D2.

Relay MH — is provided with a 10,000 ohm winding to ensure that it will operate in series with the A relay of any final selector or auto-to-auto relay set, etc., without holding that relay.

4.3 The following relays are made slow to release:-

Relay B — by short circuit, to hold during pulsing and to prevent its release due to momentary flicks of contact A1 when contacts DD3 and 4 change-over. Its release also forms part of the release guard period on unanswered outgoing calls.

Relay BG — by diode D7 to allow relay SK to operate before the release of relay BG thus preventing the premature operation of relays CA and J.

Relay CA — has a release lag to form part of the release guard period and to allow sufficient time for the operation of relay J after the receipt of the first train of pulses.

Relay CD — by short circuit, to hold during pulsing and to provide part of the release guard period during release of the circuit from outgoing calls.

Release DA — to ensure that this relay does not release prematurely when the calling subscriber flashes.

Relay HJ — to form part of the release guard period during release of the circuit from outgoing calls.

Relay J — to provide a single metering battery, of the correct duration on the M wire when the called subscriber answers (see also para. 4.4).

Relay MD — to ensure (at contact MD4) that any momentary operations of relay DE, as switching of the forward equipment takes place, cannot operate relay DD.

Relay MH — by the shunt diode D4 to ensure that on recall from a manual hold condition relay MH releasing does not prematurely disconnect the operate circuit for relay BD at contact MH1.

Relay SK — to form part of the release guard condition (see also para. 4.4).

Relay TM — to ensure that it holds long enough, during a forced release condition, to allow the preceding selector to release after relay TM is disconnected at contact DD7.

4.4 The following relays are made slow to operate

Relay J — to ensure that where digit discrimination is required after the receipt of one digit relay MA (or relay NU) will have sufficient time to operate and establish a hold circuit, before the operate circuit for relay MA (or relay NU) is disconnected at contact J3.

Relay SK — to ensure that the testing-in relay in the junction hunter is fully operated before the 150 ohm battery via resistor R5 is disconnected at contact SK1.

4.5 Contacts not previously fully explained

Contact B1 — prevents a meter pulse being connected to the M Wire if the calling subscriber clears immediately prior to the completion of the called subscriber answer sequence.

Contact BD4 — ensures that the relay set is not seized with the secondary winding of transformer T1 short-circuited, a condition which may give rise to acoustic shock.

Contact J4 — operated, short-circuits the make element of contact DE1 to ensure that the meter pulse applied to the M wire is not mutilated should the caller subscriber flash during this period.

Contact MD1y — is a 'y' action to ensure that when the called subscriber answers the selector level P wire is not disconnected at contact DD2 when relay DD operates via contact MD4.

Contact SK1 — when operated short-circuits test jack springs 19 and 20 to ensure that relay SK is not released should the test link be removed during an outgoing call.

4.6 Diodes

D1 — prevents resistor R2 from having a slugging effect on the CS uniselector.

D2) D3) — maintain a low resistance loop and prevent the operation of relay DE under normal line conditions. They allow relay DE to operate to the reversal of potential on the outgoing negative and positive wires when the called subscriber answers.

D4 — see Design Details - Relay MH.

D5 — prevents relay MH from being affected by a junction earth potential difference.

D6 — should a wrongful reversal of the negative and positive line connexions be encountered, this diode will interrupt the normal idle line current flowing via relay BG which releases to busy the circuit (see para. 3.3.15).

D7 — see relay BG.

4.7 Miscellaneous items

Resistor R4) Capacitor C3) — form a spark quench for contact A2.

Ballast Resistor RB1 — limits the current which flows via relay A and by partly compensating for variations in line resistance enables a reasonably uniform supply of current to be fed to the calling subscriber's transmitter.

Terminals MA and NU

(a) where a dialling code is permitted, connect the appropriate dialling code terminal to terminal MA via the cross-connexion strip SCA.

(b) where a dialling code is barred, connect the appropriate dialling code terminal to terminal NU via the cross-connexion strip SCA.

4.8 This circuit was designed to work in conjunction with the following common services:-

Junction Busying Alarm, U.A.X. No. 13	AT 4082 Fig. 23
Time pulse start, hold and release, U.A.X. No. 13	AT 5406 Fig. 2
N.U. tone earth, U.A.X. No. 13	AT 60131
N.U. tone earth U.A.X. No. 14	AT 4161, Fig. 1

5.

HISTORY

Issue A Test springs 6 and 9, previously spare brought into use. U 17 wiring modified to facilitate interchangeability with relay set AT 60076. Discriminator note added. Fig. 2 added to save I.D.F space. Notes 5 and 6 added and note 2 amended.

Issue B Diode D7 added.

Telecommunications Development Department
TD 1.1.2/DW/447
July 1970

END OF DIAGRAM NOTES

POST OFFICE TELECOMMUNICATIONS HEADQUARTERS

SPECIFICATION T 60075B

APPARATUS AND CABLING

OUTGOING CIRCUIT

WITH

BOTHWAY SWITCHING

TO G.S.C.

U.A.X. NOS. 13 AND 14

DIAGRAM AT 60075

I N D E X

1. GENERAL
2. RELAY-SET NO. 214796A

   2.1 Assembly Details
   2.2 Layout of Apparatus
   2.3 Apparatus Schedule
   2.4 Wiring
   2.5 Labelling and Marking

3. RACK MOUNTED EQUIPMENT AND INSTALLATION

   3.1 Assembly Details
   3.2 Apparatus Schedule
   3.3 Cabling and Wiring
   3.4 Labelling and Marking

4. RELEVANT DOCUMENTS

   4.1 Documents relevant to Relay-set No. 2/4796A
   4.2 Documents relevant to Rack-mounted Equipment and Installation

5. HISTORY

1. GENERAL

Specification T 5252 shall be taken to form part of this Specification.

2. RELAY-SET NO. 2/4796A

The relay-set shall mount one circuit to Diagram AT 60075 Fig. 1 and shall comply with Specification T 5301.

2.1 Assembly Details. The apparatus shall be assembled on a Mounting RS2/3000/26 to Drawing 61202. The Assembly shall be to Drawing TP 204, Sheet 10 Fig. 1 with rear covers to Drawing SC0/28 and Mounting, Capacitor No. 24 to Drawing 61207. The Plug No. 3201 shall be secured to the mounting plate RS2/3000/26 the apparatus shall be mounted in accordance with Specification T 5301. A front cover, Relay-cover BE, $16\frac{17}{32}$ inches, to Drawing 61204, shall be provided on the relay-set.

2.2 Layout of Apparatus

R1/R2/R3	R5A/R5B
RB1	A
T1	B ≠
	BG
BD	CD
CA	MA
HJ	NU
MH	SK
DE	TM
DA	MD
≠ DD	J ≠
+	RT
CS	SCB

≠ To be fitted with Cover to Drawing 71261

The apparatus mounting positions detailed in Clause 2.3 shall be in accordance with Specification T 5301 and Drawing TP 603.

2.3 Apparatus Schedule

≠ Indicates red label

Item	Description	Mounting Position
AT 60075		
Fig. No. 1		
A	Relay No. 3/412K ≠	A1/ 4/1
B	" No. 9762	A1/ 6/1
	Cover BX/3	on relay B
BD	Relay No. 4442	A1/ 9/1
BG	" No. 11885	A1/ 8/1
CA	" No. 5702	A1/11/1
CD	" No. 16661	A1/10/1
DE	" No. 5457 ≠	A1/17/1
DA	" No. 16086	A1/19/1
DD	" No. 17456	A1/21/1
	Cover BX/3	on relay DD
HJ	Relay No. 5280	A1/13/1
J	" No. 4907	A1/22/1
	Cover BX/3	on relay J

2.3 Apparatus Schedule (Cont'd)

Item	Description	Mounting Position
AT 60075		
Fig. No. 1		
MA	Relay No. 17457	A1/12/1
MD	" No. 17455	A1/20/1
MH	" No. 9658	A1/15/1
NU	" No. 7712	A1/14/1
RT	" No. 17590	A1/24/1
SK	" No. 5024	A1/16/1
TM	" No. 9407	A1/18/1
T1	Transformer No. 3/215A	A1/5-7/1
CS	Uniselector No. 4/31A	A1/25/1
	Jack No. 89A	A1/25/1
SCA	Strip Connexion No. 121J	D4/AB/1
SCB	" " No. 145DN	B1/26/1
RB1	Resistor Barretter No. 1	A1/ 3/1
R1	Resistor Coil No. 9 - 270 ohms	A1/ 1/1
R2	" " No. 9 - 470 ohms	A1/ 1/2
R3	" " No. 9 - 390 ohms	A1/ 1/3
(R4)	" Spool No. 6 - 200 ohms	on capacitor C3
R5A	" Coil No. 9 - 300 ohms	A1/ 2/1
R5B	" " No. 9 - 300 ohms	A1/ 2/2
(RX1)	Resistor Non-Linear No. 2	Across Coil tags CD relay
(RX2)	" " No. 2	" " " B "
(RX3)	" " No. 2	" " " BD "
(RX4)	" " No. 2	" " " DA "
(RX5)	" " No. 2	" " " J "
(RX6)	" " No. 2	" " " HJ "
(RX7)	" " No. 2	" " " MD "
(RX8)	" " No. 2	" " " TM "
(RX9)	" " No. 2	" " " DD "
(RX10)	" " No. 2	" " " SK "
(RX11)	" " No. 2	" " " CA "
C1	Capacitor M.C. No. 102C	D4/1/1
C2	" " No. 102C	D4/2/1
C3	" " No. 101	D4/3/1
(D1)	Valve Electronic No. CV 8308	SCB/1-2
(D2)	" " No. CV 8308	SCB/3-4
(D3)	" " No. CV 8308	SCB/5-6
(D4)	" " No. CV 8308	SCB/7-8
(D5)	" " No. CV 8308	SCB/9-10
(D6)	" " No. CV 8805	SCB/11-12
TJ	Jack Test No. 21G	A1/34-35/1
	" " No. 21G	A1/37-38/1

2.3 Apparatus Schedule (Cont'd)

Item	Description	Mounting Position
AT 60075 Fig. No. 1		
	Link N Red " N Red " N Green	A1/34/7-8 A1/37/19-20 A1/34/11-12
	Plug No. 3201	E1/3/1

2.4 Wiring. The relay-set shall be wired in accordance with Diagram ATW 60075 - unless otherwise specified in the order, except that any strapping shown in the notes on the diagram shall not be provided. Specification T 5241 shall apply. The numbering of the shelf plug points (U points) and test points (TJ) shall be in accordance with Diagram TP 3009.

2.5 Labelling and Marking. The circuit designation marking of components and the code marking of the relay-set shall be in accordance with Specification T 4525.

END OF SPECIFICATION FOR RELAY-SET NO. 2/4796A

3. RACK MOUNTED EQUIPMENT AND INSTALLATION

3.1 Assembly Details. Relay-set No. 2/4796A shall be mounted on the Unit Auto No. 13F or 14F which shall be in accordance with Specification T 1393 or T 5272 and Drawing TP 598 or TP 504 respectively. The items listed in the Apparatus Schedule, Clause 3.2 shall be supplied and mounted as indicated in the schedule.

3.2 Apparatus Schedule

Item	Description	Mounting Position
	Label No. 237 (four) " No. 379 (one)	B1/1/1 to B1/4/1 A1/33/1
	Jack No. 61 Fuse No. 44A/1 - one per circuit	Mounted on rack

3.3 Cabling and Wiring. Specifications T 5241 and T 1393 shall apply. The tag numbering for the shelf jack points (U points) shall be in accordance with Diagram TP 3009.

Where alternative wiring or strapping is shown, that which is appropriate to the installation of the apparatus shall be provided.

The rack common services shall be wired in accordance with Diagram TPW 3001- or TPW 3374- for U.A.X. No. 13 or 14 respectively.

3.4 Labelling and Marking. Specifications T 5180 and T 1198 or T 5260 shall apply for U.A.X. No. 13 or 14 respectively.

Marking of connexion strips on I.D.F.
Local and Multiple sides

U.A.X. No. 13 and 14

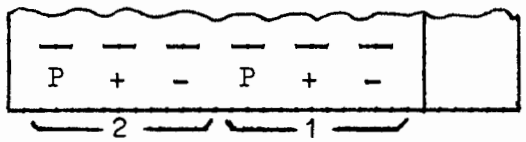
O/G		B/W
GSC	OR	GSC
F1		F1

(F1 typical; indicates Unit)

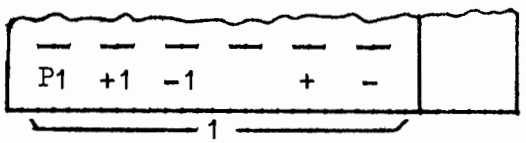
Allocation of tags on connexion strips on I.D.F.

U.A.X. No. 13:-

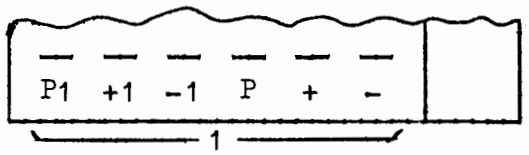
Local Side (Fig. 1)



Multiple Side (Fig. 1)

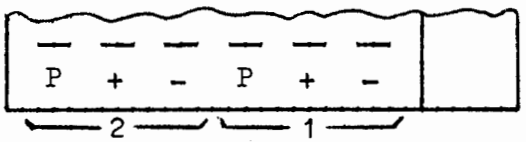


Local Side (Figs. 1 and 2)

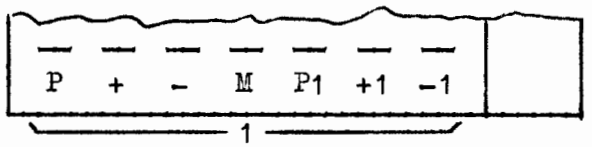


U.A.X. No. 14:-

Local Side (Fig. 1)



Multiple Side (Fig. 1)



4. RELEVANT DOCUMENTS

4.1 Documents relevant to Relay-set No. 2/4796A

Drawings	Diagrams	Specifications
61202 61204 61207 71261 SCO/28 TP 204 Sheet 10 TP 603	AT 60075 ATW 60075 TP 3009	T 4525 T 5241 T 5252 T 5301

4.2 Documents relevant to Rack mounted Equipment and Installation

Drawings	Diagrams	Specifications
TP 504 TP 598	AT 60075 ATW 60075- TP 3009 TPW 3001- TPW 3374-	T 1198 T 1393 T 5180 T 5241 T 5260 T 5272

5. HISTORY

Date	Issue	Details of Change
June 1967	Open	-
February 1968	A	Addendum No. 1 issued (CN 68/25).
August 1969	B	Relays A and NU editorial corrections. Relay DE was D, Diodes D1-6 were MR1-6. (CN 69/59)

END OF SPECIFICATION

TD 1.1.2/JHH/DW

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