K.27.8.1963 (H)

POST OFFICE ENGINEERING DEPARTMENT

DIAGRAM NOTES AT 60085

SPECIFICATION T 60085

FINAL SELECTOR 2-10 TYPE

UNIT AUTO NO. 13

(AT 5279 MODIFIED)

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1. GENERAL

The diagram shows the circuit of a 100 outlet final selector with P.B.X. groups of 2-10 lines, provided at a U.A.X. No. 13 (AT 5279) as modified for Subscriber Trunk Dialling and/or Changed Number and Service Interception.

The following diagrams should be considered in conjunction with this circuit:-

AT 60087 U.A.X. NO. 13 SUBSCRIBERS LINE, LINE FINDER AND CONTROL RELAY SET.. (AT 3721 MODIFIED FOR S.T.D.).

AT 60068 U.A.X. NO. 13 GROUP SELECTOR.

2. FACILITY SCHEDULE

Provision is made for:-

2.1 Access to a total multiple of 100 lines including 2-10 P.B.X. groups.

2.2 Holding the preceding apparatus in the chain of connexions.

2.3 Vertical stepping under the control of the first train of pulses received by the selector.

2.4 Rotary stepping under the control of the second train of pulses received by the selector.

2.5 Testing the first line of a P.B.X. group and, should it be busy, automatic rotary search for a free line over the remainder of the group.

2.6 The transmission of busy tone to the caller if a particular number dialled is busy, or if all lines in a P.B.X. group are busy.

2.7 Applying ringing conditions to the called subscriber's line and returning ring tone to the calling party.

2.8 The transmission of metering or supervisory signals to the calling party when the called subscriber answers.

2.9 Night service facilities on any line of a P.B.X. group other than the first.

2.10 Guarding the circuit against intrusion during the progress and release of a call.

2.11 A transmission and current finding bridge for the calling and called party's lines.

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2.12 Trunk offering on calls from the parent exchange.

2.13 Forced release of the circuit (a) under the control of the time pulse circuit when C.S.H. conditions are encountered and (b) when the call originates via a parent exchange faulty junction, i.e. with an earth or battery fault.

2.14 Prevention of the forced release condition from being applied when a non-meter answer signal is encountered.

2.15 The selector to be automatically busied if the wiper carriage remains off-normal during release, or if the battery is disconnected by a blown fuse, the appropriate alarm condition being given.

3. CIRCUIT DESCRIPTION

3.1 Outline

The selector wiper carriage steps vertically under the control of the "tens" digit to the level corresponding to that digit. After the inter-train pause the wiper carriage is rotated under the control of the "units" digit and the wipers stop at the bank contact appropriate to that digit. The called subscriber's line is tested and if it is free, ringing current is applied to the line and ring tone is returned to the caller. When the called party answers the ringing is tripped and supervisory and metering conditions are returned to the calling party. If busy conditions are encountered, busy tone is returned to the caller. On a call made to a P.B.X. group the first line being free, the circuit operation is as already described, but if the first line is busy, hunt start conditions are set up and rotary search takes place until either a free line is found, or the last line of the group is reached and found busy when further rotary stepping is prevented and busy tone is returned to the caller. In the case of a parent exchange call, a positive battery via the M wire operates relay TO, the contacts of which remove a short-circuit from the windings of relay OC. If the called subscriber is busy, trunk offering is effected by the operator momentarily operating the ringing key, which causes an earth to be applied to the junction loop. This unbalance operates the differential relay OC and subsequent circuit operation gives access to the wanted subscriber. When the subscriber is released from the original connexion, the operator receives the clear supervisory signal and re-operates the ringing key. The re-operation of relay OC releases relay F causing ringing to be applied to the subscribers line. When C.S.H. conditions persist, the circuit is forced released under the control of the time pulse circuit. If a call is made to a service (such as Service Interception) which returns a non-meter answer signal, the time pulse sequence occurs but forced release is prevented.

3.2 Location

It should be imagined that this diagram is divided into four equal sections and referred to as follows:-

Top left	(TL)	Top right	(TR)
Bottom left	(BL)	Bottom right	(BR)

Each relay coil and relay contact is immediately followed by an indication of the location in an abbreviated form as shown in the brackets above.

3.3 Detail

The following operational details are described:-

3.3.1 Seizure from a local subscriber or a non-parent junction.

3.3.2 Dialling.

3.3.3 Ordinary line free.

3.3.4 Called subscriber answers.

3.3.5 Ordinary line busy.

3.3.6 P.B.X. call.

3.3.7 Seizure from the parent exchange.

3.3.8 Trunk offering.

3.3.9 Subscriber accepts trunk call.

3.3.10 Operator rings subscriber.

3.3.11 Release of the selector from an unanswered call.

3.3.12 Release of the selector from an answered call.

3.3.13 Release of the selector from busy conditions.

3.3.14 C.S.H. conditions followed by forced release of the selector.

3.3.15 Faulty (earth or battery connected) parent junction.

3.3.16 Call encountering a non-meter answer signal.

3.3.17 Release alarm.

3.3.18 P.B.X. "night service" calls.

3.3.1 Seizure from a local subscriber or a non-parent junction

A loop on the negative and positive wires operates relay A.

Relay A	(TL)	operating,
A1	(BL)	operates relay B.
Relay B	(BL)	operating,
B1	(TL)	connects the guarding and holding earth to the P wire and disconnects the testing-in battery.
B2	(BL)	disconnects the release alarm earth circuit.
B3	(BL)	prepares pulsing and holding earth circuits.
B4	(BL)	operates relay CD.
B5	(BR)	prepares to operate relay HS when the 1st line of a P.B.X. is dialled. See also "Design Details".
B6	(BR)	prepares to operate relay H if the called subscriber's line is free.
Relay CD	(BL)	operating,
CD1	(BL)	are ineffective at this stage.
CD3	(BL)	
CD4	(BR)	
CD5	(BR)	
CD2	(BL)	prepares a pulsing circuit for the vertical magnet in series with the 5 ohm winding of relay CD.

The following relays are held operated at this stage:- A, B, and CD.

3.3.2 Dialling

The "tens" train of pulses releases and re-operates relay A for each pulse.

Relay A	(TL)	releasing during the break pulse,
A1	(BL)	short-circuits relay B which holds and energises the vertical magnet via the 5 ohm winding of relay CD.

During the pulsing of relay A, relays B and C hold. The selector wiper carriage is stepped vertically to the level determined by the digit dialled.

N Springs		operating when the wiper carriage steps off-normal.
N1	(TL)	are ineffective at this stage. See para. 3.3.17.
N2	(BL)	
N3	(BL)	short-circuits relay CD (700 ohm winding) to make it slow to release, and prepares operate circuits for relays E and HR.
Relay A	(TL)	held operated at the end of the pulse train,
A1	(BL)	removes the short-circuit from relay B and releases relay CD.
Relay CD	(BL)	releasing after its slow release period,
CD3	(BL)	operates relay E in series with the vertical magnet.
CD1	(BL)	are ineffective at this stage.
CD2	(BL)	
CD4	(BR)	
CD5	(BR)	
Relay E	(BL)	operating after its slow operate period,
E1	(TL)	is ineffective at this stage.
E2	(BL)	changes over the pulsing circuit from the vertical to the rotary magnet.
E3	(BL)	prepares to hold relay E.
E4	(BR)	re-operates relay CD.
E5	(BR)	are ineffective at this stage. See "Design Details".
E6	(BR)	
Relay CD	(BL)	re-operating,
CD1	(BL)	are ineffective at this stage.
CD4	(BR)	
CD5	(BR)	
CD2	(BL)	prepares the rotary magnet pulsing circuit.
CD3	(BL)	holds relay E via contact E3.

The "units" train of pulses releases and re-operates relay A for each pulse.

Relay A	(TL)	releasing and re-operating to the pulses,
A1	(BL)	repeats the break pulses to the rotary magnet.

Relays B and C hold during the pulse train. The wiper carriage is rotated to the bank contact corresponding to the digit dialled. The operation and release of the RM1 springs is ineffective at this stage.

NR Springs		operating as the wiper carriage is rotated off-normal,
NR1	(BL)	earths the P wire independently of contacts F1 and D3.
NR2	(BL)	is ineffective at this stage. See "Design Details".
NR3	(BR)	short-circuits the 700 ohm winding of relay CD to make it slow to release.

At the end of the "units" train, relay A is held by the calling loop.

Relay A	(TL)	held by the calling loop,
A1	(BL)	holds relay B and releases relay CD.
Relay CD	(BL)	releasing after its slow release period,
CD1	(BL)	are ineffective at this stage.
CD2	(BL)	
CD4	(BR)	
CD3	(BL)	releases relay E.
CD5	(BR)	connects earth via the testing relay H to the P1 wiper. See also "Design Details".

The following relays are held operated at this stage: A, B, and E.

3.3.3 Ordinary line free

Relay H	(BR)	operating to battery via the P1 wiper,
H1	(BL)	disconnects the pulsing circuit from the rotary magnet.
H2	(TR)	operates relay HR.
H3	(TR)	connect relay D to the positive and negative wires.
H4	(TR)	of the transmission bridge.
H5	(BR)	holds relay H via its 1000 ohm winding.
H6	(TR)	short-circuits the operate winding of relay H, guards the called subscriber's line circuit and holds relay K in that circuit.
Relay HR	(TR)	operating,
HR1	(TL)	is ineffective at this stage. See para. 3.3.8.
HR2	(BR)	prepares to operate relay J.
HR3	(TR)	prepares to hold relay F.
HR4	(TR)	prepares to extend ringing to the negative wire of the called line.
HR5	(TR)	connects ring return battery to the positive wire of the called line.
HR6	(BR)	is ineffective at this stage. See para. 3.3.8 and "Design Details".
Relay E	(BL)	releasing after its slow release period,
E1	(TL)	are ineffective at this stage.
E2	(BL)	
E3	(BL)	
E6	(BR)	
E4	(BR)	re-operates relay CD by removal of the shunting earth.
E5	(BR)	operates relay J.
Relay CD	(BL)	re-operating,
CD1	(BL)	are ineffective at this stage.
CD2	(BL)	
CD3	(BL)	
CD4	(BR)	
CD5	(BR)	connects an earth to the release relay lead.
Relay J	(BR)	operating,
J1	(TL)	prepares a metering circuit on the M wire.
J2	(TL)	connects ring tone to relay A, which returns it to the caller.
J3	(BL)	is ineffective at this stage.
J4	(TR)	connects ringing to the called subscriber's line via relay F.

The following relays are held operated at this stage:-

A, B, CD, H, HR and J.

3.3.4 Called subscriber answers

The loop via the called subscriber's telephone operates relay F.

Relay F	(TR)	operating,
F1	(BL)	completes the time pulse start circuit.
F2	(TL)	disconnects the ring tone circuit from relay A.
F3	(BR)	are ineffective at this stage. See "Design Details"
F4	(TR)	for contact F3.
F5x	(TR)	holds relay F.
F6	(TR)	disconnect the ringing circuit from, and connect the
F7	(TR)	transmission bridge to, the called subscriber's line. Relay D operates.

Relay D	(TR)	operating,
D1	(TL)	reverse the potentials of the incoming line for
D2	(TL)	supervisory purposes.
D3	(BL)	disconnects the time pulse start circuit.
D4	(BL)	re-operates relay E.
Relay E	(BL)	re-operating,
E1	(TL)	connects battery to the M wire for metering purposes.
E2	(BL)	
E4	(BR)	are ineffective at this stage.
E6	(BR)	
E3	(BL)	holds relay E independently of contact D4.
E5	(BR)	releases relay J.
Relay J	(BR)	releasing after its slow release period,
J1	(TL)	disconnects the metering battery from the M wire.
J2	(TL)	
J3	(TR)	are ineffective at this stage.
J4	(BL)	

The connexion between the calling and called parties' lines is now complete and conversation can proceed.

The relays held operated at this stage are:-

A, B, CD, D, E, F, H and HR.

3.3.5 Ordinary line busy

Seizing and dialling is as described in paras. 3.3.1 and 3.3.2.

Following the reception of the "units" digit, relay H tests the P wire during the slow release period of relay E. Should the line be busy relay H fails to operate and relay E releases. The following relays are operated at this stage:- A, B and E.

Relay E	(BL)	releasing after its slow release period,
E1	(TL)	
E2	(BL)	
E3	(BL)	are ineffective at this stage.
E6	(BR)	
E4	(BR)	re-operates relay CD by removal of the shunting earth.
E5	(BR)	operates relay G.
Relay CD	(BL)	re-operating,
CD1	(BL)	
CD2	(BL)	
CD3	(BL)	are ineffective at this stage.
CD4	(BR)	
CD5	(BR)	connects an earth to the release relay lead.
Relay G	(BR)	operating,
G1	(BL)	is ineffective at this stage. See para. 3.3.7.
G2	(TL)	completes the busy tone circuit via relay A.
G3	(BR)	is ineffective at this stage. See para. 3.3.9.
G4	(BR)	is not used.

Busy tone is being returned to the caller and the following relays are held operated:- A, B, CD and G.

3.3.6 P.B.X. call

3.3.6.1 P2 multiple conditions

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

3.3.6.2 First line free

Circuit operations for seizure and dialling are as in paras. 3.3.1 and 3.3.2, except that in addition the final release of contact CD4 operates relay HS to the 200 ohm resistance battery via the P2 wiper.

If the 1st line of the P.B.X. group is free, relay H operates via the P1 wiper, and the subsequent operations are as in paras. 3.3.3 and 3.3.4, except that, with relay HS operated, contact E5 releasing is ineffective and later, contact CD4 releases relay HS, as contact H5 prevents it holding on the 450 ohm winding. The release of relay HS allows relay J to operate via contact E5 released.

The operation and release of relay HS, serves no useful purpose.

3.3.6.3 First line busy

In this case, relay HS operates as in para. 3.3.6.2 but not relay H.

Relay HS	(BR)	operating,
HS1	(BL)	prepares to operate the rotary magnet.
HS2	(TL)	are ineffective at this stage. See "Design Details" for contacts HS2 and HS6.
HS4	(BR)	
HS6	(BR)	
HS3	(BR)	places relay G under the control of the RM1 springs.
HS5	(BR)	holds relay HS during subsequent P.B.X. hunting.
Relay E	(BL)	releasing after its slow release period,
E1	(TL)	are ineffective at this stage.
E2	(BL)	
E3	(BL)	
E5	(BR)	
E6	(BR)	
E4	(BR)	re-operates relay CD.
Relay CD	(BL)	re-operating,
CD1	(BL)	energises the rotary magnet.
CD2	(BL)	are ineffective at this stage.
CD3	(BL)	
CD4	(BR)	
CD5	(BR)	removes the short-circuit from relay G. Relays G and H are now in series with the P1 wiper for subsequent outlet testing.
Rotary Magnet RM		(BL) operates and steps the wipers to the next P.B.X. line,
Springs RM1	(BL)	operate relay G.
Relay G	(BR)	operating,
G1	(BL)	releases the rotary magnet.
G2	(TL)	is ineffective at this stage.
G3	(BR)	disconnects earth from the hold winding of relay HS which is slow to release.
G4	(BR)	is not used.

3.3.6.4 Intermediate line free

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

Rotary Magnet RM		(BL) releasing,
Springs RM1	(BL)	disconnect the operate circuit of relay G, which holds in series with relay H.

Relay H	(BR)	operating,
H1	(BL)	prevents further operation of the rotary magnet.
H2	(TR)	operates relay HR.
H3	(TR)	connect relay D to the positive and negative wires
H4	(TR)	of the transmission bridge.
H5	(BR)	holds relays H and HS.
H6	(TR)	earths the P1 wiper for guarding and holding purposes, and short-circuits the operate winding of relay H and the hold winding of relay G. Relay G releases.

Relay HR	(TR)	operating,
HR1	(TL)	are ineffective at this stage.
HR6	(BR)	
HR2	(BR)	prepares to operate relay J.
HR3	(TR)	prepares the hold circuit of relay F.
HR4	(TR)	prepares to connect ringing to the negative wire of the called line.
HR5	(TR)	connects ring return battery to the positive wire of the called line.

Relay G	(BR)	releasing,
G1	(BL)	are ineffective at this stage.
G2	(TL)	
G3	(BR)	releases relay HS. See "Design Details".
G4	(BR)	is not used.

Relay HS	(BR)	releasing after its slow release period,
HS1	(BL)	are ineffective at this stage.
HS2	(TL)	
HS5	(BR)	
HS6	(BR)	
HS3	(BR)	operate relay J.
HS4	(BR)	

Relay J	(BR)	operating,
J1	(TL)	prepares a metering circuit on the M wire.
J2	(TL)	connects ring tone to relay A.
J3	(BL)	is ineffective at this stage.
J4	(TR)	completes the ringing circuit to the called subscriber's line.

When the called subscriber answers, the circuit operations are as described in para. 3.3.4.

3.3.6.5 Intermediate line busy

When the wipers step to the intermediate P.B.X. line, relays G and H are applied in series to the P1 wiper and the RM1 springs operate relay G. If the line is busy relay H cannot operate, nor can relay G hold via its hold winding.

Relay G	(BR)	operating,
G1	(BL)	releases the rotary magnet.
G2	(TL)	is ineffective at this stage.
G3	(BR)	disconnects the hold circuit of relay HS.
G4	(BR)	is not used.

Rotary Magnet RM (BL) releasing,

Springs RM1 (BL) release relay G.

Relay G	(BR)	releasing,
G1	(BL)	re-operates the rotary magnet.
G2	(TL)	is ineffective at this stage.
G3	(BR)	re-energises the hold winding of relay HS.
G4	(BR)	is not used.

Rotary Magnet RM (BL) re-operating, steps the wipers to the next P.B.X. line. It is assumed that this is the last line.

Springs RM1 (BL) re-operate relay G.

3.3.6.6 Last line busy

On the last line of a P.B.X. group, the earth via the P2 bank contact holds relay G via resistor R5.

Relay G	(BR)	re-operating,
G1	(BL)	releases the rotary magnet.
G2	(TL)	prepares to connect busy tone to the A relay.
G3	(BR)	releases relay HS.
G4	(BR)	is not used.

Rotary Magnet RM (BL) releasing,

Springs RM1 (BL) leave the hold of relay G dependent on the earth via the P2 wiper.

Relay HS	(BR)	releasing after its slow release period,
HS1	(BL)	are ineffective at this stage.
HS4	(BR)	
HS5	(BR)	
HS2	(TL)	connects busy tone to the A relay.
HS3	(BR)	transfers the hold of relay G to the B3 contact.
HS6	(BR)	disconnects the circuits of relays G and H from the P1 wiper.

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

3.3.7 Seizure from the parent exchange

The circuit functions are as described in para. 3.3.1, and, in addition a low resistance positive battery is connected to the M wire from the incoming junction equipment, to operate relay TO.

Relay TO	(TL)	operating,
TO1	(TL)	remove short-circuits from the windings of relay OC, which remains unoperated to balanced line conditions.
TO2	(TL)	
TO3y	(TL)	disconnects the M wire to prevent positive battery drain.
TO4	(TL)	holds relay TO.

3.3.8 Trunk Offering

In order to obtain connexion to a busy subscriber the parent exchange operator momentarily operates the "ringing" key, thus causing earthing of the junction loop to unbalance the currents in the windings of relay OC, which, being differentially connected, operates.

The following relays are held at this stage:- A, B, CD, G and TO.

Relay OC	(TL)	operating,
OC1	(TR)	operates relay F.
Relay F	(TR)	operating,
F1	(BL)	completes the time pulse start circuit.
F2	(TL)	are ineffective at this stage.
F3	(HR)	
F4	(TR)	operates relay HR.
F5x	(TR)	prevents the re-application of a short-circuit of the 400 ohm winding of relay F.
F6	(TR)	prepare the transmission path to the wanted subscriber.
F7	(TR)	

Relay HR	(TR)	operating,
HR1	(TL)	operates relay D.
HR2	(BR)	releases relay G and operates relay J.
HR3	(TR)	prepares a hold circuit for relay F.
HR4	(TR)	complete the transmission path between the operator
HR5	(TR)	and the wanted subscriber.
HR6	(BR)	connects earth via relay H to the P1 wiper.
Relay J	(BR)	operating, its contacts are ineffective at this stage.
Relay D	(TR)	operating,
D1	(TL)	disconnect relay OC from, and reverse the potentials
D2	(TL)	to, the negative and positive wires. Relay OC releases.
D3	(BL)	disconnects the time pulse start circuit.
D4	(BL)	is ineffective at this stage.
Relay G	(BR)	releasing after its slow release period,
G1	(BL)	are ineffective at this stage.
G3	(BR)	
G2	(TL)	disconnects busy tone from relay A.
G4	(BR)	is not used.
Relay OC	(TL)	releasing,
OC1	(TR)	transfers the hold of relay F from contact H6 to contact B3.

The operator offers the trunk call to the wanted subscriber.

The following relays are held operated at this stage:- A, B, CD, D, F, HR, J, and TO.

3.3.9 Subscriber accepts trunk call

When the subscribers clear the original connexion, relay H operates to battery via the P1 wiper.

Relay H	(BR)	operating,
H1	(BL)	completes an operate circuit for relay E. See Relay E under "Design Details".
H2	(TR)	holds relay HR independently of contact F4.
H3	(TR)	releases relay D and connects one winding of the relay to the positive wire.
H4	(TR)	connects the second winding of relay D to the negative wire.
H5	(BR)	holds relay H.
H6	(TR)	earths the P1 wiper for holding and guarding purposes, and short-circuits the operate winding of relay H.
Relay D	(TR)	releasing,
D1	(TL)	restore normal potentials on the negative and
D2	(TL)	positive wires and re-connect relay OC in series with relay A.
D3	(BL)	connects an earth to the time pulse start circuit.
D4	(BL)	disconnects the operate circuit for relay E.

The operator receives the clear supervisory signal.

The following relays are held operated at this stage:- A, B, CD, F, H, HR, J and TO.

3.3.10 Operator rings subscriber

The operator momentarily re-operates the ring key and relay OC re-operates and releases.

Relay OC	(TL)	re-operating,
OC1	(TR)	releases relay F.

Relay F	(TR)	releasing after its slow release period,
F1	(BL)	disconnects earth from the time pulse start lead.
F2	(TL)	connects ring tone to relay A.
F3	(BR)	are ineffective at this stage.
F4	(TR)	
F5x	(TR)	
F6	(TR)	connect ringing to the subscriber's line.
F7	(TR)	
Relay OC	(TL)	releasing,
OC1	(TR)	is ineffective at this stage, due to contact F5x being released.

The following relays are held operated at this stage:- A, B, CD, H, HR, J and TO.

The called subscriber is being rung. When the subscriber answers, the circuit operations are as described in para. 3.3.4 with the exception that metering is prevented by contact TO3y.

3.3.11 Release of the selector from an unanswered call

Relays held prior to release are:- A, B, CD, H, HR and J (also relay TO, if the call came from the parent exchange). The calling party clears and relay A releases.

Relay A	(TL)	releasing,
A1	(BL)	short-circuits relay B which releases.
Relay B	(BL)	releasing after its slow release period,
B1	(TL)	disconnects the NR1 earth from the selector level P wire to release the preceding equipment.
B2	(BL)	prepares the rotary magnet circuit.
B3	(BL)	releases relays H, HR and J.
B4	(BL)	releases relay CD (and relay TO if the call originated at the parent exchange).
B5	(BR)	are ineffective at this stage.
B6	(BR)	
Relay HR	(TR)	releasing,
HR1	(TL)	prevents the subsequent re-operation of relay D.
HR2	(BR)	are ineffective at this stage.
HR3	(TR)	
HR6	(BR)	
HR4	(TR)	disconnect the ringing circuit from the subscriber's line.
HR5	(TR)	
Relay H	(BR)	releasing,
H1	(BL)	completes the rotary magnet self-drive circuit. The selector begins to restore to normal.
H2	(TR)	are ineffective at this stage.
H3	(TR)	
H4	(TR)	
H5	(BR)	
H6	(TR)	removes the busy condition from the P1 wiper and releases relay K in the subscriber's line circuit.
Relay TO	(TL)	releasing, its contacts are ineffective at this stage.
Relay CD	(BL)	releasing,
CD1	(BL)	are ineffective at this stage.
CD2	(BL)	
CD3	(BL)	
CD4	(BR)	
CD5	(BR)	disconnects earth from the release relay lead.

Relay J	(HR)	releasing after its slow release period,
J1	(TL)	are ineffective at this stage.
J3	(BL)	
J4	(TR)	
J2	(TL)	disconnects ring tone from relay A.

When the wiper carriage is rotated to the 12th rotary position (vertical release position) the NR springs release. As the rotary magnet is re-energised for the 13th time, the RM1 springs are prevented mechanically from re-operating and the rotary pawl is prevented from engaging with the shaft, while the wiper carriage restores vertically.

Springs NR		releasing, are ineffective at this stage.

The wiper carriage restores under spring action on the normal level and releases the N springs.

Springs N		releasing,
N1	(TL)	re-connects the testing-in battery to the selector level P wire.
N2	(BL)	releases the rotary magnet.
N3	(BL)	are ineffective at this stage.

3.3.12 Release of the selector from an answered call

Relays held prior to release are:- A, B, CD, D, E, F, H and HR (also relay TO if the call came from the parent exchange). The calling party clears and relay A releases.

Relay A	(TL)	releasing,
A1	(BL)	short-circuits relay B which releases.
Relay B	(BL)	releasing after its slow release period,
B1	(TL)	disconnects the NR1 earth from the selector level P wire, to release the preceding equipment.
B2	(BL)	prepares the rotary magnet circuit.
B3	(BL)	releases relays E, F, H and HR.
B4	(BL)	releases relay CD (and relay TO if the call came from the parent exchange).
B5	(BR)	are ineffective at this stage.
B6	(BR)	
Relay HR	(TR)	releasing,
HR1	(TL)	prevents the subsequent re-operation of relay D.
HR2	(BR)	are ineffective at this stage.
HR3	(TR)	
HR6	(BR)	
HR4	(TR)	disconnect the transmission bridge from the subscriber's line. Relay D releases.
HR5	(TR)	
Relay H	(BR)	releasing,
H1	(BL)	completes the rotary magnet self-drive circuit. The selector begins to restore to normal.
H2	(TR)	are ineffective at this stage.
H3	(TR)	
H4	(TR)	
H5	(BR)	
H6	(TR)	removes the busy condition from the P1 wiper, and releases relay K in the subscriber's line circuit.
Relay TO	(TL)	releasing, its contacts are ineffective at this stage.
Relay CD	(BL)	releasing,
CD1	(BL)	are ineffective at this stage.
CD2	(BL)	
CD3	(BL)	
CD4	(BR)	
CD5	(BR)	disconnects earth from the release relay lead.

Relay D	(TR)	releasing,
D1	(TL)	restore the normal polarity to the selector level
D2	(TL)	negative and positive wires,
D3	(BL)	completes the time pulse start circuit.
D4	(BL)	is ineffective at this stage.
Relay F	(TR)	releasing after its slow release period,
F1	(BL)	disconnects the time pulse start circuit.
F2	(TL)	
F3	(BR)	
F4	(TR)	
F5x	(TR)	are ineffective at this stage.
F6	(TR)	
F7	(TR)	
Relay E	(BL)	releasing after its slow release period, its contacts are ineffective at this stage.

The rectangular release of the selector wiper carriage and the restoration of the off-normal springs (NR and N) is as described in para. 3.3.11.

3.3.13 Release of the selector from busy conditions

Relays held prior to release are:- A, B, CD and G (also relay TO if the call came from the parent exchange).

The calling party clears and relay A releases.

Relay A	(TL)	releasing,
A1	(BL)	short-circuits relay B which releases.
Relay B	(BL)	releasing after its slow release period,
B1	(TL)	disconnects the NR1 earth from the selector level P wire, to release the preceding equipment.
B2	(BL)	prepares the self-drive rotary magnet circuit.
B3	(BL)	releases relay G.
B4	(BL)	releases relay CD (and relay TO if the call came from the parent exchange).
B5	(BR)	are ineffective at this stage.
B6	(BR)	
Relay G	(BR)	releasing,
G1	(BL)	completes the self-drive rotary magnet circuit. The selector begins to restore to normal.
G2	(TL)	disconnects busy tone from relay A.
G3	(BR)	is ineffective at this stage.
G4	(BR)	is not used.

The subsequent release of relays TO and CD and the restoration of the selector is as in para. 3.3.11.

3.3.14 C.S.H. conditions followed by forced release of the selector

Prior to the C.S.H. condition the following relays are operated:-

A, B, CD, D, E, F, H and HR.

When the called subscriber clears first, relay D releases.

Relay D	(TR)	releasing,
D1	(TL)	restore the normal potentials to the selector
D2	(TL)	level negative and positive wires.
D3	(BL)	completes the time pulse start circuit.
D4	(BL)	is ineffective at this stage.

Subsequently, a low resistance condition is returned from the time pulse circuit to operate relay TM.

Relay TM	(BL)	operating via the time pulse start lead.
TM1	(BL)	holds relay TM via the time pulse hold lead.
TM2	(BL)	prepares to release relay B.

At the end of the timing period, the time pulse release earth short-circuits relay B which releases.

Relay B	(BL)	releasing after its slow release period,
B1	(TL)	disconnects the P wire to release the preceding equipment.
B2	(BL)	prepares the self-drive rotary magnet circuit.
B3	(BL)	releases relays E, F, H and HR.
B4	(BL)	releases relay CD.
B5	(BR)	are ineffective at this stage.
B6	(BR)	
Relay HR	(TR)	releasing,
HR1	(TL)	disconnects relay D to prevent re-operation when contact H3 is normal.
HR2	(BR)	are ineffective at this stage.
HR3	(TR)	
HR6	(BR)	
HR4	(TR)	disconnect relay D from the negative and positive wipers.
HR5	(TR)	
Relay A	(TL)	released by disconnexion of the loop from the preceding equipment.
A1	(BL)	is ineffective at this stage.
Relay H	(BR)	releasing,
H1	(BL)	completes the rotary magnet self-drive circuit. The selector begins to restore to normal.
H2	(TR)	are ineffective at this stage.
H3	(TR)	
H4	(TR)	
H5	(BR)	
H6	(BR)	removes the busy condition from the P1 wiper and releases the K relay in the called subscriber's line equipment.
Relay CD	(BL)	releasing,
CD1	(BL)	are ineffective at this stage.
CD2	(BL)	
CD3	(BL)	
CD4	(BR)	
CD5	(BR)	disconnects earth from the release relay lead.
Relay F	(TR)	releasing after its slow release period,
F1	(BL)	disconnects the time pulse circuit and releases relay TM.
F2	(TL)	are ineffective at this stage.
F3	(BR)	
F4	(TR)	
F5x	(TR)	
F6	(TR)	
F7	(TR)	
Relay E	(BL)	releasing after its slow release period, its contacts are ineffective at this stage.
Relay TM	(BL)	releasing,
TM1	(BL)	are ineffective at this stage.
TM2	(BL)	

The selector and the NR and N springs restore to normal as in para. 3.3.11.

3.3.15 Faulty (earth, or battery contact) parent junction

The selector is seized as described in para. 3.3.1 with the exception that relays TO and OC are operated in addition to relays A, B and CD.

Relay OC	(TL)	operating,
OC1	(TR)	operates relay F.
Relay F	(TR)	operating,
F1	(BL)	disconnects the earth from the P wire to release the preceding equipment and completes the time pulse circuit.
F4	(TR)	prepares to operate relay HR.
F2	(TL)	are ineffective at this stage.
F3	(BR)	
F5x	(TR)	
F6	(TR)	
F7	(TR)	

The release of the preceding group selector releases relays A and OC.

Relay A	(TL)	releasing,
A1	(BL)	short-circuits relay B and operates the vertical magnet. Relay B releases.
Relay OC	(TL)	releasing,
OC1	(TR)	disconnects the circuit of relay F.
Vertical Magnet VM		(BL) operating, raises the wiper shaft to level 1, and the N springs operate.
Springs N		operating,
N1	(TL)	is ineffective at this stage.
N2	(BL)	prepares the rotary magnet circuit.
N3	(BL)	short-circuits the operate coil of relay CD, and operates relay HR.
Relay HR	(TR)	operating,
HR1	(TL)	operates relay D.
HR2	(BR)	are ineffective at this stage.
HR4	(TR)	
HR5	(TR)	
HR6	(BR)	
HR3	(TR)	holds relay F.
Relay D	(TR)	operating,
D1	(TL)	are ineffective at this stage.
D2	(TL)	
D4	(BL)	
D3	(BL)	disconnects the time pulse circuit.
Relay B	(BL)	releasing after its slow release period.
B1	(TL)	are ineffective at this stage.
B4	(BL)	
B5	(BR)	
B6	(BR)	
B2	(BL)	completes the self-drive circuit for the rotary magnet. The selector begins to restore to normal.
B3	(BL)	releases relays CD, F and HR and also the vertical magnet VM.
Relay HR	(TR)	releasing,
HR1	(TL)	releases relay D.
HR2	(BR)	are ineffective at this stage.
HR3	(TR)	
HR4	(TR)	
HR5	(TR)	
HR6	(BR)	

Relay D	(TR)	releasing,
D1	(TL)	
D2	(TL)	
D3	(BL)	are ineffective at this stage.
D4	(BL)	
Relay CD	(BL)	releasing, its contacts are ineffective at this stage.
Relay F	(TR)	releasing after its slow release period,
F1	(BL)	
F2	(TL)	
F3	(BR)	
F4	(TR)	are ineffective at this stage.
F5x	(TR)	
F6	(TR)	
F7	(TR)	

The rectangular release of the selector wiper carriage and the restoration of the off-normal springs (NR and N) is as in para. 3.3.11.

3.3.16 Call encountering a non-meter answer signal

When the service operator answers, conditions are as described under para. 3.3.4, except that relay D does not operate. Hence relay E remains normal and relay J remains operated.

Contacts D3 normal and F1 operated start the time pulse circuit, and subsequently a low resistance battery condition is returned from the time pulse circuit to operate relay TM.

Relay TM	(BL)	operating,
TM1	(BL)	holds relay TM via the time pulse hold lead.
TM2	(BL)	is prevented from short-circuiting relay B by contact J3 operated, which maintains a holding circuit for relay B via resistor R3.

The circuit remains in this condition until the caller clears.

3.3.17 Release Alarm

Should the selector fail to release due to a mechanical defect the off-normal N springs will not restore. Spring N1 (TL) busies the circuit against seizure and spring N2 (BL) completes the release alarm circuit.

3.3.18 P.B.X. "night service" calls

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

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. All times are in milliseconds.

Relay	Release Lag		Operate Lag		
	Min.	Max.	Min.	Max.	
B	150	225			
CD	100	150			
E			45	70	
F			60	90	
HS	150	225			
J	250	350			

4.2 The following relays have special features:-

Relay B (BL) is made slow to release by contact A1 (released) short-circuiting its winding. The release lag obtained holds the relay during pulsing.

Relay CD (BL) is made slow to release by the N3 springs short-circuiting its 700 ohm winding. The release lag obtained holds the relay during pulse trains.

Relay OC (TL) is connected differentially i.e. it operates only to current difference in its windings.

4.3 The reasons for the use of slow to release relays are as follows:-

Relay HS (BR) to cover the periods of disconnection of its hold circuit at contact G3, operated, during P.B.X. hunting.

Relay J (BR) provides the operation period for the local calling subscriber's meter at contact J1.

4.4 The reasons for the use of slow to operate relays are as follows:-

Relay E (BL) to ensure the relay has sufficient flux to hold for the changeover time of its control contact CD3, which is immediately re-operated from contact E4, and to prevent its operation while trunk offering, during the release of relay D following the operation of relay H.

The inherent release lag is used to prevent the operation of relay G while relays H and HR are operating and the last part of the release lag (with the operate times of relays HR and J) provides the ringing delay period required to disconnect bridging relays from the called line.

Relay F (TR) to prevent the premature operation (or vibration) of the relay to ringing current via a subscriber's bell circuit.

4.5 Rectifiers are used for the following reasons:-

MR1 (BL) to prevent an earth from the circuit being applied to the TP release lead during the operated period of contact TM2.

MR2 (BL) to prevent the shunting of the vertical and rotary magnets by the battery via resistor R2 during the pulsing periods.

MR3 (TL) to prevent the operation of relay TO by negative battery conditions on the M wire.

4.6 Resistors are used for the following reasons:-

Resistor R5 (HR) (a) prevents extension of full earth to the P2 wiper from contact CD1, via the rotary interrupter springs RM1 operated during P.B.X. hunting, thus avoiding simulation of last line conditions for other hunting selectors but (b) allows sufficient current to hold relay G operated when the selector hunts to the last line of a P.B.X. group.

4.7 Contacts not fully explained:-

B5 (HR) prevents the operation of relay HS should the selector wipers pass over the first line of a P.B.X. group during rotary release.

B6 (HR) prevents the operation of relay H when the selector wipers pass over disengaged subscribers lines during rotary release.

CD5 (HR) operated, prevents the operation of relay H when the wipers (under the control of the "units" digit) are passing over disengaged subscriber's lines.

E5 (HR) operated, prevents unnecessary operations of relay G during rotary movement of the wipers under dial control.

E6 (HR) operated, prevents earth and battery conditions via resistor R5 being applied to the P2 wiper, when the wipers are being stepped under the control of the units digit.

F3 (HR) prevents a short-circuit of relay CD by contact E4 and consequent interaction between relays CD and E, subsequent to the answer signal.

F5x (TR) operated, completes a hold circuit for relay F, before contacts F6 and F7 disconnect its operate circuit.

G3 (HR) make contact, ensures the correct sequence of release of relays G and HS respectively when switching to an intermediate P.B.X. line. Should relay HS release before relay G, busy tone would be heard by the calling subscriber.

G4 (HR) is no longer required since the ringing machine runs for the duration of the call, or continuously, as required.

H3 (TR) }
H4 (TR) } normal, disconnect relay D from the transmission bridge capacitors to prevent it adversely affecting the selector pulsing performance.

HR6 (HR) (a) completes an operate circuit for relay H under trunk offering conditions and (b) in conjunction with contact H6 makes relay H slow to release to ensure relay HR releases first on the release of the circuit. This prevents the re-operation of relay D causing the re-operation of relays A and B.

HS2 (TL) operated, disconnects the busy tone circuit from relay A during the P.B.X. hunting period.

HS6	(BR)	operated, holds relay G in series with relay H when switching to a free P.B.X. line (other than the first) to allow contact H1 sufficient time to disconnect the rotary magnet circuit.
J4	(TR)	in conjunction with contacts HR4 and HR5, provides a ringing delay period to allow sufficient time for relay K in the subscriber's line circuit to operate and remove relay L from the line, to prevent premature ring trip.
NR2	(BL)	allows relay E to release on the release of contact CD3.
T03y	(TL)	disconnects relay TO from the M wire to prevent battery drain.

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

Busy tone earth	Diagram AT 60131
Ring tone earth	" "
Int. ring	" "
Ring return battery	" "
Time pulse start, hold and release	" AT 5406 fig. 2
Release Relay	" AT 4082 fig. 2
Release Alarm Earth	" " "

5. HISTORY

Open Issue Nil.

Issue 1

Engineering Department
TPD 3/2/AWB/447
August, 1963.

END OF DIAGRAM NOTES

FIG. A

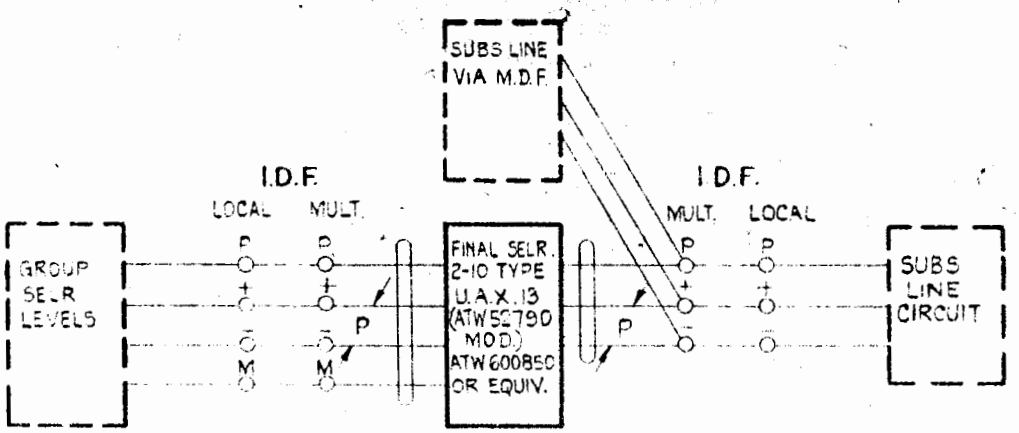
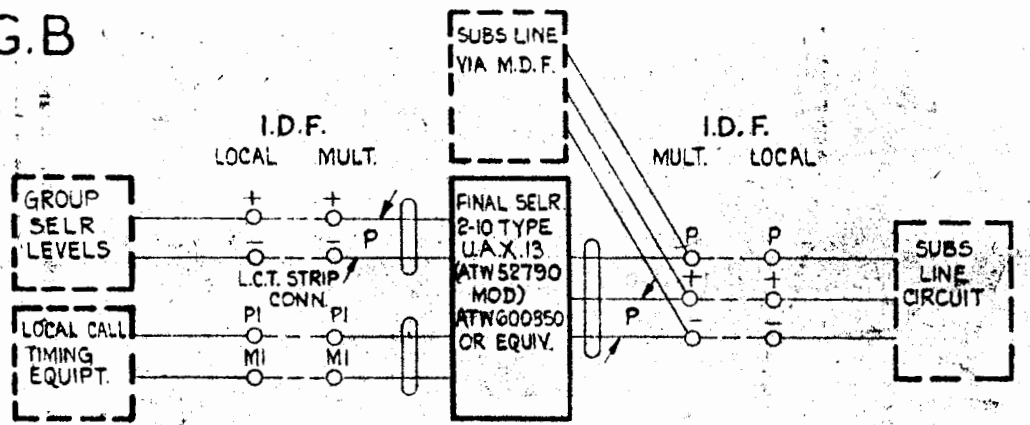


FIG. B



NOTES.

1-1 FOR ARRANGEMENT OF TERMINALS ON I.D.F. SEE TP519/2.

REDRAWN. REMOVED FROM Z CATEGORY CN64/32/13	2	25·6·64	GTB	FINAL SELECTOR 2-10 TYPE UNIT AUTO No.13
	1	16·1·64	REF.	ATW 52790 MODIFIED
AMENDMENT PARTICULARS	ISSUE	DATE	APPD.	REF. T60085 C
G.P.O. APPROVED AS STANDARD	E1/1	16/6/64		ATX 600850
WMP				

POST OFFICE ENGINEERING DEPT.
ENGINEER-IN-CHIEF'S OFFICE

UNIT AUTO No.13A.

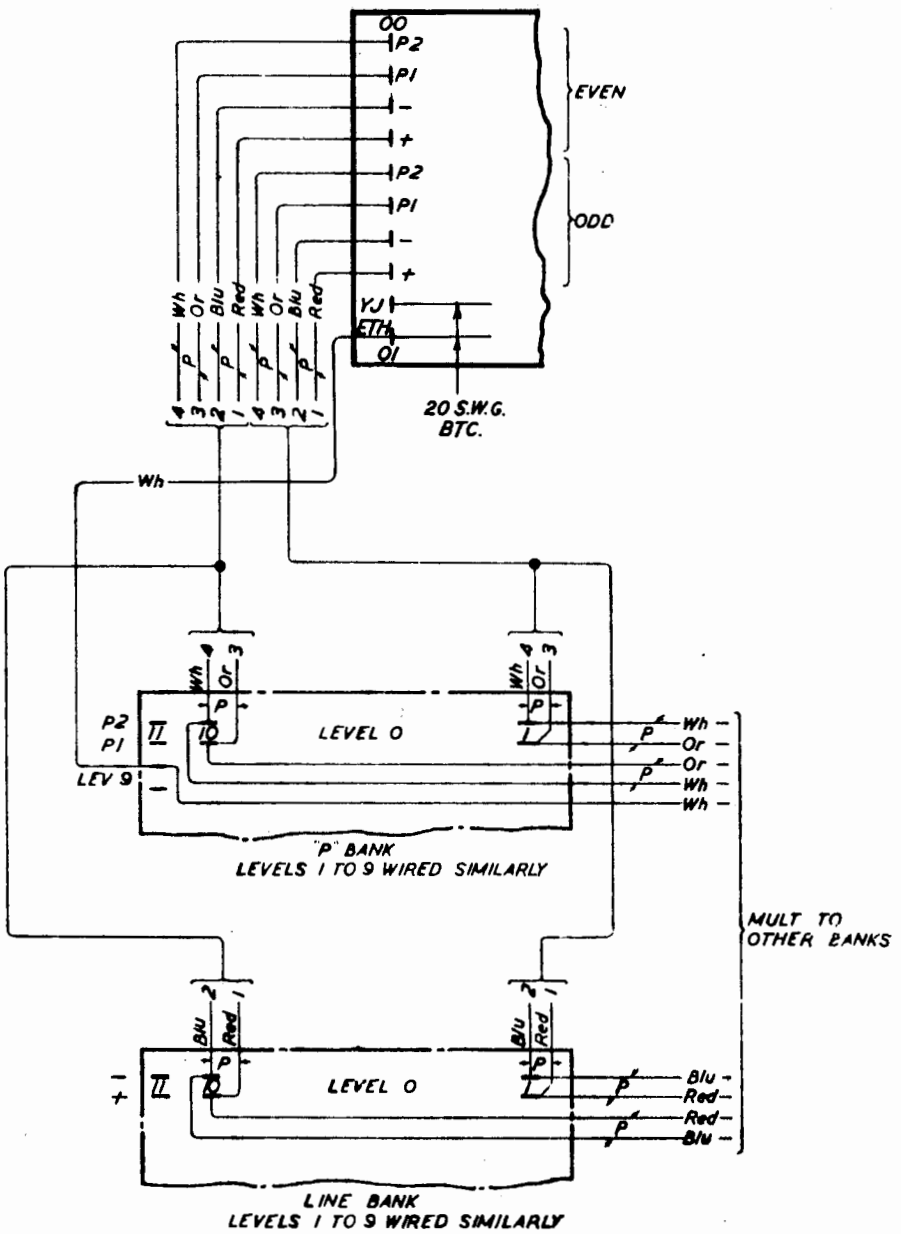
FINAL SELECTOR BANK WIRING SCHEMATIC.

SPECN. T1393.

DIAGRAM TP.3007/1

Drawn	Checked	Approved	Date	SUFFIX
			30-6-39	

Amendment



NOTE

1. FOR TYPICAL EQUIPMENT SEE DRAWING TP.511.
   FOR TYPICAL CABLING & JUMPERING SCHEMATIC SEE DIAGRAM TP.3002.