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POST OFFICE TELECOMMUNICATIONS HEADQUARTERS

DIAGRAM NOTES AT 60079A

SPECIFICATION T 60079

C.C.B. SUBSCRIBERS LINE CIRCUIT

AND LINE FINDER

(25 OR 50 POINT)

U.A.X. NOS. 12, 13 AND 14

1. GENERAL

This diagram shows the circuit arrangement of the line finder equipment used for C.C.B. lines at U.A.X. Nos. 12, 13 and 14 with S.T.D. when P.O.A. working is introduced. On its outgoing side this circuit is connected to coin and fee checking relay sets and the latter are connected to the existing C.C.B. exchange line circuits and line finder equipment.

The 24 or 49 line circuits are divided into a number of sub-groups, each group starting a different line finder as first choice. This enables calls originated simultaneously in each of the sub-groups to be set up simultaneously. Calls originated simultaneously within any one sub-group are switched sequentially without appreciable delay in returning dial tone.

Typical associated diagrams are:-

AT 60050	SUBSCRIBERS LINE, LINEFINDER AND SELECTOR CIRCUITS U.A.X. NO. 12 (AT 5541/1 MODIFIED FOR S.T.D.)
AT 3721	SUBSCRIBERS LINE, LINEFINDER AND CONTROL RELAY SET U.A.X. NO. 13.
AT 4059/1	SUBSCRIBERS LINE, LINEFINDER AND ALLOTTER CONTROLS U.A.X. NO. 14.
AT 60665	COIN AND FEE CHECKING CIRCUIT

2. FACILITY SCHEDULE

Provision is made for:-

(1) A non-homing 25 or 50 point uniselector linefinder to find a calling C.C.B. subscribers line and to connect it to an associated coin and fee checking (C.F.C.) relay set.

(2) Calling equipments to be grouped and offered a choice of linefinders. The grouping arrangements to be flexible so as to cater for various numbers of linefinders and C.C.B. lines.

(3) A start signal to be applied to a linefinder and a marking condition to be connected to the linefinder bank multiple when a C.C.B. subscriber originates a call.

(4) Guarding the final selector multiple P wire when the circuit is seized.

(5) The linefinder on seizure, to extend a pre-operate line loop to the C.F.C. relay set.

(6) The start signal to be transferred to another linefinder if, after approximately seven seconds the original linefinder has not found and switched the calling line to the C.F.C. relay set.

(7) With forced release by the C.F.C. relay set of the succeeding selector train, the calling subscriber to receive N.U. tone for a period of approximately 7 seconds after which the linefinder relay set is released, and in the case of U.A.X.s Nos. 12 and 13 the calling subscribers' line is locked out by the line circuit P relay. In the case of a U.A.X. No. 14 (and No. 13) a P.G. alarm is initiated.

(8) Alternative M wire connexions to cater for both public call offices and privately rented call offices.

(9) A group occupancy meter to be operated from a 1 sec. pulse supply when all linefinders in a group are engaged.

(10) Extending the start lead to the next linefinder when (a) the normal linefinder is busied out, (b) the associated C.F.C. relay set is busied out.

3. CIRCUIT DESCRIPTION

3.1 Location

It should be imagined that the diagram is divided into four equal sections:-

These are:-

Top Left	(TL)	Top Right	(TR)
Bottom Left	(BL)	Bottom Right	(BR)

The above symbols are used to indicate the location of relays, contacts, resistors, etc.

3.2 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.

When a C.C.B. subscriber originates a call, the operation of the line relay (Fig. 1, 2 or 3) marks the appropriate outlet on the uniselector linefinder P wire multiple and earths the linefinder start lead. While linefinder hunting is in progress, the linefinder relay set (Fig. 6) extends a loop via the associated C.F.C. relay set to an exchange calling equipment, which in turn causes the exchange line finder and its associated group selector to be seized. Dial tone is now returned to the caller.

Under various fault conditions such as C.F.C. forced release etc. a thermal timing circuit releases the linefinder equipment, and in the case of U.A.X. Nos. 12 and 13 leaves the line circuit P relay held operated to the calling loop. In the case of a U.A.X. No. 14 (also No. 13) a P.G. alarm is given.

In the following circuit operation descriptions the case of a U.A.X. No. 13 will be taken as typical.

3.3 Detail

The following operational details are described:-

3.3.1 Outgoing call from a subscriber in the first group of C.C.B. lines:-

(a) seizure by a calling subscriber.

(b) calling subscriber clears down.

3.3.2 Forced release of succeeding selector train by the C.F.C. relay set.

3.3.3 Permanent loop.

3.3.4 Fault conditions.

(a) C.F.C. relay set not seized.

(b) C.F.C. relay set seized but no earth returned via C.F.C. outgoing P wire.

(c) Linefinder fails to switch to calling line on seizure.

3.3.5 Call to local subscriber via final selector multiple.

3.3.1 Outgoing call from a subscriber in the first group of C.C.B. lines.

(a) Seizure (via Fig. 2) by calling subscriber

A loop on the negative and positive wires operate relay L.

Relay L	(TL)	operating (Fig. 2),
L1	(BL)	connects earth to the start lead to operate relay ST and start heating the thermal relay LO (see Design Details - Relay LO).
L2	(TL)	prepares the operating circuit for relay P.
L3	(BL)	marks the linefinder P wire multiple with a 560 ohm battery.
L4	(BL)	busies the calling subscriber's final selector multiple by disconnecting the K relay battery from the P wire.
Relay ST	(BR)	operating slowly (see Design Details),
ST1	(TR)	completes the drive circuit for the linefinder magnet.
ST2	(TR)	connects relay KA to the linefinder P wiper.
ST3	(BR)	see Design Details.
ST4	(TR)	seizes the associated C.F.C. relay set by looping the negative and positive wires.
ST5	(TR)	ensures that the operating circuit for relay CT is not completed before that for relay KB (see Design Details).
ST6	(BR)	prevents relay PG operating before relay CT on seizure (see Design Details).

When the linefinder P wiper reaches the marked outlet relay KA operates via both its windings in series, to the 560 ohm battery in the subscriber's line circuit.

Relay KA	(TR)	operating,
KA1	(TR)	cuts the linefinder magnet drive circuit, removes the short circuit from relay KB which operates and connects the 7 ohms winding of relay KA to the P wire to hold relay KA and operate the subscriber's line circuit relay P. The 7 ohm KA relay earth also busies the linefinder P wire bank multiple.

Relay KB	(TR)	operating,
KB1)	(TR)	prepare to extend the calling subscriber's loop.
KB2)	(TR)	
KB3)	(TR)	extend the alternative meter wires to the C.E.C.
KB4)	(TR)	relay set.
KB5	(TR)	connects earth to the linefinder P wire to hold the line circuit, also short circuits relay KA, which releases.
KB6	(TR)	prevents irregular operation of the linefinder drive magnet at a later stage and connects earth to the ring start wire (see Design Details).
KB7	(BR)	completes an alternative holding circuit for relays ST and LO.
KB8	(TR)	prepares the operating circuit for relay CT and an alternative holding circuit for relay KB.
Relay P	(TL)	operating via contacts KA1 and KB5, (Fig. 2),
P1	(TL)	prepares an independent hold circuit for relay P.
P2	(BL)	operates relay K to the earth on the linefinder P wire.
P3	(TL)	releases relay L.
Relay KA	(TR)	releasing at contact KB5, is ineffective at this stage.
Relay K	(BL)	operating at contact P2 (Fig. 2),
K2	(TL)	completes an alternative holding circuit for relay P.
K3	(BL)	disconnects earth from the calling subscriber positive line wire, and prepares the operate circuit for the subscriber's meter.
Relay L	(TL)	releasing at contact P3 (Fig. 2).
L1	(BL)	disconnects earth from the start lead but relays ST and LO hold to earth via contact LO1.
L2	(TL)	disconnects relay P from the P wire.
L3	(BL)	disconnects the R1 resistor shunt from relay K.
Relay CT	(TR)	operating via contact KB8 to earth returned via the C.F.C. relay set incoming P wire.
CT2	(TR)	extends the calling subscriber's negative line wire to the C.F.C. relay set.
CT3	(TR)	disconnects the pre-seizure resistor R1 loop from line and extends the calling subscriber's positive line wire to the C.F.C. relay set.
CT4	(TR)	operates relay CTA.
CT5	(BR)	switches the start wire to a partner linefinder relay set.
CT6	(TR)	prepares an alternative holding circuit for relay CT (see Design Details).
CT7	(BR)	operates relay PG.
Relay CTA	(BR)	operating,
CTA1	(BR)	connects the 1 sec. earth pulse to the G.O.T.M. contact chain.
CTA2	(BR)	releases relay ST.
Relay PG	(BR)	operating to earth returned via the C.F.C. relay set outgoing P wire,
PG2	(BR)	disconnects relay LO.
Relay ST	(BR)	releasing slowly,
ST1	(TR)	disconnects the original operating circuit for relay KB.
ST2	(TR)	disconnects relay KA from the linefinder P wire.
ST3	(BR)	see Design Details.

(b) Calling subscriber clears down

Relays held operated at this stage are:- Fig.2 K and P; Fig.6, CT, CTA, KB and PG.

Disconnexion of the calling subscriber's loop releases the C.F.C. relay set and the succeeding selector train. This results in the disconnexion of earth from U point 18 to release relay PG, and also an earth-dis-earth at U point 23 to release relay KB. Relay CT continues to hold during the earth-dis-earth period.

Relay KB	(TR)	releasing,
KB1)	(TR)	disconnect the negative and positive wires.
KB2)	(TR)	
KB3)	(TR)	disconnect the alternative meter wires.
KB4)	(TR)	
KB5	(TR)	disconnects earth from the linefinder P wire to release relay K (Fig. 2).
KB6	(TR)	disconnects earth from the ring start wire.
Relay K	(BL)	releasing (Fig. 2),
K1	(TL)	prepares the re-connexion of relay L to the negative line wire.
K2	(TL)	releases relay P.
K3	(BL)	re-connect earth to the positive line wire.
Relay PG	(BR)	releasing to the P wire connexion,
PG1	(BR)	prepares the re-connexion of the start wire to the first choice relay set.
Relay P	(TL)	releasing slowly at contact K2 (Fig. 2),
P2	(BL)	connects battery via relay K to the final selector multiple P wire to indicate that the subscriber's line is now free.
P3	(TL)	re-connects relay L to the negative line wire.
Relay CT	(TR)	releasing slowly on the disconnexion of earth from U-point 23 (see Design Details),
CT4	(TR)	releases relay CTA.
CT5	(BR)	prepares to restore the start wire to the first choice linefinder relay set.
CT6	(TR)	disconnects relay CT from the partner relay set.
Relay CTA	(BR)	releasing,
CTA1	(BR)	disconnects the 1 See earth pulse from the G.O.T.M contact chain.
CTA2	(BR)	restores the start wire to relay ST.

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

3.3.2 Forced release of succeeding selector train by the C.F.C. relay set

Relays held operated after seizure:- K and P (Fig. 2) CT,CTA KB and PG (Fig. 6).

If, after a call has been successfully set up as described in par. 3.3.1 the connexion is forced released for any reason (such as the subscriber failing to insert coins), the C.F.C. relay set returns N.U. tone to the calling subscriber and releases the succeeding selector train. Earth is thus disconnected from the group selector P wire and relay PG releases.

Relay PG	(BR)	releasing,
PG2	(BR)	energises relay LO.

Relay LO (BR) operating after approximately 7 seconds (see Design Details),
LO1 (TR) disconnects relay LO, and short circuits one winding of relay KB.

Relay KB (TR) releasing, slowly,
KB1) (TR)
KB2) (TR) disconnect the negative and positive wires to release the C.F.C. relay set.
KB3) (TR)
KB4) (TR) disconnect the alternative meter wires.
KB5 (TR) disconnects earth from the linefinder P wire to release relay K (fig. 2).
KB6 (TR) disconnects earth from the ring start wire.

Relay K (BL) releasing (Fig. 2),
K1 (TL) connects relay P to line which holds to the calling subscriber loop until a clear is given.
K2 (TL) initiates a PG alarm.
K3 (BL) reconnects earth to the positive line wire to complete the calling subscriber's loop.

Relay P (TL) releasing slowly when the subscriber clears (Fig. 2),
P1 (TL) disconnects the PG alarm.
P2 (BL) connects battery via relay K to the final selector multiple P wire to indicate that the subscriber's line is now free.
P3 (TL) reconnects relay L to the negative line wire.

After a cooling period of approximately 20 seconds the thermal relay LO releases.

Relay LO (BR) releasing slowly (see Design Details),
LO1 (TR) releases relay CT.

Relay CT (TR) releasing slowly,
CT4 (TR) releases relay CTA.
CT5 (BR) prepares to restore the start wire to the first choice linefinder relay set.
CT6 (TR) disconnects relay CT from the partner relay set.

Relay CTA (BR) releasing,
CTA1 (BR) disconnects the 1 Sec, earth pulse from the G.O.T.M. contact chain.
CTA2 (BR) connects relay ST to the start wire.

3.3.3 Permanent Loop

Relays held operated after seizure:- K and P (Fig. 2); CT,CTA, KB and PG (Fig. 6).

After seizure of the circuit and in the absence of dialling a deferred PG alarm will be given in the case of a U.A.X. No. 14, and for the U.A.X. No. 12 or 13 forced release of the selector will occur after a delay period. When the succeeding selector is forced released, earth is disconnected from the C.F.C. relay set outgoing P wire to release relay PG.

Circuit operation is now the same as described under par. 3.3.2.

3.3.4 Fault conditions

(a) C.F.C. relay set not seized.

Relays K, P, KB and ST are operated and relays L and KA are operated and released on seizure as described under par. 3.3.1 (a).

With the non-seizure of the C.F.C. relay set no earth is returned via U-points 23 and 18 to operate respectively relays CT and PG.

Relay LO meanwhile continues to be energised and operates after approximately 7 seconds.

Relay LO (BR) operating slowly (see Design Details),
LO1 (TR) operates relay CT and disconnects relay LO.

Relay CT (TR) operating,
CT4 (TR) operates relay CTA.
CT5 (BR) switches the start wire to a partner relay set and releases relay ST.
CT6 (TR) prepares an alternative holding circuit for relay CT.

Relay CTA (BR) operating,
CTA1 (BR) connects the 1 sec earth pulse to the G.O.T.M. chain.

Relay ST (BR) releasing slowly,
ST1 (TR) releases relay KB.
ST2 (TR) disconnects relay KA from the linefinder P wire.

Relay KB (TR) releasing,
KB5 (TR) disconnects earth from the linefinder P wire to release relay K (Fig. 2).
KB6 (TR) disconnects earth from the ring start wire (see Diagram Details).

Relay K (BL) releasing (Fig. 2),
K1 (TL) connects relay P to line so that it holds to the calling subscriber's loop until a clear is given.
K3 (BL) reconnects earth to the positive line wire to complete the calling subscriber's loop.

After a cooling period of approximately 20 seconds the thermal relay LO releases. (Note that during this period the subscriber may clear to release relay P, then recall to set up a call via a partner linefinder relay set).

Relay LO (BR) releasing slowly at contact LO1 (see Design Details),
LO1 (TR) releases relay CT.

Relay CT (TR) releasing slowly,
CT4 (BR) releases relay CTA,
CT5 (BR) prepares to restore the start wire to the first choice linefinder relay set.
CT6 (TR) disconnects relay CT from the partner relay set.

Relay CTA (BR) releasing,
CTA1 (BR) disconnects the 1 sec earth pulse from the G.O.T.M. chain.
CTA2 (BR) reconnects relay ST to the start wire.

(b) C.F.C. relay set seized but no earth returned via C.F.C. outgoing P wire

Relays K, P, CT, CTA and KB are operated and relays L, KA and ST are operated and released on seizure as described under par. 3.3.1 (a).

With the non-seizure of the group selector by the C.F.C. relay set no earth is returned via U-point 18 to operate relay PG.

Relay LO meanwhile continues to be energised via contact KB7 operated and operates after approximately 7 seconds.

Relay LO (BR) operating slowly (see Design Details),
LO1 (TR) holds relay CT and disconnects relay LO. Also short circuits one winding of relay KB.

Relay KB (TR) releasing,
KB1 (TR), KB2 (TR) release the C.F.C. relay set.
KB3 (TR), KB4 (TR) disconnects the alternative meter wires.
KB5 (TR) disconnects earth from the linefinder P wire to release relay K (Fig. 2).
KB6 (TR) disconnects earth from the ring start wire.

Relay K (BL) releasing, (Fig. 2),
K1 (TL) connects relay P to line so that it holds to the calling subscriber's loop until a clear is given.
K3 (BL) reconnects earth to the positive line wire to complete the calling subscriber's loop.

After a cooling period of approximately 20 seconds the thermal relay LO releases. (Note that during this period the subscriber may clear to release relay P, then recall to set up a call via a partner linefinder relay set).

Relay LO (BR) releasing slowly (see Design Details),
LO1 (TR) releases relay CT.

Relay CT (TR) releasing slowly,
CT4 (TR) releases relay CTA.
CT5 (BR) prepares to restore the start wire to the first choice linefinder relay set.
CT6 (TR) disconnects relay CT from the partner relay set.

Relay CTA (BR) releasing,
CTA1 (BR) disconnects the 1 sec earth pulse from the G.O.T.M. chain
CTA2 (BR) reconnects relay ST to the start wire.

(c) Linefinder fails to switch to calling line on seizure

Earth on the start wire operates relay ST and energises relay LO as for normal circuit operation.

Relay ST (BR) operating slowly,
ST1 (TR) completes the drive circuit for the linefinder magnet.
ST2 (TR) connects relay KA to the linefinder P wiper.
ST4 (TR) seizes the associated C.F.C. relay set by looping the negative and positive wires.
ST5 (TR) ensures that the operating circuit for relay CT is not completed before that for relay KB.
ST6 (BR) prevents relay PG operating before relay CT on seizure.

With the non-operation of relays KA and KB the linefinder continues to hunt and after approximately 7 seconds relay LO operates.

Relay LO (BR) operating slowly (see Design Details),
LO1 (TR) operates relay CT.

Relay CT (TR) operating,
CT3 (TR) releases the C.F.C. relay set.
CT4 (TR) operates relay CTA.
CT5 (BR) switches the start lead to a partner linefinder relay set and disconnects relays LO and ST.

Relay CTA (BR) operating,
CTA1 (BR) connects the 1 sec, earth pulse to the G.O.T.M. contact chain.

Relay ST (BR) releasing slowly,
ST1 (TR) disconnects the linefinder drive magnet circuit.

After a cooling period of approximately 20 seconds relay LO releases.

Relay LO (BR) releasing slowly (see Design Details),
LO1 (TR) releases relay CT.

Relay CT (TR) releasing slowly,
CT4 (TR) releases relay CTA.
CT5 (BR) prepare to restore the start wire to the first choice linefinder relay set.
CT6 (TR) disconnects relay CT from the partner relay set.

Relay CTA (BR) releasing,
CTA1 (BR) disconnects the 1 sec. earth from the G.O.T.M. contact chain.
CTA2 (BR) reconnects relay ST to the start wire.

3.3.5 Call to local subscriber via final selector multiple

When the called subscriber's line has been tested by the final selector an earth is extended via the final selector P wire to operate relay K (Fig. 2).

Relay K (BL) operating,
K1 (TH) disconnects relay L from the negative line wire.
K3 (BL) disconnects earth from the positive line wire.

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.

Relay	Release lag		Operate lag	
	Min	Max	Min	Max
CT	45 ms	90 ms		
ST	130 ms	200 ms	80 ms	120 ms
LO	20 secs		7 secs	

4.2 Relays

Relay CT (TR) has been made slow to release to ensure that it will hold during the earth-dis-earth period returned via U-point 23 on cleardown. This ensures that the linefinder relay set remains busied until the C.F.C. relay set has restored to normal.

Relay LO (BR) is a thermal delay relay whose operate and release lags are utilised under certain fault conditions to:-

(a) to disconnect the linefinder relay set and give a PG alarm,

(b) switch to another linefinder relay set.

Relay ST (BR) has been made slow to operate to avoid it responding to flick operations by a line relay. Additionally the slow operate feature prevents the operation of relay ST in a partner relay set if on seizure contact CT5 switches the start wire before the L relay in the subscriber's line circuit has released.

Relay P (TL and BL) (Figs. 2 and 3) has been made slow to release to ensure that it holds during the transit time of contacts K1 and K3 when the circuit is forcibly released under PG fault conditions (see par. 3.3.3).

Relay L (TL) (Fig. 3) has been made slow to release to ensure that the hold circuit for relay K is completed via contact K2 before the operate circuit of relay K is disconnected at contact L1.

4.3 Contacts not previously fully explained

Contact CT1 (TR) ensures that the linefinder relay set start wire is transferred to a partner relay set, via contact CT5, before the linefinder uniselector magnet can be energised during routine testing.

Contact CT6) (TR)
Contact ST3) (BR) when a start wire has been transferred from one linefinder relay set to an adjacent one, via contact CT5 operated, contact ST3 in the adjacent relay set ensures that the CT relay will remain energised to maintain contact CT5 operated during the switching of a call by the adjacent relay set.

Contact KB6 (TR) the ring start facility is provided only for those U.A.X.s where the ringing machine is not running continuously and is required to ensure that the N.U. tone supply is maintained where facility (7) is encountered.

Contact ST5 (TR) in conjunction with contact KB8 prevents relay CT operating before relay KB on seizure. On seizure a pre-operate circuit for the associated C.F.C. relay set is completed by contact ST4. Should contact CT3 operate before contacts KB1 and 2 the C.F.C. relay set would be disconnected and released.

Contact ST6 (BR) enables relay PG to be operated when required by a busying earth connected to the C.F.C. outgoing P wire, but ensures that on seizure relay CT operates before relay PG. This prevents the switching of the start wire to a partner relay set before the calling line has been found and switched.

4.4 Rectifiers

Rectifier D1 (TR) prevents slugging of the relays associated with the C.F.C. relay set incoming P wire by relays KB and CT on cleardown.

Rectifier D2 (BR) prevents slugging of the relays associated with the C.F.C. relay set outgoing P wire by relay PG on cleardown.

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

P.G. ALARM (U.A.X. No. 13) ..... AT 4082 Fig. 3

" (U.A.X. No. 14) ..... AT 4172 Fig. 1

RING START (U.A.X. No. 12) ..... AT 60048 Fig. 1

" (U.A.X. No. 13) ..... AT 5406 Fig. 1

TIME PULSE 1 sec. earth (U.A.X.s Nos. 12 and 13) ..... AT 60131

" " " " " (U.A.X. No. 14) ..... AT 4171 Fig. 1

5. HISTORY

Issue A	Relay CTA added to prevent relay ST reoperating when the associated C.F.C. relay set forced released the succeeding group selector
Issue 1	

Telecommunications Development Department,
TD 1.1.2/DW/447
August 1970

END OF DIAGRAM NOTES