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POST OFFICE TELECOMMUNICATIONS HEADQUARTERS

DIAGRAM NOTES AT 60665A

SPECIFICATION T 60665

COIN AND FEE CHECKING RELAY SETS

2000 TYPE

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1. GENERAL

The diagram shows the connexions of a coin and fee checking circuit (C.F.C) which is accessible from 'pay-on-answer' call office circuits. It is suitable for use at all exchanges including U.A.X.s.

At 4000 type director exchanges this C.F.C. should be used in conjunction with first code selectors to AT 60897.

Each C.F.C. comprises two relay sets and the rack may be of the relay set type (R.S.R.).

The circuit supersedes AT 5716 for new work and differs from that circuit in the following respects:-

(a) Two type 2 ratchet relays and a type 4 uniselector are used instead of 5 type 2 uniselectors.

(b) All mechanisms are mounted in Part 2 of the relay set permitting the use of a R.S.R. or part of a R.S.R.

(c) A standard rack will accommodate twice as many circuits.

(d) The coin pulse detection circuits employ polarized relays instead of double contact high speed relays and transistors.

(e) Economies have been made at the outset due to the abolition of paid for' meter pulses.

(f) A 'Circuit Free' lamp and release alarm are provided.

Just prior to issue of the diagram the audit facility was withdrawn. Components directly associated with the facility have not therefore been provided but some relay contacts i.e. MBA6, CP1, MB6, MA6 & MA7 and certain inter plate 'U' point connexions have been retained (as spare) to simplify the possible re-introduction of the facility at a later date.

In view of the fact that at any one time interest will be centred on only one type of call, local, trunk or manual board these notes have been divided into three sections each with its own facility schedule and circuit description. The three sections have been further sub-divided as shown in the table on page two. The design details, however, are common to the three parts.

DIAGRAM NOTES AT 60665A - Issue 1

Typical associated diagrams:-

AT 60079 C.C.B. SUBSCRIBERS LINE CIRCUIT AND LINEFINDER (25 OR 50 POINT) U.A.X.s NOS. 12, 13 AND 14.

AT 5369 GROUP SELECTOR. 200 OUTLET. FOR RACKS WITH GRADING FACILITIES. 2000 TYPE.

AT 60897 1ST CODE SELECTOR. 200 OUTLET. S.T.D. C.C.B. GROUPS. 2000 TYPE.

AT 5798 AUXILIARY JUNCTION HUNTER C.C.B. GROUPS D.S.R. AND SATELLITE 1ST SELECTOR. POSITIVE BATTERY METERING S.T.D. EXCHANGES. 2000 TYPE.

AT 5948 SATELLITE 1ST SELECTOR FOR SUBSCRIBER'S LINES UP TO 1000 OHMS. C.C.B. GROUPS. S.T.D. EXCHANGES 2000 TYPE.

AT 5004 SUBSCRIBER'S LINE CIRCUIT WITH TWO HOME POSITIONS. POSITIVE BATTERY METERING. 2000 TYPE.

AT 5739 AUTO-TO-AUTO RELAY SET WITH COIN & FEE CHECKING SIGNAL REPETITION TO REMOTE MANUAL BOARD. NON DIRECTOR EXCHANGES.

AT 5620 AUTO-AUTO RELAY SET WITH METERING OVER JUNCTION NON DIRECTOR EXCHANGES. 2000 TYPE.

2. LOCAL CALLS

2.1 FACILITY SCHEDULE

Provision is made for:-

(1) (a) Connecting the equipment between the line circuit or linefinder and the 1st Selector in the CCB group or

(b) between a special linefinder and a standard line circuit at U.A.X.s.

(2) Fast guard at uniselector exchanges to permit 1000 ohm line working. (The same guarding earth is used to backward hold until the standard linefinder equipment has found the C.F.C. at U.A.X.s).

(3) The circuit to function as a 'P' wire link circuit to minimize 'P' wire resistance problems at uniselector exchanges (Split 'P' wire).

(4) The transmission bridge to be introduced only when the first meter pulse is received (No dialled pulse repetition).

(5) Control of the coin slots by means of the polarity on the incoming lines. (The slots are normally closed and are opened on reversal of potentials).

(6) Decimal coinage and a 5 unit coin.

(7) The circuit to detect coin pulses, which take the form of a 5000 ohm loop connected in place of the telephone loop.

(8) All types of metering.

(9) One value of resistor for negative battery metering.

(10) Coin pulse metering, both with public call offices and renters coin boxes.

(11) A short disconnexion or 'open period' on the incoming 'P' wire on release of the circuit to release preceding equipment before reconnecting guarding earth.

(12) A 'circuit free' lamp under test jack control.

(13) Routine test facilities including test jacks and an RT relay.

(14) Connecting initial 'Pay Tone' for 9 to 10 seconds when the called subscriber answers. This tone is heard by both calling and called parties and serves to indicate that coins must be inserted.

(15) The generation of Pay Tone - that is interrupting N.U. tone at the rate of 3.5 to 4.5 times a second in such a manner that the tone is on for 125 ms and off for a similar period. A self interacting relay is employed.

(16) The generation of 1 second earth pulses by means of a self interrupting relay to step a uniselector to time off the period for which pay tone is connected and other intervals.

(17) Measuring and storing delay or compensatory time - this, however, is used on trunk calls but not local calls.

(18) Disconnecting pay tone if being applied and permitting speech when a coin is inserted.

(19) Closing the slots if a coin is not detected during the initial 'Pay tone' period.

(20) Re-opening the slots if a coin is detected in the two second period which follows the disconnexion of initial pay tone or the free speech period (See Facility 26).

(21) Force releasing the call, that is releasing forward equipment, and returning N.U. tone to the caller if a coin is not detected in the two second period after 'Pay Tone' is stopped.

(22) Starting a built in local call timer on receipt of the first coin in anticipation of the call being local.

(23) The call to be treated as local if no further meter pulses are received from succeeding equipment by the time the 10th local supply pulse has stepped the TU ratchet. The M relay is then dissociated from succeeding equipment.

(24) The local call timer to produce a periodic pulse from each 11th supply pulse.

(25) The periodic pulses produced in 24 to step the MU ratchet while coin pulses step another ratchet (CU) and when the number of periodic pulses equals the number of coin pulses, subsequent pay tone is connected to both calling and called parties for a period of 3 seconds. The transmission path is not disconnected. See also Facility 18.

(26) A 'Free Speech' or 'Grace' period of 6 to 7 seconds to follow the cessation of subsequent pay tone.

(27) Locking the slots if a coin is not detected in this period.

(28) Preventing transmission (in conjunction with the pay on answer box) while coins are being signalled. If the disconnexion is not detected an extended disconnexion of speech takes place.

(29) Closing the slots by means of springs 2 & 3 of the coincidence unit (CU/MU) when a credit of 25 unit coin pulses is accrued. The max. credit is 29 coin pulses. The difference between the two figures permits the recording of a 5 unit coin inserted just before the slots are closed.

(30) Guarding the circuit for the release time of the mechanisms and the associated selector, except at U.A.X.s where the circuit is not directly connected to a selector.

(31) A release alarm if any mechanism fails to home due to a mechanical defect (and also electrical defects at U.A.X.'s 12 & 13).

(32) Routine testing of the associated selector to busy the C.F.C. which is unaffected by meter or positive battery pulses in the idle condition.

2.2 Outline

When the CCB caller originates a call, the C.F.C. serves as a 'P' wire circuit, in that dialled pulse trains are not repeated but fed via through wires to the associated equipment. The transmission bridge is introduced on 'called sub. answer' on automatic calls, at the same time the following functions also take place:-

(a) The potentials on the incoming lines are reversed to open the coin slots.

(b) Pay tone (N.U. tone interrupted at approximately 125 ms on and off) is connected to both calling and called subscribers for a period of 9 - 10 seconds.

(c) The transmission path is split.

(d) The time interval in seconds between receipt of the meter pulse and the receipt of the first (or second) coin pulse is recorded on ratchet DU. /This information is only used however on trunk calls/.

The insertion of coins is indicated by the receipt of a train of pulses appropriate to the coin or coins inserted. The pulses are produced by the connexion of 5000 ohms in the loop and each train of pulses includes a short disconnexion. The disconnexion being used to restore the transmission path immediately.

The time allowed for the insertion of coins is approximately 9 - 10 seconds, but if a coin is detected in this period, pay tone is disconnected and the speech path established immediately. Should the caller not insert any money during the 9 - 10 second period the coin slots are closed. A period of two seconds then follows before forced release of the forward equipment and N.U. tone is returned to the caller. The two second period is provided to allow for the detection of a coin that may be in transit at the time the coin slots are closed.

When the speech path is completed the circuit begins timing the call and in the absence of any further meter pulses from trunk equipment, the TU ratchet acts as a local call timer and produces a pulse to set against the coin pulses received, from each 11th pulse (TP) received from the common pulse supply. If, however, a further meter pulse is received from trunk equipment before the 10th supply pulse the call is considered a trunk call and the local call timing circuit is disconnected.

Coins may be inserted at any time during the progress of the call and are recorded on ratchet CU. As mentioned the meter pulses produced within the circuit are recorded on ratchet MU. To keep a call going it is essential to keep the CU ratchet ahead of MU ratchet but if MU catches up and coincidence occurs a further demand for money is made by the re-connexion of 'pay tone'.

This time, and all subsequent occasions, pay tone is connected for a period of about 3 seconds followed by a six to seven second period for the insertion of coins, before the slots are closed. If a coin is not detected in this period or in a two second period following closure of the slots, the call is force released as before with N.U. tone returned to the caller. (See also Trunk Calls).

When a credit of 25 coin pulses accrues on an automatic call, the reversal is removed from the incoming lines, thus closing the slots. Capacity for 29 coin pulses is provided to allow for a 5 unit coin in transit after the slots have been closed.

Coin pulses only are recorded no matter whether the call is from a 'public' or 'renters' box and the only difference occurs on manual board calls (see separate section) when coin pulses are not recorded on the exchange meter on calls from 'renters' boxes. The only exception to the above arrangement occurs where a very small number of C.F.C.s is provided as a common group for both public and renters boxes and in these cases the metering arrangement for "renters" boxes is employed. At U.A.X.s both types of metering are taken through the linefinder.

A 'circuit free' lamp is provided to facilitate busying a circuit prior to routine testing and a release alarm is provided which is actuated if a mechanism fails to home due to a mechanical defect.

The circuit is always guarded during release except for a short 'open period' which is given to permit the subscribers K relay to release, (or KB relay in the special linefinder circuit in the case of U.A.X.s). This prevents holding a line to a faulty C.F.C.

2.3 Detail

2.3.1 Seizure

Relay FG	(D)	operates in series with the calling loop and associated selector.
FG2	(B)	connects a fast guard earth to the 'P' wire.
FG3	(J)	connects relay M to the P or M wire as required.
FG4	(G)	connects earth to the positive battery detector (Fig. 4) and holds relay FG when relay PA operates.
Relay PA	(F)	operating to earth on 'P' wire from selector.
PA1	(D)	short circuits one winding of relay FG.
PA2	(D)	holds relay FG.
PA3	(G)	prepares to hold relay CPA at the end of coin pulsing.
PA5	(B)	completes circuit for the bias winding of relay LCP.
PA6	(A)	operates relay PB and prepares the circuit for relay H.
PA7	(C)	connects earth to the 'P' wire.
PA8	(F)	holds relay PA.
Relay PB	(D)	operating, functions on release of the call.

Caller dials and nothing further happens until 'called subscriber answers'.

2.3.2 Called Subscriber Answers

When the called subscriber answers a metering condition on the P or M wire operates relay M, relay M in turn causes the operation of the following relays OS, H, LS, LCP, B, HH, MA and CPA. When the meter pulse goes off relays M and MA release. Then relays MY and DT operate and relays PT and PU begin pulsing.

Relay M	(J)	operating,
M3	(K)	operates relay OS.
M4	(E)	prepares a circuit for relay MA.
M6	(F)	holds the line relay at the next transmission bridge while the C.F.C. bridge is being switched into circuit.
Relay OS	(K)	operating,
OS1	(K)	prepares a hold circuit for relay OS.
OS2	(C))	*reverse the potentials to open the slots when relay
OS3	(C))	H operates.
OS4	(A)	operates relay H.
OS6	(G)	operates relay CPA.
Relay H	(B)	operating,
H1	(B)	holds relay H to contact PA6.
H2	(K)	prepares circuits for relay MY and holds relay OS via OS1.
H3	(C))	introduce the transmission bridge and operate
H4	(C))	relays LCP and LS.
H6	(B)	maintains bias to line relay LCP under forced release conditions.
H8	(D)	prepares the circuit for relay B.
Relay CPA	(G)	operated by contact OS6.
CPA2	(D)	disconnects speech path.
Relay LS	(C))	in operating may connect a short pulse to relay
Relay LCP	(B))	CP but relay CP is slow to operate.
LS1	(C))	operate relay B.
LCP1	(D))	
Relay B	(D)	operating,
B1	(F)	ensures that a forward loop exists when the bridge is introduced.
B2	(J)	prepares a circuit for relay M via the 'M' wire.
B3	(B)	connects another earth to the 'P' wire.
B4	(C)	operates relay HH.
B5	(B)	prepares for coin pulse metering.
Relay HH	(C)	operating,
HH1	(B)	connects relay HH to the 'P' wire.
HH2	(F)	operates relay DT to earth from SU3 wiper.
HH3	(F)	disconnects loop via contact M6 as loop via contact B1 and retard TL now exists.
HH4	(B)	operates relay MA, provides earth for many relays and prepares the circuit for relay PU.
HH6	(D)	permits a dual use of contact TU.N3.
HH8	(F)	starts relay TP pulsing.
Relay MA	(E)	operates and holds for about 150 ms after relay M has released.

*It is possible that at non-director exchanges the slots would be initially opened by the reversal from the final selector or auto-auto relay set, but for diode D10 which, when the reversal is received, shunts the line until relay HH operates. This prevents premature opening of the coin slots.

Relay DT	(J)	operating,
DT1	(H)	holds relay DT when the SU uniselector steps from normal.
DT2	(H)	starts relay PT pulsing.
DT3	(J)	prevents self drive of SU uniselector when it steps off normal.
DT4	(B)	starts relay PU pulsing.
DT5	(F)	ensures that relay DT can only release when CN operates and not when coincidence is broken.
DT6	(D)	prepares to connect pay tone to the transformer
DT7	(D)	tone winding.
Relay M	(J)	releases at the end of the meter pulse.
M2	(J)	operates relay MY.
M4	(E)	releases relay MA.
Relay MY	(H)	operating,
MY1	(H)	holds relay MY to earth at H2.
MY2	(C)	provides full earth for homing ratchets during a call.
MY3	(E)	prepare circuits for the MU, DU and TU ratchet
MY4	(F)	relays respectively.
MY5	(G)	
MY6	(H)	operates the release relay at U.A.X.s 12 & 13 or otherwise prepares the circuit for relay M. (W wire.)
MY7	(F)	prevents reseizure of forward equipment if a meter pulse is received during cleardown.
Relay MA	(E)	released by contact M4,
MA3	(F)	permits DU ratchet to register delay in seconds.
Relay PT	(E)	pulses in the range 3.5 to 4.5 p.p.s. (See notes 8 & 11).
PT1	(E)	interrupts the circuit of relay PT.
PT2	(D)	connect pulses of N.U. tone to transformer T1 to provide
PT4	(E)	pay tone.

Initial Pay Tone is heard by both the calling and called subscribers.

Relay PU	(C)	also pulses but at about one pulse per second. (See notes 9 and 11).
PU1	(C)	interrupts the circuit of relay PU.
PU2	(H)	pulses DU (delay) ratchet.
PU3	(C)	pulses the SU uniselector.

Thus we have the SU uniselector and DU ratchet both stepping to one second pulses produced by the self interrupting relay PU.

The SU uniselector times off the ten second period of 'initial pay tone' while the DU ratchet is recording the 'delay' or 'compensatory time' in seconds.

The 'delay' is the time from 'Called subscriber answers' to the initial coin pulse. In the case of a local call the delay is not used but at this stage it is not known whether the call is local.

The equipment now awaits a coin but if the SU uniselector steps to contact 9 and no coin pulse is produced relay PT is stopped and relay OS is released to close the slots as described in paragraph 'Forced Release'.

2.3.3 Caller Inserts Coin

Relay LCP	(B)	releases to each UNIT COIN PULSE.
LCP1	(D)	with LS1 held operates relay CP.

Relay CP	(C)	operates to each unit coin pulse,
CP2	(B)	connects a metering condition for every coin pulse.
CP3	(D)	operates relay DS.
CP4	(F)	connects a pulse to ratchet DU for all coins other than the first.
CP6	(D)	pulses the CU ratchet.
CP7	(G)	holds relay CPA when contact CN4 operates.
Relay DS	(E)	operates to the first coin pulse,
DS1	(D)	holds relay DS.
DS2	(F)	holds relay CPA.
The CU (Coin) Ratchet	(D)	steps off normal when the first coin pulse terminates.

If relay MA is normal, (or when MA4 releases), CN relay will operate on either the first or second step of the CU ratchet via CU.N3 or CU.S1 respectively (see note 15).

Relay CN	(E)	operates and remains operated for the rest of the call.
CN1	(E)	disconnects relay DT and holds relay CN.
CN2	(J)	so alters the circuit that subsequent pay tone is only connected for 3 seconds.
CN4	(G)	disconnects one circuit for relay CPA.
CN5	(F)	stops further stepping of the DU ratchet via contact PU2.
CN6	(H)	connects TP pulses to the TU ratchet as at this stage it is not known whether the call is local or trunk.
CN7	(F)	provides an earth for re-opening coin slots.
The TU ratchet	(G)	might step to an earth pulse from the individual (TP) contact provided on the shelf.
Relay CP	(C)	releases when the coin pulse terminates.
CP6	(D)	releases the CU ratchet.
CP7	(G)	disconnects relay CPA which holds to the coin train.
Relay DT	(J)	releases because coincidence between CU and NU is broken and relay CN is operated (see CN1).
DT2	(H)	stops relay PT pulsing.
DT3	(J)	homes the SU uniselector.
DT4	(B)	stops relay PU and uniselector SU from pulsing.
DT8	(E)	leaves relay CN held via CN1.

At the end of each coin train a short disconnexion is given. With a maximum value coin inserted relay LCP releases to the last coin pulse of the train followed by relay LS releasing to the disconnexion. Otherwise both relays LCP & LS release to the disconnexion.

Relay LS	(C)	releasing,
LS1	(C)	releases relay DS and holds relay CPA.
Relay DS	(E)	releasing,
DS2	(F)	ensures that relay CPA releases to a disconnexion.
Relay LS	(C)	re-operating,
LS1	(C)	releases relay CPA.
Relay CPA	(G)	releasing,
CPA2	(D)	now permits conversation.

Having inserted a coin or coins the caller is 'out of debt' for the time being and the coin (CU) ratchet is one or more steps ahead of the meter pulse (MU) ratchet while the subscribers are conversing. Both pulsating relays PT and PU are stopped.

2.3.4 Local Call Timing

A call is made 'local' if no further meter pulses are returned from forward equipment by the time the S springs of the TU ratchet, (which is behaving as a local call timer), operate.

TU.S Springs		operating on steps 10, 21 and 32.
TU.S1	(G)	prepares the circuit for relay MT.
TU.S2	(C)	operates relay LC (since relay TC has not previously operated).
Relay LC	(C)	operating,
LC1	(C)	holds relay LC.
LC3	(E)	releases relay FG.
LC7	(H)	prevents relay M operating any more via the 'W' wire if used.
Relay FG	(D)	releasing,
FG3	(J)	disconnects relay M from the associated selector as it is possible for further meter pulses to be returned.*
FG4	(G)	disconnects earth from the positive battery detector.

The next TP pulse performs the following functions:-

(a) operates relay MT, and (b) energizes TU ratchet. Both TU ratchet and relay MT hold for the duration of the TP pulse which is about 250 ms.

Relay MT	(K)	operating,
MT8	(E)	operates the MU ratchet.

When the TP pulse goes off the TU ratchet is released and steps once.

The TU Ratchet	(G)	Starts the second timing cycle.
Relay MT	(K)	released by TP contact,
MT8	(E)	releases the MU ratchet.
The MU ratchet	(E)	in stepping brings the two ratchets (MU and CU) one step nearer coincidence.

Let us assume that the TU ratchet continues to step and produces another meter pulse which this time will bring the two ratchets CU and MU into coincidence.

Coincidence springs CU.SP	(F)	operate as the result of the TP pulse and operate relay DT.
Relay DT	(J)	operating,
DT2	(H)	starts relay PT pulsing.
DT3	(J)	disconnects homing circuit of the SU uniselector.
DT4	(B)	starts relay PU pulsing.

With relays PU and PT pulsing the circuit functions to send Subsequent Pay Tone. With contact CN2 operated the circuit for relay PT is only maintained until the wipers step to contact 3 when the earth is disconnected so that Pay Tone is only connected for 3 seconds.

*Local call via trunk equipment.

'Free Speech Period' or Grace Time

When the wipers of the SU uniselector step to contact 3 pay tone is disconnected. For the next eight steps (or seconds) conversation is again permitted but on the sixth step earth is connected via contact 9 of SU2 arc to release relay OS by means of a short circuit.

Relay OS	(K)	releasing to the short circuit.
OS2	(C))	restore line potentials to close the slots.
OS3	(C))	

When the SU2 wiper steps from contact 10 to contact 11 the short circuit is disconnected from the OS relay and relay Z operates to disconnect the battery from the relay. See paragraph 'Forced Release'.

2.3.5 Compensatory Time

Although with a local call the 'delay' or 'compensatory' time is stored on the DU ratchet it is not used. Nevertheless whenever a coin is inserted a pulse is given to the DU ratchet by contact CP4. With an exceptionally long duration local call involving the insertion of about 20-22 coins the DU ratchet could step to contact 32 and the DU.S springs would operate to prevent the ratchet stepping any more. (The coincidence springs DU/TU are ineffective on local calls).

2.3.6 Release of Call

Relays LS and LCP release when the caller clears and release relay B.

Note:- If LS relay releases first there is no circuit for relay CP. But if relay LS releases last there is a circuit but relay CP is slow to operate for this reason.

Relay B	(D)	releasing,
B1	(F)	opens the forward loop.
B3	(B))	the last of these two contacts to release disconnects
B4	(C))	relay HH and relay K in the line circuit (or relay KB in U.A.X. equipment).
B5	(B)	prevents further metering.
Relay HH	(C)	releasing, (the lag of this relay provides the 'dis' period on the 'P' wire),
HH1	(B)	reconnects guarding earth from contacts PA3, OS5, H7, or PB2.
HH2	(F)	normally releases relay DT (if operated)
HH4	(B)	releases relays LC and CN.
HH5	(J)	completes SU homing arc.
HH6	(D)	connects earth via TU.N3 to operate relay DS if ratchet relay TU is off normal.
HH7	(K)	completes a circuit for relay MT to operate if the SU uniselector is off normal.
HH8	(F)	disconnects earth from the TP relay.
Relay LC	(C)	releases.
Relay CN	(E)	releasing,
CN6	(H)	disconnects the local timing pulses.

If relay OS is operated at the time relay CN releases then contact CN4 will re-operate and hold relay CPA until relay OS releases.

The next event is the earth-dis-earth sequence from the associated selector given from all selector circuits except D.S.R.'s.

Relay PA	(F)	releases to the 'dis'.
PA2	(D)	releases relay FG (if operated).
PA6	(A)	releases relay H.
PA8	(F)	connects relay PB to the O/G P wire.
Relay PB	(D)	holds until earth reappears and until such time as the selector or circuit has restored.
Relay H	(B)	released by contact PA6,
H2	(K)	releases relays MY and OS.
H5	(C)	operates or holds relay DS (which may have already operated via TUN3 springs and contact HH6) via the N springs CUN2, MUN2 or DUN2 if any of these ratchets are off normal, or via contact MT2 if uniselector SU is off normal.
Relay MT	(K)	releases when the SU uniselector has driven home,
MT2	(C)	disconnects an earth from the DS relay (which may still be holding to earths from 'N' springs of the ratchet relays).
Relay OS	(K)	released by contact H2,
OS6	(G)	releases relay CPA if operated.
Relay MY	(H)	released by contact H2,
MY2	(C))	
MY3	(E))	
MY4	(F))	home those ratchet relays that are off normal.
MY5	(G))	
MY6	(H)	releases release relay at U.A.X.s 12 & 13.
Relay DS	(E)	operates or remains held,
DS4	(B)	connects earth to the incoming 'P' wire.
DS5	(C)	connects earth to the release alarm at all exchanges other than U.A.X.s 12 and 13.

Ratchets CU, MU, DU and TU drive home. The last of these to home disconnects earth from the DS relay which then releases and removes the earth from the incoming 'P' wire at DS4 and restores the release alarm at DS5.

Relay PB	(D)	releases.
PB2	(C)	disconnects earth from the I/C 'P' wire.

/If however all mechanisms are 'home' and relay DS has released when relay OS releases contact OS5 will make the circuit free and the circuit may be seized with relay MY operated or on its lag but since re-seizure only involves operation of relay PA no hold circuit for relay MY can exist and and it releases/.

2.3.7 Forced Release

When the equipment is waiting for the caller to insert the first coin the DU ratchet relay steps to one second earth pulses to store the delay or compensatory time. At the same time the SU (Type 4) uniselector also steps to time off the initial pay tone period. If the SU uniselector steps to contact 9 before a coin is received relay PT is stopped and relay OS is released by short circuit means as follows:-

Relay PT	(E)	is disconnected when the SU U/S steps from contact 8 to contact 9.
PT2	(D)	stops pay tone.

Earth from contact DT2 and SU2 arc now short circuits relay OS.

Relay OS	(K)	releasing,
OS2	(C))	restore the line potentials to normal to close
OS3	(C))	the slots.

The SU uniselector now takes two further steps (2 seconds) before 'forced release' is applied. This period permits the detection of a coin in transit (a coin that may have been inserted just before the slots closed). For the description, however, we assume that no coins are inserted and therefore relay Z operates when the SU uniselector alights on contact 11.

Relay Z	(H)	operating,
Z1	(H)	prevents further stepping of the TU ratchet and ensures that no further meter pulses will be produced to break coincidence.
Z2	(D)	connects NU tone to retard TL and the line transformer.
Z3	(B)	disconnects relay PU and holds relays H and PB.
Z4	(K)	prevents re-operation of relay OS and therefore prevents the slots being re-opened.
Z5	(E)	opens the loop and releases the forward equipment.
Z6	(F)	holds relay DT.
Z7	(H)	see design details:- 'Relay contacts in series with relay M'.

About 150-750 ms after relay Z operates earth is disconnected for about 30 ms from the 'P' wire and relay PA releases.

Relay PA	(F)	releases during the 'open' period.
Relay H	(B)	holds to earth at Z3.
Relay PB	(D)	holds to earth at Z3 and maintains 'P' wire guarded at PB2.

The CFC however remains held. Relay B holds relay HH and relays HH and Z hold relays H and PB, N.U. tone being returned to the caller.

2.3.8 Slots held open forcibly by coin after forced release

If the slots are held open by a coin this will not prevent forced release taking place. If the caller then pushes the coin in the slots will close and the coin pulse(s) should be recorded in order to reduce discrepancies between the exchange meter and the contents of the box.

Relay LCP will release and relay CP will operate to each coin pulse. The CU ratchet will step according to the denomination of the coin, and relay CN will operate. The tone would be disconnected were it not for contact Z6 which holds relay DT and maintains the tone under these conditions. Contact Z1 prevents TU ratchet stepping.

2.3.9 Release from forced release

Relay LS	(C))	release when the caller clears.
Relay LCP	(B))	
LS1	(C)	releases relay B.
Relay B	(D)	releasing,
B3	(B))	the last of these contacts to release releases relay
B4	(C))	HH and relay K in the line circuit.

Relay HH	(C)	releasing,
HH1	(B)	reconnects guarding earth to the 'P' wire.
HH2	(F)	releases relay DT.
HH4	(B)	releases relays H, LC and PB.
HH5	(H)	prepare the circuit for relay MT.
HH7	(K)	
Relay DT	(J)	released by contacts HH2 and HH4,
DT2	(H)	releases relay Z.
DT3	(J)	operates relay MT and homes the SU uniselector.
Relay Z	(H)	releases.

The circuit then functions as previously described.

From the foregoing it will be seen that the K relay in the line circuit is released regardless of what happens to the associated selector. If the selector fails to restore the line circuit is not held, but the C.F.C. is of course busied by contact PB2.

2.3.10 Release from an unanswered call

Relays operated FG, PA and PB.

When earth is disconnected from the outgoing 'P' wire relay PA releases but does not re-operate as its operate circuit is disconnected by contact PB3 and relay PB holds over the 'open period' and until earth goes off the selector 'P' wire. Relay FG releases and the disconnexion given on the incoming 'P' wire is equal to the lag of this relay. The circuit is then re-guarded until relay PB releases. (The arrangement ensures that fast guard is available on a follow-on call).

2.3.11 Circuit Free Lamp

When the C.F.C.s are to be routine tested it is desirable to know by lamp indication when circuits forming a shelf (or rack) are free. Several can then be busied and when the routining of one circuit is complete the testing of another may be started without delay. The lamp is under test jack control and will glow only when all relays and mechanisms have restored to normal. Once free a circuit can be busied.

3. MANUAL BOARD CALLS

3.1 FACILITY SCHEDULE

Facilities specifically provided for manual board calls are as follows:-

(1) Introducing the transmission bridge only when the first positive battery signal is received on the positive wire, that is when the operator answers.

(2) Transmitting a CCB discriminating tone if a common group of junctions is employed for both ordinary and CCB traffic. (Note 6).

(3) The discriminating signal referred to, to be returned when the first positive pulse goes off.

(4) If facility 2 applies, the discriminating tone is disconnected on receipt of a second positive battery pulse when the operator throws the 'Ring Answer' Key.

(5) Opening the slots at the 'Pay on Answer' coin box on receipt of the third (or second if facilities 2 and 4 do not apply) positive battery pulse.

(6) Converting coin pulses to pulses of N.U. tone which are transmitted to the operator only.

(7) Manual hold.

(8) Receipt of a meter pulse on manual board calls to bring about trunk call conditions and to apply pay tone and open the slots for the subscriber to control the call.

(9) Recording coin pulses on lines associated with public boxes but not with renters boxes. Exceptionally where a small group of C.F.C.'s is used with both renters and public boxes in a common grading group, the group as a whole is treated as renters and no coin pulses are recorded.

(10) Rendering springs 2 & 3 of the coincidence unit (CU/MU) ineffective on manual board calls so that the slots are not closed after 25 unit coins have been inserted.

3.2 Outline

On a manual board call, the assistance or auto-auto relay set provides a positive battery pulse of approximately 200 ms duration on the positive line when the operator answers. In response to this signal the C.F.C. can be arranged to provide, by suitable strapping, a discriminating tone signal to the operator, thus allowing the use of joint ordinary and CCB assistance traffic groups.

The discriminating tone (which is in the form of pay tone) is disconnected by the restoration of the 'Ring Answer' key (after previously operating the key) which causes a second pulse of positive battery to be connected to the positive wire. If the insertion of coins is required to complete the call the 'Ring Answer' key is again operated, and on release of the key a further pulse of positive battery is connected, and the coin slots are opened.

Coin pulses are signalled to the operator as pulses of N.U. tone.

3.3 Detail

3.3.1 CCB Discriminating Signal and coin slot control

Calls to the manual board are set up in the usual manner and this circuit serves only as a link circuit until a positive battery signal is received on the positive (or +S) wire.

Relays FG, PA & PB operate and function as described in the local call section.

Relay MB	(G)	operates for the duration of the positive battery signal.
MB1	(J)	prepares the circuit for relay MBA.
MB2	(A)	operates relay H.
MB3	(J)	prepares the circuit for the SU magnet.
MB4	(F)	connects a resistance across the loop to prevent a 'flick' of the line or A relay at the next transmission bridge.
MB5	(J)	prevents flicking relay MT when the SU magnet is energised.
MB7	(F)	operates relay CPA.

Relay H	(B)	operating,
H1	(B)	holds relay H to earth at PA6.
H2	(K)	operates relay MBA, energizes the SU magnet and prepares the circuit of relays MY and TC.
H3	(C)	introduce the transmission bridge, and operate
H4	(C)	relays LS and LCP.
H7	(B)	connects another earth to the incoming 'P' wire.
H8	(D)	prepares the circuit for relay B.

Relay LS (C) operating,
Relay LCP (B) operating,
These two relays operate quickly and in so doing prevent the operation of relay CP.

Contacts LS1 & LCP1 operate relay B.

Relay CPA	(G)	operated by contact MB7,
CPA2	(D)	disconnects the transmission path.
CPA3	(D)	prepares path for discriminating tone of N.U. pulses via PT2 contact.

Relay B	(D)	operated by contacts LS1 and LCP1.
B1	(F)	ensures that a loop forward exists when the loop via HH3 is disconnected.
B3	(B)	connects another earth to the 'P' wire.
B4	(C)	operates relay HH.
B5	(B)	prepares circuit for recording coin pulses.

Relay HH	(C)	operating,
HH1	(B)	connects relay HH to the incoming 'P' wire.
HH3	(F)	disconnects the resistor across the forward loop, now permissible since a loop exists via retard TL.
HH4	(B)	provides earth for various relays and ratchets.
HH7	(K)	disconnects relay MT from SU3 arc.

Relay MBA	(J)	operated by contact H2.
*MBA1	(J)	holds relay MBA and prevents operation of relay DT*.
MBA2	(D)	prepares the circuit for signalling coin pulses as pulses of N.U. tone to the operator.
MBA3	(A)	inhibits coin pulses on the PM wire.
MBA4	(H)	prepares 'manual' hold by holding the callers K relay and preventing relay M operating via the 'W' wire.
MBA5	(G)	connects earth to SU1 wiper and holds relay CPA.

Relay MB	(G)	releases when the positive battery pulse goes off.
MB1	(J)	operates relay MY.
MB2	(A)	leaves relay H held via H1.
MB3	(J)	releases the SU magnet.

The wipers of the SU uniselector now step to contact 1 and with straps -13- relay CPA is held and a circuit for relay PT is completed.

Relay MY	(H)	operated by contact MB1.
MY1	(H)	holds relay MY
MY2	(C)	provides full earth for homing ratchets during a call.
MY3	(E)	prepare circuits for MU, DU and TU ratchets,
MY4	(F)	although they are never used on a
MY5	(G)	manual board call under operator control.
MY6	(H)	connects earth to 'P' wire incoming via contact MBA4 at all exchanges other than UAX's. At U.A.X.s, operates release relay.

*Relays DT and CM do not operate on manual board calls.

Relay PT	(E)	due to capacitors C2, C3 and C4 pulses at pay tone speed.
PT1	(E)	provides the self-interrupting action.
PT2	(E)	connects pulses of N.U. tone to 570 ohm coil of retard TL to provide discriminating tone.

Discriminating Tone is heard only by the operator who now operates the "Ring Answer" key and connects positive battery to the positive line so re-operating relay MB. (This action is intended to cut off the tone).

Relay MB	(G)	operating,
MB3	(J)	energises the SU magnet.

Nothing further happens until this positive battery pulse goes off and

Relay MB	(G)	releases,
MB3	(J)	releases the SU uniselector, the wipers of which step to contact 2 disconnecting relays PT and CPA.

Relay PT	(E)	stops pulsing.

Relay CPA	(G)	releasing,
CPA2	(D)	completes the transmission path.

The caller is now able to speak to the operator. If the insertion of coins is required the operator again operates the 'Ring Answer' key and a further pulse of positive battery is connected to the positive wire.

Relay MB	(G)	operating,
MB3	(J)	energises the SU magnet.

Relay MB	(G)	releases when the pulse goes off,
MB3	(J)	disconnects the SU magnet the wipers of which now step to contact 3. When wipers alight on contact 3 relays OS and TC operate.

Relay TC	(J)	operating,
TC1	(J)	holds relay TC (See design details).
TC4	(F)	prevents unnecessary generation of battery supply pulses.

Relay OS	(K)	operating,
OS1	(K)	holds relay OS to earth at H2.
OS2	(C)	reverse potentials to the incoming line from the P.O.A.
OS3	(C)	coin box to open the slots.
OS5	(B)	ensures that circuit cannot be seized with relay OS operated.

If discriminating tone is not required straps 14 are used instead of straps 13. The first operation of relay MB then releases relay CPA to permit speech and the second operation of MB steps SU to outlet 2 where relay OS and relay TC operate as described above to permit insertion of coins.

3.3.2 Insertion of coins

When the caller inserts the coins called for by the operator:-

Relay LCP	(B)	releases to each coin pulse. Relay LS (C) holds.
LCP1	(D)	with LS1 (C) operates relay CP for the duration of the coin pulse.

Relay CP	(C)	operating,
CP2	(B)	operates a meter only if the call is from a public box.
CP3	(D)	operates relay DS.
CP5	(E)	connects a pulse of tone to retard TL for every coin pulse.
CP6	(D)	steps the CU ratchet once for every coin pulse.
CP7	(G)	operates relay CPA.
Relay CP	(C)	releases.
Relay DS	(E)	operating,
DS1	(D)	holds relay DS.
DS2	(F)	completes the hold circuit for relay CPA via charged capacitor C5 to give a long release lag thereby ensuring that it holds over the coin pulse train.
Relay CPA	(G)	operated by contact CP7,
CPA1	(G)	prepares hold path for relay CPA when relay LS restores.
CPA2	(D)	disconnects the transmission path.
Relay LS	(C)	releases to the 'dis' which follows each coin train.
LS1	(C)	releases relay DS and covers contact DS2.
Relay CPA	(G)	remains held over the coin train and after the disconnexion and then releases when contact LS1 is operated.
CPA2	(D)	completes the transmission path.

Each coin inserted is signalled in this manner.

A third spring forms part of the coincidence unit associated with ratchets CU and MU. As described in the design details ('Twin Ratchet Relays') this contact is employed on automatic calls to close the slots if the CU ratchet gets too far ahead of MU ratchet.

On manual board calls this contact is ineffective since relay DT is not operated and with uniselector SU off normal there is no earth to short circuit relay OS. This is necessary as an operator may request a caller to insert coins in excess of the number which would close the slots and inhibit the insertion of some of the coins.

3.3.3 Audit

This facility has been withdrawn.

3.3.4 Meter pulse received on a manual board call

This facility is not as yet used but may be in the future and has therefore been incorporated in the design.

If a meter pulse is received during a manual board call, relay M operates which in turn operates relay TC via contact M1.

The call becomes a trunk call and the subscriber will be expected to insert coins as though he had set the call up himself.

When this facility is provided and used the operator will not have opened the slots as they open automatically to the meter pulse.

Contact M1 releases relay MBA which removes manual hold.

3.3.5 Cleardown

When the caller clears the following relays are generally operated:-

LS, LCP, B, HH, H, PA, PB, MBA, MY, OS and FG.

Relays LS & LCP	(C & B)	release when the caller clears.
LS1 & LCP1	(C & D)	release relay B.
Relay B	(D)	releasing,
B1	(F)	opens the forward loop.
B2	(J)	disconnects relay 'M' from the 'W' wire.

Manual Hold conditions ensure that earth is maintained on the outgoing 'P' wire to hold relays PA and H. Relay H in its turn holds relay MBA.

Relays PA, H & MBA		remain held.
Relay MBA	(J)	holding,
MBA4	(H)	holds earth on the incoming 'P' wire to hold the K relay in the line circuit and relay HH.
Relay PA	(F)	releases when the manual hold condition goes off.
PA2	(D)	releases relay FG.
PA4	(J)	releases relay MBA.
PA6	(A)	releases relay H.
PA8	(F)	disconnects relay PA from and connects relay PB to outgoing 'P' wire.
Relay FG	(D)	releases.
Relay PB	(D)	holds over the disconnexion and remains held until the selector clears.
Relay H	(B)	released by contact PA6.
H2	(K)	releases relays MY, OS and TC.
H5	(C)	operates relay DS via 'N' springs CUN2, if the ratchet relay is off normal.
Relay MBA	(J)	released by contact PA4.
MBA4	(H)	releases relay K in the line circuit and relay HH.
MBA7	(J)	prepares the homing circuit of the SU uniselector.
Relay HH	(C)	releasing
HH1	(B)	reconnects guarding earth to the 'P' wire from contact PB2 with FG2 normal or from contact DS4 operated.
HH7	(K)	operates relay MT.
Relay TC	(J)	releases to contact H2.
Relay OS	(K)	releases to contact H2.
Relay DS	(E)	operating,
DS4	(B)	connects earth to the 'P' wire.
DS5	(C)	connects earth to release alarm at all exchanges other than U.A.X.s 12 and 13.
Relay MY	(H)	released by contact H2,
MY2	(C)	completes the homing of the CU ratchet.
MY6	(H)	releases the release relay at U.A.X.s 12 & 13.

Relay MT	(K)	operating,
MT2	(C)	holds or operates relay DS until uniselector SU homes.
Ratchet CU	(D)	drives home.
Uniselector SU	(F)	also drives home.

The last of these mechanisms to home controls the removal of earth from the 'P' wire by allowing relay DS to release. (In the case of the SU uniselector relay MT releases when the uniselector is home which in turn allows relay DS to release).

Relay PB	(D)	releases when the associated selector restores.
Relay DS	(E)	releasing,
DS4	(B)	disconnects earth from 'P' wire.
DS5	(C)	disconnects earth from release alarm at all exchanges other than U.A.X.s 12 & 13.

3.3.6 Straps appropriate to Manual Board Call

By suitable strapping the equipment can be arranged to transmit a CCB discrimination tone when the operator answers. This permits the use of a common group of junctions to the manual board. The tone is not heard by the caller. Where a separate group of junctions is provided the discriminating tone signal is not required and this strap is omitted to prevent starting the production of pay tone, but in order that the slots will be opened by the 2nd and not the 3rd positive battery signal it is necessary to have a different strap. (See note 6 on the diagram).

4. TRUNK CALLS (AUTO)

4.1 FACILITY SCHEDULE

Provision is made for:-

(The following facilities are provided for trunk calls and are in addition to those provided for local calls and manual board calls).

(1) Absorbing any subsequent meter pulses returned from trunk equipment until receipt of a coin pulse train.

(2) Measuring in seconds the time that elapses between receipt of the first meter pulse, or last absorbed meter pulse (Facility 1) and receipt of the first coin pulse.

(3) Setting up trunk call conditions, and disconnecting the local call timing element if a second meter pulse is received before local call timing has reached a certain stage.

(4) Delaying the second and all subsequent meter pulses by the time as measured in Facility 2 above and by a further delay equal to 1 second for each coin train received after the first.

(5) Reducing or cancelling the delay (or compensatory time) when this equals or exceeds the period between meter pulses and:-

(a) Absorbing the subsequent meter pulse.

(b) Metering after a reduced delay.

(c) Delaying all subsequent meter pulses by this reduced delay.

(6) A maximum delay period of 32 seconds.

(7) Absorbing a meter pulse that arrives subsequent to the reduction of delay and prior to the recording of the delayed meter pulse.

(8) Withdrawing the meter pulse delaying facility and closing the slots if a meter pulse is received during the reduction or cancellation of delay.

(9) Comparing coin pulses received with the delayed meter pulses on a pair of ratchet relays with a 'coincidence' unit and connecting pay tone when coincidence is reached.

(10) If a meter pulse is derived during the 9-10 second period which begins with the connexion of subsequent pay tone, the 'free speech' period is cancelled at this point and the slots are closed and 'pay tone' disconnected (if being applied).

4.2 Outline

Until a call is proved to be a trunk call it is assumed that it is local and to this end the TU ratchet is used as a local call timer. If, however, another meter pulse is returned before the 10th local supply TP pulse the trunk metering takes over and local call timing is stopped.

Coins may be inserted at any time during conversation (but cause a short interruption to conversation) and each unit coin pulse is recorded on the coin ratchet CU. All meter pulses other than the first are delayed and used to step ratchet MU. When both CU and MU ratchets are standing on the same tooth, the coincidence springs re-operate to initiate a further pay demand.

Pay tone is then connected for a period of 3 seconds approx. (same as for a local call), followed by a 6-7 seconds period known as the 'free speech' or 'Grace' period to permit the insertion of coins before the slots are closed. On fast metering calls where the interval between pulses is shorter the above sequence is modified to reduce the 'free speech' period. If a meter pulse is derived during subsequent pay tone or in the ensuing 6-7 seconds the 'free speech' period is reduced and the slots are closed. The caller has thus 9 to 10 seconds or, the metering rate, whichever is the shorter period in which to insert coin(s) to keep the call going.

The meter pulses received from the metering over junction relay set are delayed by a period equal to the time in seconds between the initial meter pulse and the initial coin pulse. Any other meter pulses arriving during this process are absorbed and the delay ratchet is homed so that the delay period is measured from receipt of the last absorbed pulse.

Loss of conversation, due to the insertion of coins is compensated for by giving the caller a credit of one second per coin inserted. The total credited time in seconds is stored on ratchet DU (which first steps to 1 second earth and later to coin trains). Ratchet TU is used to go in search of coincidence on receipt of each meter pulse after the first coin has been recorded. When coincidence occurs a pulse is derived and the MU ratchet stepped once.

If the delay time is increased by the insertion of coins to the extent that it exceeds the interval between meter pulses, the last trunk pulse is absorbed and time equal to the metering period is deducted from the delay time. (This is described as reduction or cancellation of delay). The delayed pulse is then recorded at the end of the reduced delay period. The maximum delay catered for is 32 seconds.

On high rate metering calls, it is possible to receive a further meter pulse (a) following cancellation of delay but before the production of the delayed meter pulse or (b) whilst the cancellation process is actually taking place. In case (a) the pulse is absorbed, and in case (b) the pulse is recorded immediately as are any more that follow; the delay function being withdrawn and the slots closed.

When the CU ratchet is 25 steps ahead of the MU ratchet springs CU.SP2 and CU.SP3 make contact to short circuit relay OS and close the slots. The capacity on an auto call is 29 unit coin pulses and caters for a 5 unit coin in transit or partly recorded when slots are closed.

4.3 Detail

4.3.1 Trunk Call (Delayed Metering)

A trunk call is indicated by a second meter pulse being returned from trunk equipment to operate relay TC (see contact M1) before the TU 'S' springs have operated relay LC.

In the following description it is assumed that the second meter pulse arrives after a coin has been inserted and relay CN is operated. The 'delay' or 'compensatory' time is stored on the DU ratchet, as already described. It is necessary now to delay each meter pulse by the time in seconds that it took the caller to insert a coin (after the slots were opened) and for the first coin pulse to be registered in the C.F.C. (delay may be increased by the insertion of additional coins and is described at the end of this paragraph).

Relays operated:- PA, PB, FG, H, HH, LS, LCP, B, OS, MY and CN.

Relay M	(J)	operating to the first meter pulse received after a coin has been inserted.
M1	(J)	operates relay TC via contacts MB1 and MY1.
M4	(E)	operates relay MA.
Relay TC	(J)	operating,
TC1	(J)	holds relay TC.
TC2	(J)	prepares a circuit for relay MT.
TC3	(G)	homes the TU ratchet if a TP pulse has stepped it off normal (see paragraph 4.3.9).
TC4	(F)	prevents relay TP pulsing from this CFC.
TC5	(C)	prevents operation of relay LC.
TC6	(H))	function on very fast metered calls.
TC7	(K))	
Relay MA	(E)	operated by contact M4,
MA2	(C)	prepares the circuit for relay DLA.
Relay M	(J)	releasing,
M4	(E)	releases relay MA.
M5	(C)	operates relay DLA during the release lag of relay MA.
Relay DLA	(C)	operating,
DLA1	(C)	holds relay DLA.
DLA2	(D)	prepares the circuit for relay CDL (or LC).
DLA3	(J)	prepares the circuit for relay MT.
DLA4	(G)	connects ratchet TU to the one second earth pulse lead. (To time off the delay).
DLA5	(B)	starts relay PU pulsing.
DLA6	(D)	functions when normal to hold relay MA if TU ratchet is off normal to ensure operation of relay DLA when ratchet TU homes (see par. 4.3.8).
DLA7	(K)	ensures that relay MT will be operated for a satisfactory period.

The TU Ratchet	(G)	now steps to earth pulses from contact PU2 and, when coincidence between DU and TU is reached, the coincidence springs make and prepare the circuit for the next 1 second pulse to operate relay MT.
Relay MT	(K)	operates via coincidence springs TU1 and 2.
MT1	(K)	holds relay MT to earth at DLA7.
MT5	(J)	has a special function - see paragraph 4.3.6.
MT6	(C)	releases relay DLA.
MT8	(E)	operates the MU ratchet.
Relay DLA	(C)	released during the time relay MT is held.
DLA3	(J)	normally releases relay MT but if coincidence is broken DLA7 will do this.
DLA4	(G)	homes the TU ratchet.
DLA5	(B)	stops relay PU pulsing.
The TU Ratchet	(G)	drives home,
TU.N2	(C)	prepares the circuit for relay DLA to operate when the next meter pulse returned 'goes off'.
Relay MT	(K)	released by contact DLA3 or 7.
MT8	(E)	releases the MU ratchet.

When the MU ratchet is released it steps once and brings coincidence one step nearer. With the next operation of relay M the same sequence of operations begins again.

4.3.2 Increasing Delay or Compensatory Time

Whenever a coin is inserted delay is increased by one second and the circuit operations are as follows:-

Relay LCP	(B)	releases to each coin unit and
Relay CP	(C)	operates to each coin unit,
CP3	(D)	operates relay DS.
CP4	(F)	energises the DU ratchet during the operate time of relay CPA.
CP6	(D)	pulses the CU ratchet.
CP7	(G)	operates relay CPA.
Relay DS	(E)	operating,
DS1	(D)	holds relay DS to earth at contact LS1 (until the disconnexion).
DS2	(F)	holds relay CPA.
Relay CPA	(G)	operates and holds for the coin train.
*CPA2	(D)	disconnects speech path.
CPA4	(E)	disconnects the DU ratchet.

Thus a single pulse is connected to the DU ratchet. (Since relay CP is normal when CPA releases only one second is given for each coin).

4.3.3 'Disconnexion as part of coin signal'

After transmitting coin pulses the coin box mechanism transmits a short disconnexion that is used to release relay DS which when released cannot operate again until another coin is inserted. Contact DS2 ensures that relay CPA releases quickly although CPA relay is held until after LS has re-operated to minimise 'clicks' to the called subscriber.

*At this stage speech is also inhibited at the coin box.

Relay LS	(C)	releases to the disconnexion,
LS1	(C)	releases relay DS and holds relay CPA.
Relay DS	(E)	releasing,
DS2	(F)	disconnects one circuit for relay CPA.
Relay LS	(C)	re-operating at the end of the disconnexion,
LS1	(C)	now permits relay CPA to release.
Relay CPA	(G)	releasing,
CPA2	(D)	restores transmission.

4.3.4 Reduction or cancellation of delay during a call

Delay may be increased by inserting coins to extend a call to the point that the delay period equals or exceeds the period between meter pulses, (the metering rate). If this occurs a subsequent meter pulse will arrive before recording the delayed meter pulse.

It is then necessary to absorb the subsequent meter pulse and to reduce the delay period by a time equal to the period between pulses. The delayed pulse is then recorded after the remaining delay time. So we have:-

Relays LCP, LS, B, PA, PB, H, HH, FG, TC, CN and DLA operated, and

Ratchet TU	(G)	is stepping at one second intervals looking for coincidence with ratchet DU.
Relay M	(J)	then operates to a further meter pulse.
M4	(E)	operates relay MA and prepares the circuit for relay CDL.
Relay MA	(E)	operating,
MA5	(D)	operates relay CDL.
Relay CDL	(D)	operating,
CDL1	(D)	holds relay CDL to earth at HH6 via TU.N3 operated.
CDL2	(C)	prepares a circuit for relay LC.
CDL3	(F)	connect contact PT3 to ratchets DU and TU.
CDL4	(G)	
CDL5	(E)	prevents connecting any tone under these conditions.
CDL6	(F)	increases the speed at which relay PT will interrupt its own circuit (to about 18 p.p.s.) and completes the circuit for relay PT to pulse.
CDL7	(J)	prevents operation of relay MT as the DU/TU coincidence springs may operate unavoidably.
Relay PT	(E)	now pulses,
PT3	(G)	pulses both DU and TU ratchets.
Relay M	(J)	releasing,
M4	(E)	releases relay MA.
Relay MA	(E)	releases.

So we have the two ratchets DU and TU being pulsed at about 18 p.p.s. The controlling contact is TU.N1 which restores when the TU ratchet reaches the home position. Both ratchets take the same number of steps. Contact TU.N3 releases relay CDL.

Relay CDL	(D)	releasing restores various circuit elements.

Relay DLA	(C)	remains held until a pulse to relay MT is produced.
DLA4	(G))	ensure that ratchet TU continues to step to
DLA5	(B))	1 sec. pulses.

This description began with the receipt of a meter pulse but since then no pulse has been connected to the MU ratchet. It is therefore, necessary for coincidence to be reached and then a pulse is produced as described in paragraph 4.3.1.

4.3.5 Fast Rate Metering (International Call)

Second meter pulse arrives during initial pay tone prior to the insertion of a coin

On fast metering international calls, the second meter pulse from trunk equipment can be received during initial pay tone period.

Under these conditions ratchet DU commences stepping to time the period (compensatory) until the first coin is inserted but a meter pulse arrives.

Since at this stage, the coin has not been inserted relay CN is normal so that relay DLA cannot operate (see CN3) and neither can relay CDL, but with relay CN normal and DU off-normal a hold circuit for relay MA exists when the relay is operated by relay M.

Relays operated LCP, LS, B, PA, PB, DT, OS, H, HH and EG.

Relays PU & PT (C & E) are pulsing.

Relay M	(J)	operating,
M1	(J)	operates relay TC.
M4	(E)	operates relay MA.
Relay TC	(J)	operates,
Relay MA	(E)	operating,
MA1	(D)	holds relay MA via DU.N3.
MA3	(F)	drives the DU ratchet home.
MA4	(E)	prevents operation of relay CN until the DU ratchet is home. (This is essential since CN5 contact would or could interrupt the homing circuit of DU ratchet and leave a delay stored as the ratchet may need to home a maximum of 32 steps, so instead of reducing delay to zero it would increase it).
DU.N Springs		restore when the ratchet homes,
DU.N1	(E)	cuts the self-drive circuit.
DU.N3	(D)	releases relay MA.
Relay MA	(E)	releases,
MA3	(F)	reconnects the DU ratchet to the 1 second earth supply.

Any further meter pulses received during initial pay tone and prior to the insertion of a coin are similarly absorbed and DU ratchet is driven home each time.

4.3.6 'Single' or 'Double Debt' or:

Further meter pulse(s) derived during ten second period commencing with subsequent pay tone

If relay MT and ratchet MU operate to a delayed meter pulse during subsequent pay tone or the 6-7 second period following it, the following operations take place:-

Relay DT	(J)	is operated during subsequent pay tone.
Relay MT	(K)	operates,
MT1	(K)	holds relay MT to contact DLA7. The relay may also be held via PU2 and DLA3.
MT5	(J)	self drives SU uniselector to contact 9 via DT3 operated.
MT6	(G)	releases relay DLA.
MT8	(E)	operates MU ratchet.
Ratchet MU	(E)	operates.
Relay DLA	(C)	releases after about 60-90 ms.
DLA3	(J)	release relay MT.
DLA7	(K)	
Relay MT	(K)	releases when the SU wipers reach contact 9 or the 1 second pulse goes off. (or contact DLA7 releases).
MT5	(J)	stops the self-drive of the SU uniselector and leaves it to step to one second earth pulses via contacts DT4 and PU3.
MT8	(E)	releases MU ratchet.
Ratchet MU	(E)	releasing, is now one step ahead of ratchet CU.
Relay DT	(J)	remains held because the coincidence springs are designed so that the MU ratchet may be up to two steps ahead of CU ratchet before 'coincidence' is broken. (At faster metering rates the MU ratchet can get two steps ahead but relay DT will remain held).
DT2	(H)	shunt releases relay OS when SU wipers reach contact 9.

NOTE:- This is one instance of where the MU ratchet is permitted to get ahead of the CU ratchet - but since the caller has not inserted a coin it is essential to hold relay DT.

It will be necessary for callers to insert at least 2 unit coins to prevent closing the slots and forced release.

Relay OS	(K)	is short-circuited by earth from contact DT2 and SU2 arc.
OS2	(C)	close the slots.
OS3	(C)	

On contact 10 relay OS remains released.

4.3.7 Re-opening slots

It is possible that a coin could have been inserted just prior to the closing of the slots and therefore, it is necessary to open them again. When the coin is signalled relay LCP responds, relay CP pulses and steps ratchet relay CU to the coin pulses. When CU gets ahead of MU, CU.SP springs 1 and 2 break and relay DT releases, permitting relay OS to operate and open the slots.

If, when the SU wipers alight on contact 11 relay DT is still operated, a circuit is completed for relay Z which operates and functions as described earlier to effect force release.

4.3.8 Further meter pulse received during the cancellation of delay

As mentioned earlier cancellation of delay involves the two ratchets DU and TU which are pulsed together for the same number of steps until the TU is on the home contact or tooth. It is possible for a further meter pulse, on a very fast metering call, to arrive while cancellation is in progress ($1\frac{1}{2}$ second period) in which case the delay facility is withdrawn.

Relays operated - LCP, LS, B, PA, PB, H, HH, FG, CN, TC, OS, DLA and CDL.

Relays PU & PT (C & E) are pulsing.

One meter pulse operated relay DLA)
Another meter pulse operated relay CDL) as described earlier.

and now a further meter pulse operates relay LC as follows:-

Relay M	(J)	operating,
M4	(E)	completes the circuit for relays MA and LC.
Relay MA	(E)	is slow to operate for just this eventuality and permits relay LC to operate first.
Relay LC	(C)	operates, (during the slow operate of relay MA).
LC1	(C)	holds relay LC to earth at HH4.
LC2	(D)	holds relay CDL.
LC4	(K)	releases relay OS with contact TC7 operated.
LC5	(F)	holds relay DT when it operates and stops relay PT pulsing.
LC6	(C)	releases relay DLA.
LC8	(J)	operates relay MT and connects relay MT to contact M2 so that relay MT now operates with every operation of relay M
Relay MT	(K)	operating,
MT8	(E)	operates MU ratchet.
Relay CDL	(D)	holds and prevents return of pay tone (see CDL5).
Relay DLA	(C)	releases and cannot re-operate.
DLA4	(H)	homes the TU ratchet.
DLA6	(D)	holds relay MA until end of call.
Relay MA	(E)	holds until call clears.
Ratchet TU	(C)	homes, and when home TU.N1 disconnects ratchet DU.
Relay OS	(K)	released by contact LC4.
OS2	(C))	close the slots.
OS3	(C))	
Relays PU & PT		stop pulsing.

Thus while the caller has credit in hand the meter pulses received (operations of relay M) operate relay MT and ratchet MU and the delay facility is withdrawn. Once equality is reached relay DT operates and remains held. Since the slots are closed relay Z will operate in due course.

Meter pulse received with TU ratchet off normal

There are four cases:-

(a) The second meter pulse which operates relay TC is received after the TU ratchet has stepped off normal to a TP pulse. This is fully described in the next paragraph.

(b) Another meter pulse is received during the homing of the TU ratchet after deriving a delayed meter pulse. Part of next paragraph applies.

(c) Cancellation (or reduction) of delay, see earlier paragraph.

(d) Further meter pulse received during cancellation of delay. See previous paragraph (relays TC and LC operated).

4.3.9 Second meter pulse received after TU ratchet has stepped off normal due to a TP pulse

Relays operated		LCP, LS, B, PA, PB, H, HH, MY, DT, OS and FG.
Relays pulsing		PU at 1 p.p.s. steps SU U/S and DU ratchet. PT at 4 p.p.s. produces 'Pay Tone'.

In this paragraph, we assume that the caller inserts a coin, operating relay CN and shortly afterwards a TP pulse steps the TU ratchet off normal. Then a second meter pulse arrives denoting that the call is 'trunk'. Under these conditions since the TU ratchet is required for delay working it must first be driven home.

Relay CN	(E)	operating,
CN6	(H)	connects TP contact to ratchet TU.
Ratchet TU	(G)	steps off normal,
TU.N2	(C)	prevents operation of relay DLA.
TU.N3	(D)	provides a hold circuit for relay MA.
Relay M	(J)	now operates to the meter pulse received.
M1	(J)	operates relay TC via contacts MB1 and MY1.
M4	(E)	operates relay MA.
Relay MA	(E)	operating,
MA1	(D)	holds relay MA while TU ratchet is off-normal (See TU.N3).
Relay TC	(J)	operated by contact M1,
TC1	(J)	holds relay TC.
TC3	(G)	homes the TU ratchet as it is now to be used for delay working and not local call timing.

Thus the TU ratchet homes and relay MA is held until it has homed. This prevents any interference with the homing process. (If relay DLA were allowed to operate at this stage, the homing circuit would be broken at DLA4 and the TU ratchet would then be stepped to 1 second earth pulses and give an incorrect delay).

Relay M	(J)	releases as the pulse goes off.
M4	(E)	leaves relay MA held via MA1 and TU.N3.
Ratchet TU	(G)	homes,
TU.N2	(C)	operates relay DLA.
TU.N3	(D)	releases relay MA.

Relay DLA	(C)	operates during the lag of relay MA,
DLA4	(G)	now connects TU ratchet to the 1 second earth pulse.
Relay MA	(E)	releases,
Ratchet TU	(G)	steps once per second until 'coincidence' is reached.

Thus the metering condition is stored until after the TU ratchet has homed. Then the ratchet is stepped in search of coincidence in the normal manner of delay working.

4.3.10 Fast metering: Coin Pulse received during initial Pay Tone and homing of DU ratchet

In an earlier paragraph a description was given of what happens on fast metered calls if a second meter pulse arrives during initial pay tone. Briefly with no coin inserted it was only necessary to home the DU ratchet. In this paragraph we describe what happens if a coin is signalled during pay tone and the DU ratchet is homing as the result of a meter pulse.

Relays operated		LCP, LS, B, PA, PB, H, HH, MY, DT, OS and FG.
Relays pulsing		PU at 1 p.p.s. Steps SU U/S and DU ratchet. PT at approximately 4 p.p.s. Produces 'Pay Tone'.
Relay M	(J)	operates to the second meter pulse.
M1	(J)	operates relay TC via contacts MB1 and MY1.
M4	(E)	operates relay MA.
Relay TC	(J)	operating,
TC1	(J)	holds relay TC
Relay MA	(E)	operating,
MA1	(D)	holds relay MA to earth at DU.N3.
MA3	(F)	homes the DU ratchet.
MA4	(E)	prevents operation of relay CN until relay MA has released.
Ratchet DU	(F)	drives home,
DU.N3	(D)	holds relay MA.

At about this time the coin is signalled by releasing relay LCP for each unit.

Relay LCP	(B)	pulse releasing,
LCP1	(D)	pulse operates relay CP.
Relay CP	(C)	pulsing,
CP3	(D)	operates relay DS.
CP6	(D)	pulses the CU ratchet.
Ratchet CU	(D)	steps off normal and records the coin. So that earth from CUN3 is ready to operate relay CN.
Relay M	(J)	releases when the meter pulse goes off,
M4	(E)	does not release relay MA since,
Relay MA	(E)	remains held via MA1 to earth via DU.N3.
Ratchet DU	(F)	arrives at home position.
DU.N3	(D)	releases relay MA.
Relay MA	(E)	releasing,
MA4	(E)	now operates relay CN.

Relay CN	(E)	operating,
CN1	(E)	holds relay CN and releases relay DT which has been held via DT5 (coincidence springs having already broken when coin pulses were recorded).
CN4	(G)	releases relay CPA.
CN5	(F)	now permits delay to be increased by coins.
CN8	(D)	prevents earth from DU.N3 holding relay MA on other occasions.
Relay CPA	(G)	releasing,
CPA2	(D)	permits subscribers to converse.

Thus, although a coin is signalled at about the same time as a meter pulse is returned, during pay tone, the delay ratchet (DU) is homed and CN relay operated only when ratchet DU has homed.

Relay DT	(J)	releasing,
DT2	(H)	stops PT pulsing,
DT4	(B)	stops PU pulsing.

The call now proceeds as a trunk call.

4.3.11 Operation of meters

Public Boxes

In the case of public coin boxes the exchange meter is required to record the number of coin pulses. This is a relatively simple matter and the metering condition is taken directly from contact CP2.

Renters Boxes

The meters associated with 'renters' boxes also record coin pulses except on calls obtained via the manual board when operation of relay MBA inhibits metering (see contact MBA3).

4.3.12 Release

The circuit functions as for a local call except that relay FG is released by contact PA2 and relay TC released by contact H2. Exceptionally on a very fast metered call relay LC would be operated and is released by contact HH4.

5. DESIGN DETAILS

Twin Ratchet Relays

The circuit requires two twin ratchet relays (ratchet relay No. 2) CU and MU and DU and TU, both of which are mounted on part 2 (Figure 2) to minimise microphony. The coils of the ratchets are of 160 ohms resistance.

The two ratchets that form a pair are mounted in a common frame and to all intents and purposes they may be treated separately like other ratchet relays. The pairs have a common spindle and the space between the two mechanisms is used to house the 'coincidence unit' which consists of a cam and springs. Since these items rotate as the ratchet wheels rotate connexions to the springs are taken via slip rings. The cam for the pair DU and TU has one step of coincidence but that for the other pair CU and MU is more complex and is described below.

Springs 1 and 2 of the special spring set operate when both ratchets are standing on the same tooth (this includes the home position).

For a call to proceed it is essential to keep the coin ratchet CU ahead of the meter pulse ratchet MU and whenever MU catches up CU the coincidence springs make and initiate a pay demand.

If the caller inserts a large number of coins so that CU ratchet leads by 25 steps (coin pulses) the spring set is so designed that springs 2 and 3 make to short circuit relay OS to close the slots, thereby preventing CU from getting too far ahead. If the first pulse of a 5 unit coin actually brings about the closing of the slots it is still necessary to record the remaining 4 pulses. A 5 unit coin is the highest denomination catered for.

At high metering rates it is possible for one, or two meter pulses at (say) 1 per second to step MU ratchet while subsequent pay tone is being returned. This would release relay DT by breaking coincidence were it not for the design of the cam which caters for 2 additional positions or steps of coincidence when MU ratchet is leading.

To sum up, the coincidence unit gives three additional facilities over and above those given by the individual ratchets and therefore permits a much simplified and cheaper circuit. The facilities are:-

(a) A pair of springs operate on the normal or home position and when MU ratchet, which is normally the laggard, steps into coincidence.

(b) These same springs to remain operated when MU becomes the leader for two further steps.

(c) Utilizing the third spring of the spring set to bring about the closing of the slots when the CU ratchet gets 25 steps ahead of the MU ratchet in order to maintain an accurate record of credit in hand. When the gap is reduced to 24 the slots are opened again.

Fusing: The use of ratchet relays and a type 4 uniselector permits the circuit to be fused at 1.5A, although exceptionally all mechanisms could be pulse operated while a relay load exists.

Microphony. In order to minimise microphony the ratchet relays are resiliently mounted and fitted on part 2 of the relay set together with the self pulsating relays and the type 4 uniselector SU.

Variable Resistor RV1 (fig. 1) permits adjustment of the release lag of relay CPA.

Variable Resistor RV1 (fig. 2) permits adjustment of the pulsing speed of relay PT when used to derive pay tone (3.5-4.5 p.p.s.).

Relay FG has several functions:-

At uniselector exchanges contact FG2 provides a reasonably fast guard earth on the incoming 'P' wire and therefore permits the use of 1000 ohm lines.

At U.A.X.s contact FG2 backward holds the special linefinder until such time as the standard linefinder has found the C.F.C. and relay PA can operate to take over the backward holding function.

Since the relay operates in series with the loop its operation indicates that a call is to follow. Contacts FG3 and FG4 are therefore used to isolate the M and MB relays to permit routine testing of the associated selector without the CFC responding to meter pulses or CFC signals from the manual board.

The release lag of relay FG provides the 'disconnexion' on the incoming 'P' wire on release from a call that is unanswered.

FG4 prevents current drain by the positive battery detector when the circuit is not in use.

In cases where diode D10 is connected contact FG1 prevents a possible lock up should a reversal of the outgoing + and - wires occur without a meter pulse or if the meter pulse is ineffective.

Relay PA relays the busy earth from the outgoing to the incoming 'P' wire. It is a fast releasing relay designed to release in parallel with relay BB in a first code selector or relay HA/HB in a group selector. It must release in the shortest open period likely to be encountered, but at U.A.X.s (see note 12) it has a shunt connected to increase its release lag.

Relay PB has a release lag which is greater than the combined release time of relay H and the operate time of relay DS, to cover the possible unguard during release of the circuit. It will also hold over the longest open period likely to be encountered.

Relay M is designed to operate to any form of metering, earth, positive battery or negative battery under adverse conditions.

Relay MA is a slow to operate relay in order that relay LC may operate during its operate time when a very fast metered call is set up, and slow to release to provide a pulse sufficiently long to operate relay DLA.

Relay MB is slow to operate and consequently slow to release in order to prevent flick operations of the relay.

Relay OS controls the opening and closing of the slots at the 'pay-on-answer' box. It is high resistance as on most calls it is operated during the period of conversation. On auto calls it is often released by short circuit means and the contacts that serve this function have therefore been made palladium. The relay operates in series with resistor R10 - 1000 ohms.

Relay LS is a polarised relay of the S.T.C. type used as a sensitive D.C. relay designed to operate to line plus box telephone under adverse conditions. The relay holds to coin pulsing when 5000 ohms resistance is introduced by the coin pulser. The relay has a bias resistor of 4000 ohms.

Relay LCP is also a polarised relay of the same code as relay LS but has a lower bias resistor. The relay is designed to operate to the line plus box telephone under adverse conditions but must also release to coin pulsing under adverse conditions including high volts and a leaky line of 25k. The 5k resistor introduced in the P.O.A. box during each coin pulse has a 5% tolerance.

Relay B has been designed to hold to a train of 10 dialled pulses, or to a train of 5 coin pulses. The lag is therefore standard for a slugged B relay. (see table).

Relay H has a release lag which assists in maintaining a guard on the incoming 'P' wire under certain conditions.

Relay HH — is designed to have a lag of 20-30 ms when releasing in parallel with the K relay (600 type) in the line circuit or relay KB in the special linefinder which precedes the C.F.C. at U.A.X.s. In the latter case both the relays (HH and KB) have rectifiers in series and therefore should behave as if releasing to a disconnexion.

Relay MBA — operates only on manual board calls. It is a fast operating and fast releasing relay.

Relay Z — operates only under forced release conditions and in series with resistor R2 (fig. 2).

Relay MY — operates after the initial meter pulse or positive battery pulse goes off. It serves to connect up the ratchet relays. On release it homes the ratchet relays.

Relay DT — operates whenever it is required to return pay tone and therefore starts relay PT pulsing. It is virtually a donkey relay and operates in series with resistor R7-470 ohms.

Relay CP — is pulse operated per coin pulse and repeats the pulses to the ratchet relay CU and the exchange meter. The meter must be given time to release to short circuit conditions between coin pulses and it was found necessary to shorten coin pulses to increase the period between them by making relay CP slower to operate than to release, in other words to introduce negative distortion. The natural lag of the relay prevents false coin pulses being produced for example if relay LS operates before relay LCP. The operate lag is of the order of 20 to 30 ms.

Relay CN — operates on both local and trunk calls and remains operated for the duration when the first coin is inserted. It has a donkey function.

Relay MT — operates during auto calls to each meter pulse and on release it operates during the homing of the SU uniselector to guard the circuit by operating relay DS.

Relay LC — is a donkey relay and operates on local calls and on very fast metered calls (at about $1\frac{1}{2}$ seconds).

Relay TC — is a high resistance donkey relay which operates to the second meter pulse received hence the designation TC - trunk call. The relay also operates on manual board calls when the slots are opened to the second or third positive battery signal and serves two functions.

TC1 besides holding relay TC disconnects earth from contact MB3 to prevent the SU uniselector from stepping to further operations of relay MB.

TC4 disconnects the shelf TP relay on trunk and manual board calls.

Relay DS — is a fast operating and releasing relay. It is designed to release in the shortest disconnexion likely to be encountered (about 40 milliseconds) that forms part of the coin signal. The relay is also employed on release of the circuit.

Relay RT — is the routine test relay and serves to isolate the CFC from its associated selector and busies both the 'P' wires of the circuit. It also disconnects the TP pulses.

Relay CDL — operates if a meter pulse is received while relay DLA is operated and serves to cancel or reduce delay. It is a fast releasing relay.

Relay DLA — has a short release lag obtained by means of a rear end slug. The lag ensures that relay MT will be operated for an equal period and therefore ensures a satisfactory pulse under adverse conditions to MU ratchet.

Retard TL — serves as a transformer to connect pay tone or N.U. tone to line and also holds forward equipment.

Relay CPA — has an operate time greater than the pulse operate time of a ratchet relay in order to increase delay by one second for each coin (see CP4 and CPA4). Its release time is controlled by capacitor C5 and/or contact DS2. The relay is held during coin pulsing by the coin pulses (see CP7) and by the discharge current from C5. When relay DS releases the capacitor is disconnected but relay CPA is held momentarily via LS1 released, PA7 operated and CPA1 until the end of the disconnexion. This hold circuit reduces clicks to the called party.

Relay PU — provides the one second earth pulses for timing of the pay tone and forced release periods. It also times off the delay period on trunk calls. The relay is self pulsating and the speed may be adjusted by varying the capacity connected (see C1 in figure 2).

Relay PT — pulses at several speeds.

(1) to produce pay tone of 4 p.p.s. with approximately equal make and break ratios.

(2) to produce pulses for cancelling delay when relay CDL operates. Under these conditions the overall capacity is reduced to 0.47 microfarads in order that relay PT will pulse at approximately 18 p.p.s. The relay should be adjusted so that the make/break ratio of contact PT3 is about 50/50.

Relay Contacts in series with relay M

MY6, MBA4, Z7, LC7, TC6 and B2. Some of these contacts only have useful functions in director exchanges. These may be summed up as follows:-

(1) to ensure the -1 wiper of the first code selector is disconnected while travelling over bank contacts, both during the setting up of the call and on release.

(2) to disconnect -1 wiper when the selector is released as the result of forced release.

(3) to prevent relay M operating to a meter pulse returned if a local call is set up via trunk equipment

(4) to ensure that relay M operates to every pulse returned after relay LC has operated on a very fast metered trunk call.

At U.A.X. 12 & 13 exchanges contact MY6 is used to operate the release relay in the alarm circuit for the duration of the call.

Diodes (Fig. 1)

D1 prevents increasing the release lags of any relays connected to the 'P' wire at the time of release.

D2 prevents blowing the positive battery fuse during metering on the 'P' wire.

D3 prevents blowing the positive battery fuse during metering on the 'PM' wire.

D4 prevents relay PA interfering with the release performance of other relays connected to the O/G 'P' wire at the time of release.

D5) D6) These diodes prevent mutual interference between relays DS and CP when disconnected during the 'disconnexion' at the end of the coin train.

D7 has a very high backward resistance to prevent interference with the correct performance of C.S.O. equipment. The diode ensures that relay M only operates to positive battery.

D8 prevents feeding earth onto an earth common (H4 earth common) and therefore ensures the normal and intended release sequence.

D9 prevents earth from H2 and OS1 or from M3 from operating relay TC.

Diodes (Fig. 2)

D1 prevents earth, when it reappears on the outgoing 'P' wire after the disconnexion, from holding relay H.

D2 prevents earth from contact PA6 from feeding to the outgoing 'P' wire and also prevents a possible 'buzz' at contact PA8.

D3 ensures that relay CPA is not operated when earth is applied to relay PT.

D4 prevents earths that operate relay CPA such as CP7 and OS6 from starting relay PT pulsing. It also prevents relay PT pulsing immediately relay MBA operates.

D5 at U.A.X.s this diode prevents feeding earth out via U29 to release the release alarm relay.

D10 prevents coin slots being opened by a reversal from forward equipment before a meter pulse is received.

Resistor R11 (Fig. 1) is only connected at U.A.X.s and serves to make relay PA slow to release since a short disconnexion can be given by the line circuit when it switches the line through.

Relay Timing Information

To ensure satisfactory operation of this circuit, the lags of the timed relays should be within the limits shown in the table below. Limits marked N.C. are not critical for the operation of the circuit, but will not normally be exceeded. All times are in milliseconds unless otherwise stated.

Relay	Release lag			Operate Lag	
	Min.	Max.		Min.	Max.
H	90	135			
B	250	350			
HH	20	30	circuit conditions	20	30
CP				20	30
CPA	1.75 secs.			30	45
DLA	60	90			
PA	50	70	N.C. with shunt (U.A.X.s)		
PA	12	18	without shunt (exchanges other than U.A.X.s) circuit conditions.		
MA	40	60		25	37
PB	190				
MB	100	150		60	90

Common Services (main exchanges)

The diagram was designed to work in conjunction with the following common services:-

Fuse Alarm ..... AT 4701 Fig. 5

N.U. tone ..... AT 3848 Fig. 2D

Pos. batt. ..... AT 4418 Table E

Battery Pulse supply ..... AT 5711 Fig. 2

Release Alarm Battery ..... AT 4741 Fig. 4

6. HISTORY

Issue A Diode D10 added, contacts M6, MB4, MY7, FG1, HH3 and LC3 rearranged and value of R6 changed to prevent premature opening of the coin slots when a reversal from a final selector or auto-auto relay set is received before the meter pulse.

Straps 17 and 18 added to enable a unit coin to be accepted or nor as required.

Contacts in tone supply rearranged to prevent a speech path being set up via the tone winding of the transformer and retard TL during pay tone.

Contact PT4 added and PT1 changed to permit a make action to be used for pulsing ratchet relays DU and TU during cancellation of delay since the break contact did not give an adequate pulse ratio.

Contacts PA3 and PA7 changed to avoid a minor feedback problem on a disconnected common.

Contact CN7 moved and contact CP8 made spare to ensure prompt re-opening of slots on local calls. The original arrangement delayed the re-opening when a unit coin was employed.

Contacts in relay CDL circuit rearranged to prevent buzzing of this relay which occurred during the meter pulse on a call at 1 second metering rate.

Contact MY2 rearranged and diode D5 Fig. 2 removed in order to provide a full earth for the short circuit release of relay DT.

In fact, no equipment was manufactured to the open issue and the open issue of ATW 60665- corresponds to issue A of the AT diagram.

Issue 1

Post Office Telecommunications Headquarters
TD111/JPT
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END OF DIAGRAM NOTES

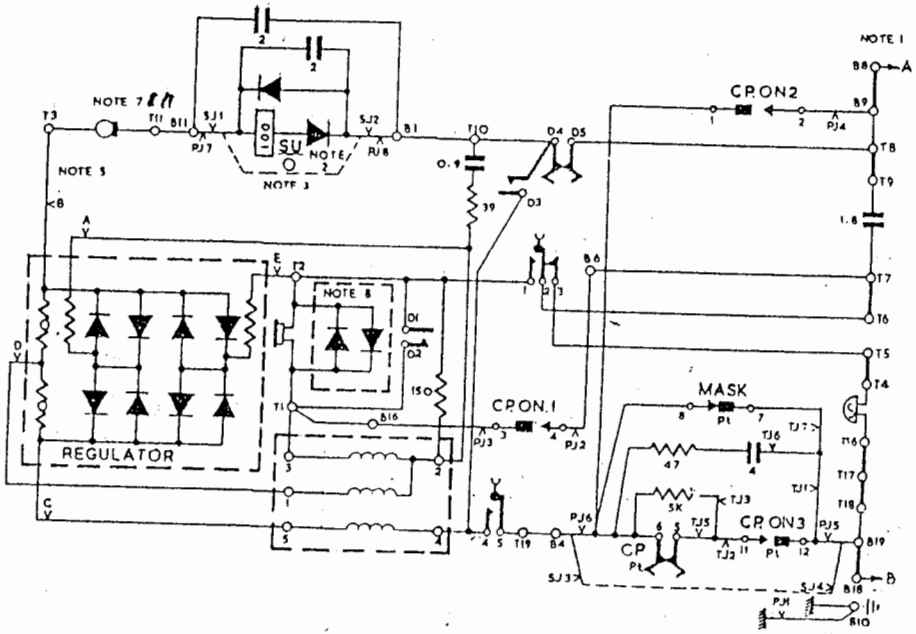
NOTES:

1. This line +VE until called sub. answers, then -VE.
2. SU unlocks coin slots whon energised by current reversal (See Note 1).
3. These points are connected by Jack 770 to provide "999" service with mechanism removed.
4. U point letter prefixes:-
   SJ - Slot unlocking Unit and Emergency Service.
   TJ - Test Jack on Pulser Unit.
   PJ - Pulser Unit.
5. When reversed in Jack Regulator connects 'B', 'C' and 'D' together, circuit then works without Regulator.
6. For wiring details of Box C.C. No.700 See N1169.
7. White wire of Handset Cord moved from T10 to T11.
8. Rectifier Element fitted to Receiver Terminals.
9. Colours in brackets refer to cable.
10. When Extension Bell required move white conductor of Cord 9/21AD from B19 to B17 and connect Bell between B17 and B18.
11. When a tele No 722 is used with Regulator No 1A connects regulator to terminals T3 - T11, not T3 - T10 as per ~~note~~ diagram N822

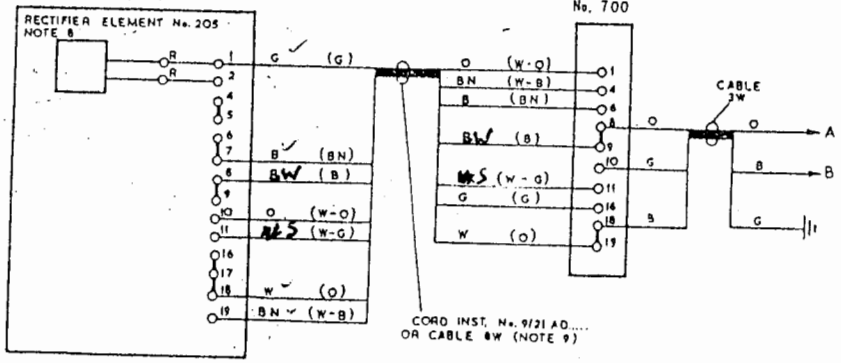
GW
13/2/26

SUBSCRIBERS DIRECT EXCHANGE LINE WITH BOX C.C. No. 700 AND TELEPHONE No. 706L, No 1/706L AND No. 711.

SCHEMA.



WIRING
TELEPHONE No. 706L OR
TELEPHONE No. 1/706 L
TELEPHONE No. 711



ISSUES		
E	NEW FORMAT	5.4.68
D	TELE. No. 711 ADDED.	15·12·63
	E.C. SEYMOUR, SI	8·3·61

P.O.M.D.
M.2.2.3.

PAPER: W

CIRCULATION
GENERAL