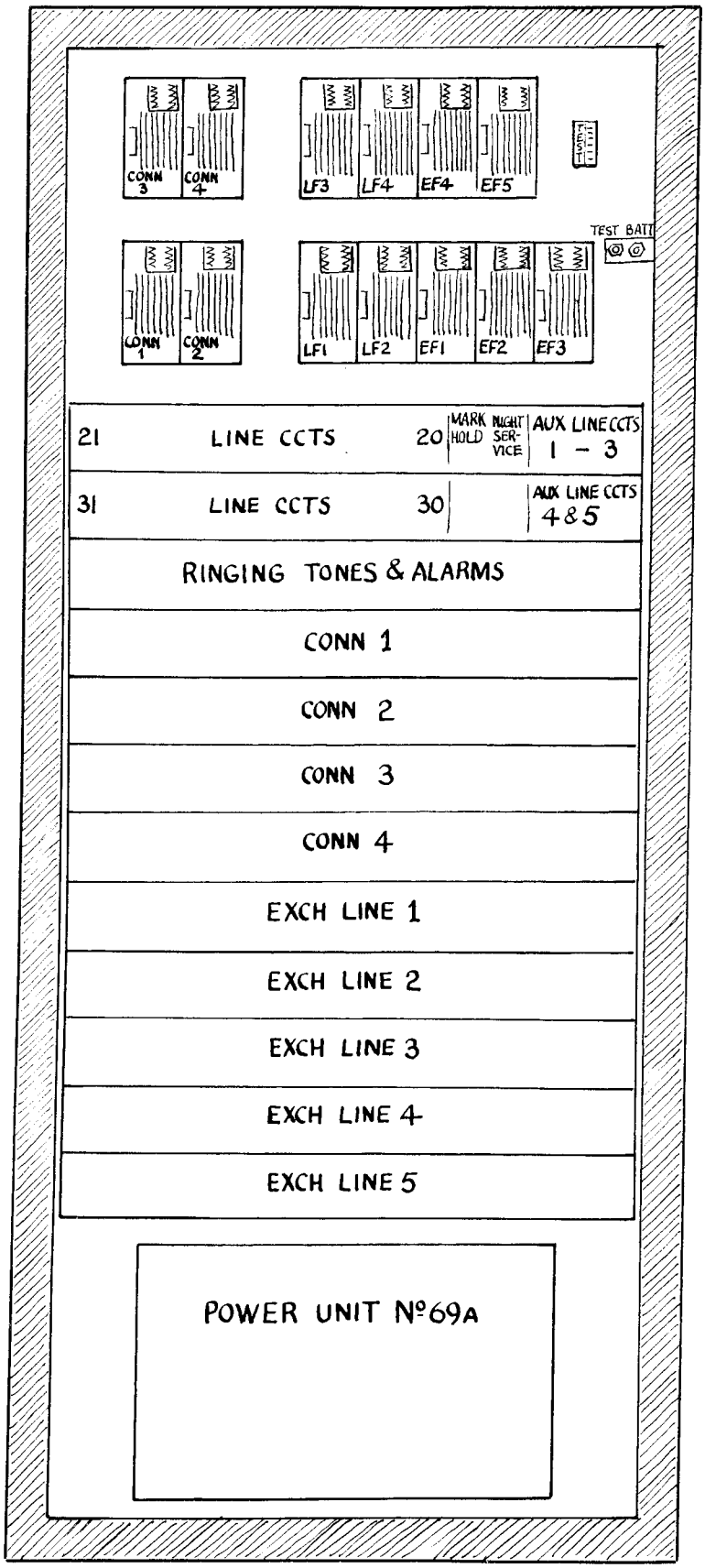
P.A.B.X. 5.

PRINCIPLES

PABX 5 — PRINCIPLES

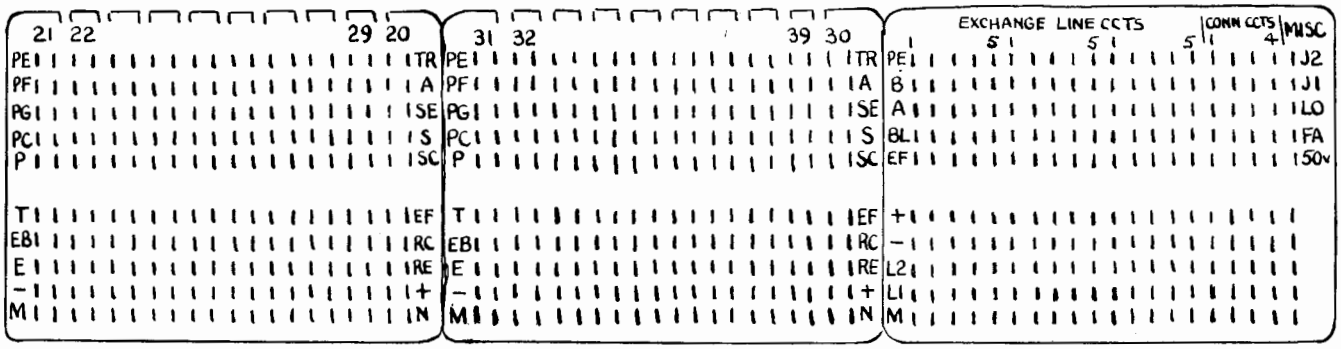
Draft issue
Dec 1972

LAYOUT — FRONT VIEW WITH COVERS ON



Behind uniselector shelf

LAYOUT — S/CONNEXIONS AND COMPONENTS



LR	LR	LR	LR	LR	LR	LR	LR	LR	LR	M	NA	LA	LA	LA
K	K	K	K	K	K	K	K	K	K		NB	KA	KA	KA

R13-15	RT BT	C1	T1	T2	IA IAT	PA	R1-3	R7-9	
P	FA S	MR1 MR2		C2	PZ	PB	R4-6	R10-12	

A	B	CA	CD	HR EF	SH SH	LR	EL	FH	R1-3
D	F	G GA	H	KC	KD	RW	SC	C1-2	MR1 R4-5

AA	BE	CR	KE	KG	MC	MH	TR SE	TP	ZB ZA
AE	CE	IT ITA	KF	LC CL	MF	RV	TF	TS	Z

REFERENCES

Diagrams

PABX 5 Trunking elements		SA 8450
" " Line, linefinder, connector and exchange line finder circuits		SA 8451
" " Ring, tones and alarm circuit		SA 8452
" 5&7 Ringing generator and tone oscillator units		SA 8453
" 5 Connecting circuit		SA 8454
" " Exchange line circuit		SA 8455
" " Interswitchboard line cct B/W dialling-in from PMBX (earth dialling)		SA 8456
" " " " " " " auto/auto (loop dialling)		SA 8457
" " Night service control telephone		SA 8458
" " Equipment & miscellaneous terminations		SA 8459
" " Interswitchboard line cct B/W dialling 1 V.F. (SSAC 13)		SA 8460
" " Telephone unit and attendants telephone		SA 8462
" " Equipment	Drawing	91839
Power unit 69 A		N 672

Telecomms Instructions

PABX 5 Facilities and apparatus	B 4	F 1501
Comparison of PABX 5 & 6	"	F 1599
PABX 5 Description	C 3	F 1050
" " Installation planning	"	F 1051
" " Installation of equipment	"	F 1052

To anyone using this document

This document has been produced by the Technical Training College at Stone, Staffs. It is organised in functions, each function being fully explained, so that when dealing with a particular fault on a P.A.B.X. 5 the relevant information is readily available in convenient form. It is only intended to explain principles of operation and not to replace, although it may supplement, other sources of information.
If you have occasion to use it and resulting from this have a suggestion or useful comment to make please don't hesitate to send it to :—

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P.O. Technical Training College
Yarnfield
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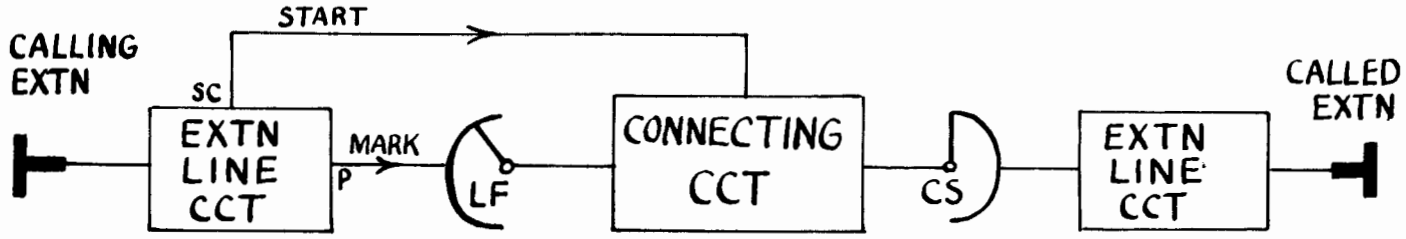
EXTENSION TO EXTENSION CALLS

Trunking



CALLING EXTN
Controls release of calls

EXTN LINE CCT
When extn handset lifted on O/G calls extends START condition over SC lead to CONNECTING CCT and MARK condition over P lead to LINE FINDER bank

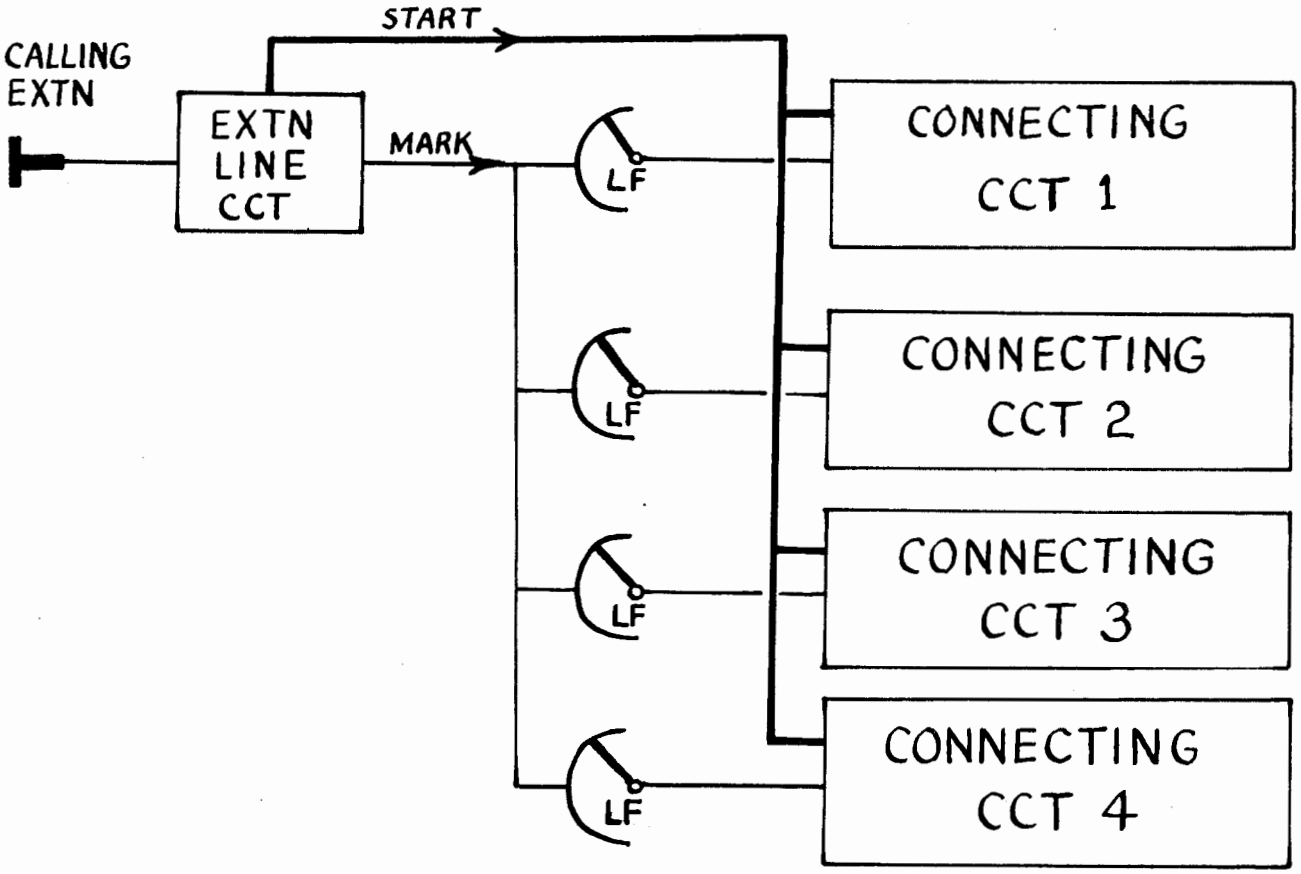
LINE FINDER
Non-homing 25 point uniselector — self drives to find CALLING EXTN and extends it to CONNECTING CCT

CONNECTING CCT
Relay set with transmission bridge — on seizure connects dial tone to caller — positions CS switch under control of dialled digits — tests CALLED EXTN —
if free : switches to & rings extn, gives ring tone to caller,
if busy : gives busy tone to caller,
if P.G or spare : gives NU tone to caller

CS SWITCH
25 point homing uniselector — extension line multiple on its banks — positioned by dialled extension number — first digit selects group of 10 contacts — second digit selects 1 out of the 10

EXTN LINE CCT
On incoming calls indicates state of extn line (free, busy or P.G.) to CONNECTING CCT via CS SWITCH — when seized by I/C call cuts off O/G call facility

Allocation of Connecting Ccts



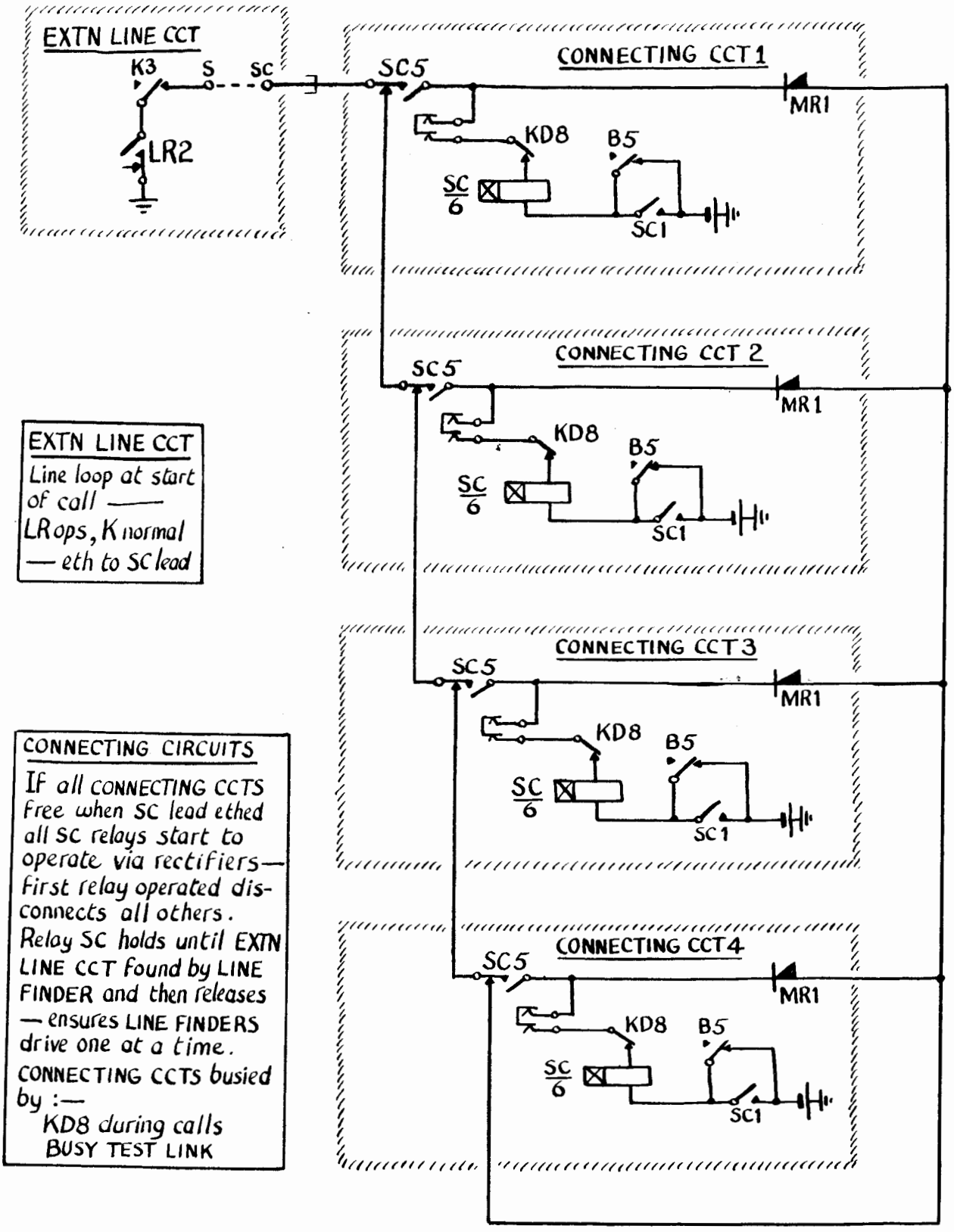
LINE FINDER

Only one LINE FINDER drives to find a MARK condition at any one time

CONNECTING CIRCUITS

CONNECTING CCT in use for duration of call — Free CONNECTING CCTS available, in random manner, to all EXTNS originating calls — First CONNECTING CCT to respond to START signal is taken into use & disconnects START lead from all other CONNECTING CCTS until its LINE FINDER has found the CALLING EXTN

Allocation of Connecting Ccts



EXTN LINE CCT

Line loop at start of call —— LR ops, K normal — eth to SC lead

CONNECTING CIRCUITS

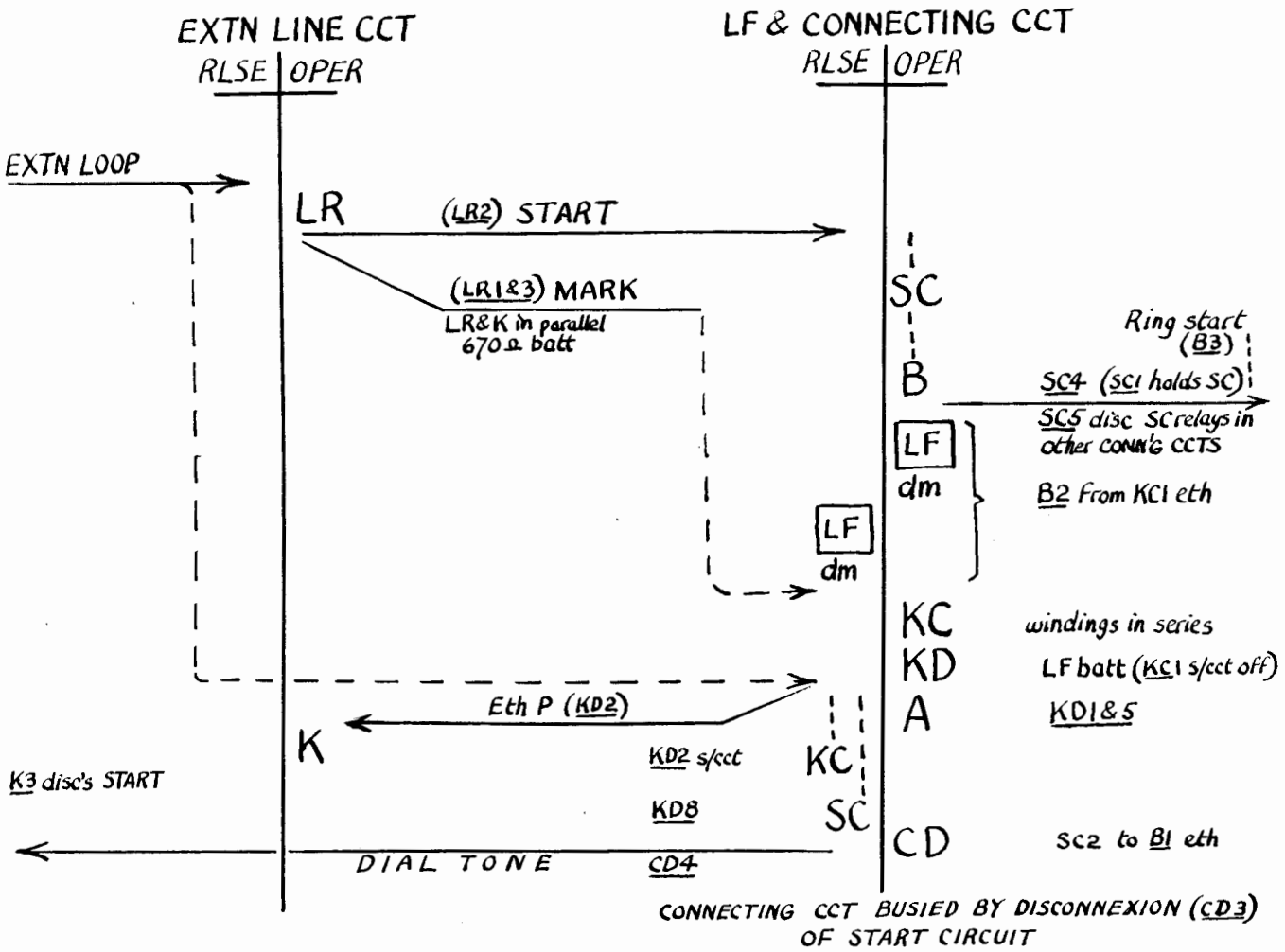
IF all CONNECTING CCTS free when SC lead ethed all SC relays start to operate via rectifiers— first relay operated disconnects all others. Relay SC holds until EXTN LINE CCT found by LINE FINDER and then releases — ensures LINE FINDERS drive one at a time.

CONNECTING CCTS busied by :—

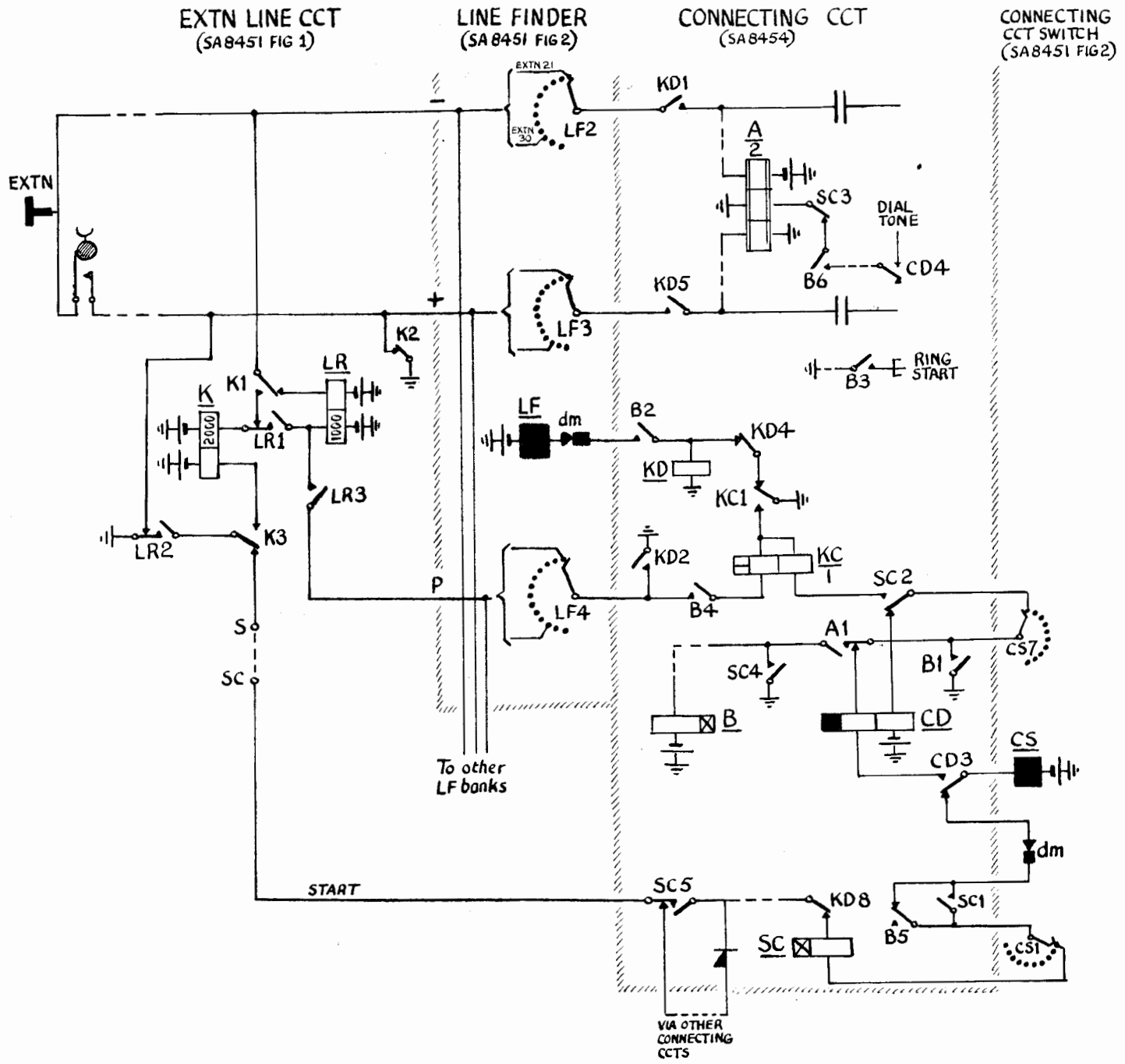
KD8 during calls

BUSY TEST LINK

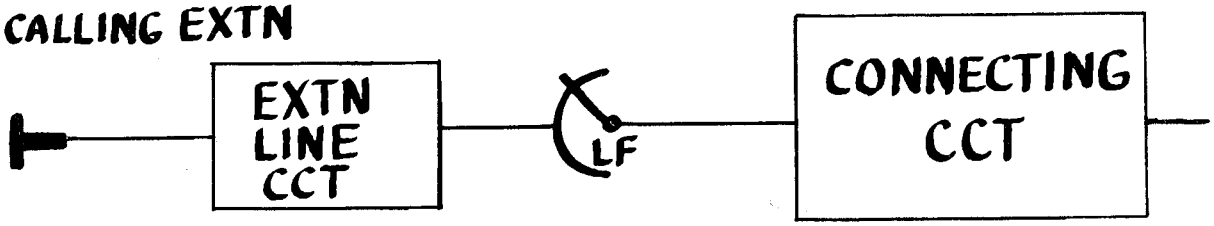
Obtaining Dial Tone



Obtaining Dial Tone



Calling Extension fails to dial (P.G)

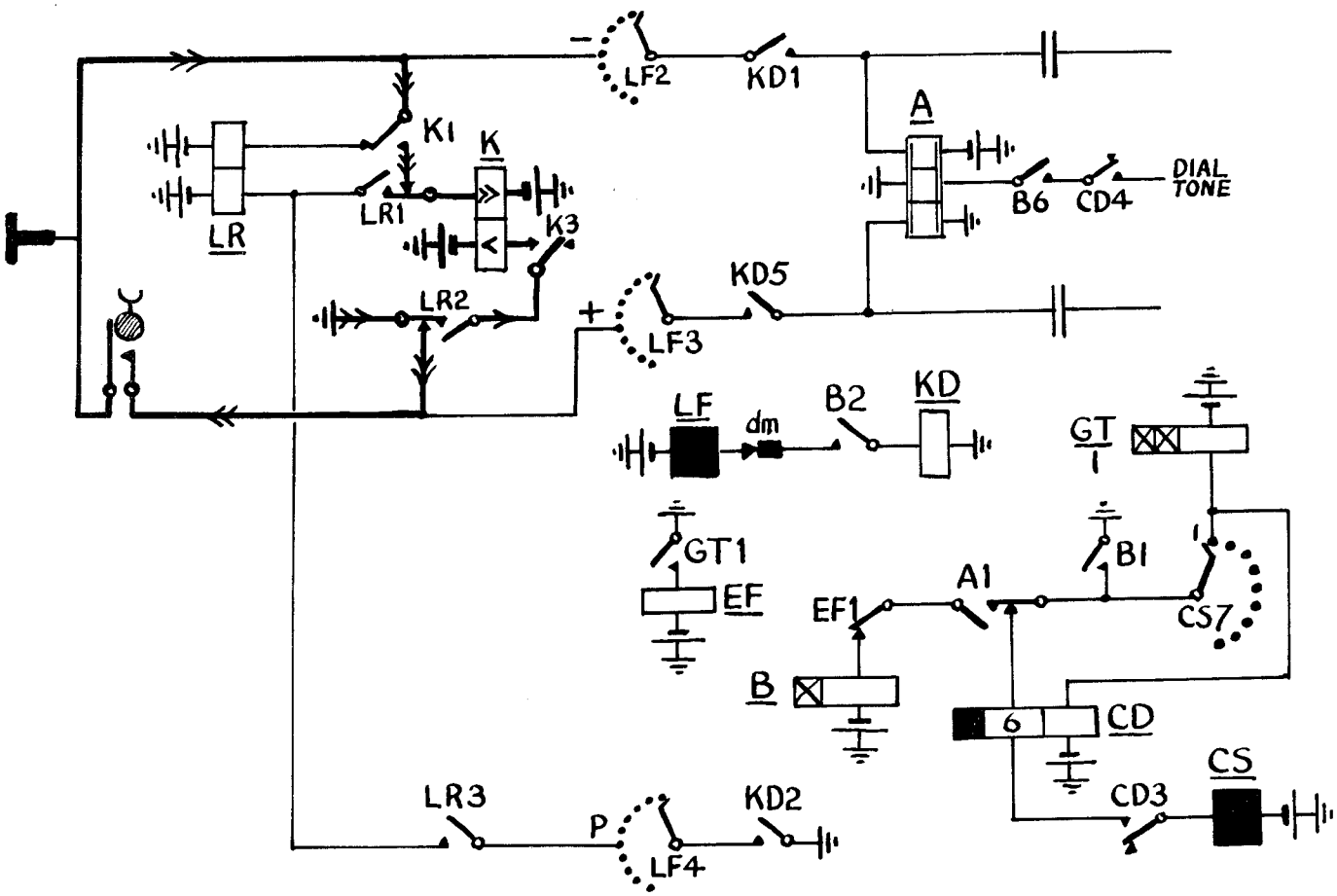


CALLING EXTENSION

Obtains dial tone, but does not dial, or unduly delays dialling
OR handset knocked off
OR fault giving loop or eth B conditions

CONNECTING CCT

Forced Released and made available for other calls after delay without dialling of approx 20 secs. Delay produced by operate time of thermal relay (GT)



EXTENSION LINE CCT [LR & K operated during seizure]

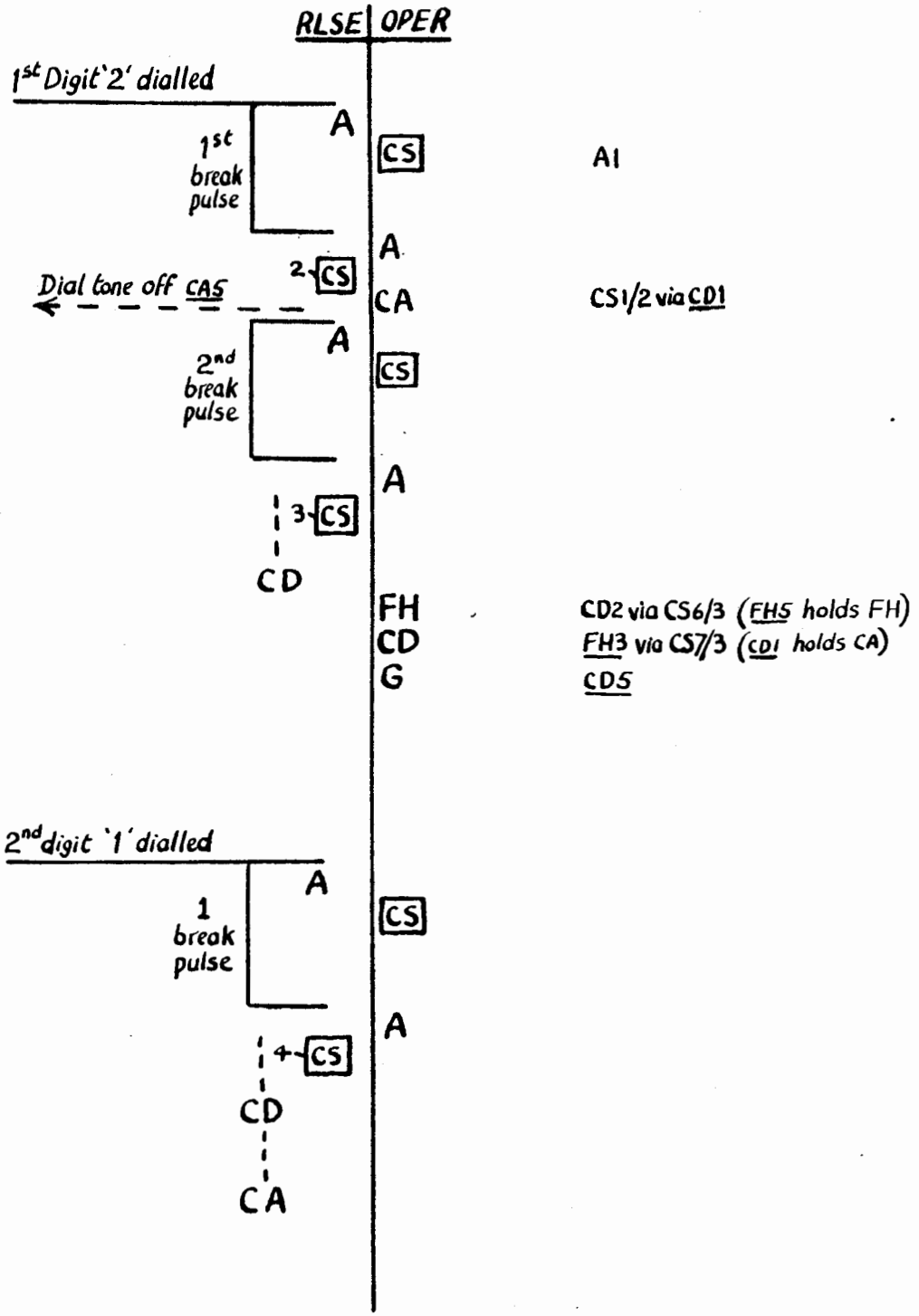
Disc P from CONNECTING CCT relses LR, but K remains held :—
Firstly via K3 & LR2 (during first part of LR relse) →
then, when LR contacts reach & pass the bunched state, via LR2, tele loop, K1 and LR1 →
K relses when handset replaced

CONNECTING CCT

A, B, CD & KD operated on seizure.
GT operates after 20 secs if CS7 still on 1 i.e. no dialling.
GT1 ops EF. EF1 relses B. B1 disconnects GT & relses CD. B2 relses KD. KD1 & 5 relse A. KD2 opens P to line cct.
GT1 relses EF

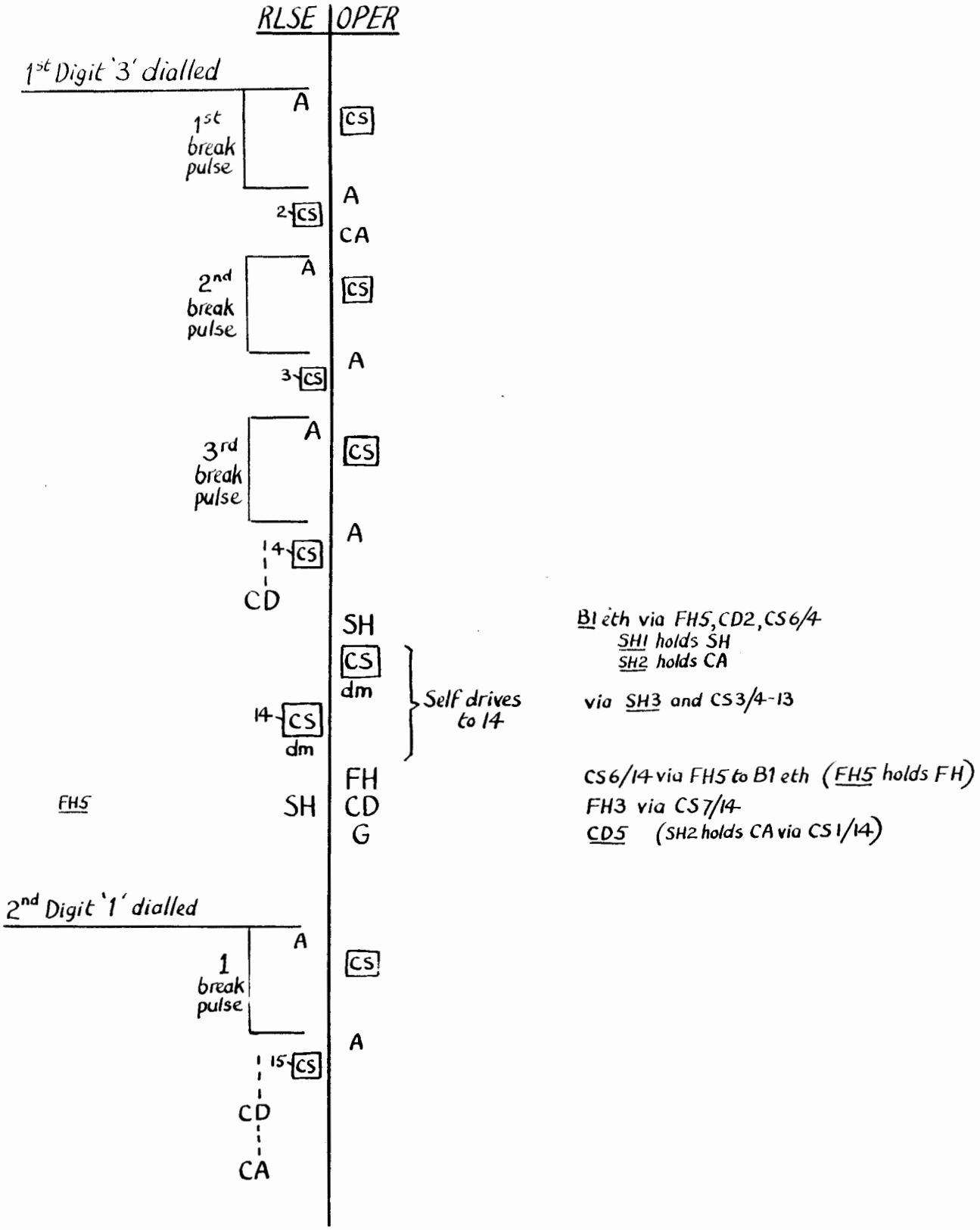
Extn to Extn Call — Dialling Extn 21 (or 22 to 20)

Connecting Circuit relays operated after seizure :— A, B, CD, KD

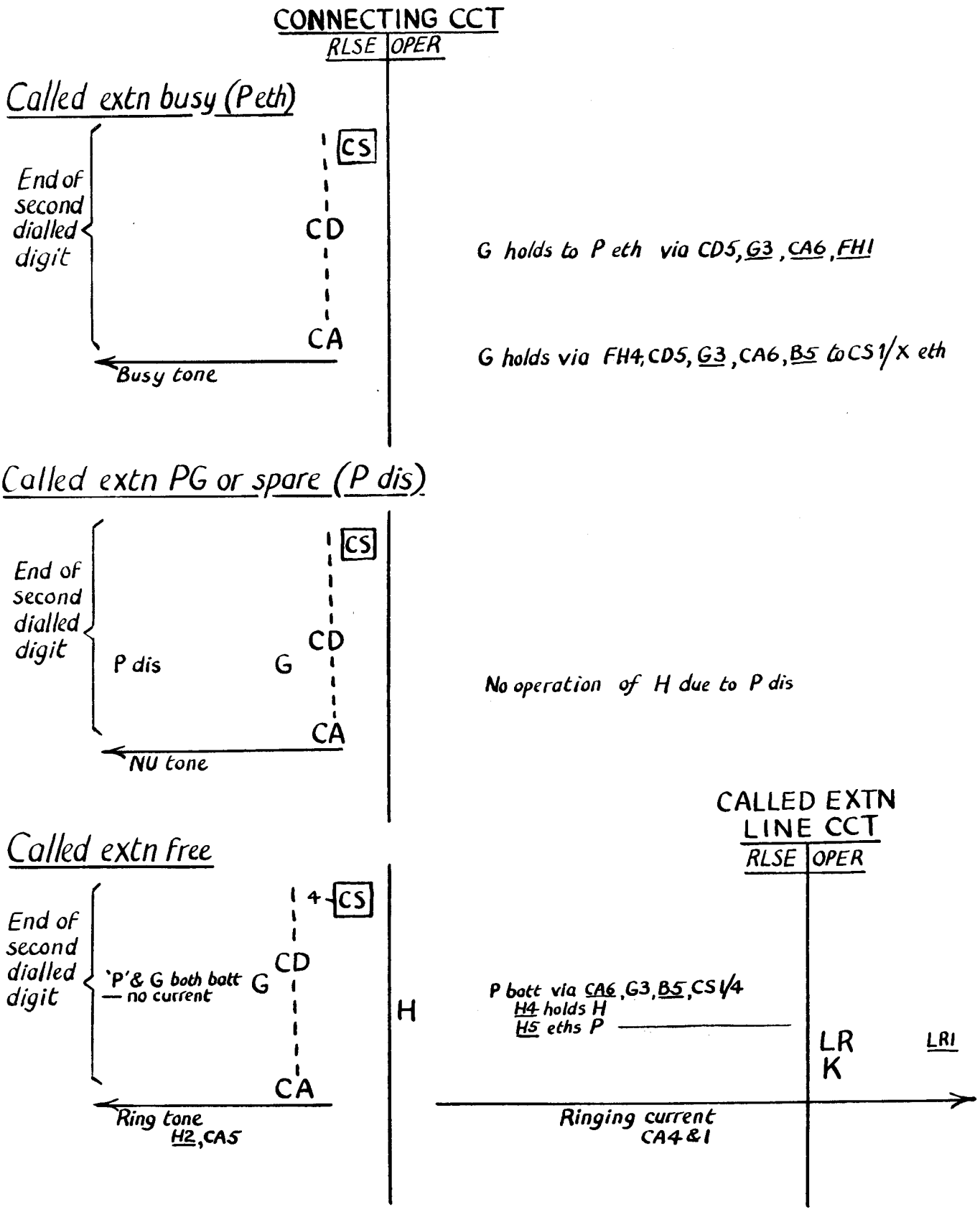


Extn to Extn Call — Dialling Extn 31 (or 32 to 30)

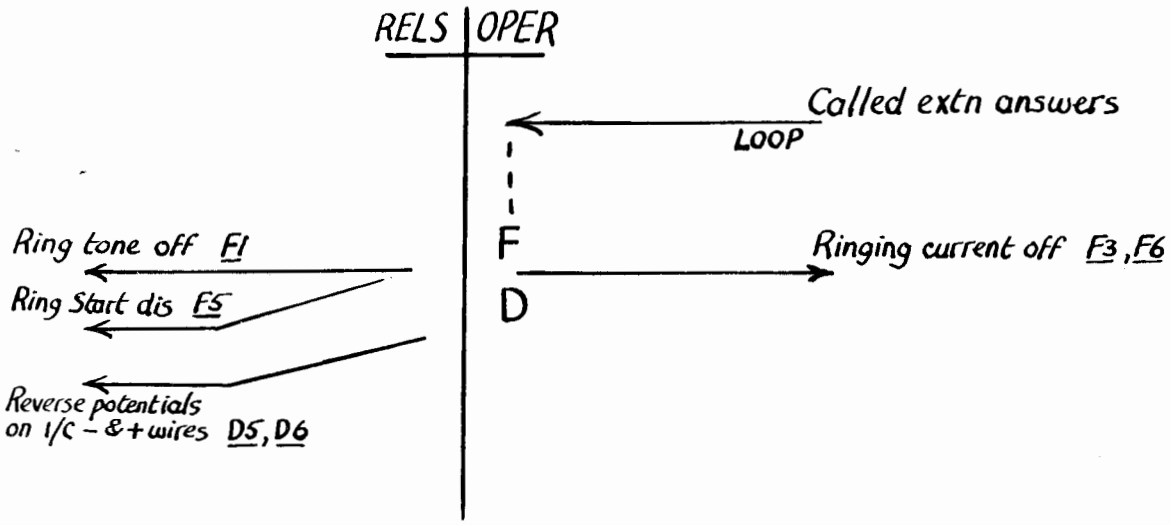
Connecting Cct relays operated after seizure :– A, B, CD, KD



Extn to Extn Call — Testing Called Extension

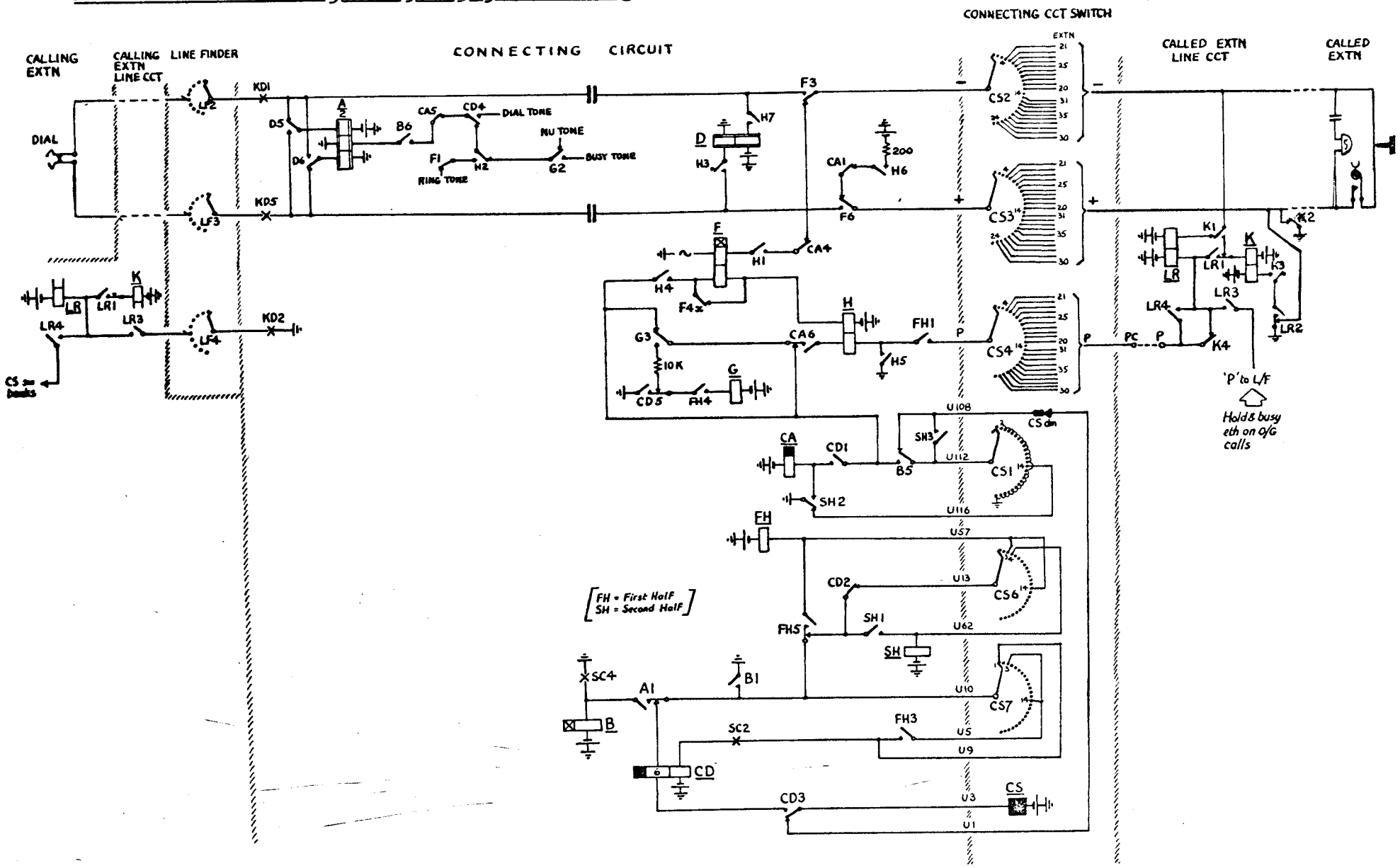


Extn to Extn Call — Called Extension Answers

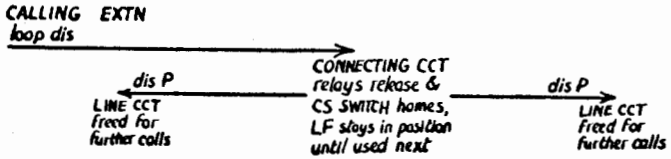


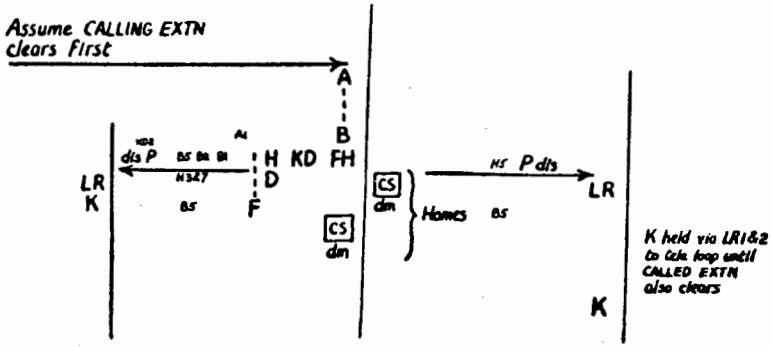
Relays operated during conversation : A, B, D, F, FH, KD, H

Extn to Extn Call — Dialling, Testing, Ringing and Answering

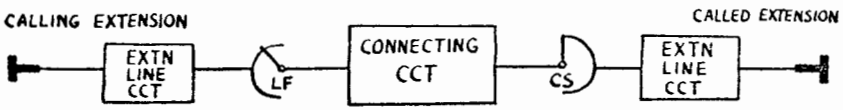


Extn to Extn Calls – Release at End of Call





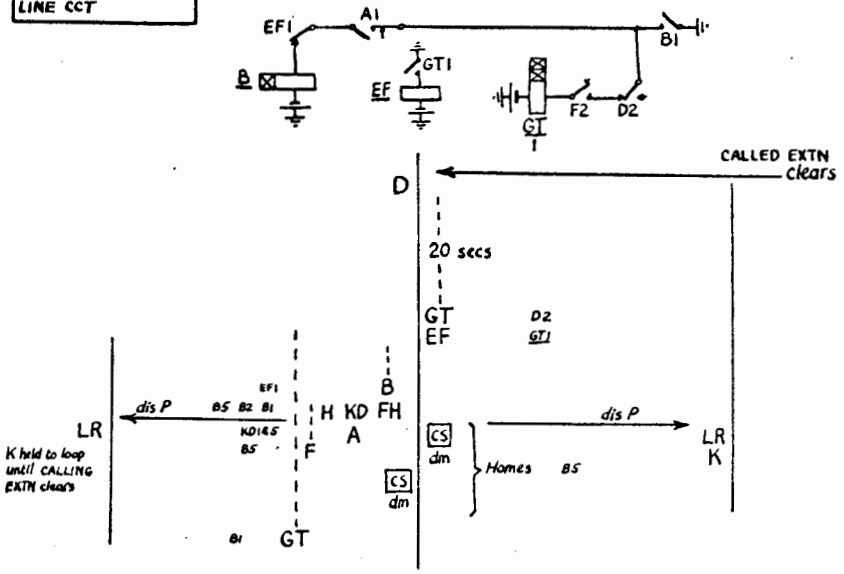
Extn to Extn Calls – Calling Extension fails to clear



CALLING EXTENSION
Handset not replaced – holds CONNECTING CCT & keeps CALLED EXTN busied. After 20 secs disconnected from CONNECTING CCT by Forced Release — thereafter extn loop only holds K in its LINE CCT

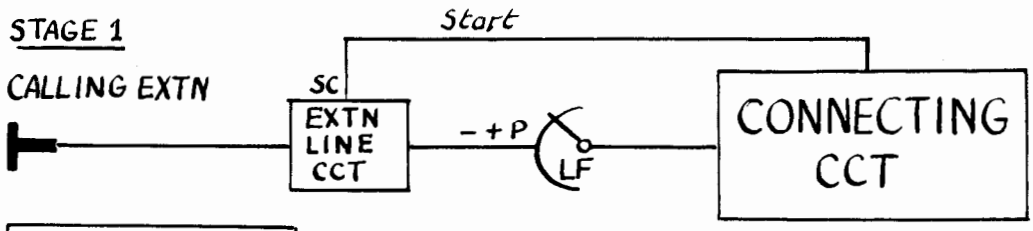
CONNECTING CIRCUIT
Clearance by CALLED EXTN starts 20 sec time delay — if CALLING EXTN not cleared after 20 secs Forced Release of CONNECTING CCT takes place — CONNECTING CCT then available for other calls.

CALLED EXTENSION
No tone due to CALLING EXTN still holding CONNECTING CCT — receives dial tone when CONNECTING CCT forced Released after approx 20 secs.



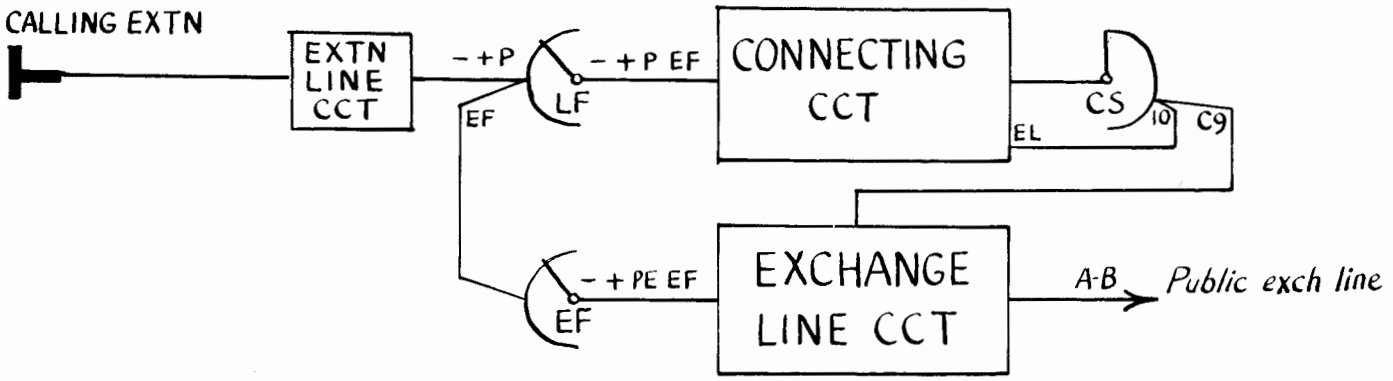
OUTGOING EXCHANGE LINE CALLS
Seizure of Public Exchange Line

STAGE 1



CALLING EXTN
Receives dial tone as in EXTN-TO-EXTN CALLS

STAGE 2



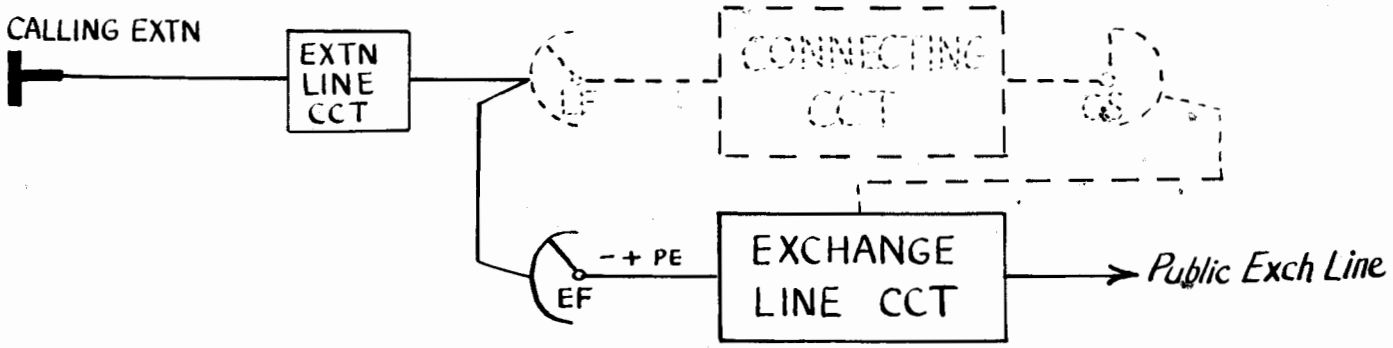
CALLING EXTN
Dials '9'

CONNECTING CCT
Informed over EL lead that EXCH LINE CCT required — requests EXCH LINE CCT over C9 lead

CS SWITCH
Stepped 9 times to contact 10

EXCHANGE LINE CCT *Receives request for Public Exch Line over C9 lead — Exch Finder EF hunts for calling EXTN LINE CCT marked from CONN'G CCT via LF wipers — also Public Exch Line seized.*

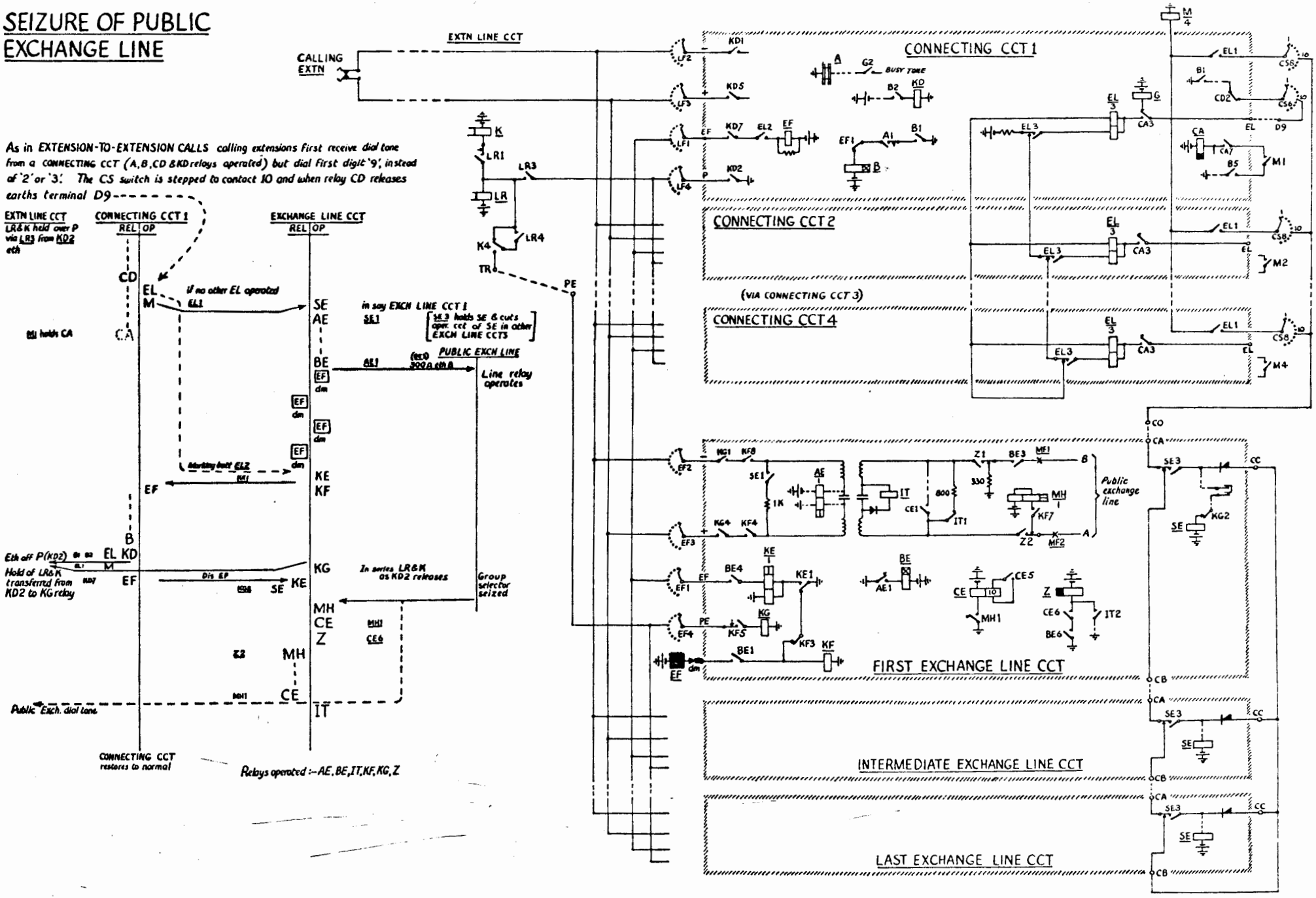
STAGE 3



CALLING EXTN
Hears dial tone from Public Exch & continues dialling

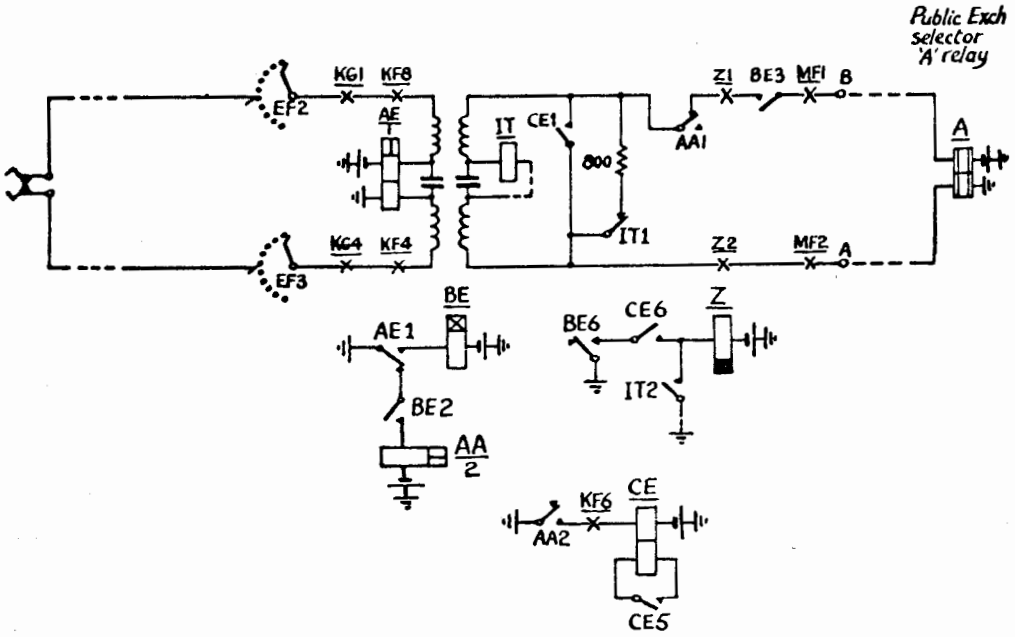
LF, CONNECTING CCT & CS SWITCH
Released when CALLING EXTN LINE CCT found by Exch Finder (EF)

SEIZURE OF PUBLIC EXCHANGE LINE

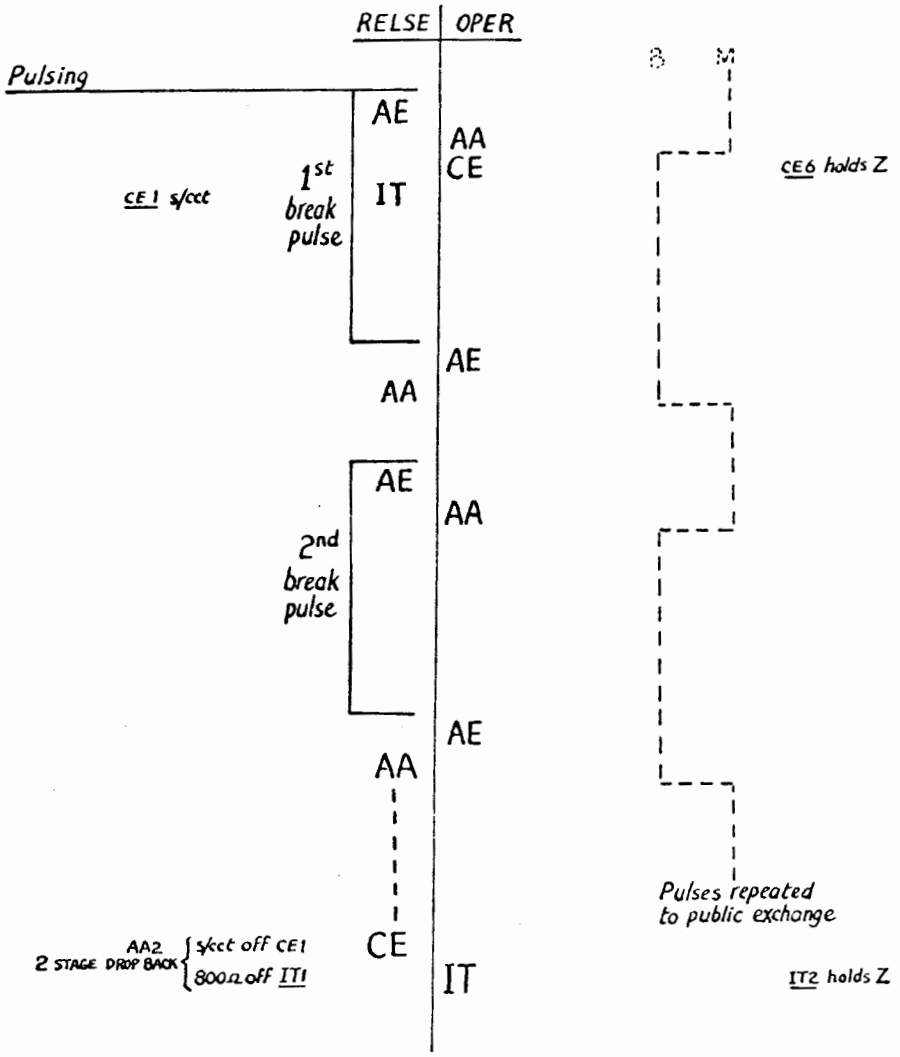


Dialling to Public Exchange

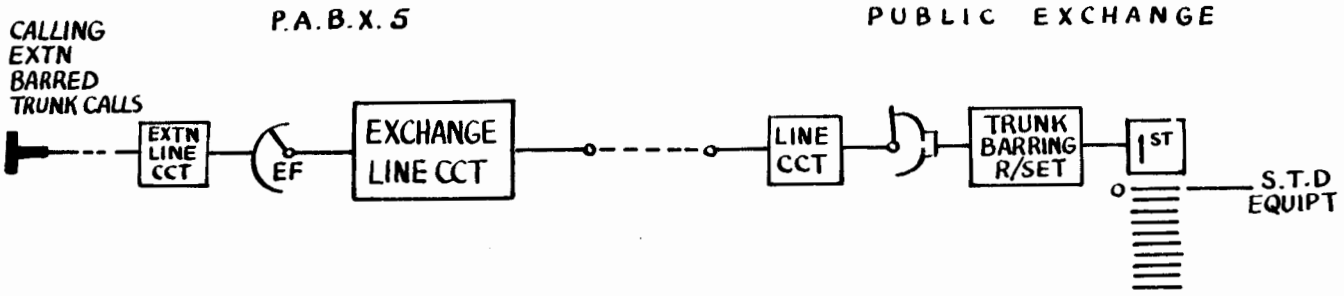
CALLING EXTENSION	EXTN LINE CCT	EXCHANGE LINE CCT
Continues dialling on hearing public exch. dial tone	Relays LR & K held over PE lead from EXCHANGE LINE CCT	Detects dial pulses — repeats dial pulses to exchange line with zero resistance make periods — end of each pulse train disconnects short circuit from transmission bridge in two stages (TWO STAGE DROP BACK)



Relays operated on seizure of Exchange Line Circuit: AE, BE, IT, KF, KG & Z



Trunk Barring



CALLING EXTN BARRED TRUNK CALLS

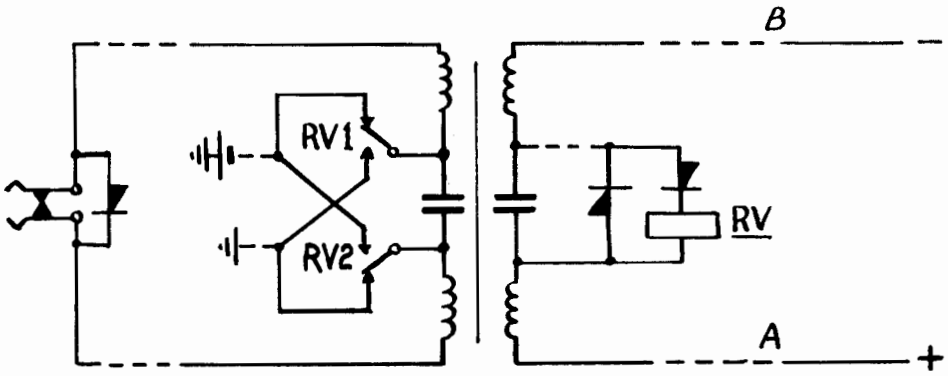
Dials :
'9' to get public exchange line — followed by '0' if making STD call — or followed by '10' if making trunk call via operator.
Dialling only effective while line conditions normal — dial short circuited when line conditions reversed.

EXCHANGE LINE CCT

Provides normal C.B. conditions towards CALLING EXTN unless reverse C.B. conditions received from public exchange, then reverses conditions towards CALLING EXTN

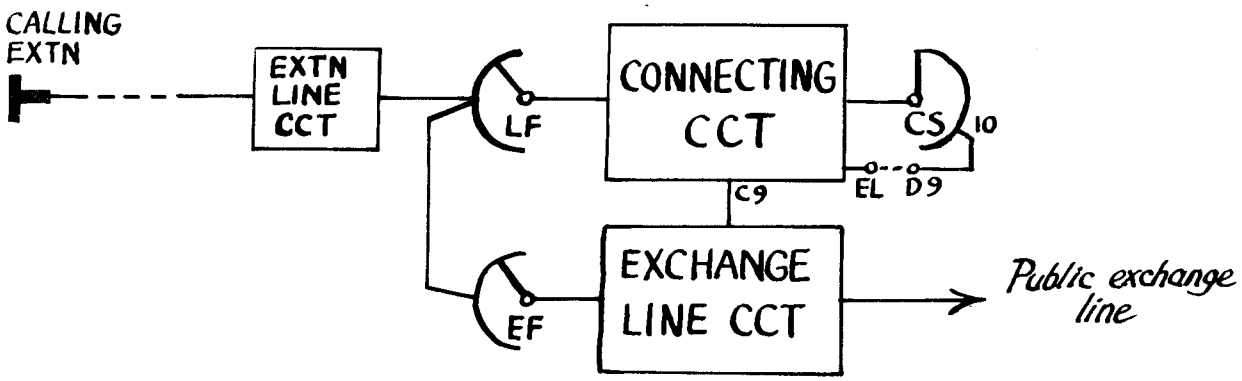
TRUNK BARRING R/SET

Monitors first digit/s dialled into public exchange — if first digit '0', or '1' followed by '0', reverses line conditions towards caller.



Normally batt on B wire, eth on A wire from selector, but if first digit/s '0' or '10' dialled TRUNK BARRING R/SET crosses – & + wires returning batt on A wire & eth on B wire

If EF Finder fails to find CALLING EXTN



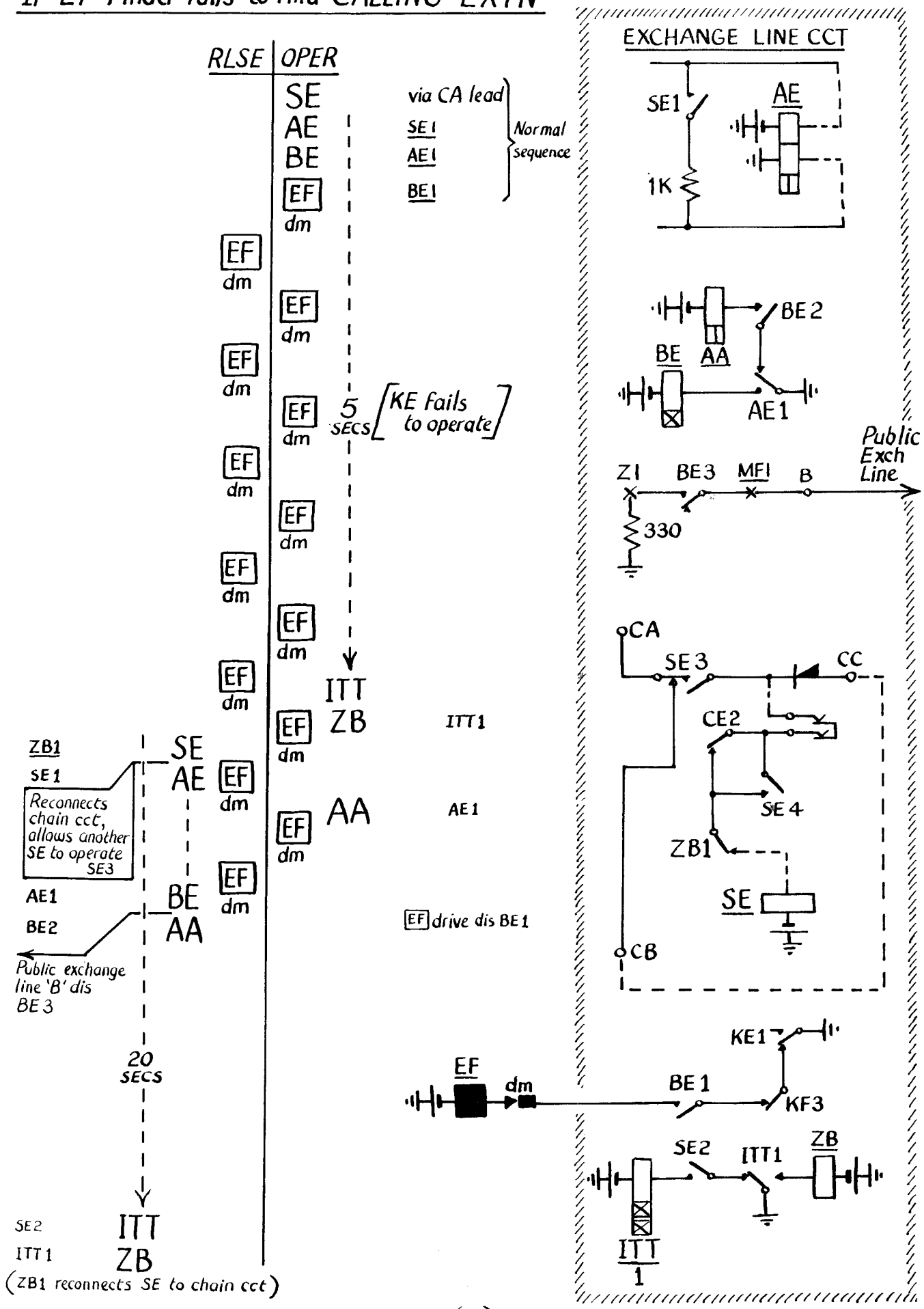
CALLING EXTN
Dials '9', waits for Public Exchange dial tone

CONNECTING CCT
On receipt of dialled digit '9' requests EXCH LINE CCT over C9 lead

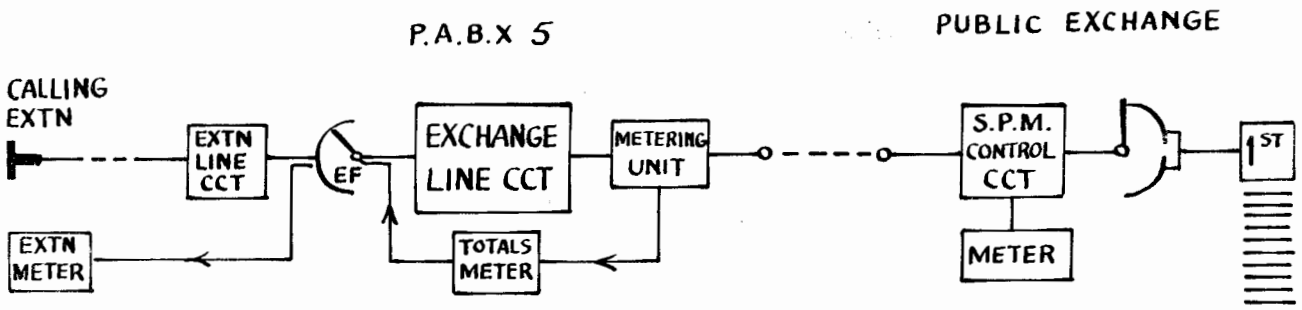
EXCHANGE LINE CCT
Request received on 'C9' lead — seizes public exchange line — drives EF finder — if EF still driving after 5 secs forcibly releases start chain relay (SE) which stops EF driving and allows another EXCH LINE CCT to search for calling EXTN LINE CCT

Public Exchange Line
Seized when EXCH LINE CCT seized — released after 5 secs by EXCH LINE CCT if connection not made with CALLING EXTN by EF finder

If EF Finder fails to find CALLING EXTN



Subscribers Private Metering



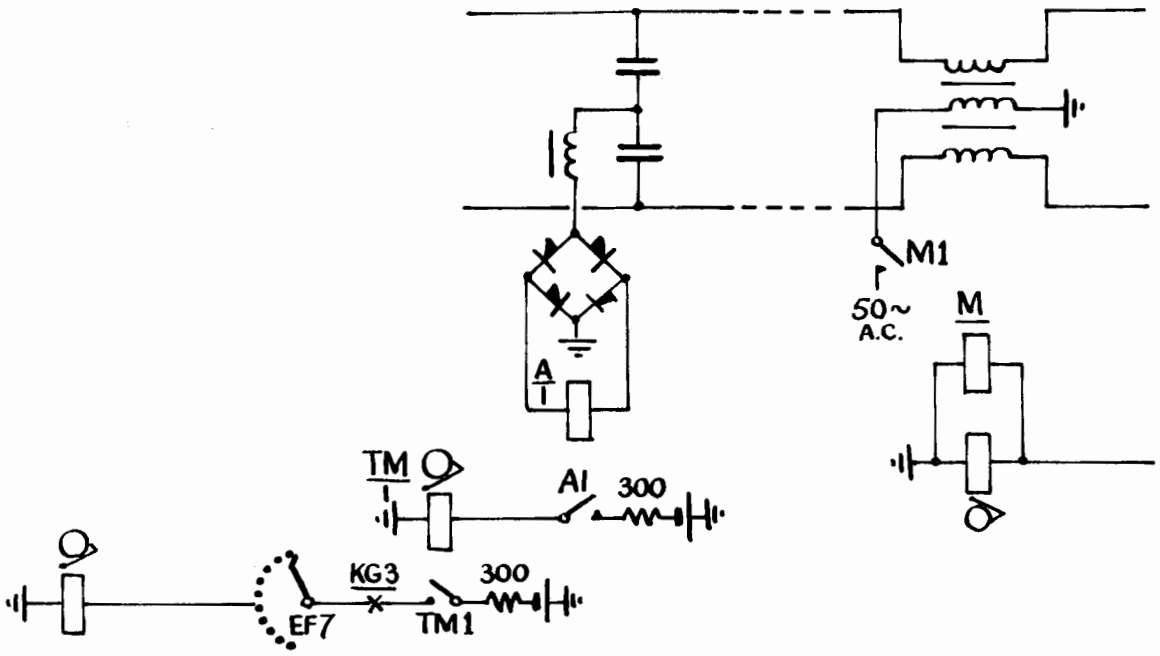
METERING UNIT
Connected in exchange line if subs private metering required — converts 50~ A.C. phantom line signals to D.C. meter pulses

S.P.M. CONTROL CCT
Repeats meter pulses as 50~A.C. signals over line phantom with eth return — no interference on conversation

METER
Registers total meter pulses for calls made via this line — data for customer's account

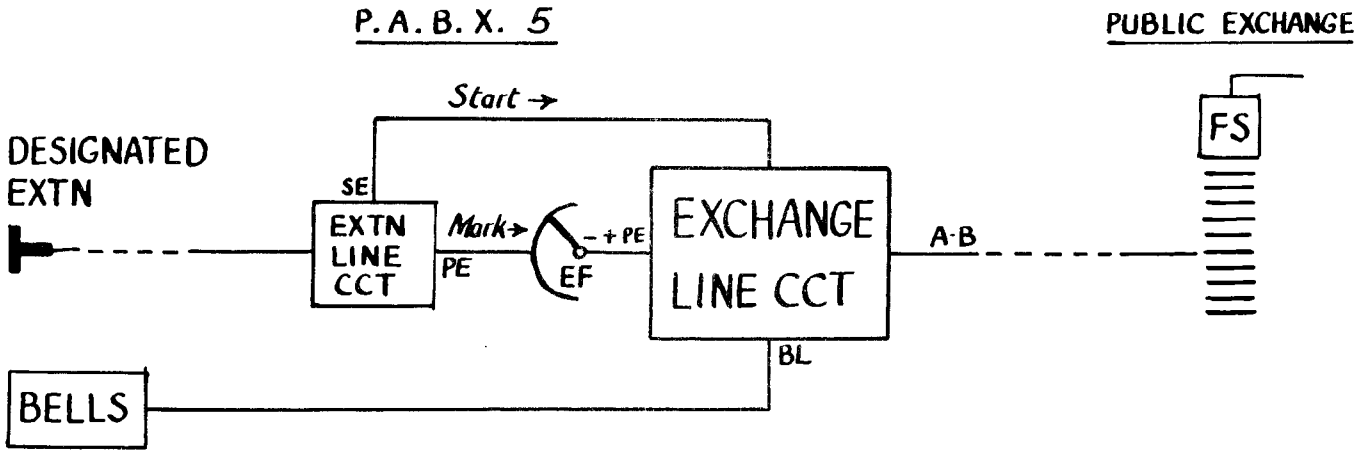
EXTN METER
Resettable — provides extn with call charge information

TOTALS METER
Registers total meter pulses incurred on exchange line by O/G calls. Repeats meter pulses to extension meters as required



INCOMING EXCHANGE LINE CALLS

Incoming Ring & Answer by Designated Extension



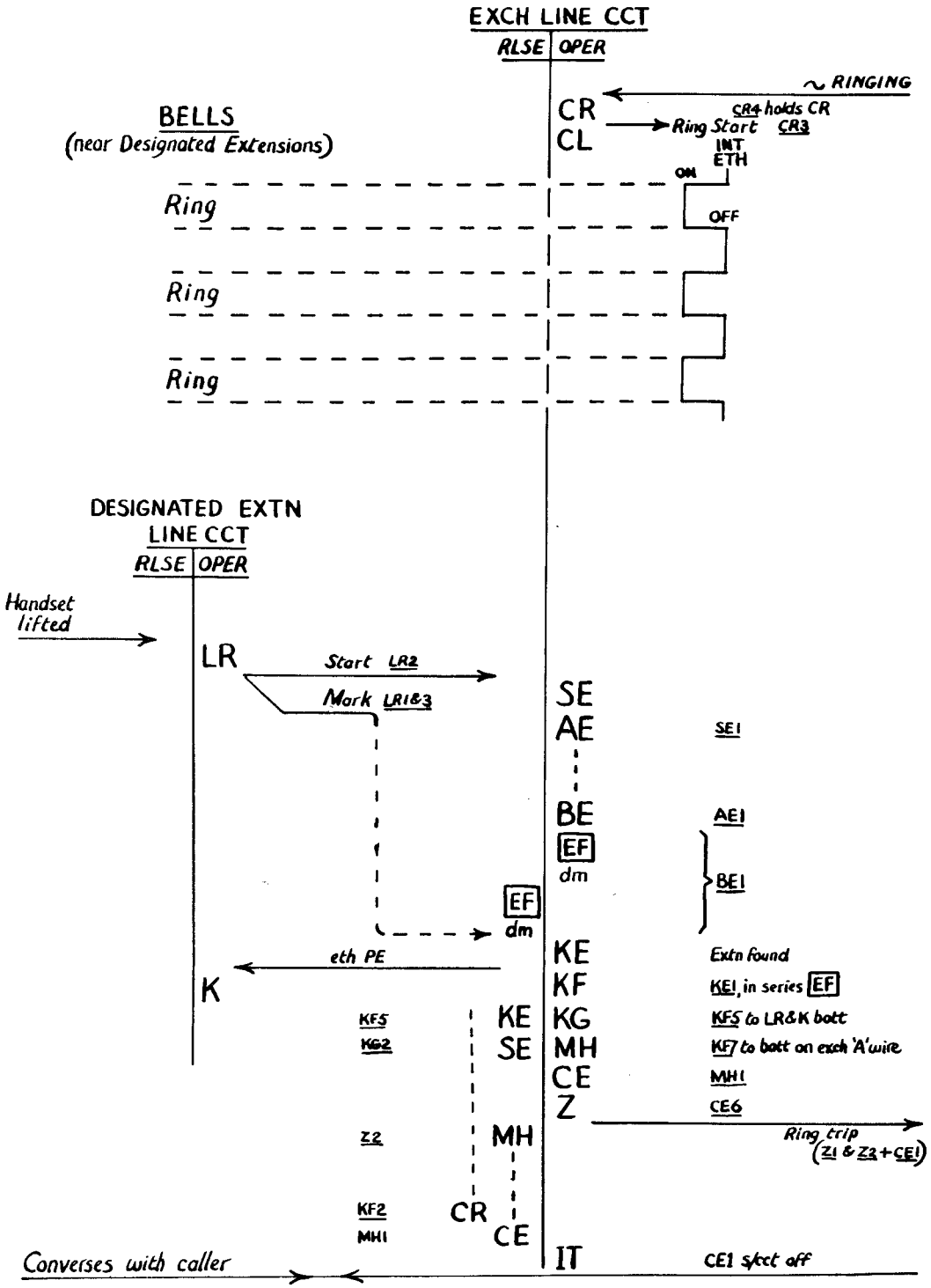
DESIGNATED EXTN
Answers incoming public exchange line calls by lifting handset when BELLS ring

BELLS
Rung by EXCHANGE LINE CCTS when incoming call/s waiting answer— stop ringing when call/s connected to DESIGNATED EXTN/S

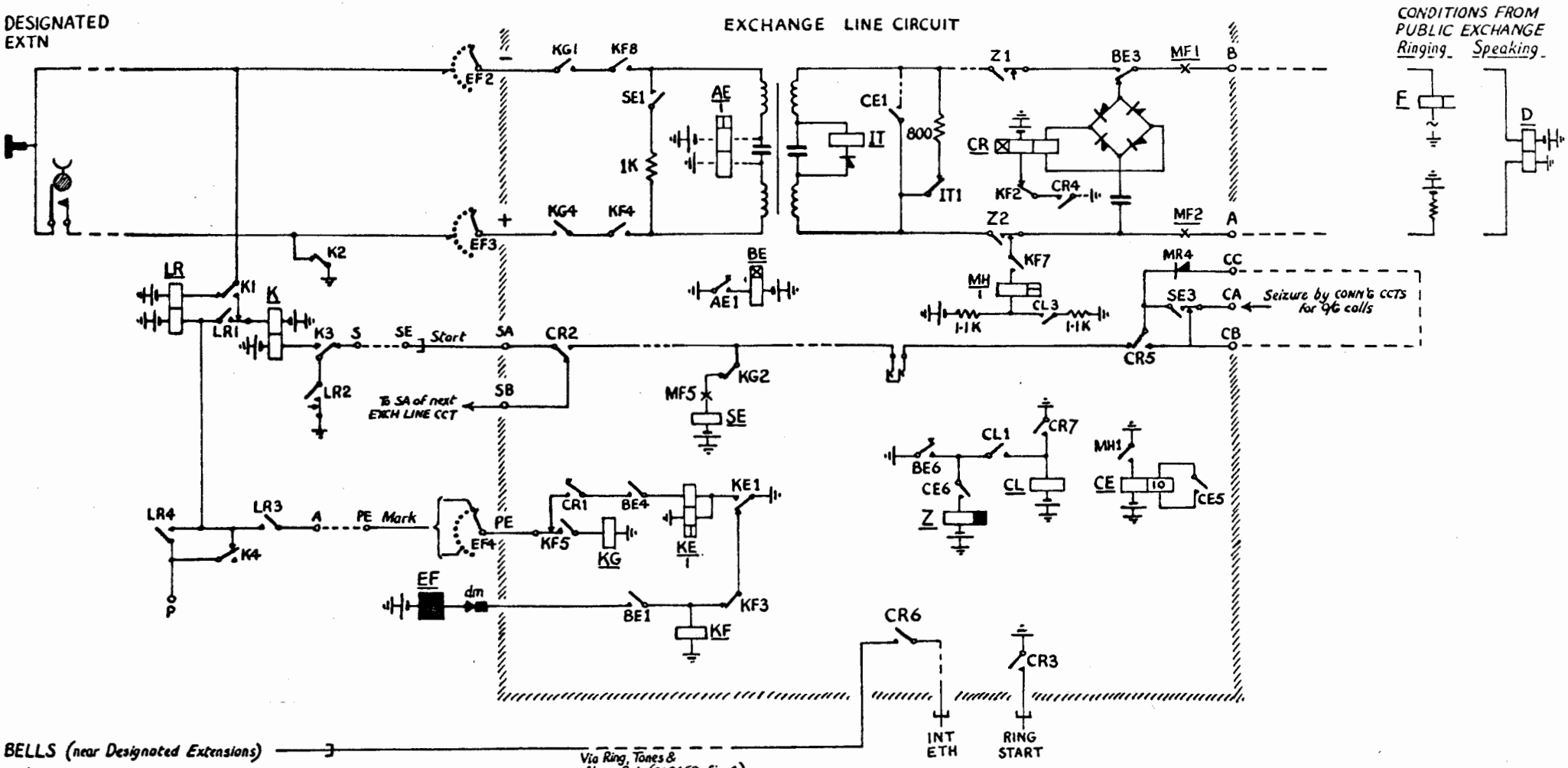
EXCHANGE LINE CCT
Seized by ringing from PUBLIC EXCHANGE — rings d.c. BELLS near DESIGNATED EXTN/S— receives 'start' on SE lead when DESIGNATED EXTN lifts handset— drives EF finder to connect incoming call to DESIGNATED EXTN

FINAL SELECTOR
Ringing conditions:
eth ringing on B wire
return batt " A " .
Ringing tripped by loop.
Speaking conditions:
batt on B wire
eth " A " .

Incoming Ring & Answer by Designated Extension



Incoming Ring & Answer by Designated Extension



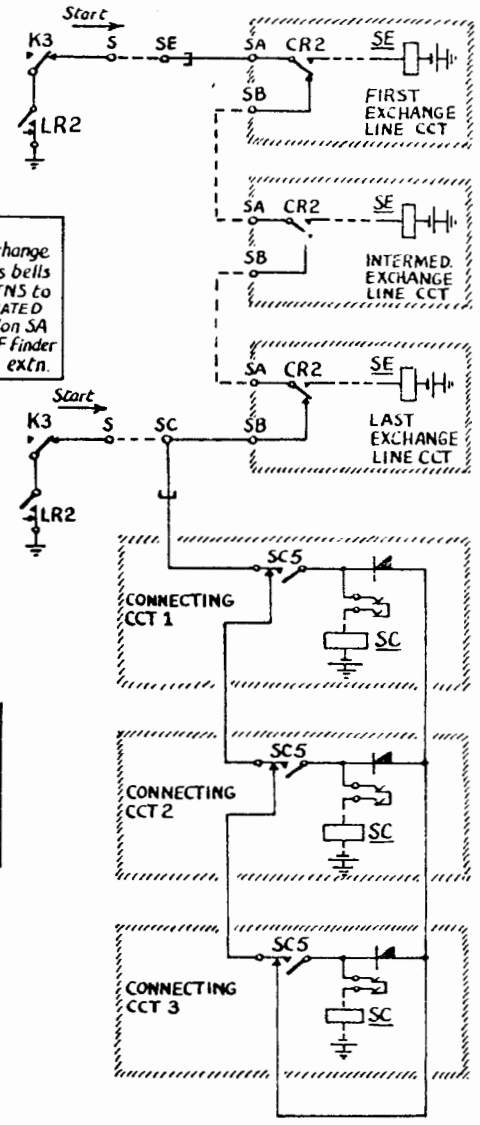
Start Lead Cct — Extensions

DESIGNATED EXTN LINE CCT
Strapped S-SE :
I/C CALL (bells ringing) — handset lifted connects 'start' to calling EXCH LINE CCT
O/G CALL (bells silent) — handset lifted, 'start' extended to CONNECTING CCT

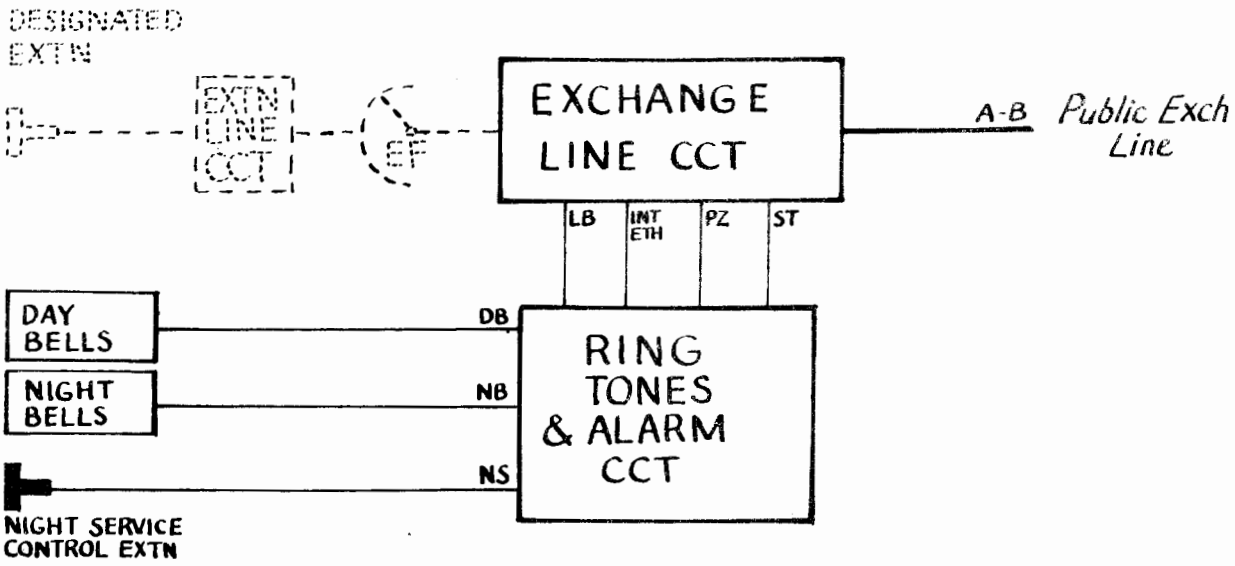
EXCHANGE LINE CCTS
Ringing from public exchange operates CR — causes bells near DESIGNATED EXTNS to ring — when a DESIGNATED EXTN answers 'start' on SA lead ops SE relay & EF finder drives & connects with extn.

NON-DESIGNATED EXTN LINE CCT
Strapped S-SC. When handset lifted for O/G call connects 'start' to CONNECTING CCT relay chain.

CONNECTING CCTS
A DESIGNATED EXTN lifting handset while bells silent (CR relays normal) receives dial tone from free CONNECTING CCT (as in EXTN-TO-EXTN CALLS).



Unanswered I/C Exchange Line Call abandoned by Caller

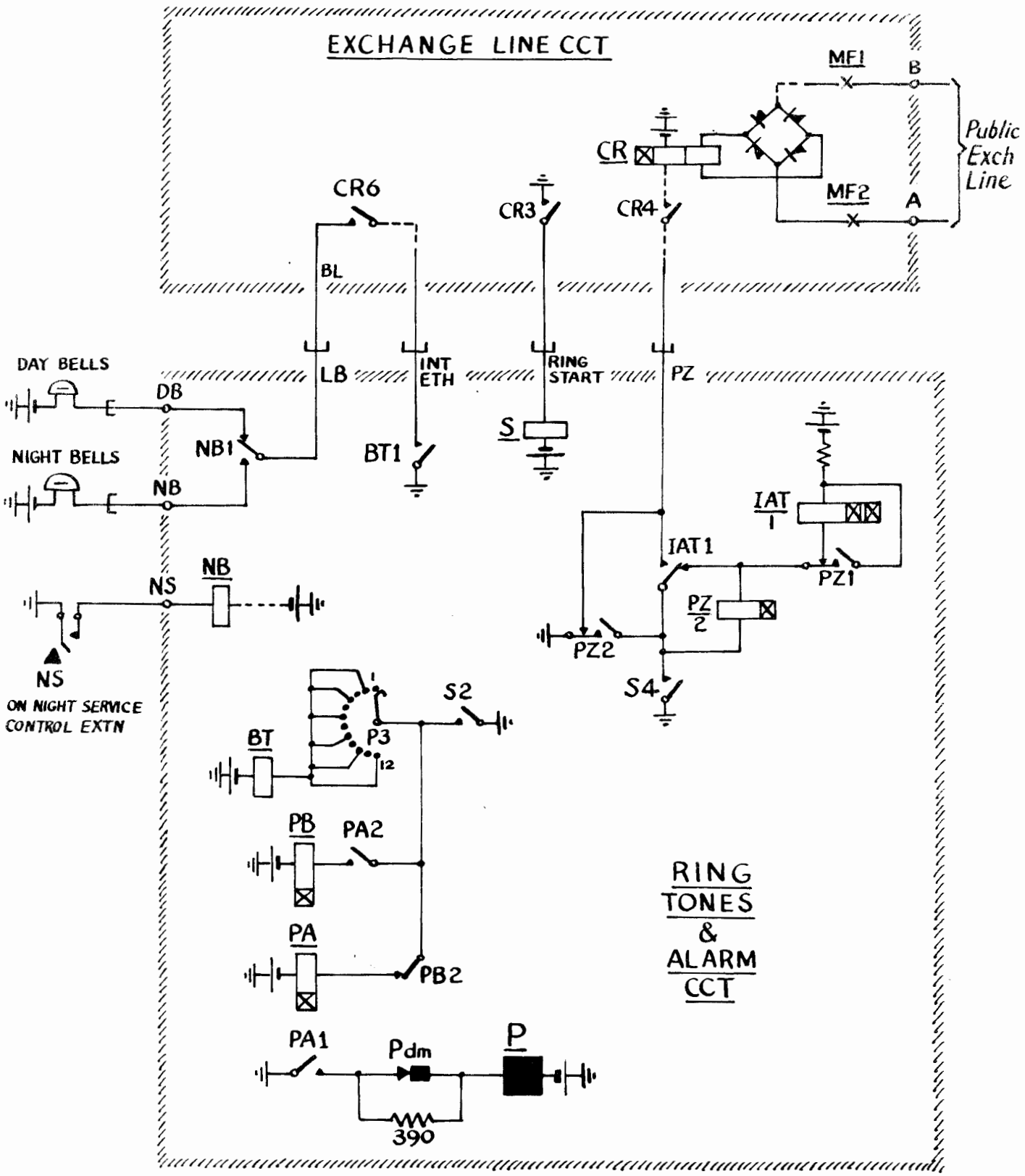


EXCHANGE LINE CCT
Starts BELLS on receipt of I/C ringing — stops BELLS when DESIGNATED EXTN answers — if no answer & caller abandons call, BELLS stopped by RING TONES & ALARM CCT open circuiting PZ lead every 50 secs.

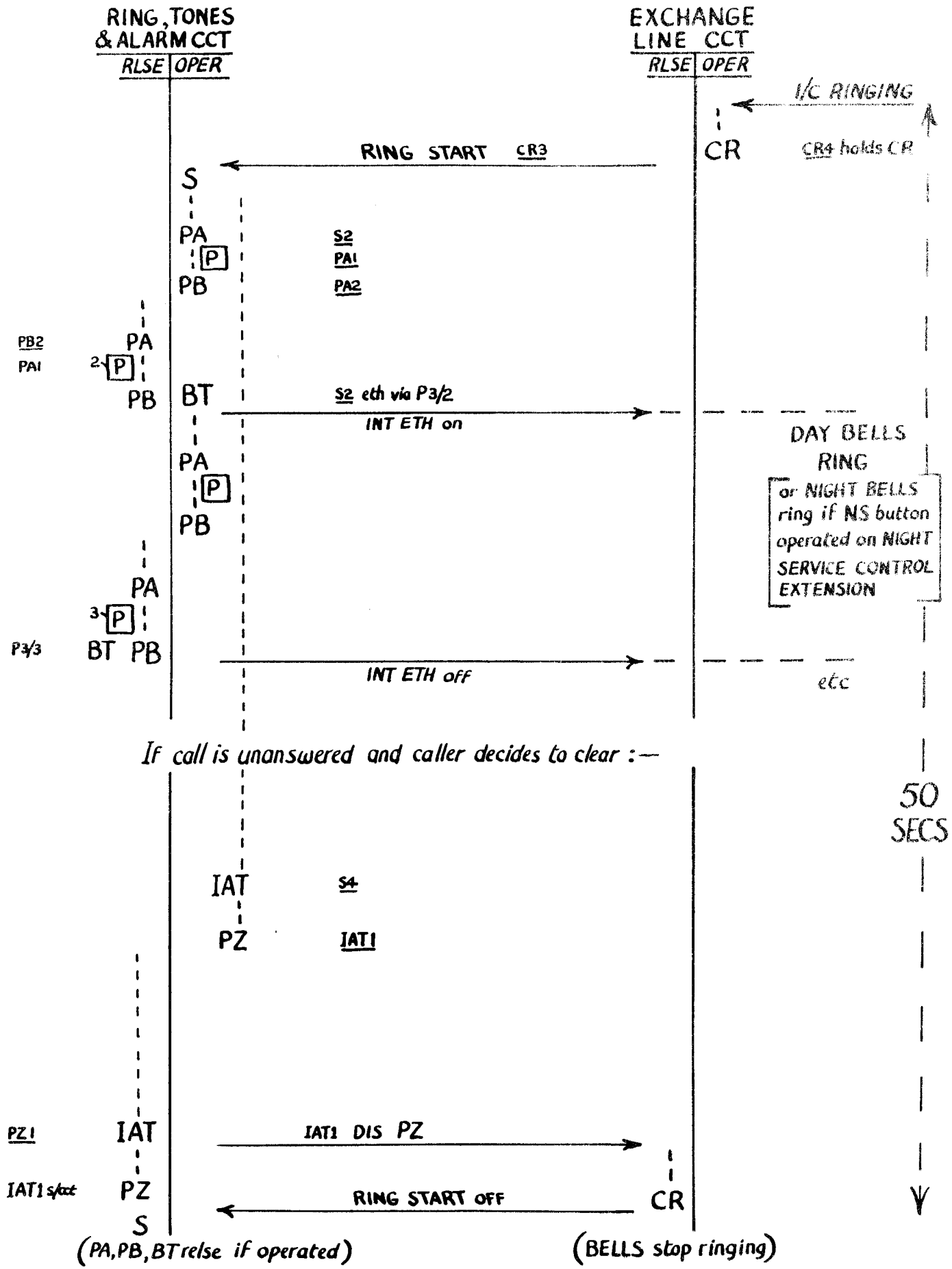
RING TONES & ALARM CCT
Generates INT ETH when START received from EXCHANGE LINE CCT — connects LB lead to DB (Day Bells) or NB (Night Bells) under control of NS signal from NIGHT SERVICE CONTROL EXTN — normally connects eth to PZ lead, but disconnects it for 400mS every 50 secs to stop BELLS ringing on unanswered abandoned I/C calls.

NIGHT SERVICE CONTROL EXTN
Fitted with NS button to control BELLS used on I/C calls

Unanswered I/C Exchange Line Call abandoned by Caller

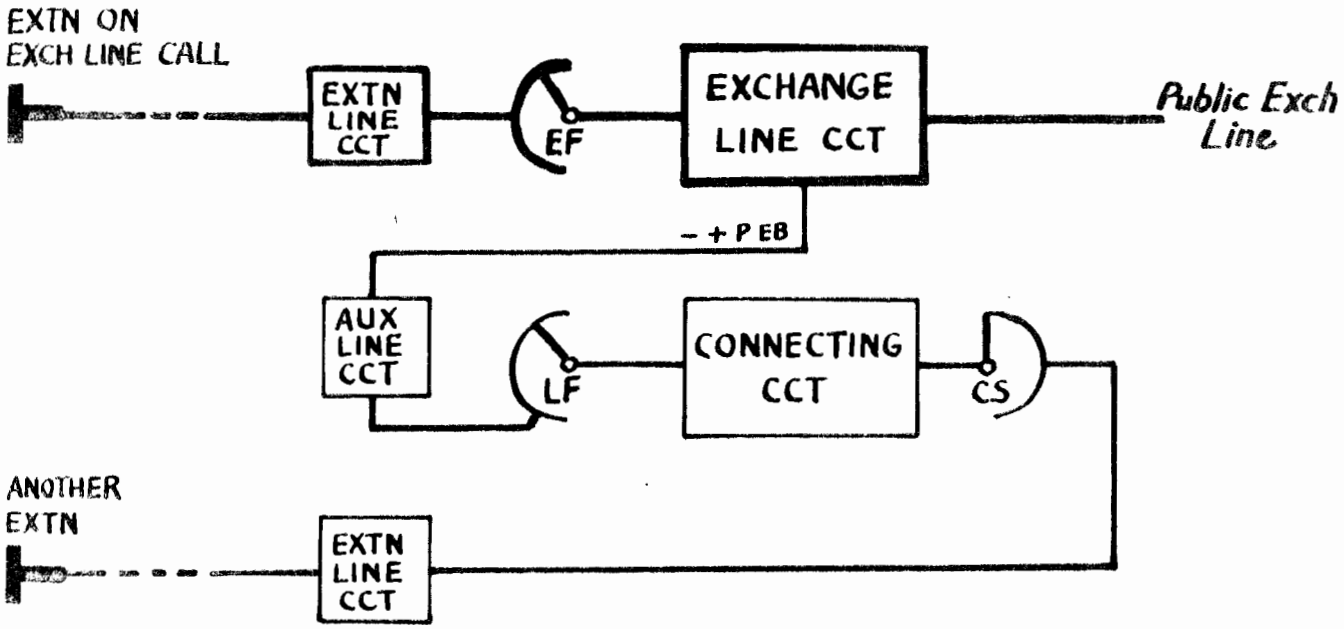


Unanswered I/C Exchange Line Call abandoned by Caller



Note : If caller still waiting on exchange line CR operates again and the cycle is repeated.

Enquiry of Another Extension by Extn on Exchange Line Call



EXTN ON EXCH LINE CALL
Makes enquiry of ANOTHER EXTN by:
asking Public Exch Line to wait,
pressing enquiry button,
obtaining dial tone from CONNECTING CCT,
dialling extn number required.
Reverts to Public Exch Line after enquiry by again pressing button.

EXCHANGE LINE CCT
On first enquiry button signal:
holds Public Exch Line,
seizes AUX. LINE CCT.
On second enquiry button signal:
releases AUX LINE CCT,
reconnects EXTN TO EXCH LINE CALL.

AUX. LINE CCT
Provides EXCH. LINE CCT with access to free CONNECTING CCT.

CONNECTING CCT
Seized via AUX LINE CCT by EXCH LINE CCT with Enquiry Call — signal on EB lead limits call to extns or Inter P.B.X. ccts.

Enquiry Button Signalling

EXTN ON
EXCH LINE CALL

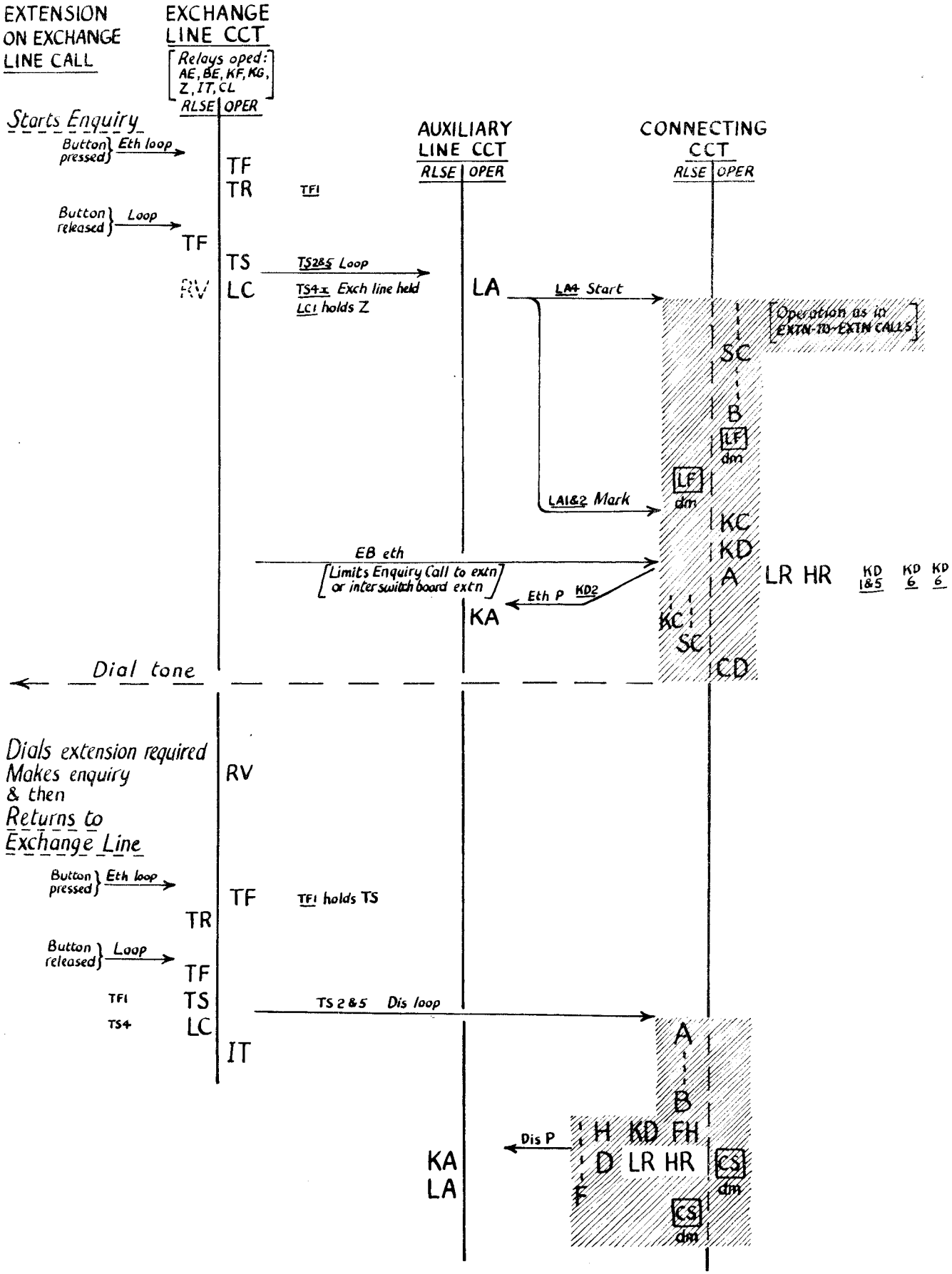
EXCHANGE LINE CCT

ENQUIRY BUTTON
Eths extn loop — shunts current from one winding of AE and TF — AE holds over one winding — TF (not operated by loop current due to opposing windings) operates.

TF RELAY
Not operated by loop current — windings connected to oppose. Operated by current in one winding when extn loop earthed.

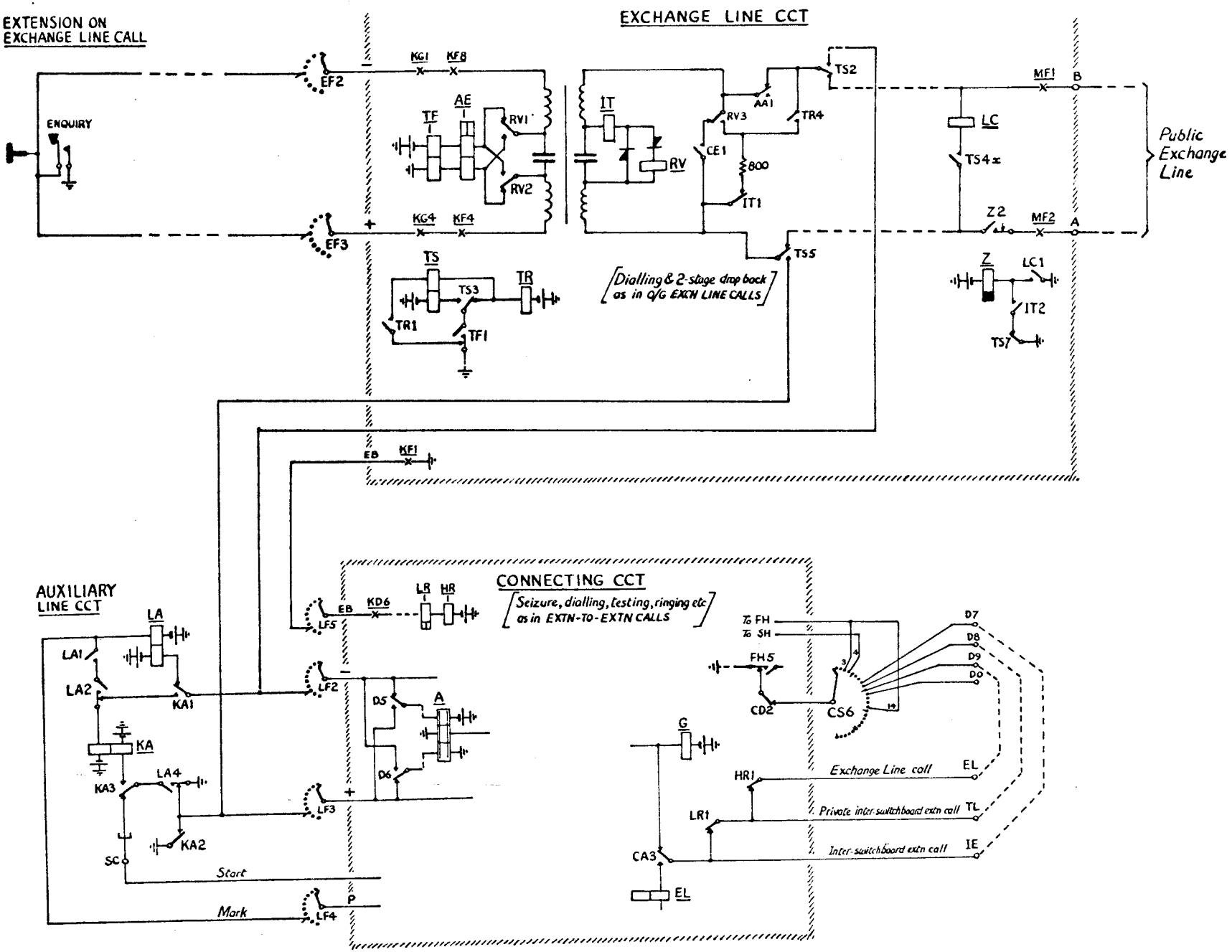
AE RELAY
Operated by loop current, or current in one winding only.

Enquiry of Another Extension by Extension on Exchange Line Call



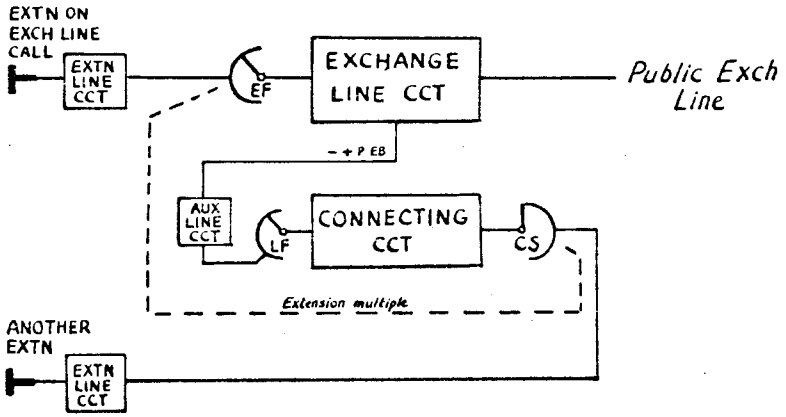
Another Enquiry can now be made if necessary

Enquiry of Another Extension by Extension on Exchange Line Call



Transfer of Exchange Line Call to Another Extension

Stage 1



EXTN ON EXCH LINE CALL
Makes enquiry of ANOTHER EXTN by:
asking Public Exch Line to wait,
pressing enquiry button,
obtaining dial tone from CONNECTING CCT,
dialling extn number required.
When extn answers, transfers call to that extn by replacing handset.

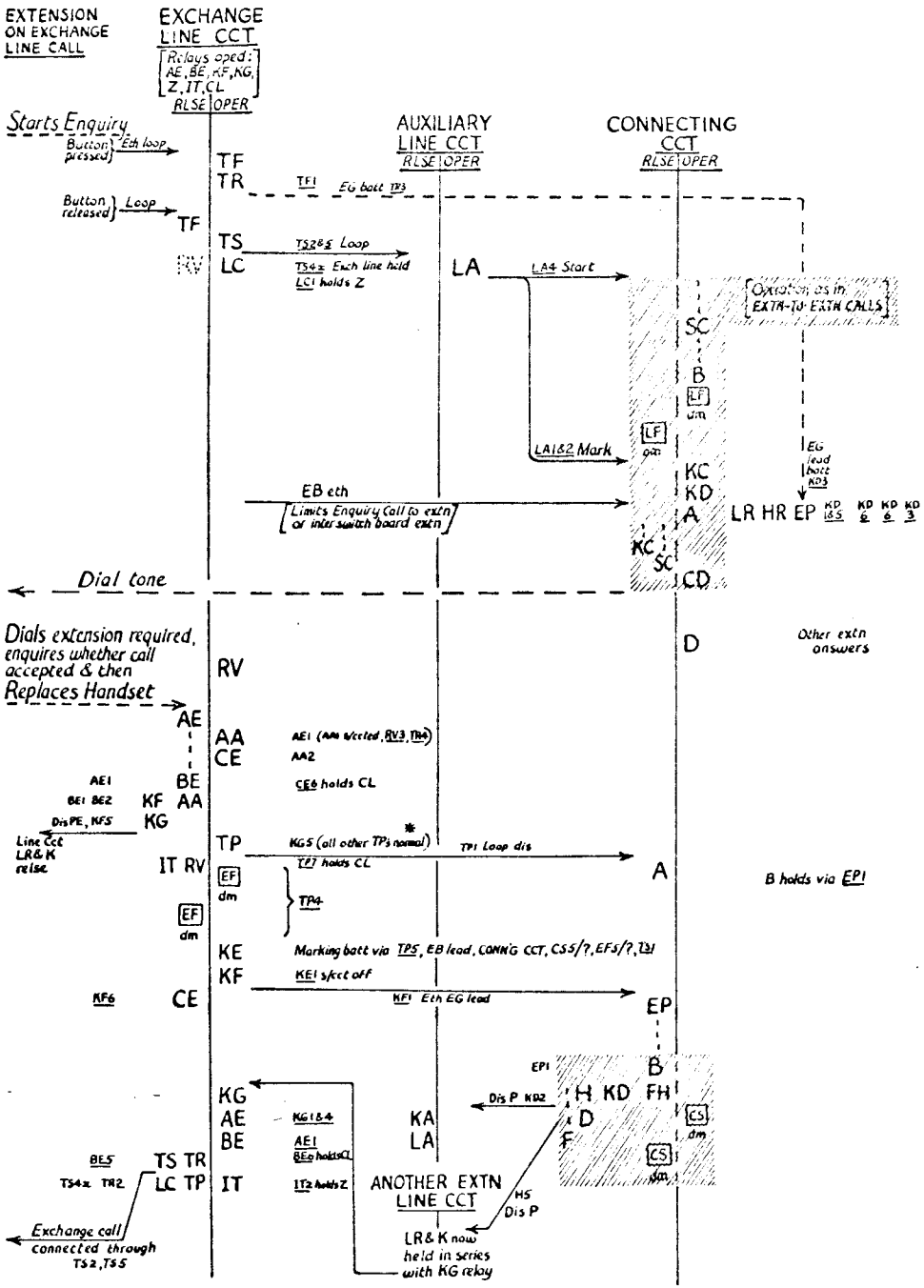
EXCHANGE LINE CCT
On enquiry button signal:
holds Public Exch line,
seizes AUX LINE CCT.
On EXTN ON EXCH LINE CALL clearing:
drives EF finder in search of ANOTHER EXTN marked via the Enquiry Call connection.

AUX LINE CCT
Provides EXCH LINE CCT with access to free CONNECTING CCT

CONNECTING CCT
Seized via AUX LINE CCT by EXCH LINE CCT with Enquiry Call — signal on EB lead limits call to extns or inter-switch board extns. For Transfer, at end of enquiry, condition on EB lead marks other extn via CS switch and extn multiple.

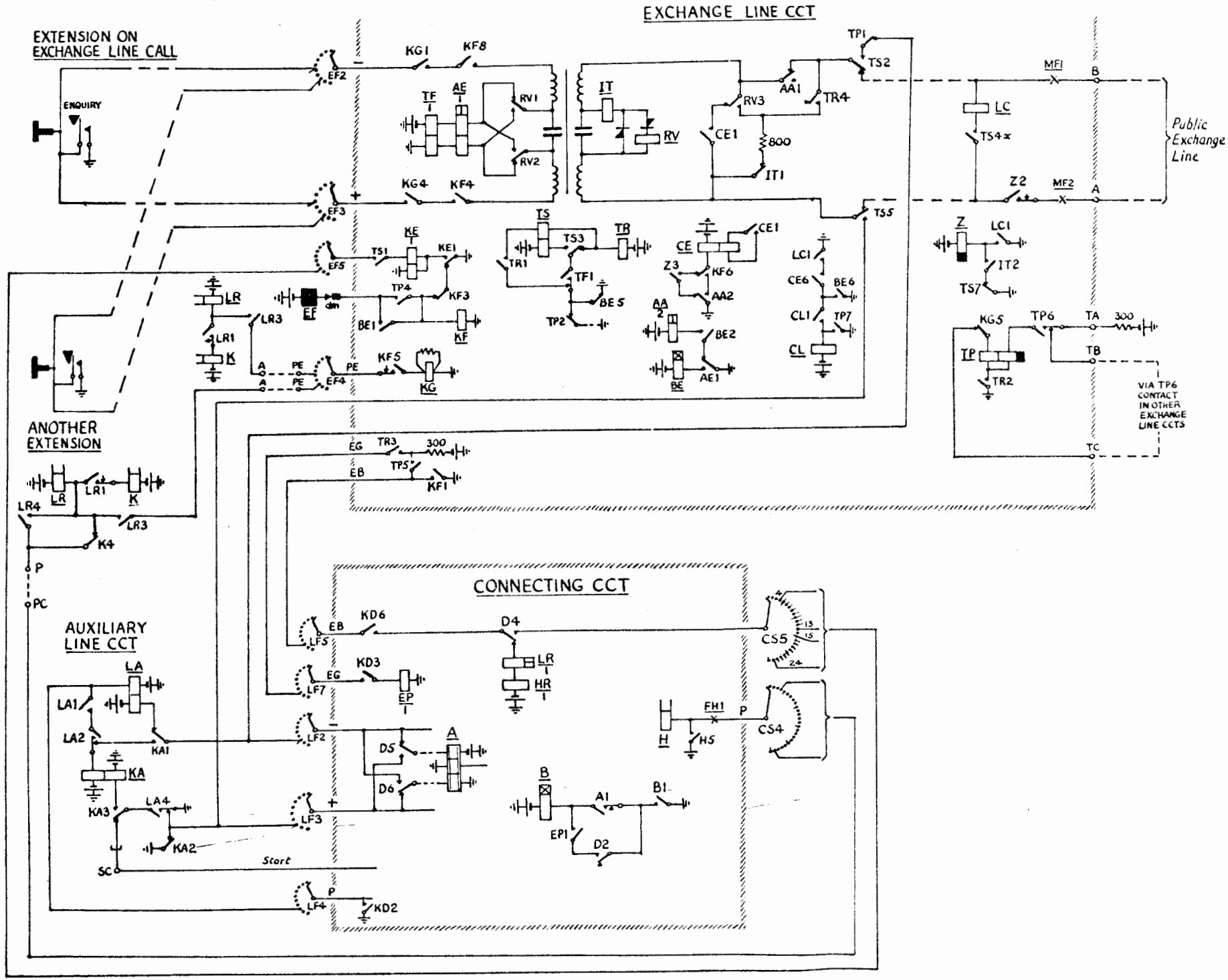
CS SWITCH
Makes connection with ANOTHER EXTN (as in EXTN-TO-EXTN CALLS) during enquiry. During Transfer extends EB lead condition through to mark ANOTHER EXTN on Extn multiple.

Stage 2



* See 'TP Relay Chain'

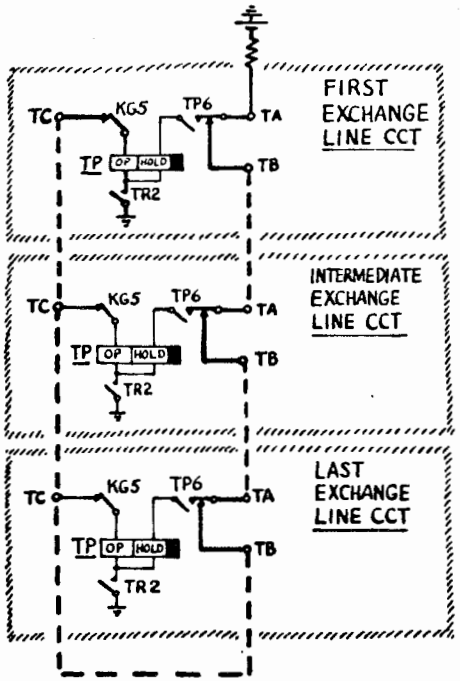
Transfer of Exchange Line Call to Another Extension



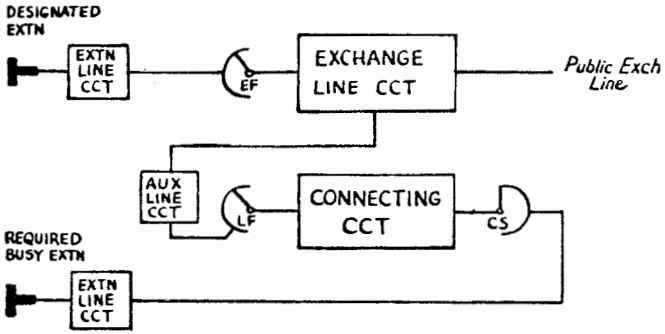
TP Relay Chain

During a Transfer Call (TR2)
KG5 releasing on cleardown by 'EXTN-ON-EXCH LINE CALL' operates relay TP providing all other TP relays are normal — ensures only one transfer operation takes place at once.

CONTACT TP6
Holds its own TP relay to TR2 eth — disconnects battery from 'OP' winding of all other TP relays.



Intrusion on Required Busy Extension by Designated Extension

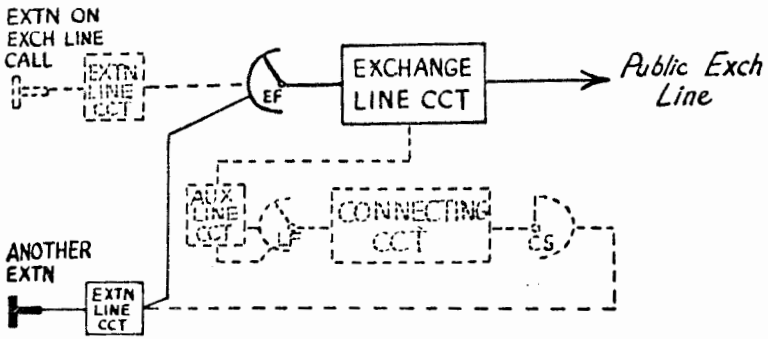


DESIGNATED EXTN
LINE CCT stropped E to RE. After dialling number of REQUIRED EXTN receives Busy Tone — dials another '1' — hears Intrusion Tone and extensions talking — speaks to REQUIRED BUSY EXTN and then:
either again presses button and returns to exchange line
or waits for REQUIRED BUSY EXTN to clear (intrusion tone stops, ring tone starts), & transfer exchange line call by replacing handset.

CONNECTING CCT
Enables DESIGNATED EXTN to intrude on REQUIRED BUSY EXTN by dialling '1' after receiving busy tone — connects INTRUSION TONE to inform REQUIRED BUSY EXTN that DESIGNATED EXTN wishes to talk.

REQUIRED BUSY EXTN
During call hears Intrusion Tone — speaks to DESIGNATED EXTN — either:
passes message & continues with call
or
ends conversation, hangs up, is re-rung, and receives exchange line call when DESIGNATED EXTN clears.

Failure of Transfer



EXTN ON EXCH LINE CALL

Transfer fails if EXTN ON EXCH LINE CALL :—

① *clears before enquiry call answered by ANOTHER EXTN*

④ *transfers call to ANOTHER engaged EXTN i.e. after intrusion, but before first connexion cleared.*

EXCHANGE LINE CCT

If transfer not completed within 5 secs of EXTN ON EXCH LINE CALL replacing handset rings incoming call bells again.

ANOTHER EXTN

Transfer fails if ANOTHER EXTN :—

② *is barred exch line access*

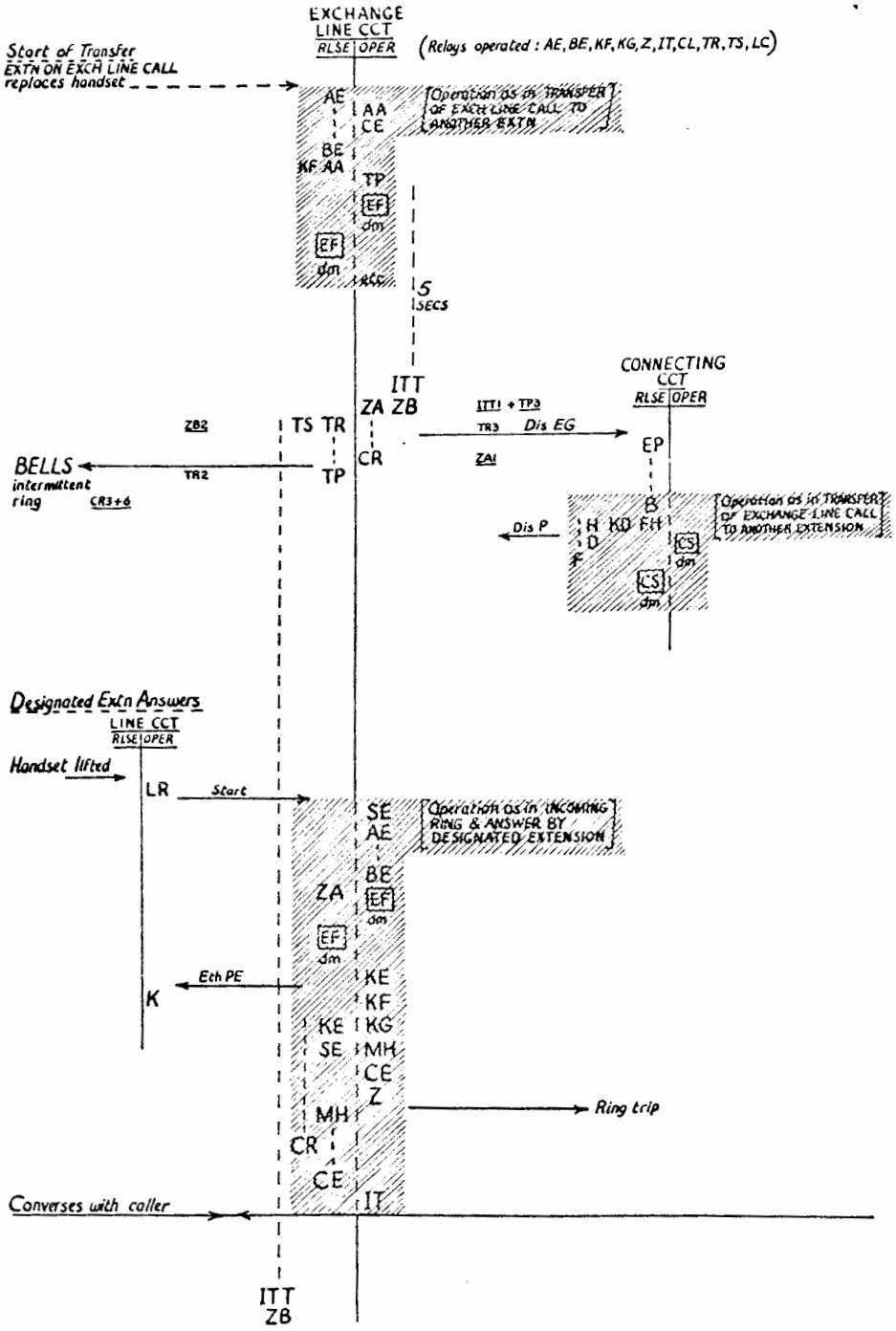
③ *replaces handset instead of waiting for transferred call.*

① Relay D not operated in CONNECTING CCT to extend marking through to CS wiper,

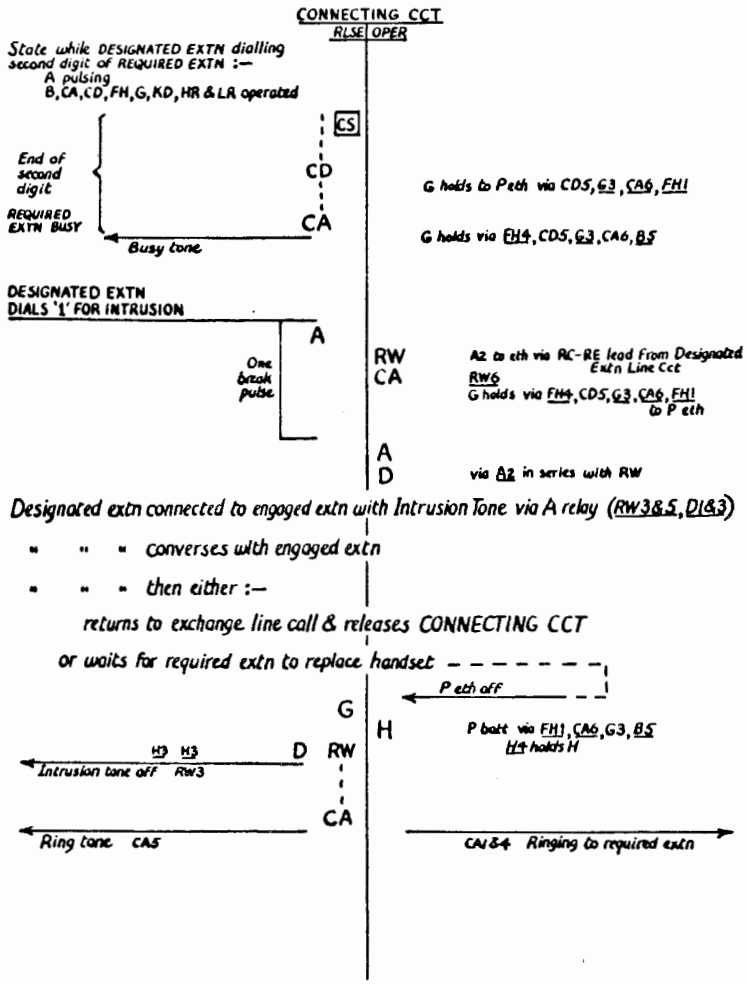
② No PE-A strap in LINE CCT, preventing LINE CCT being found by EF finder,

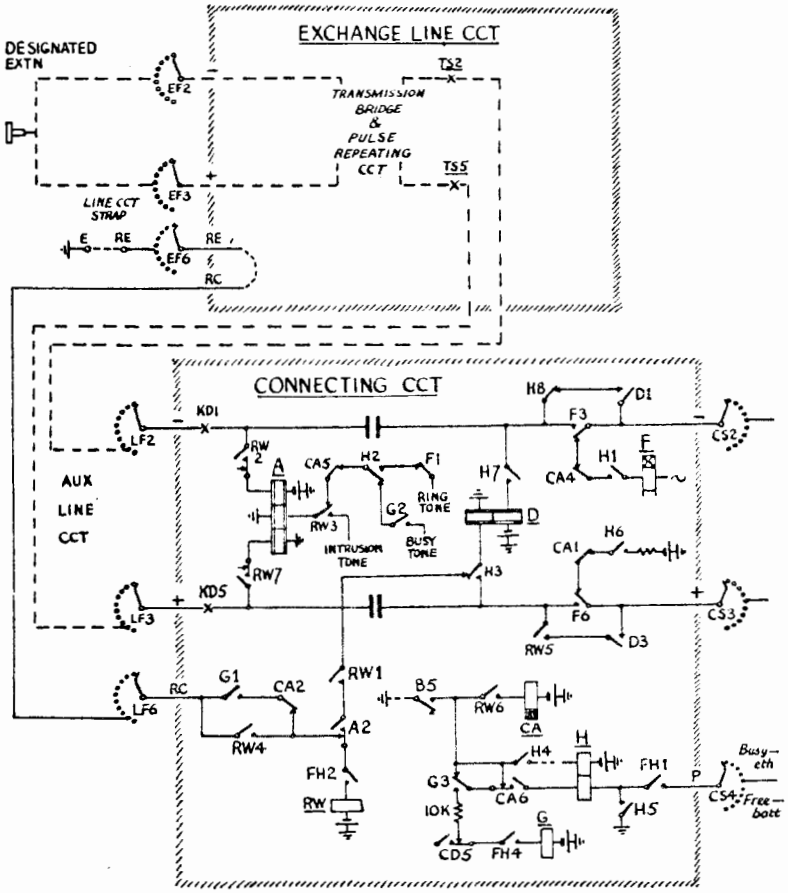
③ Relay D released in CONNECTING CCT, marking not extended to CS wiper,

④ Earth on P tag of ANOTHER EXTN line cct from first connexion (not cleared) prevents operation of KG in EXCH LINE CCT and so does not connect − & + of ANOTHER EXTN to relay AE.

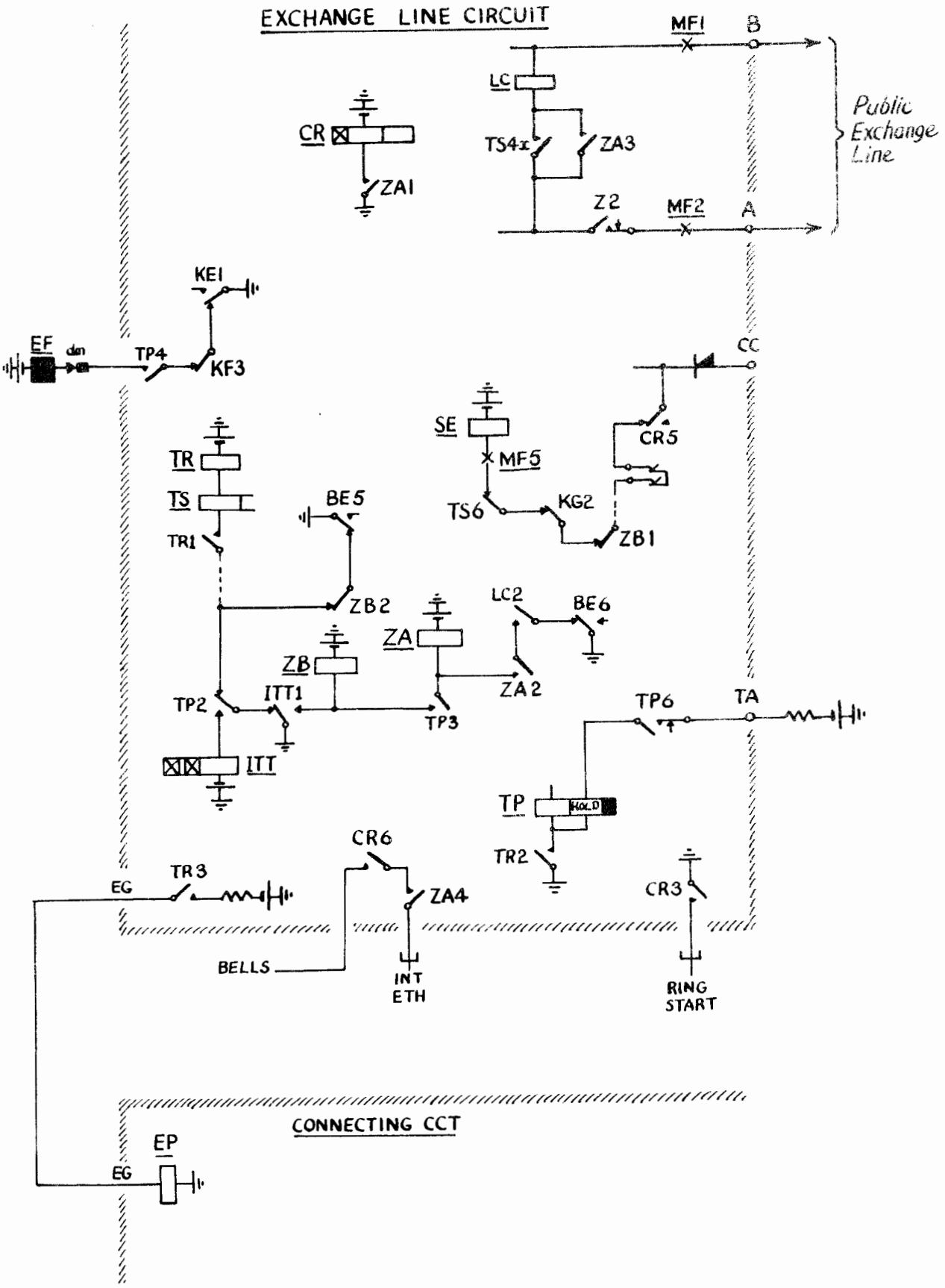


Intrusion on Required Busy Extension by Designated Extension

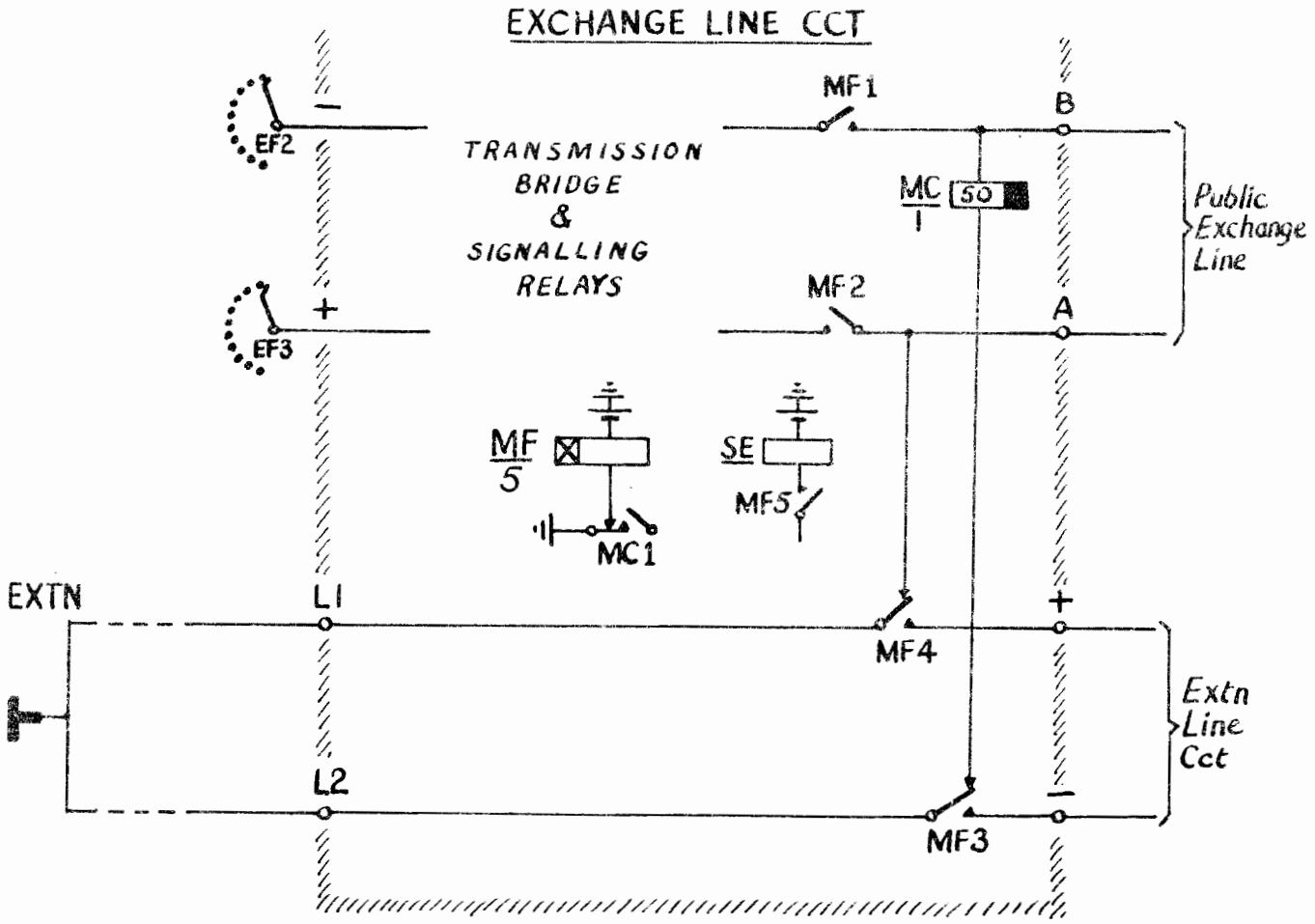




Failure of Transfer



Public Exchange Service during Power Fault



MF & MC RELAYS

In each EXCHANGE LINE CCT normally operated relay MF releases if :—

mains failure occurs (no D.C. supply)

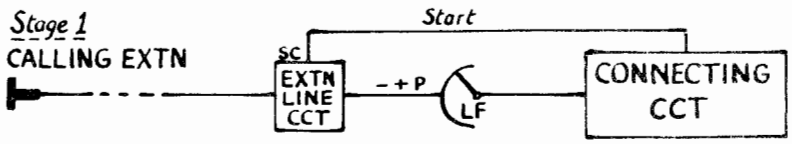
or EXCH LINE CCT (i.e. r/set) fuse blows

switching Public Exchange Line to an extension, which acts as a direct exchange line.

On restoration of power MC prevents re-operation of MF while a call is in progress.

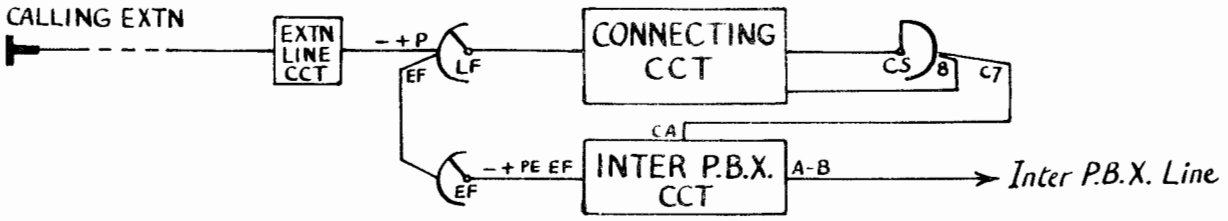
OUTGOING INTER P.B.X. CALL

Stage 1



CALLING EXTN
Receives dial tone from CONNECTING CCT as in EXTN-TO-EXTN CALLS

Stage 2

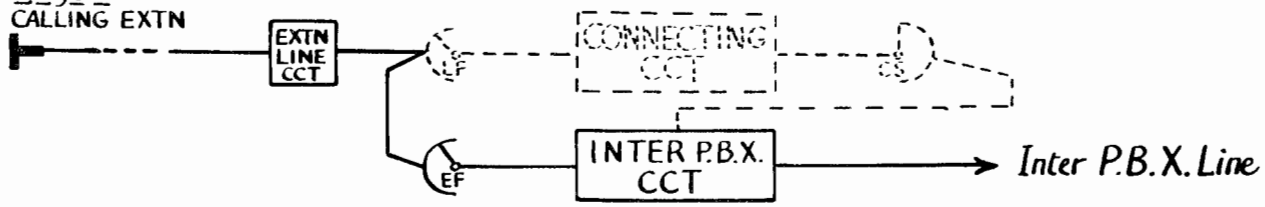


CALLING EXTN
Dials first digit, say 7, for call to extn on distant P.A.B.X. 5 — waits for dial tone from distant P.A.B.X.

CONNECTING CCT
Dialled digit '7' received — CS/8 indicates INTER P.B.X. CCT required — demand over C7 lead for free INTER P.B.X. CCT — CONN'G CCT released when CALLING EXTN LINE CCT found by EF Finder.

INTER P.B.X. CCT
Receives demand for INTER P.B.X. CCT over CA lead — EF Finder hunts for CALLING EXTN marked via LF — Inter P.B.X. Line looped to prepare distant end equipment.

Stage 3



CALLING EXTN
Dials distant extension number on hearing distant dial tone

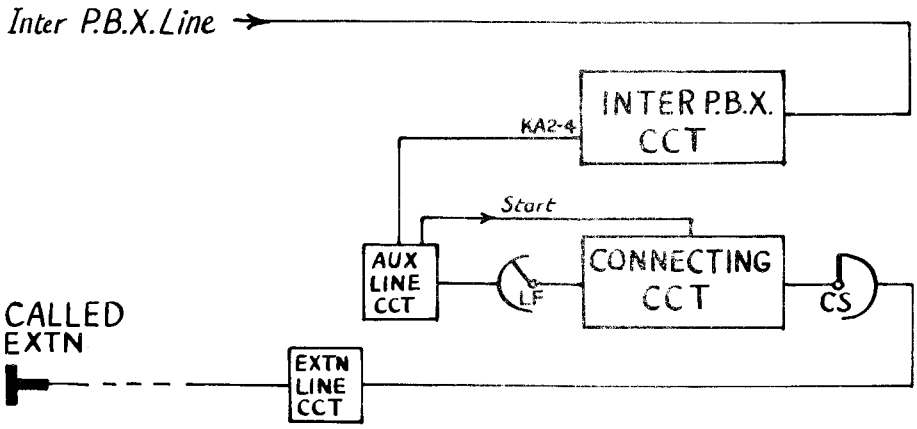
CONNECTING CCT
Released when connexion established between CALLING EXTN & Inter P.B.X. Line

INTER P.B.X. CCT
Releases CONNECTING CCT when connexion to calling EXTN LINE CCT established — provides usual auto-auto relay set facilities i.e.
- *transmission bridge*
- *dial pulse repetition*
- *2 stage drop back*
- *C.S.A. reversal repeat*

Note : Circuit operation is similar to OUTGOING EXCHANGE LINE CALLS

INCOMING INTER P.B.X. CALL

Stage 1 : Ringing CALLED EXTN



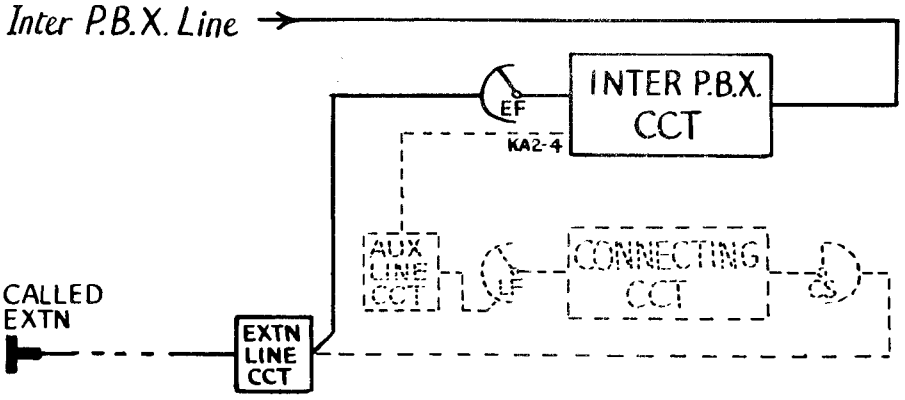
INTER P.B.X.CCT
Seized by line loop at other end — extends loop to AUXILIARY LINE CCT

AUX LINE CCT
Looped from INTER P.B.X.CCT when I/C call commences — sends 'Start' to CONNECTING CCTS — is found by LF of allocated CONNECTING CCT.

CONNECTING CCT
Seized by 'Start' signal from AUX LINE CCT — causes LF to find calling AUX LINE CCT — returns dial tone — CS steps to dialled pulses & connects with CALLED EXTN (as in EXTN-TO-EXTN CALLS).

CALLED EXTN
If free is rung from CONNECTING CCT

Stage 2 : CALLED EXTN Answers

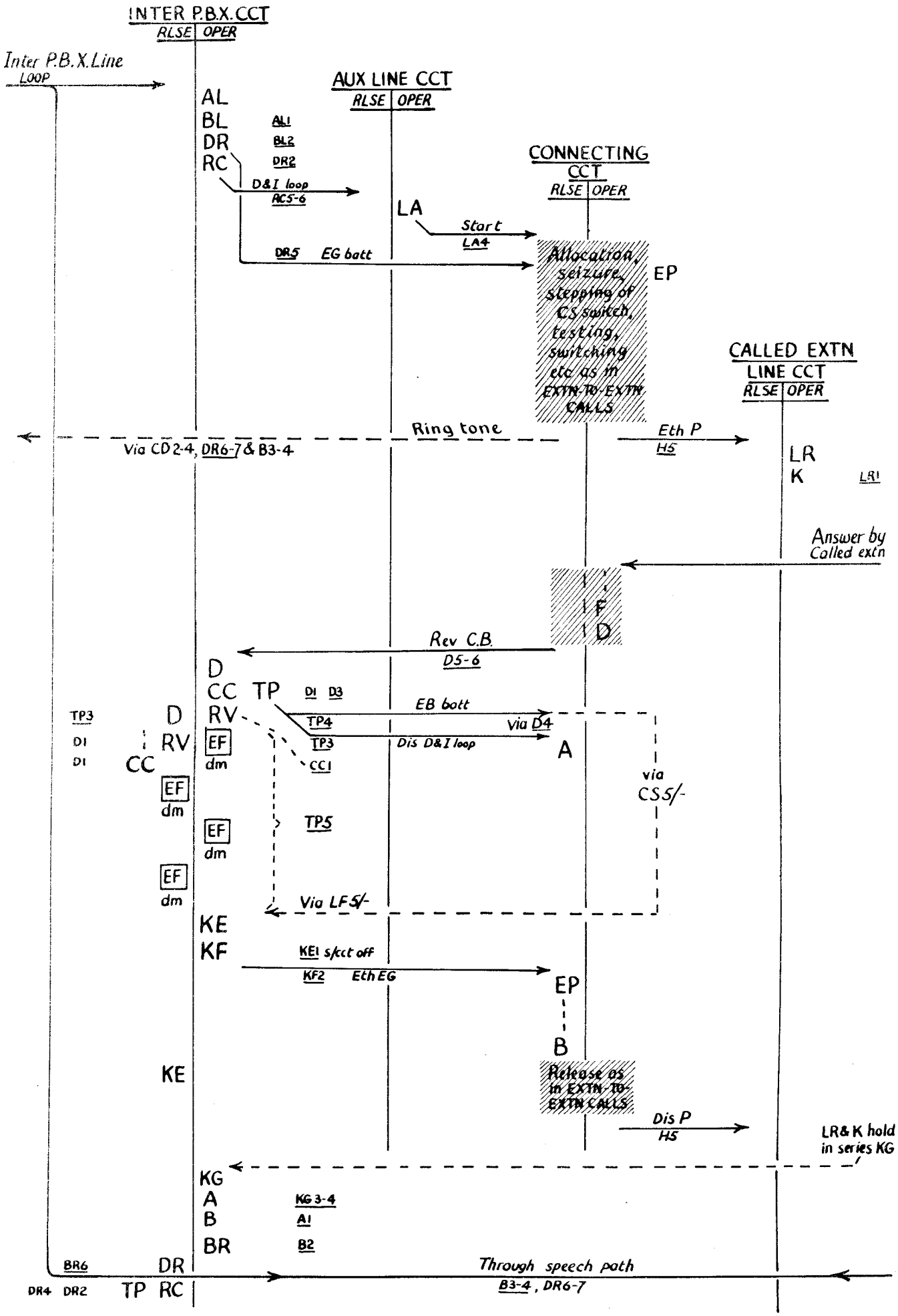


INTER P.B.X. CCT
On receipt of 'CALLED EXTN answered' signal, repeated through CONNECTING CCT, drives its EF finder to CALLED EXTN LINE CCT position, marked via LF, CONNECTING CCT, CS switch path.

CONNECTING CCT
When CALLED EXTN answers repeats answer signal (rev.C.B.) to INTER P.B.X.CCT — released when EF Finder of INTER P.B.X. CCT connects with CALLED EXTN LINE CCT

CALLED EXTN
Answers ringing.

INCOMING INTER P.B.X. CALL



PABX's

INCOMING INTER P.B.X. CALL