NOTES:-

1. D Relay is connected differentially and operates only while an Earth is applied with the loop at the Non-Multiple Extension Telephone.

2. EX Relay is normally operated.

3. For Cabling and Strapping information see Dgm. Q 503. Reference should also be made to Dgms. Q 516 535 or 537, and 540 when considering circuit operations. **For wire colours used in unit see Dgm. LD195.**

APPARATUS SCHEDULE

CODE	ITEM	CODE	ITEM
A	Relay No.17510	RC	Relay No.17515
AL	" No.6034	RR	" No.5112
B	" No.11527	S	" No.11493
D	" No.15068	SR	" No.17512
EL	" No.4403	C1-6	Capacitor, Paper No.7725
EX	" No.17513	D1-15	Valve Electronic CV 8308
F	" No.17509	R1-3	Resistor, Coil No.35A 51Ω
LA	" No.17511	R4	Resistor, Coil No.35A 200Ω
LB	" No.17514	R5-6	Resistor, Carbon No.26 GC 47K

CIRCUIT OPERATION (NOTE 3)

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PAPER:-W CIRC'LTN: GENERAL		A	**Relay D was 17508, Note 3 amended. Minor amendments**	18.5.70.
			S1/3 TD2.3.3	11.7.67.

1.0 EXCHANGE CALL FROM EXTENSION Relay Operated:- EX

EXCH Button at the Extension Instrument is Pressed, Earthing Loop to Relay Unit Q519, operating Relays A and D. D1 operates Relay EL. Then as 1.1, 1.2 or 1.3.

1.1 1st EXCHANGE LINE FREE

EL1 operates Relay LA to Earth on EA lead, battery on LA lead, from Relay Unit Q516. LA2 operates Relay B. Exchange Line looped by Resistor R4 via B3, EX3 and Relay S, which operates. XA and LPAC leads earthed by B8. S1 operates Relay SR, SR3, releases Relay EL. When EXCH Button is released at Extension, Earth removed from Telephone loop. Relay D releases. D1 releases Relay EX, EX1 and EX2 Switch Extension to Exchange Line and release Relay A. EX3 removes R4 hold Resistor from Exchange Line.

Relays Operated	Hold Circuit
LA	LA Lead (RU Q516)-LB3-LA Relay-LA1-B5 and SR6
B	SR5
S	LB1-S Relay - EX1-D Relay-RR1 - Extn. Loop - RR2-D Relay-EX2-S Relay-LB2
SR	S1

1.2 1st EXCHANGE LINE BUSY, 2nd EXCHANGE LINE FREE

EL3 operates Relay LB to Earth on EB Lead, LB3 and LB6 operate Relay LA to Battery on LB Lead, from Relay Unit Q516. LA2 operates Relay B. Exchange Line is looped by Resistor R4 via B3, EX3 and Relay S which operates. XB and LPBC Leads earthed by B8. S1 operates Relay SR, SR3 releases EL. When EXCH Button is released at Extension Earth removed from Telephone Loop releasing Relay D. D1 releases Relay EX, EX1 and EX2 Switch Extension to Exchange Line and release Relay A. EX3 removes R4 hold Resistor from Exchange Line.

Relays Operated	Hold Circuit
LB	LB4-LA3 and SR4
LA	LB Lead (RU Q516)-LB3-LA Relay-LA1-B5 and SR6
B	SR5-RC2
S	LB1-S Relay-EX1-D Relay-RR1 - Extn. Loop - RR2-D Relay-EX2-S Relay-LB2
SR	S1

1.3 BOTH EXCHANGE LINES BUSY

No further Relay operations occur due to absence of Earth on EA and EB Leads, from Relay Unit Q516.

Relays Operated	Hold Circuit
A	EX1-D Relay-RR1-Extn. Loop - RR2-D Relay-EX2
EX	Diode D11-B6-D1 and Diode D12-EL2-F3-A2-D1
EL	SR3-EL2-F3-A2-D1.

2.0 INTERCOM CALLS (Relay Operated:- EX)

2.1 MULTIPLE STATION CALLS EXTENSION

Calling Multiple Station operates Extension Button Fully, connecting a Resistance Battery to Multiple A wire, Earth to B wire, operating Relays RR and F. RR1 connects Earth Ringing to A wire of Extension Circuit to Ring Bell in Instrument. When calling Multiple Station releases Extension Button, normal conditions, Earth A wire Battery B wire, are restored. Relay RR releases. RR1 disconnects Ringing to Extension. Extension answers by pressing EXTN Button on Instrument, completing Telephone Loop and operating Relay A. A3 completes transmission circuit to Calling Multiple Station and conversation can proceed.

Relays Operated	Hold Circuit
EX	Diode D11-B6-D1
A	EX1-D Relay-RR1-Extn. Loop - RR2-D Relay EX2
F	A3-B1 - Mult. Stn, Loop - B2

2.2 EXTENSION CALLS MAIN STATION

EXTN Button on Extension Instrument is pressed completing Telephone Loop and operating Relay A. A2 operates Relay AL. AL1 operates Buzzer, AL2 lights Calling Lamp in Control Unit Q535 or Q537. MAIN Station answers by depressing Extension Button on Station Instrument, operating Relay F. F3 releases Relay AL, AL1 and AL2 disconnect Buzzer and Extension Calling Lamp. Conversation can now proceed.

Relays Operated:- As in 2.1

2.3 EXTENSION CALLS MULTIPLE STATION OTHER THAN MAIN

Extension first calls MAIN Station as in 2.2, then instructs MAIN which Multiple Station is required. MAIN Station calls Objective Station, removing Hold Loop from Relay F, which holds via A1 and F1. When Objective Station Depresses Extension Button on Station Instrument, conversation can proceed.

Relays Operated:- As in 2.1

2.4 EXTENSION CALLS EXTENSION

Extension first calls MAIN Station as in 2.2, then instructs MAIN which Extension is required. MAIN calls objective Extension removing Hold Loop from Relay F, which holds via A1 and F1 contacts. When Extension answers MAIN operates associated CONNECT and TEST Key on Control Unit Q537. Conversation between the Extensions can now proceed, via the AC and BC Leads.

Relays Operated:- As in 2.1

When extension clears, removal of Telephone Loop releases Relay A. A1 releases Relay F, F6 operates Relay AL via CONNECT and TEST Key. AL1 and AL2 operate Buzzer and Station Call Lamp in Control Unit Q537, restoration of CONNECT and TEST Key releases Relay AL to disconnect Buzzer and Extension Calling Lamp.

3.0 RECALL

Extension can hold an Exchange Line Call and call MAIN Station by depressing EXCH Button on Extension Telephone. Telephone Loop is Earthed operating Relay D.

3.1 EXTENSION MAKES ENQUIRY CALL

Relays operated: LA, B, D, S, SR (1st Exch. Line), plus LB (2nd Exch. Line). D1 operates Relay RC. RC1 connects Resistor R4 across Exchange Line to hold Call and Relay S, RC2 resleases Relay B. RC6 disconnects Earth from LPAC Lead (1st Exch. Line), RC5 disconnects Earth from LPBC Lead (2nd Exch. Line). B1 and B2 restore A and B wires of Intercom. Pair. When EXCH Button at Extension is released earth is removed from Telephone Loop releasing Relay D. D1 operates Relay EX. EX1 and EX2 Switch Telephone Loop from Exchange Line to Intercom Circuit operating Relay A. A2 operates Relay AL. AL1 operates Buzzer, AL2 lights Calling Lamp in Control Unit Q535 or Q537. When MAIN Station answers, by pressing Extension Button, Station Instrument Loop operates Relay F, F3 releases Relay AL. AL1 and AL2 disconnect Buzzer and Calling Lamp. Extension and MAIN Station can now converse independently of Exchange Line.

Relays Operated	Hold Circuit
LA	LA Lead (RU Q516)-LB3-LA Relay-LA1-SR6
S	LB1-S Relay-R4 - RC1-S Relay - LB2
SR	S1
RC	D1-B6-SR2-RC3-A4 and F7
EX	D1-B6-Diode D11
A	EX1-D Relay-RR1-Extn. Loop - RR2 - D Relay-EX2
F	A3-B1 - Mult. Stn. Loop - B2

3.2 EXTENSION RETURNS TO EXCHANGE LINE

To return to Exchange Line EXCH Button at Extension is depressed, Earthing Telephone Loop and operating Relay D. D1 operates Relay B and releases Relay RC. RC6 reconnects Earth to LPAC Lead (1st Exch. Line), RC5 reconnects Earth to LPBC Lead (2nd Exch. Line). When EXCH Button at Extension is released Earth is removed from Telephone Loop releasing Relay D. D1 releases Relay EX. EX1 and EX2 Switch Telephone Loop from Intercom Circuit to Exchange Line Circuit, releasing Relay A. EX3 removes R4 hold Resistor from the Exchange Line. A1 releases Relay F.

Relays Operated: As in 1.1 (1st Exch. Line) or 1.2 (2nd Exch. Line).

3.3 EXTENSION TRANSFERS EXCHANGE LINE CALL TO MAIN STATION

The transfer can take place in two ways, (a) Extension instructs MAIN to take over Call and then clears, (b) Extension wishes to be connected to a Station or Extension after Exchange Call has been transferred.

MAIN operates CONNECT and TEST Key. TEST 1 or TEST 2 Lamps show which Exchange Line Extension is holding.

(a) When Extension clears removal of Telephone Loop releases Relay A. Exchange Call is held by MAIN Station in following manner. F Relay holds to Earth via Multiple Station Loop. F7 holds Relay RC. RC1 holds Exchange Line Call and Relay S. S1 holds Relay SR. SR6 holds Relay LA, SR1 maintains Earth on XA or XB Leads. Relay EX is held via D1, B6 and Diode D11. MAIN Station takes over Exchange Line using Exchange Button on Station Instrument releasing Relay S and F. Relay Unit then releases.

(b) MAIN Station takes over Exchange Line Call using Exchange Button on Station Instrument releasing Relay S. S1 releases Relay SR. SR1 disconnects Earth from XA (1st Exch. Line) or XB (2nd Exch. Line) Leads, SR2 releases Relay RC, SR6 releases Relay LA. If Exchange Call is on 2nd Exchange Line Relay LB will have been operated. Contact LA3 releases Relay LB. Relays A,F, and EX are operated, as in 2.1.

4.0 EXCHANGE CALL TO EXTENSION

Incoming Call will be answered by, or passed to, MAIN Station. MAIN Station will call Extension as in 2.1, when Extension answers operations will be as in 4.1 (1st Exchange Line), or 4.2 (2nd Exch.Line).

4.1 1st EXCHANGE LINE

MAIN Station operates CONNECT and TEST Key associated with Extension, followed by TRANSFER 1 Key, on Control Unit Q535 or Q537. Relay LA operates, to Earth on X1 Lead from C.U. Q535 or Q537. LA2 Operates Relay B. B7 operates Relay AL via CONNECT and TEST Key, B8 Earths XA and LPAC Leads. AL1 operates Buzzer, AL2 lights Extension Calling Lamp, in Control Unit Q535 or Q537. When MAIN restores TRANSFER 1 Key, TEST 1 Lamp glows, Earth via Contacts B8, LB5 and Resistor R2. CONNECT and TEST Key is now restored, releasing Relay AL and disconnecting TEST 1 Lamp. AL1 disconnects the Buzzer, AL2 Extension Calling Lamp. RELEASE Button associated with Exchange Line 1 on Main Station Instrument is now operated, Exchange Line is extended to Relay Unit Q519. Resistor R4 holds the Exchange Line via B3 and EX3, Relay S operates. S1 operates Relay SR. SR5 releases Relay EX. EX1 and EX2 Switch Extension to Exchange Line and release Relay A, EX3 disconnects Resistor R4 hold Circuit. A1 releases Relay F.

Relays Operated: As in 1.1

4.2 2nd EXCHANGE LINE

MAIN Station operates CONNECT and TEST Key, associated with Extension, followed by TRANSFER 2 Key, on Control Unit Q535 or Q537. Relay LB operates to Earth on X2 Lead from C.U. Q535 or Q537. LB3 and LB6 operate Relay LA. LA7 operates Relay B, B7 operates Relay AL via CONNECT and TEST Key, B6 Earths XB and LPBC Leads. AL1 operates Buzzer, AL2 lights Extension Calling Lamp, in Control Unit Q535 or Q537. When MAIN restores TRANSFER 2 Key, TEST 2 Lamp glows, Earth via Contacts B8, LB5 and Resistor R1. CONNECT and TEST Key is now restored, releasing Relay AL and disconnecting TEST 2 Lamp. AL1 disconnects Buzzer, AL2 Extension Calling Lamp. RELEASE Button associated with Exchange Line 2 on MAIN Station Instrument is now operated, Exchange Line is extended to Relay Unit Q519. Resistor R4 holds Exchange Line via B3 and EX3, Relay S operates. S1 operates Relay SR. Relay EX is released by SR5. EX1 and EX2 Switch Extension to Exchange Line and release Relay A, EX3 disconnects Resistor R4 hold circuit. A1 releases Relay F.

Relays Operated: As in 1.2

5.0 NIGHT SERVICE EXCHANGE LINE CALLS

The NIGHT SERVICE Key on Control Unit Q535 or Q537, when operated connects NA1 and NB1 Leads from Relay Unit Q516 to NA and NB Leads of Relay Units Q519. The Key also Earths NL1 Lead to Relay Unit Q516.

5.1 1st EXCHANGE LINE

Incoming Call on Exchange Line 1 operates Relay RGA, to Ringing Cadence, in Relay Unit Q516. RGA Contact Earths NA Lead via C.U. Q535 or Q537 to operate Relay RR in Relay Unit Q519. RR1 extends Ringing to Extension to operate Bell. When Extension answers depression of EXCH Button on Extension Instrument provides Earthed Loop to operate Relays A and D. D1 operates Relay EL. Circuit operation is then as in 1.1.

5.2 2nd EXCHANGE LINE

Incoming Call on Exchange Line 2 operates Relay RGB, to Ringing Cadence, in Relay Unit Q516. RGB Contact Earths NB Lead via C.U. Q535 or Q537 to operate Relays LB and RR in Relay Unit Q519. Relay LB Holds to Earth on NL Lead via LB7. RR1 extends Ringing to Extension to operate Bell. When Extension answers depression of EXCH Button on Extension Instrument provides Earthed Loop to operate Relays A and D. D1 operates Relay EL. EL4 operates Relay LA. Circuit operation is then as in 1.2.

6.0 EXCHANGE SERVICE RESTRICTED

An extension that is Restricted as regards Exchange Calls cannot originate an Exchange Call without assistance from MAIN Station. Extension must first Call MAIN Station as in 2.2.

6.1 1st EXCHANGE LINE

MAIN depresses BAR 1 Button on Station Instrument, Earthing BA1 Lead, and tells Extension to depress EXCH Button. Earth is applied to Extension Loop to operate Relay D, D1 operates Relay EL, EL5 operates Relay LA to Earth on BA1 Lead. Circuit operation is then as in 1.1. BAR1 Button on Station Instrument is released when Exchange Line 1 Lamp glows.

Incoming Exchange Call is received, or passed to MAIN Station which calls Extension as in 2.1. MAIN Station depresses BAR1 Button on Station Instrument and tells Extension to depress EXCH Button. Earth is applied to Extension Loop to operate Relay D. D1 operates Relay EL. EL5 operates Relay LA to Earth on BA1 Lead LA2 operates Relay B. B8 Earths XA and LPAC Leads. Exchange Line 1 Lamp will change from a flashing to a steady glow. BAR1 Button is released followed by operation of RELEASE Button associated with Exchange Line 1. Circuit operation will then be as in 1.1.

6.2 2nd EXCHANGE LINE

MAIN depresses BAR2 Button, Earthing BB1 Lead, on Station Instrument and tells Extension to depress EXCH Button. Earth is applied to Extension Loop to operate Relay D, D1 operates Relay EL. EL6 operates Relay LB to Earth on BB1 Lead. Circuit operation is then as in 1.2. BAR2 Button on Station Instrument is released when Exchange Line 2 Lamp glows.

Incoming Exchange Call is received, or passed to, MAIN Station which calls Extension as in 2.1. MAIN Station depresses BAR2 Button on Station Instrument and tells Extension to depress EXCH Button. Earth is applied to Extension Loop to operate Relay D. D1 operates Relay EL. EL6 operates Relay LB to Earth on BB1 lead. LB6 operates Relay LA. LA2 operates Relay B. B8 and LB5 connect Earth to XB and LPBC Leads. Exchange Line 2 Lamp will change from a flashing to a steady glow. BAR2 Button is released followed by operation of RELEASE Button associated with Exchange Line 2. Circuit operation will then be as in 1.2.

7.0 MAINS FAILURE

When mains fails Relay EX releases. EX1 and EX2 Switch Extension Circuit to Exchange Line 1. Calls in progress on Exchange Line 1 will be maintained when Mains Fail, Calls on Exchange Line 2 will be disconnected. During Mains Fail Incoming Calls on Exchange Line 1 or 2 will not Ring Extension Instrument Bell. If a Call is in progress on Exchange Line 1 when Mains are restored Relay SR will operate via S1. SR1 Earths XA and LPAC Leads. SR5 operates Relay B.

RELAY UNIT Q519