

DIAGRAM NOTES

concerning

DIAGRAM GBW. 14660

titled

35 & 49 LINE P.A.B.X. - CONNECTING CIRCUIT1.0 GENERAL

The circuit consists of a 2000 type 100 outlet selector together with a uniselector used as a line finder.

On inter-extension calls, the calling line is found by the line finder and connection is made to the called extension via the bank contacts of the selector, as in an ordinary final selector. On exchange line calls, the circuit routes the call to the exchange line circuit and releases when the exchange line circuit has been seized. When '0' is dialled, the circuit routes the call to the attendants cabinet.

2.0 FACILITY SCHEDULE

Provision is made for:-

1. Finding and seizing a calling extension.
2. Applying an earth to the HF wire to guard the extension against intrusion and to hold the extension line circuit.
3. Busying the connecting circuit start chain.
4. Connecting a start condition to the Ringing Start and Alarm Circuit.
5. Returning dial tone to the calling extension.
6. Stepping the wiper carriage vertically under the control of the first impulse train.
7. Stepping the wiper carriage horizontally under the control of the second impulse train.
8. Extending start conditions to the exchange line circuit, or attendant's circuit.
9. The release of the connecting circuit when a call is connected via an exchange line circuit.
10. Returning busy tone if the called extension is engaged.
11. Applying ringing to a free called extension and returning ring tone to the calling extension.
12. Any extension to answer an incoming exchange line call by dialling the digit '2' under night service conditions.
13. Extension to be parked on an '0' level call if attendant is already engaged on an '0' level call.
14. Last party release of the circuit but enabling the first party to completely clear.
15. An alarm to be extended to the attendant if an extension goes P.G.
16. Access to the circuit for testing with Routine Test set GBW.13290.

3.0 CIRCUIT DESCRIPTION3.1 Outline

When an extension lifts his receiver, a start condition is extended to the Pulse circuit, which in turn extends the start condition to a free connecting circuit. The line finder associated with the connecting circuit hunts for, and seizes, the extension which is marked by a battery on a contact of the HF bank. The extension line circuit CO relay operates when the extension is seized and removes the IS relay from the line. Dial tone is returned from the connecting circuit and the extension may then dial the required number.

If the extension dials another extension the connecting circuit functions as a final selector.

If the extension requires an exchange call, or the services of the attendant, the selector is stepped to the appropriate level and then automatically steps into the bank. A start circuit is extended to the circuit required. On Exchange line calls when the line finder associated with that circuit finds the extension, the connecting circuit is released and is available for further use.

### 3.2 Detail

#### 3.2.1 Extension to Extension Call

When an extension lifts his receiver a start earth is extended from the line circuit via the pulse circuit to the connecting circuit start chain 'in' which operates the E relay, via TJ13-14, N5 and K2.

#### Relay E operating

- E1 locks relay E to start earth via hold lead against the disconnection of the earth on the start chain 'in' lead.
- E4 further disconnects the start chain 'out' lead.
- E5 operates relay A to 250 ohm battery via N2 springs.

Relay A operates relay B to a 250 ohm battery via CD1.

#### Relay B operating

- B1 prepares part of vertical magnet circuit.
- B2 prepares an operating circuit for relay K and completes the drive circuit of LF switch.
- B3 prepares an operating circuit for relay E.
- B4 prepares the test circuit for relay FT.
- B5 prepares the locking circuit for relay BT.
- B6 ineffective at this stage.

The LF switch drives until the FT relay is operated by the battery marked contact on the HF bank. Relay FT operating, cuts the drive circuit of the LF switch, and removes the short circuiting earth on relay K, thus allowing it to operate.

#### Relay K operating

- K1) extend the -ve and +ve lines to the A relay.
- K3)
- K2 disconnects the hold circuit of relay E and prepares to close the start chain.
- K4 prepares hold circuits for F and H.
- K5 prepares to connect dial tone to tone coil of A.
- K6 lights engaged lamp LP1 in series with relay P in Pulse circuit GBW.14710. Relay P operating extends an alarm to the attendant after a given time if the extension remains in a P.G. condition.
- K7 prepares the operating circuit for relay CD.
- K8 prepares operate circuit for relay G.

The release of relay E breaks the original operating circuit of relay A leaving it held to the extension's loop, returns dial tone to the caller, completes the start chain to the next connecting circuit and disconnects the hold lead.

The extension now dials the first digit to which relay A responds. At the first release of relay A, relay CD operates to the battery at the vertical magnet and is held, together with relay B, during impulsing by the short circuit applied by the A contact.

#### Relay CD operating

- CD1 removes the original operating battery of relay B, which remains held to the vertical magnet battery during impulsing.
- CD2)
- CD3) ineffective at this stage.

When the selector steps off-normal the N springs operate.

- N1 disconnects dial tone.
- N2 further disconnects operating circuit of relay A.
- N3 removes the earth on the engaged lamp thereby extinguishing it and releasing relay P in the Pulse circuit GBW.14710.
- N4 further prepares an operating circuit for relay E.
- N5 maintains the start chain circuit against the operation of relay E.

At the end of the impulse train relay CD releases, and if a working level has been dialled, the NPA springs will operate and thus further prepare the testing circuit for relay H. A circuit is also completed to operate relay E from the release earth via TJ11-12, N4, B3, NR3, and CD3.

Relay E operating

- E1 )
- E2 ) ineffective.
- E4 )
- E3 prepares a test circuit for relay H.
- E5 disconnects tone coil of relay A.
- E6 switches the impulsing circuit to the rotary magnet.

The extension now dials the second digit. At the first impulse CD again operates, and at CD2 completes a circuit to operate relay BT from earth at E3 via NPA1, CD2, and BT3.

Relay BT operating

- BT1 disconnects operating circuit of relay G.
- BT2 prepares a tone circuit to tone winding of relay A.
- BT3 holds relay BT to earth at B5.

On the first rotary step, off-normal springs NR operate.

- NR1 connects earth to ring start lead.
- NR2 disconnects the Line Finder drive circuit.
- NR3 holds relay E operated during impulsing.
- NR4 prepares short-circuit for relay CD, to prevent re-operation on release of selector.

At the end of the impulse train relay CD releases.

With NR springs operated and CD released the holding circuit for E is disconnected and E releases slowly, and during its release time H operates if the called extension is free, to the battery on the H lead.

Relay H operating

- H1 prepares hold circuit for relay F.
- H2 prepares to connect ring tone to tone coil of relay A and thence to calling extension's line.
- H3 connects called extensions -ve line to ringing via the F relay.
- H4 connects called extensions +ve line to ring return.
- H5 holds relay H on its hold winding.
- H6 not effective at this stage.
- H7 earths the called extensions H lead, thereby busying the outlet.
- H8 opens circuit of rotary magnet.

Relay E releasing

- E5 connects ring tone to tone coil of relay A.
- E6 short-circuits CD relay to prevent re-operation.

When the extension answers relay F operates to the extension's loop.

- F1 removes ring tone from calling extensions.
- F2 )
- F3 ) remove ringing and operate relay D to extension's loop.
- F4 removes short circuit on locking winding of F.
- F5 disconnects the earth on the ring start lead.
- F6 provides alternative hold circuits for relays F and H.

Relay D operating

- D1 prevents re-operation of relay P in pulse circuit.
- D2 completes hold circuit for relay H.

Conversation may now take place.

3.2.2 Call to an engaged extension

The circuit operates as for a call to a free extension up to the point of relay H testing. In this case an earth will be found on the H lead and relay H will not operate during the release of E. Busy tone is therefore connected to the tone winding of A via the un-operated contact H2 on release of relay E.

3.2.3 Release1. Calling extension clears first

When the calling extension clears first by replacing the receiver, the loop holding relay A is disconnected thereby releasing it. Relay A releases relay B.

Relay B releasing

- B2 disconnects holding circuit of relay K, thereby releasing it.
- B3) prepare release circuit of selector.
- B6)
- B4 disconnects circuit holding relay FT, thereby releasing it and the CO relay in the extension line circuit.
- B5 disconnects hold circuit of relay BT thereby releasing it.

Relay K releasing

- K1 disconnects the -ve line to A relay.
- K2 **not effective.**
- K3 disconnects the +ve line to A relay.
- K4 disconnects alternative hold circuits for relays F and H.
- K5 disconnects tone winding of relay A.
- K6 applies an earth to engaged lamp LP1, thereby lighting it, and operates relay P in GBW.14710 in series. If the called party, after a given time, has not released, an alarm is extended to the attendant.
- K7)
- K8) ineffective at this stage.

The calling extension line circuit is now released from the connecting circuit, but the latter is still held as the called extension is holding relay D to the extension loop. On the called extension clearing relay D releases which in turn releases relay H. The operating circuit of the release magnet is now completed at H8 and the switch returns to normal. The connecting circuit is ready for further use.

2. Called extension clears first

When the called extension clears first by replacing the receiver, the loop holding relay D is disconnected thereby releasing it.

Relay D releasing

- D1 applies an earth to "engaged" lamp LP1, thereby lighting it, and operates relay P in GBW.14710 in series. If the calling party, after a given time, has not cleared, an alarm is extended to the attendant.
- D2 releases relay H.

Relay H releasing removes the earth from the H lead and thus releases the called extension's line circuit CO relay. The line circuit is therefore freed for further use. The connecting circuit is still held by the calling extension's loop holding the A relay. When the calling extension clears relay A releases followed by B, and at B3 and B6 the driving circuit of the rotary magnet is completed and the switch returns to normal. B2 releases relay K and B5 releases relay BT.

### 3.2.4 Extension dials a non-working level

The circuit operation is as described in 3.2.1 until the end of the first impulse train is reached. Assuming the selector has been dialled to a non-working level, the NPB springs will operate. Relay E operates when CD releases and a circuit is completed to energise the rotary magnet from the earth at E2 via the NPB springs. The wipers will be switched to the first bank contact, and being a non-working level, an earth will be found on the contact of the G bank, thus completing a circuit to operate relay BT via BT3. NR3 operating disconnects relay E which releases, and so releases the rotary magnet. Relay BT operating completes the busy tone circuit to the calling extension. When the extension clears, the driving circuit of the rotary magnet is completed when B releases, and the switch returns to the home position.

### 3.2.5 Extension to Main Exchange Call

The extension makes an exchange line call by dialling the digit '1'. The circuit functions are as described in 3.2.1 for the first train of impulses, at the end of which the NPB springs operate, and step the wipers onto the first bank contact as described in 3.2.4. A resistance battery is connected to the first contact of the H bank (via the AS relay in the Misc. Circuit GBW.14720) and relay G operates to this battery via BT1, NPA1 springs and E3 to earth at K8. Relay G operating connects an 1150 ohm battery to the J wiper and bank contact of the LF switch. The operation of the AS relay in the Misc. circuit causes a start circuit to be completed for the exchange line circuit finder, which hunts until the battery marked contact on the J bank of the LF switch is found. The exchange line circuit now returns an earth via the HF bank and wiper of the LF switch which short circuits relay FT and causes it to release. FT releasing short circuits relay K which releases, K relay releasing breaks the loop holding relay A, and releases relay B. The release of relay B completes the drive circuit of the rotary magnet and the switch returns to normal leaving the calling extension connected to the exchange line circuit.

The NR2 springs are inserted in the LF driving circuit to guard against the LF switch being driven when the release of FT takes place.

### 3.2.6 Exchange Lines Busy

If the exchange lines are busy an earth will be found on the Line finder BD lead and therefore on the first Contact of the selector G bank level '1'. This earth will operate the BT relay, as described previously, and busy tone is connected to the calling extension.

### 3.2.7 Extension Barred Direct Access

The circuit operation in this case is the same as described in 3.2.6. The barred extension has an earth connected to the line finder BD lead. When the line finder drives to this contact, the earth is connected to the first contact of the selector G bank level '1', and the circuit operates as described in 3.2.6.

### 3.2.8 Extension to Attendant

The extension calls the attendant by dialling '0'. The circuit operation is as described in 3.2.1 for the first digit, at the end of which both NPA and NPB springs operate. The wipers are stepped to the first bank contact as described in 3.2.4. The H relay tests and finds battery from the KA relay in the attendants line circuit. Both H and KA operate, ring tone is returned to the caller. The KA relay closes a circuit which causes the attendant's '0' level line lamp to flicker, and prepares a circuit to re-operate the rotary magnet in the connecting circuit. The attendant on operating the '0' level key, operates the SA relay in the attendant's line circuit. A contact of SA completes the circuit to energise the connecting circuit rotary magnet via the DM lead, causing the switch to step to the second contact. Relay SA operating causes another relay, SB, in the attendant's line circuit to operate, thus disconnecting the energising circuit of the rotary magnet. Contacts of SB connect the lines to the attendants loop and operate relay F which trips the ringing and connects the extension to the attendant.

### 3.2.9 Attendant Busy

In this case the circuit operation is as described in 3.2.8 to the point of operation of KA. KA operates, but as the attendants line circuit relays SA and SB are already operated to the existing call there is no circuit to energise the connecting circuit rotary magnet a second time. The operation of relay H earths the H lead to busy the outlet. A contact of relay SB connects flicker to the call waiting lamp via a contact of KA. When the attendant completes the existing call, on restoring the '0' level key relay SA releases, which releases relay SB. The release of relay SB extinguishes the 'call waiting' lamp and lights the '0' level line lamp. The operator re-operates the '0' level key and the call proceeds as described in 3.2.8.

### 3.2.10 Night Service

A night service call from the main exchange may be answered by any extension barred or otherwise.

To answer a night service call, an extension lifts the receiver and dials 2. The connecting circuit is seized as previously described and the selector is stepped to level 2. The NPB springs operate and step the wipers on to the first bank contact as described in 3.2.4. Resistance battery, via the BS relay in the Misc. Circuit, is fed to the H bank contact. From this point the circuit operates in the same manner as described in 3.2.5, except that relay BS instead of relay AS provides the start circuit. The Extension answering the exchange line call is connected to the exchange line and the connecting circuit is released.

See GBW.14720 for Night Service extension line working.

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