See TI C3 C3022

THE HOUSE EXCHANGE SYSTEM

Circuit Operation

1. General.—This Instruction describes the circuit operation of the House Exchange System. The facilities provided by this equipment are detailed in Q 1001, and the operating procedure is described in Q 1003. The diagrams referred to apply generally to the 2+10 system. The corresponding diagrams for the 1+5 system are in the Loose-leaf Q 100 series.

LOCAL CALL BETWEEN INTERNAL EXTENSIONS (Diagram Q 231)

2. To call another internal extension, the caller removes the microtelephone, thereby allowing the HM springs to operate, and fully depresses the local key adjacent to the number of the required extension. Springs CB and L are thereby operated. Earth is extended *via* **HM2, CB2** and the appropriate **L2** springs to the B-line of the called extension. **HM1** and **HM2** prepare a circuit for the transmission bridge. **CB1** extends the buzzer to the common wire. **HM3** and **HM4** have no function at this stage.

3. Called extension free.—If the called extension's microtelephone is on the rest, the earth placed on the B-line is extended to the R-wire of the called extension circuit and thence *via* 1H3, 2H3, HM1 and the buzzer to battery. The called extension's buzzer is therefore actuated for the period during which the caller has the appropriate local button fully depressed.

4. *Called extension answers.*—The called extension answers by removing the microtelephone from its rest. The HM springs then operate and the telephone circuit is connected to the HLI and R-wires *via* 1X3, 2X3, and 1X2, 2X2, **HM1**, 2H3 and 1H3 respectively. Battery and earth are fed to the line through the transmission bridge RA.

5. *Speaking conditions.*—When the caller's finger is removed from the local key, the latter partially restores to the "speaking" position. The L springs remain operated in this position, but the common spring bank CB is released. The telephone circuit and the transmission bridge are connected to the A- and B-lines *via* the appropriate L1 and L2 springs and so to the called extension's telephone.

6. Transmission bridges, consisting of battery and earth fed through the two 200-ohm coils of the retardation coil RA, are provided at both stations on this type of call.

7. Called extension engaged on a local call.—If the called extension is engaged on a call to another extension, the earth on the R-wire incoming from the calling extension will not operate the buzzer at the called extension, as the buzzer circuit is disconnected at **HM1**. When the local key on the calling extension's telephone set restores to the "speaking" position however, the telephone circuit is connected to the A- and B-wires as in para. 4. A caller is thus able to break into a connexion between the two other extensions.

8. Called extension engaged on an exchange call.—If the called extension is engaged on an exchange call, the hold (H) springs on the appropriate exchange key will be operated and, at **1H3** or **2H3**, the R-wire will be connected to the common. When the caller fully depresses the appropriate local key, the earth placed on the R-wire of the called extension is extended to the common. This earth is returned to the calling extension on the common wire and operates the caller's buzzer *via* **CB1**. This serves as an engaged signal indicating that the distant extension is engaged on an exchange call.

9. Release of connexion.—At the termination of a call both extensions replace their microtelephones on the rests, which action mechanically restores all operated keys to normal.

INTERNAL EXTENSION CALLING EXTERNAL EXTENSION (Diagram Q 233)

10. When the calling extension removes the microtelephone from its rest, and fully depresses the appropriate local key, an earth is extended to the B-line (*see also* para. 2). This earth is received on the R-wire of the external extension circuit and thence *via* 2X4, 1X4, L2, BZ3y, coil of relay BZ to battery, with a parallel circuit *via* coil of relay H to battery. Relays H and BZ operate. **H1** short-circuits the 2 μF condenser and relay Q while **H2** and **H3** prepare for the extension of the

A- and B-lines. **H4** disconnects the external extension calling indicator.

11. External extension free.—Ringing current is placed on the external extension line in the following manner. Relay BZ in operating, breaks its own circuit at **BZ3y** and, consequently, releases after its slow-release period, whereupon it immediately commences to reoperate Relay BZ thus alternately operates and releases during the time that the local key at the calling extension is fully depressed. The contacts of relay BZ make and break with a frequency of approximately 16-20 per second, and the resultant reversals of potential sent to line *via* BZ1 and BZ2 ring the magneto bell at the external extension station. The path of the current with relay BZ operated is: earth, YA, **BZ1**, coil of relay L, 2X2, 1X2, **H1** to the B-line; battery, YB, **BZ2**, coil of relay L, 2X1 and 1X1 to the A-line. During the ringing period, the two 0·5 μF condensers act as a spark-quench to the contacts BZ1 and BZ2. Relay L does not operate while ringing current is being applied to the line.

12. When the earth is removed from the R-wire, relay H holds from earth, 1X3, 2X3, coil of relay H, HL-wire, calling extension telephone loop, R-wire, 2X4, 1X4 and coil of relay H to battery. Relay BZ releases, as it will not hold in parallel with H under these conditions. BZ1 and BZ2 extend earth and battery respectively *via* the coils of relay L, to prepare the transmission bridge for the external extension.

13. *External extension answers.*—The external extension answers by removing the microtelephone from the rest, and the telephone loop thus provided operates relay L. **L1** and **L2** extend the A- and B-wires from the caller's telephone circuit to the called telephone. **L3** serves no purpose at this stage. Relay BZ is disconnected at **L2.**

14. External extension engaged on a local call.—If the external extension is engaged on a call with another extension, relays H and L will be operated and, consequently, when a caller depresses the local key appropriate to the external extension number, relay BZ does not operate. When the local key restores to the "speaking" position, the caller breaks into the local connexion.

15. External extension engaged on an exchange call.—If the external extension is engaged on an exchange call, key springs **1X4** or **2X4** will be operated, thereby connecting the R-wire to the common. Therefore, when a caller fully depresses the local key adjacent to the external extension number, his own buzzer will operate as described in para. 8.

16. Release of connexion.—At the termination of a call, both extensions replace their microtelephones. Relays H and L release and the circuits are restored to normal.

EXTERNAL EXTENSION CALLING INTERNAL EXTENSION

(Diagrams Q 233 and Q 231)

17. The external extension has not the facility of direct access to internal extensions and must obtain all such calls *via* the main station.

18. External extension calls main station.—The main station is called by the action of removing the microtelephone from the rest. Relays L and Q operate *via* earth, YA, BZ1, coil of relay L, 2X1, 1X1, external extension telephone loop, coil of relay Q, 1X2, 2X2, coil of relay L, BZ2 and YB to battery. **Q1** operates relay QR, the contact of which has no function at this stage. **L1** and **L2** prepare the HL- and R-wire circuits respectively, **L3** extends an earth to operate the doll's-eye calling indicator *via* earth, **L3**, H4, T1, 1NS1, 2NS1, and indicator coil to battery. An audible alarm is given by a bell, which is actuated by earth from the calling indicator contact *via* CO1.

19. Main station answers.—The main station answers by removing the microtelephone and depressing the local key corresponding to the external extension number on the telephone set, thereby connecting the telephone circuit to the A- and B-multiple wires of the external extension station as follows: A-wire appropriate **L1** springs, 2X3, 1X3, telephone circuit, 1X2, 2X2, CB2 and appropriate **L2** springs to the B-line. The transmission bridge is provided from earth. **HM2**, 200Ω coil of RA and appropriate **L1** springs to the A-line, and battery *via* 200Ω coil of RA, **HM1**, CB2 and appropriate **L2** springs to the B-line. **HM3** and **HM4** have no function at this stage. The A- and B-wires are connected *via* the multiple to the HL- and R-wires respectively of the external extension station. The main station telephone loop applied to the HL- and R-wires completes a circuit for the operation

of relay H *via* 2X4, 1X4 and 2X3, 1X3. **H1** short-circuits relay Q, **H2** and **H3** extend the HL- and R-wires to the external extension telephone, and **H4** disconnects the indicator circuit.

20. The relays L and H together with the retard coil RA provide the necessary transmission bridges.

21. Main station calls internal extension.—The caller now informs the main station of the number of the internal extension with which he requires to communicate. The main station then calls the required extension, the circuit operation being similar to that described in paras. 2-6. The called extension, upon answering, is requested by the main station operator to call the external extension; the main station operator then replaces the microtelephone. The operation of the internal extension calling the external extension is described in paras. 10-16.

CONFERENCE FACILITIES

(Diagram Q 231)

22. The procedure to be followed when making conference calls is described in Q 1003. If a mass call were made instead of first calling the extensions individually, as soon as one station answered, the buzzers at the other called extensions would commence to operate and continue to do so even though the caller had removed pressure from the local keys. The circuit is earth, **HM2**, coil of RA, telephone loop to all the B-lines and buzzers in parallel, and the buzzers will therefore operate as soon as the circuit resistance has been sufficiently reduced by **HM2** earths in parallel.

23. Continuous operation of the buzzer until the extension answers is undesirable and it has been laid down, therefore, that a mass call should be made only after it has been ascertained that a person is in attendance at the called extensions.

INTERNAL EXTENSION WITH FULL FACILITIES CALLING THE EXCHANGE

(Diagrams Q 231 and Q 232)

24. To call the public exchange, the internal extension station removes the microtelephone thereby operating the HM contacts, and depresses (say) Exchange Key No. 1 thus operating the X and H springs. **1X1** and **1X2** remove the hold coil and prepare to connect the telephone to the exchange line. **1X2** and **1X3** also disconnect the local side of the circuit. **1H1** prepares an engaged-test circuit (see para. 30). **1H2** prepares an operate circuit for relay AA. **1H3** connects the R- and common-wires to provide an engaged test to calling extensions (see para. 8).

25. Exchange line free.—If the exchange line is disengaged, relay AA operates from battery, coil of AA, **HM3, 1H2**, AA4 and D-wire to earth at G1 on the exchange-line termination (Q 232). **AA1** and **AA3** extend the telephone circuit to the A- and B-wires and thence to the exchange line. **AA2** extends the earth *via* **HM2** and **1H1** to the C-wire, to operate relay G at the exchange-line termination. **AA4** provides a locking circuit for relay AA *via* **HM3, 1H2, AA4** and **HM2** to earth. At the exchange-line termination, relay G in operating removes the earth from the D-wire at **G1** in order to avoid intrusion. **G2** removes the exchange indicator and 2 μF condenser from the speaking circuit. C.B. type telephones are fitted at the extensions and suitable Units, Auxiliary Apparatus are fitted at exchange-line terminations on C.B.S. and magneto exchanges. If an automatic exchange is concerned, the caller receives dialling tone and may proceed to set up the connexion.

26. *Release of connexion.*—At the termination of a call, the calling extension replaces the microtelephone, thereby restoring the HM, X and H spring banks. Relays AA and G release, to restore the circuits to normal, when a clear is given to the exchange.

27. Main exchange C.B.S.—If the main exchange is a C.B.S. No. 1, 2 or 3 type, a Unit, Auxiliary Apparatus No. 18, modified to conform with Diagram CBS 536 (L 106), is fitted in each exchange line.

28. Main exchange magneto.—If the main exchange is of the magneto type, Units, Auxiliary Apparatus CBS 1074 (Diagram Q 301), are fitted in the exchange lines at the main exchange. The existing calling equipment at the main exchange must also be modified for loop calling, in accordance with Diagram Q 301. When an exchange line is seized by a calling extension, the loop from the caller's telephone operates relay LL *via* RG1 and RG2. **LL1** extends earth to relay LR, which operates. **LR1** and **LR3** have no function at this stage. **LR2** places a 1200-ohm loop, consisting

of the coils of the retards IA, IB and IC, in series across the exchange line to operate the calling indicator at the main exchange. **LR4** is spare. **LR5** disconnects relay RG and establishes the speaking circuit. Battery and earth, fed through the 50-ohm coils of relay LL, provide the necessary transmission bridge for the C.B. telephone at the calling extension.

29. *Release of connexion.*—At the termination of a call, the caller replaces the microtelephone, and a ring-off signal is given by the application of ringing to the exchange line for a period equal to the release lag of relay LS, the circuit operation being as follows. Relay LL releases when the calling extension's loop is removed. LL1 removes the earth from relay LR and operates relay LS. **LS1** extends the LL1 earth to operate relay LT, and **LS2** prepares to extend earth to the B-line. **LS3** and **LT1** prepare for the extension of ringing to the A-line *via* **LR2** and coil of retard IA. **LS4** and **LT5** extend an earth to energize the ringing vibrator. **LT2** has no function at this stage. **LT3** disconnects relay RG from the B-line against the release of **LR5.** **LT4** disconnects the A-line. At condensered cord-circuit exchanges, when relay LR releases, ringing is applied to the exchange from the ringing vibrator *via* **LT1, LS3,** LR2, coil of retard IA, exchange indicator, coil of retard IB, LR3 and **LS2** to earth. LR1 disconnects earth from relay LS which releases after its slow-release period. LS1 disconnects earth from relay LT, which releases and restores the circuit to normal. At non-condensered cord-circuit exchanges when relay LR releases, earth is extended to the B-line *via* LR3, **LS2** and retard IB, and battery is extended to the A-line *via* retard IA, LR2, **LS3** and **LT1.** When LS releases, LS2 removes earth from the B-line, which is then connected to battery *via* **LT1.** LS3 disconnects the A-line from battery and extends an earth from **LT2** to this line. A clearing signal is thus given to the exchange by first appyling battery and earth to the A- and B-lines respectively during the release period of relay LS, and, when relay LS releases, the potential applied to the lines is reversed for a period equal to the release lag of relay LT. On the release of relay LT, the circuit is restored to normal.

30. Exchange line engaged.—When the key of an engaged exchange line is depressed (with the microtelephone on or off the rest), the caller's buzzer will operate from battery, coil of buzzer, AA2, **1H1,** and the C-wire to an earth applied by the **HM2** contacts of the engaging extension. The caller's AA relay will not operate, due to the absence of earth on the D-wire of an engaged exchange line, and secrecy on exchange calls is thus provided.

EXTERNAL EXTENSION CALLING EXCHANGE—DAY SERVICE

(Diagram Q 233)

31. To gain access to a public exchange, the external extension must first call the main station. This operation is described in paras. 18-20.

32. The main station, having ascertained that the external extension requires an exchange call, proceeds to test an exchange line by depresing the exchange line key on the telephone set (see para. 30). When a free line is found, it is switched to the external extension line by throwing the appropriate EXTENSION TO EXCHANGE key on the main station unit. The main station then replaces the microtelephone.

33. EXTENSION TO EXCHANGE key contacts function as follows. **X1** and **X2** connect the external extension to the A- and B-wires of the exchange line. **X3** extends an earth *via* 2NS2, 1NS2 and **X5** to the C-wire, to operate relay G and place engaged-test conditions on the exchange line. **X4** disconnects relay BZ from the R-wire and connects the R-wire to the common, in order to busy the extension against incoming local calls. **X6** has no function at this stage. Relay Q operates from the public exchange battery to the extension station's telephone loop and at **Q1** operates relay QR. **QR1** disconnects the indicator circuit.

34. If the public exchange is of the automatic type, relay Q responds to the impulses dialled from the extension, relay QR however, being slow-to-release, remains operated during the dialling operation.

35. Release of connexion.—At the termination of a call, the external extension station replaces the microtelephone, to give a through clear to the public exchange. Relay Q releases, followed by relay QR. QR1 now extends earth from **X3,** to operate the clearing indicator *via* T1, 1NS1 and

2NS1. The operation of the clearing indicator places an earth *via* CO1 to the bell associated with the main station unit, to provide an audible clear. The main station now restores the EXTENSION TO EXCHANGE key, to re-establish normal conditions.

INCOMING EXCHANGE CALL

(Diagram Q 232)

36. All incoming exchange calls are received on indicators fitted in the Unit, Transfer, Intercom. at the main station. The indicators, which are of the doll's eye type, operate to rectified ringing current from the public exchange *via* the A-line, T1, coil of indicator, 2 μF condenser, G1 and T2 to the B-line. The indicator when operated extends an earth *via* CO1, to operate the alarm bell.

37. Main exchange magneto (Diagram Q 301).—If the main exchange is of the magneto type, relay RG in the Unit, Auxiliary Apparatus CBS 1074 operates to ringing current from the exchange *via* the B-line, LR5, LT3, coil of relay RG and 1 μF condenser to earth. **RG1** and **RG2** extend the exchange ringing and an earth, respectively, to operate the exchange indicator at the main station (see para. 36). When the main station asnwers, the call proceeds in a similar manner to an outgoing call (see para. 28).

38. Main station answers.—The main station answers all exchange calls by removing the microtelephone and depressing the appropriate exchange key on the telephone set. The circuit operation is then similar to that described in paras. 24 and 25.

39. Call for internal extension (Diagram Q 231).—Incoming exchange calls for an internal extension are first received by the main station, as described in paras. 36 and 38.

40. Upon ascertaining the number of the extension required, the main station fully depresses the local key corresponding to this number. This operation mechanically restores the exchange-line key to the " hold " position. In this position the H springs remain operated but the X springs are released, and the exchange line is now held by a circuit from the A-line, **AA1,** 600-ohm resistance coil, 1X1, **AA3,** to the B-line. The main station telephone circuit is disconnected from the exchange line at springs 1X1 and 1X2, and, when pressure is released from the local key, the telephone is switched to the A- and B-lines of the called extension *via* the appropriate L1 springs, 2X3, 1X3, telephone loop, 1X2, 2X2, CB2, and the appropriate L2 springs. The called extension is then requested to " pick up " the exchange line on which the call is being held. To do this, the distant extension depresses the appropriate exchange key, whereupon the buzzer at that station will operate as described in para. 30. Buzzer tone is passed back to the main station from earth, 0·4Ω coil of the buzzer, **1X3,** 2X3 to the HL-wire and thence at the main station *via* A-wire appropriate **L1** springs, 2X3 and 1X3 to the telephone circuit. On receipt of tone, the main station replaces the microtelephone on its rest; this restores all keys to normal, and removes the busy condition from the C- and D-wires. The AA or AB relay at the extension station is then allowed to operate to earth on the D-wire and so connect this extension to the calling exchange line, as detailed in para. 25.

41. *Called extension engaged.*—If the required extension is engaged on a local call, the main station is enabled to break in on the connexion, as described in para. 7, and offer the exchange call to the extension concerned. If the required extension is engaged on an exchange call the main station can break in on the connexion only if provided with monitoring facilities (see para. 58).

42. Call for external extension (Diagram Q 233.)—Upon ascertaining that the external extension is required, the main station calls the external extension by depressing the appropriate local key, the exchange line being held meanwhile in the manner described in para. 40. The external extension is advised that an exchange call is waiting, and the main station then throws the appropriate EXTENSION TO EXCHANGE key on the main station unit.

43. The main station replaces the microtelephone on the rest, and the call now proceeds as detailed in paras. 33–35.

TRANSFERENCE AND HOLDING OF EXCHANGE CALLS

(Diagrams Q 231 and Q 232)

44. Internal extension to internal extension.—If an extension, after speaking on an exchange line, desires to transfer the exchange call to the main

station or to another extension having full facilities, the operations are similar to those described for a main station transference (see paras. 40 and 41).

45. Internal extension to external extension.—An exchange call cannot be transferred direct from an internal extension to the external extension but must be transferred *via* the main station. The successive operations are as described in paras. 44 and 42 respectively.

46. External extension to internal extension.—By "flashing" the main station operator it is possible for exchange calls to be transferred from the external extension to any other extension *via* the main station. In automatic areas, directly-dialled calls originated by the external extension cannot be transferred.

47. Holding one exchange line while transferring a call on the other.—If on an installation with two exchange lines, the main station is talking on one line and a call is received on the second line, the main station may temporarily abandon the call on the first line and, by depressing the second exchange key (which automatically restores the first exchange key to the "hold" position, see para. 40) may accept the call, the operations being as described in para. 38.

48. The main station then depresses the local key corresponding to the number of the extension to which it is desired to transfer the call. This causes the second exchange line key to restore to the "hold" position.

49. If the call is for the external extension, it is transferred as described in para. 42. If the call is to be transferred to an internal extension, the procedure is as described in para. 40 except that, on receipt of buzzer tone, the main station releases the second exchange line from the instrument by operating the associated "trigger key." This causes the "hold" springs associated with the second line to restore, while leaving the "hold" springs on the first exchange key in the operated position. The distant extension's AA relay may then operate as described in para. 40.

50. The first exchange key has meanwhile remained in the "hold" position and, by again fully depressing this key, the main station may continue the conversation on this exchange line. The action of fully depressing the exchange key also restores the local key previously operated.

51. An internal extension station (other than a main station) with full facilities may, in the same manner, hold one exchange line while transferring an originated call on the second exchange line.

52. Holding one exchange line while making a call on the other.—The depression of the second exchange key automatically restores the first exchange key to the "hold" position. The call is then set up as described in para. 24. Either exchange call may now be transferred, the procedure being as described in para. 44. On termination of the call on the second exchange line, operation of the associated trigger key releases this line from the instrument, and connexion with the first exchange line may then be re-established by again fully depressing the first exchange key.

MISCELLANEOUS FACILITIES

53. Exchange calls barred (E.C.B.) extension (Diagram Q 231).—Any internal extension may be barred the facility of direct access to the exchange lines, but may be allowed exchange calls, as occasion demands, at the discretion of the main station operator. At these extensions, the D-wires connected to the AA and AB relays in the telephone set are cross-connected at the junction box to the corresponding D1 multiple wires and not to the D-wires as usual. The multiple D1-wire is normally disconnected from earth but, by operation of a press-button labelled EXCHANGE CALL and situated on the main station unit (Diagram Q 232), the D1-wire may be earthed and thus allow the AA or AB relay to operate at the E.C.B. extension.

54. *Outgoing exchange call.*—To make an outgoing exchange call, the E.C.B. extension first calls the main station in the normal way (paras. 2-6). If an exchange call is to be allowed, the main station operator tests and engages a free exchange line. The E.C.B. extension is then instructed to depress the appropriate exchange key. On receipt of buzzer tone from the E.C.B. extension (see para. 40), the main station operator holds down the appropriate EXCHANGE CALL button, at the same time replacing the microtelephone on the rest.

55. When the main station replaces the microtelephone, relay G releases and relay AA or AB at the E.C.B. extension will now operate *via* the D1-wire, contacts of the EXCHANGE CALL button and G1 to earth. The E.C.B. extension is now

connected to the exchange line as described in para. 25.

56. *Incoming exchange call.*—Incoming exchange calls to E.C.B. extensions may be extended at the discretion of the main station operator. The operation is similar to that described in para. 40 except, that on receipt of buzzer tone, the main station operator depresses the EXCHANGE CALL button and at the same time replaces the microtelephone. The call then proceeds as described in para. 55.

57. *Transferring exchange call from internal extension to E.C.B. extension.*—An exchange call may be transferred to an E.C.B. extension from another internal extension, by first transferring the call to the main station (para. 44) and requesting the attendant to re-transfer the call to the extension required (para. 56).

58. Monitoring exchange calls (Diagram Q 231).—Secrecy is normally given on exchange connexions. Monitoring facilities may, however, be allowed at the main station or any of the internal extensions. By altering the position of the strap (shown in the diagram), the instrument relay at that station is disconnected from the D-wire, and a local operating circuit is provided. Monitoring facilities may be provided on either or both of the exchange lines.

59. When it is desired to monitor an exchange call, the internal extension having monitoring facilities first tests the exchange line by depressing the appropriate exchange key, without removing the microtelephone from the rest. The operation of the buzzer will indicate an engaged exchange line (see para. 30). When the microtelephone is removed, relay AA operates *via* **HM3, 1H2,** AA4 spring 23, strap 2-3, to earth at **HM2. AA2** disconnects the buzzer from the C-wire. On depression of the appropriate exchange key, the telephone circuit is connected to the A- and B-lines of the engaged exchange line *via* **AA1, 1X2,** and **1X1, AA3,** so that the monitoring extension is now able to listen to the conversation or to offer a trunk call.

60. Second-choice main station (Diagram Q 232).—By the operation of a key or keys labelled TRANSFER at the first-choice main station unit (the key straps having previously been removed), the functions of that station may be transferred to the second-choice main station. When the transfer key on the main station unit is thrown, **T1, T2, T4** and **T3** transfer the A- B-, C- and D-wires respectively from the first-choice to the second-choice main station. All incoming exchange calls will now operate the exchange indicators at the second-choice main station unit, those calls which are for internal extension stations being dealt with as described in paras. 38-41.

61. On installations with an external extension, the facility of switching the external extension to an exchange line is not transferred to the second-choice main station, although the external extension calling and clearing signals are received at the latter station, which may therefore deal with requests for local calls by the external extension.

62. *External extension calling exchange.*—The external extension calls the second-choice main station as described in para. 18, and the latter answers as described in para. 19.

63. If the external extension requires an exchange call, the second-choice main station operator requests the external extension to replace the microtelephone. The main station operator, after replacing the microtelephone at the second-choice main station then proceeds to the first-choice main station and tests for a free exchange line on the telephone set at that station. When a free exchange line is found, it is switched to the external extension in the manner described in paras. 32 and 33.

64. The microtelephone at the first-choice main station is now replaced. The operator may (after restoring the transfer keys and so placing the first-choice main station in control) wait at this station for the external extension clearing signal and on receipt of this signal, restore the EXTENSION TO EXCHANGE key, reoperate the transfer keys and then return to the second-choice main station. Alternatively, the operator may return to the second-choice main station at once and, on receipt of the clearing signal at that station, proceed again to the first-choice main station in order to restore the EXTENSION TO EXCHANGE key and, subsequently, return to the second-choice main station.

65. *Incoming exchange call for external extension.*—If an incoming exchange call is for the external extension station, the second-choice main station operator must hold the exchange line, by

leaving the microtelephone off the rest at this station. The operator must then proceed to the first-choice main station and, after calling the external extension station (see paras. 10-13), switch the exchange call through as described in paras. 32 and 33. The microtelephone at the second-choice main station is replaced after the call is switched through.

66. Night service (Diagram Q 233).—The external extension station may be permanently switched to an exchange line at night, by operation of the EXTENSION TO EXCHANGE key and the NIGHT SERVICE key on the main station unit. **X1** and **X2** connect the external extension station to the exchange line. **X3** and **X5** prepare to extend an earth to the C-wire. **X4** disconnects relay BZ from the R-wire and connects the R- and common-wires to busy the extension against incoming local calls. The indicator circuit is disconnected by the operation of **X6** and **NS1**. **NS2** removes the **X3** earth from the C-wire so that the exchange line will test free to internal extensions when it is not in use by the external extension.

67. The external extension station removes the microtelephone from the rest, thereby applying the telephone loop to the exchange line. Relay Q operates and **Q1** operates relay QR. **QR1** extends the earth from **X3** to the C-wire *via* **X5**, so causing the exchange line concerned to test engaged to other local extensions, and also operating relay G which functions as described in para. 25.

68. *Exchange line engaged.*—If, when the external extension removes the microtelephone from the rest, the exchange line is in use by an internal extension, the external extension will be connected to the engaged exchange line and thus enabled to break in on the exchange call.

69. *Incoming exchange call for external extension.*—An incoming exchange call on the exchange line to which the external extension is switched will ring the external extension bell and also operate the exchange indicator on the main station unit. On removal of the microtelephone at the external extension station, relays Q, QR and G will operate as described in para. 67. The exchange indicator at the main station will therefore restore, and the call will then be received at the external extension station.

70. Extension bells.—The exchange line or external extension alarm bell circuits and the internal extension buzzer signals may be extended to any point or points on the system. The extension bell or buzzer is connected to the terminal marked EB in the diagram and is thus in parallel with the main bell or buzzer.

71. The extension of the exchange line or external extension alarm bell enables incoming calls to be answered at other points during the absence of the main station operator. On Units, Transfer, Intercom. No. 1A and No. 2, a common alarm bell serves both indicators, and, at points where signals are provided by an extension bell, it may therefore be necessary to test both of the exchange lines or the exchange line and the external extension by operating the appropriate keys on the intercom. telephone.

72. Terminal S (Diagram Q 133 and Q 233).—The wire from L3 to the terminal marked S has no function in any facilities at present available. It is included, however, to meet future anticipated requirements.

References :—Q 1001, Q 1003
(S1)

END

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