HOUSE EXCHANGE SYSTEM No. 4

Installation

1 **Scope of Instruction.** This Instruction describes the installation of the House Exchange System (HES) No. 4 to which has been given the sales name of 'Keymaster 2 + 10'. The facilities available in the HES No. 4 are described in Q 1015.

2 **Contents.**

(116688)

3 Advice Notes. The Advice Note for a HES No. 4 will specify the type of exchange line connexion and the number of multiple stations to be provided. The Advice Note will also specify whether non-multiple extensions or other external circuits are required, and such miscellaneous requirements as extensions bells, exchange service restrictions and monitoring.

4 Equipment required for automatic and C.B. manual areas. The main items of equipment required as shown in Tables 1-5.

5 Equipment required for LB areas. The equipment shown in Table 1 should be used but in addition an auxiliary apparatus unit must be associated with the exchange line to present CB conditions to the House Exchange System.

In CBS Nos. 1, 2 and 3 exchange areas a Unit, Auxiliary Apparatus, CBS 536 (Dgm. CBS 536) is required for the exchange line. The unit will normally be fitted at the public exchange. In magneto exchange areas a Unit, Auxiliary Apparatus, CBS 1074 (Dgm. CBS 1074) is required for the exchange line; the unit must be fitted at the public exchange.

6 Power supply. The power supply is derived from a Power-unit No. 52A which is mains operated. A suitable mains connexion point is needed close to the position chosen for mounting the power-unit and relay-units (see para. 30). The mains outlet must be a 3 pin BS socket (preferably with switch) with the third pin effectively earthed. If a suitable mains outlet does not exist, the subscriber should be asked to provide one in accordance with leaflet A 188, a copy of which should be given to the subscriber. The power-unit must be fitted near to the relay-units, and cabling between them must be kept to a minimum to prevent excessive voltage drop. A long flexible mains lead should not be fitted to connect to a distant mains point. A two amp output is required from the Power-unit No. 52A and attention is drawn to note 7 of Dgm. N 637.

7 Exchange line limits. The telephone instruments used in the HES No. 4 contain the standard 700-type transmission circuit. Direct exchange line limits defined in TRANSMISSION, Telephone, B 3502 apply. When the installation includes a non-multiple extension the signalling limit is reduced by 80 ohms and the transmission limit by 100 ohms TER to allow for the signalling relays in the exchange lines; these reduced limits include the two-wire line to the non-multiple extension (see TRANSMISSION, Telephone, B 3567).

8 Layout of the system. Diagrams for the HES No. 4 are listed in the Q 5... series index.

The layout of typical systems is shown in Dgms. Q 502, Q 508 and Q 509. To ensure satisfactory operation of the signalling circuits, the length of cable between the first multiple station and the power-unit should not exceed 400 yards.

9 Unsuitable situations. Very damp or dusty situations are unsuitable for house exchange installations. If during installation damp conditions are found all reasonable attempts must be made to avoid them. Where this is not possible the cables should preferably enter the box connexion No. 6A and No. 7A and power and relay units from below; this will prevent moisture which may condense on cable sheaths from running into the equipment.

TABLE 1. INSTALLATION OF MULTIPLE STATIONS ONLY

Apparatus required per multiple station		Common equipment (one per installation)	Power supply (one per installation)	Multiple cable (Cable, P.V.C. No. 1...)
Telephone, Intercom., No. 4/1 (L or CB) [Dgm. Q 540]	Box, Connexion, No. 6A [Dgm. Q 510]	Relay-unit Q 516 [Dgm. Q 516]	Power-unit No. 52A (Dgm. N 637)	41 Wire 6½, Grey [Dgm. Q 503]

TABLE 2. ADDITIONAL APPARATUS REQUIRED WHEN A 2ND-CHOICE MAIN STATION IS PROVIDED

Number of non-multiple extensions or private circuits	Equipment required at main station		Equipment required at 2nd-choice main station	
1	Control-unit Q 537 with Cord. Inst., No. 18/04AJ, Grey, 72 in. Relay-unit Q 539 Switch No. 5A-8 Part No. 1/DPL/2135	Block, Terminal, No. 37...	Control-unit Q 535 with Cord, Inst., No. 1B/04AJ, Grey, 72 in.	Block, Terminal, No. 37...
2	Control-unit Q 537 with Connector No. 1046A, Grey Relay-unit Q 539 Switch No. 5A-8 PartNo. 1/DPL/2135	Box, Connexion, No. 6A	Control-unit Q 537 with Connector 1046A, Grey	Box, Connexion No. 6A
3	Control-unit Q 537 with Connector No. 1046A, Grey Relay-unit Q 538 Relay-unit Q 539 Switch No. 5A-8 Part No. 1/DPL/2135	Box, Connexion, No. 6A	Control-unit Q 537 with Connector No. 1046A, Grey	Box, Connexion, No. 6A
4	Control-unit Q 537 with Connector No. 1052A, Grey Relay-unit Q 538 Relay-unit Q 539 Switch No. 5A-8 Part No. 1/DPL/2135	Box, Connexion, No. 6A	Control-unit Q 537 with Connector No. 1046A, Grey	Box, Connexion, No. 6A

TABLE 3. INSTALLATION INCLUDING NON-MULTIPLE EXTENSIONS AND PRIVATE CIRCUITS

Apparatus required per non-multiple extension	Apparatus required per private circuit	Additional apparatus at main station (without 2nd-choice main station see also Table 2)			Cable between common eqpt. and main station control-unit (Cable, P.V.C., No. 1...)
		For one circuit	For two circuits	For 3 or 4 circuits	
Relay-unit Q 519 [Dgm. Q 519]	Relay-unit Q 524 [Dgm. Q 524]	Control-unit Q 535 [Dgm. Q 535]	Control-unit Q 537 [Dgm. Q 537]	Control-unit Q 537 [Dgm. Q 537]	24 Wire 6½, Grey at installations with 1 external circuit
Telephone No. 710 [Dgm. Q 550] (This diagram lists the auxiliary parts required for the Telephone No. 710)		Block, Terminal, No. 37 Cord, Inst., No. 18/04AJ, Grey, 72 in.	Block, Terminal, No. 37 Cord, Inst., No. 25/04AJ, Grey, 72 in.	Box, Connexion, No. 6A [Dgm. Q 510] Connector No. 1046A, Grey, 72 in.	41 Wire 6½, Grey at installations with 2, 3 or 4 external circuits

NOTE:- The combined total of non multiple extensions and private circuits fitted at any installation must not exceed four. Each extension or private circuit replaces one multiple station.

TABLE 4. ITEMS REQUIRED TO PROVIDE EXCHANGE SERVICE RESTRICTED FACILITY AT A MULTIPLE STATION

To restrict service on one line only	To restrict service on two lines
For each station to be restricted 1 Relay-unit Q 527	*For each station to be restricted* 1 Relay-unit Q 527 1 Relay-unit Q 52B
To be fitted at controlling station 1 Part No. 4/DBU/355 1 Part No. 1/DSU/3126	*To be fitted at controlling station* 1 Part No. 4/DBU/355 1 Part No. 5/DBU/355 2 Part No. 1/DSP/3126

NOTE:- For non multiple extensions see para. 32.

TABLE 5. ITEMS REQUIRED TO PROVIDE MONITORING FACILITY AT A MULTIPLE STATION

To monitor one line	To monitor two lines
1 Part No. 1/DSP/3125 1 Part No. 6/DBU/355	2 Parts No. 1/DSP/3125 1 Part No. 6/DBU/355 1 Part No. 7/DBU/355

NOTE:- This facility can be provided at only one multiple station of an installation.

10 External multiple stations. An external multiple station may be provided, exceptionally, if satisfactory cabling arrangements can be made. The transmission and signalling limits are the same as those applicable between internal multiple stations.

11 Non-multiple extension line. The running of the two-wire extension line to a non-multiple extension (whether internal or external) and the fitting of the non-multiple extension telephone should follow ordinary subscribers' installation practice. Dgm. Q 550 shows the non-multiple extension telephone. It should be noted that a signalling-earth connexion is required at this extension.

12 Cabling of the system. Provision of the internal multiple cabling should should be in accordance with INTERNAL WIRING, Stations, A 1018 using Cable, P.V.C. No.1,41 Wire 6½, Grey. For external multiple stations the same cable will often be suitable, and in these instances the precautions in INTERNAL WIRING, Stations, A 1018 regarding the use of plastic-covered cables externally, must be strictly observed. When these conditions cannot be adhered to, a suitable external cable should be used, but the total length of internal and external type multiple cable used at an installation must not exceed 400 yards.

13 Numbering of stations. Stations should be numbered in sequence, according to their position in the multiple cabling. If non-multiple extensions or private circuits are provided they must always be connected at the end of the multiple cable, and numbered 10, 9, 8 and 7 in that order. Dgm. Q 502 shows this arrangement.

14 Boxes, Connexion, Nos. 6A and 7A. The Box, Connexion, No. 6A provides the termination point for the multiple cable and the connector of the Telephone, Intercom., No. 4/1.

Wiring provided between the plug pins and the terminals on the underside of the tablets is shown in Dgm. Q 510.

The Box, Connexion, No. 7A is similar in appearance to the Box, Connexion, No. 6A but the base has a mounting for three 28-way terminal tablets, on which the multiple and spur cables for two multiple stations may be terminated.

Normally, multiple cables should be run directly, without interruption between stations and terminated on Boxes, Connexion, No. 6A. Where one station is to be provided in an isolated position or the channels provided for concealed wiring are not large enough to accommodate two 41-wire cables, however, a Box, Connexion, No. 7A should be provided at a convenient point in the multiple cable and a single cable provided between the connexion box and the affected station.

Wiring involving the use of Boxes, Connexion, No. 7A is shown in Dgms. Q 503 and Q 508.

15 Fitting. The position of the Box, Connexion, No. 6A will be decided by the position of its associated Telephone, Intercom., No. 4/1, and the two should be considered together so that they will be within the range of the standard 72 in. cord fitted to the telephone.

Boxes, Connexion, Nos. 6A and 7A may be mounted directly on to walls or other permanent mounting surfaces, but never directly on to floors. Where floor fixing is unavoidable, the connexion box should be mounted on a Tablet, Polished, Hardwood, No. 4, and care should be taken in siting the fixture to minimize the dangers due to water, cleaners' equipment, movable furniture etc. Exceptionally, connexion boxes may also be mounted on Tablets, Polished, Hardwood, if it is considered that heavy condensation is likely to occur inside the connexion boxes when they are mounted directly on to the surface, or if fitted in association with wall outlets of under-floor duct systems.

16 Dgms. Q 503, Q 505, Q 508 and Q 509 show connexion box wiring for typical installations. The cable ends should be stripped and terminated as described in INTERNAL WIRING, Stations, A 1018. Spare conductors should be tied back and not cut off. Neatness of layout is essential and occasional cable-ties should be used where necessary to maintain tidiness in the cable form.

The multiple cable connexions should be made on the front facing terminals of connexion boxes.

In the Box, Connexion, No. 7A, when connecting spur cables to the terminals on the underside of the tablets, it may assist the installer if the tablet is reversed and secured to its mounting during the connexion of the cables. Care must be taken to ensure that the cable is neither strained nor misplaced after the tablet has been turned back to its correct position.

Attention is drawn to the straps to be fitted at the first station; these are shown in Dgms. Q 503..

When the position of the cables into the connexion box has been decided, the knockouts covering the appropriate cable entries in the cover should be carefully cut out using a sharp knife and, if necessary, the edges filed off with a File, Half-round, Smooth, 6 in. Only the entries to be used should be opened.

17 Securing the cable. As cable clamps are not provided in Boxes, Connexion, Nos. 6A and 7A, the cables must be secured by cleating to the mounting surface at the point of entry to the connexion box.

18 Fitting the Telephone, Intercom., No. 4/1. The Telephone, Intercom., No. 4/1 is issued complete with a cord and connecting socket. When connecting the instrument to the system the connector on the cord should be positioned over the plug in the Box, Connexion, No. 6A, and the cord grommet positioned over the retaining frame at the side of the plug.

The socket and grommet should be simultaneously pressed into engagement. The plug and socket should engage smoothly and excessive force must not be exerted or damage to plug pins may occur.

The instrument cord, connexions for each station are shown in Dgm. Q 540.

19 Labelling. It is intended that subscribers will complete and fit station identification labels and label covers, and for this purpose four Labels No. 469 should be left with the subscriber on completion of an installation.

The Labels No. 469/1 and No. 469/2 provided in the telephone are intended as temporary labels, and fitting staff should complete these labels in manuscript pending the typing and fitting of permanent labels by the subscriber.

Dial labels are still to be fitted and maintained by PO engineering staff.

20 Main station. At each installation one multiple station will be designated as the 'main station'. At this station the BELL ON/BELL OFF press-buttons in the Telephone, Intercom., No. 4/1 must be made inoperative by removing the straps between terminals 33, 34 and 35 in the telephone, thus ensuring that the bell always rings on incoming exchange calls.

The main station may also be required to control additional facilities; in these circumstances the BELL ON/BELL OFF press-buttons and spring-sets may be replaced, or additional buttons and spring-sets provided. Details of such changes are given in paras. 25 and 26.

When non-multiple extensions and/or private circuits are included in an installation, a Control-unit Q 535 or Q 537 is provided at the main station.

21 Control-units Q 535 and Q 537. A Control-unit Q 535 must be provided at the main station of an installation fitted with one non-multiple extension or private circuit and not having a 2nd-choice main station. Where a 2nd-choice main station is fitted the Control-unit Q 535 should be provided at this station only and a Control-unit Q 537 provided at the main station.

At installations having more than one non-multiple extension and/or private circuit a Control-unit Q 537 should be provided at the main station, and also at the 2nd-choice main station when one is fitted.

The terminal block or connexion box associated with the Control-unit should be fitted adjacent to the Box, Connexion, No. 6A of the station instrument. Cable, PVC No. 1, 41 Wire 6½, Grey must be provided between the main station and the Relay-units Q 516, Q 519 and Q 524. Dgms. Q 503 and Q 505 show the cable terminations.

22 2nd-choice main station. The Switch No. 5A-8, together with Relay-unit Q 539, and when required Relay-unit Q 538, should be mounted in the Control-unit Q 537 at the main station. The Switch No. 5A-8 is positioned in the rectangular cut-out in front of keys two and three, and fixed by two 8BA × $\frac{1}{8}$ in. Csk. Hd. screws. The Relay-unit Q 539 is mounted on the existing bracket alongside the buzzer. The Relay-unit Q 538 is positioned alongside the first key and fixed by two 8BA × $\frac{1}{8}$ in. Csk. Hd. screws. The existing face plate Part No. 2/DPL/2135 must be changed for a Part No. 1/DPL/2135.

Dgm. Q 505 shows the cable and other connexions and the strap arrangements of control-units at each station.

23 Multiple stations. In addition to the main station, at multiple stations where the bell is required to be rung for all incoming exchange calls, the straps between terminals T33, T34 and T35 must be removed. At stations where the bell is not to ring, terminals T33 and T34 must be strapped.

Normally, up to five bells may remain in circuit.

To remove the station identification label press one end of the transparent cover retaining the label with the blunt end of a pencil or similar object. This will cause the middle of the cover to bow upwards where it may be gripped by finger and thumb and gently lifted.

24 Installations with 11th station. The 'home station' press-button on each instrument may be used to call an 11th station. Where the installation includes external-type circuits, they must be kept at the end of the multiple cable and the 11th station connected into the multiple cable with the other multiple stations. The external-type circuits will still be numbered from 10 to 7 as required.

Where an 11th station is fitted, the facility of calling a station while it is engaged on an exchange line call cannot be given. This is because the 'home station' press-button at the station cannot be used to put the exchange call into the 'hold' condition, and so allow the station to speak to the unknown calling station.

Dgm. Q 509 shows typical layouts and cabling for installations including an 11th station. Cable and connector conductors are not allocated for the 11th station, and when this station is required the conductors normally used for controlling restricted exchange service must be reconnected for the 11th station (see para. 25).

25 Modifications to Telephones, Intercom., No. 4/1. *Exchange service restricted.* When a station is to be barred exchange line service, except at the discretion of the main or other controlling station, one relay-unit per exchange line should be fitted in the Telephone, Intercom., No. 4/1 at the station to be restricted, and one BAR button per exchange line should be fitted at the controlling station.

(a) To restrict one line only. A Relay-unit Q 527 should be fitted over the right-hand bell gong, viewed from the front of the telephone, and the flexible leads connected to the appropriate line.

(b) To restrict both lines. In addition to the Relay-unit Q 527 a Relay-unit Q 528 should be fitted over the left-hand bell gong. Relay-unit Q 527 must then be connected to line one and Relay-unit Q 528 connected to line two.

To install the units, remove the bell gong fixing screw, place the unit over the bell gong with its relay armature facing to the rear of the telephone, and replace the screw through the fixing hole in the unit.

At the controlling station fit, as required, buttons BAR 1 (Part No. 4/DBU/355) and BAR 2 (Part No. 5/DBU/355) together with one or two spring-sets (Part No. 1/DSP/3126).

Button BAR 1 with its spring-set should be fitted in position A of the telephone. Button BAR 2 with its spring-set should be fitted in position D. The connexions from the spring set are shown in Dgm. Q 527.

To provide this facility at installations having an 11th station (see also para. 24), it will be necessary at the restricted station to change the Connector No. 1046A for a Connector No. 1052A. Also, the conductors of the multiple cable normally used for controlling barring will be required for the 11th station, and an additional one pair cable (Cable, PVC No. 1, 2 Wire 6½,) must be provided between the controlling station and the restricted stations.

Cable and connector connexions are shown in Dgm. Q 527.

26 Monitoring. The facility of monitoring exchange calls is allowed at only one station of an installation. At the monitoring station fit one or two MON buttons and associated spring-sets as required. To monitor exchange line one, fit button MON 1 (Part No. 6/DBU/355) with spring-set (Part No. 1/DSP/3125) and to monitor exchange line two, fit button MON 2 (Part No. 7/DBU/355) with spring-set (Part No. 1/DSP/3125). Change the Connector No. 1046A for a Connector No. 1052A. The wiring connexions of the spring-sets within the telephone are shown in Dgm. Q 530.

A four-wire cable should be provided from the monitoring station forward to the Box, Connexion, No. 6A of station one or to another suitable point from where the lines to be monitored may be intercepted before entering the multiple cabling.

At the forward end terminate the four-wire cable to the exchange lines, and at the monitoring station connect the cable and Connector No. 1052A as shown in Dgm. Q 530.

Where the monitoring station is the main station, fit the MON 1 and MON 2 buttons in positions A and D respectively when these are available. Should positions A and D be occupied by BAR buttons, then the BELL ON/BELL OFF buttons together with their spring-set should be recovered and the MON 1 and MON 2 buttons with their spring-sets should be fitted in positions B and C respectively.

At other stations the facilities of controlling barring and monitoring cannot be provided together, unless the magneto bell is left permanently in circuit by removing the strap between T33, T34 and T35 and recovering the BELL ON/BELL OFF buttons together with their spring-set.

27 To allow a multiple station to call the main station when it is engaged on an exchange call. This facility is provided by removing a strap from between terminals T3 and T4 and connecting it between terminals T2 and T3 in the telephone fitted at the main station (see Dgm. Q 540).

28 Exchange service prohibited. At stations to be prohibited exchange service, the lamp and bell circuits together with the exchange lines must be isolated from the telephone. These circuits should be modified in the Box, Connexion, No. 6A as described in Dgm. Q 526.

29 Wall-mounting of relay-units and power-unit. Wall-mounted relay-units include Relay-units Q 516, Q 519 and Q 524, and details of their uses are given in Tables 1 and 3.

To reduce cabling the power- and relay-units should be mounted in a convenient position close to the end of the multiple cable, after the last multiple station.

The units may be mounted directly on to a smooth firm surface and, wherever possible, vertically above each other, with the power-unit at the bottom. For uneven surfaces, battening should be fixed to the wall and the units secured to the battening. In special cases floor-standing racking should be made locally. The complete assembly should be clamped to the wall by one or two fixing screws to prevent movement and consequent strain on cable connexions.

Space must be left at the side of the units to allow opening of the hinged plates for maintenance purposes. Also, due to the position of the power-unit cover fixing screws, a minimum clearance of 6 in. must be left between the lower edge of the cover and any horizontal surface beneath it.

The relay-units have a hole in the backplate fitted with a grommet for cable entry, and a terminal strip is fixed to the backplate for cable termination.

Cable connexion for the power- and relay-units are given in Dgms. Q 503, Q 505, and Q 509.

30 Power-unit No. 52A. This power-unit is fully described in POWER, General, S 1051, and Dgm. N 627. When connecting the mains supply care must be taken to ensure that the correct tapping is used for the local supply voltage. When connecting the 50V d.c. supply to the system, care must be taken to ensure that the polarity is correct otherwise damage may occur to the station lamps, and to the transistor equipment in Relay-unit Q 516.

31 Ringing converters. Where external extensions, or private circuits using G/A.C. out signalling are provided, or additional magneto bells are required a 25 c/s ringing supply will be needed. Where a Ringing, Converter, No. 7 is used it should be fitted in the space provided in the Power-unit No. 52A. Other types of ringing converters should be mounted adjacent to the power-unit.

Dgm. Q 545 refers to ringing circuits for external-type circuits and additional magneto bells.

32 Non-multiple extensions. Provision of the Telephone No. 710 for the non-multiple extension is shown in Dgm. Q 550, which also lists the additional switches, parts etc. that must be fitted into the telephone. The press-button engraved EXCH is fitted in position B and that engraved EXTN is fitted in position C. The pin of Part No. 1/DPL/378 in position C must engage with the slot of Part No. 1/DPL/379 fitted in position B. The latch plate should be arranged to lock plunger C, but not plunger B. The release of plunger C is by gravity switch; the latching bracket settings are shown in Dgm. Q 550.

Extension Plans 1,1A, and 4, internal only, may be provided at the non-multiple extension and these are described in Dgms. Q 552 to Q 554.

The method of restriction or prohibition of exchange line service is shown in Dgm. Q 526.

33 Earth connexion. An efficient telephone earth connexion must be provided and connected to the positive terminal of the 50V supply. The earth connexion should not be obtained from the mains supply or from conduit.

34 Cords. Telephones, Intercom., No. 4/1 are issued fitted with Connector No. 1046A. The position of stations should, wherever possible, be chosen to allow the use of the 72 in. cord. Exceptionally, cords 120 in. long, which are available on requisition, may be provided in lieu of the standard length.

35 Dial-centre labels. At multiple stations in automatic areas Labels Nos. 386A, 386B or 386D should normally be used. At the non-multiple extension in manual and automatic areas and at multiple stations in manual areas Labels No. 386E should normally be used. For stations with restricted service Labels Nos. 160N and 160R are available, and may be used if desired. These labels are described and illustrated in A 3202.

36 Extension bells and buzzers. Separate or additional magneto bells may be connected to the exchange line ringing circuit at multiple stations, but the total number which may be rung from the exchange ringing supply must not exceed five. Additional magneto bells may be rung from a local source, or d.c. bells may be used.

One extension magneto bell may be provided at the non-multiple extension.

Loud sounding bells may be provided as extension bells.

One d.c. bell or buzzer may be provided at each multiple station as an extension of the buzzer signalling circuit.

Dgms. Q 545 and Q546 show how extension bells and buzzers are connected and A 3113 describes the bells and buzzers which may be used.

37 Subscribers' private meters. Meters No. 19 may be associated with the HES. No. 4 either by connexion to the exchange lines before they enter the multiple or by connexion at a multiple station, or a non-multiple extension.

38 Association with a PBX. The HES No. 4 may be associated with a PBX by one of the following methods:-

(a) By terminating one or two extensions from the PBX in place of exchange lines on a normal house exchange installation.

(b) By terminating a private circuit in lieu of a multiple station at the HES No. 4 and as an extension of the switchboard.

39 Connexion to a PBX by method (a). The HES No. 4 should be installed in the normal manner; standard practice for the particular type of PBX concerned should be followed to determine the transmission and signalling limits for the complete installation, and whether or not auxiliary units will be needed in the connecting circuits. The house exchange station most distant from the point of connexion of the lines from the PBX should be considered as a PBX extension for the purpose of determining the appropriate limits. If the HES No. 4 is to have a non-multiple extension, the normal transmission and signalling limits are reduced by 80 ohms for connexion via the PBX including that extension.

40 Connexion to a PBX by method (b). The HES No. 4 should be installed in the normal manner. The private circuit should be terminated at the HES No. 4 on a Relay-unit Q 524 which occupies the position normally taken by a multiple station (see par. 13). Circuit details of the relay-unit are shown in Dgm. Q 524.

Dgms. Q 562 to Q 567 show the connexions for the various signalling conditions. Dgms. Q 502 and Q 503 give cabling details.

The extension of exchange calls over a private or inter-switchboard circuit is not normally allowed, and the straps in the unit for this facility should not be provided unless called for on the Advice Note.

41 Connecting circuits between two house exchange systems. The HES No. 4 may be connected to another HES by use of a private circuit, terminated at the HES No. 4 by a Relay-unit Q 524 (see par. 40). When the distant installation comprises a HES No. 3, the circuit should be terminated there by a Relay-unit Q 415; see Q 3011 and Dgms. Q 415 and Q 441 to Q 447.

When the distant installation is either a HES No. 1 or No. 2 the circuit may be terminated there as a non-multiple extension on a Unit, Transfer Intercom., No. 1A or No. 3 which should be modified locally as required.

The extension of exchange calls over a connecting circuit is not normally allowed and this facility should not be provided unless called for on the Advice Note.

42 Operator recall. When the HES No. 4 is subsidiary to a PBX the facility of operator recall, by overpress on the exchange line buttons, may be provided. Dgm. Q 540 shows the connexions required in the Telephone, Intercom., No. 4/1.

43 Testing. Each new installation must be checked for:-

(a) Continuity of multiple wiring.
(b) Insulation of exchange line wiring.
(c) Function of circuits at multiple stations.
(d) Function of circuits at non-multiple extensions.

44 Continuity test of multiple wiring. After completion of the multiple wiring, but before connecting the power-unit, relay-units or instruments, the continuity of the multiple between the first and last multiple stations should be tested. At the last connexion box all terminals should be temporarily connected together. At other connexion boxes (except the first) series connected circuits must be completed by temporary connexions. From the first connexion box loop-continuity tests should be made on each conductor in the multiple, using a dry cell and Detector No. 4 or other suitable testing equipment. Dgms. Q 503, Q 505, Q 508 and Q 509 show how the multiple is connected at each connexion box.

45 Insulation test of exchange line multiple. After removing temporary connexions made for the continuity tests, but before connecting the d.c. power supply, connect the relay-units, telephones and exchange lines. Apply insulation tests in co-operation with the test clerk as described in TESTS & INSPECTIONS, Routine, L 5106 to the exchange line. Tests made under this condition will automatically include the non-multiple extension line and instrument, if fitted. On completion of the tests, the polarity of the 50V d.c. supply should be carefully checked and the supply then connected.

46 Tests at multiple stations.

(a) Make an outgoing call to the exchange from each station. Check that the appropriate exchange line engaged lamp (adjacent to exchange line press-button) and station engaging lamp (adjacent to conference press-button) glow when an exchange line press-button is pressed.

(b) Obtain an incoming call on each exchange line in turn. During the ringing of each call check that the magneto bell rings at the main station; check that the BELL ON and BELL OFF buttons function at stations where exchange line ringing is optional; check that no ringing occurs at stations where the bell should be short-circuited. Also check at all stations, that the exchange line lamp flashes in rhythm with the exchange ringing. A poor ringing response, or ringing on one line, causing lamp flashing on the other line also, may be due to a high-resistance earth connexion.

(c) At station one make an outgoing call on exchange line one; hold and then transfer this call to station two. Repeat the hold and transfer at each of the remaining stations. Check at each multiple station that the exchange line lamp flashes during the hold condition, and that the station engaging lamp glows when the station receives the transferred call. Repeat the test using exchange line two.

(d) At each multiple station signal and speak over the intercom circuit to the other stations in turn, then together on a conference call.

47 Testing a non-multiple extension. When a non-multiple extension is fitted the following tests should be made in addition to those in par. 46.

(a) Call the main station. Confirm that the lamp glows and the buzzer operates in the Relay-unit Q 535 or Q 537 fitted at the main station, and that they are respectively dimmed and silenced when the call is answered.

(b) Obtain a call from and speak to each multiple station in turn.

(c) Make an exchange line call, and then transfer it to the main station. Arrange for the main station to transfer the call back after the non-multiple extension has cleared. Arrange for the first exchange line to be engaged by a multiple station, then repeat the test, using the second exchange line which should now be engaged by the non-multiple extension.

(d) At installations where night service facilities are provided, operate the NIGHT SERVICE key at the main station, then obtain an incoming call on each line in turn, and check that the bell rings at the non-multiple extension.

(e) Disconnect the 50V d.c. supply by switching off the mains input. Relay EX in the Relay-unit Q 519 will release. Check at all non-multiple extensions, that outgoing exchange service is available by pressing the EXCH button, and making an exchange line call.

48 Testing a private circuit.

(a) Call the main station. Confirm that the lamp glows and the buzzer operates in the Relay-unit Q 535 or Q 537 fitted at the main station and that they are respectively dimmed and silenced when the call is answered.

(b) Obtain a call from and speak to each multiple station in turn

(c) At installations where the private circuit is allowed incoming exchange calls.

(i) At the main station, obtain an incoming exchange call on the first exchange line and transfer the call to the private circuit. Check that the calling signal is received and speak over the circuit. Repeat the test on the second exchange line.

(ii) Operate the NIGHT SERVICE key at the main station, then obtain an incoming call on each exchange line in turn, and check that the incoming signal is received. Speak over the circuit and check that the line is released on cleardown.

49 Installation diagrams for HES No. 4 were previously drawn in the Q (L) series. When diagrams are reissued they will in future be in the Q series of diagrams, but no change will be made to the number.

Numerical and alphabetical indexes to the Q 500 series pertinent to HES No. 4 are given in dgms. Q 500 and Q 501. The following diagrams also apply:-

SA 9208 sheets 1 and 2 Typical Installation with one Non-multiple Station.

SA 9209 sheets 1 and 2 Typical Installation with Multiple Stations only.

References:- A 3113, A 3202, Q 1015, Q 3011
T.D. 2.3.3. INTERNAL WIRING, Stations, A 1018
POWER, General, S 1051
TESTS & INSPECTIONS, Routine, L 5106
TRANSMISSION, Telephone, B 3502, B 3567

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