HOUSE EXCHANGE SYSTEM NO. 3 (KEYMASTER)

Installation

1. Scope of Instruction. This Instruction describes the installation of the House Exchange System (H.E.S.) No. 3, to which has been given the sales name of 'Keymaster'. The facilities available in the H.E.S. No. 3 are described in Q 1011.

2. Contents.

3. Advice Notes. The Advice Note for a H.E.S. No. 3 (Keymaster) will specify the type of exchange line connexion and the number of multiple stations to be provided. The Advice Note will also specify whether a non-multiple extension is required and such miscellaneous requirements as extension bells and exchange line barring and/or monitoring.

4. Equipment required for C.B. manual and automatic areas. Table 1 shows the main items of equipment required for an installation.

TABLE 1

Item	Use	Quantity	Remarks
Telephone, Intercom., No. 3/1 (L or CB), Colour	Multiple station telephone	One per multiple station	No. 3/1L for use in automatic areas No. 3/1CB for use in C.B. manual areas. Dgm. Q(L) 422
Telephone No. 710 (L or CB), Colour	Non-multiple extension telephone		For additional items required see Dgm. Q(L) 420
Block, Terminal, No. 37A	At multiple stations, to terminate cable and Telephone Intercom., No. 3/1 (L or CB)	One per multiple station	
Relay-unit Q 405 (Note 1)	Common equipment	One per installation	Used at installations with multiple stations only. Dgm. Q(L) 405
Relay-unit Q 410 (Note 1)	Combined common equipment and non-multiple extension, speech and signalling equipment	One per installation	Used only at installations fitted with a non-multiple extension. Dgm. Q(L) 410 and Diagram Notes Q(L) 410
Power-unit No. 51A	Power supply for signalling, local speech etc.	One per installation	Supplies 1 amp maximum at 50V d.c. Dgms. N 636, Q(L) 403, 404, 435
Converter, Ringing, No. 7	To call non-multiple extension	One per installation if required	Only required when non-multiple extension is fitted. Converter is fitted inside Power-unit No. 51A. Dgms. N 654, Q(L) 403, 404 and 435
Relay-unit Q 415	Terminates circuit from remote switchboard or H.E.S.	One per circuit	Fitted in lieu of a multiple station. Adaptable for various signalling groups. Dgm. Q(L) 415
Relay-unit Q 408	To bar exchange service	One per station to be barred	Fitted inside telephone at each station to be optionally barred. Dgm. Q(L) 408
Relay-unit Q 409	Monitoring unit	One per installation if required	Fitted inside telephone which is to monitor exchange line. Dgm. Q(L) 409

NOTE:- Should an installation of multiple stations later require a non-multiple extension the Relay-unit Q 405 must be recovered and a Relay-unit Q 410 fitted.

5. Equipment required for L.B. 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 C.B. conditions to the House Exchange System.

In C.B.S. 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 will be fitted at the public exchange.

6. Power supply. The power supply is derived from a Power-unit No. 51A which is mains operated; POWER, General, S 1051 refers. A suitable mains connexion point is needed close to the position chosen for mounting the power-unit and relay-unit (see par. 22). The mains outlet must be a 3-pin B.S. 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. A copy of form A 188 should be given to the subscriber at each installation. The power-unit must be fitted near to the relay-unit (see par. 24) and multiple cabling must be kept to the minimum to prevent excessive voltage drop. A long flexible mains lead should not be fitted to connect to a distant mains point.

7. Exchange line limits. The telephone instruments used in the H.E.S. No. 3 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 T.E.R. to allow for the signalling relays in the exchange line; these reduced limits include the 2-wire line to the non-multiple extension (see TRANSMISSION, Telephone, B 3567).

8. Layout of the system. Dgm. Q(L) 402 shows the layout of typical systems. The maximum length of cable between the most distant multiple station and the power-unit should not normally exceed 100 yds. This ensures satisfactory operation of the signalling circuits. In many installations the multiple will contain spare conductors which may be bunched with the battery and earth wires to extend the multiple to 150 yds.

9. Unsuitable situations. Very damp or dusty situations are unsuitable for House Exchange Systems. If damp conditions are found locally during the installation of a system, the sites of the Block, Terminal, No. 37A and the power- and relay-units must be chosen to avoid them. The cables should preferably enter the terminal block from below; this will prevent moisture which may condense on cable sheaths from running into the block.

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 2-wire extension line to the non-multiple extension (whether internal or external) and the fitting of the non-multiple extension telephone should follow ordinary subscribers' installation practice. Dgm. Q(L) 420 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. The cabling for internal multiple stations should be in accordance with standard practice using Cable, P.V.C., No. 1, 21 Wire 6½ Grey. For external multiple stations the same cable will often be suitable but where heavier conductors or sheathing are necessary, an external type of cable may be used.

13. Numbering of stations. Stations should normally be numbered in sequence according to their position in the multiple cabling [see Dgm. Q(L) 403 and Q(L) 404]. If a non-multiple extension is provided it is always connected at the end of the multiple and becomes the last station.

14. Block, Terminal, No. 37A. Block, Terminal, No. 37A consists of a terminal strip screwed to a moulded base which has a moulded clip-on cover. 'Knock-outs' are provided in the base and cover for cable entry.

There are 25 terminal insets in the strip in two rows of ten terminals and a centre row of five terminals. Terminal screws are fitted on both upper and lower faces of the strip.

15. *Fitting.* The positions of Blocks, Terminal, No. 37A will be decided by the position of their associated intercom. telephones, and the two should be considered together so that they will be within the range of the standard 72 in. cords fitted to the telephones. Normally, terminal blocks are mounted directly on to walls or other permanent mounting surfaces, but never directly on floors. Where floor fixing is unavoidable, the block should be mounted on a Tablet, Polished Hardwood, No. 2 and care should be taken in siting the terminal block to minimize the dangers due to water, cleaners' equipment, movable furniture etc. Exceptionally, blocks may also be mounted on a Tablet, Polished Hardwood, No. 2 if it is considered that heavy condensation is likely to occur inside the terminal block when they are mounted normally or if the block is fitted in association with wall outlets of underfloor duct systems.

16. *Wiring.* Dgms. Q(L) 403 and Q(L) 404 show the terminal block wiring for typical installations. The cable-ends should be stripped and terminated in the standard manner to the screws on the underside of the terminal strip. Spare conductors should be tied back and not cut off. It may assist the installer if the terminal strip is reversed and secured to its base during the connexion of the multiple cables, but care must be taken to ensure that the cables are neither strained nor misplaced after the terminal strip has been turned over to its correct position.

NOTE:- There are five signalling wires in the cable, corresponding to the five stations; the line cord of the Telephone, Intercom., No. 3/1 has four signalling conductors and one buzzer conductor, each terminating on a particular terminal in the Block, Terminal, No. 37A. The cable terminal connexions will therefore differ on each block. The 'home' buzzer is always connected to terminal 11 of the terminal block serving the 'home' station, e.g. the wire on which station 2 is called appears on terminal 13 at stations 1, 3, 4 and 5 and on terminal 11 at station 2.

Attention is drawn to the straps to be fitted at the first or last stations. When the position of the cables in the terminal blocks has been decided, the 'knock-out' covering the appropriate cable entries in the cover should be carefully broken out using Pliers, Cutting, 5 in. Square Nose and the rough 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 Block, Terminal, No. 37A the multiple cables must be secured by cleating to the mounting surface at the point of entry to the Block, Terminal, No. 37A.

18. Fitting of Telephones, Intercom., No. 3/1. Telephones, Intercom., No. 3/1 is issued with a Cord, Instrument, No. 20/03AJ, ..., 72 in. fitted to it. The cord tails are fitted with spade terminals and at the terminal block end are arranged in two rows of ten. Each row of tags is spaced out to match the Block, Terminal, No. 37A terminal spacing and moulded into a strip of soft plastic.

To connect the instrument cord to the terminal block all the outer 20 terminal screws are withdrawn two complete turns. The spade terminals in their plastic strip are then pushed under the cupped washers so that the numbering on the plastic strip corresponds to that of the terminals in the block, and the screws are then tightened. Before replacing the cover, secure the cord grommet in the slot provided in the base. A Block, Terminal, No. 37A with cord and harness fitted is shown in Dgm. Q(L) 424.

19. Main station. One multiple station in each installation will be designated the 'main station'. At this station the strap between T16 and T17 in the telephone is removed to make the bell cut-off key ineffective and so ensure that the bell always rings on incoming exchange calls. The main station may also be required to control additional facilities including night service at the non-multiple extension; in these circumstances the BELL-OFF button must be changed for an appropriate Part .../DBU/341 [see Dgm. Q(L) 430].

20. Multiple stations. If in addition the bell at any other multiple station is required to signal all incoming exchange calls, the strap T16 and T17 must be removed (see par. 19). If the installation is connected to an exchange with a non-standard ringing supply (e.g. a vibrator), it may not be possible to ring more than two bells; bells at the remaining multiple stations should be permanently short-circuited by strapping terminals T16 and T4.

Telephones, Intercom., No. 3/1 are issued with station-calling buttons numbered 1-4. At installations with five stations the number plates on certain buttons must be reversed, to show the figure 5 which is provided at the back, in accordance with Dgm. Q(L) 424.

If the intercom. telephone is removed from a working multiple station, scries circuits must be maintained by strapping the terminals 1-6, 2-5, and 17-18 in the station terminal block.

21. Non-multiple extension. The Telephone No. 710 at the non-multiple extension must be fitted with two Switches No. 5A-4, a Thermistor No. 1A-1, Press-buttons 2/DBU/260, 3/DBU/260 and Plungers 1/DPL/378, 1/DPL/379. The press-button engraved EXCH is fitted in position B and that engraved EXTN in position C. A Switch No. 5A-4 and Part No. 1/DPL/379 are fitted in position B with the extension piece of the plunger facing position C. A Switch No. 5A-4 and Part No. 1/DPL/378 are fitted in position C; the pin of this plunger must engage with the slot in the other plunger. The latches must be arranged to lock plunger C but not plunger B; release of C is by the gravity switch.

Other stores items required and the connexions at the non-multiple extension are shown in Dgm. Q(L) 420.

22. Relay-units. Signalling and switching relays and the transmission bridge for the intercom. circuit are contained in wall-mounting units. Relay-unit Q 405 is required at installations with multiple stations only. Relay-units Q 410 replaces Relay-unit Q 405 at installations with a non-multiple extension. Relay-unit Q 405 may be connected to either end of the multiple but Relay-unit Q 410 must be connected after the last multiple station [see Dgms. Q(L) 403 and 404].

When a H.E.S. No. 3 system is to be connected by a private circuit to another subscriber's installation an additional unit, Relay-unit Q 415, may be required; the installation and operation of this unit will be described in a later Instruction.

23. Power-unit No. 51A and Converter, Ringing, No. 7. Dgms. N 636, N 654, Q(L) 403, 404 and 435 refer. The maximum d.c. supply required for a fully equipped H.E.S. No. 3 is approximately 750 mA at 47.6-50V. The d.c. supply is obtained from a mains-operated Power-unit No. 51A requiring a mains input of 200-250V a.c. 50 c/s; the loading due to the power unit is 40-90 watts. Power-unit No. 51A is described in POWER, General, S 1051.

When a H.E.S. No. 3 installation includes a non-multiple extension a 25 c/s ringing supply is required. This is obtained from a Converter, Ringing, No. 7 which is fixed to the base-plate of Power-unit No. 51A (see POWER, Machines & Switchboards, E 3004). A ringing converter will also be required in conjunction with Relay-unit Q 415 when generator signalling is used over a private circuit.

24. Mounting of relay-units and power-unit. To reduce cabling the relay-unit and power-unit should be mounted close to the end of the multiple on a suitable permanent surface. When deciding the mounting position consideration must be given to access for maintenance purposes. Due to the position of the power-unit cover fixing screws, a minimum clearance of 6 in. must be allowed between the lower edge of the cover and any horizontal surface beneath it. The relay-unit should be mounted wherever possible immediately above the power-unit, with space at the sides to allow full opening of the hinged panel in the relay-unit.

The units are each provided with a grommeted hole in the back plate for cable entry, and each unit has a terminal block fixed to the back plate for cable termination.

25. Earth connexion. An efficient earth connexion must be provided for the power plant and connected to the positive terminal of the 50V supply. The earth connexion should not be obtained from the mains supply earth lead or conduit but it may be taken from a main water pipe.

26. Cords. Telephones, Intercom., No. 3/1 are issued fitted with Cords, Instrument, No. 20/03AJ, ..., 72 in. The positions of stations should, wherever possible, be chosen to allow the use of the 72 in. cord. Exceptionally, cords 120 in. or 180 in. long, which are available on requisition, may be provided *in lieu* of the standard length (see Stations, A 3111).

27. Dial centre labels. At multiple stations in automatic areas, Labels Nos. 386A or 386B will normally be used. At the non-multiple extension in manual or automatic areas and at multiple stations in manual areas, Label No. 386E will normally be used (see Stations, A 3202).

28. Extension bells and buzzers. Separate or additional magneto bells may be connected to the exchange line ringing circuit or multiple stations, but the total number of bells which are to be rung must not exceed five. This may mean that one or more of the bells in Telephones, Intercom., No. 3/1 will have to be permanently short-circuited (see par. 20).

One extension magneto bell may be provided at the non-multiple extension in addition to the magneto bells provided at multiple stations.

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.

Dgm. Q(L) 419 shows how extension bells and buzzers are connected and Stations, A 3113 describes the bells and buzzers which may be used.

29. Testing. Each new installation should be checked for:-

(a) Continuity of multiple wiring

(b) Insulation

(c) Function of circuits.

30. *Multiple wiring continuity tests.* After completion of multiple wiring, but before connecting the power-unit, instruments or relay-unit, the continuity of the multiple between the first and the last multiple stations should be tested. At the last terminal block all terminals should be connected together temporarily.

At other terminal blocks (except the first) series-connected circuits must be completed by temporary connexions at each block: strap terminals 2 to 5, 1 to 6 and 17 to 18. From the first terminal block loop continuity tests should be made on each conductor in the multiple, using a dry cell and a Detector No. 4. Dgm. Q(L) 403 shows how the multiple is connected at each terminal block.

31. *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-unit, telephones and exchange line. 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.

32. *Tests at multiple stations.* Tests for the correct operation of the installation should be made as follows:-

(a) Make an outgoing call to the exchange from each station. Check that the intercom. engaged lamp glows on lifting the receiver and that when the EXCH button is pressed the exchange engaged lamp glows as the intercom. engaged lamp darkens.

(b) Obtain an incoming exchange call, check at each multiple station that the magneto bell rings, and that, except at the main station, the BELL OFF button when operated short-circuits the bell. Also check that the exchange line engaged lamp flashes in rhythm with the exchange ringing.

(c) Make an outgoing call to the exchange from station No. 1, then hold and transfer the call to station No. 2. Repeat the hold and transfer test at each of the remaining multiple stations. Check at each multiple station that the exchange engaged lamp flashes while the call is being held.

(d) At each multiple station signal and speak over the intercom. circuit to the other stations in turn, then together as a conference call. Check that the intercom. engaged lamp glows at each multiple station when the circuit is in use.

33. *Testing the non-multiple extension.* When a non-multiple extension is fitted the following tests should be made in addition to those in par. 32:-

(a) Call the main station. Confirm that the intercom. circuit engaged lamp glows when the non-multiple extension calls and continues to glow during conversation.

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

(c) Make an exchange 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.

(d) Operate the NIGHT SERVICE button at the main station, then obtain an incoming exchange call and check that the bell rings at the non-multiple extension.

(e) The 50V d.c. supply should be disconnected by switching off the mains input. Relay EX in Relay-unit Q 410 will release. Obtain an incoming exchange call and check that the non-multiple extension bell rings and that the call can be answered.

34. Other facilities. The installation of the following facilities will be described in a later Instruction:-

(a) Restricted and barred exchange service

(b) Exchange line monitoring

(c) Operator recall

(d) S.T.D. metering

(e) S.T.D. trunk barring

(f) Association with a P.B.X. or another H.E.S. installation.

References:- (S1/3)
Stations, A 3111, A 3113, A 3202, Q 1011
POWER, General, S 1051
" Machines & Switchboards, E 3004
TESTS & INSPECTIONS, Routine, L 5106
TRANSMISSION, Telephone, B 3502, B 3567

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