THE HOUSE EXCHANGE SYSTEM

CONTENTS

INTRODUCTION

This system provides facilities for direct intercommunication between a number of stations in the same building or block of buildings, and allows direct access from these stations to the public exchange with secrecy on exchange calls.

It is thus superior to a simple house telephone system in that direct access to an exchange line can be provided from each extension and, further, it is superior to a private manual branch exchange in that such access is obtained without the aid of an operator. It is suitable for installations which otherwise would be served by:-

(a) Private intercommunication systems (house telephones) supplemented by direct exchange lines.

(b) Private branch exchanges.

(c) Extension arrangements.

The system may be connected with any type of public exchange, a standard type of instrument being used at all internal stations and a standard type of unit fitted in addition to a telephone set at the main station. This unit is designed, however, to work on C.B. principles and an auxiliary unit is required to be fitted on the line termination at L.B. exchanges.

Multiple stations on a house exchange system are fitted with intercommunication telephones linked to the system by a multiple cable. Multiple stations are normally confined to a building or block of buildings.

One non-multiple station, usually an external extension, may be included in the system, and is fitted with a normal C.B. or auto handset telephone linked to the system by a 2-wire cable. Non-multiple stations have restricted facilities in comparison with a multiple station, but can be associated with normal C.B. extension plans.

Power is normally supplied from a power lead. Otherwise primary cells or secondary cells with a trickle-charger may be fitted at the subscriber's premises. The voltage limits are 18 and 28 and the maximum current required for a system with 2 exchange lines and 10 extensions is of the order of 1.3 amp.

FACILITIES

The following facilities are offered by the system:-

Local Intercommunication Calls

(a) Direct calling between all multiple stations (no secrecy).

(b) An engaged test is given if the called station is engaged on an exchange call.

(c) Direct calling of a non-multiple station from all multiple stations.

(d) A non-multiple station gains access to a multiple station by calling the main which then requests the station required to call the non-multiple station, i.e. the call is reverted.

(e) Establishment of conference calls, i.e. connexion between any number of stations on the system at one time.

Exchange Calls

(a) Direct connexion from any multiple station to the public exchange over any exchange line connected to the installation.

(b) Direct outgoing exchange calls may be barred to chosen stations which may, however, originate exchange calls via the main station.

(c) Connexion, via the main station, of a non-multiple station to the public exchange over any exchange line connected to the installation.

(d) Incoming exchange calls may be answered at any predetermined station. This station is known as the main station and is provided with special unit equipment. Arrangement can also be made for equipping any one of the multiple stations as a 2nd choice main station. On such installations, the functions of the 1st choice main station can be transferred to the 2nd choice main station when desired by the operation of a key, or keys fitted on the transfer unit at the 1st choice main station. As an alternative to the 2nd choice main station, any multiple station with full facilities may be equipped with an extension bell or bells to enable incoming exchange or external extension calls to be answered at this point.

(e) An incoming or originated exchange call may be transferred from any station to any other station without breaking down the exchange connexion.

(f) Any multiple station may hold an exchange call while making a call to any other station. (This call cannot be overheard by the outside subscriber).

(g) An audible engaged signal is given on pressing the exchange line button should the exchange line be in use. (The subscriber's own buzzer operates).

(h) Secrecy is given on exchange connexions. Monitoring facilities may, however, be allowed at the main or at any of the multiple stations if desired.

Night Service

The non-multiple station may be given night service facilities.

APPARATUS

The instruments used are:-

(a) Intercommunication telephones (for multiple stations)

(b) Transfer units (for 1st or 2nd choice main station)

Intercommunication Telephones

Figs. 1 and 2 show the two types of telephone set.

The mechanism is mounted on a metal base and is enclosed in a moulded bakelite cover having a cradle for a standard handset. The sloping top accommodates a set of interlocked plunger keys coloured as follows:-

(a) Exchange keys (red)
(b) Local keys (black)
(c) Conference key(green)

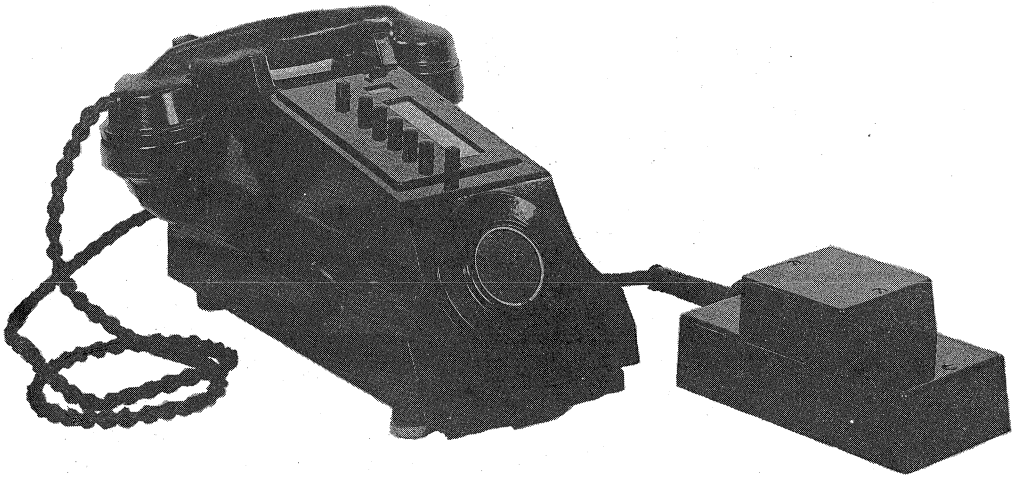

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Fig. 1. Intercommunication telephone with one exchange key, five local keys and a conference key.

The exchange keys have three positions of rest, viz. normal, intermediate, and fully operated. The latter is the calling and speaking position and the intermediate (hold) position is that to which the key automatically returns when a local key or the other exchange key is depressed. On the larger instrument, trigger keys are provided in order to enable one exchange key to be released while retaining the other in the intermediate position during the transfer of an exchange call.

The local keys have two positions of rest, normal and speaking. When fully depressed they are non-locking and the calling signal is given; when releases they restore to the speaking position.

The mechanical locking arrangement is such that depression of any one key restores any other that may have been operated. The conference key modifies this arrangement so that more than one local key can remain depressed at one time.

Replacement of the handset on the cradle restores all keys.

As will be seen from Fig. 2, P.O. Standard 600 type relays are used in the sets.

The normal capacity is one exchange line and five stations, or two exchange lines and ten stations. In each case one station may be non-multiple. This may be increased to a maximum of six and eleven stations respectively by using the home station local keys. The A and B wires of each local key are then cross-connected to the A and B wires of the additional station. This is done on each instrument strip in the junction boxes throughout the installation.

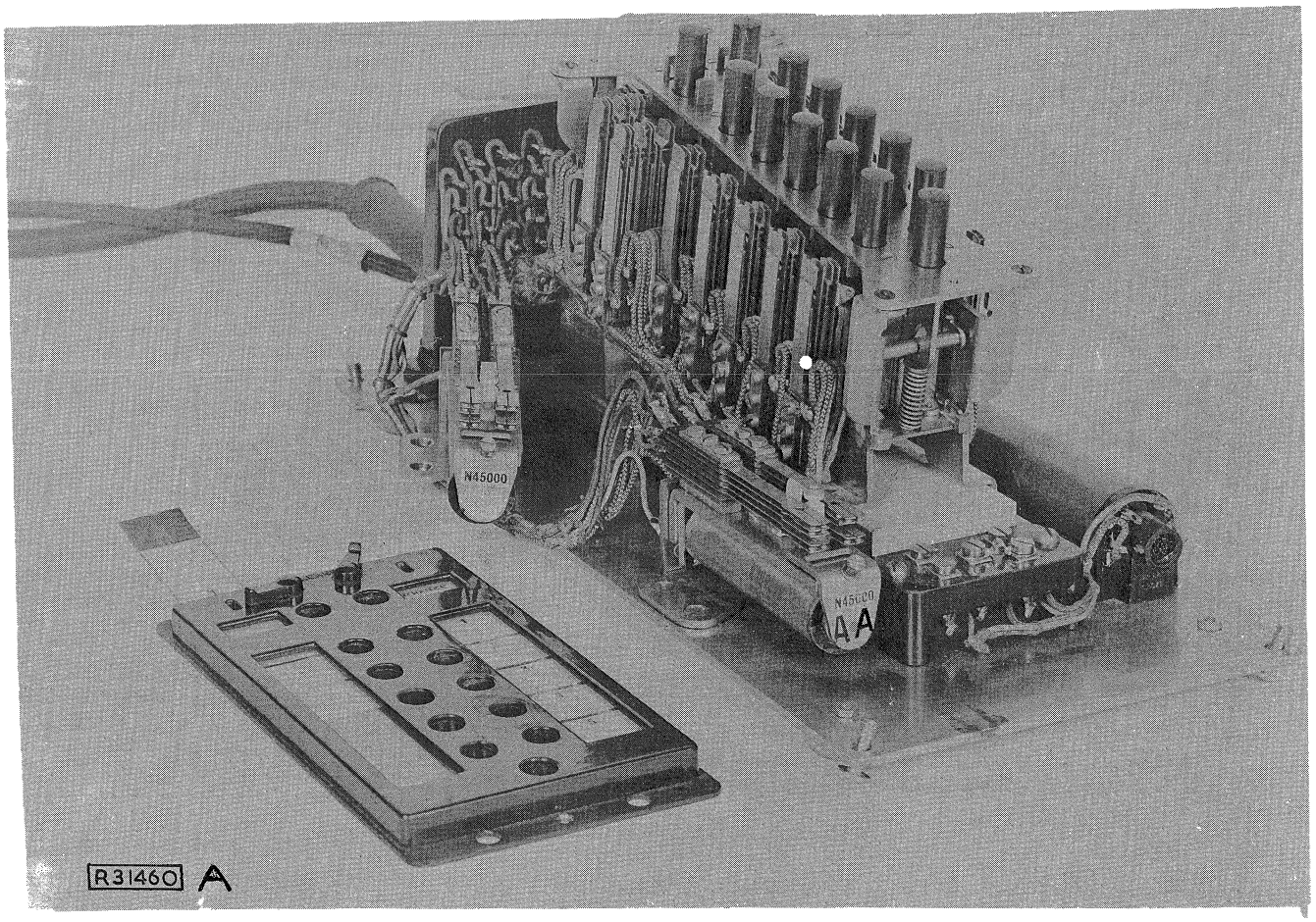

Fig. 2. Intercommunication telephone with two exchange keys, ten local keys and a conference key

Transfer Units

Equipment known as a transfer unit is required at the main station i.e. that station which handles exchange line traffic. The unit provides the apparatus which enables the extensions to ring the non-multiple station and enables the non-multiple station to call the main station and the exchange. Figs. 3 and 4 show such a unit. This particular unit accommodates eyeball indicators for one exchange line and one external extension together with a night service key, an alarm off key and an extension to exchange switching key.

Altogether there are four types of units - the type used being dependent on the capacity of the house exchange system, viz.

(a) For one exchange line without a non-multiple station.

(b) For one exchange line with one non-multiple station.

(c) For two exchange lines without a non-multiple station.

(d) For two exchange lines with one non-multiple station (fitted in addition to a unit as in (c) above).

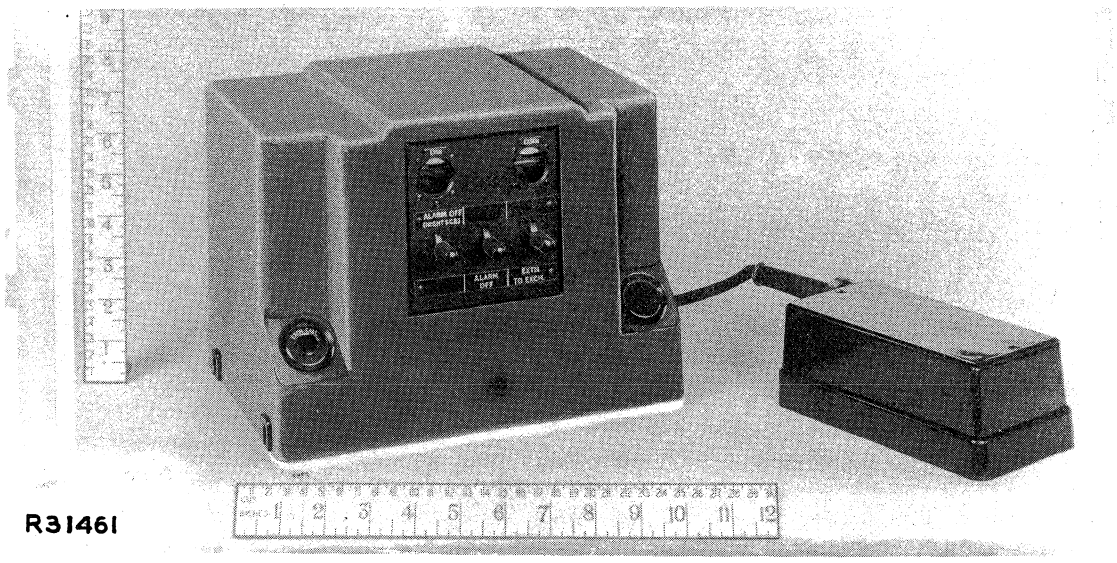

Fig. 3 Transfer Unit

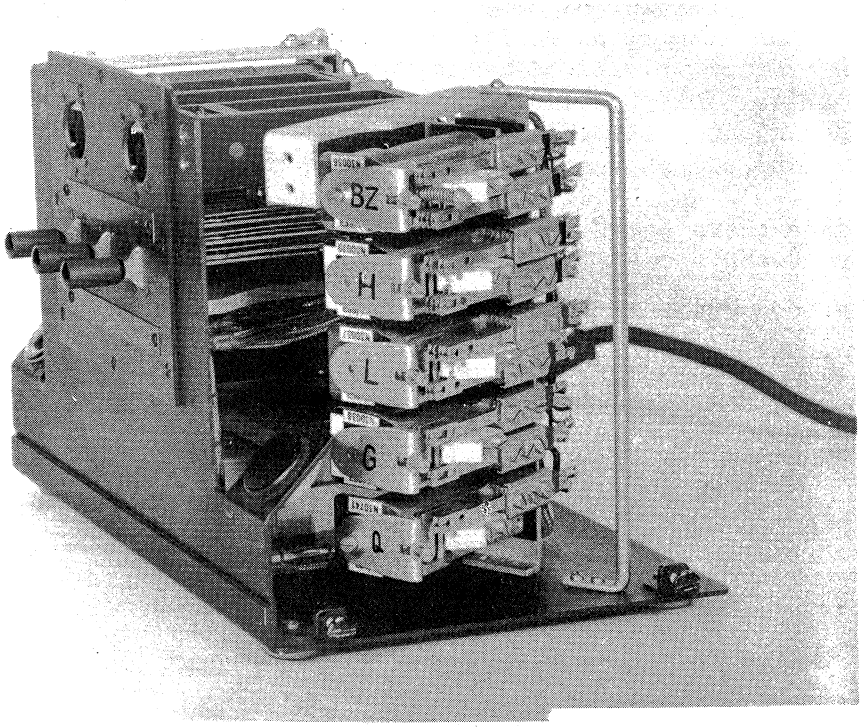

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Fig. 4 Transfer Unit, showing method of access to relays.

Junction Boxes

These are moulded in bakelite and incorporate four terminal strips. The terminal posts are drilled in order to accommodate cross-connexions of 18 S.W.G. tinned copper wire. They are provided in two sizes, having 30 or 48 terminals per strip.

Cabling

The cable used is P.V.C. No. 1, either 24-wire or 41-wire, having tinned copper conductors.

Layout

A typical schematic layout for a system with 1 exchange line, 5 multiple stations, 1 non-multiple station, and a second choice main station is shown in Fig. 5.

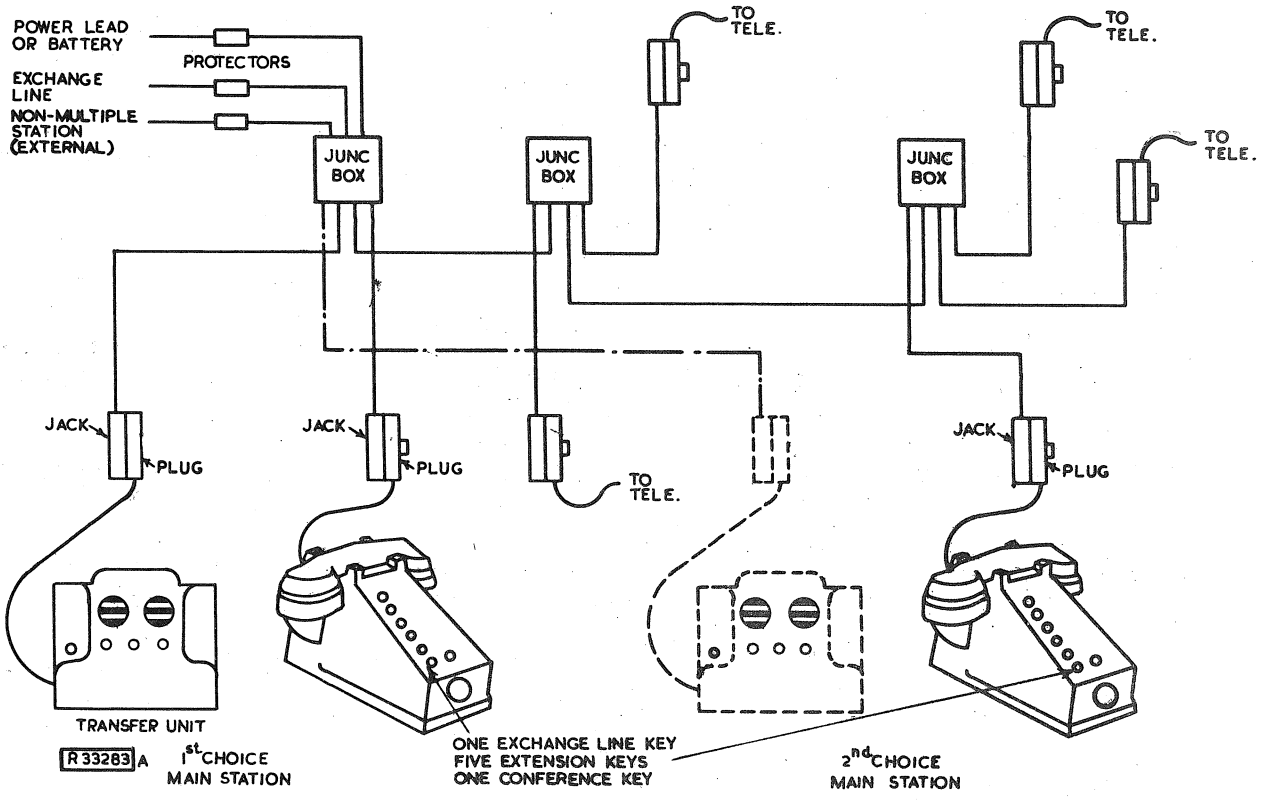

Fig. 5

Plugs and Jacks

Each intercommunication telephone and unit is terminated on a plug (one can be seen in Fig. 1). These plugs and the associated jacks are of a standard type so that any layout on which development is expected can be fitted with small capacity telephones initially and at a later date telephones of larger capacity can easily be substituted.

CIRCUIT OPERATION

The following circuit description is given for a house exchange system with one exchange line, five multiple (internal) stations and one non-multiple (external) station. Fig. 6 gives a diagram of a transfer unit and Fig. 7 shows the circuit elements of a telephone set fitted at any of the multiple stations.

Nomenclature

Intercommunication Telephone (Fig. 7)

Local keys	L	(e.g. 1L2 = No. 1 local key, spring-set No.2).
Exchange keys	X	(Spring-set operated when key fully depressed).
Hold springs	H	(Operated in intermediate position of exchange key. Remain operated when key fully depressed).
Common spring bank	CB	(Operated when a local key is fully depressed).
Cradle switch	HM	(Handset normally "ON").

Transfer Unit (Fig. 6)

Transfer key	T	(Operated when transferring all exchange and non-multiple calls to the second choice main station).
Extension to Exchange Key	X	(Operated when switching non-multiple station through to the exchange).
Alarm Off (Night Service) Key	NS	(Operated in conjunction with the "exchange to extension" key for night service).
Alarm Off key	CO	(Operated when it is required to disconnect the audible alarm associated with the indicators).

Incoming Exchange Calls

An incoming ring operates the indicator on the main station transfer unit (Fig. 6). The main station attendant answers by lifting the telephone handset and depressing the appropriate exchange key on the telephone set (Fig. 7) thus causing the operation of relay AA over the D wire to the G3 earth. AA holds via AA4 to the HM2 earth and at AA1 and AA3 connects the telephone circuit to the calling exchange line. AA2 extends earth over the C wire to operate relay G in the transfer unit. G3 removes earth from the D wire to prevent intrusion by another station. The earthed C wire also servis to complete a circuit for the operation of the buzzer at any station attempting to call the exchange on that exchange line.

When an incoming call is received for a multiple station, the main station ascertains the station required and then fully depresses the local key of the required station. This operation mechanically restores the exchange line key to the "hold" position, i.e. X springs restore and H springs remain operated. The exchange line is then held by the 600 ohm resistance coil connected via springs X1, the main telephone being disconnected from the exchange line by springs X1 and X2. The required station is called by an earth on the B line connected via springs L2, CB2 and HM2. When the pressure is released from the local key the main telephone is connected to the A and B wires of the required station via the L springs.

The called station is requested to "pick-up" the exchange line on which the call is being held, by operating the exchange line key. The buzzer at the called station then operates to the earth on the C wire from the main telephone. Buzzer tone is passed via the 0.4 ohm coil of the buzzer and the X3 springs to the main telephone via the A wire.

On receipt of the buzzer tone, the handset is replaced at the main station, restoring all the keys to normal. The removal of the earth from the C wire allows relay G to release, and contact G3 restores an earth to the D wire. This allows relay AA (at the called station) to operate and connect the telephone to the exchange line.

Outgoing Exchange Calls

Before making an exchange call, partial depression of the appropriate exchange key (with the handset on or off) connects the buzzer to the C wire via H1. If the line is busy the buzzer operates, and if it is free full depression of the key causes the telephone circuit to be connected at X1 and X2 while AA operates as before to the G3 earth.

For stations with restricted facilities (see page 2. Exchange calls, paragraph (b)) the AA relay is connected to the D1 wire instead of to the D wire. In this case AA cannot operate until the attendant at the main has depressed the "EXCHANGE CALL" button on the transfer unit.

On exchange calls, current from the main exchange excites the transmitter at the main or extension station.

Internal Calls

Full depression of the appropriate local key and removal of the handset causes the operation of the common spring bank and the local key springs, thus extending the HM2 earth via CB2 to the B line of the required station. At the required station the earth is received on the R wire and operates the buzzer.

If the called station was engaged on an internal call, the buzzer circuit would be broken at HM1 and the caller would merely break in on the conversation. If say, station 1 is engaged on an exchange call and another multiple station attempts to call him, an earth is extended over the B wire to the R wire, through spring set H3 (operated), to the common wire and thus operating the buzzer at the calling station via CB1. The operation of this buzzer serves as an engaged signal. Springs X2 and X3 isolate the telephone circuit of the engaged station to give secrecy.

On releasing the local key it returns to the hold position thus releasing the common spring bank and connecting the telephone circuit to the line at CB2. The called station answers by lifting the handset, thus breaking the buzzer circuit and connecting the telephone circuit to the line at HM1. Each station provides current via impedance RA for exciting its transmitter.

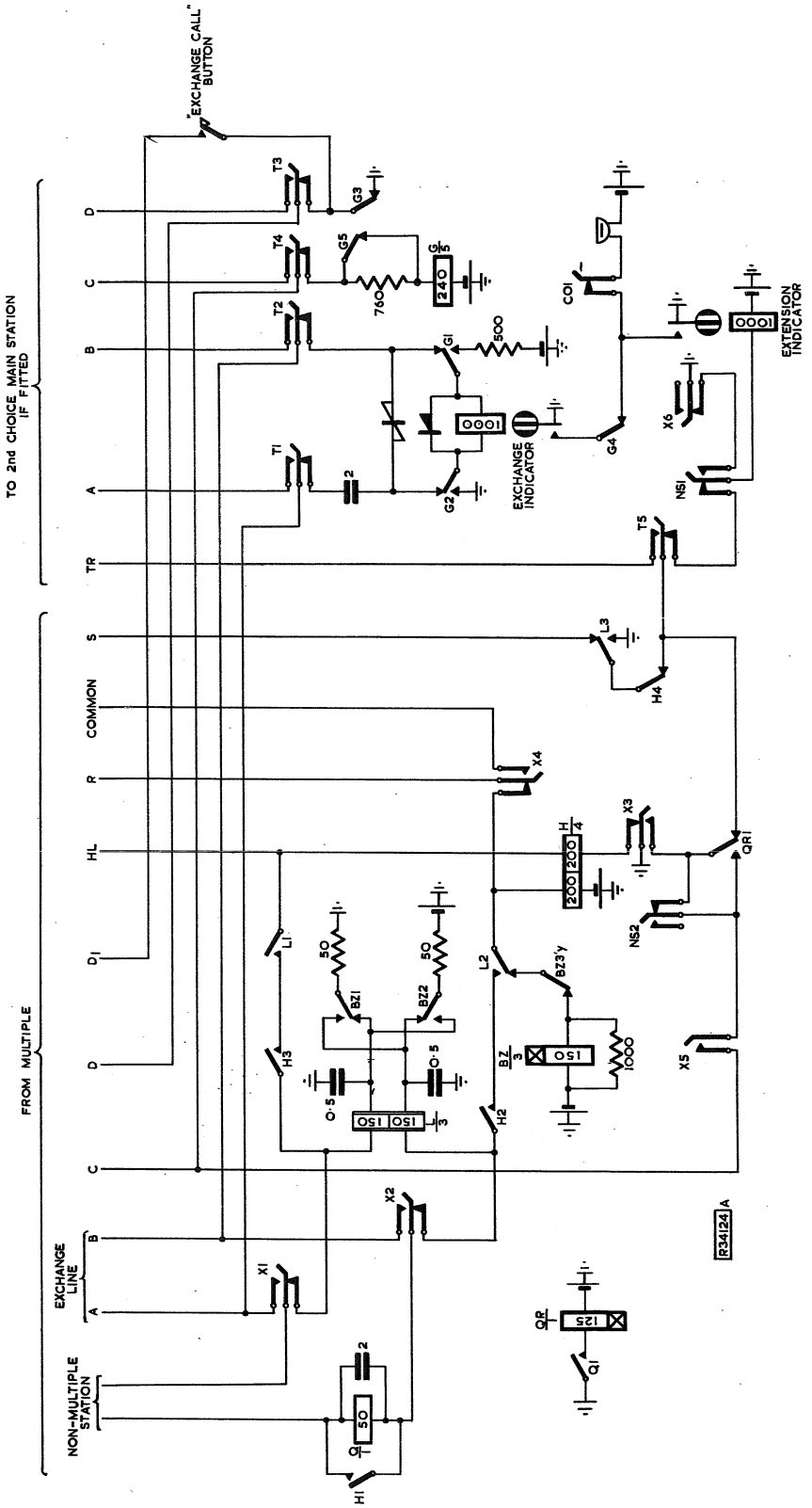

Fig. 6 Transfer Unit

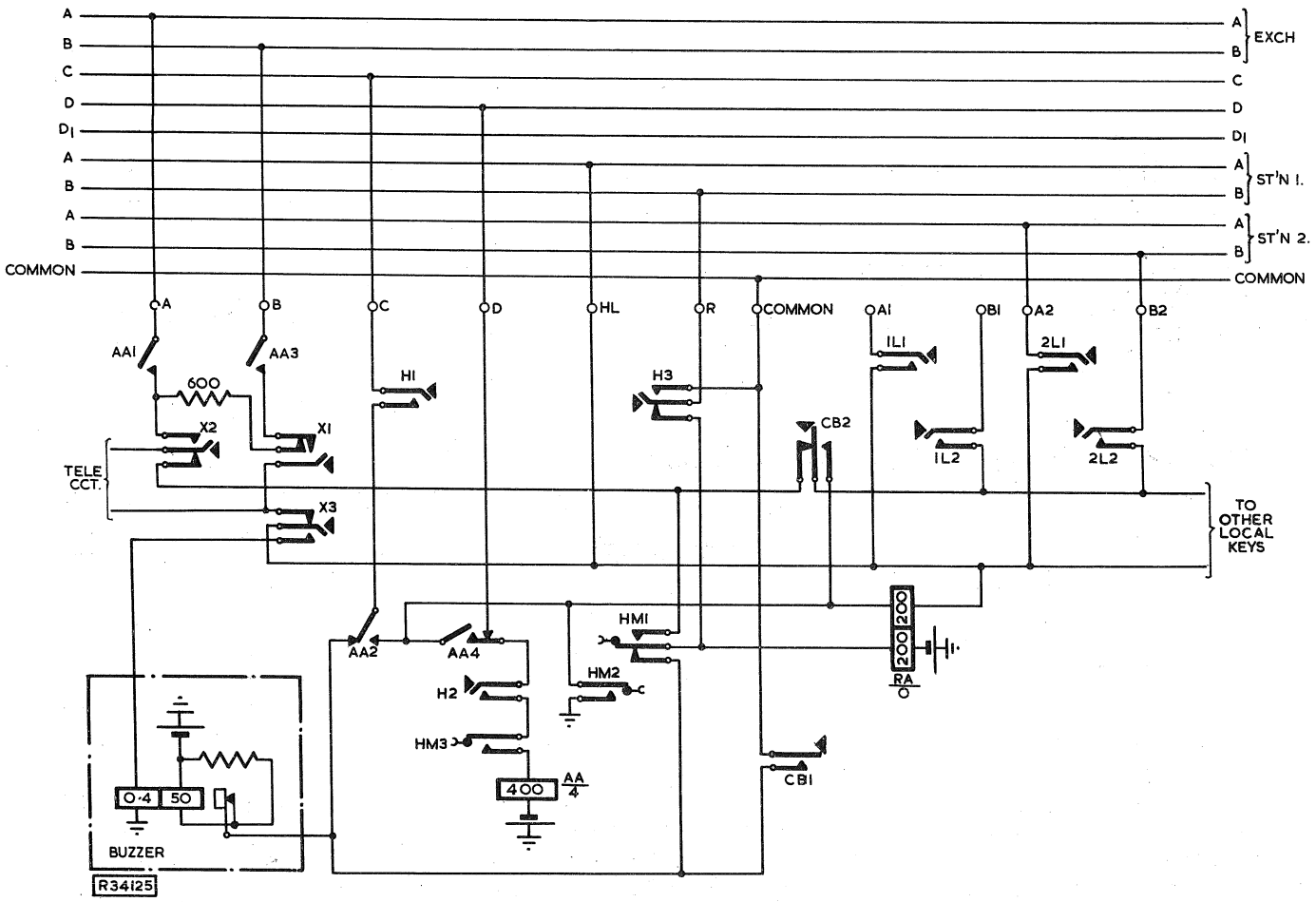

Fig. 7. Intercommunication telephone
(Wired as Extension No. 1)

Non-multiple Station Traffic

A normal C.B. telephone is provided at the non-multiple station and, when the handset of this telephone is lifted, a 'doll's eye' indicator, fitted on the transfer unit, is operated by the telephone loop. The call is answered by the main station attendant in the normal way. The non-multiple station can then be switched through to a free exchange line if required or the wanted multiple station can be advised to call the non-multiple station.

The non-multiple station is called from any other station in the normal manner - by depression of the appropriate local key. This causes ringing current to be connected to the line by the transfer unit. When the non-multiple station answers the ringing is 'tripped' and connexion is established between the two stations via the transfer unit.

Non-multiple station calling Multiple Station

The circuit element is shown in Fig. 8.

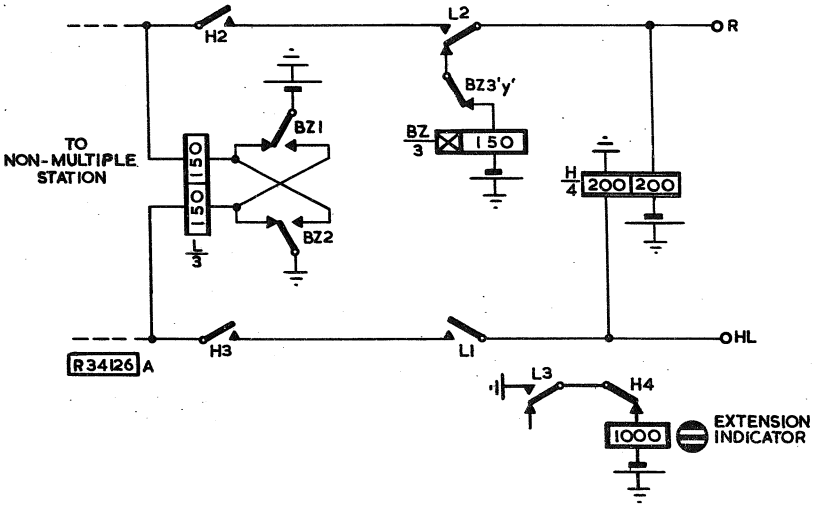

Fig. 8

When the handset at the non-multiple station is lifted, relay L on the transfer unit operates to the telephone loop, and contact L3 operates the extension dolls-eye indicator giving an audible alarm. Contacts L1 and L2 prepare for the extension of the calling line to the main instrument. The main station answers by removing his handset and depressing the local key corresponding to the non-multiple station number. The telephone loop of the main station is thereby connected to the A and B wires which are strapped to the R and HL wires of the transfer unit; this loop therefore operates relay H. Contacts H2 and H3 complete the circuit for the transmission bridge connecting the instruments at the non-multiple and main stations, thus enabling both parties to speak. Contact H4 disconnects the indicator circuit. If the non-multiple station requires a multiple station, then the main station attendant calls the required extension in the normal way and the called extension, upon answering, is requested to call the non-multiple station. The main station attendant then replaces his handset, thus releasing relay H in the transfer unit.

When the multiple extension (with his handset removed) fully depresses the appropriate key, an earth is extended to the R wire of the non-multiple station and re-operates relay H in the transfer unit at the main station. Contacts H2 and H3 complete the transmission bridge circuit, as before, and H4 disconnects the indicator circuit.

Multiple Station calling Non-multiple Station

When a multiple station wishes to call the non-multiple station, the depression of the appropriate key causes an earth to be extended over the R wire of the multiple cable to the transfer unit, to operate relay H, and relay BZ operates via L2 and BZ3. If the non-multiple station is free, relay BZ alternately operates and releases by breaking its own circuit at BZ3y. BZ1 and BZ2 reverse the earth and battery conditions to line. These reversals of potential across the bell cause the latter to ring. When the non-multiple station answers, the telephone loop operates relay L. Contact L2 disconnects relay BZ and, with contact L1, completes the transmission bridge circuit.

If the non-multiple station is engaged on an exchange call, the exchange key on the transfer unit will be operated and the R wire will be connected to the common wire at X4 (see Fig. 6). Hence, when a caller fully depresses the appropriate local button, the earth extended is returned over the common wire to operate his own buzzer via CB1. (see Fig. 7).

Non-multiple Station calling the Exchange

The circuit element is shown in Fig. 9.

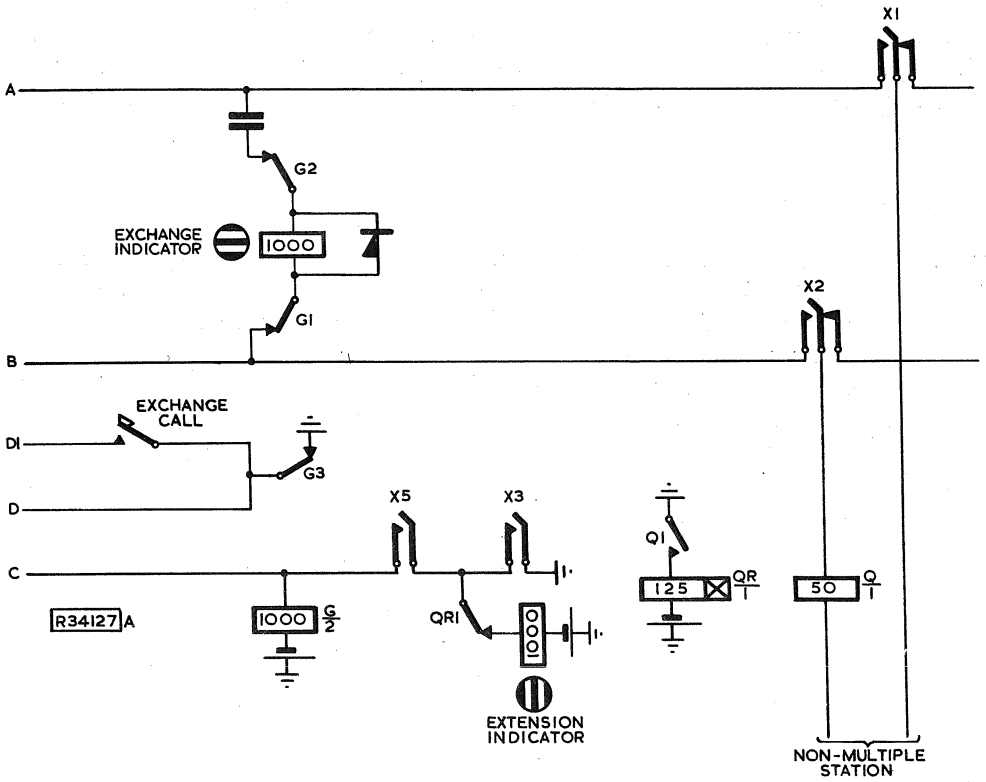

Fig. 9

The non-multiple station user, on lifting his handset, signals the main station in the manner described in the previous paragraphs. The main station attendant, having ascertained that an exchange call is required, proceeds to test the exchange line by depressing the exchange line key on the main instrument. If the line is free, it is switched to the non-multiple station by throwing the 'extension to exchange' key on the transfer unit. Contacts X3 and X5 operate relay G and, at the same time, apply an engaging earth to the C wire of the multiple. G3 prevents access to the exchange line by other parties. Contacts X1 and X2 extend the non-multiple station to the exchange. Relay Q operates to the extension loop and at Q1 operates relay QR. The latter relay is slugged and does not respond to the dialled pulses during the setting up of the call. At the end of the call, through-clearing from the non-multiple station is provided by relay QR which, at QR1, energizes the extension indicator and thus gives a clearing signal.

Incoming Exchange Call to Non-Multiple Station

The call is received at the main station, and the attendant calls the non-multiple station by depressing the appropriate local key, the exchange line being held meanwhile. Upon answering, the non-multiple station is advised that an exchange call is waiting, and the main station operator then throws the 'extension to exchange' key on the transfer unit.

Night Service

The non-multiple station may be permanently switched to the exchange line at night by the operation of the extension-to-exchange and night service keys on the transfer unit. Contacts NS1 and X6 prevent the operation of the extension indicator. Contact NS2 prevents the C wire of the multiple from being permanently earthed, thus allowing multiple stations to gain access to the exchange line when the non-multiple station is not using it.

Conference Facilities

Any multiple station may call and speak simultaneously to all or any number of other stations. If a conference is required, the stations which will participate are first called individually in the normal manner and advised to "hold on". When all required stations have been called, the conference button is depressed and each individual local station key is depressed for a second time. The mechanical arrangements are such that, when the conference button has been operated, it is possible for a number of local buttons to remain in the operated position simultaneously. They will all restore to normal when the handset of the calling station is replaced.

END