The G.E.C. Extension Telephone System.

THERE are many instances in which it is desirable for two, or even three, telephones to be associated with one exchange line; for example, in an office where an executive may at times require incoming calls to be answered by his secretary, who extends them to him when necessary, or in a shop, where most incoming calls are of a business nature, to be answered and dealt with in the shop, but are interspersed with private calls which, for convenience, require extension to the living quarters.

The apparatus offering this facility has, in the past, comprised a switching bell set operating in conjunction with a local dry battery and main and extension telephones. The switch from which the switching bell set derived its name established circuit conditions for (*a*) the usual bell in the main instrument to provide the calling signal from the exchange, (*b*) a bell in the switching bell set to respond to calls from a hand generator in the extension telephone, and (*c*) the bell in the latter to provide the calling signal for calls to the extension, whether from the hand generator of the switching bell set or from the exchange.

The arrangement gave all that was required and held favour for many years. In the light of modern ideas, however, it had several disadvantages, the appearance of the bell set was not distinguished by a shape which could lead to its retaining its place amongst subscribers' apparatus become decorative as well as useful, the main station apparatus which had to be readily accessible to the subscriber was in two separate assemblies, the bell set itself and the telephone instrument, and finally, the use of hand-generators on ordinary telephones was so much the exception, at least in Great Britain, that there developed a further tendency to regard this bell set as out of date.

The General Electric Company therefore designed a new extension telephone system. This employs a switching telephone, one or two extension telephones as desired, a primary battery of two cells and a separate bell associated with the switching telephone. Should additional calling signals be required at a distance from the telephones themselves, then extension bells may be employed. The arrangement is shown in Fig. 1. Normally, incoming calls are answered at the switching telephone. The call may require a question to be put to an extension, who may then be called whilst the exchange connexion is held, if

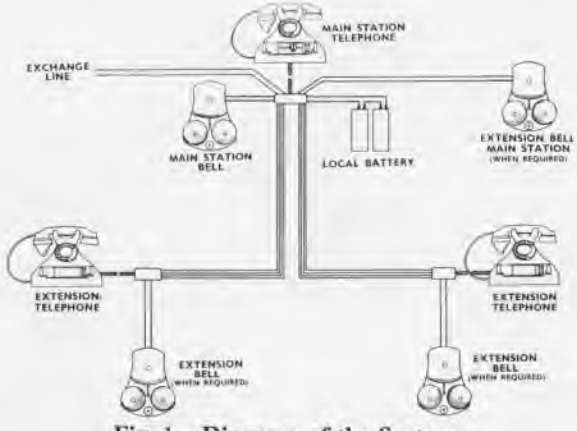

Fig. 1.—Diagram of the System.

Fig. 2.—Switching Telephone.

necessary, the exchange line may then be switched through to the extension. With the switch in the appropriate position, outgoing calls may be made from any instrument, and whether or not an exchange call be made, an extension may always call the switching telephone, and *vice versa*. Finally, at any time, the exchange line may be left switched through to the extension line or lines in order that incoming calls shall be answered and outgoing calls made independently of the switching instrument. It is not possible to leave the switch in a position such that a bell will not ring on an incoming call.

The system gives the facilities outlined and combines them with the convenience of a handset, the efficiency of a modern transmission circuit, and the pleasing appearance of high-quality bakelite mouldings.

Switching Telephone.

The extent to which convenience in use has been studied is evident in the design of the switching telephone (Fig. 2). Not only is it a telephone of the handset type (which surmounts a detachable base) but the four-position switch is built-in, as also are two pushes for the selective calling of the extension instruments. The switch positions have been arranged for maximum convenience, following a natural sequence in movement from the normal position. Through a transparent aperture in the base is displayed an "engaged" signal when conversation is held between exchange and extension. Thus in one assembly is included all the apparatus which the subscriber has to operate or observe.

Within the base is fitted a buzzer which, operated from the local battery, signals calls from an extension. With the bell for signalling calls from the exchange mounted separately, the base is able to be of a size and shape that make it the complement of the actual telephone mouldings.

Extension Telephone.

The extension telephone is seen in Fig. 4 to consist of the same mouldings as are used in the switching telephone. As the four-position switch and the signal relay are not,

Fig. 3.—Interior of Switching Telephone.

of course, fitted, there is space made available in the interior to permit the incorporation of the bell. With the buzzer also included, the extension telephone is completely self-contained. The push button for calling the main station is seen on the right-hand side of the base, and instructions as to its use are given on a label fitted across the front of the moulding.

Special Features.

The circuit employed in the two instruments is the British Post Office new standard, based on that of the Gecophone. It incorporates an induction coil which, whilst giving maximum suppression of sidetone, has a non-inductive winding shunted across the transmitter to regulate transmitter current and contribute to long service life without impairing transmission efficiency.

The cradle in the main station set and in both forms of extension set is of extremely robust construction whilst possessing a shape which conforms perfectly to the general contours of the telephone itself.

Fig. 4.—Extension Telephone.

Fig. 5.—Showing portion of ventilated cradle cut away.

It is of a design that is unique and gives a particular advantage when in service under tropical conditions. It fits in a manner that leaves an aperture between cradle lip and case, and thus, with a series of holes drilled in the top of the case (Fig. 5), a circulation of air is maintained through the sound outlet holes in the base, the interior of the instrument, holes and aperture. Condensation within the set is therefore minimised. A closely-coiled wire inside the cradle lip prevents ingress of insects or foreign matter, without obstructing the passage of air The sound outlet holes for the bell in the base of the extension instrument are covered with fine gauze with the same object of excluding insect life.

Internally, the choice of materials and the nature and quality of finishes contribute to long service life under even the most adverse climatic conditions.

For Manual Systems.

The dials are omitted when the instruments are required for use on C.B. manual systems, the apertures being filled by the

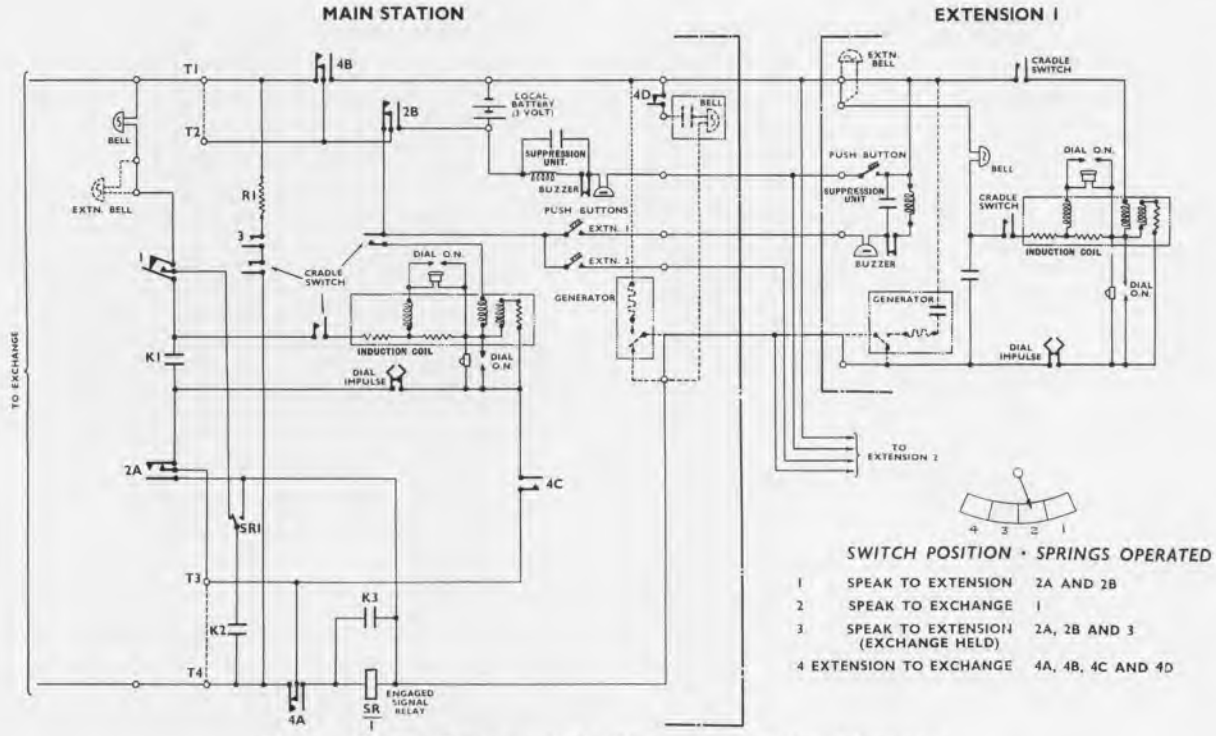

Fig. 6.—Circuit Diagram, Switching and Extension Telephones

usual dial dummies. Conversion for automatic systems is made simply by adding dials and connecting the dial cords to marked terminals from which straps are removed.

Circuit.

The circuit is given in Fig. 6, in which the extension switch is shown in normal position, that is, contacts 1 are operated. The bell is thus in series with condenser *K*1 and contacts 2*A* of the extension switch across the line. Should the switch be left in any position other than normal after a call, contacts 1 will be restored and the bell will be in series with normal contact *SR*1 and condenser *K*2, still across the line.

On a call to the extension with the switch in position 3, the exchange connexion is held over the loop formed by *R*1 in series with operated contacts 3 and operated contacts of the cradle switch.

The dial impulse springs are connected across the line, with condenser *K*1 and a resistance winding of the induction coil providing a spark-quench circuit during impulsing.

Relay *SR*, in series with the line, is held operated on an exchange-to-extension call —showing an engaged signal, as already mentioned—and adding the shunting effect of condenser *K*2 to that of *K*3 in order to provide a by-pass for speech currents. On the same call, contacts 4*C* are operated and apply a short circuit across the impulsing springs in order that inadvertent operation of the dial at the main station instrument shall not cause objectionable noise on the line.

Terminals *T*1 and *T*2, *T*3 and *T*4 are provided in the base of the main station instrument, straps between the two pairs enabling the main station subscriber to listen to conversations when the line is switched to the extension. Omission of the straps secures secrecy on calls between extension and exchange.

With contacts 2*B* operated, either extension telephone may be called by depression of the appropriate push button, the buzzer operating over a circuit from the local battery, calling wire and common return wire.

At the extension telephone, the circuit is virtually that of the standard Gecophone, with the addition of a buzzer and press button.

It will be seen from the diagram that a four-wire line connects the main instrument with an extension, the need for four wires arising as a result of the use of buzzers. In some instances, however, the line to an extension may run over a pole route, making the use of four wires a matter of importance on the grounds of cost of wire and associated line plant. The convenience of buzzer calling may then be sacrificed in favour of magneto calling with its attendant advantage of two line wires between main and extension. In that case a generator fitted in a separate box would be installed at the main station, together with a bell and condenser, whilst at the extension would be installed a generator and condenser The connections would be as shown in dotted lines.

Bell.

The bell used with the switching telephone, or as an extension bell for either or both instruments, is of the pattern described on page 25.