Pushbutton Extension Telephone Systems

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The G.E.C. are now producing a new range of telephone instruments for use in its extension telephone systems. These have the same attractive appearance and high standard of performance as the "New Gecophone" The only action necessary in the operation of the system is the simple depressing of the appropriate pushbutton. At the switching telephone (or main-station instrument), the pushbuttons are mounted in a plinth, which fastens to the underside of the standard "New Gecophone" and is connected to it by leads passing up through the base. In the extension instruments, the necessary pushbuttons are fitted in the case of the "New Gecophone" itself.

The telephones were designed by the G.E.C. in conjunction with the British Post Office, and are the only telephones now accepted by the B.P.O. giving full Plan 5 and Plan 7 facilities.

The G.E.C. Extension Telephone System is well-known and widely used as a means of connecting any one of three telephones to one exchange line in such a way that each telephone can be connected independently to the exchange line. In addition, the telephones form a private intercommunication system in which calls can be made between the telephones, independent of the exchange.

In the previous telephones used in this system, the switching from one telephone to another was performed by a four-position switch in the bell set at the base of the instrument, and pushbuttons were provided to call the extension telephones. The previous extension telephones themselves were also fitted with the bell-set base, but only had pushbuttons to call the main and not a four-position switch.

The switching operations that were controlled by the four-position switch in the earlier models, are now performed by four pushbuttons, which, together with the other necessary equipment, are contained in the plinth, fixed to the base of the "New Gecophone"

The plinth, with its attractive lines blending pleasingly with the main telephone, is specially designed for use with this instrument and has been approved by the Council of Industrial Design. The rectangular push-buttons are located conveniently at the front of the telephone below the dial. The plinths are available in two-tone grey , production in one or two other colours is under consideration. In a two-tone telephone, the body is the same colour as the handset and the push-buttons are the same colour as the case.

Fig. 1.—Switching telephone.

Fig. 2.—Extension telephones.

In the extension telephones, the necessary push-buttons are housed in the cases of the instruments themselves , a plinth is not required.

Features

Calls from the exchange can be answered at any telephone. Normally they are answered at the main telephone and transferred to either of the extension telephones when required.

Outgoing calls can be made from any telephone, as required.

Calls between the main telephone and the exchange are secret from the extension , calls between an extension and the exchange can be secret or non-secret from the main, as desired.

Intercommunication calls between the main and an extension are secret from the exchange, and can be made while an exchange call is held.

It can be arranged that an incoming call from the exchange is signalled at the extension. In this case, the bells can also be rung at the main and at the second extension, when fitted.

Where a number of wires can be run between the main and extension telephones, the system should be connected as an internal installation, but when only two wires are available, such as overhead line or underground cable, the system should be connected as an external installation. Two extensions may be fitted for both internal and external installations.

Signalling between the main and extension or between two extensions is by d.c. buzzer for internal installations. In an external installation, where the signalling is over the two line wires, the main is provided with a 20c/s transistorised ringing converter, which supplies the a.c. to ring the bell at the extension. No a.c. generator, however, is required at the extension as in previous systems, because the extension calls the main by extending an earth over one line wire which causes a relay to operate and sound the main's buzzer.

The system gives the same service as the "New Gecophone" on an exchange connexion. This means that on a 50-volt 200/200-ohm exchange the loop resistance of the line from the exchange to extension can be up to 1000 ohms. Where the exchange line to the main is short, the line to either external extension from the main can be long, up to 1000 ohms. To enable the engaged lamp indicator to operate over this increased line range, a transistor switch has been incorporated. The system can also be connected to other types of telephone exchange.

The system can be used on either automatic or C.B. manual exchanges, on either exclusive or shared-service lines for internal systems and on exclusive lines for external systems.

No modifications are required to apparatus at the exchange.

Equipment

The equipment required for a complete extension telephone system is a main (switching) telephone, one or two extension telephones, as required, and a 12-volt d.c. power supply. If the extensions are external to the building in which the main telephone is installed, an a.c. ringing generator is also required. This is a compact transistorised device contained in a small case that can mount conveniently alongside the terminal block.

Main (Switching) Telephone

The main telephone consists essentially of a "New Gecophone" instrument mounted on a plinth. This contains the necessary keys and apparatus for the operation of the system. There are six keys altogether , four of these are plainly marked "Speak to Exchange", "Speak to Extension—Exchange Held", "Extension to Exchange" and "Release" The first three are locking keys, while the "Release" key is non-locking and simply serves to release any of the locking keys at the end of a call. The other two keys are for calling the extensions. The operation of the various keys will be discussed in detail later in the article.

A red panel behind the "Exchange Held" key is illuminated when the exchange is in the held condition and an illuminated amber panel behind the "Extension to Exchange" key indicates that the extension has engaged the exchange line.

An 18-way cord connects the plinth to a terminal block, and fly-leads pass up through the plinth to the main telephone above. In the telephone an additional cradle-switch springset and capacitor is fitted. A push-button is also fitted in the telephone case when shared-service or recall working is required.

Extension Telephones

The extension telephones are also of the "New Gecophone" design. If the extensions are internal, an adaptor panel containing a d.c. buzzer for signalling from the main is fitted. Up to four pushbuttons may be fitted in the telephone instrument. One of these is always fitted to provide calling to the main telephone. The remainder provide additional facilities such as direct calling between extensions, executive right-of-way, and recall or shared service, when required.

If the extensions are external, the buzzer is not needed as a.c. signalling is used, and only one pushbutton is required. This is used for calling the main.

Power Supply

A 12-volt d.c. power supply is required to provide the main to extension speaking current, the current for the warning lamps, the supply to the transistor switch and to the ringing converter. A small power unit for connexion to the a.c. mains has been designed for this purpose, or, alternatively, dry cells can be used if required.

A.C. Converter Unit

When the lines from the main to the extensions are restricted to one pair (usually an external extension), a ringing converter unit is connected to the terminal block. This contains a 20c/s transistorised ringing converter powered by the 12-volt d.c. supply and a relay.

Fig. 3.—A.C. converter unit with cover removed.

Fig. 4.—Internal view of plinth.

Operation

The operation of the system is by depression of the appropriate pushbutton. The operation of these keys is the same for both internal and external installations, but the circuit arrangements are somewhat different, the change from one to the other being effected by a movement of straps on the plinth terminals.

Fig. 5 shows the complete circuitry of the switching telephone.

When all keys are normal, the main telephone is connected to the extension lines under the control of the cradle-switch, but the main bell is connected to the exchange line so that incoming calls from the exchange will always be received by the main even if engaged in conversation with an extension. Whenever conversation takes place between extension and main or extension and exchange, the line current flowing through the transistor switch VT1, VT2 causes relay A to operate. The contacts of relay A prepare the circuit for the operation of the push keys. The back-to-back arrangement of the transistors is to allow for the reversal of the exchange-line current.

Speak to Exchange

To answer or call the exchange from the main, the "Speak to Exchange" key is pressed to the locked position. This operates the KX springs thereby transferring the main telephone to the exchange line where it functions as an ordinary independent telephone, any conversation being completely secret from the extension (Fig. 6). When the main telephone is engaged on an exchange call, it can still be called by an extension, as explained later Incoming calls from the exchange ring the bell at the main only. At the end of the call the key is restored to normal by pressing the non-locking "Release" key.

Speak to Extension—Exchange Held

When the main desires to confer with the extension during an exchange call, the "Speak to Extension—Exchange Held" key is pressed. This operation causes the "Speak to Exchange" key to be released from its locking mechanism and return to normal, thus releasing the main telephone from the exchange line and restoring it to the extension lines, i.e., the normal condition.

The pressed "Speak to Extension—Exchange Held" key locks down and, via its springs KH1 and the cradle switch contacts, connects a holding resistance of 300 ohms (R3) across the exchange lines (Figs. 9 and 10).

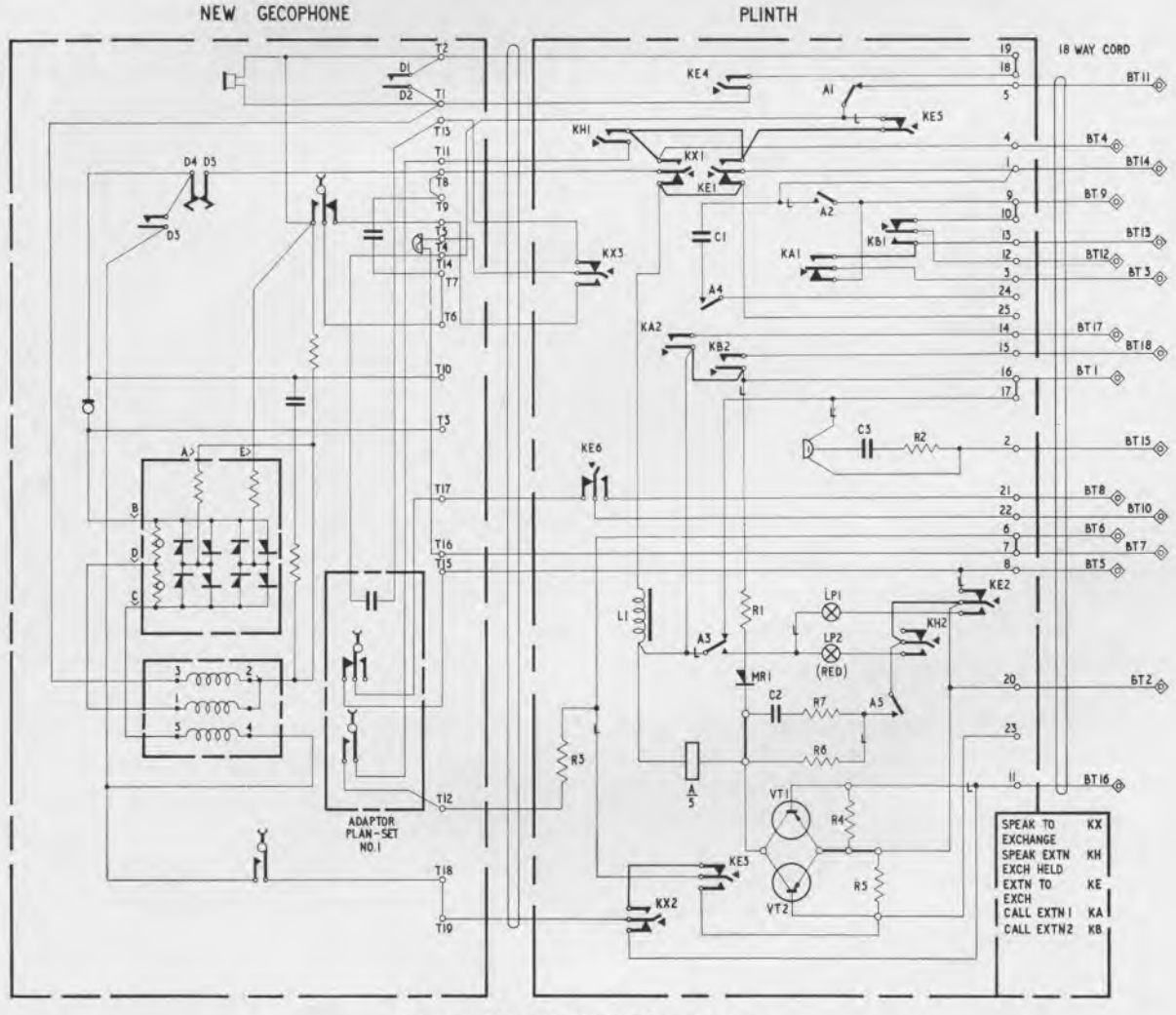

Fig. 5.—Circuit of switching telephone.

The main calls the wanted extension by pressing the appropriate ring key, thereby operating the extension buzzer or bell via springs KA1 or KB1. Contacts KH2 connect a lamp to the battery, via relay contacts A3, and for the duration of the conversation between main and extension the lamp illuminates the red panel behind the "Hold" key (Fig. 5). At the end of the internal conversation, the main telephone can be re-connected to the exchange line by again pressing the "Speak to Exchange" pushbutton. Alternatively, the exchange call can be switched through to the extension by pressing the "Extension to Exchange" pushbutton, thereby releasing the "Hold" key.

On an internal installation (Fig. 7), the operation of the "Extension to Exchange" key connects the main and extension bells in series, hence there is no danger of falsely operating the ring-trip relay at the exchange or of causing bell-tinkle during dialling.

When the extensions are connected externally over two wires, the bells will be in parallel (Fig. 8), so in order to prevent bell-tinkle when the extension dials the exchange, the main bell is removed from the line by the operation of relay A at contacts A1 When two external extensions are fitted, thermistors must be connected in series with the bells of these telephones to prevent bell-tinkle.

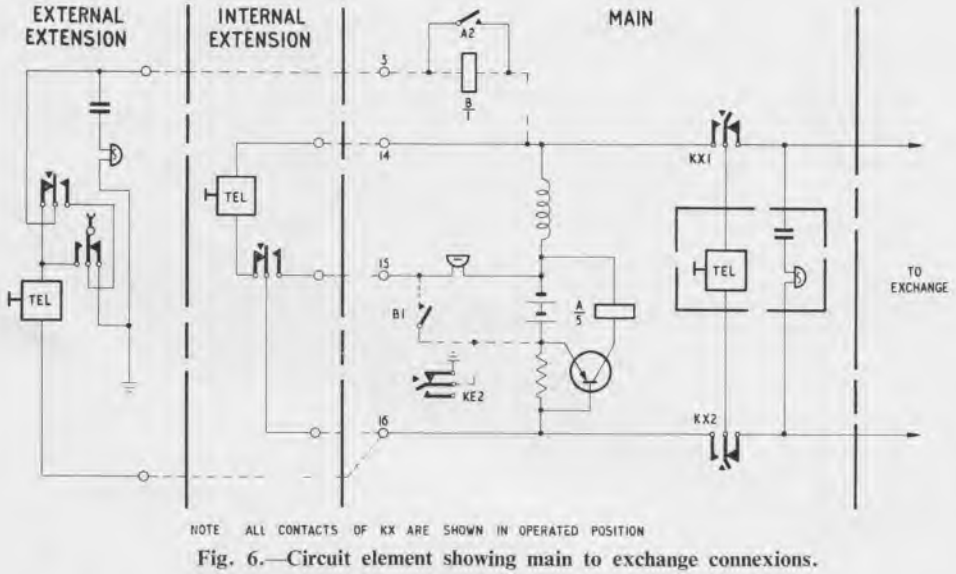

Fig. 6.—Circuit element showing main to exchange connexions.

Extension to Exchange

When this key is operated, the extension telephones are connected to the exchange line by the operation of the KE1 and KE3 contacts. If the key is left in the operated position, the extension can make calls to the exchange in the usual manner by lifting the handset and dialling the required number. During the period when the exchange line is being engaged by the extension an amber panel behind the "Extension to Exchange" key is illuminated via contacts KE2 and relay contacts A3 (Fig. 7 and 8). On completion of the call when the extension restores the handset, relay A falls and the lamp is extinguished. Incoming calls from the exchange are then normally signalled at both the extensions and the main but, if required, only the extension bell will ring.

The main and extension bells must be rung via one line to earth. Further, as no more than two bells should be rung in parallel for fear of ring-trip, the main bell should then be strapped out at terminals 4-5. An indication of an incoming exchange to extension call can then be made at the main by connecting the rectifier across relay B, housed in the ringing converter unit. This will make relay B operate in sympathy with the ringing cadences, thereby causing the main buzzer to sound via contacts B1 and so give the main an indication of the call.

When the lamp is extinguished after an extension to exchange call the main may restore the key to normal by pressing the "Release" key.

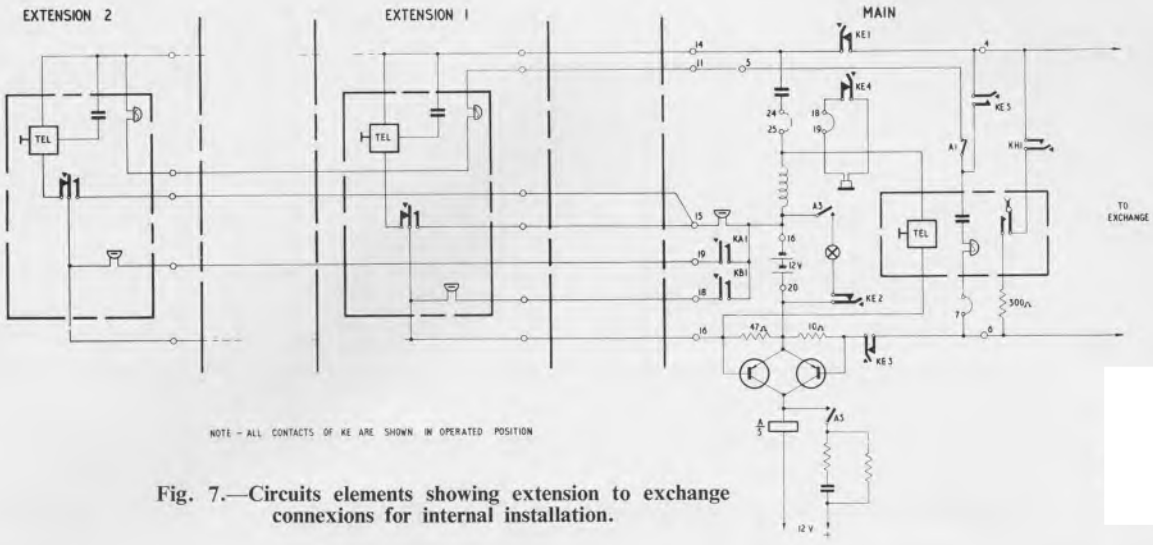

Fig. 7.—Circuits elements showing extension to exchange connexions for internal installation.

The equipment is normally arranged for the conversation between extension and exchange to be secret, but if strap 18-19 be removed and 24-25 added, the main can take part as a third party in the call.

Main to Extension

Either of the two extensions can be called from the main telephone by pressing the appropriate ring push-button to operate either the KA1 or KB1 contacts. Similarly, either extension can call the main telephone. By lifting their handsets, the main and extension telephones are connected for speech , no further push-button operation is required. The two extensions and the main are in parallel when talking to each other on a common choke-feed battery supply.

The calling conditions for an external installation are different from those on internal installations due to the fact that only two wires are available from the main to each extension. Internal extensions are called by buzzer from the main battery, via contacts KA1 and

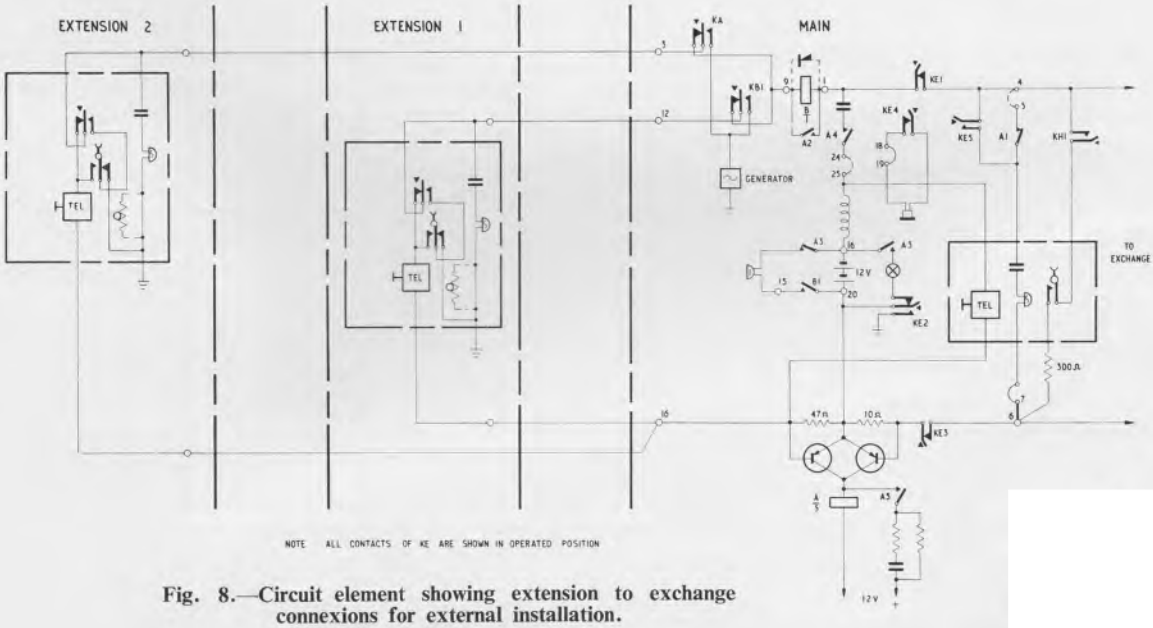

Fig. 8.—Circuit element showing extension to exchange connexions for external installation.

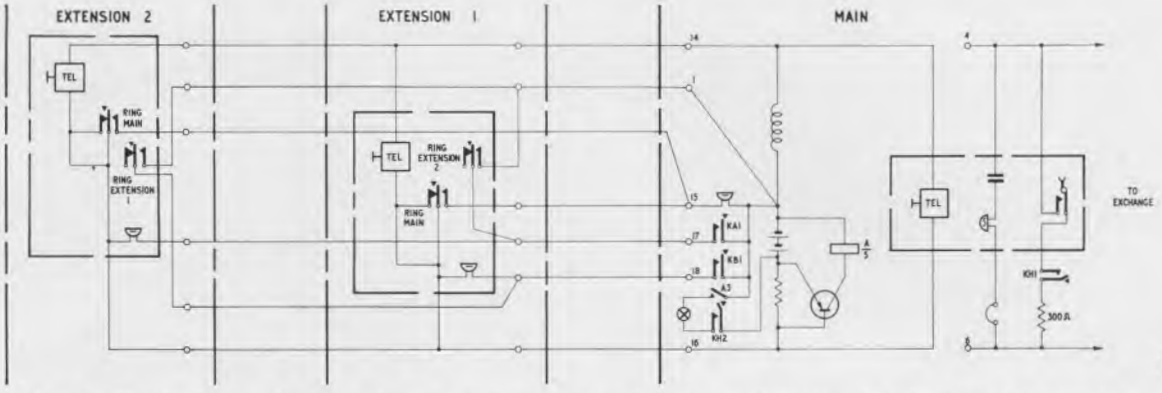

Fig. 9.—Circuit element showing main to extension and extension to extension connexions for internal installation.

KB1 (Fig. 5) and the main's buzzer is operated by either extension call key.

External extensions are called by their normal bells which are rung by a 20c/s a.c. supply from a transistorised ringing converter (Fig. 10). This unit is only fitted when the installation is for external extensions. The generator receives its battery supply via contacts KA2 or KB2 of the ring key and contacts KA1 or KB1 apply the 20c/s a.c. to the wanted extension line.

Extension to Main

When the extensions are internal they call the main by applying battery to the main buzzer over separate wires (Fig. 9). This allows the main to be called under all conditions such as when the extension is switched through to the exchange or the extension wishes to recall the main during an exchange call.

As external extensions only have two line wires, an alternative calling method is required. Housed in the generator case fitted at the main terminal block, is an additional relay B (Fig. 10), which is connected in series with either extension line.

This relay is normally short-circuited by the transistor-switch-relay A, but when the extension ring pushbutton is pressed, an earth is connected to the B line which causes relay A to fall and relay B to operate to the line current. This causes the main buzzer to sound, via relay contacts B1. On external extensions the call pushbutton must be pressed before lifting the handset.

When the extension is left connected to the exchange, the supply from exchange battery must be the right way round so that current will flow from the ring-key earth through the B relay, hence the B line of the switching telephone must always be connected to the B line from

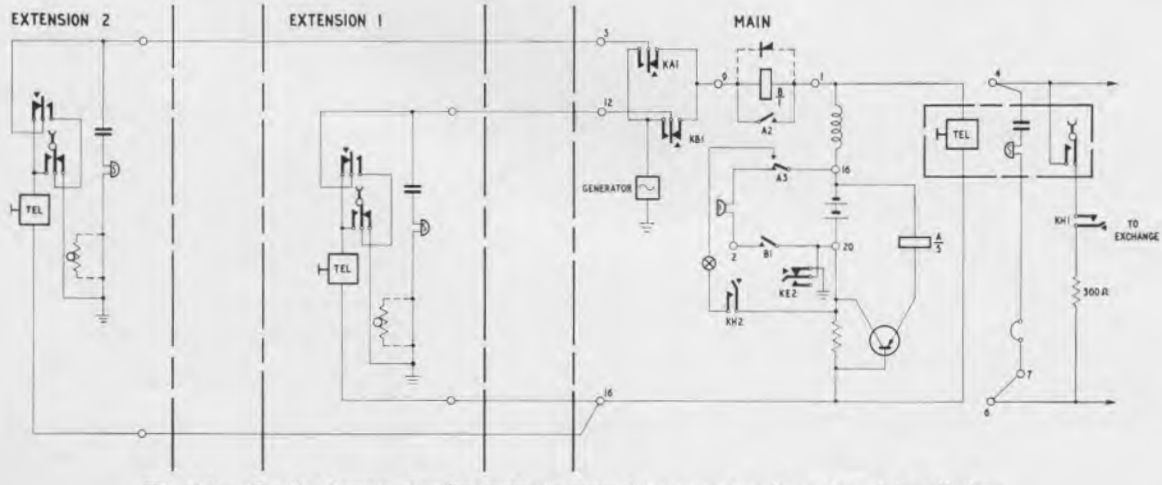

Fig. 10.—Circuit element showing main to extension connexion for external installations.

the exchange. The advantage of this system for external extensions is that no additional power supply is required at the extension positions. In the previous systems, hand-generators were used.

Extension to Extension

On internal installations, fitting an additional key to the extension telephones provides the extensions with the facility of calling each other direct.

An external extension, however, must ask the main to call the other extension, then the two extensions can talk independently of the main.

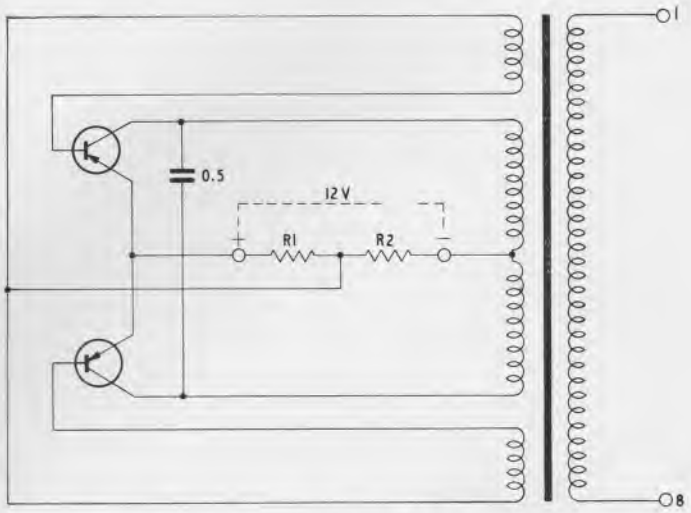

Fig. 11.—Simplified circuit of a.c. convertor unit.

Shared-Service

This facility can be provided on an internal installation by fitting a shared-service key to each telephone and a thermistor between the series ringers and earth.

Recall the Main

An internal extension can recall the main during an exchange call. This facility is not provided on external extensions because the line has to be broken to call the main and, on exchanges that give a battery reversal, an extension to exchange call would be lost. This is prevented by routing the call key through an additional cradle switch springset as in Figs. 8 and 10.

Private Exchanges—Recall

By fitting an additional key at each telephone, recall to a private exchange can be provided in the same manner as with the "New Gecophone" Facilities are also provided in the switching telephone, via key springs E6 and cradle switch, to transfer a P.M.B.X. recall facility to the extension.

Ringing Current Supply

When the extension is an external installation, a ringing generator is supplied to provide the 20c/s a.c. ringing current to ring the normal telephone bell. The generator is a transistorised d.c./a.c. converter of the self-driven push-pull, saturating-core type.

The generator has a high open-circuit voltage to provide a quick initial heating to the thermistors fitted in series with the bells when two external extensions are used. It will ring up to four bells in series with a 1·84μF capacitor. The converter is shown in Fig. 3, where it will be seen to consist of a five-winding coil, two transistors, two resistors and a capacitor assembled to occupy a minimum of space.

When the battery is connected, the resistance network formed by R1 and R2 (Fig. 11) applies a small forward bias to the transistors and brings them into a starting condition. At the same time, transient voltages, which tend to turn one transistor on and the other off, are induced in the base winding.

The switch-on action continues until the saturation condition is reached when, with no increase in the primary current, no feedback current is induced into the base bias winding, hence that transistor switches off. The consequent collapse of the magnetic field in the coil switches on the other transistor, the process being repeated at a frequency dependent on the design of the coil, and an alternating current is generated.