

A Loudspeaking Telephone for Private Automatic Systems.

THE immense value of a private telephone system is fully appreciated by all progressive business houses of whatever size or type, this indispensable aid to efficiency being found in all up-to-date offices, factories and warehouses. Excellent as is the service given by a modern telephone system however, it is possible to render it still more attractive by special consideration of the requirements of persons holding executive positions. Conversation by means of the standard type of instrument, even of the modern handcombination pattern, involves the use of at least one hand and, further, imposes very definite limitations on movement about the office. Consequently, access to files, records and papers necessitates temporary cessation of conversation, resumption being possible only on returning to the instrument. In addition, since only one hand is free, papers etc., cannot easily be arranged for examination and notes made during conversation. These limitations of movement assume considerable importance in the case of a busy executive and it is obvious that their removal will appreciably increase the value and convenience of the telephone system.

All these difficulties are overcome by employing the loudspeaking telephone set developed by The General Electric Company. This consists of a moving-coil loudspeaker, a valve amplifier unit and a telephone of the

Gecophone pattern incorporating a microphone. Before describing the apparatus the features of this loudspeaking set are given below —

- (1) Gives complete freedom of movement about the office whilst conversation is in progress.
- (2) Merely by lifting the handset at any time the loudspeaker and microphone are disconnected and the set may be used as an ordinary telephone. This facility enables received speech to be reproduced by the loudspeaker or heard only by the user of the set, the choice being made instantly either before or during conversation.
- (3) The amplifier and loudspeaker give excellent reproduction and ample volume for a large office.
- (4) May be fitted to any P.A.X. line after a simple modification of the line-circuit.
- (5) Inexpensive in operation since low-consumption valves are employed.
- (6) Incorporates, when required, materials and finishes suitable for a tropical climate.

The telephone set is illustrated in Fig. 1 and is particularly notable for the unobtrusive manner in which the microphone is incor-



Fig. 1.—Telephone set with microphone fitted behind dial.

porated. Situated behind the dial, the microphone does not upset the familiar contour of the telephone instrument and, of course, this method of mounting avoids the necessity for a separate microphone unit. Appearing on the front of the set are a key and a lamp, the functions of which will be clear from the description of the operation.

The moving-coil loudspeaker, which is of the permanent magnet type, is contained in a polished wood cabinet (Fig. 2), adding not only to the practical but also to the decorative part of office equipment. The use of a moving-coil speaker results in the very best response to speech frequencies, whilst permanent-magnet excitation avoids field-magnet current consumption.

Fig. 4 shows the amplifier unit, which may be supplied either for mains or battery operation. The illustration is of the mains set, a three-pin plug being provided. In each type a wood box, of approximate dimensions 18 ins. by $10\frac{1}{2}$ ins. by 9 ins., accommodates the apparatus, compartments being provided for either batteries or mains unit. Two valves are employed in the amplifying circuits, the filament current consumption of each being 0.2 ampere and the

anode potentials 100/120 volts. At the lower figure the anode current is 17.2 mA and at 120 volts the current is 20 mA. In the battery set a 2 volt secondary cell is required for filament supplies in addition to a 9 volt grid-bias battery and a suitable anode battery. In the mains set, as has been stated, the power unit is housed in the box and consists of a rectifying valve providing anode and grid supplies, a metal rectifier feeding filaments, and a smoothing circuit for the elimination of mains hum. The mains transformer can be wound for any specified voltage.

To ensure the best results in any given conditions of use, provision is made to vary independently the gains of the amplifying valves. This variation is made by adjusting the grid bias, a clip on the grid terminal of each valve enabling resistance to be included until the optimum value of bias is obtained. After the initial setting this adjustment is not varied.

Operation.

In the following outline of the operation the different classes of calls are dealt with



Fig. 2.—Loudspeaker.

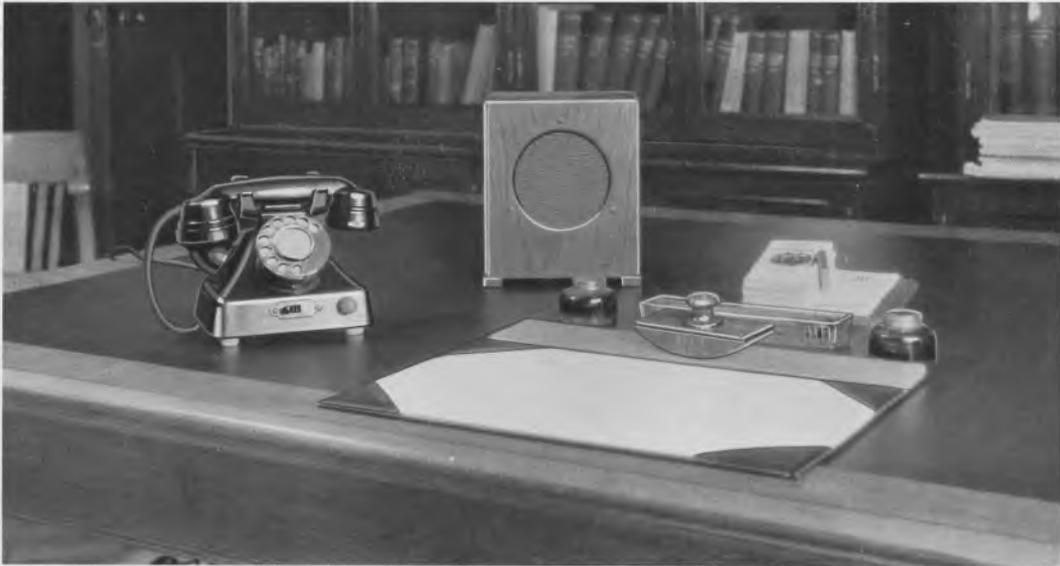


Fig. 3.

under their respective headings and it will be seen that the keynote of the whole operation is simplicity

Loudspeaking Station Calling another line.

(a) *Using telephone set.*

The handset is removed and the number dialled. When called party answers conversation may follow. The usual tones at the various stages are heard in the receiver. At the end of conversation the handset is replaced.

(b) *Using loudspeaking set.*

The key on the telephone set is thrown to the "on" position and the number is dialled. The called party's answer is heard on the loudspeaker and speech from the master station is picked up by the microphone and transmitted to the distant end. The usual tones at the various stages are

heard in the loudspeaker. At the end of conversation the key is restored.

Loudspeaking Station called.

(a) *Using telephone set.*

The bell in the telephone set rings and the call is taken on the handset in the usual manner.

(b) *Using loudspeaking set.*

When the bell rings, the key is thrown and conversation takes place



Fig. 4.—Mains operated amplifier unit.

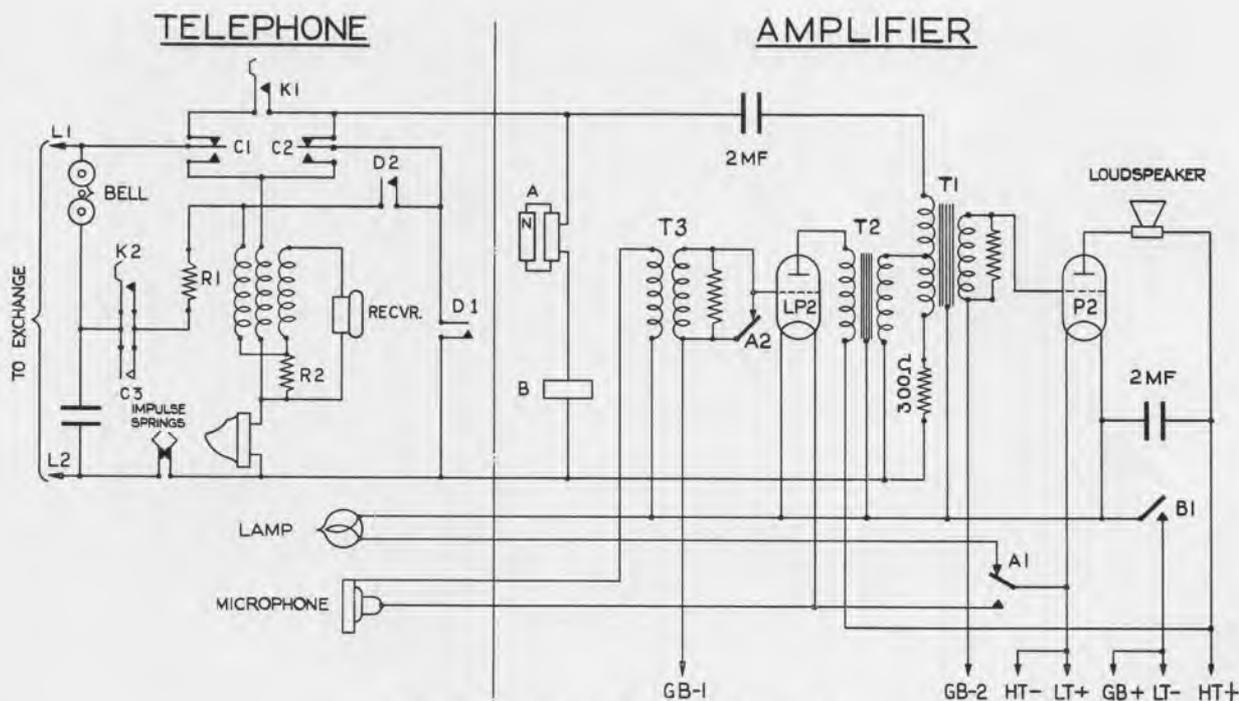


Fig. 5.—Circuit of loudspeaking telephone set.

via the loudspeaker and microphone. The key is restored at the end of conversation.

When the handset has been used, it is, of course, a natural action to replace it at the end of conversation, but it is not so much a matter of habit to restore the key and, consequently, the warning lamp on the telephone set glows if the key is not restored to disconnect the amplifier

Circuit operation.

The complete circuit is shown in Fig. 5. When a call is made and it is not intended to use the loudspeaker, the handset is lifted, whereupon the cradle switch operates, establishing a loop at contacts C1 through the induction coil and transmitter. Impulsing then follows, the dial "off-normal" springs D1 and switch springs C2 short-circuiting

the coil and transmitter whilst the dial is operated. Springs D2 and C3 connect the condenser and resistance R1 across the impulse springs to effect spark-quenching during impulsing. The value and direction of the potentials induced across R2 are such as almost completely to suppress reproduction in the receiver of speech picked up by the transmitter. Thus the functioning of the set is exactly as that of the standard Gecophone, giving maximum side-tone suppression.

To make a call when it is desired to use the loudspeaking equipment, the key is thrown. At K1 the line is extended to the amplifier, relay B operating over the loop. Relay A is polarised and does not operate. Contacts B1 feed current to valve P2 and to the lamp on the set. If dial tone is fed from the exchange, this is received over the line,

amplified by valve P2 and heard on the loudspeaker. During dialling, springs D1 short-circuit relays A and B. As has been stated, the only alteration to the exchange equipment necessitated by the installation of this loudspeaking station is a simple modification of the line circuit. This results, when the called party answers, in a reversal of the polarity of the lines, and relays A and B now operate. Contacts A1 cut off the supply to the lamp and feed current to the filament of valve LP2 and to the microphone. Speech received over the line is fed by transformer T1 to valve P2, amplified, and reproduced by the loudspeaker. Speech picked up by the microphone is fed by transformer T3 to valve LP2, amplified, and passed by the output transformer T2 to the line via the primary winding of transformer T1. It will be seen that the output transformer feeds two circuits in parallel, the first consisting of one half of the primary winding of T1 and the line, and the second consisting of the other half of the primary winding and a 300 ohms resistance. If these two parallel circuits are identical, the currents in each will be equal and there will be no flux to induce currents in the secondary of T1 and, therefore, no

unwanted sound reproduced in the loudspeaker. The value of 300 ohms has been selected as suited to the average line for which the equipment is designed. In the worst cases of unbalance, howling may occur and is eliminated by adjusting the gains of the valves, generally by reducing the gain of valve P2, resistance being placed across the grid winding of the transformer.

If, during conversation on the loudspeaking equipment, the handset is removed, cradle switch springs C1 and C2 disconnect the amplifier from the line, releasing relays A and B and cutting off the current supply. The loudspeaking equipment is thus disconnected and conversation may be continued by means of the handset.

At the end of conversation on the loudspeaking equipment, if the distant receiver is replaced but the key not restored, the exchange connection is released but the amplifier valves are still consuming power. With the restoration to normal of the line polarity following the replacement of the distant receiver, relay A releases and at A1 disconnects the supply to the microphone and valve LP2 and lights the warning lamp on the telephone set.

