The New "Minor" Relay.

As a result of the progressive improvement in the design of telephone systems and the rapid development of public services during the past thirty or forty years there has been seen a gradual increase in the number of types of almost every class of apparatus commonly used. Various standards have been adopted by both manufacturers and administrations, and largely on account of this, numerous instances may be found to-day of the use in one telephone system of apparatus which differs considerably in design from that employed for identical or very smilar purposes in another

For several reasons the retention of more types than one to perform a given function is undesirable. So far as the cost is concerned it is impossible without some measure of standardisation to organise production on the most economical lines. In order to satisfy demands for a variety of types of even one accessory, the manufacturer is required to maintain an extensive range of both materials and tools, while the adoption of different designs by various users often means the handling of a great number of items in comparatively small quantities. Such factors invariably influence the manufacturing cost. With regard to service problems, those acquainted with the task of maintaining systems in which there is little or no uniformity in types of apparatus are fully aware of the inconvenience and difficulties that variety causes.

The aim of the British Post Office to employ, as far as possible, only one type of each class of apparatus and to adhere rigidly to the principle of standardisation in the equipment of the telephone system is already well known. In helping to limit the variety of items the manufacturer is called upon to supply, in simplifying maintenance work, and in many other ways, this policy has been largely responsible for the degree of efficiency attained in the British telephone service to-day It is therefore natural to find that more of the principal overseas administrations are closely following this example and taking advantage, wherever possible, of the position of the manufacturer who produces B.P.O. standard types of apparatus on a large scale.

Since the advent of automatic telephony an increased amount of work has been carried out in connection with the selection and development of standard components, and an important item in respect of which a number of conclusions have recently been reached is the telephone relay Of this familiar piece of apparatus many types have been introduced from time to time, and in view of its very extensive use in all systems the benefits to be obtained by standardisation of design will readily be appreciated. A comprehensive study of the relay problem resulted firstly in the introduction of an improved type, somewhat similar to that favoured by a number of users, but incorporating several new features and, as far as possible, all the advantages of other known varieties. Since this relay, however, is designed not only for ordinary service but also to meet the severe operating conditions so common in automatic systems, it is necessarily more expensive than is warranted by the simple require-

Fig. 1.—Typical "Minor" Relay and individual cover.

ments of many of the circuits employed in manual exchanges. Furthermore, there are instances where, in an automatic system, a simpler form of relay will suffice. Further investigation was therefore undertaken and has been followed by the adoption of a miniature type, commonly known as the " minor." With this addition there are now two relays—" major " and " minor "—which between them will meet the majority of requirements in both manual and automatic exchanges.

The essential features of a relay to perform comparatively simple functions may easily be summarised. It should be

(1) low in cost, and therefore simple in construction,

(2) small in size, so that the greatest possible economy may be obtained in mounting space,

(3) simple to adjust and maintain and

(4) efficient and reliable in operation.

The new " minor " relay, in the development of which The General Electric Company has collaborated closely with the British Post Office, answers these requirements fully. As will be seen from Fig. 1 it is simple and yet robust in design, while from Fig. 2, which shows the principal dimensions together with those of a relay of the larger type commonly used, an idea may be gained of the saving in mounting space obtained. For the purpose of illustration, identical spring combinations have been shown, the height in each case representing the maximum. On a mounting plate 19″ × 3½″ a total of forty " minor " relays can be accommodated under one cover, the minimum mounting centres being 25/32″ × 1½″. When individual covers are employed centres of $\frac{7}{8}$″ × 1 $\frac{9}{16}$″ are required.

The difference in capacity between two typical mounting plates suitable for use on standard racks is illustrated in Fig. 3. Both plates are of a regular length (22$\frac{1}{8}$″), the width of one being 3½″, and of the other 2$\frac{3}{4}$″. Whereas the former is actually larger than necessary to carry the forty " minor " relays shown, the latter will mount only seventeen of the existing type. It will be obvious that in the design of both large exchanges and small switchboards, the use wherever possible of the " minor " relay will effect a considerable saving in space. It should perhaps be mentioned that this is obtained entirely by reason of the smaller dimensions and not at the expense of accessibility.

The reduction in weight is also valuable, the saving in this respect being specially notable. Considering again the examples shown in Fig. 2, having identical spring sets

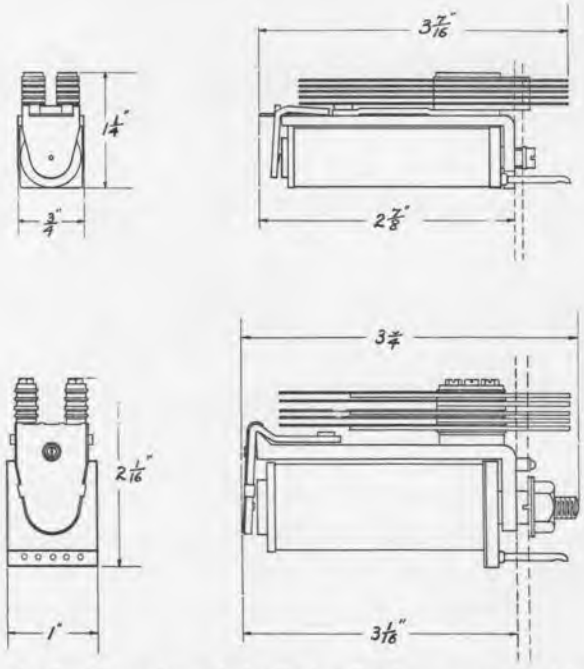

Fig. 2.—Dimensions of the "minor" relay compared with those of the larger type in general use.

and similar coil windings, the respective weights are $5\frac{1}{2}$ ounces and $9\frac{1}{2}$ ounces.

The magnetic circuit of the "minor" relay is generally similar to that of "major" type, incorporating the knife-edge principle of armature suspension. From Figs. 1 and 2 it will be seen that a simplified design of both armature and yoke has been employed, and also a simple means of retaining the armature in position. The armature is provided with a short tongue, over which is fitted a retaining plate secured to the yoke by a single screw. Accurate positioning of this plate is ensured by the provision of a guide stud permanently fitted in the top of the yoke and in alignment with the fixing screw. With this method of retaining the armature, friction is reduced to a minimum and the relay may be mounted horizontally with the contact springs at the top or on either side. Side mounting is favoured since it prevents the collection of dust and foreign matter on the surface of the springs.

An improved method of securing the core to the yoke has been adopted, giving a joint of low magnetic reluctance and so increasing the efficiency of the iron circuit. It also allows the coil to be removed without detaching the relay from its mounting plate or disturbing spring adjustment or wiring. After the armature has been taken off, the coil is released by unscrewing a nut on the threaded end of the core which projects through the heel piece and a hole in the mounting plate. A screwdriver is the only tool necessary, the nut being slotted so as to render the use of a special spanner unnecessary.

The relay is secured to the mounting plate by means of two screws, for which threaded holes are prepared in the relay frame, one on each side of the coil securing nut. By the use of a bush on each of the screws and an insulating plate which is seen in Fig. 1, the relay frame may, where necessary, be insulated from the mounting.

Upon consideration of the various purposes the "minor" relay would satisfactorily serve, it was concluded that in the majority of cases not more than ten contact springs would be necessary. Dimensions governed by this factor were accordingly fixed on the basis of two sets of five springs each. This limitation of contacts and, therefore, of the load on the armature, together with the efficiency of the magnetic circuit, makes it possible to allow a comparatively large residual air gap so as to obtain very quick release of the armature when the relay is de-energised. For all normal purposes the actual clearance between core and armature when operated is 8 mils.

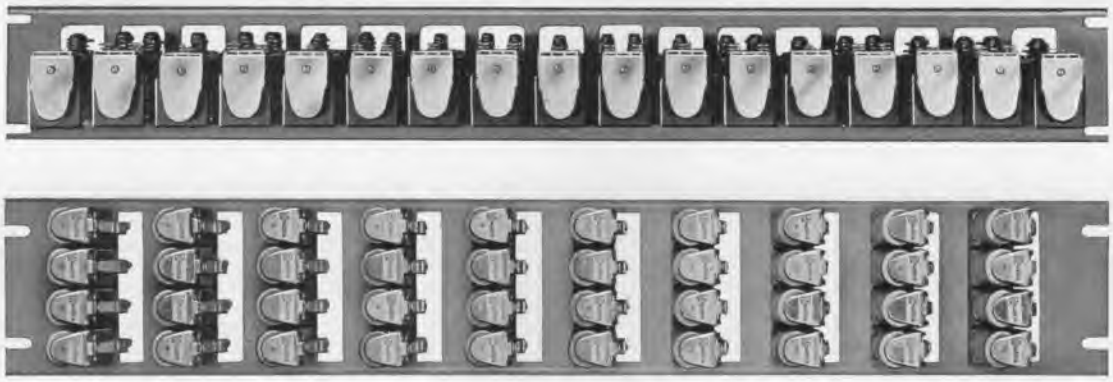

Fig. 3.—Two fully-equipped standard plates of equal length, showing saving in mounting space.

The high efficiency which is characteristic of relays employing the knife-edge principle of armature suspension gives an added advantage in that the flux leakage or stray magnetic field is extremely small. In this respect the "minor" relay is particularly notable. Flux leakage is so reduced that in all normal circumstances the possibility of magnetic interaction between adjacent relays can be completely ignored.

As already mentioned the maximum number of contact springs for which provision was considered necessary was ten. The relay frame is prepared to take either one central pile of up to five springs, or two similar piles side by side, the end of the armature carrying three insulated operating studs so as to meet either of these conditions. Each pile of five contact springs will cover one change-over and one make, or break, so that within the spring capacity stated a number of alternative combinations can be provided.

It might be added that the method of building up the springs will permit of the fitting of more than ten to meet exceptional requirements. Each pile forms a complete unit incorporating a rigid buffer stop, the whole being held firmly together by two screws and secured to the frame by a further single screw. Withdrawal of the latter allows the entire set of springs to be removed without in any way affecting the adjustments. The position of the buffer stops has been carefully chosen so as to eliminate the possibility of contact "bounce."

The thickness of the moving springs, the contact pressures and the clearances are the same as those at present widely used, thus ensuring a degree of reliability equivalent to that obtained with larger relays. Where circuit conditions demand extreme sensitivity the standard figures for these details may be reduced, but such modification naturally involves finer adjustment and greater care in maintenance. The contacts are ordinarily of platinum-gold-silver alloy, but alternatively may be of platinum if required.

The bobbin formed by the core and cheeks is designed for the fitting of either two or four tags, and any normal combination of inductive and non-inductive windings can be provided. The ampere turns necessary for the operation of the relay vary from about 55 in the case of a single-make spring set to about 150 with the maximum equipment of springs. Operating and releasing figures for some typical "minor" relays are given in the accompanying table. In the last example the

Winding Ohms.	Approx. number of turns.	Spring Sets.	Minimum Operating Current.	Maximum Releasing Current.	Adjustment.
50	3300	2 breaks	30 mA	5 mA	Standard
100	4600	1 make	13 mA	1.5 mA	,,
300	7300	1 make	8 mA	1 mA	,,
500	9600	3 makes	12 mA	1.5 mA	,,
1000	15000	2 breaks	7 mA	1 mA	,,
2000	21000	2 change-overs	6 mA	1 mA	,,
100+100	2900 + 2900	1 make	20 mA (either wdg.)	2.5 mA (either wdg.)	,,
20+50 N.I.	2200 (ind. wdg.)	1 break	25 mA	4 mA	Special

special adjustment referred to consists of a contact pressure of 8 grammes and a clearance of 7 mils, as against the standard adjustment of 20 grammes contact pressure and 10 mils contact clearance.

When relays of the " minor " type require individual protection, as is usually the case to avoid cross-talk when adjacent relays are traversed by speech currents, a small cover as shown in Fig. 1 is supplied. On each side this cover a guide is provided in the form of a pressed channel, the position and shape of which is so arranged that it is impossible for the cover to come into contact with the relay springs while it is being removed or replaced. The shoulders formed by these channels inside the cover serve also to position it securely on the relay frame, no extra supporting parts being necessary An additional feature is the introduction of two buffer stops, also obtained by a press operation. Before the relay is mounted, these bear upon the rear coil cheek and prevent the cover from passing so far over as to cause damage to the armature or retaining plate. Each relay can therefore be stocked in its individual cover and shipped with safety.

In conclusion, the new " minor " relay can be employed with advantage for many classes of work for which it has been common practice hitherto to use larger and more expensive types. For a simple, inexpensive and yet highly efficient relay as described there is an extremely wide field of application. The first 60,000 for the British Post Office, which are now being manufactured by The General Electric Company, are intended chiefly for service as subscribers' supervisory and cut-off relays in C.B. branch exchange switchboards.