A New Mechanical Keysender.

SINCE the widespread adoption of automatic telephone systems there has been a demand for a mechanical impulsing device which could replace the dial at busy switchboard positions and would render unnecessary the concentration of the operator's attention throughout the impulsing period. Many designs have been suggested, but the main requirements of reliability, compactness, simplicity and ease of installation have not been found until the successful development of the new mechanical keysender which has recently been standardised by the British Post Office.

The need for such an instrument arises particularly at private branch switchboards from which calls are extended to a public automatic exchange. Manipulation of the dial, occupying almost the whole of the impulsing period, demands a considerable proportion of the time devoted by the operator to each call and constitutes a serious deterrent to the expeditious handling of traffic. It follows that increased efficiency will result if a reduction can be effected in the time spent in originating impulses. Since, however, these must be of standard duration and spacing the actual impulsing period cannot be reduced and therefore any device to relieve the operator must permit of the setting up of digits at a speed higher than that at which impulses are sent out. To accomplish this it becomes necessary to store the digits rapidly and provide for the transmission of impulses at normal speed. An electrical device for this purpose was described in Vol. 3 No. 1 (January, 1933) of this Journal. Employing telephone type relays, operated by current from the exchange battery, this keysender permits digits to be set up at a high speed, thus freeing the operator for other duties on the switchboard whilst impulses are sent out.

If, however, battery capacity is no more than sufficient for normal requirements, an additional load imposed by an electrical keysender cannot be sustained and it is essential in such cases that impulses should be originated entirely by mechanical means. The new keysender, seen in Fig. 1, requires no source of electric power supply An original design of the British Post Office, it has been developed for manufacture in collaboration with The General Electric Company and tests in actual use on a busy private branch switchboard have shown a saving of approximately 66% in the time devoted by the operator to origination of impulses. To a keysender reliable in operation and easily installed, a wide field of application is open if, in addition, its cost is comparatively low It is here that the Company's experience in mass production of accurate parts is combined with virtues in the original design to enable the sender to be offered at an attractive figure.

A description with reference to diagrams illustrating the elements of the mechanism will serve to show that storage of digits and transmission of impulses may be achieved by an instrument devoid of complications and it is felt that in this new type of keysender will be recognised a really notable aid to operating efficiency

The sender is remarkably compact, its overall height being only six inches. Keys of a typewriter pattern project through the frame and carry designations which may be digits only or digits and letters when the sender is used in a director area.

No limitation is imposed on the digits which may be keyed per call, either in number or speed. Storage is accomplished as a result of imparting to a storage rocker an angular motion, the degree of which is dependent upon the key depressed. The principle is illustrated in Fig. 2 where it will be seen that the key levers are pivoted on a bearing rod at the back of the frame, the storage rocker being so shaped as to present a contact edge at an angle to the key levers. The distance of the contact point from the key lever pivot is thus different on each lever,

Fig. 1.—British Post Office new standard Keysender No. 5. Dimensions 4⅜" wide, 6" high, 6" deep.

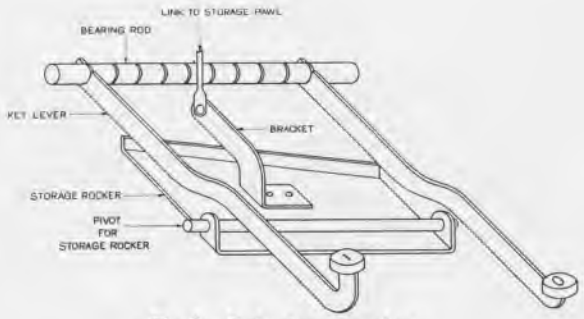

Fig. 2.—Code storage rocker.

being a minimum for digit 1 and a maximum for digit 0, resulting in different angular movements of the contact point and, therefore, of the storage rocker, for different keys.

A bracket fixed to the storage rocker communicates the motion to a storage pawl operating on a ratchet wheel, giving a ratchet displacement governed by the key depressed. As will be seen later, this rotary motion resulting from the depression of a key is the means whereby digits are stored. In Fig. 3 is shown the storage pawl, and, fixed to the ratchet by a flat spring, a marking arm, which is carried round by the ratchet. Starting from the position occupied at the end of a previous impulsing train, this arm passes over pins held friction tight in a code storage ring. It will be clear that the number of pins traversed is dependent upon the digit key depressed. For a reason that will be apparent later, this number is always the digit value plus six.

At the moment of release of a digit key the marking arm is positioned opposite a pin which, to affect the impulsing mechanism, is pushed forward through the agency of a striking mechanism so as to project on the other side of the code storage ring. A striker rocker is pivoted on the same spindle as the storage rocker and, on the depression of any key, is given an angular displacement which, constant for all keys, is communicated

by a bracket and link to a striking cam shown in Fig. 3. Fixed to the marking arm and projecting through the ratchet wheel are two striking pins, a striking arm attached to the frame by means of a flat spring has an end so shaped as to cause the cam on the downward motion to pass behind it and on the return to pass in front, pushing the striking arm against the striking pins and causing the marking arm to push forward the "marked" code pin. The flat springs restore both arms to normal and on the depression of the next key the whole operation is repeated. Thus, after keying, say, a six-digit number, six pins are pushed forward in the code storage ring, the spaces between them being governed by the digits.

The description so far has been of the storage feature and a summary, with reference to Fig. 4, may prove helpful before passing to a description of the impulse mechanism.

Fig. 4 shows a key depressed and on the point of release, the ratchet and marking arm being moved round under the action of the storage pawl to the limit for the particular key. The marking arm is positioned over a code pin, and the striking cam, not visible in the illustration since it is at the extremity of its downward movement, will, on release of the key, return to normal position, passing over the face of the striking arm, seen just above the frame, and cause the marking arm to push forward the "marked" code pin. The pins, one per digit, pushed through the storage ring by the marking arm, provide an indication which is interpreted by the impulse mechanism in a manner now to be described.

Rotation of the ratchet wheel winds up a main spring contained in a cup, through which, as is seen in Fig. 5, the main spindle passes. Fixed to the cup are two members

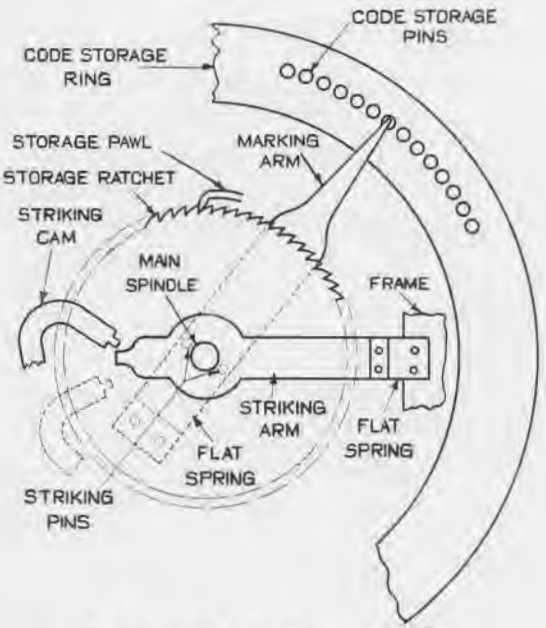

Fig. 3.—Marker and striker mechanism.

A and *B*. On *A* is carried a planet wheel for which a toothed orbit is fitted on the inside of the code storage ring. On release of a digit key the main spring rotates the whole impulse mechanism (carried on *A* and *B*) about the main spindle, causing the planet wheel to run round its orbit and turn an impulse wheel to which it is secured. The impulse wheel operates the impulse springs fitted on *B*. Also carried on *B* is a pivoted lever which sweeps over the code storage pins until, on encountering a pin projected by the storage mechanism, it lifts the impulse springs clear of the wheel.

In describing the "marking" of code pins it was said that the number of pins traversed by the marking arm from a starting point is the digit value plus six. The reason for this will be clear if consideration is given to the inter-digit pause which has been fixed at a constant 600 milliseconds, *i.e.*, six impulse periods. The relation between the angular velocities of the planet wheel about its own axis and in its orbit about the main spindle is

such that a main axial rotation of one pin space corresponds exactly to one complete impulse period. One pin space thus represents one impulse and, to ensure an inter-digit pause of six impulse periods, the length of the profile *C* is such that when it encounters a projecting pin the impulse springs are lifted clear of the impulse wheel during a rotation of six pin spaces. These represent, then, not impulses sent out, but the pause between successive digits and, being added to each digit value, give the number of pins to be traversed by the marking arm.

At this point the operation of the keysender may be summarised. On depression of a digit key the storage rocker is given an angular displacement which results in the storage ratchet and marking arm being moved round to mark a code pin. By means of the striking mechanism the marking arm is caused to push forward this pin. Depression of another key causes a second code pin to be marked, which in turn is pushed forward, and so on for each digit. Rotation of the storage ratchet winds up a main spring which, when a digit key is released, causes the whole impulse mechanism to rotate about the main spindle. In running round its toothed orbit the planet wheel rotates the impulse wheel, which operates the impulse springs. Successive keying stores energy in the spring and thus rotation continues, impulses are sent out, and an inter-digit pause is introduced each time the pivoted lever engages a projecting storage pin. When the last impulse has been sent, the impulse mechanism encounters a stop, suitably positioned by the storage mechanism, and rotation ceases. It should be noted that the impulse mechanism commences to rotate immediately the first digit

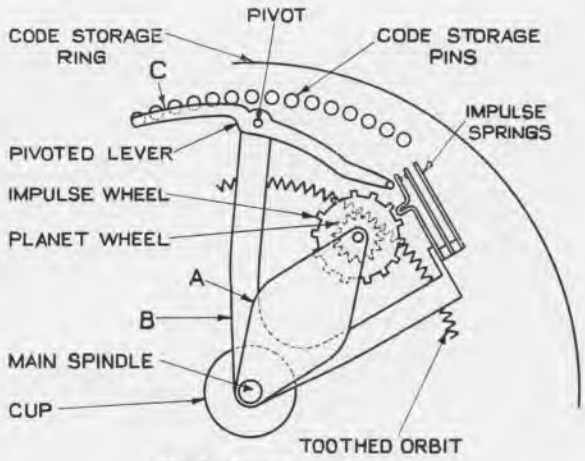

Fig. 5.—Impulse mechanism.

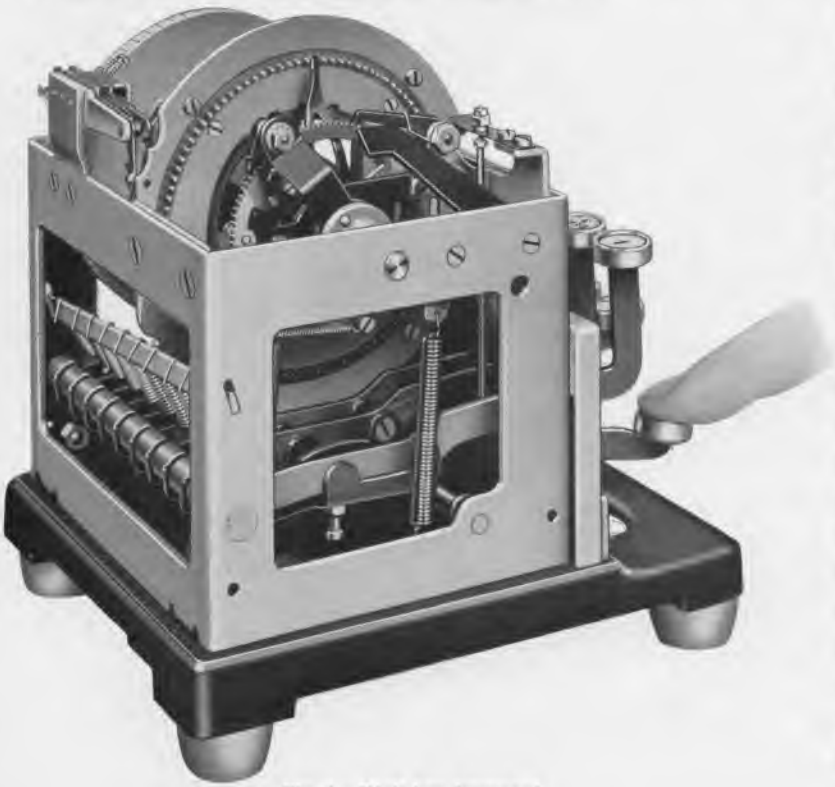

Fig. 4.—Digit key depressed.

key is released and is thus sending the first digits of a number whilst subsequent digits are being stored, resulting in a very minimum of time for the whole operation.

The principal parts of the impulse mechanism may be seen in Fig. 6. The code storage ring is clearly visible with the profile (*C*) bearing on a projecting pin and lifting the impulse springs. On the inner edge of the storage ring can be seen a portion of the toothed orbit of the planet wheel, whilst the main spring cup may be discerned at the centre of the ring. A governor mechanism similar to that employed on a dial controls the speed of rotation, off-normal springs being held operated during the sending of impulses. Two members seen in Fig. 6, which rotate with the impulse mechanism, are a trailer to restore projecting pins to normal position, and a disc which may be seen by the operator, providing a visual indication that the sender is in operation. This indication is necessary, of course, because the sender must not be taken into use on a second call whilst still impulsing on the first.

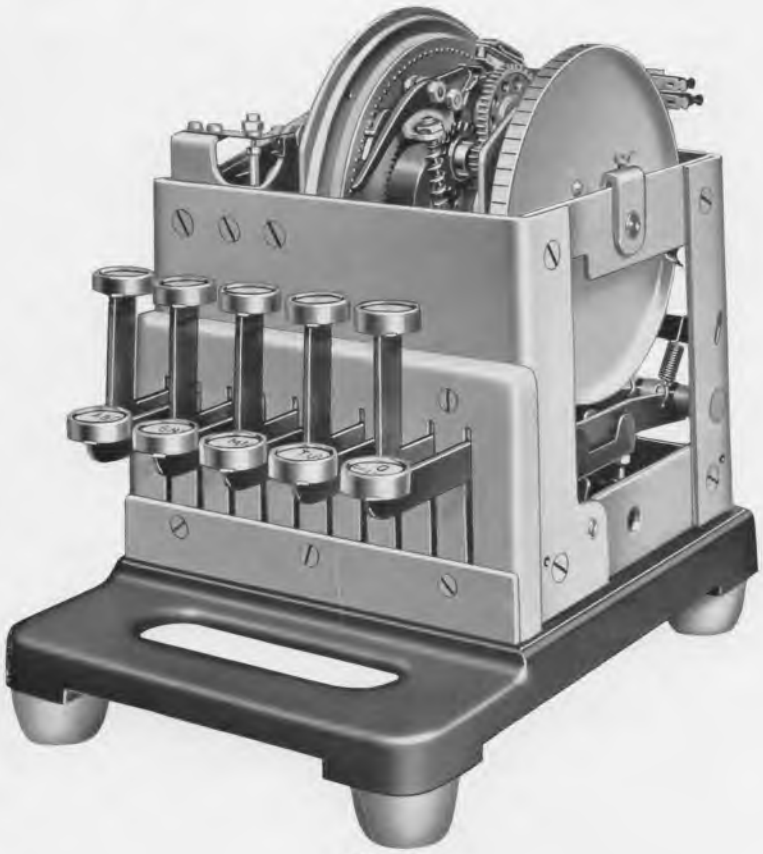

Fig. 6.

The keysender may easily be fitted on any manual position and is, of course, suitable in particular for use at private branch exchanges where operators are required to extend calls to the public automatic system. The Company is at present manufacturing for the British Post Office the first supply of these instruments which will shortly be offered to P.B.X. users in this country

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A very comprehensive description of the new Keysender No. 5 by Lt.-Col. F Reid, M C., T.D., B.Sc. (Hons.) A.R.C.Sc. appears in the Post Office Electrical Engineers' Journal, Vol. 27, Part 1, April 1934. Copies will gladly be supplied on request.
