March 30, 1937. P. E. BUCH ET AL 2,075,499

SWITCHING DEVICE

Filed Jan. 11, 1936

FIG. 1

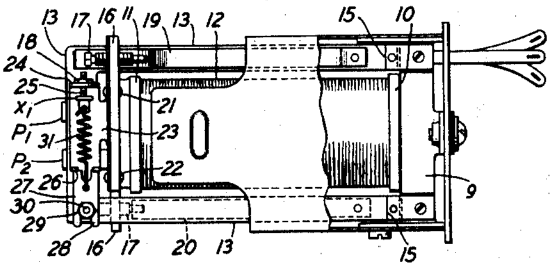


FIG. 2

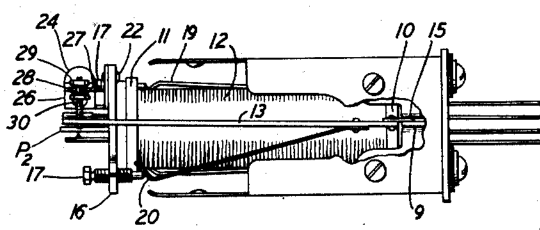


FIG. 4

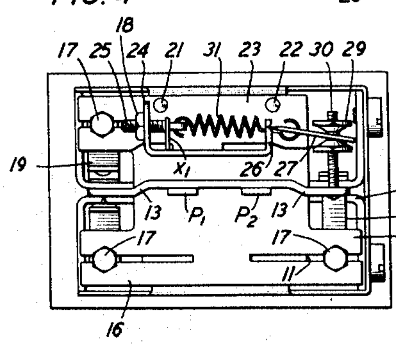


FIG. 3

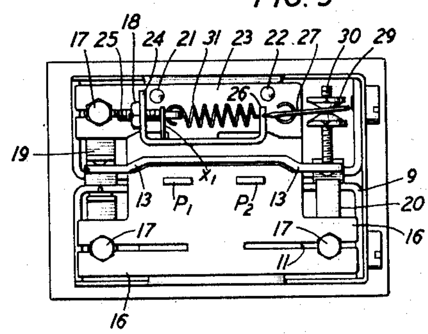


FIG. 5

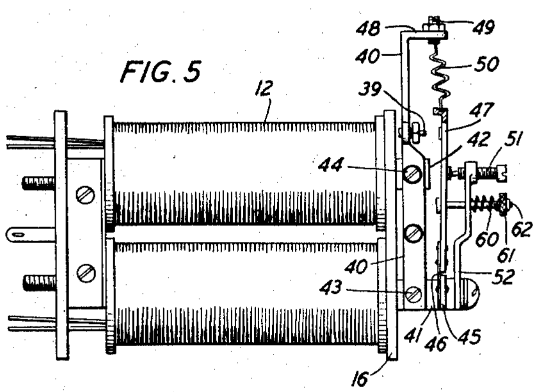
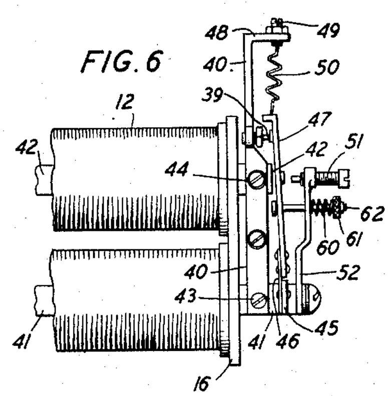


FIG. 6



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UNITED STATES PATENT OFFICE

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SWITCHING DEVICE

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Application January 11 1936, Serial No. 58,652

1 Claim. (Cl. 200—91)

This invention relates to electromagnetically operated switching devices in which contacts are operated by the movement of an armature in response to the energization of a magnet.

In swtiching devices of this type and in particular those used in certain telephone circuits, for example, where the motor magnet is energized by an alternating current source, the core of the magnet, as is well known, is fitted with a copper plate which is provided to maintain the magnet energized during the reverse cycle of the current. In such magnets, however, it has been found that even the accurate dimensioning of such a plate with respect to the frequency used did not prevent chattering of the armature, and that of the contacts actuated thereby, and that this condition was the cause of objectionable noise or clicks generated in the telephone talking circuit in which these relay contacts form a part.

The object of the invention is to provide a switching device of the type above referred to which is free of such objections.

In accordance with this invention, an electromagnetically operated switching device is provided in which means, in the form of a toggle mechanism, cooperates with the energizing force of the magnet on its armature as afforded by the flux furnished by the copper plate for holding the armature against the core and to retain it in its operated position during the reversing cycle of the current, thus preventing the chatter of the armature and the contacts operated thereby, means being provided for adjusting the effect of such a mechanism on the armature and with respect to the energizing force of the magnet on its armature.

Other novel features and advantages of the invention will appear from the following description and by the claim appended thereto, reference being had to the accompanying drawing, in which:

Fig. 1 is a front view of a magnet embodying the toggle mechanism of the invention;

Fig. 2 is a side view thereof;

Fig. 3 is an enlarged top view showing the magnet armature in its retracted position;

Fig. 4 is another enlarged top view showing the magnet armature in its operated position;

Fig. 5 is a front view of a magnet showing a modification of the invention, the magnet armature being shown in its retracted position; and

Fig. 6 is a partial view of the modified magnet showing the armature in its operated position.

The alternating current magnet to which the invention is particularly well adapted for use generally consists of a core 9 fitted at both ends with spoolheads 10 and 11 and a winding 12. The core 9 extends beyond the spoolheads 10 and 11 and is formed at its rear end with lateral projections for mounting an armature 13 in attractable relation with the prongs P1 and P2 formed at the other end of the core, as shown in Figs. 3 and 4, the armature 13 being attached to the rear end of core 9 by two similar ribbon springs 15 shown in Figs. 1 and 2 which permit the pivotal movement of the armature at this point. A copper plate 16 is secured on spoolhead 11 at the front end of the magnet and engages the prongs P1 and P2 of the core 9, the copper plate 16 being provided for holding the relay energized during the reverse or negative cycle of the current and on this plate are mounted a number of screws, such as 17, bearing on the camming portions of springs, such as 20, secured to the arms of armature 13 for returning this armature to its retracted position upon each deenergization of the magnet.

On the copper plate 16 is secured, as by rivets 21 and 22, an angle-shaped bracket 23 having an upright extending lug portion 24 provided for receiving a screw 25 which is axially movable therein by the turning movement of nut 18, the screw 25 being held against turning movement upon the turning of nut 18 by an arm X1 extending against the vertical portion of bracket 23, as shown in Figs. 2 and 3. Bracket 23 is formed with a portion 26 provided for mounting, as on a knife-edge pivot, a link member 27, having a slot 28 shown in Fig. 1 for engaging the constricted portion of a nut 29 threadedly engaging a screw 30 carried by armature 13, the link member 27 being held against the bracket portion 26 by a spring 31 having one of its ends hooked to the screw 25 and its other end to the link 27, as shown in Figs. 1, 3 and 4, the line of maximum tension of spring 31 occurring where the longitudinal axis of the link 27 forms a straight line with respect to the attaching point of spring 31 on the screw 25, its pivotal point on the bracket portion 26 and its attaching point with this link, and any deviation of link 27 from such a line will cause the spring 31 to move the armature 13 either toward the core 9 of the magnet or away therefrom, as the case may be, for a purpose that will be hereinafter described in detail.

The nut screw 29 may be moved on the screw 30 in position wherein the link 27 will be moved to impart to the armature 13 the desired pressure toward the core in relation to the adjustment of the screw 17 bearing on the camming portion of retractile spring 20.

In the modification of the invention shown in Figs. 5 and 6, an arm 40 is secured on the ends of cores 41 and 42 by screws 43 and 44, the core 41 at this end being provided with a lug 45 for securing one end of a ribbon spring 46 which serves as a pivot for the armature 47.

The arm 40 is provided at its free end with a lug 48 laterally extending therefrom for mounting a screw 49, the end of the screw having a conical recess for receiving the pointed end of a compression spring 50, and the other end of this spring engages a similar recess in the end of armature 47, the line of maximum tension of spring 50 occurring when the pivotal point of armature 47, the axis of screw 49, and the engaging point of spring 50 with the armature 47 are in straight line relation and any deviation of the armature from such a line will cause the spring 50 to force this armature either toward the end of core 42 or toward the screw 51 which limits the movement of armature 47 away from the core 42, the screw 51 being adjustably mounted on arm 52 which is, in turn, secured to the core 41.

In a typical example of operation of the device shown in Figs. 1, 2, 3 and 4, the energization of the magnet and the consequent attraction of armature 13 from the position shown in Fig. 3 is effective to move the link 27 for tensioning the spring 31 to a maximum which occurs when the link 27 forms a straight line with respect to its attaching points with the screw 25, its pivot and its connecting point with the other end of spring 31. However, upon the continued movement of the armature and, therefore, the passing of link 27 beyond such a line, the link 27 is moved in the position shown in Fig. 4 with the armature 13 engaging the prongs P1 and P2 of the magnet, the tension of spring 31 being thus effective to assist the magnetic flux as afforded by the copper plate 16 in holding the armature in its operated position during the reverse or negative cycle of the current and thereby preventing chattering of the armature and that of the contacts actuated thereby under the tension of the retractile spring 20 which is adjusted to overcome the tension of spring 31 upon the complete deenergization of the relay. The change from a positive to a negative force on the armature can be adjusted to be sufficient to overlap the margin of pull which exists between the peak and the minimum values of flux produced by the alternating current so that the relay once operated will remain so until the current applied has been appreciably reduced.

In an example of operation of the modification shown in Figs. 5 and 6, the compression spring 50 normally holds the armature in its retracted position, as shown in Fig. 5, and in engaged relation with the adjustable screw 51. Upon the movement of armature 47 when electromagnet 12 is energized, the spring 50 is compressed up to a point where the armature is in line with respect to its pivotal point and the axis of screw 49. The passing of armature 47 beyond such a line in engaged relation with the ends of the cores 41 and 42, the tension of spring 50 as adjusted by the screw 49 is effective to assist the magnetic flux as afforded by the copper plate 16 to hold the armature 47 in engaged relation with the core during the reverse or negative cycle of the current, thus preventing the chattering of the armature 47 and the contact actuated thereby against the tension of retractile spring 60 which is adjusted by the turning movement of nut 61 on screw 62 carried by the magnet armature.

From the foregoing, it is apparent that we have provided a relay, the performance of which is stabilized and certain of its operating characteristics modified by an auxiliary spring. This relay thus provides for a decrease in the holding current value as compared to the operating current value; for slower operating or slower releasing without employing non-commercial contact spring adjustments; for increased contact pressures. Also, when used in direct current relays which are normally held operated over considerable periods of time, the auxiliary spring by serving to reduce the holding force required on the armature permits of the use of an auxiliary contact to insert resistance in series with the winding after the relay has been operated, thereby reducing current drain, or, in relays having heavy spring pile-ups the auxiliary spring can be employed to partially balance the build-up force of the contact spring pile-up which develops as the relay armature is operated and thus, without lessening contact pressures, permit economies in winding design or decrease in the value of the required holding as well as operating current, and in slow operate and release relays, the auxiliary spring by balancing part of the restoring force of the contact springs may permit larger numbers of springs on a relay for a given slow characteristic or of increasing the time of release or operation.

It is to be understood that the auxiliary spring may be used to either pass from one side to the other of its line of unstable equilibrium, to move from one side only to its approximate line of equilibrium, or to move from its line of equilibrium to one side of this line, and that any of such arrangements fall within the scope of the invention.

What is claimed is:

In a switching device for use in a circuit energized by an alternating current source, a magnet having a core, a copper plate mounted at one end of said core, an armature for said magnet, a toggle mechanism operatively connected to said armature for assisting the magnetic flux furnished by said copper plate upon the reverse cycle of the current for holding the armature against said core, a retractile spring for said armature, and contact members operated by said armature.

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