Feb. 25, 1930. C. L. HANEL 1,748,219

ELECTROMAGNETIC RELAY

Filed Jan. 31, 1928

Fig. 1.

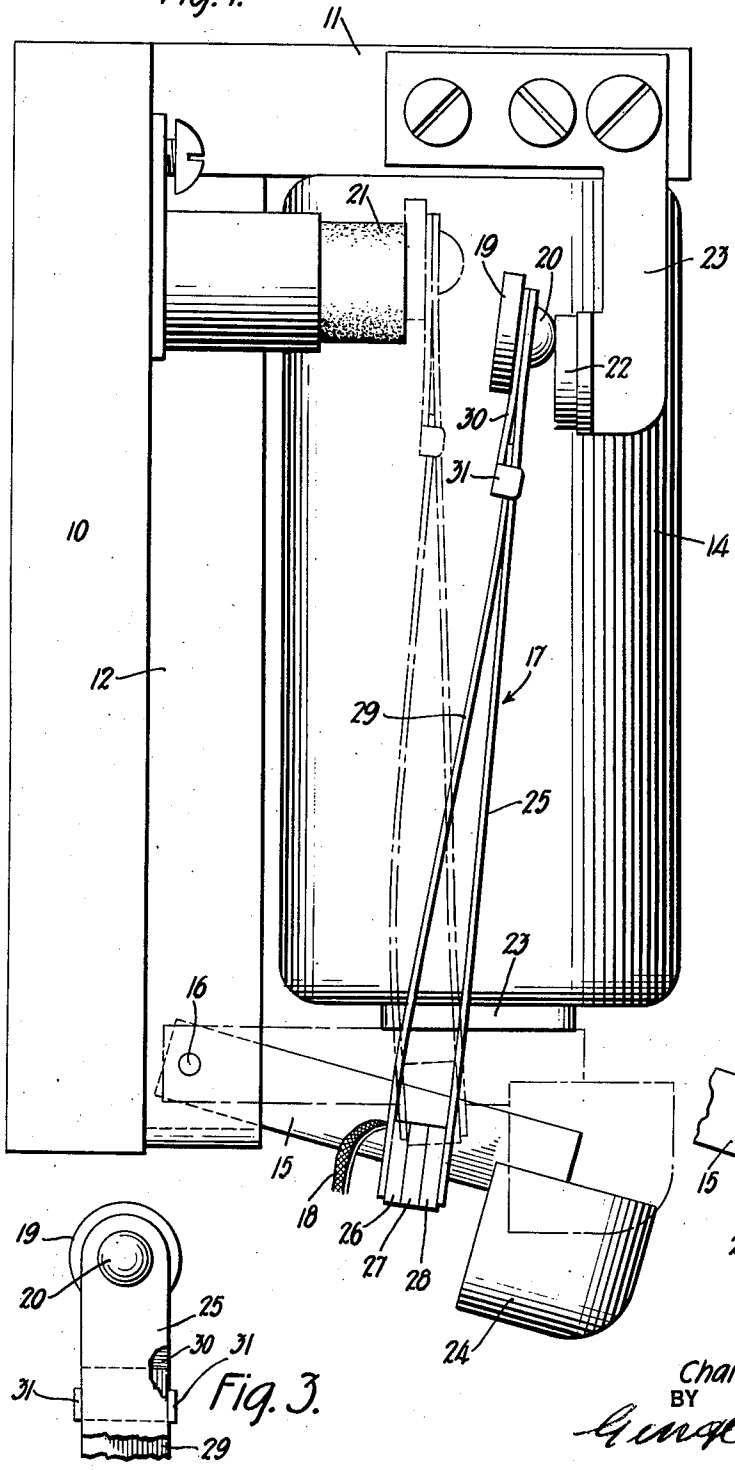

Fig. 2.

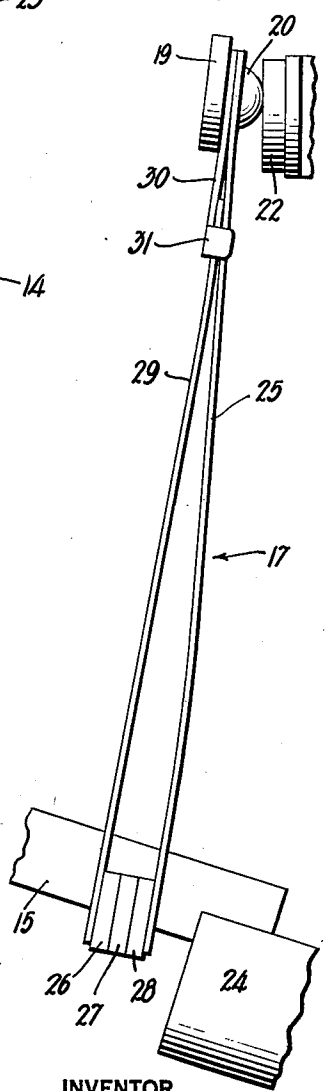

Fig. 3.

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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC RELAY

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The present invention relates to switches for controlling circuits and more particularly to switches including self damping or dead beat switch arms. Such switching devices constructed according to the present invention may have an extended field of usefulness, but are primarily intended for use in connection with signal relays. A conventional relay of this type may include a vertically disposed plate, a vertically disposed core supported by said plate and energized by a winding forming part of a controlling circuit, an armature pivoted to the lower end of the plate, and switch arms carried by the armature so as to straddle the magnet and arranged to coact with contacts on said plate to close a controlled or work circuit when the armature was attracted by the magnet and also a back contact against which the switch arm is thrown when the magnet is deenergized and through which a second circuit is closed, thus rendering the switch arm double acting. Preferably, the armature is weighted so that the back strokes will be powerful and the back contact firm. An important feature of the invention relates to a self damping or dead beat switch arm so constructed that it will not chatter when swung against a stationary contact either by the magnetic or the gravitational means.

Such switch arms have been made as single leaf springs of light weight and small resilience and also have been built up of a number of leaves in laminated arrangement, so as to afford frictional resistance during flexing for the purpose of checking or deadening their vibration. According to the present invention, the switch arms are each made up of a plurality of strips of light leaf spring material arranged as a pair of truss-like members with a wide base and with the members out of contact with each other throughout the greater part of their length.

In an illustrative form of switch embodying the present invention, the armature is provided with a weight for increasing the effective weight tending to move it away from the magnet. This affords great inertia slowing down all movements and, in combination with relatively slight resilience of the springs, greatly increases the time period of natural vibration of the armature. This combination of lightness of the springs with frictional damping afforded by my switch arm, results in complete elimination of chattering.

The above noted and other features of the invention may be better understood from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is an enlarged scale view in side elevation of a device embodying the present invention, and shows in dot and dash lines the final position and shape of the spring members of the switch arm when the magnet is energized, and in full lines the condition of same members when the arm first comes into engagement with the back contact; and

Fig. 2 is a fragmentary view, on a similarly enlarged scale, illustrating the changed position and shape of the same members, after striking the back contact as a result of the momentum of the armature and its associated weight.

Fig. 3 is a fragmentary view of the upper part of the arm viewed from the right.

In these drawings a vertically arranged backing plate 10 carries a magnet core 11 of a general U-shape, also disposed vertically and at right angles to the backing plate to which one leg 12 is secured, the other leg being surrounded by a coil or winding 14. Associated with the core 11 is an armature 15 which is pivotally mounted on the lower end of the leg 12 by means including a pintle 16.

Mounted upon the armature 15 but insulated therefrom is a switch arm 17 connected at its lower end with a conductor 18 and having at its upper end oppositely facing contacts 19 and 20, of which contact 19 is brought into engagement with a stationary contact 21, preferably of carbon, mounted on the backing plate, when the magnet is energized to attract the armature 15. On the back stroke, when the magnet is deenergized and the armature falls away from the core, by combined action of gravity and the spring arms 17, the contact 20 strikes against a stationary contact 22 carried by a metallic plate 23 supported on the core 11 but insulated therefrom

in any suitable manner. The contacts 20 and and 22 are preferably faced with silver, platinum or the like. In order to decrease the velocity of the gravitational swinging movement of the armature 15 and increase the final pressure on the back contact 22, the armature 15 is provided with a suitable weight 24 at the end thereof farthest from the pintle 16.

The dead beat switch arm 17 is of truss-like form and comprises a leaf spring 25 carrying at its upper end the contacts 19 and 20 and supported at its lower end on the armature 15 by means including plates 26, 27 and 28. The switch arm 17 also includes a leaf spring 29 connected at its lower end with the leaf spring 25 but spaced therefrom by the plates 26, 27 and 28. The spring 29 is shorter than the spring 17 and its upper end is held in frictional engagement with the spring 17 by means of a metal plate or leaf 30 secured to the upper end of the leaf spring 17 and extending downwardly so as to receive the upper end of the leaf spring 29 between its lower end and the leaf spring 17, the plate 30 preferably being provided with lugs 31 struck out of the plane thereof so as to pass on opposite sides of the leaf springs 25 and 29 and to maintain them in proper relation with respect to each other see Fig. 3. In the form illustrated, the switch arm 17 is supported on the plate 27 which is connected with but insulated from the armature 15 and the plates 26 and 28 serve principally as spacers and to provide electrical connection between the leaf springs 25 and 29.

When the magnet is energized, the armature 15 will be drawn up against the leg of the magnet core 11 and the arm 17 will be swung to the left to bring the contact 19 into engagement with the stationary contact 21, as indicated in dot and dash lines in Fig. 1. After the contact 19 engages the stationary contact 21, both members of the arm 17 will be flexed rearwardly, and the relative arrangement of parts is such that the contact 19 slides upward on the end surface of the contact 21. In this movement the upper end of the leaf spring 29 is drawn downwardly between and in frictional engagement with the leaf spring 25 and the plate 30 to an extent determined by the dimensions of the triangle on which the truss-like members are proportioned. Other things being equal, the wider the base as determined by spacers 26, 27, 28, the greater the distance of this frictional sliding movement. On the return of the switch arm to its normal shape, it will be opposed by the frictional resistance opposing return of the upper end of the leaf spring 29 to its normal untensed position between the leaf spring 25 and the plate 30. Thus the spring actuated components of movements are damped and chattering of the contacts is prevented.

When the magnet is deenergized, the action of the spring arm is first moderated and then accelerated by weight 24, which swings the switch arm 17 until the contact 20 engages the contact 22 as indicated in full lines in Fig. 1. The switch arm 17 will not, however, check instantly the movement of the armature 15 and weight 24 but will be flexed and changed from its full line shape in Fig. 1 to its full line shape in Fig. 2. During this change of shape the upper end of the leaf spring 29 will be moved upwardly between the leaf spring 25 and the plate 30, thus gradually checking the movement of the armature 15, and at the same time, giving a rubbing contact between 20 and 22. The tendency of rebound of the contact end of the arm will be resisted by the frictional grip of the upper end of the leaf spring 29 between the leaf spring 29 and the plate 30.

It will be evident that the truss formation with a wide base and anchorage of the springs on the armature and the resulting very light weight and small inertia of the springs as compared with the armature are conducive to effective dead beat action of the relatively small mass represented by contacts 19, and 20.

It is to be understood that self damping or dead beat switch arms constructed in accordance with the present invention may be found useful in connection with various types of switching apparatus other than that illustrated.

While my above described invention may be embodied in instruments of different kinds and sizes, it is to be understood by those skilled in the art that prevention of chattering requires that the damping weight, as 24 and the damping friction at the outer end of spring 29 may be greater or smaller according to the weight and stiffness of the springs and the weight of the contacts carried at the free end thereof. As to sizes, it will also be understood that in the relays for ordinary signal purposes which I have actually constructed, all parts, while proportioned as shown in the drawings, are on a smaller scale, such that the switch arm 17, for instance, would be 2½ to 3 inches long, the other parts being in proportion. The entire structure has been magnified in the drawings for the purpose of clearness and the thickness of the leaf springs is greater, in proportion, than will ordinarily be found desirable for a structure having an armature 15 and weight 24 of the size indicated.

I claim:

1. A non-chatter switch arm including a leaf spring anchored at one end and having a free end for yielding contact with a cooperating contact, a second leaf spring of a natural periodicity differing from that of said first spring having one of its ends anchored in fixed relation with the anchored end of the first spring and having its outer end in sliding frictional relation to the free

end of said first spring, thereby affording yielding support for the latter and frictionally damping the action of the free end of said switch arm.

2. Circuit controlling means, including a stationary contact, a movable support and a movable switch arm including a leaf spring anchored upon said support, means on said spring to contact with said stationary contact and a second leaf spring shorter than the first leaf spring projecting from said support in the same general direction as the first spring and spaced therefrom through the greater part of its length but having its outer end in frictional engagement therewith.

3. Circuit controlling means including a stationary contact, a swinging support and a switch arm including a leaf spring anchored upon said swinging support and having a free end adapted to coact with said stationary contact, a second leaf spring secured to said supporting device in spaced relation with the first spring throughout the greater part of its length but with its outer end in frictional contact with the first spring, and means to prevent disengagement of the outer end of the second spring from the first.

4. Circuit controlling means, including a stationary contact, a swinging supporting device and a switch arm, including a leaf spring anchored upon said supporting device and adapted to coact with said stationary contact, a second leaf spring secured to said supporting device so as to be spaced from the first spring throughout the greater part of its length but to have its outer end in frictional contact with the first spring, and means to prevent disengagement of the outer end of the second spring from the first including a member secured to the first spring at its outer end and extending rearwardly over the outer face of the second spring to press its outer end towards the first spring.

5. Circuit controlling means including a stationary contact and a switch member including a swinging supporting device, a leaf spring secured to said supporting device and adapted to coact with said stationary contact, a second leaf spring secured to said supporting device so as to be spaced from the first spring throughout the greater part of its length but to have its outer end in frictional contact with the first spring, and means to prevent disengagement of the outer end of the second spring from the first, said means including a resilient member secured to the first spring at its outer end and extending rearwardly over the outer face of the second spring to hold its outer end against the first spring and lugs projecting from said member at opposite edges of said springs to hold them in alignment.

6. A dead beat switch arm in the form of a truss, including a wide base, leaf springs of different lengths projecting from spaced apart anchorages on said base; contact means at the outer end of the longer spring, and means holding the outer end of the shorter spring against the longer spring.

Signed at New York city, in the county of New York, and State of New York, this 27th day of January, A. D. 1928.

CHARLES LUDWIG HANEL.