

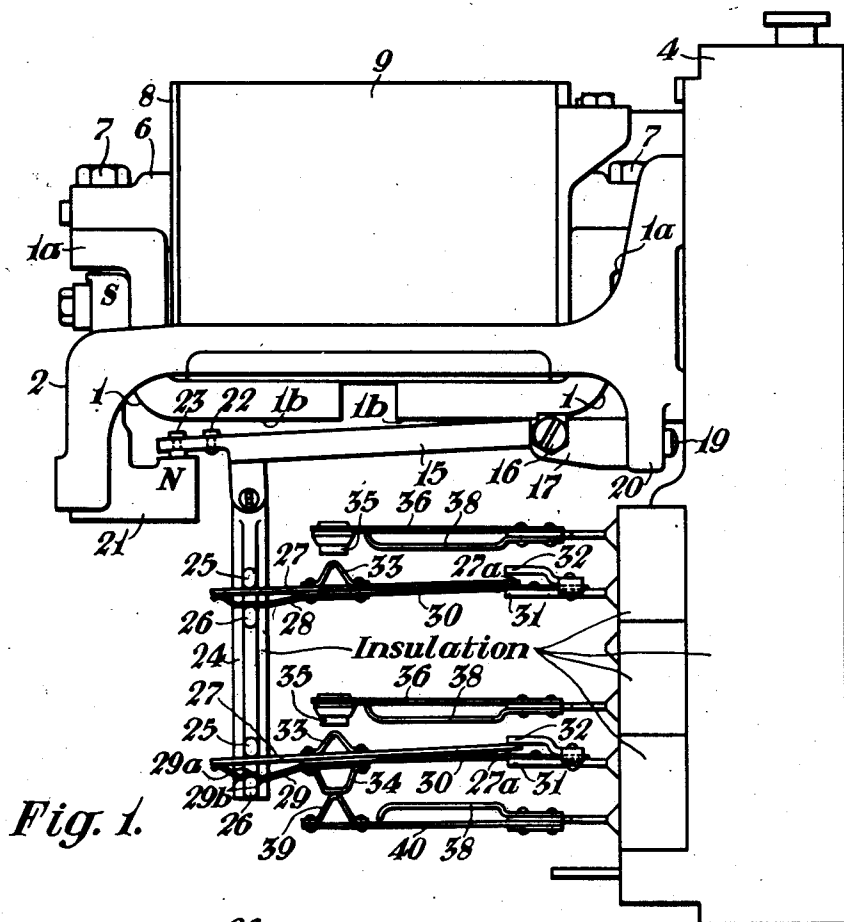
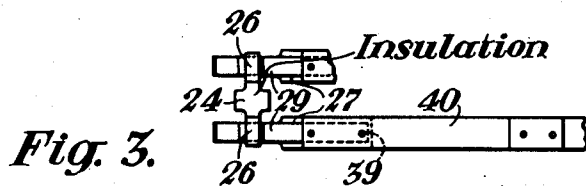
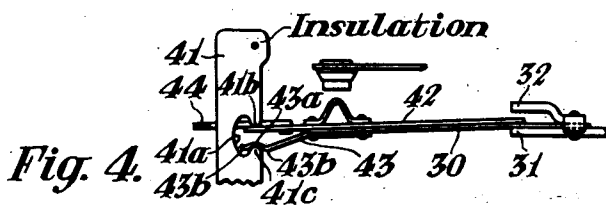
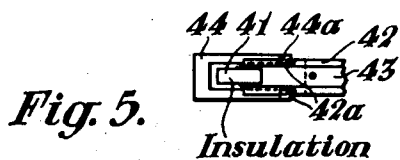
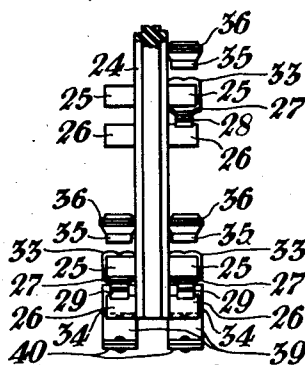
May 12, 1953

P. N. MARTIN

2,638,514

ELECTRIC CIRCUIT CONTROLLER

Filed Sept. 25, 1948



INVENTOR.
Paul N. Martin
BY 
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,638,514

ELECTRIC CIRCUIT CONTROLLER

Paul N. Martin, Penn Township, Allegheny County, Pa., assignor to Westinghouse Air Brake Company, a corporation of Pennsylvania

Application September 25, 1948, Serial No. 51,261

5 Claims. (Cl. 200—1)

1

My invention relates to electric circuit controllers, and particularly to contact supporting and operating mechanisms usable in multiple contact relays.

My invention is illustrated herein as applied to a relay including groups of movable contact fingers, and in which the movable contact fingers of each group are connected with the relay armature through the medium of an associated operating member of insulating material pivotally attached to the armature.

One object of my invention is to provide improved means for drivingly connecting an operating member to a contact-carrying finger.

Another object is to provide an improved spring pivot structure for a contact-carrying finger.

Another object of my invention is to provide an improved electrical relay of the type described in Letters Patent of the United States No. 2,198,704, granted to Branko Lazich on April 30, 1940 for Electrical Relays; No. 2,347,834, granted to John W. Lovington on May 2, 1944 for Electrical Relays; and No. 2,372,594, granted to myself on March 27, 1945 for Mounting for Oscillatory Members.

My invention is described herein as applied to a relay having contact fingers in spaced vertical rows below the relay armature, and in which each row or pair of rows is provided with a contact operating member pivotally attached to the armature. In this relay, the foregoing and other objects of my invention are attained by providing the contact operating member with a pair of spaced opposed convex abutments for each finger. The fingers extend between these pairs of abutments, and each finger carries a leaf spring which is biased to engage one abutment and biases the finger into engagement with the other abutment. Two species of abutment structures and two species of leaf spring arrangements for engaging the abutment structures are illustrated.

The improved hinge structure includes a relatively stiff, rigid finger attached at an intermediate point to a very flexible heel spring of the leaf spring type. The other end of the heel spring is rigidly fastened to a fixed support. The stiff spring overlies the flexible heel spring except for a small portion of the latter near the support. Movement of the pivot end of the stiff spring away from the heel spring is limited by a stop structure. The stiff spring extends over the fixed support so that its movement toward the flexible spring is limited by the support it-

2

self. In this way, a hinge structure is provided which can be easily moved by a small force, but which after a short initial movement becomes capable of transmitting large forces without further movement.

Other objects and characteristic features of my invention will become apparent as the description proceeds.

I shall describe two forms of electric circuit controllers embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a side elevational view of a relay embodying my invention. Fig. 2 is a fragmentary front elevational view of a portion of the contacts of the relay of Fig. 1. Fig. 3 is a fragmentary bottom view of the relay of Fig. 1. Fig. 4 is a side elevational view of a modified form of relay contact structure. Fig. 5 is a bottom view of the contact structure of Fig. 4.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Figs. 1, 2, and 3, the relay to which I have shown my invention applied is of the type described and claimed in Letters Patent of the United States to Lazich, No. 2,198,704, referred to hereinbefore, and comprises two magnetizable pole pieces 1 secured as by riveting to a nonmagnetizable supporting bracket 2, which supporting bracket, in turn, is fastened by suitable means to a backplate 4 of insulating material that can be readily moulded, such for example, as a phenol condensation product. The pole pieces extend upwardly through slots (not shown) formed in the bracket 2, and are provided at their upper ends with outwardly extending portions 1a. A magnetizable backstrap 6 is secured at its ends to the outwardly extending portions 1a of the pole pieces 1 by means of screws 7, and mounted on this backstrap is an insulating spool 8 provided with an energizing winding 9. The portions of the pole pieces which are located on the underside of the top plate extend toward each other, and have their lower pole faces 1b ground to lie in the same plane.

The relay also comprises a magnetizable armature 15 which is pivotally supported at one end in trunnion screws 16 for swinging movement toward and away from the pole faces 1b of the pole pieces 1. The trunnion screws 16, only one of which is visible in the drawings, are supported in outstanding lugs 17 secured by means of screws 19 to a depending portion 20 of the bracket 2.

The relay further comprises an L-shaped permanent magnet 21 which is secured at one end to the outer pole piece 1, and the other end of which extends underneath the armature 15 opposite the pole face 1b of the outer pole piece 1 in such manner that when the armature 15 is swung away from the pole pieces 1 it will be swung toward the permanent magnet, and vice versa. The armature is prevented from actually touching the pole pieces 1 by means of a core pin 22 of nonmagnetizable material riveted to the armature adjacent its forward end. A core pin 23 similar to the core pin 22 prevents the armature from actually touching the pole face of the permanent magnet 21.

Assuming that the lower end of the permanent magnet 21 is a north magnetic pole and the upper end a south magnetic pole, as indicated by the letters N and S in the drawings, when the winding 9 is deenergized, the armature 15 will drop under the influence of gravity to the position shown, and under these conditions a part of the flux from the permanent magnet will pass lengthwise through the armature and will exert on the armature a torque which assists the pull of gravity in retaining the armature in the position shown. When, however, the winding 9 becomes energized, if it is energized in such direction that the front pole piece 1 becomes a south pole and the rear pole piece 1 becomes a north pole, the permanent magnet and electromagnet fluxes will buck each other, and as the electromagnet flux builds up on the armature, a point will be reached at which the upward pull exerted on the armature by this flux will exceed the downward pull due to the permanent magnet flux and the force of gravity, and when this happens the armature 15 will swing upwardly toward the pole pieces 1 to the position determined by the core pin 22. If the winding 9 is energized in such a direction that the front pole piece 1 becomes a north pole and the rear pole piece 1 becomes a south pole when the armature 15 occupies its deenergized position, the flux due to both the electromagnet and the permanent magnet will then thread the armature 15 in the same direction, and under these conditions the armature 15 will remain in the position shown even though the energization of the winding 15 is increased to many times its normal value.

It should be particularly pointed out that, if the polarity of the permanent magnet 21 be reversed from that shown in the drawings, the armature will operate in a manner similar to that just described except for the fact that the polarity of the current which must be supplied to winding 9 to cause it to pick up will then be reversed.

A contact finger operating member 24, preferably formed of moulded insulating material, is pivotally connected at its upper end to the armature 15. In the arrangements shown in Figs. 1, 2, and 3, one operating member 24 is provided for each pair of vertical rows of contact fingers. Spaced pairs of pins or abutments project from the opposite sides of operating member 24, each pair comprising an upper pin 25 and a lower pin 26. The pins 25 and 26 are preferably moulded in the operating member 24, but may be rigidly attached to it in any suitable manner.

Between each pair of pins 25 and 26 projects a rigid contact finger 27. A leaf spring 28 or 29 is attached to each of the fingers 27 and projects between the pins 25 and 26. Each spring 28 or 29 yieldably engages the lower pin 26, and there-

by biases the finger 27 into engagement with the upper pin 25.

The pins 25 and 26, the fingers 27, and the springs 28 and 29 are contoured so that their surfaces move freely relative to each other without binding. The pins 25 and 26 are provided with smooth convex surfaces. The surfaces of fingers 27 which engage the pins 25 are smooth and flat so that they move freely on those convex surfaces. The spring 28 is also flat so that it moves freely on pin 25. The spring 29 is provided with a concave portion 29a between two convex portions 29b. Because it is contoured in this manner, the spring 29 not only moves freely on the pin 26, but accidental endwise movement of finger 27 and spring 29 out from between the pins 25 and 26 is prevented.

A flexible heel spring 30 is provided for supporting the opposite end of each of the rigid contact fingers 27. Each of the springs 30 is a leaf spring having one of its ends attached to the finger 27 at an intermediate point on the finger and having its opposite end attached to a fixed support 31. The rigid fingers 27 are long enough so that their extremities 27a overlie the ends of the fixed support 31. A fixed stop 32 is attached to each of the supports 31, and is spaced a short distance above it, overlying the tip 27a of the rigid finger 27.

Near its center, each finger 27 carries either a front movable contact 33, a back movable contact 34, or both. Stationary front contacts 35 are provided, in alignment with the movable front contact 33. Each contact 35 is carried at the ends of a leaf spring 36 attached to a fixed support 37. Each leaf spring 36 is self-biased to carry the contacts 35 toward the movable contact 33, but its movement in that direction is limited by a fixed stop member 38.

Stationary back contacts 39 are provided, each carried at the end of a leaf spring 40 whose opposite end is attached to a fixed support. The leaf springs 40 bias the contacts 39 toward their associated movable contacts, and their movement in that direction is limited by another stop member 38.

Operation of Figs. 1 to 3

The parts are shown in the drawings in the position they assume when the relay winding 9 is deenergized. The back contacts are therefore closed and the front contacts open. Starting with these conditions, let it be assumed that the winding 9 is energized, causing armature 15 to be moved upwardly, carrying with it the contact finger operating member 24. The springs 28 and 29 are stiff enough so that the fingers 27 are then raised with no lost motion between them and the operating member 24. When the contact 33 engages the stationary contact 35, then the upward movement of finger 27 is slowed, and the springs 28 or 29 and 36 are compressed. Additional upward movement of the member 24 is effective to increase the contact pressure. When the springs 28 and 29 have been sufficiently compressed, the front contact supporting springs 36 deflect with further upward motion of the operating member 24. The right ends of the rigid contact fingers 27 are solidly supported by the fixed support 31 at this time. The contact fingers 27 are sufficiently rigid that they do not distort as the pressure at the contact is thus increased.

When the relay winding 9 is deenergized, the armature 15 and contact operating member 24 drop. The left ends of the fingers 27 are then

positively driven by the pin 25. The fingers 27 pivot on the leaf springs 30.

When the back contacts associated with the lower finger 27 engage, downward movement of the central portions of the fingers 27 is resisted by the back contact spring 40. As the left end of the lower finger 27 continues to move downward, its right end 27a rises and engages the stop 32. As soon as the stop 32 is engaged, the further downward movement of the contact operating member 24 causes compression of the back contact spring 40. Since there is no back contact 33 associated with the upper finger 27, its downward movement is not resisted, and consequently its right end does not rise to engage its stop 32.

The pins 25 and 26 provide in effect a lost-motion connection between the operating member 24 and the rigid contact fingers 27. All the lost motion in these connections is taken up, however, by the springs 28 and 29. By virtue of this connection, it may be seen that it is not necessary to make any adjustment between the various contact fingers and the driving pins during manufacture. The springs 28 and 29 will take up all the lost motion, regardless of variations in dimensions of the parts due to manufacturing tolerances. Furthermore, since all the pins 25 and 26 are rigidly connected to the operating member 24, the stresses applied to one pair of pins are not transmitted to the pair of pins on the opposite side of the operating member. It is therefore not necessary that the front and back contacts be arranged in pairs on each finger, nor that the fingers be arranged in pairs on opposite sides of the operating member.

My improved pivot heel spring arrangement including the leaf spring 30 and the stop 32 for the rigid finger 27 insure that the pivoting movement of the finger between its two positions requires only a small operating force. At the same time, the stiffness of the finger 27 is sufficient to insure that it will not distort as the contact pressure is increased after the finger tip 27a has engaged the stop 32 or is backed up by the fixed support 31.

Figs. 4 and 5

I have illustrated in Figs. 4 and 5 a somewhat different type of contact operating structure in which each vertical row of contact fingers has its own operating member, instead of using one operating member for two adjacent vertical rows of contact fingers as in the previous modification.

Referring to Figs. 4 and 5, there is shown an operating member 41 whose upper end is pivotally connected to a relay armature by suitable means not shown. The operating member 41 is provided with a recess 41a for receiving the end of a contact finger 42. The sides of recess 41a are smoothly contoured to form a set of opposide contact abutments 41b and 41c. A leaf spring 43 is attached to the finger 42 and extends between the abutments 41b and 41c. The spring 43 is generally similar to the spring 29 of Fig. 1. It is provided with a concave portion 43a for engaging the abutment 41c. A pair of convex portions 43b lies on the opposite sides of the concave portion 43a, and help to prevent longitudinal movement of the finger 42 with respect to arm 41.

If desired, such longitudinal movement of finger 42 with respect to arm 41 may be further prevented by the use of a U-shaped locking piece 44, whose arms span the operating member 41

and are provided at their ends 44a with hooks engaging notches 42a in the contact finger 42.

The pivotal support for the opposite end of finger 42 may be the same as that for fingers 27 in Fig. 1, as illustrated in Fig. 4.

Although I have herein shown and described only two forms of electric circuit controllers embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Electric circuit controlling apparatus, comprising a rigid finger, operating means for positioning one end of the finger, a fixed support adjacent the opposite end of the finger, a pivot spring connecting an intermediate point on the finger to the support, a stop spaced from the support for limiting the movement of said opposite finger end away from the support, a first electric contact on the opposite side of the finger from said stop, a second electric contact, and spring means yieldably supporting the second contact in alignment with the first contact, so that upon movement of said one finger end in a contact-making direction, said pivot spring yieldably supports said opposite end until the contacts engage, whereupon said opposite finger end is moved to engage its stop, and thereafter the finger pivots about said stop and the spring means supporting the second contact yields.

2. Electric circuit controlling apparatus, comprising a rigid finger, an operating member having a pair of spaced facing abutments straddling one end of the finger, a spring on the finger engaging one abutment and biasing the finger into engagement with the other abutment, a fixed support adjacent the opposite end of the finger, a pivot spring connecting an intermediate point on the finger to the support, a stop spaced from the support for limiting the movement of said opposite finger end away from the support, a first electric contact on the opposite side of the finger from said stop, a second electric contact, spring means yieldably supporting the second contact in alignment with the first contact, and means for moving the operating member, said pivot spring being effective upon movement of said one finger end in a contact-making direction to yieldably support said opposite end until the contacts engage, whereupon said opposite finger end is moved to engage its stop, and thereafter the finger pivots about said stop and the spring means supporting the second contact yields.

3. Electric circuit controlling apparatus, comprising a rigid finger, operating means for positioning one end of the finger, a fixed abutment adjacent one side of the opposite end of the finger, a leaf spring lying along the finger and connecting an intermediate point in the finger to the abutment, a stop for limiting the movement of said opposite finger end away from the abutment, first and second movable electric contacts carried on the opposite sides of the finger, first and second stationary electric contacts, means yieldably supporting the stationary contacts in alignment with their respective movable contacts, so that upon movement of said one finger end in a direction to engage the contact on the abutment side of the finger, said spring yieldably supports said opposite end until the contacts engage, whereupon said opposite finger end is moved to engage its stop, and thereafter the finger pivots

7

about said stop, and so that upon movement of said one finger end in the opposite direction, said spring yieldably supports said opposite end until the contacts engage, whereupon said opposite finger end moves until it is stopped by said abutment and thereafter the finger pivots about said abutment.

4. Electric circuit controlling apparatus, comprising a stationary contact, a movable contact, a finger pivotally mounted at one end and supporting said movable contact, an operating member recessed to receive the free end of said finger, the sides of said recess being formed by two facing convex abutments, a spring on the finger engaging one of said abutments and biasing the finger into engagement with the other abutment, said spring and finger having surfaces contoured to move freely on said convex abutments, means for moving said operating member to pivot the finger and move the movable contact into and out of engagement with the stationary contact, and a locking member for holding the free end of the finger in the recess, said locking member being a U-shaped piece straddling the operating member and having the ends of its arms attached to the finger.

5. Electric circuit controlling apparatus, com-

8

prising a rigid finger, operating means for positioning one end of the finger, first spring means yieldably supporting the opposite end of the finger, a stop for limiting the movement of said opposite finger end, a first electric contact on the opposite side of the finger from said stop, a second electric contact, second spring means yieldably supporting the second contact in alignment with the first contact, so that upon movement of said one finger end in a contact-making direction, said first spring means yieldably supports said opposite end until the contacts engage, whereupon said opposite finger end is moved to engage its stop, and thereafter the finger pivots about said stop and the second spring means supporting the second contact yields.

PAUL N. MARTIN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,660,877	Manson	Feb. 28, 1928
2,021,706	Twyman	Nov. 19, 1935
2,372,594	Martin	Mar. 27, 1945
2,490,280	Rees	Dec. 6, 1949