March 31, 1942. F. E. WOOD 2,278,230

ELECTROMAGNETIC RELAY

Filed April 24, 1939

FIG. 1

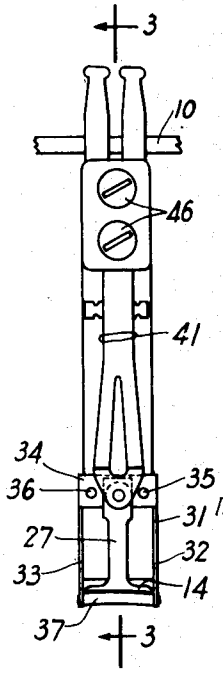


FIG. 2

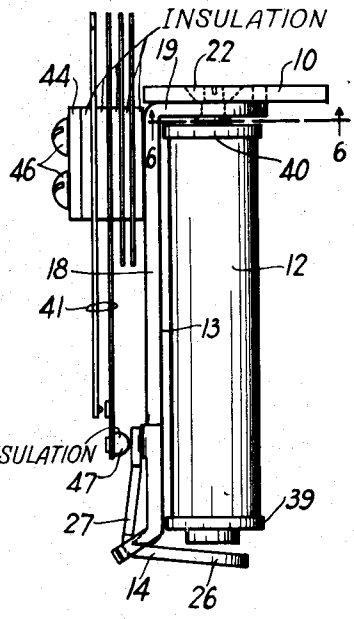


FIG. 3

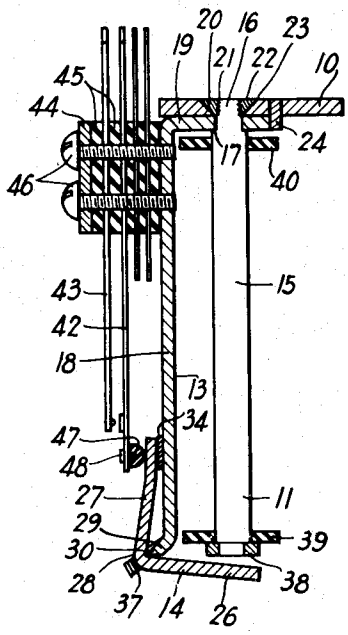


FIG. 4

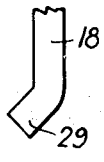


FIG. 5

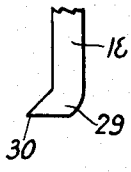


FIG. 6

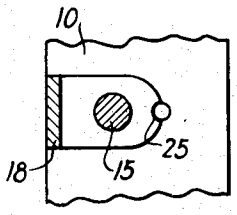


FIG. 8

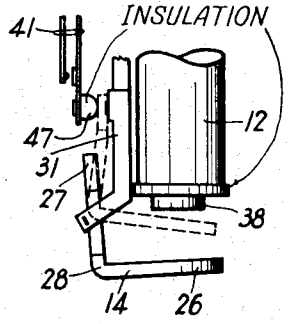
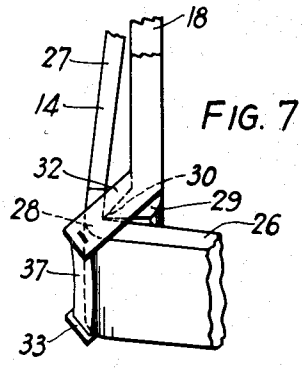


FIG. 7



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2,278,230

ELECTROMAGNETIC RELAY

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Application April 24, 1939, Serial No. 269,691

4 Claims. (Cl. 175—336)

The present invention relates to relays and, more particularly, to electromagnetic switching relays.

An electromagnetic relay conventionally comprises a field structure including a core provided with a winding, a movable armature carried by the field structure, and a set of switch springs operatively associated with the armature.

It is an object of the present invention to provide an improved relay of the type described which is of rugged and economical construction and which is reliable and positive in operation.

Another object of the invention is to provide a relay of the type described including an improved knife-edged mounting arrangement for the armature thereof.

In brief, the objects set forth above are in part realized in accordance with one feature of the present invention by providing an electromagnetic switching relay comprising a longitudinally extending field element, a substantially L-shaped armature including a body portion and an operating portion disposed in angular relationship, and means including a support carried by the field element adjacent the end thereof and provided with a laterally extending knife-edge engaging the knee of the armature for pivotally mounting the armature on the field element. Also, the relay comprises a set of contacts, the armature being so constructed and arranged that the body portion thereof is operatively associated with the field element and that the operating portion thereof is operatively associated with the set of contacts. Means is provided including two outwardly extending members disposed on opposite sides of the field element adjacent the support for restraining the armature against lateral displacement; and means is provided including an element carried by the members and engaging the knee of the armature for retaining the knee of the armature in place on the knife-edge provided on the support. More specifically, the element carried by the members comprises a leaf spring extending between the members and engaging the knee of the armature at a point disposed in alignment with the knife-edge provided on the support, thereby to retain the knee in place on the knife-edge provided on the support.

The two outwardly extending members disposed on opposite sides of the field element adjacent the support are flexible and comprise arms carried by a member formed of nonmagnetic material. A portion of the last-mentioned member is disposed between the field element and the operating portion of the armature, thereby to prevent the operating portion of the armature and the field element from sticking together due to the electromagnetic forces therebetween. Furthermore, the two outwardly extending resilient arms of the last-mentioned member and the resilient leaf spring extending therebetween are so constructed and arranged that placement and removal of the armature are readily facilitated while the relay is otherwise completely assembled.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawing, in which Figure 1 is a plan view of an electromagnetic switching relay constructed and arranged in accordance with the present invention; Fig. 2 is a side elevational view of the relay shown in Fig. 1; Fig. 3 is a longitudinal sectional view of the relay taken along the line 3—3 in Fig. 1; Fig. 4 is a fragmentary side elevational view of the end of the field element of the relay, illustrating an initial step in the method of forming the knife-edge thereon; Fig. 5 is a fragmentary side elevational view of the end of the field element of the relay, illustrating the knife-edge formed thereon; Fig. 6 is a fragmentary sectional view of the relay taken along the line 6—6 in Fig. 2, illustrating the arrangement for positioning the base portion of the field element with respect to the support therefor; Fig. 7 is a fragmentary perspective view of a portion of the relay shown in Fig. 1; and Fig. 8 is a fragmentary side elevational view of the relay shown in Fig. 1, illustrating the manner in which the armature thereof may be placed and removed while the relay is otherwise completely assembled.

Referring now more particularly to Figs. 1 to 3, inclusive, and 6 of the drawing, the electromagnetic switching relay there shown comprises a non-magnetic support 10 and a field structure including a longitudinally extending core element 11 provided with a winding 12, a longitudinally extending field element 13 and a movable armature 14 operatively associated with the core element 11 and the field element 13. The core element 11 includes a body portion 15 and a base portion 16 of reduced cross-sectional area, whereby a shoulder 17 is provided on the core element 11 between the body portion 15 and the

base portion 16. The field element 13 has a substantially L-shape and includes a body portion 18 and a base portion 19 disposed in angular relationship. The base portion 19 of the field element 13 has an opening provided therein; and the base portion 16 of the core element 11 is positioned in the opening provided in the base portion 19 of the field element 13 and projects therethrough, the shoulder 17 provided on the core element 11 being disposed in engagement with the wall of the base portion 19 of the field element 13 adjacent the opening provided therein. Also, the support 10 has an opening provided therein in which the base portion 16 of the core element 11 is arranged. The opening provided in the support 10 is provided with a tapered seat 20; and the outer end of the base portion 16 of the core element 11 is externally threaded as indicated at 21. A member 22 provided with a tapered seat 23 is arranged in the opening provided in the support 10 and in threaded engagement with the outer end of the base portion 16 of the core element 11. The arrangement of the member 22 in threaded engagement with the outer end of the base portion 16 of the core element 11 and the cooperating tapered seats 20 and 23 respectively provided in the opening provided in the support 10 and on the member 22 insure that the core element 11 and the field element 13 are securely retained in assembled relationship upon the support 10. Also, an arrangement is provided for positioning the field element 13 with respect to the support 10, which comprises a stud 24 carried by the support 10 and an interfitting recess 25 formed in the base portion 19 of the field element 13. It is noted that the stud 24 carried by the support 10 is arranged in alignment with respect to the opening provided therein through which the base portion 16 of the core element 11 projects, thereby to provide an arrangement for positively insuring proper alignment of the core element 11 and the field element 13 of the relay with respect to the support 10. It is noted that the support 10 may carry a number of laterally spaced-apart studs and have a number of openings formed therein respectively associated with the studs carried thereby, in order to provide a convenient arrangement for mounting a corresponding number of relays upon the support 10.

The arrangement for retaining the core element and the field element of the relay in assembled relationship and for securing these elements to a support is disclosed and claimed in the copending application of Frederic E. Wood, Serial No. 310,301, filed December 21, 1939, which application is a division of the present application.

As best shown in Figs. 2, 3 and 7, the armature 14 comprises a one-piece substantially L-shaped structure including a body portion 26 and an operating portion 27 disposed in angular relationship, a knee 28 being provided between the body portion 26 and the operating portion 27. The armature 14 is pivotally mounted on the field element 13 by an arrangement including an upwardly and outwardly extending support 29 carried by the body portion 18 of the field element 13 adjacent the end thereof. More particularly, the support 29 is provided with a laterally extending knife-edge 30 engaging the knee 28 of the armature 14.

Preferably, the support 29 is first formed as the end of the body portion 18 of the field element 13 by a bending operation, as shown in Fig. 4. The knife-edge 30 is then provided on the support 29 by a milling or grinding machine operation, as shown in Fig. 5.

The knee 28 of the armature 14 is retained in bearing engagement with the laterally extending knife-edge 30 provided on the support 29 by an arrangement including a member 31 having two upwardly and outwardly extending arms 32 and 33 disposed on opposite sides of the body portion 18 of the field element 13 adjacent the support 29 and a body portion 34 extending between the arms 32 and 33. Preferably, the member 31 is formed of resilient metallic stock and comprises a nonmagnetic material, such as brass, the body portion 34 of the member 31 being disposed between the outer end of the operating portion 27 of the armature 14 and the adjacent outer surface of the body portion 18 of the field element 13. Preferably, the body portion 34 of the member 31 is secured to the adjacent outer surface of the body portion 18 of the field element 13 by two laterally spaced-apart driving screws 35 and 36 of the Parker-Kalon type extending through aligned openings provided in the body portion 34 of the member 31 and in the body portion 18 of the field element 13. The outer ends of the arms 32 and 33 of the member 31 are provided with aligned openings therein which receive the opposite ends of a concave leaf spring 37 extending therebetween. The arms 32 and 33 of the member 31 are so constructed and arranged that they engage the opposite sides of the knee 28 of the armature 14, thereby to restrain the knee of the armature against lateral displacement with respect to the knife-edge 30 provided on the support 29. The leaf spring 37 is so constructed and arranged that the intermediate portion thereof engages the knee 28 of the armature 14 at a point disposed in alignment with the knife-edge 30 provided on the support 29, thereby securely to retain the knee of the armature in place on the knife-edge provided on the support.

The arrangement of the body portion 34 of the member 31 between the outer end of the operating portion 27 of the armature 14 and the outer surface of the body portion 18 of the field element 13 prevents the outer end of the operating portion of the armature and the adjacent outer surface of the body portion of the field element from sticking together due to the residual magnetic forces therebetween.

Furthermore, it is noted that the leaf spring 37 and the resilient arms 32 and 33 of the member 31 are so constructed and arranged that placement and removal of the armature 14 are facilitated while the relay is otherwise completely assembled. As best shown in Fig. 8, in order to remove the armature 14, while the relay is otherwise completely assembled, it is only necessary to grasp the body portion 26 thereof and exert an outward force thereupon, the resiliency of the leaf spring 37 and the arms 32 and 33 of the member 31 accommodating outward movement of the armature. Also, the knee 28 of the armature 14 may be readily placed upon the knife-edge 30 provided on the support 29 by inserting the operating portion 27 of the armature between the leaf spring 37 and the knife-edge 30 provided on the support 29 and then forcing the armature inwardly into position.

Also, it is noted that the outer end of the body portion 15 of the core element 11 carries an annular pole piece 38 which cooperates directly with

the body portion 26 of the armature 14. Furthermore, two longitudinally spaced-apart winding retaining heads 39 and 40 are carried by the body portion 15 of the core element 11, thereby positively to position the winding 12 carried by the body portion of the core element.

A set of associated switch springs 41 is carried by the body portion 18 of the field element 13 and operatively associated with the operating portion 27 of the armature 14. The set of switch springs 41 comprises two cooperating individual switch springs 42 and 43 arranged in superimposed relationship. Each of the switch springs comprises a base end and a free end and is provided with a cantilever mounting at its base end. Also, the switch springs are insulated from each other and from the body portion 18 of the field element 13 at their base ends. The arrangement for mounting and for insulating the base ends of the set of switch springs 41 comprises a clamping plate 44 and a plurality of insulating strips 45 disposed between the body portion 18 of the field element 13, the clamping plate 44 and the switch springs 42 and 43. Also, two screws 46 are provided which extend through aligned openings provided in the clamping plate 44, the insulating strips 45 and the switch springs 42 and 43 and are threaded into tapped holes provided in the body portion 18 of the field element 13. The switch springs 42 and 43 are of similar construction, the switch spring 42 having an elongated eyelet formed therein adjacent the free end thereof; while the switch spring 43 has a substantially Y-shape configuration. The constructions of the switch springs 42 and 43 provide each of the switch springs with two elongated laterally spaced-apart and independently flexible portions, the two flexible portions of the switch spring 43 being arranged in superimposed relationship with respect to the two flexible portions of the switch spring 42. The two flexible portions of each of the switch springs carry two metallic contacts which are arranged in cooperating relationship with two metallic contacts carried by the two flexible portions of the associated switch spring. More particularly, each pair of cooperating metallic contacts is arranged in crossing relationship, thereby to insure proper contact between the cooperating pairs of metallic contacts in spite of slight mechanical variations in the positions of the switch springs 42 and 43.

In order to facilitate movement of the switch spring 42 with respect to the associated switch spring 43, an operating member 47 is secured to the switch spring 42 adjacent the free end thereof by a driving screw 48. Preferably, the driving screw 48 is of the Parker-Kalon type; while the operating member 47 is formed of an inactive organic material, such, for example, as a suitable cellulose acetate.

The construction and arrangement of the switch springs, the operating member therefor, and the metallic contacts carried thereby are disclosed and claimed in the copending application of Frederic E. Wood, Serial No. 269,689, filed April 24, 1939.

The operating end of the operating member 47 carried by the switch spring 42 is arranged in direct engaging relationship with the operating portion 27 of the armature 14, whereby the armature 14 is biased in a clockwise direction about the laterally extending knife-edge 30 provided on the support 29, as viewed in Figs. 2 and 3, into a normal position. When the winding 12 of the relay is energized, the armature 14 is rotated about the laterally extending knife-edge 30 provided on the support 29 in a counterclockwise direction, as viewed in Figs. 2 and 3, thereby to cause the armature 14 to be moved from its normal position to an operated position. When the armature 14 is moved from its normal position to its operated position, the operating portion 27 thereof engages the operating member 47, thereby to cause the switch spring 42 to be bent toward the cooperating switch spring 43. More particularly, the two pairs of metallic contacts carried by the set of switch springs 41 are moved into respective engagements.

In view of the foregoing, it is apparent that an improved electromagnetic switching relay is provided which is of rugged and economical construction and which is reliable and positive in operation.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An electromagnetic relay, comprising a longitudinally extending field element, a substantially L-shaped armature including a body portion and an operating portion disposed in angular relationship, means including a support carried by said field element adjacent the end thereof and provided with a laterally extending knife-edge engaging the knee of said armature for pivotally mounting said armature on said field element, whereby the body portion thereof is operatively associated with said field element, means including two outwardly and longitudinally extending members disposed on opposite sides of said field element adjacent said support for restraining said armature against lateral displacement, a resilient element extending laterally between said members, the opposite ends of said element being supported by the ends of said members, and means including a mid-section of said element engaging a mid-section of the knee of said armature at a point disposed in alignment with the knife-edge provided on said support for retaining the knee of said armature in place on the knife-edge provided on said support.

2. An electromagnetic relay, comprising a longitudinally extending field element, a substantially L-shaped armature including a body portion and an operating portion disposed in angular relationship, means including a support carried by said field element adjacent the end thereof and provided with a laterally extending knife-edge engaging the knee of said armature for pivotally mounting said armature on said field element, whereby the body portion thereof is operatively associated with said field element, means including two outwardly and longitudinally extending members disposed on opposite sides of said field element adjacent said support for restraining said armature against lateral displacement, a concave leaf spring extending laterally between said members, the opposite ends of said leaf spring being supported by the ends of said members, and means including a mid-section of said leaf spring engaging a mid-section of the knee of said armature at a point disposed in alignment with the knife-edge provided on said support for retaining the knee of said arma-

ture in place on the knife-edge provided on said support.

3. An electromagnetic relay, comprising a longitudinally extending field element, a substantially L-shaped armature including a body portion and an operating portion disposed in angular relationship, means including a support carried by said field element adjacent the end thereof and provided with a laterally extending knife-edge engaging the knee of said armature for pivotally mounting said armature on said field element, whereby the body portion thereof is operatively associated with said field element, means including two outwardly and longitudinally extending resilient members disposed on opposite sides of said field element adjacent said support and engaging the opposite sides of the knee of said armature for restraining said armature against lateral displacement, a resilient element extending laterally between said members the opposite ends of said element being supported by the ends of said members, and means including a mid-section of said element engaging a mid-section of the knee of said armature for retaining the knee of said armature in place on the knife-edge provided on said support, said resilient members and said resilient element being so constructed and arranged that placement and removal of said armature is readily facilitated while said relay is otherwise completely assembled.

4. An electromagnetic relay, comprising a longitudinally extending field element, a substantially L-shaped armature including a body portion and an operating portion disposed in angular relationship, means including a support carried by said field element adjacent the end thereof and provided with a laterally extending knife-edge engaging the knee of said armature for pivotally mounting said armature on said field element, said armature being so constructed and arranged that the body portion thereof is operatively associated with said field element and that the operating portion thereof extends along said field element, a member formed of nonmagnetic material and carried by said field element adjacent the end thereof, said member being provided with two outwardly extending resilient arms disposed on opposite sides of said field element adjacent said support and engaging the opposite sides of the knee of said armature, thereby to restrain said armature against lateral displacement, the ends of said arms being apertured and extending beyond said armature, means including a leaf spring extending between the arms of said member and engaging the knee of said armature for retaining the knee of said armature in place on the knife-edge provided on said support, the ends of said leaf spring being received in the apertures in the ends of said arms, said member and said leaf spring being so constructed and arranged that placement and removal of said armature is readily facilitated while said relay is otherwise completely assembled, and means including a portion of said member disposed between said field element and the operating portion of said armature for preventing the operating portion of said armature and said field element from sticking together due to the electromagnetic forces therebetween.

FREDRIC E. WOOD.