Jan. 21, 1947. R. B. IMMEL 2,414,468

ELECTROMAGNETIC CONTACTOR

Filed Sept. 2, 1943 2 Sheets-Sheet 1

Fig. 1.

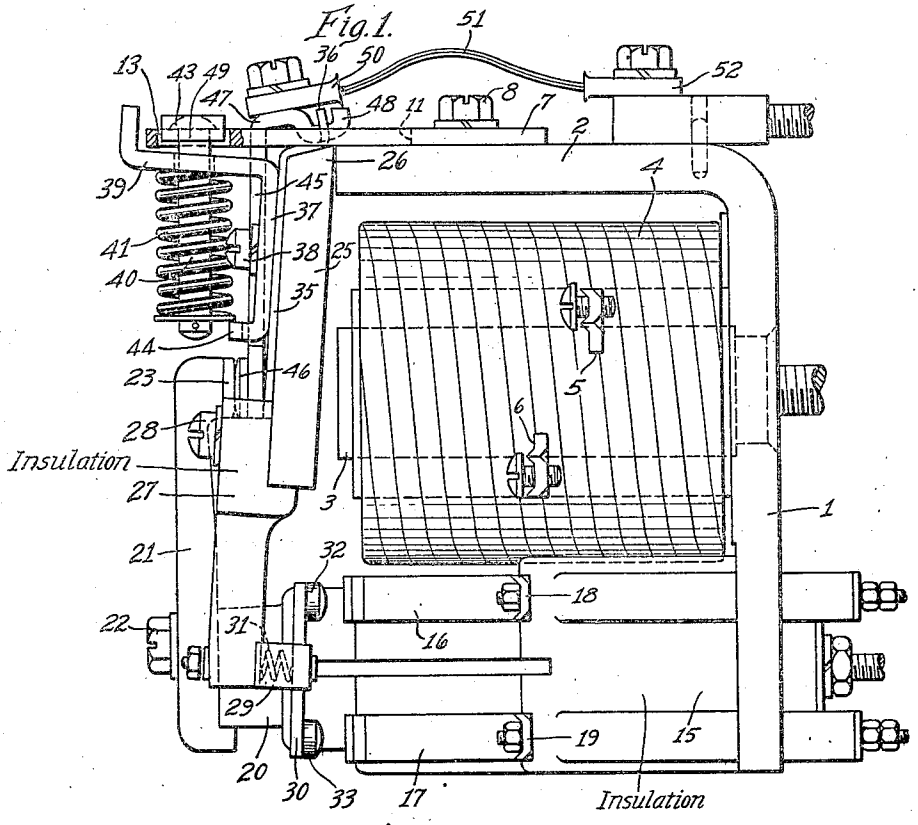
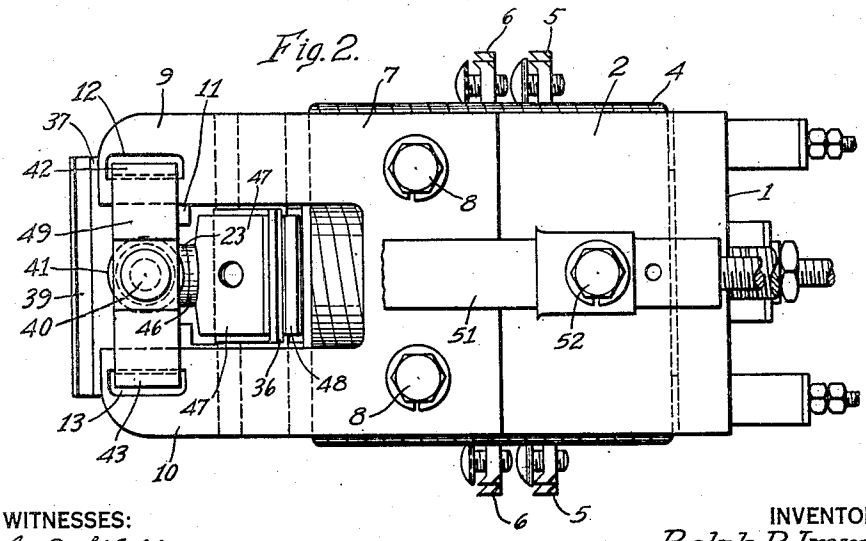


Fig. 2.



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Fig. 3.

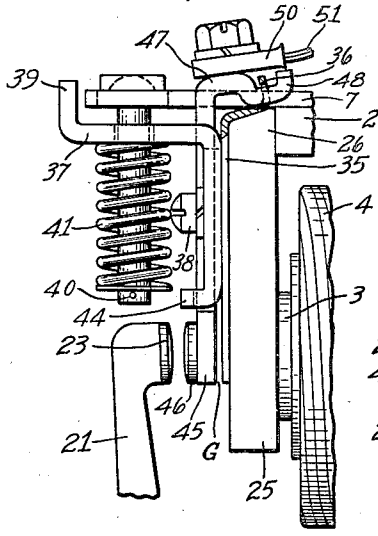


Fig. 4.

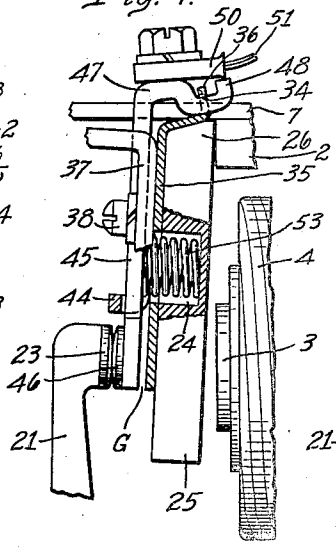
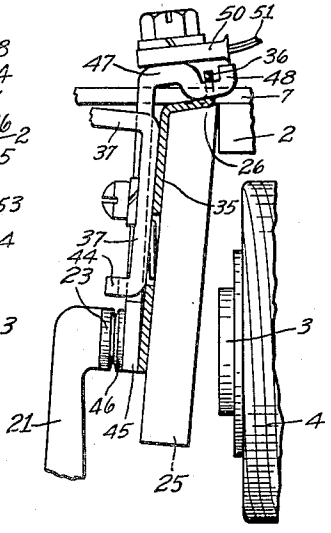


Fig. 5.



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UNITED STATES PATENT OFFICE

2,414,468

ELECTROMAGNETIC CONTACTOR

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Application September 2, 1943, Serial No. 500,888

2 Claims. (Cl. 200—87)

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This invention relates to electromagnetic contactors in which a movable contact is pivotally mounted on a rocking armature so as to be capable of limited angular motion relative to the armature and in opposition to a spring bias.

In the known contactors of this type, the armature-operated contact performs a sliding, wiping or rolling motion relative to the appertaining stationary contact during the period of the so-called armature overtravel, that is, after the movable contact has touched the stationary contact and hence stopped its forward motion while the armature, by virtue of the spring force effective between the armature and its contact, is permitted to continue to travel over for a limited additional distance (overtravel).

It is one of the recognitions underlying this invention that due to the above-mentioned sliding, wiping or rolling motion the electrical stress and wear on the contacts is increased, and hence the useful life of the contacts and consequently the period of undisturbed relay operation considerably reduced as compared with the operating time otherwise feasible. The reason for this detrimental effect lies in the fact that the relative motion between the contacts, occurring after the electrical engagement has been established, causes the transfer of contact material from one contact to the other and may also produce slight local sparking which enhances the transfer effect. This is especially the case with contacts of silver, or the like highly conductive material as is preferably employed in circuit-closing contacts, for instance, in time-limit relays.

Therefore, an object of the invention is to provide a contactor of the type here concerned, which is distinguished by a considerably increased life or operating time of its relay contacts as compared with the known contactors of this type.

Another object related to the foregoing is to reduce or substantially eliminate the tendency of the contacts to arc or spark and to develop a transfer of contact material during the overtravel period of the armature.

According to another object, the invention aims at achieving these results by providing a relay in which the overtravel motion of the armature has no appreciable effect on the motion of the contact resiliently assembled with the armature so as to eliminate any sliding, wiping, bouncing or rolling motion of the contact during the overtravel period.

An object in conjunction with those mentioned is to prevent relative motion of the relay contacts during the overtravel period by means of an armature structure of simple construction and easy method of assembly so that the desired advantages are obtained without drawbacks in other respects, and preferably by structural means which are even more easily to manufacture or assemble than the corresponding parts of comparable known relay constructions.

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For achieving these objects and in accordance with my invention, the armature of an electrically actuated contactor carries a substantially rigid contact member which is pivotally linked to the armature about an axis which substantially coincides with the rocking or pivot axis of the armature, both the armature and the movable contact member being biased towards a stationary stop.

According to a more specific feature of the invention, the armature of the contactor has a knife-edge type pivot edge resting against the stationary base or supporting structure and is provided with an extension or hinge member which projects over the pivot edge and forms a journal for the movable contact member.

These and other features of my invention will be apparent from the following description of the embodiment exemplified by the drawings, in which:

Figures 1 and 2 show a lateral and front view, respectively, of a timing relay according to the invention; and

Figs. 3, 4 and 5 illustrate schematically the armature and contact assembly of the same relay in three different stages of operation.

Referring to the timing relay represented in Figs. 1 through 5, the numeral 1 denotes the magnetic supporting or frame structure of the contactor. This frame is substantially L-shaped and carries a magnet core 3 in parallel to the limb 2 of the frame. A coil 4 is mounted on core 3. The coil has two separate windings, one forming the main winding of the relay and the other an auxiliary or neutralizing winding for providing a definite time limit. The neutralizing winding is provided with terminals 5 and the main winding with terminals 6 (Fig. 2). The use of two coils is not essential to the present invention, but is advantageous in timing relays for the reasons explained in United States Patent No. 1,979,709 to W. Schaelchlin et al.

An abutment plate 7 is firmly secured to the link 2 of the frame structure 1 by means of screws 8. The abutment plate 7 is bifurcated and forms two legs 9 and 10 separated from each other by a recess 11 (Fig. 2). The legs 9 and 10 have each an opening 12 and 13, respectively, for a purpose described in a later place.

An insulating body 15 is mounted on the structure 1 and carries two stationary contacts 16 and 17 and appertaining terminals 18 and 19, respectively. A copper blade 20 is mounted on the insulating body 15 and carries a stationary contact member 21 which is firmly attached to the blade 20 and the insulating body 15 by means of a screw 22. Member 21 carries a contact 23 consisting preferably of silver or the like highly conductive material. The above-described elements in totality form substantially the stationary assembly of the relay.

The movable relay assembly includes a magnetic armature 25 which has one of its edges beveled so as to form a knife-type edge at 26. This edge rests against the dihedral pivot bearing formed in the corner between the two adjacent surfaces of the limb 2 and the abutment plate 7. The armature 25 thus lies in a magnetic circuit formed by the magnetic core 3, the base portion of the structure 1, the limb 2 and the armature 25.

An insulating member 27 is firmly mounted on the armature 25 by means of a screw 28 and carries at its peripheral end a saddle 29 which serves as a guiding member for a bridge piece 30 and houses a coiled compression spring 31 tending to move the bridge piece 30 away from the insulating carrier 27. Two contacts 32 and 33 are attached to the bridge piece 30 in order to cooperate with the stationary contacts 16 and 17, respectively. Consequently, when the armature assembly is in the position illustrated in Fig. 1, the circuit between stationary contacts 16 and 17 is interrupted, while, when the armature is attracted by the magnet core 3 upon proper energization of the relay main winding, the bridge piece 30 is pressed against the stationary contacts under compression of spring 31, and hence establishes a conductive connection between contacts 16 and 17.

A hinge plate 35 located at the surface of the armature 25 away from the magnet is firmly secured to the armature, and has one of its ends extending close to the pivot edge at 26. The outermost end 36 of plate 35 is bent away from the armature (Fig. 1) and has an opening 34 (Fig. 4) which forms a hinge for the movable contact member described hereinafter.

A rigid bracket 34, for instance of steel, is also attached to the armature, a screw 38 serving to connect the bracket 37 and the hinge plate 35 to the armature 25. The limb 39 of bracket 37 has an opening traversed by a bolt 40 which carries a helical compression spring 41 (Fig. 1). A cross bar 49 is firmly secured to the bolt 40 and has its lateral short edges bent away at a right angle so as to form lugs at 42 and 43 (Fig. 2). When in the illustrated operative position, the spring 41 is compressed between leg 39 of bracket 37 and a washer carried by the bolt 40. As a result, the spring 41 pulls lugs 42 and 43 into the respective openings 12 and 13 in legs 9 and 10 of the abutment plate 7. In this manner, the armature assembly is yieldingly secured in proper working position relative to the stationary parts of the relay structure and is limited to angular movements about the pivot axis at 26.

A rigid contact member 45 which carries a contact 46 is pivoted to the armature in the following manner. The end 47 away from contact 46 is bent at an angle to the main portion of member 45 and passes at its outermost end 48 through the opening 34 in the hinge plate 35 (Fig. 4). Consequently, the contact member 45 is capable of angular motion about the pivot formed at 34 and 48. A compression spring 53, placed in a cavity 24 of the armature 25 and pressing against the member 45, biases the member away from the armature. The relative motion between contact member and armature is limited by a stop 44 formed by the bracket 37 (Fig. 4).

A terminal 50 is attached to the portion 47 of the movable contact member 45 and is connected by a flexible cable 51 with a terminal 52 serving to supply electric current through the movable contact member to its contact 46. The contact 46 cooperates with the stationary contact 23 and consists also of a highly conductive material, such as silver.

The operation and advantages of the above-described timing relay will be more fully understood from a consideration of its contact closing function, three different stages of which are illustrated in Figs. 3, 4 and 5.

A timing relay of the type here exemplified has the main function of performing a contact closing operation upon the elapse of a given period of delay after the deenergization of the relay main winding. In order to place the relay in operative condition, the main winding is energized so that the armature assembly is normally attracted by the magnet and closes the auxiliary contacts at 16, 32 and 17, 33 (Fig. 1), while the main timing contact between 23 and 46 is kept open. This condition of the main timing contacts is represented in Fig. 3.

Upon deenergization and after the elapse of the timing period, the armature 25 is magnetically released and moves away from the magnet under the bias of spring 41 (Fig. 1). The movable contact member 45 pivoted to the armature is at first pressed by spring 53 against the stop 44 (Fig. 4), and hence participates in the motion of the armature without performing any motion relative to the armature. This concurrent motion continues until the contact 46 hits the stationary contact 23, and thus is stopped from further motion away from the magnet 3. This stage of the contact closing operation is shown in Fig. 4. At this stage, a gap exists at G between the movable member 45 and the armature 25. However, while contact 23 engages the movable contact member, it does not stop the further angular motion of the armature 25. That is, the main spring 41 of the relay is stronger than the spring 53, and hence continues to force the armature 25 farther away from the magnet until eventually the gap at G is closed. Then the armature is also stopped.

Considering now the period of overtravel motion, i. e. the period elapsing between the positions shown in Figs. 4 and 5, it will be seen that, during the angular motion of the armature 25 necessary for closing the gap G, the movable contact 46 and the appertaining contact member 45 do not perform an appreciable motion relative to the stationary contact 23. In other words, the only effect of the relative overtravel between the armature and the movable contact member is to increase the compression of spring 53, thus increasing the contact pressure between contacts 23 and 46 up to the desired magnitude.

The absence of a wiping, rolling or bouncing motion between the contacts during the overtravel period is especially noticeable if the relay according to the invention is compared with known relays of comparable type.

The superiority of devices according to the in-

vention as compared with known relays that permit a relative contact motion to take place during the overtravel period has been verified by a number of comparative tests. The tests were made with timing relays according to Figs. 1 through 5 in comparison with relays of the known type and under operating conditions similar to the customary test requirements for such timing relays. The contacts were rated for 300 amperes continuously and were used for closing the circuit only. The tests were made by closing a resistive load circuit of 500 amperes and 230 volts. Under equal conditions for both relays, it was found that, in cases where the entire contact material was transferred from one contact to the other in between 10,000 and 20,000 closing operations when using the known type relay, the relay according to the present invention remained in satisfactory condition after as many as 160,000 closing operations. After this number of operations, the tests were discontinued because the satisfactory appearance of the contacts indicated that the operations would have to be continued up to a great multiple of this number in order to produce appreciable damage to the contacts. Oscillograms taken with the two contact assemblies were in line with the just-mentioned results. A ripple in the arc voltage line of the known type relay indicated that bouncing occurred between the contacts during the overtravel periods. The corresponding arc voltage line of the contact assembly, according to this invention, did not show these ripples, and hence indicated the absence of such bouncing.

It should be noted that in spite of these advantages the above-described relay according to my invention is of simple construction and advantageous to manufacture and assemble. Thus, the entire movable armature assembly of the relay is attached to the stationary structure merely by the force of the main spring **41**. Consequently, the movable assembly can be removed from the relay by pulling the lugs **42** and **43** out of the openings **12** and **13** and then moving the entire armature assembly away from the stationary structure. The assembly can just as easily be reinserted. This facilitates manufacturing and assembling the relay and affords free access to the magnet core for the purpose of making repairs or adjustments, in particular for changing the adjustment of the time limit by exchanging the short-circuiting winding or sleeve or the one magnetic shim usually provided in such relays for obtaining a desired delay period.

Being aware of the fact that others skilled in the art may modify the relays according to my invention without departing from the objects, the features and scope of the invention, I wish this specification to be understood as illustrative and not in a limiting sense.

I claim as my invention:

1. A contactor comprising a stationary structure, an armature having two aligned pivot edges spaced from each other for engaging said structure so as to permit limited angular movement of said armature relative to said structure, a substantially rigid member having one end pivoted to said armature at a point between said pivot edges and substantially in alignment therewith, means disposed between said armature and said member for biasing said member a limited extent angularly away from said armature, a movable contact mounted on said member, a stationary contact mounted on said structure for engaging said movable contact, a spring for biasing said armature so as to hold said movable contact in engagement with said stationary contact while stressing said biasing means, and actuating means for causing said armature to move said member and movable contact away from said stationary contact in opposition to said spring.

2. A contactor comprising a stationary structure, an armature having two aligned pivot edges spaced from each other for engaging said structure so as to permit limited angular movement of said armature relative to said structure, said armature having a hinge disposed between said pivot edges, a substantially rigid arm disposed substantially in face-to-face relation to said armature and having one end linked to said hinge so as to be capable of angular motion relative to said armature about an axis substantially in alignment with said edges, a movable contact mounted on the other end of said arm, means disposed between said arm and said armature for biasing said latter end a limited extent away from said armature, a stationary contact mounted on said structure for engaging said movable contact, a spring for biasing said armature so as to hold said movable contact in engagement with said stationary contact while stressing said biasing means, and actuating means for causing said armature to move said member and movable contact away from said stationary contact in opposition to said spring.

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