MULTIPOLAR ELECTROMAGNETIC CONTACTOR

John Scheib, Jr., Elmsford, and Carl Ehmann, Yonkers, N.Y., assignors of one-half interest to Ward Leonard Electric Co., Mount Vernon, N.Y., a corporation of New York, and one-half interest to Struthers-Dunn, Inc., Pitman, N.J., a corporation of Pennsylvania

Filed Nov. 3, 1966, Ser. No. 591,760
15 Claims. (Cl. 335—126)

ABSTRACT OF THE DISCLOSURE

A multipolar electromagnetically operable contactor is disclosed designed for ready and simple assembly, and for ready conversion from normally open to normally closed contacts, or vice versa. The contactor includes a movable contact carrier having slots therein for receiving normally open and normally closed movable contact assemblies. The assemblies include movable contact bars, biasing springs and spring retainers. Fixed projections from the housing fit into the slots of the movable contact carrier for receiving the load of at least some of the spring biased movable contacts for reducing the strength required of the return springs.

This invention relates to an electromagnetically operable contactor, and particularly a multipole control circuit relay.

One purpose of the invention is to provide a multipole electromagnetically operable relay so designed as to be readily and simply assembled.

Another purpose is to provide a relay as aforesaid which is not only designed for simplified assembly but which is also so designed that its contacts are readily convertible from normally open to normally closed, or vice versa.

Another purpose is to provide a relay of the foregoing type in which the stress or loading on the magnet frame is the same whether the contacts are assembled for normally open or normally closed, thereby to reduce the strength required of the return spring.

Still another purpose is to provide a relay of the foregoing type which is quiet and not subject to vibrational noise.

The way in which the foregoing purposes as well as other purposes and advantages are accomplished will be clear from the following detailed description of one preferred form of the relay selected for illustration in the drawings, wherein:

FIG. 1 is a front view of a four-pole relay according to the present invention;

FIG. 2 is a top view of the relay of FIG. 1;

FIG. 3 is a view in section along the line and looking in the direction of the arrows III—III of FIG. 2, showing the interior of the relay;

FIG. 4 is a view in section along the line and in the direction of the arrows IV—IV of FIG. 3, showing the interior of the relay looking in a direction perpendicular to that of FIG. 5;

FIG. 5 is an end view in section looking rearwardly at the stationary contacts along the line and in the direction of the arrows V—V of FIG. 3;

FIG. 6 is a view in section looking rearwardly along the line and in the direction of the arrows VI—VI of FIG. 3, showing the guide for the contact carrier and yoke assembly;

FIG. 7 is a detailed view in section of one of the fixed contacts looking along the line and in the direction of the arrows VII—VII of FIG. 3, showing the interference fit of the contact in the slot of the housing;

FIG. 8 is a detail view looking forwardly at the backside of the fixed contact of FIG. 7 along the line and in the direction of the arrows VIII—VIII of FIG. 7;

FIG. 9 is a detail view of one of the movable contacts looking along the line and in the direction of the arrows IX—IX of FIG. 4;

FIG. 10 is a detail view of the spring retaining washer looking along the line and in the direction of the arrows X—X of FIG. 9; and

FIG. 11 is a view of the two halves of the housing and of the contact carrier, yoke, armature, coil and frame about to be put together in final assembly.

Referring now to the drawings, the relay housing consists of a lower half 20 and an upper half 21, each half being a molded plastic piece. In FIG. 11, the lower half 20, which has a projecting base portion 20a, is shown on the left, and the upper half 21 is shown on the right. The dot-and-dash lines indicate how the pieces fit together.

As seen best in FIGS. 3, 4 and 5, the two halves of the housing support the electromagnetic coil 22, the magnet frame 23, and eight fixed or stationary terminal contacts. The fixed terminal contacts are in two sets of four each, the contacts of the one set, the left set as viewed in FIGS. 3, 5 and 11 being identified by reference numeral 31, and the contacts of the other set, the right set, being identified by the reference numeral 32. The two housing halves also provide guides for the movable contact carrier 48 and yoke 48d, later described in connection with FIGS. 3, 4 and 11. The housing halves also provide mounting means, not shown, for the relay. The relay is ordinarily mounted in horizontal position, that is, in such position that the contact carrier 48 moves horizontally. In FIG. 11, for example, the edge of the relay along the dotted bracket line would be mounted, ordinarily at least, on a vertically disposed panel board.

The upper housing half 21 is fastened to the lower housing half 20 by means of two projections 42 which project from the base of the upper half 21 and fit into recesses or slots 26 in the base of the lower half 20, as indicated in FIG. 11. These projections and slots interlock the two housing halves at the base. The two housing halves are held together at the front by a spring clip 28.

The spring clip 28 contains a rectangular slot 29 (FIG. 1) which fits over projections 41 and 42 which project from the front of the upper and lower housing halves. The rectangular slot 29 of the spring clip 28 is accurately made and functions to hold the two housing halves together without use of the spring clip tension. The spring clip 28 holds itself onto the two housings halves by means of downward spring projections 28a, 28b, as seen in FIGS. 2 and 3.

The eight fixed or stationary terminal contacts 31 and 32 have an interference fit into slots 33, 34 of the two housing halves, as seen in FIG. 7. This will be described in detail later.

The E-shaped laminated magnet frame 23 (FIGS. 3 and 4) fits loosely into the lower housing half 20. The outer edges of the end legs of the E-shaped laminations are slotted, and these slots receive the locking projections 20a and 20b of the lower housing half 20. The center leg of the E-shaped laminations projects outwardly into the bore of the electromagnetic coil 22. The laminated unit 23 while locked by the projections 20a and 20b has limited freedom of movement, and this freedom of motion eliminates a source of vibration noise which sometimes occurs if the magnet frame is tightly fastened.

The laminated armature 46 fits loosely into the yoke 48a of the contact carrier 48, being locked by the locking projections 48b and 48c. The loose fit eliminates a possible
source of noise which would occur if the armature were fastened rigidly to the contact carrier. The armature has ground faces which are very flat and a tight fit would tend to distort them.

The return spring 45 (FIGS. 3 and 4) is assembled between the electromagnetic coil 22 and the E-shaped laminated armature 46 and fits into a recess 47 in the coil molding 22a. This locates the return spring.

In FIG. 3, the relay, the contact carrier 48 and yoke 48b with the E-shaped laminated armature 46 loosely locked thereto, the return spring 45, the electromagnetic coil 22, and the E-shaped magnet frame 23, all of which are shown together in the center of FIG. 11, are held together, as by the fingers of the assembler, and inserted into the lower housing half 20, using a sliding motion, the locking projections 20a and 20b entering the slots in the edges of the magnet frame 23. The upper housing half 21 is then placed in position, and the housing halves locked.

It will be seen that the electromagnetic coil 22 (FIGS. 3 and 4) is located by means of the upper and lower housing halves 20 and 21 and is loosely held by these housings. The fact that the coil 22 is not rigidly fastened to the magnet frame 23 also eliminates a possible source of noise.

The contact carrier 48 contains eight rectangular slots, four forward slots 51 and four rearward slots 55. The movable contact bars are assembled in these slots. The movable contact bars are located in the assembly, whereas the four rearward slots 55 are for the normally closed assemblies. The movable contact bars, later identified, can be used for either normally open or normally closed contact by merely shifting the bars to a forward or rearward slot.

In FIG. 4, 51 of the drawing, two movable contact bars 52 are shown in two of the four forward normally open slots 51, and two movable contact bars 56 are shown in two of the four rearward normally closed slots 55.

The lower housing 20 contains four projections 65 (FIGS. 3 and 4) which fit into the normally closed rearward slots 55 of the contact carrier 48. In FIG. 4, two movable normally open contact springs 78 are shown in the forward slots 51 and two movable normally closed springs in the rearward slots 55. Associated with each spring is a cup washer or retainer 77. When the coil 22 is in energized condition, the contact carrier 48 is in its forward position, the housing projections 65 fit behind the cup washers or retainers 77 of the movable contact springs 78. By means of the housing projections 65, the force of the springs 78 is transmitted from the carrier 48 to the housing. Thus, the loading on magnet frame 23 is the same whether the contacts are assembled normally open or normally closed. This reduces the strength required for return spring 47, which otherwise would have to be strong enough to overcome up to a possible eight normally closed contacts.

The four contact springs 78 shown in FIG. 4, two in the forward slots 51 and two in the rearward slots 55, bear upon the movable contact bars 52 in the forward slots 51 and upon the movable contact bars 56 in the rearward slots 55. The cup washers 77 in the rearward normally closed slots function not only as spring retainers, they simplify the assembly of the normally closed contacts. As shown in FIG. 7, the cup washers or cup washers 77a which allow the cup washer and spring to be cammed forward by the ramp edge 65a of the housing projection 65 during assembly.

The cup washers 77 also contain, as best seen in FIG. 9, a projection 77b for locating the spring. The projection 77b is located so that the spring is fastened to the projection and retained by the undercut. In this way, the spring washer 77 and the spring 78 become an assembly. This makes very convenient the assembly and the converting of contacts from normally open to normally closed and vice versa.

The movable contact bars 52 and 56 have rectangular shaped holes in their centers (see FIG. 5 for holes 56a) which fit over projections 49 within the slots 51 and 55 of the contact carrier 48. The projections 49 project forward from the forward slots 51 and project rearward from the rearward slots 55. These projections 49 act as guides for the movable contacts. This construction also allows the option of substituting two movable contact bars and obtaining bifurcated contacts.

As best seen in FIG. 6, the contact carrier 48 and yoke 48a are centrally guided by means of a molded projection 48b at the bottom of the contact carrier 48 which fits into a slot 25 in the lower molded housing 20. A projection 61 at the front of the movable contact carrier 48 fits into an open slot 27 at the front of the housing. The projection 61 may, if desired, also contain a T-shaped slot, not shown, which may be used for fastening either a pneumatic timer or a latch to the contact carrier. This is an optional feature.

Reference is now made to the way in which, after the pieces shown in FIG. 11 are assembled together, the stationary terminal contacts 31 and 32 are interference fitted into slots 33, 34 in the housing halves. FIG. 5 is a view looking rearwardly at the stationary contacts 31 and 32. FIGS. 7 and 8 are detailed views of one of the stationary contacts 31 fitted into the housing slot 33. Slot 33 is somewhat wider than the widest part of stationary contact 31 and is also somewhat higher than the contact 31 so that initial entry of the contact into the slot 33 is easily made. The part 31b of the contact 31 is wider than the portion 31a, and shoulders 31c are formed where the change in width occurs. As the contact is slid into the slot, the shoulders 31c reach and abut against shoulders 33c in the housing slot. Immediately adjacent the housing shoulders 33c, wedge shaped projections 33d of the housing engage the surface of the contact 31 at the wide portion 31b, thereby clamping the contact 31 in place with sufficient firmness to allow ready and easy insertion of the terminal screw 35 without risk of the fixed contact 31 falling out during the screw inserting operation. This feature contributes importantly to the simplified and easy manner in which the relay is assembled.

Contact carrier 48 may preferably be formed of nylon. While the preferred embodiment of this invention has been described in some detail, it will be obvious to one skilled in the art that various modifications may be made without departing from the invention as hereinafter claimed.

What is claimed is:

1. In an electromagnetically operable contactor, first and second housing halves supporting therein an electromagnetic coil and a magnetic frame, said first and second housing halves having slots therein for receiving stationary terminal contacts; stationary terminal contacts fitted into said slots in said first and second housing halves; a movable contact carrier and yoke assembly guided for movement within said housing; means fastening said first and second housing halves together in interlocked relationship; an armature fitted into said contact carrier and yoke assembly, said contact carrier having rectangular slots therein for receiving normally open and normally closed movable contact assemblies; movable contact assemblies in said slots of said contact carrier, said assemblies including a plurality of bars, biasing springs and spring retainers; housing projections fitted into said slots of said contact carrier for receiving the load of at least some of the spring-biased movable contacts; and a return spring for returning said armature and movable contact carrier to the de-energized position.

2. In an electromagnetically operable contactor, first and second housing halves supporting loosely therein an electromagnetic coil and a magnetic frame, said first and second housing halves having slots therein for receiving stationary terminal contacts; stationary terminal contacts interference fitted into said slots in said first and second housing halves; a movable contact carrier and yoke as-
3,409,851

assembly guided for movement within said housing; means fastening said first and second housing halves together in interlocked relationship; an armature loosely fitted into said contact carrier and yoke assembly, said contact carrier having first and second rectangular slots therein for receiving normally open and normally closed movable contact assemblies, respectively; movable contact assemblies in said slots of said contact carrier, said assemblies including movable contact bars, biasing springs and spring retainers; housing projections fitted into said second slots of said contact carrier adjacent said spring retainers for receiving the load of said spring-biased normally closed movable contacts; and a return spring for returning said armature and movable contact carrier to the de-energized position.

3. In a device as claimed in claim 2 characterized in that said spring retainers are provided with ramp extensions and in that said housing projections are provided with ramp edges for camming engagement with the ramp extensions of said spring retainers.

4. In a device as claimed in claim 2 characterized in that said means for fastening said first and second housing halves together includes fixed projections from each housing half, and a spring clip having a slot therein for receiving and embracing said projections.

5. In a device as claimed in claim 2 characterized in that said movable contact carrier and yoke assembly is centrally guided by a central bar projection on said carrier and yoke assembly, and a central slot in said housing.

6. In a device as claimed in claim 2 characterized in that said first and second slots in said contact carrier are provided with projections, and in that said movable contact bars are provided with center slots for receiving said projections.

7. In a device as claimed in claim 3 further characterized in that said spring retainers are cup washers having an undercut projection for receiving and retaining the spring.

8. In a device as claimed in claim 3 further characterized in that said means for fastening said first and second housing halves together includes fixed projections from each housing half, and a spring clip having a slot therein for receiving and embracing said projections.

9. In a device as claimed in claim 3 further characterized in that said movable contact carrier and yoke assembly is centrally guided by a central bar projection on said carrier and yoke assembly, and a central slot in said housing.

10. In a device as claimed in claim 3 further characterized in that said first and second slots in said contact carrier are provided with projections, and in that said movable contact bars are provided with center slots for receiving said projections.

11. In an electromagnetically operable contactor; first and second housing halves supporting therein an electromagnetic coil, a fixed magnetic frame, a movable contact carrier and yoke assembly, and an armature loosely fitted into said contact carrier and yoke assembly; the sides of both housing halves having slots and recesses therein for receiving respectively stationary terminal contacts and terminal screws, said recesses communicating with said slots; stationary terminal contacts interference fitted into said slots; and terminal screws in said recesses connected to said stationary terminal contacts; said contact carrier having first and second rectangular slots for receiving normally open and normally closed movable contact assemblies, respectively; movable contact assemblies in said slots, said assemblies including movable contact bars, biasing springs and spring retainers; said first housing half having projections which fit into said first slots adjacent the spring retainers for receiving the load of said spring-biased normally closed movable contacts.

12. In a device as claimed in claim 11 further characterized in that said spring retainers contain ramp extensions, and in that said housing projections have ramp edges for camming engagement with the ramp extensions of the spring retainers.

13. In an electromagnetically operable contactor; first and second housing halves supporting therein an electromagnetic coil, a fixed magnetic frame, and a movable contact carrier, yoke, and armature assembly, said carrier having first and second slots therein; normally open and normally closed movable contact assemblies in said first and second slots respectively, said assemblies including movable contact bars, springs and spring retainers; said second housing half having projections fitting into said second slots of said carrier adjacent the spring retainers for receiving the load of the normally closed spring-loaded movable contacts therein.

14. In a device as claimed in claim 13 further characterized in that said spring retainers have ramp extensions, and in that said second housing projections have ramp edges for camming engagement with the ramp extensions of the spring retainers.

15. In a device as claimed in claim 14 further characterized in that said spring retainers have an undercut projection for receiving and retaining said springs, thereby to facilitate assembly of said device.

References Cited

<table>
<thead>
<tr>
<th>UNITED STATES PATENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,129,304 4/1964 Hyink</td>
</tr>
<tr>
<td>3,194,920 7/1965 Schieb</td>
</tr>
<tr>
<td>3,215,800 11/1965 Hurter</td>
</tr>
<tr>
<td>3,290,628 12/1966 McGary</td>
</tr>
</tbody>
</table>

BERNARD A. GILHEANY, Primary Examiner.

H. BROOME, Assistant Examiner.