Nov. 5, 1968 J. SCHEIB, JR., ET AL 3,409,851

MULTIPOLE ELECTROMAGNETIC CONTACTOR

Filed Nov. 3, 1966 2 Sheets-Sheet 1

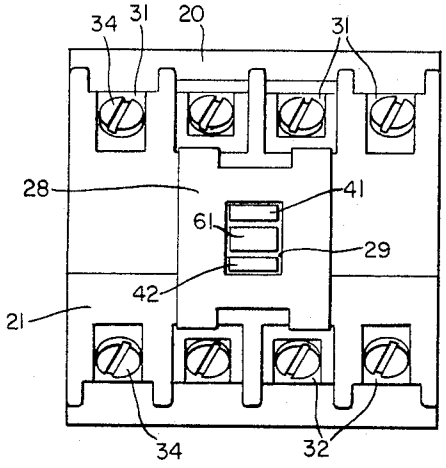


Fig. 1

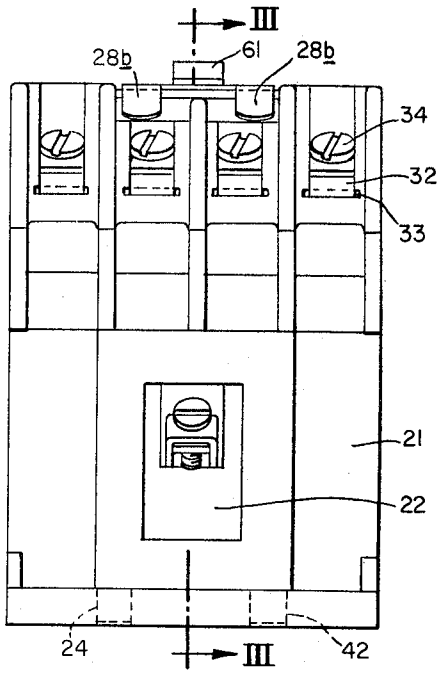


Fig. 2

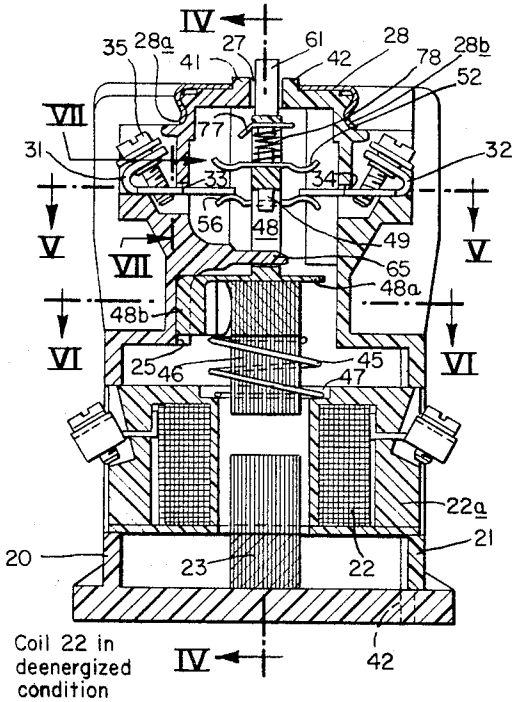


Fig. 3

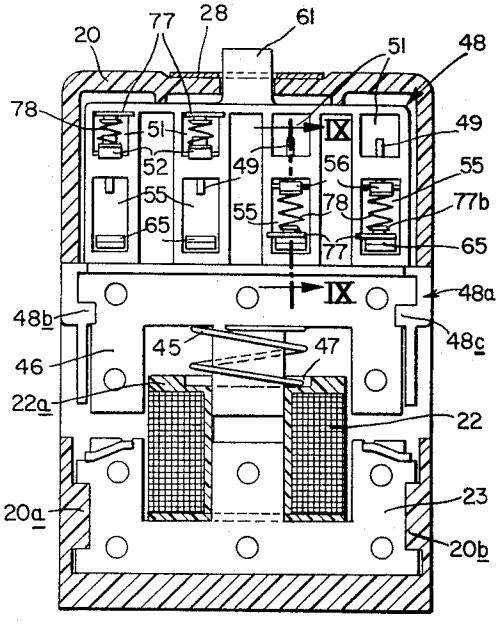


Fig. 4

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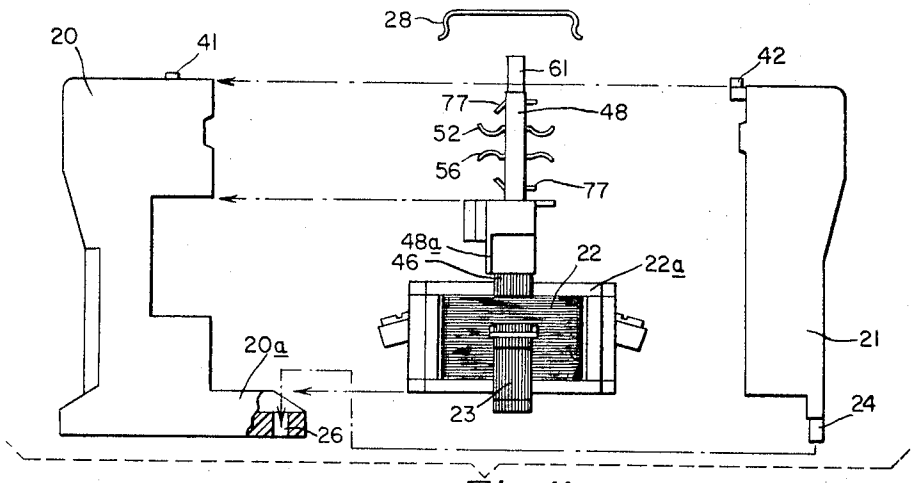


Fig. 11

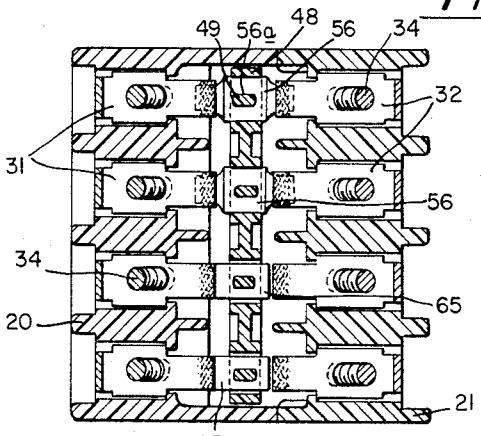


Fig. 5

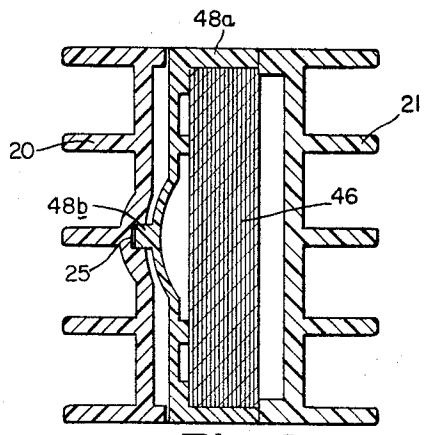


Fig. 6

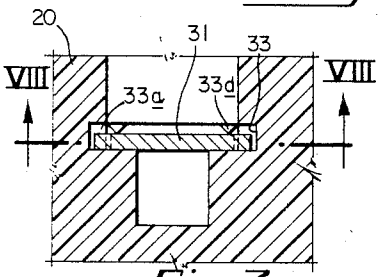


Fig. 7

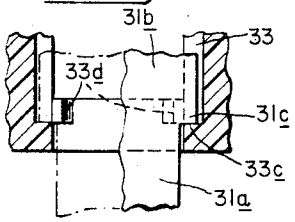


Fig. 8

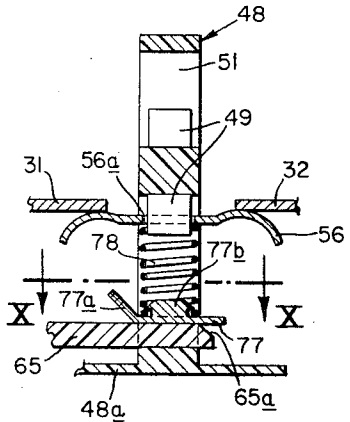


Fig. 9

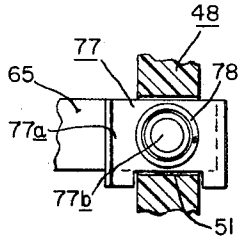


Fig. 10

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MULTIPOLE ELECTROMAGNETIC CONTACTOR

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

ABSTRACT OF THE DISCLOSURE

A multipole 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. 3;

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 **20***a*, 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 and 4, 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 **48***a*, 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 **24** 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 **28***a*, **28***b*, 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 **20***a* and **20***b* of the lower housing half **20**. The center leg of the E-shaped laminations projects outwardly into the center bore of the electromagnetic coil **22**. The laminated unit **23** while locked by the projections **20***a* and **20***b* 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 to the housing.

The laminated armature **46** fits loosely into the yoke **48***a* of the contact carrier **48**, being locked by the locking projections **48***b* and **48***c*. 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 **22***a*. This locates the return spring.

In assembly of the relay, the contact carrier **48** and yoke **48***b* 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 **20***a* and **20***b* 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 four forward slots **51** are for the normally open contact assemblies, 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 to a rearward slot.

In FIG. 4 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 deenergized condition, and 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. 9, the cup washers **77** contain a ramp **77***a* which allows the cup washer and spring to be cammed forward by the ramp edge **65***a* of the housing projection **65** during assembly.

The cup washers **77** also contain, as best seen in FIG. 9, a projection **77***b* for locating the spring. The projection **77***b* is undercut so that the spring **78** 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 **56***a*) 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 **48***a* are centrally guided by means of a molded projection **48***b* 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 is thick, so that initial entry of the contact into the slot **33** is easily made. The part **31***b* of the contact **31** is wider than the portion **31***a*, and shoulders **31***c* are formed where the change in width occurs. As the contact is slid into the slot, the shoulders **31***c* reach and abut against shoulders **33***c* in the housing slot. Immediately adjacent the housing shoulders **33***c*, wedge shaped projections **33***d* of the housing engage the surface of the contact **31** at the wide portion **31***b*, 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 movable contact 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-

sembly 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.

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