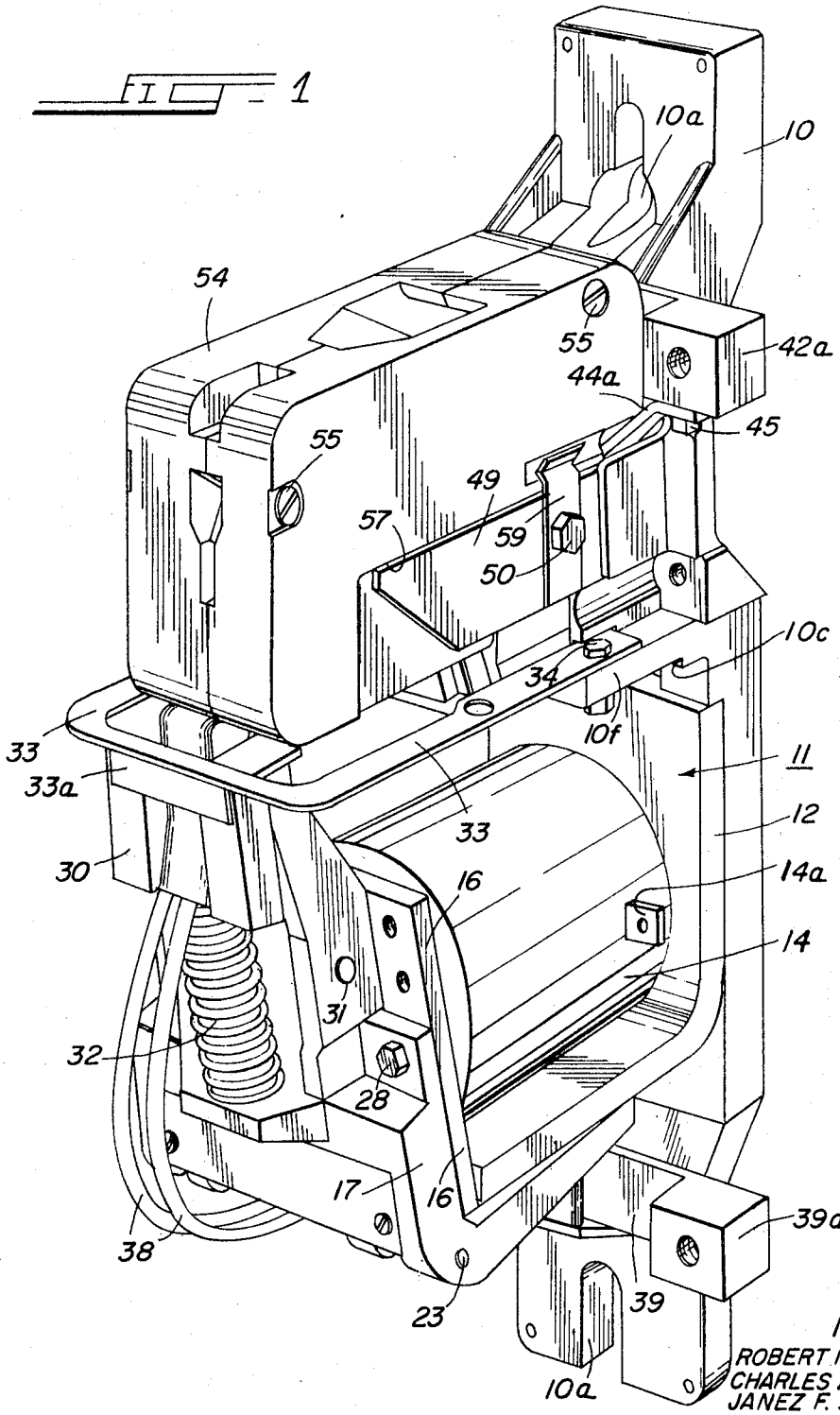
Aug. 18, 1970 R. M. SCHRAMM ET AL 3,525,059

ELECTROMAGNETIC CONTACTOR

Filed May 6, 1968 4 Sheets-Sheet 1

FIG. 1



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ELECTROMAGNETIC CONTACTOR

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FIG-3

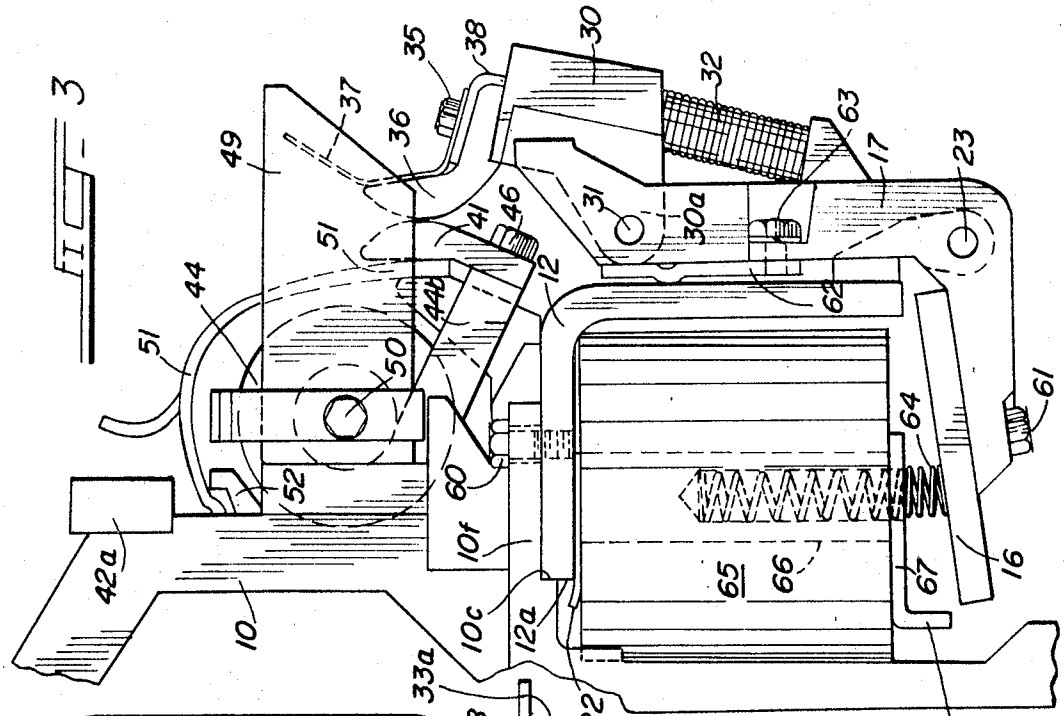
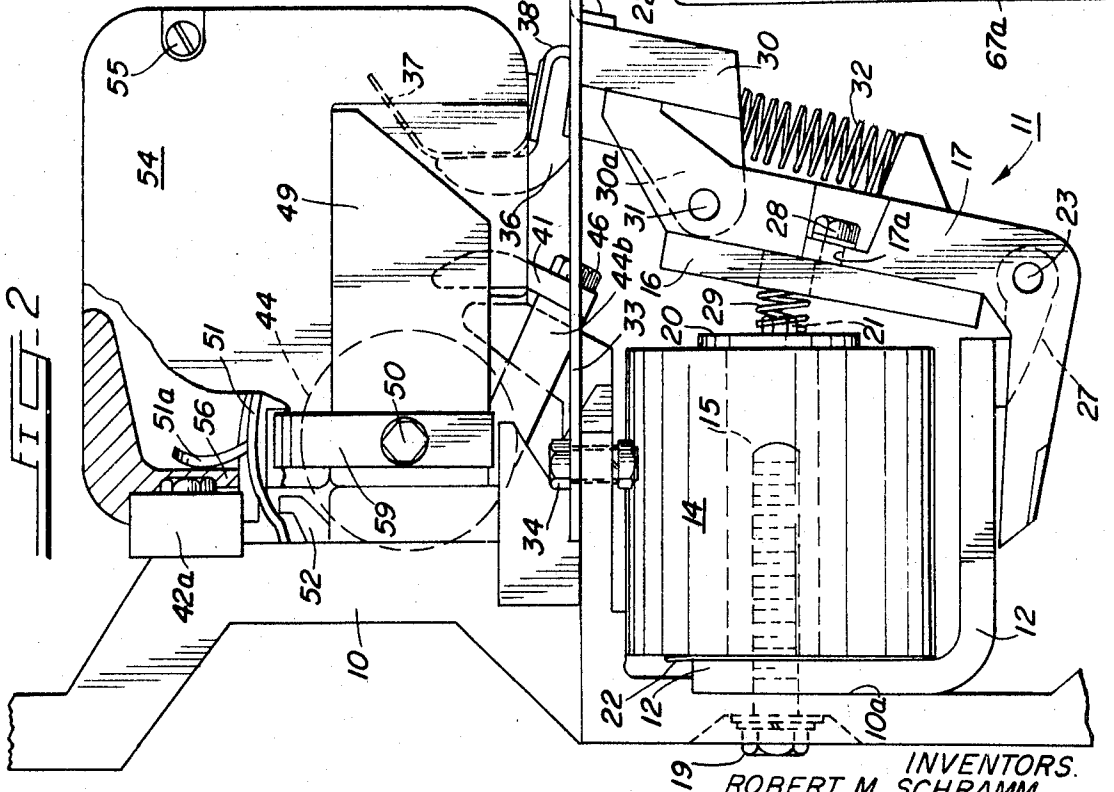


FIG-2



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ELECTROMAGNETIC CONTACTOR

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FIG. 4

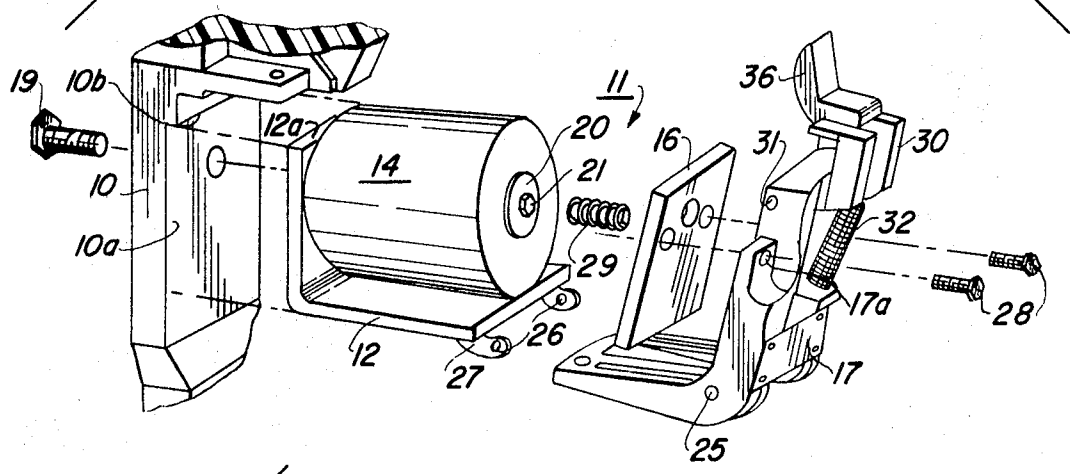
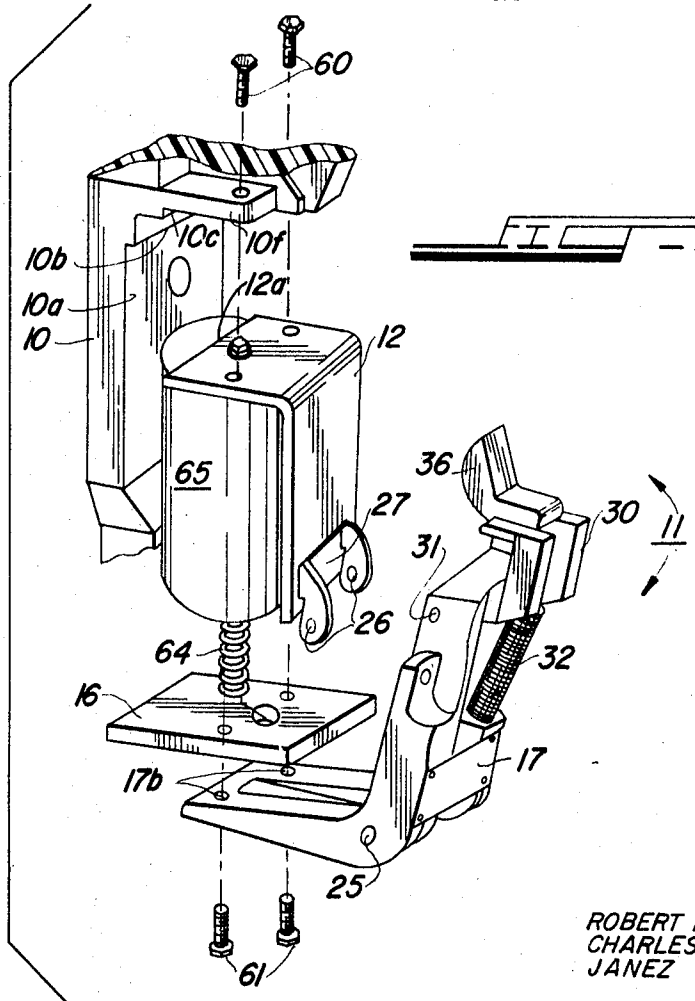


FIG. 5



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ELECTROMAGNETIC CONTACTOR

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FIG. 6

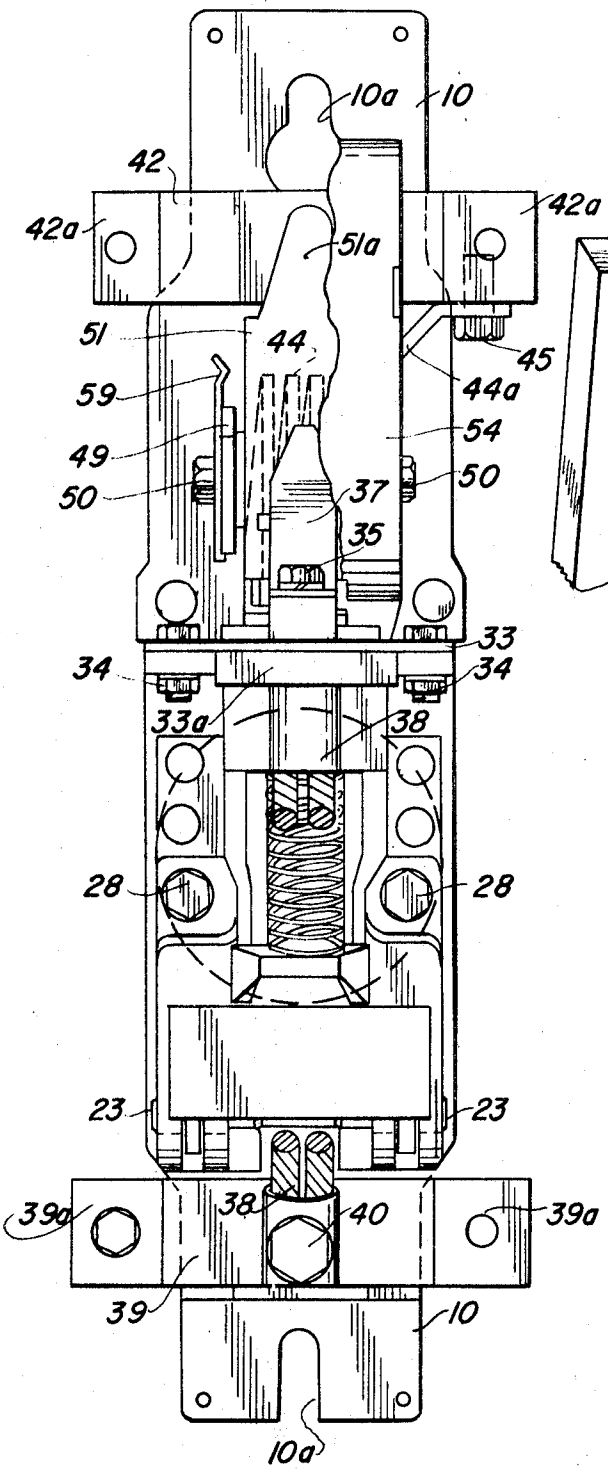


FIG. 7

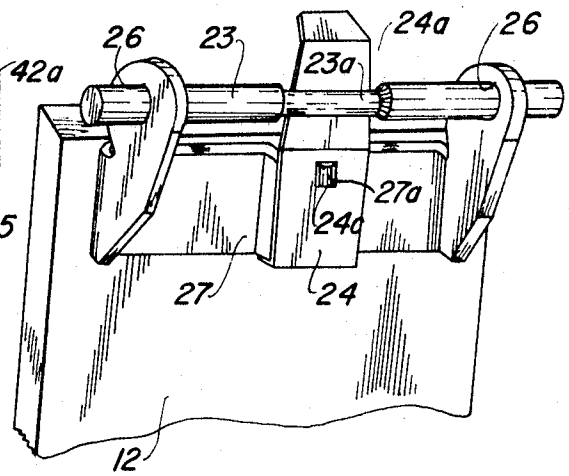
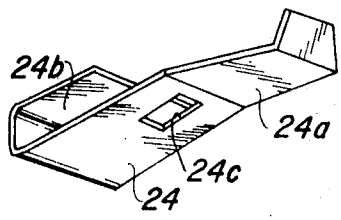


FIG. 8



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3,525,059

ELECTROMAGNETIC CONTACTOR

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Int. Cl. H01h 50/16
U.S. Cl. 335—132 9 Claims

ABSTRACT OF THE DISCLOSURE

A clapper-type electromagnetic contactor which may be assembled as either a normally-open or a normally-closed device from substantially the same set of components. Once assembled, the contactor may be converted from normally-open to normally-closed, or vice versa, by changing the relative positions of certain components and substituting only a few others.

This invention relates to an electromagnetically-operated clapper-type contactor the armature of which is spring-biased toward one position and magnetically moved to another position for controlling electric contacts by the armature movement. More particularly, the invention relates to such a contactor which may be assembled in either a normally-open or a normally-closed arrangement from substantially the same set of components, and which, once assembled, may be readily converted from normally-open to normally-closed, or vice versa, principally by changing the relative positions of certain components in the assembly.

Both normally-open and normally-closed electromagnetic relays and contactors have long been provided for use in electrical circuitry. Likewise, it is well known in the art to provide small relays and contactors of relatively low power rating with reversible contacts or the like for converting the devices from normally-open to normally-closed configurations, and vice versa. In heavy duty or mill type contactors of the prior art capable of repeatedly switching circuits carrying fifty amperes or more, conversion from normally-open to normally-closed configuration is not readily accomplishable and, generally, separate families of such normally-open and normally-closed contactors have been provided. Although the prior normally-open and normally-closed heavy duty contactors do have certain parts in common with each other, the differences in construction and in the components employed in the separate devices render it impractical and relatively difficult to convert from one configuration to the other.

The contactor of the present invention makes it possible to accomplish such conversion with relative ease by interchanging the location of certain principal components of the contactor and by substitution of a few minor components. Accordingly, the present invention enables contactors to be assembled in either a normally-open or normally-closed configuration from a relatively small inventory of parts.

A principal object of the present invention is to provide an electromagnetically-operated clapper-type heavy duty contactor which may be assembled in either a normally-open or normally-closed arrangement from substantially the same set of components with relative ease.

Another object is to provide an electromagnetically-operated clapper-type heavy-duty contactor which, once assembled, may be readily changed from normally-open to normally-closed configuration principally by changing the relative positions of certain components in the assembly.

Other objects and advantages will become apparent

from the following specification wherein reference is made to the drawings, in which:

FIG. 1 is a perspective view of an electromagnetic contactor in accordance with this invention, the contactor being assembled for a normally-open mode of operation;

FIG. 2 is a side view of the contactor assembled as in FIG. 1, a portion of an arc chute of the contactor being broken away to illustrate additional detail;

FIG. 3 is a side view similar to that of FIG. 2, but with the contactor assembled for a normally-closed mode of operation and with its arc chute removed;

FIG. 4 is an exploded perspective view of a portion of the contactor arranged for the normally-open mode of operation as in FIGS. 1 and 2;

FIG. 5 is an exploded perspective view of a portion of the contactor arranged for the normally-closed mode of operation as in FIG. 3;

FIG. 6 is a front view of the contactor assembled as in FIGS. 1 and 2, a portion of the arc chute being broken away for clarity of illustration; and

FIGS. 7 and 8 show additional details of the contactor.

Referring first to FIGS. 1 and 2 of the drawings, an electro-magnetic contactor in accordance with this invention comprises a base **10** having means such as upper and lower slots **10***a* by which the contactor may be mounted upon a control panel. Preferably, the base **10** is molded of a strong, electrically insulative material such as glass-reinforced polyester.

As shown in FIGS. 1, 2, and 4 an operating assembly **11** of the contactor comprises a magnet frame **12** having two leg portions disposed generally at right angles to each other, an operating winding or coil **14**, a cylindrical core **15**, an armature **16**, and a contact arm **17**. The magnet frame **12** and the core **15** are secured to the base **10** against a flat mounting surface **10***a* thereof by a screw **19** which is received, through aligned openings in the base and one of the leg portions of the magnet frame, in a threaded axial socket in the core **15**. Thus, one leg portion of the magnet frame **12** serves as a mounting leg portion for mounting the frame **12** on the base **10**. The coil **14**, comprising a winding encapsulated in an insulating material such as epoxy or the like, has an axial opening extending therethrough and also has a pair of terminals **14***a* adapted for connection to a source of power for energizing the coil.

The coil **14** is received on the core **15** where it is retained in place by a core cap **20** which is secured to the core **15** by a screw **21**. A thin non-magnetic spacer (not shown) may be placed adjacent the core cap **20** under the head of the screw **21**. A spring washer **22**, disposed between the coil **14** and the mounting leg portion of the frame **12**, urges the coil firmly against the core cap **20**.

The contact arm **17**, also preferably molded of a strong insulative material such as glass-reinforced polyester, is pivotally retained on the magnet frame **12** by a pin **23** which is received through respective pairs of aligned openings **25** and **26** (FIG. 4) in the arm **17** and in the ears of a U-shaped depending bracket **27** welded to the other leg portion of the magnet frame **12**. The pin **23** is restrained against axial movement by means of a spring member **24** (FIGS. 7 and 8) having an end portion **24***a* which is seated in and resiliently bears against a narrowed neck portion **23***a* of the pin **23**. The member **24** is itself removably secured to the bracket **27** by a clip-like portion **24***b* which is slidably received about a shallow raised section of the bracket **27**. A small tang **27***a* raised from the bracket **27** is received in an opening **24***c* of the spring member **24** to assist in retaining the member **24** securely on the bracket **27**.

The armature **16**, best illustrated in FIG. 4, is a flat, generally rectangular steel plate member and is secured

to the contact arm **17** by a pair of screws **28** threaded into respective holes in the armature through openings **17***a* in the contact arm. Thus, the armature **16** is carried by the contact arm and is adapted for pivotal movement therewith toward and away from the coil **14** between respective closed and open positions. A return spring **29** (FIG. 2) disposed between the core cap **20** and the contact arm **17**, and retained at one end about the head of the screw **21** and seated at its other end in an opening in the armature **16**, assists the forces of gravity in returning the contact arm to its open position. The contact arm **17** carries, in addition, an auxiliary arm **30** which is pivotally mounted on the contact arm as by means of a pin **31** passing through aligned openings in spaced ears **30***a* of the arm **30**. A spring member (not shown) like the member **24** constrains the pin **31** against axial movement. A helical spring **32** biases the auxiliary arm **30** in a counterclockwise direction about its pivotal axis as viewed in FIG. 2. Like the contact arm **17**, the auxiliary arm **30** is preferably molded of glass-reinforced polyester. A stop plate **33**, mounted on the base **10** by bolt and nut fasteners **34**, has a distal end portion **33***a* which lies in the path of movement of, and cooperates with, the auxiliary arm **30** to determine the open position of the contact arm **17**.

Mounted on the auxiliary arm **30** by means of a cap screw **35** are a contact tip **36** (designated the movable contact), an arc horn **37**, and one end of a flexible connector **38**. The other end of the flexible connector **38** is fastened, as best illustrated in FIG. 6, to a terminal block **39** by a screw **40** which also secures the terminal block to the base **10**. The flexible connector **38** completes an electrical circuit between the movable contact **36** and the terminal block **39**, and the terminal block has lug portions **39***a* which are drilled and tapped so as to facilitate the attachment of terminal lugs of one or more electrical leads (not shown) of the circuit which is to be controlled by operation of the contractor.

Electrical connection from the circuit to be controlled to a stationary contact **41** of the contactor is provided through a terminal block **42** disposed at an upper end portion of the base **10** and having lug portions **42***a* similar to the lug portions **39***a* of the block **39**. A blowout coil **44**, comprising a multi-turn coil of edgewound copper conductor, completes the electrical circuit between the terminal block **42** and the stationary contact **41**, one end **44***a* of the blowout coil **44** being connected to the lug portion **42***a* of the terminal block **42** by a screw **45** (FIGS. 1 and 6). A screw **46** (FIGS. 2 and 3) secures the other end **44***b* of the blowout coil **44**, together with the stationary contact **41**, to the base **10**. Thus, when the movable and stationary contacts **36** and **41** are in engagement with each other, a complete circuit extends from the terminal block **42**, through the blowout coil **44**, the stationary contact **41**, the movable contact **36**, and the flexible connector **38** to the terminal block **39**.

As is customary in the art, the blowout coil **44** is disposed between and in flux-linking arrangement with a pair of blowout ears **49**, the ears **49** being fastened in spaced relation to the blowout coil **44** by a pair of screws **50** to opposite end faces of an insulated cylindrical flux-conducting core (not shown) disposed coaxially within the blowout coil **44**. As illustrated in FIG. 2, the blowout ears **49** are so disposed with respect to the contacts **36** and **41** as to concentrate the flux produced by the blowout coil across the gap between the contacts **36** and **41**.

An electrically conductive non-magnetic arc runner **51** (FIGS. 2, 3 and 6), preferably formed of copper, has one of its ends disposed beneath and in electrical contact with the stationary contact **41**. The other end of the runner **51** is supported in a recess in the base **10** and is retained therein by means of a projection **52** of the base **10** which cooperates with a shallow bend in the runner **51** so as to prevent withdrawal of the runner when its one end is secured in position beneath the contact **41**.

To assist in confining and extinguishing arcs formed upon separation of the contacts **36** and **41**, the contactor is provided with a removable arc chute **54**. While the arc chute may take any one of the many forms well known in the arc, the preferred embodiment of the arc chute **54** comprises two complementary portions, molded of suitable arc-suppressing material, which are secured to each other in assembled relationship by fastening means such as tubular threaded stud and screw fasteners **55**. Although not illustrated in the drawings, the arc chute **54** is provided with conventional internal baffles which assist in extinguishing the arc.

In order to assist in removably retaining the arc chute **54** on the contactor, an upwardly struck tang portion **51***a* of the arc runner **51** cooperates with an internal shoulder portion **56** (FIG. 2) of the chute **54** to prevent movement of the arc chute in a direction normal to, and away from, the front-face of the base **10**. Likewise, shoulders **57**, defined by a recessed portion on the exterior of each of the complementary portions of the arc chute **54**, cooperate respectively with the upper edges of the blowout ears **49**, as shown in FIG. 1, to support the chute **54** on the contactor. In addition, a pair of resilient members **59**, secured beneath the screws **50**, respectively, and having offset end portions, cooperate with grooves in the arc chute **54** to assist in retaining the chute in place. Thus, although the arc chute **54** is securely retained on the contactor, it may be removed therefrom at will merely by withdrawing it in an upward direction out of engagement with the tang portion **51***a* of the arc runner **51**.

One of the principal features of the present invention resides in that the contactor may be changed from the normally-open device shown in FIGS. 1, 2, and 4 to a normally-closed device as shown in FIGS. 3 and 5 by re-arranging the principal parts and by substitution or addition of a small number of other components. This feature enables either a normally-open or a normally-closed version of the same basic contactor to be manufactured from a relatively small inventory of parts. Also, once assembled, the contactor can be changed, if necessary, from one mode of operation to the other with relative ease.

The manner of assembly of the contactor of this invention as either a normally-closed or normally-open device, or the manner of changing the same from one version to the other, is best illustrated in FIGS. 4 and 5 of the drawings. As is evident from a comparison of these two figures, the change from the normally-open to the normally-closed configuration is accomplished substantially by re-arranging and interchanging components of the operating assembly **11**. The base **10** and its associated blowout coil **44**, stationary contact **41** and arc chute **54**, and the magnet frame **12**, armature **16**, and contact arm **17** are common to both configurations. Substitution of components is required only for the operating coil **14**, the core **15** and its associated core cap **20** and spacer, the spring **29**, and the stop plate **33**.

In the normally-open arrangement, shown in exploded view in FIG. 4, the mounting leg portion of the magnet frame **12** is disposed parallel to and abuts the mounting surface **10***a* of the base **10** as previously described, with the edge **12***a* of the magnet frame **12** positioned adjacent to and in abutting relationship with a shoulder **10***b* on the base. Also, as previously described, the armature **16** is retained on the contact arm **17** by the screws **28** received through the openings **17***a*.

In the normally-closed arrangement, illustrated in exploded view in FIG. 5, the magnet frame **12** is repositioned with respect to the base **10** so that it is disposed on the base with its mounting leg portion normal to the surface **10***a* and with its edge **12***a* positioned adjacent a shoulder **10***c* of a supporting projection **10***f* which is molded integrally with and extends normal to the plane of the base **10**. In this position, the mounting leg portion of the frame **12** is disposed in abutting relationship with a mounting surface on the underside of the projection **10***f*, which

surface is disposed normal to the mounting surface **10***a*. A pair of screws **60** secures the frame **12** to the contactor base **10**. The cooperation of the edge **12***a* with the shoulder **10***b* in the normally-open configuration of the contactor, and with the shoulder **10***c* in the normally-closed configuration, assures that the magnet frame **12** will be in proper alignment when it is secured to the base **10** in either configuration.

In the normally-closed arrangement, the armature **16** is retained on the contact arm **17** by screws **61** threaded into the armature through openings **17***b* which are located at the opposite side of the pivotal axis of the contact arm from the openings **17***a*. A stop plate **62** (FIG. 3) is secured to the contact arm **17** by screws **63** which are received in threaded holes in the stop plate through the openings **17***a*.

Thus, as is evident from a comparison of FIGS. 2 and 3, the contacts **36** and **41** in the normally-open arrangement of FIG. 2 are closed, upon energization of the coil **14**, by the forces of electromagnetic attraction between the core **15** and the armature **16**. The contacts **36** and **41** are opened, upon deenergization of the coil **14**, by the force of gravity assisted by the spring **29** and, in the initial stage of movement, by the spring **32**. Conversely, in the normally-closed arrangement of FIG. 3, the contacts **36** and **41** are urged to their closed position by the force of a closing spring **64** and are caused to open upon energization of a coil **65**.

In the normally-closed arrangement, the spring **64** must of itself provide sufficient force to positively maintain the contacts **36** and **41** in their normally-closed position. Accordingly, the spring **64** of the normally-closed arrangement is selected so that it applies a greater force than that of the spring **29** in the normally-open configuration which only assists in opening the contacts. As a consequence of the greater force provided by the spring **64** in the normally-closed contactor, the coil **65** for the normally-closed arrangement is likewise selected so that it will, when energized, provide sufficient electromagnetic force to compress the spring **64** and effect a quick and positive opening of the contacts. In order to accommodate a spring of increased spring rate, a core **66** for the normally-closed arrangement of the contactor has an axial bore so as to permit a spring of increased length to be employed. Additionally, in order to provide the desired magnetic pull characteristics to assure rapid separation of the contacts **36** and **41**, a magnetic core cap **67** of generally rectangular configuration and having a bent flange portion **67***a* is provided in place of the core cap **20**. However, neither the substitution of the springs, the coils, nor the cores and associated core caps detracts materially from the ease of convertibility of the contactor from normally-open to normally-closed configuration, or vice versa, inasmuch as these components are dimensioned so as to permit ready interchangeability in the basic contactor assembly.

We claim:

1. An electromagnetic contactor including a base, a magnetic frame, means for mounting said frame selectively in either of two positions on said base, a movable contact arm supported for to and fro pivotal movement with respect to said base, an armature, means for supporting said armature on said contact arm selectively at either side of the pivotal axis of said contact arm, said armature being supported at one side of said pivotal axis when said frame is mounted on said base in one of said two positions, and said armature being supported at the other side of said pivotal axis when said frame is mounted on said base in the other of said two positions.

2. A contactor in accordance with claim **1** wherein said frame has two leg portions disposed at right angles to each other, one of the leg portions comprises a mounting leg portion for mounting said frame on said base, said means for mounting said frame on said base comprises first and second mounting surfaces on said base for mounting said mounting leg portions thereon, selectively, said first and second mounting surfaces being normal to each other, and said mounting leg portion is secured to said first mounting surface in said one of said two positions and is secured to said second mounting surface in said other of said two positions.

3. A contactor in accordance with claim **2** and additionally including a flux-conductive core supported at one end on said mounting leg portion of said frame in flux-conducting relationship therewith and extending generally parallel to the other of said leg portions, and a coil coaxially surrounding said core, whereby the longitudinal axis of said coil and core extends generally parallel to said second mounting surface when said frame is mounted on said base in said one of said two positions and extends generally parallel to said first mounting surface when said frame is mounted on said base in said other of said two positions.

4. A contactor in accordance with claim **2** wherein said contact arm is pivotally carried by the free end portion of the other of said leg portions.

5. A contactor in accordance with claim **4** wherein a pin is provided for pivotally supporting the contact arm and has a narrowed neck portion disposed between its respective end portions, and wherein a spring member is provided having a portion which is seated in and resiliently bears against the neck portion of the pin so as to restrain the pin against movement in an axial direction.

6. A contactor in accordance with claim **1** wherein a flux-conductive core is supported at one end on said frame in flux-conducting relationship therewith, said armature moves toward and away from the other end of said core as said contact arm pivots to and fro, a stationary contact is supported by said base, a movable contact is carried by said contact arm and is movable therewith between first and second positions with respect to the stationary contact as said contact arm pivots to and fro, and biasing means biases said contact arm so as to urge said armature away from said core, thereby to urge the movable contact to its first position when said frame is mounted on the base in said one of said two positions and said armature is supported at said one side of the pivotal axis, and to urge the movable contact to its second position when said frame is mounted on the base in said other of said two positions and said armature is supported at said other side of the pivotal axis.

7. A contactor in accordance with claim **6** wherein an electrically energizable coil is provided for moving the movable contact between its first and second positions against the force of said biasing means.

8. A contactor in accordance with claim **1** wherein a flux-conductive core is supported at one end on said frame in flux-conducting relationship therewith, said armature moves toward and away from the other end of said core as said contact arm pivots to and fro, a stationary contact is supported by said base, a movable contact is carried by said contact arm and is movable therewith between open and closed positions with respect to the stationary contact as said contact arm pivots to and fro, and biasing means biases said contact arm so as to urge said armature away from said core, thereby to urge the movable contact to its open position when said armature is supported on the contact arm on the same side of the pivotal axis as said movable contact, and to urge the movable contact to its closed position when said armature is supported on the contact arm at the opposite side of the pivotal axis from said movable contact.

9. In an electromagnetic contactor including a base, a stationary contact supported by said base, a magnetic frame, a flux-conductive core supported at one end in flux-conducting relationship with said frame, an electrically energizable operating winding surrounding said core, a movable contact arm pivotally supported for to and fro pivotal movement with respect to said base, an armature on said contact arm movable toward and away

from the other end of said core as said contact arm pivots to and fro, said armature being responsive to energization of said operating winding to cause said to and fro pivotal movement, a movable contact supported on said contact arm and movable therewith toward and away from said stationary contact as said arm pivots to and fro, and biasing means biasing said armature away from said core, the improvement comprising means on said contact arm for receiving said armature, selectively, in either of two positions, and means on said base for receiving said frame, selectively, in either of two positions, the contactor being so constructed and arranged that when said frame and said armature are disposed on said base and said arm, respectively, in one of their respective positions, the contactor is in a normally-open configuration, and when said

frame and said armature are disposed on said base and said arm, respectively, in another of their respective positions, the contactor is in a normally-closed configuration.

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