May 27, 1958 D. L. PETTIT 2,836,685

MAGNETIC BLOWOUT SWITCH

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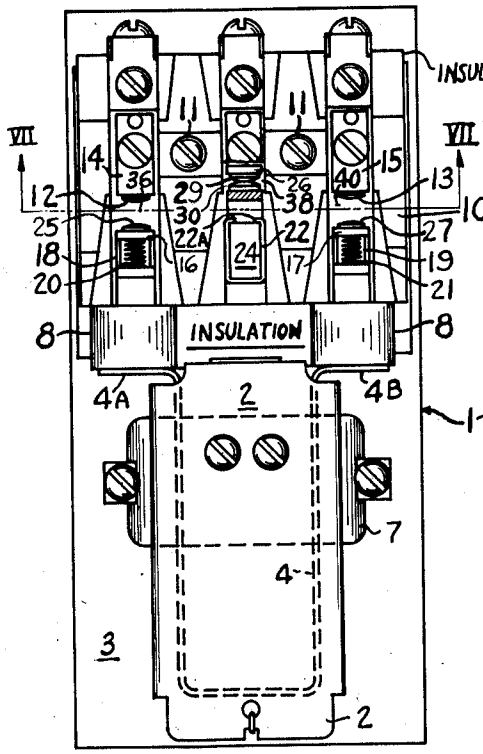


FIG. 1

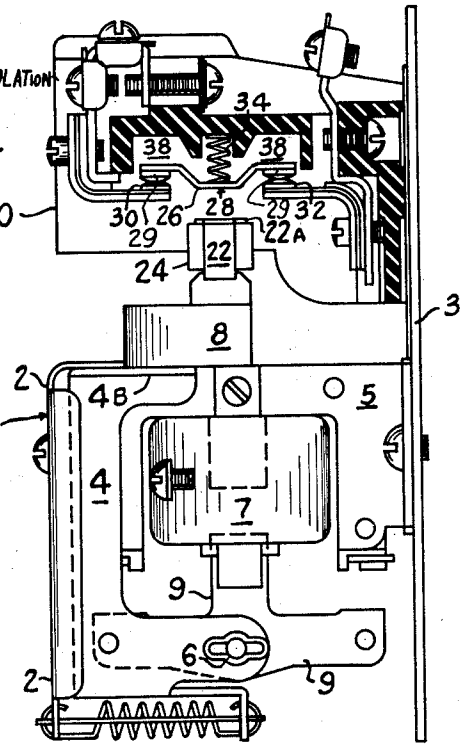


FIG. 2

FIG. 3

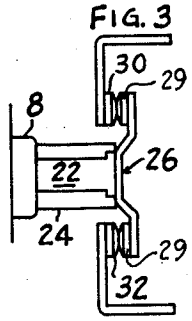


FIG. 4

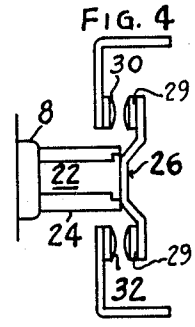


FIG. 5

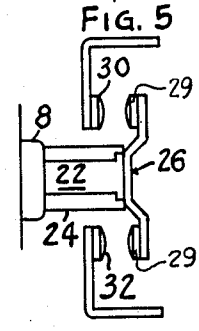


FIG. 6

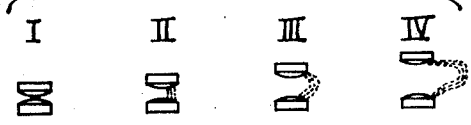
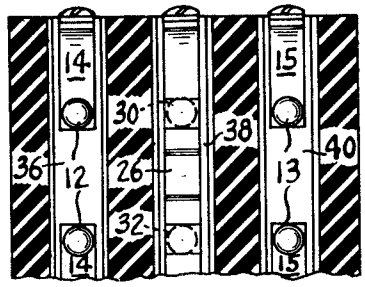


FIG. 7



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MAGNETIC BLOWOUT SWITCH

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13 Claims. (Cl. 200—147)

This invention relates to electric circuit interrupting devices employing permanent magnets to effect blowout of the arc produced by said devices during their circuit interrupting function. More particularly, this invention concerns a novel arrangement for positioning permanent magnets in a contactor to effectively retard and diminish the effects of destructive arcing during operation of the contactor.

The object of this invention is to provide a magnetic blowout arc extinguisher associated with movable contacts wherein the magnetic blowout mechanism moves with the movable contacts and into the area where an arc will be produced.

It is a particular object of this invention to provide a magnet in close proximity to the contacts of a contactor to blow an arc formed by operation of the contactor against the sides of an arcing chamber to improve the circuit interrupting ability of the contacts.

It is a further object of this invention to provide a permanent magnet mounted upon a movable portion of a contactor in juxtaposition to the movable contacts and following the path of movement of the movable contacts to position the magnetic field of the magnet within the purview of the contact gap when the contactor is moved in an arc-producing direction.

It is a still further object of this invention to provide in a contactor, an arrangement of a permanent magnet in a location relative to the position of normally closed contacts to effectively blow out an arc produced when the contacts are opened and also in a location relative to the position of the normally open contacts to improve the interrupting ability of the other contacts after their closure and subsequent opening operation.

It is a further object of this invention, in accordance with the preceding objects, to provide an electric circuit interrupting device having a magnetic blowout feature employing a permanent magnet in which the magnet may be mounted in either of opposite positions of polarity without effect upon the magnetic blowout feature of the device.

Further objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating a preferred embodiment in which:

Figure 1 is a front elevational view of a contactor embodying the invention.

Figure 2 is a side view partially in section of the contactor of Figure 1.

Figure 3 is a fragmentary side view of the contacts and magnet shown in the initial contact opening position.

Figure 4 is a fragmentary side view similar to Figure 3 with the contacts in half open position.

Figure 5 is a fragmentary side view similar to Figure 3 with the contacts in full open position.

Figure 6 is a composite view of the contacts showing an exaggerated arc gap and the blowout effect of the magnet.

Figure 7 is a fragmentary view taken along the line VII—VII of Figure 1.

In Figures 1 and 2 is shown a conventional three pole electric contactor **1** supported on a mounting plate **3**. The contactor **1** comprises an electromagnetic contact operating means consisting of an E-shaped stationary core member **5**, an operating coil **7** mounted thereon, and a T-shaped armature **9** reciprocably movable within the coil and toward the core. A U-shaped actuating beam **4** is pivotally connected to the armature **9** by means of a pivot pin **6** at the lower end thereof and is adapted to ride along the inner surface of a support bracket **2** under the influence of the movement of armature **9**. An insulation member **8** is secured to extremities 4A and 4B of the beam **4** by means of screws or rivets (not shown) so as to be reciprocably movable therewith by action of the electromagnetic operating means and its armature **9**.

The contactor **1** is provided with a stationary contact means consisting of an insulation block **10** fixed to the plate **3** by means of screws **11** in which three pair of stationary contacts are supported. The outer pair of contacts are identical and consist of a pair of stationary contacts **12** and **13** mounted on terminal strips **14** and **15** for cooperation with a pair of movable contacts **25** and **27** supported on contact carriers **16** and **17** mounted within finger guides **18** and **19** and biased against the outer extremity of the guides by springs **20** and **21** respectively. The guides **18** and **19** are secured to the insulation piece **8** previously described as adaptable to move with the armature **9**. Also secured to the insulation block **8** between the guides **18** and **19** is a guide **22** with turned-over ends **22A** adaptable to embrace and hold a permanent magnet bar **24**. The turned-over ends **22A** and permanent magnet **24** are further adapted for abutting engagement with a movable contact member **26** of a normally closed contact assembly **28**. The contact assembly **28** has a pair of oppositely disposed stationary contacts **30** and **32** shown in engagement with the movable contacts **29** on contact member **26** (Figures 1, 2, 3 and 7) and a spring **34**, held within a recess in block **10**, biases the movable contact member **26** toward its closed contact position. The three sets of contacts have arc chambers **36**, **38** and **40** formed within the block **10**, with each having side and end walls substantially isolating each from the other. A side view of the arc chamber **38** for the normally closed contacts **28** is shown in Figure 2 and is representative of the other two chambers **36** and **40** which are identical thereto.

Operation

With the contacts and the operating mechanism in the positions shown in Figures 1 and 2, the energization of operating coil **7** results in the attraction of armature **9** toward the stationary core **5**. This action moves the insulation piece **8** and its guides **18**, **22** and **19** toward their corresponding arc chambers **36**, **38** and **40**. The outer two guides **18** and **19** with their movable contacts **25** and **27** on carriers **16** and **17** are moved into engagement with the corresponding fixed contacts **12** and **13**, while the center guide **22** carrying the permanent magnet **24** moves into abutting relationship with the movable contact carrier **26** (Figure 3). Further movement of the guide **22** in the same direction causes the turned-over ends **22A** to push the movable contact carrier **26** against the bias of spring **34** to move contacts **25** out of engagement with the fixed contacts **30** and **32** (Figure 4). This continue movement of guide **22** also positions the permanent magnet **24** between the stationary contacts **30** and **32**.

As the movable contact carrier **26** moves out of initial engagement with the fixed contacts **30** and **32**, a destructive arc is formed as depicted in Figure 6, Diagram I. Further separation of the contacts along with the influence

of the magnet 24 begins to attenuate the arc as in Diagram II, and, because the magnet 24 is moving in a direction parallel to the direction of the movable contacts 25, its maximum magnetic strength and direction of flux lines are efficiently utilized for arc quenching. Effective arc quenching requires that the generated arc be spread or attenuated as soon as possible to minimize its destructive effects and, if possible, that the arc be directed away from the center of the contacts from which it originates to increase its length and move the situs of destruction. The insulation block 10 and its arc chambers 36, 38 and 40 is composed of heat resisting material designed to withstand the arcing temperatures much more effectively than the material of which the contacts and terminals are constructed and because of this, the arc is directed as quickly as possible to the surfaces of the arcing chamber by the moving magnet 24.

The positioning and polarity of the permanent magnet 24 is so selected that regardless of the direction of current flow through the contacts 29—30 or 29—32 and regardless of the end-for-end reversal of the magnet itself, the reaction of the magnetic lines of force of the magnet with current flow in the arc created is such as to move the arc toward the sides of the arc chamber 38. This feature is accomplished by design of the magnet and its guide so as to permit only one plane of assembly for the magnet with no regard for direction of polarization within that plane. In this manner, during assembly of the device, the magnet may be placed in its supporting finger without concern of polarization because the arc extinguishing features of the magnet will merely be reversed in direction. The magnet and guide are designed to align the polarization of the magnet parallel to the movable contact carrier 26 with the north pole in either direction. With this polarization and current flow through the device either from contact 30 toward contact 32 or the reverse, the resultant movement of the created arc will be either to the left or the right with reference to the position of the device as shown in Figure 1, and the arc blown from one set of contacts 29—30 or 29—32 will be opposite with respect to the other set. Reversal of either current flow or polarization will cause only reversal of direction of arc blow-out within the same former plane.

As shown in Diagram III of Figure 6, the arc is blown away from the center line between the contacts toward the wall of the arc chamber and also away from the center of the contact surfaces toward their peripheries. In Diagram IV, the arc is shown progressively attenuated prior to extinguishment under the influence of the progressively advancing magnet 24, similar to the contact position of Figure 5. The effectiveness of this arrangement can be better realized with reference to prior art arrangements providing fixed position for the blowout magnet relative to the moving contact which, though somewhat effective, did not provide a blowout magnet tracking or following the arc in constant proximity thereto. Another feature of the present arrangement lies in the fact that as the magnet traverses the area between the contacts, it provides a current of air to cool the arc to further aid the quenching thereof.

Upon deenergization of the operating coil 7, reverse operation of the contactor is effected. With the movement of the insulation piece 8 away from the block 10, the then closed contacts 12—25 and 13—27 are separated and the attendant arcs are aided in their extinguishment by the proximity of the moving magnet 24 which, though not as close to these arcs as in the case of contacts 29 and 30—32, is moving in a direction to influence the arcs formed in the outer arc chambers 36 and 40 to aid in the extinguishment thereof.

In the arrangement disclosed in this invention, the magnet 24 is mounted in space not utilized by other components so as to cause no increase in the physical dimensions the contactor must employ. It should be further noted that because conducting parts are placed in the proximity of normally closed contacts during opening operation thereby increasing the susceptibility of arc formation, that the blowout magnet serves an increasingly more important function by substantially eliminating the arcing damage. Another feature of this invention pertains to the disposition of the magnet in a manner that provides equal blowout protection regardless of the direction of the current flow because of its mounting equidistant between the contacts 30 and 32 where it is equally effective on current flow in both directions.

Therefore, while a certain preferred embodiment of this invention is disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In an electric circuit interrupting device, a stationary contact, a movable contact normally in engagement with said stationary contact, a contact operating means movable to separate said contacts whereby an arc is formed, and a magnet carried by and movable with said means into juxtaposed spaced relation to said contacts for positioning a magnetic field for opposing the normal path of said arc to lengthen the path thereof.

2. In an electric circuit interrupting device, a pair of stationary contacts, a movable contact normally bridging said stationary contacts, a contact operating means movable into abutting relationship with said movable contact to separate said contacts whereby an arc is formed, and a magnet carried on said means and movable therewith for positioning the magnet between the stationary contacts and in the proximity of said separated contacts and opposing the normal path of said arc to lengthen the path thereof.

3. In an electric contactor, a stationary contact, a movable contact for engagement with said stationary contact, a contact operating means movable in one direction to close said contacts and movable in another direction to open said contacts, and a magnet carried on said means and movable therewith in both directions, said magnet being positioned in proximity to the gap formed by the separation of said contacts, said movable magnet providing a movable magnetic field for blowout of an arc formed between said open contacts.

4. In an electric contactor, a stationary contact, a movable contact cooperating with said stationary contact, operating means movable to separate said movable contact and said stationary contact, and a magnet supported by said means and movable by said means in a plane parallel to the plane of separation of said contacts and into the area of separation of said contacts.

5. In an electric contactor, a pair of stationary contacts, a movable contact normally bridging said stationary contacts, operating means movable to separate said movable contact and said stationary contacts, and a magnet supported by and movable with said means into engagement with said movable contact and thereafter movable with said movable contact in proximity to the gaps formed between said movable contact and said stationary contacts.

6. In an electric contactor, a pair of stationary contacts, a movable contact normally bridging said stationary contacts, operating means movable to separate said movable contact and said stationary contacts, and a magnet carried by and movable with said operating means into engagement with said movable contact and thereafter movable with said movable contact and said operating means, said magnet movably positioned in a plane equidistant between said stationary contacts and into the area of separation of said contacts.

7. In an electric circuit interrupting device, a pair of stationary contacts, a movable contact normally bridging said stationary contacts, an operating means adaptable

to move said movable contact out of engagement with said stationary contacts and to permit engagement of said movable contact with said stationary contacts, means mounted on said operating means for engagement with said movable contact, and a magnet held by said means and movable therewith into a position alongside of the gap formed upon disengagement of said movable and stationary contacts.

8. In an electric circuit interrupting device, a pair of stationary contacts, a movable contact normally bridging said stationary contacts, an operating means adaptable to move said movable contact into and out of engagement with said stationary contacts, means mounted on said operating means for engagement with said movable contact, and a magnet fixed in position on the operating means by said means and movable therewith in a plane equidistant between said stationary contacts.

9. A magnetic blowout means for an electric circuit interrupting device comprising a pair of stationary contacts, a contact bridging means engageable with said stationary contacts to complete a circuit therethrough, means biasing said bridging means to said circuit completing position, and operating means engageable with said bridging means to open the circuit through said device, a permanent magnet fixed to said operating means and carried thereby into the plane of said stationary contacts whereby the magnetic lines of force of said magnet are operative upon an arc struck between said stationary contacts and said bridging means to bend and extinguish the same.

10. A magnetic blowout means for an electric circuit interrupting device having an arcing chamber and electromagnetic operating means, a pair of spaced stationary contacts supported in said chamber in one plane thereof, a bridging means movable in the chamber and engageable with said stationary contacts in the plane of said contacts to complete a circuit therethrough, means normally biasing said bridging means into engagement with said stationary contacts, said electromagnetic operating means operable upon said bridging means to open the circuit through said device, and an exposed permanent magnet fixed to said operating means, said magnet being moved with said operating means through the plane of said stationary contacts and between the same whereby the lines of force of said magnet are operative upon an arc struck between said stationary contacts and said bridging means to move said arc into said arcing chamber.

11. In an electric circuit interrupting device having an arcing chamber, a pair of spaced stationary contacts supported in said arcing chamber, contact bridging means movable in said arcing chamber and engaging said stationary contacts to complete a circuit through said device, means normally biasing said bridging means into engagement with the stationary contacts, and an electromagnetic operating means, an abutting surface on said operating means engageable with said bridging means to move said bridging means against the bias of said biasing means to move the bridging member from its engaging position, a permanent magnet and means on said abutting surface for securing said permanent magnet to the electromagnetic means, said permanent magnet being moved with said abutting surface contiguous to said stationary contacts and between the same during circuit opening movement whereby the magnetic lines of force of said magnet are operative upon an arc struck between said stationary contacts and said bridging means to move said arc into said arcing chamber.

12. In an electric circuit interrupting device having an arcing chamber and a plurality of arcing cavities within said chamber, spaced pairs of stationary contacts supported within said arcing cavities, individual bridging means movable into and out of engagement with their associated pairs of stationary contacts to close and open circuits through said device, electromagnetic operating means operable upon said bridging means to move the same, and a permanent magnet secured to the operating means and movable by said operating means into said arcing chamber contiguous to said paired stationary contacts whereby the lines of force of said magnet are operative upon an arc struck between said stationary contacts and their associated bridging means to move said arc into said arcing cavities.

13. In an electric circuit interrupting device having an arcing chamber, stationary contacts supported within said arcing chamber, movable contacts cooperating with said stationary contacts to open and close a circuit through said device, operating means operative upon said movable contacts, a permanent magnet carried by and movable by said operating means for actuating said movable contacts and positioning said magnet adjacent said contacts, said magnet being carried on the operating means without regard for polarization whereby said permanent magnet is movable by said operating means into said arcing chamber contiguous to said stationary contacts so that the lines of force of said magnet regardless of polarization are operative upon an arc struck between said movable and stationary contacts to move said arc against said arcing chamber.

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