Sept. 3, 1963 C. F. BRUNNER 3,102,937

ARC ATTENUATOR

Filed June 7, 1961

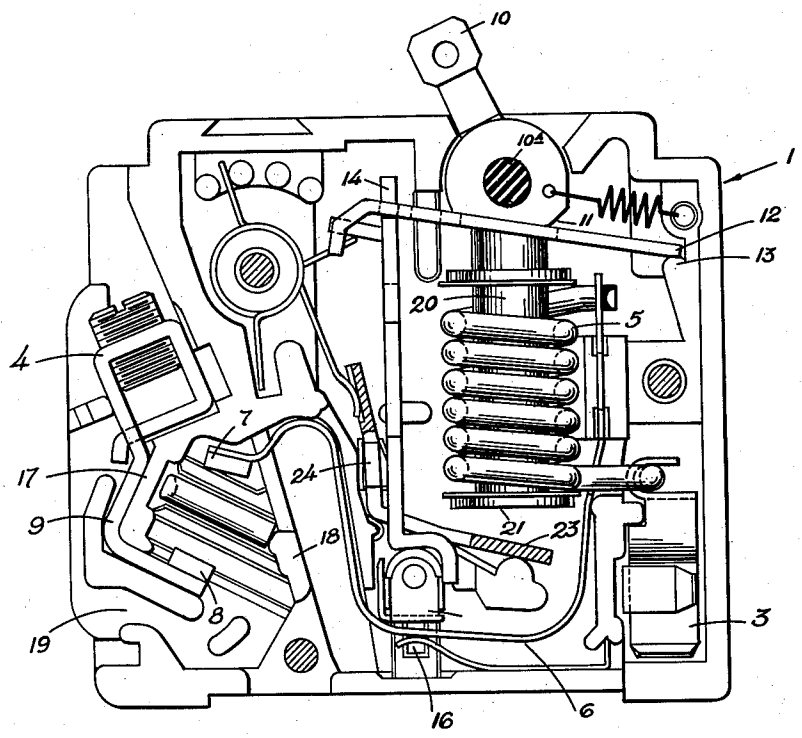


Fig. 2

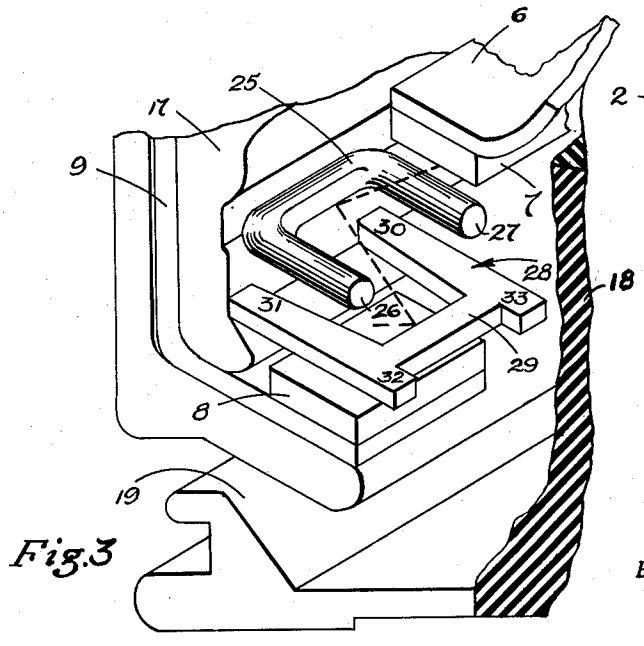


Fig. 3

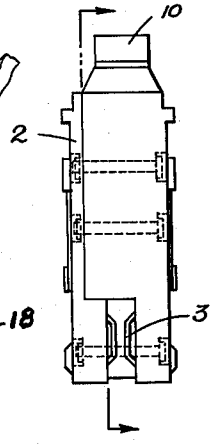


Fig. 1

INVENTOR.
CARL F. BRUNNER

BY Roy C. Hayward
ATTORNEY

United States Patent Office 3,102,937 Patented Sept. 3, 1963

3,102,937

ARC ATTENUATOR

Carl F. Brunner, Floral Park, N.Y., assignor to Murray Manufacturing Corporation, Brooklyn, N.Y., a corporation of New York

Filed June 7, 1961, Ser. No. 115,435
4 Claims. (Cl. 200—147)

This invention relates to circuit breakers for opening and closing electric circuits, and more particularly this invention relates to improved arc attenuating means for electromagnetic type circuit breakers.

More specifically, this invention relates to a compact, molded case type of electromagnetic circuit breaker such as described in Patent No. 2,890,306 for Electromagnetic Circuit Breaker, issued June 9, 1959, to Rypinski et al. and assigned to Murray Manufacturing Corporation. The patented circuit breaker comprises the usual handle for manually opening and closing the breaker circuit, electromagnetic means for actuating a spring-loaded trip mechanism, whereby in response to a predetermined overload condition the breaker is automatically "tripped" into the "open" position, and a partially enclosed switch contact cavity within the case for substantially confining the effects of arcing. The patented circuit breaker also has a U-shaped magnetic member located to partially enclose the path of a movable switch contact as it travels in the cavity for arc cutoff, when the breaker is opened under load. This invention has particular utility in connection with the aforementioned patented circuit breaker.

The patented circuit breaker is primarily designed for rated capacities of 20 amperes or less. At higher current ratings the single U-shaped arc suppressor is inadequate to extinguish the arc sufficiently rapidly to prevent damage to the contacts and the casing in close proximity to the contacts.

There are, of course, many known forms of arc suppressors for use in circuit breakers. However, the known forms could not be adapted for the aforesaid circuit breaker without requiring substantial modification to the casing or to the general construction of the circuit breaker.

Standardization of electrical components has become extremely important in the electrical industry because of the keenness of competition and the desire to make relatively few components serve similar functions in different devices.

Accordingly, it is an object of the invention to provide a novel arc attenuating arrangement for use in the above mentioned circuit breaker, requiring no material change in the construction of the casing.

It is another object of the invention to provide a novel arc attenuating arrangement in the above mentioned type of circuit breaker which, because of its arc suppressing ability, permits the use of standard components in breakers of different ratings within a given range, excluding, of course, current carrying components.

A further object of the invention is to provide such improved arc attenuation means without sacrifice to the existing advantages in the above mentioned type of circuit breakers.

A still further object of my invention is to provide improved arc attenuation means entirely within the existing switch contact cavity of the circuit breaker.

According to an embodiment of my invention, I provide a second magnetic member in cooperation with the above mentioned U-shaped arc suppressor member which is so shaped and located as to cause the arc to extend in zig-zag fashion from one contact to the other. The zig-zag configuration effectively elongates the length of the arc and thereby shortens its duration for a given overload.

The shape and orientation of the second magnetic member cause an arc deflection which directs the gases through the existing exhaust outlet in the cavity. Specifically, the second magnetic member is in the form of an H and located so that the cross-bar of the H is opposed to the base of the U-shaped arc suppressor, and the legs of the U and the upper arms of the H extend towards each other in overlapping, spaced relationship.

The hot ionized gases are therefore more rapidly removed from the switch contact cavity and the dielectric properties of air between the contacts are more rapidly restored. Thus, arc lifetime and consequent thermal and chemical damage to switch contacts and other components are minimized and the higher amperage arc may be safely extinguished.

From the outside the circuit breaker incorporating the invention appears identical to the patented circuit breaker having a lower current rating. Increased current rating is obtained with only one added part. Neither increased size nor additional volume inside the case are required. The second magnetic member of the invention is simple to fabricate and is easily installed. All that is required for installation is incorporation of supporting ridges, grooves, or the like in the plastic case. No other changes in the circuit breaker are necessary for improved arc cutoff ability, and the prior advantages of simplicity and compactness are preserved.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a front end view of a circuit breaker incorporating an embodiment of my invention;

FIG. 2 is a side view of the circuit breaker of FIG. 1 with the cover removed; and

FIG. 3 is a partial perspective view of the switch cavity showing the contacts and arc suppressing arrangement.

As previously mentioned, an object of the invention is to utilize as many components as possible from the patented breaker. Since the patented breaker is disclosed in detail in the aforesaid patent, the several parts will not be described in detail herein. Only those parts will be described which are necessary for an understanding of the invention.

Referring now to the figures, the circuit breaker comprises a molded case 1, including a cover 2, which supports and contains the several parts.

An electrical contact clip 3 is provided at the front end of the breaker for plug-in connection to a bus-bar (not shown).

A load connector 4 is provided at the rear end of the breaker for connection to a circuit or a load wire. The electrical circuit of the breaker comprises a coil 5, one end of which is connected to the spring contact clip 3, an electrically conductive spring member 6 connected to the opposite end of the coil 5, a movable contact 7 connected to an end of the conductive spring member 6, and a stationary contact 8 attached to an extension 9 of the load connector 4.

The contacts 7 and 8 are closed when a handle 10 is moved to the right, in the sense of the drawing, about a shaft 10A causing its cam surface 11 to depress a cam follower plate 12 about a pivot support 13. The cam follower plate 12 is thus moved downwardly (continuing in the sense of the drawing) against an actuating plate 14 which bears against and drives a roller assembly 15 in a guided slot 16. The lower end of the roller

assembly actuates the conductive spring member 6 in the downward direction causing the movable contact 7 to come into engagement with the stationary contact 8.

As best seen in FIGS. 2 and 3, the two contacts are located in a cavity within the case. Movement of the contact 7 is entirely within this cavity. Barrier walls 17, 18 on opposite sides of the cavity afford partial closure thereof. The barriers serve to protect adjacent parts of the breaker from arcing defects. The upper part of barrier 17 also serves to limit movement of the spring conductor 6 when the movable contact is displaced from the fixed contact. A passage or duct 19 is provided from the fixed contact side of the cavity through the case 10 for exhausting gases when an arc occurs in the cavity.

The electromagnetic circuitry comprises the coil 5 which surrounds a sealed tube 20 containing a movable pole piece in a damping medium such as a silicone coil. At one end of the tubular member a fixed pole piece 21 is provided. The movable pole piece within the tubular member is spring urged in the direction opposite the fixed pole piece. Excessive current flowing through the coil 5 tends to urge the movable pole piece towards the fixed pole piece. If excessive current is maintained for a period of time sufficient for the movable pole piece to reach the fixed pole piece, the magnetic field is intensified to such an extent that an armature member 23 is attracted to the fixed pole piece 21. The armature is rockably mounted at 24 within the side walls of the casing so that the lower leg thereof, in being attracted to the fixed pole piece, will trip the plate member 14 off the roller assembly 15, thereby releasing the spring member 6 to separate the movable contact from the fixed contact.

Referring now specifically to the arc suppressing arrangement (FIG. 3), a U-shaped member 25 is located in the cavity where it is supported by grooves in the barrier wall 17 and the case of the breaker. The U-shaped member 25 is formed of magnetic material and is positioned with its base portion against the wall 17. The legs 26, 27 of the U project along opposite sides of the path of the movable contact. As discussed previously, this single magnetic member is adequate for arc cutoff in breakers rated 20 amperes or less.

As is well known when an arc is drawn between two contacts such as 7 and 8, numerous potentially destructive mechanisms are present. There is of course heating which may be sufficient to melt adjacent components. The dielectric medium between the contacts (air in the present case) breaks down and becomes a good conductor. A gaseous dielectric is heated making increased pressure a potential hazard. A gaseous dielectric also becomes ionized and extremely reactive thereby causing sputtering which results in pitting or rapid corrosion at the contact surfaces.

The total amount of damage which can be done by an arc depends on power and time. The interrupting capacity of a circuit breaker is dependent upon the amount of time required to extinguish an arc drawn between contacts when the breaker is opened. Accordingly, for arcs of high amperage steps must be taken to shorten arc lifetime in order to minimize risks of arc damage.

In the embodiment of the invention shown, a second magnetic member 28 is provided adjacent the fixed contact for enhancing arc attenuation and shortening arc lifetime. The second magnetic member 28 is generally H-shaped; the cross-bar of the H 29 being located closer to one end of the H and positioned opposite the base of the U-shaped member 25. The arms 30, 31 extending from the cross-bar are in overlapping, spaced relationship to the legs 26, 27, also embracing the path of the movable contact.

The second magnetic member serves magnetically to displace the arc when it is drawn between the contacts upon opening of the movable contact. The arc is displaced from a straight line path between the contacts to the cross-bar 29 as the movable contact 7 passes the second magnetic member 28. As the contact continues in its movement, it passes between the legs 26, 27 and the arc is then deflected to the base of the U. The path of the arc is shown by broken line in FIG. 3 and as observed is substantially elongated from the straight path it would have assumed in the absence of the second magnetic member 28.

Also, as shown, the cross-bar of the second magnetic member is positioned on the side of the path adjacent to duct 19, and the space between the legs 32, 33 of the H presents an unobstructed opening in alignment with the duct 19. Thus, the arc is displaced to the cross-bar and also towards the exhaust outlet. This means that hot ionized gases produced by the arc in the vicinity of duct may be rapidly exhausted. With the second magnetic member of this invention, the total time required to exhaust hot, ionized gases from the cavity is minimal. This not only permits rapid cooling of the cavity but also permits rapid rehabilitation of the dielectric properties of the air between the contacts.

While the foregoing description sets forth the principles of the invention in connection with specific apparatus, it is to be understood that this description is made only by way of example and not as a limitation of the scope of the invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. A circuit breaker comprising, in combination, a case having internal opposing barrier walls defining a partially enclosed cavity therein and having a passage communicating between said cavity and the outside of the case; switch means disposed in said case and including a fixed contact mounted in said cavity and a movable contact located in said cavity and capable of limited movement between opened and closed positions; means mounted in said case and responsive to overload conditions for opening said switch means; a U-shaped magnetic member supported in said cavity adjacent the path of movement of said movable contact with the side arms thereof embracing said path and the base thereof spaced from said path adjacent one of said barrier walls; and, a second magnetic member supported in said cavity adjacent said path and spaced from said U-shaped member, said second member having a U-shaped portion with the side arms thereof disposed in overlapping, spaced relationship to the other of said side arms and embracing said path, and the base thereof disposed spaced from said path adjacent the other of said barrier walls.

2. The circuit breaker of claim 1 and in which the U-shaped portion base of said second magnetic member is supported adjacent the entrance to said passage.

3. The circuit breaker of claim 2 and in which said second magnetic member is in the form of an H, two adjacent arms of said H extending in overlapping relationship to the legs of said U-shaped member, and the adjacent legs of said H extending to said other of the barrier walls and defining with said other of the walls and the cross-bar of the H an opening adjacent the entrance to said passage.

4. A circuit breaker having a case including opposing barrier walls defining a partially enclosed cavity therein and a passage communicating between said cavity and the outside of said case, switch means disposed in said case including a fixed contact mounted in said cavity and a movable contact in said cavity capable of limited movement between opened and closed positions, means mounted in said case and responsive to overload for opening said switch means, a U-shaped member of magnetic material supported in said cavity adjacent the path of movement of said movable contact near the opened position thereof, said U-shaped member being disposed with the side arms thereof embracing said path and the base thereof spaced from said path adjacent one of said barrier walls, the improvement comprising a substantially H-

shaped member of magnetic material supported in said cavity adjacent said path near said fixed contact, said H-shaped member also being disposed adjacent said passage with a pair of adjacent arms thereof embracing said path and the lower arms thereof bearing against the other of said barrier walls, the cross-bar of said H-shaped member being spaced between said path and said other of the walls and defining with the other pair of adjacent arms and other of the walls an opening adjacent the entrance to said passage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,227,134	Hara	Dec. 31, 1940
2,890,306	Rypinski et al.	June 9, 1959