April 19, 1949. J. G. JACKSON 2,467,937

ARC SUPPRESSOR

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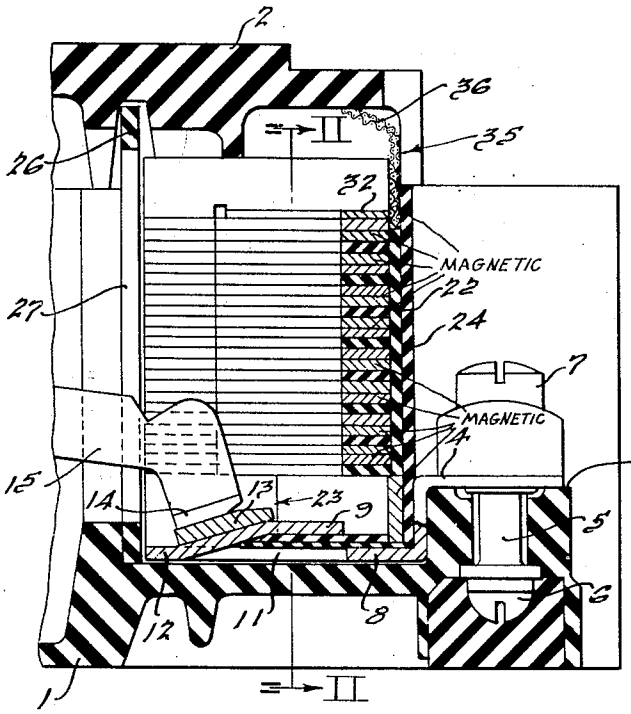

Fig. 1.

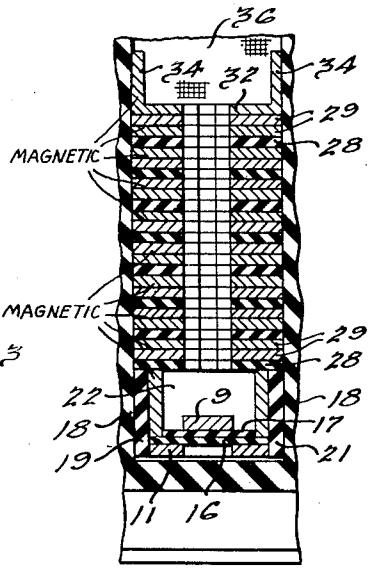

Fig. 2.

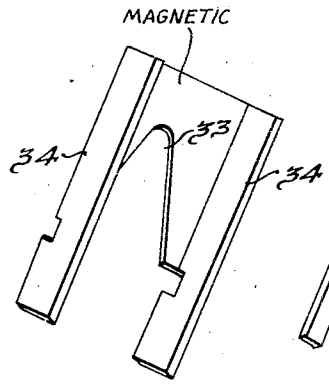

Fig. 3.

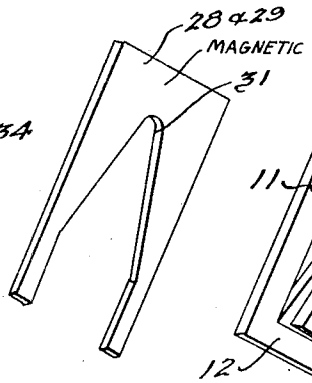

Fig. 4.

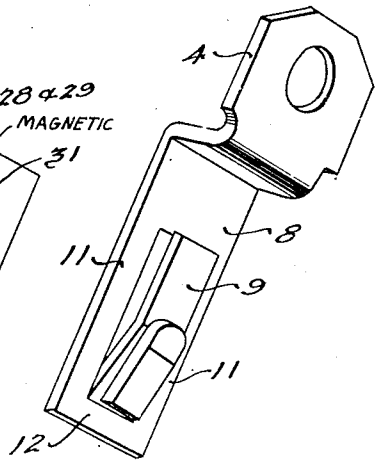

Fig. 5.

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ARC SUPPRESSOR

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4 Claims. (Cl. 200—147)

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This invention relates to arc suppressors for electric circuit interrupters and has for its object the provision of an arc suppressor for successfully interrupting relatively heavy power arcs in electric circuit interrupters, such as automatic electric circuit breakers.

Automatic electric circuit breakers of the air break type, while of relatively small size, may be required to interrupt arcs of considerable power; for example, in a circuit breaker rated at 575 volts, the minimum requirement is for a plurality of successful interruptions of a circuit having current capacity of 10,000 R. M. S. amperes, while for certain applications it may be desired for the breaker to operate successfully on even higher current values at this voltage. With the relatively small size of the circuit breaker parts, designed principally from the standpoint of their continuous current carrying capacity which may be quite small, the interruption of arc currents of the order stated becomes a serious problem. The suppressor, according to this invention, provides an efficient and compact structure for successfully interrupting such arcing currents.

Another object of the invention is the provision of an arc suppressor structure utilizing a group of continuously stacked plates of magnetic and insulating material having superimposed slots therein whose edges embrace the path of movement of the movable contact and which is provided with an enlarged communicating chamber adjacent to the position of contact engagement.

Another object of the invention is to provide an arc suppressor in accordance with the preceding object with an enlarged communicating chamber adjacent the open position of the movable contact, which chamber is provided with a suitable venting opening to the exterior.

Another object of the invention is to provide an improved form of stationary contact including an arc horn or runner with the current to the stationary contact suitably directed so as to assist in moving the arc formed at the contact on to the runner.

Other objects and features of this invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

Figure 1 is a sectional view through an arc suppressor chamber according to the present invention, such as utilized in an electric circuit interrupter.

Figure 2 is a sectional view on the line II—II of Figure 1.

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Figure 3 is a perspective view of the top magnetic plate of the suppressor structure.

Figure 4 is a perspective view of a plate either of magnetic or insulating material from which the main body portion of the suppressor is built up.

Figure 5 is a perspective view of the stationary contact and terminal connector.

The arc suppressor of the present invention is illustrated in the manner in which it is incorporated into an automatic electric circuit breaker of enclosed form, having an insulating base 1 and a cover 2 sealably mounted thereon. Upon the end ledge 3 of the base is mounted a conducting connector strap 4 as by means of a spun over portion of a metallic insert 5 through which extends a stud 6 carrying a conductor securing nut 7 at its upper end. The connector 4 is of Z shape as shown, with a leg 8 disposed on the bottom wall of the base 1. The leg 8 is provided with a pressed out portion 9 leaving in the main plane of the leg 8 the side portions 11 and the end joining portion 12. The pressed out portion 9 includes an inclined face upon which is mounted the stationary contact 13. Cooperating with the stationary contact 13 is a movable contact 14 mounted upon a conducting switching arm 15 with the conducting switching arm 15 being movable to its open position adjacent the cover 2 manually and automatically by any automatic electric circuit breaker mechanism.

Between the presed out portion 9 and the leg 8 of the conducting connector are disposed a pair of insulating sheets 16 and 17, the insulating sheet 16 being the full width of the connector leg 8. Between the side walls 18 of the base 1 and the edges of the connector 8 are disposed the insulating plates 19 and 21. Upon the plate 16 and against the side plates 19 and 21 is disposed a U-shaped magnetic piece 22. The legs of the U-shaped piece 22 terminate at the line indicated at 23 in Figure 1 so that the side plates 19 and 21 are exposed adjacent to the stationary contact 13. The plate 17 has the interior dimensions of the U-shaped piece 22 and prevents its movement toward the position of contact engagement. Between the bight of the U-shaped magnetic piece 22 and the perpendicular leg of the connector 4 is disposed an elongated insulating plate 24 disposed in grooves in the opposite side walls 18 of the base and maintained in position by engagement with the cover 2. Above the bight of the U-shaped magnetic piece 22 and interiorly of the insulating sheet, plate 24 is a second but shorter insulating plate 25. The interior wall of the arc

chamber is formed by an insulating plate 26 which extends from the bottom wall of the base 1 to the interior wall of the cover 2 and which has therein an elongated narrow slot 27 through which movement of the switching arm 15 is effected.

Upon the plates 19 and 21 and the U-shaped magnetic piece 22 is disposed a stack of plates, one of which is shown in perspective in Figure 4. These plates, with the exception of the top one shown in Figure 3, are all of the type shown in Figure 4 and are arranged in a stack composed of insulating plates 28 and magnetic plate 29. The stack starts with an insulating plate 28 immediately adjacent to the magnetic piece 22, following with two magnetic plates 29 and being continuously built up of layers of one insulating plate and two magnetic plates for the heighth shown which is substantially through the path of movement of the movable contact. The stacked plates form a chamber about the path of movement of the movable contact 14 which is represented by the opening or slot in the plates, shown in Figure 4. This path embracing chamber includes a constricting notched portion at 31 beyond the path of movement of the movable contact. The plates 28 and 29 are identical in form, and their edges forming the chamber are flush with each other.

The top plate 32 has a notched portion 33 identical with the notched portion 31 of the plates 28 and 29, but includes upstanding side portions 34 which embrace the opposite sides of the chamber formed above the restricted converging chamber which embraces the contact path. This upper enlarged chamber is provided with a vent indicated at 34 as formed in the edge of cover 2 which is partially closed by a screen 36 through which arc gases vented to the outer air must pass. Cover 2 engages the upper edges of side portions 34 to hold the parts of the arc suppressor structure in place.

While the invention in its broader aspects contemplates the formation of the insulating plates herein described of any insulating material; in one specific embodiment of the invention it has been found desirable to form at least certain of the insulating plates which are contiguous to the arc of a gas-evolving material such as fiber or arc resisting Bakelite. For example, plates 17, 19, 21 and 28 have been formed of fiber and plate 26 has been formed of arc resisting Bakelite, the latter being a sheet material having a main body portion of Bakelite with outer, thin sheet coatings of fiber. However, the invention in its broader aspects is not to be limited to any particular material for these plates as, for certain applications, other materials such as mica, lava, or transite will prove suitable, the example of gas producing materials being efficacious, however, in one preferred embodiment of the invention.

In the operation of the arc suppressor according to this invention, opening of the circuit is initiated by movement upwardly of the movable contact 14 as viewed in Figure 1. Due to the pressed out portion 9, the current through the connector 4 will pass through the side portions 11 to the end connector portion 12 and then in reverse direction to the stationary contact 13. This direction of the current path, coupled with the magnetic elements 22 and 29 of the arc suppressor, results in a movement of the arc toward the right, as viewed in Figure 1, and away from the observer as viewed in Figure 2. This movement of the arc appears to transfer it from the stationary contact 13 to the relatively cool arc horn or runner 9. Further, the arc appears to extend within the enlarged chamber formed by the plates 19 and 21 and magnetic yoke 22 and appears to loop under the lowermost plate 28 as is evidenced by burning on the bight of the magnetic piece 22 in a test sample. The arc is also constricted by being drawn within the V-shaped notch formed by the slot portions 31 of the plates 28 and 29. The major portion of the arc gases, including the gases evolved by any gas producing material which may be present adjacent the arc path move upwardly into the chamber embraced by the legs 34 on the magnetic piece 32, where metallic particles will be attracted. The arc gases then exit through the vent 35 by passing through the screen 36. Arc gases within the suppressor structure are compressed by being drawn within the V-shaped notch formed by the notches 31 in the plates 28 and 29 and are also placed under pressure due to any gases which may be evolved from gas producing material which may be adjacent to the arc. The arc gases are cooled by contact with the surfaces provided, particularly the metallic heat conducting surfaces provided by the magnetic parts 22 and 29. The screen 36 further serves to cool the products of the arc before they are vented to the exterior of the breaker and also serves to prevent passage of any large particles which might be present therein.

In attempting to describe the operation of the arc suppressor structure, it has been necessary to theorize upon the action of the suppressor upon the arc; however, it is to be understood that the nature of the phenomena is such that it is impossible to determine the exact path of the arc or the nature of the suppressor action thereon due to the extremely short periods of time, of the order of one-half cycle, during which the arc exists. Such theory as has been given has been based upon observation and deduction from the condition of parts in test samples after successful arc interruption and it is, of course, understood that applicant is not to be limited to any particular theory of operation of his arc suppressor nor to the factual truth of the theory which has been advanced herein to explain its operation; and, while a preferred embodiment of the invention has been disclosed it will be 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 arc suppressor structure for an automatic electric circuit breaker, a conducting connector having an integral, partially severed portion which remains connected thereto only at the connector end and disconnected therefrom along the length of the portion, a stationary contact mounted on said portion at a point remote from the end thereof so that the end of the portion forms an arc horn or runner to which an arc struck to the stationary contact may be drawn, a chamber about said stationary contact defined at least in part by a U-shaped magnetic yoke having its bight disposed in the direction of extension of said runner, a restricted chamber disposed above said magnetic yoke along the path of movement of the movable contact, said restricted chamber being formed by the edges of slots within a group of stacked plates of magnetic

and insulating material, said plates being arranged in an alternating series with insulating plates between at least certain of said magnetic plates, the edges of said slots being flush so as to form continuous walls for said restricted chamber, said slot edges converging in the direction in which an arc between the contacts is drawn.

2. In an arc suppressor structure for an automatic electric circuit breaker, a conducting connector having an integral, partially severed portion which remains connected thereto only at the connector end and disconnected therefrom along the length of the portion, a stationary contact mounted on said portion at a point remote from the end thereof so that the end of the portion forms an arc horn or runner to which an arc struck to the stationary contact may be drawn, a chamber about said stationary contact defined at least in part by a U-shaped magnetic yoke having its bight disposed in the direction of extension of said runner, a restricted chamber disposed above said magnetic yoke along the path of movement of the movable contact, said restricted chamber being formed by the edges of slots within a group of stacked plates of magnetic and insulating material, said plates being arranged in an alternating series with insulating plates between at least certain of said magnetic plates, the edges of said slots being flush so as to form continuous walls for said restricted chamber, said slot edges converging in the direction in which an arc between the contacts is drawn, and a third chamber above said restricted chamber and having magnetic elements forming at least a portion of the walls thereof, said third chamber having a cross-sectional area considerably greater than the cross-sectional area of said restricted area and being provided with a vent to the exterior atmosphere.

3. An arc suppressor for an electric circuit interrupter having separable contacts between which an arc is drawn upon separation of the contacts under load, comprising a chamber about the engaged position of said contacts, which chamber is substantially closed except at its top and having a front wall providing entrance for a switching arm carrying a movable contact, said chamber being substantially wider than the contacts and extending a substantial distance above the engaged position of the contacts in the direction of contact separation, said chamber being bounded on its back and at least a portion of its side walls by a magnetic yoke U-shaped in cross-section and having a height substantially equal to the chamber height, and a chamber restricted in cross-section with respect to the cross-section of said first mentioned chamber communicating therewith and extending thereabove along the path of separation of said contacts, said restricted chamber being formed of the edges of slots within a group of stacked insulating and magnetic plates, said slots converging in the direction in which an arc produced between the contacts is drawn, with the edges of the slots flush so as to produce a continuous wall surface in said restricted chamber preventing entrance of the arc between the stacked plates.

4. An arc suppressor for an electric circuit interrupter having separable contacts between which an arc is drawn upon separation of the contacts under load, comprising a chamber about the engaged position of said contacts, which chamber is substantially closed except at its top and having a front wall providing entrance for a switching arm carrying a movable contact, said chamber being substantially wider than the contacts and extending a substantial distance above the engaged position of the contacts in the direction of contact separation, said chamber being bounded on its back and at least a portion of its side walls by a magnetic yoke U-shaped in cross-section and having a height substantially equal to the chamber height, and a chamber restricted in cross-section with respect to the cross-section of said first mentioned chamber communicating therewith and extending thereabove along the path of separation of said contacts, said restricted chamber being formed of the edges of slots within a group of stacked insulating and magnetic plates, said slots converging in the direction in which an arc produced between the contacts is drawn, with the edges of the slots flush so as to produce a continuous wall surface in said restricted chamber preventing entrance of the arc between the stacked plates, and a third chamber of relatively large cross-sectional area with relation to the cross-sectional area of said restricted chamber disposed above said restricted chamber and communicating therewith and positioned adjacent the open position of the movable contact.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
973,898	Wallbillich	Oct. 25, 1910
1,840,292	Slepian	Jan. 5, 1932
1,869,552	Ellis	Aug. 2, 1932
1,905,038	McDowell	Apr. 25, 1933
1,914,129	Jennings	June 13, 1933
1,963,643	Brainard et al.	June 19, 1934
1,991,878	Baker et al.	Feb. 19, 1935
2,030,582	Graves	Feb. 11, 1936
2,039,054	Boden et al.	Apr. 28, 1936
2,200,070	Armstrong et al.	May 7, 1940
2,243,040	Ludwig	May 20, 1941
2,249,499	Seaman	July 15, 1941
2,268,336	Jackson et al.	Dec. 30, 1941
2,328,318	Wood	Aug. 31, 1943

FOREIGN PATENTS

Number	Country	Date
71,393	Switzerland	Jan. 3, 1916