United States Patent [19]

Harper

[11] **3,780,249**

[45] **Dec. 18, 1973**

[54] **DUST SEAL HIGH PERFORMANCE BREAKER**

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[73] Assignee: **Airpax Electronics Incorporated,** Cambridge, Md.

[22] Filed: **Apr. 28, 1972**

[21] Appl. No.: **248,406**

[52] **U.S. Cl.** ..... **200/168 G,** 200/144 R

[51] **Int. Cl.** **H01h 9/04**

[58] **Field of Search** ..... 200/144 R, 168 G, 200/146 R

[56] **References Cited**

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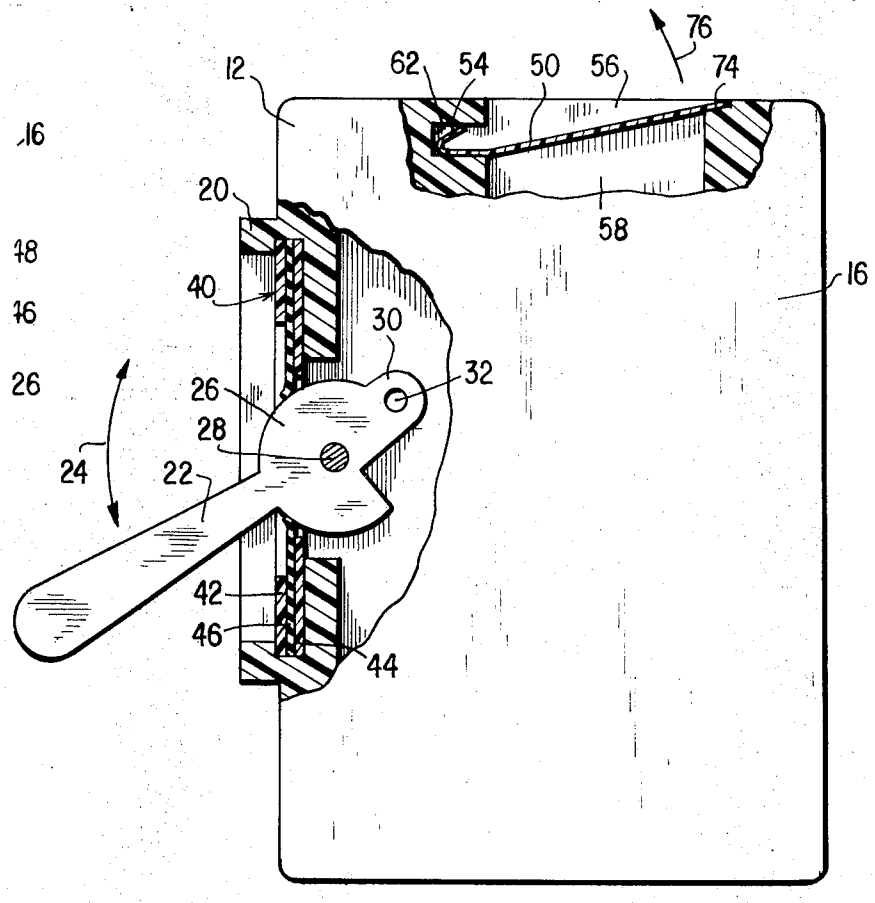
Primary Examiner—Robert K. Schaefer
Assistant Examiner—William J. Smith
Attorney—Robert E. LeBlanc et al.

[57] **ABSTRACT**

Disclosed is a high performance dust or explosion proof electrical circuit breaker. In one embodiment the breaker is provided with a dust seal flap for venting arcing gases to atmosphere while at the same time substantially reducing the entry of dust and dirt into the breaker housing. In a second embodiment the dust seal is replaced by a fine mesh screen for increased safety when the breaker is used in an atmosphere which may present a danger of explosion.

17 Claims, 8 Drawing Figures



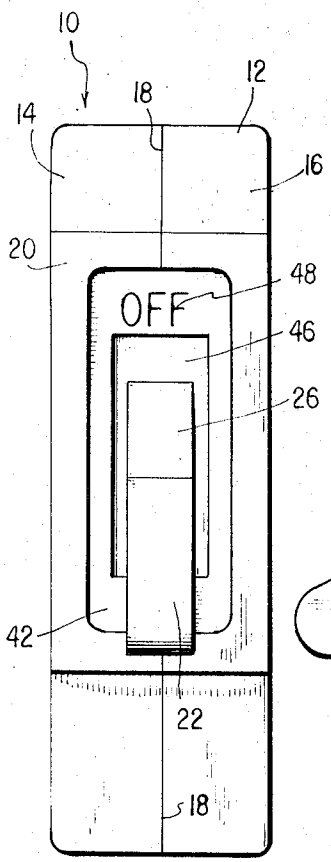


FIG. 1

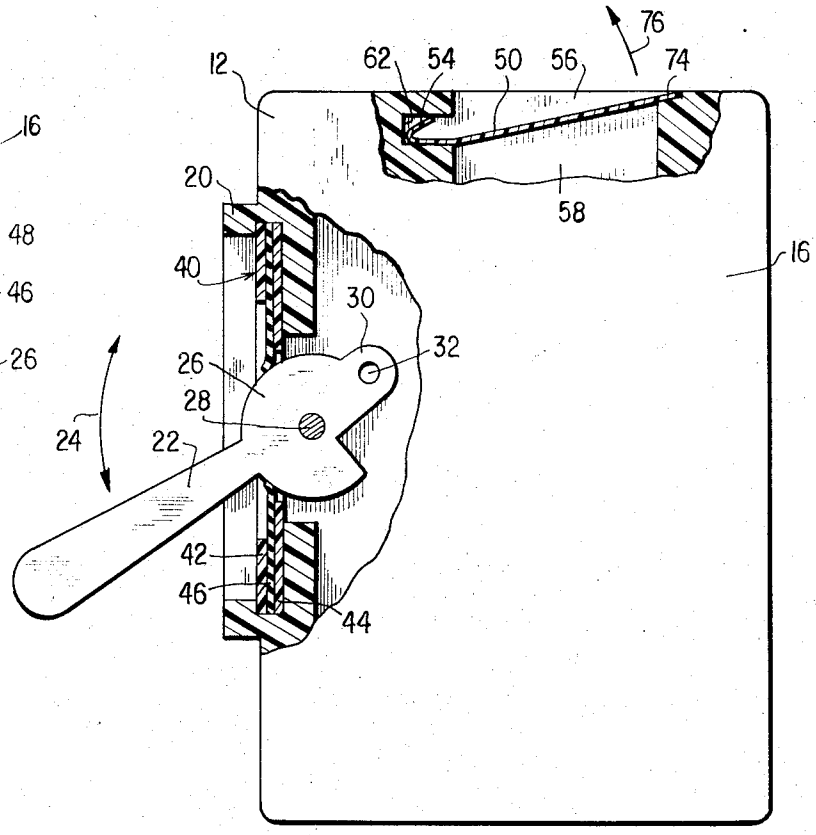


FIG. 2

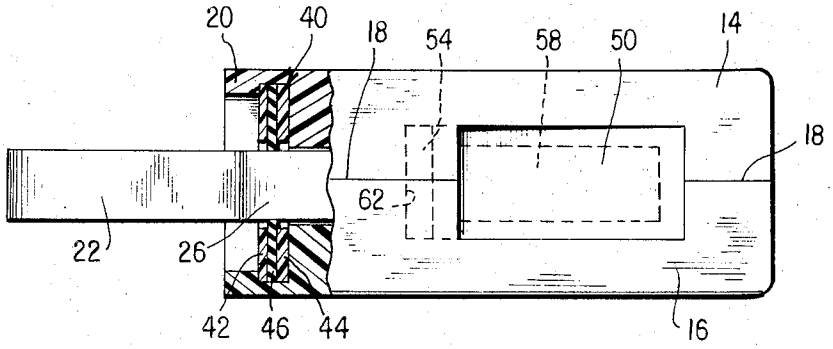


FIG. 3

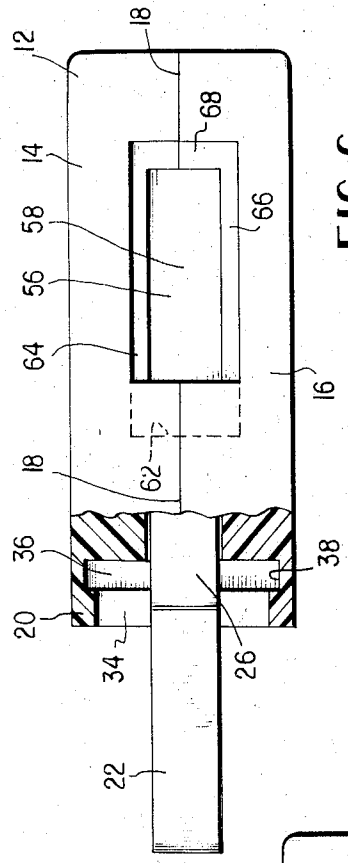


FIG. 6

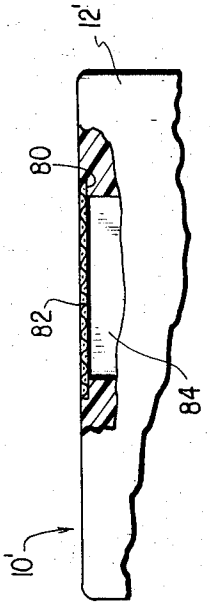


FIG. 7

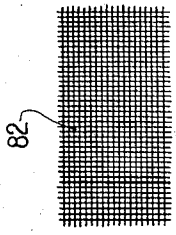


FIG. 8

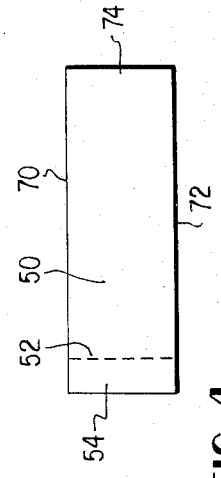


FIG. 4

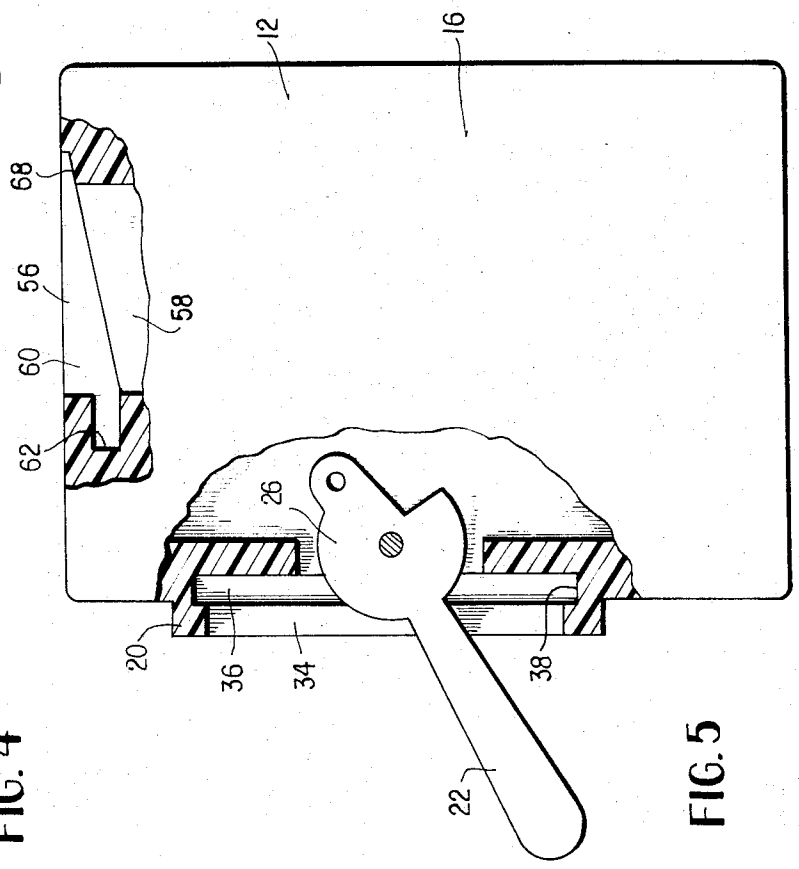


FIG. 5

DUST SEAL HIGH PERFORMANCE BREAKER

This invention relates to a high performance electrical circuit breaker for use under adverse conditions. In particular, it is directed to an electromagnetic circuit breaker which may be used in dusty atmosphere or under conditions in which the atmosphere may present a danger of explosion.

As is well known, the opening and closing of the electrical contacts of a circuit breaker are often accompanied by the creation of an electrical arc across the contacts. This electrical arcing causes increases in heat and pressure within the circuit breaker housing. The arcing across the electrical contacts may be particularly severe when the contacts are opened in response to an overcurrent flowing through the breaker. In order to minimize arcing and the accompanying heat and pressure within the breaker it is customary to provide a so called arc chute in the arc chamber of the breaker adjacent the area in which the arc is formed. While these arc chutes may have some value, they do not completely eliminate breaker arcing.

Because of the increased pressures of the arc gases created in the area of the circuit breaker contacts many circuit breakers are provided with vents for venting the arc gases generated in the arc chamber of the circuit breaker to atmosphere. This not only releases the excessive pressures generated in the arc chambers but also helps to more rapidly dissipate heat from the breaker which might otherwise have an adverse affect on the circuit breaker components. However, vented circuit breakers are not suitable for use in many situations where contaminants in the atmosphere may gain access through the vents in the circuit breaker housing to the working components of the breaker. For example, it has been found that when a circuit breaker is incorporated in the compartment of a deisel engine locomotive, dust and dirt from the engine atmosphere tends to fill and clog the circuit breaker vents so as to prevent proper exhaust of the arc gases from the circuit breaker housing. In addition, the dust and dirt collects on the electrical contacts and other moving parts of the circuit breaker mechanism further adversely affecting circuit breaker operation to the point where the tripping characteristics of the breaker are no longer reliable.

There are other situations in which vented circuit breakers are undesirable. For example, vented circuit breakers are not acceptable for use in the bilge area of a marine vessel or boat. As is well known, the bilge area of a boat tends to trap gasoline vapors from the boat engine and when these vapors build up to a sufficient degree, they present a danger of explosion. Needless to say, a marine explosion can be fatal. The buildup of gasoline vapors in the bilge presents a serious safety problem to the operator of a boat or other marine vessel. These gasoline vapors may be ignited when the excessive pressures in the circuit breaker accompanying the electrical arc across the circuit breaker contacts causes a small flame to be actually blown out of the circuit breaker through the exhaust vents into the potentially explosive gasoline vapor atmosphere.

In order to cope with these problems and dangers encountered when circuit breakers are operated under such adverse conditions, it has been proposed to use under circumstances of this type electrical circuit breakers which are contained in completely sealed or completely closed housings so that no gases may be vented to atmosphere and no contaminants from the atmosphere may gain access to the interior of the circuit breaker. While completely sealed circuit breakers find some utility in adverse atmospheres, the fact that they are completely closed permits the buildup in the circuit breaker of excessive amounts of heat and pressure due to contact arcing. As a result, completely enclosed circuit breakers of this type generally possess very poor electrical short circuit features and they are not considered to be high performance breakers.

The present invention overcomes these and other problems by providing a high performance circuit breaker which can be used under adverse conditions and in particular provides a breaker which can be used in a dusty or a dirty atmosphere such as an engine compartment of a deisel locomotive or in a potentially explosive atmosphere such as the bilge of a marine vessel. In one embodiment of the present invention, the circuit breaker is provided with a novel silicone rubber seal around the circuit breaker handle. Further, the circuit breaker housing or case is provided with an aperture communicating with the interior of the arc chamber of the breaker. In order to minimize the entry of dust, dirt and other contaminants from the atmosphere, this aperture is closed off by a movable dust seal, preferably in the form of a flexible flap restrained at one end but having its other end free to move under the influence of increased arc created pressures in the interior of the breaker. When contact arcing occurs, the elevated pressure in the arc chamber causes the flap to move and open the aperture exhausting the arc gases to atmosphere and relieving the excessive amounts of heat and pressure in the circuit breaker. During those times when no arcing occurs across the circuit breaker contacts, the resilient nature of the flexible dust seal flap causes it to return to its initial position closing the exhaust aperture and sealing the circuit breaker against the entry of dust and dirt.

In a second embodiment of the present invention the dust flap seal is replaced by a fine wire mesh screen. This screen acts as a flame arrestor for the arc chamber and while it permits the arc gases and the excessive heat and pressure accompanying them to vent through the exhaust aperture to the atmosphere the screen prevents any flame from being blown out of the arc chamber and substantially increases the safety with which the circuit breaker may be used in a potentially explosive atmosphere such as the bilge area of a marine vessel. It has been found that in order to adequately operate as a flame arrestor, a single layer screen constructed in accordance with this invention should be provided with relatively small openings. In particular, it has been found that the screen should have openings no larger than 30 mesh and a single layer of 60 mesh screen is preferred. If multiple layers of screen are used, a larger mesh size (lower mesh number) may be employed but in any event, the combined effect of the multiple layers should be to provide an effective mesh opening no larger than 30 mesh.

It is therefore, one object of the present invention to provide an approved high performance circuit breaker.

Another object of the present invention is to provide a high performance circuit breaker usable under adverse conditions.

Another object of the present invention is to provide a high performance electrical circuit breaker usable in a dusty and dirty atmosphere such as the atmosphere surrounding the engine of a diesel locomotive.

Another object of the present invention is to provide a high performance circuit breaker usable in a potentially explosive atmosphere such as the bilge of a marine vessel.

Another object of the present invention is to provide an improved high performance dust seal circuit breaker.

Another object of the present invention is to provide a high performance circuit breaker incorporating a dust seal in the form of a flexible and resilient flap for venting the arc chamber of a circuit breaker housing to atmosphere.

Another object of the present invention is to provide a high performance circuit breaker incorporating a flame arrestor vent for the circuit breaker arm chamber.

Another object of the present invention is to provide a flame arresting vent for a circuit breaker arc chamber in the form of a fine wire mesh screen having oepnings no later than approximately 30 mesh.

Another object of the present invention is to provide a high performance circuit breaker with an improved silicone rubber seal for the circuit breaker operator or handle.

These and further objects and advantages of the invention will be more apparent upon reference to the following specification, claims and appended drawings wherein:

FIG. 1 is a front view of a magnetic circuit breaker constructed in accordance with this invention.

FIG. 2 is a side view of the circuit breaker of FIG. 1 with portions broken away and parts in section to more clearly show the novel features of the present invention.

FIG. 3 is a top plan view of the circuit breaker of FIG. 2 again with parts broken away and parts in section for the sake of clarity.

FIG. 4 is a plan view of the dust seal flap forming a part of the circuit breaker of FIGS. 1–3.

FIG. 5 is a side view similar to FIG. 2 but with the seals omitted to show the supporting structure.

FIG. 6 is a top plan view similar to FIG. 3 again with the seals omitted to more clearly show the supporting structure for the seals.

FIG. 7 is a partial side view similar to FIG. 2 showing a modified embodiment in which the dust seal of flap is replaced by a fixed flame arresting fine mesh wire screen.

FIG. 8 is a top plan view of the flame arresting metal screen of the circuit breaker of FIG. 7.

Referring to the drawings, the novel high performance circuit breaker of the present invention is generally indicated at **10** in FIG. 1 as including a housing **12** formed of mating sections or housing halves **14** and **16.** Housing **12** is preferably molded from a black colored phenolic material and after the operating mechanism of the breaker is inserted the two halves, **14** and **16** are joined together in a conventional manner by screws or the like to form a single unitary housing **12.** The parting line defining the two housing halves **14** and **16** is indicated at **18.** The operating mechanism of the circuit breaker forms per se no part of the present invention and has been omitted for the sake of clarity. It is understood that the circuit breaker mechanism is preferably of the magnetic type but it is understood that the features of the present invention are equally applicable to other types of circuit breaker mechanisms including the bi-metallic or thermal breakers. By way of example only, the operating mechanism of the breaker of the present invention may be of the type disclosed in the assignee's U.S. Pat. No. 3,412,351 or in assignee's U.S. Pat. No. 3,486,140.

Referring to FIGS. **2** and **3,** housing **12** is provided at its front or face with an outwardly extending rectangular boss **20** through which projects the operator or handle **22** manually movable between the "off" position illustrated in the drawings and the "on" position as indicated by the double ended arrow **24** in FIG. **2.** Handle **22** is preferably made from a suitable electrically insulating plastic such as nylon and is formed integral with a semi-cylindrical handle disc **26.** Passing through the center of semi-cylindrical disc **26** is a pivot pin **28** which has its outer ends supported by the walls of housing **12.** In this way, the nylon disc which forms a bearing material is free to rotate about pin **28,** between the in and off positions of the handle. Formed integral with handle disc **26** are a pair of outwardly extending ears one of which is illustrated at **30** FIG. **2** which are apertured as at **32** to receive a pin for connecting the handle disc to a collapsible toggle linkage mechanism of the type shown and described in the two above-identified patents. When the handle is in the off position, as illustrated, the circuit breaker contacts (not shown) are closed and when the handle is moved upwardly in FIG. **2** to the on position, the contacts are closed in a well known manner. Tripping of the toggle by an overcurrent causes the contacts to open and the handle to move to the off position.

Referring to FIGS. **5** and **6** in conjunction with FIGS. **1** to **3** boss **20** is provided with an aperture **34** through which that handle **22** passes and this aperture which is of rectangular configuration communicates with a second larger rectangular aperture **36** in the circuit breaker which larger aperture defines a groove, **38** extending completely around the handle. Positioned with its outer edges received in the groove **36** is a handle seal **40** formed as a sandwich construction and comprising a rigid outer support **42,** a rigid inner support **44** and an intermediate flexible sealing member **46** preferably formed of silicone rubber. By way of example only, outer support **42** may be formed of a suitable black colored phenolic having printed on it in white letters the word "off" above handle **22** as illustrated at **48** in FIG. **1** and the word "on" beneath the handle. The word "on" is obscured when the handle is in the downward position illustrated in the drawings and the word "off" is obscured when the handle is in its uppermost position. Each of the supports **42** and **44** as well as the silicone rubber seal are formed from thin rectangular sheets and each is provided with a central rectangular aperture through which the handle passes. However, the central aperture in sealing member **46** is smaller than the apertures in the supports **42** and **44** so that sealing member **46** is the only one which actually touches handle disc **26.** Preferably silicone rubber seal **46** engages the handle or disc all the way around to tightly seal the handle aperture against the entry of dust, dirt and the like. The silicone rubber forms a good sliding seal with the disc portion of handle **22** and permits the handle to be moved up and down because of the resilient and flexible nature of the silicone rubber while at all times maintaining a good dust seal.

An additional important feature of the circuit breaker illustrated in FIGS. **1–3** is the incorporation in

the housing 12 of a dust seal flap 50 adapted to close off an exhaust aperture 56 through the housing communicating with the circuit breaker arc chamber 58. Flap 50 is formed from a thin flat sheet of suitable plastic material preferable "mylar" as illustrated in FIG. 4 and is bent at one end around an imaginary line indicated at 52 in FIG. 4 to form the turned over end 54 illustrated in FIG. 2.

Flap 50 closes off aperture 56 which is best seen in FIGS. 5 and 6. This aperture includes at its lower end a rectangular cross section portion 58 forming a part of the circuit breaker arc chamber and an enlarged upper portion 60. Enlarged upper end 60 defies a groove 62 in which is placed the turned over end 54 of the mylar flap 50. Enlarged portion 60 of the opening also defines a pair of shoulders 64 and 66 which shoulders slope outwardly or upwardly in FIG. 5 and terminate in an ajoining ledge 68. The two edges 70 and 72 of flap 50 illustrated in FIG. 4 normally rest against the inclined respective shoulders 64 and 66 and the remote end 74 of the flap rests against the shoulders and ledge to tightly seal passageway 56 against the entry of dust, dirt and the like by the resilient nature of the turned over end 54 bearing against the sides of groove 62 as illustrated in FIG. 2. However, when an overpressure occurs in the arc chamber 58, the base of the V formed by turned over end 54 acts as a pivot and the free end 74 of the flap moves outwardly away from the housing and ledge 68 in the direction of the arrow 76 in FIG. 2 to permit the excess pressure and some of the heat to exhaust to atmosphere from the arc chamber. When the overpressure has been relieved, the resilient nature of the "mylar" strip causes the flap to return to the position illustrated in FIG. 2 to again seal the opening 56 against the entry of dust, dirt and other contaminants which may be in the atmosphere surrounding the circuit breaker.

FIG. 7 shows a modified construction in which housing 12 is counterbored as at 80 to receive a fine wire mesh screen 82 which closes off a passageway 84 communicating with the circuit breaker arc chamber. FIG. 8 is a top plan view of the wire mesh screen 82 which is preferably of conventional woven wire mesh construction and in the preferred embodiment has mesh openings of 60 mesh. It is understood that the remainder of the circuit breaker embodiment illustrated in FIGS. 7 and 8 is identical in constructin to the embodiment previously described with respect to FIGS. 1–6. It has been found that the fine wire mesh screen 82 acts as a flame arrestor so that the modified circuit breaker of FIG. 7 is suitable for use in potentially explosive atmospheres such as marine bilges where gasoline vapors tend to collect and otherwise might be exploded by a flame blowing out through vents in the circuit breaker housing from the arc chamber. Screen 82 may be secured in the counterbore 80 in any suitable manner such as by the application of a suitable adhesive to the outer edges of the screen. In order to be suitable for use in a potentially explosive atmosphere, it has been found that the openings in the single layer wire mesh 82 can be no larger than approximately 30 mesh and as previously indicated, the preferred size for the mesh openings is 60 mesh. If multiple layers of screen material are used for the screen 82, then larger mesh sizes (lower mesh numbers) can be used but in any event the effective openings formed by the multiple layers should be the equivalent of 30 mesh size or smaller.

It is apparent from the above that the present invention provides an improved high performance circuit breaker for use under adverse conditions and particularly a circuit breaker in one embodiment suitable for in a dusty atmosphere and in another embodiment, a circuit breaker suitable for use in a potentially explosive atmosphere. In both of the embodiments, the handle aperture is closed off by a novel silicone rubber seal which remains in sealing engagement with the handle during all handle movements. In the dust seal embodiment the breaker housing is in addition to the handle seal provided with a resilient and flexible vent flap seal so that excessive pressures associated with contact arcing may be vented to atmosphere whereas during the vast majority of the time the flap is closed and the circuit breaker tightly sealed against the entry of dust.

Changes and modifications where desired are readily apparent. For example, plastic mesh constructions may be substituted for the woven wire meshes, materials other than "mylar" may be used for the dust seal flap and other appropriate materials may be substituted for the elements of the handle seal 40 although silicone rubber has been found particularly suited for engagement with the handle disc 26. In some instances, the back support 44 of FIG. 2 may be completely eliminated and the silicone rubber seal 46 held in place between a portion of the circuit breaker housing and the support 42.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which-come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a circuit breaker having a housing and a handle extending outwardly from the housing, the improvement comprising sealing means engaging said handle to establish a seal between said handle and housing, an arc chamber gas vent in said housing, and a dust seal across said vent for closing off said vent against the entry of dust into said housing while permitting gases to exhaust to atmosphere from said housing through said vent.

2. Apparatus according to claim 1 wherein said dust seal comprises a movable flap.

3. Apparatus according to claim 1 wherein said sealing means comprises at least one rigid support member having a central aperture through which said handle passes, and a sealing member supported in said housing by said support member, said sealing member having a central aperture with its edges in sealing contact with said handle.

4. Apparatus according to claim 3 wherein said support member and sealing member apertures are rectangular.

5. Apparatus according to claim 3 wherein said housing is provided with a groove, the outer edges of said support and sealing members being received in said groove.

6. Apparatus according to claim 3 wherein said sealing member is made from a flat strip of silicone rubber.

7. Apparatus according to claim 6 wherein said support member is made from a flat strip of phenolic material.

8. Apparatus according to claim 7 including a second support strip of plastic material on the side of said sealing member remote from said phenolic strip.

9. A dust seal high performance circuit breaker comprising a housing, said housing having a first aperture, a handle extending through said first aperture, first sealing means in said aperture establishing a first seal between said housing and said handle, said housing have a second aperture, and dust seal means on said housing for sealing said second aperture against the entry of dust into said housing while permitting gases to exhaust from said housing through said second aperture.

10. A circuit breaker according to claim 9 wherein said dust seal means comprises means normally closing off said second aperture but movable in response to an overpressure in said housing to open said second aperture.

11. A circuit breaker according to claim 10 wherein said dust seal means comprises a flap resiliently biased closed but pivoted to open upon a rise in pressure within said breaker housing.

12. A high performance circuit breaker for use in potentially explosive atmospheres comprising a housing, said housing having a first aperture, a handle extending through said first aperture, sealing means in said first aperture establishing a seal between said housing and said handle, said housing having a second aperture, and flame arresting means on said housing for preventing contact arc flames from being blown out of said housing through said second aperture.

13. A circuit breaker according to claim 12 wherein said flame arresting means comprise a fine mesh screen extending across said second aperture.

14. A circuit breaker according to claim 13 wherein said screen has an effective mesh size no larger than 30 mesh.

15. A circuit breaker according to claim 13 wherein said screen comprises a single layer wire mesh having a mesh size of about 60 mesh.

16. A dust seal high performance circuit breaker comprising a housing, said housing having a first aperture, a handle extending through said first aperture, first sealing means in said aperture establishing a first seal between said housing and said handle, said housing having a second aperture, and dust seal means on said housing for sealing said aperture against the entry of dust into said housing while permitting gases to exhaust from said housing through said second aperture, said dust seal means comprising means normally closing off said second aperture but movable in response to an overpressure in said housing to open said second aperture, said dust seal means comprising a flap resiliently bias closed but pivoted to open upon a rise in pressure within said breaker housing, said flap comprising a strip of plastic turned over at one end, said circuit breaker housing including a groove adjacent said second aperture receiving said turned over end of said flap.

17. A circuit breaker according to claim 16 wherein said flap is made of resilient plastic.

* * * * *

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(5/69)

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,780,249 Dated December 18, 1973

Inventor(s) George S. Harper

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 15, "arm" should read --arc--.

Column 4, line 19, "in" should read --on--.

Signed and sealed this 9th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

PO-1050
(5/69)

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