Jan. 7, 1941. J. D. HILLIARD 2,228,232

EXPULSION CIRCUIT BREAKER

Filed Feb. 28, 1938 2 Sheets-Sheet 1

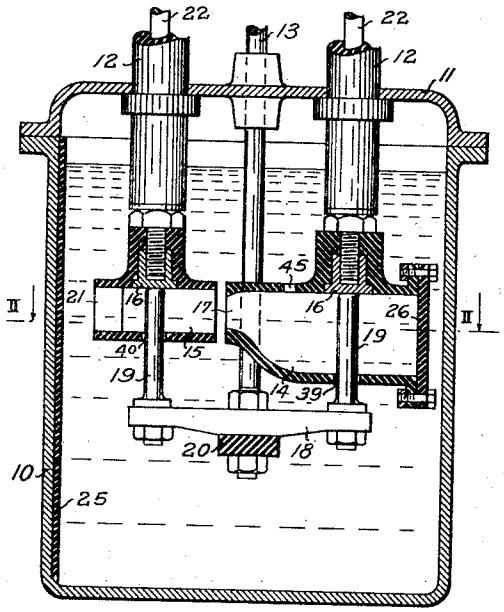


Fig. 1

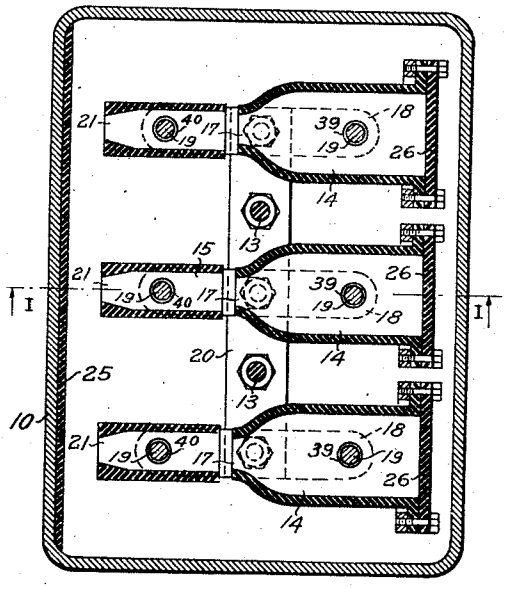


Fig. 2

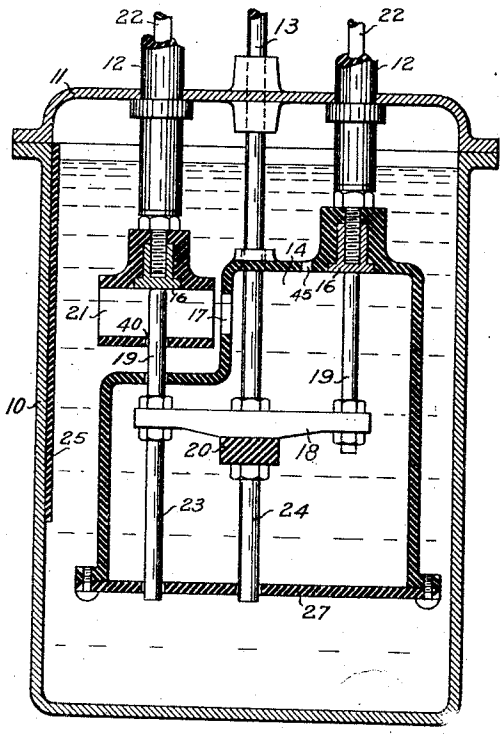


Fig. 3

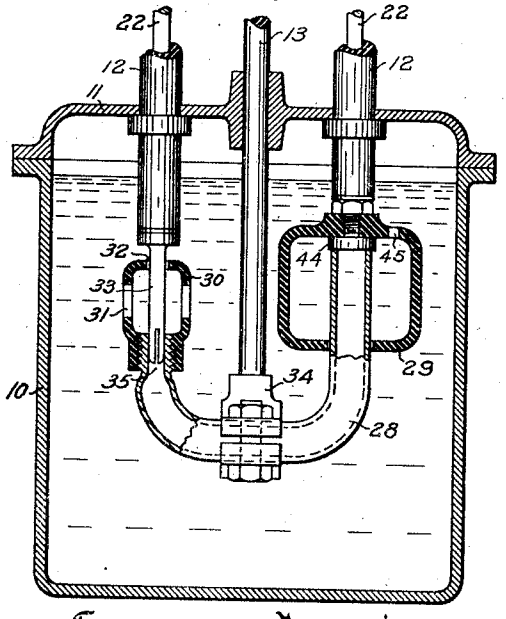


Fig. 4

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EXPULSION CIRCUIT BREAKER

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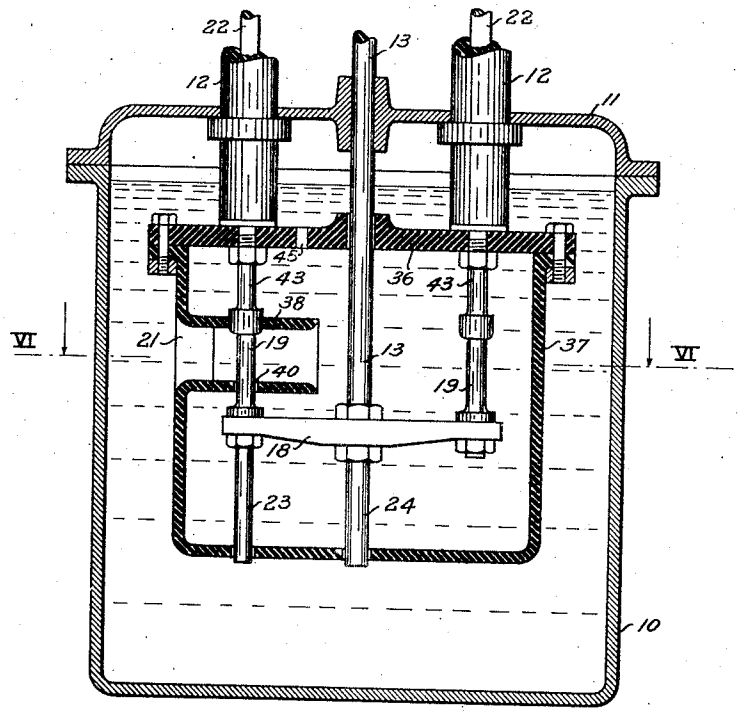


Fig. 5

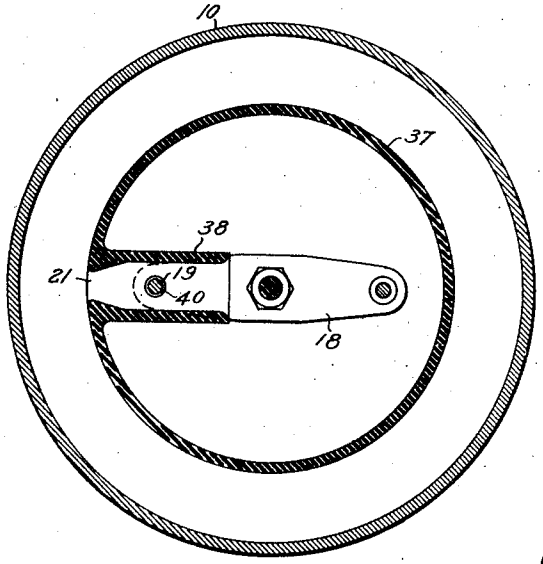


Fig. 6

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UNITED STATES PATENT OFFICE

2,228,232

EXPULSION CIRCUIT BREAKER

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Application February 28, 1938, Serial No. 192,927

7 Claims. (Cl. 200—150)

This invention relates in general to circuit breakers of the blast or expulsion type and more particularly to circuit breakers wherein an arc formed between one pair of a plurality of pairs of serially connected contacts separating in oil or some similar insulating and arc extinguishing fluid is utilized to aid in extinguishing the arc drawn between another pair of contacts.

In circuit breakers of the prior art where an attempt has been made to utilize one pair of serially connected arcing contacts to provide a pressure tending to act on another pair of contacts, it has been found that where both pairs of serially connected contacts are in the same chamber, that hot gases and arc products as well as oil are forced across the arc extinguishing contacts. Gas which is ionized by an arc is a good conductor and to extinguish an arc between separating contacts, such gas must be removed and replaced with good dielectric material. When contacts carrying an alternating current are separating and drawing an arc, the only time that no gas is being generated by such arc is during a current zero.

In the prior art, where pressure generating and arc extinguishing pairs of contacts are provided in a single chamber, there is grave danger that the ionized gas generated by the pressure generating arc will form a conducting path between the stationary contacts.

The present invention avoids the above disadvantages by providing a pressure chamber large enough so that a pressure is maintained therein even during a current zero. Also, a means is provided whereby the ionized gases in the blasting chamber are swept away and at a current zero, cool oil unmixed with ionized gas is inserted between the separating contacts. To provide against the possibility of an arc striking through the path caused by the ionized gas between the two stationary contacts, the pressure generating contacts and the arc extinguishing contacts are in entirely separate chambers.

It is an object of this invention to provide an improved circuit breaker avoiding the above disadvantages and wherein the arc is extinguished and the circuit is interrupted in an improved and more efficient manner.

A further object of this invention is to provide in a circuit breaker of the above type having serially connected pairs of cooperating contacts, a pressure chamber enclosing one pair of contacts and a blasting chamber enclosing the other pair of contacts so arranged that the pairs of contacts are electrically separate when the circuit breaker is in open position.

It is also an object of the present invention to provide a circuit breaker of the above type, having a pressure chamber at one pair of contacts and a blasting chamber at the other pair of contacts, with a contact bridging member for operatively connecting the two chambers.

It is also an object of the present invention to provide, in a circuit breaker of the above type, a means for balancing the pressures set up by movement of the bridging member and moving contact into the pressure chamber.

It is a further object of the present invention to provide in a circuit breaker of the above type a means for utilizing one pair of serially connected contacts for providing a pressure operative to move a solid slug of liquid between the other pair of serially connected contacts, to aid in extinguishing the arc therebetween but at the same time providing separate arcing chambers for each pair of serially connected contacts.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a vertical section view taken on the line I—I of Fig. 2 of a circuit breaker embodying the present invention;

Fig. 2 is a top view of the circuit breaker of Fig. 1 taken on the line II—II;

Fig. 3 is a vertical sectional view of a modified form of a circuit breaker embodying the present invention;

Fig. 4 is a vertical sectional view showing another modified form of a circuit breaker embodying the present invention;

Fig. 5 is a vertical sectional view of a further modified form of a circuit breaker embodying the present invention;

Fig. 6 is a top sectional view of a circuit breaker of Fig. 5 taken on the line VI—VI.

The circuit breaker of Figs. 1 and 2 is of the so-called blast or expulsion type. A tank 10 contains oil or a similar arc extinguishing fluid and has a cover 11 supporting the bushing 12 which carries the circuit current carrying rod 22 electrically connected to the stationary contact 16. A pressure chamber 14 of insulating material is supported in the insulating liquid by one stationary contact 16 and is closed at one end by a cover 26, thereby forming a chamber closed except for a nozzle opening 17.

Alined with the nozzle vent 17, is a blasting chamber 15 of insulating material supported

by another stationary contact 16. The movable contacts 19 are carried by a bridging member 18 carried by the operating rod 13 of insulating material connected to an operating means not shown. The moving contacts 19 cooperate with the stationary contacts 16 through a throat member 39 in the pressure chamber 14 and through a throat 40 in the blasting chamber 15. It will be noted when the circuit breaker shown in Fig. 1 is in the open position, the live stationary contacts 16 are electrically separated and insulated against creepage voltage and against an arc following ionized gas along the walls of the chambers.

In operation of the circuit breaker shown in Figs. 1 and 2, a pressure generating arc is drawn between contacts 19 and 16 in the pressure chamber 14, which arc may be drawn simultaneously with or shortly prior to the drawing of an arc between contacts 16 and 19 in the blasting chamber 15. Due to the pressure generated in the pressure chamber 14 and also due to the fact that this chamber has only the single arc blasting vent or nozzle 17, a solid slug of oil is blasted through the tube 15 and across the contacts 19 and 16 therein. This solid slug of oil forces any ionized gases in the chamber 15 out of the chamber and substitutes therefor during a current zero a solid slug of cool oil. This provides a dielectric preventing the reignition of the arc and thereby interrupting the circuit.

In the embodiment of the invention shown in Fig. 3, a similar contact and bushing structure is utilized. In order to provide with certainty that a solid slug of oil is forced between the separating contacts in the blasting chamber 21 during a current zero, it is necessary that a pressure be maintained in the pressure chamber 14 at such time as substantially no pressure obtains in the blasting chamber.

The time of zero pressure generation in the blasting chamber is during a current zero, and by providing a pressure chamber of considerable size relative to the size of the blasting chamber, a pressure may be built up therein which will be maintained by gas expansion during a current zero. During a current zero no ionized gases are being generated by the separating contacts in the blasting chamber. If at such time a solid slug of oil is forced between the separating contacts and at the same time any ionized gases remaining in the blasting chamber are eliminated therefrom, the arc will be unable to restrike and the circuit will be interrupted.

The circuit breaker of Fig. 3 therefore provides a pressure chamber 14, the size of which relative to the size of the blasting chamber 21 is such that the pressure therein due to the arc drawn between contacts 19 and 16 will be maintained during a current zero. Such pressure will force oil from the pressure chamber 14 through the vent 17 and across the contacts 19 and 16 in the blasting chamber 21 so as to extinguish the arc. A sheet of insulating and heat resistant material 25 is supplied to prevent burning of the casing 10 and to prevent the striking of the arc from the contacts 16 in the blasting chamber to the tank 10.

In a circuit breaker having a pressure chamber such as shown in Fig. 3, both the operating rod 13 and the blasting chamber moving contact 19 move into the pressure chamber when the circuit breaker is moved to open position. This produces a decided piston effect which, when acted upon by the pressure generated in the pressure chamber, tends to reclose the circuit breaker by resisting the movement of rod 13 and contact 19. To avoid this piston effect, extension 24 on the operating rod 13 and extension 23 on the moving contact 19 are supplied. These extensions counterbalance the pressures caused by movement of operating rod 13 and contacts 19 into the pressure chamber, by preventing upwardly directed force from acting on the lower ends of rod 13 and the contact 19 extending into the pressure chamber. The pressures on the top and the bottom of the contact 19 entirely within the pressure chamber counterbalance each other and no compensation is necessary. In other words, without elements 23 and 24, movement of the left hand contact 19 into the pressure chamber (filled with liquid) would tend by piston action to pump liquid out through port 17. By providing members 23 and 24 of a size so that the exit volume thereof per unit of time is equal to the entrance volume of contact 19 and rod 13 per unit of time, no such pumping action obtains and there is no tendency to reclose the contacts. As the bridging member moves to open position and the operating rod 13 and contact 19 move into the pressure chamber, the extensions 23 and 24 move out therefrom, hence counterbalancing any piston effect.

In Fig. 4 a modification of the invention above described is shown. A pot of insulating material is formed by the member 29 and is supported on the stationary contact 44. The bridging member of this circuit breaker is formed of a hollow conducting tube 28 which is carried by a clamping member 34 on the operating rod 13. The blasting chamber of this circuit breaker is formed by an insulating member 30 carried by the bridging member 28 and having therein a throat member 32 through which the stationary contact 33 cooperates to make contact with the tube 28. The blasting chamber is further provided with vents 31.

When the circuit breaker of this embodiment is moved to open position, an arc is drawn between the conducting bridging member 28 and the stationary contact 44 thereby generating a high pressure in the chamber 29. Means of egress from this chamber (except for a small gas bleed vent) is only through a tubular bridging member 28 which substantially fills the opening in member 29. Due to this pressure, a blast of oil is directed through the nozzle 35 of the bridging member 28, across the arc drawn between the member 28 and the stationary contact 33 and out the vents 31 of the blasting chamber 30. This blast provides that the clean cool oil in the tube 28 which is unmixed with ionized gases, be forced between the separating contacts 34 and the bridging member 28 during a current zero thereby extinguishing the arc. The circuit breakers described and shown in Figs. 1 to 4 may be either single phase or polyphase circuit breakers other than the three phase breaker illustrated in Figs. 1 and 2.

The circuit breaker shown in Figs. 5 and 6 discloses another embodiment of the present invention and shows a method of applying the same to a round tank type of circuit breaker. This construction is very rugged and sturdy in that an insulating member 36 may be simply and firmly supported on the circuit breaker studs 22. A pot of insulating material 37 is bolted to the member 36 thereby forming both the pressure chamber and the blasting chamber. The pot 37 has a reentrant portion 38 forming the blasting chamber and providing the only means (except for a small gas bleed vent) of egress of oil and arc products from

the pressure chamber. The pressure chamber contacts may separate simultaneously with or slightly prior to the contacts separating in the blasting chamber.

When such separation occurs, a pressure is generated in the pressure chamber, similarly to that in the previous modifications, and a solid slug of liquid is forced across the separating contacts in the reentrant portion **38**. This sweeps out any ionized gases from between the separating contacts during a current zero and prevents restriking of the arc, thereby interrupting the circuit. Counterbalancing members similar to those shown in Fig. 3 may be utilized to prevent any tendency to reclose the circuit breaker during the opening movement. The circuit breakers of Figs. 4, 5 and 6 may be provided with insulation similar to **25** of Figs. 1, 2 and 3 to prevent burning of the tank and to prevent the arc from being blasted from the fixed contact of the expulsion chamber to the tank.

Although but a few embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A circuit breaker comprising a tank containing arc extinguishing liquid, fixed contacts supported in said liquid, a substantially closed chamber of insulating material enclosing one of said fixed contacts and fixed relative thereto, a vented chamber of insulating material enclosing another of said fixed contacts when an arc is drawn therewith, and a hollow conducting movable member bridging said contacts and connecting said chambers, said vented chamber being supported on and movable with said conducting member.

2. A circuit breaker comprising a tank containing arc extinguishing liquid, fixed contacts supported in said liquid, a substantially closed chamber of insulating material enclosing one of said fixed contacts and fixed relative thereto, a vented chamber of insulating material enclosing another of said fixed contacts, a hollow conducting member bridging said contacts and connecting said chambers, said conducting member arranged to separate from said fixed contact in said pressure chamber prior to separation thereof from said fixed contact in said venting chamber, and means whereby said vented chamber is mounted on and movable with said conducting member.

3. In combination, a casing containing arc extinguishing liquid, a pressure chamber of insulating material supported in said liquid, a first pair of contacts cooperable to draw an arc in said pressure chamber, a second chamber open to said pressure chamber and to said casing, a second pair of contacts operable to draw an arc in said second chamber, one of said second pair of contacts extending into said pressure chamber, a conducting member serially connecting one of each of said pairs of contacts, a member extending into said pressure chamber and operable to move said conducting member, and means comprising a member extending through the wall of said pressure chamber for compensating the extension of said operating member and said one of said second pair of contacts into said pressure chamber.

4. In combination, a casing containing arc extinguishing liquid, a pressure chamber of insulating material supported in said liquid, a first pair of contacts cooperable to draw an arc in said pressure chamber, a reentrant wall of said pressure chamber arranged to form a second chamber open to said pressure chamber and to said casing, a second pair of contacts serially connected with said first pair of contacts and operable to draw an arc in said second chamber, one of said second pair of contacts extending into said pressure chamber, and means including a member movable through the wall of said pressure chamber at substantially the same volume of said member per unit of time as the entrance volume per unit of time of said one of said second pair of contacts into said pressure chamber.

5. In combination, a tank containing arc extinguishing liquid, a plurality of serially connected pairs of contacts immersed in said liquid, a pressure chamber enclosing one of said pairs of contacts, a vent in said pressure chamber, a second chamber spaced in said liquid from said pressure chamber, and apertures in opposite walls of said second chamber, said apertures arranged in alinement with said vent.

6. In combination, a tank containing arc extinguishing liquid, a plurality of serially connected pairs of contacts immersed in said liquid, a pressure chamber enclosing one of said pairs of contacts, a second chamber enclosing another of said pairs of contacts and electrically spaced from said pressure chamber to provide a gap between adjacent walls of said chambers, said chambers being mutually exclusive, and means providing for reception in said second chamber of said liquid at a high velocity from said pressure chamber.

7. In combination, a tank containing arc extinguishing liquid, a plurality of serially connected pairs of contacts immersed in said liquid, a pressure chamber enclosing one of said pairs of contacts, a second chamber enclosing another of said pairs of contacts and electrically spaced from said pressure chamber and mechanically connected thereto only above the level of said liquid, and means providing for reception in said second chamber of said liquid at a high velocity from said pressure chamber.

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