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ELECTRIC CIRCUIT BREAKER

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Fig.1.

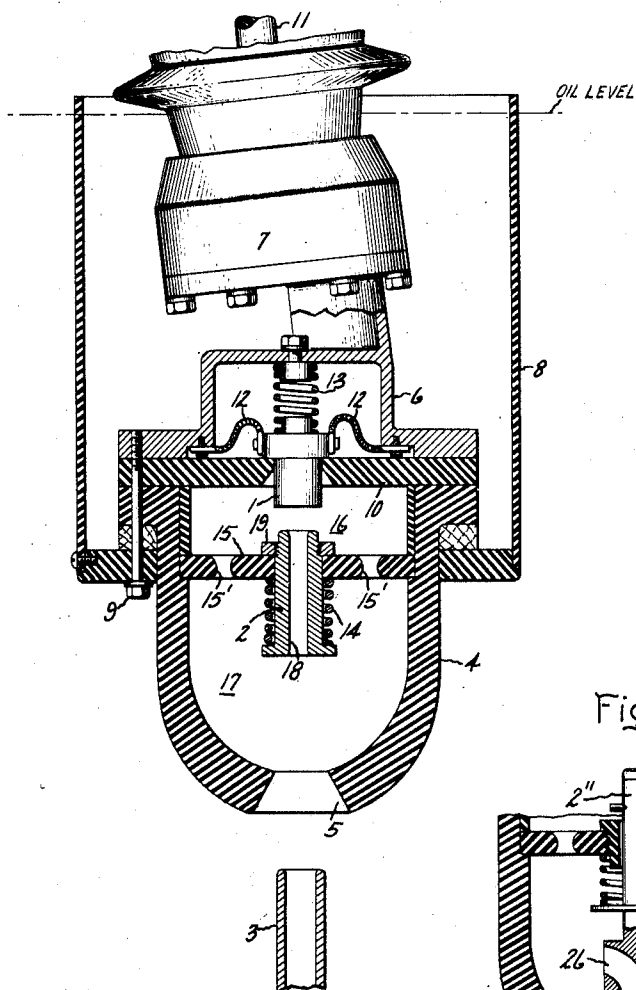


Fig.3.

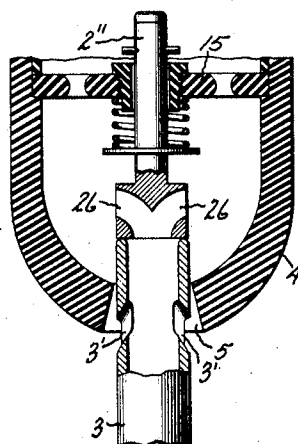
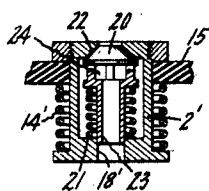


Fig.2.



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ELECTRIC CIRCUIT BREAKER

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5 Claims. (Cl. 200—150)

My invention relates to electric circuit breakers, more particularly to those of the oil-blast type wherein an arc drawn in an insulating or arc extinguishing liquid, such as oil, generates pressure for directing an arc extinguishing blast of said liquid through another arc.

In a well known form of oil-blast circuit breaker relatively movable contact structure, including an intermediate contact, coacts within a so-called explosion pot forming upon opening of the circuit a pressure generating arc and a main arc. Oil in said pot is forced through the main arc by the pressure generating arc. In this design the oil movement for causing interruption of the main arc is generally dependent on separation of the contacts at the main break which is formed subsequent to the pressure generating break. In the case of large short circuit currents, excessive pressure may thus be generated within the explosion pot before being relieved by the oil blast. Furthermore, a certain time lag in the oil blast occurs since the oil must be accelerated from practically a state of rest.

The principal object of my invention is the provision of an improved circuit breaker of the aforesaid type which shall initiate movement of liquid from the explosion pot in the direction of the liquid blast prior to formation of the main arc, and more particularly initiate movement of said liquid into the region of said main arc so as to facilitate and hasten the interruption of said main arc by the liquid blast.

In accordance with my invention, a part of the relatively movable contact structure is provided with a passage communicating or connecting respectively with the regions in which the pressure generating and main arcs are drawn. More particularly, the contact structure in a preferred form of my invention includes a movable tubular contact, the interior of which is generally in alinement with the aforesaid passage arranged so that upon initial formation of said pressure generating arc liquid from the region thereof is moved through said passage and into said tubular contact prior to formation of the main arc by said tubular contact.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, Fig. 1 is an elevational view, partly in section, of one pole of an

oil-blast circuit breaker embodying my invention. Fig. 2 is a detailed sectional view of a modified form of a part of the contact structure, and Fig. 3 is a similar view illustrating a modified form of contact structure embodying my invention.

Referring to Fig. 1, the single pole of the oil blast circuit breaker comprises relatively movable contact structure including a fixed contact 1, an intermediate contact 2 and a movable tubular contact 3. The contacts 1, 2 and 3 are arranged in alinement to make butt contact and coact within a so-called explosion chamber or pot 4 which is formed of insulation and provided with a lower throat opening 5 for receiving the tubular contact 3. The explosion pot 4 is suitably secured to the adapter structure 6 which is in turn supported at the lower end of the lead-in conductor bushing 7. An insulating shield 8 is secured, as at 9, to the explosion pot, the assembly including an insulating plate 10 which is clamped between the explosion pot and the adapter forming the upper wall of the explosion pot and guide for the fixed contact 1. The above structure is immersed in oil or other suitable arc extinguishing liquid as indicated.

The circuit breaker is illustrated in the open circuit position, the circuit being normally completed through the lead-in conductor 11, adapter 6, electrical conductors 12 interconnecting the adapter and fixed contact 1, intermediate contact 2 and tubular contact 3. The fixed contact 1 is normally biased by a spring 13 to the position shown where it is seated on the insulating plate 10. The intermediate contact 2 is likewise biased by a spring 14 seated between an insulating partition 15, in which the intermediate contact is mounted and guided, and the lower end of the intermediate contact so as to bias contact 2 away from contact 1. The lower position of contact 2 is determined by a shoulder 19. Upward or closing movement of the tubular contact 3 causes butt engagement of the contacts 2 and 3 and following movement of the contact 2 against the bias of spring 14 until contacts 2 and 1 are in engagement to complete the circuit. The spring 13 provides for over-travel of the contact 3.

In the operation of the conventional design opening movement of the tubular contact 3, with the resulting following movement of the usual solid intermediate contact, causes an initial or pressure generating arc between the contacts in the pressure chamber 16 which is in communication with the main arcing chamber 17 through

apertures 15' in the partition 15. The continued opening movement of contact 3, due to the limited following movement of the intermediate contact, causes a break between said contacts which forms the main arc. The pressure generated in the pot by the arc in chamber 16 then effects a radial blast of oil into the tubular contact 3 through the main arc, causing extinguishing of the same.

Accordingly, it will be noted that no movement of oil into the tubular contact 3 can take place in the case of well known forms of oil blast breakers including an intermediate solid butt contact until separation of the contacts. Furthermore, it will be apparent that due to the inertia of the oil body in the region of the main arc and in the tubular contact 3, instant acceleration of the blast to the desired velocity is not obtained. In the ideal condition movement of oil is well under way for immediate application to the main arc.

For the purpose of initiating such oil movement, the intermediate contact 2 is provided with a longitudinal passage 18 in communication respectively with chambers 16 and 17 and generally in alignment with the passage through the tubular contact 3. The intermediate contact in this form not only utilizes immediately the pressure in the chamber 16 for moving and accelerating oil through the passage 18 and into the tubular contact 3, thereby facilitating acceleration of the oil blast upon separation of contacts 2 and 3, but also directly and immediately relieves high pressures in the chamber 16 generated by arcing during interruption of excess or short circuit currents.

In normal operation, arcing pressure generated in chamber 16 upon separation of the contacts 1 and 2 causes immediate flow of oil from said chamber through the aligned passages in contacts 2 and 3 thereby accelerating the oil in the tubular contact 3. Immediately upon separation of the contacts 2 and 3, the high velocity oil and gas jet through the passage 18 further aids the oil blast from the chamber 17 into the tubular contact 3 by reason of the lower pressure existing in the region of the exhaust of the passage 18. This lower pressure resulting from the jet effect, therefore, facilitates acceleration of the radial oil blast from the region adjacent the main arc into the tubular contact 3.

It will likewise be apparent that since initial high pressure in the chamber 16 may be relieved directly through the intermediate and tubular contacts, the explosion pot throat opening at 5 need not be as large as in previous designs. Accordingly, the oil within the explosion pot may be used mainly for the effective oil blast with a minimum leakage at the throat for pressure relief. For a given interrupting capacity it, therefore, follows that a smaller explosion pot may be used.

An important factor in the interruption of power currents is gas formation. The amount of gas generated by a power arc depends, among other things, on the length of the arc and duration of the arc. Since a comparatively short arc in the chamber 16 is effective to generate the required pressure and since initial movement of the oil through the intermediate contact greatly facilitates acceleration of the oil blast through the arc formed upon separation of contacts 2 and 3, it will be apparent that the arcing time is very brief due to the fast application of the oil blast. The resulting gas formation is therefore low.

Referring more particularly to Fig. 2, there is

shown a form of intermediate contact particularly adaptable for operating conditions wherein a wide range of current values must be dealt with. For example, very light currents at high voltage may generate insufficient pressure for an effective oil blast, whereas a short circuit current on the same line may generate high pressures which might blow up the breaker unless relieved.

To this end an intermediate contact 2' is provided, as in the previous case, with a longitudinal passage 18' which is controlled by valve 20. The valve is normally biased by a spring 21 into seating engagement with the upper portion of the contact at 22 and is provided with a hollow stem 23 guided within the passage 18'. As illustrated, the passage 18' is enlarged to provide for the spring 21 and is in communication with the passage to the valve stem through the lateral ports 24. The intermediate contact 2' is normally biased into following engagement with the contact 3 by the spring 14'.

The operation of the intermediate contact shown by Fig. 2 is believed to be clear, the valve 22 remaining seated under the bias of spring 21 for building up more pressure in the pot 4 when light currents are being interrupted, and opening to relieve the pressure and accelerate the oil blast in the manner above explained in response to higher currents.

In Fig. 3 there is shown a modified form of contact structure wherein the intermediate contact 2'' is provided with an enlarged contact portion 25 having lateral passages 26 which merge to form a passage communicating with the interiors of the explosion pot 4 and the tubular contact 3 respectively. The contact arrangement is essentially the same as that in Fig. 1, the intermediate contact 2'' being arranged to engage in butt contact an upper fixed contact (not shown). In this case the pressure generated by the initial arc, which instantly sets up fluid pressure in all parts of the explosion pot, initiates acceleration of the liquid blast into the tubular contact 3 from the lower part of the explosion pot. By this arrangement practically no gas formed by the initial arc is mixed with the accelerated oil blast. The tubular contact 3, as illustrated, is provided with ports 3' which likewise serve to decrease the resistance to quick acceleration of the oil blast.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric circuit breaker of the oil-blast type comprising an explosion pot, relatively movable contact structure including fixed, intermediate and tubular contacts coacting in said pot and arranged to form two breaks in series, the arc at one of said breaks creating pressure within said pot for driving a blast of arc extinguishing liquid through the arc at the other break, said intermediate contact having a passage generally in registry with said tubular contact for transmitting pressure from said pot to the interior of said tubular contact prior to separation of said intermediate and tubular contacts.

2. An electric circuit breaker of the oil blast type comprising relatively movable contact structure arranged upon opening of the circuit to form a pressure generating arc and a main arc, said contact structure including a contact mem-

ber having a passage freely communicating respectively in the open circuit position with both regions in which said arcs are drawn, the co-acting contact structure also having a passage in registry with the aforesaid passage in the closed circuit position for permitting initial acceleration of oil therethrough.

3. An electric circuit breaker of the oil blast type comprising an explosion pot, relatively movable contact structure arranged to coact within said pot including a fixed contact, an intermediate contact and a movable tubular contact arranged to form in said pot upon opening movement of said tubular contact a pressure generating arc and a main arc, said intermediate contact having a passage therethrough communicating respectively with the region in which said pressure generating arc is drawn and the interior of said tubular contact.

4. An electric circuit breaker of the oil blast type comprising an explosion pot, an insulating partition having apertures therein dividing said pot into a pressure generating chamber and a

main arcing chamber, a fixed contact disposed in said pressure generating chamber, a tubular contact movable into said main arcing chamber, and an intermediate contact mounted in said partition for engaging both said fixed and tubular contacts, said intermediate contact having a passage therethrough independent of the apertures in said partition communicating respectively with said pressure generating chamber and main arcing chamber and in general alignment with the passage through said tubular contact.

5. An electric circuit breaker of the oil blast type comprising relatively movable contact structure arranged upon opening of the circuit to form a pressure generating arc and a main arc, said contact structure including a contact member having a passage therethrough communicating respectively with the regions in which said arcs are drawn, and a pressure actuated valve for normally closing said passage except when the pressure in the region of said pressure generating arc exceeds a predetermined value.

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