July 28, 1936. D. C. PRINCE 2,049,318

ELECTRIC CIRCUIT INTERRUPTER

Filed May 23, 1934 2 Sheets-Sheet 1

Fig. 1.

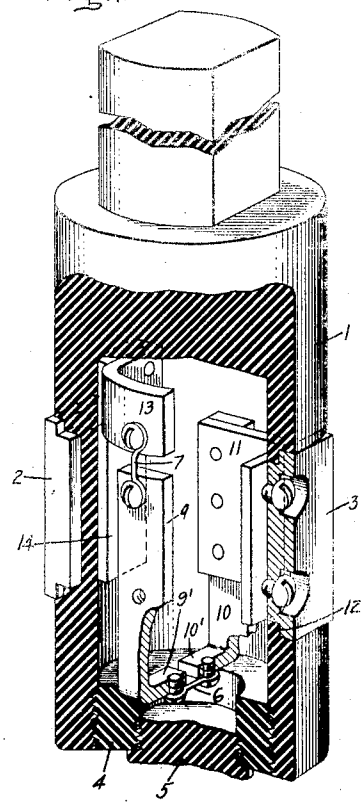


Fig. 2.

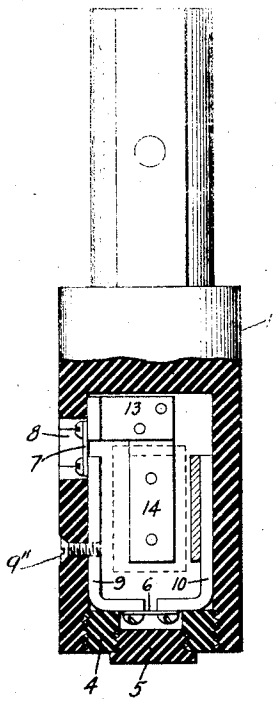
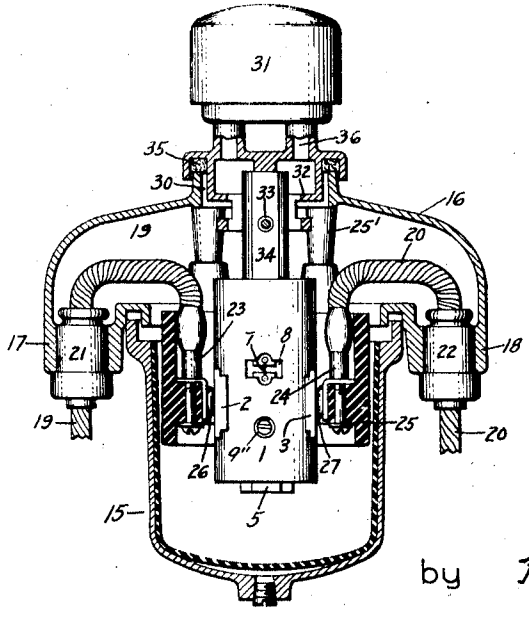


Fig. 3.



Inventor:
David C. Prince,
by Harry E. Dunham
His Attorney.

July 28, 1936. D. C. PRINCE 2,049,318

ELECTRIC CIRCUIT INTERRUPTER

Filed May 23, 1934 2 Sheets-Sheet 2

Fig. 4.

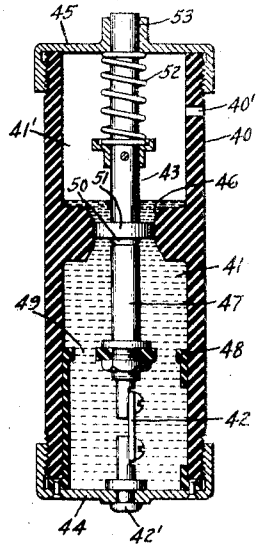


Fig. 5.

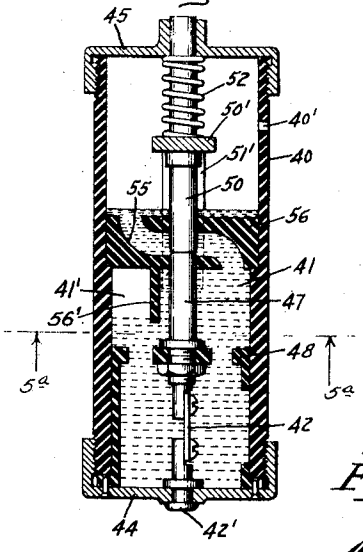


Fig. 5a

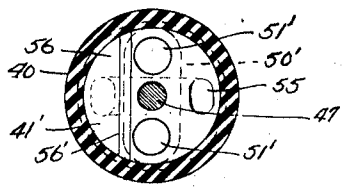
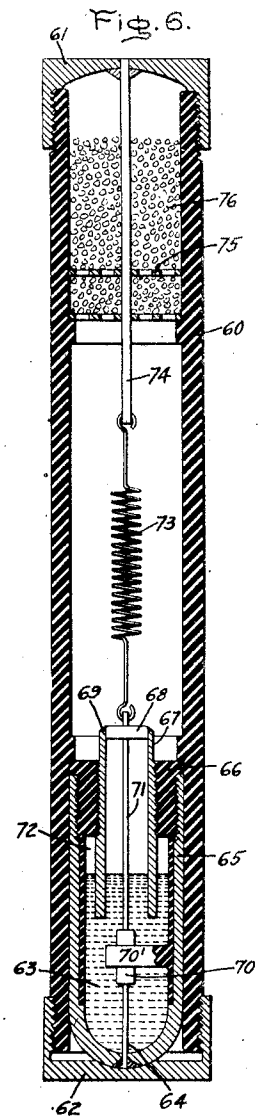


Fig. 6.



Inventor:
David C. Prince,
by Harry E. Dunham
His Attorney.

Patented July 28, 1936 2,049,318

UNITED STATES PATENT OFFICE

2,049,318

ELECTRIC CIRCUIT INTERRUPTER

David C. Prince, Swarthmore, Pa., assignor to General Electric Company, a corporation of New York

Application May 23, 1934, Serial No. 727,146

7 Claims. (Cl. 200—120)

My invention relates to electric circuit interrupters, more particularly to circuit interrupters of the fluid-blast type wherein pressure is utilized to effect a blast of arc-extinguishing or insulating liquid through a break in the circuit to be interrupted, and has for its principal object the provision of an improved circuit interrupter of the aforesaid type which shall have high interrupting capacity and be efficient and positive in operation and simple and compact in construction.

In accordance with one aspect of my invention for example, pressure is generated within a fixed casing by blowing of a fusible element immersed in an insulating liquid and connected in the circuit to be interrupted, and the aforesaid liquid blast is directed through a break in said circuit for extinguishing arcing at that point.

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

Referring to the drawings, Fig. 1 is a perspective view, partly in section, of a fluid-blast circuit interrupter embodying my invention; Fig. 2 is an elevational view, partly in section of the circuit interrupter shown in Fig. 1; Fig. 3 is an elevational view, partly in section, of a type of oil immersed fuse illustrating an application of my invention; and Figs. 4, 5, 5*a*, and 6 are elevational and plan views, partly in section, of forms my invention may assume.

The fluid-blast circuit interrupter illustrated by Figs. 1 and 2 comprises a cylindrical casing 1 which may be formed of a suitable insulating material, as a mechanically strong fibrous material, and terminals 2 and 3 which are adapted to be connected in the circuit to be interrupted. The casing 1 contains an arc-extinguishing or insulating liquid, as oil for example, and is closed at its upper end and at the lower end as by an insulating ring 4 and plug 5.

Connected in series with the terminals 2 and 3 is the fusible element or link 6 and circuit controlling means, as a second fusible element 7, which is adapted to form a break in series with the fusible element 6. The fusible links 6 and 7 may be composed of any suitable material, as cadmium for example. The fusible element 6 is immersed in the insulating liquid at the lower part of the casing and is preferably remotely positioned with respect to the fusible element 7 which is positioned adjacent and opposite an exhaust passage 8 (referring to Fig. 2) formed in the side wall of the casing 1, the arrangement being such that upon blowing of the fusible element 6 in response to excess current the pressure generated within the insulating liquid causes a blast of said liquid through the exhaust passage 8. The fusible element 7 which is likewise blown simultaneously or slightly afterwards by the excess current forms a break in the circuit and the resulting arc is extinguished by the blast of insulating liquid directed transversely through the arc path and exhaust passage 8.

Means for mounting and electrically connecting the fusible elements 6 and 7 in the circuit between the terminals 2 and 3 comprise any suitable arrangement and as illustrated, by way of example, the fusible element 6 is connected to a pair of conducting members 9 and 10 having inwardly turned portions 9' and 10' which are spaced and interconnected by the fusible element 6 by screws, or the like, as clearly illustrated in Figs. 1 and 2. The conducting member 10 extends along one side of the casing 1 and is connected to a conducting strip 11 which is in turn directly connected to the terminal 3 in a suitable manner, as by screws or the like. The casing 1 is cut away as at 12 so that the plate-like terminal 3 forms a substantially flush insert in the casing wall forming thereby a direct electrical connection between the exterior of the casing and one terminal of the fusible element 6. The conducting member 9, which is connected to the other terminal of the fusible element 6 and which may be suitably secured to the side wall of the insulating casing 1 as by a countersunk screw 9'' extending through said wall, extends along the opposite side of the casing 1 and comprises the support for the lower terminal of the fusible element 7. The other or upper terminal of the fusible element 7 is connected to a conducting strip 13, which is in turn connected to a conductor 14 terminating in the terminal 2 in a manner similar to that above described.

In case of a replacement the lower plug 5 is readily removable for obtaining access to the fusible element 6 and for replacing the same and the exhaust passage 8 permits ready access to the fusible element 7 and the terminals thereof so that the same may be replaced through the wall of the casing, as clearly illustrated by Fig. 2.

The casing 1 may be entirely or partially filled with insulating liquid depending on the circuit interrupting requirements of the device. In the interruption of heavy short circuit currents, considerable pressure may possibly be generated

within the casing and for that reason a small space above the liquid level forming a gas cushion may be desirable for relieving excessive bursting pressures within the casing. For the same reason the dimensions of the exhaust passage 8 may vary in accordance with the operating requirements of the device.

In operation my improved circuit interrupter not only is effective to interrupt the normal current rating within one-half cycle of commercial frequency alternating current, but operates generally with very little formation of gas and resulting gas pressure within the casing. The circuit is consistently cleared with practically no disturbance other than an occasional slight report.

Fig. 3 illustrates a form of oil immersed fuse to which my invention may be readily applied. The casing 1 housing the circuit interrupter illustrated by Figs. 1 and 2 is mounted as a unit within a housing comprising an oil tank 15 and a cover structure 16 having lateral depending outlets 17 and 18 for the electrical connections, or cables 19 and 20, connected to the device. The cables 19 and 20 are mounted within insulating bushings 21 and 22, respectively, which make liquid-tight joints with the cover structure 16. The aforesaid cables which extend within the cover structure are looped over and extend within the tank 15 terminating in the terminal structures 23 and 24 carried by an insulating shell 25. The insulating supporting shell or structure 25 is carried by insulators 25' secured to the cover structure 16. The terminal structures 23 and 24 include the wire-contact members 26 and 27, respectively, which are adapted to engage and coact with the terminals 2 and 3 of the fluid-blast circuit interrupter. The contacts 26 and 27, which are suitably connected, as illustrated, to the terminal structures may be of resilient construction so as to make good contact engagement with the terminals 2 and 3 in normal operation of the device which, as illustrated, is connected directly in the circuit including the cables 19 and 20.

The cover structure 16 is provided with a central opening 30 through which the circuit interrupter 1 may be withdrawn for inspection and replacement of fuses, etc. To this end the cover structure 16 is provided with a cap 31 having a depending structure 32 which is connected, as at 33, by a through-pin to an extension 34 secured to the casing 1 of the circuit interrupter. A fluid tight joint between the cap 31 and the cover 16 is formed by a resilient gasket 35, the cap 31 providing likewise a breathing or venting structure communicating with the interior of the device or passage 36.

In practice, the tank 15 is filled with insulating oil at or above the level of the exhaust passage 8 of the circuit interrupter so that after a circuit interruption the circuit interrupter may be withdrawn through the top of the casing by the cap 31 without disturbing the permanent electrical connections or necessitating removal of the oil tank 15 by reason of the sliding connections at the terminals 2 and 3. After replacement of the fuses, the circuit interrupter is again lowered into the tank 15 so that the terminals 2 and 3 are in engagement with the coacting contacts 26 and 27 and the unit is in readiness for another circuit interrupting operation.

There is illustrated by Fig. 4 a circuit interrupter wherein the circuit controlling means adapted to form a break in series with the fusible element comprises a pair of contacts separable in response to pressure generated by blowing of said fusible element. As illustrated, a casing 40 containing an insulating liquid 41, as oil, has mounted therein at its lower end a fusible element 42 connected in series with circuit controlling means 43. The casing 40 comprising an insulating cylinder is suitably closed, as by end caps 44 and 45, and provided with a restricted passage 46 adjacent its mid-portion. The fusible element 42 is connected to a terminal 42' mounted in the end cap 44 and to a stationary conductor stud 47 supported within the casing as by insulating structure 48. The upper wall of the insulating structure 48 is provided with apertures 49.

The circuit controlling means 43 comprises a movable contact member 50 having a flanged or piston-like portion 51 normally closing the passage 46 and the oil-containing chamber formed beneath the same. The contact 50 is resiliently biased by a spring 52 into engagement with the stationary stud or contact 47, the contact 50 being suitably guided, as at 53, through the terminal end cap 45.

In operation, blowing of the fusible element 42 in response to excess current generates pressure within the oil 41 in the lower chamber so as to force the contact 50 away from contact 47 to form the second break and open the exhaust passage 46. The pressure generated likewise forces a blast of oil through the passage 46 and through the arc within the restricted passage 46 between the separating contacts so that the circuit is quickly interrupted. Since the fusible element 42 is already blown, the gap at that point which is effectively insulated by oil is sufficient to prevent reestablishment of arcing so that the spring 52 may return the contact 50 to its normal contacting position.

In the above-described device the strength of the arc-extinguishing blast may be regulated to a certain extent by design of the exhaust passage 46 and the spring 52 in accordance with the interrupting requirements of the device. The spring 52 of course confines the pressure within the pressure chamber until it builds up to a predetermined and effective blast value for actuating the movable contact 50. With this arrangement the contacts 50 and 47 are separated at the most effective time; that is, during the occurrence of a strong blast of oil from the lower chamber. The arc drawn between the separating contacts is therefore efficiently and quickly interrupted. An aperture 40' may be formed in the upper part of the casing for venting gases.

Fig. 5 illustrates an arrangement generally similar to that shown in Fig. 4 except that the oil blast is directed in a transverse cross jet through the arc between the separating contacts. In this arrangement the movable contact 50 is connected through a crosshead 50' to a pair of depending plungers 51' which are acted upon by pressure within the lower chamber. The separation of contacts 50 and 47 takes place within a transverse passage or channel 55 which is formed in an insulating baffle 56. The plungers or pistons 51' for actuating the movable contact extend through apertures in the baffle 56 at opposite sides of the passage 55, as indicated by Fig. 5*a*, so that when the fusible element blows during a circuit interrupting operation, pressure within the lower chamber acting on the pistons 51' causes separation of the contacts within the transverse passage 55 and a blast of oil through said passage across the arc and into the upper chamber. For the purpose of increasing the effectiveness of the oil blast and for introducing a safety factor when

high bursting pressures are encountered, there is provided means, as a gas cushion, for absorbing and storing energy generated by blowing of the fuse link. In the case of a very sudden rise of pressure upon blowing of the fuse link, the gas cushion not only tends to prevent premature separation of the contacts but also fracture of the pressure-confining casing.

The other function above referred to, namely, storing of energy, is to maintain a high velocity oil blast through the arc at a current zero. An alternating current circuit is normally interrupted at a current zero at which there is no gas evolution and consequently no source of pressure. The compressed gas in the gas cushion serves to store energy during the high current values so that the velocity of the oil through the blast passage is maintained at a time when it is most effective, that is, at the current zero.

In the arrangement illustrated, the entrapped gas cushion 41' formed by the depending baffle portion 56' functions as described above and allows sufficient blast pressure to build up within the lower chamber before the spring 52 is overcome and the contacts separate. The contacts 50 and 47 when in engagement substantially close the transverse passage 55 so that the oil blast is released upon separation of the contacts to interrupt the circuit at a current zero.

In Fig. 6 the circuit interrupter comprises an insulating tubular casing 60 sealed at its opposite ends by conducting terminal caps 61 and 62 and containing a suitable arc-extinguishing or insulating liquid 63 in which is immersed a fusible element 64.

In the present instance the insulating liquid may be a halogenated hydrocarbon such for example as chlorinated benzene or chlorinated diphenyl which when subjected to the decomposing influence of an electric arc gives off chlorine gas as contrasted with the explosive gas mixture resulting from arc interruption within oil.

The insulating liquid and fusible element are contained within a capsule-like member 65 of conducting material sealed at its upper end by an insulating plug 66 through which the tubular conductor 67 extends. The upper end of the tubular member 67 is normally closed and sealed, as by a cap-like member 68, forming a movable contact of the circuit controlling means in series with the fusible element 64. The contact member 68 is suitably secured, as at 69, to the tube 67 by solder or the like. The fusible element 64 is connected at one end to a conducting member 70 in turn supported by an insulating bracket 70', a second fuse wire 71 interconnecting the conductor 70 and the contact member 68.

For the purpose of providing a gas cushion of the above described character in the chamber containing the fusible element, the tube 67 extends within the liquid 63 so as to form an annular space 72 providing a gas cushion upon interruption of the circuit. When the fusible element 64 is blown in response to excess current, pressure generated within the member 65 rapidly builds up until it is sufficient to displace the contact member 68. When this occurs the blast pressure directs liquid through the tube 67 and through the arc stream. A tension spring 73 serving, together with the conductor 74, electrically to connect the contact member 68 to the terminal 61 is provided to accelerate the opening of the contact member 68 when it is displaced by the blast pressure. The insulating walls of the tube 60 confine the arc drawn at the break between the contact 68 and the tube 67 substantially within the liquid blast from the lower part of the casing.

The gas cushion 72 functions similar to cushion 41' as described in connection with Fig. 5 and prevents premature displacement of the contact member 68 since a comparatively small displacement of the liquid 63 before the pressure is built up sufficiently serves to compress the gas within the space 72 rather than displace the contact member 68. The fusible element 64 is designed to blow slightly ahead of the link 71 so that adequate blast pressure is generated within the liquid 63. In practice the link 71 would probably be broken mechanically by blowing out of the member 68.

The present device is designed so as to be completely sealed and self-contained, there being no liquid throw or emission of gas during the circuit interruption. For this purpose the upper part of the casing 60 is provided with perforated baffles 75 above which a suitable gas absorbing material 76, as sodium hydroxide in the present instance, is disposed. When the liquid 63 is expelled into the upper part of the casing the baffle structure serves to prevent passage of the liquid while admitting gas into the absorbing body 76.

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 interrupter of the fluid-blast type comprising a fixed casing containing an arc-extinguishing liquid, a fusible element immersed and arranged to blow initially in said liquid within said casing, said casing having an exhaust passage remote with respect to the point of initial blowing of said fusible element, circuit controlling means arranged to form a break in series with said fusible element normally closing said exhaust passage, pressure generated within said liquid by blowing of said fusible element causing displacement of said circuit controlling means and a blast of liquid through the aforesaid break, and means confining the arc drawn at said break substantially within the liquid blast from said casing.

2. An electric circuit interrupter of the fluid-blast type comprising a casing containing an arc-extinguishing liquid, a fusible element immersed and arranged to blow initially in said liquid within said casing, said casing having a restricted exhaust passage, circuit controlling means arranged to form a break in series with said fusible element including a contact member secured to said casing and normally sealing said exhaust passage, said member adapted to be displaced by predetermined pressure generated within said liquid by blowing of said fusible element, and means confining the arc drawn at said break to a passage through which a blast of liquid from said casing is directed by said pressure.

3. An electric circuit interrupter of the fluid-blast type comprising a fixed casing containing an arc-extinguishing liquid, means immersed and arranged to generate pressure in said liquid in response to a circuit condition, said casing having an exhaust passage, and circuit controlling means normally closing said exhaust passage and casing, said casing forming with respect to said liquid a gas cushion opposing displacement of

said liquid until a predetermined pressure for displacing said circuit controlling means is obtained.

4. An electric circuit interrupter of the fluid-blast type comprising a casing containing an insulating liquid, a fusible element immersed in said liquid, a tubular member forming an exhaust passage for said casing, said tubular member at one end extending within said casing and beneath the liquid level so as to form an annular gas space above said liquid, circuit controlling means arranged to form a break in series with said fusible element including a contact member normally closing the opposite end of said tube, and frangible means securing said contact member to said tubular member, blowing of said fusible element resulting in displacement of said contact member coincident with a blast of insulating liquid through the aforesaid break.

5. An electric circuit interrupter of the fluid-blast type comprising a casing containing an insulating liquid, a fusible element immersed in said insulating liquid, means providing a restricted exhaust passage for said liquid, circuit controlling means arranged to form a break in series with said fusible element normally closing said exhaust passage, blowing of said fusible element causing displacement of said circuit controlling means coincident with a blast of insulating liquid through the aforesaid break, and means disposed in another part of said casing beyond said exhaust passage for absorbing gases generated within said liquid during an arc interrupting operation, said casing being completely sealed so as to form a self-contained circuit interrupting unit.

6. An electric circuit interrupter of the fluid-blast type comprising a casing containing an insulating liquid, a fusible element immersed in said liquid, means forming an exhaust passage for said liquid, circuit controlling means arranged to form a break in series with said fusible element including a contact normally disposed in said exhaust passage, and means including a piston member operatively connected to said contact and actuated by pressure generated within said insulating liquid by blowing of said fusible element causing opening movement of said contact coincident with a blast of insulating liquid through the aforesaid passage for interrupting arcing at said break.

7. An electric circuit interrupter of the fluid-blast type comprising a casing containing an insulating liquid, an insulating baffle in said casing forming a restricted passage, said baffle being immersed in said liquid and forming a pressure chamber filled with said liquid, a fusible element disposed in said chamber, circuit controlling means arranged to form a break in series with said fusible element including a contact normally disposed in said exhaust passage, means including a piston member operatively connected to said contact, and a spring connected to said piston member for opposing pressure generated within said chamber by blowing of said fusible element, predetermined pressure causing opening movement of said contact coincident with a blast of insulating liquid through the aforesaid passage for interrupting arcing at said break.

DAVID C. PRINCE.