Nov. 20, 1945. C. L. DENAULT 2,389,346

CIRCUIT INTERRUPTER

Filed Aug. 8, 1942

Fig. 1.

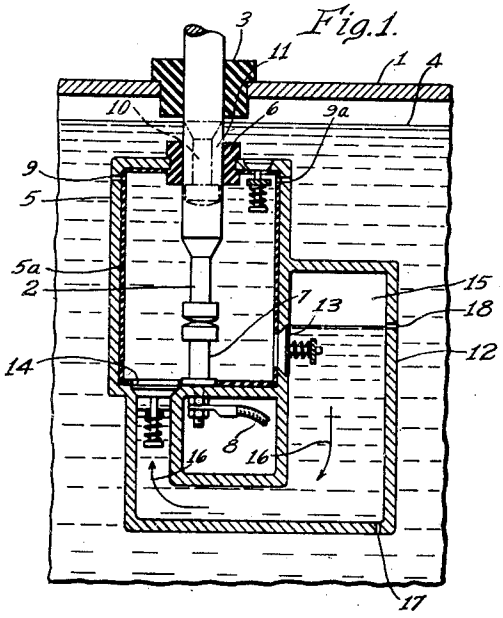


Fig. 2.

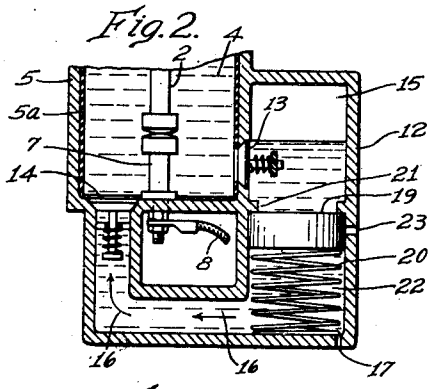


Fig. 3.

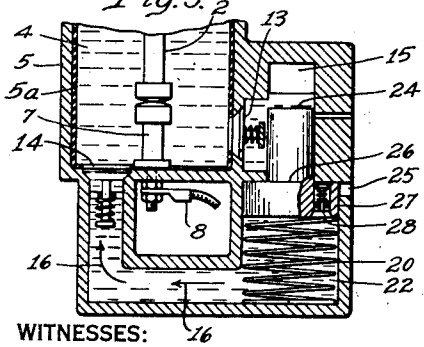


Fig. 4.

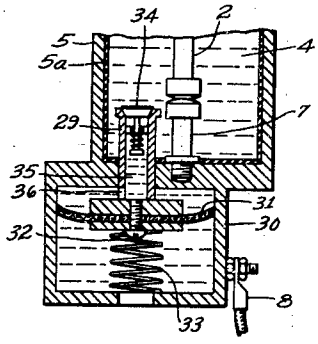


Fig. 5.

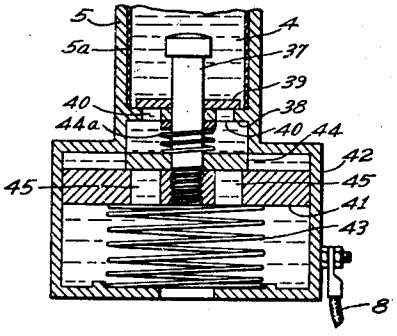
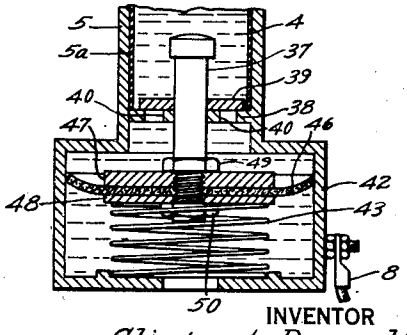


Fig. 6.



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CIRCUIT INTERRUPTER

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16 Claims. (Cl. 200—150)

This invention relates to circuit interrupters, and more particularly to circuit interrupters of the type which create arcing pressure in a substantially closed arcing chamber.

In circuit interrupters of the type which draw an arc in an arc extinguishing medium, such as oil, to facilitate the interruption of the arc, it is desirable to get rid of the contaminated arc extinguishing medium which results during a circuit interrupting operation. When oil is used, carbonized products of decomposition tend to remain in the arcing chamber and to lower the dielectric strength of the oil remaining therein. Where opening and reclosing operations are frequent this contamination of the arc extinguishing medium within the arcing chamber is especially undesirable.

It is, therefore, an object of the present invention to provide an improved flushing system for flushing the decomposed arc extinguishing medium out of the arcing chamber following a circuit opening operation.

It is more specifically an object of the present invention to utilize the arcing pressure to energize such a flushing system and to render the same operative following the subsidence of arcing pressure within the arcing chamber.

Another object of the present invention is to provide an improved circuit interrupter which increases the arc length by making one of the relatively movable contacts responsive to the pressure within the arcing chamber. Consequently, the arc length will be increased not only by the normal operation of the movable contact mechanism, but also by additional movement of the stationary contact in response to the arcing pressure. During the interruption of high currents, the arcing pressure will correspondingly increase and the arc will be lengthened at an increased rate as compared to the lengthening of the arc during interruption of low currents.

It is a specific object of the present invention to provide a circuit interrupter in which the stationary contact is movable in response to arcing pressure and is operative in a flushing container to result in a flushing of the arcing chamber following a circuit opening operation.

Another object of the present invention is to provide a circuit interrupter having an arcing chamber which communicates through suitable valve means to an adjacently disposed flushing chamber in which is placed resilient means responsive to the pressure created in the arcing chamber to render said flushing chamber operative. In such a flushing chamber a piston may be disposed, or a volume multiplying piston may be positioned.

My invention is not limited to use only in liquid type circuit interrupters, for it will be apparent to one fully understanding its principles that it is applicable to circuit interrupters which generate arcing pressure in other mediums such as gases or even air.

By way of illustration and not by way of limitation, I describe my invention as used in liquid type circuit interrupters.

Further objects and advantages will become readily apparent upon a reading of the following specification considered in conjunction with the accompanying drawing, in which:

Figure 1 is a view in cross section of a liquid type circuit interrupter embodying the present invention and shown in the closed circuit position;

Fig. 2 is a fragmentary view in cross section of a further embodiment of the present invention;

Fig. 3 is a fragmentary view in section of a further embodiment of the present invention;

Fig. 4 is a fragmentary view in cross section of another liquid type circuit interrupter embodying the present invention;

Fig. 5 is a fragmentary view in section showing another embodiment of the present invention; and

Fig. 6 is a fragmentary view in section of another form which the present invention may assume.

Referring to the drawing, and particularly to Fig. 1, the reference numeral 1 designates the cover of a tank of conventional design, through which the movable contact 2 reciprocates being guided by an insulating bushing 3. The tank is filled with a suitable arc extinguishing liquid 4, such as oil. Immersed in the oil is a metallic arc interrupting chamber 5 provided with an insulating liner 5a into which the movable contact 2 extends, being guided therein by the insulating bushing 6.

Disposed at the lower end of the arc interrupting chamber 5 is a stationary contact 7 electrically connected to a line terminal 8, only a part of which is shown. It will, therefore, be apparent that the electrical circuit through the interrupter comprises the movable contact 2, stationary contact 7 and line terminal 8. A bleeder opening 9 is provided to permit the gradual seepage of remaining gas bubbles out of the arc interrupting chamber 5 following a circuit opening operation.

When the circuit interrupter is opened the movable contact 2 is drawn upward away from

the stationary contact 7 to assume a position indicated by the dotted lines 10, in which position there is provided an annular space between the reduced portion of the movable contact 2 and the insulating guide bushing 6 which is indicated by the reference numeral 11. It is, consequently, apparent that in the open circuit position, indicated by the dotted lines 10, decomposed gas and liquid particles may flow out of the arc interrupting chamber 5 through the annular space 11. A second bleeder opening 9a may also be provided to assist the bleeder opening 9 in permitting gas bubbles to escape after an interrupting operation.

When the movable contact 2 is drawn upward away from the stationary contact 7 an arc will be drawn which will react upon the oil within the arc interrupting chamber 5 to create high arcing pressure. It is desired to utilize this arcing pressure to energize the flushing system which is operated following the subsidence of pressure within the arc interrupting chamber 5. For this purpose I have provided an adjacently disposed metallic chamber 12 which communicates by valves 13 and 14 with the arc interrupting chamber 5. At the upper end of chamber 12 is a space 15 filled with a compressible fluid such as air.

When the movable contact 2 separates from the stationary contact 7 to draw an arc, the pressure created by the establishment of said arc will act through the valve 13 to place the compressible fluid in the region 15 under pressure, the valve 14 remaining closed during this time. When the movable contact 2 is raised to the position indicated by the dotted lines 10, the arc pressure within the chamber 5 will decrease due to the venting through the annular space 11. At this time the valve 14 will open to permit the compressed fluid in the region 15 to force oil within the chamber 12 to pass through the valve 14 in the direction of the arrows 16. Since the distance from the valve 13 to the valve 14 is considerable, fresh oil of high dielectric strength will pass through the valve 14 to flush out the arc interrupting chamber 5 carrying the deionized products of decomposition upward through the annular space 11. Bleeder openings 17 and 18 are provided in the chamber 12 to permit oil to flow into the flushing chamber 12 following a flushing operation. However, the bleeder openings 17 and 18 are not of sufficient size to interfere with the flushing operation.

It will be observed that for a portion of the upward travel of the movable contact 2 the insulating guide bushing 6 is substantially closed thus permitting the pressure within the arc interrupting chamber 5 to have sufficient time to act through the valve 13 to compress the compressible fluid 15. Further upward travel of the movable contact 2 opens the annular passage 11 to permit a reduction of pressure within the arc interrupting chamber 5 and a consequent operation of the flushing system.

In the embodiment of my invention shown in Fig. 2 the arrangement is similar to that previously described in connection with Fig. 1. However, a piston 19 is provided within the flushing chamber 12, being biased upwards by a compression spring 20 against a flange 21 integrally formed with the flushing chamber 12. The operation of the flushing system shown in Fig. 2 is similar to that previously described in connection with Fig. 1. However, the provision of the piston 19 slidably operative in the flushing chamber 12 adds at least two desirable features. The piston 19 prevents contamination of the flushing oil contained in the flushing chamber 12 below the piston 19, indicated by the reference numeral 22, by the contaminated discharge products passing from the arc interrupting chamber 5 through the valve 13 above the piston 19. Consequently, only fresh oil of high dielectric strength passes in the direction indicated by the arrows 16 through the valve 14 following a subsidence of the arcing pressure within the arc interrupting chamber 5. The presence of the piston 19 also permits the use of a large bleeder opening indicated by the reference numeral 23, since this bleeder opening 23 can be substantially sealed when the piston 19 is in its initial position. The provision of the compression spring 20 permits a rapid restoration of the piston 19 to its normal position.

In the circuit interrupter shown in Fig. 3 a volume multiplying piston 24 is provided to produce an increased flow of fresh oil of high dielectric strength through the valve 14 in the direction of the arrows 16. Consequently, a small volume of highly compressed gas 15 will produce a large volume movement of flushing oil. During the downward motion of the volume multiplying piston 24, oil is drawn through the aperture 25, which may be of considerable size, to the back side 26 of the enlarged portion 27 of the volume multiplying piston 24. A rapid unimpeded downward movement of the volume multiplying piston 24 is thus achieved. During the retraction of the volume multiplying piston 24 by the compression spring 29, the valve 28 opens to permit oil to pass from the back side 26 of the enlarged portion 27 through the valve 28 into the region 22 for the next operation.

In the circuit interrupter shown in Fig. 4 a piston 29 is provided which slidably operates through a wall of the arc interrupting chamber 5. The other end of the piston 29 is operative in a flushing chamber 30. A resilient washer member 31 made of flexible material, such as leather, is attached by a screw 32 to the lower end of the piston 29. A compression spring 33 biases the piston 29 into the chamber 5. The diameter of the flushing chamber 30 is made relatively large to contain a considerable quantity of oil. A valve 34 is provided at the end of the piston 29 extending within the arc interrupting chamber 5, the purpose for which will appear more clearly hereinafter. A fluid connection 35 through the piston 29 is provided which communicates at its upper end with the valve 34 and at its lower end with an aperture 36 which opens to the region above the washer member 31.

The operation of the flushing system illustrated in Fig. 4 will now be explained. When the movable contact 2 is moved upward away from the stationary contact 7, an arc will be drawn to create pressure within the arc interrupting chamber 5. This pressure will act upon the piston 29, maintaining the valve 34 closed, to cause downward motion of the piston 29 in to the flushing chamber 30. The resilient washer member 31 will flex to permit a passage of oil to the top side thereof, the spring 33 meanwhile being compressed. When the pressure within the arc interrupting chamber 5 decreases sufficiently following the interruption of the arc, the compression spring 33 will retract the piston 29 to its upward position, forcing oil above the washer member 31 through the aperture 36 and through the fluid connection 35 to open the valve 34 and flush the

lower end of the chamber **5**. The size of the flushing chamber **30** is sufficient so that the quantity of oil used for flushing purposes is sufficient to cover the stationary contact **7**. The flushing of the lower portion of the arc interrupting chamber **5** will wash the products of decomposition upwards within the chamber **5** out through the annular venting passage **11** (not shown in Fig. 4, see Fig. 1).

The circuit interrupter shown in Fig. 5 comprises a stationary contact **37** which is slidably movable through a guide web **38**, in this instance formed as an integral part of the metallic arc interrupting chamber **5**. A washer member **39** serves as a check valve to close the apertures **40** through the guide web **38**. The lower end of the stationary contact **37** is threadedly secured to a piston **41** slidably operative in a piston casing **42**. The piston **41** is biased upwards by a compression spring **43**. A washer member **44** slidable on the stationary contact **37** serves as a check valve for apertures **45** provided in the piston **41**. A compression spring **44***a* encircling the stationary contact **37** may be provided to form a resilient stop for the upward travel of the washer member **44**.

The operation of the circuit interrupter shown in Fig. 5 will now be explained. When the movable contact **2** (not shown in Fig. 5) is withdrawn from the stationary contact **37**, an arc will be drawn to create pressure within the arc interrupting chamber **5**. This pressure will force the stationary contact **37** downward and will close the washer member **39** over the apertures **40** provided in the guide web **38**. The downward movement of the stationary contact **37** will also carry downward the piston **41** opening the check valve **44**, thus permitting oil to flow through the apertures **45** in the piston **41** to the top side of the piston **41**. The compression spring **43** will be compressed until the pressure subsides within the arc interrupting chamber **5**, at which time the compression spring **43** will move the piston **41** upward closing the check valve **44** to force oil upward through the apertures **40** raising the check valve **39** to consequently result in fresh oil of high dielectric strength completely covering the stationary contact **37** and washing products of decomposition upwards out of the chamber **5**. It will be noted that the diameter of the piston casing **42** is sufficiently large so that the oil moved by the piston **41** is sufficient in quantity to completely cover the stationary contact **37** when it is in its upper position.

It will furthermore be noticed that I have provided a circuit interrupting structure in which the stationary contact is responsive to the arc pressure produced in the chamber **5** to effect a very rapid lengthening of the arc which is drawn between the stationary contact **37** and the movable contact **2** (not shown). Thus the length of the arc is not only determined by the movement of the contact operating mechanism moving the movable contact **2**, but also by the pressure created in the interrupting chamber **5**. Consequently, upon the interruption of high currents the arc will be rapidly lengthened by the downward movement of the stationary contact **37** in addition to the operation of the normal movable contact operating mechanism. It is apparent that the motion of the stationary contact **37** in response to the arcing pressure created within the interrupting chamber **5** facilitates the interruption of the arc by the rapid lengthening thereof.

It will furthermore be noticed that fresh arc extinguishing liquid is drawn into the piston casing **42** during each circuit opening operation, thus providing a circulation of oil completely through the arc interrupting chamber **5**.

The interrupter shown in Fig. 6 is similar to the interrupter just described in connection with Fig. 5 except that a resilient washer member **46**, composed of a resilient material, such as leather, may be used to simplify the valve structure attached to the lower end of the stationary contact **37**. The resilient washer member **46** is rigidly secured to the lower end of the stationary contact **37** by means of two washers **47**, **48** fastened to the lower end of the stationary contact **37** by nuts **49**, **50**. The operation of the flushing system shown in Fig. 6 is the same as that previously described in connection with Fig. 5, namely, the arcing pressure forcing the stationary contact **37** downward to force oil above the resilient washer member **46** and to compress the compression spring **43**. Upon the subsidence of pressure within the arc interrupting chamber **5**, the compression spring **43** will retract the stationary contact **37** forcing oil up through the apertures **40** in the guide web **38** and through the check valve **39** to flush out the arcing chamber **5**. Again the diameter of the piston casing **42** is such as to move a sufficient quantity of oil to cover the stationary contact **37** when the latter is in its normal raised position.

It will be noted that the circuit interrupters in Fig. 5 and Fig. 6 provide a resilient mounting for the stationary contact **37** by the provision of the compression spring **43**. Consequently, part of the movement of the stationary contact **37** may be used, when desired, to take up the shock of the movable contact **2** striking against the stationary contact **37** during a closing operation of the interrupter.

It will be apparent that my invention is not only applicable to a liquid type circuit interrupter, but it may also be applied to a circuit interrupter operating in a gaseous medium, such as air. The energizing of the flushing system is merely dependent upon the arcing pressure and it is not necessary to have a liquid medium in which the arcing pressure is formed. The arc extinguishing medium and also the flushing medium may be a gas, such as air, in any of the circuit interrupters previously described. Merely for purposes of illustration only, and not by way of limitation, have I described my invention in connection with a liquid type circuit interrupter.

It will furthermore be observed that not only have I utilized the arcing pressure to energize a flushing system operative upon a subsidence of the arcing pressure, but also I have utilized the arcing pressure to produce a rapid motion of the stationary contact, which rapid motion of the stationary contact is effective to lengthen rapidly the arc and to facilitate its interruption. This feature of my invention, namely, the movement of the stationary contact in response to arcing pressure to effect a rapid lengthening of the arc, is independent of the flushing system and may be used on any interrupter which need not have any form of flushing system.

Although I have shown and described particular structures, it is to be understood that the same were for illustrative purposes and that changes and modifications may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit breaker, means defining an arcing chamber, means for establishing an arc within

said arcing chamber, a second adjacently disposed chamber, a compressible fluid partly filling said second chamber, a first valve means connecting said two chambers to compress said compressible fluid during the establishment of said arc, a second valve means operative after the subsidence of pressure within said arcing chamber to utilize the energy stored in said compressible fluid for flushing out said arcing chamber.

2. In a liquid break circuit interrupter, an arcing chamber immersed in an arc extinguishing liquid, means for establishing an arc within said arcing chamber, an adjacently disposed flushing container only partly filled with said arc extinguishing liquid, a first valve means connecting said arcing chamber with said flushing container for utilizing the arcing pressure to compress the fluid above the liquid within said flushing container, a second valve means operative after the subsidence of arcing pressure for permitting the compressed fluid within said flushing container to force liquid within said flushing container into said arcing chamber to flush the latter.

3. In a circuit interrupter, an arcing chamber, means for establishing an arc within said arcing chamber, an adjacently disposed flushing container, a movable piston within said flushing container, valve means connecting said arcing chamber with said flushing container on one side of said piston, a compressible fluid within said flushing container on the same side of said piston, said valve means permitting a compressing of said compressible fluid during the arcing period, a second valve means connecting the other side of said piston with said arcing chamber, said second valve means being operative after a subsidence of arcing pressure to permit said compressed fluid to force said piston to move, said piston forcing arc extinguishing fluid through said second valve means to flush said arcing chamber after a circuit opening operation.

4. In a circuit interrupter of the liquid break type, an arcing chamber immersed in an arc extinguishing liquid, means for establishing an arc within said arcing chamber, an adjacently disposed flushing container only partly filled with arc extinguishing liquid, the rest of said flushing container being filled with a compressible fluid, a piston disposed within said flushing container, valve means between said arcing chamber and said flushing container to permit the pressure of arcing to compress said compressible fluid within said flushing container, a second valve means connecting said arcing chamber with said flushing container to permit liquid contained within said flushing container to be forced by said compressed fluid within said flushing container through said second valve means to flush out said arcing chamber upon the subsidence of arcing pressure therein.

5. In a circuit interrupter, an arcing chamber, means for establishing an arc within said chamber, an adjacently disposed flushing container, valve means disposed between said arcing chamber and said flushing container, a compressible fluid within said flushing container, a volume-multiplying piston disposed within said flushing container, and second valve means connecting said flushing container with said arcing chamber, the arrangement being such that arcing pressure compresses said compressible fluid within said flushing container and when the arcing pressure subsides the compressible fluid forces the piston to move the force arc extinguishing fluid through said second-mentioned valve means to flush said arcing chamber.

6. In a circuit interrupter of the liquid break type, an arcing chamber immersed in arc extinguishing liquid, means for establishing an arc within said arcing chamber, an adjacently disposed flushing container being only partly filled with arc extinguishing liquid, the rest of said flushing container being filled with a compressible fluid, a first valve means connecting the arcing chamber with the flushing container, a volume-multiplying piston disposed within said flushing container, a second valve means connecting said arcing chamber with said flushing container, the arc pressure within said arcing chamber acting through said first-mentioned valve means to compress said compressible fluid within said flushing container, said second-mentioned valve means being operative to permit said piston to force arc extinguishing liquid into said arcing chamber following the subsidence of pressure within said arcing chamber.

7. In a liquid break circuit interrupter, an arcing chamber immersed in an arc extinguishing liquid, means for establishing an arc within said arcing chamber, an adjacently disposed flushing container only partly filled with arc extinguishing liquid, the rest of said flushing container being filled with a compressible fluid, valve means connecting said arcing chamber with said flushing container, a volume-multiplying piston disposed within said flushing container having the small area working surface toward said compressible fluid, spring means biasing said piston toward said compressible fluid, valve means carried by said piston to facilitate the refilling of said flushing container, and a third valve means connecting said arcing chamber with said flushing container, the arrangement being such that the arcing pressure compresses said compressible fluid through said first mentioned valve means, the third mentioned valve means permitting the piston to force liquid into said arcing chamber upon the subsidence of arcing pressure therein.

8. In a circuit interrupter, an arcing chamber, means for establishing an arc within said arcing chamber, an adjacently disposed flushing chamber, a piston disposed within said flushing chamber and extending into said arcing chamber, a valve carried by said piston, a fluid connection through said piston, the arcing pressure forcing said piston into said flushing chamber, spring means for biasing said piston into said arcing chamber, second valve means carried by said piston within said flushing chamber, the return of said piston by said spring means following the subsidence of arcing pressure forcing arc extinguishing fluid through said fluid connection in said piston into said arcing chamber to flush the latter following the circuit opening operation.

9. In a liquid break circuit interrupter, an arcing chamber immersed in an arc extinguishing liquid, means for establishing an arc within said arcing chamber, a piston extending through the wall of said chamber and responsive to the pressure therein, a fluid connection through said piston, means biasing said piston into said arcing chamber, an adjacently disposed piston casing, said piston being movable in the adjacently disposed piston casing, valve means carried by the part of said piston movable within said piston casing to charge said piston with arc extinguishing liquid following the movement of said piston into said piston casing, the arrangement being such that the arcing pressure forces said piston

into said piston casing to charge it with arc extinguishing liquid, the piston being movable back into said arcing chamber upon the subsidence of arcing pressure to force liquid through said fluid connection to flush out said arcing chamber following a circuit opening operation.

10. In a circuit interrupter, an arcing chamber, an adjacent disposed piston casing, a first contact disposed within said arcing chamber, a movable contact cooperating with the first contact to establish an arc within said arcing chamber, said first contact being movable into the adjacently disposed piston casing upon the establishment of an arc, valve means carried by the end of said first contact movable in said piston casing, said valve means being operable to force arc extinguishing fluid into said arcing chamber following the subsidence of arcing pressure upon the retraction of said first contact into said arcing chamber.

11. In a liquid break circuit interrupter, an arcing chamber immersed in an arc extinguishing liquid, a first contact and a movable contact cooperable therewith to establish an arc within said arcing chamber, an adjacently disposed piston casing, said first contact being movable into said piston casing upon the creation of arc pressure within said arcing chamber, a check valve attached to the end of said first contact movable into said piston casing, a second check valve surrounding said first contact, the arrangement being such that the arc pressure forces said first contact into said piston casing to charge the first contact with arc extinguishing liquid, the first contact being movable back into said arcing chamber upon the subsidence of arcing pressure to force liquid through said second-mentioned check valve into said arcing chamber for flushing purposes.

12. In a circuit interrupter, an arcing chamber, a first contact cooperable with a movable contact for establishing an arc within said arcing chamber, an adjacently disposed piston casing, said first contact being movable into said piston casing a flexible washer attached to the end of said first contact movable in said piston casing, the first contact being biased to its normal position within said arcing chamber, the arrangement operating to move said first contact into said piston casing during the establishment of an arc to charge said first contact with arc extinguishing fluid, the first contact being retractible into said arcing chamber following the subsidence of arcing pressure therein to force fluid into said arcing chamber for flushing purposes.

13. In a circuit interrupter of the liquid-break type, an arcing chamber, means for establishing an arc within the arcing chamber, an adjacently disposed chamber having an inlet into one part thereof and a separate outlet leading from another part thereof into the arcing chamber, and energy storing means charged by arcing pressure and operable upon decrease in pressure in the arcing chamber to force liquid from the adjacently disposed chamber through the outlet opening and into the arcing chamber.

14. In a circuit interrupter of the liquid-break type, an arcing chamber, means for establishing an arc within the arcing chamber, an adjacently disposed chamber having an inlet into one part thereof and a separate outlet opening leading from another part thereof into the arcing chamber, energy storing means charged by arcing pressure for forcing liquid from the adjacently disposed chamber through the outlet opening and into the arcing chamber, and a pressure responsive valve at the outlet opening responsive to the pressure in the arcing chamber for preventing the forcing of the liquid through the outlet opening and into the arcing chamber until after the pressure has subsided in the arcing chamber.

15. In a circuit interrupter of the liquid-break type, an arcing chamber, means for establishing an arc within the arcing chamber, an adjacently disposed chamber having a piston therein, an outlet leading from the space at one side of said piston into the arcing chamber, means permitting flow of liquid within the adjacently disposed chamber from one side of said piston to the other side only in the direction which admits liquid into said space from which the outlet leads into the arcing chamber, and spring means charged by arcing pressure and biasing the piston to force liquid through the outlet and into the arcing chamber.

16. In a circuit interrupter of the liquid-break type, an arcing chamber, means for establishing an arc within the arcing chamber, an adjacently disposed chamber having a piston therein, an outlet leading from the space at one side of said piston into the arcing chamber, means permitting flow of liquid within the adjacently disposed chamber from one side of said piston to the other side only in the direction which admits liquid into said space from which the outlet leads into the arcing chamber, spring means charged by arcing pressure and biasing the piston to force liquid through the outlet and into the arcing chamber, and one-way valve means preventing flow of liquid from the arcing chamber into the adjacently disposed chamber.

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