June 17, 1947. W. M. LEEDS 2,422,569

CIRCUIT INTERRUPTER

Filed May 28, 1943 5 Sheets-Sheet 1

Fig. 1.

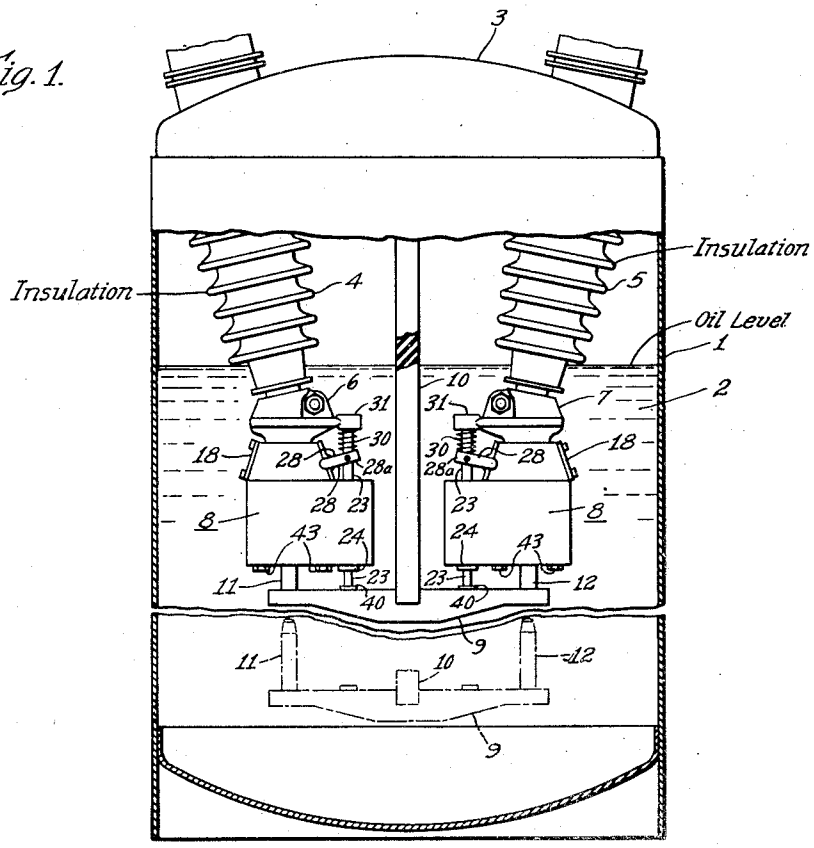
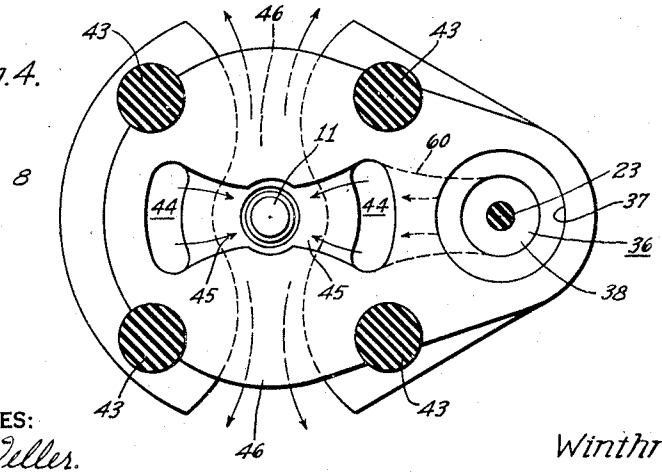


Fig. 4.



WITNESSES:

E. J. Weller.

W. R. Court

INVENTOR

Winthrop M. Leeds.

BY

Ralph W. Swingle

ATTORNEY

June 17, 1947. W. M. LEEDS 2,422,569

CIRCUIT INTERRUPTER

Filed May 28, 1943 5 Sheets-Sheet 2

Fig. 2.

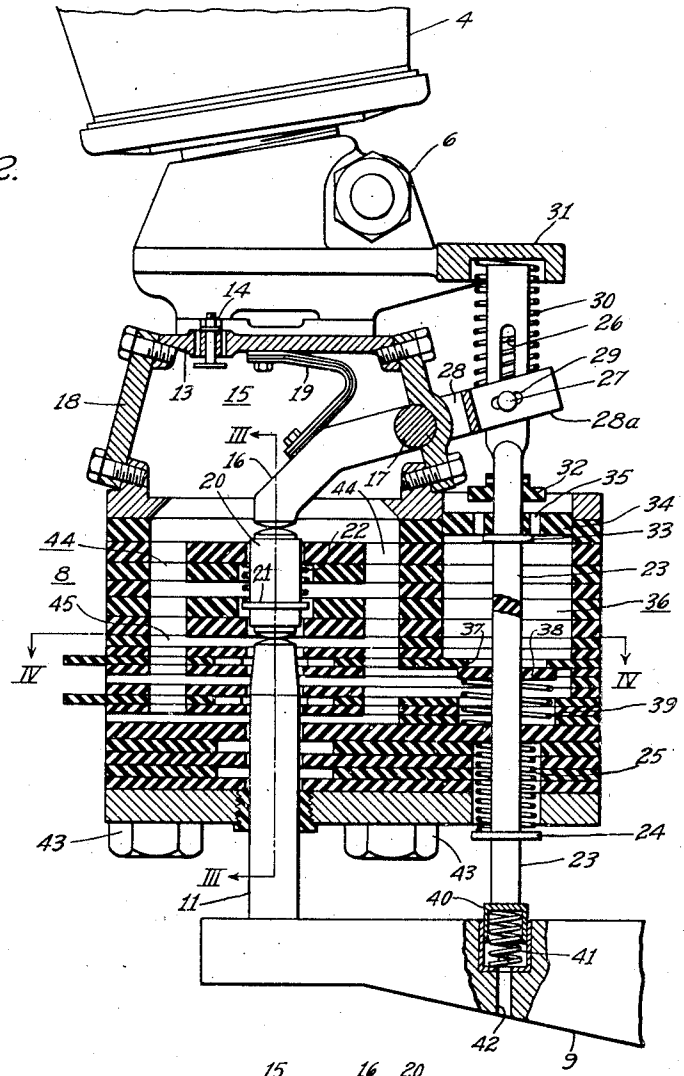
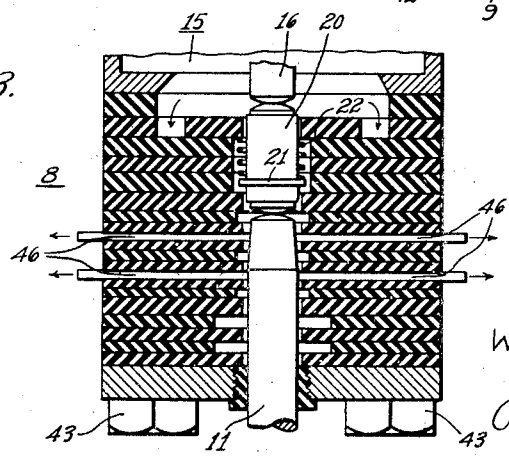


Fig. 3.



WITNESSES:

E. J. Weller.

W. R. Crout

INVENTOR

Winthrop M. Leeds.

BY

Ralph W. Smith

ATTORNEY

June 17, 1947. W. M. LEEDS 2,422,569

CIRCUIT INTERRUPTER

Filed May 28, 1943 5 Sheets-Sheet 3

Fig. 5.

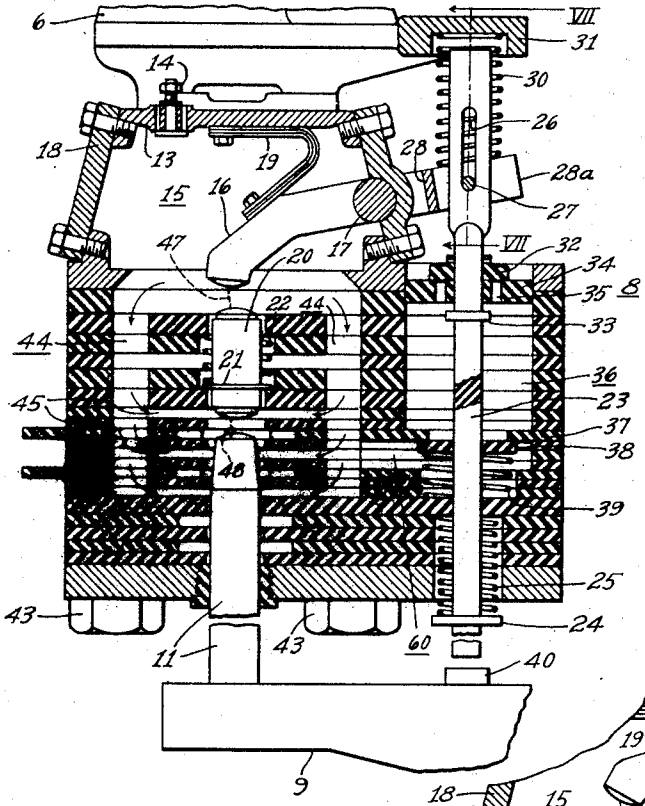


Fig. 6.

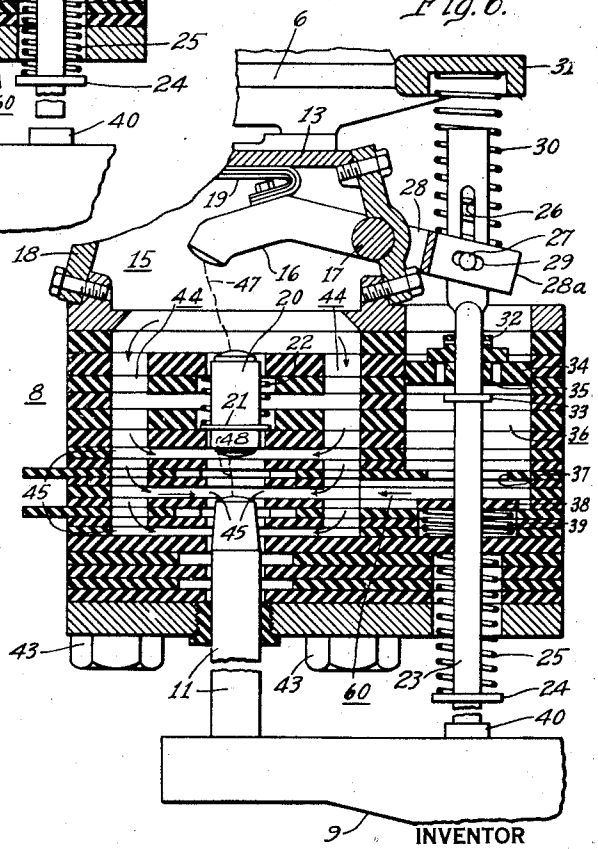
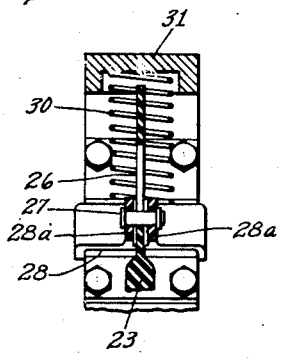


Fig. 7.



WITNESSES:

C. J. Weller.

W. R. Court

INVENTOR

Winthrop M. Leeds.

BY

Ralph H. Swingle

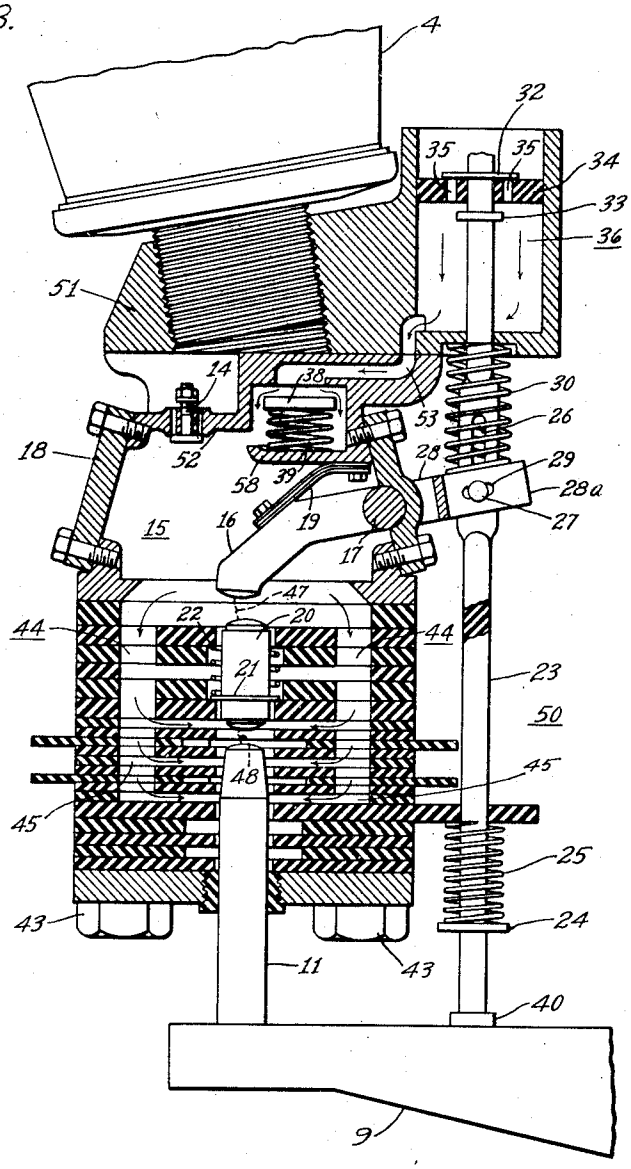
ATTORNEY

June 17, 1947. W. M. LEEDS 2,422,569

CIRCUIT INTERRUPTER

Filed May 28, 1943 5 Sheets-Sheet 4

Fig. 8.



WITNESSES:
C. J. Weller.
W. R. Crout

INVENTOR
Winthrop M. Leeds.
BY
Ralph H. Swingle
ATTORNEY

June 17, 1947. W. M. LEEDS 2,422,569

CIRCUIT INTERRUPTER

Filed May 28, 1943 5 Sheets-Sheet 5

Fig. 9.

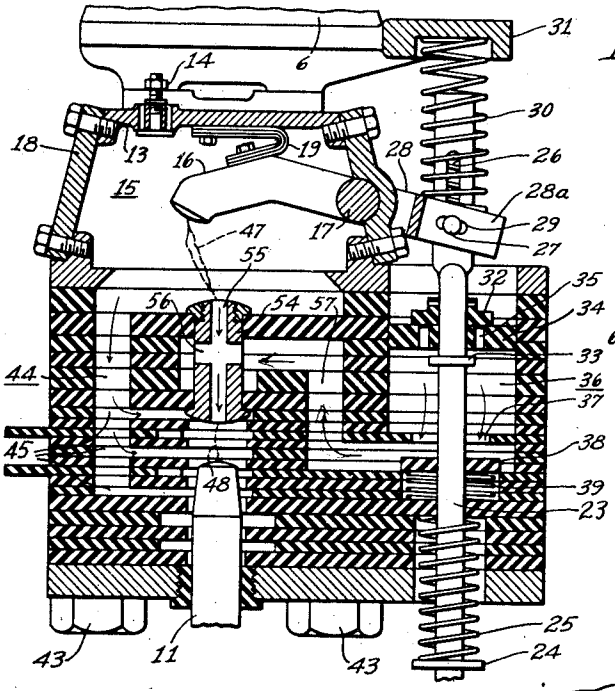


Fig. 11.

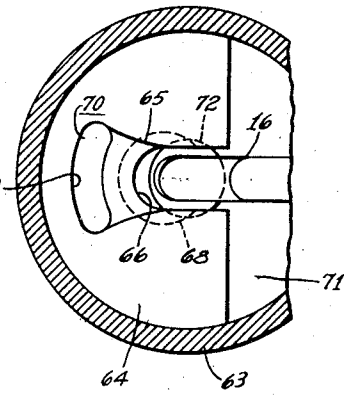


Fig. 10.

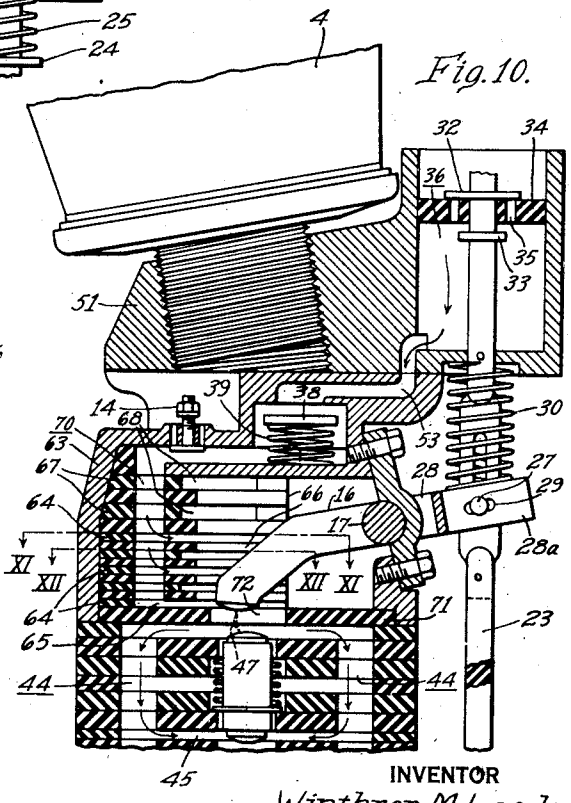
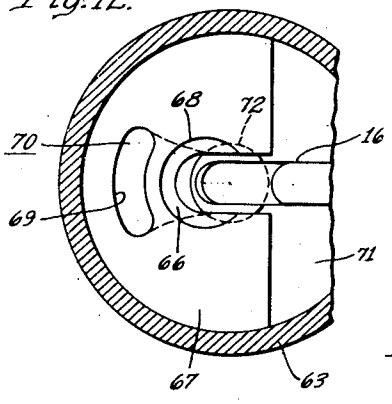


Fig. 12.



WITNESSES:

E. J. Weller.

W. R. Gout

INVENTOR

Winthrop M. Leeds.

BY

Ralph W. Swingle

ATTORNEY

Patented June 17, 1947

2,422,569

UNITED STATES PATENT OFFICE

2,422,569

CIRCUIT INTERRUPTER

Winthrop M. Leeds, Wilkinsburg, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 28, 1943, Serial No. 488,847

20 Claims. (Cl. 200—150)

1

This invention relates to circuit interrupters and, more particularly, to arc extinguishing structures therefor.

In arc extinguishing structures of the type which draw both a pressure generating arc and an interrupting arc, and which utilize the pressure created by the pressure generating arc to force fluid under pressure toward the interrupting arc to facilitate the latter's extinction, the separation between the pressure generating contacts is largely determined by low current conditions. In other words, the pressure generated by the pressure generating arc is largely a function of the length of the pressure generating arc, and consequently during low current interruption it is desirable to have a considerable separation between the pressure generating contacts to generate adequate pressure to effect interruption of the interrupting arc.

I have found that it is desirable to provide means to prevent a lengthening of the pressure generating arc during high current interruption when the pressure is excessive, and my invention is concerned with the provision of a circuit interrupter incorporating such means.

A general object of my invention is to provide an improved circuit interrupter having an improved arc extinguishing structure.

Another object of my invention is to provide an improved circuit interrupter in which are disposed contact means for establishing and lengthening an arc. I provide a valve means responsive to a predetermined pressure created in part by the arc to prevent further lengthening of the arc by continued movement of the contact means.

Another object is to provide an improved circuit interrupter in which a pressure generating arc forces fluid under pressure toward an interrupting arc to facilitate the latter's extinction, and to provide suitable valve means responsive to a predetermined pressure created at least in part by the pressure generating arc to prevent a lengthening of the pressure generating arc.

Another object is to provide an improved circuit interrupter in which a pressure generating arc is established, and to force fluid under pressure toward the pressure generating arc during low current interruption to increase the pressure formed thereat.

Another object is to provide an improved circuit interrupter in which both a pressure generating arc and an interrupting arc are established, and to provide means for sending a supplementary blast of fluid toward both arcs simultaneously during low current interruption.

2

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

Figure 1 is an elevational view, partly in section, of a circuit interrupter embodying my invention and shown in the closed circuit position;

Fig. 2 is an enlarged elevational view, in vertical section, taken through one of the arc extinguishing units of Fig. 1, the parts being shown in the closed circuit position;

Fig. 3 is a fragmentary vertical sectional view taken along the line III—III of Fig. 2;

Fig. 4 is a view in section taken along the line IV—IV of Fig. 2;

Fig. 5 is a view similar to Fig. 2, but showing the disposition of the parts during high current interruption under high pressure conditions;

Fig. 6 is a view similar to Fig. 5 but showing the disposition of the parts during low current interruption under low pressure conditions;

Fig. 7 is an enlarged fragmentary view in vertical section taken along the line VII—VII of Fig. 5;

Fig. 8 is a modified type arc extinguishing unit embodying my invention, and showing the disposition of the parts during low current interruption under low pressure conditions;

Fig. 9 is another modified type arc extinguishing unit embodying my invention, and showing the disposition of the parts during low current interruption under low pressure conditions;

Fig. 10 is a fragmentary enlarged view of still another modified type arc extinguishing unit embodying my invention, and showing the disposition of the parts during low current interruption under low pressure conditions;

Fig. 11 is a view in section taken along the line XI—XI of Fig. 10, and;

Fig. 12 is a view in section taken along the line XII—XII of Fig. 10.

Referring to the drawings, and in particular to Fig. 1, the reference numeral 1 designates a tank filled to the level indicated with a suitable arc extinguishing fluid 2, in this instance oil. Suspended from the cover 3 of the tank 1 are insulating bushings 4, 5 which enclose terminal studs (not shown). At the lower ends of the insulating bushings 4, 5 and clamped to the terminal studs are contact feet 6, 7.

To the contact feet 6, 7 are secured arc extinguishing units generally designated by the ref-

erence numeral 8. The arc extinguishing units 8 are electrically connected together in the closed circuit position of the interrupter, as shown in Fig. 1, by a conducting cross-bar 9, which is reciprocally operated by an insulating operating rod 10, actuated by suitable operating mechanism (not shown). At the opposed outer ends of the conducting cross-bar 9 are movable contacts 11, 12.

Referring more particularly to Fig. 2 it will be observed that I have provided a top dome casting 13 secured to the contact foot 6 having a gas escape valve 14 and forming a pressure chamber generally designated by the reference numeral 15.

Disposed within the pressure chamber 15 is a pressure generating contact 16 pivotally mounted at 17. An inspection plate 18 is provided to enable one to view the interior of the pressure chamber 15 without dissembling the arc extinguishing unit 8. A flexible shunt 19 electrically connects the dome casting 13 with the pressure generating contact 16. Cooperating with the pressure generating contact 16 is an intermediate contact 20 having a flange portion 21 which serves as a lower seat for a compression spring 22. Consequently, the intermediate contact 20 is biased downwardly by the compression spring 22.

In the closed circuit position of the interrupter, as shown in Figs. 1 and 2, the electrical circuit therethrough comprises the left hand terminal stud (not shown), contact foot 6, top dome casting 13, flexible shunt 19, pressure generating contact 16, intermediate contact 20, movable contact 11, conducting cross-bar 9, movable contact 12, through the right-hand arc extinguishing unit 8 in an identical manner, to the contact foot 7 and finally to the right-hand terminal stud (not shown).

An insulating operating rod 23 having a flange portion 24 is biased downwardly by a compression spring 25. At the upper end of the operating rod 23 is a slot 26, through which passes a pin 27, the latter also passing through the legs 28*a* of a bifurcated actuating member 28, which serves to actuate the pressure generating contact 16. Slots 29 are provided in the legs 28*a* to accommodate vertical movement of the operating rod 23.

A compression spring 30 having an upper seat in a bracket 31, which in this instance is an integral portion of the contact foot 6, surrounds the upper portion of the operating rod 23, and has a lower seat upon the legs 28*a*, as more clearly shown in Figs. 5 and 7. It will, consequently, be apparent that the compression spring 30 biases the legs 28*a* downwardly to maintain the pin 27 at the bottom of the slot 26 in the operating rod 23 as shown in Fig. 7.

An insulating valve disc 32 is rigidly secured to the operating rod 23. The operating rod 23 also has a flange portion 33. Disposed between the valve disc 32 and the flange portion 33, and slidable upon the operating rod 23, is a piston member 34 having apertures 35 formed therein. The piston member 34 is adapted to move in a piston chamber generally designated by the reference numeral 36.

The piston chamber 36 has an opening 37 at its lower end which is normally closed by a disc valve 38 slidable on the operating rod 23 and biased upwardly by a compression spring 39.

Referring to Fig. 2 it will be observed that an abutting cylinder 40 is slidable in the cross-bar 9 and biased upwardly by a compression spring 41, an aperture 42 being provided in the cross-bar 9 to control the back-pressure on the cylinder 40. The function of the cylinder 40 and compression spring 41 is to cushion the shock when the cross bar 9 picks up the operating rod 23, and to provide the requisite contact pressure for the interrupter in the closed circuit position.

The arc extinguishing unit 8 comprises a plurality of suitably shaped insulating plates held together by tie rods 43. Certain features of the arc extinguishing unit 8 are described and broadly claimed in a patent application by Leon R. Ludwig, Benjamin P. Baker and Winthrop M. Leeds, filed November 11, 1942, Serial No. 465,244, now U. S. Patent 2,406,469, issued August 27, 1946, entitled Circuit interrupters, and assigned to the assignee of the present application.

The insulating plates of the arc extinguishing unit 8 form vertical flow passages generally designated by the reference numeral 44, which communicate at their upper end with the pressure chamber 15, and at their lower end with a plurality of inlet passages 45, at the latter leading toward the interrupting arc 48. After the oil has contacted the interrupting arc 48 it passes out of the arc extinguishing unit 8 through the exhaust passages 46 more clearly shown in Fig. 3.

The opening operation of the interrupter will now be described. When it is desired to open the electrical circuit passing through the interrupter, or when overload conditions exist in the electrical circuit controlled by the interrupter, suitable operating mechanism (not shown) moves the insulating operating rod 10 downwardly to result in a downward movement of both the conducting cross-bar 9 and the movable contacts 11, 12.

During the interruption of low currents the operating rod 23 moves downwardly at the same rate of speed as the cross-bar 9, as shown in Fig. 6, to result in the pressure generating contact 16 rotating in a clockwise direction about the pivot point 17 to draw a pressure generating arc 47. Substantially simultaneously the movable contact 11 separates from the intermediate contact 20 to draw an interrupting arc 48. The valve disc 32, rigidly secured to the operating rod 23, moves therewith downwardly to close the apertures 35, pick up the piston member 34 and carry the piston member 34 downwardly in the piston chamber 36 to move the oil within the piston chamber 36. The oil, now under pressure within the piston chamber 36, opens the disc valve 38, against the upward biasing action of the compression spring 39, to permit oil to flow under pressure out of the piston chamber 36, through the opening 37 and passage 60 toward the inlet passages 45, as indicated by the arrows in Fig. 6. This action occurs only during the interruption of low currents. After the pressure generating contact 16 has reached its maximum open circuit position, as shown in Fig. 6, the insulating operating rod 23 may continue to move downwardly because of the presence of the slot 26 in the rod 23. Thus the piston action is continued after the pressure generating contact 16 has stopped moving. It will, consequently, be apparent that during low current operation when the pressure produced by the pressure generating arc 47 is low that the piston member 34, biased downwardly by compression spring 25, will serve to send a supplementary flow of oil under pressure through passage 60 toward the inlet passages 45 into engagement with the interrupting arc 48. The fully open circuit position of the interrupter is shown by the dotted lines of Fig. 1.

During the interruption of high current arcs

the pressure created by the pressure generating arc 47 is sufficient to close the disc valve 38 against the opening 37 to prevent oil leaving the piston chamber 36. The trapped oil within the piston chamber 36 under pressure prevents the downward movement of the piston member 34; and this, in turn, halts the downward movement of the operating rod 23. The operating rod 23 then separates from the abutting cylinder 40 as shown in Fig. 5.

It will be observed that when the insulating operating rod 23 is halted in its downward movement by the high pressure within the arc extinguishing unit 8, the pressure generating contact 16 cannot continue to rotate in a clockwise direction about the pivot point 17 to further increase the length of the pressure generating arc 47, and thus further increase the pressure in the chamber 15.

When the pressure subsides within the arc extinguishing unit 8 the oil under pressure within the piston chamber 36 will then be able to open the disc valve 38 and flow out of the piston chamber 36, through the opening 37 and passage 60 toward the inlet passages 45 to flush the region where the interrupting arc 48 was extinguished. This flushing action raises the dielectric strength in the region where the interrupting arc 48 has been extinguished and prevents delayed restriking of the interrupting arc 48, which would prolong the arcing time of the interrupter. It also prevents premature breakdown of the contact gap during a closing operation.

It will therefore be apparent that my invention is operative to produce a supplementary oil flow by piston action during the interruption of low currents. It is also apparent that during high current interruption my invention is operative to prevent a further lengthening of the pressure generating arc 47. During such high current interruption my invention is operative to send a flushing stream of uncontaminated oil toward the region where the interrupting arc 48 was extinguished after the pressure subsides within the arc extinguishing unit 8. This flushing action prevents restriking of the interrupting arc 48 and washes contaminated oil and carbon deposits out of the arc extinguishing unit 8.

In a patent application by Benjamin P. Baker and Winthrop M. Leeds, filed February 10, 1943, Serial No. 475,394, now U. S. Patent 2,412,858, issued December 17, 1946, entitled Circuit interrupters, and assigned to the assignee of this application, certain structural features which I here disclose are described and broadly claimed.

After an interrupting operation has occurred, and after the pressure has completely subsided within the arc extinguishing unit 8, the gas escape valve 14 opens to permit accumulated gas within the pressure chamber 15 to flow out of the unit 8.

During the closing operation the piston member 34 is picked up by the flange portion 33. This opens the apertures 35 to permit oil of high dielectric strength to rapidly fill the piston chamber 36. Consequently the closing operation is not opposed by suction behind the piston member 34.

It will be apparent that when the interrupter is operated under no load conditons, that is, with no current flowing through the interrupter, my invention provides a means for completely flushing the arc extinguishing unit 8 with oil brought in through the piston chamber 36.

In the embodiment of my invention shown in

Fig. 8 I provide a modified type arc extinguishing unit generally designated by the reference numeral 50. It will be noted that a modified contact foot 51 is utilized to form the piston chamber 36 at the upper end of the arc extinguishing unit 50. In this embodiment of my invention a bracket 58, integrally formed with the top dome casting 52, serves as a lower seat for the compression spring 39 which biases the disc valve 38 upwardly to close the conduit 53.

The operation of the operating rod 23 is identical to the operation of the operating rod 23 used in the embodiment of my invention shown in Figs. 1 through 7. Therefore, a minute description of the operation does not appear to be necessary to fully understand this embodiment of my invention. It suffices to say that during low current interruption, when the pressure produced at the pressure generating arc 47 is small, the pressure of the oil in the piston chamber 36 is sufficient to force the disc valve 38 downwardly against the biasing action of the compression spring 39 and to send a supplementary oil flow through the conduit 53 toward the pressure generating arc 47.

Thus, oil is forced into the pressure chamber 15 from the piston chamber 36 to cause fresh oil to contact the pressure generating arc 47 to increase the pressure formed at the pressure generating arc 47. Also some of the oil from the piston chamber 36 passes through the vertical flow passages 44 and through the inlet passages 45 to help extinguish the interrupting arc 48.

Fig. 8 shows the disposition of the parts during low current interruption when the disc valve 38 has been opened by the pressure of the oil in the piston chamber 36. The direction of flow is indicated by the arrows.

During the interruption of high currents the pressure formed at the pressure generating arc 47 within the pressure chamber 15 will be sufficient to maintain the disc valve 38 closed against the conduit 53. As previously explained this halts the downward movement of the operating rod 23 to prevent a further lengthening of the pressure generating arc 47. However, when the pressure has subsided within the pressure chamber 15, after the interruption of the high current arcs, the pressure of the oil within the piston chamber 36 will then be sufficient to open the disc valve 38 and send a fresh quantity of oil through the conduit 53 into the pressure chamber 15 to flush out the contaminated oil within the arc extinguishing unit 50.

It will, therefore, be evident that in the embodiment of my invention shown in Fig. 8 I position the piston chamber 36 at the upper end of the unit 50 to force fresh oil against the pressure generating arc 47 during low current interruption to increase the pressure formed therein; and during high current interruption the piston chamber 36 is operative to flush out the entire unit 50 after a circuit opening operation.

In the embodiment of my invention shown in Fig. 9 I provide a modified stationary intermediate contact 54 which has a longitudinal passage 55 extending axially therethrough. The longitudinal passage 55 intersects a lateral passage 56, which communicates with the passage 57 leading from the piston chamber 36. It will be apparent that in the operation of this embodiment of my invention during low current interruption the piston member 34 will be operative to send a quantity of fresh oil through the opening 37, through the passage 57 and through the inter-

mediate contact 54, to contact both the pressure generating arc 47 and also the interrupting arc 48. The fresh oil which passes through the intermediate contact 54 to engage the pressure generating arc 47 will increase the pressure formed thereat. The fresh oil which passes through the intermediate contact 54 and engages the interrupting arc 48 serves to facilitate the extinction of the interrupting arc 48. It will, therefore, be apparent that in the embodiment of my invention shown in Fig. 9 I utilize a novel construction of intermediate contact 54 to utilize more effectively the supplementary oil blast forced out of the piston chamber 36 during low current interruption.

During high current interruption, after the pressure has subsided within the unit, the piston chamber 36 will be operative to send a fresh flow of oil through the opening 37, through the passage 57, through the passage 55 in the intermediate contact 54 and toward both regions where the two arcs were extinguished. This raises the dielectric strength in these two regions to prevent reignition, and also prevents premature breakdown during a rapid reclosing operation.

In the embodiment of my invention shown in Figs. 10 through 12 the constructional features are somewhat similar to the arrangement shown in Fig. 8. Therefore, similar reference numerals have been used where possible. However in this embodiment of my invention I provide a modified type dome casting 63 in which are disposed a plurality of insulating plates to form a plurality of jets of oil which contact the pressure generating arc 47 during low current interruption, when the pressure formed at the pressure generating arc 47 may be small.

The insulating plates are of three kinds. The first kind is herein called an insulating inlet plate and is designated by the reference numeral 64, and shown more clearly in Figs. 10 and 11. The insulating inlet plate 64 has an inlet passage 65 formed therein, as shown more clearly in Fig. 11. The second kind of plate is designated by the reference numeral 66 and is shown more clearly in Figs. 10 and 12. The third kind of insulating plate is herein called an insulating pocket plate and is designated by the reference numeral 67. The configuration of the insulating pocket plate 67 is more clearly shown in Figs. 10 and 12. The insulating pocket plate 67 has formed therein a pocket 68 which serves to retain a quantity of fresh oil adjacent the path of movement of the pressure generating contact 16.

All of the insulating plates 64, 66 and 67 are provided with cut out portions 69, which, when assembled, form a vertical flow passage generally designated by the reference numeral 70. The flow passage 70 communicates with the conduit 53 leading toward the piston chamber 36.

At the lower end of the dome casting 63 is an insulating plate designated by the reference numeral 71, which has an orifice 72 formed therein accommodating the movement of the pressure generating contact 16.

The operation of the embodiment of my invention shown in Figs. 10 through 12 will now be explained. During the interruption of low currents, when the pressure formed at the pressure generating arc 47 is small, the pressure of the oil within the piston chamber 36 will open the disc valve 38 to force under pressure a fresh quantity of oil out of the piston chamber 36, through the conduit 53, through the vertical flow passage 70 and toward the pressure generating arc 47 through the inlet passages 65. This fresh oil strikes the pressure generating arc 47 as the latter lengthens to increase the pressure formed thereat. This pressure acts through the orifice 72 in the insulating plate 71 to act downwardly through the vertical flow passages 44, through the inlet passages 45 and toward the interrupting arc 48 not shown.

As the pressure generating contact 16 rotates in a clockwise direction about pivot 17, the pressure generating arc 47 is drawn past the pockets 68 provided in the insulating pocket plates 67. Consequently, the pressure generating arc 47 is not only drawn past the pockets 68 containing fresh oil, but also the pressure generating arc 47 is drawn adjacent the inlet passages 65, through which fresh oil from the piston chamber 36 passes toward the pressure generating arc 47. This raises the pressure within the pressure chamber 15 and facilitates the interruption of the interrupting arc 48.

During the interruption of high currents when th pressure formed by the pressure generating arc 47 in the pressure chamber 15 is sufficiently high to maintain the disc valve 38 closed, the operating rod 23 is halted to prevent a lengthening of the pressure generating arc 47. After the interruption of the high current arcs, the pressure subsides within the pressure chamber 15 to permit the piston 34 to move downwardly in the piston chamber 36 to send a flushing stream of oil through the conduit 53, through the vertical flow passage 70 and into the pressure chamber 15. This cleans out the contaminated oil within the pressure chamber 15 and raises the dielectric strength within the entire arc extinguishing unit.

Certain aspects of increasing the pressure created at a pressure generating arc to facilitate rapid interruption of one or more interrupting arcs are described and broadly claimed in a patent application by Benjamin P. Baker, S. N. 471,847, filed January 9, 1943, now U. S. Patent 2,412,857, issued December 17, 1946, and assigned to the assignee of this application.

It will be observed that in each embodiment of my invention the piston chamber 36 is operative during the closing operation to draw fresh oil into the piston chamber 36, which fresh oil is subsequently used during the next opening operation of the interrupter. Consequently, it will be apparent that the piston chamber 36 is operative to send oil in unidirectional path through the arc extinguishing unit. It will be apparent that during low current interruption my invention is operative to send a supplementary oil flow toward one or both of the established arcs. During high current interruption my invention is operative to flush out the entire unit to prevent restriking and also to prevent premature breakdown during rapid reclosing.

The broad concept of forcing fluid under pressure both toward the pressure generating arc and the interrupting arc is disclosed and broadly claimed in a patent application by Roswell C. Van Sickle, Robert E. Freidrick and Francis J. Fry, filed May 27, 1943, Serial No. 488,624, entitled Circuit interrupters, and assigned to the assignee of the instant application.

Although, I have shown and described specific structures it is to be clearly understood that the same were merely for purposes of illustration, and that changes and modifications may be readily made by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. In a circuit interrupter, means for establishing and lengthening a pressure generating arc, means for establishing an interrupting arc, the pressure generating arc forcing fluid under pressure toward the interrupting arc to facilitate the latter's extinction, a piston chamber, and valve means disposed at the entrance to the piston chamber and responsive to a predetermined pressure created in part by the pressure generating arc to prevent the first-mentioned means from lengthening the pressure generating arc.

2. In a circuit interrupter, a pressure generating contact cooperable with an intermediate contact to establish and lengthen a pressure generating arc, a movable contact cooperable with the intermediate contact to establish an interrupting arc, operating means movable in response to motion of the movable contact for actuating the pressure generating contact, a piston chamber, piston means disposed in the piston chamber and operated by the operating means, and valve means disposed at the entrance to the piston chamber to halt the motion of the operating means when the pressure created at least in part by the pressure generating arc exceeds a predetermined pressure.

3. In a circuit interrupter, means for establishing and lengthening an arc, a piston chamber containing fluid, piston means operative within the chamber to assist in circuit interruption, and valve means disposed at the entrance to the piston chamber and operative at a predetermined pressure created in part by the arc to close the entrance to the piston chamber and stop the operation of the piston means and also to prevent a further lengthening of the arc by said first-mentioned means.

4. In a circuit interrupter, a first contact cooperable with a second contact to establish and lengthen an arc, a piston chamber, operating means for the first contact extending through the piston chamber, and valve means disposed at the entrance to the piston chamber and responsive to a predetermined pressure created at least in part by the arc to stop the operation of the operating means and hence to prevent a further lengthening of the arc.

5. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created at the pressure generating arc to force fluid under pressure toward the interrupting arc to facilitate the latter's extinction, and piston means operable only during low current interruption for forcing fluid toward the pressure generating arc and the interrupting arc simultaneously.

6. In a circuit interrupter, a pressure generating contact cooperable with an intermediate contact to establish a pressure generating arc, a movable contact cooperable with the intermediate contact to establish an interrupting arc, the intermediate contact having a fluid conducting passage formed therein, and means for forcing fluid through the passage toward both arcs only during low current interruption.

7. In a circuit interrupter, a pressure generating contact cooperable with an intermediate contact to establish a pressure generating arc, a movable contact cooperable with the intermediate contact to establish an interrupting arc, the intermediate contact having a fluid conducting passage formed therein, and piston means operable only during low current interruption for forcing fluid through the passage toward both arcs.

8. In a circuit interrupter, a pressure generating contact cooperable with an intermediate contact to establish a pressure generating arc, a movable contact cooperable with the intermediate contact to establish an interrupting arc, the intermediate contact having a fluid conducting passage extending axially therethrough, and means for forcing fluid through the passage toward both arcs to effect their extinction.

9. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created adjacent the pressure generating arc to force fluid toward the interrupting arc to effect the latter's extinction, and means for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat.

10. In a circuit interrupter, an arc extinguishing unit, means for establishing a pressure generating arc at a first end of the unit, means for establishing an interrupting arc adjacent the other end of the unit, and piston means disposed adjacent the first end of the unit and operative at a predetermined low pressure to send a jet of fluid toward the pressure generating arc.

11. In a circuit interrupter, means for establishing and lengthening a pressure generating arc, means for establishing an interrupting arc, the pressure generating arc forcing fluid under pressure toward the interrupting arc to facilitate the latter's extinction, and valve means responsive to a predetermined pressure created in part by the pressure generating arc to prevent the first-mentioned means from lengthening the pressure generating arc.

12. In a circuit interrupter, a pressure generating contact cooperable with an intermediate contact to establish and lengthen a pressure generating arc, a movable contact cooperable with the intermediate contact to establish an interrupting arc, operating means movable in response to motion of the movable contact for actuating the pressure generating contact, piston means operated by the operating means, and valve means to halt the motion of the operating means when the pressure created at least in part by the pressure generating arc exceeds a predetermined pressure.

13. In a circuit interrupter, means for establishing and lengthening an arc, a piston chamber containing fluid, piston means operative within the chamber to assist in circuit interruption, and valve means operative at a predetermined pressure created in part by the arc to stop the operation of the piston means and also to prevent a further lengthening of the arc by said first-mentioned means.

14. In a circuit interrupter, a first contact cooperable with a second contact to establish and lengthen an arc, a piston chamber, operating means for the first contact extending through the piston chamber, and valve means associated with the piston chamber and responsive to a predetermined pressure created at least in part by the arc to stop the operation of the operating means and hence to prevent a further lengthening of the arc.

15. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created adjacent the pressure

generating arc to force fluid toward the interrupting arc to effect the latter's extinction, and means including a plurality of insulating plates disposed in contiguous relationship for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat.

16. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created adjacent the pressure generating arc to force fluid toward the interrupting arc to effect the latter's extinction, and piston means for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat.

17. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created adjacent the pressure generating arc to force fluid toward the interrupting arc to effect the latter's extinction, and piston means operable only during low current interruption for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat.

18. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created adjacent the pressure generating arc to force fluid toward the interrupting arc to effect the latter's extinction, plate structure for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat, and piston means for forcing fluid through the plate structure to strike the pressure generating arc in a plurality of jets as the latter is lengthened.

19. In a circuit interrupter, means for establishing a pressure generating arc, means for establishing an interrupting arc, means for utilizing the pressure created adjacent the pressure generating arc to force fluid toward the interrupting arc to effect the latter's extinction, plate structure for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat, and piston means operable only during low current interruption for forcing fluid through the plate structure to strike the pressure generating arc in a plurality of jets as the latter is lengthened.

20. In a circuit interrupter, a pressure generating contact cooperable with an intermediate contact to establish a pressure generating arc, a movable contact cooperable with the intermediate contact to establish an interrupting arc, means for utilizing the pressure created adjacent the pressure generating arc to force fluid toward the interrupting arc to effect the latter's extinction, an insulating plate having an orifice therethrough through which the pressure generating arc is drawn, and means for directing a plurality of jets of fluid into the pressure generating arc as the latter is lengthened to increase the pressure formed thereat.

WINTHROP M. LEEDS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,292,547	Sadler	Aug. 11, 1942
2,147,497	Prince et al.	Feb. 14, 1939
2,258,226	Skeats	Oct. 7, 1941
1,992,109	Whitehead	Feb. 19, 1935
2,095,441	Howe	Oct. 12, 1937
1,814,847	Paul	July 14, 1931
2,077,338	Lingal et al.	Apr. 13, 1937
715,291	Potter	Dec. 9, 1902
2,075,749	Paul	Mar. 30, 1937