March 2, 1954

R. C. DICKINSON

CIRCUIT INTERRUPTER

2,671,144

Filed May 18, 1950

3 Sheets-Sheet 1

Fig.3.

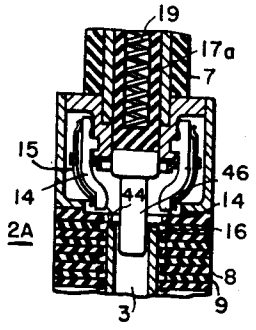
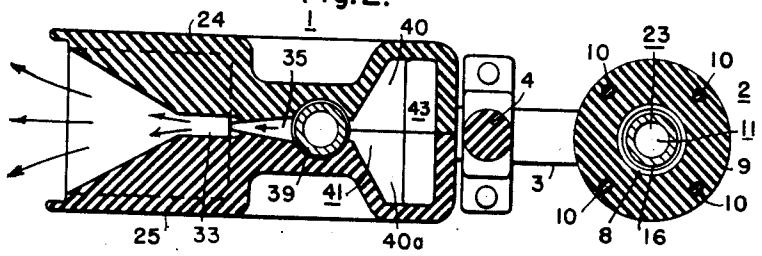


Fig.1.

Fig.2.



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3 Sheets-Sheet 2

Fig.4.

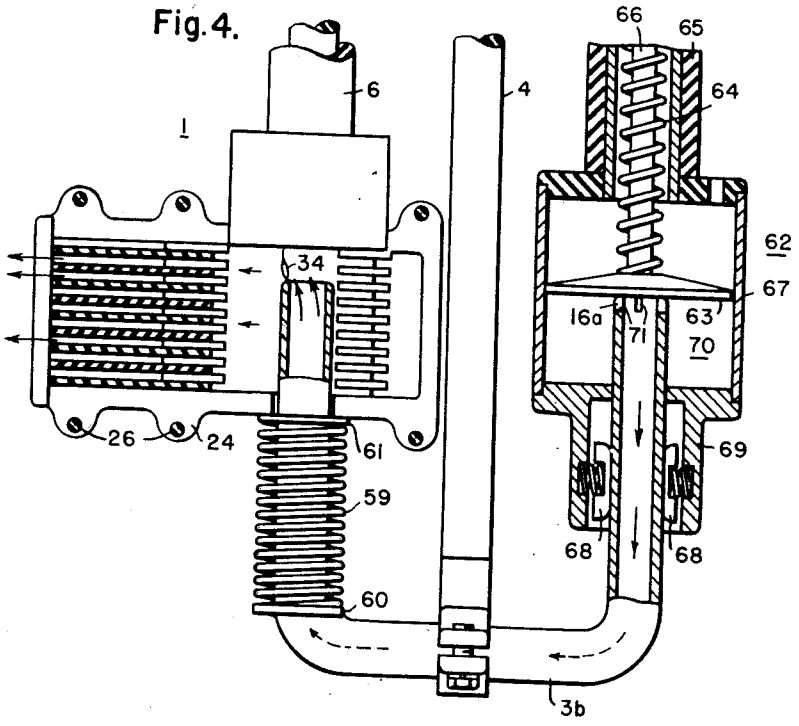
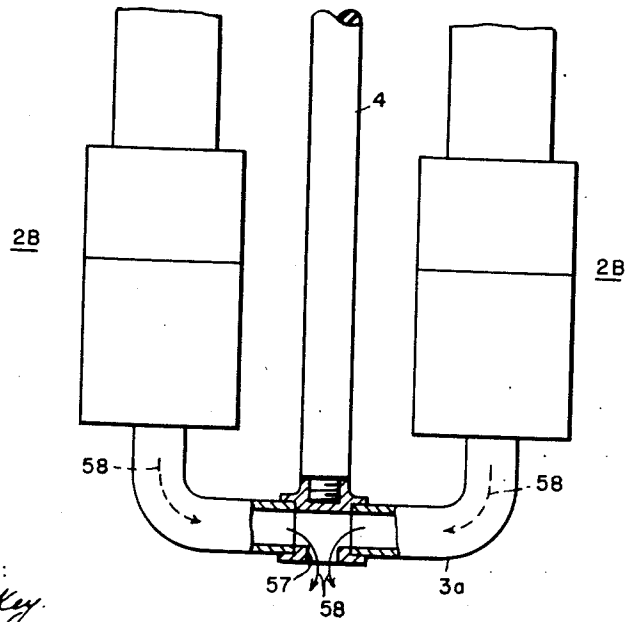


Fig.6.



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3 Sheets-Sheet 3

Fig.5.

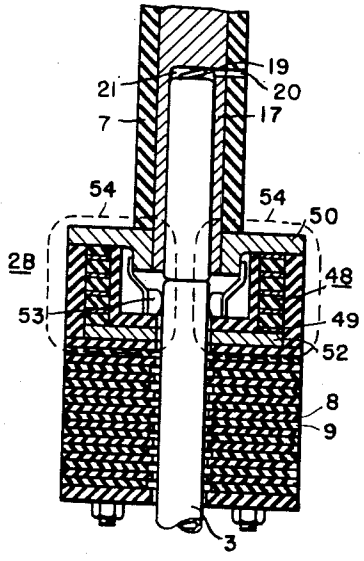


Fig.7.

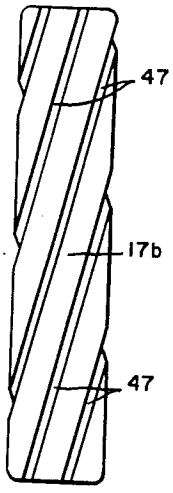


Fig.8.

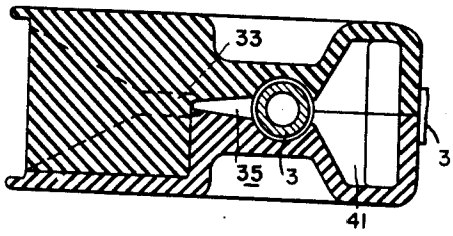


Fig.11.

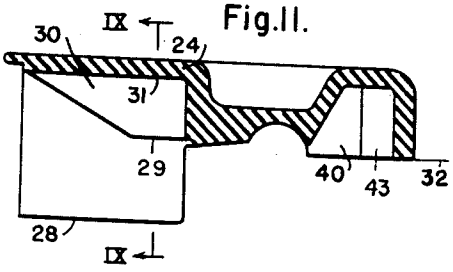


Fig.9.

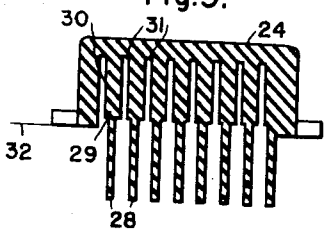


Fig.12.

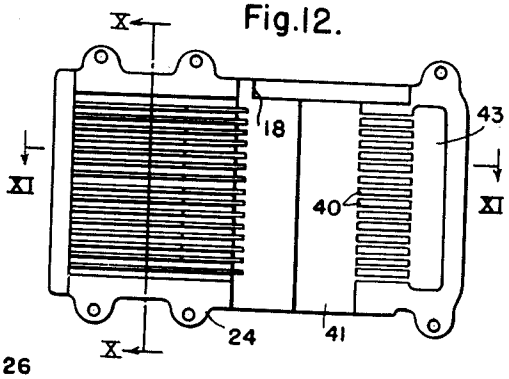
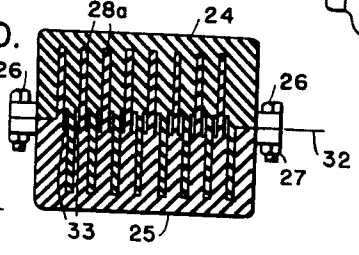


Fig.10.



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2,671,144

UNITED STATES PATENT OFFICE

2,671,144

CIRCUIT INTERRUPTER

Robert C. Dickinson, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 18, 1950, Serial No. 162,684

14 Claims. (Cl. 200—144)

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

A general object of my invention is to provide an improved circuit interrupter, either of the liquid-break type or of the air-break type, in which a pair of interrupting units are bridged by a tubular conducting bridging member and in which improved operation is attained.

Another object is to provide an improved circuit interrupter in which a pair of interrupting units are bridged by a tubular conducting bridging member, and in which one of the units is substantially enclosed, whereas the other unit is vented, so that fluid, either liquid or gas, may flow through the tubular conducting bridging member from the substantially enclosed interrupting unit to the vented interrupting unit.

An ancillary object is to provide an improved circuit interrupter of the type specified in which the substantially enclosed interrupting unit is particularly adapted for low-current interruption and in which the vented interrupting unit is particularly suitable for high-current interruption.

Another object of my invention is to provide an improved method of assembling an arc chute of the spaced-plate type in which the arc is drawn through apertures provided in the plate structure.

Another object is to provide an improved method of assembling an arc chute of the spaced-plate type in which a storage region is provided within the arc chute so that accumulated gases may be stored and pass through the arc at or near a current zero to effect the extinction thereof.

Still another object is to provide a pair of cooperating interrupting units, bridged by a tubular conducting bridging member, in which the interrupting units are vented through the tubular bridging member to the region externally of the units.

Still a further object is to provide an improved circuit interrupter of the type in which a low-current interrupting unit and a high-current interrupting unit are bridged by a tubular movable bridging member, in which improved means are utilized in the low-current interrupting unit to bring about effective extinction of the arc therein, and also to minimize deterioration of the several parts of the low current unit.

In the development of self-generating gas blast interrupters, particularly of the type in which interrupting gas is developed by the decomposition of solid material by the heat of the arc, it is difficult to obtain circuit interruption over a

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wide range of currents, such as from several amperes to several thousand amperes. This is usually due to the fact that when an interrupter is suitably designed for high current interruption, insufficient gases are generated at the low currents, or the gases are not sufficiently mixed in the arc space to interrupt the arc.

Another object of my invention is to provide an improved circuit interrupter, particularly of the type in which gas is evolved by contact of the arc with gas-evolving material in which the interrupter is suitable for use over a wide range of current values.

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

Figure 1 is a vertical sectional view through a circuit interrupter embodying my invention, the contact structure being shown in the partly open circuit position;

Fig. 2 is a view, in section, taken along the line II—II of Fig. 1, looking in the direction of the arrows;

Fig. 3 shows a fragmentary vertical sectional view through a modified type of follower arrangement which may be utilized in place of the follower arrangement of Fig. 1, the contact structure being shown in the partly open circuit position;

Fig. 4 shows a vertical sectional view through a modified type of circuit interrupter embodying my invention, the contact structure being shown in the partly open circuit position;

Fig. 5 is a fragmentary vertical sectional view through a modified type of low current interrupting unit utilizing a radial magnetic field to bring about rotation of the established arc;

Fig. 6 shows an arrangement in which a pair of low current interrupting units, such as those illustrated in Figs. 1, 3 and 5, may be utilized together, with the venting taking place through the movable tubular bridging member;

Fig. 7 is an enlarged fragmentary view of the helical groove arrangement which may be utilized with the follower to bring about uniform deterioration of the follower by the action of the arc thereon;

Fig. 8 is a view in section taken along the line VIII—VIII of Fig. 1;

Fig. 9 is a vertical sectional view taken along the line IX—IX of Fig. 11;

Fig. 10 is a sectional view taken through the interrupter of Fig. 8 the plane being indicated by the line X—X on Fig. 12 thereof;

Fig. 11 is a view in section taken through the interrupting half-section of Fig. 12, along the line XI—XI thereof; and

Fig. 12 is a side elevational view of one-half of the high current interrupting assembly of Fig. 8.

Referring to the drawings, and more particularly to Fig. 1 thereof, the reference numeral 1 designates a high-current interrupting unit which cooperates with a low-current interrupting unit, the latter being generally designated by the reference numeral 2. The interrupting units 1 and 2 are electrically interconnected by a tubular movable U-shaped conducting bridging member 3.

The bridging member 3 is actuated vertically by an insulating lift rod 4, which may be actuated by any suitable mechanism, which forms no part of my invention and therefore will not be described. The interrupting units 1, 2 are respectively appended from terminal bushings 6, 7 which preferably extend through the cover of a suitable container, not shown. In case the invention is applied to a liquid-break type of interrupter, the container will contain a suitable arc extinguishing liquid, such as circuit breaker oil. In the event that the invention is utilized with an air-break type of interrupter, the container will merely contain air at atmospheric pressure and will merely serve as a grounded support for the interrupter, the terminal bushings 6, 7 extending preferably through the top portion or cover thereof.

The low current interrupting unit 2 will now be described. The low current interrupting unit 2 includes a plurality of gas-evolving insulating washers 8, 9 of different internal diameter. Upon assembling a plurality of such washers 8, 9 upon insulating tie rods 10, the result will be an annular arcing chamber 11, having a corrugated inner surface, as clearly shown in Fig. 1.

Disposed at the upper end of the low current interrupting unit 2 is a stationary contact assemblage, generally designated by the reference character 13, and including a plurality of, in this instance four, contact fingers 14 biased inwardly by leaf springs 15. The lower ends of the contact fingers 14 make contacting engagement with the upper end 16 of the tubular bridging member 3.

Movable within the stationary contact assemblage 13 is a movable hollow insulating follower 17 spring-biased downwardly into following engagement with the contact 16 by a compression spring 19. A vent 20 is provided at the upper end of the follower chamber 21 so that downward opening motion of the follower 17 will not be interfered with by cavitation.

Preferably the lower end of the follower 17 has a plurality of grooves 22 provided therein to permit communication from the arcing chamber 11 to the region 23 interiorly of the contact bridge 3, even though the follower 17 is in abutting engagement with the upper end 16 of the contact bridge 3, the purpose for which will be more apparent hereinafter.

The high current interrupting unit 1 includes a pair of half-sections 24, 25 secured together by bolts 26 and nuts 27, as more clearly shown in Fig. 10. The general form of the interrupter is described and claimed in United States patent application, filed May 18, 1950, Serial No. 162,666, on behalf of Herbert L. Rawlins, deceased, entitled "Circuit Interrupter," now U. S. Patent 2,660,647, issued November 24, 1953, and assigned to the assignee of the instant application.

Referring to Fig. 11, which more clearly shows the half-section 24, it will be noted that there are formed integrally with the half-section 24 a plurality of stepped tongues 28. Each tongue 28 has a widened portion 29 which includes a raised plate portion 30 having a configuration more clearly shown in Fig. 11. Between the widened portions 29 are grooves or slots 31 into which fit, in the assembled condition of the interrupter 1, the tongues 28a of the cooperating half-section 25, as shown in Fig. 10. It will be observed that the raised plate portions 30 are back of the center line 32 of the arc chute 1 so that discharge passages 33 (Fig. 10) are formed between the raised plate portions 30 of the two half sections 24, 25. Fig. 8 may be referred to for the general configuration of the several discharge passages 33.

Thus, generally, the high current interrupting unit 1 includes essentially a plurality of spaced splitter portions 28 which hold the arc 34, drawn within the high current unit 1, within the arcing slot 35 (Figs. 1 and 8). Between the splitter portions 28 are the vents or discharge passages 33 of flaring shape, as shown more clearly in Figs. 2 and 8.

From the foregoing construction of the high current unit 1, it will be apparent that each half-section 24, 25 may readily be molded out of a suitable gas-evolving material. The two half-sections 24, 25, when clamped together by the bolts 26 and nuts 27, have their upper semicircular portions 18 (Fig. 12) clamped about a cylindrical stationary contact assembly, generally designated by the reference character 36, and including a plurality of stationary segmental contact fingers 37 biased radially inwardly by leaf springs 38 and cooperating with the upper end 39 of the tubular conducting bridging member 3 to establish an arc 34 within the high current interrupting unit 1.

Each half-section 24, 25 also includes a plurality of tongue projections 40 extending to the center line 32 of the arc chute, as more clearly shown in Figs. 2 and 11, so that in the assembled condition of the interrupter the tongue projections 40, 40a cooperate to form a plurality of spaced cooling plate portions, generally designated by the reference character 41, as shown more clearly in Figs. 2 and 8. It will be observed that a storage region 43 is formed to the right of the plate portions 41 so that gas may be stored during the peak of the alternating current wave in the high current unit 1 within the storage chamber or region 43, and released therefrom at or near a current zero on the alternating current wave, to pass to the left, as viewed in Fig. 1, through the arc 34, holding the latter against the splitters 28 and deionizing the same to effect its extinction.

The theory and general manner of operation of the high current interrupting unit 1 is disclosed and claimed in the foregoing Rawlins application. It is there disclosed that during low current interruption the evolved gas generated by contact of the arc 34 with the gas-evolving material forming the half-sections 24, 25 is relatively low, and reliance must be placed upon an auxiliary gas blast during such low current interruption to effect speedy extinction of the arc 34. It being observed that the low current interrupting unit 2 is substantially enclosed, gas evolved by contact of the arc 44 of the low cur-

rent unit 2 with the walls of the gas-evolving washers 8, 9 will pass downwardly through the region 23 interiorly of the U-shaped tubular bridging member 3 to pass upwardly through the upper end 39 of the bridging member 3 into the high current interrupting unit 1 to assist in effecting extinction of the arc 34 drawn between the contacts 36, 39 of the high current interrupting unit 1.

During high current interruption, the amount of evolved gas within the high current interrupting unit 1 is sufficient to effect extinction of the high current arc 34 within the unit 1 with comparative ease. It is only during low current interruption that assistance must be placed upon the cooperation of the low current unit 2, with the auxiliary gas blast passing through the interior of the U-shaped conducting bridge 3 in the direction indicated by the arrows 45.

During low current interruption even when the follower 17 abuts against the top 16 of the conducting bridge 3, the provision of the grooves 22 nevertheless permits the gas blast to pass from the annular arcing chamber 11 of the low current unit 2 into the interior 23 of the tubular bridge 3 to assist in extinction of the arc 34 within the high current unit 1.

Fig. 3 shows a modified type of follower 17*a* having a lower projecting portion 46 extending interiorly within the tubular bridge 3. Again the arc 44 is drawn between the upper end 16 of the bridge 3 and the stationary contact fingers 14, the projecting portion 46 serving to increase the evolution of evolved gas and somewhat blocking the flow of gas through the tubular bridge 3 so as to raise the pressure and hence the dielectric strength of the evolved gas within the modified type of low current interrupting unit 2A. Again, the gas evolving follower 17*a* is spring-biased downwardly by a compression spring 19, and is picked up during the closing operation by the upper end 16 of the bridge 3.

It is desired to effect uniform erosion over the surface of the follower 17, and if the follower 17 has a smooth surface, it is known that a groove tends to burn in the follower, and it thus deteriorates at a high rate. To prevent such localized deterioration of the follower 17, I show in Fig. 7 a modified type of follower 17*b*, drawn to an enlarged scale, and having a plurality of shallow helical grooves 47 formed therein. The helical grooves 47 cause the arc to spread out more evenly across the surface of the follower 17*b*, and therefore to have a more general deteriorating effect.

It may, in certain applications, be desirable to effect rotation of the arc 44 drawn within the low current interrupting unit, and to effect such rotation I show in Fig. 5 a radial field coil, generally designated by the reference character 48, and including a series coil 49 electrically connected between the top cap 50 of the low current interrupting unit 2B and an arcing ring 52. Stationary contacts 53 are directly connected to the conducting cap 50, so that in the closed circuit position of the low current unit 2B, as shown in Fig. 5, the series coil 49 is shorted out.

During the opening operation, the tubular bridge 3 moves downwardly separating from the fingers 53 and passing adjacent to the arcing ring 52. The established arc 44 has its upper terminal transferred from the stationary fingers 53 to the arcing ring 52, so that the radial field coil 48 is energized, thereby setting up a radial magnetic field, in the direction indicated by the

broken lines 54, to cause rotation of the arc 44 drawn within the low current unit 2B. In other words, the arc 44 will rotate around the arcing ring 52 and will also rotate around the upper ring-shaped contact portion 16 of the tubular bridge 3.

Since the follower 17, being spring-biased downwardly by the spring 13, tends to follow the tubular bridge 3, the rotating arc 44 will be caused to rotate in the constricted annular arcing chamber 11, provided between the inner corrugated walls of the low current unit 2B and the outer surface of the gas-evolving follower 17. If desired, grooves 22, as shown in Fig. 1, may be provided in the follower 17, or the latter may have no such grooves and thereby tend to raise the pressure within the low current unit 2B.

From the foregoing description, it will be apparent that by providing the follower 17, and either having a radial magnetic field to effect rotation of the arc or by having a helical groove construction on the surface of the follower, more effective gas evolution occurs within the low current unit 2B, thereby enabling the low current interrupting unit 2B to cover a certain useful range of currents in itself. In this event, two such units 2B may be employed, as somewhat diagrammatically illustrated in Fig. 6, with a vent 57 provided at the lower end of the modified tubular bridge 3*a*. It will, of course, be obvious that in place of the two low current interrupting units 2B, two units 2 with the spiral groove construction 47 may be employed, or merely two units 2, as shown in Fig. 1 or 3, may be employed in the construction of Fig. 6.

In other words, Fig. 6 indicates the possible use of two cooperating low current interrupting units 2 with the tubular bridge 3*a* being vented at 57. The direction of the gas flow is indicated by the arrows 58.

Fig. 4 shows a modified type of interrupter in which the high current unit 1 is similar to that previously described in connection with Fig. 1. The conducting bridge 3*b* is biased downwardly, in a circuit opening direction by a compression spring 59 seating upon a flange 60 integrally formed with the bridge 3*b*. The upper end of the accelerating compression spring 59 seats against a movable washer 61, the latter abutting against the lower end of the high current unit 1, in the closed circuit position of the interrupter, not shown.

In place of a low current interrupting unit 2 at the right-hand end of the tubular bridge 3*b*, I employ a piston, generally designated by the reference numeral 62, and including a movable piston member 63 biased downwardly in a working direction by a compression spring 64 and charged, during the closing stroke of the interrupter, by the upper tip portion 16*a* of the bridge 3*b*. Contact is made between the bridge 3*b* and the upper terminal stud 65 by means of the conducting piston cylinder 67. Preferably, the piston 63 has a guide stem portion 66, encircled by the compression spring 64, to assist in guiding the downward travel of the piston 63. Stationary contacts 68 bear against the side walls of the tubular bridge 3*b*, the contacts 68 being in electrical contact with the lower conducting cap 69 of the piston 62, and thereby with the terminal stud 65.

The operation of the modified type of interrupter shown in Fig. 4 will now be explained. During high current interruption, the high current interrupting unit 1 is sufficient by itself to

effect speedy interruption of the arc 34, because of the voluminous quantity of evolved gas at this time. This gas, under high pressure, may back up through the tubular bridge 3b to stall downward travel of the piston member 63. In this event subsequent downward travel of the piston member 63, following extinction of the arc 34 and a consequent subsidence of the pressure within the unit 1, will provide a flushing flow of gas through the tubular bridge 3b. In the event that the tubular bridge 3b has pulled completely out of the piston arrangement 62, the compressed gas caused by the working stroke of the piston or puffer 62 will merely pass out through the lower end of the piston 62.

During low current interruption, when the amount of gas evolved in the high current unit 1 is relatively small, at this time the spring 64 will cause the piston 63 to follow the tubular bridge 3b compressing gas within the region 70 of the piston 62. The gas, compressed within the region 70, will flow through the notches 71, provided at the upper end 16a of the tubular bridge 3b, to pass interiorly through the bridge 3b and into the high current interrupting unit 1 to assist in effecting arc extinction therein.

In the fully open circuit position of the interrupter, preferably the tubular bridge 3b is completely withdrawn from both the high current unit 1 and the piston assembly 62. During the closing stroke, the tubular bridge 3b reenters the unit 1 and the piston 62 to cause charging, closing operation of the piston member 63.

From the foregoing description of several embodiments of my invention, it will be apparent that I have provided an improved circuit interrupter adaptable in covering a wide range of current values. The device, if utilized in a liquid, such as circuit breaker oil, would not need to have the plates 8, 9, and the half-sections 24, 25 composed of gas evolving material. The reaction of the two arcs 34, 44 upon the oil itself, which would fill both units 1, 2, would be sufficient. In such an eventuality the unit 2 would serve as a pressure-generating arc-extinguishing unit, being substantially enclosed, and the left-hand unit 1 would serve substantially as a vented interrupting arc-extinguishing unit. Liquid and gas flow from the right-hand pressure-generating unit 2 would pass through the tubular bridge 3 and into the vented left-hand interrupting unit 1, in which the interrupting arc 34 would be blasted by a flow of liquid and gas coming upwardly from the bridge 3. This flow would, of course, pass to the left, as viewed in Fig. 1, and restrict the arc 34 at the splitters 28, the oil flow passing to the left through the discharge passages 33 disposed intermediate the splitter portions 28.

Consequently, my invention is not merely applicable to air-break devices, but may be applied to liquid-break devices with little change in construction.

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

I claim as my invention:

1. A circuit interrupter including a relatively stationary substantially enclosed low current interrupting unit and a relatively stationary substantially enclosed high current interrupting unit, relatively stationary contact means disposed interiorly within each unit, a movable tubular conducting bridging member electrically interconnecting the two relatively stationary units in series in the closed circuit position of the interrupter, the low current unit being substantially enclosed and forming an elongated arc passage closely confining one end of the tubular conducting bridging member, means along the arc passage for evolving gas under pressure upon contact with the arc drawn within the low current unit, the low current unit forcing fluid through the tubular conducting bridging member into the high current unit, and the high current unit being vented and having a plurality of splitter plates against which the arc in the high current unit is forced.

2. A circuit interrupter including a relatively stationary substantially enclosed low current interrupting unit and a relatively stationary substantially enclosed high current interrupting unit, relatively stationary contact means disposed interiorly within each unit, a movable tubular conducting bridging member electrically interconnecting the two relatively stationary units in series in the closed circuit position of the interrupter, the low current unit being substantially enclosed and forming an elongated corrugated arc passage closely confining one end of the tubular conducting bridging member, means along the arc passage for evolving gas under pressure upon contact with the arc drawn within the low current unit, the low current unit forcing fluid through the tubular conducting bridging member into the high current unit, a spring-biased follower member associated with the low current unit for confining the arc drawn in the low current unit, and the high current unit being vented and having a plurality of splitter plates against which the arc in the high current unit is forced.

3. A circuit interrupter including a relatively stationary substantially enclosed low current interrupting unit and a relatively stationary substantially enclosed high current interrupting unit, relatively stationary contact means disposed interiorly within each unit, a movable tubular conducting bridging member electrically interconnecting the two relatively stationary units in series in the closed circuit position of the interrupter, the low current unit being substantially enclosed and forming an elongated corrugated arc passage closely confining one end of the tubular conducting bridging member, means along the arc passage for evolving gas under pressure upon contact with the arc drawn within the low current unit, a spring-biased follower member associated with the low current unit for confining the arc drawn in the low current unit, the low current unit forcing fluid through the tubular conducting bridging member into the high current unit, the high current unit being vented and having a plurality of splitter plates against which the arc in the high current unit is forced, and means for rotating the arc within the low current unit.

4. A circuit interrupter including a low current interrupting unit and a high current interrupting unit, a tubular conducting bridging member electrically interconnecting the two units in series in the closed circuit position of the interrupter, the low current unit being substantially enclosed and forming an elongated corrugated arc passage closely confining one end of the tubular conducting bridging member, means along the arc passage for evolving gas under

pressure upon contact with the arc drawn within the low current unit, a spring-biased movable follower member associated with the low current unit for confining the arc drawn in the low current unit, the high current unit being vented and having a plurality of splitter plates against which the arc in the high current unit is forced, and the follower member having a plurality of helical grooves on the surface thereof to distribute the arc erosion thereon.

5. A circuit interrupter including an arc chute of the spaced plate splitter type, means for establishing an arc within the arc chute, the arc chute comprising two half-sections, each half-section including a plurality of slot portions and a plurality of stepped tongue portions, the tongue portions of one half-section fitting tightly within the slots of the other half-section so that no clearance remains therebetween, and the stepped portions of the tongue portions being disposed laterally of the center line of the arc chute to form upon assembly discharge passages between the splitter tongue portions.

6. A circuit interrupter including a fixed interrupting unit and a fixed piston cylinder disposed in spaced relation therefrom, a tubular U-shaped conducting member entering both the interrupting unit and the piston cylinder and removable therefrom, a movable piston disposed within the piston cylinder, means separate from the conducting member biasing the piston to move within the piston cylinder, and the tubular U-shaped conducting member charging the piston during the closing operation.

7. A circuit interrupter including means defining an elongated arc passage, a relatively stationary contact and a movable tubular contact cooperable to establish an arc within the arc passage, a movable follower member composed at least in part of insulating material, means biasing the movable follower member in the direction of opening motion of the movable tubular contact, and one or more grooves disposed in the abutting face of the follower member so that even when the follower member and the movable tubular contact are in abutting engagement, nevertheless arc gases may pass through the grooves and out through the movable tubular contact.

8. A circuit interrupter including means defining an elongated arc passage, a relatively stationary contact and a movable tubular contact cooperable to establish an arc within the arc passage, a movable follower member composed at least in part of insulating material and having a projecting portion extending interiorly within the movable tubular contact in the closed circuit position of the contacts, means biasing the movable follower member in the direction of opening motion of the movable tubular contact, and the projecting portion restricting the passage of arc gases out through the movable tubular contact.

9. A circuit interrupter including a relatively stationary substantially enclosed low current interrupting unit and a relatively stationary substantially enclosed high current interrupting unit, relatively stationary contact means disposed interiorly within each unit, a movable tubular conducting bridging member electrically interconnecting the two relatively stationary units in series in the closed circuit position of the interrupter, the low current unit being substantially enclosed and forming an elongated arc passage closely confining one end of the tubular conducting bridging member, means along the arc passage for evolving gas under pressure upon contact with the arc drawn within the low current unit, the low current unit forcing fluid through the tubular conducting bridging member into the high current unit, and the high current unit being vented and having a plurality of plate portions against which the arc in the high current unit is forced.

10. A circuit interrupter including a relatively stationary substantially enclosed low current interrupting unit and a relatively stationary substantially enclosed high current interrupting unit, relatively stationary contact means disposed interiorly within each unit, a movable tubular conducting bridging member electrically interconnecting the two relatively stationary units in series in the closed circuit position of the interrupter, the low current unit being substantially enclosed and forming an elongated arc passage closely confining one end of the tubular conducting bridging member, means along the arc passage for evolving gas under pressure upon contact with the arc drawn within the low current unit, the low current unit forcing fluid through the tubular conducting bridging member into the high current unit, a spring-biased follower member associated with the low current unit for confining the arc drawn in the low current unit, and the high current unit being vented and having a plurality of plate portions against which the arc in the high current unit is forced.

11. A circuit interrupter including a pair of substantially enclosed spaced interrupting units, a tubular conducting bridging member for electrically interconnecting the units in series in the closed-circuit position of the interrupter, and the tubular member being vented intermediate the units to the large space surrounding the units so that pressure relief from the two units may take place in venting to said large space.

12. A circuit interrupter including a pair of substantially enclosed spaced interrupting units, a tubular conducting bridging member for electrically interconnecting the units in series in the closed-circuit position of the interrupter, an operating rod connected intermediate the ends of the tubular conducting bridging member for actuating the same to the open and closed-circuit positions, the tubular member being vented intermediate the units to the ample space around the units so that pressure relief from the two units may take place in venting to said ample space, and means preventing pressure relief taking place interiorly of the operating rod.

13. A circuit interrupter of the liquid-break type including an arc-extinguishing unit submerged in liquid, means for establishing an arc within the unit including a tubular movable contact movable out of the unit during the opening operation and through which liquid may pass, a cavitation-preventing piston associated with the unit, means biasing the piston into the unit, and means responsive to the closing movement of the movable contact for charging the piston.

14. A circuit interrupter of the liquid-break type including a tank, a pair of arc-extinguishing units disposed within the tank, one being a substantially confined pressure-generating unit and the other being a vented interrupting unit, means including a movable tubular cross-bar for electrically interconnecting the two units and providing fluid flow therebetween, and a cavitation-preventing piston associated with one unit, means biasing the piston into said unit, and means re-

sponsive to the closing movement of the movable cross-bar for charging the piston.

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