Jan. 26, 1954 R. C. VAN SICKLE ET AL 2,667,556

CIRCUIT INTERRUPTER

Filed June 14, 1950 4 Sheets-Sheet 1

Fig.1.

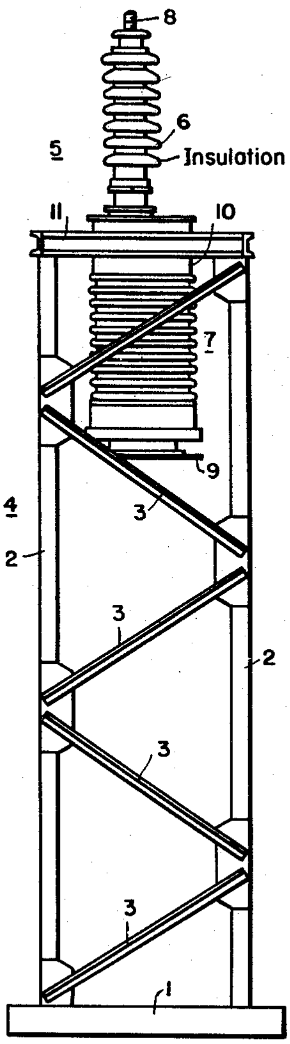

Fig.3.

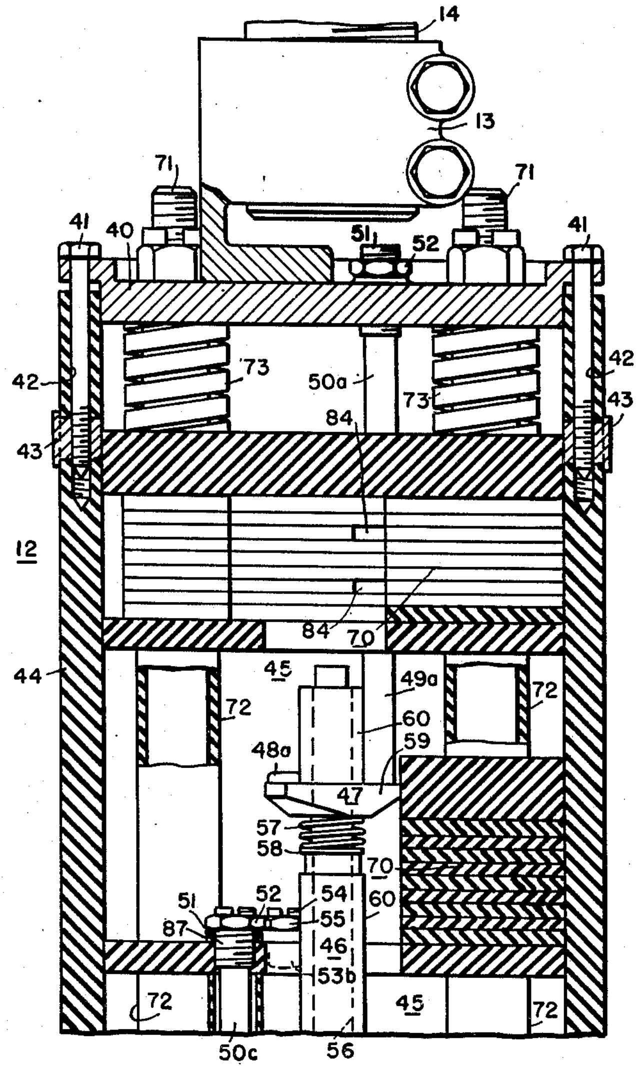

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Fig.2.

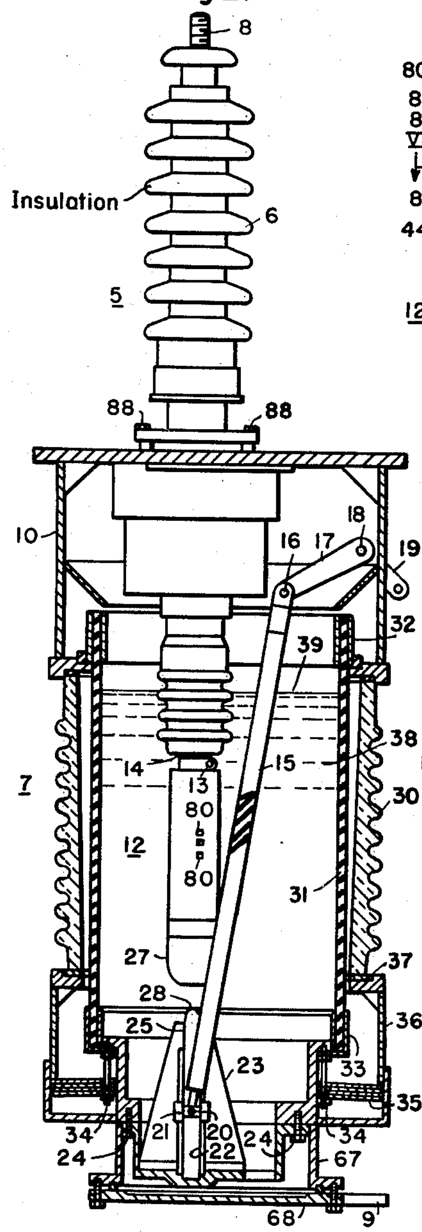
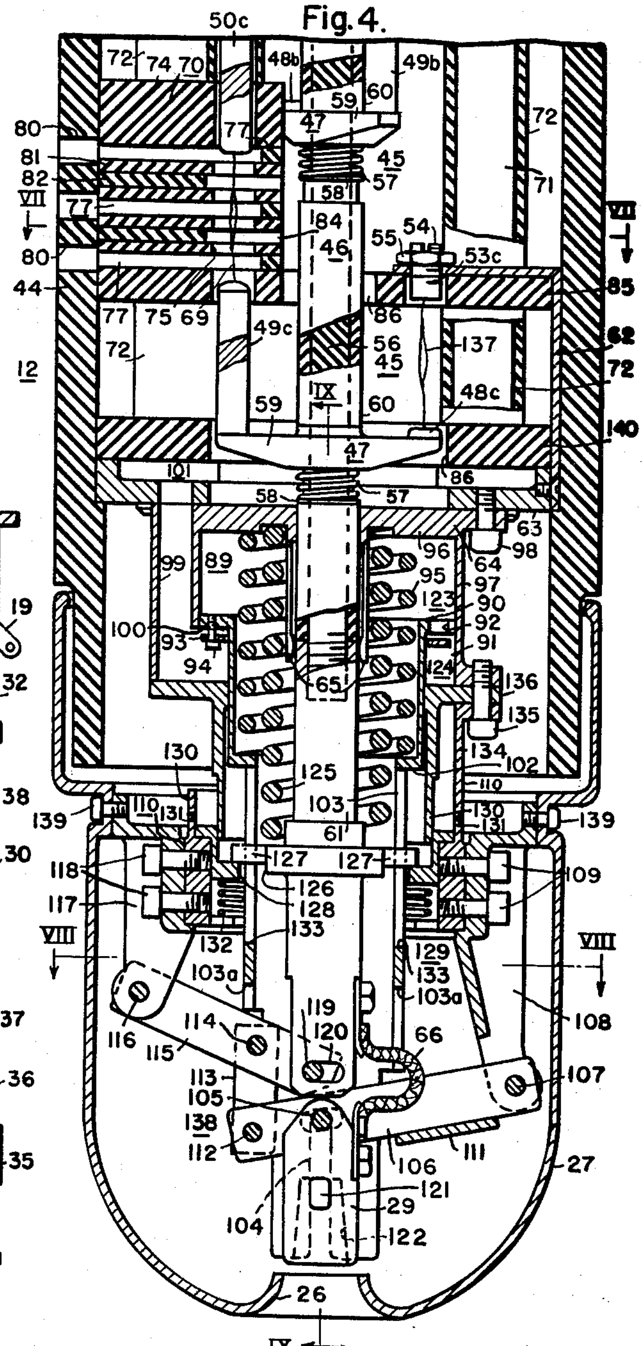


Fig.4.



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CIRCUIT INTERRUPTER

Filed June 14, 1950 4 Sheets-Sheet 3

Fig.5.

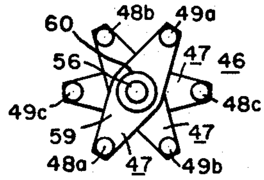


Fig.6.

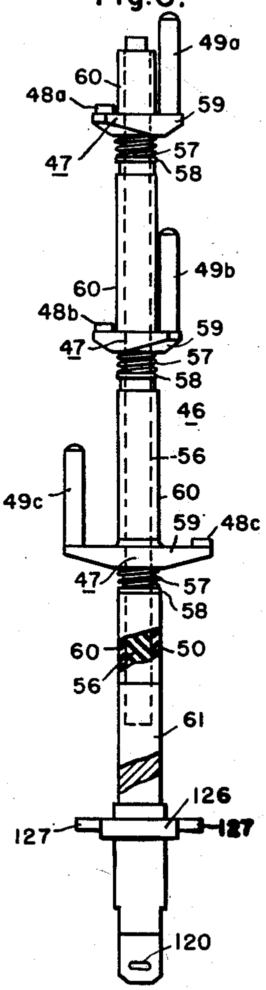


Fig.7.

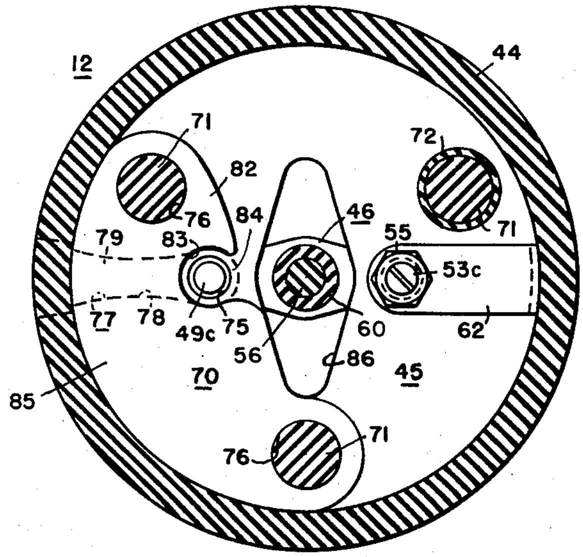
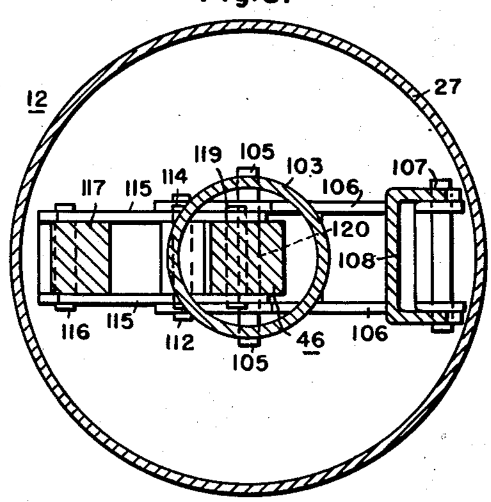


Fig.8.



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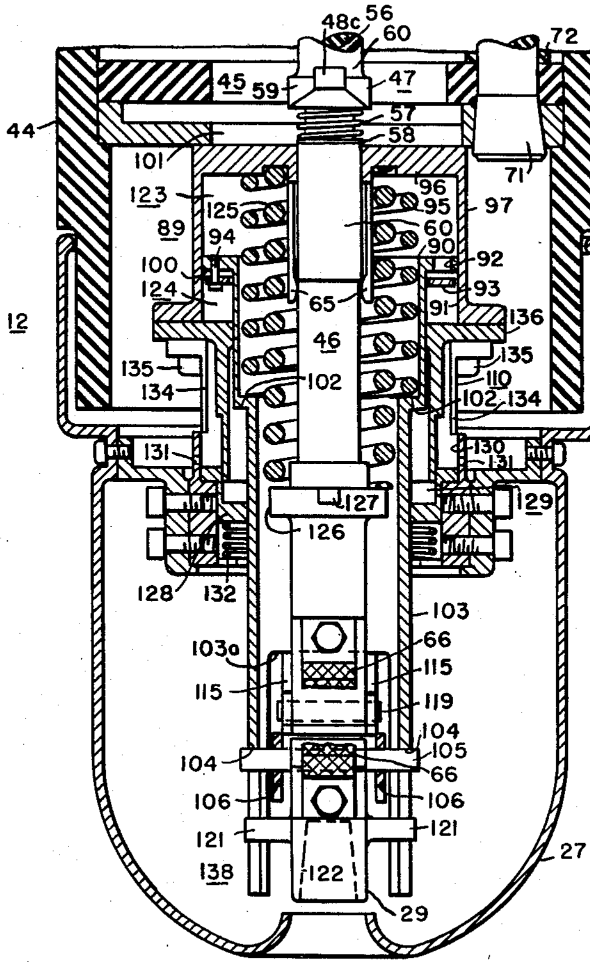
CIRCUIT INTERRUPTER

Filed June 14, 1950 4 Sheets-Sheet 4

Fig. 9.



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Patented Jan. 26, 1954

2,667,556

UNITED STATES PATENT OFFICE

2,667,556

CIRCUIT INTERRUPTER

Roswell C. Van Sickle, Wilkinsburg, Pa., and James M. Cumming, deceased, late of Monroeville, Pa., by Helen J. Cumming, executrix, Monroeville, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application June 14, 1950, Serial No. 167,988

11 Claims. (Cl. 200—150)

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

A general object of our invention is to provide an improved circuit interrupter which will more rapidly and effectively interrupt the circuit therethrough than has heretofore been attained.

Another object is to provide an improved arc-extinguishing structure for a liquid-break type of circuit interrupter in which the contact structure is more easily adjusted, and in which maintenance and servicing are more readily brought about.

A more specific object is to provide an improved movable contact assembly for a circuit interrupter of the type specified in the immediately preceding paragraph.

Still another object is to provide an improved circuit interrupter in which the movable contact assembly is such that improved operation is obtained, and the movable contact assembly may be completely removed from the interrupter for inspection purposes more easily than has heretofore been obtained.

Still a further object is to provide an improved liquid-driving piston pump for a circuit interrupter of the foregoing type for aiding in the extinction of low currents.

Another object is to provide an improved casing construction for a circuit interrupter in which the casing may be removed while permitting the skeleton supporting framework to remain in place so that the interior of the interrupter may be easily viewed, and contact adjustment and inspection may more readily be brought about.

A further object is to provide an improved actuating mechanism for a circuit interrupter of the foregoing type in which the speed of movement of the movable contact assembly may be considerably more than that of the liquid-driving piston pump used for aiding in low-current interruption, and in which during high-current interruption the pumping piston may remain stationary due to the high pressure generated and yet the movable contact assembly may readily and rapidly move to its fully open circuit position.

A further object is to provide an improved circuit interrupter having an improved movable contact assembly in which the movable contacts are disposed angularly about the axis of the movable contact assembly so that the interrupting chambers for the interrupting contacts may have exhaust ports out of the casing in different directions to prevent external voltage breakdown.

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

Figure 1 is a side elevational view of a circuit interrupter embodying our invention;

Fig. 2 is an enlarged elevational view, partially in vertical section, of the improved circuit interrupter of our invention, the contact structure being shown in the fully open position with the circuit disconnected;

Fig. 3 is an enlarged fragmentary view, taken in vertical section, of the upper end of the improved arc-extinguishing assemblage of our invention, the contact structure being shown in the fully open-circuit position;

Fig. 4 is a view similar to Fig. 3, but showing the lower end of the improved arc-extinguishing assemblage, the contact structure being, of course, similarly shown in the open-circuit position;

Fig. 5 is a plan view of our improved movable contact assemblage;

Fig. 6 is a side elevational view of our improved movable contact assemblage;

Fig. 7 is a sectional view taken along the line VII—VII of Fig. 4;

Fig. 8 is a sectional view taken along the line VIII—VIII of Fig. 4, looking in the direction of the arrows; and

Fig. 9 is a vertical sectional view taken along the line IX—IX of Fig. 4, looking in the direction of the arrows.

Referring to the drawings, and more particularly to Fig. 1 thereof, the reference numeral **1** designates a suitable base upon which is supported upstanding angle members **2**, braced by diagonally extending angle iron supports **3**. The up-standing support, generally designated by the reference character **4**, supports at its upper end a circuit interrupter **5** comprising a high-voltage bushing **6**, preferably of the condenser type, extending into casing means **7**. A line terminal **8** is disposed at the upper end of the bushing **6**, and a second line terminal **9** is disposed at the lower end of the casing means **7**.

Referring to Fig. 2, which more clearly shows the internal construction of the circuit interrupter **5**, it will be noted that the interrupter **5** is supported by the support **4**, intermediate the ends thereof, at a metallic housing support **10**, the latter being secured, as by bolts, not shown, to the upper angle support **11** of the support **4**.

As illustrated, the terminal bushing 6 extends within the casing means 7 and has depending from the lower end thereof an arc-extinguishing means, or assemblage, generally designated by the reference character 12. The assemblage 12 is clamped, as at 13, to the terminal stud 14 extending internally through the bushing 6. An insulating operating rod 15 is movable substantially longitudinally externally of the assemblage 12, being pivoted at its upper end, as at 16, to a crank arm 17, the latter being fixedly secured to a shaft 18. The shaft 18 extends externally of the housing support 10, and may be actuated by a crank arm 19 connected to any suitable mechanism.

The lower end of the operating rod 15 is pivotally connected, as at 20, to a contact-actuating member 21. The actuating member 21 slides vertically in a slotted raceway 22 formed in an upstanding support bracket 23, the latter being supported by bolts 24 to the lower end of the casing means 7, as shown.

The contact-actuating member 21 has connected thereto a lower movable disconnect contact 25, which is shown in the fully open disconnect position in Fig. 2. During the closing operation, the crank arm 19 is rotated clockwise around the shaft 18 to move the operating rod 15 upwardly to thereby cause upward closing movement of the contact-actuating member 21 and the movable disconnect contact 25. The upward motion of the movable disconnect contact 25 into the opening 26 (Fig. 4) of the lower shield 27 of the assemblage 12 causes engagement between the upper tip portion 28 of the movable disconnect contact 25 and a relatively stationary disconnect contact member 29, shown more clearly in Figs. 4 and 9.

Certain features of the supporting framework 4 and mounting features for the interrupter 5, together with the operating arrangement therefor are set forth and claimed in the United States Patent 2,479,381, issued August 16, 1949, to Leon R. Ludwig and Benjamin P. Baker and assigned to the assignee of the present invention.

The casing means 7 includes a cylindrically-shaped porcelain member 30, under compression, which surrounds an internally disposed insulating cylinder 31 under tension. The cylinder 31 is clamped at its upper and lower ends to ring-shaped support members 32, 33. The upper ring-shaped support member 32 is secured by suitable means, not shown, to the grounded metallic housing support 10. The lower end ring-shaped support member 33 is bolted, as at 34, to a plurality of steel spring rings 35, which support at the outer periphery thereof a cylindrical member 36, the upper end of which supports through a suitable gasket 37, the lower end of the porcelain casing 30. Thus, the porcelain casing 30 is, as mentioned, under compression, and the insulating cylindrical member 31 is under tension. A suitable arc-extinguishing liquid, such as circuit breaker oil 38, fills the casing 7 to the level 39.

Referring more particularly to Figs. 3, 4, 7, 8 and 9, which more clearly show the internal construction of the arc-extinguishing assemblage 12, it will be noted that the upper clamp 13 is suitably secured by means not shown to an upper support plate 40 (Fig. 3). A plurality of bolts 41, positioned around the periphery of the plate 40, extends through apertures 42 provided at the upper end of an insulating tubular casing 44. Circular members 43 with transverse tapped holes therein serve as nuts for the bolts 41, thereby holding the casing 44 rigidly in place. Casing 44 extends along the entire length of the extinguishing assemblage 12, and forms a plurality of interconnected pressure chambers 45.

Movable internally within the arc-extinguishing assemblage 12, and axially thereof, is a movable contact assemblage, generally designated by the reference character 46. The contact assemblage 46 resiliently carries therewith a plurality, in this instance three, bridging contact assemblages, generally designated by the reference numeral 47, and each comprising a movable pressure-generating contact 48*a*, 48*b*, or 48*c* and a movable interrupting contact 49*a*, 49*b*, or 49*c*.

The movable interrupting contacts 49*a*, 49*b* and 49*c* make abutting contacting engagement with stationary interrupting contacts 50*a*, 50*b* and 50*c*. The stationary contacts 50*a*, 50*b* and 50*c* are adjustably secured in place having their upper ends threaded, as at 51. A locking nut 52 is tightened after the adjustment has been made.

The movable pressure-generating contacts 48*a*, 48*b* and 48*c* engage in abutting engagement, a plurality of stationary pressure-generating contacts 53*a*, 53*b* and 53*c*, which are also adjustable, having their upper ends 54 threaded, and clamping nuts 55 being tightened after the adjustment is once made.

It will be observed that the actuating rod 56 (Fig. 6) for the movable contact assemblage 46 is composed of insulating material, and has the bridging contact assemblages 47 resiliently supported thereon by compression springs 57. The compression springs 57 have their lower seats upon flanges 58 secured to and movable with the actuating rod 56. The upper ends of the compression springs 57 seat upon the bridging portions 59 of the bridging contact assemblages 47. The upward motion of the bridging portions 59 is limited by enlarged portions or sleeves 60 surrounding the actuating rod 56. The lower end 61 of the movable contact assemblage 46 is formed of conducting material, the purpose for which will appear hereinafter.

In the closed circuit position of the interrupter, the electrical circuit therethrough includes line terminal 8, terminal stud 14, conducting clamp 13, support plate 40, upper stationary interrupting contact 50*a* (Fig. 3), upper movable interrupting contact 49*a*, bridging portion 59, movable pressure-generating contacts 48*a*, upper stationary pressure-generating contact (not shown), suitable contact strap means (not shown) to middle stationary interrupting contact (not shown). The circuit then extends through middle movable interrupting contact 49*b*, through the conducting bridge 59 to the middle movable pressure-generating contact 48*b*, through middle stationary pressure-generating contact 53*b* (Fig. 3), through conducting strap 87 to the lower stationary interrupting contact 50*c*, to lower movable interrupting contact 49*c*, through lower conducting bridge 59 to lower movable pressure-generating contact 48*c*. The circuit then extends through lower stationary pressure-generating contact 53*c* and through a conducting strap 62 to lower conducting plate 63.

The circuit then extends through a casting member 64, through conducting spring fingers 65 to the conducting portion 61 of the movable contact assemblage 46. The circuit then extends through a flexible conducting strap connection 66 to the relatively stationary disconnect contact member 29. The circuit then proceeds through the movable disconnect contact 25, through the contact actuating member 21, through the support bracket 23 and through the casting 67 to lower plate 68, to the lower line terminal 9 of the interrupter.

To facilitate the interruption of the interrupting arcs 69, which are drawn during the opening operation, we provide suitable interrupting arc-extinguishing units, generally designated by the reference character 70. Each arc-extinguishing unit 70 is formed out of a plurality of suitably configured insulating plates held in contiguous relationship by three insulating tie rods 71 and insulating spacer sleeves 72. Surrounding the three insulating tie rods 71 at the upper ends thereof are three compression springs 73, which serve to maintain the several insulating plates under desired compressive force so that they will maintain their contiguous relationship.

The arc-extinguishing units 70 will now be described. Referring particularly to Figs. 4 and 7, which more clearly illustrate the lower interrupting arc-extinguishing unit 70, it will be noted that the upper plate of the unit 70 is designated by the reference character 74. This plate 74 has a single aperture 75 formed therein to accommodate the lower stationary interrupting contact 50c, as shown in Fig. 4. The plate 74 also has two apertures 76 formed therein (Fig. 7) to accommodate the insulating tie rods 71. Immediately below the insulating plate 70 is an insulating vent plate 77, having a configuration more clearly shown by the dotted lines in Fig. 7. The vent plate 77 has a cut-out portion 78 removed therefrom to form a vent passage 79 which leads out of the casing 44 through suitable openings 80 formed therein.

Immediately below the vent plate 77 is an insulating orifice plate designated by the reference character 81. The orifice plate 81 is similar in configuration to the insulating plate 74 previously described, except that it is less thick than the plate 74.

Immediately below the insulating orifice plate 81 is an insulating inlet plate 82 which has a configuration more clearly shown in Fig. 7. It will be observed that the insulating inlet plate 82 has the apertures 76 (as do all the other plates) as well as a cutout portion 83 (Fig. 7) which forms an inlet passage 84.

Immediately below the inlet plate 82 is a second orifice plate 81. Then follows a second vent plate 77, orifice plate 81, inlet plate 82, orifice plate 81, and a lower vent plate 77. Below the vent plate 77 is an insulating plate 85 which extends across the casing 44 and has a diamond-shaped opening 86 formed therein, the purpose for which will appear more clearly hereinafter.

The particular multi-flow interrupting structure 70 is more fully described, and the theoretical reasons for its performance are more fully set out in United States Patent 2,467,760, issued April 19, 1949, to Leon R. Ludwig, Benjamin P. Baker and Winthrop M. Leeds and assigned to the assignee of the instant application.

To assist in the interruption of low amperage currents, we provide suitable piston means, generally designated by the reference character 89, and including a piston 90, movable within a piston chamber 91. The piston 90 has a plurality of apertures 92 provided therein. A ring-shaped valve plate 93 controls the passage of liquid, in this instance oil, through the apertures 92, the valve ring 93 being supported by bolts 94 to the piston 90, as shown more clearly in Figs. 4 and 9.

The piston 90 is biased downwardly in a working direction by a compression spring 95, which seats at its upper end against the upper wall 96 of a suitably configured casting member 97. The casting member 97 is secured by bolts 98 to the metallic plate 63 of the assemblage 12.

It will be observed that the casting member 97 has one or more liquid conduits 99 formed in the side walls thereof (Fig. 4) which connect hydraulically the lower working face 100 of the piston 90 through a passage 101 to the lowermost pressure chamber 45 of the assemblage 12. As previously dsecribed, the three pressure chambers 45 are all interconnected so that there is a free passage of oil from the piston chamber 91 through conduits 99, passages 101, to all of the pressure chambers 45 throughout the assemblage 12.

The compression spring 95 seats at its lower end upon a shoulder 102 formed on a downwardly extending cylindrical extension 103 of the piston member 90, as shown more clearly in Figs. 4 and 9. Thus, the piston member 90 is biased downwardly in a fluid driving direction by the compression spring 95.

Referring to Fig. 9, it will be observed that the lower cylindrical extension 103 of the piston 90 has a pair of slots 104 formed therein at the lower end thereof through which extends a pin 105. The pin 105 extends through the relatively stationary disconnecting contact 29 and also through a pair of levers 106, pivotally connected at their right-hand ends to a stationary pivot 107. The stationary pivot 107 is mounted on a stationary support bracket 108 bolted, as at 109, to a casting member 110. Preferably a plate 111 is welded to the lower sides of the two levers 106 to give them additional rigidity.

A pin 112 extends through the left-hand ends of the levers 106 and also extends through the lower ends of a pair of links 113. The upper ends of the links 113 have a pin 114 extending therethrough, the pin 114 also extending through a pair of levers 115, which have their left-hand ends secured by a pivotal connection at 116 to the lower end of a support bracket 117. The bracket 117 is secured by bolts 118 to the casting member 110.

A pin 119 extends through the right-hand levers 115 and rides in a slot 120 disposed in the lower end of the actuating rod 56 as shown more clearly in Fig. 6.

Integrally formed with the relatively stationary disconnect member 29 are a pair of pins 121 which ride in the slots 104 of cylindrical extension 103 for the purpose of guiding the relatively stationary disconnect member 29. It will be noted that the relatively stationary disconnect member 29 has an open tapered recess 122 formed therein to accommodate the upper tip portion 28 of the movable disconnect contact rod 25. The depending cylinder 103 may have additional slots 103a therein to accommodate movement of the leverage mechanism.

The charging motion of the piston 90 will now be described. Upward closing motion of the movable disconnect contact rod 25 causes the tip 28 thereof to enter the recess 122 of relatively stationary disconnect contact member 29 to cause upward closing motion of the same. Since the pin 105 is secured by a press fit to the contact carrier 29, it moves upwardly together with the contact carrier 29 and movable disconnect contact 25 to thereby rotate the levers

106 in a clockwise direction about the stationary pivot 107.

The clockwise rotation of the levers 106 about the stationary pivot 107 causes corresponding upward motion of the links 113 and hence counterclockwise closing motion of the levers 115 about their stationary pivot 116. This causes upward motion of the pin 119 and hence upward motion of the actuating rod 56 and hence the movable contact assemblage 46. Also, since the pin 105 moves up, by its engagement with the upper ends of the slots 104 of the cylindrical extension 103 of the piston member 90, it causes upward closing charging movement of the piston member 90 in opposition to the biasing action exerted by the compression spring 95. Because of the leverage in the mechanism 138 upward travel of rod 56 occurs at a greater rate of speed than upward travel of relatively stationary disconnect contact member 29 and piston 90. Piston 90, of course travels with relatively stationary disconnect contact 29. During this closing charging movement of the piston 90, the valve ring 93 remains open to permit liquid to flow out of the region 123, through the apertures 92 and into the region 124 within the piston chamber 91.

It will be observed that we have provided a second compression spring 125 biasing the actuating rod 56 downwardly. The upper end of the compression spring 125 seats against the upper wall 96, and the lower end of the compression spring 125 seats against a flange 126 integrally formed with the conducting part 61 of the actuating rod 56. During the upward closing motion of the actuating rod 56, as previously described, the compression spring 125 is compressed as well as the compression spring 95 which biases the piston 90 downwardly.

To halt the downward opening motion of the actuating rod 56, we have provided a pair of bosses 127 integrally formed with the flange 126 which strike a piston 128 of a dashpot means, generally designated by the reference character 129. The dashpot means 129 includes a dashpot piston 128 which moves within a dashpot piston chamber 130 having a plurality of apertures 131 provided therein. Also a return compression spring 132 is provided to move the dashpot piston 128 upwardly above the apertures 131 during the closing operation.

It will be observed that the cylindrical extension 103 has a pair of slots 133 formed therein to accommodate motion of the bosses 127 without their interfering in any manner with motion of the cylindrical extension 103 and hence the piston member 90.

It will be observed that the casting member 110 not only provides the dashpot piston chamber 130, but also has one or more upstanding wall portions 134 (Figs. 4 and 9) which permit the upper end thereof to be bolted by bolts 135 to a cylindrical casting member 136 and also to the lower end of the casting member 97, as shown more clearly in Fig. 4.

The operation of our improved interrupter will now be described. In the closed circuit position of the interrupter the electrical circuit extends therethrough in the manner previously described, and the disconnect member 25 maintains the contact carrier 29 upwardly in its closed position, not shown, maintaining thereby the actuating rod 56 and the piston member 90 in their upward closed position. Contact is made between all the movable contacts and all the stationary contacts with the compression springs 57 providing the desired contact pressure.

To effect an opening operation of the interrupter suitable mechanism, not disclosed, but responsive to either manual operation or to the existence of overload conditions existing in the circuit controlled by the interrupter is operative to cause counterclockwise opening rotative motion of the crank arm 19. This causes downward opening motion of the operating rod 15 and hence movable disconnect contact rod 25. The downward motion of the movable disconnect contact rod 25 permits the contact carrier 29 to be forced downwardly by the linkage previously described in response to downward biasing action of the accelerating compression spring 125. The downward motion of the actuating rod 56 and hence the contact assemblage 46 opens the several pairs of pressure-generating and interrupting contacts simultaneously to establish hereby simultaneously three pressure-generating arcs 137 and three interrupting arcs 69.

Although Fig. 4 indicates a fully open circuit position of the interrupter 5, nevertheless for purposes of clarity we have drawn in the pressure and interrupting arcs 69, 137. The interrupting arcs 69 are all drawn within the three interrupting arc-extinguishing units 70. The three pressure-generating arcs 137 are drawn within the interconnected pressure chambers 45. Consequently, the three pressure-generating arcs 137 react upon the oil, which completely fills the casing 44 to form pressure within the pressure chambers 45. As a result, oil under pressure is forced from the three pressure chambers 45 through the several inlet passages 84 associated with the three interrupting units 70. The oil entering the inlet passages 84 strikes the interrupting arcs 69, flows longitudinally through the orifices 75 and out of the assemblage 12 through the several vent passages 79 and openings 80. Interruption of the interrupting arcs 69 soon occurs and the circuit is consequently interrupted.

If the pressure generated within the pressure chambers 45 is low because of the low amperage current being interrupted, the piston 90 will move down as a result of compression spring 95, closing the valve ring 93 over the apertures 92 and force oil from the region 124 through the conduits 99 through passage means 101 and into the interconnected pressure chambers 45, whence the oil can flow through the interrupting units 70 in the manner previously described. However, if the pressure generated within the pressure chambers 45 is high, as a result of high pressure being established at the pressure-generating arcs 137 in response to high current interruption, then the high pressure thus generated may stall the piston 90 preventing it from moving downwardly. It will only move downwardly following a subsidence of the pressure within the pressure chambers 45 following circuit interruption, and in so doing will send a flushing flow of liquid through the pressure chambers 45 and through the three interrupting units 70 to wash carbonized oil out of the units 70 through the exhaust passages 79.

It is to be noted, however, that whether the piston 90 moves downwardly or not, dependent upon the pressure conditions within the pressure chambers 45, nevertheless, the contact assemblage 46 will always move downwardly unhindered by any motion whatsoever of the piston member 90. This follows because of the provision of the slots 104 in the cylindrical extension 103 which permits the pin 105 to slide downwardly in the slots 104 with the contact carrier 29. Thus the pin 105 can move downwardly within the slots 104 separating from the closed ends of the slots 104 and leaving the piston 90 in its upward position due to the existence of high pressure within the pressure chambers 45. Consequently, downward opening motion of the movable contact assemblage 46, of contact carrier 29 and movable disconnect contact 25 takes place without regard to any motion whatsoever of the piston means 89. By the time that the bosses 127, secured to and movable with the movable contact assemblage 46, have struck the dashpot means 129 and have been halted thereby, following circuit interruption, at this time, the tip portion 28 separates from the contact carrier 29 thereby inserting an isolating gap into the circuit, as more clearly shown in Fig. 2.

An important feature of our invention is the fact that the lower electrostatic shield 27 may be removed without disturbing any of the linkage actuating means 138. Thus by removing the bolts 139, the shield 27 may be moved downwardly so that the left-hand side thereof, as viewed in Fig. 4, will clear the bracket 117 and levers 115, after which time the shield 27 may be moved slightly to the right, as viewed in Fig. 4, so that the right-hand side thereof will clear the bracket 108 and levers 106. When the shield 27 is once removed, inspection may be easily had of the linkage actuating means 138.

After the shield 27 has been removed, it is possible, with our improved construction, for the cylindrical casing 44 to be slid downwardly so that it may be completely removed from the assemblage 12 and inspection readily had of the several movable pressure-generating and interrupting contacts 48a, 48b, 48c, 49a, 49b and 49c as well as of the stationary contacts 53a, 53b and 53c. In other words, by removing the bolts 41, the casing 44 may be moved freely downwardly leaving the skeleton framework for the interrupters 70 and the actuating mechanism 46, 138 in place thereby enabling one to view the interior of the assemblage 12. By so doing, the stationary contacts 53, 50 may be adjusted and operation of the assemblage 46 may be viewed if desired.

This skeleton framework comprises the tie-rods 71, sleeves 72, plate 40, extinguishing plate structures 70 together with lower support plate 63, to which is bolted the actuating mechanism 138.

Naturally such visual inspection is facilitated if the assemblage 12 is used in a dead tank type of oil breaker, in which case two such assemblages 12 would be secured to the lower ends of the two terminal bushings extending into the tank. Usually a covered manhole is provided in the side of the tank so that a man may crawl into the tank and make such a visual inspection without removing either the terminal bushing or the assemblage.

We have described the use of the assemblage 12, however, in an oil-poor type of breaker construction, and in such case it is necessary to either drop the casing means 7 from the housing support 10, or else unscrew the bolts 88 and lift the entire bushing 6 with its attached assemblage 12 by means of a crane. In the latter case, the bushing 6 with its attached assemblage 12 may be placed in a suitable fixture placed nearby and such visual inspection made.

A further feature of our invention is the fact that the linkage actuating means 138 may be removed by removing the bolts 135. When this is done, the bolts 98 may be loosened, pin 119 having previously been removed as well as shunt connection 66, so that the movable contact assemblage 46 may be removed downward completely out of the assemblage 12 through the diamond-shaped openings 86 provided in the several insulating plates 63, 140, 85, etc. This removal of the contact assemblage 46 may be obtained by slightly rotating the assemblage 46 after each set of contacts has been removed through the lowermost opening 86 of the plates 63, 140. By so doing, inspection may readily be had of the entire movable contact assemblage 46 without disturbing the framework which still remains clamped to the bushing 6 and including the arc-extinguishing units 70.

It will be noted that in this instance we have provided three sets of bridging contact assemblages 47 spaced 120° from each other. Obviously, a greater number of contact assemblages 47 or a lesser number could be utilized. Preferably, however, if two or more are used, they are angularly disposed with relation to each other so that they are equally spaced about the axis of the assembly 46.

The foregoing consrtuction shows how we have provided extreme flexibility in the maintenance of the assemblage 12 and have aided the operator in making adjustments. The stationary contacts 53, 50 may also be removed without completely disassembling the assemblage 12. In most conventional interrupters this operation is not possible.

It will furthermore be observed that we have provided a piston means for providing the necessary liquid flow during low-current interruption, and which functions during high-current interruption to provide a flushing flow of liquid out of the units 70. Such piston means assures a minimum pressure available for arc extinction even when the pressure generated at the pressure-generating arcs is negligible.

It is furthermore to be observed that, if desired, the assemblage 12, instead of being placed in an oil-poor structure, as shown in Figs. 1 and 2, might well be positioned instead in a conventional tank type interrupter having the usual cross-bar and intermediately disposed lift rod. Merely for the purpose of illustration have we disclosed the assemblage 12 as appended to the lower end of a high voltage terminal bushing extending within an oil-poor enclosure.

Although we have shown and described a specific structure, it is to be clearly understood that the same was 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.

We claim as our invention:

1. A circuit interrupter including an arc extinguishing assemblage, means supporting the arc extinguishing assemblage adjacent one end thereof, a skeleton frame-work extending along the assemblage, relatively stationary contact structure stationarily supported by said skeleton framework, one or more pressure chambers disposed within the arc extinguishing assemblage, and a removable casing forming a portion of the wall of said one or more pressure chambers and removable from the assemblage from the opposite end thereof without disturbing the relatively stationary contact structure, the removal of the casing from the arc extinguishing assemblage per-

mitting ready inspection to be had of the contact structure and also contact operation.

2. A circuit interrupter of the liquid break type, a movable disconnect contact member, a relatively stationary disconnect contact carrier, a movable contact assemblage, one or more movable contacts carried by the contact assemblage, movable piston means, the movable disconnect contact member striking the relatively stationary disconnect contact carrier during the closing operation of the interrupter, means interconnecting the piston means with the relatively stationary disconnect contact carrier, and means interconnecting the movable contact assemblage with the relatively stationary disconnect contact carrier so that an accelerated closing motion of the assemblage relative to the disconnect contact carrier results.

3. A circuit interrupter of the liquid break type including an arc extinguishing assemblage, means supporting the arc extinguishing assemblage adjacent one end thereof, a skeleton framework extending along the assemblage, the assemblage including a plurality of arc extinguishing units disposed in spaced relation, one or more pressure chambers disposed within the arc extinguishing assemblage, contact structure supported by said skeleton framework, and a removable casing forming a portion of the wall of said one or more pressure chambers and removable from the assemblage from the opposite end thereof without disturbing the arc extinguishing units so that contact operation may be visually observed.

4. A circuit interrupter of the liquid break type, a movable disconnect contact member, a relatively stationary disconnect contact carrier, a movable contact assemblage, one or more movable contacts carried by the contact assemblage, movable piston means, the movable disconnect contact member striking the relatively stationary disconnect contact carrier during the closing operation of the interrupter, lever means pivoted adjacent one end thereof to a substantially stationary pivot, the contact carrier being pivoted to an intermediate point of the said lever means, second lever means pivoted adjacent one end thereof to a substantially stationary pivot, the movable contact assemblage being pivoted adjacent the other end of the said second lever means, means interconnecting the other end of the first said lever means to an intermediate point of the said second lever means, and means carried by the movable contact carrier for charging the piston means.

5. A circuit interrupter of the liquid break type, a movable disconnect contact member, a relatively stationary disconnect contact carrier, a movable contact assemblage, one or more movable contacts carried by the contact assemblage, movable piston means, the movable disconnect contact member striking the relatively stationary disconnect contact carrier during the closing operation of the interrupter, lever means pivoted adjacent one end thereof to a substantially stationary pivot, the contact carrier being pivoted to an intermediate point of the said lever means, second lever means pivoted adjacent one end thereof to a substantially stationary pivot, the movable contact assemblage being pivoted adjacent the other end of the said second lever means, means interconnecting the other end of the first said lever means to an intermediate point of the said second lever means, means carried by the movable contact carrier for charging the piston means, and means permitting the piston means to remain stationary during the opening operation of the interrupter due to high gas pressure, when the contact carrier and contact assemblage move to the open circuit position.

6. A circuit interrupter including a casing, a movable contact assemblage movable within the casing, the movable contact assemblage having an actuating rod and a plurality of bridging contact assemblages movable therewith, each bridging contact assemblage including a bridging portion, each bridging portion including a movable pressure-generating contact at one end thereof and a movable interrupting contact disposed at the other end thereof, a relatively stationary arc-extinguishing unit for each movable interrupting contact to extinguish the arc drawn thereat, each arc-extinguishing unit being disposed off-center within the casing, and each bridging portion being angularly displaced about the actuating rod with respect to the adjacent bridging portion to clear the adjacent arc extinguishing unit.

7. A circuit interrupter including a movable disconnect contact member, a relatively stationary disconnect contact carrier, a movable contact assemblage, one or more movable contacts carried by the contact assemblage, the movable disconnect contact member striking the relatively stationary disconnect contact carrier during the closing operation of the interrupter, lever means pivoted adjacent one end thereof to a substantially stationary pivot, the contact carrier being pivoted to an intermediate point of the said lever means, second lever means pivoted adjacent one end thereof to a substantially stationary pivot, the movable contact assemblage being pivoted adjacent the other end of the said second lever means, and means interconnecting the other end of the first said lever means to an intermediate point of the said second lever means to effect the actuating thereof.

8. A circuit interrupter including a casing, a movable contact assemblage movable within the casing, the movable contact assemblage having an actuating rod and a plurality of bridging contact assemblages movable therewith, each bridging contact assemblage including a bridging portion, each bridging portion including a movable pressure-generating contact at one end thereof and a movable interrupting contact disposed at the other end thereof, a relatively stationary arc-extinguishing unit for each movable interrupting contact to extinguish the arc drawn thereat, each arc-extinguishing unit being disposed off-center within the casing, the movable interrupting contact being of greater axial length than the movable pressure-generating contact of each bridging contact assemblage so as to enter the arc extinguishing unit associated therewith, and each bridging portion being angularly displaced about the actuating rod with respect to the adjacent bridging portion to clear the adjacent arc extinguishing unit.

9. A circuit interrupter including a movable contact assemblage, the movable contact assemblage including an actuating rod and a plurality of centrally located bridging contact assemblages movable therewith and disposed along the axis thereof in spaced relation, each bridging contact assemblage including a bridging portion and a pair of movable contacts disposed adjacent the opposite ends of the bridging portion, one of the two movable contacts of each pair being of greater axial length than the other movable con-

tact, and each movable contact of greater axial length being angularly displaced about the actuating rod with respect to each adjacent movable contact of greater axial length.

10. A circuit interrupter including a movable contact assemblage, the movable contact assemblage including an actuating rod and a plurality of centrally located bridging contact assemblages movable therewith and disposed along the axis thereof in spaced relation, each bridging contact assemblage including a bridging portion and a pair of movable contacts disposed adjacent the opposite ends of the bridging portion, and the bridging portion of one bridging contact assemblage being angularly displaced about the actuating rod with respect to the bridging portion of the immediately adjacent bridging contact assemblage.

11. A circuit interrupter including a movable contact assemblage, the movable contact assemblage including an actuating rod and a plurality of bridging contact assemblages movable therewith, each bridging contact assemblage including a bridging portion and a pair of movable contacts disposed adjacent the opposite ends of the bridging portion, one of the two movable contacts of each pair being of greater axial length than the other movable contact, a pair of relatively

stationary contacts cooperable with each pair of movable contacts to establish a pair of serially related arcs, the arcs along the assemblage being established in staggered positions, and the bridging portion of one bridging contact assemblage being angularly displaced about the actuating rod with respect to the bridging portion of the immediately adjacent bridging contact assemblage.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
708,006	Ball	Sept. 2, 1902
1,350,924	Eaton	Aug. 24, 1920
2,138,382	Leeds et al.	Nov. 29, 1938
2,164,175	Frank	June 27, 1939
2,228,432	Baker et al.	Jan. 14, 1941
2,460,450	Cumming	Feb. 1, 1949
2,463,029	Fry	Mar. 1, 1949
2,477,781	Baker et al.	Aug. 2, 1949
2,518,195	Skeats	Aug. 8, 1950
2,522,994	Coggeshall	Sept. 19, 1950
2,539,175	Balentine	Jan. 23, 1951