Jan. 13, 1948. D. J. MARSDEN 2,434,422

CIRCUIT INTERRUPTER

Filed Oct. 22, 1946 2 Sheets-Sheet 1

Fig. 1.

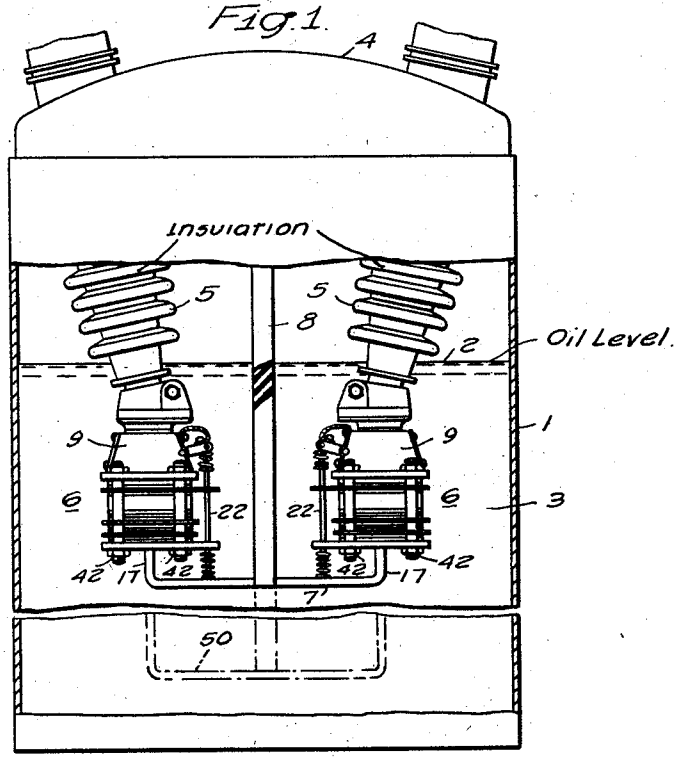


Fig. 5.

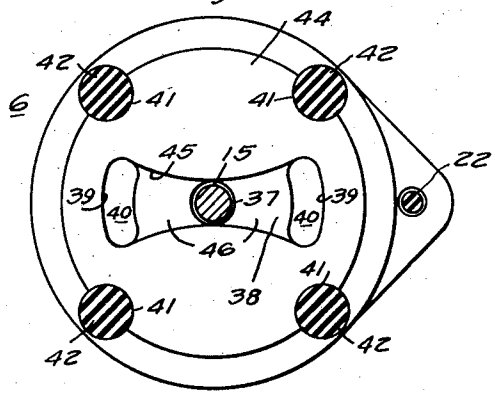
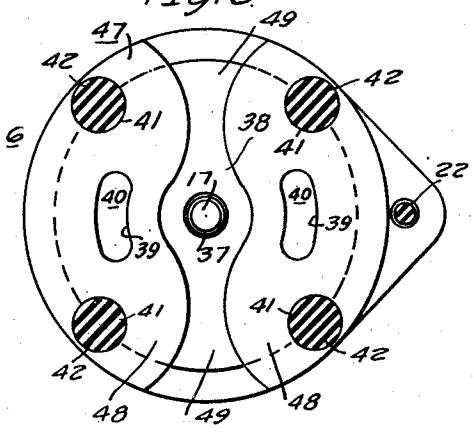


Fig. 6.



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Fig. 2.

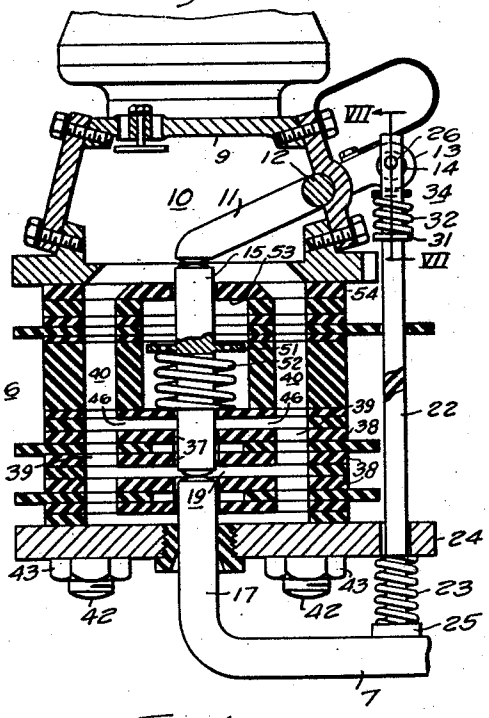


Fig. 3.

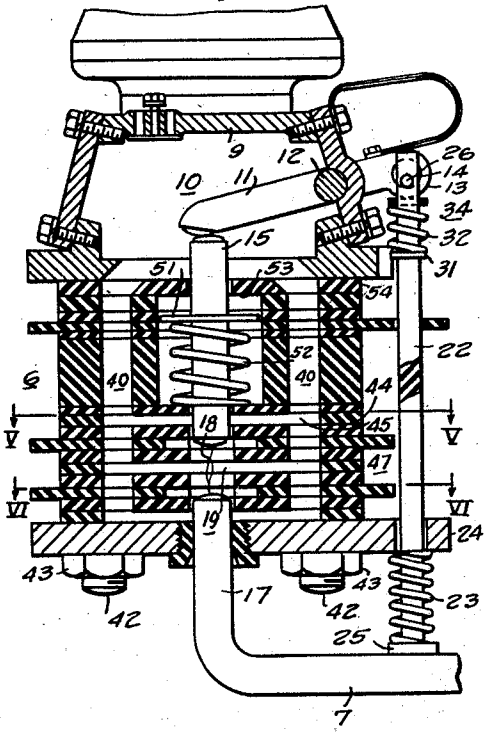


Fig. 4.

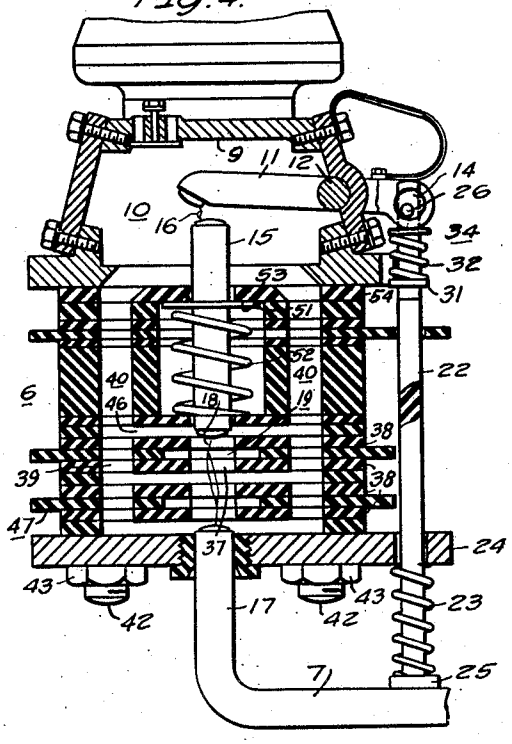
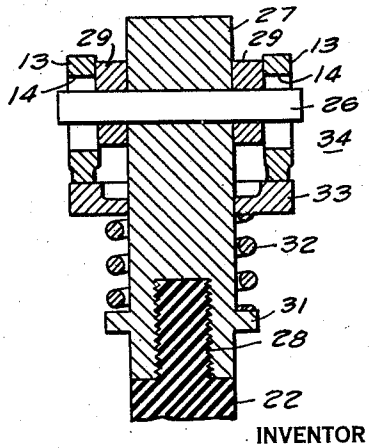


Fig. 7.



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CIRCUIT INTERRUPTER

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Application October 22, 1946, Serial No. 704,884

5 Claims. (Cl. 200—150)

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

Circuit interrupters of the prior art of the type establishing pressure and interrupting arcs have suffered from the disadvantage of opening both sets of contacts to establish the arcs before a sufficient interrupting gap exists for interruption of the interrupting arc to occur. In other words, before interruption of the interrupting arc is possible from fluid flow directed from the pressure arc or from other means establishing fluid pressure, a certain minimum length of interrupting gap distance must be obtained.

Gas generation before this time is reached is detrimental to breaker operation inasmuch as the fluid within the breaker is unnecessarily contaminated. The main object of my invention, therefore, is to provide an improved circuit interrupter of the foregoing type in which separation of the pressure contacts is delayed for a predetermined time to thereby draw an interrupting arc of predetermined length. When this predetermined interrupting gap is obtained I then by improved means very rapidly cause the initial separation of the pressure contacts to establish very quickly the pressure-generating arc. The considerable pressure thus rapidly created directs the flow of fluid under pressure toward the interrupting arc (of predetermined interrupting length at this time) to quickly effect the latter's extinction.

A more specific object is to provide an improved contact construction of the type in which a pair of movable contacts separate in substantially opposite directions away from a relatively stationary intermediate contact and in which means are employed for biasing the intermediate contact in the direction of one of the outer contacts so that arcing between the latter contacts will be delayed until a predetermined time.

Still another object is to provide an improved circuit interrupter of the type establishing a pressure-generating arc and an interrupting arc in which a pivotally mounted pressure-generating contact construction is employed with a relatively stationary intermediate contact. Preferably, a lower movable contact separates from the intermediate contact to draw a second serially related arc, and operating rod means are employed between the pivotally mounted pressure-generating contact and the lower movable contact to interconnect the motions thereof.

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 a side elevational view, partially in section, of a circuit interrupter embodying my invention and shown in the closed circuit position;

Fig. 2 is an enlarged vertical sectional view through the left-hand arc-extinguishing unit of Fig. 1, the contacts being shown in the closed circuit position;

Fig. 3 is a view similar to Fig. 2 but showing the position of the contacts during the initial portion of the opening operation in which only the interrupting contacts have separated and the pressure-generating contacts are still in engagement;

Fig. 4 is a view similar to Fig. 2 but showing the position of the several contacts during a later stage of the opening operation;

Fig. 5 is a sectional view taken along the line V—V of Fig. 3;

Fig. 6 is a sectional view taken along the line VI—VI of Fig. 3; and

Fig. 7 is an enlarged vertical fragmentary sectional view taken along the line VII—VII of Fig. 2.

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Referring to the drawings, and more particularly to Fig. 1 thereof, the reference numeral 1 designates a tank filled to the level 2 with a suitable arc-extinguishing fluid 3, in this instance circuit breaker oil. Depending from the cover 4 of the tank 1 are two insulating terminal bushings 5 supporting at their lower ends identical arc-extinguishing units 6.

The arc-extinguishing units 6 are electrically interconnected in the closed circuit position of the interrupter, as shown in Fig. 1, by a conducting cross-bar 7 reciprocally operated in a vertical direction by an insulating lift rod 8. Suitable mechanism, not shown, is employed to cause actuation of the lift rod 8.

Referring to Fig. 2, which shows more clearly than does Fig. 1 the internal construction of the arc-extinguishing units 6, it will be observed that I have provided a top casting 9 forming a pressure-generating chamber, generally designated by the reference numeral 10. A pivotally mounted third movable contact 11 is employed, being pivotally mounted at 12 to a fixed pivot formed by a portion of the casting or housing 9. Integrally formed with the third movable contact 11 and extending externally of the casting 9 are a pair of actuating arms 13 (Fig. 7) having apertures 14 extending therethrough.

The third movable contact 11 is cooperable with a relatively stationary first or intermediate contact 15 to establish a pressure-generating arc 16 within the pressure-generating chamber 10, as more clearly shown in Fig. 4. Also cooperable with the relatively stationary first contact 15 is a relatively movable second contact 17 constituting one extremity of the cross-bar 7 and establishing an interrupting arc 18 (Figs. 3 and 4) within an interrupting chamber, generally designated by the reference numeral 19 and formed by the use of a plurality of superimposed insulating plates.

An insulating operating rod 22 interconnects

the motion of the second contact 17 with the pivotally mounted third movable contact 11. More specifically, the operating rod 22 extends longitudinally externally of the unit 6 and is biased downwardly in the circuit opening direction by a compression spring 23. The compression spring 23 has its upper seat against the bottom metallic plate 24 of the unit 6. The lower end of the compression spring 23 seats upon a flange 25 fixedly secured to the lower end of the operating rod 22. An actuating pin 26 is secured by a press fit to a metallic extension 27 threadedly secured at 28 to the upper end of the rod 22 as more clearly shown in Fig. 7.

It will be observed that the pin 26 extends through the apertures 14 provided in the two externally extending actuating arms 13, washers 29 being interposed between the extension 27 and the arms 13, as more clearly shown in Fig. 7. The extension 27 has integrally formed therewith a flange portion 31 which serves as a lower seat for a compression spring 32. The upper end of the compression spring 32 seats against a washer 33 freely slidable upon the extension 27 and biased by the compression spring 32 into abutting engagement with the lower sides of the actuating arms 13. Fig. 7 clearly shows this construction. Thus, I have provided a lost motion connection, generally designated by the reference numeral 34 interposed between the operating rod 22 and the pivotally mounted third movable contact 11.

The plate structure forming the interrupting chamber 19 is more fully set forth in U. S. patent application, Serial No. 465,244, filed November 11, 1942, by Leon R. Ludwig, Winthrop M. Leeds and Benjamin P. Baker, now United States Patent 2,406,469, issued August 27, 1946, and assigned to the assignee of the instant application.

Referring more specifically to Figs. 2, 5 and 6, it will be apparent that the lower movable second contact 17 moves through orifices 37 provided by orifice insulating plates 38. The orifice insulating plates 38 also have cutout portions 39 provided therein which upon alignment form vertical flow passages, generally designated by the reference numeral 40 and interconnecting the pressure-generating chamber 10 with the interrupting chamber 19. The orifice insulating plates 38 also have apertures 41 provided therein to accommodate insulating tie rods 42, which in conjunction with nuts 43 serve to hold the several insulating plates fixedly in position. Adjacent to the orifice insulating plates 38 are insulating inlet plates 44 having a configuration more clearly shown in Fig. 5. The inlet plates 44 have apertures 41 therein to accommodate the tie rods 42. The inlet plates 44 also have a cutout portion provided therein, generally designated by the reference numeral 45 and providing a pair of opposed inlet passages 46. Thus, the inlet passages 46 lead from the vertical flow passages 40 to the interrupting arc 18 drawn within the interrupting chamber 19.

The fluid, in this instance oil, is vented out of the unit 6 through vent plates, generally designated by the reference numeral 47, and having a configuration more clearly shown in Fig. 6. The vent plates 47 are composite and are formed by two insulating halves 48. Each insulating half 48 has a cutout portion 39 provided therein and also apertures 41 to accommodate the tie rods 42. The two insulating halves 48 are spaced apart, as shown in Fig. 6, to form two opposed vent passages designated by the reference numeral 49 in Fig. 6.

From the foregoing description it will be apparent that oil under pressure from the pressure-generating arc 16 flows downwardly from the pressure-generating chamber 10 through the vertical flow passages 40 and radially inwardly toward the interrupting arc 18 through the plurality of pairs of inlet passages 46 provided by the insulating inlet plates 44. The oil passes vertically through the orifices 37 provided by the orifice insulating plates 38 and passes laterally out of the unit 6 through the opposed vent passages 49. Extinction of the interrupting arc 18 soon follows, and the movable second contact 17 moves downwardly out of the unit 6 to place an isolating gap in the circuit, as more clearly shown by the dotted lines 50 of Fig. 1.

It will be noted that the relatively stationary first contact 15 has an apertured flange portion 51 integrally formed therewith, which is biased upwardly by a compression spring 52 toward a stop 53 formed by a stop plate 54. The apertures are provided to avoid any piston action of the flange 51.

The construction is such that during the closing operation, the lower movable second contact 17 moves upwardly to enter the extinguishing unit 6. The cross-bar 7 strikes the insulating rod 22 to force the pivotally mounted pressure-generating third contact 11 to move toward the intermediate contact 15. The third movable contact 11 strikes the intermediate or relatively stationary first contact 15 to force it downwardly, as shown in Fig. 3, against the upward biasing action exerted by the compression spring 52. Since the compression spring 32 is stronger than the compression spring 52, the pin 26 will be positioned at the bottom of the apertures 14 during this portion of the closing operation before the contact 17 strikes the intermediate contact 15 as shown in Fig. 3. The continued upward movement of the contact 17 and operating rod 22 forces the intermediate contact 15 downwardly, as shown in Fig. 2, until the contact 17 strikes the lower end of the intermediate contact 15 at which time the intermediate contact 15 reverses its movement and moves upwardly while the pin 26 moves upwardly in the apertures 14 to bring about contact pressure between the several contacts. The fully closed circuit position of the interrupter is shown in Fig. 2.

During the opening operation, suitable mechanism, not shown, is employed to cause downward opening motion of the lift rod 8. The downward motion of the lift rod 8 causes corresponding downward motion of the cross-bar 7 and contacts 17. The first thing that happens within the unit 6 during the opening operation is the downward travel of the pin 26 within the apertures 14. This removes the contact pressure completely when the pin 26 strikes the bottom of the apertures 14 provided in the actuating arms 13. Then occurs separation between the contacts 17, 15 to establish an interrupting arc 18 within the interrupting chamber 19 of the extinguisher 6, as shown in Fig. 3. The compression spring 23 causes continued downward motion of the operating rod 22 to thereby rotate the pivotally mounted pressure-generating contact 11 about its pivot 12 in a clockwise direction to thereby permit upward travel of the intermediate contact 15, as caused by the biasing action exerted by the compression spring 52 until the stop 53 is contacted by the flange 51 secured to and movable with the intermediate contact 15 as more clearly shown in Fig. 4.

When this occurs, the continued clockwise rotative travel of the pressure contact 11 draws a pressure-generating arc 16 within the pressure-generating chamber 10, as shown in Fig. 4. Fluid flow occurs in the manner previously described and rapid interruption of the interrupting arc 18 soon follows. Continued downward opening travel of the lower movable second contact 17 causes separation to occur between the cross-bar 7 and the operating rod 22. The fully open circuit position of the interrupter is indicated by the dotted lines 50 of Fig. 1 where it will be observed two isolating gaps in the circuit are provided.

A distinct advantage of my invention is that the pressure arc 16 is established after the establishment of the interrupting arc 18. Thus, during a closing operation, all arcing occurs in the interrupting gap. No gas is formed in the pressure chamber 10 during a closing operation. During an interruption less gas is formed in the pressure chamber 10 due to decreased arcing time which has proved helpful in high speed reclosing operations.

During heavy current interruptions pressure generated by the pressure-generating arc 16 forces the intermediate contact 15 downwardly, thus increasing the length of the pressure-generating arc 16 with the resultant increased deionizing action in the interrupting gap through the oil movement. Delayed action during the interruption operation occurs inasmuch as the pressure arc 16 is not formed until the interrupting arc 18 is being increased in length at the maximum rate of speed, This is very desirable in the prevention of restrikes during charging current interruption.

From the foregoing description, it will be apparent that I have provided an improved circuit interrupter of the type establishing a pressure-generating arc and an interrupting arc in which biasing means are employed in conjunction with the intermediate contact 15 to bias the same toward the pressure-generating contact 11 so that the interrupting arc 18 is established before the drawing of the pressure arc 16.

Although I 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.

I claim as my invention:

1. In a circuit interrupter, an arc-extinguishing unit, means defining a pressure-generating chamber within the unit, means defining an interrupting chamber within the unit, a relatively stationary first contact, a relatively movable second contact separable from the first contact in one direction to establish an interrupting arc within the interrupting chamber, a relatively movable third contact separable from the first contact substantially in the opposite direction to establish a pressure-generating arc within the pressure-generating chamber, means biasing the first relatively stationary contact to move in the direction of opening motion of the third movable contact, and means causing the third movable contact to engage the first contact during the closing operation before the engagement thereof by the second contact to effect motion of the first contact against the biasing action exerted by the biasing means.

2. In a circuit interrupter, an arc-extinguishing unit, means defining a pressure-generating chamber within the unit, means defining an interrupting chamber within the unit, a relatively stationary first contact, a relatively movable second contact separable from the first contact in one direction to establish an interrupting arc within the interrupting chamber, a relatively movable third contact separable from the first contact substantially in the opposite direction to establish a pressure-generating arc within the pressure-generating chamber, means pivotally mounting the third movable contact, means including an operating rod for actuating the pivotally mounted third contact, means biasing the first relatively stationary contact to move in the direction of opening motion of the third pivotally mounted movable contact, and a portion of the second contact striking the operating rod during the closing stroke to cause thereby closing rotation of the pivotally mounted third contact to engage the first contact before the engagement thereof by the second contact.

3. In a circuit interrupter, an arc-extinguishing unit, means defining a pressure-generating chamber within the unit, means defining an interrupting chamber within the unit, a relatively stationary first contact, a relatively movable second contact separable from the first contact in one direction to establish an interrupting arc within the interrupting chamber, a relatively movable third contact separable from the first contact substantially in the opposite direction to establish a pressure-generating arc within the pressure-generating chamber, means pivotally mounting the third movable contact, means including an operating rod for actuating the pivotally mounted third contact, means biasing the first relatively stationary contact to move in the direction of opening motion of the third pivotally mounted movable contact, a portion of the second contact striking the operating rod during the closing stroke to cause thereby closing rotation of the pivotally mounted third contact to engage the first contact before the engagement thereof by the second contact, and a lost motion connection interposed between the operating rod and the pivotally mounted third contact.

4. In a circuit interrupter, contact means including a relatively stationary first contact and a relatively movable second contact for establishing an interrupting arc, second contact means including the said relatively stationary first contact and a relatively movable third contact for establishing a pressure-generating arc, fluid flow passage means interconnecting the two arcs whereby fluid under pressure from the pressure-generating arc may flow toward and into engagement with the interrupting arc to facilitate the latter's extinction, means biasing the relatively stationary contact in the direction of opening motion of the third movable contact, and operating means operable so as to cause following motion of the stationary contact with the third movable contact while maintaining contacting engagement with the latter in response to the action of the biasing means after separation has occurred between the first and second contacts.

5. In a circuit interrupter, contact means including a relatively stationary first contact and a relatively movable second contact for establishing an interrupting arc, second contact means including the said relatively stationary first contact and a relatively movable third contact for establishing a pressure-generating arc, fluid flow passage means interconnecting the two arcs whereby

fluid under pressure from the pressure-generating arc may flow toward and into engagement with the interrupting arc to facilitate the latter's extinction, means biasing the relatively stationary contact in the direction of opening motion of the third movable contact, operating means operable so as to cause following motion of the stationary contact with the third movable contact while maintaining contacting engagement with the latter in response to the action of the biasing means after separation has occurred between the first and second contacts, and stopping means for stopping the following engaging motion of the relatively stationary contact after a predetermined time so as to very rapidly draw the pressure-generating arc between the first and third contacts.

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