May 18, 1943 H. A. TRIPLETT 2,319,276

CIRCUIT INTERRUPTING APPARATUS

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Fig. 1.

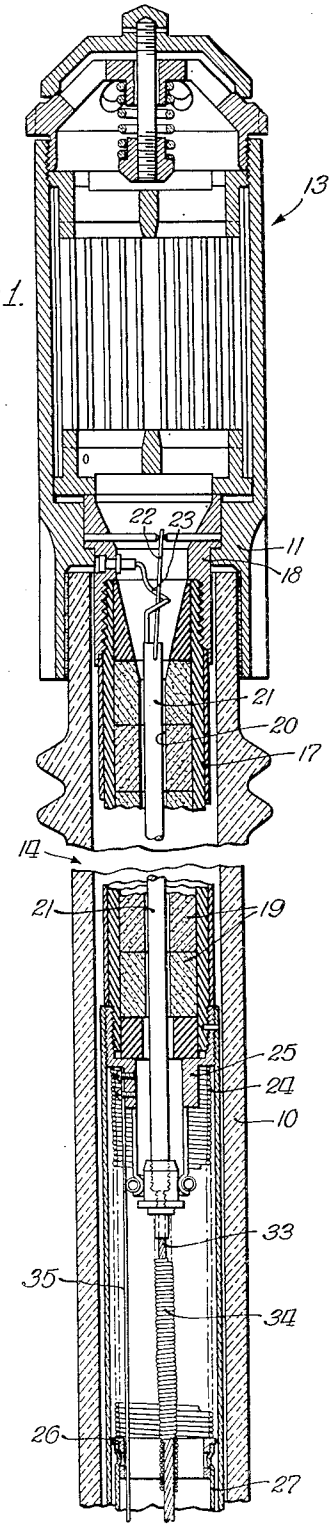
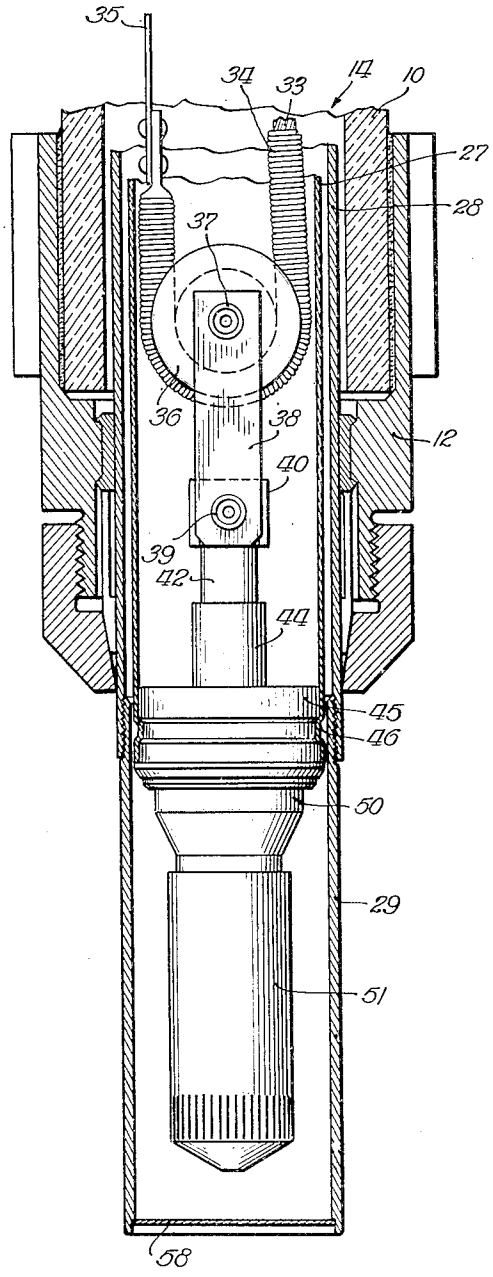


Fig. 2.



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Fig. 3.

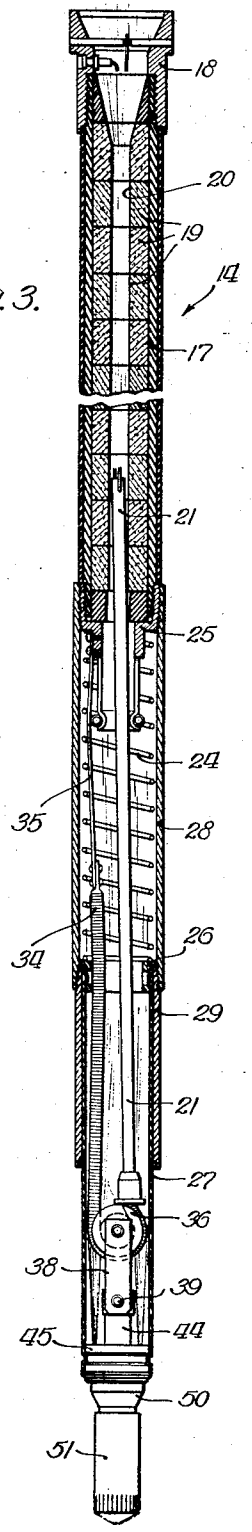
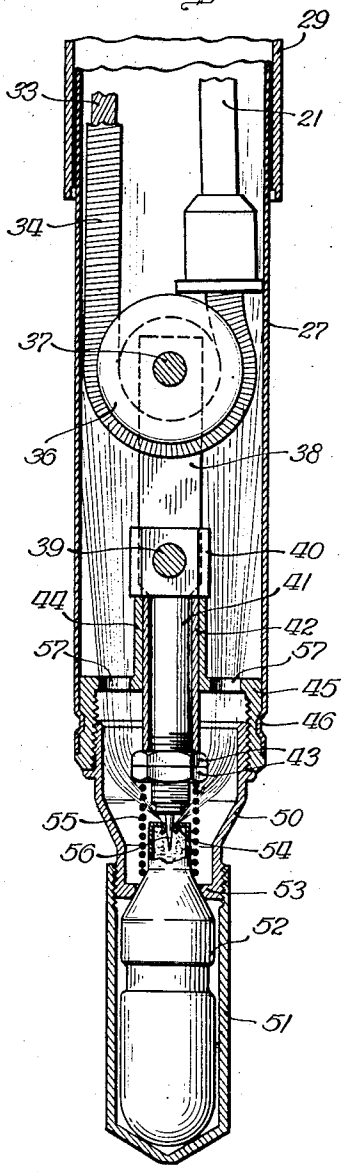


Fig. 4.



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UNITED STATES PATENT OFFICE

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CIRCUIT INTERRUPTING APPARATUS

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Application April 27, 1942, Serial No. 440,628

9 Claims. (Cl. 200—120)

My invention relates generally to circuit interrupting apparatus and it has particular relation to such apparatus in which means are especially provided for interrupting relatively low current arcs. The present invention relates to and constitutes an improvement over the circuit interrupting apparatus disclosed in my copending application, Serial No. 372,217, filed December 30, 1940.

One of the objects of my invention is to provide for releasing an arc extinguishing fluid into the space occupied by an arc between relatively movable apart terminal members when one of the terminal members reaches a predetermined position.

Another object of my invention is to provide a limited degree of relative movement between a reservoir containing the material which when released discharges an arc extinguishing fluid into an arc space and the rod-like terminal such that the arc extinguishing fluid is released when the relative movement takes place.

A still further object of my invention is to provide for holding the material which is discharged in the form of a fluid into the arc space in a replaceable capsule so arranged as to be readily renewable.

It is also an object of my invention to provide for discharging the arc extinguishing fluid into a bore in arc extinguishing material for assisting in extinguishing the arc and scavenging the walls of the bore by blowing out products of the arc deposited thereon which are likely to facilitate restriking of the arc.

Other objects of my invention will, in part, be obvious and in part appear hereinafter.

For a more complete understanding of the nature and scope of my invention reference can be had to the following detailed description taken in connection with the accompanying drawings in which;

Figure 1 is a longitudinal sectional view of the upper end portion of a high voltage solid material fuse construction which can be employed in practicing the present invention;

Figure 2 is a longitudinal sectional view, at an enlarged scale, of the lower end portion of the fuse construction shown in Figure 1, illustrating how the present invention can be incorporated therein;

Figure 3 is a longitudinal sectional view of the replaceable cartridge for the construction shown in Figures 1 and 2, the cartridge being shown in the blown condition with the arc extinguishing fluid being discharged into the arc space; and

Figure 4 is a view, at an enlarged scale, of the lower end portion of the cartridge shown in Figure 3, the relative positions of the parts being those occupied at the instant that the arc extinguishing fluid is released from the replaceable capsule.

Reference will first be had to the fuse construction shown in Figures 1 and 2 of the drawings. The fuse construction there shown is generally similar to the fuse construction shown in my copending application, Serial No. 365,232, filed November 12, 1940. It comprises a suitable insulating housing **10**, such as glass or porcelain, having external terminals **11** and **12** at its ends. It will be understood that the terminals **11** and **12** are arranged to be mounted in suitable terminal contact clips which, in turn, are connected to line conductors in a conventional manner. Integrally formed with the upper terminal **11** is a condenser housing, shown generally at **13**, which houses a condenser assembly for cooling and condensing the products incident to the formation of the arc that is drawn on operation of the device. Since the construction of the condenser is set forth in detail in my copending application, Serial No. 365,232, referred to, and forms no part of the present invention, it will not be further described herein.

The insulating housing **10** is arranged to receive and the terminals **11** and **12** are arranged to be interconnected by a replaceable cartridge assembly shown generally at **14** and illustrated in more detail in Figure 3 of the drawings. It will be observed that the cartridge **14** comprises a housing **17** of insulating material having a terminal member **18** at its upper end for connection to the terminal **11** at the upper end of the insulating housing **10**. Within the insulating housing **17** there is provided a liner of solid arc extinguishing material formed by a number of rings **19** of insulating material such as magnesium borate or boric acid. The rings **19** are stacked one above the other to provide a bore **20**. The material employed for forming the bore **20** is preferably such as will evolve a relatively large amount of arc extinguishing material when subjected to the heat of an arc.

A rod-like terminal member **21** is mounted for longitudinal movement in the bore **20**. It is restrained from such movement by means of a strain wire **22**, Figure 1, which is shunted by a fusible element **23**, preferably a silver wire, which directly interconnects the upper end of the rod-like terminal member **21** and the terminal member **18**. It will be understood that when the

fusible element 23 and the strain wire 22 blow, due to excess flow of current therethrough, an arc will be formed between the terminal members 18 and 21 which it is desired to extinguish as rapidly as possible. This arc is drawn into the bore 20 as the rod-like terminal member 21 is retracted therein. If this arc is formed as the result of relatively heavy current flow so that the bore 20 is substantially filled, relatively little difficulty is encountered in extinguishing it since it is of sufficient size to cause the evolution of a relatively large quantity of arc extinguishing medium from the walls forming the bore in the solid arc extinguishing material 19. However, when the arc formed in the bore 20 has a relatively small amount of current flowing through it, proportionately less heat is generated and it is often the case that an insufficient amount of arc extinguishing material is evolved to quickly extinguish the arc and deionize the arc space. Such a small current arc may not be extinguished until the rod-like terminal member 21 is retracted substantially the entire distance through which it normally moves. Even then, under certain power factor and voltage conditions, the arc may still persist. As a result some damage may be caused by the continued existence of the small current arc. It is to the provision of means for extinguishing particularly small current arcs in a circuit interrupter otherwise well adapted to extinguish heavier current arcs that the present invention is directed in part.

It will be observed that the rod-like terminal 21 is arranged to be retracted by a coil compression spring 24 which reacts between a contact member 25 and a collar 26 carried by and secured to the upper end of a metallic sleeve 27. The metallic sleeve 27 is slidably mounted within a conducting sleeve 28 which serves to interconnect the contact member 25 and the lower terminal 12, Figure 2, on the insulating housing 10. An extension 29 depends from the conducting sleeve 28 for a purpose which will be presently apparent.

The rod-like terminal member 21 is connected by means of a flexible conductor 33, Figure 1, having a protective covering of non-magnetic wire 34, to a strap 35 which, as shown, is connected to the contact member 25. The flexible conductor 33 is looped over a pulley 36 which is mounted to move with the metallic sleeve 27 as urged by the coil compression spring 24. With this construction the terminal member 21 moves at twice the speed that the metallic sleeve 27 moves and the arc formed between the terminal members 18 and 21 is correspondingly extended.

As shown in Figures 2 and 4, the pulley 36 is rotatably mounted on a pin 37 which extends through a pair of links 38 that are secured by a pin 39 to the head 40 of a bolt 41. A metallic sleeve 42 surrounds the shank of the bolt 41 and provides a strut against which lock nuts 43 are tightened to provide a unitary construction. It will be observed that the sleeve 42 which is movable with the bolt 41 is slidably mounted in a cylindrical extension 44 of a collar 45 that is secured, as indicated at 46, by having a lower portion of the metallic sleeve 27 deformed into a suitable peripheral groove therein. A connecting member 50 is threaded into the collar 45 and onto it is threaded a cap 51 which serves to hold a reservoir or capsule 52 in place against an inwardly projecting flange 53 of the connecting member 50. The reservoir or capsule 52 contains a material, such as carbon dioxide, which when released constitutes an arc extinguishing fluid that is capable of assisting in extinguishing the arc formed in the bore 20 and deionizing the space occupied by the arc. The reservoir or capsule 52 can be purchased under the trade name "Sparklet" although other similar reservoirs or capsules can be employed if desired. The upper end of the reservoir or capsule 52 is sealed by a diaphragm 54.

As previously indicated, the bolt 41 and accompanying sleeve 42 are slidably mounted in the extension 44 of the collar 45. There is then a certain amount of lost motion between the bolt 41 and the reservoir or capsule 52. A coil compression spring 55 is provided for maintaining the bolt 41 and the reservoir or capsule 52 in spaced relation prior to operation of the device. At the lower end of the bolt 41 there is provided a needle 56 which is arranged to puncture or rupture the diaphragm 54 so as to permit the escape of the arc extinguishing fluid from the reservoir or capsule 52 through suitable apertures 57, Figure 4, in the collar 45. As shown in Figure 3 of the drawings, this arc extinguishing fluid is discharged into the bore 20. The fluid is discharged into the bore 20 under sufficient pressure and in sufficient quantity so as to sweep out the low current arc which may persist therein after the rod-like terminal member 21 has substantially completed its downward movement. The continued discharge of the fluid also acts after interruption of any magnitude of fault current to scavenge the walls of the bore 20 so as to blow out any remaining products of the arc which might form a conducting path between the terminals 18 and 21 which might facilitate restriking. This restoration of the dielectric strength of the walls of the bore is important, particularly in high voltage installations as will be readily appreciated by those skilled in the art.

When the rod-like terminal member 21 is released upon blowing of the fusible element 23 and strain wire 22, the coil compression spring 24 expands and moves the metallic sleeve 27 downwardly. The reservoir or capsule 52 in the cap 51 also moves downwardly. After the cap 51 is moved downwardly a slight distance through the extension 29, as shown in Figure 2, a diaphragm 58 is ruptured and the cap 51 continues to move downwardly through the open lower end of the extension 29 to the position shown in Figure 3 of the drawings. This then provides an indication that the fuse has operated and should be replaced with an unblown cartridge.

The reservoir or capsule 52 continues to move downwardly together with the rod-like terminal member 21 although the latter moves at a speed which is twice that of the former. This movement continues until the collar 26 engages the upper end of the extension 29 whereupon further downward movement of the sleeve 29 and reservoir or capsule 52 is prevented. However, the rod-like terminal member 21 continues to move downwardly because of its inertia and, since the bolt 41 is slidably mounted in the extension 44 a somewhat further downward movement is permitted when the lower end of the rod-like terminal member 21 strikes the pulley 36. The coil compression spring 55 is then compressed and the needle 56, which is normally located above the diaphragm 54, is moved downwardly so as to puncture it as shown in Figure 4, thereby releasing the arc extinguishing fluid in the reservoir or capsule 52 as previously described.

The cartridge 14 can be readily restored to its initial condition by replacing the strain element 22 and the fusible element 23 and by replacing the blown reservoir or capsule 52 with an unblown one. In the event that the bore 20 in the solid arc extinguishing material 19 has been injured or damaged because of the circuit interruption, then it may be necessary to replace some or all of the rings of this arc extinguishing material.

Since it is obvious that other embodiments of my invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawings and described hereinbefore shall be construed as illustrative and not in a limiting sense.

I claim as my invention:

1. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a reservoir for holding material which when released is in the form of an arc extinguishing fluid, and means for releasing said fluid into said bore and the arc space when said rod-like terminal member reaches a specific position for assisting in extinguishng an arc that may exist between said terminal members and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

2. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a reservoir for holding material which when released is in the form of an arc extinguished fluid, and means controlled in accordance with the movement of said rod-like terminal member for releasing said fluid into said bore and into the space ocupied by an arc between said terminal members for assisting in extinguishing the same and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

3. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a reservoir for holding material which then released is in the form of an arc extinguishing fluid, releasable means retaining said material in said reservoir, and means for releasing said releasable means when said rod-like terminal member is in a specified position whereby said arc extinguishing fluid flows into said bore and into the space occupied by the arc for asisting in extinguishing the same and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

4. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a reservoir for holding material which when released is in the form of an arc extinguishing fluid, said reservoir being movable together with said rod-like terminal member, releasable means retaining said material in said reservoir, and means for releasing said releasable means when said rod-like terminal member reaches a predetermined position whereby said arc extinguishing fluid flows into said bore and into the space occupied by the arc for assisting in extinguishing the same and scavenging the surface of said bore.

5. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a reservoir for holding material which when released is in the form of an arc extinguishing fluid, said reservoir being movable together with said rod-like terminal member, means providing relative movement between said reservoir and said rod-like terminal member, releasable means retaining said material in said reservoir, and means for releasing said releasable means in response to said relative movement between said reservoir and said rod-like terminal member whereby said arc extinguishing fluid flows into said bore and into the space occupied by the arc for assisting in extinguishing the same and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

6. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a reservoir for holding material which when released is in the form of an arc extinguishing fluid, a diaphragm sealing said reservoir, and means controlled in accordance with the movement of said rod-like terminal member for rupturing said diaphragm to release said fluid into said bore and into the space occupied by an arc between said terminal members for assisting in extinguishing the same and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

7. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a replaceable capsule containing material which when released is in the form of an arc extinguishing fluid, said replaceable capsule being movable together with said rod-like terminal member, a diaphragm sealing said capsule, and means for rupturing said diaphragm as a result of movement of said rod-like terminal member to a predetermined position to release said arc extinguishing fluid into said bore and the arc space for assisting in extinguishing an

arc that may exist between said terminal members and scavenging the surface of said bore.

8. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a replaceable capsule containing material which when released is in the form of an arc extinguishing fluid, a diaphragm sealing said capsule, and means for rupturing said diaphragm to release said arc extinguishing fluid into said bore and the arc space for assisting in extinguishing an arc that may exist between said terminal members and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

9. In circuit interrupting apparatus, in combination a body of arc extinguishing material having a bore, a pair of relatively movable terminal members between which an arc is adapted to be formed, one of said terminal members being located adjacent one end of said bore and the other being rod-like in character and movable through said bore, a replaceable capsule containing material which when released is in the form of an arc extinguishing fluid, a diaphragm sealing said capsule, said replaceable capsule being movable together with said rod-like terminal member, means providing relative movement between said capsule and said rod-like terminal member, said capsule and rod-like terminal member being biased apart, means for arresting movement of said capsule when it has been moved to a specified position while said rod-like terminal member continues to move, and means operated as a result of movement of said rod-like terminal member after movement of said replaceable capsule has been arrested for rupturing said diaphragm to release said arc extinguishing fluid into said bore and the arc space for assisting in extinguishing an arc that may exist between said terminal members and for blowing out of said bore products of the arc deposited on the surface thereof and likely to facilitate restriking.

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