

Aug. 16, 1932.

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1,872,530

HIGH TENSION CIRCUIT INTERRUPTER

Filed Nov. 25, 1930

2 Sheets-Sheet 1

Fig. 1.

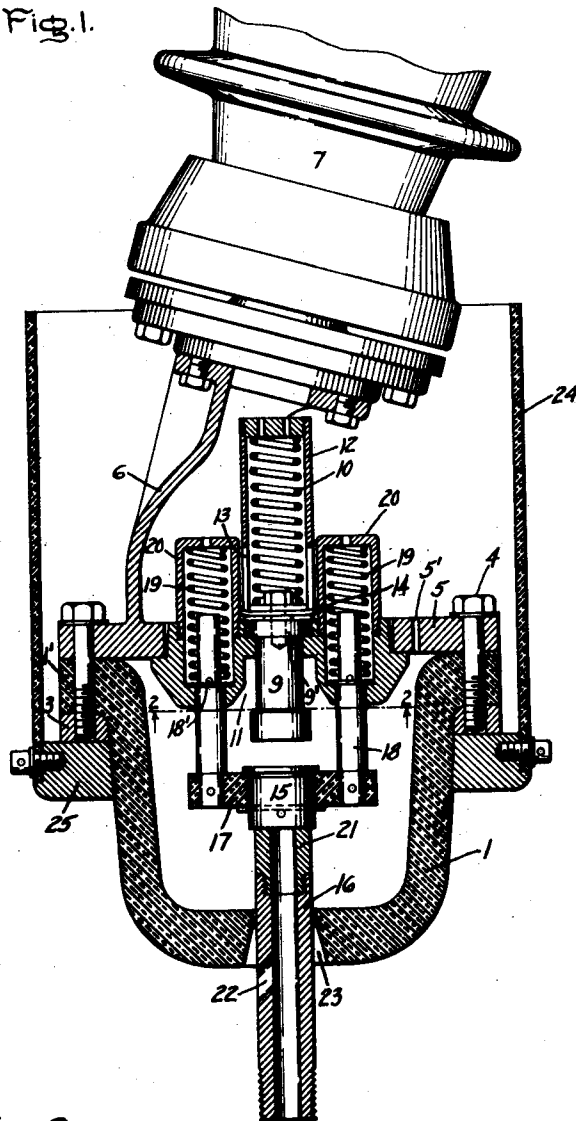
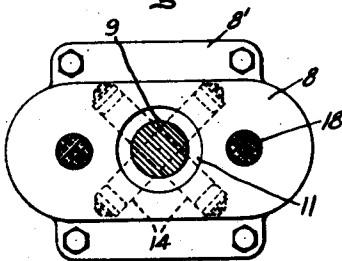


Fig. 2.



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Fig. 3.

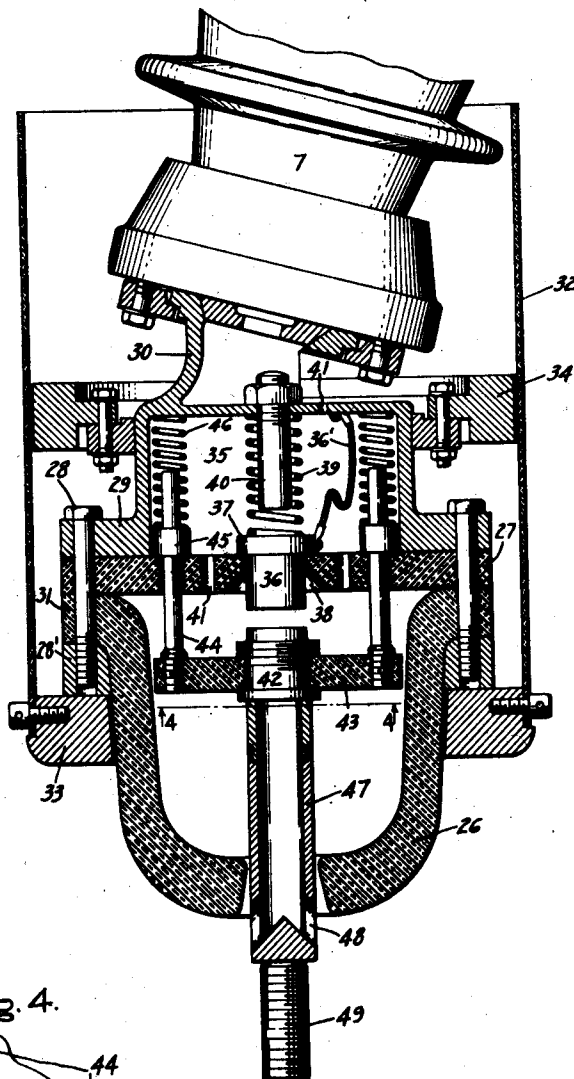
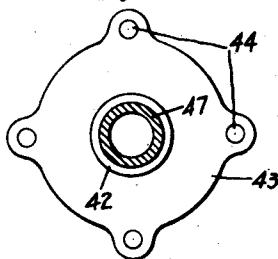


Fig. 4.



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UNITED STATES PATENT OFFICE

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HIGH TENSION CIRCUIT INTERRUPTER

Application filed November 25, 1930. Serial No. 498,075.

My invention relates to high tension circuit interrupters of the fluid-break type, and more particularly to the explosion chamber type wherein an initial or pressure generating arc is utilized to effect a blast of oil or other insulating liquid through and across the main arc for interrupting the circuit.

One of the major problems in interrupting high tension circuits, as of the order of 132 kv. or more, is that of preventing flashover in the circuit interrupting apparatus during interruption of high tension arc. In many cases, the insulating structure for the switch contacts has failed with the result that the arc is shorted to parts of the apparatus other than the normal contact surfaces, so that failure of the switch generally results.

It is a principal object of my invention to provide an improved high tension circuit interrupter wherein the current carrying parts are effectively insulated so that flashover during circuit interruption is substantially precluded.

It is a further object of my invention to provide an improved high tension circuit interrupter of the character above referred to which shall have comparatively few parts and be simple and rugged in construction and which may be easily assembled and inspected.

My invention will be more fully set forth in the following description referring to the accompanying drawings, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawings, Fig. 1 is an elevational view, partly in section, of high tension circuit interrupting apparatus embodying my invention; Fig. 2 is a plan view taken along the line 2—2 of Fig. 1, Fig. 3 is an elevational view, partly in section, of a similar form of circuit interrupting apparatus likewise embodying my invention and Fig. 4 is a plan view taken along the line 4—4 of Fig. 3.

In Fig. 1 there is shown a single pole of a high tension circuit interrupter of the fluid-break explosion chamber type compris-

ing an explosion chamber member or pot 1 constructed entirely of insulating material secured at its flanged end wall 1', as by the clamping ring 3 and bolts 4, to the peripheral flange portion 5 of the metallic adapter 6 constituting the supporting structure for the switch contact structure. The adapter 6 is clamped in a well known manner to the lower end of the lead-in insulator 7 through which the conductor stud connected to the adapter extends.

For the purpose of simplicity but a single pole of the circuit interrupter is shown, it being of course understood that the insulator 7 may be mounted in the usual manner in the top of a steel tank containing oil within which the circuit interrupting apparatus is immersed.

The insulating explosion chamber member 1 is constructed to withstand high internal pressures, and preferably is of the construction disclosed in a copending application Serial No. 358,072, filed April 25, 1929, by Charles F. Petersen for method and apparatus for making laminated insulation explosion chamber members, and assigned to the same assignee as the present invention.

The upper or contact supporting side of the explosion chamber comprises a plate-like member 8 secured in any suitable manner as by bolts to the lower plane side of the adapter 6. The plate member 8 in the present instance comprises a metallic casting or alloy and is provided with lateral flanges 8' having apertures through which bolts may extend to clamp the same to the adapter 6. It shall be understood, however, that the plate member 8 may if desired be constructed of strong insulating material.

The switch contact structure comprises a butt contact 9 of brass or other suitable arc-resisting material mounted and guided for reciprocal movement within a centrally disposed aperture in the plate member 8 and biased, as by a spring 10, towards a lower limiting position with respect to the plate. The aperture for the contact 9 includes a flared opening 11 formed in the plate 8 within which the contact extends. When the plate 8 is of metal the lower edge of this

opening serves as an arcing tip in the event that the contact 9 is forced in a manner hereinafter described upwardly far into the opening 11. A positioning and guide tube 12 encloses the spring 10 and is detachably mounted, as by screw-threaded engagement, to the plate member 8. The tube 12 is likewise slotted at 13 to permit extension there-through of the flexible conductors 14 which are suitably connected to the butt contact 9 and to the plate 8, or to the adapter 6 in case the plate 8 is of insulation.

Coacting with the butt contact 9 within the explosion chamber is a floating contact 15 likewise of brass or the like including upper and lower butt contact surfaces for engaging respectively the contact 9 and a rod contact 16 operable to extend within the explosion chamber. The floating contact 15 is carried by an insulating disk 17 of fibre or other strong insulating material which is in turn supported by a pair of insulating pins 18 mounted and guided for reciprocal movement within the plate member 8 and provided with stops members 18' coacting therewith. The insulating guide pins 18 may extend on opposite sides of the contact 9 and preferably are constructed of strong insulating fibre material. Each of the guide pins 18 is biased by a spring 19, mounted within and bearing against the upper end of a positioning and guide tube 20, so that the floating contact 15 is biased downwardly and away from the contact 9 in the open position illustrated in Fig. 1. The tubular butt contact 16, which is provided with a removable contact tip 21 of brass or other arc-resisting material, and a pressure relief vent 22, is operable to move in a vertical direction through the throat opening 23 of the explosion chamber member to abut one end of the floating contact 15 and to force it, against the bias of the springs 19, into engagement with the butt contact 9, thereby completing the circuit from the adapter 6 to the movable rod contact 16. The contact structure in the position illustrated in Fig. 1 may be considered as in the partly closed position wherein the contact rod 16 in its upward movement has engaged the floating contact so that further closing movement causes the floating contact to be moved against the bias of the springs 19 into engagement with contact 9.

The switch opening operation is performed by lowering the rod contact 16, which may be connected in the usual manner to a bridging member and operating rod within the switch tank. The spring 10 acting on the butt contact 9 permits a certain amount of overtravel of the movable contact rod so that the coacting butt contact surfaces are each resiliently urged into engagement with each other at substantially constant contact pressure. Therefore, upon downward movement of the rod 16, the contacts 9 and 15

tend to remain in limited following engagement until the shoulder 9' of the butt contact 9 engages the plate member 8. At this point an arc is drawn between the floating contact 15 and the butt contact 9 due to the fact that the floating contact 15 is still in following engagement with the rod 16. This initial or pressure generating arc causes decomposition of the oil within the explosion chamber and formation of gases at a high rate so as to develop high pressure within the explosion chamber. This pressure is mainly confined in the explosion chamber by the rod 16 until the floating contact 15 reaches its lower limit of movement thereupon causing the rod 16 to separate therefrom and draw a second arc between the same and the floating contact. When this occurs the end of the tubular contact 16 is uncovered so that the pressure within the explosion chamber is effective to direct a blast of oil radially across the arc and into the tubular contact to exhaust exteriorly of the chamber through the vent 22. It will, therefore, be apparent that the pressure generated by the initial arc may be directed so as to extinguish a main arc in series therewith by literally washing the arc into the tubular contact before it even leaves the explosion chamber. For the purpose of permitting oil completely to fill the explosion chamber after a circuit interruption, the upper part of the chamber is provided with a vent 5' through which entrapped gas may escape.

It will be noted that the arrangement of the floating contact supporting disk 17 together with the insulating guide pins 18 within the insulating explosion chamber 1 effectively insulates the contacts so that flash-over between the stationary and movable conducting switch structure is improbable. In the present instance, the floating contact is so insulated that shorting thereof by an arc extending directly between the upper butt contact and the movable rod contact is precluded.

The apparatus may likewise be provided with the usual cylindrical insulating shield 24 mounted at its lower end in any suitable manner on the supporting ring 25 of wood or the like secured to the clamping ring 3.

In a preferred modification shown in Fig. 3 the adapter structure and the plate member forming the upper part of the explosion chamber are designed so as to eliminate practically all conducting material, with the exception of the contacts themselves, in the region of the circuit interrupting parts of the switch. In this arrangement the explosion chamber member or pot 26 is of insulation material as in the previous instance and is constructed to withstand high internal pressures. The member forming the upper side of the explosion chamber comprises in the present instance a rigid plate 27 of strong

insulating fibre material which is clamped, as by the bolts 28 and the clamping ring 28', between the flange 29 of the adapter 30 and the peripheral flange 31 of the explosion chamber member. Accordingly, the adapter 30 serves both to support the explosion chamber structure as a unit and to position the insulating plate 27. The cylindrical insulating shield 32 is mounted, as in the previous instance, at its lower end on a supporting ring 33 composed of wood or other suitable material, the ring 33 being secured as by bolts (not shown) to the rings 28'. A supporting ring 34, likewise of wood or similar insulating material, is suitably mounted on the adapter 30 for bracing the insulating shield 32 with respect to lateral movement.

The adapter 30 has formed therein an inverted cup-shaped recess 35 disposed above the insulating plate 27 and serving as a housing for certain parts of the contact structure. A butt contact 36 having a flexible connection 36' suitably connected to the adapter 30 and a shoulder portion 37 is carried by the plate 27 and extends through a flared aperture 38 therein. The contact 36 is biased, as by spring 39, towards a limiting position wherein the shoulder 37 engages plate 27, an adjustable pin or stop 40 mounted in the adapter 30 serving both to position the spring 39 and to limit upward movement of the contact 36 in a manner hereinafter described. The plate 27 and the adapter 30 are likewise provided with vents 41 so that no gas pockets may form preventing oil from refilling the chamber after a circuit interruption.

The floating contact 42 mounted on and carried by the insulating disk 43 is similar in construction and arrangement to that previously described, the plate 43 being carried by a plurality of strong insulating pins 44, circumferentially arranged and extending through apertures in the plate 27. For the purpose of spacing the pins 44 as far as possible from the arc in order to prevent or minimize carbonization of the insulating material by the arc, the disk 43 is provided with projections as illustrated in Fig. 4 in which the pins are mounted. This arrangement allows sufficient passage between the upper and lower compartments of the explosion chamber while removing the insulating supporting pins from the vicinity of the arc. Accordingly, the effect of "creepage", due to carbonization, is greatly minimized.

Each guide pin is provided with a collar 45 limiting the downward movement of the pin under the influence of the spring 46. The tubular contact rod 47 is in general similar to contact rod 16, the only difference being in the arrangement of the pressure relief vents 48 and the screw-threaded portion 49 for securing the same to the bridging member.

The operation of the circuit interrupter shown in Fig. 3 is substantially the same as

described in connection with Fig. 1 except for the fact that the stop member 40 limits the "popback" action of the butt contact 36 in response to the initial arcing pressure. It shall, of course, be understood that the stop 40 is adjustable so that the lengthening of the initial pressure generating arc may be limited to a very small amount, thereby insuring substantially constant length and constant pressure of the initial arc.

It will furthermore be noted that the heavy insulating plate 27 eliminates all conducting material in the region of the switch contacts so that there is practically no possibility for the arc to shift or strike from the contact rod to conducting parts other than the switch contacts. Due to the fact that the initial pressure generating arc is quite short and practically constant in length, it will have little tendency to shift whereas the main arc drawn between the floating contact and the contact rod is so far removed from other conducting parts of the apparatus that flash-over is substantially precluded. The resulting separation of the tubular contact rod from the floating contact near the lower end of the explosion chamber within a body of oil insures a blast of comparatively cool oil across and through the arc into the tubular contact. The gases generated by the initial arc are in general confined to the space in the chamber above the insulating disk carrying the floating contact so that these gases are not mixed to any appreciable extent with the oil directed across the main arc.

The shape of the insulating disk carrying the floating contact may assume various forms, a limiting factor being the relation of its area, for certain interrupting capacities, with respect to the internal cross sectional area of the explosion chamber at that particular position. In other words, there must be sufficient passage around the edge of the disk efficiently to transmit the pressure to the main arc while preventing union of the gas bubbles formed by the pressure generating and main arcs. As is well known, the gas bubble formed in the oil by the arc is a very good conductor so that mingling of the gas bubbles within the explosion chamber would in all probability short the arc around the floating contact and thereby defeat the purpose of the same.

Accordingly, the communicating passage from the pressure generating chamber, i. e. the space above the floating contact disk in which the initial arc is drawn, to the main arcing chamber, i. e. the space in the explosion chamber below the aforesaid disk, may be designed to relieve the pressure at the rate desired. In Fig. 3, the pressure is relieved more slowly so that oil is forced through the tubular contact even after the arc has been extinguished, thereby producing a scavenging effect on the arc products in the arc gap.

It shall be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. A high tension circuit interrupter of the fluid-break type comprising metallic supporting structure, an explosion chamber member of insulating material secured to said supporting structure, a contact supporting member forming one side of said explosion chamber, a pair of coacting contacts carried by and resiliently mounted with respect to said supporting member for reciprocal movement, and a relatively movable rod contact extending within said explosion chamber for completing the circuit.

2. A high tension circuit interrupter of the fluid-break type comprising supporting structure, an explosion chamber pot of insulating material secured to said structure, a member forming one side of said explosion chamber, a butt contact mounted in said member, a relatively movable floating contact coacting with said butt contact within said chamber, an insulating supporting disk for said floating contact, said disk being guided for reciprocal movement with respect to said butt contact by insulating guides, and a rod contact operable to extend within said chamber and abut said floating contact.

3. A high tension circuit interrupter of the fluid-break type comprising an explosion chamber pot of insulating material adapted to withstand high internal pressures, a member of insulating material forming one side of said explosion chamber, means for clamping said member to said explosion chamber pot and for supporting the same, a butt contact mounted in said insulating member, a floating contact carried by said insulating member, and a coacting contact operable to engage said floating contact and to bias it into engagement with said butt contact.

4. A high tension circuit interrupter of the fluid-break type comprising a lead-in insulator, an adapter of conducting material clamped to the lower end of said insulator, said adapter having a peripheral flanged portion, an explosion chamber pot of insulating material adapted to withstand high internal pressures, said pot likewise having a flanged peripheral portion, a plate of insulating material forming the upper side of said explosion chamber, a pair of relatively movable contacts carried by said plate, clamping means for securing in position said plate between the flanged portions of said adapter and explosion pot respectively, and a movable contact extending within said chamber coacting with said pair of contacts.

5. A high tension circuit interrupter of the

fluid-break type comprising an explosion chamber pot of insulating material adapted to withstand high internal pressures, a member forming the upper side of said chamber, an adapter with respect to which the explosion chamber structure is mounted, a butt contact mounted in said member, a coacting floating contact mounted on an insulating disk within said chamber, said insulating disk supported by insulating guides mounted for reciprocal movement within said member, springs biasing said insulating guides to cause separation of said floating and butt contacts, and a rod contact operable to extend within said chamber and abut said floating contact and bias the same into engagement with said butt contact in the closed circuit position.

6. A high tension circuit interrupter of the fluid-break type comprising an explosion chamber pot of insulating material adapted to withstand high internal pressures, an adapter of conducting material to which the explosion chamber structure is secured, a plate member forming the upper side of said chamber and secured to said adapter, an arcing portion on said plate member, a butt contact mounted for reciprocal movement within said plate member, a floating contact coacting with said butt contact within said chamber, said floating contact carried by an insulating disk supported by insulating guide pins mounted in said plate member, and a rod contact operable to extend within said chamber and abut said floating contact to bias the same into engagement with said butt contact in the closed circuit position.

7. A high tension circuit interrupter comprising an adapter of conducting material, an explosion chamber member of strong insulating material, the wall of said member having a peripheral flange, a contact supporting fibre plate engaging one side of said flange and forming the upper side of the explosion chamber, a contact carrying insulating disc depending from said plate, a clamping ring engaging the opposite side of said flange, and bolts coacting with said adapter and said ring for clamping the explosion chamber structure as a unit to said adapter.

In witness whereof I have hereunto set my hand this 24th day of November, 1930.

WILLIAM H. TURNPENNY.