Dec. 19, 1933. W. S. EDSALL 1,940,120

ELECTRIC SWITCH AND ARC EXTINGUISHING APPARATUS

Filed May 22, 1930

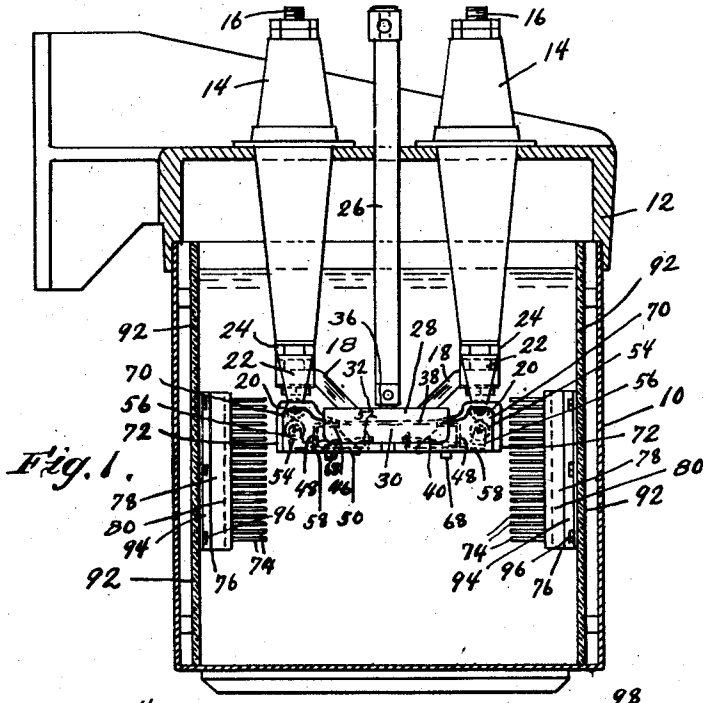


Fig. 1.

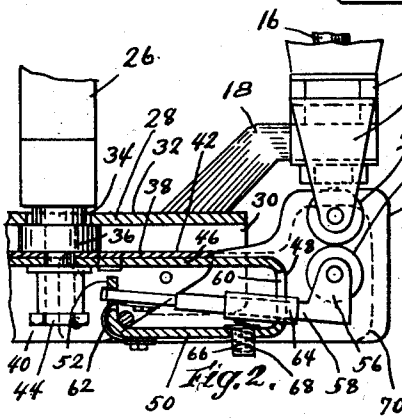


Fig. 2.

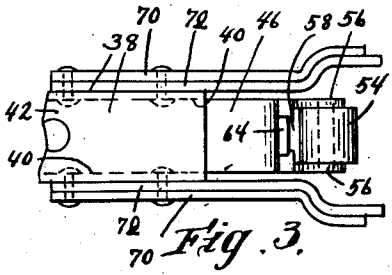
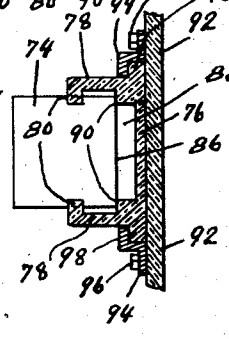


Fig. 3.



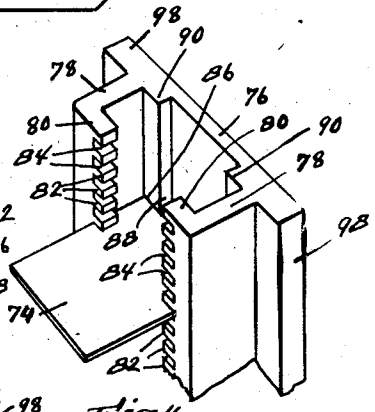


Fig. 4.

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1,940,120

ELECTRIC SWITCH AND ARC EXTINGUISHING APPARATUS

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Application May 22, 1930. Serial No. 454,647

5 Claims. (Cl. 200—150)

This invention relates to electric switches and particularly to oil immersed switches and alternating current switches.

One of the objects of the present invention is to provide an oil immersed electric switch with means which is supported independently of the stationary and movable switch members for breaking up the circuit interrupting arc into a plurality of small arcs and for cooling the small arcs so that they are rapidly extinguished and so that circuit interruption takes place with a minimum of disturbance either to the oil or to the circuit controlled by the switch.

Another object of the invention is the provision of an electric switch having means traversed by the switch current for forcing the separable contact members together and also for setting up a magnetic field that blows the circuit interrupting arc into a plurality of conducting plates where the arc is broken up into a plurality of short arcs that are rapidly deionized and extinguished.

A further object of the invention is the provision of a plurality of closely spaced metal plates which are supported close to but independently of the stationary and movable switch members and preferably by the insulating lining of the oil receptacle in which the switch members are immersed and which plates act to receive the circuit interrupting arc and divide it into a plurality of short arcs which are rapidly deionized and extinguished.

A yet further object of the invention is generally to improve the construction and operation of electric switches.

Fig. 1 is a sectional elevation of an electric switch embodying the present invention.

Fig. 2 is an enlarged sectional detail of the cooperating parts of the stationary and movable contact members.

Fig. 3 is a plan view of the apparatus of Fig. 2.

Fig. 4 is a perspective detail of one of the plate holders.

As here shown, the switch embodying the present invention includes the oil containing casing comprising the oil containing receptacle 10 and the switch frame 12 which constitutes a cover for the open top of the oil receptacle.

The switch includes a pair of insulated stationary switch members 14 having conducting studs 16. Said switch members are carried by the frame 12 and depend into the oil of the receptacle. Each stationary switch member is provided with a main current-carrying contact member that comprises an inverted brush member 18 that is secured to the lower end of the stud 16. An auxiliary contact or arcing member comprising a horizontally disposed cylindrical roll 20 is located beneath the brush member between the arms 22 of a supporting frame that is clamped between the shank of the brush member and a nut 24 on the stud 16. The movable switch member includes a lifting rod 26 that is vertically movable to open and close the switch and is operated by suitable mechanism not herein necessary to illustrate. The lifting rod at its lower end carries a bridging member 28 which comprises an inverted channel having depending flanges 30 and a horizontal connecting web 32. Said web is located loosely upon a spacing bushing 34 carried by a stud 36 that is secured to and depends below the lifting rod 26. Said bridging member is adapted to be raised to engage the toe portions of the brush members 18 and thereby to close the current carrying path of the circuit through the switch. A supporting member 38 is located on said stud 36 beneath the bridging member 28 and between the flanges 30 thereof. Said supporting member comprises an inverted channel of non-magnetic material having depending flanges 40 and a horizontal connecting web 42. Said web is apertured to receive the stud 36 and is clamped to the lifting rod between the collar 34 and the nut 44. A conducting bar 46 is located within the flanges of the supporting member and is clamped against the lower face of the web 42 and is provided at each end with an outer depending section 48, a lower horizontal and inwardly directed section 50 which is parallel with the body portion 46 and an upwardly directed inner end section 52, all of which cooperate to form a conducting loop. A movable auxiliary contact or arcing member 54 cooperates with and is similar in construction to the stationary arcing member 20 and is located between the upstanding ears 56 of a horizontal arm 58 which is extended loosely and generally horizontally inwardly into the interior of the loop through a vertically elongated slot 60 in the outer end section 48 and is pivotally connected with the end of the upturned inner section 52. The inner end of said arm is connected electrically through a flexible conductor 62 with the inner end portion of the horizontal section 50. An insulating bushing 64 surrounds said arm in the slot 60 and thereby prevents the arm from contacting electrically with any outer portion of the loop. A spring 66 is received in a cup 68 carried by the bottom section 50 and bears against said insulating bushing whereby to urge said arm and the arcing member carried thereby toward the stationary arcing member 20.

As thus arranged, the current which traverses the arm 58 is in the same direction as the current which traverses the body portion 46 of the conductor and in the opposite direction to the current which traverses the lower section 50. The arm thus reacts magnetically with both portions of the conductor in a direction which urges the arm forcibly upwardly in a direction to force its arcing member into engagement with the stationary arcing member 20. Thus the contact members are maintained in engagement by the magnetic reactions of the currents traversing the arm and the looped portions of the conductor 46. Pole plates 70 of magnetic material are secured to the depending flanges 40 of the supporting member 38 and lie on opposite sides of the loop portion of the conductor and extend outwardly therefrom and are terminated on opposite sides of the arcing members, whereby to concentrate the magnetic flux of the loop portion of the conductors and of the arms 58 in the arc zone between the contact members whereby to react with the circuit interrupting arc in a direction to force the arc outwardly toward the opposite side walls of the oil receptacle.

The magnetic field set up by the looped portion of the conductor even without the pole plates 70 is sufficient in itself to exert a strong blowout effect upon the circuit interrupting arc, especially at the high values of current where the blowout effect is most needed. The presence of the pole plates 70, however, serves to enhance the magnetic blowout effect of the conducting loop for relatively low values of current so that the switch has a strong blowout effect at all values of current where the length of the interrupting arc will be important.

Protective plates 72 of insulating and arc resisting material are preferably located on the inner faces of the pole plates so as to prevent the pole plates from being contacted with or damaged by the circuit interrupting arc.

The construction thus described is essentially the same as is disclosed and claimed in the copending application of Chester D. Ainsworth, Serial No. 453,179 filed May 17, 1930, and assigned to the assignee of the present application.

In accordance with the present invention, means are provided to receive the magnetically distorted circuit interrupting arc and to divide the long arc into a series of separate short arcs and to cool or deionize rapidly the short arcs so that they are rapidly extinguished with small disturbance to the oil or to the circuit controlled by the switch. To this end a plurality of horizontal metal plates 74 having good heat absorbing or conducting and dissipating ability, as copper plates, are disposed in vertically spaced rows or stacks close to the arc zones between the separable arcing members and between said arcing members and the opposite side walls of the oil receptacle. The stacks of plates preferably are sufficiently long to extend adjacent the entire length of the arc zone between the contact members so that the plates are effective to receive the arc even though the arc should persist for the entire length of opening movement for the switch members. Ordinarily, however, it is not necessary to extend the stacks downwardly this extreme distance. Each stack of plates is contained within an insulating holder 76 which has a vertical rear wall 77 and forwardly extended walls 78 that terminate in confronting walls 80 provided with rows of teeth 82 and slots 84 located between the teeth. The plates 74 are located in the slots 82 with the teeth located in the spaces between the plates, thereby to define the spacing of the plates. The inner edges 86 of the plates are preferably spaced from the rear wall 76 to provide a vertical channel 88 between the plates and the wall that is open at the top and also at the bottom in which any gas or liquid that is forced out of the stack can escape from the holder. The inner edges of the plates preferably abut against shoulders 90 of said holder whereby to define the position of the plates in the holder. Preferably the plates are only retained frictionally in the holder so that if burned or damaged they can be readily removed and replaced by other plates.

The holders 76 are secured to the opposite walls of the insulating tank lining 92 and are secured to said lining by horizontally spaced vertically extended Z-bars 94 which are secured by screws 96 to the lining and provide channels in which the oppositely extended flanges 98 of the holders are located. The holders preferably are loosely received in said supporting channels so that they can be withdrawn with the plates as a unit upon need.

The outer edges of the plates are located close to the separable arcing members and the movable arcing members, when the switch opens, are caused to travel downwardly in front of said stacks of plates. The magnetic field in the arc zone causes the arcs to be blown outwardly toward the stack and in between the plates thus to divide the arcs into a series of short arcs which by the blowout field are forced over the surfaces of said plates and toward the tank walls. The spaces between the plates are relatively narrow so that the oil that is between the plates tends to remain therein so that the arcs are caused to be held magnetically into intimate contact with the bodies of oil. The bodies of oil are maintained cold by the cooled plates and thereby rapidly extinguish the short arcs. The movement of the arcs over the plates also cools and deionizes the arcs so that the result is that the arcs are rapidly extinguished and the circuit interrupted with small disturbance to the oil and to the switch circuit.

Any oil gases that are generated are caused to be cooled by the plates so that danger of ignition of any combustible mixture in the gas expansion space of the switch casing above the oil level is minimized.

The arc voltage that can be absorbed by any pair of spaced plates depends largely upon the spacing therebetween. When the spacing of the plates is so great that the deionizing effect of the plates can not be exerted throughout the entire arc zone between them, the arc potential that can be absorbed across any pair of plates is in the vicinity of three hundred volts, which represents the break down value of the instantaneously recovered dielectric strength of the normal gas insulating medium between the plates. When, however, the plates are close together, for instance, a millimeter more or less, so that the deionizing effect of the plates can extend throughout the entire length of the arc zone between the plates then any pair of plates can absorb an arc potential which is practically equal to the break down potential of the entire length of the insulating gaseous medium between the plates. In this latter case, each pair of plates can absorb a thousand volts or more, the arc going out at the current zero and not being re-established unless the recovered potential is high

enough to break down the insulation between the plates. Thus by properly designing and spacing the plates, the switch can be operated on circuits of widely differing voltages.

I claim:

1. An electric switch comprising an oil containing casing, an insulating lining therein, stationary and movable switch members having cooperating arcing members immersed in the oil in said casing, and an arc extinguishing device comprising an insulating holder carried by said lining having opposed toothed walls and a stack of superposed arc-receiving and extinguishing metal plates located in the interdental spaces of and carried by said walls having their similar ends terminated close to said arcing members and the line of movement of said movable switch member.

2. An electric switch comprising an oil containing casing, an insulating lining therein, stationary and movable switch members having cooperating arcing members immersed in the oil in said casing, and an arc extinguishing device comprising an insulating holder carried by said lining having opposed toothed walls and a stack of superposed arc-receiving and extinguishing metal plates located in the interdental spaces of and carried by said walls having their similar ends terminated close to said arcing members and the line of movement of said movable switch member, and electromagnetic means carried by said movable switch member which forces the circuit interrupting arc into said stack of plates where the arc is divided into a series of short arcs that are rapidly extinguished.

3. An electric switch having separable oil immersed arcing members, and an arc extinguishing device having means which supports it independently of said arcing members, said device including a holder having an oil containing channel which is open at the top and bottom and a plurality of superposed metal plates which are located in said channel, said plates being extended outwardly beyond said holder and having their similar outer ends terminated close to the line of separation of said arcing members and having their inner ends spaced from the end of said channel, the spaces between said plates being open to said channel, and means which forces the circuit interrupting arc into the engagement of said plates.

4. An electric oil switch having stationary and movable arcing members, an arc extinguishing device comprising a stack of spaced electrically-conducting plates located close to and extended in the direction of movement of said movable arcing member, a casing removably enclosing said arcing members and plate-stack and containing oil that quenches the arc and occupies the spaces between the plates, and an insulating lining disposed removably between said casing wall and said arcing members and constituting the support for said stack, the stack being removable with the lining.

5. An oil immersed electric switch comprising an oil containing casing, stationary contact members depending therein, a bridging member for connecting said contact members movable vertically thereunder, and arc extinguishing devices comprising stacks of vertically spaced horizontal metal plates disposed each beside the bridging member and a separate one of said stationary contact members and between said contact member and said casing and immersed in the oil and having oil between the plates, said stacks being located close to and extended in the direction of movement of said bridging member, and an insulating lining located removably within said casing and outside of said stacks, said stacks being carried by and being removable with said lining, and said lining constituting means which supports said stacks in the aforesaid position.

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