Nov. 13, 1934. G. A. BURNHAM 1,980,471

CIRCUIT INTERRUPTER

Filed Nov. 28, 1932 2 Sheets-Sheet 1

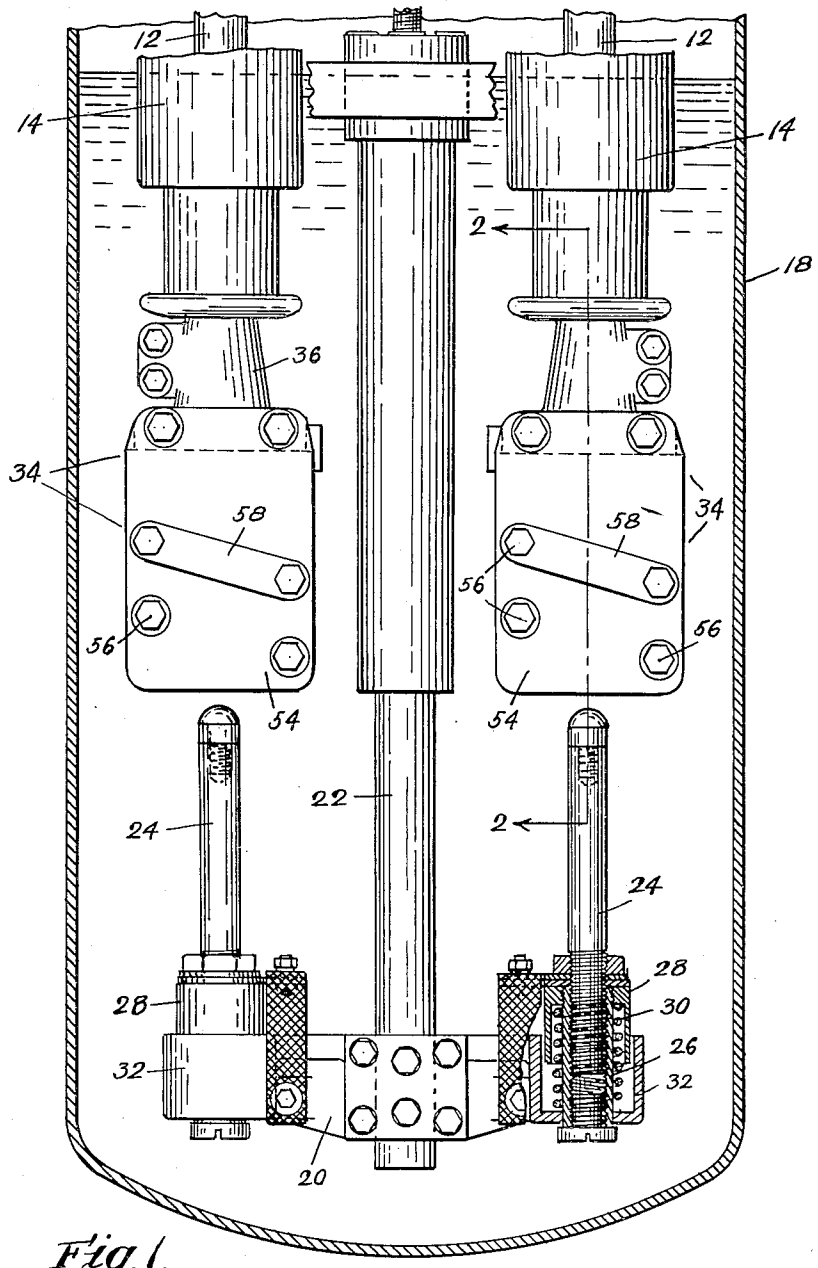


Fig. 1.

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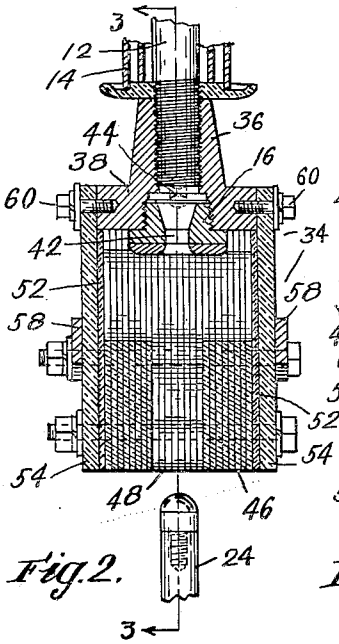


Fig. 2.

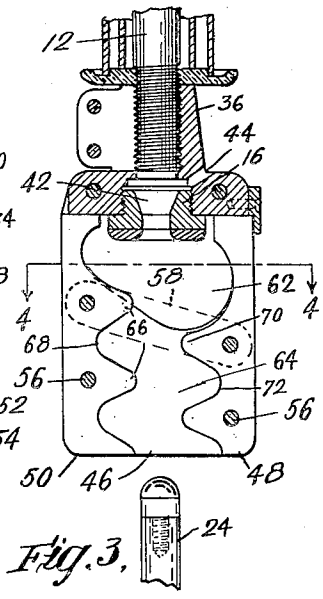


Fig. 3.

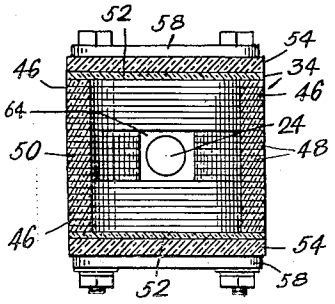


Fig. 4.

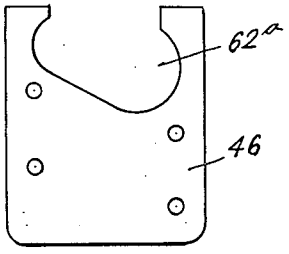


Fig. 5.

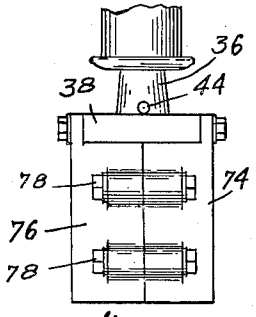


Fig. 7.

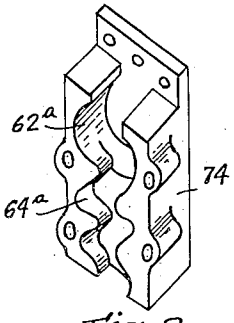


Fig. 8.

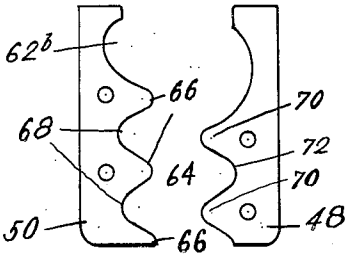


Fig. 6.

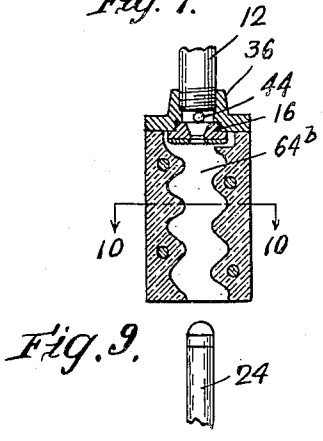


Fig. 9.

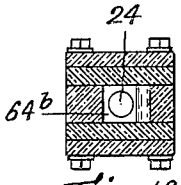


Fig. 10.

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UNITED STATES PATENT OFFICE

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CIRCUIT INTERRUPTER

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Application November 28, 1932, Serial No. 644,658

8 Claims. (Cl. 200—150)

This invention relates to the interruption of electric circuits and especially alternating current circuits, under heavy load and to circuit interrupters especially of the type wherein the separable contact members are separated and the circuit interrupting arc is established in an arc extinguishing fluid, usually oil.

An object of the present invention is the provision of a simply constructed circuit interrupter without valves, pistons or accessory moving parts, and particularly arranged to interrupt the circuit interrupting arc over wide ranges of current values rapidly and uniformly with little decomposition of the oil and carbon formation and with the generation of low gas pressures in the switch casing.

The specific interrupter embodying the present invention has its contact members separable, and the circuit interrupting arc established, in a volumetrically-small pressure-resisting oil-containing chamber having a restricted outlet into which the circuit interrupting arc is adapted to be drawn and through which the oil under pressure of the arc gases generated from the oil in the chamber by the arc, and the pressure arc gases, is caused to flow, the outlet having a plurality of wall members which are disposed in staggered relation on opposite sides of the normal arc path and which define a tortuous path through which the oil under elevated pressure or head in the chamber is caused to flow at a substantial velocity at an angle with respect to the normal arc path repeatedly against and through the arc.

A further object is generally to improve circuit interruption and interrupters.

Fig. 1 is a side elevation of the stationary and movable elements of the interrupter embodying the present invention, the oil containing enclosing casing being shown in section.

Fig. 2 is a sectional elevation of one of the two identical arc interrupting devices associated with a stationary contact member of Fig. 1, the section being taken along line 2—2 of Fig. 1.

Fig. 3 is a section at right angles to the view of Fig. 2 taken along line 3—3 of Fig. 2.

Fig. 4 is a section taken along line 4—4 of Fig. 3.

Fig. 5 is a plan view of one of the chamber plates of Figs. 2 and 3.

Fig. 6 is a plan view of a pair of the outlet plates of Figs. 2 and 3.

Fig. 7 is a side elevation of a modified form of arc extinguishing device.

Fig. 8 is a perspective view of one of the two similar halves of the device of Fig. 7.

Fig. 9 is a longitudinal section of a further modified form of arc interrupting device.

Fig. 10 is a section along line 10—10 of Fig. 9.

The circuit interrupter embodying the present invention includes fixed terminals or studs 12 supported by insulating bushings 14 and connected to stationary contact members 16, see Figs. 2 and 3, and immersed in oil in the enclosing casing or tank 18. A bridging member 20 is raised and lowered toward and away from the stationary contact members by suitable mechanism, not shown, connected with the upper end of the lifting rod 22 to move the movable contact members 24 into and out of engagement with the stationary contact members, thereby to complete and interrupt the circuit through the interrupter.

The movable contact members 24 comprise vertically disposed rods screw-threaded at their lower ends into vertical sleeves 26 which at their upper ends are screw-threaded into caps 28 that bear against the upper ends of helical springs 30 that are received in recesses or bosses 32 of the bridging member 20 and are seated on the bottoms of said bosses. This arrangement is such that the contact members can yield relatively to the bridging member when they are in engagement with the stationary switch members to permit the bridging member to be moved into a locked closed position.

An arc extinguishing device 34, with which this invention is more particularly concerned, is associated with and encloses each stationary contact member 16 and the circuit interrupting arc that is drawn between the separable contact members during the opening movement of the interrupter under load. The circuit interrupter members are identical and but one will be described with reference to Figs. 2 through 10. The lower end of the switch terminal, or stud, 12 is screw-threaded into a boss 36 that is terminated at its lower end in a horizontally disposed plate 38. The contact member 16 is screw-threaded into said plate in line with the stud 14 and has an outstanding flange 40 that overlies the lower face of the plate. The contact member, as here shown, is provided with a passage 42 therethrough in line with the cooperating movable contact member 24, which contact member is adapted to seat upon the wall of and over said passage in the closed position of the interrupter. A restricted vent passage 44 passes through said boss 36 and communicates with the passage 42 and permits residual gases in the arc interrupting device to escape after circuit interruption and

the device to be refilled with oil from the enclosing casing 18. The circuit interrupting device of Figs. 2, 3 and 4 comprises a series of vertically disposed side plates 46 and middle plates 48 and 50 composed of suitable insulating material as Fuller board arranged in contact with each other and confined between end plates 52 of similar material and cover plates 54 and all secured together by through bolts 56 to provide an enclosing casing in which the circuit interrupting arc is established and extinguished. Reinforcing straps 58 traverse the middle portion of the cover plates 54 for the purpose of reinforcing them against the internal pressure. The plate 38 of the boss 36 lies against the tops of the plates 46, 48 and 50 and between the cover plates 54 and is secured thereto by bolts 60.

The arc interrupting device is provided in the upper portion thereof with an oil containing chamber 62 in the upper portion of which the contact member 16 is located and an outlet passage 64 of small cross-section extending from the lower portion of said chamber to the bottom of the device where it opens into the oil in the casing 18. The volume of the chamber and the outlet is adapted to contain enough oil to effect the interruption of the arc at the highest current adapted to be interrupted by the interrupter. Any greater volume is superfluous. The movable contact member 24 is adapted to move in a straight line longitudinally of the outlet passage into and out of contact with the stationary contact member. In the open position of the interrupter the movable contact member preferably is entirely out of the arc interrupting device. The oil containing chamber 62 is formed by the alignment of the recesses 62*a* in the series of side plates 46. The middle plates 48 and 50 are also provided with confronting marginal indentations 62*b* which in general conform to the configuration of the recesses 62*a* whereby to cooperate with the recesses preferably, although, not necessarily, to form an oil chamber that is of approximately the same transverse configuration. The inner margins of the middle plates 50 at the outlet are provided with a plurality of projections 66 and indentations 68 connected preferably by curves to form a tortuous path of sinuous contour. The plate 48 is similarly provided with a series of projections 70 and indentations 72 but with the projections 70 and indentations 72 confronting the indentations 68 and projections 66, respectively, of the plates 50, so that the projections and indentations of the two plates are arranged in staggered relation. The horizontally projected spacing between the projections 66 and 70 preferably is but little greater than the diameter of the movable contact member, being sufficiently larger than the diameter of the contact member to permit free movement of the contact member in a circuit controlling direction regardless of small inaccuracies in manufacture. The transverse width of the passage 64 between confronting side plates 46 is also intended to be but slightly greater than the diameter of the contact member.

When the interrupter is closed, the chamber 62 and the outlet 64 are full of oil. When the contacts are separated under heavy load in the switch circuit an arc is formed at the contacts and is elongated within the outlet passage 64 during the continued circuit opening movement of the contact member until the arc is extinguished at sometime prior to the arrival of the movable contact member in its complete circuit open position. The arc in the chamber 62 vaporizes a certain amount of the oil in the chamber and hence creates a substantial amount of gas pressure which forces the oil and the arc gases out of the chamber and along the outlet passage 64 at an angle to the normal position of the arc and repeatedly against and through the arc in said passage resulting in a rapid interruption thereof with little deterioration to and carbon formation in the oil.

An interrupter embodying the principles set forth has been found to interrupt sixty cycle alternating current circuits consecutively and uniformly from a few hundred amperes to twelve thousand amperes at thirteen thousand volts in the short time of practically two cycles of arc duration with little deterioration and decrease of dielectric strength of the oil and with substantially reduced pressures in the casing 18. While an oil circuit interrupter ordinarily can be found to perform reasonably well at some particular load on the circuit, the interrupter usually will operate less favorably when interrupting both higher and lower loads. Tests upon the present interrupter have, however, indicated that the currents from six hundred to twelve thousand amperes, the arcing time is consistently around two cycles, thereby indicating effectiveness of the design over a wide range of load.

In Figs. 7 and 8 the arc interrupting device is composed of two complementary blocks 74 and 76 secured in abutting relation by bolts 78 and attached to the plate 38 and formed with the oil chamber 62*a* and outlet 64*a* corresponding respectively to the chamber 62 and outlet 64 of Figs. 2 and 3. This construction permits the ready removal of the arc interrupting device to inspect the stationary contact member 16 and affords a simple construction of great strength and less cost.

In Figs. 9 and 10 the arc extinguishing device is composed entirely of a tortuous outlet or passage 64*b* corresponding to the passage 64 of Fig. 3. The upper portion of the passage in this instance constitutes the equivalent of the pressure chamber 62 of Fig. 3. If the passage itself can hold enough oil or other arc extinguishing fluid to effect the interruption of the arc at the highest arc current for which the switch is designed, without requiring too great a length of the movable contact rod and travel thereof, the chamber 62 of Fig. 3 can be eliminated.

I claim:

1. A circuit interrupter comprising means providing an oil containing pressure-generating chamber and a tortuous outlet passage therefor having a free opening into the bottom of said chamber at the bottom of the oil body therein, a contact member in said chamber, a cooperating contact member having its arcing end movable along the length of a tortuous part of said outlet passage into and out of engagement with said first contact member, said chamber being substantially closed except for said outlet passage, and means for normally maintaining said chamber and outlet passage full of oil.

2. A circuit interrupter comprising means providing a fluid containing pressure-generating chamber and a restricted outlet passage therefor having a longitudinally sinuous configuration and a free opening into the bottom of said chamber at the bottom of the oil body therein, a contact member within said chamber, a cooperating contact member having its arcing end movable longitudinally in the tortuous part of said outlet into and out of engagement with said first con-

tact member, said chamber being substantially closed except for said outlet passage, and means for normally maintaining said chamber and outlet passage full of oil.

3. A circuit interrupter comprising a casing having an oil containing pressure-generating chamber and a restricted outlet passage therefor having a free opening into the bottom of said chamber at the bottom of the oil body therein, a contact member within said chamber, and a cooperating contact member movable longitudinally of said outlet into and out of engagement with said first contact member, said outlet having opposed walls provided with staggered projections and indentations between and across which the circuit-interrupting arc is adapted to be drawn, said chamber being substantially closed except for said outlet passage, and means for normally maintaining said chamber and outlet passage full of oil.

4. A circuit interrupter comprising a casing having an oil containing pressure-generating chamber and an outlet passage therefor having a free opening into the bottom of said chamber at the bottom of the oil body therein, a contact member at the end of said chamber, a second contact member movable in and longitudinally of said outlet into and out of engagement with said first contact member, said outlet having walls which are disposed to guide the oil in said chamber and outlet to flow along the length of said outlet in successive alternate directions at an angle to the median line of the outlet and a circuit interrupting arc therein at said walls, said chamber being substantially closed except for said outlet passage, and means for normally maintaining said chamber and outlet passage full of oil.

5. A circuit interrupter comprising a casing having a chamber and a passage extending therefrom, said casing comprising a series of plates having confronting flat faces and presenting similar ends to define one wall of said passage and chamber, a second series of plates opposed to said first series and presenting similar ends to define an opposite wall of said passage and chamber, each plate of said two series forming a part of the wall of both said passage and chamber, end plates disposed on opposite sides of said two series of plates and forming opposite walls of said passage and chamber, a cover for the top of said chamber, a contact member within said chamber, and a cooperating contact member movable lengthwise of said passage into and out of said chamber.

6. A circuit interrupter comprising a casing having a chamber and a passage extending therefrom, said casing comprising a series of plates presenting similar ends to define one wall of said passage and a part of the wall of said chamber, a second series of plates opposed to said first series and presenting similar ends to define an opposite wall of said passage and a part of the opposite wall of said chamber, each plate of said two series forming a part of the wall of both said passage and chamber, end plates disposed on opposite sides of said two series of plates and forming opposite walls of said passage and having registering openings therethrough above said passage which define side parts of said chamber, cover plates for the open ends of the registering openings in said end plates, a cover for the top of said chamber, a contact in said chamber, and a cooperating contact member movable lengthwise of said passage into and out of said chamber.

7. A circuit interrupter as defined in claim 6, wherein the ends of said plates that and where they define the opposed walls of said passage are provided with a series of projections and indentations that alternate along the length of said passage, with the projections of the plates of one wall confronting the indentations of the plates of the opposite wall.

8. A circuit interrupter comprising a casing having a pressure generating chamber provided with a long outlet passage of smaller cross-sectional area than said chamber, said chamber being substantially closed except for said outlet passage and said outlet passage opening into the bottom of both said chamber and the oil body therein and extended therebelow and having a series of vertically spaced projections extended inwardly of the passage from opposite walls thereof, the projections of one wall being staggered with respect to the projections of the opposite wall, the entrance to said outlet passage from the bottom of said chamber being free and unrestricted so that oil in said chamber can flow freely into said passage, a receptacle enclosing said casing containing oil in which said casing is submerged so that said chamber and said outlet normally are full of oil, a contact member within said chamber, and a cooperating contact member movable along the length of said outlet passage between said sets of projections into and out of cooperating relation with said first contact member.

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