Nov. 21, 1933. G. E. WHITEHEAD 1,936,492

CIRCUIT BREAKER

Filed March 3, 1931 2 Sheets-Sheet 1

FIG. 1.

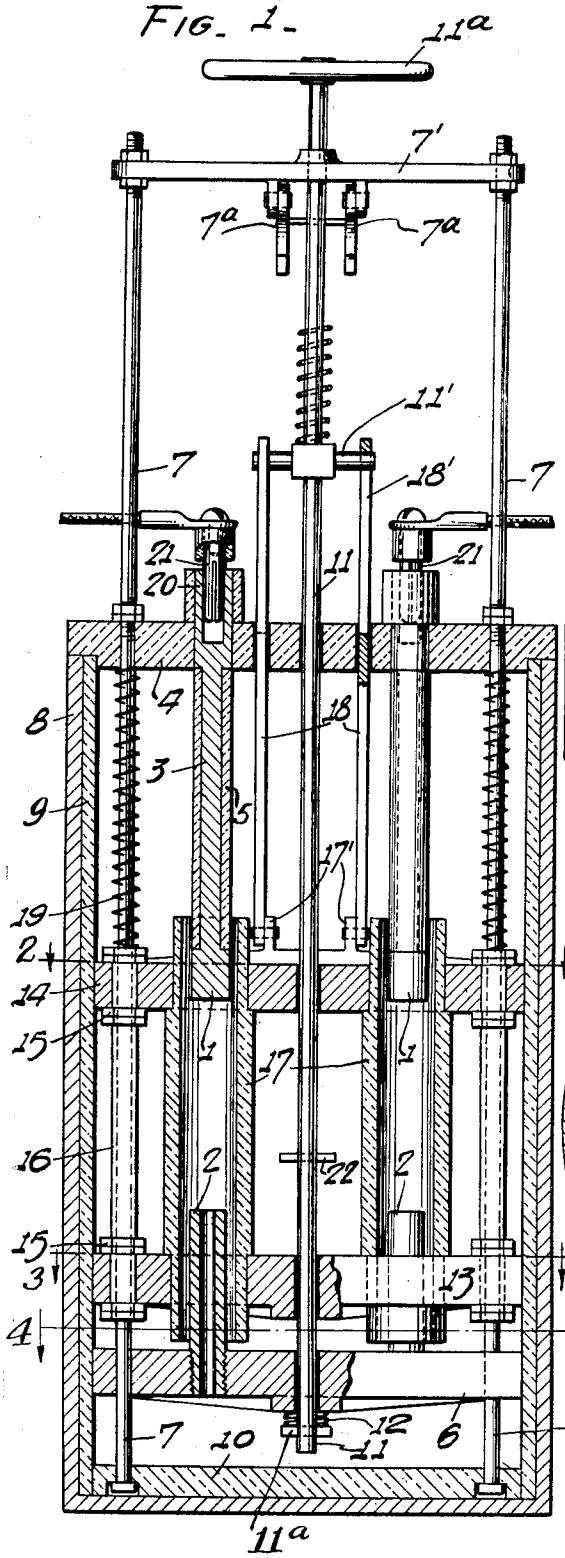


FIG. 1a.

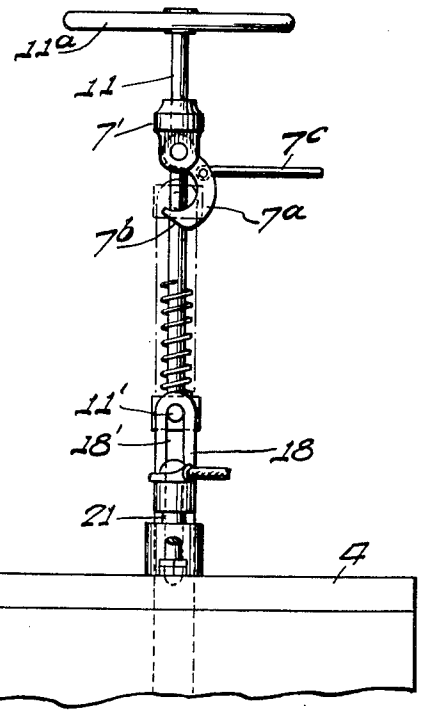
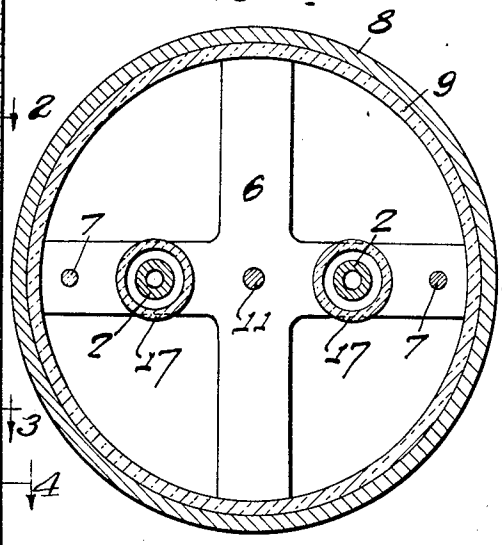


FIG 4.



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CIRCUIT BREAKER

Filed March 3, 1931 2 Sheets-Sheet 2

FIG. 2.

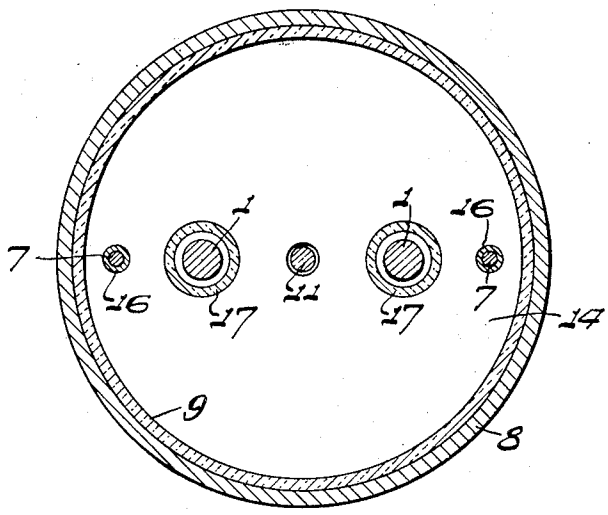
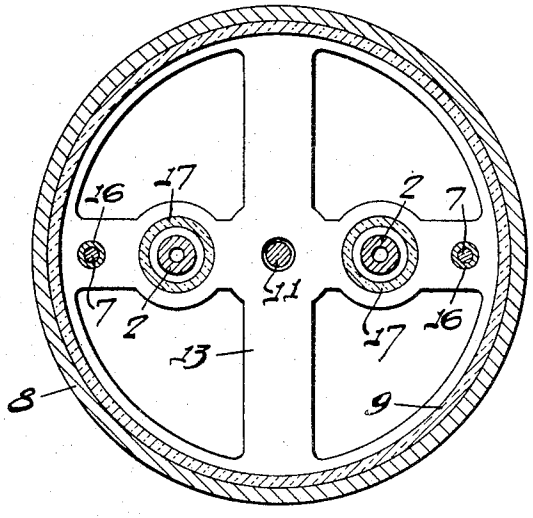


FIG. 3.



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CIRCUIT BREAKER

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15 Claims. (Cl. 200—150)

This invention relates to switches or circuit breakers intended more especially for breaking circuits carrying relatively heavy currents.

In the switch or circuit breaker according to the invention oil is pumped, preferably under appreciable pressure, upon and over the surfaces of separating contacts. Preferably the pumping of the oil is effected completely automatically by the opening movement of the switch or circuit breaker and after the contacts have separated a predetermined distance. One of the contacts is preferably hollow in order that the oil may be pumped through it. Preferably also the co-operating contacts are enclosed in an arc-quenching chamber which comprises an insulating tube coaxial with said contacts and having an internal cross-sectional area only slightly greater than the cross-sectional area of the contacts, through which tube the oil is caused to pass under considerable pressure. Preferably also said insulating tube is adapted to move so as to follow up the separating contact.

The moving contacts may be carried by an insulating crosshead adapted to slide on guide rods, or on some of said guide rods, in the lower end of the main casing, said crosshead being star-shaped or of open-work but rigid formation so that it can move down readily in the oil to permit the switch or circuit breaker to open rapidly. The contacts may be insulatingly mounted in a metal crosshead. The crosshead may be carried on a central operating rod with an interposed spring if the contacts are of the butt type.

The arc-quenching tubes of insulating material may be carried on another crosshead, or between a pair of further crossheads axially displaced from one another. In the latter case, one of the pair of crossheads is of star-shaped or open-work formation, whilst the upper one constitutes a piston adapted to operate in the main casing, said pair of crossheads being rigidly connected together by means, for example, of metal tubes adapted to slide upon the aforesaid guide rods, or upon some of them. The operating or pull rod of the crosshead carrying the moving contacts slides freely through the upper crosshead or pair of crossheads but has a crosspin or other stop arranged to engage the upper crosshead or one of them when the co-operating contacts have opened a predetermined distance shorter than the full separation whereby to cause the oil in the case of the main casing to be pumped up with considerable pressure and velocity through the insulating arc-quenching chambers or tubes and over the surfaces of the co-operating contacts to the upper part of the main casing. The invention contemplates an arrangement in which the parts are so proportioned as to their dimensions and movements that a displacement of at least 60 per cent. of the total oil is brought about when the switch or circuit breaker is opened.

To enable the arc-quenching chambers and the moving contacts to be raised to reclose the switch or circuit breaker, an externally operable elevating member adapted for vertical movement may be provided with a latch for normally retaining the moving contacts and insulating tubes in their upper position, which latch is adapted to be released when the switch or circuit breaker is tripped, throw-off springs for the moving contacts being conveniently located around the operating or pull rod whilst springs located around the guide rods may be used for urging the piston to its lower position when released, in addition to or in place of the aforesaid pin or stop on the operating rod of the moving contacts.

To reclose the switch or circuit breaker it is merely necessary to move down the elevating member until the catch thereon engages the operating or pull rod of the moving contacts and thus to raise the elevating member again.

To enable the invention to be clearly understood and carried into effect it will now be described with reference to the accompanying drawings in which

Fig. 1 is a sectional elevation of a single pole, double break switch or circuit breaker in accordance with the invention,

Fig. 1*a* is an elevation of the upper portion of the switch shown in Fig. 1 as viewed from the right,

Fig. 2 is a horizontal section on the line 2—2, Fig. 1,

Fig. 3 is a horizontal section on the line 3—3, Fig. 1, and

Fig. 4 is a horizontal section on the line 4—4, Fig. 1.

Referring first to Fig. 1 of the drawings, 1 are the fixed contacts which may be solid and are mounted on stems 3 carried in the top 4 of a main casing 8. The stems 3 are preferably closely shrouded with solid insulation 5 which may be moulded thereon.

The moving contacts 2 are preferably tubular as shown, although this is not essential. Said contacts 2 are mounted in a metal bridge 6 which is conventiently of star shape or other openwork formation. The top 4 has perforations through which extend guide rods 7 fixed within the main casing 8. Said casing 8 may consist of metal,

and may be lined with insulating material 9 and provided with a floor 10, also of insulating material, to which the guide rods 7 may be secured. The crosshead or bridge 6 carrying the movable contacts 2 is moved toward and away from the top 4 by means of a rod 11, a spring 12 being introduced between a flange 11a on the rod 11 and the lower side of the crosshead 6 in the case of butt type or other non-resilient contacts, such as those shown, so that the requisite contact pressure can be obtained without undesirably straining the switch actuating mechanism.

Two further crossheads are slidable upon the guide rods 7, namely, a lower crosshead 13, which is of star or other openwork formation and may be similar to the bridge or crosshead 6, whilst the upper crosshead 14 is in the form of a disc so that it can act as a pump piston within the lining 9 of the main switch or circuit breaker casing. The crossheads 13 and 14 are rigidly held together by means of nuts 15 engaging spacing tubes 16 which extend between said crossheads and are adapted to slide upon the guide rods 7.

The upper crosshead 14 is provided for example with ears 17' to which may be attached pull rods 18 whereby the crossheads 13 and 14 may be raised. Tubes of insulating material 17, which may consist of hard insulating materials such as those known under the registered trademarks "Bakelite" and "Lorival", extend through and between the crossheads 13 and 14. These tubes 17 extend, as shown, slightly above and below the crossheads 14 and 13 respectively.

In Fig. 1 the switch or circuit breaker is shown with the parts in the open or tripped position. In order to close the circuit breaker it is necessary to raise the pull rods 18 and the main operating rod 11 until the moving contacts 2 firmly engage the fixed contacts 1.

The rod 11 and pull rods 18 may be raised by any suitable means, the means shown in Figures 1 and 1a being constructed as follows:

The guide rods 7 extend through the top 4 of the casing and are connected adjacent their upper ends by a crosshead 7'. The rod 11 and the pull rods 18 are slidable through openings in the top 4. The rod 11 is also slidable through the crosshead 7' and below said cross head carries a cross bar 11', the ends of which extend, respectively, through longitudinal slots 18' in the pull rods 18.

A handle 11a is secured to the upper end of the rod 11 whereby said rod may be raised.

A pair of hooks 7a, each having a beveled nose 7b, are pivoted on the lower side of the crosshead 7' and are adapted, when the rod 11 is raised, to engage the cross bar 11' and hold said rod in its raised position. A link 7c is connected to the hooks 7a for rocking said hooks and thereby disengaging them from the cross bar 11'.

When the rod 11 is raised by its handle 11a said rod will raise the bridge 6 and the cross bar 11', by engagement with the upper ends of the slots 18' of the pull rods 18, will raise said rods and with them the crossheads 13 and 14. When the cross bar 11' contacts with the beveled noses 7b of the hooks 7a said hooks will be rocked out of the path of said cross bar and will thereafter rock back beneath the cross bar to hold the rod 11 and pull rods 18 in their raised position and the movable contacts 2 in engagement with the fixed contacts 1. By pulling on the link 7c (to the right in Fig. 1a) the hooks 7a may be disengaged from the cross bar 11' to permit the rod 11 and pull rods 18 to move downwardly.

Coiled springs 19 upon the guide rods 7 between the top 4 and crosshead 14 serve to force the crossheads 13 and 14 and tubes 17 downwards when the pull rods 18 and actuating rod 11 are released.

The stems 3 have sockets 20 in their upper ends in which the circuit terminals 21 are frictionally held.

The casing 8—9 is adapted to be substantially filled with oil, and it will be readily understood that, upon the tripping of the switch or circuit breaker by the release of the rods 11 and 18, the crosshead 6 carrying the moving contact 2 will move down comparatively rapidly in the oil since said crosshead is of open formation, that is to say is so shaped that it cannot act like a pump piston as does the crosshead 14. The latter also moves down, but at a slower speed owing to the fact that during its movement it will displace the body of oil which is contained in the main casing beneath the crosshead or piston 14. The downward movement of the latter due to the powerful springs 19 causes oil to be forced with considerable pressure and at considerable velocity upwards through the tubular moving contacts 2 and also around the latter into the lower ends of the tubes 17 which constitute arc quenching chambers. The oil passes up through the tubes 17, around the fixed contacts 1, to the upper side of the piston crosshead 14. The parts are preferably so proportioned that about 60 per cent. of the total volume of oil used in the circuit breaker is displaced in the manner just above described each time the switch or circuit breaker is tripped. It will be observed that the internal diameter of the tubes 17 constituting the arc quenching chambers is only relatively slightly greater than the external diameter of the contacts 1 and 2, so that the oil must flow over said contacts at a relatively high velocity, thereby effectively cooling them whilst tending effectively to quench the arc.

In some cases it may be convenient to provide a stop 22 on the actuating rod 11, adapted to engage the crosshead 13 when the main contacts have separated a part of the full distance so that the rod 11 in its downward movement may assist in moving the piston crosshead 14.

In Fig. 3 balls 60 are shown between the co-operating contacts 1 and 3.

It will be understood that various modifications of the circuit breakers shown in the drawings may be made without departing from the scope of the invention.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An electric oil switch comprising an oil-containing casing, an oil barrier extending across said casing, a tubular arc quenching chamber of insulating material in said casing and extending through said barrier, said chamber being always at least partly immersed in the body of oil in said casing and open at both ends, a pair of co-operating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another longitudinally of said chamber to make contact in said chamber and forming with said chamber at all times a free oil channel from end to end of said chamber, and means permitting a relatively rapid separating movement between said contacts, said barrier being operable substantially independently of the

separating movement of said contacts to cause a considerable quantity of oil to flow under pressure through said channel during the separating movement of said contacts.

2. An electric oil switch comprising an oil-containing casing, a tubular arc quenching chamber of insulating material in said casing, said chamber being open at both ends and always at least partly immersed in the body of oil in said casing, means for moving said chamber longitudinally of said casing, a pair of co-operating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another and to said chamber longitudinally of said chamber, said contacts forming at all times with said chamber a free oil channel through the latter from end to end, means for causing a short rapid separation of said contacts, and means operable by the separation of said contacts for causing the flow of a considerable quantity of oil under pressure through said channel during the separating movement of said contacts.

3. An electric oil circuit breaker comprising an oil containing casing, a tubular arc quenching chamber of insulating material movable longitudinally of said casing, said chamber being open at both ends and always at least partly immersed in the body of oil in said casing, means for moving said chamber longitudinally of said casing, a pair of cooperating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another and to said chamber longitudinally of said chamber, said contacts forming at all times with said chamber a free oil channel through the latter, means permitting a relatively rapid separating movement between said contacts, and means associated with the said chamber and operable by the movement of the latter during the separation of said contacts for compressing the main body of oil and causing a large proportion of it to flow under pressure through said channel.

4. An electric oil switch comprising an oil-containing casing, a tubular arc quenching chamber of insulating material movable longitudinally of said casing, said chamber being open at both ends and always at least partly immersed in the body of oil in said casing, means for moving said chamber longitudinally of said casing, a pair of cooperating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another and to said chamber longitudinally of said chamber and forming with said chamber at all times a free oil channel through the latter, means permitting a relatively rapid separating movement between said contacts, and pumping means associated with said chamber for causing a considerable quantity of such oil to flow under pressure through said channel during the separating movement of the contacts.

5. An electric oil switch comprising a main oil tank, a tubular arc quenching chamber of insulating material always at least partly immersed in the body of oil in said tank and open at both ends, a pair of cooperating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another longitudinally of said arc quenching chamber and forming with said chamber at all times a free oil channel through the latter, means permitting a relatively rapid separating movement between said contacts, and means for causing a considerable quantity of the body of oil to flow under pressure through said channel during the separating movement of said contacts, said means comprising a piston in the main oil tank and movable in a direction parallel with that of contact separation.

6. An electric oil switch comprising an oil-containing casing, a tubular arc quenching chamber of insulating material open at both ends and always at least in part immersed in the body of oil in said casing, a pair of cooperating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another longitudinally within said arc quenching chamber to make contact therein and forming with said chamber at all times a free oil channel through the latter, means permitting rapid initial separation of said contacts, pumping means for causing a considerable quantity of oil to flow under pressure through said channel during the separating movement of said contacts in said chamber, and interconnecting means between the pumping means and the movable contact for first permitting the movable contact to move independently of said pumping means and thereafter causing said movable contact to move with said pumping means.

7. An electric oil switch comprising an oil-containing casing, a tubular arc quenching chamber movable longitudinally of said casing, said chamber being open at both ends and always at least in part immersed in the body of oil in said casing, a fixed contact member extending into one end of said chamber, a cooperating contact member extending into the other end of said chamber and movable therein to engage said fixed contact member, said contacts being of smaller cross-section than the internal cross-section of said tubular chamber to provide at all times a free oil channel through said chamber, and means for causing said chamber to follow the movement of said movable contact.

8. An electric oil switch comprising an oil-containing casing, a tubular arc quenching chamber of insulating material movable longitudinally of said casing, said chamber being open at both ends and always at least in part immersed in the body of oil in said casing, a fixed contact extending into one end of said chamber, a carrier stem for said contact which stem is shrouded in solid insulation, a cooperating movable contact extending into the other end of said chamber, a carrier member for said movable contact, said carrier members and contacts being of smaller cross-section than the internal cross section of said chamber to provide at all times a free oil channel through said chamber, and means for causing said chamber to follow the movement of said movable contact.

9. An electric oil switch, comprising an oil-containing casing, a tubular arc quenching chamber of insulating material open at both ends and always at least in part immersed in the body of oil in said casing, a fixed contact extending into one end of said chamber, a carrier stem for said contact which stem is shrouded in solid insulation, a co-operating movable contact extending into the other end of said chamber, a carrier member for said movable contact, said co-operating contacts being of smaller cross-section than the internal cross-section of said chamber to provide at all times a free oil channel through said chamber, supporting means for said chamber, said supporting means being movable in said casing for

causing a considerable part of the body of oil to flow under pressure through said chamber during separation of said contacts, and means for moving said supporting means longitudinally of said casing.

10. An electric oil switch, comprising a main oil tank, a pump piston movable in said tank, a tubular arc quenching chamber of insulating material extending through said piston, said chamber being open at both ends and always at least in part immersed in the body of oil in said tank, a fixed contact member extending into one end of said chamber, a second movable contact member extending into the other end of said chamber, said contact members being of smaller cross-section than the internal cross-section of said chamber to provide a free oil channel through said chamber, spring means normally urging said piston in the direction of separation of said moving contact, and trippable latching means for holding said piston against said spring means when the contact members are engaged.

11. An electric oil switch, comprising a main oil tank, a pump piston movable in said tank, a tubular arc quenching chamber of insulating material extending through and carried by said piston, said chamber being open at both ends and always at least in part immersed in the main body of oil in said tank, a fixed contact member extending into one end of said chamber, a second contact member extending into the other end of said chamber and movable into and out of engagement with the first-named contact member, means for moving said second contact member into engagement with the fixed contact member, said contact members being of smaller cross-section than the internal cross-section of said chamber to provide a free oil channel through said chamber, spring means normally urging said piston in the direction of separation of said moving contact member, spring means normally urging the movable contact member away from the fixed contact member, and trippable latching means for holding said piston against the first named spring means when the contact members are in engagement and for retaining said movable contact member against the second named spring means and in engagement with said fixed contact member, said second named spring means tending, when the piston and the movable contact member are in the latched positions, to move the movable contact member in advance of the piston and thereby cause a quick separation of said contact members while oil is pumped by the piston through the oil channel in the arc quenching chamber.

12. An electric oil switch, comprising a fixed oil-containing pump cylinder, a pump piston movable in said cylinder, a tubular arc quenching chamber of insulating material carried by and extending through said piston and always at least in part immersed in the body of oil in said cylinder, a fixed conductor stem extending into one end of said chamber, a switch contact member on the end of said stem within said chamber, a movable contact extending into the other end of said chamber and movable toward and away from said fixed contact member, said contacts, stem and chamber affording a free oil passage through said chamber, an actuating rod for said movable contact, said rod being movable relatively to said pump piston parallel to the direction of movement of the latter, spring means biassing said movable contact away from said fixed contact, spring means biassing said pump piston in the direction of separation of said contacts, latching means engageable with said actuating rod for holding said contacts together and holding the pump piston in opposition to its spring biassing means, and tripping means for releasing said latching means.

13. An electric oil switch comprising an oil-containing casing, an oil barrier across said casing, a tubular arc quenching chamber of insulating material extending through said barrier and always at least partly immersed in the body of oil in said casing and open at both ends, a pair of co-operating contacts extending, respectively, into the opposite ends of said chamber so as to make contact therein and movable relatively to one another and to said chamber longitudinally of said chamber, said contacts forming at all times with said chamber a free oil channel through the latter from end to end, means for causing a short rapid separation of said contacts, and means whose operation commences with but is otherwise substantially independent of the separation of said contacts for causing the flow of a considerable quantity of oil under pressure through said channel from one side of said barrier to the other during the separating movement of said contacts.

14. An electric oil circuit breaker comprising an oil containing casing, an oil barrier across said casing, a vertical tubular arc quenching chamber of insulating material extending through said barrier, said chamber being open at both ends and always at least partly immersed in the body of oil in said casing, a pair of co-operating contacts extending, respectively, into the opposite ends of said chamber and movable relatively to one another and to said chamber longitudinally of said chamber so as to make contact therein, said contacts forming at all times with said chamber a free oil channel through the latter, means permitting a relatively rapid separating movement between said contacts, and means associated with said chamber and operable at least in part independently of the movement of the contacts during their separation for compressing the main body of oil and causing a large proportion of it to flow under pressure upwards through said channel from the lower to the upper side of said barrier.

15. An electric oil switch comprising an oil-containing casing, an oil barrier across said casing, a tubular arc quenching chamber of insulating material extending through said barrier, said chamber being open at both ends and always at least partly immersed in the body of oil in said casing, a pair of co-operating contacts extending, respectively, into the opposite ends of said chamber so as to make contact therein and movable relatively to one another and to said chamber longitudinally of said chamber and forming with said chamber at all times a free oil channel through the latter, means permitting a relatively rapid separating movement between said contacts, and a pump piston within the casing movable substantially independently of the separating movement of said contacts for causing a considerable quantity of oil to flow under pressure through said channel during the separating movement of the contacts.

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