C. CHRISTENSEN.

OIL SWITCH.

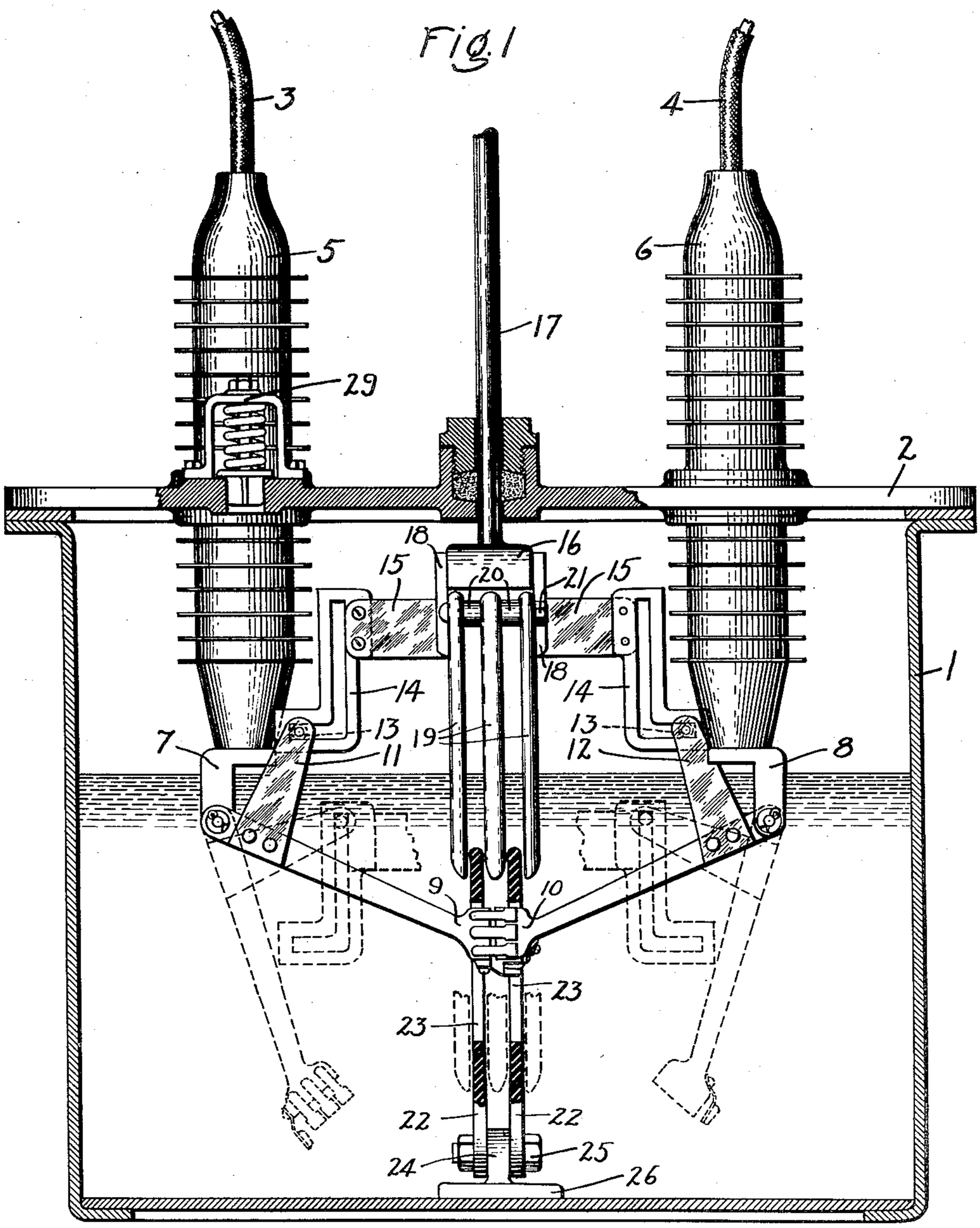
APPLICATION FILED JUNE 3, 1907.

991,480.

Patented May 9, 1911.

2 SHEETS—SHEET 1.

Fig. 1



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2 SHEETS—SHEET 2.

Fig. 2

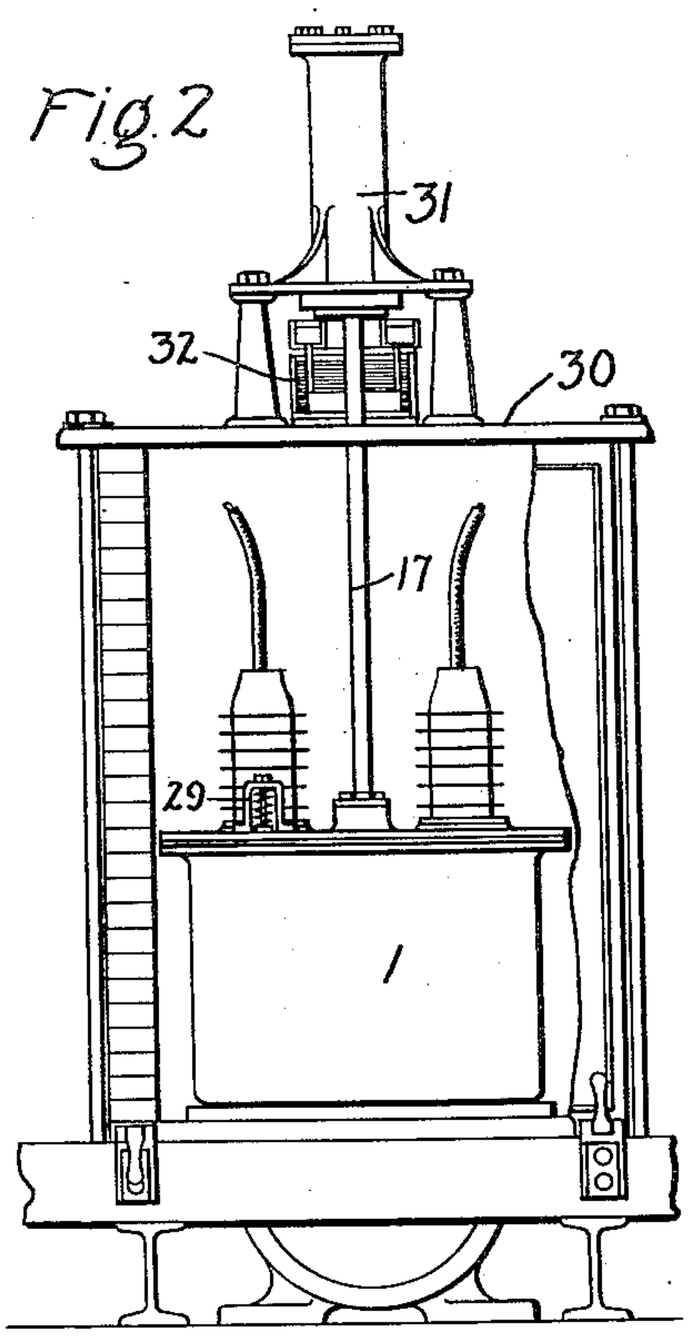
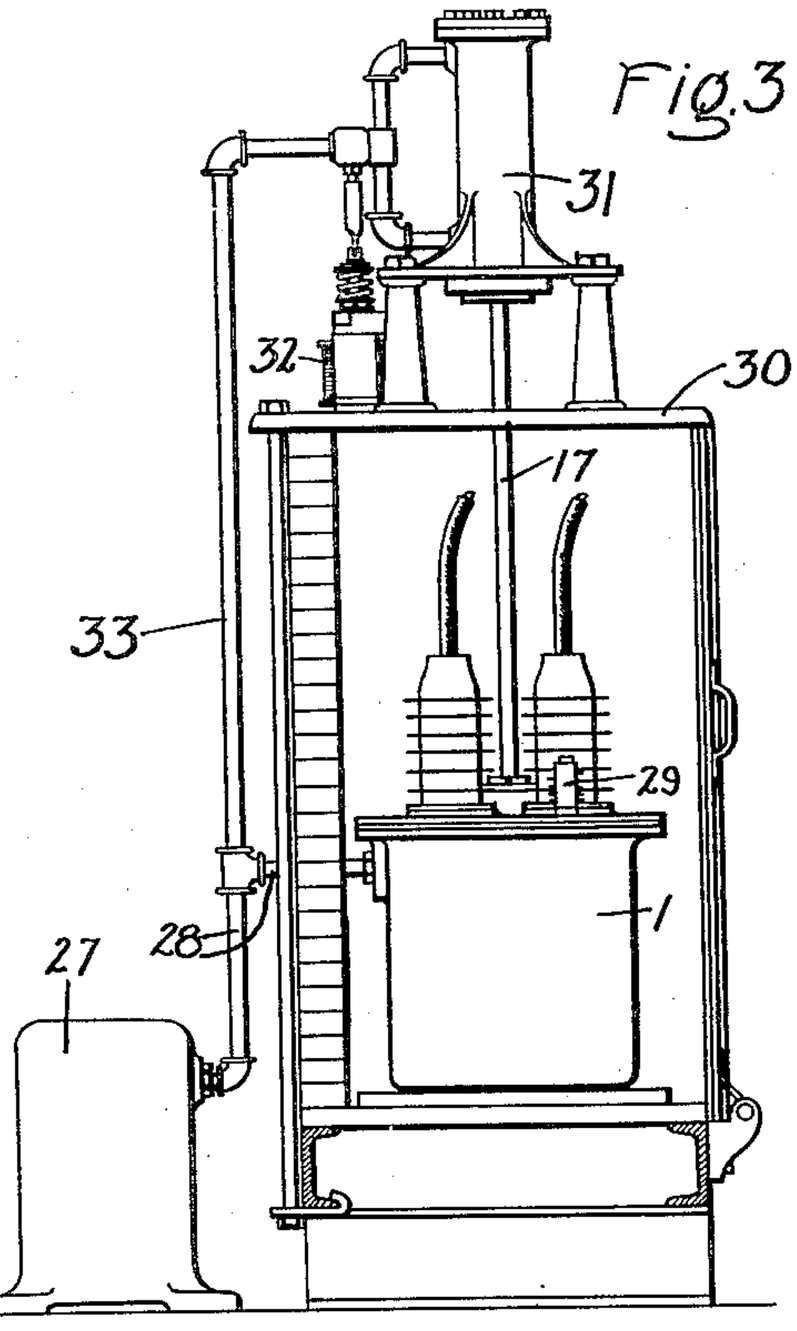


Fig. 3



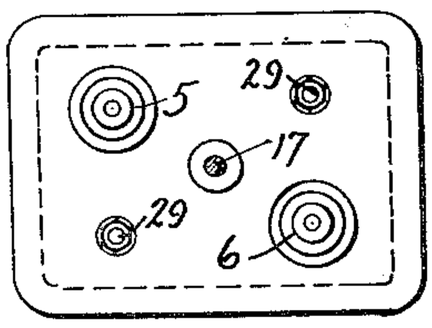


Fig. 4

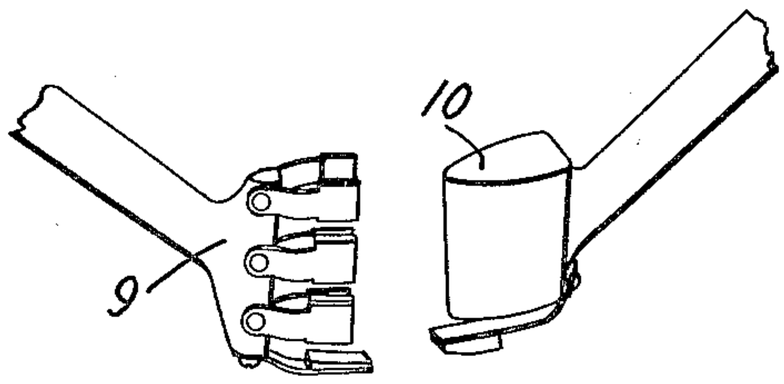


Fig. 5

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UNITED STATES PATENT OFFICE.

CHRISTEN CHRISTENSEN, OF SCOTIA, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

OIL-SWITCH.

991,480. Specification of Letters Patent. Patented May 9, 1911.

Application filed June 3, 1907. Serial No. 376,912.

To all whom it may concern:

Be it known that I, CHRISTEN CHRISTENSEN, a subject of the King of Denmark, residing in the village of Scotia, county of Schenectady, State of New York, have invented certain new and useful Improvements in Oil-Switches, of which the following is a specification.

My invention relates to electric switches and more particularly to switches in which oil or other insulating fluid is used to extinguish the arc formed when the circuit is opened.

The extent to which the contacts of a switch must be separated in order to break the arc which is formed as the switch opens increases with the voltage on the circuit, until with the high voltages used on modern transmission lines the contacts of the switches must move through a path of such length that the switches for controlling such high voltage circuits become very bulky and therefore objectionable. It has also been found that the arc formed on opening a circuit carrying a large amount of energy is very persistent, tending to drive the oil away from the vicinity of the arc and preventing the oil from flowing between the contacts, so that the arc becomes much larger than is desirable.

The object of my invention is to produce an oil switch which will occupy much less space than the switches heretofore used for controlling circuits of the same voltage, in which the cross-section of the arc is reduced mechanically until the arc breaks, and in which the effectiveness of the oil is much increased.

In carrying out my invention, I reduce the dimensions of the switch by shortening the path of movement of the contacts, and insure the rupturing of the arc by contracting the cross-section of the arc by mechanical means such as moving barriers of refractory insulating material, these barriers acting on opposite sides of the arc stream and coöperating with each other to shear or cut the arc and finally interpose a barrier of solid insulating material between the two contacts after the contacts have separated. I also increase the efficiency of the oil in the switch by drawing the arc horizontally and therefore approximately parallel to the surface of the oil and by maintaining the oil under pressure, thereby insuring a flow of oil into the space between the contacts at the instant the contacts separate, preventing the cross-section of the arc stream from increasing even though the amount of energy on the circuit is great and insuring that the arc will be drawn horizontally into cool oil which is not lifted and scattered by the heat of the arc.

My invention will best be understood in connection with the accompanying drawings, which are merely an illustration of one embodiment of my invention and in which—

Figure 1 is a cross-section of an oil vessel of one form of oil switch to which my invention is adapted; Fig. 2 a front elevation showing the operating mechanism of the switch and the fire-proof cell in which the oil vessel is placed; Fig. 3 a side view, partly in section, of the mechanism shown in Fig. 2; Fig. 4 a top plan view of the switch showing the disposition of the insulators; and Fig. 5 a perspective view of the contacts.

The drawings show a switch in which the oil is contained in any suitable oil vessel 1, preferably constructed of boiler plate or other material having considerable tensile strength. The oil vessel is rendered air-tight by a top 2 which makes a tight joint with the edges of the oil vessel. Leads 3 and 4 of the circuit to be controlled are brought to the switch and connected through insulators 5 and 6 carried by the top 2, to heads 7 and 8 firmly attached to the lower ends of the insulators projecting into the oil vessel 1. The circuit is opened and closed by means of coöperating contacts, 9 and 10, pivotally mounted on the heads 7 and 8 to swing toward and away from each other and draw the arc horizontally and approximately parallel to the surface of the oil. The contacts are swung on their pivots by means of any suitable actuating mechanism, and for purposes of illustration, I have shown the contacts provided with operating arms 11 and 12, preferably of insulating material, each arm with one end firmly secured to the contact and the other end carrying a roller 13 engaging a right angled slot in an actuating member 14. The horizontal portion of the slot is at right angles to the path of movement of the actuating member and the vertical portion is parallel to said path. The actuating members 14 are carried by cross arms 15 of insulating material which are securely attached to a head

16 of an actuating rod 17 which passes through a stuffing box in top 2. A downward movement of the rod 17 causes the rollers 13 to move along the horizontal portion of the slots in the actuating members 14, whereupon the contacts 9 and 10 are swung away from each other to the position shown in dotted lines in Fig. 1. When the contacts reach this position, the rollers 13 are in alinement with the vertical portion of the slots in the actuating members 14, and further downward movement of the actuating rod and the actuating members 14 locks the contacts in the position shown in the dotted lines.

The distance between the contacts when they are in the position shown in dotted lines in Fig. 1 is much less than in the switches heretofore used for controlling circuits of the same voltage, and it is necessary to provide some means for insuring the rupture of the arc even though it should hold over through the oil. The arc is preferably positively ruptured by mechanical means acting to reduce the area of the cross-section of the arc stream and finally to cut the arc stream in two. One arrangement for accomplishing this result is shown in the drawings and comprises arms 18 mounted on the head 16 at right angles to the plane of the cross-arms 15, and carrying barriers 19 of any suitable refractory material, preferably fused quartz, which has a high dielectric value and a very low coefficient of expansion, so that it is not affected by sudden changes of temperature. If a plurality of barriers are used, I provide for a free flow of oil between them by mounting them as shown in Fig. 1, with spacers 20 between the barriers and with the barriers held in proper relation to each other by means of bolts 21. The barriers 19 are secured to the actuating mechanism of the movable contacts, and move up and down through the oil as the switch is operated, to engage one side of the arc. In order to reduce the cross-section of the arc, the barriers 19 must cooperate with other barriers engaging the other side of the arc, and I have shown them coöperating with stationary barriers 22, each of which is provided with an opening 23 for the passage of the movable contacts. In the drawing, I have shown two barriers 22 secured by bolts 25 to the uprights 24 of brackets 26 attached to the bottom of the oil pot. The length of the barrier 19 is preferably less than the length of the barriers 22, so that the oil between the barriers 22 may freely escape as barrier 19 descends. The number of the barriers and their relation to each other is immaterial so long as they cooperate to reduce the cross-section of the arc, and finally to shear or cut it. In the arrangement shown in the drawing, the movable barriers 19 are interleaved with the stationary barriers 22 and act upon the arc stream extending from one contact through the openings 23 to the other contact, like several pairs of shears, first compressing the arc stream and then shearing or cutting it in two. The free movement of the barriers is not hindered by oil trapped between them, since the oil may flow freely from between the barriers to the oil vessel.

It has been found that when an arc is formed under oil, the arc gases and the vaporized oil tend to drive the oil away from the arc, thereby giving the arc stream an opportunity to increase in cross-section, whereupon its resistance is reduced and more current flows, thereby increasing the amount of heat generated by the arc. If the amount of energy to be ruptured by the switch is great, the arc may produce an explosive action in the oil, driving practically all of the oil away from the vicinity of the contacts and permitting the area of the cross-section of the arc to increase very rapidly particularly if the arc is drawn approximately parallel to the surface of the oil. It is desirable, therefore, to restrict the increase of size of the arc as much as possible and to cause the oil to flow in between the electrodes at the instant the electrodes separate. I accomplish this result by maintaining the oil in which the contacts separate under considerable pressure, which may amount to several hundred pounds per square inch if necessary, so that the increase in cross-section of the arc stream is resisted much more strongly than in the ordinary oil switch, while the oil is forced in between the contacts at the instant they separate and before the arc attains an objectionable size and volume. The pressure may be maintained upon the oil in any suitable manner, but the arrangement which I prefer for this purpose is shown in Fig. 3, and comprises an air compressor 27 which, through a pipe 28, delivers air under a pressure of one hundred or more pounds per square inch to the oil vessel 1. In order to avoid the destruction of the oil vessel in case a circuit carrying a very great amount of energy is opened by the switch, I provide safety valves 29 on the top 2 of the switch, so set that they will yield under excess pressure and permit some of the air and gas in the switch to escape and thereby prevent destruction of the oil vessel.

The actuating mechanism of the switch may be given a reciprocating motion by any suitable mechanism, and the mechanism which I have shown for the purposes of illustration only is that described in patent to Hewlett, No. 815,824, dated March 20, 1906. This operating mechanism, mounted upon the top-plate 30 of the fire-proof cell in which the oil vessel is mounted, comprises a cylinder 31, having a piston connected to the actuating rod 17, and actuated by com-

pressed air, its movements being controlled by a valve mechanism operated in any suitable manner by a controlling magnet 32. The compressed air for driving the piston in the cylinder 31 is supplied through a pipe 33 by the air compressor 27.

My invention may be embodied in many other forms than that shown and described, and I therefore do not desire to be restricted to the precise construction shown, but intend to cover by the appended claims all changes and modifications within the spirit and scope of my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is,—

1. In an oil switch, the combination with a closed chamber partially filled with oil, of coöperating contacts arranged to separate therein under oil to draw the arc horizontally, and means for maintaining pressure upon an elastic fluid in said chamber.

2. In an oil switch, the combination with a closed chamber partially filled with oil, of coöperating contacts arranged to separate therein under oil to draw an arc horizontally, and means for maintaining air in said chamber under pressure.

3. In an oil switch, the combination with a closed chamber partially filled with oil, and means for maintaining air in said chamber under pressure, of oppositely movable coöperating contacts arranged to separate therein under oil to draw an arc horizontally, actuating means for said contacts, and a vertically movable barrier controlled by said actuating means to engage the arc to cut it.

4. In an oil switch, the combination with a chamber for oil, of coöperating contacts arranged to separate therein under oil, a movable actuating member for said contacts, a movable barrier mounted to move through the arc between said contacts, and means connected to said member and to said barrier for causing said barrier to remain out of engagement with the arc until after the greater part of the separating movement of said contacts has been completed and for then moving said barrier through the arc to cut it.

5. In an oil switch, the combination with a chamber for oil, of coöperating contacts separable therein under oil, movable actuating means arranged to separate said contacts during the first part of the movement of said actuating means and to lock the contacts immovable during the remainder of the movement of said actuating means, and a barrier carried into the arc stream by said actuating means after the contacts are locked immovable.

6. In an oil switch, the combination with a chamber for oil and coöperating pivoted contacts separable under oil in said chamber, of actuating means movable in a straight line and having slots with one part parallel to the line of movement and another part at right angles thereto, arms connected to said pivoted contacts, and rollers on said arms engaging the slots in said actuating means.

In witness whereof, I have hereunto set my hand this first day of June, 1907.

CHRISTEN CHRISTENSEN.

Witnesses:

HELEN ORFORD.

BENJAMIN B. HULL.