E. M. HEWLETT.

OIL SWITCH.

APPLICATION FILED FEB. 23, 1906.

1,045,288. Patented Nov. 26, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

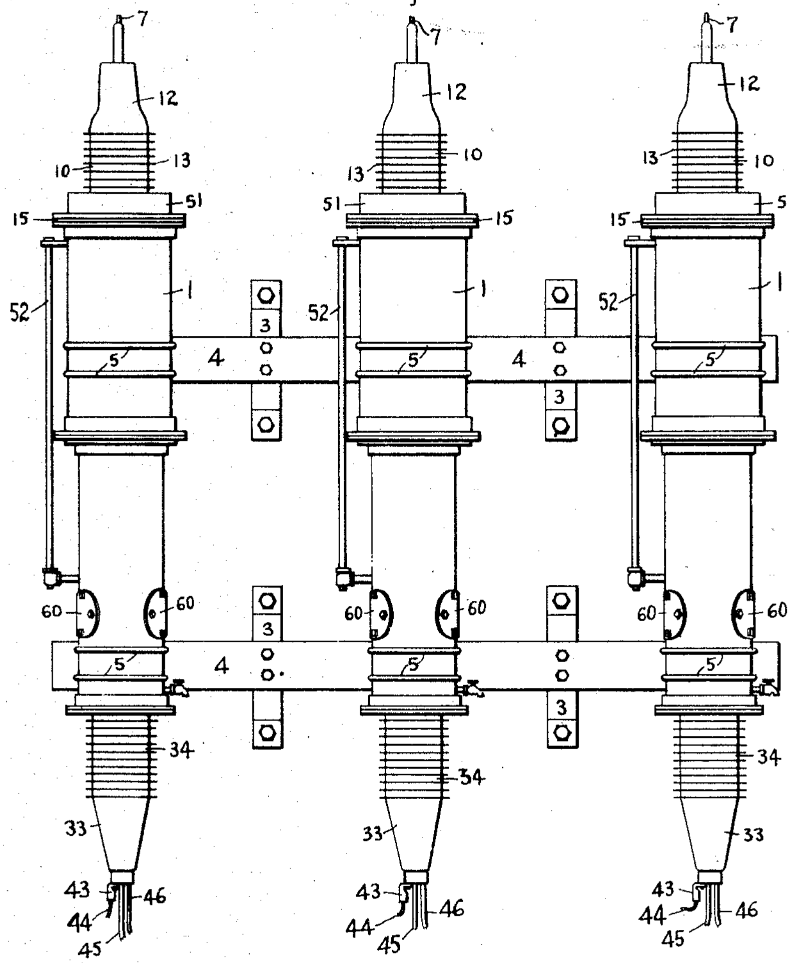
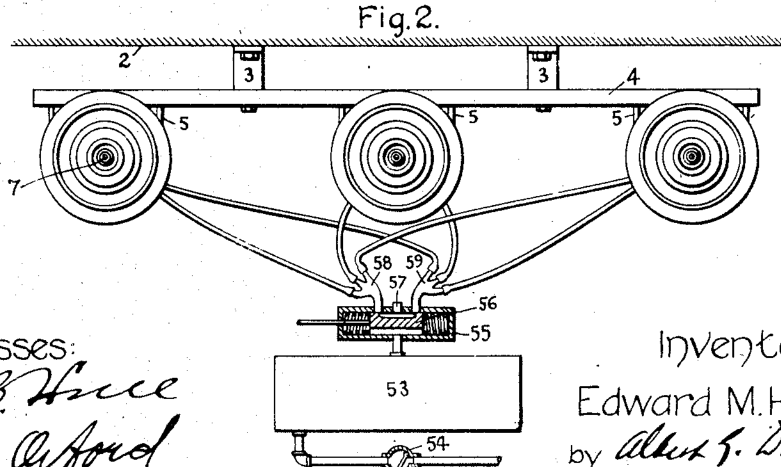


Fig. 2.



Witnesses:
B. B. Hull
Helen Orford

Inventor;
Edward M. Hewlett.
by Albert G. Davis
Att'y.

E. M. HEWLETT.

OIL SWITCH.

APPLICATION FILED FEB. 23, 1906.

1,045,288. Patented Nov. 26, 1912.

2 SHEETS—SHEET 2.

Fig.4

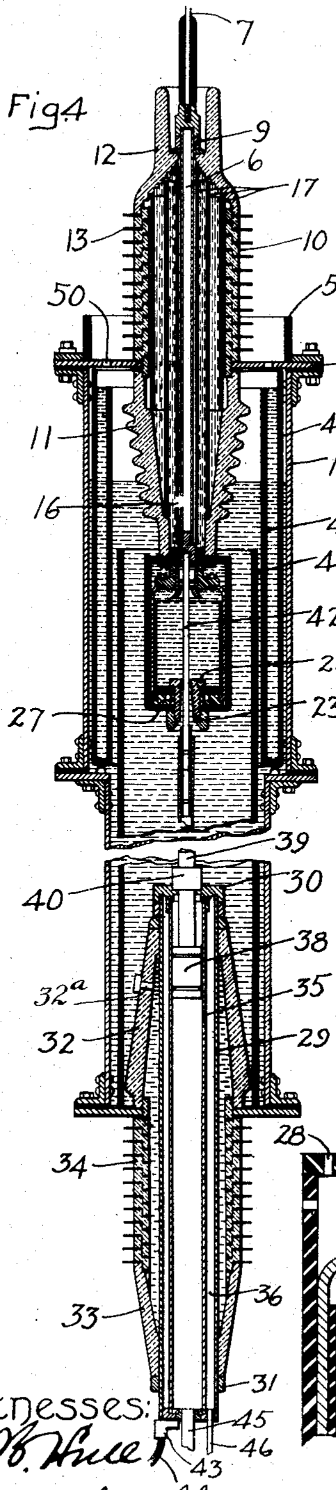


Fig.3

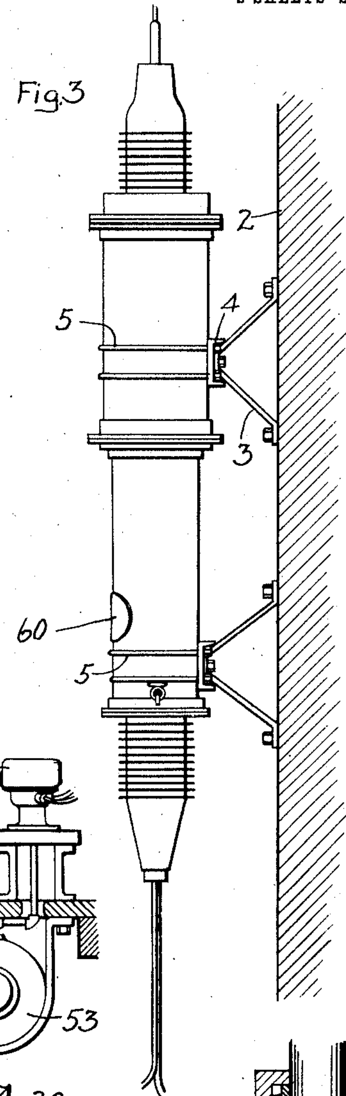
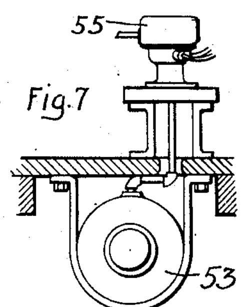


Fig.7



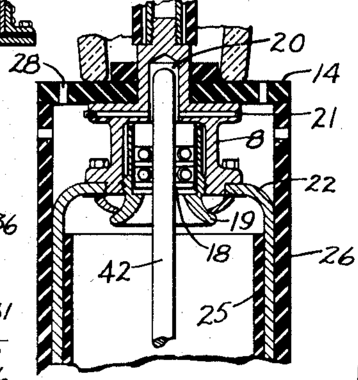
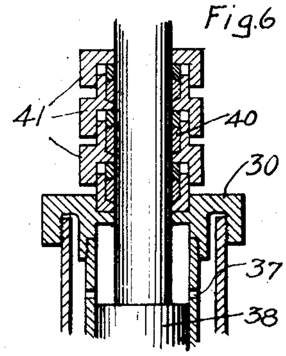


Fig.5

Fig.6



Witnesses:
B. B. Hull
Helen Orford

Inventor:
Edward M. Hewlett,
By Albert G. Davis
Att'y.

UNITED STATES PATENT OFFICE.

EDWARD M. HEWLETT, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

OIL-SWITCH.

1,045,288. Specification of Letters Patent. Patented Nov. 26, 1912.

Application filed February 23, 1906. Serial No. 302,438.

To all whom it may concern:

Be it known that I, Edward M. Hewlett, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Oil-Switches, of which the following is a specification.

This invention relates to devices for controlling electric circuits for currents of high potential and great volume.

The tendency in electrical practice at the present time is toward the use of very high potentials, especially in long distance transmission of power. As the potentials of transmission systems are increased, difficulties are encountered by reason of new problems which require extraordinary provisions to insure safety of operation and prevent danger to apparatus and operators. The present switch will safely handle potentials of 100,000 volts and upward, chiefly by reason of the novel construction which prevents breaking down of insulation and insures safe extinguishment of the powerful arc. In order to prevent destruction of the apparatus, the distance between those parts of the controlling devices which may be at different potentials must be increased as the potential of the circuit increases, and this distance becomes so great with extremely high voltages that the space factor becomes extremely important and renders the buildings unduly expensive.

The object of this invention therefore is to provide an improved apparatus of as small compass as is consistent with safety of operation, which shall be capable of controlling with ease and safety either single or polyphase circuits carrying currents of high potentials of the order hereinbefore referred to and of large amperage; to reduce the floor space required as compared with devices heretofore used to control such circuits; to simplify and strengthen the structure and increase the reliability and efficiency of operation; to make the insulation safe; to avoid the possibility of destructive arcs being formed from one part of the apparatus to another through the air; to extinguish quickly and surely the arc formed when the contacts separate to open the circuit; to provide means for quickly and positively opening or closing the circuit; and in general to render perfect the operation of controlling apparatus for circuits of high potential.

My invention consists, in general, of a vessel containing oil or other insulating liquid, relatively movable contacts in the ends of the vessel thoroughly insulated therefrom and connected to the leads of the circuit, and means for bringing the contacts into engagement or for separating them to close or to open the circuit. The contacts are preferably below the surface of the oil in the vessel and so arranged that only one is movable and shifts toward the bottom of the vessel when the circuit is broken. The movable contact may be actuated in any way desired, but it is considered preferable to actuate the contact by some other force than the strength of the operator and to do it with great rapidity to prevent any considerable arc products being formed; and my invention furthermore consists in providing a device, mounted at one end of the vessel and insulated therefrom, for actuating the movable contact by some power medium, preferably compressed air.

My invention furthermore consists in providing means for storing a sufficient supply of compressed air to operate the device and open the circuit in case the device for supplying compressed air fails to operate for any reason.

My invention also consists of means for drawing the arc in a strong small chamber filled with oil having small vents by reason of which the tremendous energy of the arc develops great pressure, and thus squeezes or contracts the arc stream thus increasing its ohmic resistance.

It consists also of additional means for increasing the arc resistance by causing the movable terminal to retreat through a small hole in an insulating diaphragm and then traverse a long path in the oil.

It comprises also other details of construction and of combinations of elements hereinafter described and pointed out in the claims.

The invention will be best understood by reference to the accompanying drawings, in which—

Figure 1 shows the switch in elevation; Fig. 2 is a plan view; Fig. 3 is a side elevation, showing the manner of supporting the switch; Fig. 4 is a sectional view of a cell of the switch; Fig. 5 is an enlarged sectional view of the fixed contact and surrounding parts; Fig. 6 is an enlarged sectional view of the upper end of the motor for operating the movable contact; and Fig. 7 is a view in elevation of the storage reservoir and distributing valve.

The particular switch shown in the drawings is for the purpose of controlling a three-phase circuit, although it will be apparent to engineers that the device may be modified to control a circuit of any number of phases. In the arrangement shown three cells are provided each controlling one of the phases of the circuit and all simultaneously opened or closed. Each cell consists of a casing 1 mounted in any convenient way and provided with a good ground. A masonry or other suitable wall 2 carries a series of brackets 3, which support two channel iron beams 4. The casings 1 of the cells are secured to the beams 4 by means of clamps 5, consisting of iron bands encircling the casing and holding the casings firmly in position by means of nuts threaded on the ends of the bands and engaging the beams.

At the upper end of each casing a tubular contact rod 6 is mounted, to which a conductor 7 leading to the line is connected. The tubular contact rod is secured to a head 8 at one end, and carries a nut 9 at the other end. It is supported on the end of the casing and insulated therefrom by an insulator composed of a series of annular sections 10, and porcelain caps 11 and 12, the whole being held together by the tubular contact rod 6. The sections 10 are formed of indurated fiber, or any suitable insulating material, and disks 13 of insulating material are placed between the sections, projecting beyond the outer surface of the sections in order to increase the creepage surface of the insulator. The lower porcelain cap 11 is cone shaped, and may have ribs or projections on the surface. This cap projects downward into the casing, and the lower end thereof may be beneath the surface of oil in the casing. The lower end of the cap 11 is engaged by an insulating disk 14, which is held in position between the cap 11 and the head 8 of the tubular contact rod. The upper end of the cap 11 is in engagement with the lower surface of a cover 15, which closes the top of the casing. The bottom one of the sections 10 is in contact with the upper surface of the cover 15, and as many sections are added as are necessary to build up the insulator to the desired height. The top of the insulator is formed by the cap 12, through which the tubular contact rod 6 passes. The nut 9 engages the cap 12 and thereby the tubular contact rod 6 holds all the parts of the insulator firmly in place. The annular sections form the walls of a short tube the ends of which are closed by the caps 11 and 12. A small opening 16 is provided in the tubular contact rod 6 forming a passage between the interior of the insulator and the interior of the rod. The interior of the insulator is filled with oil or other insulating liquid by pouring the oil into the upper end of the tubular contact rod 6. The oil rises quietly in the insulator, and no air bubbles are formed. Partitions 17, preferably but not necessarily of insulating material, are arranged in the interior of and concentric with the walls of the insulator, thereby dividing the oil into a series of concentric layers. It has been found that this arrangement materially increases the dielectric strength of the body of oil.

The head 8 carries a ring contact 18, formed of a series of segments held in position by springs which tend to move said segments toward the center of the ring. The contact 18 is held in place by a sleeve 19 screwed into the head 8. The head 8 is provided with an axial passage 20 and a transverse passage 21, of small area, forming a restricted vent. A plug may be placed in the end of the passage 21 and a small opening transverse to the passage provided, in order to diminish the velocity of the gases passing through the passage 21.

A pressure accumulating and restraining chamber 22 is secured to the head 8 by bolts or in any other suitable way. This chamber is preferably formed of pressed steel and is of great strength. The lower edges of the chamber are turned inward and support a closure 23 which carries a sleeve 24, preferably of insulating material, but not necessarily so, as the sleeve may be made of metal, if insulated from the head 8. The opening through the sleeve 24 is preferably cone shaped, and larger at the bottom than at the top. The chamber 22 is lined with insulation 25 while an insulating sleeve 26 loosely surrounds the chamber and is held against the insulating disk 14 by a disk 27, which is supported by the chamber 22. Vents 28 are provided in the disk 14 to permit air or gas to escape from the chamber 22 by way of the passages 20 and 21 without disturbing the body of oil surrounding the chamber 22. Oil may form a thin layer of insulation between the chamber 22 and the sleeve 26, which is not disturbed by movements of the oil in the casing 1.

The lower end of the casing 1 is closed by an insulator constructed in substantially the same manner as the insulator mounted on top of the casing. The lower insulator is held together by a tube 29 carrying a head 30 at the upper end and a nut 31 threaded on the tube at the lower end. The head 30 and the nut 31 engage porcelain end-pieces 32 and 33, and thereby hold the insulating rings 34 of the insulator in place, the spaces around the tube 29 being filled with oil through an opening 32^a in the porcelain end piece 32, this opening being closed by a suitable plug after the insulator is filled. Inside the tube 29 is mounted a cylinder 35, the outer diameter of which is less than the inner diameter of the tube. As a result of this construction, there is formed an annular chamber 36 between the outer wall of the cylinder and the inner wall of the tube. This chamber 36 communicates with the interior of the cylinder at the upper end thereof by means of ports 37, which are located a short distance from the head 30. A piston 38 works in the cylinder 35 and carries a tubular piston-rod 39 passing out through a stuffing-box 40 on the upper end of the insulator. The stuffing-box is formed with several glands 41 to insure durability. The tubular piston-rod 39 carries at the upper end thereof a contact-rod 42 which passes through the sleeve 24 in the chamber 22 and comes into engagement with the fixed contact 18. The cylinder 35 is preferably made of brass or other good conducting metal, and is in electrical connection by means of the connector 43 and the tube 29 with a lead 44 connected to the generator. As a result of this arrangement the cylinder 35 is always at the potential of the generator lead and current flows through the lead 44 to the cylinder 35, thence to the piston 38, through the tubular piston-rod 39 to the fixed contact 18 and to the line. The cylinder 35 and piston 38 form a motor for actuating the movable contact which is operated by means of compressed air supplied through pipes 45 and 46. The pipe 45 communicates with the interior of the cylinder 35, while the pipe 46 communicates with the annular chamber 36 between the cylinder and the tube. The admission of compressed air to the cylinder 35 through these pipes is controlled by mechanism hereinafter described.

The casing of the switch is provided with an insulating lining 47 extending from the bottom of the switch to within a short distance of the top thereof. The upper end of the casing is enlarged and is provided with an insulating lining formed of two concentric walls 48 and 49 of insulating material, these walls being connected at the bottom. The walls of insulating material extend to the top of the casing, and the annular space between the insulating walls is filled with oil or other insulating liquid. When the switch is in use oil is put into the casing so that the chamber 22 is submerged, but the oil does not reach to the top of the casing 1. The insulating walls 48 and 49 extend to the cover, which closes the upper end of the casing. These insulating walls with the layer of oil between them form a lining for the upper end of the switch, which is not affected by any movement of the body of oil in the switch casing. It may occur in the operation of the switch that the arc gases formed on opening the circuit will escape from the chamber 22 and bubble up through the body of oil, thereby materially decreasing the dielectric strength of the body of oil and setting up a path of comparatively low resistance between the chamber 22 and the upper end of the casing 1. The insulating walls and the layers of undisturbed oil between them, however, provide a lining of sufficient dielectric strength to prevent the passage of a spark from the chamber to the casing, even though all the oil between the chamber and the insulating lining were removed.

The lining 47 is concentric with the casing of the switch and with the linings 48 and 49 divides the body of oil into sections. The lining 47 does not extend to the surface of the oil, and is for the purpose of preventing displacement of the oil when the switch is operated. When the circuit is opened the arc produced tends to blow the oil out of the casing an set up disturbances which decrease the insulating power of the body of oil. As a result of the use of the lining 47 any disturbance in the oil caused by the arc will be confined to the immediate neighborhood of the contacts, and a layer of oil between the lining 47 and the casing 1 remains undisturbed.

In order to allow for the escape of the vapors and gases caused by the arc, vents 50 are provided in the upper cover 15 of the casing. These vents are not large, and permit the free escape of the vapors, although tending to prevent the oil splashing out of the switch casing. A ring 51 mounted on the cover prevents loss of oil.

In order to insure that the oil is maintained at the proper level, a gage-glass 52 is connected to the interior of the casing at a point well down where the oil is not disturbed or agitated so that the attendant can see at all times the level of the oil.

In order that the stuffing-box may be repacked or tightened up in case it should become necessary, hand-holes 60 are provided in the casing, the each hand-hole being closed by a plate. The holes are large enough to permit the attendant to reach the stuffing-box and make any necessary repairs thereto. The sections of the casing are detachably secured together, and may be separated to facilitate repairs which cannot be made through the hand-holes.

The switches are operated by means of compressed air, which may be furnished from any convenient source, such as a pump or compressor, operated either by hand or by power. It is evident that any fluid under pressure could be used and also that the switches might be operated by means of rods connected to the movable contacts, the rods being moved in any convenient manner. In a large station, where several switches are in use, an air compressor may be installed, driven by an induction motor or any other similar device. The compressor delivers to a large supply reservoir, and pipes lead from the supply reservoir to storage reservoirs 53 connected to the switches. Each switch is provided with a storage reservoir 53 for furnishing air to operate the switch. In the arrangement shown in the drawings, where each switch is composed of three cells, the reservoir 53 of each switch supplies air to all three cells. As it is desirable that the air used in operating the switches be very dry, some sort of dryer is preferably placed either between the compressor and the supply reservoir or between the supply reservoir and the storage reservoirs of each of the switches. The dryers may be any of the well-known devices used for removing moisture from air. A check-valve 54 is provided between the supply reservoir and each storage reservoir 53 for the purpose of admitting air to the storage reservoirs, but preventing the passage of air from the storage reservoirs to the supply reservoir. The purpose of this arrangement is to insure a supply of air in the storage reservoir sufficient to open the switch even though the air compressor or the supply reservoir should fail.

The dry air from the storage reservoir 53 is led to the switches through the pipes 45 and 46. These pipes, substantially equal in length, are composed of insulating material, and are of such length that there will be no leakage of current from the generator lead along the pipes to the storage reservoir. A portion of the pipes is preferably made of glass in order that any leakage of oil through the stuffing-box, into the cylinder and into the pipes, may be readily detected and also in order that moisture in the air for operating the switch may be detected by the attendant.

Air from the storage reservoir 53 is distributed to the pipes 45 and 46 by means of a distributing valve of any desired form, mounted in a valve chest 55. It is evident that many forms of distributing valve could be used to deliver air to the pipes 45 and 46 at the proper times, and the slide valve 56 shown in the drawings is merely an illustration of one of the numerous forms which may be used. This valve is a sliding D-valve. The valve is mounted in the chest 55 having ports 57, 58 and 59. The port 57 is an exhaust-port and opens to the air. The port 58 communicates with the pipes 46, which lead into the annular space between the tube and cylinder. The other port 59 communicates with the pipes 45 which lead to the interior of the cylinders of the switches. The valve is so proportioned that when in normal position both port 58 and port 59 are in communication with exhaust port 57, thereby permitting exhaust to atmosphere from both ends of the operating cylinder. The distributing valve 56 may be operated in any desired manner, either by the hand of the operator in charge of the switches or in any other desirable way, as by solenoids. Springs are provided, as indicated, which tend to return the distributing valve to its normal position, whenever the operating means is released.

The operation of the circuit controlling device is as follows: Assuming the switch to be closed, the movable contacts are in engagement with the fixed contacts. The distributing valve 56 is moved so as to uncover the port 58. Compressed air flows from the storage reservoir through the pipe 46 to the annular space 36 between the tube and the cylinder of each switch, and, acting upon the upper surface of the piston, forces it downward, thereby separating the contacts and opening the circuit. As the contacts separate an arc is formed in the chamber 22, but the force of the explosion caused by this arc is confined to the chamber 22, and as the arc gases rush out through the sleeve 24 in the bottom of the chamber, the gases are cooled by the surrounding oil. The breaking of the arc is aided by the rapidity with which the moving contact leaves the stationary contact. The movable contact, after withdrawing from the small cylinder 22, has a long path of movement in the main cylinder and the arc is certain to be ruptured. This is assisted materially by the contracted opening in the bottom of the small cylinder 22 and by the long downward movement in oil. In order to close the switch, the distributing valve is moved to the other position. The port 59 is uncovered, admitting compressed air to the interior of the cylinders. When the valve 56 returns to normal position, after having been moved to open the switch, communication is established between the port 58 and port 57, thereby permitting the air to escape from the upper end of the cylinder through the annular space 36 between the tube and the cylinder, the pipe 46 and the port 57 to the outer air. The pressure of the air beneath the piston forces the piston upward and brings the contacts into engagement, thereby closing the circuit.

The distributing valve 55 is placed below the level of the cylinder 35, so that the pipes 45 and 46 are given enough inclination to cause any moisture or oil which may accumulate in the pipes to drain toward the valve 55.

Many changes and modifications may be made in the structure above described by those skilled in the art without departing from my invention, and I therefore do not regard my invention as limited to the exact structure shown, but consider all changes in structure and arrangement that are within the scope of the appended claims, to be within the scope of my invention.

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

1. In an electric switch, the combination of a metallic support, relatively movable coöperating contacts mounted on and insulated from said support, fluid pressure operating mechanism mounted on and insulated from said support and connected to one of said contacts, said mechanism being connected to one of the leads of the circuit to be controlled, and insulating means for supplying fluid under pressure to said operating mechanism.

2. In an electric switch, a metallic support, insulators mounted on said support adjacent each other, a stationary contact mounted on one of said insulators, fluid pressure operating mechanism mounted on the other of said insulators, a movable contact mounted on said mechanism to be carried into and out of engagement with said stationary contact, and insulating means for supplying fluid under pressure to said operating mechanism.

3. In an electric switch, the combination of a metallic support, an insulator secured to said support, fluid pressure operating mechanism mounted on said insulator, and connected to one lead of the circuit to be controlled, a movable contact mounted on said operating mechanism and moved thereby into and out of circuit closing position, insulating means for supplying fluid under pressure to said operating mechanism, and a stationary contact insulated from said support and mounted thereon in a position to be engaged by said movable contact.

4. In an electric switch, the combination of a metallic vessel containing oil, a stationary contact mounted on and insulated from one wall of said vessel in a position to project into the oil in said vessel, a fluid pressure operating mechanism mounted on and insulated from another wall of said vessel and projecting into the oil in said vessel, a movable contact carried by said operating mechanism into and out of engagement with said stationary contact, and insulating means for supplying fluid under pressure to said operating mechanism.

5. In an electric switch, the combination of a metallic vessel containing oil, a stationary contact mounted on said vessel to project into the oil in said vessel, a cylindrical insulator mounted in another wall of said vessel, a metallic cylinder extending through said insulator longitudinally thereof and connected to one lead of the circuit to be controlled, a metallic piston in said cylinder, a metallic contact mounted on and carried by said piston, and insulating means for supplying fluid under pressure to said cylinder to cause said piston to carry said movable contact into and out of engagement with the stationary contact.

6. In an electric switch, the combination with a metallic vessel containing insulating fluid, of a stationary contact insulated from and mounted on one end of said vessel, a movable contact mounted to coöperate with said fixed contact, fluid pressure operating mechanism insulated from and mounted on the other end of said vessel and comprising a metal guide for said movable contact, said guide being connected to form part of the circuit to be controlled, and insulating means for supplying fluid under pressure to said operating mechanism.

7. In an electric switch, the combination with a metallic vessel containing insulating fluid, of a stationary contact at one end of said vessel, a movable contact insulated from said vessel and mounted to coöperate with said fixed contact, fluid pressure operating mechanism for said movable contact mounted on and insulated from the opposite end of said vessel, and insulating means for supplying fluid under pressure to said operating mechanism.

8. In an electric switch, the combination with a vessel containing insulating fluid, of a stationary contact arranged to project into said vessel, an insulator mounted on said vessel at one end thereof, a cylinder carried by said insulator, a piston in said cylinder, a movable contact actuated by said piston to coöperate with said fixed contact and connected to one lead of the circuit to be controlled, and insulating means for supplying fluid under pressure to said cylinder for actuating said piston.

9. In an electric switch, the combination with a metallic vessel containing insulating fluid, of a stationary contact mounted on and insulated from one wall of said vessel, an insulator mounted on another wall of said vessel, a metal cylinder mounted in said insulator and connected to one lead of the circuit to be controlled, a piston in said cylinder, a movable contact mounted on said piston and carried thereby into and out of engagement with the stationary contact, and insulating means for supplying fluid under pressure to said cylinder to actuate said piston.

10. In an electric switch, the combination with a vessel containing insulating fluid, of coöperating relatively movable contacts, an insulator mounted on one wall of said vessel, fluid pressure operating mechanism comprising a metallic cylinder and a piston mounted in said insulator and connected to

one of said contacts, a source of supply of fluid under pressure, and insulating connections between said source and said fluid pressure operating mechanism.

11. In an electric switch, the combination with a vessel containing insulating fluid, of a stationary contact mounted to project into said fluid, a cylinder mounted on and insulated from said casing and connected to one lead of the circuit to be controlled, a piston in said cylinder having a piston rod formed as a contact to coöperate with said fixed contact, insulated pipes connected to the opposite ends of said cylinder, and means for introducing at will fluid under pressure to said pipes.

12. In an electric switch operated by fluid under pressure and comprising a vessel containing insulating liquid, the combination with an insulated fluid pressure operating mechanism connected to one lead of the circuit to be controlled and mounted on said vessel to project through the wall thereof below the surface of said liquid, of a distributing valve for fluid provided with an exhaust port and placed below said mechanism, and insulating pipes leading upward from said valve to said operating mechanism.

13. In an electric switch, the combination with a metallic casing connected to the ground, of coöperating switch contacts carried thereby, and insulators for supporting said contacts composed of annular sections forming the walls of a chamber for insulating liquid, caps closing the ends of said chamber, and means for holding said caps in position.

14. An electric switch comprising a vertical switch cell, hollow insulators containing oil at each end of the cell, porcelain caps for the insulators carrying the leads and the contacts, a pressure chamber in which the arc is drawn mounted on the upper insulator, and a movable contact mounted in the lower insulator, whereby an arc of high potential may be drawn by a long movement of the movable contact.

15. In an electric switch, the combination of a vessel containing oil and a cover for said vessel, of a porcelain cap engaging the inner side of said cover, a chamber filled with oil having walls formed of annular sections engaging the outer side of the cover, a cap for closing the outer end of said chamber, partitions concentric with the walls of said chamber, and means for holding said porcelain cap and said annular sections in engagement with said cover.

16. In an electric switch, the combination with a casing containing an insulating liquid, of an insulating lining for said casing, and a plurality of walls mounted concentric with the walls of said casing to place the spaces between said walls in communication and to divide the liquid into layers.

17. In an electric switch, the combination with a vessel containing an insulating liquid, of coöperating relatively movable contacts therein, and a plurality of walls with intercommunicating spaces between them mounted concentric with the walls of the vessel to divide the liquid into layers.

18. In an electric switch, the combination with a vessel containing an insulating liquid, of coöperating relatively movable contacts therein, and a plurality of partitions mounted concentric with the walls of the vessel with spaces between the partitions in communication whereby the liquid is divided into layers.

19. In an electric switch, the combination with a cylindrical vessel containing oil, and coöperating relatively movable contacts beneath said oil, of a cylindrical oil restraining wall mounted concentric with the walls of said vessel to surround said contacts and to permit the oil to flow over one end of said oil restraining wall and thereby establish communication between the oil on both sides of said wall.

20. In an electric switch, the combination with a cylindrical vessel containing oil and relatively movable coöperating contacts therein, of an annular vessel having a central opening therein and set within said cylindrical vessel to surround said contacts, said annular vessel being filled with oil to form an annular insulating wall around said contacts.

21. In an electric switch, the combination with a vertical cylindrical vessel containing an insulating liquid, of coöperating relatively movable contacts, and a plurality of vertical concentric walls immersed in the liquid around the contacts with the spaces between said walls in communication.

In witness whereof I have hereunto set my hand this 21st day of February, 1906.

EDWARD M. HEWLETT.

Witnesses:

Benjamin B. Hull,

Helen Orford.