No. 887,723. PATENTED MAY 12, 1908.

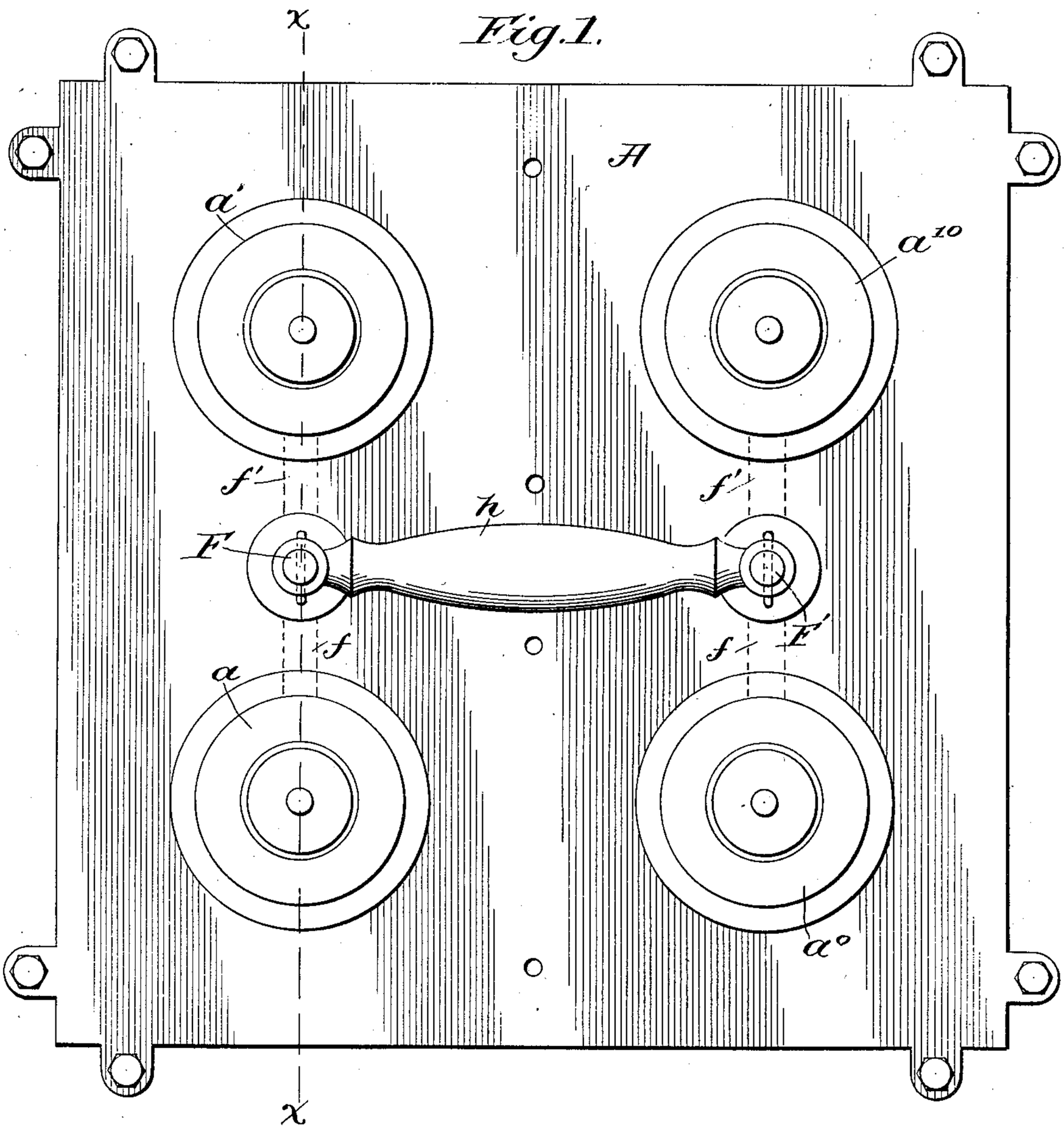
J. D. HILLIARD, Jr. & C. E. PARSONS.

ELECTRICAL SWITCH.

APPLICATION FILED MAY 13, 1905.

2 SHEETS—SHEET 1.

Fig. 1.



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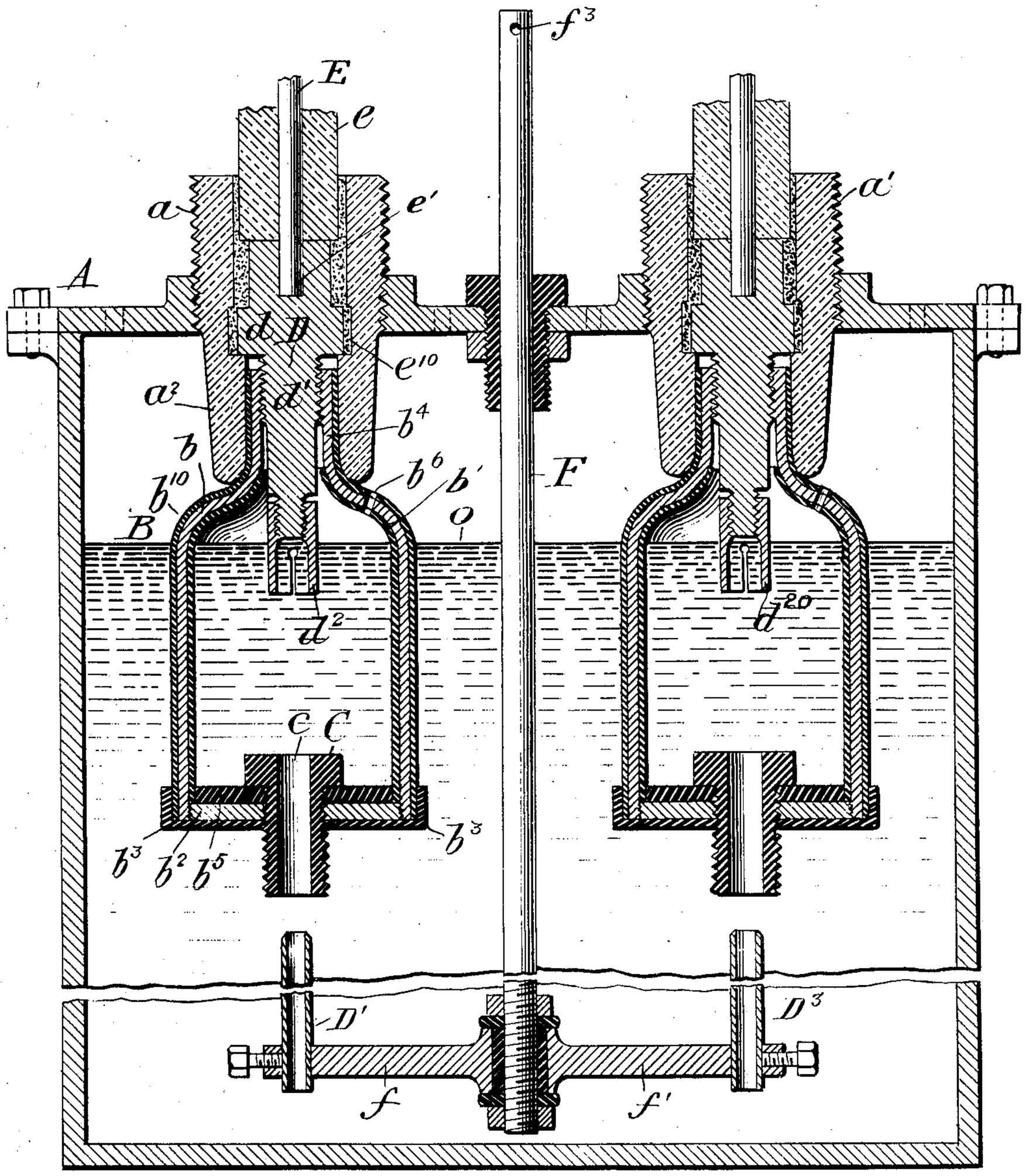
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

JOHN D. HILLIARD, JR., AND CHARLES E. PARSONS, OF UTICA, NEW YORK.

ELECTRICAL SWITCH.

No. 887,723. Specification of Letters Patent. Patented May 12, 1908.

Application filed May 13, 1905. Serial No. 260,237.

To all whom it may concern:

Be it known that we, JOHN D. HILLIARD, Jr., and CHARLES E. PARSONS, citizens of the United States, residing at Utica, in the county of Oneida and State of New York, have invented certain new and useful Improvements in Electrical Switches, of which the following is a specification, reference being had therein to the accompanying drawing.

Our invention relates to switches for electric circuits, and has for its object the production of a switch by which circuits may be controlled and opened directly which could not be so controlled or opened with safety in any other way, or in any way now known.

Incidental objects of the invention are to increase the efficiency and ease of operation of switches for circuits conveying considerable energy.

Heretofore some forms of circuit breakers and switches have been designed to open their circuits by separating terminals under oil or other insulating liquid, the idea being to avoid the formation or continuance of dangerous and destructive arcs. Such devices are satisfactory up to a certain point, but in the forms now commercially used and with which we are familiar, there are defects which prevent the attainment of perfect efficiency, and particularly such attainment in connection with very high potential circuits and those conveying large quantities of energy. Upon separating the terminals of such a switch the arc momentarily sprung will instantly form gases, partly by volatilizing some of the metal, and partly by decomposing the oil; the expansion of these gases as the arc is drawn out tending to force the oil away, and indeed to expel it from the containing vessel unless completely inclosed.

Experiment has demonstrated that if a jet of oil be projected into or across the path of an arc, the latter will be destroyed. Applying this to our purpose, according to our invention we cause the pressure developed by the generation and expansion of gases due to the arc to act upon a confined body of oil so as to force a jet thereof into an opening through which the arc is drawn. From this statement it will be perceived that in its broadest aspect our invention comprises a method of operation, as well as a form of apparatus by which the method may be practiced.

Our invention is illustrated, as to one embodiment, in the accompanying drawings, wherein

Figure 1 is a top plan view of a double-pole double-break switch, and Fig. 2 is a vertical transverse section on the line *x*—*x* in Fig. 1, looking in the direction of the arrow.

Broadly stated, and for the moment disregarding the method, which will be sufficiently disclosed in the description of apparatus, our invention comprises an outer containing vessel partially filled with oil, and an inner vessel immersed therein, with one terminal inclosed in the inner vessel and communicating with outside circuits, and the other terminal lying in the outer vessel and communicating with the first terminal by a reciprocating rod which passes through an opening in the inner vessel. When the terminals are separated, the tendency is for the arc to be drawn through the opening from one vessel into the other, and as pressure is developed in one vessel the oil is forced therefrom at high velocity through the opening, destroying the arc. One pair of terminals and the containing vessels thus referred to constitute a unit, or a single pole switch, and any number of these units may be aggregated and operated simultaneously to produce double pole and multi-break switches. In a sense, this type of oil break switch may be called an "inclosed-arc with oil jet." The units may have their movement in either direction, that is, with the fixed terminal inclosed and the movable terminal passing in and out to it, as shown in Fig. 2, or with the movable terminal inclosed and passing in and out of the bottle or inner vessel to reach the fixed terminal located outside.

We will first describe the direct form, referring therefor to Figs. 1 and 2.

A is the outer inclosing case or shell, filled with oil or other suitable insulating liquid to the level marked O. Extending into this casing from the top are four inclosed fixed terminals, corresponding to the spring jaws of an ordinary switch. As all of these are alike, a description of one will suffice. The top of casing A is bored and may be threaded to receive the hollow insulator *a*, preferably of porcelain or other refractory material. The bore of the insulator *a* is provided with an enlargement about midway of its length, and below this with a shoulder. Within this bore we fit the stud or plug D of metal, having a shoulder *d* resting upon the shoulder of the insulator. The circuit conductor E with

its insulation *e* is introduced into the upper end of the insulator, and the bared end *e'* of the conductor is secured directly to the stud D. The lower end of the stud carries the socket d^2, preferably with a taper opening and slits to form a spring jaw, and this is inclosed within the bottle or shell B, whose neck b^4 is secured, and preferably hermetically sealed, within the lower end of the insulator by being threaded to screw upon the lower end of the stud, *d'*. This bottle consists preferably of a body of metal, *b*, insulated inside and out, at *b'* and b^{10}. In its upper part it is provided with a vent b^6, of comparatively small size, and its bottom plate b^2 has an insulating disk b^5 within, and an insulating cap b^3 without. It is centrally perforated to receive the hollow insulator C, whose opening *c* is exactly alined with the socket d^2. The unit thus described is duplicated in the two sides of Fig. 2, and in each side of the double pole switch. To make and break connection between the two sockets d^2 and d^{20}, we provide the yoke *f*—*f'*, carried upon an operating rod F, and supporting at each end an extended terminal D' and D^3, each of a length and in proper axial position to enter the opening *c* in an insulator, and to reach into the socket d^2 or d^{20}. The rod F slides in a suitable bushing or guideway in the top of the casing A, and may be controlled and moved by any suitable mechanism, the same forming no part of our present invention. Between the rod and the yoke we preferably insert insulating material, as shown, to prevent accidents and short-circuit. Since in a complete double pole switch there are two pairs of terminals, there will be four insulators *a*, *a'*, a^9 and a^{10}, two operating rods F and F', and two yokes *f*—*f'*, each with its long terminals.

In Fig. 1 we have shown the rods F, F' connected by a handle *h*. This serves to maintain the yokes squared and the terminals in alinement, but in practice we may provide guides,

It will be sufficiently obvious to those skilled in this art that any automatic switch of this type should be very quick in its action; and it is of course common and well known to provide mechanical, hydraulic, and other power actuated operating means for switches of this general type; hence, it is to be understood that while the specific operating mechanism forms no direct part of the present invention, it is contemplated herein to use what good practice requires, *i. e.* a motor mechanism operating in say a part of a second, so as not to affect synchronous apparatus to throw it out of step.

The operation of this part of our invention will now be understood. When a terminal D' is separated from the socket d^2 an arc is sprung in the bottle B. Gas is thereby generated and a high pressure instantly created. In order to, prevent this rising so high as to rupture the vessel B, either the terminal D' fits loosely in the channel *c*, or as shown it is made hollow or tubular, the pressure being relieved by a rush of oil through this tube. As the terminal is withdrawn through the opening *c* the jet of oil continues therethrough with a high velocity, and as a consequence the arc is destroyed.

Although we have described the simplest and most specific way in which to accomplish a desired result we wish it clearly understood that many modifications and changes may be resorted to or effected in practice without departing from the spirit of our invention. All such changes are contemplated by us and are considered to be within the scope and purview of the appended claims.

After the switch is operated in the manner described, the oil level inside the bottle B is lowered, while the oil level in the main casing A is raised. The principal function of the vent b^6 is to permit the oil to resume its normal level in both vessels by equalizing the pressures in the spaces above the oil. In other words, the vent b^6 may be called a "bleeding vent", permitting the gradual escape of gases from the bottle B so the oil can reënter through the channel *c*. It should be understood, however, that the opening b^6 is so small that it will not vent sufficiently under the high pressures and with the large volumes of gas generated when the arc is sprung, to injuriously reduce the pressure thereby created upon the surface of the oil in the bottle B.

In accordance with standard practice, we usually make the outer casing A of iron or steel, and the bottles B are produced in the same manner and of substantially the same grade of steel as the tanks employed to hold compressed gases, especially carbonic acid gas. The pressures generated in these bottles B when breaking considerable energy are enormous; and in order to safely withstand these pressures the bottles are tested in advance for even higher pressures in order that there may be a suitable factor of safety.

A point of considerable importance in our structure is the unitary and integral character of the bottle B. In previous structures oil pots have been formed with baffle-plates or with disks or cylinders connected across or within the outer oil pot so as to form a separate chamber; but in every case a portion of the walls of said separate chamber have been formed in part of the walls of the outer casing. This is highly objectionable for several reasons. In the first place it makes an expensive structure; in the second place, the inclusion of joints introduces an element of weakness; and in the third place, any electrical contact or any whipping of the arc inside of the inclosed chamber is directly com-

municated to the outer casing with great danger to the operator. We believe we are the first to present a construction which meets these and other objections heretofore militating against the successful operation of switches of this character. By forming the bottles B as heavy pressure resisting integral and unitary structures, connecting them tightly with their fixed terminals so that the same are sealed therein, insulating their walls and particularly insulating the parts contiguous to the arc, so that it is absolutely confined at every step in the operation of the switch to the spaces between the terminals, we insure efficiency, prevent all danger to the operator, and at the same time prolong the life of the switch indefinitely.

It will be apparent after reading the foregoing that the casing A is not really an essential part of the switch, its functions being purely subsidiary and confined mainly to holding the oil supply for the explosion bottles or pressure chambers.

Having thus described our invention what we claim and desire to secure by Letters Patent is:

1. An electrical switch comprising in combination an outer receptacle containing fluid insulating material, an inner receptacle formed of material adapted to resist high pressure due to confined arc gases and projecting into said fluid, a fixed terminal within said inner receptacle, a coöperating terminal without said receptacle, an opening bushed with insulation in the inner receptacle permitting circulation of the insulating fluid, and means to connect and separate said terminals through said bushed opening.

2. An electrical switch comprising in combination an outer and an inner fluid receptacle, the inner receptacle being of metal with its surface insulated, an insulating support therefor, a contact terminal mounted therein, with outside circuit connections, an opening in said inner receptacle, a contact device adapted to pass from the outer vessel through said opening to the inclosed terminal in making the circuit, and the reverse in breaking the circuit, and an equalizing vent in the inner vessel.

3. An electrical switch comprising in combination an outer and an inner fluid receptacle, said inner receptacle having its surface insulated and being carried upon an insulated support, a contact terminal within said inner receptacle and outside circuit connections therefor, an opening in said inner receptacle, a hollow contact device adapted to pass from the outer receptacle through said opening to the inclosed terminal in making the circuit and the reverse in breaking the circuit, and an equalizing vent in the inner receptacle.

4. In an electrical switch, the combination with an oil pot partially filled with oil, of a second connected oil pot also partially filled with oil and constructed so as to form a pressure retaining vessel for said oil, separable contacts arranged to break under the oil in the second pot, and insulating means carried by said second pot for conducting the oil when put under pressure by the arc gases against the arc so as to extinguish it.

5. In an electrical switch, the combination with an oil pot partially filled with oil, of a second pot also partially filled with oil, located within the first mentioned pot and shaped to form a pressure retaining vessel, a stationary contact mounted within said second pot, a movable contact adapted to engage said stationary contact for making and breaking the circuit, and an insulator carried by the second pot for conducting the oil put under pressure by the arc gases upon breaking the contact, against the arc so as to extinguish it.

6. In an electrical switch, the combination with an oil pot partially filled with oil, of a second oil pot located therein forming a pressure retaining pot, an aperture in said second pot below the oil level and a relatively small vent above it, whereby the normal oil level is kept the same in both pots, a stationary contact in one of said oil pots, a movable contact adapted to pass through said aperture to and from the stationary contact in making and breaking the circuit, and insulating means in the aperture for conducting the oil put under pressure by the arc gases against the arc so as to extinguish it.

7. In an electrical switch, the combination of an outer vessel and an inner vessel both partially filled with oil, a stationary contact in one of said vessels, a movable contact adapted to pass from the other vessel into engagement with the stationary contact in making the circuit and the reverse in breaking the circuit, and an insulator through which the movable contact passes, adapted to direct the oil put under pressure by the arc gases against the arc to extinguish it.

8. An electrical switch comprising two oil vessels, one located interiorly of and communicating with the other, oil partially filling both vessels, separable contacts arranged to break in the inner vessel so that pressure will be generated therein by the arc, and insulating means adapted to confine the arc and simultaneously to direct the oil put under pressure against the arc to extinguish it.

9. An electrical switch comprising two oil vessels, one within the other, oil partially filling both vessels, a stationary contact in the inner vessel, a movable contact passing from the outer vessel into engagement with the contact in the inner vessel, and an apertured insulator carried by the inner vessel, forming a passageway for the movable contact and adapted to restrict the arc and conduct the

oil put under pressure by the arc gases into the path of said movable contact as it is withdrawn from the inner vessel so as to extinguish the arc.

10. In an oil break switch for high potential circuits, an outer containing vessel partially filled with oil, a metallic pressure resisting inner vessel projecting into said oil and also partially filled therewith, said inner vessel being supported on but insulated from the outer vessel, having its walls covered with insulating material, and having an opening in its bottom fitted with an insulated bushing, a fixed terminal seated within the inner vessel and a movable terminal adapted to pass from the outer vessel through the bushed opening into the inner vessel to engage said fixed terminal, whereby upon withdrawal of said movable terminal and the consequent formation of an arc within the inner vessel, said arc will be confined to the space between the terminals, and when the movable terminal passes the bushing the arc will be extinguished by the rush of oil therefrom.

11. In an oil switch, the combination of inner and outer oil pots, the inner pot forming a pressure retaining vessel and having its walls covered with insulation as well as being insulated from the outer pot, an opening through one wall of said inner pot provided with an insulating bushing, a fixed terminal mounted within the inner pot, and a coöperating movable terminal adapted to pass in and out of the inner pot through the insulating bushing.

12. In an oil break switch, an outer oil pot, an inner metal oil pot adapted to resist high pressure, oil in both pots, a fixed terminal seated in the inner pot, a movable terminal passing through an opening into the inner pot to engage the fixed terminal, and means insulating the movable terminal in all operating positions from the inner pot, said means acting to confine the arc formed upon separation of the terminals to the space between them.

13. In an oil break switch, a vessel containing oil, a separate inclosed and superficially insulated pressure retaining vessel located therein, with a passageway also insulated, and contacts adapted to engage within said insulated vessel and to be separated through said passageway, one of said contacts being permanently secured to and inclosed within said insulated vessel.

14. In an electrical switch, an outer vessel, a separate unitary pressure-retaining inner vessel supported in but insulated from the outer vessel, both of said vessels containing insulating fluid, and a pair of electrodes adapted to make and break contact in said inner vessel, one of said electrodes permanently inclosed therein and the other adapted to pass into and out of the same.

15. In an oil break switch, an outer oil vessel, a fixed circuit terminal extending into but insulated from said outer vessel, an inner pressure-retaining vessel inclosing the end of said terminal and supported thereon, oil partially filling both of said vessels, and a movable terminal adapted to make and break connection with the fixed terminal within said inner vessel.

16. In an electrical switch, an outer inclosing vessel, a fixed circuit terminal extending into the vessel, an insulator engaging said vessel and supporting the terminal thereon, an inner inclosing vessel supported on the terminal, and a movable terminal lying in the outer vessel when the switch is open, but adapted to be moved into the inner vessel to make and break contact therein with the fixed terminal.

17. In an oil switch, an outer oil vessel, a plurality of fixed terminals passing through the top of said oil vessel and supported thereon by means of insulators, an inner independent pressure-retaining vessel for each terminal supported on its terminal, a movable terminal device coöperating with the fixed terminals, and oil in both of said vesesls.

18. An electrical switch comprising separable contacts, a closed receptacle therefor containing insulating fluid, an immovable supplemental vessel located therein adapted to inclose the arc formed upon breaking the contacts and to confine the insulating fluid when put under pressure by the arc so as to extinguish it, together with means associated with said supplemental vessel to insulate and restrict the arc.

19. In an oil switch, an outer oil vessel, a body of oil therein, an independent, integral, unitary supplemental oil pot extending into said body of oil, separable terminals arranged to break inside said supplemental pot, and means mechanically supporting said supplemental pot in the oil but maintaining the same electrically insulated from the main pot or casing.

20. In an oil switch, an outer vessel, a body of oil therein, an independent, integral, unitary supplemental pot extending into said oil and forming a pressure retaining vessel therefor, with a pair of separable contacts arranged to break within said chamber.

21. In an electrical switch, an oil pot or reservoir, a body of oil therein, an independent, integral, unitary vessel or pot communicating with said reservoir to receive oil therefrom and forming a pressure retaining vessel for the oil, with a pair of separable contacts arranged to break within said pressure vessel, and means to conduct the oil when put under pressure by the arc formed upon breaking against the same to extinguish it.

22. An electrical switch unit composed of a pair of elements, each comprising a fixed contact terminal, a metal pressure bottle at-

tached to and inclosing said terminal, and a movable contact terminal, said bottle having its walls and bottom superficially insulated and an opening in the latter lined with insulation; together with operating means for the unit comprising a yoke connecting the two movable contacts both electrically and mechanically, and means to move said yoke so as to insert the movable contacts through the insulated openings into the pressure bottles in making, and to entirely withdraw the contacts from the bottles in breaking, whereby the arcs then formed are drawn out through the respective insulators and exposed to blasts therefrom due to the arc-created pressures in the bottles.

23. An electrical switch comprising the following instrumentalities: an insulated metal pot constructed so as to restrict high pressures due to an electric arc, a fixed contact seated inside the upper part of said pot, an insulated opening in the lower part of said pot, means for maintaining oil in the pot with an air or gas space above the oil level, a movable contact adapted to pass into and out of the pot through said insulated opening and through the oil in making and breaking the circuit, and means for actuating said movable contact whereby the arc formed upon breaking will produce a high pressure in the pot, which will be cushioned by compression of the air or gas therein until the moving contact has passed out of the opening, and will then cause a jet of oil through said opening in the path of the arc to extinguish it.

24. In an electrical switch, a contact element comprising of the following instrumentalities: a fixed terminal stud with a circuit lead directly connected therewith, an insulator surrounding and supporting said stud by means of engaging shoulders, plastic insulating material filling the insulator around the stud and its joint with the lead, a drawn steel bottle having its neck tightly fitted and solidly secured to the stud, insulation covering the inside of said bottle, an opening in the bottom thereof, an insulating bushing therein, and a movable contact rod adapted to be passed into and out of said bottle through said bushing to engage and disengage said terminal stud.

25. An electric switch comprising an oil pot containing oil, separable contacts both insulated from the oil pot and arranged to break under oil, and a pressure retaining vessel surrounding said contacts, said vessel having in one wall an opening lined with insulation to confine the arc and simultaneously to direct the oil put under pressure by the arc against the arc to extinguish it.

26. An electric switch comprising a casing containing oil, a pressure retaining vessel therein, one wall of said vessel being provided with an aperture, a stationary contact located in said vessel and a tubular contact movable through said aperture to coöperate with the stationary contact.

In testimony whereof we affix our signatures in presence of two witnesses.

JOHN D. HILLIARD, JR.
CHARLES E. PARSONS.

Witnesses:
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PETER J. KEANE.