E. B. MERRIAM.

ELECTRIC SWITCH.

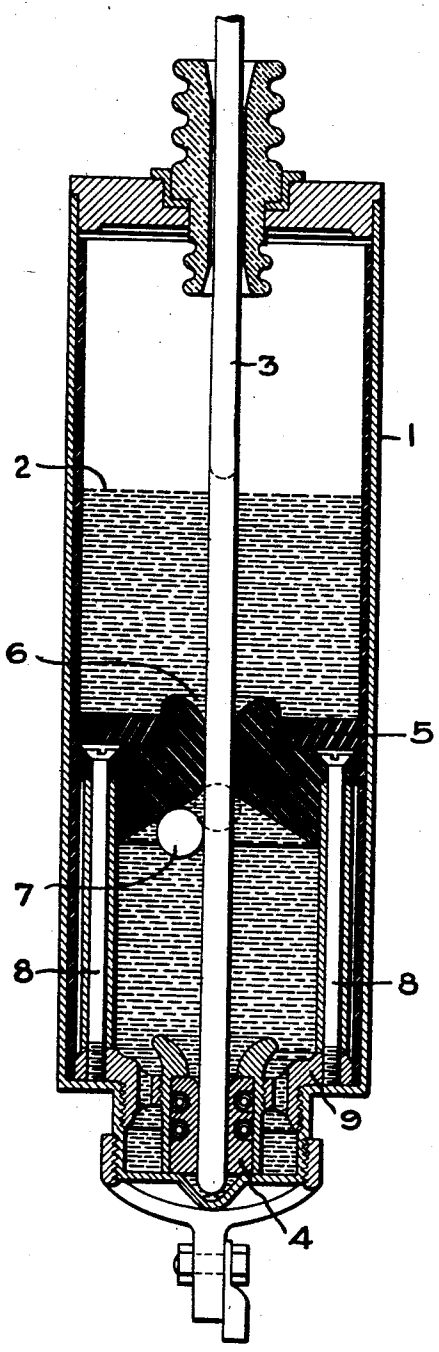
APPLICATION FILED AUG. 15, 1912.

1,122,019.

Patented Dec. 22, 1914.

2 SHEETS—SHEET 1.

Fig. 1.



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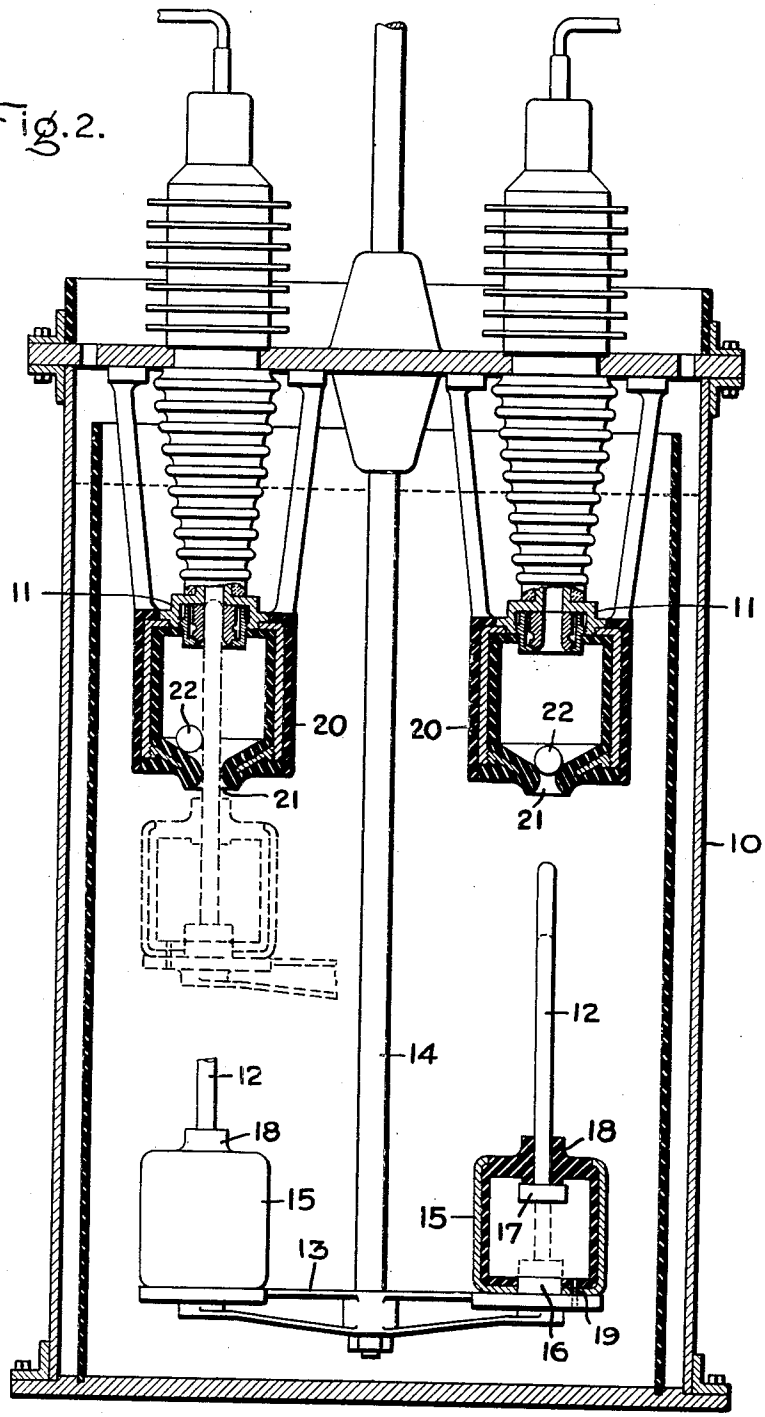
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

EZRA B. MERRIAM, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH.

1,122,019. Specification of Letters Patent. Patented Dec. 22, 1914.

Application filed August 15, 1912. Serial No. 715,227.

To all whom it may concern:

Be it known that I, EZRA B. MERRIAM, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches, of which the following is a specification.

My invention relates to electric switches and more particularly to switches in which the contacts separate beneath an insulating liquid, such as oil, and which are commonly used to control circuits carrying large amounts of energy.

When the contacts of a switch in a circuit carrying a large amount of energy separate in an insulating liquid, such as oil, the arc formed between the contacts tends to put the oil under pressure and to blow it away from the contacts. The effectiveness of the oil in extinguishing the arc and opening the circuit is increased, if this tendency of the arc to blow the oil away from the contacts is overcome in some suitable manner, and especially if the pressure exerted by the oil upon the arc is increased. It is also well understood that the flow of current in the circuit is more easily interrupted where the break in the circuit is in the form of a number of gaps in series than is the case where the break consists of only one gap.

The object of my invention is to provide a switch in which the tendency of the arc to blow the oil away from the contacts is effectively resisted; in which the pressure exerted by the oil upon the arc is much greater than in switches of the type heretofore used; in which the oil immediately adjacent the contacts and the gases of the arc between the contacts are both effectually trapped and sealed up in contact with the arc, so that the oil put under pressure by the arc exerts great pressure upon the arc and thereby greatly increases the effectiveness of the oil in extinguishing the arc; in which the circuit is opened by a number of breaks in series, the arc in at least one of the breaks being subjected to great pressure by oil which is trapped and held in the neighborhood of the arc; in which the arc at each end of the break formed in opening the circuit is subjected to the pressure of oil trapped and held in contact with the arc; and which is in many particulars more specifically hereinafter pointed out, an improvement in switches of this general character.

My invention will best be understood in connection with the accompanying drawings which, merely for purposes of illustration, show some of the various forms in which my invention may be embodied, and in which—

Figure 1 is a longitudinal section of one form of switch embodying that form of my invention in which the oil is trapped and held in contact with the arc in a single break in the circuit; and Fig. 2 is a longitudinal section of the switch embodying one form of my invention in which several breaks in series are used to open the circuit, the arcs in each of the breaks being subjected to the pressure of oil firmly held in contact with the arc.

In the particular form of my invention shown in Fig. 1, an oil pot 1 contains oil or other suitable insulating fluid 2 in which the circuit is broken. The movable contact 3, actuated by any suitable mechanism, is mounted to move longitudinally of the oil pot 1 to coöperate with a contact 4 fixed in the bottom of the oil pot. As the switch opens, the movable contact 3 is lifted until its end reaches the position shown in dotted lines. During this separation of the contacts an arc forms between them and is eventually extinguished by the action of the oil 2. As the arc forms between the contacts 3 and 4 and exerts pressure on the oil and tends to blow it away from the contacts, I provide suitable means by which the oil is firmly held in the neighborhood of the contacts and in contact with the arc. The preferred arrangement for securing this result is that shown in the drawings in which the oil is held in the lower part of the oil pot in a strong pressure retaining chamber in which the arc is drawn. The pressure retaining chamber may be formed by the bottom and lower walls of the oil pot, together with an insulating partition 5 provided with an opening 6 through which the contact 3 passes with slight clearance. The oil beneath the partition 5 is put under pressure by the arc but is prevented from escaping through the partition by some suitable form of valve or closure which seals up the opening 6 as soon as the contact 3 passes upward through the opening, thereby preventing the escape of oil from beneath the partition 5, and compelling the oil, which is trapped beneath the partition, to remain in intimate contact with the arc. Various forms of

valves or closers for the opening 6 may be used, but the device which I prefer is a ball 7 preferably made of wood or other insulating material and of a specific gravity less than that of the oil, so that the ball 7 will quickly rise and seal up the opening 6 as the contact moves upward. At the same time that the ball 7 seals up the opening 6 and prevents the escape of oil from the partition 5, it also cuts or intercepts the arc stream. The clearance between the contact 3 and the walls of the opening 6 is very slight, so there is practically no escape of oil from beneath the partition 5 during the time that the contact 3 is moving upward and the arc is being drawn between the contacts. The oil pressure developed is high and the partition 5 must be held in place in such a manner that it cannot be lifted upward by the pressure beneath it. The preferred construction for securing this result is shown in the drawings, in which bolts 8 are threaded into a metal collar 9 which in turn is threaded to the bottom of the oil pot 1. In this way the upward thrust exerted upon the partition 5 is resisted by the bottom of the oil pot and by the bolts 8, which are amply strong to withstand any pull exerted upon them as a result of pressure beneath the partition 5.

The particular form of switch shown in Fig. 2 comprises an oil tank 10 filled with oil or other suitable insulating liquid to the level shown by the dotted line. In this form of switch the leads of the circuit to be controlled enter and leave the switch at the top and are connected to stationary contacts or terminals 11 which are electrically connected through some suitable form of metallic bridge when the circuit is to be closed. In the particular arrangement shown in the drawing an intermediate contact rod 12 is provided to coöperate with each of the stationary contacts 11 and is carried upon a metal bridging contact 13 which in turn is raised and lowered by means of an actuating rod 14 preferably made of wood or other suitable insulating material and connected to some form of actuating mechanism not shown. When the switch is closed, the parts are in the position shown in dotted lines at the left of Fig. 2, with the intermediate contact 12 in firm engagement both with the stationary contacts 11 and with the bridging contact 13, whereby a metallic bridge between the stationary contacts 11 is established and the circuit is closed. To open the circuit the bridging contact moves downward to the position shown in full lines. During this movement the intermediate contact 12 separates from the bridging contact 13 thereby making a break in the circuit, and also separates from the stationary contact 11, thereby making a second break in the circuit in series with the first. During the downward movement of the bridging contact 13 the intermediate contact is in the position shown in full lines at the right hand side of Fig. 2, although after the parts have come to rest the contact 12 can settle down into engagement with the bridging contact 13 as shown in dotted lines.

The stationary contacts 11 are preferably so made as to grip quite firmly the upper end of the intermediate contacts 12 when the switch is closed. The lower ends of the intermediate contacts merely rest upon the bridging contact 13 with a pressure sufficiently great to insure good conductivity, but in such a manner that very little risistance is offered to the separation of the bridging contact 13 and the intermediate contacts 12. Suitable connections are provided between the bridging contact and the intermediate contacts so that as the bridging contact 13 begins its downward movement the intermediate contacts 12 are held stationary by the stationary contacts 11, whereupon the bridging contact 13 moves away from the intermediate contacts 12 and produces a break in the circuit in series with each intermediate contact. The connections between the bridging contact and the intermediate contacts 12 constitute, in effect, a lost motion connection of such a character that after the bridging contact has moved downward a short distance and the intermediate contacts are separated from the bridging contact, the intermediate contacts are forcibly pulled downward out of the stationary contacts 11. The lost motion connection by which this result is obtained is of such a character that the intermediate contacts are mechanically connected to the bridging contact during the greater portion of its downward movement but are electrically disconnected from it, so that there is a break in the circuit between each intermediate contact and the bridging contact. As a result of this construction, the switch shown in Fig. 2 introduces into the circuit four breaks in series, two between the intermediate contacts and the bridging contact 13, and two between the intermediate contacts and the stationary contacts 11. As all the parts are submerged in oil in the oil tank 10, the arcs in these breaks are subjected to the extinguishing action of the oil and the circuit is quickly broken.

In order to counteract the tendency of the arc to blow the oil away from the contacts and in order to secure the maximum effect of the oil upon the arc, I provide means by which the oil surrounding the arc formed at any or all of the breaks in the circuit is trapped and held in a very strong chamber where it is put under great pressure and is in contact with the arc. In the particular form of switch shown, I have provided means whereby the arc between the bridg-

ing contact 13 and the intermediate contact 12 is subjected to very great pressure by being sealed up in a strong pressure retaining chamber 15 mounted upon the bridging contact 13 and surrounding the point of separation between the intermediate contact 12 and the bridging contact. The lower end of the intermediate contact 12 engages a contact block 16 inside of the pressure retaining chamber 15 when the switch is closed, as best shown in dotted lines on the left-hand side of Fig. 2. The intermediate contact has a head 17 which engages the contact 16 and which also prevents the intermediate contact 12 being drawn out of the chamber 15. The intermediate contact is supported and guided by an insulating wall 18 which forms part of the pressure retaining chamber 15 and which is provided with an opening in which the intermediate contact 12 is slidably mounted to move with such slight clearance that practically no oil can escape along the contact 12. As shown in the drawing, the intermediate contact 12 is free to move upward in the pressure retaining chamber 15 until the head 17 engages the insulating wall 18, whereupon the intermediate contact 12 is positively carried along by the downward movement of the bridging contact 13, although the only electrical connection between the intermediate contact and the bridging contact 13 is through the arc which may be existing between the contact 16 and the head 17 of the intermediate contact. The pressure retaining chamber 15 therefore acts not only as a pressure retaining chamber but also as an insulating lost motion connection by means of which the intermediate contact is permitted to move a certain distance from the bridging contact and thereby introduce a break in series with the circuit, but is at the same time mechanically and rigidly connected to the bridging contact 13 and must move with it. The arc is sealed up in the closed chamber 15 and is subjected to very high pressure. When very high pressure is not necessary, I may provide for the chamber 15 a very small and restricted vent opening 19 adjacent the contact 16.

Ordinarily the pressure exerted by the oil trapped in the pressure retaining chamber 15 will be sufficient to extinguish the arc very quickly, especially when the arc between the contact 16 and the head 17 is weakened by the introduction of another arc in series with it because of the separation of the intermediate contact 12 from the stationary contact 11. Where the service is especially severe and the dimensions of the switch must be kept as small as possible while retaining its arc extinguishing power, I provide means whereby the arc between the intermediate contact and the bridging contact and also the arc between the intermediate contact and the stationary contact are both subjected to the pressure of oil trapped in a chamber and held in engagement with the arc. To secure this result, I provide each stationary contact 11 with a pressure retaining chamber 20 having an outlet or opening 21 through which the intermediate contact 12 passes with very slight clearance, so that practically no oil can escape from the chamber as the switch is opened. The chamber 20 is practically sealed up and the oil in it is maintained in contact with the arc by some suitable form of check valve controlled by the intermediate contact 12. The form of valve which I prefer to use is a ball 22 which will roll down and close the opening 21 as soon as the intermediate contact passes out of the chamber 20.

My invention may be embodied in many other forms than that described and I therefore do not limit my invention to the precise arangement disclosed except in so far as it is limited by the scope of the annexed claims.

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

1. An electric switch comprising a vented pressure retaining chamber containing insulating fluid, relatively movable coöperating contacts mounted to draw an arc in said pressure retaining chamber during their separation, and means controlled by one of said contacts for sealing up said chamber during the separation of said contacts and thereby confining in contact with the arc the fluid put under pressure by the arc in said chamber.

2. An electric switch comprising relatively movable coöperating contacts, a pressure retaining chamber containing insulating fluid and mounted to contain a portion of the arc formed upon the separation of said contacts, and means for sealing up in said chamber both that portion of the arc in said chamber and the insulating fluid put under pressure by said portion of the arc.

3. An electric switch comprising relatively movable coöperating contacts, a pressure retaining chamber containing insulating fluid surrounding one of said contacts and having in one wall a vent through which the other contact passes out of said chamber, and means controlled by said other contact for sealing said vent as said other contact passes out through said vent and thereby sealing up in said chamber a portion of the arc and the insulating fluid put under pressure in said chamber by the arc.

4. An electric switch comprising a pressure retaining chamber containing insulating fluid and having a vent in one wall, a contact mounted in said chamber in alinement with said vent, a coöperating contact mounted to move into and out of said cham-

ber through said vent, and a valve for closing said vent as said coöperating contact moves out of said chamber through said vent and thereby sealing up in said chamber a portion of the arc and the insulating fluid under pressure during the opening of the circuit.

5. An electric switch comprising a pressure retaining chamber containing insulating fluid and having an insulating wall with an opening therein, a contact in said chamber, a coöperating contact mounted to move in said opening with a slight clearance and to engage said first mentioned contact, means for moving said coöperating contact through said opening to cause said contacts to separate in said chamber, a valve controlled by said coöperating contact for closing said opening as said coöperating contact moves out of said opening whereby the arc in said chamber is subjected to the pressure of insulating fluid put under pressure by the arc.

6. An electric switch comprising a stationary contact, a coöperating movable contact, a pressure retaining chamber containing an insulating fluid and inclosing each of said contacts, an intermediate contact between said stationary and movable contacts movable into engagement with both of said contacts within their respective pressure retaining chambers as the switch is closed, and means for separating said intermediate contact within said chambers from both said stationary and movable contacts whereby the arc formed at each end of said intermediate contact is subjected to the insulating fluid in said pressure retaining chambers put under pressure by the arc.

7. An electric switch comprising relatively movable coöperating contacts, an intermediate contact separably mounted between said contacts to produce a break in the circuit at each end of said intermediate contact, and means for subjecting the arc formed at both ends of said intermediate contact to the pressure of insulating fluid put under pressure by the arc.

8. An electric switch comprising relatively movable coöperating contacts, an intermediate contact separably mounted between said contacts to produce a break in the circuit at each end of said intermediate contact, and substantially closed pressure retaining chambers containing insulating fluid and mounted to inclose the arc produced at each end of said intermediate contact as the switch is opened whereby the arc at each end of the break in the circuit is subjected to the pressure of insulating fluid put under pressure by the arc.

9. An electric switch comprising relatively movable contacts, an intermediate contact between said contacts and movable into engagement with said contacts as the switch is closed, means for separating said intermediate contact from both said relatively movable contacts as the switch is opened, and pressure retaining chambers containing insulating fluid mounted in a position to contain the arc produced at each end of the intermediate contact as the switch is opened whereby the two arcs in series with the intermediate contact are subjected to insulating fluid put under pressure by said arcs.

10. An electric switch comprising three relatively movable coöperating contacts in series, a substantially sealed pressure retaining chamber containing insulating fluid and having the intermediate contact slidably mounted in one wall to engage one of the other contacts when the switch is closed, and operating mechanism for separating all of said contacts during the opening of said switch whereby the arc drawn in said pressure retaining chamber between said intermediate contact and the other contact is subjected to the pressure of the insulating fluid in said chamber.

11. An electric switch comprising three relatively movable contacts in series and in engagement when the switch is closed, a substantially sealed pressure retaining chamber containing insulating fluid and inclosing the engaging surfaces of two of said contacts, and operating mechanism for separating all of said contacts during the opening of the switch whereby the arc in said pressure retaining chamber is subjected to insulating fluid put under pressure by the arc and is in series with another break in the circuit.

12. An electric switch comprising relatively movable contacts, an intermediate contact normally in engagement with said movable contacts when the switch is closed, a substantially sealed pressure retaining chamber containing insulating fluid and inclosing one of said movable contacts, said intermediate contact being slidably mounted in an opening in the wall of said chamber to project into said chamber and to move relatively to the contact in said chamber, and means for preventing said intermediate contact from moving out of said chamber during the opening movement of the switch until said intermediate contact first separates from the other contact.

13. An electric switch comprising a vessel containing insulating fluid, two fixed contacts mounted in said vessel, a movable bridging contact in said vessel, and two intermediate contacts mounted on said bridging contact in position to engage said fixed contacts and separable to a predetermined extent from said bridging contact during the opening movement of the switch whereby four breaks in series are introduced into the circuit as the switch opens.

14. An electric switch comprising a vessel

containing oil, fixed contacts projecting into said vessel to a point beneath the surface of the oil, a movable bridging contact in said vessel, substantially closed pressure retaining chambers mounted on said bridging contact, an intermediate contact projecting from each chamber in a position to engage said fixed contacts and said bridging contact when the switch is closed, said intermediate contacts being separable from the bridging contact as the switch opens, and means for preventing withdrawal of said intermediate contacts from said chambers.

15. An electric switch comprising two relatively movable contact members, pressure retaining chambers containing insulating fluid and inclosing said contact members, an intermediate coöperating contact member slidably mounted in the wall of the pressure retaining chamber of one of said contact members to engage the contact member inclosed therein and movable as the switch closes into the other pressure retaining chamber to engage the other of said contact members, and means operative upon opening of the switch for causing said intermediate contact to separate from said contact member in whose chamber it is mounted before separating from said other contact member whereby two breaks are formed in series as the switch opens, the arcs formed thereby being subjected to the insulating fluid in said chambers put under pressure by the arcs.

16. An electric switch comprising a vessel containing oil, three relatively movable contacts in series in said vessel, one of the end contacts being constructed to frictionally engage and hold the intermediate contact, and an insulating lost motion connection between the other end contact and said intermediate contact whereby during the opening movement of the switch said intermediate contact first separates from the last mentioned end contact and then separates from the first mentioned end contact.

17. An electric switch comprising two stationary contacts, a bridging contact movable relatively to said stationary contacts to open and close the circuit, two intermediate contacts loosely mounted on said bridging contact to engage said stationary contacts and said bridging contact when the switch is closed, and lost motion connections between said intermediate contacts and said bridging contact whereby said intermediate contacts are electrically disconnected from said bridging contact as the switch opens but are mechanically connected thereto so that the opening movement of said bridging contact separates said intermediate contacts from the stationary contacts.

18. An electric switch comprising a vessel containing insulating fluid, a bridging contact movably mounted in said vessel, intermediate contacts loosely mounted on said bridging contact, an insulating lost motion connection between said bridging contact and each of said intermediate contacts which permits each of said intermediate contacts to be electrically disconnected from the bridging contact while mechanically connected thereto during the opening of the switch, and stationary contacts mounted in said vessel to frictionally engage said intermediate contacts.

19. An electric switch comprising a vessel filled with insulating liquid, a pressure retaining chamber submerged in the liquid in said vessel, relatively movable coöperating contacts mounted to engage in said chamber, one of said contacts being slidably mounted in one wall of said chamber and having thereon inside the chamber a flange which engages said wall as said contacts separate.

20. An electric switch comprising a vessel filled with insulating liquid, a contact submerged in the liquid in said vessel, a pressure retaining chamber inclosing said contact and provided with a restricted vent adjacent said contact the wall of said chamber opposite said contact having therein an opening with insulating walls, a coöperating contact slidably mounted in said opening to make a substantially fluid-tight joint with the walls thereof, and means associated with said coöperating contact whereby said contact always maintains said opening sealed.

21. An electric switch comprising a vessel filled with insulating liquid, relatively movable coöperating contacts mounted to separate in said vessel beneath the liquid therein, a pressure retaining chamber secured to one of said contacts to inclose the same and having the other contact slidably mounted in the wall of said chamber to separate from the first contact and to substantially seal said vessel during the initial opening movement of the switch, and operating mechanism for bringing said contacts into and out of engagement with each other.

In witness whereof, I have hereunto set my hand this 14th day of August, 1912.

EZRA B. MERRIAM.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.