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1,847,463

ELECTRIC SWITCH

Filed March 3, 1930

3 Sheets-Sheet 1

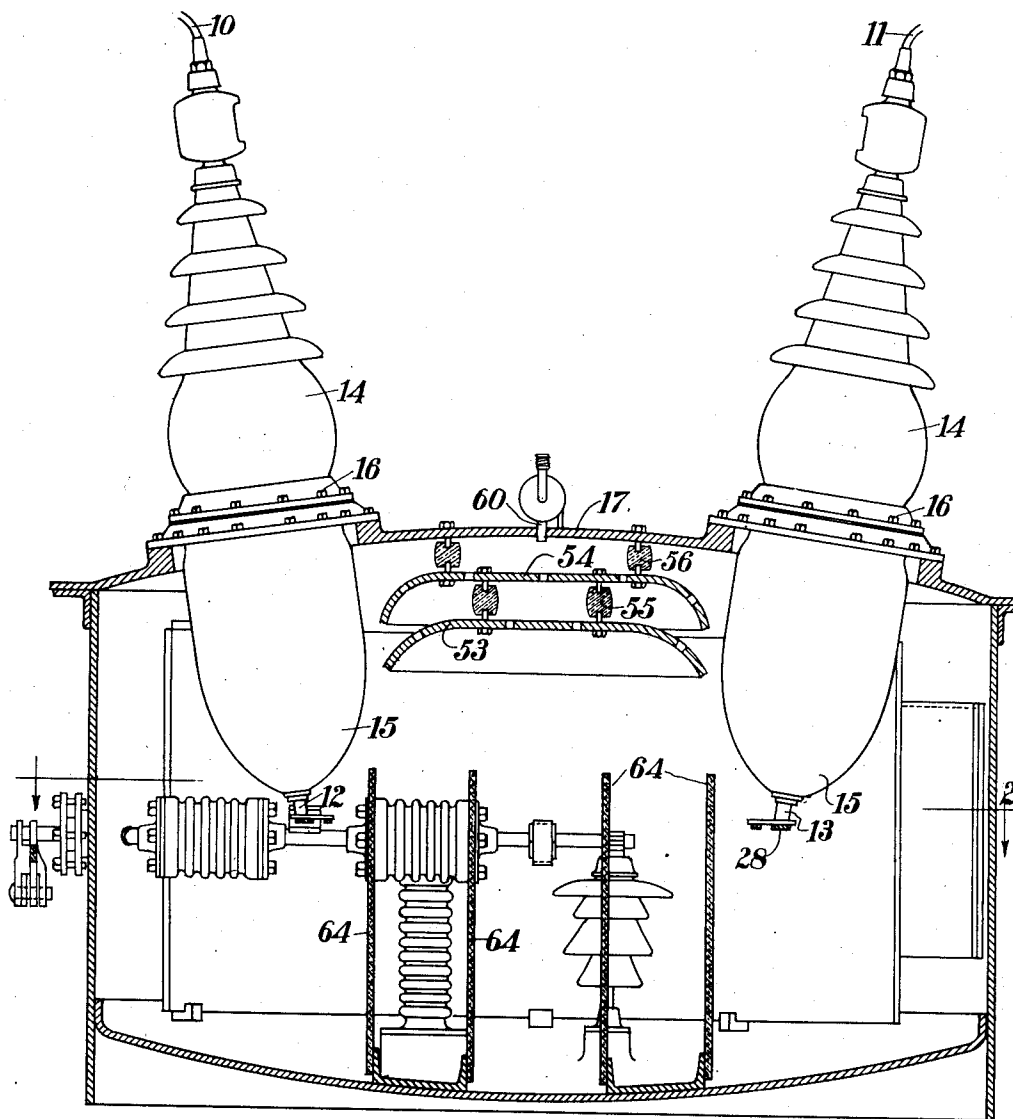


Fig. 1

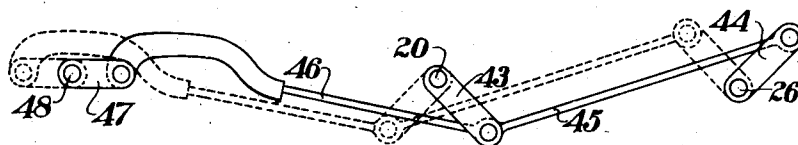


Fig. 3

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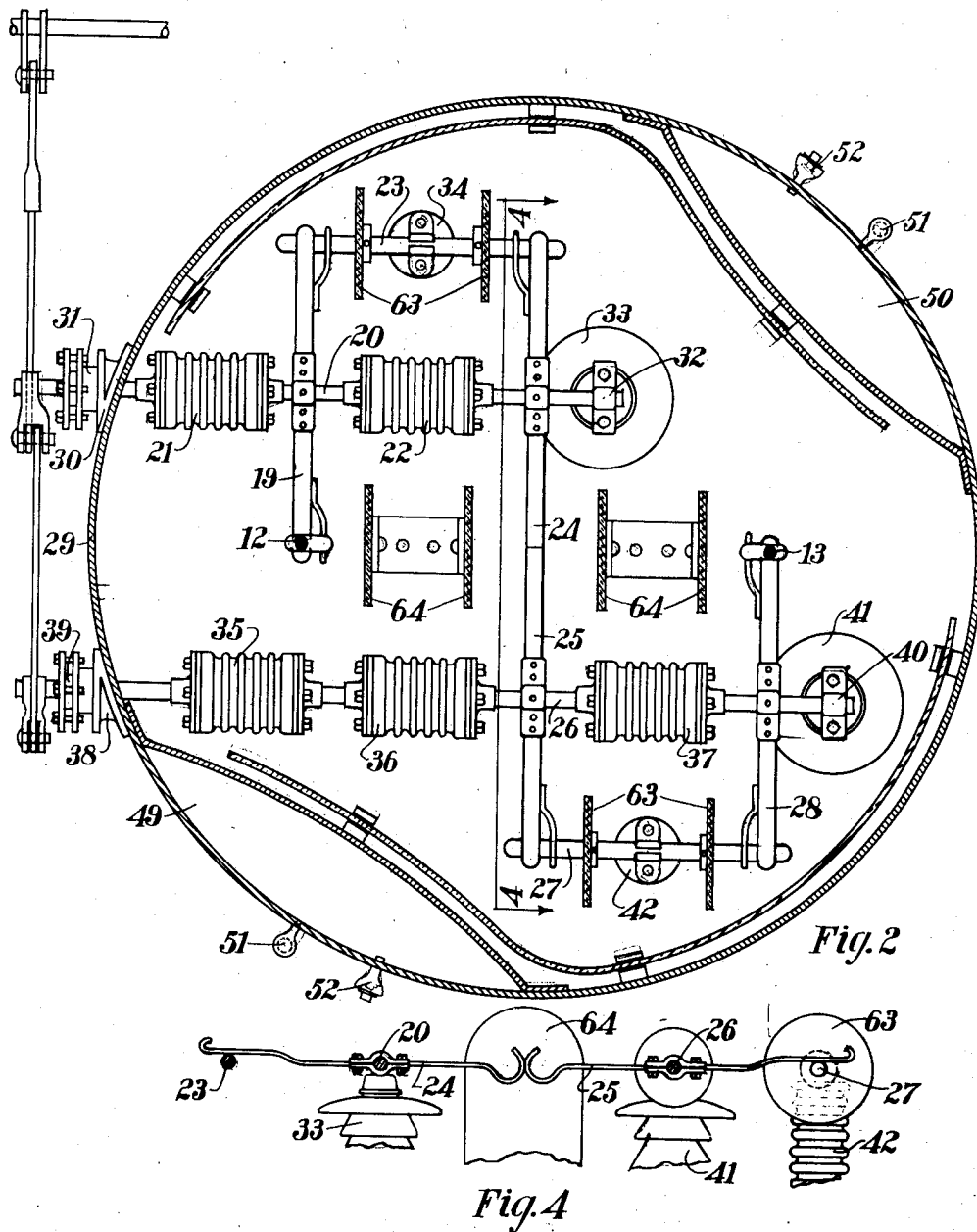
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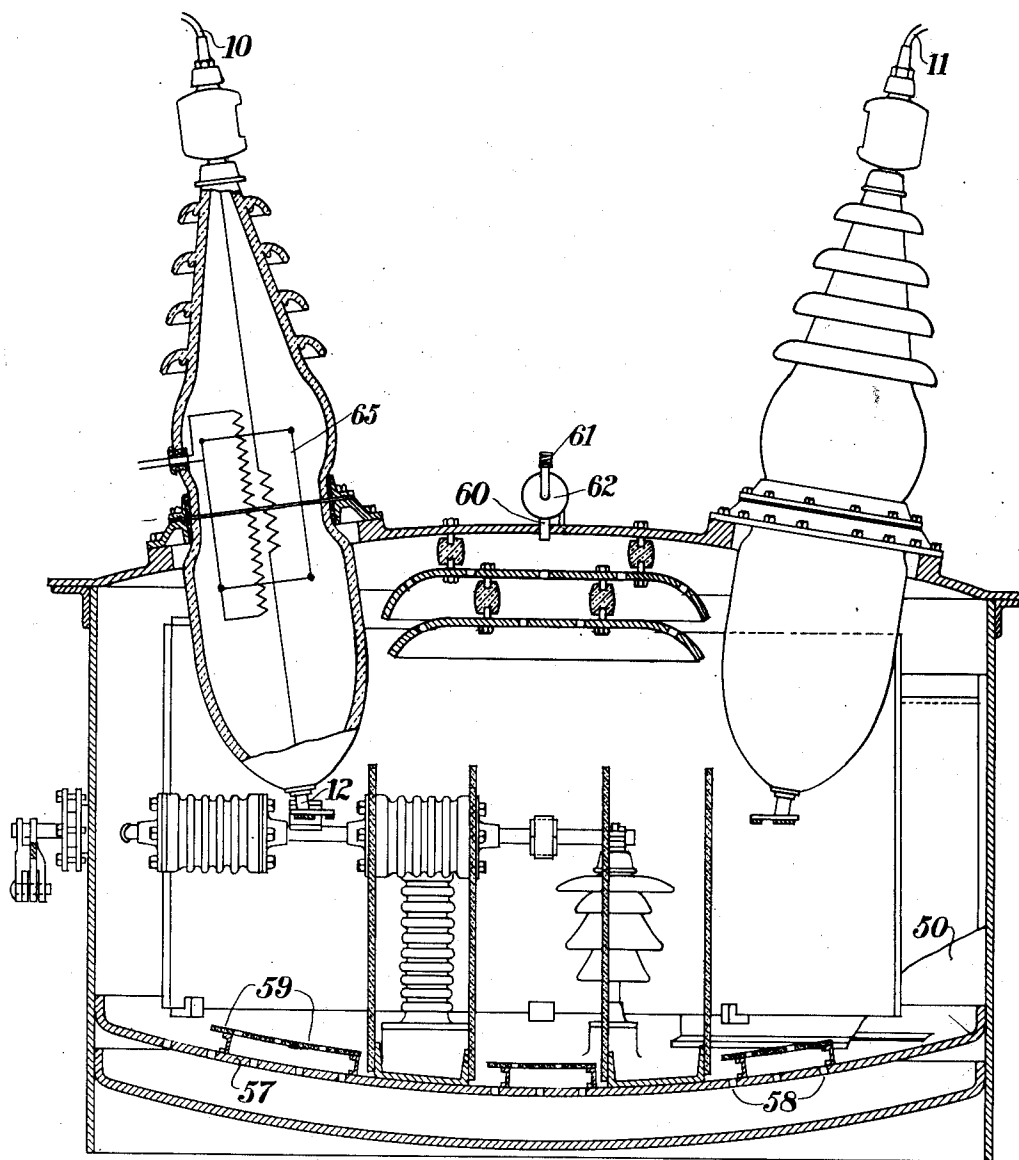


Fig. 5

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UNITED STATES PATENT OFFICE

ARTHUR O. AUSTIN, OF NEAR BARBERTON, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS,
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ELECTRIC SWITCH

Application filed March 3, 1930. Serial No. 432,821.

This invention relates to electric switches and switch housings, and has for one of its objects the provision of switch mechanism suitable for high voltage circuits which is compact in its arrangement and permits the use of a small sized housing.

Another object is to provide an oil break switch in which the danger of a ground or short circuit is reduced to a minimum.

A further object is to provide an oil break switch which can be conveniently operated without danger to the operator.

A further object is to provide an oil break switch in which the circuit will be broken at a large number of places, thus reducing the amount of arcing.

Other objects and advantages will appear from the following description.

The invention is exemplified in the combination and arrangement of parts shown in the accompanying drawings and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a vertical sectional view of an oil break switch and housing showing one embodiment of the present invention.

Fig. 2 is a horizontal sectional view substantially on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary elevation of the operating link mechanism for the switch.

Fig. 4 is a fragmentary section substantially on line 4—4 of Fig. 2.

Fig. 5 is a view similar to Fig. 1 showing a slightly modified form of the invention.

In high voltage oil circuit breakers, it is desirable to have very complete control of interruptions of the current so that the circuit may be opened quickly. Considerable difficulty has existed in providing an interrupting mechanism having small inertia so that the circuit may be opened quickly without danger to the insulation. In circuit breakers as heretofore manufactured, the large size of operating parts and the correspondingly large housings required for the parts has rendered the circuit breaker bulky and expensive. In my improved type of circuit breaker, many of these objections are

overcome providing a circuit breaker of lower cost or one of more efficient operation.

The circuit breaker shown in Figs. 1 and 2 is for a single phase only of a transmission line. Similar breakers will be provided for the other phases. The high tension leads 10 and 11 are passed through the bushings to the lower terminals 12 and 13. Each of the high voltage bushings has insulating shells 14 and 15 located, respectively, above and below the flange 16, used for attaching the bushing to the circuit breaker cover 17. Switch arms are provided within the switch housing through which the current flows from bushing to bushing when the circuit breaker is closed. The contact arm 19 is arranged to contact with the lower bushing terminal 12. This arm 19 is fixed to a shaft 20 and insulated from ground and from the rest of the mechanism by insulators 21 and 22. In operation, the current flows along the contact arm 19 to an insulated bus or contact bar 23 and from bar 23 to a switch blade 24 also fixed to shaft 20.

The blade 24 extends past the axis of shaft 20 and makes contact with a similar rotating blade 25 mounted on an operating shaft 26 and arranged to contact with an insulated bus or contact bar 27 similar to bar 23. A contact arm 28 mounted on shaft 26 connects the bar 27 with the terminal 13 when the switch is closed. The operating shaft 20 is divided into sections by insulators 21 and 22 and the outer end of the shaft extends through the housing wall 29 and is journaled in a bearing 30 provided with a stuffing box 31. The inner end is journaled in a bearing 32 mounted on an insulator 33. The contact bar 23 is carried on an insulator 34. The shaft 26 is provided with sectionalizing insulators 35, 36 and 37 and also extends through the housing wall 29 and is provided with a bearing 38 and stuffing box 39. The inner end of the shaft 26 is journaled in a bearing 40 carried on an insulator 41. The contact bar 27 is mounted on an insulator 42. The insulators may be of any suitable size, depending upon their voltage duty, and may be formed of single or several parts arranged in series where the voltage is high or arranged in multiple

if desired, for great mechanical strength. The latter arrangement is more applicable to low voltage breakers of high current capacity, although there may be an application of this arrangement where the circuit breakers are very large in size tending to place heavy stresses on the insulating parts. In general, however, the insulators are very strong for torsional stresses and since the inertia of the moving parts is relatively slight, quick operation for interrupting the circuit is obtained.

The circuit breaker is opened or closed by operating the link mechanism, shown in Fig. 3, which is located entirely outside of the circuit breaker tank. Since this mechanism is located well below the top of the circuit breaker tank, it does not lower the effective flashover of the bushing and is readily accessible for servicing or adjusting without necessitating the operator's coming near the high voltage leads. The operating link mechanism comprises crank arms 43 and 44 secured to the projecting ends of shafts 20 and 26 respectively, the outer ends of the crank arms being connected together by a link 45 and one of said arms being connected by a rod 46 with an operating crank 47 mounted on an operating shaft 48. When the operating link mechanism is in the position shown in full lines in Fig. 3 the switch will be closed and the switch blades 24 and 25 will be in contact with each other at their inner ends and with their respective contact bars at their outer ends. When the operating shaft 48 is rotated 180° to the broken line position shown in Fig. 3, the shafts 20 and 26 will each be rotated 90°, swinging the inner ends of the blades 19, 24, 25 and 28 downwardly and their outer ends upwardly and thus breaking the circuit in seven different places. While the shafts 20 and 26 may be operated independently of each other, if desired, it is usually simpler to operate the shafts together. With the arrangement of circuit breaker shown, it is possible to employ a small circuit breaker tank and still provide the necessary insulation. The entire tank may be filled with oil or, if desired, an air space may be allowed above the oil in the top of the tank. In general, however, where it is possible to fill the breaker with oil, the danger of an explosive mixture is reduced as the only gases which will contact with the hot gases rising from the arcs at the contact points of the switch will be gases produced by cracking the oil. This is made possible by providing expansion chambers 49 and 50. These expansion chambers are open at the bottom and closed at the top and may be filled with air or other gas if desired. The amount of air in the expansion chambers is indicated by gauge glasses 51 or other suitable indicating means. An inlet valve 52 is provided for adding air or gas to the tanks. In the operation of a breaker, the pressure produced at the time of

opening the circuit breaker is relieved by the compression of the gas in the pockets 49 and 50 located at the sides of the circuit breaker tank. The relief afforded by these pockets prevents the circuit breaker case from being ruptured, particularly where the oil level is high in the circuit breaker tank or fills the space up to the cover. By regulating the size of the expansion chambers or the amount of air or gas they contain, the pressure developed in the circuit breaker may be controlled to a large extent. Where the pressure is high, the gas formed by the arc at the contact members will be compressed and prevented from forming a path to ground. The time required for the gas to rise will also be longer where the pressure is high, giving the switch a chance to open the circuit before the gas produces a short circuit path to ground. As a further precaution, baffles 53 and 54 may be used to break up the path of the gas rising from the oil. These baffles are preferably insulated by insulators 55 and 56. The baffles may be of conducting material or of insulating material. If these baffles are provided with openings, they will break up the large pockets of gas so that the gas, instead of passing to the upper part of the breaker housing, will be broken up into bubbles surrounded by an insulating oil. If the baffles are insulated and are made up of heat conducting material, they will absorb an appreciable amount of the heat in the hot gas. Baffles of this type may be placed around the bushings, if desired.

Where the circuit breaker tank is almost entirely filled with oil, the rush of oil due to pressure caused by an arc will not be upward towards the air chamber in the top of the breaker but will tend to be downward. This in itself is an aid in preventing a short-circuit path formed by hot gases and permits the use of baffles for insulating and breaking up the gas pockets which might otherwise be destroyed by the flow of oil at the opening of the breaker. By providing openings to the pockets at the bottom of the breaker, it is possible to direct the flow of oil in practically any direction desired to minimize the danger of the hot gases forming a path to ground. Baffles may be placed below, as well as above, or to the side if desired.

In the construction shown in Fig. 5, two bottoms are placed in the circuit breaker tank. In this case, the expansion chambers 49 and 50 connect to the first bottom 57, the openings from the expansion tanks through the bottom 57 being preferably very large. The first or false bottom 57 is equipped with a number of holes or openings 58 which may be so located and of proper size to control the direction of flow of the oil and give it any direction of flow desired. The baffles for controlling the direction of flow need not be con-

lined to the bottom but may be placed at the side or at any other position in the tank to effect the desired direction of flow of the oil. As these openings may be numerous, their size can be rather small so that the flow of oil from the arcing contacts will not be in a direction which will tend to carry the hot gas to the case causing a short-circuit, although a rapid passage of oil will be permitted through the baffle or false bottom relieving the pressure as determined by the size and amount of air or gas in the expansion chambers. If desired, insulating baffles 59 may be placed about the openings in the false bottom which will further break up any gas and prevent a free passage.

It is evident that, following the opening of the switch or circuit breaker, under conditions where an appreciable amount of gas is formed, some means should be provided for relieving the pressure. An outlet 60 is formed at the top of the tank which may be provided with a safety valve 61 and a centrifugal oil trap 62 for returning oil to the tank which may be carried out by the escaping gas. By providing suitable floats or other control mechanism, air or gas may be admitted to the expansion chambers as desired.

The internal expansion chamber has other advantages besides those mentioned above. With the internal expansion chamber, it is possible to prevent the constant breathing of the circuit breaker housing which tends to lower the insulation of the oil due to the moisture taken up from the air. The construction shown permits the use of bushings of minimum length, thereby reducing their cost and providing bushings of a higher degree of reliability. In general, circuit breaker bushings are provided with current transformers for operating relays or trip coils. By making use of bushings equipped with internal current transformers 65, illustrated diagrammatically in Fig. 5 and shown more in detail in my prior Patent No. 1,723,000, it is possible to place the current transformer entirely within the bushing, thereby making it possible to use an exceedingly short bushing below the cover. This makes it possible to reduce the size of the circuit breaker tank and still at the same time provide a bushing with a current transformer or current transformer and capacitance tap, if desired, for the operation of relays or trip coils. With the internal transformer, shown in my prior patent, it is possible to bring the leads from the current transformer out of the bushing either above or below the flange or through the flange if desired.

This type of current transformer has material advantages as a large amount of energy in the secondary of the current transformer may be obtained for the operation of trip

coils or relays regardless of the current flowing through the bushing. Where the bushing is to be used with a small current, the necessary ampere turns on the primary of the current transformer may be obtained by increasing the turns in the primary winding. With the switch mechanism shown, a large number of breaks may be obtained in the oil tending to cut down the energy at any one point. The number of breaks may be increased or decreased, if desired, as the mechanism lends itself very readily to a large number of contact arms and breaks. With the control of the flow of oil in the breaker, the danger of hot gas pockets from the series arcs coming together and shunting a part of the opening mechanism is greatly reduced. If desired, however, insulating baffles 63 and 64 may be placed so as to prevent hot gas pockets coming together. These baffles may be rigidly mounted or so mounted that they can be deflected at the time of maximum pressure, returning to position when the pressure decreases. Where these baffles are insulated, they may be of a conducting material in which case, however, their construction should be such as to break up the gas pocket and also so as to absorb heat. In general, however, an insulator baffle perforated or with suitable openings will not be damaged by explosion force, while at the same time it will prevent the extension of the conducting path by a pocket formed by the arc at the opening contact. If desired, bushings may be provided with capacitance taps as well as current transformer taps for the operation of suitable relays which in turn control the movement of the operating mechanism for closing or opening the circuit breaker.

I claim:

1. A high potential switch comprising a housing, a pair of substantially parallel shafts mounted to rotate within said housing and having spaced switching members thereon operable by said shafts when said shafts are rotated, said shafts having means thereon for insulating said switching members from one another, fixed contacts connecting the switching members on each shaft in series when said shafts are in the closed position of said switch, two switching members, one on each shaft, engaging each other in the closed position of said switch and connecting the switching members of the two shafts in series, all of said switching members being disengaged from their connected contacts to make a plurality of series breaks in the switch circuit when said shafts are rotated to open the switch, and means disposed outside of said housing for rotating said shaft.

2. A high voltage switch comprising a housing, a bushing insulator extending through the top of said housing, a conductor extending through said insulator into said housing, a horizontally disposed shaft within said

housing, said shaft having a portion thereof formed of conducting material and an end abutting portion formed of insulating material for insulating the conducting portion of said shaft from said housing for insulating a portion of said shaft from said housing, a switching member mounted on the insulated portion of said shaft and movable into and out of electrical connection with said conductor by rotation of said shaft, said shaft having an operating portion projecting through the side wall of said housing, and means connected with said projecting portion outside of said housing for rotating said shaft.

3. A high voltage switch comprising an oil containing housing, a bushing insulator extending through the top of said housing, a conductor extending through said insulator into said housing, switching mechanism disposed within said housing beneath the surface level of the oil in said housing, said switching mechanism comprising a horizontally extending shaft, means for insulating a portion of said shaft from said housing, a switching member mounted on the insulated portion of said shaft and movable into and out of electrical connection with said conductor by rotation of said shaft, additional switching members mounted on said shaft and insulated from each other, and fixed contacts electrically connecting said additional switching members when said shaft is in the closed position of said switch but separated from said additional switching members when said switch is open, one of said additional switching members being electrically connected with said first mentioned switching member, said shaft having an operating portion extending into the side wall of said housing below the surface level of the oil within said housing, and means connected with the operating portion of said shaft outside of said housing for rotating said shaft.

4. An oil break switch comprising an oil containing housing, a pair of bushing insulators extending through the wall of said housing, conductors extending through said insulators into said housing, switching mechanism disposed within said housing for connecting and disconnecting said conductors, said switching mechanism comprising a pair of substantially parallel horizontally disposed shafts mounted for rotation within said housing, insulators for dividing said shafts into insulated sections, means for insulating said sections from said housing, switch members mounted on the insulated sections of said shafts, one switching member on each shaft being arranged to connect electrically with one of said conductors when said shafts are in the closed position of said switch, fixed contacts arranged to engage other switching members and connect the switching members on each shaft in series

when said shafts are in the closed position of said switch, a pair of switching members, one on each shaft, being arranged to engage each other and electrically connecting the switching members on the two shafts in series when said shafts are in the closed position of said switch, said switching members being movable out of electrical connection with their respective cooperating contacts and with said conductors when said shafts are rotated to the open position of said switch, thus opening the circuit through said switch at a plurality of points in series and means for rotating said shafts.

5. Switching mechanism comprising a pair of spaced terminal members, a pair of rotatable switch members, each having electrical connection with one of said terminal members when in one position and also having electrical connection with each other when in said position, and means for rotating said terminal members said terminal members when rotated being arranged to break their electrical connection with each other and their electrical connection with said terminal members substantially simultaneously.

6. An electric switch comprising a pair of spaced terminal members, and means for making and breaking electrical connection between said terminal members comprising a pair of substantially parallel shafts, each having arms extending radially therefrom in opposite directions, certain of said arms being arranged to make electrical connections with said terminal members, and others of said arms being arranged to make electrical connection with each other to form a continuous circuit between said terminal members when said shafts are in one position.

7. An electric switch comprising a pair of spaced substantially parallel shafts, insulators for dividing said shafts transversely into axially aligned sections separated electrically but mechanically connected by said insulators, switch arms carried by said insulated sections, a pair of spaced terminals and contact members for engaging said switch arms, said switch arms and contact members being arranged to form a continuous electrical circuit between said terminals when said shafts are in one position and to break said circuit at a plurality of points substantially simultaneously when said shafts are rotated to a different position.

8. An electric switch comprising a pair of substantially parallel shafts, insulators for dividing said shafts into insulated sections, switching arms projecting radially from said shafts in opposite directions, two of said arms being arranged to form electrical connection with each other, a pair of spaced terminal members each arranged to form electrical contact with one of said arms, and contact members arranged to engage others of said arms, said arms and contacts forming a

continuous circuit between said terminal members when said shafts are in one position, means for rotating said shafts to break the electrical connections between said arms and terminal members and between said arms and contacts and between the electrically connected arms so as to break the connection between said terminals at a plurality of places substantially simultaneously when said shafts are rotated.

9. An oil break switch comprising a housing, switching mechanism disposed within said housing, a false bottom for said housing having perforations therethrough, forming passages through said false bottom, the lower ends of which are flush with the lower surface of said false bottom and an expansion chamber communicating with the space below said false bottom.

10. An oil break switch comprising a housing, switching mechanism disposed within said housing, an expansion tank opening near the bottom of said housing, and means for controlling the direction of the flow of oil from the interior of said housing to said expansion tank.

11. An oil break switch comprising a housing, switching mechanism disposed within said housing, a false bottom for said housing, an expansion tank open at its lower end through said false bottom to the space below said false bottom, said false bottom having perforations therethrough having open lower ends flush with the lower surface of said false bottom controlling the direction of the flow of oil to said expansion tank caused by arcing when said switching mechanism is open.

In testimony whereof I have signed my name to this specification this 28th day of Feb. A. D. 1930.

ARTHUR O. AUSTIN.