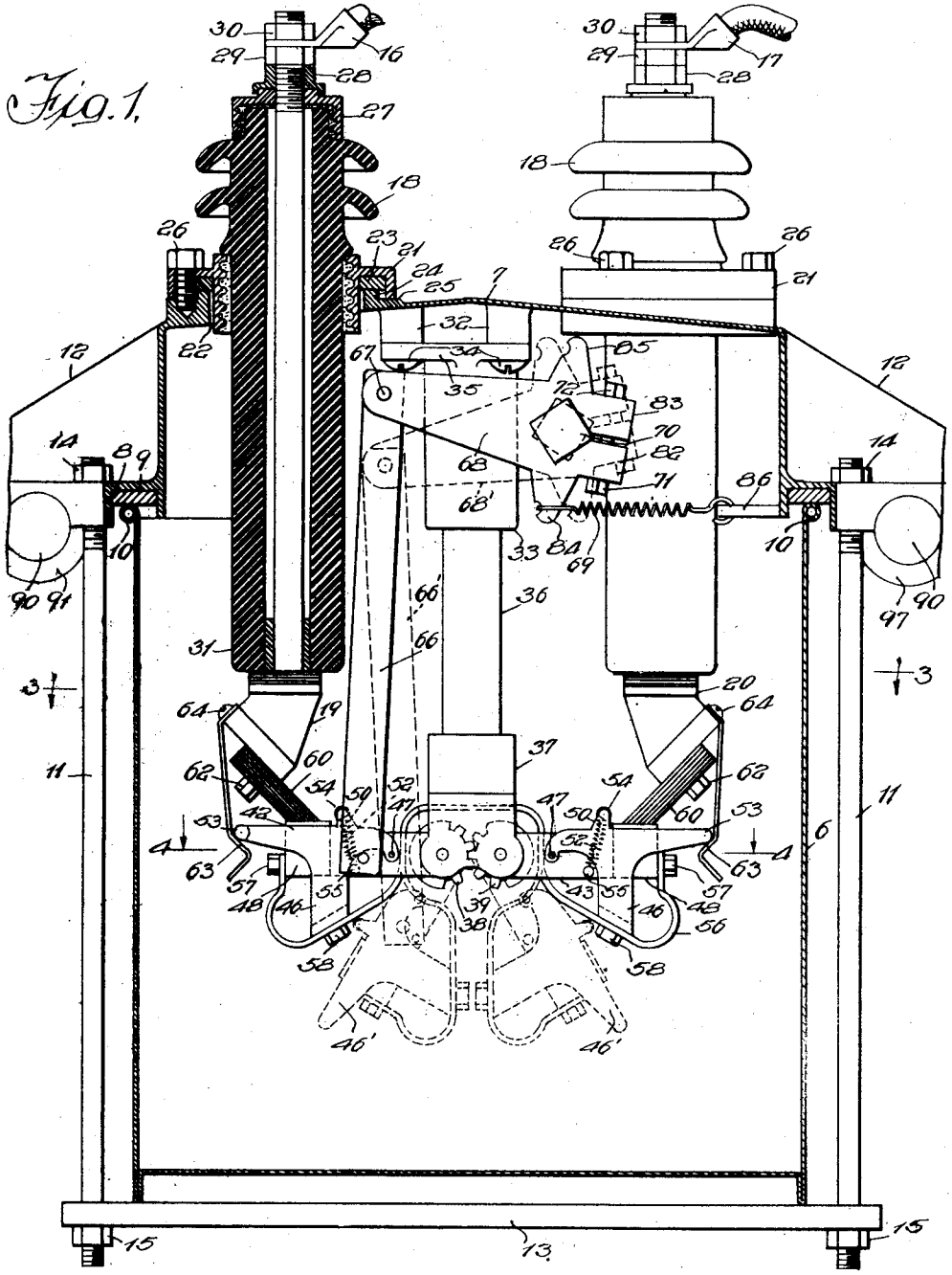
Jan. 27, 1931. A. F. C. LOTZ 1,790,275

OIL SWITCH

Original Filed Dec. 1, 1924 3 Sheets-Sheet 1

Fig. 1.



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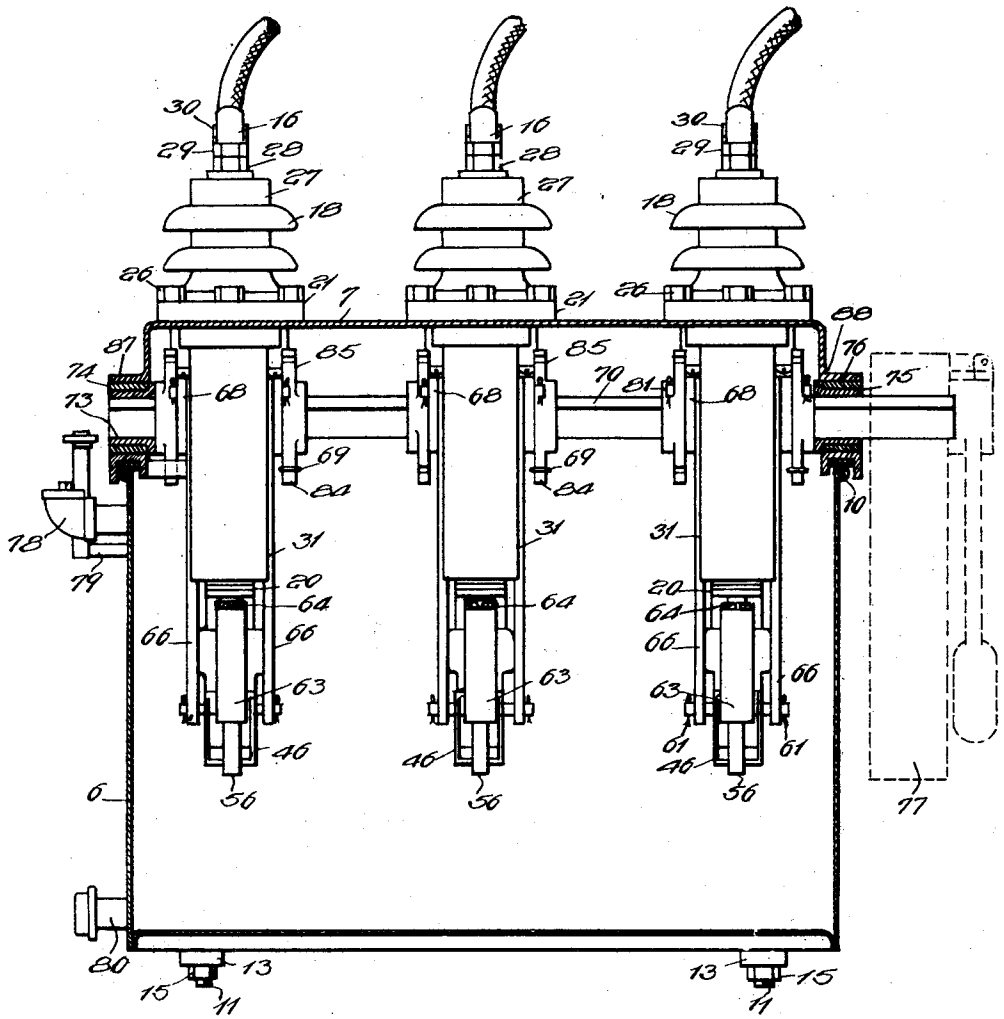
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OIL SWITCH

Original Filed Dec. 1, 1924 3 Sheets-Sheet 2

Fig. 2.



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OIL SWITCH

Original Filed Dec. 1, 1924 3 Sheets-Sheet 3

Fig. 3.

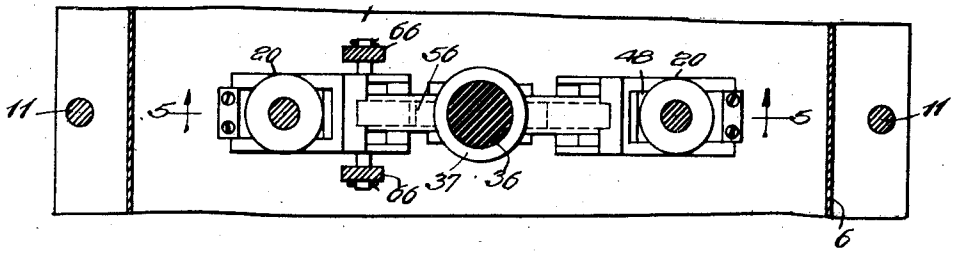


Fig. 4.

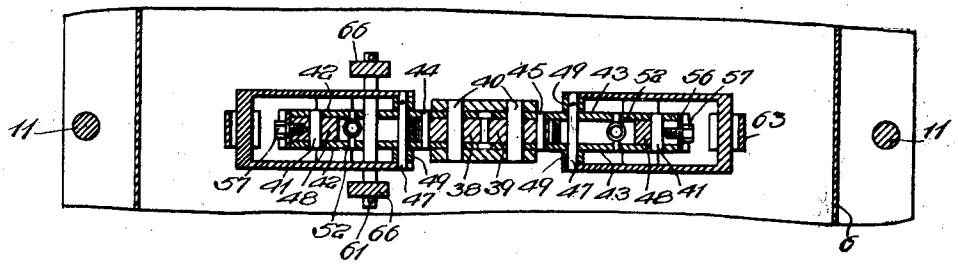
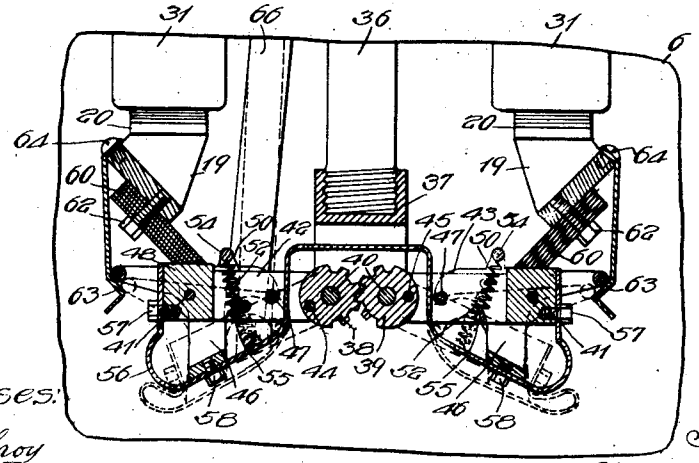


Fig. 5.



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Patented Jan. 27, 1931

1,790,275

UNITED STATES PATENT OFFICE

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OIL SWITCH

Application filed December 1, 1924, Serial No. 753,028. Renewed October 2, 1930.

This invention relates to improvements in switches of the oil immersed type. Although special reference has been made to oil switches, these improvements may, nevertheless be embodied in switches of other types.

It becomes necessary, in switches of this sort, to not only break away the contact means from each other quickly, but also to extinguish the arc which is created when the contact is broken. To do this, it is necessary that the contacts be separated in a quenching medium such as oil, and also that the operating parts not only be light to act quickly, but also be strong enough to withstand the magnetic and mechanical stresses to which they are subjected.

Heretofore, it has been necessary to make the contact actuating parts relatively heavy and massive to stand up under the stresses mentioned. These have also been of rather intricate design and due to their inertia, it became a difficult problem to get a quick and positive separation of the switch contacts. Furthermore, the break occurred only in one place and this did not permit as prompt an extinguishment of the arc as is possible where the circuit is broken simultaneously at two points, for in the latter case the separate arcs are proportionately weaker and hence can be extinguished faster.

One of the objects of my invention is the provision of an oil switch which is positive and quick acting. This is accomplished by breaking the circuit simultaneously at two points by means of a suitable gear actuating mechanism for the movable contacts.

Another object is the provision of a simple contact mechanism of light but rugged construction. As previously pointed out, a construction of this sort is essential in order that the inertia of the parts may be a minimum and also that the parts may stand up under the magnetic and mechanical stresses to which they are subjected when the switch is operated.

In order to acquaint those skilled in the art with the manner of constructing and operating my invention, I shall in connection with the accompanying drawings describe an embodiment of the same which is particularly adaptable for use in a three phase circuit.

In the drawings:

Figure 1 is a vertical section of a switch embodying the invention showing one of the terminal insulators and its fittings in section and the other in elevation;

Figure 2 is a front vertical section of the switch showing the units for one side of a three phase line, in elevation;

Figure 3 is a horizontal section taken on line 3—3 of Figure 1;

Figure 4 is a horizontal section taken on line 4—4 of Figure 1 showing in greater detail the arrangement of the contact mechanism; and

Figure 5 is a fragmentary vertical section taken on the line 5—5 of Figure 3 showing the manner of mounting the separable contact means.

The switch shown comprises an oil tight tank 6 having a cover 7. The cover 7 has a relatively rectangular groove or recess 8 extending around the entire perimeter of the bottom side thereof. In the groove 8, a strip liner of felt or other suitable material 9 is snugly fitted to permit of a tight fit between the cover and the rounded edges 10 of the tank 6.

The tank 6 rests on suspension bars 13. These bars are suspended from the cover 7 by means of suspension rods 11, which are threaded at both ends, the threaded portions thereof passing respectively through holes in the suspension bars 13 and through holes in the laterally projecting lugs 12 which are integral with the cover 7 and directly in line with the holes in the bars. By tightening the nuts 14 and 15, which are fitted to the threaded portions of the rods 11, the tank and cover are held firmly in position relative to each other. To remove the oil tank, therefore, it is only necessary to take off the nuts 15. This permits the suspension bars 13 to be removed and the tank 6 to be lowered out of its position.

Conductors, provided at their outer ends with terminal sockets 16 and 17, are led through cover 7 by means of suitable insulators 18. These conductors terminate within

the tank 6 in terminals 19 and 20, which are integral with them and the two taken together are known in the art as terminal rods. The base portions of the terminal rods on which the insulators 18 rest, are relatively circular. From the bottom of this circular portion a web extends angularly outward and terminates in a relatively rectangular base portion. The terminal rods should preferably be cast of copper.

In the embodiment shown, the insulators 18, which may be made of any suitable insulating material, are cemented in supports or rings 21. The rings 21 are mounted over the openings 22 in the cover 7. To insure a snug fit between them and the cover 7, a flange 24 projects upward from each opening 22 and fits tightly against a gasket 23 fitted into the inner side of the ring 21. The bottom surfaces of the rings 21, rest on accurately machined surfaces 25 of the cover 7 and are held firmly against these surfaces by the cap screws 26. At the upper end of each insulator 18 is cemented a metal bushing cap 27 through which the threaded portions of the terminal rods 19 and 20 are guided. Nuts 28 which fit on upwardly projecting bosses of the bushing caps 27, are used to secure the terminal rods 19 and 20 in position with relation to the insulators 18. The nuts 28 are locked in place by lock nuts 29 on which are mounted the sockets 16 17 and which are held in fixed relation thereto by the nuts 30. At the lower portions of the insulators 18, the terminal rods are separated from the inner walls thereof by insulating bushings 31.

Integral with and along the central portion of the inner side of the cover 7 are downwardly projecting lugs 32. These lugs are tapped to receive machine screws 34 which are used to secure the base 35 firmly against them. The base 35 has a downwardly extending portion 33 which is integral therewith. A central opening is provided in the extending portion 33 into which the insulator 36 is fitted and rigidly secured by cement means.

A metal cap 37 fits over and is cemented to the lower end of the insulator 36. This cap has lugs extending vertically downward from diametrically opposite sides thereof so that the inner faces of the lugs are relatively parallel to each other. Between the two inner parallel faces of the extending lugs of the cap 37, gears 38 and 39 are pivotally mounted by means of pivot pins 40. The gears 38 and 39 are preferably made of steel and are accurately cut in order to insure their smooth and simultaneous operation. Secured to each side of the parallel faces of the gears 38 and 39 are metal gear plates 42 and 43 which are also mounted on the pivot pins 40. The gears 38 and 39 are rigidly secured to their respective gear plates 42 and 43 by means of pins 44 and 45. Since the gears 38 and 39 are in themselves identical, it is necessary in order that they mesh properly that one gear be set on its bar plate an angular distance which is equivalent to one gear tooth. This is done by fixing the gear 38 to its gear plates 42 by offsetting the holes through which the pin 44, which firmly holds the gear 38 to its plates, passes an angular distance which is equivalent to that of one gear tooth.

Between the parallel faces of the respective gear plates 42 and 43 and at ends opposite the gears 38 and 39 are mounted the contact blocks 48 by means of pins 41. Contact blocks 48 are preferably made of copper and are secured to the gear plates by press fits of the pins 41 through them and the gear plates.

The arc horns 46 may be cast of copper and consist of hollow central portions through which the gear plates 42 and 43 may be freely admitted. The front portions are downturned and at the ends of these downturned portions and on the inner sides thereof are projecting bosses 49. These are drilled laterally to serve as bearing surfaces for the pins 47 on which the gear plates 42 and 43 are pivotally mounted. The pins 47 are held in position by drilling a hole through them and one of the two bosses on each arc horn and then inserting a cotter pin through the boss and the pin.

Integral upright lugs 50 of the arc horns 46 are also drilled laterally to receive the pins 54. Springs 52 are connected to these pins before they are pressed into position ing the lugs 50. The other ends of the springs 52 pass between the gear plates 42 and 43 respectively and are fastened to pins 55. The pins 55 are pressed into and have their ends flush with the outer faces of the gear plates. The purpose of the springs 52 is to hold the gear plates 42 and 43 in relatively normal position with the arc horns 46.

Contact blocks 48, which are secured to each pair of gear plates 42 and 43, are electrically connected with each other by means of a flat, flexible cable 56. This cable is fastened to the lower outer end portions of the contact blocks by means of the cap screws 57. It is also fastened to the bottom sides of the downward extending portions of the arc horns 46 by the cap screws 58, and then passes upward between the respective pairs of gear plates 42 and 43 and thence over the gears 38 and 39 between the downward projecting walls of the cap 37.

To the bottom sides of the angularly disposed rectangular base portions of the terminal rods 19 and 20, are secured the brushes 60 by means of the cap screws 62. These brushes are preferably made of copper sheets which have been soldered together at the ends that are secured to the terminal rods.

The ends making contact with the contact blocks 48 are accurately ground so that good surface contact is insured between the surface of the contact blocks and the brushes.

Arcing springs 63 are provided to draw the arc which occurs when the circuit is opened and the contact between the brushes 60 and the contact blocks 48 is broken. These springs are made of phosphor bronze and are fastened by means of the screws 64 to the upper side of the rectangular base portion of the terminal rods 19 and 20. When the switch brushes 60 and the contact blocks 48 are in contact relation, the circular end portions 53 of the arc horns 46 rest against the upper end of the V at the lower end of the springs 63. On opening the circuit, as will be later explained, the springs 63 and the circular portions 53 are still in contact relation and remain so until the circular portions 53 pass the V bend in the springs 63 when the circuit is actually broken and the arcs occur.

Since the respective contact mechanisms for each side of the circuit are relatively identical, it is only necessary since they are both made operable simultaneously by the gears 38 and 39, to connect actuating means to only one of them. This is done by securely mounting a pin 65 in the gear plates 42. Pin 65 has its ends extending under and beyond the arc horns 46 to permit the actuating links 66 to be pivotally mounted at each end thereof.

These links are kept in position by cotter pins 61 which are inserted through holes in the pins between the links 66 and the ends of the pins. Links 66 may be made of fiber or other suitable insulating material which is capable of withstanding relatively high tensive and compressive stresses. At their upper ends they are pivotally connected to the operating arms 68 by means of pivot pins 67 and are held in position on the pins by suitable cotter pins 81.

An operating arm 68 is provided for each set of operating links 66. The operating arm is generally cast of malleable iron and is provided at one end with a square opening for the square operating shaft 70. A longitudinal slot splits this same end into the split end portions 82 and 83. Through the split end portions and relatively perpendicular to the slot an opening is provided for admitting the bolt 71 to which is threaded the nut 72. By tightening this nut the square opening in the arm 68 is firmly clamped to the shaft 70. Integral lugs 84 and 85 projecting downward and upward from the operating arm 68 proper serve respectively as a spring arm and stop arm. To a recess at the lower end of the spring arm 84 the operating spring 69 is connected. The other end of the operating spring 69 is connected to the lug 86 which is cast integral with the cover 7.

One end of the shaft 70, is mounted in a bushing 73. The bushing 73 is journaled in a bearing 74 which in turn is fitted into the outward projecting portion 87 of the cover 7. The other end of the shaft passes through the bushing 75 which is journaled in the bearing 76. This bearing is also fitted into an outward projecting portion 88 of the cover 7. The extended end of the shaft is long enough to permit a suitable setting and trip mechanism 77 for operating the switch to be attached thereto. This may be of the type which is shown and described in my copending application, Serial No. 33,886 filed June 1, 1925, now issued as Patent No. 1,672,494 of June 5, 1928.

Pipe means 78 are threaded into the upper part of one side of the oil tank 6 and serve as means through which oil may be poured into the tank. An oil gage 79 is also provided to indicate the level of the oil in the tank. A plugged nipple 80 for draining the tank when it is necessary to change the oil, is fitted to the tank preferably on the same side with the gage 79 and the pipe fitting 78, but at the lower end thereof so that the bottom of the nipple is relatively on the same level with the bottom side of the tank to permit of complete draining of the tank when necessary.

The entire switch may be mounted on pipes which pass through the openings 90. These openings are formed by the semi-circular opening in the lugs 12 which are integral with the cover 7 and by the semi-circular openings in the clamping means 91 which may be clamped to the lugs 12 by suitable bolt means.

To open the circuit in which the switch is used, the operating mechanism 77 is tripped. This causes the shaft 70 to rotate in a counterclockwise direction by virtue of the pull on the spring arm 84 by the operating spring 69. In the unit shown in Figure 1, the operating arm 68 will take the dotted line position 68′ and the links 66 will move into the dotted line position 66′.

During the switch closing operation my improved mechanism functions in a novel manner quite superior to the mode of operation of such switches of the past with which I am familiar. As the switch is being moved upwardly to the closed position it moves the arcing horn 46 with it, the horn on the left hand side of Figure 1 abutting against the arcing spring 63 and flexing the same to the left. As the circular portion 53 of the arcing horn 46 passes the apex of the V bend of the arcing horn 63 this last named arcing horn is permitted to move back to its original position as shown in the drawings and in moving back it forces the roller 53 of the arcing contact 46 upwardly. This is produced by a snap motion and it causes the arcing horn 46 to tend to turn about its pivot

47. This turning motion tends to stretch the spring 52 thereby drawing the main movable contact upwardly and into abutting relationship with the laminated spring contact 60. This is of considerable importance not only in that it produces a snap engagement between the block 48 and brush 60 but also for the following reasons: As previously stated, the closing operation of the switch is obtained by the rotation of the shaft 70, said shaft transmitting its motion through the operating arm 68 and the links 66. This shaft may be rotated by any suitable form of switch closing mechanism already known in the art. Such switch closing mechanisms are frequently provided with stop means for limiting the extent of rotation of the shaft 70 in the switch closing direction, said shaft operating until it abuts against the stop means, which stop means is adjusted in its position so that abutment therewith is obtained at the same time that the contact block 48 obtains abutment with its contact brush 70. Now, after prolonged operation of the switching mechanism an appreciable amount of loose play may develop between the various links and other mechanism extending from the contact block 48 to the switch operating mechanism such as the mechanism 77 (Figure 2). When the switch operating mechanism is operated in a switch closing direction, under such circumstances the initial operation thereof will be effective merely to take up the play before it produces any movement of the contact block 48. As a result, the switch operating mechanism may reach its limit of motion a slight interval before the contact block 48 is moved thereby into full abutting relationship with the laminated spring 60. If it were not for the presence of the spring 63 then a poor contact would be obtained between the main contact of the switch. As is, this spring 63 forces the roller 53 upwardly thereby forcing the contact block 48 upwardly through the action of the spring 52. This takes up the free play that may have developed in the connecting mechanism and results in the obtaining of a firm pressure contact between the block 48 and the laminated spring. This is of particular importance in switches wherein the contacts have butting engagement with one another when the switch is closed.

The above description is directed primarily to the action of the left hand contact block 48 shown in Figure 1. With reference to the right hand contact block shown in that figure, all of the above functions are obtained and in addition there is this advantage: Suppose that a certain amount of wear has occurred between the gears 38 and 39 and there is a certain limited amount of free play developed. Under such circumstances when the contact block 48 on the left hand side of the switch fully engages its laminated spring then further upward motion of the actuating links 66 is not possible. If there is a certain amount of play between the gears then under these conditions the right hand contact 48 will not have been moved into firm abutting engagement with its laminated spring on the right hand side of the switch by the action of the links 66 and under such conditions the functioning of the spring 63 and the roller 53 on the right hand side of the switch is exceedingly important. This roller 53 has now ridden past the apex of the V formation in the spring 63 and therefore this spring forces the arcing contact 46 upwardly. As this right hand arcing contact 46 moves upwardly under the action of the spring 63, it tends to swing about its pivot 47 thus stretching the spring 52 which draws the contact 48 upwardly into firm engagement with its laminated spring 60 notwithstanding the failure of the links 66 to do so. As a result of this arrangement, a firm electrical engagement is obtained between both of the contacts 48 and their respective laminated springs, thereby insuring the establishment of a low resistance switching circuit.

This movement of the links 66 causes the gear plates 42 and 43 to be moved downwardly moving the blocks 48 out of contact with brushes 60. During the first part of the opening operation the rounded elements 53 of horns 46 remain in contact with the upper arms of the V-shaped elements adjacent the lower ends of the arcing springs 63. Continued downward movement of the gear plates 42 and 43 places the springs 52 under tension. After the blocks 48 have been moved away from brushes 60 a sufficient distance to eliminate any danger of arcs striking across from the brushes to the blocks, elements 53 pass over the vertexes of the V-elements of springs 63 and the springs 52 act to move the horns away from springs 63 with a snap action. This serves to produce a quick break and the arcs are quickly drawn in the bath and quenched thereby. This operation will be readily understood by referring to Figs. 1 and 5 of the drawings, the positions of the parts immediately prior to the break between the arcing horns and the springs 63 being indicated in the latter figure. It will also be noted that the arcing horns contact with springs 63 before the blocks 48 contact with brushes 60, in closing the switch. As the brushes have butt contact with the blocks, this arrangement is of value as eliminating arcing between the brush and block with consequent injury to the switch. The snap action of the horns in the bath is also of importance as quickly drawing the arc in such manner that it is readily quenched by the bath before it has any opportunity to build up.

The invention as described has been limited to the details of a particular embodiment. It is understood that it is not to be limited to the particular details and embodiment, set forth, as others are contemplated within the scope of the appended claims.

I claim:

1. In combination, a pair of contact blocks spaced relative one another, plates fastened to each side of said contact blocks, and intermeshing pivotally mounted gears, the opposite ends of said plates being fixed to said gears.

2. In combination, a pair of arc horns, gear plates pivotally mounted between the inner faces of said arc horns, contact blocks fastened between said gear plates at one end thereof, cooperating gears fastened between said gear plates at the other end thereof, and a spring connected to said arc horns and said gear plates for holding said arc horns and gear plates in relatively normal position.

3. In combination, a centrally mounted member, a bifurcated lug fixed to said member, cooperating gears pivotally mounted between the inner faces of said lug, gear plates fastened to the flat faces of said gears at one end and to contact blocks at the other end, arc horns mounted upon said gear plates and a flexible conducting cable fastened to said contact blocks and said arc horns and passing between the inner faces of said lug and above said gears.

4. In combination, an arc horn, a pair of gear plates pivotally mounted between the inner faces of said arc horn, spring means connecting said arc horn with said gear plates for maintaining said gear plates in relatively normal position with said arc horn, a pin fixed in said gear plates, and linkage means pivotally connected to said pin for actuating said gear plates.

5. In a switch, in combination, a cover, insulators passing therethrough and fixed to said cover, conductor means passing through said insulators, lugs integral with the bottom side of said cover and between said insulators, a base secured to said lugs, an insulator secured to said base, a cap having downward extending lugs secured to said insulator, gears in cooperative relation pivotally mounted between said downward extending lugs, and means connected to said gears for cooperating with said conductor means.

6. In combination, a pair of conductor means having base portions, arcing springs and contact brushes secured to said base portions, circuit closing and opening means mounted between said conductor means, said means comprising a pair of pivotally mounted cooperating gears, gear plates secured to said gears, contact blocks secured to said plates for engagement with said brushes, arc horns pivotally mounted on said gear plates and engaging with said arcing springs, flexible cable means interconnecting said contact blocks, and linkage means pivotally connected to the gear plates secured to one of said gears to make or break said electric circuit by actuating said gears causing said contact blocks and arc horns to make or break contact with said contact brushes and arcing springs respectively.

7. In combination, a cover, a shaft journaled in said cover, an operating arm clamped to said shaft, switch mechanism operated by said arm, said operating arm having lugs integral therewith projecting downward and upward respectively, an operating spring attached to one of said lugs and to said cover, said spring urging the arm in switch opening direction, and means cooperating with the other lug to limit opening movement of the arm, the shaft being releasably held in switch closing position.

8. In a switch, the combination of a pair of terminal rods having enlarged base portions, a pair of brushes fastened to the bottom sides of said base portions, a pair of pivotally mounted cooperating gears, gear plates secured to said gears, contact blocks secured to said gear plates and adapted to contact with said brushes, and linkage means for simultaneously swinging said blocks into and out of contact with said brushes.

9. In a switch, the combination of a pair of terminal rods, brushes fastened to the lower ends of said rods, arcing springs fastened to said rods opposite said brushes, contact blocks adapted for contact with said brushes, arc horns adapted for contact with said arc springs, gear plates fastened to said contact blocks and having a pair of pivoted cooperating gears pivoted thereto at their adjacent ends, and means for moving one set of the gear plates about the axis of their associated gear for swinging said contact blocks and arc horns about said gears into and out of contact with said brushes and arc springs, respectively.

10. In a switch, the combination of a pair of arc horns, a pair of contact blocks, pivoted gear plates fastened to said contact blocks, intermeshing gears secured to said plates, and resilient means fastened to said arc horns and said gear plates for holding said horns in normal position with respect to said plates.

11. In a switch, the combination of a tank, a cover for said tank, a pair of insulator conductor means leading through said cover, a fixed insulating member intermediate said conductor means, a pair of cooperating gear members pivotally mounted on said insulating member, brushes secured to the lower ends of said conductor means, contact blocks adapted for cooperation with said brushes, means connecting said contact blocks with

said gears, and means pivotally connected to one of said connecting means for moving the same about the axis of its associated gear for swinging said contact blocks into and out of contact with said brushes about the pivotal mountings of said cooperating gears.

12. An electric switch including contact means, a pair of switch arms movable into and out of butt contact with the contact means, means for actuating one of said switch arms to the switch closed position, a driving connection extending from said one switch arm to the other for actuating said other arm, and means associated with said contact means and with said other switch arm for moving said other switch arm into engagement with the contact means independently of said driving connection after said other switch arm has been moved into proximity of the contact means, whereby said other arm firmly engages the contact means even though loose play should develop in the driving connection between the two contact arms whereby said other contact arm would not otherwise reach its full closed position when the contact arm that is actuated is in full abutment with the contact means.

13. An electric switch including contact means, a pair of switch arms movable into and out of butt contact therewith, common actuating means for the switch arms, said actuating means being limited in its motion by the abutment of either one of switch arms with the contact means, and means associated with at least one of the switch arms and the contact means for moving said one switch arm into engagement with the contact means independently of the actuating means after said one switch arm has been moved into proximity of the contact means, whereby said one arm firmly engages the contact means even though loose play should develop in the driving connection to said one switch arm to prevent said one arm reaching firm engagement with the contact means under the action of the actuating means due to the previous abutment of said other arm against the contact means.

14. An electric switch including a main contact, a switch arm movable into butt contact therewith actuating means for actuating the switch arm, and arcing contacts associated with the main contact and with the switch arm for engaging one another prior to the engagement of the switch arm with the main contact, said arcing contacts including means effective after a predetermined engaging movement thereof and prior to the engagemen of the switch arm with the main contact for moving the switch arm toward the main contact independently of the switch actuating means, whereby firm electrical contact is obtained between the switch arm and the main contact in the event that the switch arm is not in the full closed position when the switch actuating means reaches its limit of motion.

15. An electric switch including a main contact, a switch arm movable into butt contact therewith, actuating means for actuating the switch arm, and arcing contacts associated with the main contact and with the switch arm for engaging one another prior to the engagement of the switch arm with the main contact, said arcing contacts including means for accelerating the movement of the switch arm in the switch closing direction as the same approaches its full closed position.

16. An electric switch including a main contact, a switch arm movable into butt contact therewith, actuating means for actuating the switch arm, and arcing contacts associated with the main contact and with the switch arm for engaging one another prior to the engagement of the switch arm with the main contact, said arcing contacts including means for snapping the contact arm into abutment with the main contact.

In witness whereof, I hereunto subscribe my name this 26th day of November, 1924.

ALFRED F. C. LOTZ.