B. HASKINS.

SWITCH.

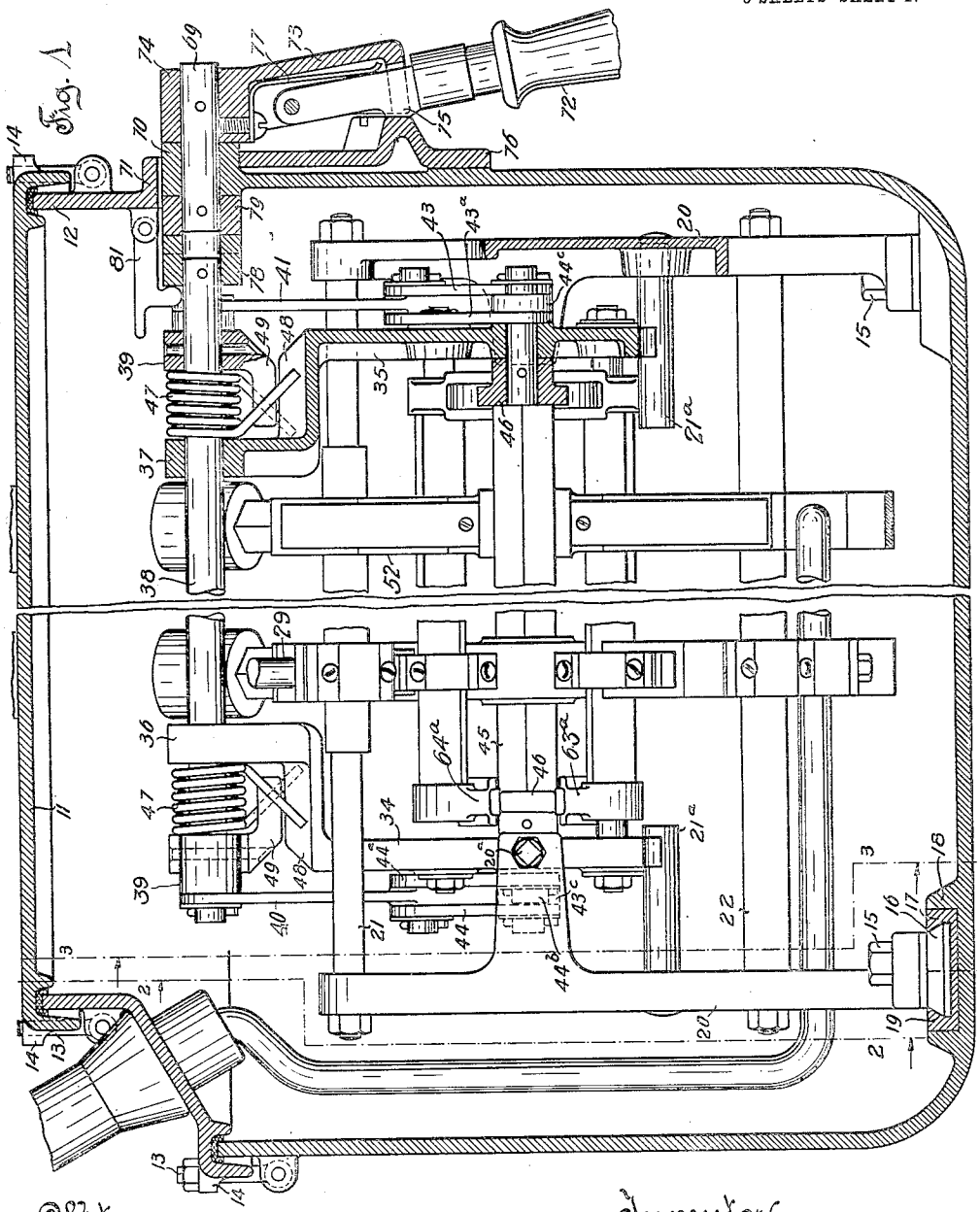
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1,123,870.

Patented Jan. 5, 1915.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses

Rob. E. Stoll

Chas. L. Byron

Inventor

Bradley Haskins

By Chas. E. Lord

Attorney

B. HASKINS.

SWITCH.

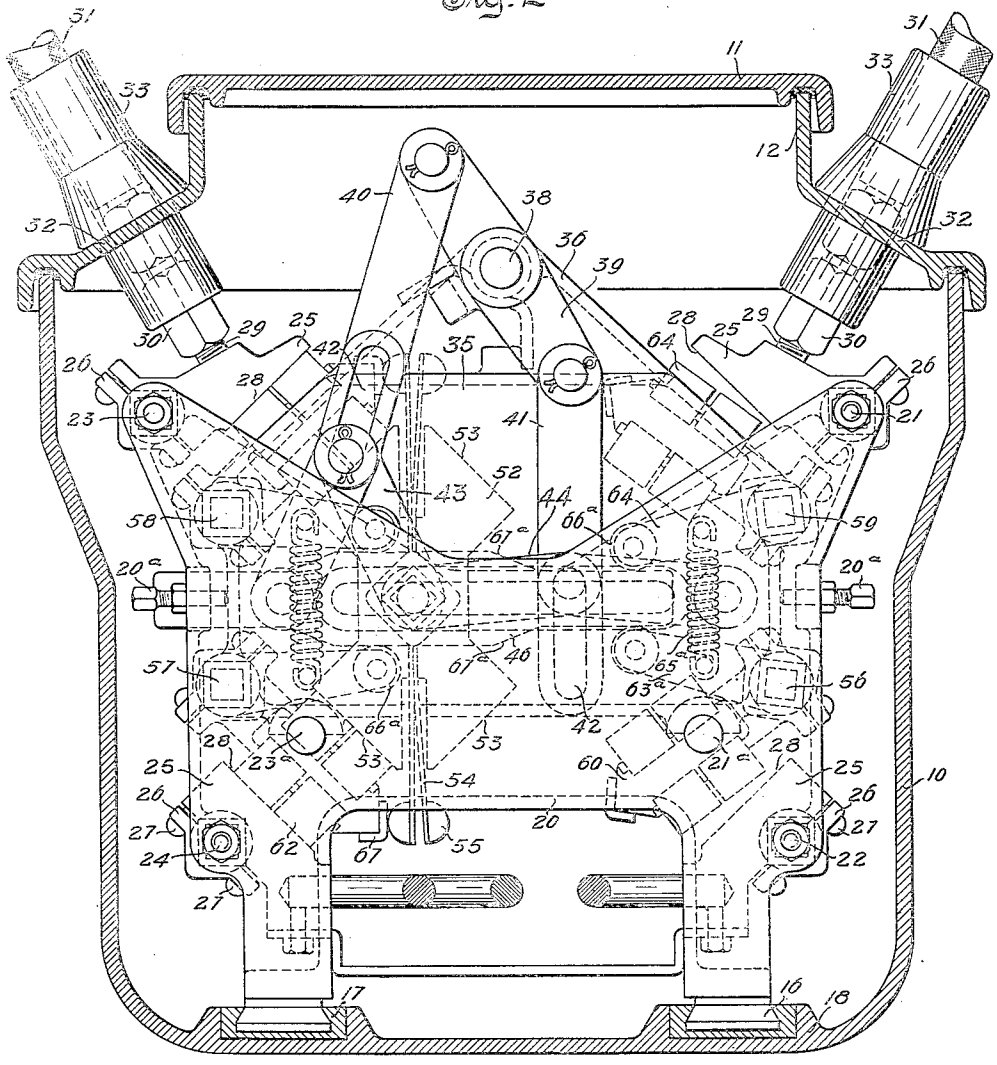
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5 SHEETS—SHEET 2.

Fig. 2



Witnesses

Rob. E. Stoll.

Chas. L. Byron.

Inventor

Bradley Haskins

By Chas. E. Lord

Attorney

B. HASKINS.

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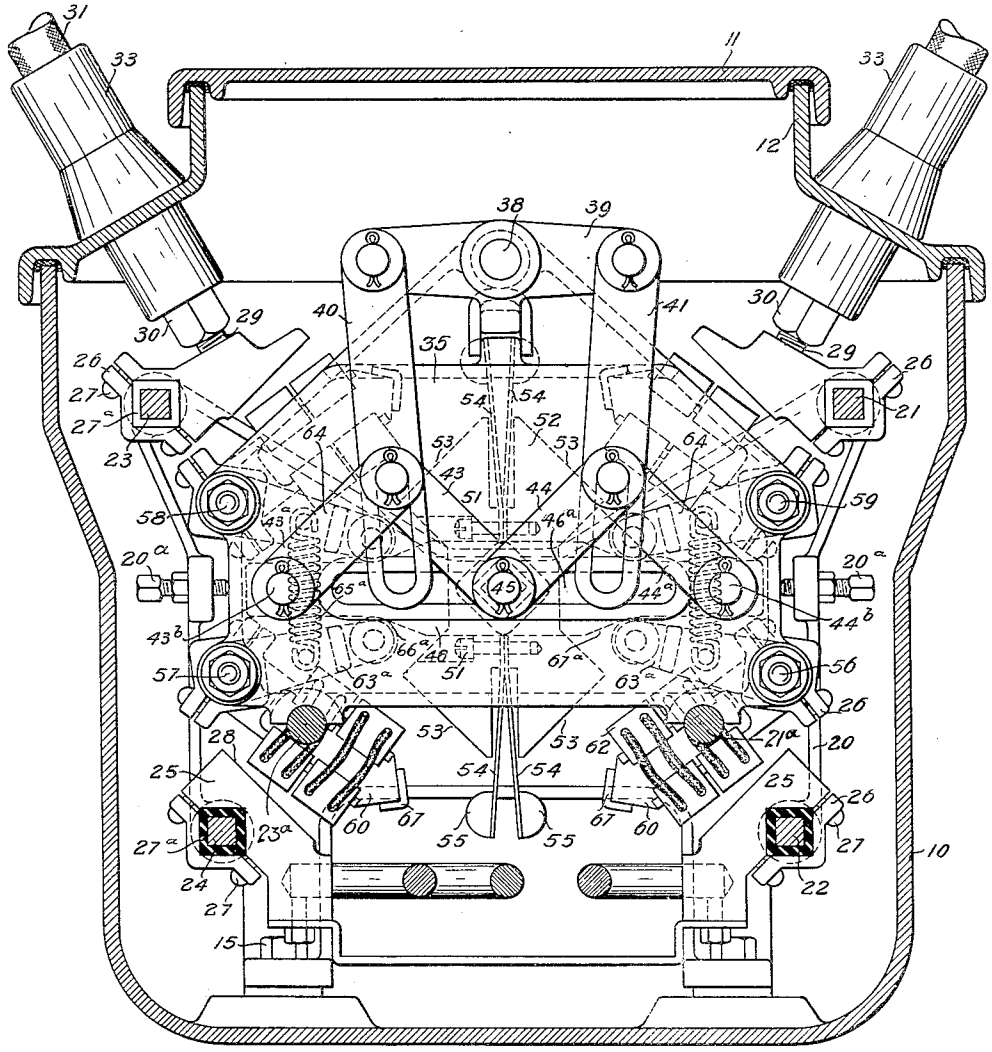
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5 SHEETS—SHEET 3.

Fig. 3.



Witnesses

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Chas. L. Byron

Inventor

Bradley Haskins

By Chas. E. Lord

Attorney

B. HASKINS.

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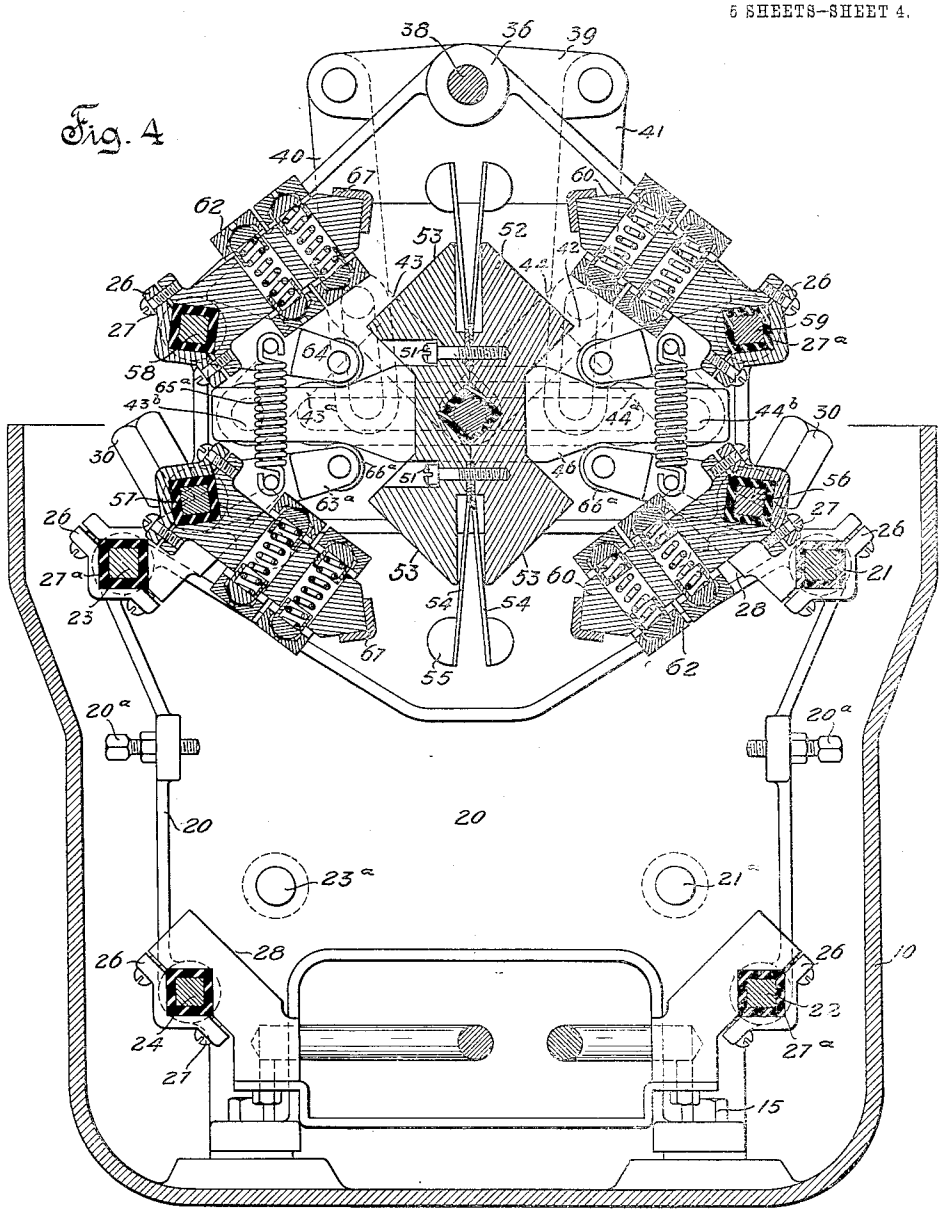
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5 SHEETS—SHEET 4.

Fig. 4



Witnesses

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Chas. L. Byron

Inventor

Bradley Haskins

By Chas. E. Lord

Attorney

B. HASKINS.

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5 SHEETS—SHEET 5.

Fig. 5

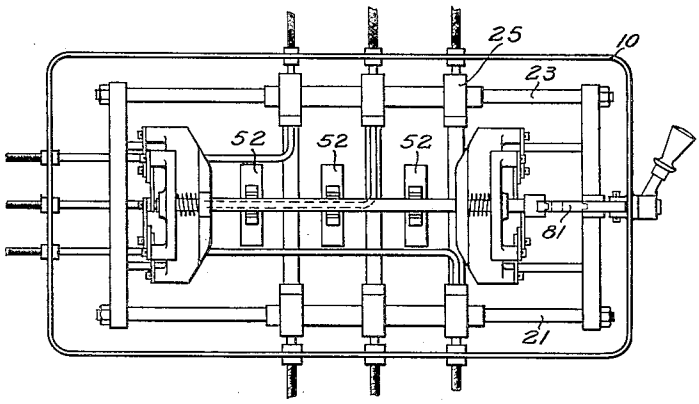


Fig. 6

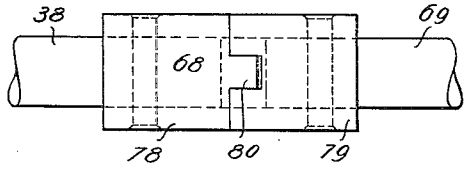
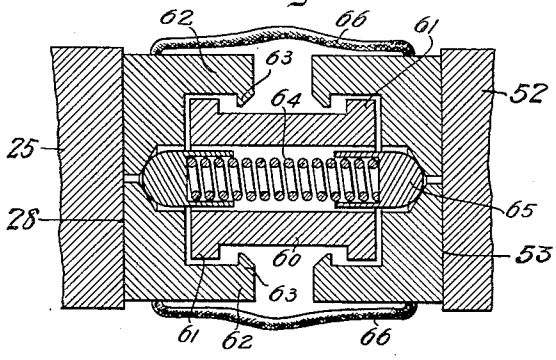


Fig. 7



Witnesses

Rob. E. Stall.

Chas. L. Byron

Inventor

Bradley Haskins

By Chas. E. Lord

Attorney

UNITED STATES PATENT OFFICE.

BRADLEY HASKINS, OF MILWAUKEE, WISCONSIN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ALLIS-CHALMERS MANUFACTURING COMPANY, A CORPORATION OF DELAWARE.

SWITCH.

1,123,870. Specification of Letters Patent. Patented Jan. 5, 1915.

Application filed February 4, 1910. Serial No. 542,081.

To all whom it may concern:

Be it known that I, BRADLEY HASKINS, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Switches, of which the following is a full, clear, and exact specification.

This invention relates to improvements in switches and particularly in oil switches.

In prior applications filed for improvements in oil switches, there have been disclosed oil switches in the form of a self-contained unit removable as a whole from the oil tank and from the line terminals, the stationary contact terminals being separable and the portions which are connected to the line terminals being fixed in the tank, and the portions which are engaged by the movable bridging contacts forming part of the removable unit. With this construction the parts of the switch, particularly the contacts, can be cleaned, repaired, adjusted, etc., conveniently and with safety, inasmuch as it is unnecessary for the workman or operator to work near any live parts and he will not be compelled to work in cramped quarters or under the disadvantage of a poor light such as frequently exists behind switchboards, or need he be annoyed by oil dripping from the recently immersed parts as is the case with the usual construction of switches. The present invention embodies improvement in switches such as just described.

One of the objects of the present invention is the provision of a switch which may be utilized as a double throw switch and having a construction such that the movable or bridging contacts can be caused to operate with one of either of two sets of contacts or contact terminals, without requiring a switch of much larger proportions than is required for a single throw switch.

A further object is to provide a simple and effectively operated double throw oil switch wherein the coöperating relatively movable contact and operating mechanisms are in the form of a self-contained unit, which may be removed as a whole from the oil tank for the purpose of inspection, repairing, adjusting, etc.

Another object is to improve the contact mechanism of switches in general, and particularly to provide contacts which engage and disengage each other in a manner such that the engaging faces of the contacts will be maintained in a smooth and clean condition free from grit, dirt and small particles of fused copper.

A still further object is the provision of a novel form of contact mechanism which permits the switch unit to be readily removed and separated from the fixed contact terminals which are connected to the line terminals, and which permits the unit to be again restored in the tank and to be more easily and accurately placed in operative relation with respect to the fixed contact terminal than is possible with prior constructions.

My invention further consists in certain novel details of construction and combinations and arrangements of parts to be described in the specification and particularly set forth in the appended claims.

Referring to the accompanying sheets of drawings, Figure 1 is a longitudinal sectional view of the switch, parts being broken away, and portions of the operating mechanism being shown in elevation. Fig. 2 is a transverse sectional view taken substantially along the line 2—2 of Fig. 1, looking in the direction indicated by the arrows, and shows the switch in one of its closed positions. Fig. 3 is a transverse sectional view taken substantially along the line 3—3 of Fig. 1, showing the switch in its open position looking in the direction indicated by the arrows. Fig. 4 is a somewhat similar view with the cover removed and the switch unit partially removed from the tank. Fig. 5 is a plan view with the cover removed, the parts being shown somewhat conventionally or diagrammatically. Fig. 6 is a plan view of a portion of the operating mechanism, showing particularly the clutch which is employed between the operating handle and switch; and Fig. 7 is an enlarged sectional view

showing the coöperating contact members in the relative positions which they occupy when the switch is closed.

Referring now to the figures of the drawings, it will be seen that the switch includes an oil tank 10 which is preferably formed from cast metal and is provided with a removable cover 11 secured to an extension 12 of the tank by bolts 13 which pass through the cover and engage in suitable lugs 14 at the corners of the extension. The extension 12 is in turn secured to the tank in a similar manner. The switch may be supported in any suitable manner but preferably adjacent a switchboard (not shown). Secured by means of bolts 15 to wedge-shaped members 16, which are held in channels 17 on the bottom of the tank adjacent opposite ends thereof, are two frames or brackets 20, and extending between these brackets and secured to the ends thereof in any suitable manner are four rods 21, 22, 23 and 24 respectively, which are parallel and extend substantially the length of tank. The channels are formed by lugs 18, and the wedge-shaped members are held in the channels by Babbitt metal 19. These rods 21, 22, 23, and 24 are designed to support certain contact terminals, the number of which depends upon the number of poles of which the switch is composed. As was before stated, I have here provided a switch which may be utilized as a double throw switch, and it may be here stated that in the preferred form of my invention I provide on each side of the switch sets of stationary contact terminals which are connected respectively to supply and line or conducting terminals, and I connect the contact terminals of each set by means of a movable or bridging contact mechanism which is designed to be shifted sidewise of the tank. Accordingly for each pole of the switch I have two contact terminals on each side of the switch, said terminal being adapted to be connected to the line terminals by means of the horizontal movable contact mechanism. I have here shown a three-pole switch and therefore each of the rods 21, 22, 23, and 24 carries three stationary contact terminals 25. The contact terminals are clamped to the rods 21, 22, 23, and 24 respectively by caps 26 and screws 27, the rods being preferably square as shown, and the terminals being separated from the rods by insulation 27^a. Each contact terminal is provided with an inclined flat face 28 which is adapted to be engaged by certain contact members to be referred to presently, and each one of the stationary contact terminals has a threaded socket in which is secured a terminal rod 29 connected by a right-and-left-hand threaded coupler 30 to line terminals 31 which extend from the tank through openings 32 provided in the side and end slope portions of the tank extension 12. These terminals as well as the connections for the rods 29 are surrounded by insulating bushings 33 which also extend through the openings 32. These bushings may be slid up on the line terminals so as to expose the connections and permit the line terminals to be separated from the rods 29.

By referring to Fig. 5 wherein the stationary contacts are shown somewhat conventionally in order that the relative arrangement of these parts may be made clear, it will be seen that the contact terminals 25 which are mounted on rods 21, 22, 23, 24 are directly opposite each other making possible a perfectly horizontal double throw switch arrangement. The general stationary electric connections are also shown in this figure. The mechanism so far described constitutes the fixed or normally non-removable part of the switch. The remaining parts of the contact mechanism of the switch are mounted in a removable skeleton structure including two end plates 34 and 35 which are held predetermined distances apart by members to be referred to presently and are supported on rods 21^a and 23^a which act as slide rods. These end plates 34 and 35 are so supported that they, together with the mechanism carried thereby, may be shifted longitudinally of the tank on the slide rods 21^a and 23^a and may be removed as a unit from the tank.

Supported in bearings 36 and 37 at the tops of the end plates 34 and 35 is a rotary or oscillatory operating shaft 38, and mounted at or near each extremity of said shaft 38 is a system of linkages comprising a main crank 39, which is mounted directly on the shaft 38, and downwardly extending links 40 and 41, which are respectively pivoted to the two ends of the crank 39. These links 40 and 41 are provided with slotted portions 42 in which are secured and connected for movement other links 43 and 43^a, and 44 and 44^a. One end of links 43 and 44 respectively are connected to a central supporting rod 45, and as mentioned, the other ends of said links and also one end of links 43^a and 44^a are slidably retained in links 40 and 41 respectively. The other ends of links 43^a and 44^a are pivotally secured and held stationary by means of pins 43^b and 44^b respectively which engage and are supported by the end frames 34 and 35. Collars 43^c and 44^c separate the links 43 and 44, keeping them directed in straight lines. The rod 45 when in its normal position is directly below the rotary operating shaft 38, and is adapted to be shifted by said shaft and system of linkages and is guided in its horizontal movements by members 46, which are secured to the rod 45 and are slidable in

slots 46ª in the end plates 34 and 35. These members 46 therefore serve as cross-heads for the rod 45 and also serve as camming members to shift certain other parts when the shaft 38 and the parts supported thereby are shifted as will be explained presently. By the system of linkages, a rotary movement of the shaft 38 shifts the rod 45 horizontally, or sidewise of the tank. Set screws 20ª in projecting portions of the stationary end plates 20 bear against the end plates 34 and 35 of the removable frame and act as reinforcing members when the switch is moved to either closed position. The sidewise movement of the rod 45 is opposed by coil springs 47, which are mounted on the rotary shaft 38 with their ends embracing flanges 48 on the upper part of the end plates 34 and 35 respectively and projections 49 on the cranks 39.

Supported on the rod 45 and clamped thereto by means of screws 51 are three movable and bridging contacts or contact members 52, there being one bridging contact for each pole of the switch, and each being adapted to connect one of the lower stationary contact terminals 25 with one of the upper stationary contact terminals 25 which are located opposite each other in a vertical direction. The arrangement of the bridging contact member relative to the stationary contact terminals will be best understood by referring to Figs. 2 and 5. Each of the bridging contacts is preferably in the form of irregular but symmetrically shaped blocks which are provided on opposite sides with inclined faces 53, parallel to the inclined faces 28 of the contact terminals 25. Between the two parts of each bridging contact member 52 are resilient arms or levers 54 at the outer ends of which are auxiliary or arcing contacts 55. The bridging contacts 52 do not engage directly the stationary contact terminal 25, as is the case in the usual construction of switches, but I have provided between the bridging contacts and the stationary contact terminal 25 additional contact members which will now be described.

Extending between the end frames 34 and 35 and mounted so that they have a slight rocking movement are four rods 56, 57, 58, and 59, each of which is provided with three inclined contact supporting arms 60. These contact arms are arranged in groups, each including an arm on every rod. The arms of each group are located in the same plane with one of the bridging contacts 52, and comprise two pairs located at opposite sides of the tank. Each of these arms is provided at opposite sides, as is best shown in Fig. 7, with flanges or ribs 61, and each has loosely mounted therein a plurality of relatively movable substantially U-shaped contact members 62 provided with inwardly extending flanges 63 forming grooves which receive loosely the flanges 61 on the arms 60. These contact members 62 are arranged in pairs as is shown clearly in the drawings, the members of each pair being spread apart by coil springs 64 which are located in transverse openings in the arm 60, as shown, and have their ends received in sockets or thimbles 65, the outer ends of which are rounded, as shown, and are received in sockets on the inner sides of the contact members 62. Thus it will be seen that with this construction the contact members 62 located on opposite sides of the arm 60 are capable of movement toward and away from each other, and it may be here stated that these contact members are adapted to be compressed between the bridging contact members 52 and the stationary contact terminals 25. The contact members 62 of each pair are preferably connected together by flexible conductors 66 so that there will be good conductivity between the stationary contact terminals and the bridging contacts, and the outer ends of the arms 60 are provided with arcing tips 67 which are adapted to be engaged by the arcing contacts 55 carried by the contact levers 54.

As will be seen by referring particularly to Fig. 3 the contact supporting arms 60 are normally so inclined that the contact members 62 carried by these arms are out of engagement with the fixed contact terminals and are also out of engagement with the bridging contacts. However, I have provided means whereby the contact members 62 on the outer sides of the arms 60 are brought into engagement with the inclined faces 28 of the contact terminals 25 just before the switch is closed or before the bridging contacts are brought into engagement with the contact members 62 on the inner faces of the arms 60, and this is accomplished by the following construction:

Secured to the ends of the rods 56, 57, 58, and 59 are two pairs of levers or arms 63ª and 64, each pair being connected together by coil springs 65ª and being provided at their free ends with rollers 66ª. As was previously stated, the rod 45 carrying the bridging contacts is guided in its horizontal movement by combined camming and cross head members 46. These members 46 are provided near their extreme ends with inclined or camming faces 67ª which, when the switch is being closed and the member 46 is moved horizontally, and before the bridging contacts engage the intermediate contact members 62, engage the rollers 66ª at the free ends of the arms 63ª and 64 and spread these arms 63ª and 64 so as to rock slightly the rods 56, 57, 58, and 59 and cause the contact members 62 adjacent the station-

ary contact terminals 25 to engage the contact faces 28 of the latter. Beyond the camming faces toward the rod 45 the member 46 has parallel faces which are engaged by the rollers during the final closing movement of the switch. After the intermediate contact members 62 engage the contact terminals 25, the bridging contacts 52 are brought against the adjacent contact members 62. This engagement between these members takes place before the movable switch members complete their closing or horizontal movement, so that the U-shaped parts of the pairs of contact members 62 are shifted toward one another, or are compressed between the contact terminals and bridging contacts. This yielding action of the contact members 62 during the final closing movement of the switch and after the contact members 62 are engaged by the bridging contacts, causes a relative sliding movement between the bridging contacts and the adjacent contact members 62 with the result that there is a wiping and cleaning action between the adjacent contact or engaging faces. The auxiliary contacts 55 engage the arcing tips 67 just before the bridging contact members engage the contact members 62 when the switch is being closed, and when the switch is being opened the bridging contacts are first separated from the contact members 62 and the auxiliary contacts 55 are separated from the arcing tips 67, after which the arms 60 carrying the intermediate contact members 62 are shifted inwardly or toward each other and the contact members 62 move out of engagement with the stationary contact terminals, this inward movement of the arms 60 and of the intermediate contact member 62 being caused by the rollers 66 riding outwardly on the inclined faces 67 of the camming members 46. It will be seen, therefore, that the circuit is broken at each pole of the switch before the intermediate contact members leave the stationary contact terminals, and as a result the arcing will take place only between the auxiliary arcing contacts 55 and 67, and perhaps to a slight extent between the bridging contacts and the adjacent contact members 62. Consequently, this wiping and cleaning action takes place between the members which are subject to arcing, and therefore the conducting or engaging faces of these members will be maintained in a clean condition and the contacts will, therefore, have much greater life than the contact terminals of ordinary switch constructions. The bridging contacts and the intermediate contact members 62, the latter of which, in a sense, constitute part of the stationary contact mechanism, are included in the unit which is removable from the tank.

The end of the shaft 38 is connected by means of a clutch 68 to a rod or shaft 69 extending through a bearing 70 in the end of the tank 10 under a flange 71 of the tank extension 12. This rod 69 may be turned by a suitable handle to open and close the switch; this handle may be located at any suitable place, as on a switch-board, the shaft 69 being of suitable length for that purpose. The handle preferably consists of two parts 72 and 73, the portion 73 having a sleeve 74 which receives and is secured to the rod 69, and the portion 72 being pivoted to the portion 73 and having a tongue 75 which coöperates with suitable notches in a plate 76 which is secured to the outer side of the switch casing. The portion 72 of the handle is pressed toward the notches of the plate 76 by means of a leaf spring 77.

As before stated, the operating shaft 38 is connected to the rod 69 by a clutch 68. The clutch includes two principal parts 78 and 79, the part 78 being secured to the end of the shaft 38 and being provided with a tongue 80 and the part 79 being secured to the end of the rod 69 and having a slot which receives the tongue 80. When the switch is open, the handle is in off position, the tongue 80 and slot which it engages are vertical, and when these members are in vertical position the switch unit, including the skeleton frame, bridging contact, intermediate contact members and operating mechanism for these contact members may be removed as a whole from the tank. The unit cannot be removed from the tank, however, unless the tongue and slot of the clutch 68 are vertical and the switch is in open position, and the unit cannot be replaced in the tank unless the parts are in the same position. By forming the operating parts of the switch in a unit which can be removed as a whole without disturbing the line terminals or stationary contact terminals, the parts can be very readily cleaned, repaired or adjusted or can have any other labor performed on them with absolute safety to the workman for the reason that the unit can be removed from all live parts at a distance from the oil tank and the switch board if necessary. The operator, therefore, can work free from obstructions and from the live parts, and will not be under the disadvantages that he usually encounters when working behind a switch board and working on the parts of the ordinary switch constructions. It is to be noted that the switch can be changed from a closed position on one side to an open position and then to a closed position on the other side by simply swinging the operating handle from one side to the other without the use of other appliances essential to other constructions.

As before stated, the bridging contacts are capable of sidewise movements in the

tank so that the contact terminals 25 on each side of the switch can be connected by the bridging contact members 52 to the line terminals. Consequently, the rod 69 which is connected by the clutch to the operating shaft 38 is mounted in the bushing 70 for rotary movement in either direction so that the bridging contacts and the intermediate contact members are moved from one set of stationary contact terminals 25 to the set directly opposite in a straight line.

In order to take out the removable switch unit, it is necessary to shift it longitudinally of the tank in order that the intermediate contact members may pass the upper stationary contact members, as shown in Fig. 5 of the drawings. This longitudinal shifting of the removable unit is obtained by sliding such unit along the slide rods 21^a and 23^a; it can be done only when the switch is in an open position, and then only after raising a latch 81, which is secured to extension 12 of the tank.

By providing a switch unit which can be removed only when the switch is open and by providing in a double throw switch means for preventing the shifting of the unit from one operative position to another, without the switch going through an open position, the removal of the switch unit or its shifting from one position to another can be accomplished with absolute safety to the operator and to the switch, inasmuch as in either case the contacts of the movable unit are dead.

It will be seen that the arrangement and construction of contact mechanism which I have provided, is particularly adapted for use in connection with a switch having a self-contained removable unit such as is disclosed in this application, for the reason that the intermediate contact members, which may be considered parts of separable stationary contact members, are out of engagement with the stationary contact terminals to which the line terminals are connected when the switch is open. Consequently, in restoring the switch unit to its position in the tank, it is unnecessary that the two cooperating members of the stationary contact terminals be fitted together with great accuracy as would be the case if parts of the stationary contact mechanism were moved out of engagement on the removal of the unit and were again fitted into engagement or in conductive relation, on the restoration of the unit. It will be seen also that the construction and arrangement of the contact members and the manner in which they are shifted into and out of engagement, are such that the engaging faces of the contact members and particularly the faces between which arcing may take place will be maintained in a smooth and clean condition and as a result arcing will have a less detrimental effect on the contact members than in the usual switch construction. It will be apparent also by arranging different sets of contact terminals on opposite sides of the oil switch, and by providing movable contact members which may be shifted horizontally in the oil tank so that either set of the terminals of the switch may be connected to the line terminals in the manner above described, I am able to provide a horizontal double throw switch which is compact and is very little larger than a single throw switch.

In this application I make no claim to such features of construction as are claimed in Patent No. 1,088,769, granted to H. W. Cheney.

There may be many modifications in the precise form and arrangement here shown and described, and I aim to cover all such modifications which may be made without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new is:

1. In a switch, a stationary contact terminal, a movable contact adapted to be shifted toward and away from the same, a compressible contact member interposed between the contact terminals and the movable contact, and means for causing said compressible contact member to be brought into engagement with and compressed between said contact terminal and said movable contact upon the closing of the switch.

2. In a switch, a stationary contact terminal, a movable contact adapted to be shifted toward and away from the same, a movable arm having contact members interposed between the terminal and movable contact but normally out of engagement with the same, the contact members on the arm being adapted to be compressed between the terminal and the movable contact when the switch is closed.

3. In a switch, a stationary contact terminal, a movable contact adapted to be shifted toward and away from this terminal, a compressible contact member between the terminal and the movable contact and out of engagement with both the latter when the switch is open, and means for shifting said yieldable contact member into engagement with the terminal and then for compressing said contact member between the terminals and the movable contact.

4. In combination, in a switch, a pair of stationary contact terminals, a movable bridging contact adapted to be shifted toward and away from the same, contact members between the terminals and the bridging contacts, and means operated by the shifting of the bridging contact toward the terminals for causing engagement first between said contact members and said terminals

and then between said contact members and the bridging contact.

5. In a double throw switch, a pair of supports having a plurality of contact terminals secured thereto, a second pair of supports having a plurality of contact terminals secured thereto opposite the first named terminals, and a plurality of movable bridging contacts adapted to be moved in different directions to close the switch through different ones of said supported terminals.

6. In a switch, a receptacle, line terminals secured in position in said receptacle, a removable switch unit in said receptacle comprising pairs of relatively fixed contacts, the contacts of each pair being disposed one above another when in place in said receptacle and being electrically connected to said line terminals, and bridging means movable transversely of the contacts of each of said pairs of relatively fixed contacts and in either direction to bridge the contacts of either of said pairs of contacts.

7. In a double throw switch, a pair of supports having a plurality of contact terminals secured thereto, a second pair of supports having a plurality of contact terminals also secured thereto and opposite the first named terminals, a plurality of bridging contacts movable in a horizontal direction when the switch is being opened or closed, and means for preventing a lateral shifting of the movable contacts.

8. In a switch, a stationary contact terminal, a horizontally movable contact adapted to be shifted toward and away from the contact terminal, a plurality of relatively movable contact members between the terminal and horizontally movable contact, and means for shifting said relatively movable contact member into engagement with the terminals and for shifting the horizontally movable contact into engagement with said contact members so as to produce a wiping and cleaning action between the engaging faces of the latter and of the horizontally movable contact.

9. In a switch, a pair of contact terminals having inclined faces, a horizontally movable bridging contact adapted to be shifted toward and away from the terminals and having inclined faces, a pair of arms interposed between the terminals and the bridging contact and provided with yieldable contact members adapted to be compressed between the terminals and the bridging contact, and means for shifting said contact members into engagement with the inclined faces of the terminal and for shifting the bridging contact into engagement with said contact members so that the latter are compressed and a wiping action is produced between the engaging faces of the bridging contact and of the contact members engaged thereby.

10. In combination, in a switch, a plurality of stationary contact terminals, and a switch unit movable with respect thereto and including a bridging contact, contact members which are interposed between the terminals and bridging contacts and are normally out of engagement with the terminals, and means for causing said contact members to engage the contact terminals and the bridging contact as the switch is closed and to be disengaged first from the bridging contact and then from the contact terminals as the switch is opened.

11. In combination, in an oil switch, an oil tank, a plurality of fixed contact terminals supported in said tank, a switch unit removable as a whole from the tank, said unit comprising a supporting frame, bridging contacts mounted for moving in said frame toward and away from the terminals, rods supported by said frame, and contact members carried by said rods and located between the terminals and bridging contacts, said rods being movable so that the contact members supported thereby may be swung into and out of engagement with the terminals when the switch is being closed and opened respectively.

12. In combination, in an oil switch, an oil tank, fixed contact terminals supported in said tank, a self-contained switch unit removable as a whole from the tank, said unit comprising a supporting frame, an operating shaft, a rod having a plurality of horizontally movable bridging contacts adapted to be shifted by said shaft, and a pair of rods rotatably mounted in the frame, said rods carrying contact members adapted to be engaged by the bridging contacts and to be swung in and out of engagement with the terminals when the switch is being closed and opened respectively.

13. In combination, in an oil switch, an oil tank, fixed contact terminals supported in said tank, a self-contained switch unit removable as a whole from the tank, said unit comprising a supporting frame, an operating shaft, a rod having a plurality of horizontally movable bridging contacts adapted to be shifted by said shaft, and rods rotatably mounted in the frame, said rods carrying contact members adapted to be engaged by the bridging contacts and to be swung into and out of engagement with the terminals when the switch is being closed and opened respectively, and means for preventing the removal of the unit except when the switch is open.

14. In combination, in a horizontal double throw oil switch, an oil tank, stationary contact terminals in the tank, and a self-contained switch unit having contact members for engagement with the stationary contact terminals and one or more contacts horizontally movable relatively to the frame into

and out of engagement with different ones of said contact members, supports for said unit arranged inside of said tank, said unit being movable longitudinally of the tank along said supports and being removable from the tank.

15. In a switch, the combination of a stationary contact terminal, a movable contact adapted to be shifted toward and away from the terminal, a plurality of movable intermediate contact members between the contact terminal and the movable contact, and means for shifting one of said intermediate contact members into and out of engagement with the contact terminal and the movable contact into and out of engagement with said intermediate contact members.

16. In a switch, the combination of a pair of contact terminals having inclined faces, a movable bridging contact adapted to be shifted toward and away from said terminals and also having inclined faces, a pair of arms interposed between the terminals and the bridging contact and provided with yieldable contact members adapted to be compressed between the terminals and the bridging contact, and means for shifting said contact members into engagement with the inclined faces of the terminals and the bridging contact into engagement with said contact members so that the latter are compressed and a wiping action is produced between engaging surfaces.

17. In combination, in a switch, a plurality of stationary contact terminals, and a switch unit movable with respect thereto and including a bridging contact and compressible contact members, said compressible contact members being interposed between the terminals and the bridging contact and normally out of engagement with the terminals.

18. In combination, in an oil switch, an oil tank, contact terminals supported in the tank, and switch mechanism removable as a unit from the tank and comprising movable contacts and additional contact members, said additional contact members being out of engagement with the movable contacts and the terminals when the switch is open and being engaged thereby upon the closing of the switch.

19. In combination, in an oil switch, an oil tank, a plurality of contact terminals supported in said tank, line terminals connected thereto, and switch mechanism in the form of a unit removable as a whole from the tank, said unit including a plurality of bridging contacts, and contact members which are interposed between the terminals and the bridging contacts, are out of engagement with the terminals and bridging contacts when the switch is open, and are engaged by said terminals and bridging contacts upon the closing of the switch.

20. In combination, in an oil switch, an oil tank, a plurality of contact terminals supported in said tank, line terminals connected thereto, switch mechanism in the form of a unit removable as a whole from the tank, said unit including a plurality of bridging contacts, and contact members which are interposed between the terminals and the bridging contacts, said contact members being out of engagement with the terminals and the bridging contacts when the switch is open and being engaged thereby upon the closing of the switch, and releasable means for preventing the removal of the unit.

21. In combination, in an oil switch, an oil tank, a plurality of fixed contact terminals supported in said tank, and a switch unit removable as a whole from the tank, said unit comprising a supporting frame, bridging contacts mounted for movement in said frame toward and away from the terminals, a pair of rods supported in said frame, and contact members carried by said rods and located between the terminals and bridging contacts, said rods being movable so that the contact members supported thereby may be swung into and out of engagement with the terminals when the switch is being closed and opened respectively.

22. In combination, in an oil switch, an oil tank, fixed contact terminals supported in said tank, and a self-contained switch unit removable as a whole from the tank, said unit comprising a supporting frame, an operating shaft, a rod having a plurality of movable bridging contacts adapted to be shifted by said shaft, and a pair of rods rotatably mounted in the frame, said rods carrying contact members adapted to be engaged by the bridging contacts and to be swung into and out of engagement with the terminals when the switch is being closed and opened respectively.

23. In combination, in an oil switch, an oil tank, fixed contact terminals supported in said tank, a self-contained switch unit removable as a whole from the tank, said unit comprising a supporting frame, an operating shaft, a rod having a plurality of movable bridging contacts adapted to be shifted by said shaft, and a pair of rods rotatably mounted in the frame, said rods carrying contact members adapted to be engaged by the bridging contacts and to be swung into and out of engagement with the terminals when the switch is being closed and opened respectively, and means for preventing the removal of the unit except when the switch is open.

24. In an oil switch, the combination of a tank, a contact located in said tank, removable switch mechanism comprising two movable contacts one of which is movable into

and out of engagement with said contact terminal and the other is movable into and out of engagement with the first, and common means for moving said two movable contacts.

25. In an oil switch, the combination of a tank, a pair of contact terminals located in said tank, removable switch mechanism comprising a frame, a bridging contact, and two intermediate contacts movably mounted in said frame and normally out of engagement with one another and the contact terminals, and means for moving said intermediate contacts into engagement with said contact terminals and said bridging contacts into engagement with the intermediate contacts to close the switch.

26. In an oil switch, the combination of an oil tank, a pair of contact terminals located in said tank, switch mechanism removable as a unit from the tank, said switch mechanism comprising a frame, a bridging contact, and a pair of intermediate contacts carried by said frame and normally out of engagement with one another and with the contact terminals, and means for moving said bridging contact and said intermediate contacts to connect one contact terminal to the other through one intermediate contact, the bridging contact, and the other intermediate contact in series.

27. In an oil switch, the combination of an oil tank, a pair of contact terminals located in said tank, switch mechanism removable as a unit from the tank, said switch mechanism comprising a frame, a bridging contact, and a pair of intermediate contacts carried by said frame and normally out of engagement with one another and with the contact terminals, and means for moving said bridging contact and said intermediate contacts to connect one contact terminal to the other through one intermediate contact, the bridging contact, and the other intermediate contact in series, and to disconnect one contact terminal from the other by first separating the bridging contact from the intermediate contacts and then separating the intermediate contacts from the contact terminals.

28. In an oil switch, the combination of an oil tank, a pair of contact terminals located therein, switch mechanism removable as a unit from said tank, said switch mechanism comprising a bridging contact and a pair of intermediate contacts, and means for closing the switch by moving first said intermediate contacts into engagement with the respective contact terminals and then the bridging contacts into engagement with said intermediate contacts, and for opening the switch by separating first the bridging contact from the intermediate contacts and then the intermediate contacts from the contact terminals.

29. In an oil switch, the combination of an oil tank, contact terminals located in said tank, and switch mechanism removable as a unit from said tank, said switch mechanism comprising a frame and movable contacts carried by said frame, said contacts being normally out of engagement with one another and with the contact terminals but being movable some into engagement with said contact terminals and others into engagement with the contacts which engage said terminals, and said frame being movable transversely to the plane or planes of movement of said movable contacts.

30. In an oil switch, the combination of a tank, contact terminals mounted in said tank, switch mechanism removable from said tank as a unit and comprising a frame carrying contacts which are movable relatively to said frame some curvilinearly and the rest rectilinearly, and means for moving the curvilinearly movable contacts into engagement with the contact terminals and the rectilinearly movable contact or contacts into engagement with the curvilinearly movable contacts, said frame being movable transversely to the direction of movement of said rectilinearly movable contact or contacts.

31. In an oil switch, the combination of a tank, contact terminals mounted in said tank, switch mechanism removable from said tank as a unit and comprising a frame carrying contacts which are movable in planes relatively to said frame some curvilinearly and the rest rectilinearly, and means for moving the curvilinearly movable contacts into engagement with the contact terminals and the rectilinearly movable contact or contacts into engagement with the curvilinearly movable contacts, said frame being movable transversely to the planes of movement of said curvilinearly movable contacts.

32. In an oil switch, the combination of an oil tank, a group of contact terminals located in said tank, and switch mechanism removable as a unit from said tank, said switch mechanism comprising a frame which is rectilinearly slidable in the tank and contacts which are movable relatively to said frame, one or more of said contacts being movable into and out of engagement with contact terminals and another or others into and out of engagement with those contacts which may engage the contact terminals.

33. In an oil switch, the combination of an oil tank, a group of contact terminals located in said tank, and switch mechanism removable from said tank as a unit, said mechanism comprising a frame which may be lifted from the tank and is slidable horizontally in the tank, and contacts movable relatively to said frame in planes substan-

tially perpendicular to the direction in which said frame is horizontally movable, one or more of said movable contacts being movable into and out of engagement with contact terminals and another or others into and out of engagement with those contacts which may engage the contact terminals.

34. In an oil switch, the combination of an oil tank, a group of contact terminals located in said tank, switch mechanism removable as a unit from said tank, said switch mechanism comprising a frame which is rectilinearly slidable in the tank, and contacts which are movable relatively to said frame, one or more of said contacts being movable into and out of engagement with contact terminals and another or others into and out of engagement with those contacts which may engage the contact terminals, and common operating means for the movable contacts.

35. In an oil switch, the combination of an oil tank, a group of contact terminals located in said tank, switch mechanism removable from said tank as a unit, said mechanism comprising a frame which may be lifted from the tank and is slidable horizontally in the tank, and contacts movable relatively to said frame in planes substantially perpendicular to the direction in which said frame is horizontally movable, one or more of said movable contacts being movable into and out of engagement with contact terminals and another or others into and out of engagement with those contacts which may engage the contact terminals, and common operating means for the movable contacts.

36. In an oil switch, the combination of an oil tank, contact terminals located in said tank, and switch mechanism removable from said tank as a unit, said switch mechanism comprising a frame which may be lifted from the tank and which is slidable horizontally while in the tank and movable contacts carried by said frame and movable relatively thereto in a plane or planes transverse to the horizontal direction in which said frame is slidable, some of said contacts being movable into and out of engagement with contact terminals and one or more others of said contacts being bridging contacts movable into and out of engagement with those contacts which have been moved to engage contact terminals.

37. In an oil switch, the combination of an oil tank, parallel rods mounted in said tank, one or more switch terminals mounted on each of said rods, and switch mechanism removable as a unit from said tank and comprising a frame which is slidable in the tank in a direction substantially parallel to said rods, and contacts mounted in said frame and movable relatively thereto in a plane or planes transverse to said rods, some of said contacts being movable into and out of engagement with contact terminals and one or more others being bridging contacts which are movable to interconnect a pair or pairs of the contacts which have been moved into engagement with contact terminals.

38. In an oil switch, the combination of an oil tank, rods mounted in said tank, one or more contact terminals mounted on each of said rods, and switch mechanism which is movable as a unit, said switch mechanism comprising a frame including rotatable rods parallel to said first named rods, said frame being slidable in said tank in a direction parallel to the rods, contact members mounted on the rotatable rods and movable by the rotation of said rods into and out of engagement with said contact terminals, and one or more bridging contacts carried by said frame and movable to interconnect one or more pairs of the rotatably mounted contacts which have been brought into engagement with contact terminals.

39. In an oil switch, the combination of an oil tank, contact terminals located in said tank, and switch mechanism movable as a unit and comprising a horizontally movable frame carrying a plurality of contacts movable relatively to the frame in a vertical plane or planes, some of said contacts being movable into and out of engagement with contact terminals and one or more others being bridging members movable to interconnect in pairs contacts which have been moved into engagement with contact terminals.

40. In an oil switch, the combination of an oil tank, contact terminals located in said tank, and switch mechanism movable as a unit and comprising a rectilinearly movable frame carrying a plurality of contacts movable relatively to the frame in a plane or planes transverse to the direction in which the frame is movable, some of said contacts being movable into and out of engagement with contact terminals and one or more others being bridging members movable to interconnect in pairs contacts which have been moved into engagement with contact terminals.

41. In an oil switch, the combination of an oil tank, contact terminals located in said tank, switch mechanism movable as a unit and comprising a rectilinearly movable frame carrying a plurality of contacts movable relatively to the frame in a plane or planes transverse to the direction in which the frame is movable, some of said contacts being movable into and out of engagement with the contact terminals and one or more others being bridging members movable to interconnect in pairs contacts which have been moved into engagement with contact terminals, and common operating mechanism for the contacts carried by said frame.

42. In a switch, a stationary contact ter-

minal, a movable contact adapted to be shifted toward and away from said stationary contact terminal, an intermediate contact between said stationary contact terminal and said movable contact, and means for effecting by one operation relative movement between said stationary and intermediate contacts and relative engagement between said intermediate and movable contacts.

43. In combination, in an oil switch, an oil tank, contact terminals supported therein, switch mechanism removable as a unit from said tank and comprising a contact movable at an angle to the direction of removal of said unit, and an intermediate contact adapted to be engaged by the movable contact and the contact terminal.

44. In a switch, the combination of a group of more than two contacts, a bridging contact, an operating shaft, and oppositely disposed toggles connecting said bridging contact and said operating shaft, and guiding means coöperating with said bridging contact, said toggles and guiding means acting, on the actuation of said shaft, to cause said bridging contact to engage different pairs of said groups of contacts accordingly as the shaft is turned in one direction or another.

Milwaukee, Wisconsin, February 1, 1910.

In testimony whereof I affix my signature, in the presence of two witnesses.

BRADLEY HASKINS.

Witnesses:

CHAS. L. BYRON,

ROB. E. STALL.