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[56]

## References Cited

## UNITED STATES PATENTS

|           |        |                          |             |
|-----------|--------|--------------------------|-------------|
| 3,132,226 | 5/1964 | Bennett.....             | 200/150 R   |
| 3,150,243 | 9/1964 | Hermann.....             | 200/63 R    |
| 3,275,890 | 9/1966 | Carlson, Jr. et al. .... | 200/150 R X |
| 3,310,643 | 3/1967 | Dripps.....              | 200/67 A    |
| 3,462,611 | 8/1969 | McMorris.....            | 307/17      |

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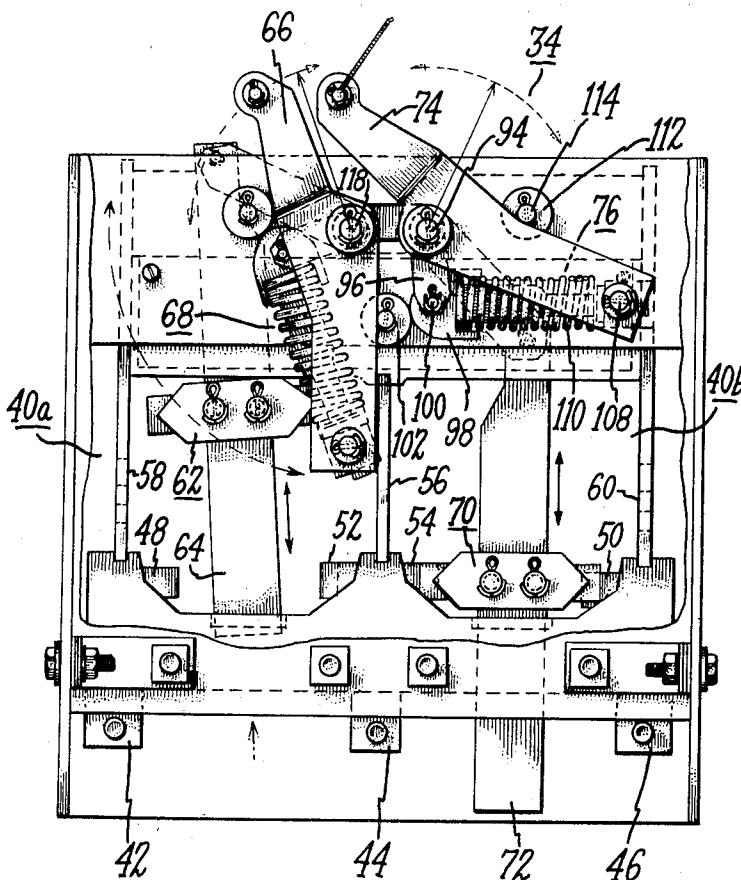
[54] **OIL IMMERSSED SNAP ACTION LOADBREAK SWITCH**  
7 Claims, 5 Drawing Figs.

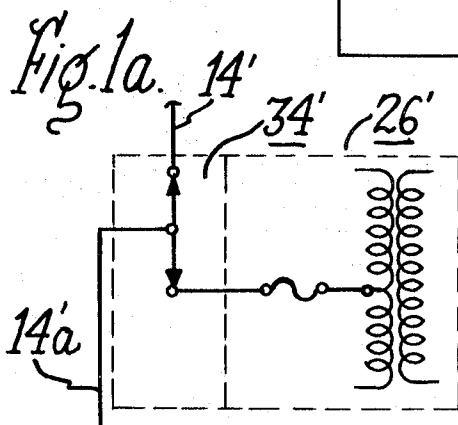
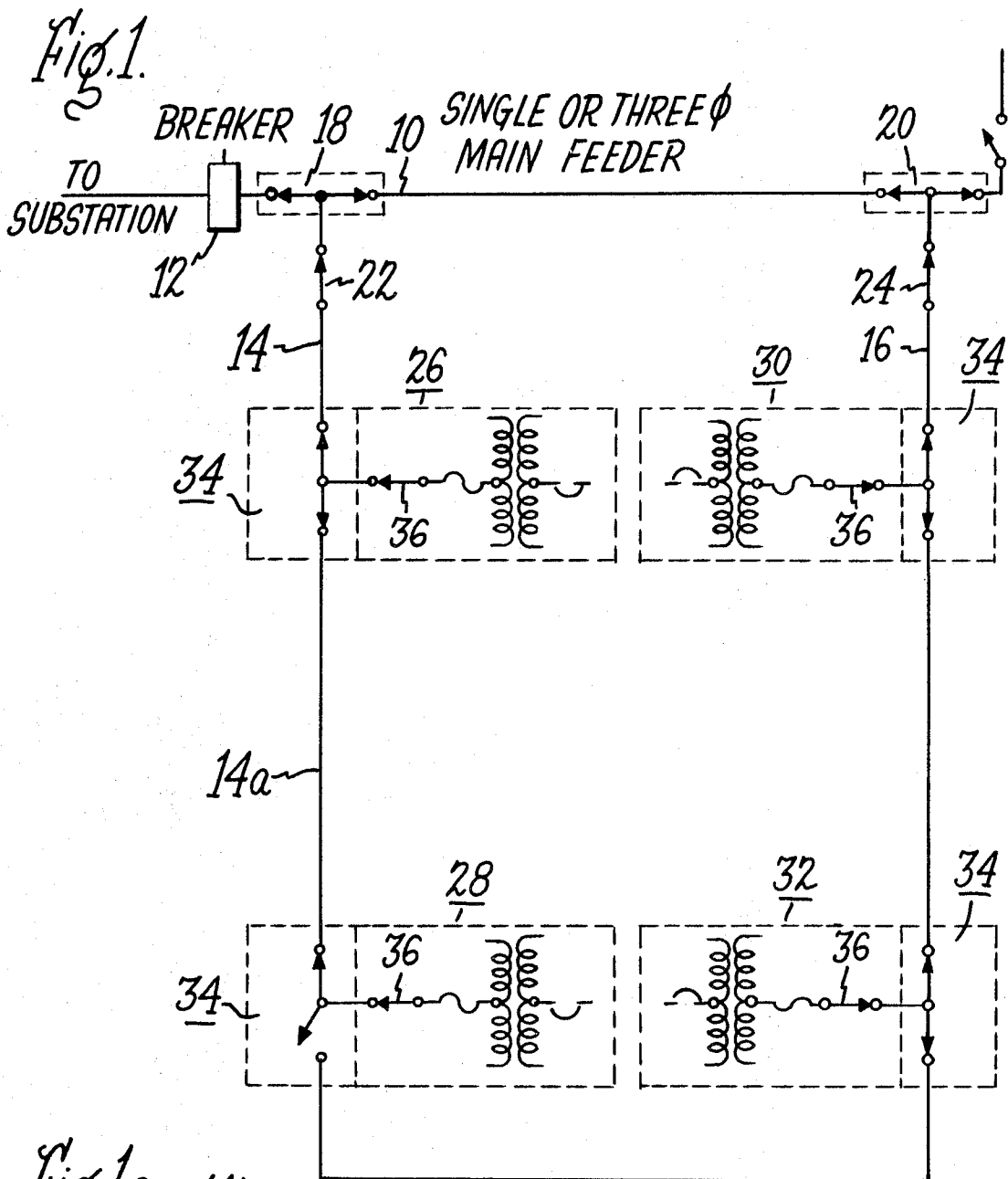
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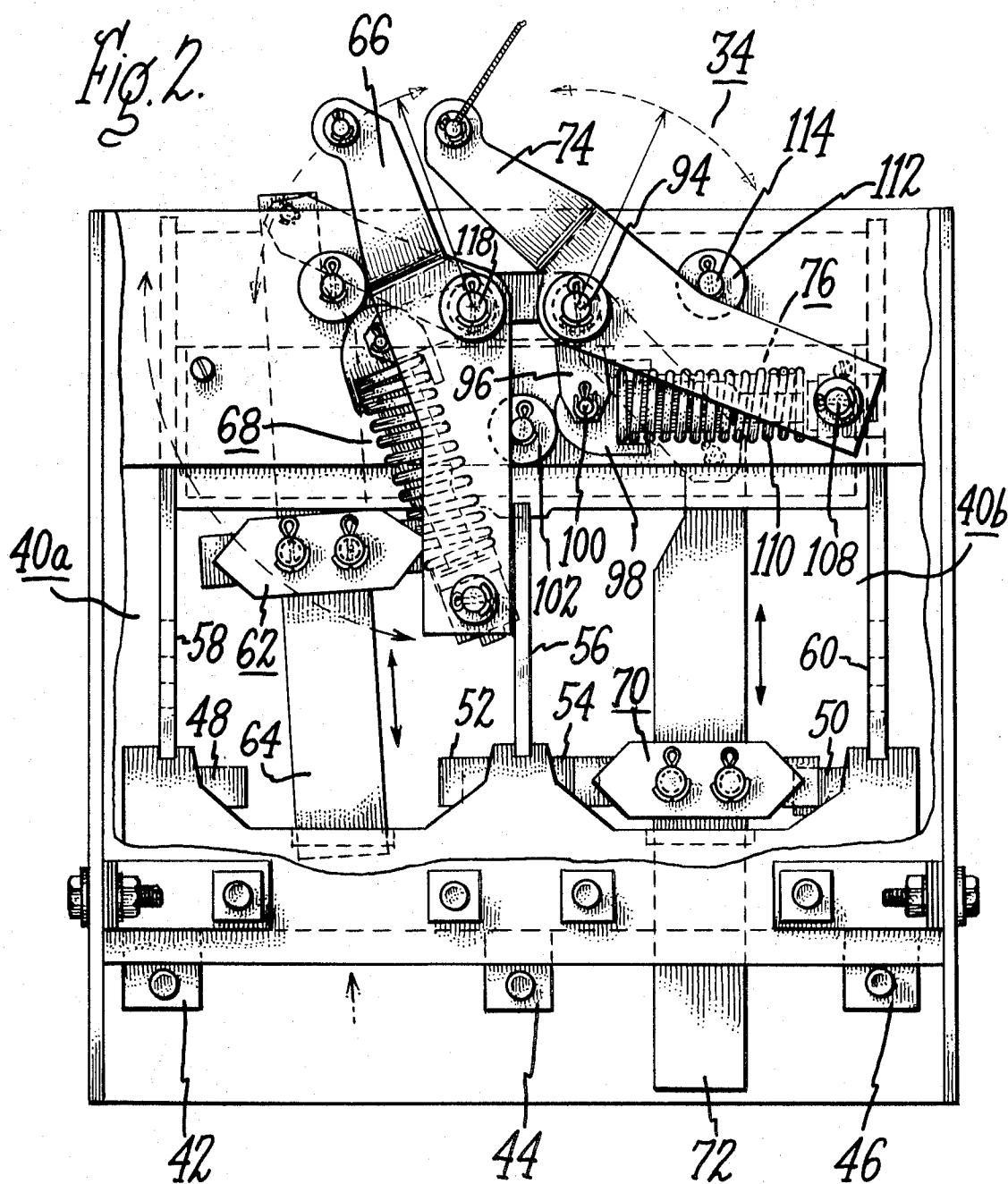
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**ABSTRACT:** A pair of two position snap action oil immersed switches are provided using an overcenter spring toggle to make or break contacts. Three terminals are provided, one terminal being common to each switch. The movable contacts have a double break to aid in arc interruption and the arc formed on one break tends to force oil across the arc formed at the other break to help interrupt the arc. The switches can be ganged to provide three phase switching.

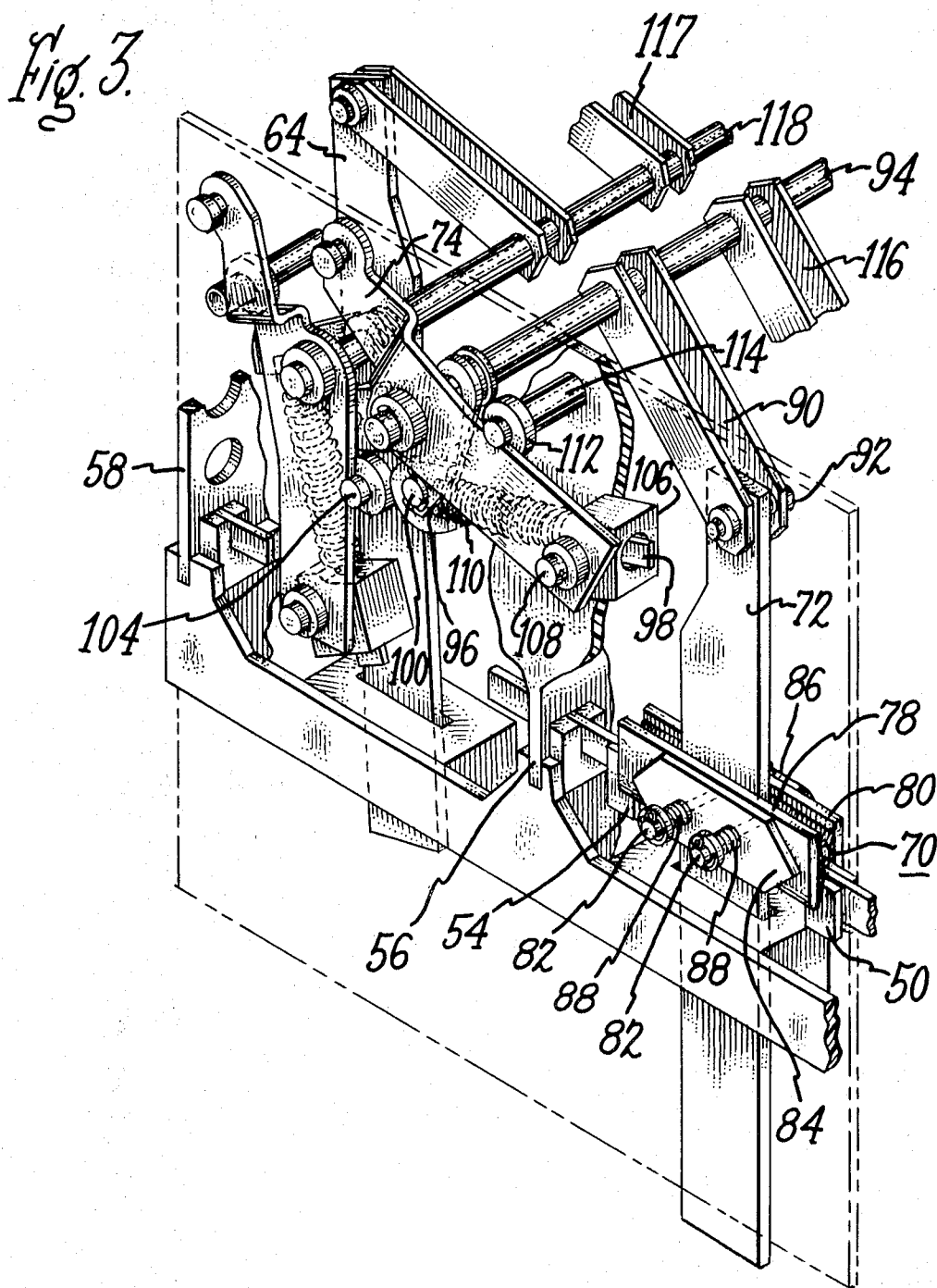




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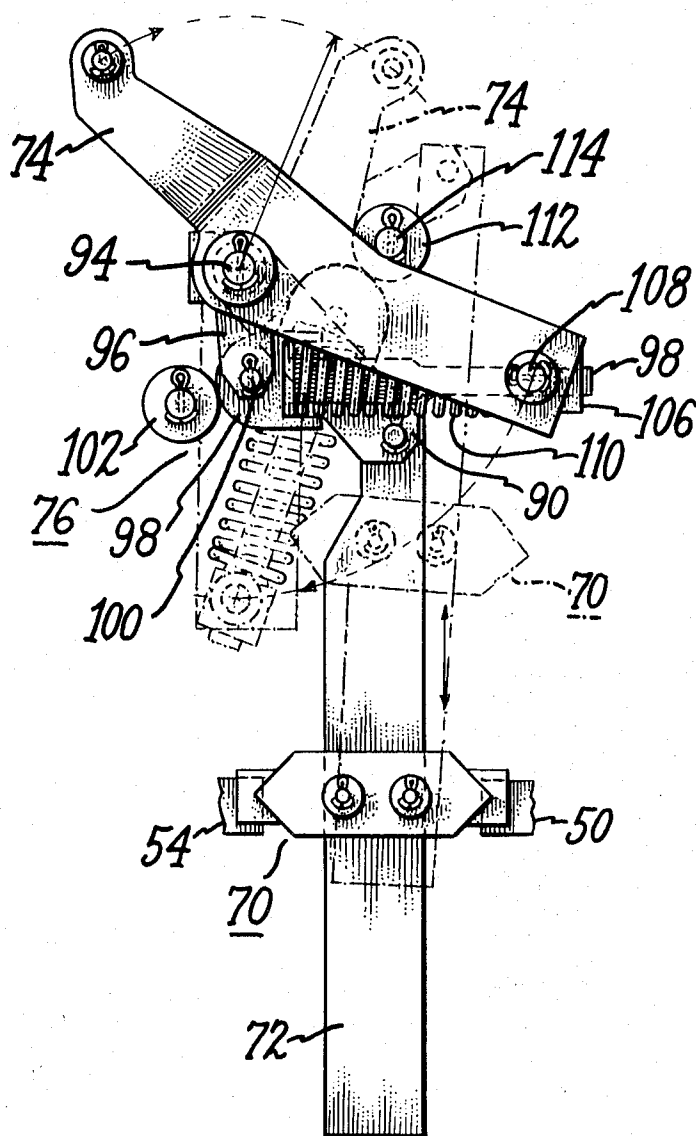


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Fig. 4.



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## OIL IMMERSSED SNAP ACTION LOADBREAK SWITCH

## BACKGROUND OF THE INVENTION

This invention relates to oil immersed snap action switches, and more particularly to pairs of two position oil immersed snap acting switches for single or three phase application which are especially useful in electrical distribution loop feed systems.

Present day distribution systems for use in underground distribution often make use of a loop feed system for energizing the primary circuits of the various distribution transformers in such system. In this type of system, a plurality of distribution transformers are connected in an open loop circuit to a source of electrical power. Each distribution transformer of the system is provided with two energizable power lines such that the transformer may be energized from either line. With this type of system, if any transformer or section of primary cable develops a fault, the remaining portions of the system may be energized by the alternate cables. As will be apparent with a loop feed system, even if one portion of the loop becomes opened, the other portion of the loop will still conduct electrical power to the various distribution transformers connected to that portion of the loop feed system.

As is well understood by those skilled in the distribution art, it is necessary to provide means for removing a transformer from the line when desired, or for a means of sectionalizing a portion of the loop feed system. Sectionalizing as used herein means to isolate a portion of the loop feed system which connects two adjacent transformers in the system. For example, when it is desired to remove a transformer from the primary line for inspection or repairs or for changing, it is desired that the energized lines to the distribution transformer be deenergized before the work is begun. Further, when it is desired to inspect the primary wire or cable or to replace the wire or cable connecting two distribution transformers, it is desirable that this portion of the line be deenergized. To perform the above functions, either a transformer must be disconnected from the two energized cables or a cable which is connected to two transformers must be disconnected from each transformer. Of course, as will be understood, it is desired that this type of disconnection be accomplished by switching means at each transformer.

As underground distribution expands into commercial areas, the load increases and often three phase distribution systems are used. Heavily loaded loop feed systems often have a main feeder which may carry 300 to 400 amperes requiring the branch circuits within the loop feed to carry from 150 to 200 amperes under normal full load conditions. Of course, when the entire loop is being fed from one end, the switching equipment may carry and be required to interrupt 400 amperes. While the prior art has developed a number of air break switches which are useful in loop feed systems, such switches require extremely large strike distances for operation in the air with heavy currents. Thus an oil switch for either single or three phase distribution is desired for interrupting the maximum current that could be carried in a distribution loop as above described. Further, it is possible that the switch could be closed when there is a system fault present. It is desired to have an oil switch which is provided with adequate fault closing capacity. Also, it is required that snap action be provided so that the switch may be opened and closed rapidly independently of the speed of the operation of the switch handle.

Therefore, it is one object of this invention to provide an oil immersed loop feed switch having high current load break capability.

A further object of this invention is to provide an oil immersed switch having snap action to provide rapid opening and closing independent of the speed of operation of the switch handle.

A still further object of this invention is to provide an oil immersed snap action switch with a high fault closing rating.

A further object of this invention is to provide an oil immersed snap action switch having ganged contact members for use in three phase distribution.

## SUMMARY OF THE INVENTION

Briefly in a preferred form, this invention comprises a pair of two position switches mounted in an oil filled compartment. Each switch comprises a pair of fixed contacts with a movable contact which is movable into and out of bridging electrical connection with a pair of fixed contacts.

Terminals are provided connected to the fixed contacts for connection to energized cables and to a transformer. The transformer terminal may be a common terminal to each switch and is electrically connected to a fixed contact in each switch. An operating member is provided for each movable contact and has overcenter spring means for each operating member for moving the movable contact with a snap action into and out of bridging connection with the pair of fixed contacts. For use in a three phase system, three separate poles are provided on each switch with three movable contacts, with the movable contacts being ganged for operation simultaneously by a single operating handle.

The invention which is sought to be protected will be particularly pointed out and distinctly claimed in the claims appended hereto. However, it is believed that this invention and the manner in which its various objects and advantages are obtained as well as other objects and advantages thereof will be better understood by reference to the following detailed description of a preferred embodiment thereof, particularly when considered in the light of the accompanying drawings.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic representation of a loop feed distribution system showing the use of the switch of this invention;

FIG. 1a is a schematic representation of another form of loop feed distribution, where the switch of this invention is connected for loop-radial switching.

FIG. 2 is a front view of a preferred embodiment of the loadbreak switch of this invention;

FIG. 3 is a perspective view of the loadbreak switch shown in FIG. 2; and

FIG. 4 is a front view of one operating member and its movable contact of the preferred form of loadbreak switch of this invention.

## DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings in which like numerals are used to indicate like parts throughout the various views thereof, there is shown a novel snap acting switch according to a preferred embodiment of the invention. This novel snap action switch finds special utility in a loop feed distribution system as is shown schematically in FIG. 1 of the drawing.

Referring to FIG. 1, the loop feed system is shown as comprising a plurality of distribution transformers connected in an open loop to a source of electrical power, the source being designated 10, and as indicated in the drawing, being either a single or a three phase main feeder line. As is indicated in the drawing a feeder line 10 is connected to a substation (not shown) by means of a breaker 12. The loop feed system provides a pair of parallel paths 14 and 16 from the main feeder 10. Each parallel path is provided with a main loop feeder switch 18 and 20. Further, a lateral tap switch 22 and 24 is provided for each path, as shown. Transformers 26 and 28 are connected to the lateral feed line 14 while transformers 30 and 32 are shown as being connected to the lateral feed line 16. Each transformer is provided with an oil immersed, snap action, loadbreak switch as is indicated at 34, the switch being made according to the preferred embodiment of this invention, as will be more fully discussed hereafter. Of course, it will be understood that the main loop feed switches 18 and 20 and the lateral tap switches 22 and 24 could each be oil immersed switches constructed according to the switch of this invention.

As is shown in FIG. 1, one loop feed switch 34 is open at one end thereby preventing line 16 from energizing transformer 28. Each transformer is also shown as being provided with a transformer disconnect switch 36 which, as will be un-

derstood, may be provided when desired. A disconnect switch such as 36 may be particularly desirable in those instances where the loop feed, loadbreak switch 34 is mounted in a separate oil filled compartment apart from the various transformers as will be well understood by those skilled in this art.

As will be apparent, should one of the distribution transformers develop a fault such that it must be removed from service, for example, the distribution transformer 28, it will be apparent that the remaining distribution transformers 26, 30 and 32 will be continued to be energized from source 10 by means of lines 14 and 16. In order to remove distribution transformer 28 from the line, it is necessary to use some disconnection means in order to disconnect transformer 28 from lines 14 and lines 16. As is shown in FIG. 1, the switch 34 is provided and as shown it is open from line 16 and of course may be readily opened from line 14. In this manner the transformer 28 will be completely disconnected from the energized lines and may be changed out or otherwise worked on without contact with energized sources. Of course, as will also be understood, where the switch 34 of transformer 28 is mounted in the transformer and thereby may have leads which can be contacted during work on transformer 28, it is desired to disconnect the transformer in a manner that there will be no energized leads into the transformer. In order to perform this disconnection as will be apparent, the switch 34 in transformer 26 may be opened on the side leading to transformer 28, thereby deenergizing the portion of line 14 leading to transformer 28. In a similar manner, switch 34 in transformer 32 may also be opened on the side leading to transformer 28, thus deenergizing the portion of line 16 leading to transformer 28. Again if it is desired to deenergize a portion of the feeder cable in order to work on such cable, the switches 34 may also be used for this purpose. For example, should cable 14a between transformers 26 and 28 be desired to be examined or worked on, it is possible to open switch 34 in transformer 26 connected to line 14a thereby deenergizing line 14a from that side. In a similar manner, in transformer 28 the open portion of switch 34 may be closed to energize transformer 28 from line 16. At the same time, the switch 34 may be opened, that is disconnected from line 14a, thus deenergizing 14a from both sides. As will be apparent, transformer 28 will then be energized from line 16. Transformer 26 is energized from line 14 and line 14a is completely deenergized. As will be apparent from the following description, the loop feed snap back switch of this invention is particularly useful for performing the above functions. However, it will be apparent from the following description that the snap acting switch of this invention may also be used for other switching and is not limited to loop feed switching. Of course, it will be apparent that for three phase distribution, each portion of the switch is provided with three separate switching members which are actuated simultaneously by the operating members so as to simultaneously open all three lines of the three phase feeder.

Referring to FIG. 1a, a loadbreak switch 34' is shown, providing connection between primary lines 14' 14'a and transformer 26'. In this schematic representation, the common terminal of the switch 34' is shown as connected to one of the primary energized lines. With this type of connection the primary feed may be disconnected from transformer 26' without disconnecting the remainder of the transformers on feeder 14'a.

Referring now to the remaining figures of the drawing and first considering FIG. 2, which shows a preferred embodiment of the novel snap acting loop feed switch of this invention, such embodiment will be described in detail. As is shown in FIG. 2, switch 34 is mounted in a compartment 40, which, as will be understood is oil filled, and may be either part of the transformer or may be a separate oil filled compartment, separated from such transformer. As is shown, compartment 40 is provided with three separate terminal members 42, 44 and 46. In the preferred embodiment shown, terminals 42 and 46 are adapted for connecting to energized lines such as, for example, line 14 and 14a of FIG. 1. Terminal 44 is adapted for

connection to a transformer such as, for example, the transformer 26 of FIG. 1. Terminal 42 extending below compartment 40, as shown, is electrically connected to a fixed contact member 48 within the compartment while terminal 46 is connected to a fixed contact 50 within such compartment. The terminal 44 is electrically connected to a pair of fixed contacts 52 and 54 which operate with separate movable contacts, as will be described. As shown, compartment 40 is divided by a solid insulating member 56 through substantially the center of the compartment and has side insulating walls 58 and 60 as is shown. Walls 58 and 56 form one compartment portion 40a in which one movable contact member acts while walls 56 and 60 form a second compartment portion 40b where a second movable contact member is located.

As is shown in FIG. 2, a first movable contact structure 62 is mounted in compartment 40a formed between walls 58 and 56. Movable contact structure 62 is mounted on an elongated insulating member 64 and is provided with an operating member 66 for moving contact 62 into and out of bridging contact relation with the fixed contacts 48 and 52. Operator 66 is connected to insulated arm 64 by means of an overcenter spring toggle assembly 68, which will be more fully described hereafter, so as to move contact 62 into and out of bridging electrical engagement with fixed contacts 48 and 52 with a snap action to thereby make or break electrical connection between terminal 42 and 44. As will be apparent from FIG. 2, when bridging contact 62 breaks electrical connection between contacts 48 and 52, a double break is provided on each side of movable contact 62 which provides better arc interruption as will be more fully described hereafter.

In a similar manner, in compartment 40b the movable contact structure 70 is mounted on an insulating member 72 and is connected to an operator 74 which through an overcenter toggle assembly 76 causes the movable contact 70 to make bridging connection with fixed contacts 50, 54 in compartment 40b with a snap action. Of course, it is also apparent that bridging movable contact 70 will have a double break action when removed from contacts 50, 54 thereby providing a double break to aid in arc interruption. As will be understood, the compartment 40 which includes the inner compartments 40a and 40b containing the fixed contacts and movable contacts will be immersed in oil such that the breaking and making of the contacts are completed under oil. Additionally, as will be more fully described, provision is made such that one of the contact breaks will create oil movement across the compartment 40a or 40b and out through openings in walls 58 and 60. The oil moving across the other arc aids in interrupting such arc. As will be apparent from FIG. 2 of the drawing, insulating members 64 and 72 slide in slots formed in the top and bottom walls of compartments 40a and 40b. These slots provide guides for insulating members 64 and 72, insuring that contact structures 62 and 70 move in substantially a straight line in opening and closing of the switch.

Referring now to FIG. 3 of the drawing, in conjunction with FIG. 2, the particular connection between the toggle assemblies 68 and 76, the operators 66 and 74 and the contacts 62 and 70 will be explained. Referring now to FIG. 3, which is a perspective view of a portion of the switch with parts broken away to more clearly show its action, it can be seen that the movable contact structure 70 has a pair of solid electrical conducting members 78 and 80 which are fixed to the insulating member 72 by means of a pair of rivets or bolts 82. Metal backup members 84 and 86 are provided on opposite sides of the conductive members 78 and 80 as shown. As is clearly indicated, spring members 88 are mounted on the bolts 82 so as to spring press the conducting members 78 and 80 of contact structure 70 into firm electrical connection with the fixed contacts 50, 54 as will be well understood by those skilled in the art. In the preferred form of this invention, metal backup members 84 and 86 are formed of magnetizable material. As will be understood, current flow across contact structure 70 will generate a magnetic flux in members 84 and 86, providing a magnetic force drawing members 84 and 86 toward each

other. Insulating member 72 is pivotally connected to arm member 90 by means of bolt 92, while arm member 90 is fixedly mounted on a rod 94. The rod 94 in turn is fixed to a rocker arm 96 which in turn is pivotally connected to a toggle member 98 by a bolt 100. Toggle member 98 is provided with a rounded upper portion as shown, which, as can be seen in FIGS. 2 and 3, is in contact with roller 102 mounted on shaft 104 while its opposite end slides in a keeper member 106 which is pivotally attached to the operator 74 by a bolt 108. Obviously, keeper 106 and bolt 108 could be made as a single piece. A spring member 110 is mounted on toggle 98 as is shown, between the rounded portion and the keeper 106. As can also be seen from the drawings, the operator 74 is pivotally mounted on the shaft 94.

As will be apparent considering particularly FIGS. 2 and 3 of the drawing, as operator handle 74 is rotated clockwise about shaft 94, keeper 106 will pivot about the end of operator 74 and compress the spring 102 as the toggle 98 rotates with roller 102. Additionally, toggle 98 pivots about pin 100 in rocker arm 96. In the first portion of the action of operating member 74, as will be apparent, the rocker arm 96 remains in the position shown in FIGS. 2 and 3, and the movable contact structure 70 remains connected to fixed contacts 50 and 54. However, as the toggle mechanism reaches an overcenter position, with the spring 110 strongly compressed on toggle 98 by means of keeper 106, the toggle will break rotating rocker arm 96 in a counterclockwise direction by means of the spring 110, with a snap action. This rotates shaft 96 in a counterclockwise direction which will move arm 90 counterclockwise, thus lifting the insulating member 72 and carrying with it the movable contact 70. Thus, as will be apparent, when the toggle breaks, the movable contact structure 70 will be snapped free from fixed contacts 50 and 54 by release of the compression in spring 110, thus opening the contact with a rapid snap action. Toggle 98 will be snapped into position against the roller 112, which is rotatably mounted on the pin 114 as shown in FIGS. 2 and 3.

As will be understood, as contact structure 70 moves from fixed contacts 50 and 54, a double break will occur on each side of contact structure 70, thus causing an arc to form at each end of contact structure 70 and fixed contacts 50 and 54. The break between contact structure 70 and contact 54 forms an arc which generates pressure on the oil in chamber 40b forcing the oil across the chamber and out through the openings in the wall 60. The oil moving through chamber 40b and out through the openings in wall 60 will aid in interrupting the arc between contact 50 and the other side of contact structure 70. As will be understood, arc interruption normally occurs at current zero.

Referring now to FIG. 4, there is shown a view of the operator mechanism and the contacts in solid view with both contacts closed and in dotted lines showing the operation of operator 74 in moving from the closed position to the contact open position. As can be seen, in FIG. 4 as operator 74 moves from the closed position shown by the solid lines to the open position shown in phantom lines, the toggle assembly 76 rotates from the horizontal position shown in solid lines to the substantially vertical position shown in phantom lines. As will be understood, as operator 74 rotates through the arc, the spring 110 is compressed between the end of the toggle and the keeper mechanism 106. As is clear from FIG. 4, as operator 74 pivots about shaft 94 the toggle 98 pivots about the pin 100 and, as will be apparent, the spring 110 is compressed on the toggle 98. As will be understood, as the operator 74 and the toggle 98 line up, moving through the arc indicated by the broken arrow line, the toggle mechanism will move over center with reference to the rocker arm 96. This will release the compression on spring 110 causing the toggle 98 to move rocker 96 in a counterclockwise direction with a snap action until toggle 98 hits the roller 112. This of course snaps the movable contacts 70 to the position indicated in phantom line with a rapid snap action on release of the compression of spring 110. As will be clear the contact structure 70 moves

from the closed to the open position rapidly, without regard to the speed of movement of operator 74 by the lineman opening the switch. Of course, it will be clear that in moving from the position shown in phantom lines to the position shown in solid lines that the operator arm 74 is rotated in the opposite direction about shaft 94 and the toggle assembly 76 operates in the opposite manner to move rocker arm 96 in a clockwise direction, thus moving movable contact structure 70 into engagement with fixed contacts 50, 54 with a snap action. Of course, it will be apparent that the action of operator 66 and toggle assembly 68 in moving movable contact structure 62 into and out of bridging contact relation with fixed contacts 48 and 52 occurs in the same manner.

Referring again to FIG. 3, it can be seen that an extra arm or arms, such as 116, may be fixedly mounted on shaft 94. In a similar manner, another arm or arms 117 may be fixed on the shaft 118, which pivotally carries the operator 66. Obviously by means of arms 116 and another arm, not shown, fixed on shaft 94 three phase switching can be provided by means of the switch of this invention. It will of course be apparent that as shaft 94 is rotated by the rocker arm 96 all of the arms connected thereto will operate simultaneously either to open or to close the electrical connection between the fixed contacts by means of the movable contact. It will also be obvious that double switching may be provided by use of arms 90 and 116. This will be useful for those utilities that connect opposite sides of a transformer primary to different phase lines. In such instances it is desirable to simultaneously disconnect both sides of such primary, as may be readily accomplished by the switch of this invention. Thus, as will be apparent by means of this switch, either single phase switching, dual switching or three phase switching, or more, if desired, may be readily provided on high current feeder lines. Further, due to the double break provided by means of the movable contact which bridges a pair of fixed contacts and the movement of the oil, due to the construction of the switch member, large blocks of current may be readily broken by means of this loadbreak switch.

From the above detailed description of the preferred embodiment of the loadbreak switch of this invention, it will be apparent to those skilled in the art that there has been described novel, snap acting, loadbreak switch which will be particularly useful in high current loop feed distribution systems. It will be apparent to those skilled in the art that the novel, snap acting, loadbreak switch of this invention may also be used in other types of systems, wherever it is desired to provide high current loadbreak, switching means.

While the preferred embodiment of this invention has been described in accordance with the Patent Statutes, it will be understood by those skilled in the art that many modifications may be made in the construction and materials of the switch without departing from the spirit and scope of the invention hereinbefore set forth. Obviously, all such modifications as fall within the scope of the invention as defined in the appended claims are included herein.

What is claimed as new and is desired to secure by Letters Patent of the United States is:

1. An oil immersed, loadbreak switch comprising, three terminal members, one terminal member having connected thereto a pair of fixed contacts, and a second and third terminal member each having connected thereto a single fixed contact, a pair of movable contacts, one of said pair of movable contacts movable to a position to bridge one said single fixed contact and one of said pair of fixed contacts, the other of said pair of movable contacts movable to a position to bridge the other said single fixed contact and the other of said pair of fixed contacts, an operating member for moving each of said pair of movable contacts, overcenter spring means on each said operating member for moving each of said pair of movable contacts with a snap action into and out of said bridging position.

2. An oil immersed loadbreak switch as claimed in claim 1 in which additional terminal members, additional fixed contacts, and additional movable contacts are provided, said addi-

tional movable contacts connected to one of said operating members to provide simultaneous switching with said pair of movable contacts.

3. An oil immersed loadbreak switch comprising an oil filled chamber, a central wall member dividing said chamber into two compartments, sidewalls in each compartment having openings therein, a fixed contact mounted on said central wall extending into each compartment, a fixed contact on each sidewall extending into each compartment, a movable, bridging contact movably mounted in each compartment, an operator member connected to each said movable contact for moving each said movable contact into and out of bridging connection with said fixed contacts in each compartment, and an overcenter spring toggle connected to each said operator member for moving each said movable contact with a snap action.

4. An oil immersed loadbreak switch as claimed in claim 3 in which two additional groups of compartments are provided, for three phase switching, fixed and movable contacts provided in each said additional compartment, the movable contacts in one of said two groups of compartments connected to one of said operator members and the movable contacts in the other of said two groups of compartments connected to the other of said operator members to provide simultaneous three phase switching.

5. An oil immersed, loadbreak switch comprising an oil filled compartment, a pair of fixed contacts, one of said pair of

fixed contacts mounted on one wall of said compartment and the other of said pair of fixed contacts mounted on an opposite wall of said compartment, a movable bridging contact mounted on a movable insulating member within said compartment, an operator member connected to said insulating member for moving said bridging contact into and out of bridging electrical connection with said pair of fixed contacts, and an overcenter, spring toggle member connected to said operator member for moving said bridging contact with a rapid snap action.

6. An oil immersed, loadbreak switch as claimed in claim 5 in which at least one other compartment is provided, each of said at least one other compartment having a pair of fixed contacts and a movable contact mounted therein, each of said other movable contact connected to said operator member for simultaneous movement with said bridging contact.

7. An oil immersed, loadbreak switch as claimed in claim 5 in which said bridging contact comprises a pair of electrical conductive members mounted on opposite sides of said insulating member, a magnetizable metal backup member mounted on each of said pair of electrical conductive members, pins extending through said insulating member, said pair of electrical conductive members and said metal backup members and springs mounted on said pins pressing said conductive members and said backup members against said insulating members.

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