United States Patent

[11] **3,590,183**

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[45] Patented **June 29, 1971**
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[54] **QUICK-MAKE AND QUICK-BREAK SWITCH**
19 Claims, 28 Drawing Figs.

[52] **U.S. Cl.** **200/67,**
200/67, 174/151, 336/137, 200/166, 200/168, 200/70
[51] **Int. Cl.** **H01h 13/28**
[50] **Field of Search** ..... 200/67 PK, 70, 67, 166 E, 166 B, 168 G, 170 A, 67 PK, 67 B, 167 R; 174/151

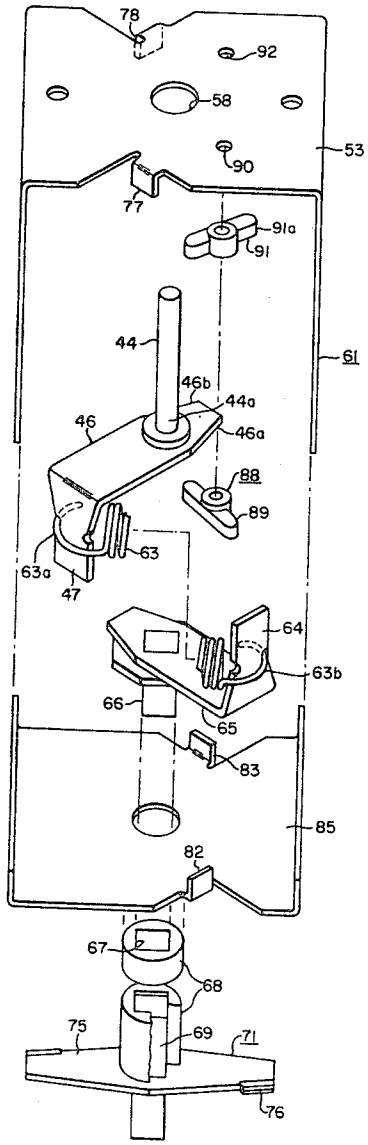
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ABSTRACT: This invention relates, generally, to quick-make and quick-break types of switches and, more particularly to an improved quick-make and quick-break type of switch, which may be readily mounted on transformer installations and operated with facility for sectionalizing cables in the distribution system, and as a load-break switch at the transformer itself.



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SHEET 1 OF 8

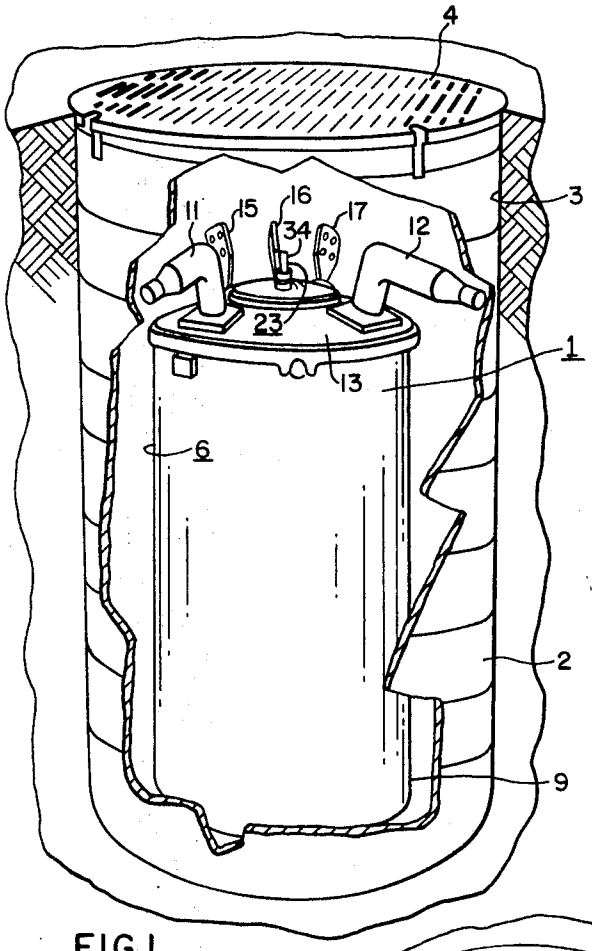


FIG. 1.

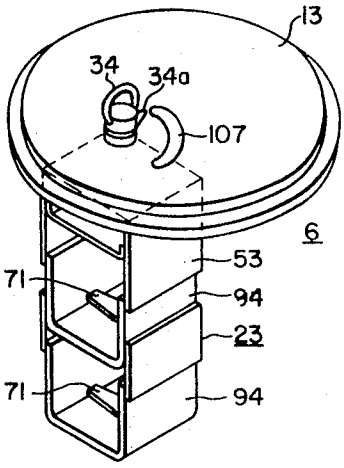


FIG. 4.

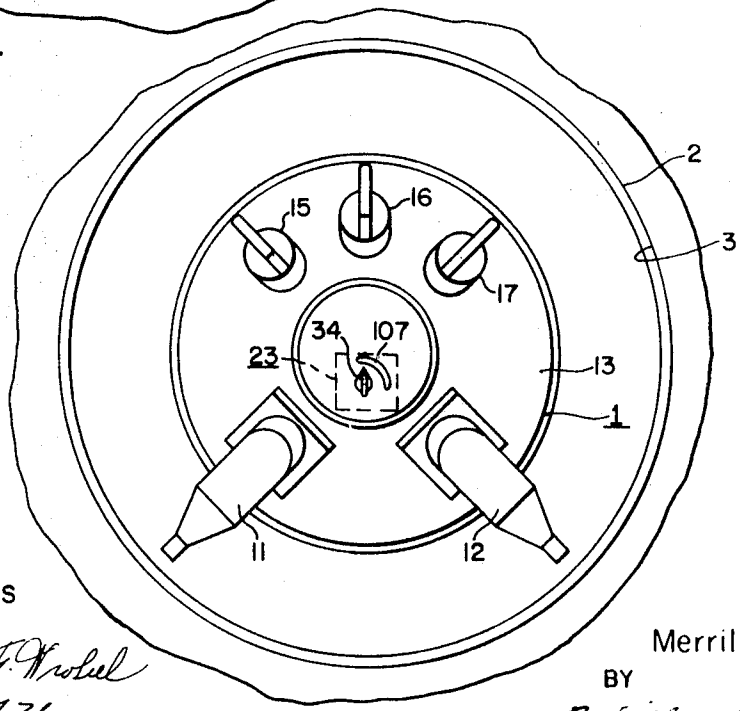


FIG. 2.

WITNESSES

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ATTORNEY

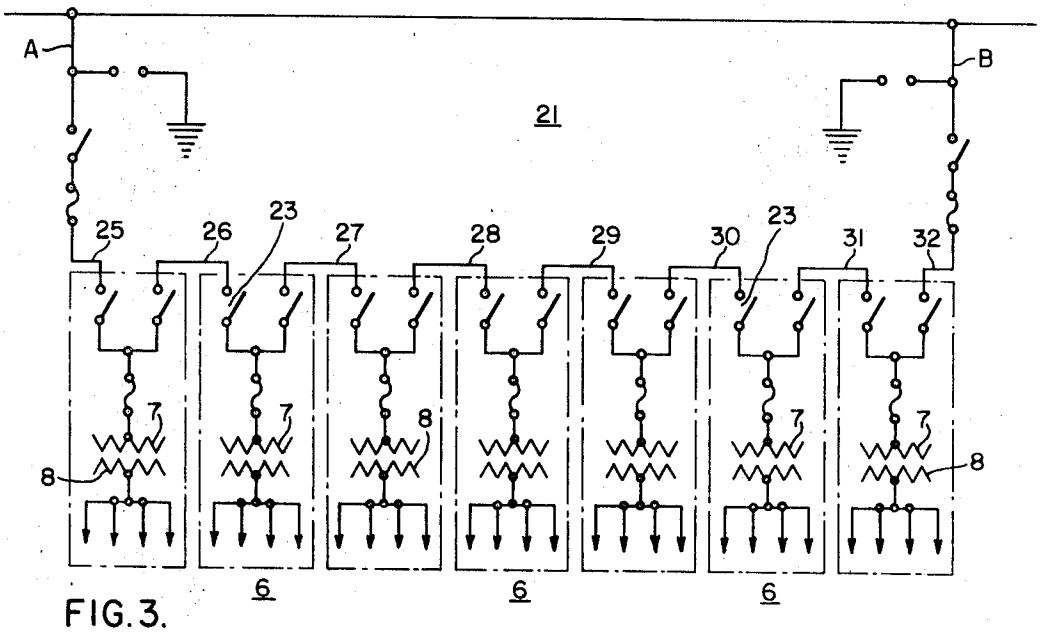

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FIG. 3.

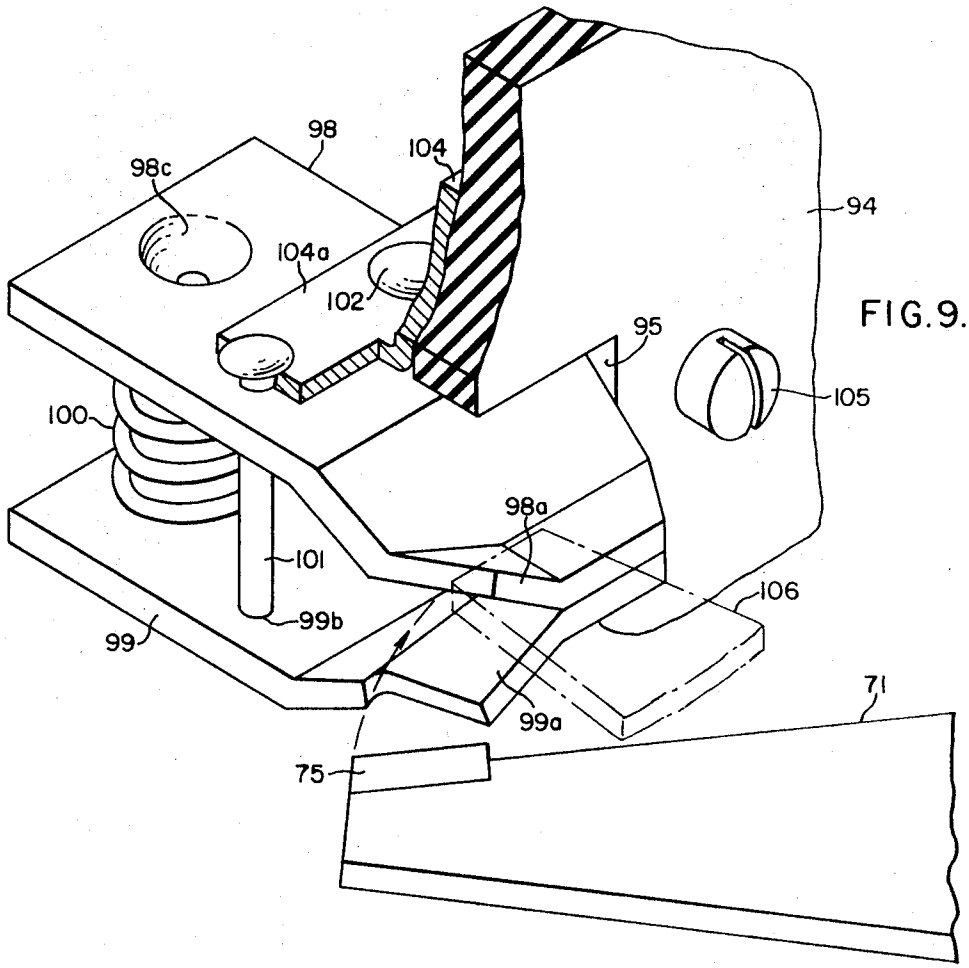

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98c
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104a
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FIG. 9.

FIG. 12.

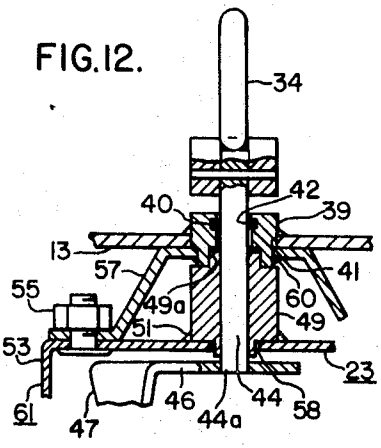
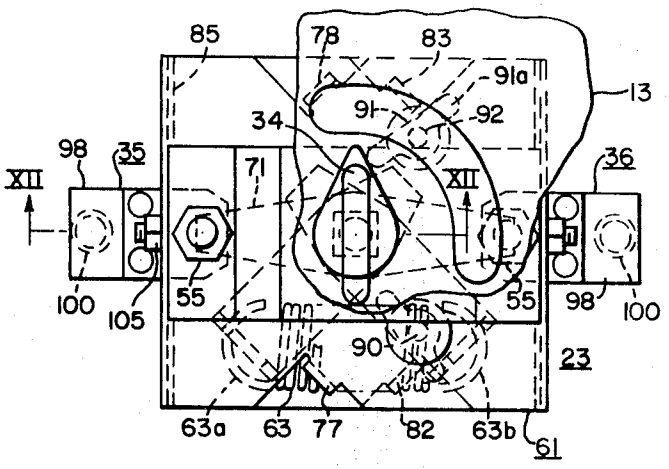


FIG. 7.



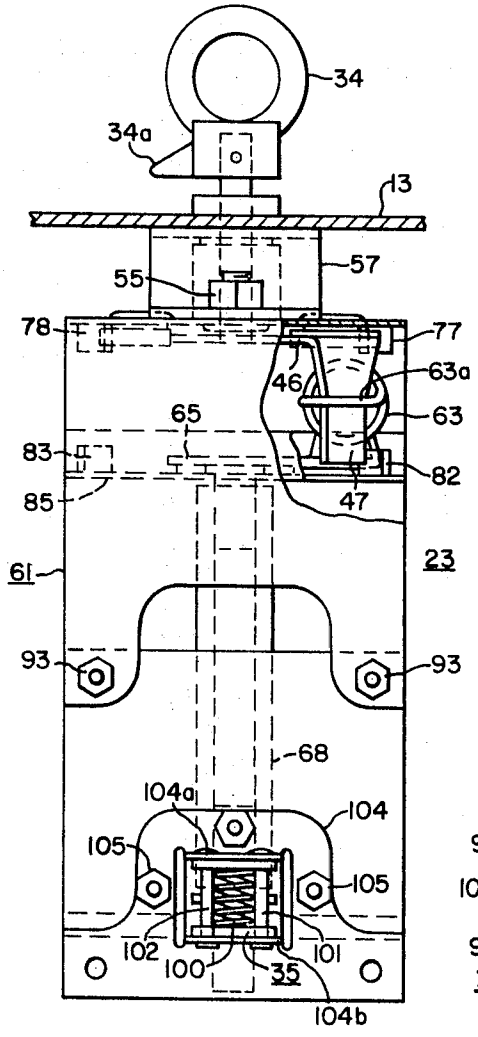


FIG. 6.

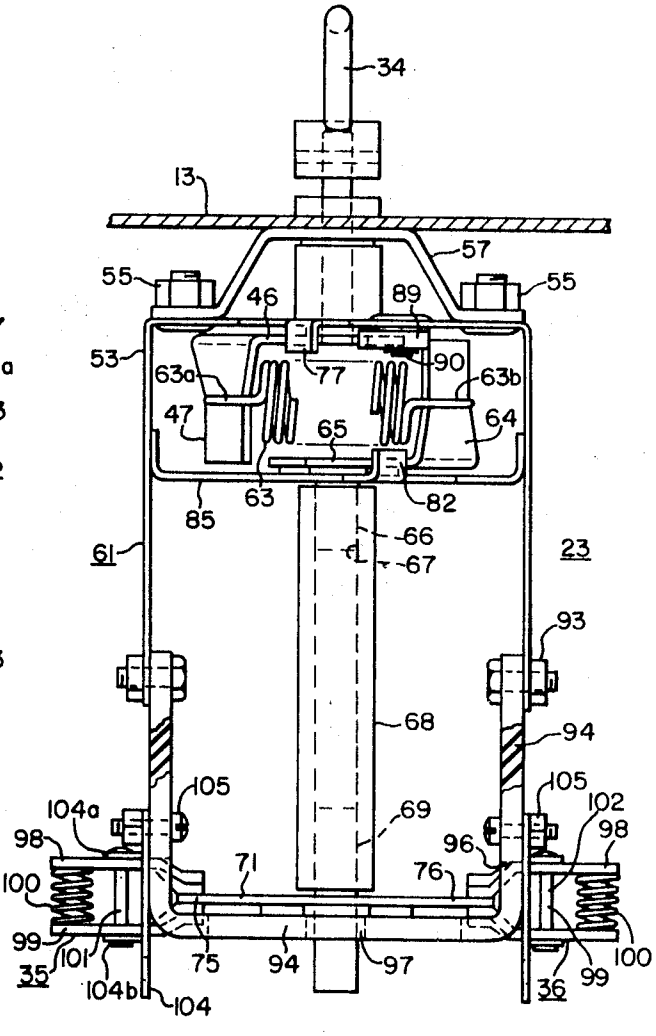


FIG. 5.

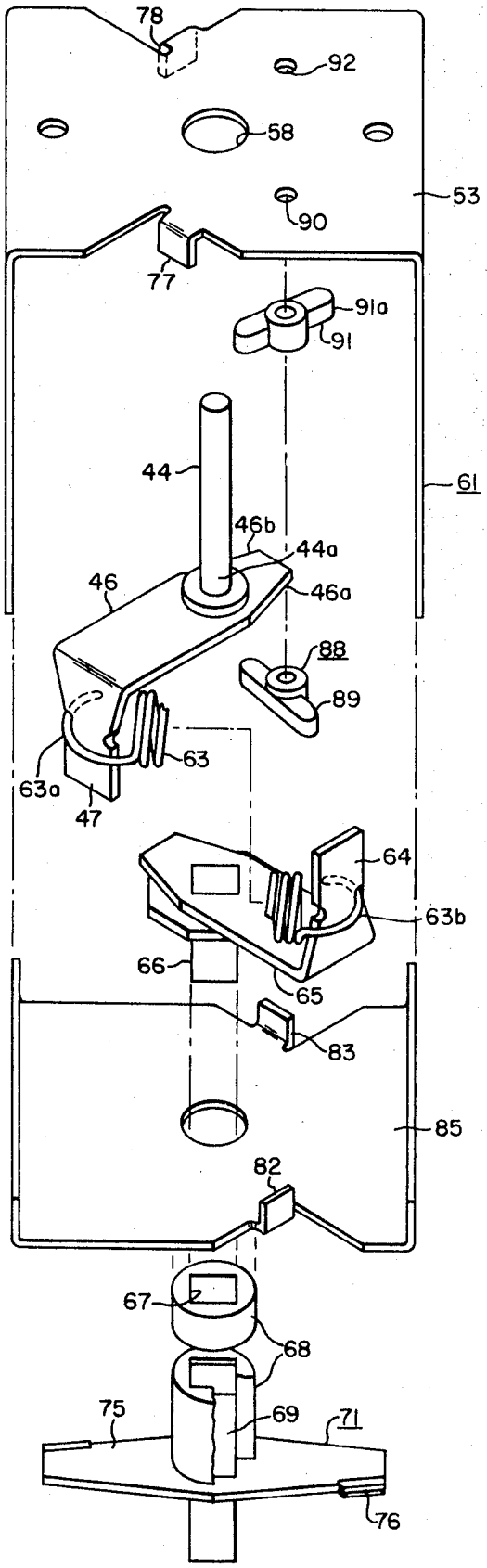

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46b
44a
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46a
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63b
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FIG.8.

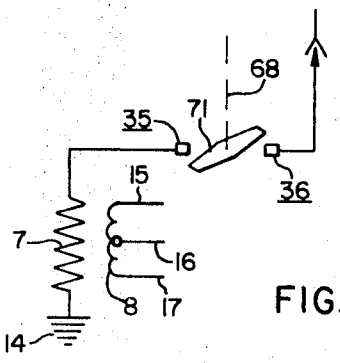


FIG.13.

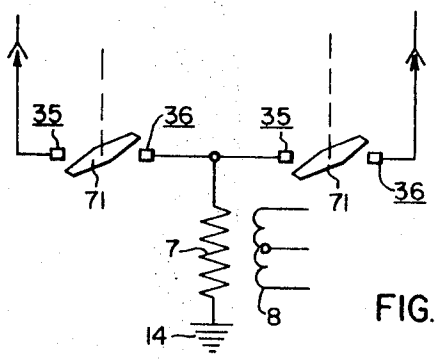
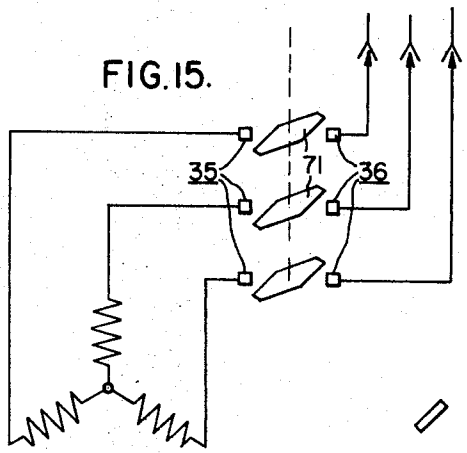


FIG.14.

FIG.15.



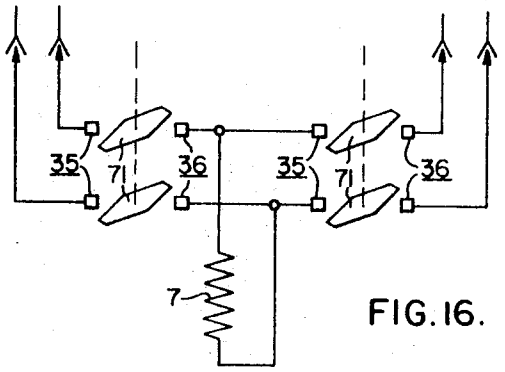


FIG.16.

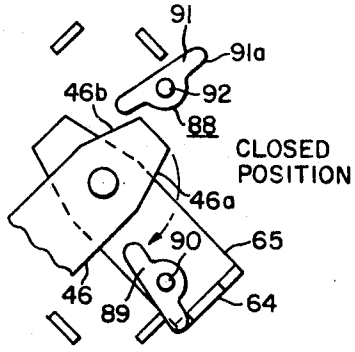


FIG.7A.

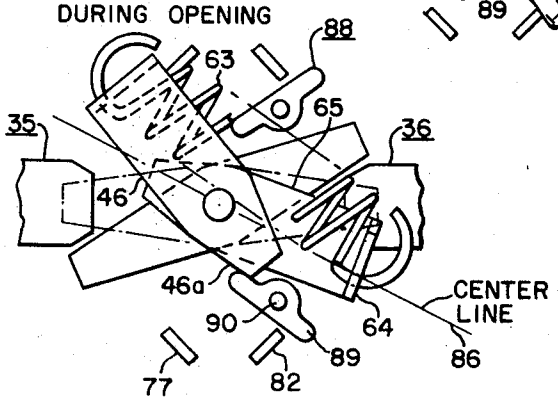


FIG.10.

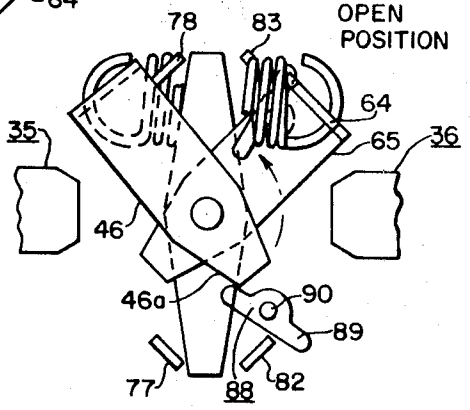


FIG.11.

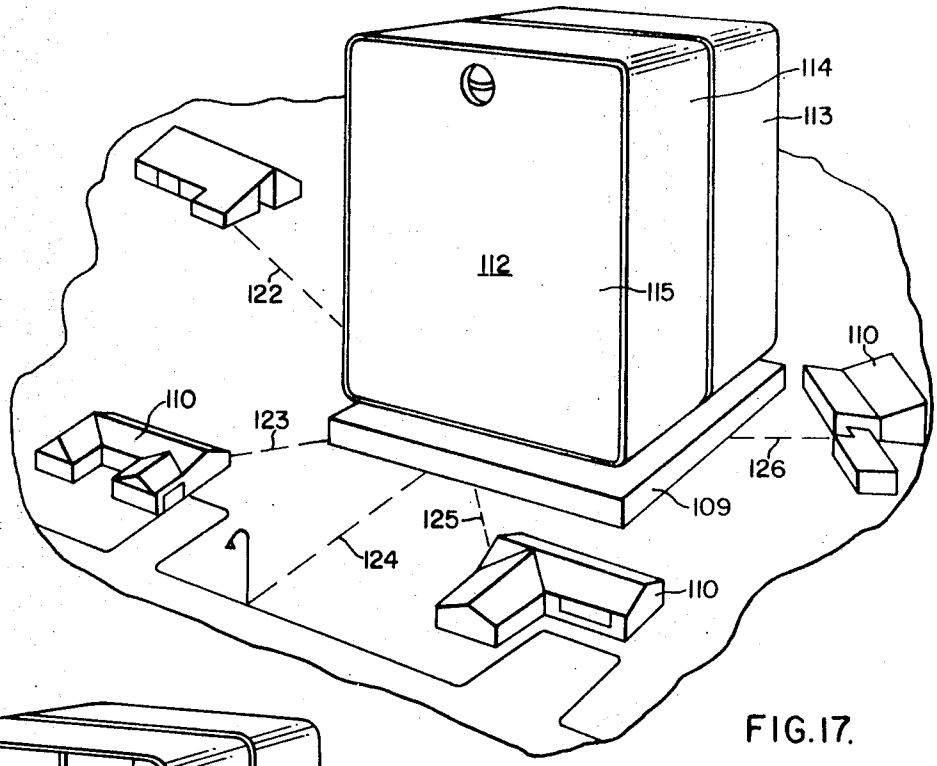


FIG.17.

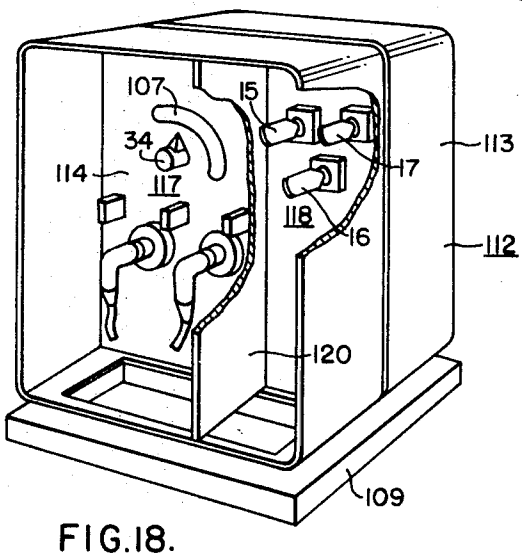


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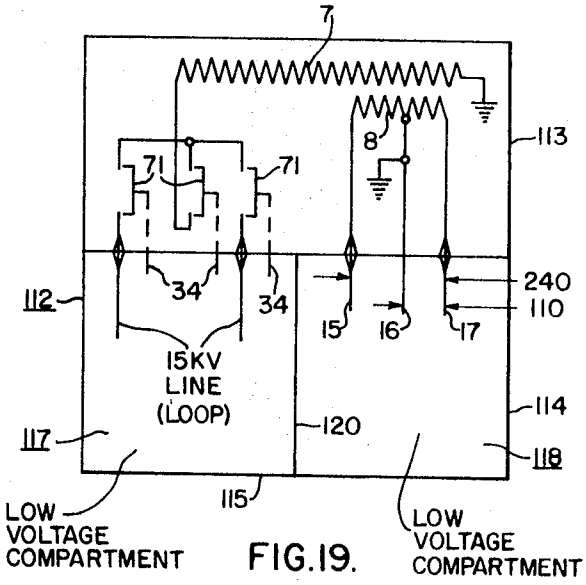


FIG.19.

FIG. 21.

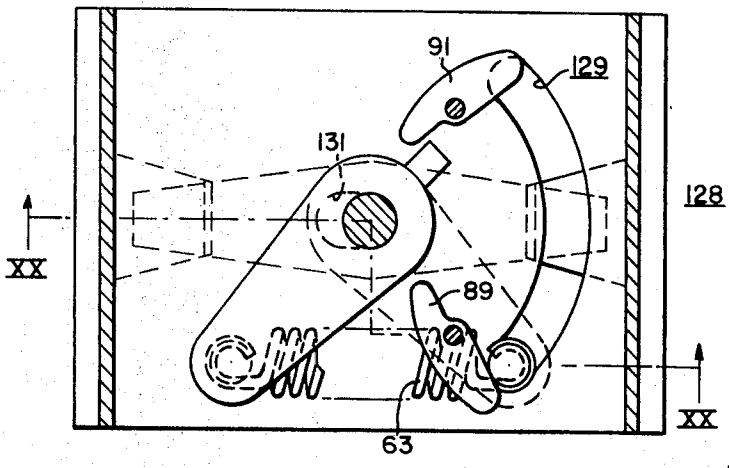


FIG. 22.

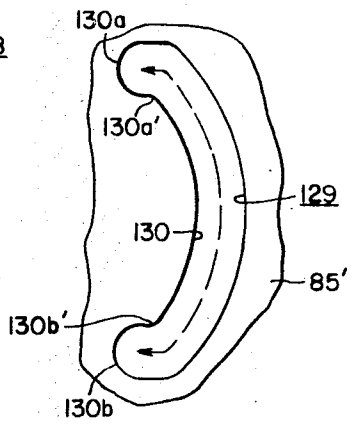


FIG. 20.

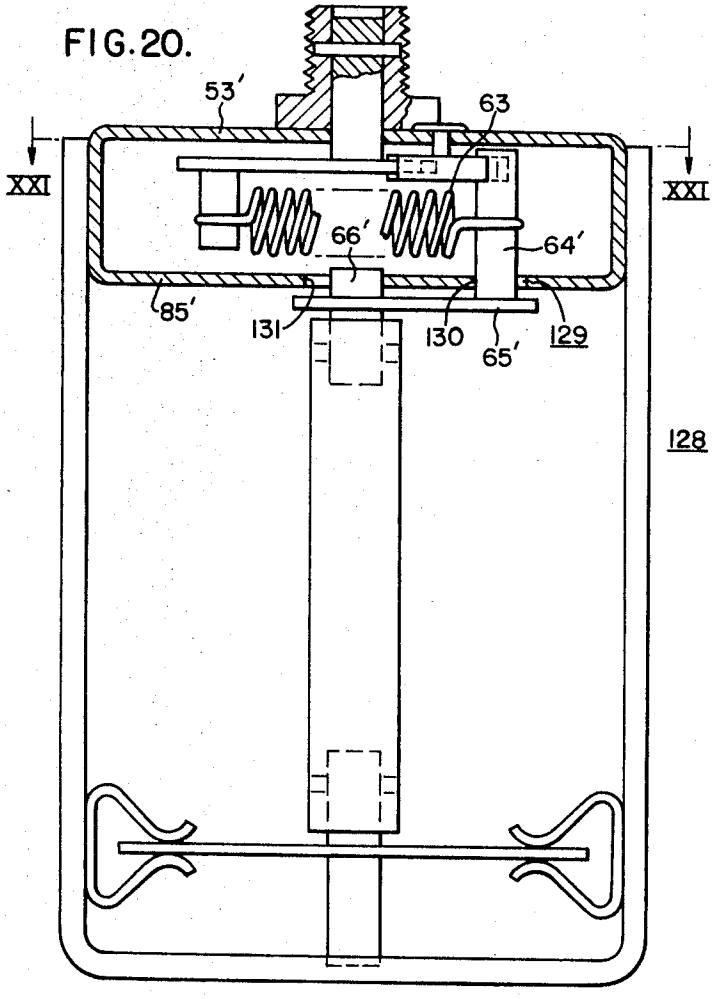
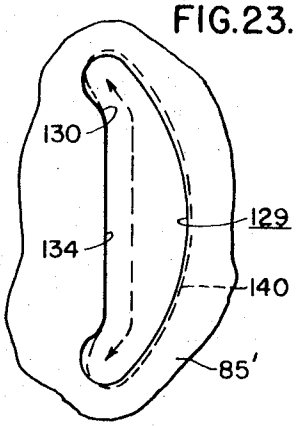


FIG. 23.



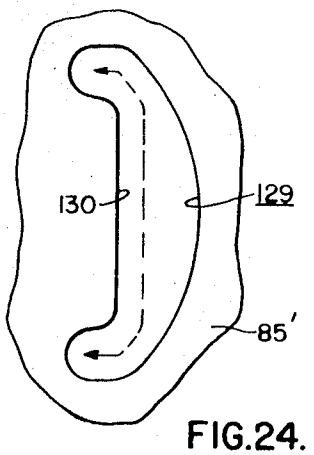


FIG. 24.

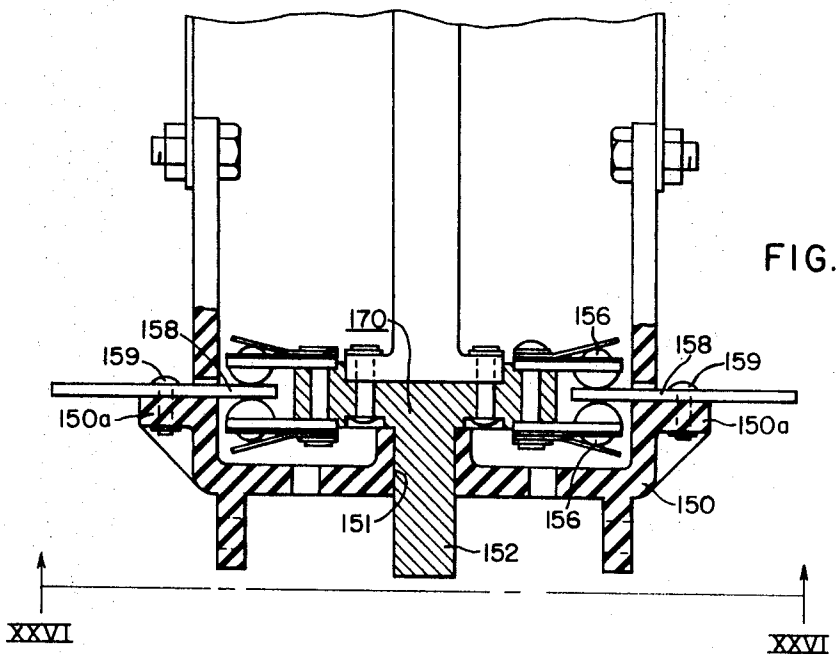


FIG.25.

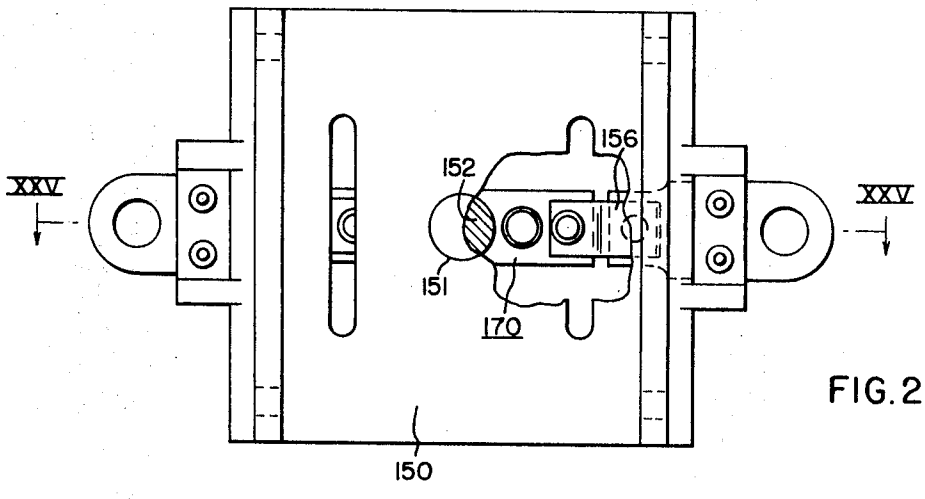


FIG.26.

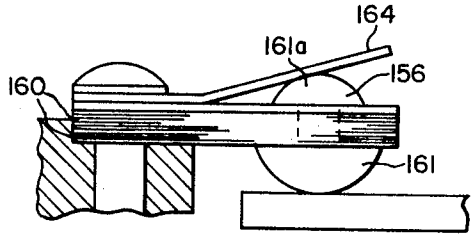


FIG.27.

QUICK-MAKE AND QUICK-BREAK SWITCH

A general object of the present invention is to provide an improved quick-make and quick-break type of switch, which will not only result in fast opening and closing movement, but, additionally, will provide a positive opening and closing action even if the contacts have considerable frictional engagement.

Another object of the present invention is the provision of an improved quick-make and quick-break type of switch, which may be readily adapted for a wide variety of switching connections.

Another object of the present invention is the provision of a quick-make and quick-break type of switch, which may be operated easily by servicemen in connection with submersible types of transformer installations.

Another object of the present invention is the provision of a quick-make and quick-break type of switch in which the detent action on the driven crank arm may be positively controlled without hampering the actuating motion of the switch.

Still a further object of the present invention is the provision of an improved quick-make and quick-break type of switch adaptable for volume manufacture, and composed of relatively few easily manufactured and readily assembled items.

Still a further object of the present invention is the provision of an improved mounting construction for a quick-make and quick-break type of switch which will accommodate a wide variety of misalignment conditions in the assembly operations by relatively unskilled workmen.

Another object of the present invention is the provision of a quick-break and quick-make type of switch having aligned rotating driver and driven crank arms, in which "kickers," or actuating members, are engaged by the driving crank arm to insure positive opening and closing motion of the driven crank arm to break any possible welding, or frictional conditions at the separable contact members.

Another object of the invention is to provide a quick-make and quick-break type of switch mechanism having positive actuators or "kickers" to overcome frictional or slight welding conditions at the separable contact structure, in which a correct indication of switch position is provided even if, due to excessive welding, the actuators become incapable of operation.

In accordance with a preferred embodiment of the invention, a manually operated driving crank arm, carrying one end of an overcenter spring, is provided having the other end of the overcenter spring connected to the free end of a driven, or follower crank arm, which actuates the movable contact structure. A moving portion of the driving crank arm engages at the end extremities of its opening and closing motion a pair of pivotally mounted "kickers," or actuators, which positively engage the spring support member secured to the free end of the driven crank arm, and supporting the end of the overcenter spring. As a result, movement of the overcenter spring by the driving crank arm will effect snap opening and closing movement of the driven crank arm, and hence operation of the contact structure, with positive operating movement of the contact structure assured at the end of the opening and closing movements of the driving crank arm.

According to another embodiment of the invention, the spring-support pin on the driven crank arm rides in a slot, or cam surface cutout of a stationary frame member to thereby permit more variety in detent action than is possible with a fixed bearing.

Preferably, each of the aforesaid embodiments is supported in a novel manner capable of accommodating misalignment of the moving contact assembly by having a bearing sleeve guiding the rotative motion of the driving crank arm and secured to the switch frame, with the said sleeve bearing having a pilot action in a stationary guide-sleeve bearing fixedly secured to the tank cover, or sidewall of the adjacent tank structure.

Further objects will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

FIG. 1 is a sectional perspective view of a submersible-type transformer, designated Type "SPB" manufactured by the Westinghouse Electric Corporation and developed for underground distribution systems;

FIG. 2 is a fragmentary view looking down into the underground vault showing the upper end of the submersible-type transformer of FIG. 1;

FIG 3 is a diagrammatic view of a typical loop-type distribution system to indicate the necessity for switching at the individual transformer units for house and streetlighting circuits, and illustrating the location of the load-break switches associated with each of the unit transformers;

FIG. 4 is a fragmentary perspective view of the load-break switch of the present invention mounted in the dome cover of a subway pole base transformer of the type set forth in FIGS. 1 and 2, and illustrating the position of a plurality of contact structures in a closed connecting position;

FIG. 5 is an enlarged side elevational view of the quick-break and quick-make type of load-break switch of the present invention, as secured to the tank cover or sidewall of a distribution transformer, the contact structure being illustrated in the closed-circuit position;

FIG. 6 is an end elevational view of the switch structure of FIG. 5;

FIG. 7 is a top plan view of the switch structure of FIGS. 5 and 6, with reference being had to FIG. 4;

FIG. 7A is a fragmentary top plan view of a portion of the switch mechanism in the closed-circuit position;

FIG. 8 is an exploded perspective view of the switch in the closed position with some portions of the switch omitted for clarity;

FIG. 9 is an enlarged view of two stationary cooperative contact fingers and indicating their relationship with a moving bridging contact blade;

FIGS. 10 and 11 illustrate fragmentarily the partially open and fully open circuit positions of the separable contact structure;

FIG. 12 is a fragmentary vertical sectional view taken substantially along the line XII–XII of FIG. 7 illustrating the provided supporting and alignment action associated with the upper frame support and driving crank arm, together with a sealed construction to the tank cover;

FIGS. 13—16 illustrate variant types of circuit connections, which may be obtained with the novel switch structure of the present invention;

FIG. 17 illustrates a pad-mounted transformer installation utilizing another embodiment of the switch structure; and illustrates diagrammatically the relationship of the pad-mounted transformer relevant to a surrounding residential neighborhood;

FIG. 18 illustrates the location of the second embodiment of the switch structure in the high-voltage compartment of the pad-mounted transformer of FIG. 17;

FIG. 19 illustrates diagrammatically the internal circuit connections of the pad-mounted transformer of FIGS. 17 and 18;

FIG. 20 illustrates in vertical section, a second embodiment of the switch structure of the present invention in which the spring support member of the driven, or follower crank arm is positively guided by cam action, the contact structure being illustrated in the closed-circuit position and the view being taken along the line XX–XX of FIG. 21;

FIG. 21 is a top plan view in section of the modified switch structure of FIG. 20, the view being taken substantially along the line XXI–XXI of FIG. 20;

FIGS. 22—24 illustrate fragmentarily, modified types of cam slot action as applied to the switch construction of FIG. 20;

FIG. 25 illustrates partially in side elevation, and partially in vertical section, a modified type of contact structure, which may be applied to either of the switch mechanisms of FIG. 5 or FIG. 20, the contact structure being shown in the closed-circuit position and taken along the line XXV–XXV of FIG. 26;

FIG. 26 is an inverted plan view in section of the modified type of contact structure shown in FIG. 25 taken substantially along the line XXVI–XXVI of FIG. 25; and,

FIG. 27 is a considerably enlarged view of one of the resilient contact fingers of FIGS. 25 and 26.

FIGS. 1—19 FIRST EMBODIMENT

With reference to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a submersible-type transformer, of the Type "SPB" manufactured by the Westinghouse Electric Corporation, and developed to provide underground distribution circuits for residential neighborhoods. Generally, the submersible-type transformer 1 comprises an underground vault 2 positioned in an excavation 3 dug out of the ground. The vault 2 has a flush-mounted grate 4 secured thereto at ground level. With reference to FIGS. 1 and 2, it will be observed that a distribution transformer 6 is located within the cylindrical housing member or vault 2, and, at times, may be completely submerged with water. As well known by those skilled in the art, the transformer 6 comprises a high-voltage winding 7 (FIG. 13) and a low-voltage secondary winding 8, which are inductively coupled.

By way of illustration only, and not by way of limitation, the transformer 6 may have a KVA rating of say, for example, 25 to 167, and may be designed for systems rated 15 kv., grounded "Y" and below. Two high-voltage bushings 11, 12 are secured to the upper dome cover 13, and also three bushings 15—17 are mounted on the cover 13 being connected to the secondary winding 8. Preferably plug-in high-voltage connectors, sold under the trade name "Elastimold" by the ESNA Corporation, and described in U.S. Ruete et al. Pat. No. 3,243,756, are provided for submersible applications. The standard Type "SPB" transformer is internally connected for a loop feed primary and a 240/120 secondary. The two primary bushings 11, 12 are connected internally by a 200 ampere bus that completes the external feeder loop. The line side of the primary winding 7 is connected to the internal feeder bus, and the other side of the primary winding 7 is internally grounded to the transformer tank, as at 14 (FIG. 13).

The secondary winding 8 is internally connected at either end to the two low-voltage bushings 15, 17. A neutral center tap terminates at the neutral low-voltage bushing 16, and is externally grounded to the transformer tank. As shown, the neutral terminal 16 has a porcelain insulator, and is of the spade type.

Reference may be had to a typical loop distribution system 21, as illustrated in FIG. 3 of the drawings, to illustrate the location of a number of transformers 6 of the type set forth in FIG. 1 in relation to a residential neighborhood. It will be noted that the primary high-voltage winding 7 may be connected by either of two load-break switches 23 to either side "A" or "B" of the loop. This is desirable for sectionalizing cable connections 25—32, and as a load break switch at the transformer 6.

In the particular application of the quick-break and quick-make switch 23 of the present invention, the switch 23 is mounted inside the transformer tank 9. The switch 23 may be manually operated by an externally situated operating handle 34, mounted on the dome cover 13 of the transformer tank 9. The switch 23 offers the following four switch positions;

I. Feedthrough, transformer 6 energized.

II. Feed from left side "A" of loop (FIG. 3), right side "B" of loop open, transformer 6 energized.

III. Feed from right side "B" of loop (FIG. 3), left side "" of loop open, transformer 6 energized.

IV. Left and right sides "A" and "B" of loop (FIG. 3) open, transformer 6 disconnected from loop.

These switching positions enable the operating personnel to quickly isolate a line fault in a A"system 21, while still maintaining full service. Or, a transformer 6 can be quickly disconnected from the loop for maintenance or changeout without disrupting the service of the remaining transformers 6 on the loop. This switching flexibility of the switch 23 enables utilities to minimize outage time during emergencies.

The present invention is particularly concerned with a novel type of quick-make and quick-break load-break switch 23, which insures positive actuation despite frictional, or welding conditions at the contacts 35, 36, either in the open or closed-circuit positions. FIG. 4 illustrates the mounting of the switch 23 in the dome cover 13 of the distribution transformer 6 of FIG. 1, and the disposition of the eyelet operating handle 34, which effects switch actuation. The operating handle 34 may be rotated to "open" and "closed" positions by a switch stick, as well known by those skilled in the art.

FIGS. 5,6 and 7 collectively illustrate side, end and top views, respectively, of the switch structure 23 in the closed-circuit position. With particular reference being directed to FIG. 5 and to the sectional view of FIG. 12, it will be observed that a sealing sleeve 39, with a relatively large O-ring 40 mounted therein, is securely welded in an opening 41 provided in the top dome cover 13 of the transformer 6. Extending downwardly axially within a slightly enlarged opening 42, provided by the sealing sleeve 39, is an actuating shaft 44, the lower end 44*a* of which is welded to an offstanding driving crank arm, or spring bracket 46, having an outer spring-support portion 47 at the free extremity thereof. Reference may be had to FIG. 8 in this connection.

It will be observed that the shank portion of the actuating shaft 44 extends through a bearing sleeve 49 (FIG. 12), which is welded, as at 51, to the upper side of a frame support member 53, which, in turn, is fixedly secured by mounting bolts 55 to a supporting bracket 57 having an aperture 58 therethrough, and fixedly secured, as by welding at 60, to the sealing sleeve 39. Thus, the sealing function through the tank is provided by the fixed sleeve 39 having the slightly enlarged bore 42 therethrough, the bearing function is provided by the frame 61 of the switch 23, the concentricity is provided by the pilot action of an upstanding shoulder portion 49*a* of the bearing sleeve 49, and any slight angular misalignment is permitted by the clearance 42 in the short sealing sleeve 39 and the design of the O-ring 40.

With reference to FIGS. 5,6 and 8, it will be noted that an overcenter spring 63 has one end 63*a* thereof secured to the spring support portion 47 of the driving operating crank 46, and the other end 63*b* of the overcenter spring 63 is securely fastened to an upstanding spring support portion 64 of a driven, or follower crank arm 65, which is welded to a square operating shaft portion 66. Reference may be had to FIG. 8 in this connection.

The shaft portion 66, secured to the driven crank arm 65, is inserted within a rectangular opening 67 provided by a downwardly extending insulating square tubular shaft portion 68 so as to effect the rotation thereof, as brought about by rotative driven action of the crank arm 65.

At the lower end of the tubular square insulating shaft 68 is a square shaft portion 69, which is secured, as by welding, to a rotatable movable bridging contact 71 having the movable end portions 75, 76 thereof making separable contacting engagement with a pair of spaced contact finger assemblies 35, 36, the latter being fixedly mounted and more particularly described hereinafter.

To limit the end positions of the rotative action of the driving crank arm 46, there is provided a pair of downwardly jutting tabs 77, 78, which are bent down from a configured plate portion of the top frame 53, thereby constituting stop, or limiting portions for restricting the end rotative opening and closing motion of the driving is provided arm 46.

In similar manner, to limit the opening and rotative end positions of the driven, or follower crank arm 65, there is provided a pair of upstanding tabular portions 82, 83 bent upwardly from the lower frame member 85 and serving to arrest opening and closing motions of the driven crank arm 65. As will be obvious, the overcenter spring 63 provides a quick-make and quick-break action once its line of action extends over the centerline 86 (FIG. 10) of the device.

In the event that there is considerable friction between the rotative bridging member 71 and the cooperable spaced stationary finger contact assemblies 35, 36, or should there be present a slight welding condition therebetween it is desirable to provide a positive actuating means 88, particularly in the opening direction, to effect positive switch-opening movement. To this end, there is provided a rotative "kicker" or actuator 89, which is pivotally mounted on a pivot pin 90, and is positively engaged by an operating portion 46*a* (FIG. 10) of the driving crank arm 46. When this occurs, the rotation of the actuator 89 will pick up the spring support 64 of the driven crank arm 65, as indicated in FIG. 7A of the drawings, thereby forcibly causing opening motion of the driven crank arm 65. In similar manner, during the closing operation, the closing motion of the operating portion 46*b* of the driving crank arm 46 will engage a second pivotally mounted actuator 91, pivotally mounted on a pivot pin 92, and cause the tail portion 91*a* thereof to physically engage the spring supporting portion 64 of the driven crank arm 65 to effect consequent closing movement thereof.

It is extremely desirable to provide a correct indication of the switch position, that is whether the switch is "open" or "closed," inasmuch as an "open" indication of a switch, which in fact is closed, could present a serious hazard, and could result in a serious accident to operating personnel.

It will be observed that if, due to excessive welding at the switch contacts it is impossible to effect rotation of the actuators 89, 91, the line of action of the overcenter spring 63 will not pass over the centerline 86 (FIG. 10) and the externally visible handle 34 will automatically be retrieved to the "closed" position, thereby giving a correct indication of the switch position.

With reference to FIG. 5, it will be observed that the generally U-shaped platelike frame support member 53 is secured, as by mounting bolts 93, to a generally U-shaped insulating lower frame support member 94 having oppositely provided contact openings 95, 96 therein. The lower portion of the insulating frame member 94 has a bearing opening 97 therein to accommodate the stub shaft 69, which, in turn, may be used to actuate a second rectangular insulating shaft portion 68 for operating two further pairs of separable contacts 35, 75 and 76, 36. Reference may be had to FIG. 4 in this connection for a general diagrammatic showing of the arrangement of plural contact assemblies.

With reference to FIGS. 5—7 and 9, it will be observed that there is provided a pair of flexibly mounted spaced finger contacts 98, 99, each of which comprises a stamped plate of good conducting material, such as copper, and so configured as to be beveled at 98*a*, 99*a* (FIG. 9), and provide alignment of the free end portions 75, 76 of the rotatable main bridging contact member 71. A compression spring 100 is interposed between the outer ends of the contact fingers 98, 99 and seated on stamped projections 98*c*, 99*c*. The contact fingers 98, 99 have a pair of positioning pins 101, 102 loosely extending through openings 98*b*, 99*b* provided therein. A plate support member 104 (FIG. 6) is provided having tabular portions 104*a*, 104*b* jutting outwardly therefrom to provide supporting portions for said pair of locating pins 101, 102. The upper end of the contact plate member 104 is secured, as by bolts 105, to the lower portion of the insulating frame support member 94. With the foregoing arrangement, it is obvious that the rotative action of the main bridging contact member 71 will be smoothly guided between the beveled surfaces 98*a*, 99*a* of the contact fingers 98, 99 to a proper contact seating engagement, as indicated by the dot-dash lines 106 of FIG. 9.

From the foregoing it will be apparent that manual rotation of the eyelet handle 34, either by manual rotation thereof, or by switch-stick operation by a serviceman, will effect rotation of the driving crank arm 46 to thereby carry the line of action of the overcenter spring 63 to a position where it will effect either snap-opening or snap-closing movement of the lower driven, or follower crank arm 65. This will effect corresponding opening or closing movement of the separable contact structure; and an indicator plate 107, coupled with the rotating indicator pointer 34*a*, will indicate the "open" or "closed" circuit positions of the switch 23.

As mentioned, further extensions of the operating shaft 68, including additional pairs of separable contacts as illustrated in FIG. 4, may provide a wide variety of circuit connections, as evidenced by FIGS. 15 and 16 of the drawings.

FIGS. 17—24 SECOND SWITCH EMBODIMENT

The novel load-break switch of the present invention may have another form of mechanism for more positive detent control, as illustrated in FIGS. 20—24 of the drawings. This particular embodiment of the invention may be used in a pad-mounted transformer application of the type set forth in FIGS. 17—19 of the drawings.

For modern distribution applications, it is desirable in many instances to provide a pad-mounted application in which the distribution transformer 6 is mounted upon a concrete pad 109, and is adaptable, in a centralized location, to provide power to a plurality of houses 110. Reference may be had to FIG. 17 in this connection.

The pad-mounted transformer 112, as illustrated in FIGS. 17 and 18, embodies a transformer tank 113, which is completely sealed and accommodates the usual core-coil assembly and insulating oil. The top, bottom and walls are formed of one-piece heavy-gauge steel welded at the bottom seam, and the transformer compartment 113 is bolted to the cable compartment 114; therefore convenient changeout to higher KVA ratings is possible.

The cable compartment 114 provides a completely enclosed cabinet for terminating both the high- and low-voltage cables so that no live parts are exposed. A free standing enclosure, this compartment can be installed, if desired, when the system is laid out, and the transformer compartment 113 added as distribution is needed. A lift-off door 115 is easily removed for convenient access to both the high- and low-voltage sections 117, 118. The low-voltage section 118 is separated from the high-voltage section 117 by a heavy insulating mechanical barrier 120, and contains secondary terminals 15, 16 and 17 to feed the load circuits 122—126 (FIG. 17), oil drain, etc.

As indicated in FIGS. 20 and 21, the load-break switch 128 is provided with a manual eyelet handle 34 extending horizontally through the sidewall of the transformer tank compartment 113, thereby situating the switch 128 beneath the level of the oil for more effective arc-extinguishing action.

FIGS. 20 and 21 illustrate, respectively, in vertical section, and in top plan, a modified mechanism construction in which the spring support member 64′ for the driven crank arm 65′ is positively guided by a slot 129 provided in the lower frame support portion 85′. It will be seen that the pin 64′ on the lower spring arm 65′ rides on a cam surface 130 cut out of the frame portion 85′. This permits more variety in detent action than is possible with a fixed bearing. An elongated slot 131 is provided in the lower frame member 85′ to accommodate lateral movement of the stub-shaft portion 66′ of the driven crank arm 65′, as the spring support pin 64′ is moved along the cam slot 129. Again the overcenter spring action 63 insures a positive opening and closing movement of the driven crank arm 65′ by the provision of "kickers" or actuators 89, 91, which are pivotally mounted in the top frame support portion 53′, and function in a manner identical to that described hereinbefore.

The cam slot, illustrated in FIG. 21 of the drawings, shows a slot configuration 129 which is identical to the travel obtained by the crank design of FIG. 5 in controlling the pin 64′ travel. FIG. 22 illustrates a modified type of cam slot 129, which is modified for greater detent action at both ends of travel by being provided with end notches 130*a*, 130*b*. The corners 130*a*′, 130*b*′ provide a detent action so that a greater travel of the overcenter spring is required prior to an initial movement of the crank pin 64′.

FIG. 23 is similar to the cam slot illustrated in FIG. 21; however, it has a flattened portion of the center 134 for faster

traverse of the driven pin 64'. For still easier release of the driven pin 64', the configuration of the ends of the cam slot 129 could be as per the dotted lines 140 in FIG. 23. FIG. 24 is a modified type of cam slot, which combines the cam slot configurations of FIG. 22 and FIG. 23.

From the foregoing it will be apparent that there are various modifications of the cam slots 129, which are possible for various kinds of detent action desired. As will be obvious, the torque, which is necessitated to start the motion of the driven crank arm 65', depends upon the particular cam slot configuration 129 provided.

FIGS. 25—27 illustrate a modified type of contact structure, which has been found to be far superior to the contact structure illustrated in FIGS. 5—7 of the drawings. In fact, the use of this contact design has raised the level of successful close-in on a fault from 3,000 amperes to 10,000 amperes. A very important characteristic of the cooperating contact fingers is their stiffness characteristics, which has been found surprisingly to be of considerable importance. U.S. Pat. application filed Jan. 22, 1968, Ser. No. 699,593, now U.S. Pat. 3,461,259 issued Aug. 12, 1969, to Merrill G. Leonard, Robert J. Manes describes and claims this variant contract structure.

In more detail, FIG. 25 illustrates a modified type of bolted lower support 150 having a central bearing opening 151 therethrough, which accommodates the contact holder stub-shaft portion 152 so that the cooperating finger contacts 156 may make sliding engagement with the stationary contact blades 158, which are secured by bolts 159 to an outwardly extending flange portion 150*a* of the molded lower insulating support 150. The spring contact fingers 156 are comprised of a plurality of laminations 160, with the contacts 161 riveted to the outer extremity thereof and having a leaf spring 164, which bears upon the upper rivet portion 161*a* of the contact 156, as illustrated more clearly in FIG. 27 of the drawings. As mentioned hereinbefore, the stiffness characteristic of the individual spring fingers is exceedingly important as set out in the aforesaid patent application, and has led to surprising results inasmuch as it has minimized any bouncing action between the contact fingers 156 and the stationary contact blades 158.

The mechanism, which may be associated with the modified type of movable bridging contact structures 170, set forth in FIGS. 25—27, may be either of the type set forth in FIGS. 5—7 of the drawings, or the mechanism modification illustrated in FIGS. 20—24 of the drawings.

From the foregoing description of the load-break switch of the instant application, it will be observed that a highly effective quick-make and quick-break action is secured during both the opening and closing movements, with positive actuation being provided by the pivotally mounted actuator members 89, 91, which overcome any slight frictional or welding resistance at the contacts. For excessive welding conditions, which render actuation of the actuators 89, 91 impossible, an automatic correct indication of switch position is provided.

Although there has been illustrated and described specific embodiments of the invention, it is to be clearly understood that the same were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. Switch means including a switch frame, a pair of actuators pivotally mounted on said switch frame, an actuating shaft having a rotatable driving crank arm fixedly secured thereto, said rotatable crank arm having a spring support at one end and a positive actuating portion at the other extremity thereof for abutting engagement with said pair of actuators, a driven crank arm having a spring support at one end thereof, an overcenter tension spring interconnecting the two spring supports for snap-opening and snap-closing action, separable contacts mechanically connected to said driven crank arm, each pivotal actuator having an actuating end and a positive driving end, said actuating end being disposed in the path of movement of the positive actuating end portion of the rotatable driving crank arm, the positive driving end of the actuator positively driving the spring-supporting end of the driven crank arm, for positively driving the driven crank arm should the separable contacts become welded closed.

2. The combination of claim 1, wherein the line of action of the overcenter tension spring does not pass over the centerline should the pivotal actuators fail to move due to excessive welding conditions at the contacts, and thereby the handle being retrieved to its initial "closed" position for correct switch indication position.

3. Switch means including a pair of spaced metallic plate portions having bearing openings therethrough in alignment, a pair of actuators pivotally mounted on one metallic plate portion, an actuating shaft extending through the bearing opening of said one metallic plate portion and having a rotatable driving crank arm fixedly secured thereto, said rotatable crank arm having a spring support at one end and a positive actuating portion at the other extremity thereof for abutting engagement with said pair of actuators, a driven crank arm having a spring support at one end thereof, an overcenter tension spring interconnecting the two spring supports for snap-opening and snap-closing action, separable contacts mechanically connected to said driven crank arm, each pivotal actuator having an actuating end and a positive driving end, said actuating end being disposed in the path of movement of the positive actuating portion of the rotatable driving crank arm, the positive driving end of the actuator positively driving the spring-supporting end of the driven crank arm for positively driving the driven crank arm should the separable contacts become welded closed.

4. The combination according to claim 3, wherein a rotatable bridging member having two sets of cooperable flexible finger contacts is provided.

5. In combination, a mounting member having an opening therethrough, switch-frame means including a bearing sleeve fixedly supported to the mounting member, a sealing sleeve fixedly supported in said opening and supporting a ring of elastomeric material, an actuating switch member rotatably mounted with a relatively tight fit in said bearing sleeve and with a relatively loose fit in said sealing sleeve, and shoulder means on said bearing sleeve telescoping within a shoulder portion of the sealing sleeve for providing concentricity of the two sleeves.

6. The combination according to claim 1 wherein a cam slot guides the motion of the driven rotatable crank arm.

7. The combination according to claim 6, wherein detent notches are provided at the ends of said cam slot.

8. The combination according to claim 6, wherein the cam slot is widened at the intermediate portion thereof to thereby reduce the detent action.

9. The combination according to claim 1, wherein a rotatable bridging member having two sets of cooperable flexible finger contacts is provided.

10. The combination according to claim 3, wherein the other metallic plate portion is provided with a cam slot which guides the motion of the driven rotatable crank arm.

11. The combination according to claim 10, wherein detent notches are provided at the ends of said cam slot.

12. The combination according to claim 11, wherein the cam slot is widened at the intermediate portion thereof to thereby reduce the detent action.

13. The combination according to claim 5, wherein the mounting member is a transformer casing, and the actuating switch member is a rotatable operating shaft extending externally of the transformer casing.

14. The combination according to claim 5, wherein the switch-frame means is a generally rectangularly shaped member.

15. The combination according to claim 1, wherein spaced stops formed on the frame limit the degree of rotation of the driving crank arm.

16. The switch means of claim 3, wherein the line of action of the overcenter tension spring does not pass over the centerline should the pivotal actuator fail to move due to excessive welding conditions at the contacts, and thereby the handle being retrieved to its initial "closed" position for correct switch indication position.

17. Switch means including a switch frame, at least one actuator pivotally mounted on said switch frame, an actuating shaft having a rotatable driving crank arm fixedly secured thereto, said rotatable crank arm having a spring support at one end and a positive actuating portion adjacent the other extremity thereof for abutting engagement with said one actuator, a driven crank arm having a spring support at one end thereof, an overcenter tension spring interconnecting the two spring supports for snap-opening and snap-closing action, separable contacts mechanically connected to said driven crank arm, said one pivotal actuator having an actuating end and a positive driving end, said actuating end being disposed in the path of movement of the positive actuating portion of the rotatable driving crank arm, the positive driving end of the actuator positively driving the spring-supporting end of the driven crank arm should the separable contacts become welded closed.

18. The combination according to claim 3, wherein spaced stops are formed on the switch frame to limit the degree of rotation of the driving crank arm.

19. The combination of claim 17, wherein the line of action of the overcenter tension spring does not pass over the centerline should the pivotal actuator fail to move due to excessive welding conditions at the contacts, and thereby the handle being retrieved to its initial "closed" position for correct switch indication position.