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LINE SWITCHING DEVICE

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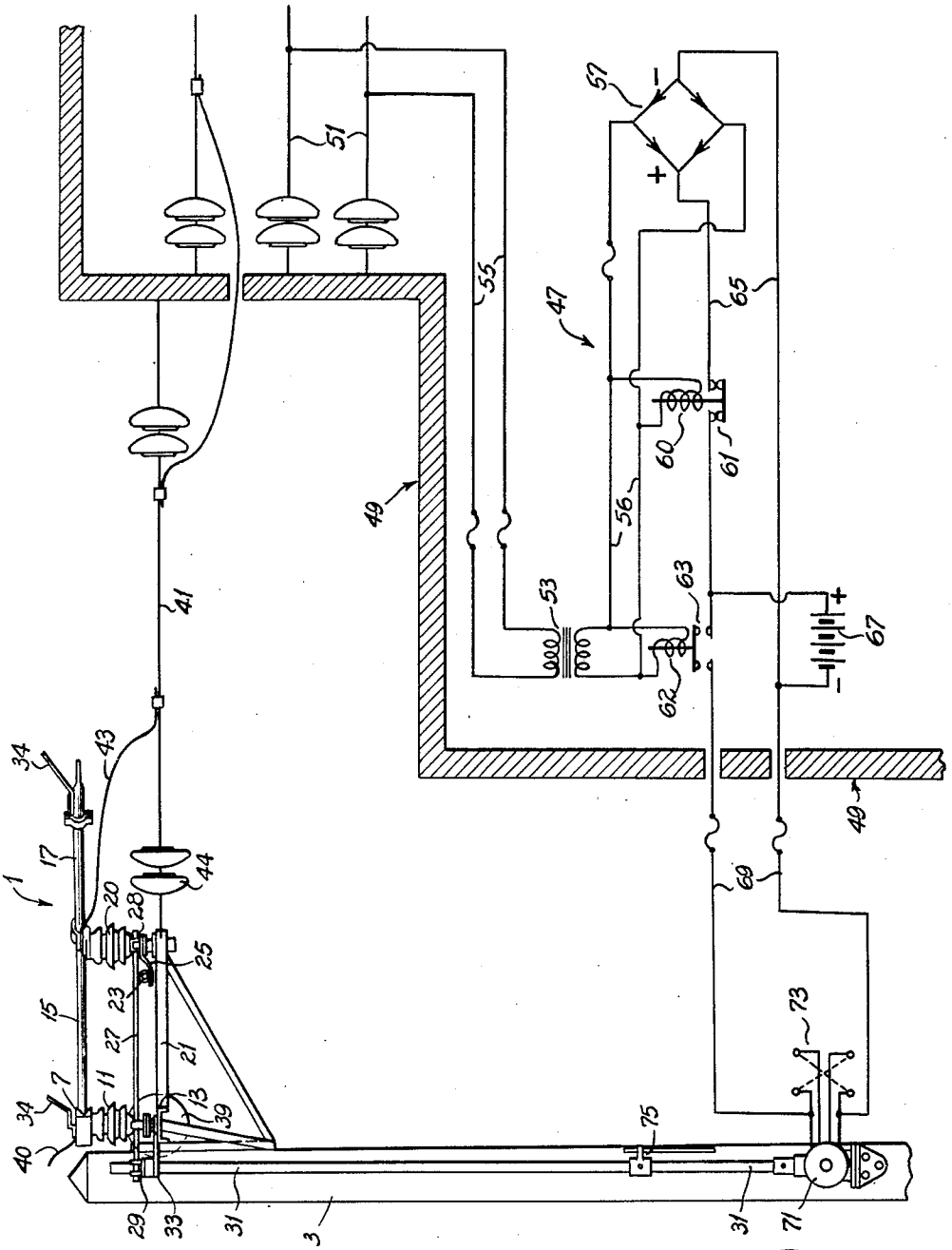


FIG. 1.

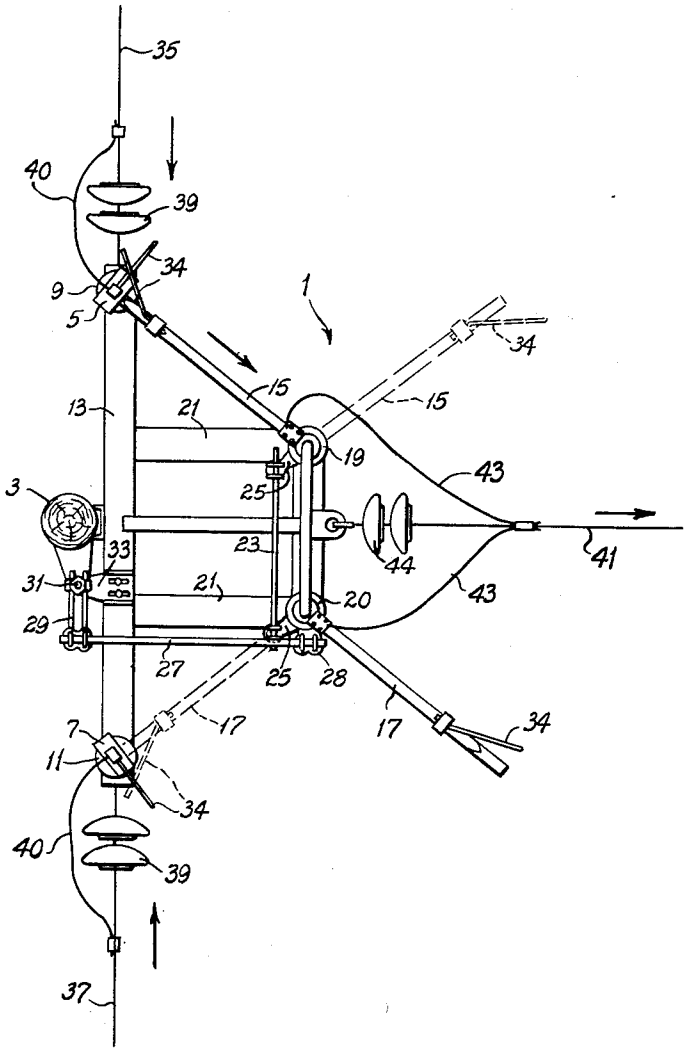
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FIG. 2.



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LINE SWITCHING DEVICE

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This invention relates to a line switching device, and more particularly, to an automatic line transfer switching mechanism for electrical power distribution systems.

The switching mechanism of this invention has primary application in power distribution systems wherein it is desired to connect an output feeder or branch line selectively to one of a pair of input feeders, or duplicate main lines. There is provided a power-operated air-break transfer switch and electrical means for mechanically operating the transfer switch. Connected in the output feeder circuit is a control circuit which is operative to energize the switch-operating mechanism and thereby switch the output feeder from one input feeder to the other input feeder in response to a decrease in the voltage of the output feeder circuit. Operation may be fully automatic or manual under remote control. Other features will be in part apparent, and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a diagram illustrating the automatic line transfer switching mechanism of this invention; and,

Fig. 2 is a top plan view of the switch.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

The main lines of a power distribution system are generally protected by centrally located circuit breakers under the supervision of a control engineer. When a failure occurs, the circuit breakers open to disconnect the faulty main lines and all branch lines connected thereto are deenergized. Where continuity of service is important, it is a frequent practice to have duplicate or alternate main lines. Thus, in the event that one set of main lines fails, the service can be maintained by switching the branch lines to the other live set of main lines. This invention provides apparatus for accomplishing such a transfer automatically upon the occurrence of a failure.

Referring to the drawings, the switching mechanism of this invention comprises an air-break transfer switch assembly generally designated 1,

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structurally of the general type described in United States Patent No. 2,470,576. The switch unit 1 is mounted on a pole 3 so as to operate in a horizontal plane. Contact clips 5 and 7 and supporting pin insulators 9 and 11, respectively, are disposed at the opposite ends of a cross channel bar 13. A pair of rotary switch blades 15 and 17 forming a moving contact device are disposed outwardly for cooperation with the contact clips 5 and 7 respectively. Switch blade 15 is mounted on a rotary pin type insulator 19 which in turn is journalled in a framework 21. Switch blade 17 is similarly mounted on a rotary pin type insulator 20 which is journalled in the framework 21. The switch blades 15 and 17 are operated in unison through a switch-operating mechanism including a transverse lever 23 coupled to each of the rotary pin insulators 19 and 20 as by brackets 25. A second link 27 reaches from a bracket 28 on pin insulator 20 to a crank arm 29. The latter is secured to a vertically extending shaft 31 journalled at its upper end in a bracket 33 affixed to the crossbar 13. When shaft 31 is rotated clockwise as viewed in Fig. 2 from above, switch blade 15 is opened and switch blade 17 is closed as indicated by the dashed lines. Arcing horns are shown at 34.

Duplicate main lines or input feeders 35 and 37 are supported at opposite ends of the crossbar 13 by means of tension insulator strings 39, and are electrically connected to the contact clips 5 and 7 respectively by leads 40. A branch line or output feeder 41 is connected to the switch blades 15 and 17 by means of leads 43. The output feeder is supported by a tension insulator string 44 anchored to the switch framework 21.

The output feeder 41 leads to a transformer substation generally indicated within a housing 49. It will be understod that feeder 41 is connected to the primary of a conventional stepdown transformer (not shown). The secondary buses of the transformer are shown at 51.

The housing 49 also includes a control circuit 47 for operating the switch 1 in response to a drop in the line voltage of the output or branch circuit. A control-circuit transformer 53 is supplied from the secondary buses 51 by leads 55. While the transformer 53 may be connected to the primary side of the branch circuit, such a connection would require a better insulated, more expensive transformer. The transformer in turn feeds through lines 56 to a rectifier 57, to the coil 60 of a normally-open relay switch 61 and to the coil 62 of a normally-closed relay switch 63. The normally-open relay switch 61 when energized

completes a circuit from the rectifier 57 through conductors 65 to a storage battery 67. The normally-closed relay switch 63 when energized opens a circuit from the storage battery 67 through leads 69 to a D. C. motor 71. It will be understood that the relay switches 61 and 63 can be incorporated into a single transfer relay, if desired, and that the terms normally-open and normally-closed are used in the sense of being open or closed when the relay coils are deenergized.

The motor 71 drives the shaft 31 of the switch-operating mechanism through a conventional gear reduction unit incorporated therewith. A reversing switch indicated at 73 is adapted to reverse the D. C. motor after the shaft has turned the predetermined amount necessary to operate the switch 1 from one position to the other. A handle 75 is provided to permit manual operation of the shaft 31.

Operation is as follows:

With the parts in position as shown, current is supplied from the input feeder 35 through switch contact clip 5 and switch blade 15 to the output feeder 41. The output circuit is thus energized and secondary buses 51 are energized. Relay switch 61 is closed and relay switch 63 is open. The battery 61 is thus charged by the rectifier 57 through switch 61. If feeder line 35 should develop a fault to the extent that the main circuit breakers (not shown) open to cut out line 35, line 41 and secondary buses 51 are deenergized. The relay switches are deenergized so that switch 61 opens and switch 63 closes. The bridge rectifier 57 is disconnected from the battery, and the battery is connected to supply current to the motor 71. Motor 71 in turn drives the vertical shaft 31. Rotary movement of the shaft 31 is communicated through the linkage 29, 27 and 23 to cause switch blade 15 to open and switch blade 17 to close. The output feeder 41 is thus automatically transferred from the dead line 35 to the alternate live line 37.

When the shaft 31 has rotated through the arc necessary to complete switching operation, reversing switch 73 reverses the connections of motor 71, preparing the system for an inverse cycle of operation. At the same time output feeder 41 is energized by main line 37, and the secondary buses 51 are energized. The relay switch 63 opens to stop the motor 71 before it can start to reverse and relay switch 61 closes to recharge the battery. The D. C. voltage output of the rectifier approximates the normal voltage rating of the storage battery, thus providing a trickle charge and preventing overcharging.

It is clear that the system, having been switched from operation from line 35 to operation from 37, has an inverse operation similar to that already described. By inverse operation is meant disconnecting line 37 from line 41 in response to a fault which causes tripping of the circuit breakers in line 37 and connection of line 35 to line 41. It is understood that in the ordinary case the prior fault in the line 35 will have been eliminated and its circuit breakers restored.

If at any one time both lines 35 and 37 are deenergized by opening of both of their respective circuit breakers, the present device will alternatively continue to connect first one dead line and then the other, and will come to rest connecting the first one of these lines in which the circuit breakers are restored.

It will be appreciated that many faults occur in lines such as 35 and 37 which are of a temporary enough nature so as not to cause opening

of the circuit breakers in the lines, or minor voltage reductions may occur in the lines due to excessive load or the like. It is not intended that the present switch gear shall operate in response to any reduction in voltage due to such conditions. To this end, the relay switches 61 and 63 are designed to respond only to substantially complete deenergization of the lines 35 and 37, determined by the circuit breakers. It will be understood, however, that if desired the present switch gear could be used in connection with circuits such as 35 or 37 without circuit breakers therein, and be made to respond to any predetermined reduction in voltage desired, short of complete deenergization. Relay switches 61 and 63 would be designed accordingly.

It will be understood that while a single-phase, single-line protection system is shown, the invention may be readily incorporated into a three-phase system. This would be accomplished by mounting two more switch units 1 upon the pole 3 in superimposed relation, the shaft 31 extending to operate all three units in unison.

An additional feature of the invention is that it permits the control engineer to switch back to the initial input feeder if the fault therein is temporary. This is accomplished by opening the control station circuit breakers for input feeder 37, thereby causing the automatic switching mechanism to operate and reconnect the output feeder 41 to the input feeder 35. Thus, the switching mechanism is remotely operative to connect the output feeder selectively to either of the input feeders.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. Automatic line transfer switching mechanism for an electrical power distribution system having a pair of input feeder circuits and an output feeder circuit, said mechanism comprising a power-operated transfer switch, electrical means for mechanically operating said transfer switch, a power source for the switch-operating means, and electric control means connected in the output feeder circuit operative to connect said switch-operating means with its power source in response to an abnormal decrease in the energization of the output feeder circuit and to disconnect said switch-operating means from its power source when the energization of the output feeder circuit is normal.

2. Automatic line transfer switching mechanism for an electrical power distribution system having a pair of input feeder circuits and an output feeder circuit, said mechanism comprising an air-break transfer switch having a rotary blade connected to the output feeder circuit and switch contact clips connected to the input feeder circuits, a motor for moving said switch blade, and a control circuit connected in the output feeder circuit operative to energize said motor in response to a deenergization of the output feeder circuit and to deenergize said motor when the output feeder circuit is energized.

3. Automatic line transfer switching mechanism for an electrical power distribution system

having a pair of input feeder circuits and an output feeder circuit, said mechanism comprising an air-break transfer switch having a pair of rotary switch blades connected to the output feeder circuit and switch contact clips connected to the input feeder circuits, a linkage for driving said switch blades in unison to connect the output feeder circuit selectively to either of the input feeder circuits, a motor for operating said switch-operating linkage, and a control circuit connected in the output feeder circuit operative to energize said motor in response to a deenergization of the output feeder circuit and deenergize said motor when the output feeder circuit is energized.

4. Automatic line transfer switching mechanism for an electrical power distribution system having a pair of input feeder circuits and an output feeder circuit, said mechanism comprising an air-break transfer switch having a pair of rotary switch blades, a linkage for moving said switch blades in unison to connect the output feeder circuit selectively to one of the two input feeder circuits, a motor for driving said switch-operating linkage, a normally-closed relay switch energized from the output feeder circuit adapted to complete a power circuit for said motor upon deenergization of the output feeder circuit and otherwise open the motor circuit when the output feeder circuit is energized.

5. Automatic line transfer switching mechanism for an electrical power distribution system having duplicate main lines and a branch line, said mechanism comprising an air-break transfer switch having a pair of rotary switch blades for selectively connecting the branch line to the main lines, switch-operating mechanism for rotating the blades in unison from a position wherein the branch line is connected to one of the main lines to a position wherein the branch line is connected to the other main line, a motor for driving the switch-operating mechanism, a storage battery for said motor, a normally-closed relay switch in the battery-motor circuit, and connections from the branch line to the relay switch for opening the relay switch when the branch line is energized.

6. Automatic line transfer switching mechanism as set forth in claim 5 further including a rectifier supplied from the branch line feeding direct current to said storage battery, a normally-open relay switch in the rectifier-battery circuit and connections from the branch line for closing said normally-open relay switch when the branch line is energized.

7. Automatic line transfer switching mechanism for an electrical power distribution system having alternate main lines and a branch circuit including a step-down transformer, said mechanism comprising a transfer switch having a pair of rotary switch blades for selectively connecting the branch circuit to the main lines, switch-operating mechanism for rotating the blades in unison from a position wherein the branch circuit is connected to one of the main lines to a position wherein the branch circuit is connected to the other main line, a motor for driving the switch-operating mechanism, a storage battery for said motor, a normally-closed relay switch in the battery-motor circuit, and connections from the secondary side of the branch circuit to the relay switch for opening the relay switch when the branch circuit is energized.

8. Automatic line transfer switching mechanism for an electrical power distribution system

having a pair of input feeder circuits and an output feeder circuit, said mechanism comprising a power-operated air-break transfer switch, electrical means for mechanically operating said transfer switch to connect the output feeder circuit selectively to one of the two input feeder circuits and a normally-closed relay switch energized from the output feeder circuit adapted to complete a power circuit for said electrical switch-operating means upon deenergization of the output feeder circuit and open the power circuit for said electrical switch-operating means when the output feeder circuit is energized.

9. Automatic line transfer switching mechanism for an electrical distribution system having a pair of main lines and a branch circuit, said mechanism including a transfer switch for selectively connecting the branch circuit to either of the main lines, a motor for driving said switch, a motor circuit, a normally-closed relay switch in the motor circuit, connections from the branch circuit for opening the relay switch when the branch circuit is energized, and a reversing switch for reversing the motor connections after the transfer switch has completed a cycle of operation in switching the branch circuit from one main line to the other main line and preparatory to beginning another cycle of operation.

10. Automatic line transfer switching mechanism for an electrical power distribution system having duplicate main lines and a branch line leading to a transformer, said mechanism comprising an air-break transfer switch having a pair of rotary switch blades for selectively connecting the branch line to the main lines, switch-operating mechanism for rotating the blades in unison from a position wherein the branch line is connected to one of the main lines to a position wherein the branch line is connected to the other main line, a motor for driving the switch-operating mechanism, a storage battery for said motor, a normally-closed relay switch in the battery-motor circuit, connections from the secondary side of the branch line to the relay switch for opening the relay switch when the branch line is energized, and a reversing switch for said motor responsive to operation of said transfer switch adapted to reverse connections for the motor after the transfer switch has been driven by said motor from one position to the other.

11. Automatic transfer switching mechanism for an electric load fed alternatively from two sources of supply, said mechanism comprising a two-position switch having a moving contact member, electric switch-operating means adapted when energized to actuate the moving contact member from one position wherein the load is connected to one source of supply to the other position wherein the load is connected to the other source of supply, a control circuit for energizing said switch-operating means in response to failure of the load-connected source of supply, and means for reversing the direction of actuation of the switch-operating means after one actuation and preparatory to another actuation.

12. In an electrical distribution system having a pair of circuit-breaker protected main power lines and a branch line adapted to be fed alternatively from the main lines, switching mechanism comprising a double-throw air-break switch having a moving contact member, electric switch-operating means adapted when energized to actuate the moving contact member from one position wherein the branch line is connected to one main line to the other position wherein the

branch line is connected to the other main line, a control circuit for energizing said switch-operating means when the main line supplying the branch line is cut out by its circuit breaker, and means for reversing the direction of actuation of the switch-operating means after one actuation and preparatory to another actuation.

13. Automatic line transfer switching mechanism for an electrical power distribution system having a pair of input feeders and an output feeder, said mechanism comprising a transfer switch operable by reverse movements to connect one or the other of said input feeders to the output feeder, means for electromechanically operating said transfer switch, a power source independent of the output feeder for energizing the switch-operating means, and an electric control having means operative between a first position wherein said switch-operating means is connected to said power source and a second position wherein said switch-operating means is disconnected from said power source, said control being in said first position when the output feeder is deenergized and having electric means energized from said output feeder when the feeder is energized adapted to maintain the control in said second position, and means actuated upon completion of an operation of the switch-operating means to place said switch-operating means in condition for reverse movement.

14. Automatic line transfer switching mechanism for an electrical power distribution system having a pair of input feeder circuits and an output feeder circuit, said mechanism comprising a

power-operated transfer switch, electrically controlled means for mechanically operating said transfer switch, a power source for the switch-operating means, said power source being independent of the output feeder, and a control circuit including a relay connected in the output feeder circuit operative to energize said switch-operating means in response to an abnormal decrease in the energization of the output feeder circuit and to deenergize said switch-operating means when the energization of the output feeder circuit is normal, said switch control circuit including a normally-closed relay the field coil of which is energized by means of the output feeder circuit, and a second circuit connecting said power source to the switch-operating means, said relay switch being connected to interrupt said second circuit.

15. Automatic line transfer switching mechanism as set forth in claim 14 further including a reversing switch adapted to effect reversal of the connections of the switch-operating means upon the completion of an operation thereof.

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