March 18, 1941. F. KESSELRING 2,235,074

CIRCUIT INTERRUPTER

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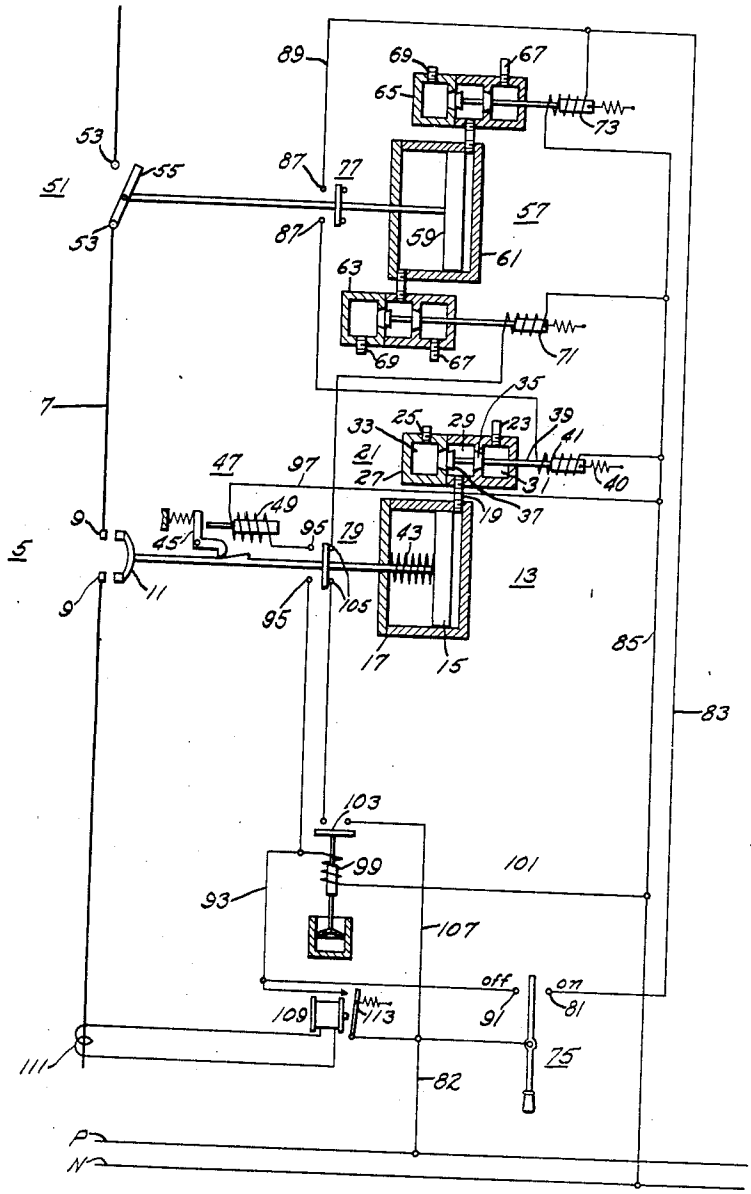


Fig. 1.

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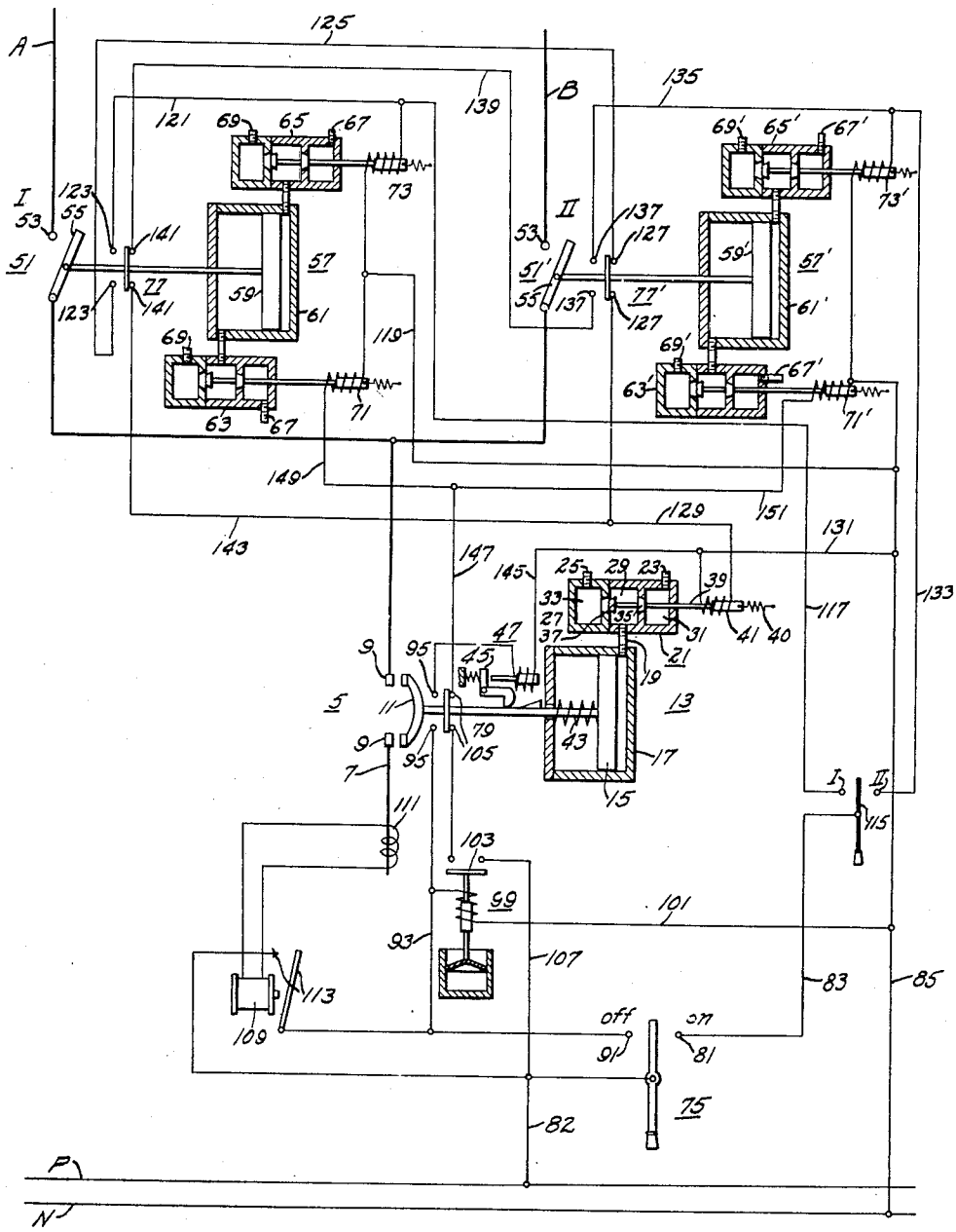


Fig. 2.

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CIRCUIT INTERRUPTER

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18 Claims. (Cl. 171—97)

The invention relates generally to electrical switching apparatus, and more particularly to a control arrangement for operating a circuit breaker and one or more associated disconnecting switches.

Circuit breakers have been developed which have relatively large interrupting capacity, and which are simple and inexpensive to manufacture and service. These breakers, however, especially those which contain only a small quantity of oil or which do not contain any oil at all, do not in themselves have a sufficiently large leakage-proof path and gap in the open position to render them entirely safe for use in controlling large amounts of power at high voltages.

The use of such breakers for high voltage application has been made possible by providing the breaker with auxiliary contacts in series with the breaker contacts and a mechanism for causing the auxiliary contacts to open a sufficient distance after opening of the breaker contacts to provide a safe air gap. The provision of such auxiliary contacts and mechanism, however, complicates the structure and considerably increases the size and cost of the apparatus.

An object of the invention is the provision of a novel switching arrangement which permits the use of a simple inexpensive circuit breaker of the type previously described for controlling large amounts of power at high voltages and which eliminates the necessity of any special construction or auxiliary contacts in the breaker itself for providing the safe air gap.

Another object of the invention is the provision of a novel switching arrangement for controlling high voltage circuits which utilizes the existing disconnecting switch in series with the breaker for providing a safe air gap when the circuit is opened.

In accordance with the invention, an operating or control system is provided which electrically interlocks the circuit breaker with its neighboring disconnecting switch in such a manner that an electrical impulse is transmitted or a circuit is completed after opening of the breaker which effects the automatic opening of the disconnecting switch. In this manner the existing disconnecting switch, which is required any way for sectionalizing and disconnecting purposes, is utilized to provide the safe air gap. Thus the necessity of providing the breaker with any special construction or auxiliary contacts to give a special air gap is eliminated, and a simple and inexpensive breaker can be used to control high voltage circuits.

In electrical systems embodying double connecting bus bars and in which the circuit breaker may be connected selectively to either of the bus bars by a pair of disconnecting switches, the control system of the present invention is preferably so constructed that the opening of the breaker causes the transmission of an electrical impulse which is effective to cause automatic opening of whichever disconnecting switch was in closed position.

The invention is not limited to any particular type of circuit breaker but is applicable to all types of breakers whether they embody a construction providing a safe air gap or not.

Another object of the invention is the provision of an electrical control system for a circuit breaker and a separate disconnecting switch in series therewith, which is operable to cause a predetermined sequence of operation of the breaker and switch.

Another object of the invention is the provision of an electrical control arrangement for causing opening or closing of a circuit breaker and a separate disconnecting switch in series therewith, in which the mechanisms of the breaker and switch are electrically interlocked in such a manner that the switch is always closed before the breaker is closed and opened after the breaker has been opened.

Another object of the invention is the provision of an electrical control arrangement for controlling opening or closing of a circuit breaker and any one or more of a plurality of associated disconnecting switches arranged for connection in series with the breaker, characterized by the fact that the opening of the breaker causes the transmission of an electrical impulse to effect automatic opening of whichever switch is in closed position.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of several embodiments thereof when read in conjunction with the accompanying drawings, in which—

Figure 1 is a schematic diagram illustrating the control arrangement of the present invention for controlling the operation of a circuit breaker and its neighboring disconnecting switch; and

Fig. 2 is a schematic diagram showing a modified control arrangement for controlling the oper-

ation of a circuit breaker and either of two associated disconnecting switches.

Referring to Fig. 1 of the drawings, the reference character 5 designates generally a circuit breaker for opening and closing a high voltage main circuit represented by a conductor 7. The circuit breaker has a pair of stationary contacts 9 connected in the circuit 7, and a movable bridging contact 11 which is movable to open or closed circuit position by an operating mechanism 13.

The breaker operating mechanism 13 comprises an air pressure operated piston 15 mechanically connected to the movable contact 11, and a cylinder 17 in which the piston is movable. The right-hand end of the cylinder 17 is connected by a tube 19 to an electromagnetically controlled valve 21 which is operable when opened to cause closing of the breaker by admitting air under pressure to this end of the cylinder from an air pressure supply tube 23 which is connected to a source of compressed air (not shown). When the valve 21 is closed, it shuts off the supply of compressed air and connects the end of the cylinder 17 to the outside air through an exhaust port 25.

The valve 21 comprises a housing 27 having an intermediate chamber 29 connected to the cylinder 17 through the tube 19, an inlet chamber 31 which is connected to the air pressure supply tube 23, and an exhaust chamber 33 which communicates with the outside air through the exhaust port 25. The inlet and exhaust chamber communicate with the intermediate chamber through valve openings which are opened and closed by inlet and exhaust valves 35 and 37 secured to a valve stem 39. The valve stem 39 is biased to closed position by a spring 40 in which position it closes the inlet valve 35 and opens the exhaust valve 37. The valve member 39 is moved to open position by a solenoid 41.

The circuit breaker is biased to open position by a spring 43 disposed in the cylinder 17, and is releasably held in closed circuit position by the spring biased latch 45 of a tripping device 47. The latch 45 is adapted to be released by the tripping solenoid 49 to cause opening of the circuit breaker 5 under the influence of its biasing spring 43.

The circuit breaker may be of any conventional type but is preferably of simple inexpensive construction which contains only a small quantity of oil or a liquid such as water. This type of breaker, while having a relatively large interrupting capacity, does not in itself provide a sufficiently safe dielectric gap in the open position for safely withstanding high voltage surges above the normal voltage of the line.

In accordance with the present invention, use is made of the existing neighboring disconnecting switch 51 for providing the safe air gap when the breaker 5 is open. The disconnecting switch is a required element of any power switching system for disconnecting or sectionalizing purposes. According to the invention, the disconnecting switch is arranged to be automatically opened after each opening operation of the breaker 5 and automatically closed before the breaker is closed in a manner which will hereinafter be described. By utilizing the existing disconnecting switch in this manner, the necessity of providing the breaker with any special construction or auxiliary contacts to give a safe air gap is eliminated.

The disconnecting switch 51 is connected in series with the breaker 5 in the circuit 7 and has a pair of stationary terminals 53 and a movable switching member or blade 55 which is movable to open and to closed circuit position by a fluid pressure operating means 57. The operating means 57 for the switch comprises an air pressure actuated piston 59 mechanically connected to the switch member 55, and a cylinder 61 in which the piston is movable in either direction by air pressure.

The opposite ends of the cylinder 61 are adapted to be selectively connected to a source of compressed air (not shown) through the agency of a pair of electromagnetically controlled valves 63 and 65 connected to the air pressure supply tubes 67, for causing opening or closing of the switch. The valves 63 and 65 are similar in construction and operation to the valve 21 of the breaker mechanism, and each is operable when closed to shut off the supply of air under pressure to the cylinder 61 and to connect the corresponding end of the cylinder 61 to the outside air through an exhaust port 69. The switch closing valve 65 is operable when opened to cause closing of the switch 57 by admitting air under pressure to the right-hand end of the cylinder 61 to drive the piston 59 and switch blade 55 to closed position. The switch opening valve 63 is operable when opened to cause opening of the switch 51 by admitting air under pressure to the left-hand end of the cylinder 61 to drive the piston 59 and switch member 55 to open circuit position. The valves 63 and 65 are biased to closed position, and are adapted to be moved to open position by their solenoids 71 and 73.

An electrical control system is provided for controlling the operation of the breaker 5 and disconnecting switch 51. The system is operable to cause opening of the breaker 5, followed by automatic opening of the disconnecting switch 51 after the breaker 5 reaches open position, and is also operable to cause closing of the disconnecting switch 51 followed by automatic closing of the breaker 5 after the switch 51 is closed. The system comprises in general a double-throw manual control switch 75 operable to cause opening or closing of the breaker 5 and switch 51, various circuits for energizing the valve controlling solenoids, and auxiliary switches 77 and 79 on the disconnecting switch 51 and breaker 5 for electrically interlocking the mechanisms of the breaker 5 and switch 51 to cause opening of the breaker before the disconnecting switch is opened, and closing of the disconnecting switch before the breaker is closed. Current for operating the system is obtained from the supply lines represented by P and N.

The control switch 75 is movable from a neutral position as shown to an "on" position in engagement with a contact 81 to complete a circuit for causing closing of the disconnecting switch 51. This circuit extends from the line P, through a conductor 82, the switch 75 and its contact 81, conductor 83, switch closing valve solenoid 73, through a common return conductor 85 to the line N. Energization of the solenoid 73 causes opening of the valve 65 and thus effects closing of the disconnecting switch 51. As soon as the disconnecting switch 51 is closed, a circuit is completed through the contacts 87 of the auxiliary switch 77 and the control switch 75 for causing opening of the vlave 21 to effect closing of the breaker 5. This circuit extends from the line P through conductor 82, control switch 75 and its contact 81, conductors 83 and 89, contacts 87 of auxiliary switch 77 which are closed when the

disconnecting switch is closed, through the solenoid 41 and common return conductor 85 to the line N. Energization of the solenoid 41 opens the valve 21 causing the air pressure to drive the piston 15 and breaker to closed position. After the circuit 7 is closed, the control switch is returned to its neutral position.

To open the circuit 7, the control switch 75 is moved to the "off" position in engagement with its contact 91 to complete a circuit for causing opening of the breaker 5. This circuit extends from the line P through conductor 82, control switch 75 and its contact 91, a conductor 93, contacts 95 of the auxiliary switch 79 through the tripping solenoid 49 and conductors 97 and 85 to the line N. The energization of the tripping solenoid 49 releases the latch 45, and the spring 43 moves the breaker to open position. When the control switch is in the "off" position, a circuit is also completed from the line P through the conductor 82, control switch 75 and its contact 91, conductor 93 through the coil of a relay 99 and conductors 101 and 85 to the line N. Energization of the relay 99 causes it to close its contacts 103. As soon as the breaker reaches open position, the auxiliary switch 79 thereof closes its contacts 105 to complete a circuit for causing opening of the disconnecting switch 51. This circuit extends from the line P through a conductor 107, contacts 103 of the relay 99 and contacts 105 of the auxiliary switch 79, solenoid 71, and conductor 85 to the line N. Energizing of the solenoid 71 through the circuit causes opening of the valve 63 to effect opening of the disconnecting switch 51. The relay 99 is of the slow release type and maintains its contacts 103 closed for a sufficient length of time to permit opening of the breaker 5 and switch 51. After the breaker 5 and switch 51 are opened the control switch 75 is returned to its neutral position.

An overload protective relay 109 is provided which is operable in response to predetermined overload conditions in the circuit 7 to effect automatic opening of the breaker 5 followed by automatic opening of the disconnecting switch 51. The relay 109 is energized from the circuit 7 through a current transformer 111. The contacts 113 of the relay are connected to the conductors 82 and 93 so that when closed they shunt the control switch 75 and its contact 91. Thus when the relay 109 closes its contacts 113 upon the occurrence of an overload in the circuit 7, it causes opening of the breaker 5, and automatic opening of the disconnect switches 51, after the breaker is opened, by means of the same circuits previously traced for the "off" position of the control switch 75, except that the circuits extend through the contacts 113 of the relay instead of through the control switch 75 and its contact 91.

The invention is illustrated in Fig. 2 as applied to a circuit breaker and a pair of disconnecting switches for selectively connecting the breaker to either one of a pair of power buses A or B. The disconnecting switch I, when closed, connects the breaker 5 and circuit 7 to the power bus A, and the disconnecting switch II, when closed, connects the circuit breaker 5 and a circuit 7 to the other power bus B. The breaker 5 and disconnecting switches I and II and the operating mechanisms therefor are identical in structure and operation to the breaker and disconnecting switch described in connection with Fig. 1, and hence the same reference characters have been used to designate the corresponding parts, primed reference numerals being used to designate the corresponding parts of the disconnecting switch II.

The system for controlling the operation of the breaker 5 and disconnecting switches is also substantially similar to that described in connection with Fig. 1 except that a selector switch 115 is added for selecting which of the disconnecting switches is to be operated in conjunction with the breaker. Also, the operating mechanisms of the two disconnecting switches are electrically interlocked so as to prevent closing of the breaker should both switches happen to be closed, as well as to cause opening of the breaker before opening of either disconnecting switch and closing of the selected disconnecting switch before the breaker is closed. The same reference characters have been used to designate the corresponding parts of the control system wherever applicable.

When the selector switch 115 is moved into engagement with its contact I and the control switch 75 is moved to the "on" position in engagement with its contact 81, a circuit is completed for causing closing of the disconnecting switch I. This circuit extends from the line P through conductor 82, control switch 75, conductor 83, selector switch 115, conductor 117, solenoid 73 and conductors 119 and 85 to the line N. Energization of the solenoid 73 causes opening of the valve 65 to effect closing of the disconnecting switch I.

As soon as the disconnecting switch I is closed, the circuit is completed for causing closing of the circuit breaker 5. This circuit extends from the line P through the conductor 82, control switch 75, selector switch 115, conductors 117 and 121, contacts 123 of the auxiliary switch 77, conductor 125, contacts 127 of the auxiliary switch 77', conductor 129, solenoid 41, and conductors 131 and 85 to the line N. Energization of the solenoid 41 through this circuit causes opening of the valve 21 to effect closing of the circuit breaker 5. After the disconnecting switch and circuit breaker have been closed, the control switch 75 is returned to its neutral position.

If, on the other hand, it is desired to close the circuit breaker 5 and the disconnecting switch II to connect the circuit breaker to the power bus B, the selector switch 115 is moved into engagement with its contact II and the control switch 75 is moved to the "on" position in engagement with the contact 81 to complete a circuit for closing the disconnecting switch II. This circuit extends from the line P through conductors 82, control switch 75, and selector switch 115, conductor 133, solenoid 73' of the switch II and through the common return conductor 85 to the line N. Energization of the solenoid 73' causes opening of the valve 65' to effect closing of the disconnecting switch II.

As soon as the disconnecting switch II is closed, a circuit is automatically completed for causing closing of the circuit breaker 5. This circuit extends from the line P through the conductor 82, control switch 75, conductor 83, selector switch 115, conductors 133 and 135, contacts 137 of the auxiliary switch 77', conductor 139, contacts 141 of the auxiliary switch 77, conductors 143 and 129, solenoid 41 and conductors 131 and 85 to the line N. Energization of the solenoid 41 causes opening of the valve 21 to effect closing of the circuit breaker 5.

Assuming that the disconnecting switch I and breaker 5 are closed, to open the circuit the control switch 75 is moved to the "off" position in

engagement with its contacts 91 to complete a circuit for causing opening of the circuit breaker 5. This circuit extends from the line P through conductor 82, control switch 75, conductor 93, contacts 95 of the auxiliary switch 79, tripping solenoid 49, and conductors 145, 131 and 85 to the line N. Energization of the tripping solenoid 49 releases the latch 45 and allows the spring 43 to move the circuit breaker to open position.

When the control switch 75 is in its "off" position, it also completes a circuit extending from the line P through conductor 82, control switch 75, conductor 93, the coil of relay 99, and conductors 101 and 85 to the line N, causing the relay 99 to close its contacts 103.

As soon as the circuit breaker 5 reaches open position, a circuit is completed for causing opening of whichever disconnecting switch is in closed position, in this instance the disconnecting switch I. This circuit extends from the line P through conductors 82 and 107, contacts 103 of relay 99, contacts 105 of the auxiliary switch 79, conductors 147 and 149, solenoid 71 and conductors 119 and 85 to the line N. Energization of the solenoid 71 by this circuit causes opening of the valve 63 to effect opening of the disconnecting switch I.

If the disconnecting switch II happens to be the one in closed position when the breaker 5 is thus opened, the disconnecting switch II will be automatically opened by energization of the circuit extending from the line P through the conductors 82 and 107, contacts 103 of the relay 99, contacts 105 of the auxiliary switch 79, conductors 147 and 151, solenoid 71' and conductor 85 to the line N. This energization of the solenoid 71' causes opening of the valve 63' to effect opening of the circuit breaker II. After the breaker and disconnecting switch have been opened, the control switch 75 is returned to its neutral position.

If an overload of predetermined magnitude occurs in the circuit 7, the protective relay 109 closes its contacts 113 to cause opening of the breaker followed by automatic opening of whichever disconnecting switch is in closed position, after the circuit breaker reaches full open position. This results from the fact that closing of contacts 113 of the protective relay 109 causes energization of the circuits for opening the breaker 5 and either of the disconnecting switches in the same manner as when the control switch 75 is moved to the "off" position.

It will thus be seen that the control system is operable to cause opening of the circuit breaker followed by automatic opening of whichever disconnecting switch is closed when the breaker reaches open position. It will be noted that the breaker 5 cannot be closed if both of the disconnecting switches I and II should be closed. This results from the fact that the energizing circuit for the solenoid 41 of the valve 21 will be opened either at the contacts 141 of the auxiliary switch 77 or at the contacts 127 of the auxiliary switch 77'.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details thereof may be made without departing from the spirit of the invention. For example, the control system of the present invention is equally applicable to switches and circuit breakers having other types of operating mechanisms than the fluid pressure type disclosed. It is, therefore, desired that the appended claims be given the broadest reasonable construction permissible in view of the prior art.

I claim as my invention:

1. In a switching system, a circuit breaker, operating mechanism therefor, a separate disconnecting switch in series with said breaker, operating mechanism for said switch, electrical control means operable to cause opening of said breaker and automatic opening of said switch after said breaker is opened, and operable to cause closing of said switch and automatic closing of said breaker after said switch is closed.

2. In combination, a circuit breaker, operating mechanism therefor, a separate disconnecting switch in series with said breaker having an air gap in its open position capable of withstanding considerably higher voltages than said breaker can withstand in its open position, operating mechanism for said switch, an electrical control system operable to cause opening or closing of both said breaker and switch including means electrically interlocking said switch mechanism with said breaker for causing automatic opening of said switch after said breaker has been opened.

3. In combination, a circuit breaker, operating mechanism therefor, a separate disconnecting switch connected in series with said breaker, operating mechanism for said switch, and control means operable to cause said mechanisms to open or close both said breaker and switch including means electrically interlocking said mechanisms to cause opening of said switch after said breaker is opened and closing of said switch before said breaker is closed.

4. In combination, a circuit breaker, operating mechanism therefor, a separate disconnecting switch connected in series with said breaker having an air gap in its open position capable of withstanding considerably higher voltages than said breaker is capable of withstanding in its open position, operating mechanism for said switch, and electrical control means operable to cause said breaker mechanism to open said breaker and said switch mechanism to automatically open said switch after said breaker has reached open position, and also operable to cause said mechanisms to close both said switch and breaker in a predetermined sequence.

5. In combination, a circuit breaker, electrically controlled operating mechanism therefor, a separate disconnecting switch in series with said breaker, electrically controlled operating mechanism for said switch, and an electrical control system operable to cause opening or closing of both said breaker and switch, said control system including auxiliary contacts on said breaker closed when breaker is open for causing energization of said switch mechanism to automatically open said switch, and auxiliary contacts on said switch closed when said switch is closed for causing energization of said breaker mechanism to close said breaker.

6. In combination, a circuit breaker, electrically controlled operating mechanism therefor, a separate disconnecting switch in series with said breaker, electrically controlled operating mechanism for said switch, and an electrical control system for said breaker and switch comprising a common control switch means operable to cause opening or closing of both said breaker and switch and means electrically interlocking the mechanisms of said breaker and switch to cause closing of said disconnecting switch before said breaker is closed, and opening of said breaker before said switch is opened.

7. In combination, a circuit breaker, electrical-

ly controlled operating mechanism therefor, a separate disconnecting switch connected in series with said breaker, electrically controlled mechanism for said switch, and an electrical control system for controlling the operation of said breaker and switch comprising a common control switch means operable to cause opening or closing of both said breaker and switch, electro-responsive means for causing opening of said breaker and switch in response to predetermined abnormal conditions, and means electrically interlocking the mechanisms of said breaker and switch to cause opening of said breaker before said switch is opened, and closing of said switch before said breaker is closed.

8. In combination, a circuit breaker having electro-responsive trip means operable to cause opening of said breaker, a separate disconnecting switch connected in series with said breaker having an air gap in its open position capable of withstanding considerably higher voltages than said breaker can withstand in its open position, electrically controlled operating mechanism for said switch, means operable to cause said electro-responsive trip means to effect opening of said breaker, and means comprising auxiliary contacts on said breaker closed when said breaker is open for causing automatic opening of said disconnecting switch after said breaker is opened.

9. In combination, a circuit breaker, operating mechanism therefor, a separate disconnecting switch in series with said breaker having an air gap in its open position capable of withstanding considerably higher voltages than said breaker can withstand in its open position, operating mechanism for said switch, control means operable to cause opening of said breaker, and means operable when said breaker reaches open position for automatically causing operation of said switch mechanism to open said switch.

10. In combination, a circuit breaker, operating mechanism therefor, a separate disconnecting switch in series with said breaker, operating mechanism for said switch, control means operable to cause opening of said breaker, and means operable when said breaker reaches open position for automatically causing operation of said switch mechanism to open said switch, said control means also being operable to cause said switch mechanism to close said switch, and means operable when said switch is closed for automatically causing said breaker mechanism to close said breaker.

11. Switching apparatus for controlling high voltage circuits comprising a circuit breaker having a dielectric gap in the open position which is incapable of safely withstanding high voltages, operating mechanism for said breaker, a separate disconnecting switch connected in series with said breaker having a gap in the open position capable of withstanding high voltages, operating mechanism for said switch, control means for opening or closing said breaker and switch comprising means operable to cause said breaker mechanism to open said breaker, and means operable when said breaker reaches open position for automatically causing said switch mechanism to open said switch.

12. Switching apparatus for controlling high voltage circuits comprising a circuit breaker having a dielectric gap in the open position which is incapable of safely withstanding high voltages, operating mechanism for said breaker, a separate disconnecting switch connected in series with said breaker having a gap in the open position capable of withstanding high voltages, operating mechanism for said switch, a control system operable to cause opening or closing of both said breaker and switch including means electrically interlocking the mechanisms of said breaker and switch to cause opening of said breaker before said switch is opened, and closing of said switch before said breaker is closed.

13. In a switching system, a circuit breaker, electrically controlled mechanism for opening or closing said breaker, a separate disconnecting switch connected in series with said breaker, electrically controlled mechanism for opening or closing said switch, an electrical control system for controlling opening and closing of said breaker and switch comprising a control switch movable to one position to complete a circuit for causing closing of said disconnecting switch and to prepare a circuit for causing closing of said breaker, and movable to another position to complete a circuit for causing opening of said breaker and to prepare a circuit for causing opening of said disconnecting switch, auxiliary contacts on said disconnecting switch closed when said disconnecting switch is closed for completing the circuit for causing closing of said breaker, and auxiliary contacts on said breaker closed when said breaker is open for completing the circuit for causing opening of said disconnecting switch.

14. In combination, a circuit breaker, fluid pressure operating means for said breaker, a separate disconnecting switch connected in series with said breaker having an air gap in its open position capable of withstanding considerably higher voltages than said breaker can withstand in its open position, fluid pressure operating means for said switch, control means operable to cause automatic opening or closing of both said breaker and switch including means interlocking the operating means of said breaker and switch to cause opening of said breaker before said switch is opened, and to cause closing of said switch before said breaker is closed.

15. In combination, a circuit breaker, fluid pressure operating means for said breaker, a separate disconnecting switch connected in series with said breaker, fluid pressure operating means for said switch, a control system operable to cause opening or closing of both said breaker and switch including means electrically interlocking the operating means of said breaker and switch to cause opening of said breaker before said switch is opened, and closing of said switch before said breaker is closed.

16. In an electrical distribution system, a plurality of buses, a circuit breaker, operating mechanism therefor, connections and a plurality of separate disconnecting switches for selectively connecting said breaker to any one of said buses, an individual operating mechanism for each of said switches, a control system for opening or closing said breaker and switches comprising means operable to cause said breaker mechanism to open said breaker and means operable when said breaker reaches open position for automatically causing the mechanism of whichever switch is in closed position to open said switch.

17. In an electrical distribution system, a plurality of buses, a circuit breaker, operating mechanism therefor, connections and a plurality of separate disconnecting switches for selectively connecting said breaker to any one of said buses, an individual operating mechanism for each of said switches, a control system operable to cause opening or closing of said breaker and any one of

said switches including means for selecting which of said switches is to be opened or closed in conjunction with said breaker, and means electrically interlocking the mechanisms of said breaker and switches to cause opening of said breaker before the selected switch is opened and closing of the selected switch before said breaker is closed.

18. In an electrical distribution system, a plurality of buses, a circuit breaker, operating mechanism therefor, connections and a plurality of separate disconnecting switches for selectively connecting said breaker to any one of said buses, an individual operating mechanism for each of said switches, a control system operable to cause opening or closing of said breaker and any one of said switches including means for selecting which of said switches is to be opened or closed in conjunction with said breaker, and means electrically interlocking the mechanisms of said breaker and switches to cause opening of said breaker before the selected switch is opened and closing of the selected switch before said breaker is closed, and for preventing closing of the breaker when more than one of said switches is closed.

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