Aug. 30, 1932. S. RUPPEL 1,874,808

SWITCH PLANT

Filed April 6, 1929 5 Sheets-Sheet 1

Fig. 1.

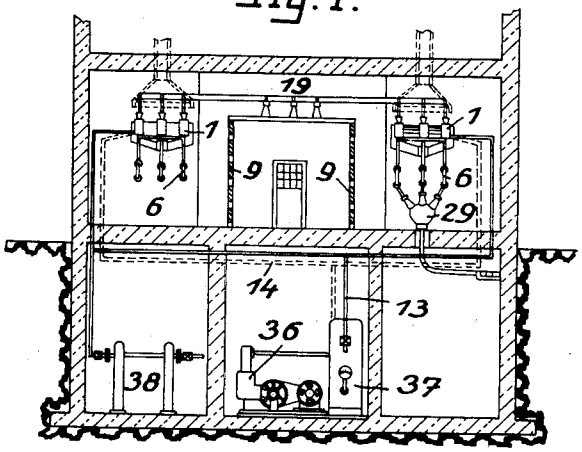
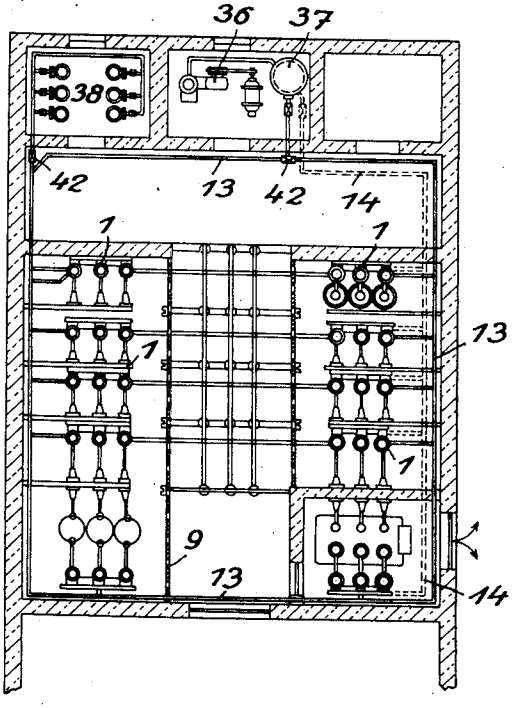


Fig. 2.



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Fig. 4.

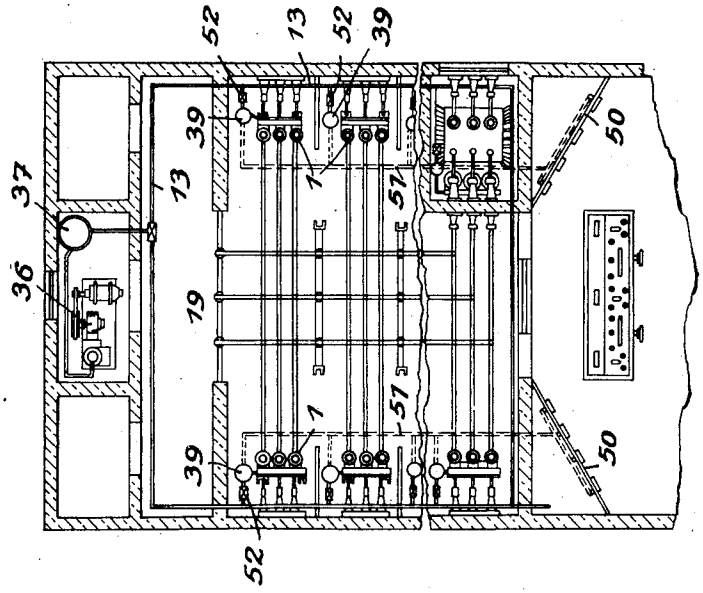


Fig. 3.

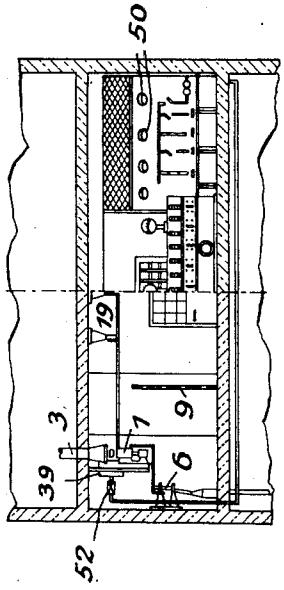
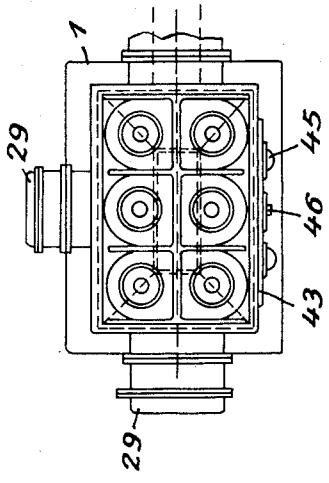


Fig. 6.



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SWITCH PLANT

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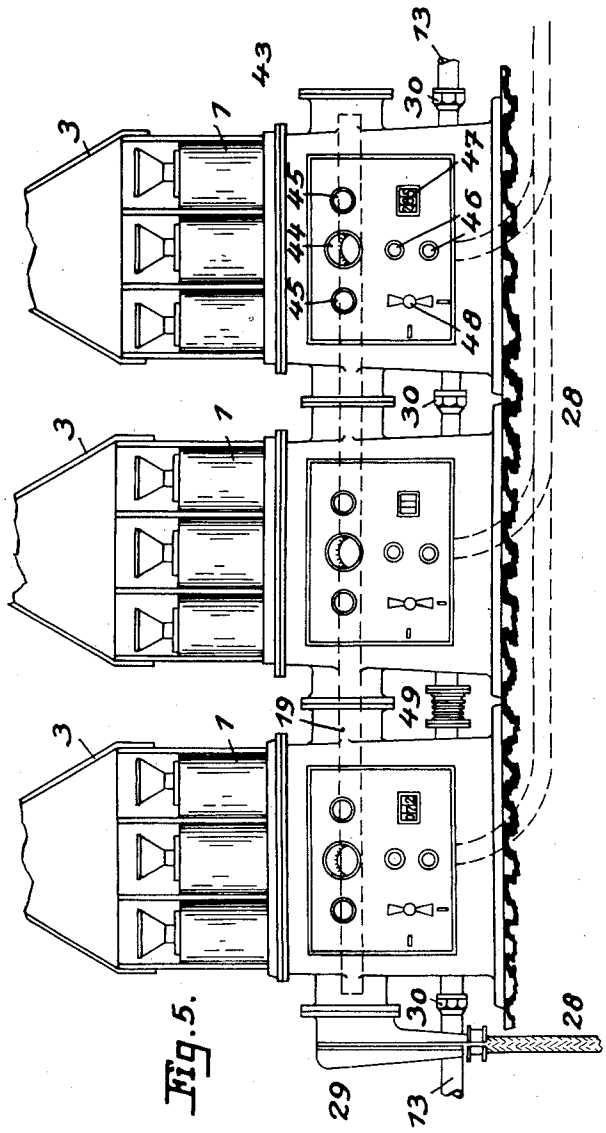


Fig. 5.

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SWITCH PLANT

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Fig. 7.

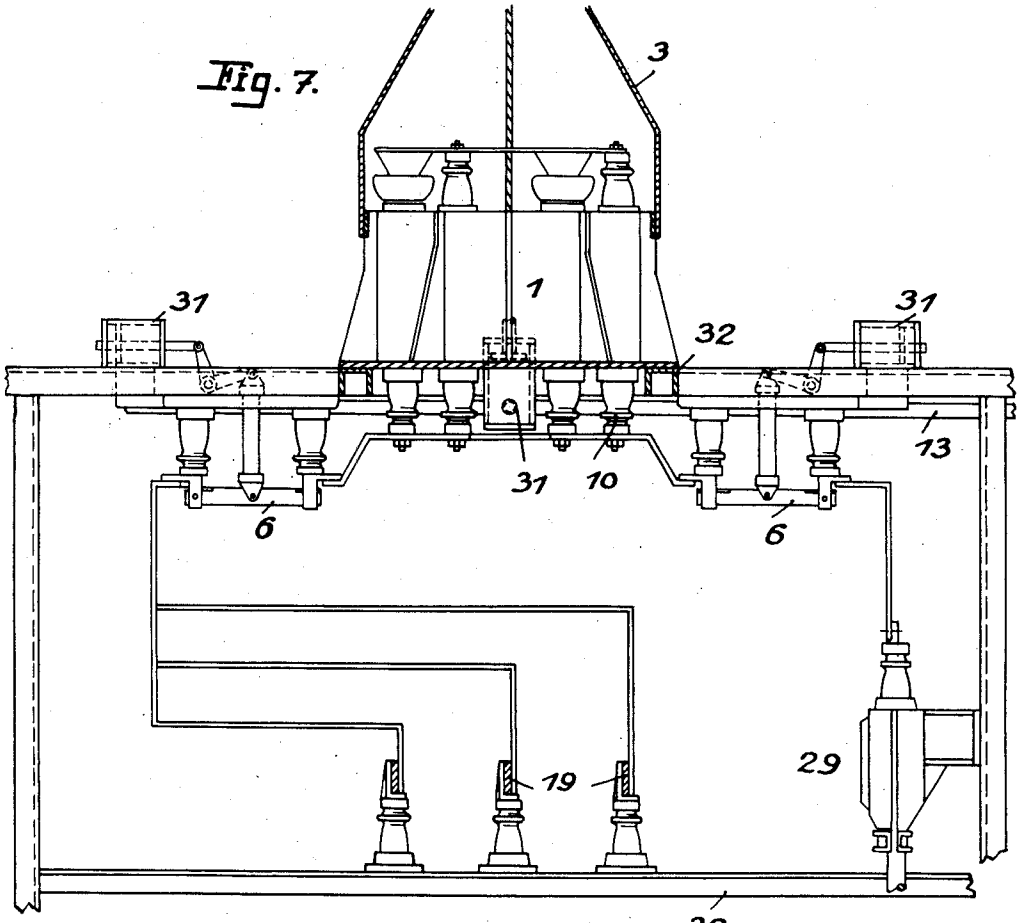
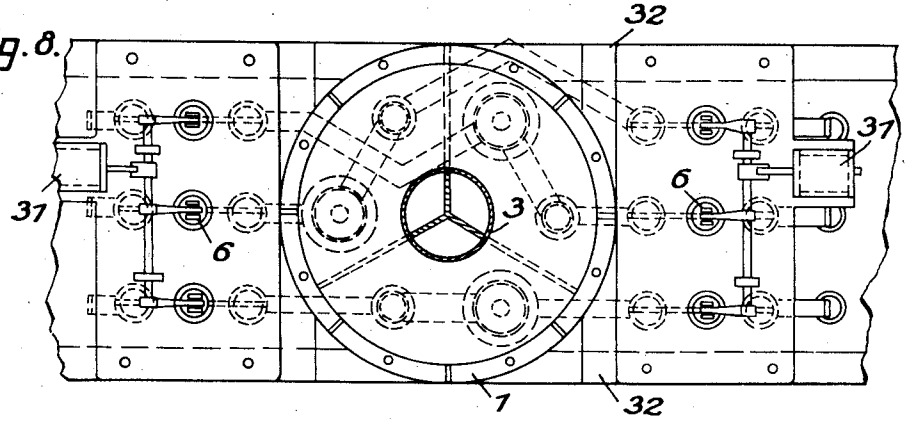


Fig. 8.



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SWITCH PLANT

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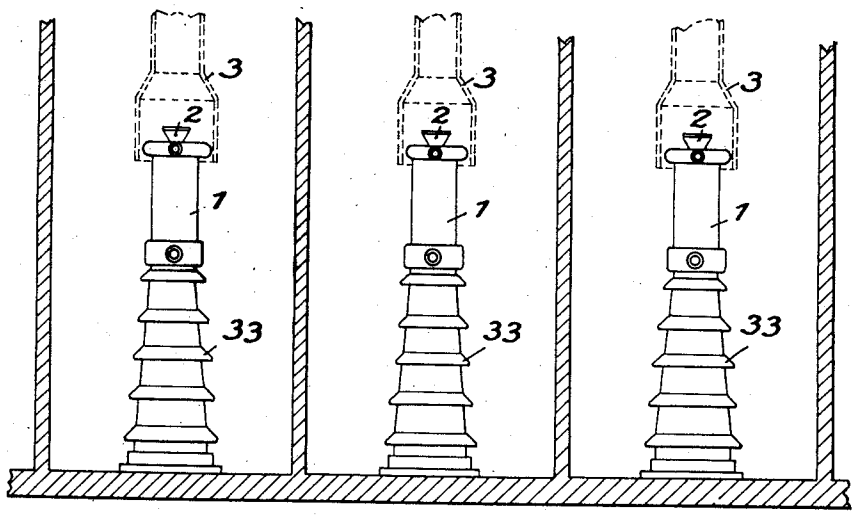


Fig. 9.

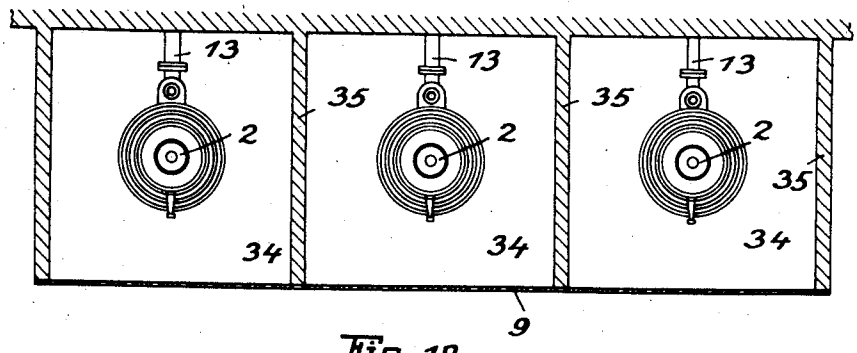


Fig. 10.

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1,874,808

UNITED STATES PATENT OFFICE

SIGWART RUPPEL, OF FRANKFORT-ON-THE-MAIN, GERMANY

SWITCH PLANT

Application filed April 6, 1929, Serial No. 353,239, and in Germany February 14, 1927.

This invention relates to electric power generating stations, substations and the like. More particularly, it relates to switch plants for such stations, and has for its object the provision of an improved form of pressure gas switch plant of simple and rugged construction and adapted for efficient and reliable operation.

In recent years, oil switches have come into quite extensive use in the construction of switch plants for electrical generating stations, substations, and similar establishments for the generation and control of electric power. Concomitant with various developments and improvements in apparatus of this general type, there have been evidences of late, however, of a tendency to employ pressure gas switches instead of oil switches, even in installations of large capacity; the contention being that pressure gas switches in relying on a stream of high pressure gas to extinguish the switch arc possess manifold advantages over oil switches.

Not the least of these advantages is the comparative simplicity of a pressure gas switch installation, such characteristic oil switch installation features as special switch pits, retaining walls, explosion proof chambers, and underground construction being unnecessary. Moreover, since pressure gas switches are relatively light in weight, as compared with oil switches, and free of the danger of explosion, they may be readily arranged directly on the switch board frame or mounted on a carrier frame in the upper part of the switch plant; it being necessary only to exercise a precaution that the switch arcs do not interfere with the other elements of the switch board.

However, in considering a pressure gas switch installation from the standpoint of its many structural advantages, some of which have been mentioned, it should be borne in mind that the utmost importance attaches to the pressure gas conduit system, for it is upon the safe and reliable supply of pressure gas that the proper operation of the switches depends. If the pressure gas conduit system is in any way deficient, subject to leaks, surges of pressure, or otherwise defective, the safety and operation of any one switch and even the safety of the switch plant may be endangered.

The value of any switching apparatus lies in its ability to act as a switch at the proper time and in the proper manner. Accordingly, if the switching ability of a pressure gas switch installation is lost at any time through the failure or improper regulation of the pressure gas supply, the operation of such installation will be affected, with the result that any number of undesirable conditions may occur as a consequence.

In order to eliminate as far as possible the various undesirable consequences mentioned as being attendant upon a failure of the conduit system of a pressure gas switch installation, I have devised the present invention, the important characteristic of which is the provision of a reliable and efficient pressure gas conduit system.

Generally speaking, my invention concerns the provision, in conjunction with properly constructed and regulated main supply conduits for the pressure gas, of additional or auxiliary means adapted to support, or be substituted for, the main conduits to effect a reliable and uninterrupted supply of pressure gas to the switches. Preferably, the conduit system is such that pressure gas is supplied to each switch from no less than two points.

In accordance with the invention, pressure gas supply to each switch from two or more points is effected either by ring or duplex conduits branching from the central source of supply. When duplex conduits are used, provision may be made by means of suitable valves or the like, controllable from the switch board, for the transfer of the switching apparatus from one conduit to the other in the event of a failure of one of the conduits. If automatic transfer is to be effected, double valves or other suitable mechanism may be employed, whereby when the pressure in one conduit decreases below a predetermined value the switching apparatus is automatically cut over to the other conduit.

To prevent condensates or moisture from

being carried through the conduits and into the switching apparatus, suitable provision may be made, in accordance with the invention, for cleaning and condensing devices at various points in the system. In addition, the conduits may be suitably insulated or equipped with temperature regulating devices to insure a substantially uniform temperature. In some instances it also may be advisable to protect the conduits against the passage of high voltage currents to earth from the various high voltage lines of the switch board. This may be accomplished, among other ways in accordance with the invention, by providing insulating sections in the conduits wherever separation between the voltage carrying lines and the pressure gas supply mains is necessary. These insulating sections also may be provided at the junction of the conduits and the switches, in which case they may be so formed as to serve as connecting fittings or terminal blocks.

In order that the invention may be better understood, reference is made to the accompanying drawings, which, together with the description relating thereto, serve to illustrate by way of example one embodiment of the invention.

In the drawings:

Figs. 1 and 2 represent, respectively, an elevation and plan view of one form of switch plant in accordance with the invention.

Figs. 3 and 4 represent, respectively, an elevation and plan view of a second form of switch plant in accordance with the invention.

Fig. 5 is a side view on an enlarged scale of a battery of three enclosed switches.

Fig. 6 is a top view on an enlarged scale of one of the switches shown in Fig. 5.

Figs. 7 and 8 represent, respectively, a side and top view of an assembly of various switch details, and

Figs. 9 and 10 represent, respectively, a side and top view of further switch details.

Considering more in detail the embodiment of the invention shown in the drawings, Figs. 1 and 2 represent diagrammatically a form of switch house wherein a pressure gas storage tank 37, supplied by a suitable compressor 36, feeds a supply conduit 13 leading to the switches, which may be conveniently located on a floor above the compressor room. The operation of the compressor may be either controlled in the customary manner by a suitable pressure regulating device dependent on the pressure in the storage tank, or, to insure the maintenance of sufficient pressure directly at the switches, may be controlled by pressure regulating devices located adjacent the switches. Inasmuch as the details of either of such control systems are well known and understood, they are not shown in the drawings.

The supply conduit 13 leading from the storage tank is formed as a ring conduit, to which a plurality of switches 1 are so connected by connecting conduits that they may be supplied with pressure gas from two directions. A second conduit 14 may also be provided, if conditions demand, carrying a different pressure, preferably higher than that in the conduit 13. If such an auxiliary conduit is provided, however, the conduit 13 need not be formed as a ring conduit. To further insure the proper supply of pressure gas to the switches, some or all of them may be provided with duplicate connecting conduits, as indicated for the upper left hand switch 1 in Fig. 2.

The separating switches for the switches 1 are shown at 6 (Fig. 1) and the bus bar connections at 19, while 29 indicates the cable end conductor of the power cable. To facilitate easy inspection of the switch plant, a guard network or grill 9 may be provided as shown, separating the banks of switches from a central inspection chamber.

Thus far only the general arrangement of the switch plant has been described. For the satisfactory maintenance of the supply of pressure gas to the switches, suitable automatic valves 42 are provided, which may be of such form as to indicate the change in pressure in the conduit system. Since it is of importance to a switch board operator to be able to tell at a glance whether there is enough pressure available at a given switch to cause its operation, it is advisable to provide adjacent the switch board position of each switch suitable means for indicating the condition of the pressure gas supply to the switch. Likewise, it may be deemed advisable to provide a numbering device or counter, whereby the amount of gas being consumed may be readily determined. In the subsequent discussion of Fig. 5 these features will be considered more in detail.

In order that the pressure gas system may be as reliable as possible, a special reserve supply should be provided to safeguard against the event of a failure of the main supply 37. Where the installation of a second compressor unit is not practicable, such reserve supply may take the form of one or more pressure gas tanks or storage vessels arranged in a suitable central location 38 and tied in with the conduit 13, or, in some instances, the reserve supply may be provided by a small vessel located directly at each switch and having a capacity sufficient to operate the switch at least once, as explained in the following paragraph. Other arrangements for providing a suitable reserve supply of pressure gas also may be found practicable and may include such means as reserve vessels connected to the main conduit at suitable intervals, specially constructed switch rooms capable of acting as storage

chambers, or main conduits of such large cross-sectional area as to serve as a source of reserve supply.

Figs. 3 and 4 illustrate a modification of the arrangement shown in Figs. 1 and 2, wherein each switch 1 is provided with a separate pressure gas reserve tank 39 connected into the main conduit system 13 by a valve 52. The valves 52 are so constituted that a sufficient supply of pressure gas is fed to the tanks from the conduit 13 to permit actuation of the switches at least once, when the pressure in the main conduit 13 falls below a predetermined value. The rate of supply to the tanks or the pressure therein may be suitably indicated on a switch board 50 through the use of conduits 51 connecting the tanks to the switch board. Moreover, since the pressure in the tanks 39 is dependent on the operation of the valves 52, which, in turn, regulate the pressure in tanks 39 in accordance with the pressure in conduit 13, the instruments on the switch board can be used to indicate the condition of the pressure gas in conduit 13. Proper control of the switches by any desired means accordingly may be effected in conformity with the switch board indications of the condition of the various pressure gas supply elements of the system.

In Fig. 5 is represented on an enlarged scale, a battery of three enclosed pressure gas switches. The switches are enclosed in separate casings suitably connected to provide for the accommodation of bus bars 19, and the electric power cables 28 are led to and from the casings through appropriate cable end fittings 29. The pressure gas supply conduit sections for the individual switches are connected in series by collars 30 and may be provided with suitable expansion or compensation joints 49. The pressure gas may be supplied to the switches from a storage tank, as shown in Figs. 1 and 2, or from reserve tanks, as shown in Figs. 3 and 4, which reserve tanks may be mounted alongside or beneath the switches. Fig. 6 shows in plan view a single switch casing of the type shown in Fig. 5, provided at its side and back with cable fittings 29.

To provide for the proper escape of pressure gas, the switches are covered by hoods 3 leading to suitable exhaust pipes or passages, not shown. In order that smooth discharge of the pressure gas may be effected, the hoods are of such form as to permit free expansion of the gas immediately after it leaves the switches. Moreover, it is preferable that means be provided in the exhaust system for insuring the proper circulation of the discharge gas, because any appreciable amount of back pressure tends to interfere with the satisfactory operation of the switches. To this end, exhaust or suction fans may be employed. Additional means for preventing the entrance of dirt and dust into the exhaust system and thus into the switches also may be provided if desired.

As shown in Fig. 5, each switch is provided with a separate control board 43 on which are mounted various indicating and control devices such as a selector handle 48, for selecting the pressure gas conduit, an indicator 44, for indicating the condition of the pressure gas supply, operating buttons 46, for controlling the pressure gas supply to open and close the switch, recording lamps 45, for indicating the position of the switch, and a counting device 47. Although the foregoing devices have been mentioned, it is of course apparent that other devices for accomplishing the same purpose may be substituted for those named.

In Figs. 7 and 8 is shown a pressure gas switch having a sunken type of mounting instead of an enclosed mounting as shown in Fig. 5. According to this arrangement, the switch 1 is mounted on a suitable frame 32 likewise supporting the various switch details. The electric power cable is lead up from below to the cable end fitting 29, and the bus bars 19 are mounted beneath the switch. Connection between the switch and the cable and bus bars is effected through suitable separating switches 6, which may be provided with separate pressure gas operating cylinders 31 the same as the switch 1. As in Fig. 5, the upper part of the switch 1 is covered by an exhaust hood 3.

The correlation between the operating mechanism of the switch 1 and the separating switches 6 is such that after the switch 1 opens the switches 6 will open without additional manipulation. In closing, the switches 6 operate to close first and then the switch 1 closes under the influence of the pressure gas supplied to the switch unit. A special indicating device for indicating the position of the switch 1, as in Fig. 5, is unnecessary in the present instance because the position of switch 1 corresponds to that of the switches 6. When the switches 6 and 1 are interconnected through their operating mechanism the supply conduit need be connected only to the switch 1. On the other hand, the separating switches may be operated individually, in which case suitable means should be provided for ensuring proper correlation between their movement and that of the main switch.

Figs. 9 and 10 illustrate a three pole switch mounted on hollow supports 33 and having its separate poles disposed in cells 34 separated by partitions 35. The front of the cells is closed by a screen 9 to permit ready inspection. Each of the poles is provided with an exhaust hood 3, and within each hollow support 33 is contained a pressure gas operating cylinder suitably connected to the switch contact which it governs. The pressure gas supply conduit for the mechanism of the in-

dividual poles is provided with a separate branch for each pole but the supply is controlled by a common control valve, whereby the operation of all of the pole contacts in unison is ensured. A switch of this type is particularly applicable to high voltage installations.

I claim:

1. In an electrical switching system, a combination of a plurality of gas pressure operated switches, a main conduit system for supplying pressure gas to said switches including at least two branch conduits for each of said switches, and auxiliary means operatively connected to said main system adapted to provide an additional supply of pressure gas available for reserve.

2. In an electrical switching system, the combination of a plurality of gas pressure operated switches, a main source of pressure gas, an auxiliary source of pressure gas derived from said main source, and a conduit system for supplying pressure gas from either of said sources to said switches.

3. In an electrical switching system, the combination of a plurality of gas pressure operated switches, a main conduit system for supplying pressure gas, a storage vessel for each switch, said storage vessel having a pressure gas capacity sufficient for operating its associated switch at least once, and a valve between each of said storage vessels and said main conduit, said valve being adapted to control the supply of pressure gas from said main conduit to said vessel and to trap in said vessel a quantity of pressure gas sufficient for operating its associated switch at least once, upon failure of the pressure in said main conduit.

4. In an electrical switching system, the combination of a plurality of switches operated by gas pressure, a main conduit system supplying pressure gas to said switches, said conduit system comprising a closed reentrant circuit encircling said switches and an auxiliary pressure gas supply operatively connected to said system.

5. In an electrical switching system, the combination of a plurality of switches operated by gas pressure, a main source of pressure gas, an auxiliary source of pressure gas, and a conduit system supplying pressure gas from either of said sources to said switches, said sources of pressure gas having relatively different pressure.

6. In an electrical switching system, the combination of a plurality of switches operated by gas pressure, a main source of pressure gas, an auxiliary source of pressure gas and a conduit system supplying pressure gas from either of said sources to said switches, said main source comprising a compressor and said auxiliary source at least one storage vessel.

7. In an electrical switching system, the combination of a plurality of switches operated by gas pressure, a main source of pressure gas, an auxiliary source of pressure gas, a conduit system supplying pressure gas from either of said sources to said switches, said auxiliary source comprising a plurality of storage vessels at least one of said vessels being connected to at least a pair of said switches.

8. In an electrical switching system, the combination of a plurality of switches operated by gas pressure, a main source of pressure gas, an auxiliary source of pressure gas and a conduit system supplying pressure gas from either of said sources to said switches, said auxiliary source comprising a plurality of storage vessels, and an additional storage cell connected to each of said switches.

9. In an electrical switching system, the combination of a plurality of switches actuated by gas pressure, a main conduit system supplying pressure gas to said switches and means to permit the closing of any of said switches only when a sufficient supply of pressure gas is available for opening said switches.

10. An electrical switching station comprising a plurality of switches actuated by gas pressure, a main conduit system for supplying pressure gas to said switches, auxiliary storage tanks adapted to provide an additional supply of pressure gas, a switchboard, a subsidiary pressure gas conduit system leading from said switches to said switchboard, and means on said switchboard adapted to control both said main conduit system and said subsidiary conduit system.

11. An electrical switching station comprising a plurality of gas pressure operated switches, a main conduit system for supplying pressure gas to said switches, an auxiliary conduit system, a switchboard, control devices for said main conduit system and said auxiliary conduit system, and electrical means for actuating said control devices and indicating the operating position thereof on said switchboard.

In testimony whereof I affix my signature.

SIGWART RUPPEL.