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[54] **MULTI-PHASE PRESSURE GAS INSULATED METAL ENCLOSED SWITCH PLANT**

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[51] **Int. Cl.**...**H01h 33/57**

[58] **Field of Search**...200/148 B, 148 E, 148 D, 145; 317/100

[56] **References Cited**

UNITED STATES PATENTS

3,129,309	4/1964	McKeough et al.	200/148 B
3,230,293	1/1966	Turgeon	317/100 X
3,481,393	12/1969	Chu	317/100 X
3,504,268	3/1970	Hoffman et al.	317/100 X

FOREIGN PATENTS OR APPLICATIONS

716,624	1/1942	Germany	200/148 E
1,490,075	2/1964	Germany	200/145

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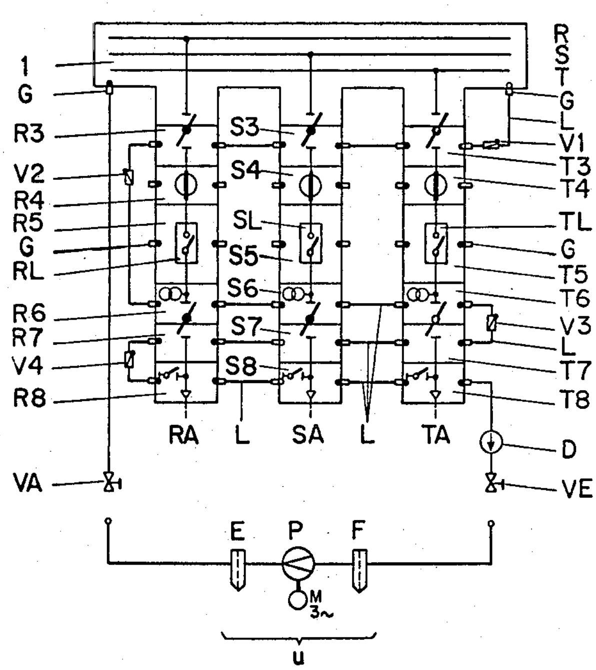
[57] **ABSTRACT**

A pressurized gas insulated switchgear panel includes a pressurized gas chamber enclosing a three-phase bus bar, to which are connected single-phase outlets. Each outlet is divided in succession into a first gas-pressurized isolating switch chamber, a low-pressure chamber and a correlated high-pressure chamber for the phase circuit breaker, a gas-pressurized voltage transformer chamber, a second gas-pressurized isolating switch chamber and finally a further gas-pressurized chamber housing the ground and cable connections. A gas circulating plant including a pump has its high pressure, outlet side connected to the gas chamber enclosing the three-phase bus bar and its low pressure, inlet side connected to the outlet from the ground chambers.

11 Claims, 3 Drawing Figures



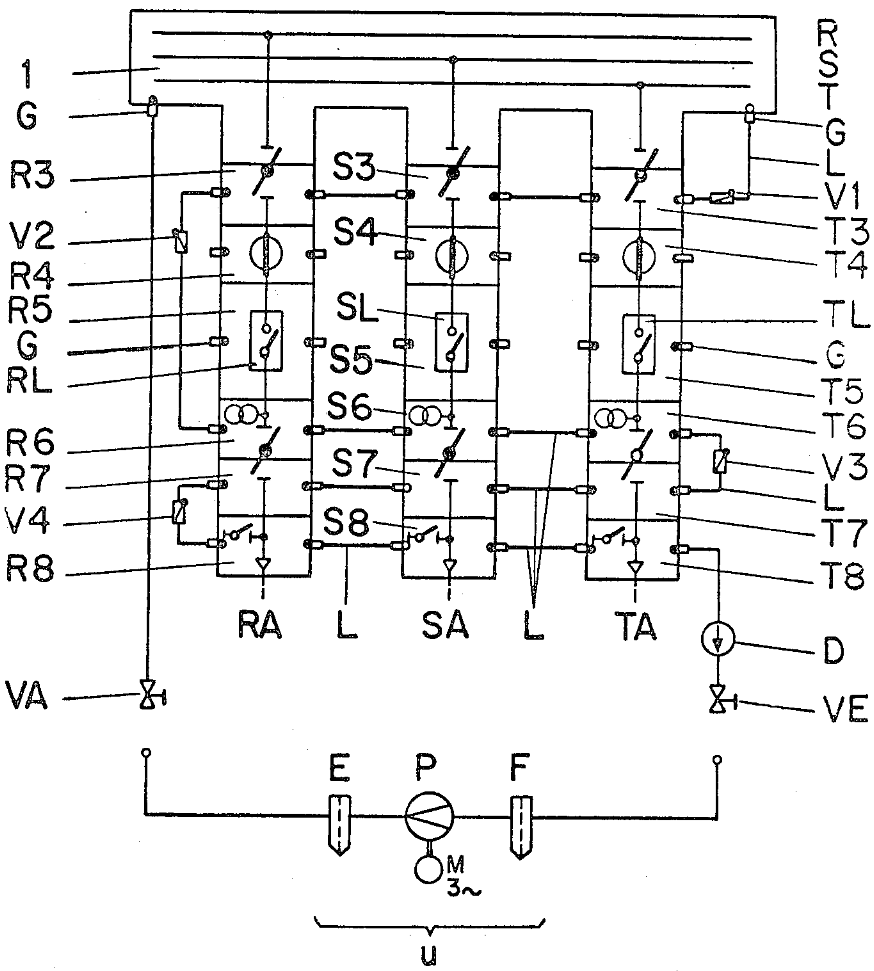


Fig. 1

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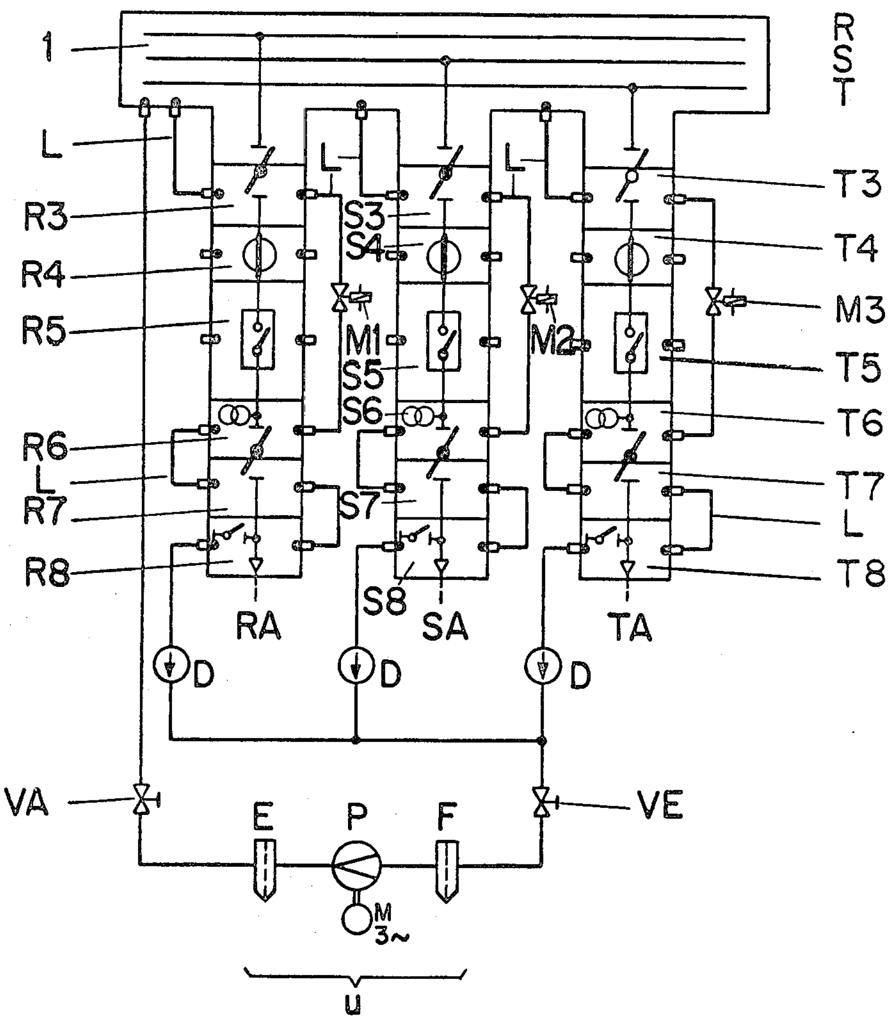

Fig. 2

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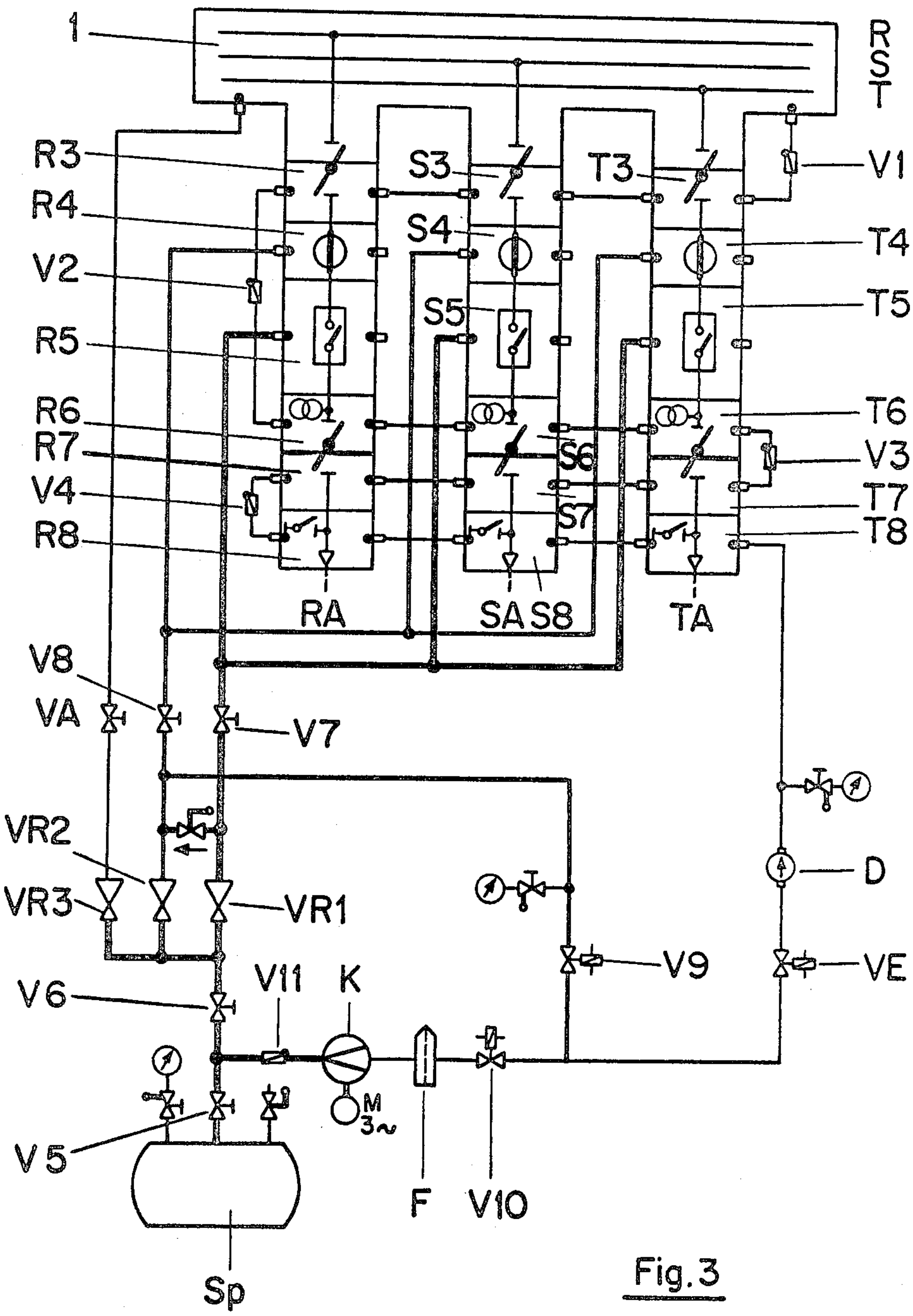

Fig.3

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MULTI-PHASE PRESSURE GAS INSULATED METAL ENCLOSED SWITCH PLANT

In accordance with one embodiment, three separate gas paths may be established respectively from the gas chamber enclosing the three-phase bus bar through the isolating switch chambers, voltage transformer chamber and ground chamber of each single-phase outlet to the inlet side of the pump. According to a second embodiment, one continuous gas path is established from the gas chamber enclosing the three-phase bus bar through the first isolating switch chambers in series, thence through the voltage transformer chambers in series, thence through the second isolating switch chambers in series and thence through the ground chambers in series to the inlet side of the pump. Relief, i.e., one-way valves are interposed in the gas connections in the series between the various chambers.

The high and low pressure gas chambers associated with the respective phase circuit breakers are supplied with the necessary pressurized gas from the pump, or other source through separate circuits.

This invention relates to a multiphase, pressure-gas insulated, metal-enclosed switch plant with single-phase outlets. A metal-enclosed, gas pressurized, bus bar chamber contains the bus bars for all phases and single phase outlets are connected to the bus bar chamber. Each outlet comprises a row of metal-enclosed gas pressurized chambers containing the power circuit breaker for the phase and related operating components such as an isolating switch, voltage transformers and ground and cable connections, each housed within a separate chamber and seriately connected between the appertaining bus bar and the phase outlet terminal.

The subdivision into individual gas pressurized chambers is effected so that any troubles of an electrical nature as well as troubles, which may be caused by gas impurities or leakage losses, cannot affect the entire plant, and it is thus possible to remove individual operating components separately from the switch plant for inspection, without having to stop the entire plant and making it gas-free. The subdivision into individual gas pressurized chambers requires, however, a complicated pressure monitoring system for the individual gas pressurized chambers which necessitates a great number of pressure monitors or gas density monitors and possibly the connection of several additional gas cylinders for the gas supply.

The object of the invention is to permit a gas supply to these gas chambers in such switch plants while maintaining the sectioning into individual gas pressurized chambers, which reduces the risk of contamination of individual gas pressurized chambers and which extends the time intervals for a general overhaul and replenishment of gas, and which also simplifies the monitoring of the pressure in the individual chambers.

This problem is solved according to the invention in switch plants of the above-mentioned type by connecting the sectionalized gas chambers of a switchgear panel over pressure gas lines and/or valves in such a way that, when a first gas chamber is connected to a common gas supply for all gas chambers, a gas chamber row is formed which can only be traversed in one direction.

The advantage achieved with the invention lies particularly in the fact that the inlet and the outlet of the gas chamber row can be connected by a gas-circulating plant consisting substantially of a pump, filter, and dehumidifier. In addition to the central filling of all gas chambers combined to a row, it is thus possible to circulate the gas contained in the chambers continuously or intermittently according to the requirements. This circulation of gas is effected over filters and dehumidifiers, so that the risk of contamination or excessive moisture content is reduced to a minimum. A particular advantage is that this gas circulation can also be effected during the operation without any effect on the operation of the switch plant. Depending on the requirements, a permanent installed gas circulating plant can be used for this purpose or a mobile plant which is only connected in spacial intervals. It also provides the possibility of an extremely simple pressure indication for all gas chambers, which can be effected at the end of the gas chamber row by means of a flowmeter. For checking the gas supply it suffices to start the gas flow through the gas chamber row, and the flowmeter provides information about the gas supply of all gas chambers. Individual monitoring of the gas chambers is thus not necessary. When the operation is started, only this one flowmeter has to be checked, instead of the pressure manometers which would otherwise be required for each individual gas chamber.

The gas chamber row of all gas chambers of a switchgear plant according to the invention can preferably be subdivided in a further development of the invention into individual sections which comprise the gas chambers of the operating components of like function of all phases, the adjoining sections being connected over restrictors and/or valves in such a way that with a sudden pressure difference between the sections caused by a breakdown, the pressure equilibrium can only be established with delay. For particularly comfortable switch plants, automatic shut-off valves can be provided between the sections which are controlled by pressure monitors in the individual sections, that is, with a sudden pressure loss in one section, the respective pressure monitor controls the shut-off valve arranged in this section and selects this way the fault.

The invention benefits from the fact that the switchgear panels of these switch plants are very compact and that the enclosing sections of the individual phases of a switchgear panel are very close together so that the connection of the individual gas chambers over valves or pipe fittings presents no difficulties. For this reason the individual phases of a switchgear can be easily combined in their functions, that is, the single-pole installation of the switchgears used in open air switch plants is not of importance in fully enclosed switch plants, but an embodiment is preferred which is encased individually with regard to phase but combined to a multiphase switchgear with regard to function.

If the combination of the gas chambers of the individual phases of a multiphase switchgear on the basis of the single-pole installation of conventional switch plants is not desired, that is, if each phase is to be possibly self-sufficient, a combination of the individual gas chambers of a phase can be readily realized according to the invention. The gas chambers of a phase form a separate gas chamber row, and the parallel-connected gas chamber rows of the individual phases of a switchgear panel have a common inlet and a common outlet. The flow-meter is then arranged preferably at the end of each gas chamber row, since only this way a reliable reading about the pressure supply of all phases can be obtained. When the gas circulation starts, it can be seen on each flowmeter whether the gas is circulated uniformly in all phases.

Since it is common in a multipanel switch plant, for reasons of cost, to divide the bus bar corresponding to the individual connected switchgear panels into sections, it may be advisable under certain circumstances not to include the gas chamber of the bus bar in the gas chamber row according to the invention, but to connect it to a separate gas supply. This somewhat more complicated construction results from an increased need for safety, where the bus bars are not to be included in the gas cycle of the individual devices, which can naturally not be as trouble-free as the bus bar itself. On the other hand, the gas chamber of the bus bar extending over several switchgear panels as a common gas line for the connection of the gas chamber rows of the individual panels represents an arrangement which is particularly recommended for low-cost switch plants.

If gas blast switches with a separate gas cycle, consisting of a high pressure part and a low-pressure part, are used in the switch plants, the gas supply of the switch will in general not be combined with that of the remaining switch plant, because the gas blast switch requires constant readiness, which necessitates a separate supply and monitoring of the pressure gas, adapted to the conditions of the switch. It may be of advantage, however, to effect the gas-circulation according to the invention in the gas chambers of a switchgear panel combined to a gas chamber row by the compressor, which is anyway required for the gas blast switch. The compressor of the gas blast switch can be connected, for example, over electromagnetic valves to the inlet or outlet of the gas chamber row. Here a control is recommended which gives preference at any rate to the gas cycle of the gas blast switch, that is, the compressor switched for gas circulation to the gas chamber row of the switchgear panel must be switched back immediately to the gas cycle of the switch when the pressure difference between the high-pressure part and the low-pressure becomes too low there.

An embodiment of the invention is represented in the drawing and will be described more fully below.

FIG. 1 shows in a schematic representation a three-phase switchgear panel whose individual gas chambers, with the exception of the chambers comprising the gas blast switch, are combined to a gas chamber row.

FIG. 2 shows a three-phase switchgear panel where the gas chambers of a phase form each a separate gas chamber row.

FIG. 3 shows the switchgear panel according to FIG. 1 with a separate gas cycle for the gas chamber row and for the gas blast switch, which can be connected over a common compressor.

With reference now to the drawings the represented pressure gas-insulated, metal enclosed switchgear panel consists substantially of a gas chamber 1 defined by a metal enclosure containing the three-phase bus bars R,D,T, to which are connected the single-phase metal enclosed outlets RA, SA and TA. Each metal enclosed outlet is sub-divided by transverse walls successively into an isolating switch chamber R3, S3, T3, a low-pressure chamber R4, S4, T4 and a high-pressure chamber R5, S5, T5 of the circuit breaker Rl, SL, TL, a voltage transformer chamber R6, S6, T6, another isolating switch chamber R7, S7, T7 as well as a chamber for the ground -and cable terminal R8, S8, T8.

According to the invention, the gas chambers of the switchgear panel are connected with each other over valves V1, V2, V3, V4 and pressure gas pipe fittings L to a gas chamber row. According to FIG. 1, starting from gas chamber 1 of the three-phase bus bar, are connected over a one-way valve V1 the three isolating switch chambers in the order T3, S3, R3, then over another one-way valve V2 the voltage transformer chambers R6, S6, T6. Then follow over one-way valve V3 the isolating switch- or ground chambers, again in the order T7, S7, R7; and finally over another one-way valve V4 the chambers of the ground-and cable terminals R8, S8, T8. Excepted from this gas chamber row are merely the gas chambers R4, S4, T4 and R5, S5, T5 which represent the high- and low-pressured parts of the circuit breaker and thus must have their own gas supply. The connection and the entrance respectively into the gas chamber row thus formed is effected at valve VA, while the outlet is formed by valve VE. Ahead of the valve VE is arranged a flowmeter D so that, when valve VE is opened briefly, a reading appears immediately showing whether all gas chambers 1, R1 . . . T8 are supplied with pressure gas. Of great importance is also the fact that a gas circulating plant U, consisting of pump P, filter F and dehumidifier E, can be arranged between the connecting valve VA and the end valve VE. This gas-circulating plant U can be either permanently connected (see FIG. 2) or it can be designed as a mobile gas circulating plant so that the connection can be effected in certain intervals. The valves VA and VE are then designed as corresponding connection points, this being shown schematically in FIG. 1.

Characteristic of the example according to FIG. 1 is also the fact that the three operating components with the same function, for example, R3, S3, T3 or R6, S6, T6 of the three phases are combined to a continuous section in the gas chamber row and that each section is separated from the following by a one-way valve V1 . . . V4. This has the result that the operating components of the three phases belonging together also form a unit with regard to the pressure gas, which is of importance, in case of trouble, for the inspection and disassembly, if necessary of the switchgears. In certain cases it may be advisable to use magnetic valves instead of the one-way valves so that the gas-connection between the sections can be completely interrupted, if necessary. But a certain gas separation can also be effected by providing, instead of the valves V1 . . V4, simple restrictors which permit an equalization of gas between the sections only over a longer period. The gas circulation and pressure reading are not affected by it, but with a sudden pressure drop in one section the pressure equalization takes so long that the counter-measures necessary in this case can be taken. The design of the connection points G of the gas connecting lines L as instantaneous couplings, for example, permits also any desired bridging of individual sections or gas chambers by flexible gas lines, so that the gas circulation through the remaining gas chamber row is maintained when individual instruments have to be inspected.

FIG. 2 shows how the individual gas chambers of each phase RA, SA, TA can form a separate gas chamber row in a principally similar switch plant, as it is represented in FIG. 1. Starting from the gas chamber 1 of the bus bar, the gas chambers R3, R6, R7 and R8 are connected over the pipe fittings L as a separate gas chamber row, S3, S6, S7, S8, and T3, T6, T7 and T8 likewise each as a separate gas row chamber. The pressure gas circuit breaker arranged in the two gas chambers R4, R5, S4, S5 and T4, T5 respectively was again not included in the gas chamber row. The three gas chamber rows are provided each with a flowmeter D and then combined over valve VE with the permanently installed gas circulating plant, which is arranged with the other side at the inlet valve VA. When the gas circulation starts, a reliable reading is again obtained about the gas supply in all three phases. In a variation of the embodiment according to FIG. 1, no one-way valves are used here between the individual gas chambers but magnetic shut-off valves M1, M2, M3 have been provided between the isolating switch chambers R3, S3, T3 and the voltage transformer chambers R6, S6, T6 which can be automatically controlled over pressure monitors (not represented) or at will. Thus, for example, the gas chambers of the voltage transformers R6, S6, T6 can be separated completely from the other gas chambers of the switchgear panel. The pipe fittings L have a sufficient throttling effect so that the pressure equilibrium between the individual chambers can again be established only with delay, and the sectioning between the individual gas chambers maintains its effect. The embodiment according to FIG. 2 will be used when switch plants with possibly self-sufficient phases are required.

FIG. 3 finally shows how the gas chamber row already described in FIG. 1 can be combined with the gas pressure supply and the pressure gas cycle of the gas blast switch. The gas chamber row between the inlet valve VA and the end valve VE is identical with that according to FIG. 1. For the pressure gas supply of the circuit breaker LR, LS, LT, a pressure-gas storage Sp is provided here, to which are connected over various shut-off valves V5, V6, V7 and a reducing valve VR1 the gas chambers R5, S5, T5 comprising the high-pressure part. During switching operation, the gas of the high-pressure part flows over the switching zones of the circuit breaker into the gas chambers R4, S4, T4 which form the low-pressure part of the circuit breaker. The low-pressure part is then connected over the valves V8, V9, V10 and a filter F with the low-pressure side of a compressor K which pumps the gas from the low-pressure part over a one-way valve V11 back into the storage Sp or directly into the gas chambers R5, S5, T5 of the high-pressure part. In order not to jeopardize the gas supply in the low-pressure part of the circuit breakers, the low pressure gas chambers R4, S4, T4 are connected with the storage Sp, over a reducing valve VR2 set to the rated pressure of the low-pressure part, so that the pressure gas can also flow, if necessary, from the storage Sp directly into the chambers R4, S4, T4.

According to the invention, the gas supply of the gas chambers 1, R3..T8 forming the gas chamber row is coupled with the above described gas supply of the circuit breaker, the inlet valve VA of the gas chamber row being arranged over an additional reducing valve VR3 likewise on the gas storage Sp, or on the high-pressure side of the compressor K. The end or the outlet of the gas chamber row, however, is connected over the outlet valve VE with the low-pressure side of the compressor, the outlet side of the gas chamber row between the two valves V9 and V10 being connected to the line extending from the low-pressure part of the circuit breaker. It is thus possible to operate selectively by means of the compressors, depending on the position of the valves VA, VE, V7, V8, V9 and V10, either the gas cycle in the circuit breaker - the valves V6, V7, V8, V9 and V10 must then be open, or the gas cycle in the gas chamber row 1, R3..Ts, in which case the valves VA, VE, V10 and V6 must be open, while the first mentioned valves remain closed.

We claim:

1. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant comprising a metal-enclosed gas-pressurized chamber for the bus bar of each phase, single phase outlets electrically connected respectively to the corresponding phase bus bar, each said outlet comprising a row of metal-enclosed gas-pressurized chambers containing respectively the power circuit breaker for the phase and related operating components such as an isolating switch, voltage transformer and cable and ground connections and which are seriately connected between the appertaining bus bar and the phase outlet terminal, and means including a gas line arrangement connecting a plurality of said chambers containing said related operating components in series to provide a gas flow therethrough in one direction from a common pressurized gas supply source.

2. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein the series connected chambers of each phase outlet containing said related operating components are supplied with gas through separate gas lines connected respectively to said gas supply source.

3. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein the series connected chambers of each phase outlet containing said related operating components are supplied with gas from said gas supply source through a gas line common to all of said phase outlets.

4. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 3 wherein a first set of chambers of the phase outlets containing related operating components which have the same function are directly connected together in series whereby the gas flow is directed therethrough prior to next being passed through a second set of directly connected chambers of the phase outlets which contain related operating components having the same function.

5. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein said gas line arrangement connecting said chambers in series includes one-way valves which maintain the gas flow therethrough in the desired direction.

6. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein said gas line arrangement connecting said chambers in series is connected to said gas supply source through

said gas-pressurized chamber containing the phase bus bars.

7. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein said gas line arrangement includes a gas flow indicator for determining the rate of gas flow through the series connected chambers.

8. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 and which further includes a gas circulating plant including a pump, filter and de-humidifier connected by said gas line arrangement to said series connected chambers for effecting circulation of gas through the chambers.

9. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein said gas line arrangement includes connection points for a mobile plant including a pump, filter and de-humidifier by which to circulate the gas through said series connected chambers.

10. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein the power circuit breaker for each phase is of the gas blast type having a gas circuit closed over separate high and low pressure parts and wherein the high pressure part and the low pressure part of the gas blast switch have respective gas circuits independent of the gas circuits which pass through the series connected chambers containing said related operating components.

11. A multi-phase, pressure-gas insulated, metal-enclosed switchgear plant as defined in claim 1 wherein the series connected chambers of each phase outlet containing said related operating components are supplied with gas from said gas supply source through a gas line common to all of said phase outlets, a first set of chambers of the phase outlets containing related operating components which have the same function being directly connected together in series whereby the gas flow is directed therethrough prior to next being passed through a second set of directly connected chambers of the phase outlets which contain related operating components having the same function, and flow restriction means interposed between the first and second sets of series connected chambers such that upon occurrence of a sudden difference in gas pressure between said first and second sets of series connected chambers equalization of the gas pressures therein is effected with a delay.

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