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[54] **ELECTRICAL SWITCHGEAR APPARATUS OPERATING WITH PRESSURIZED GASEOUS ARC-QUENCHING MEDIUM**

[75] Inventors: **Karl Heinz Wagner**, Mannheim; **Reiner Muellerpoths**, Schwetzingen; **Rudolf Hammel**, Mannheim, all of Germany

[73] Assignee: **Brown Boveri & Company Limited**, Baden, Switzerland

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

[58] **Field of Search** ..... 200/148 E, 148 B, 148 G

[56] **References Cited**

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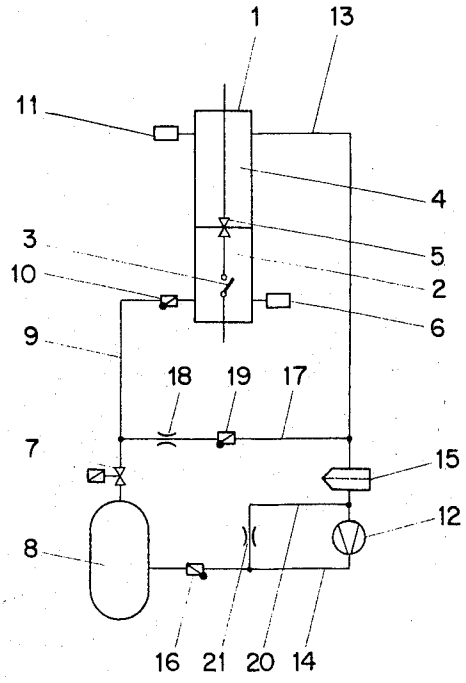
Primary Examiner—Robert S. Macon

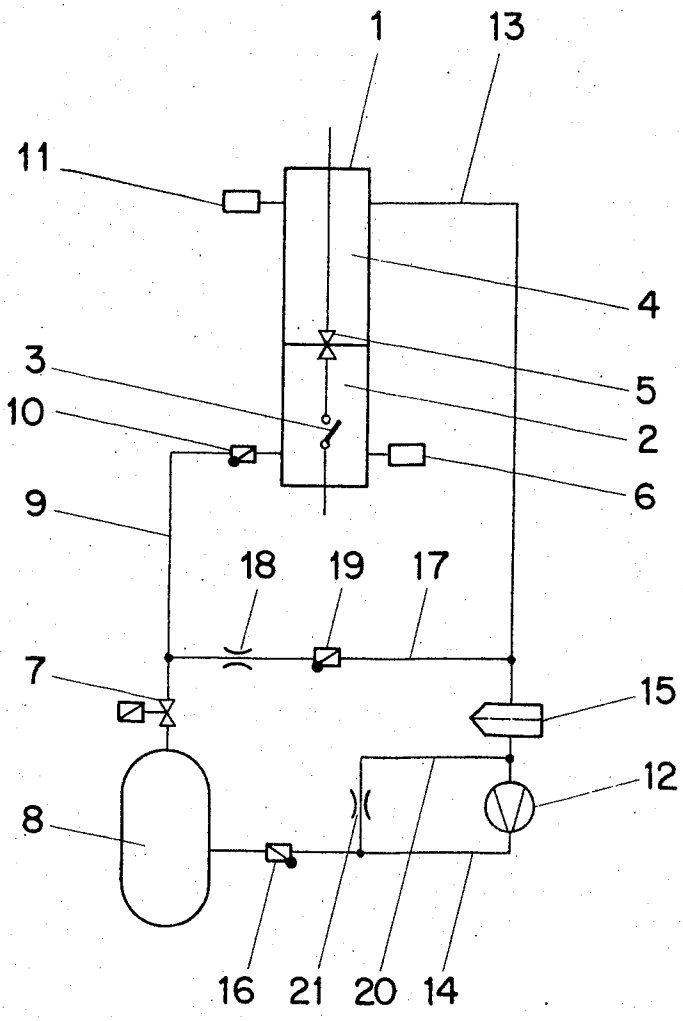
Attorney, Agent, or Firm—Pierce, Scheffler & Parker

[57] **ABSTRACT**

Electrical switchgear apparatus using a pressurized arc-quenching and insulating gaseous medium particularly SF_6 wherein the gas is maintained at high pressure in a switching chamber and is transferred to an adjacent low-pressure chamber during a switching operation, and wherein the gas is supplied to the switching chamber from a storage container via a high-pressure supply line, then returned via a low-pressure return line from the low-pressure chamber to a compressor for re-compression and feed back via a feed line into the storage container. To prevent condensation of gas in its high-pressure state which may become trapped in the gas supply line between the storage container and the switching chamber, and also similarly trapped in the gas feedback line between the compressor and the storage container, vent lines are provided. A first vent line including a flow restrictor and non-return valve interconnects the gas supply line and the low-pressure return line, and a second vent line including a flow restrictor interconnects the gas feedback line with the low-pressure return line.

3 Claims, 1 Drawing Figure

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ELECTRICAL SWITCHGEAR APPARATUS OPERATING WITH PRESSURIZED GASEOUS ARC-QUENCHING MEDIUM

The present invention relates to an improvement in electrical switchgear apparatus using a pressurized arc-quenching and insulating gaseous medium particularly SF_6 wherein the gas is maintained at high pressure in a switching chamber and is transferred to a low-pressure chamber during a switching operation, and wherein the gas is supplied to the switching chamber from a storage container via a high-pressure supply line, then returned via a low-pressure return line from the low-pressure chamber to a compressor, is filtered preferably prior to passage through the compressor, and then fed back via a feed line into the storage container for re-use.

It is a characteristic of SF_6 gas that it will condense under the pressure required for quenching the arc created upon disengagement of the circuit breaker contacts and at low temperatures to which the switchgear may be exposed during the winter. A condensed SF_6 gas, however, is not suitable for arc-quenching. Efforts have been made to keep the temperature of the pressurized gas at a non-condensing temperature level by winding a heating coil around the high pressure storage container as well as the high-pressure chamber containing the switching mechanism where arc-quenching is needed thus heating up both of these units. However, there still remains the problem of preventing condensation of the pressurized gas in the high-pressure supply line to the switching chamber and in the high-pressure feedback line from the compressor to the storage container. For this reason it is also known to provide these high-pressure gas lines with heating coils in order to maintain the gas temperature at a non-condensing level.

The costs involved in arranging heating coils for the high-pressure storage container and the high-pressure switching chamber are not considered to be excessive in comparison with the overall costs of both of these units. However, providing the high-pressure gas lines with heating coils is relatively expensive and involves difficulties in construction.

The principal object of the present invention is to provide an improved arrangement for preventing condensation of the high-pressure gas in the gas lines interconnecting the various operating components of the switchgear apparatus, and this objective is attained by reducing the gas pressure therein when the apparatus is between switching operations. That is when the circuit breaker contacts are in a closed state and the compressor is not operating. The reduction in pressure is effected by means of two vent lines, wherein a first pressure vent line interconnects the high-pressure gas supply line and the low-pressure gas return line, and wherein a second pressure vent line interconnects the gas feedback line with the low-pressure gas return line. The two pressure venting lines each include flow restrictors to minimize diversion of the gaseous medium therethrough when the valve admitting the pressurized gas to the switching chamber is open, and when the compressor is operating.

A preferred embodiment of the invention will now be described in conjunction with the attached drawing the single FIGURE of which illustrates it in somewhat schematic form.

With reference now to the drawing, the enclosed power switching apparatus **1** includes a high-pressure chamber **2** within which is located a power circuit breaker **3** and an adjacent low-pressure chamber **4** interconnected with the high-pressure chamber **2** by way of a blow valve **5** which remains closed when the contacts of the circuit breaker are closed thus maintaining a high gas pressure within the chamber **2** which serves to provide a protective insulating effect. When it is desired to open the circuit breaker **3**, the blow valve **5** is likewise opened whereupon the pressurized gas such as SF_6 stored in chamber **2** will then flow through the valve **5** into the low-pressure chamber **4** in conjunction with performance of its arc quenching function. An automatic pressure controller **6** associated with the high-pressure chamber **2** and which then responds as the pressure within chamber **2** drops as a result of the flow into chamber **4** effects opening of a solenoid actuated valve **7** located in a high-pressure gas supply line **9** extending between the outlet of a high-pressure gas storage container **8** and the inlet to high pressure chamber **2**, a non-return valve **10** being located in this supply line adjacent the gas entry point to chamber **2** to prevent any loss of pressure from chamber **2** when the supply valve **7** located near the outlet from the container **8** re-closes.

A low-pressure gas return line **13** extends from the low-pressure chamber **4** through a filter **15** which serves to repurify the gas contaminated by arc extinction products and thence into a compressor **12.** The outlet from compressor **12** is connected by way of a feed line **14** to the high-pressure gas storage container **8,** and a non-return valve **16** is placed in this feed line at the entry point to container **8** to prevent any loss of pressure when the compressor **12** cuts off.

As a result of the switching operation in the high-pressure chamber **2,** the pressure will rise within low-pressure chamber **4.** This pressure rise is detected by an automatic pressure controller **11** associated with chamber **4** and causes the compressor **12** to be started thus drawing gas from chamber **4** through line **13** and filter **15** into the inlet side of compressor **12** where it is recompressed to the desired high pressure and delivered to storage container **8** via feed line **14.** Thus, a complete switching operation entails gas flow through valve **5** from the high-pressure chamber **2** to low-pressure chamber **4,** replenishment of gas in chamber **2** by opening valve **7,** and actuation of compressor **12** to draw off contaminated gas from chamber **4,** and deliver repurified gas at high pressure into storage container **8.**

Upon completion of the above-described switching operation, the quenching gas, e.g. SF_6 at ambient temperature would, in the absence of the present invention, become trapped in the high-pressure supply line **9** between valve **7** at the storage container **8** and non-return valve **10,** and similarly trapped in the high-pressure feed line **14** between compressor **12** and non-return valve **16.** The trapped gas could then tend to undesirably condense. To obviate condensation, the invention provides a vent line **17** which extends from a tapping point on gas supply line **9** intermediate valve **7** and non-return valve **10** to the low-pressure return line **13** e.g. ahead of filter **15,** the line **17** serving to effect a pressure reduction of the gas in line **9** as gas is bled off from it to a point of lower pressure. The line **17** is provided with a flow restrictor **18,** e.g. a diaphragm having a small flow-through aperture to prevent exces-

sive gas flow through it when the supply valve **7** is open, and the flow-through aperture is dimensioned such that any increase in pressure in the low-pressure chamber **4** caused by in-flow of gas from the vent line **17** will be negligible. A non-return valve **19** is also placed in the vent line **17** to prevent any back flow of contaminated gas from return line **13** as the pressure in the low-pressure chamber **4** builds up.

Similarly, the invention provides another vent line **20** which extends from a tapping point on the gas feed line **14** intermediate non-return valve **16** and the outlet from compressor **12** to the low-pressure return line **13**, the vent line **20** serving to effect a pressure reduction in feed line **14** as gas is bled off from it to a point of lower pressure. The vent line **20** is also provided with a flow restrictor **21** containing a small flow-through aperture which is also dimensioned that the venting period will somewhat exceed the period that compressor **12** operates. Thus, there exists no possibility that gas delivered by the compressor can flow back in any significant amount to the inlet side of the compressor through the vent line while the compressor is running.

We claim:

1. Electrical switchgear apparatus comprising a switching chamber containing switching means and which chamber is pressurized to a high pressure by a gaseous arc-quenching and insulating medium such as SF_6, a low-pressure chamber adjacent said switching chamber and which is connected thereto by valve means, a storage container for the pressurized gaseous medium, a high-pressure gas supply line extending between said storage container and said switching chamber, a control valve placed in said gas supply line at the outlet from said storage chamber, a first non-return valve also located in said gas supply line at the entrance to said switching chamber, a gas compressor, a low-pressure gas return line extending from said low-pressure chamber to the inlet of said compressor, a gas feed line extending from the outlet from said compressor to said storage container, said gas feed line including a second non-return valve located at the inlet to said storage container, a first vent line interconnecting said high-pressure gas supply line and said low-pressure gas return line for venting gas thereto when said control valve is closed, said vent line including a flow restrictor for limiting flow particularly when said control valve is open and a non-return valve permitting flow only in the direction of said low-pressure gas return line, and a second vent line interconnecting said gas feed line and said low-pressure gas return line for venting gas thereto when said compressor is not operating, said second vent line likewise including a flow restrictor for limiting flow therethrough particularly when said compressor is operating.

2. Electrical switchgear apparatus as defined in claim **1** and which further includes a filter located in said low-pressure gas return line for removing impurities from the gas prior to entering said compressor, and wherein said first vent line is connected to said low-pressure gas return line between the inlet to said filter and said low-pressure chamber.

3. Electrical switchgear apparatus as defined in claim **2** and wherein said second vent line is connected to a point on said low-pressure return line intermediate the compressor inlet and the outlet from said filter.

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