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**Kessler**

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[54] **METAL-CLAD HIGH-VOLTAGE SWITCHING SYSTEM**


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[51] **Int. Cl.** ..... **H02h 1/00**

[58] **Field of Search** ..... 200/148 R, 148 G, 200/148 B, 148 H, 148 BV; 317/60, 58, 62, 59, 71



[56] **References Cited**

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| 2,757,261 | 7/1956 | Lingal et al. | 200/148 B |
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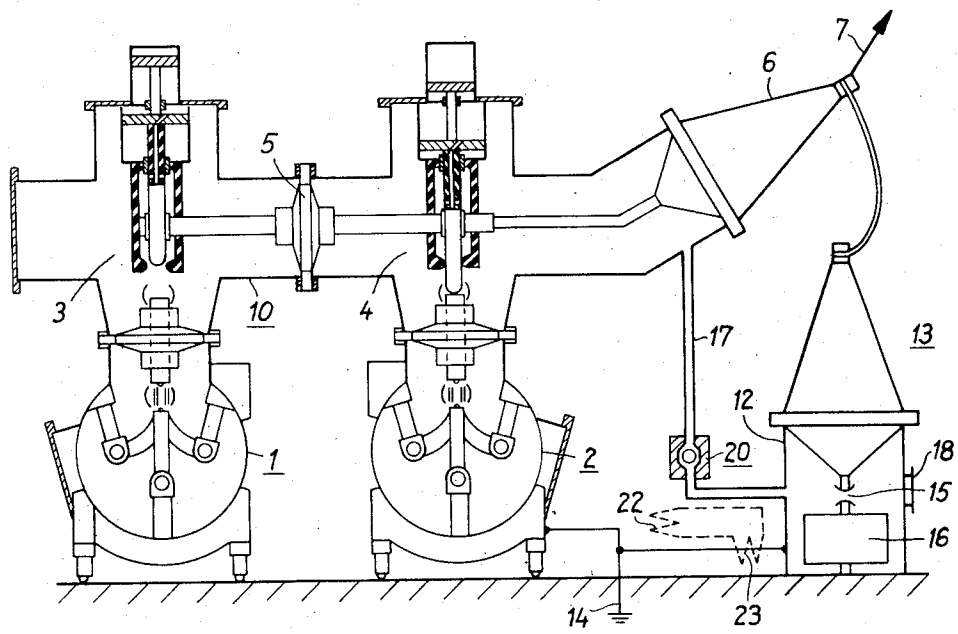
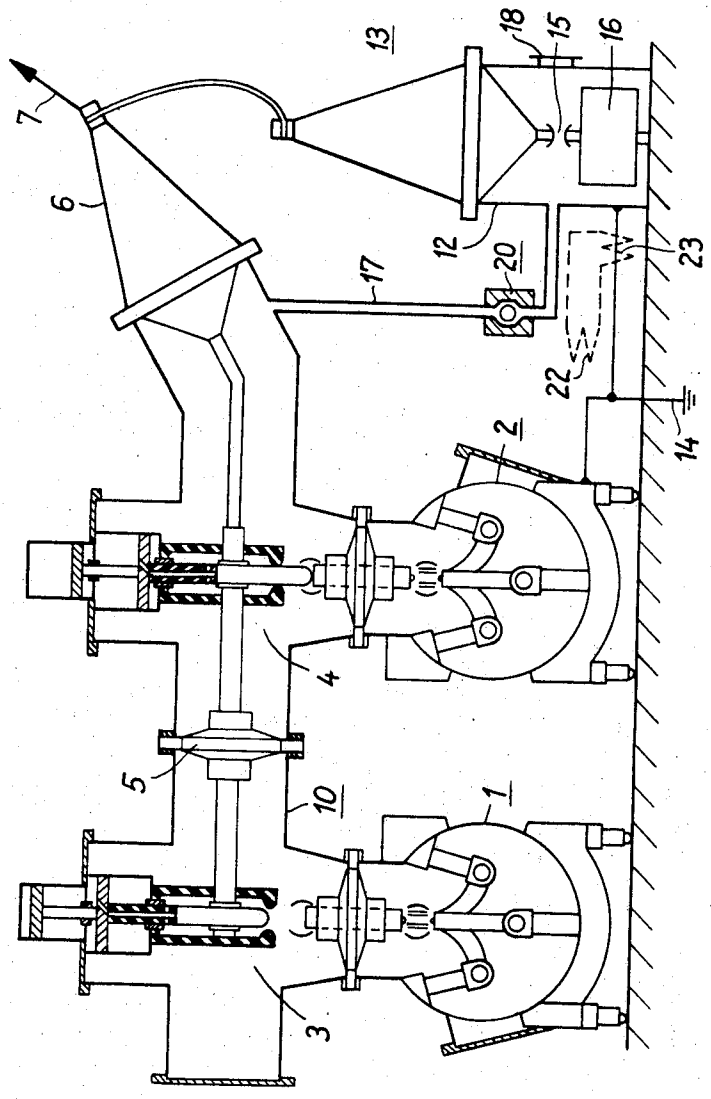
[57] **ABSTRACT**

An overvoltage arrester for a metal-clad high-voltage switching system is provided in a separate housing which is filled with an insulating heavy gas. The separate housing contains a spark gap arranged in a heavy gas atmosphere which is the same as the insulating heavy gas filled within the metal encapsulation for the switching system. The separate housing is connected with the encapsulation via a valve-controlled gas line. The overvoltage arrester is particularly well suited for metal-clad high-voltage switching systems that are insulated by sulfur hexafluoride.


**7 Claims, 1 Drawing Figure**

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# METAL-CLAD HIGH-VOLTAGE SWITCHING SYSTEM

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to metal-clad high-voltage switching systems, and more particularly relates to an overvoltage arrester for such systems.

2. Description of the Prior Art

In the German Published Patent application 1,241,514 there is disclosed a metal-clad high voltage switching system in which the metal encapsulation is filled with a heavy gas other than air, such as sulfur hexafluoride. A separate housing having a spark gap therein is provided as an overvoltage protector. The separate housing is formed of a tube of insulating material inserted into the metal encapsulation of the system. The tube closes the electrodes of the spark gap and is connected with the gas space of the encapsulation via a small pressure equalization opening. The pressure equalization opening functions so that, in the separate housing for the spark gap, the same pressure prevails as in the encapsulation itself. The known arrangement is generally suitable under ideal conditions in which the arc at the spark gap is to be of only short duration, if the decomposition products are not to escape from the separate housing. However, in the event of an arc-over, the decomposition products generated at the spark gap could escape from the separate housing in an appreciable amount.

Also, in the U.S. Pat. No. 2,757,261, it is known to fill an overvoltage arrester with sulfur hexafluoride for the purpose of increasing the switching capacity of the arrester. It is essential for the system that a breakdown characteristic exists at the spark gap which corresponds to the breakdown characteristic of the gas in the encapsulation of the high-voltage switching system. To this end, a gas atmosphere is provided by the gas line which is identical to the gas atmosphere of the encapsulation. By accommodating the spark gap in a separate housing which is independent of the encapsulation of the system, there exists the advantage that the spark gap can be constructed and monitored as an overvoltage arrester of normal design. Among the features of a normal design is, for example, a so-called rupture protection which releases an opening in the housing when the overvoltage arrester is overloaded under unfavorable conditions. If such an overvoltage arrester were arranged within the encapsulation of the high-voltage switching system, a response of the arrester could lead to an arc-over in the encapsulation through the degradation of the gas atmosphere, if the overvoltage arrester were not adequate for the overvoltage. This undesirable arc-over condition caused by the arrester would inhibit its basic purpose which is to serve as a protection for the system.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a metal-clad high voltage switching system with compressed-gas insulation and a spark gap in a separate housing, which provides an overvoltage protection.

It is another object to provide a metal-clad high voltage switching system wherein the spark gap in the separate housing is connected with the gas space of the encapsulation, but produces no detrimental effect on the gas of the encapsulation, even under the worst conditions such as an arc of arbitrarily long duration.



These, and other objects, are achieved by the present invention which provides a metal-clad high voltage switching system including a metal encapsulation enclosing the high voltage switches of the system forming a gas space filled with a heavier than air gas, such as sulfur hexafluoride, which is under pressure. An overvoltage arrester consists of a separate housing providing a spark gap therein as an overvoltage protection for the switching system. The separate housing is arranged outside of the encapsulation and is filled with the heavy gas. The interior of the separate housing is connected with the gas space of the encapsulation by means of a valve-controlled gas line.

The gas line is shut off in the high-voltage switching system in the event of an overload of the arrester. In this fashion, the encapsulation with its gas filling will remain intact. Also, the overvoltage arrester, which can be associated with an open-air terminal connection at the high-voltage switching system, can be replaced in the conventional manner.

According to one embodiment of the invention, the gas line is provided with a flow-dependent valve in which the operation is dependent on the flow and which prevents the gas from flowing out from the encapsulation via the arrester housing, which might possibly be destroyed. The valve may optionally have two response directions for the flow, so that a sudden pressure drop in the arrester housing can also be prevented. For this purpose, the valve described in the U.S. Pat. No. 3,097,280 may be employed.

According to another embodiment of the invention the gas line is provided with a pressure-dependent valve which shuts off the gas line if either the pressure drops below a certain absolute value, or if a definite pressure difference exists between the housing of the arrester and the encapsulation of the system.

According to a further embodiment of the invention, the gas line is provided with an electrically controlled valve which can be closed in dependence on an electric current flowing through the arrester. The electrically controlled valve also assures that an overpressure occurring during the normal response of the arrester cannot drive decomposition products into the metal encapsulation. The electrically controlled valve can be opened again after a given time by means of a timing control, which may be of either the mechanical or electrical type.

## BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE shows a schematic representation of the metal-clad high-voltage switching system with its overvoltage arrester, illustrative of the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the FIGURE there is shown a metal-clad high-voltage switching system employed, for example, in a **110** kilovolt line of a three-phase network. The system comprises a dual bus bar system with bus bars **1** and **2**. Power circuit breakers **3** and **4** are connected with the bus bars **1** and **2** and are connected with each other via a feedthrough bushing **5**. Circuit breakers **3** and **4** are connected with an open-air terminal **7** via a

feedthrough bushing 6. The open-air terminal 7 may also be a feeding point for the bus bars 1 and 2.

A grounded metal encapsulation 10 of the high-voltage switching system forms a uniform gas space filled with sulfur hexafluoride at an overpressure of 0.5 kg/cm². Outside of the metal encapsulation 10, the metal housing 12 of an overvoltage arrester 13 is arranged. The overvoltage arrester 13 is electrically connected on the one hand via a bushing with the open-air terminal 7, and on the other hand, via its housing, with a ground terminal 14. The housing 12 of overvoltage arrester 13 is grounded and contains a spark gap 15 and voltage-dependent resistors 16 in series. Housing 12 is connected with the encapsulation 10 of the high-voltage switching system via a gas line 17. Housing 12 is also provided with a rupture diaphragm 18 which releases an exit opening in the event that the arrester fails, and thereby prevents the housing 12 from bursting.

In the gas line 17 is arranged a valve 20, which is normally open. The separate housing 12 of the overvoltage arrester 13 is, therefore, filled with sulfur hexafluoride at the same pressure as that in the encapsulation 10. Thus, the breakdown characteristic of the spark gap 15 of the overvoltage arrester 13, which is a function of the gas and the pressure, is matched to the high-voltage switching system. Nevertheless, the overvoltage arrester can function without influencing the encapsulation 10, such as by opening its housing 12 in the event of an overload, without causing contamination of the gas in the encapsulation 10.

According to one embodiment, the valve 20 comprises a flow-dependent check valve which prevents the gas from flowing out from the encapsulation 10 via the housing 12 of the overvoltage arrester 13. It is assumed here that the gas line 17 between the housing 12 and the encapsulation 10 itself has so large a flow resistance that a pressure wave generated when the arrester 13 responds cannot push contaminated gas into the encapsulation. Instead of this simplest embodiment of the invention, however, other embodiments of the valve 20 described above can also be chosen.

According to another embodiment of the invention, the valve 20 comprises a pressure-dependent valve which closes the gas line when either the pressure drops below a certain absolute value, or when a definite pressure difference exists between the housing 12 and the encapsulation 10.

According to a further embodiment, the valve 20 comprises an electrically controlled valve which is closed in dependence on an electric current flowing through the arrester 13. The current for controlling a magnet coil 22 which actuates the valve is obtained via a transformer 23 which is placed around the ground line 14 of the overvoltage arrester 13, as indicated in the figure by dashed lines.

Although the above description is directed to the preferred embodiments of the invention, it is noted that other variations and modifications will be apparent to those skilled in the art and, therefore, may be made without departing from the spirit and scope of the present disclosure.

I claim:

1. A metal-clad high-voltage switching system, comprising:

a metal encapsulation enclosing the high voltage switches of the system, said encapsulation forming a gas space filled with a gas, heavier than air, which is under pressure;

an overvoltage arrester consisting of a separate housing providing a spark gap therein as an overvoltage protection for the switching system, said separate housing being arranged outside of said encapsulation and filled with a heavy gas, and said separate housing being connected with said gas space of the encapsulation by means of a small pressure equalization opening; and

a valve-controlled gas line for directly connecting the interior of said separate housing with the gas space of said encapsulation by means of said pressure equalization opening, including a voltage overload responsive valve for controlling the flow of said gas between said arrester housing and said encapsulation, said valve closing said gas line and preventing flow of said gas from said encapsulation to said arrester housing upon the occurrence of a voltage overload of said overvoltage arrester.

2. A metal-clad high-voltage switching system as recited in claim 1, wherein said valve comprises a flow-dependent valve.

3. A metal-clad high-voltage switching system as recited in claim 1, wherein said valve comprises a pressure-dependent valve.

4. A metal-clad high-voltage switching system as recited in claim 1, wherein said valve comprises an electrically controlled valve, said valve being operated as a function of a current flowing through said overvoltage arrester.

5. A metal-clad high-voltage switching system as recited in claim 1, wherein said gas line is attached to grounded portions of said separate housing.

6. A metal-clad high-voltage switching system as recited in claim 1, wherein said gas is sulfur hexafluoride.

7. A metal-clad high-voltage switching system as recited in claim 1, wherein said separate housing includes a rupture diaphragm which releases an exit opening in the event said over-voltage arrester fails, thereby preventing said housing from bursting.

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