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[54] HIGH VOLTAGE CIRCUIT BREAKER

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[51] **Int. Cl.**.....**H01h 33/54**

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

200/148 R, 150 R

[56] **References Cited**

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3,075,060 1/1963 Strom.....200/148 D

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1,133,067 11/1968 Great Britain.....200/148 E

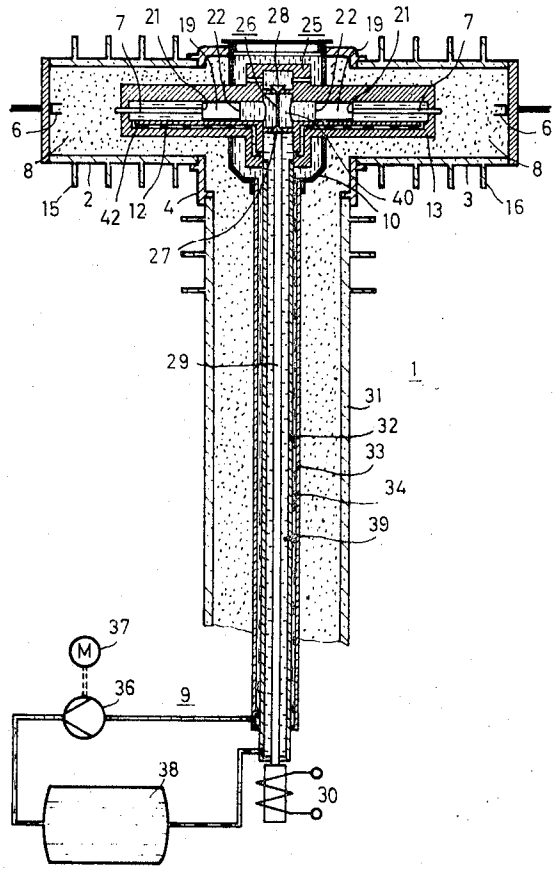
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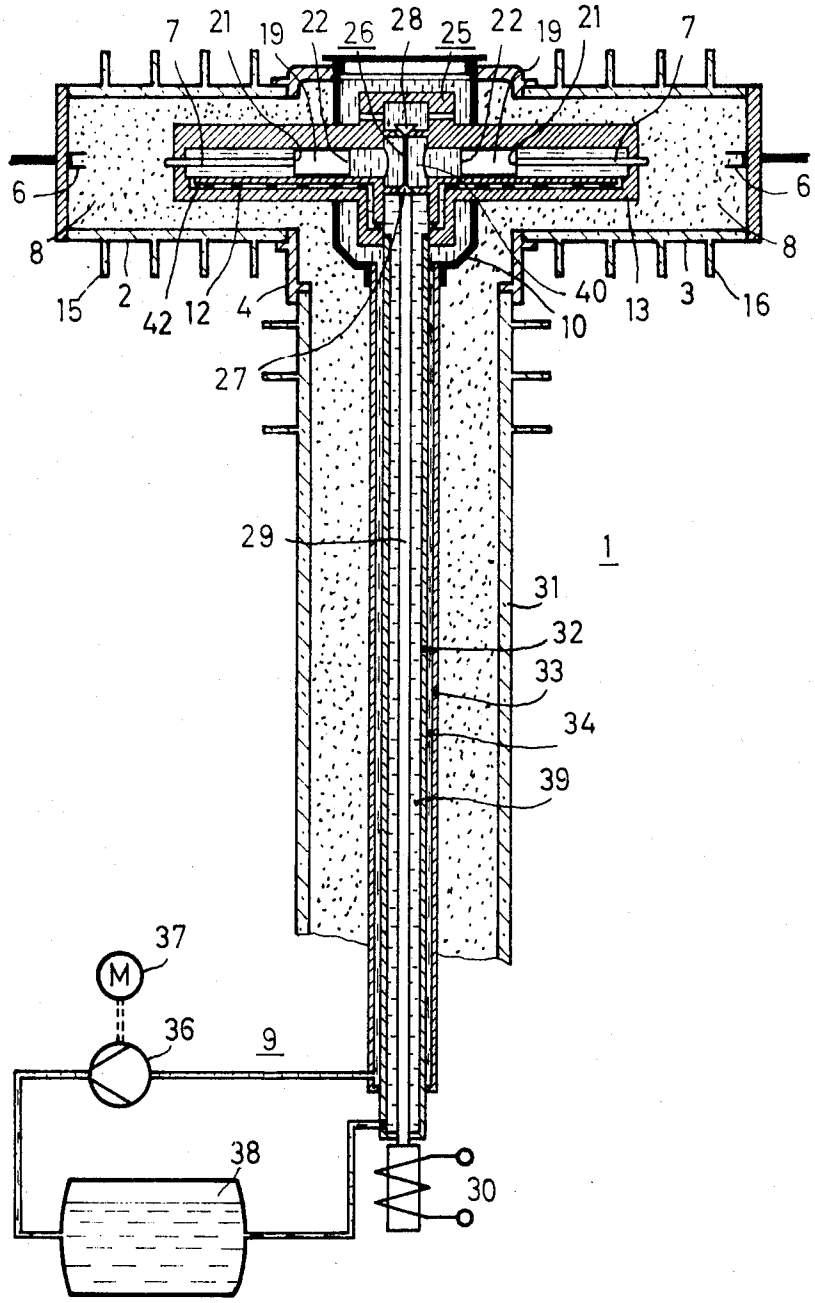
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[57] **ABSTRACT**

In high voltage circuit breakers with a hydraulic actuator, the lines of which consist of insulating material and lead through sulfur hexafluoride, the problem exists that the lines can be attacked by the decomposition products of the sulfur hexafluoride SF_6. This has been prevented by surrounding a high pressure hydraulic line by a low pressure hydraulic line. The low pressure line consists of insulating material which is insensitive to decomposition products of the sulfor hexafluoride, while the high pressure line consists of glass fiber reinforced insulating material. The invention is particularly suitable for high power circuit breakers.

2 Claims, 1 Drawing Figure




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HIGH VOLTAGE CIRCUIT BREAKER

High voltage circuit breakers and especially high power circuit breakers are known which use sulfur hexafluoride as the quenching and/or insulating medium, and a hydraulic actuator. If the actuator is directly at the contacts in order to keep the masses to be moved small, the hydraulic lines go from grounded parts to parts at high voltage potential. These lines can be made of insulating material and can be brought through a hollow standoff insulator, which contains sulfur hexafluorode, as is described for instance, in U.S. Pat. No. 3,075,060.

Difficulties can arise in circuit breakers of this kind because decomposition products of the sulfur hexafluoride attack many insulating materials and thereby reduce the mechanical and also the electrical strength. Attempts to prevent this by filtering the sulfur hexafluoride. Rapid and complete filtering, however, requires very large filters. Attempts have also been made to find insulating materials, which are impervious against decomposition products of the sulfor hexafluoride. Insulating materials known for this purpose, however, have only limited mechanical strength. This mechanical strength, although perfectly satisfactory for the gas pressures common in SF_6 circuit breakers with less than **20** atmospheres, is unsatisfactory for the substantially higher requirements in hydraulic systems with pressure of approximately 300 atmospheres.

It is an object of the present invention to provide a high voltage circuit breaker wherein the described problems are simply and inexpensively solved. According to the invention, a high pressure hydraulic line is surrounded in a low pressure hydraulic line. The low pressure line consists of insulating material which is impervious against attacks of the sulfur hexafluoride decomposition products while the hydraulic high pressure line consists of a glass fiber reinforced insulating material.

In the circuit breaker according to the invention, the insulating material of the high pressure hydraulic line, which is mechanically the most stressed, does not at all come into contact with the sulfur hexafluoride as this line is completely shielded by the low pressure hydraulic line. In addition, to this shielding against the decomposition products, there is the further advantage of insensitivity of the arrangement against slight leakages of the high pressure line as such leakages leak from there only to the low pressure pipe and not directly to the interior of the circuit breaker.

The low pressure pipe of the hydraulic system is stressed, if at all, only by low pressure which is caused, for instance by the fact that one wishes to prevent the generation of gas bubbles in the hydraulic system. Therefore, one can use as the insulating material tubing that confines the low pressure oil, a SF_6 resistant insulating material with very low mechanical strength. Among these are numbered, for instance, plastic materials with polyester fibers as the reinforcing material, which is processed with epoxy resin in the form of thermosetting slur-free fibers. However, polyester plastics which are fabricated directly, for instance by injection molding, can also be considered and, as far as the mechanical requirements can be satisfied, tubing of polytetrafluorethylene.

In a preferred embodiment of the invention, the high pressure hydraulic line encloses an actuator rod consisting of a glass fiber reinforced insulating material for a valve at high voltage potential. The rod is thereby also protected against attack by SF_6. It can, therefore, be made of high quality mechanical material and be designed with low mass.

In order to explain the invention in more detail, an embodiment example will be described with the aid of the Drawing, which is a schematically simplified representation.

The high voltage power circuit breaker **1**, for example 220 kV, has two switching chambers **2** and **3**, which are supported by a metallic drive or actuator housing **4**, and are electrically connected in series. The two switching chambers **2,3** are identical. They each contain a fixed contact **6** which, in closed position, cooperates with a movable contact pin **7**. The arc which occurs during the opening of the breaker is extinguished by the sulfur hexafluoride of, for instance, 5 atmospheres pressure, which fills the interior **8** of the switching chambers. The sulfur hexafluoride can be directed in a manner known, per se, against the breaking arc by blowing devices (not shown) which consist of pistons and cylinders. The blowing devices and the contact pins **7** are actuated by a hydraulic actuator system **9**.

A metal vessel **10**, from which two cylinders **12** and **13** protrude into the insulators **15** and **16** of the switch chambers **2** and **3**, is located in the breaker head (actuator housing) **4**. Drive pistons **19**, connected with the movable contact pin **7**, slide within the respective cylinders **12** and **13**. The pistons **19** are differential pistons. The cross-sectional area **21**, near contact pin **7**, is smaller than the piston area **22**.

The metal vessel **10** constitutes a low pressure tank at high voltage potential for the hydraulic fluid used to drive the piston **19**. It contains a combined inlet-outlet valve, designated in its entirety with **25**, for the control of the hydraulic actuation. Included in the valve **25** is a movable valve member **26** with a valve head **27** for the inlet side and a valve head **28** for the outlet side. Both valve heads are connected via an insulating rod **29** with magnetic drive **30**, which is at ground potential, as it is arranged at the grounded chassis, how shown in detail, of the circuit breaker **1**, by which the breaker head **4** is supported via a hollow standoff insulator **31**.

The rod **29** of insulating material, which is situated at the axis of the hollow cylindrical standoff insulator **31**, filled with sulfur hexafluoride, consists of glass fiber reinforced insulating material. The rod runs through a hydraulic high pressure pipe **32**, which is also made of glass fiber reinforced laminated material of high mechanical and electrical strength.

The tube **32** of insulating material is concentrically surrounded by tube **33** of insulating material, consisting of a laminated material based on an electrically high grade epoxy resin with polyester fibers as the reinforcing material. The insulating material tube **33** is impervious to attacks by decomposition products of the sulfur hexafluoride, so that it does not lose its good electrical properties even if exposed to the action of SF_6.

The annular space **34** between the insulating material tubes **32** and **33**, serves as the hydraulic low pressure line by which the low pressure vessel **10** is connected with a pump **36** at ground potential. The pump **36**, driven by motor **37**, delivers the hydraulic fluid into

reservoir hydraulic **38**, which also is at ground potential and is connected via the interior **39** of the insulating material tube **32** with valve **25** at high voltage potential.

The circuit breaker **1** is shown in the open position. In order to close it, magnet **30** is energized. Valve member **26** is thus moved downward. Valve head **28**, thereby, closes the outlet to the low pressure tank **10**. Valve head **27** simultaneously opens connecting high pressure tube **32** with the interior **40** of the valve. The high pressure fluid pushes the pistons **19** away from the valve **25**, so that the contact pins **7** come into contact with the fixed contacts **6**. The circuit through the breaker is thereby closed, which runs through the two switching chambers **2** and **3** and the metallic drive head **4**.

To open the switch, the movement of insulating material rod **29** is reversed. For this purpose, magnet **30** can be deenergized. It is also possible, however, to utilize the force of the hydraulic fluid for actuating the valve **25** by suitable design of the exposed parts of the valve member **26**. It is important that the large area **22** of the differential pistons **19** is now in connection with the interior of the low pressure vessel **10**, so that the high pressure oil conducted through lines **42** to the smaller piston area **21** can open the circuit breaker **1**.

As is seen the sulfur hexafluoride in the standoff insulator of the circuit breaker comes into contact only with the outer tube **33** of insulating material. This tube is under mechanical stresses only very little. With the hydraulic fluid contained in the ring space **34**, the tube shields the insulating material tube **30** so that this tube can consist of mechanically high grade glass fiber reinforced plastic material. The actuator rod **29** for the valve **26**, which is commonly stressed only in tension, is also protected by the oil of the hydraulic piston, so that similarly a mechanically high grade, low mass material can be chosen.

What is claimed is:

1. In a high voltage circuit breaker, with a hydraulic actuator, the lines of which consist of insulating material and lead through sulfur hexafluoride, the improvement which comprises surrounding a high pressure hydraulic line by a low pressure hydraulic line, said low pressure line consists of insulating material which is impervious to attacks by the decomposition products of the sulfur hexafluoride, and the high pressure line consists of glass fiber reinforced insulating material.

2. The high voltage circuit breaker of claim **1**, wherein the high pressure hydraulic line surrounds an actuator rod consisting of glass fiber reinforced insulating material for a valve at high voltage potential.

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