United States Patent

[11] **3,566,062**

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[54] **HEATER ARRANGEMENT FOR SF-6 CIRCUIT BREAKERS**
6 Claims, 4 Drawing Figs.

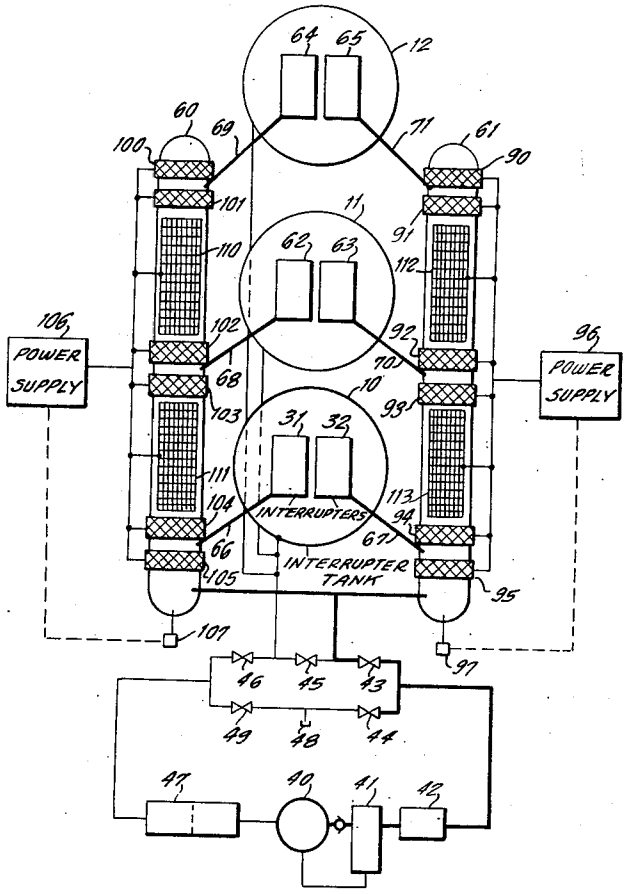
[52] **U.S. Cl.** **200/148,** 200/148, 200/145
[51] **Int. Cl.** **H01h 33/80**
[50] **Field of Search** ..... 200/148.5, 148.2, 148 (D&A)

[56] **References Cited**
UNITED STATES PATENTS

2,955,182	10/1960	Caswell et al.	200/148(.5)
3,118,995	1/1964	Colclaser, Jr. et al.	200/148
3,137,777	6/1964	Yeckley et al.	200/148
3,303,310	2/1967	McKeough et al.	200/148(.2)
3,358,104	12/1967	Cromer et al.	200/148
3,359,390	12/1967	Frowein	200/148(.5)

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ABSTRACT: Heaters are disposed uniformly over the exterior of high-pressure sulfur hexafluoride tanks which supply high-pressure sulfur hexafluoride gas to three interrupter tanks, which contain interrupter structures. A gas recirculating system is provided for drying and cleaning gas which circulates between a high-pressure and low-pressure system.



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SHEET 1 OF 3

FIG. 1.

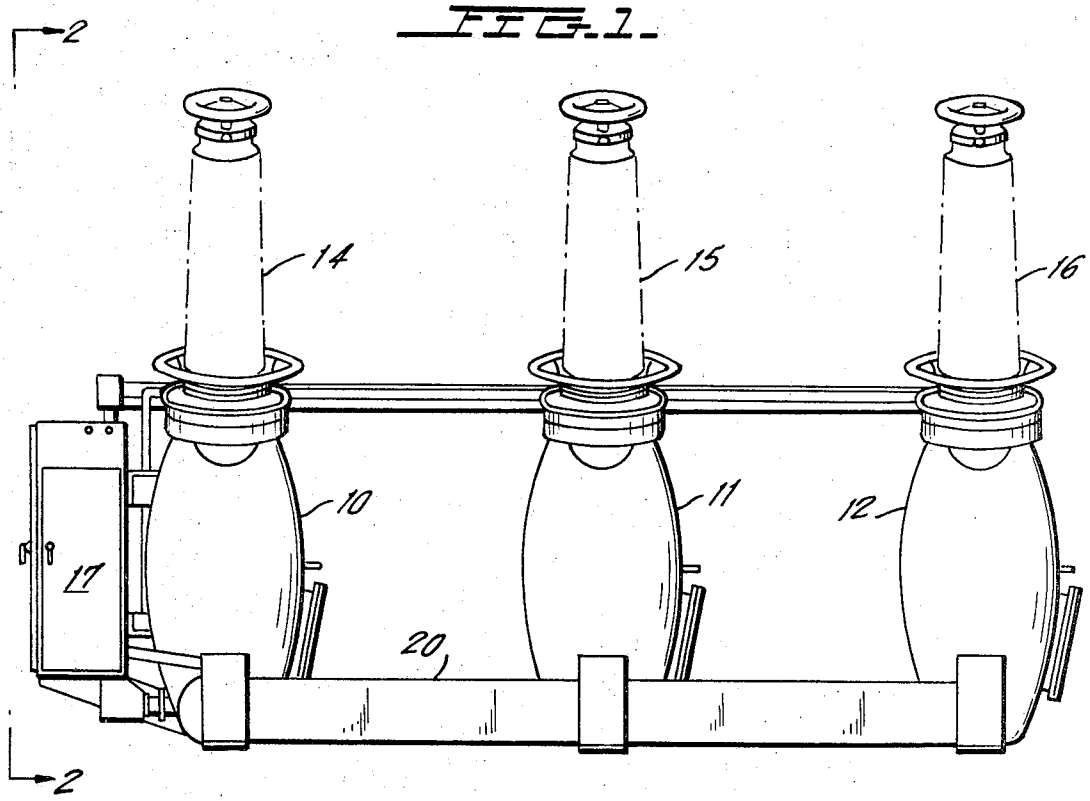
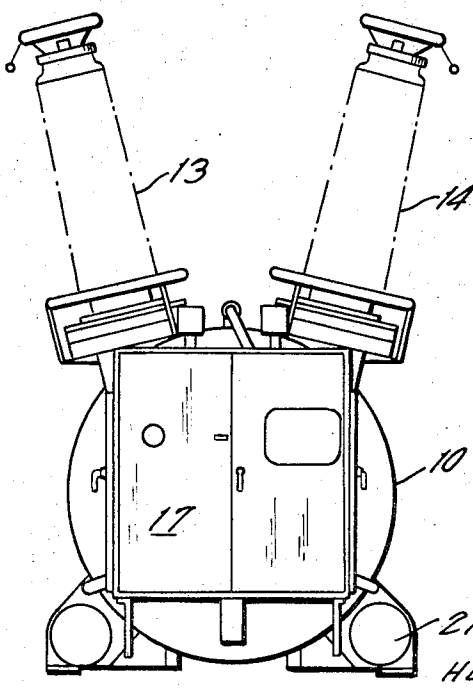


FIG. 2.

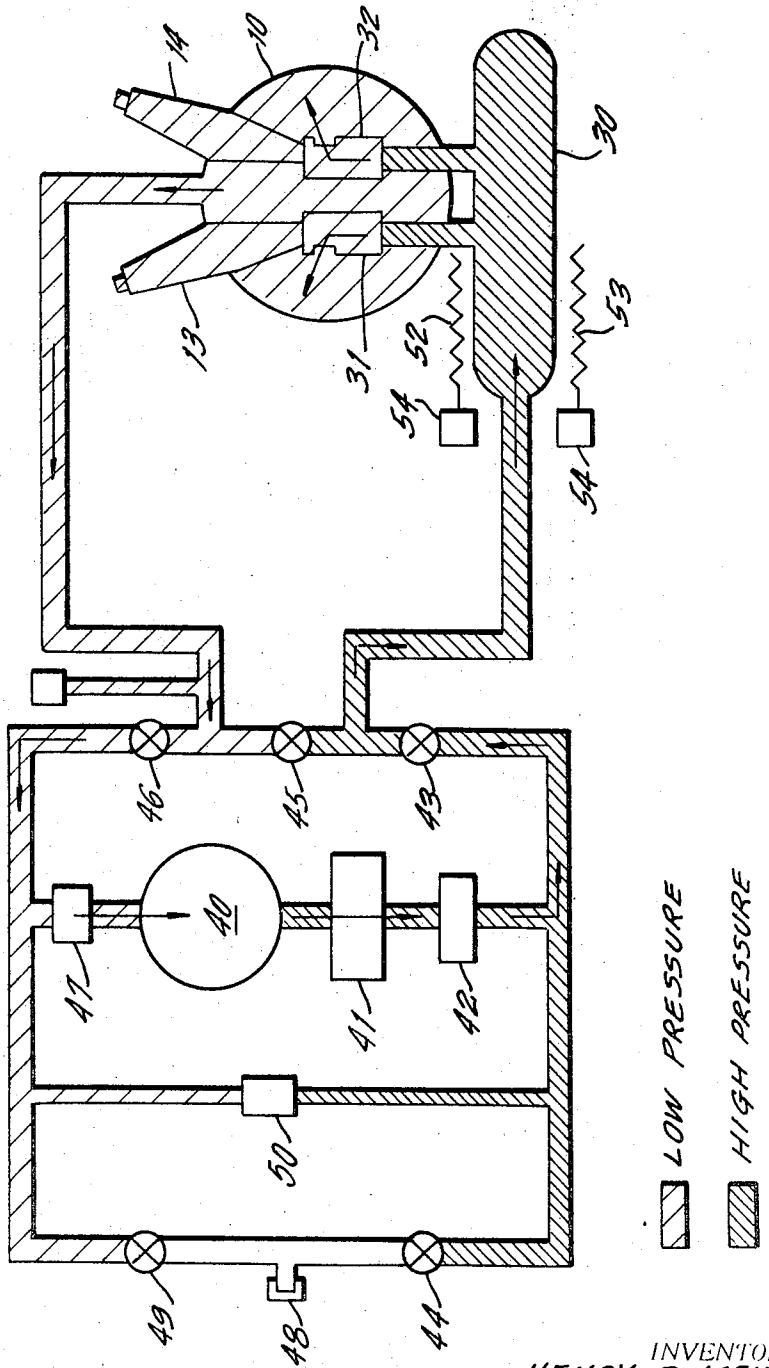


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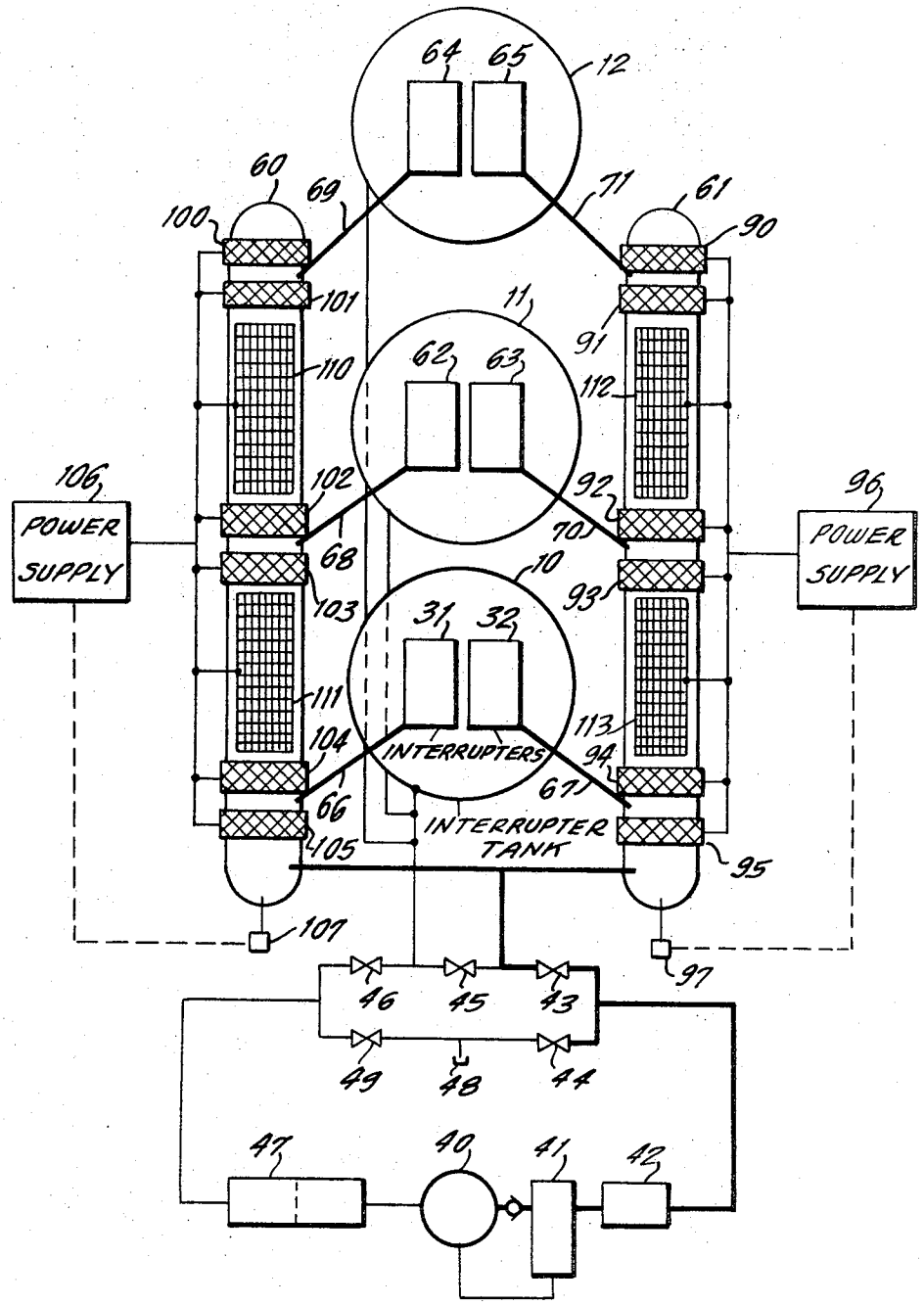
FIG. 2.



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FIG. 4.



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HEATER ARRANGEMENT FOR SF-6 CIRCUIT BREAKERS

RELATED APPLICATIONS

This application is for use with gas blast circuit interrupters of the type described in copending application Ser. No. 680,778, filed Nov. 6, 1967, in the name of John H. Golota, and assigned to the assignee of the present invention.

BRIEF SUMMARY OF INVENTION

This invention relates to sulfur hexafluoride gas interrupters, and more particularly relates to a novel means for heating the high-pressure reservoir tanks for such devices to prevent condensation of the gas by maintaining the gas temperature above its condensation temperature regardless of ambient temperature conditions.

It is well known to use sulfur hexafluoride for interrupters where the sulfur hexafluoride at relatively high pressures is an excellent dielectric medium for interrupting arcs and for maintaining a high dielectric between conductive components at different potentials. A major difficulty with sulfur hexafluoride is that it must be used at relatively high pressures, for example, 10 atmospheres. At such pressures, the gas tends to condense at ambient temperatures which can be easily reached in service conditions. For this reason, it is necessary to heat the gas since it loses its desired dielectric properties when in a liquid condition. The high-pressure reservoirs for the gas are commonly elongated cylinders which are connected to interrupter structures within a low-pressure tank. In the past, a heater structure has been placed within the high-pressure tank and the tank has been tilted toward the heater so that liquefied sulfur hexafluoride would flow toward the heater and thus be converted to its gaseous state. Thus this arrangement has the disadvantage of permitting the liquefaction of gas and has the further disadvantage of making the heaters relatively inaccessible since they are in the interior of the high-pressure tank.

In accordance with the present invention, heater bands or heater blankets are distributed along the length of such tanks to uniformly heat the exterior and interior of the elongated tank, thereby to prevent liquefaction (due to cold spots) within the tank. Moreover, these heaters are applied to the exterior of the tank so that they are easily accessible for maintenance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation of a circuit breaker of the type to which the present invention may apply.

FIG. 2 is a side view of the circuit breaker of FIG. 1.

FIG. 3 schematically illustrates the gas system for a typical phase of the circuit breakers of FIGS. 1 and 2.

FIG. 4 schematically illustrates the manner in which heaters are applied to the high pressure reservoirs of FIGS. 1 to 3 in accordance with the present invention, and further schematically illustrates the gas system of FIG. 3.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring first to FIGS. 1 and 2, there is shown therein a three phase gas circuit breaker which consists of three low-pressure tanks 10, 11 and 12, one for each phase, where each tank is provided with two terminal bushings. Tank 10 in FIGS. 1 and 2 is seen to have terminal bushings 13 and 14, while the terminal bushings 15 and 16 are seen in FIG. 1 for tanks 11 and 12. A control cabinet 17 is provided, as shown in FIGS. 1 and 2, and provides the various controls and compressors, and the like, required for the operation of the interrupters contained within tanks 10, 11 and 12 and for the operation of the gas system as will be described later.

Two elongated tanks are then contained within enclosures 20 and 21 which receive high-pressure gas which is to be connected to the interrupters contained within tanks 10, 11 and 12 and which are heated in accordance with the present invention. Details of the construction of the interrupters are disclosed in the aforementioned copending application Ser. No. 680,778.

FIG. 3 schematically illustrates high-pressure tank 30 which might be contained within one of housings 20 or 21 in connection with the housing 10 for the first phase of the circuit breaker of FIGS. 1 and 2. It will be noted that the tank 10 contains two schematically illustrated interrupters 31 and 32 which are connected to the schematically illustrated bushings 13 and 14. In FIG. 3, the darkened regions represent high-pressure gas while lightly colored regions represent low-pressure gas. The gas system includes a compressor 40 having a high-pressure side connected to an oil filter and trap 41 and a gas dryer 42. From the gas dryer 42 the high-pressure gas flows through shutoff valve 43 which is normally open and into the main tank 30. The high-pressure gas from dryer 42 is normally isolated from the low-pressure system by the normally closed shutoff valves 44 and 45.

Gas blast valves of the type described in copending application Ser. No. 680,778 are provided for interrupters 31 and 32 to normally terminate the high pressure below interrupters 31 and 32. The low-pressure system extends from the interior of tank 10 through the normally open shutoff valve 46 through a filter-dryer 47 and back to the compressor 40. A service connection 48 is also provided which is connected to the system through valve 44 and a valve 49 in the low-pressure system. Safety relief valves 50 and 51 are also provided as shown.

FIG. 3 further schematically shows resistance heaters 52 and 53 which cooperate with the main gas reservoir 30 to keep the gas above its condensation temperature. Thermostats 54 and 55 are provided for heaters 52 and 53, respectively.

During the operation of the circuit breaker, the gas blast valves associated with interrupters 31 and 32 are opened (not shown), thereby connecting high-pressure gas to the interrupter chambers in order to force gas through the separating contacts of the interrupters (not shown). This gas is shut off by the closing of the blast valve after the interruption of the circuit, with compressor 40 maintaining the desired pressure differential between the high and low-pressure gas systems.

FIG. 4 schematically illustrates the novel arrangement of heaters for tanks 60 and 61 which are contained within housings 20 and 21 of FIGS. 1 and 2. Note that appropriate insulation may be provided between the housings 20 and 21 and the main high-pressure tanks 60 and 61. In FIG. 4, the tanks 10, 11 and 12 are schematically illustrated as are the interrupters 31—32 of tank 10 and the interrupters 62—63 of tank 11 and the interrupters 64—65 of tank 12.

The heavy solid lines of FIG. 4 indicate high-pressure gas connections. Thus it is seen that interrupters 31 and 32 are connected to tanks 60 and 61, respectively, by high-pressure connectors 66 and 67, respectively. Similar high-pressure connectors 68 and 69 make high-pressure connection between tank 60 and interrupters 62 and 64, while connectors 70 and 71 connect the high-pressure gas of tank 61 to interrupters 63 and 65.

The gas system shown in FIG. 4 corresponds generally to that shown in FIG. 3 wherein compressor 40 has its high-pressure side connected through oil filter and trap 41, dryer 42, valve 43, and thence to the interior of tanks 60 and 61. The low-pressure side of compressor 40 is connected through the filter-dryer 47, valve 46, to a low-pressure conduit 80 which is connected to the interiors of tanks 10, 11 and 12. The novel heater arrangement then consists of circular band heaters 90—91 disposed on either side of the connection to conduit 71; band heaters 92—93 connected on either side of the connection to conduit 70; and band heaters 94—95 connected on either side of the connection to conduit 67. These band heaters consist of any desired electrical resistance heater which may be connected to power supply 96 as schematically illustrated. The power supply 96 is then actuated from a suitable thermostat 97 or from a plurality of thermostats disposed along the length of the tank 61 so that power is applied to the

various band heaters **90** to **95** as required by ambient temperature conditions. It will be apparent that this novel placement of band heaters in regard to their axial displacement along the length of the tank will insure uniform heating of the gas within the tank.

A similar disposition of heaters is provided for tank **60** and includes the band heaters **100** to **105** and their respective power supply **106**. Power supply **106** is operated from thermostat **107**. If desired, it is possible to drive heaters **90—100**, **92—102** and **94—104** from one power supply and the other band heaters from the second power supply. This will insure proper heat distribution even though one power supply may fail. It will also be observed that the circular band heaters are wrapped completely around the exterior surface of the high-pressure tanks and are accessible for maintenance without the need for obtaining access to the interior of the high-pressure tanks.

FIG. **4** shows the further placement of blanket-type heaters **110—111** for tank **60** and **112—113** for tank **61**. The use of such blankets further improve the distribution of heat to the length of the tanks **60** and **61**, with these blankets being appropriately driven from power supplies **96** and **106**.

Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited not by the specific disclosure herein, but only by the appended claims.

We claim:

1. In a gas blast circuit breaker; first, second and third interrupter structures connected to first, second and third phases of an electrical system; gas pressure supply means for said first, second and third interrupter structures for supplying thereto sulfur hexafluoride under greater than atmospheric pressure; said gas pressure supply means including a main elongated hollow cylinder containing said sulfur hexafluoride and first, second and third conduits connected between the interior of said main elongated hollow cylinder to a respective interrupter of said first, second and third interrupters; said first, second and third conduits connected to said cylinder at axial regions thereof generally adjacent its first end, its center end and its opposite end, respectively; and a plurality of heater bands encircling the exterior of said cylinder and axially spaced along the axis of said cylinder for generally uniformly heating the gas within said cylinder.

2. The circuit breaker of claim **1** wherein said plurality of heater bands include first, second and third bands directly adjacent said first, second and third conduits.

3. The circuit breaker of claim **1** which includes a power source for energizing said heater bands and thermostat means connected to said cylinder for controlling said power source.

4. The circuit breaker of claim **2** which further includes heater blanket means disposed between said first and second heater bands, and between said second and third heater bands.

5. The circuit breaker of claim **2** which includes first and second band sections for each of said first, second and third bands, respectively.

6. The circuit breaker of claim **5** which includes first power supply means connected to said first band section of each of said first, second and third bands and second power supply means connected to said second band section of each of said first, second and third bands.