PARTITIONED GAS-FILLED ELECTRICAL APPARATUS

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This invention relates to gas-filled electrical apparatus, and more particularly to gas-filled electrical apparatus in which it is desired not to affect the integrity of one portion of the gas-filled apparatus by a leakage failure in another portion of the apparatus. Specifically, the invention is concerned with gas-filled electrical apparatus having partitions which compartmentally divide the electrical apparatus into separate gas-filled chambers. The invention has particular applicability to gas-filled circuit-breaker and circuit-releas ing structures.

It is known to fill the casing of an electric circuit interrupter with a gaseous arc-extinguishing medium, for example, sulfur hexafluoride (SF₆) or selenium hexafluoride (SeF₆). It is a general object of the present invention to improve such gas-filled circuit interrupters. According to the invention, the gas-filled circuit interrupter is subdivided into a plurality of closed chambers, such as an interrupting chamber, an actuating chamber or an insulating supporting enclosure, which communicate with each other only through provided valves.

The invention provides the advantage that if there is a leak in a portion of the interrupter casing, the gas will escape only from that portion of the interrupter which has developed such a leak; and no gas will escape from the cooperating adjacent disposed spaces, or chambers. In addition, the invention has the particular advantage that those parts, or portions of the circuit interrupter which are not affected by the leak will continue to function in their normal fashion as far as their operation is dependent upon the gaseous extinguishing medium, such as performing their interrupting function or their insulating function in a proper manner.

Since it is desirable for circuit interrupters employing a gaseous arc-extinguishing medium to have a maximum volume of extinguishing medium in order to keep the amount of gas, which is decomposed and consumed by the arc during the interruption of the circuit, at a minimum, in comparison to the total volume of the extinguishing medium, the valves should be so constructed that an exchange of gas among the individual chambers may take place. For example, the valves may be so arranged that they can be opened for a certain period of time after each circuit interrupting opening and closing operation. In a preferred embodiment of the invention, however, the valves are adapted to be normally open, and to be closed only upon the sudden development of a pressure differential between two adjacent chambers.

A closure means, or a closing valve, particularly suitable for the purposes of the invention, is obtained by inserting into the wall between two adjacent gas-filled chambers a partition plate which is provided with an aperture. Connected to the external portions of such plate, so as to provide a gas-tight connection therewith, is a resilient diaphragm, said diaphragm also being provided with one, or a plurality of openings therein. Preferably, these openings are so disposed that they do not register with the aperture provided in the partition plate. The manner of operation of the valves is as follows: A pressure differential between any of the adjacent chambers, separated from each other by said wall having the valve plate inserted therein, will cause the diaphragm to engage the plate, in abutting fashion, and thereby close the aperture therein. The force with which such engagement takes place is the product of the pressure differential between the pressures in the two adjacent chambers, and the cross-sectional area of the aperture in the partition plate. This force can readily be made sufficient to seal off the aperture in the partition plate.

Preferably, the sealing surface of the diaphragm and the plate near the aperture in the partition plate should be a raised surface. For this purpose, either the resilient diaphragm or the partition plate, or both of said parts may be provided with a raised portion, so that when said diaphragm is pressed against the partition plate, the resulting force will be concentrated upon a relatively small surface area. The specific contact pressures obtained thereby permit a perfect gas-tight sealing of the aperture within the partition plate.

The magnitude of the differential pressure at which the valve, designed according to the invention will respond, is, to close, can be varied by means of a spring disposed between the diaphragm and the partition plate, such that the spring is adapted to bias the diaphragm away from the plate. Thus, in order to press the diaphragm against the aperture in the plate, there is required to be a force, which is greater than the biasing spring. From this, it will be seen that the pressure differential, to which the valve will respond, can be predetermined by choosing a spring with the proper spring characteristics and consequently having the proper strength. While the valve described above will respond to a pressure gradient in only one direction, that is, if the pressure at the side of the plate remote from the diaphragm is lower than the pressure at the side of the plate provided with the diaphragm, the valve, or closure, may also be designed so as to be responsive to a pressure differential regardless of the direction of the pressure gradient. Such a valve would have a diaphragm on both sides of the partition plate, which two diaphragms may be identical.

From the foregoing, it will be apparent that it is an object of the invention to provide improved gas-filled electrical apparatus in which a loss of pressure at one portion of the gas-filled apparatus will not result in a complete loss of pressure throughout the entire apparatus.

Another object of the invention is to provide electrical apparatus having partition means separating the electrical apparatus into a plurality of gas-filled portions, with closure means associated with the partition means, such that a loss of gas pressure in one portion of the gas-filled apparatus will not be effective to result in a complete loss of gas pressure throughout the entire apparatus.

A more specific object of the present invention is to improve the effective and reliable operation of gas-filled power circuit interrupters of the type enclosing a suitable arc-extinguishing and dielectric gas, such as SF₆ or SeF₆.

Another object of the present invention is to provide an improved power circuit interrupter of the gas-filled type involving a pair of serially related activating chambers, in which valve-controlled partition means are provided so that should there occur a loss of pressure in one interrupting chamber, the associated serially related interrupting chamber will still remain effective to interrupt the controlled circuit.

A more specific object of the present invention is to provide an improved gas-filled circuit interrupting structure involving the valves and interrupting chambers, at least one actuating chamber, and at least a supporting chamber, all of which are gas-filled, in which apertured partition plates are provided between the adjacent chambers, com-
partamentally dividing the circuit interrupter into separate gas-filled regions, whereby a loss of pressure within one of said regions is effective to isolate the region which leaks, and to permit normal operation in the other regions by the closure of suitable valve means provided in the partitioned regions.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawing, in which:

FIGURE 1 is a somewhat schematic vertical sectional view through a gas-filled electrical apparatus, such as a portable circuit-cutting yoke, showing the contact structure thereof being shown in the partly open-circuit position:

FIG. 2 is a considerably enlarged, vertical sectional view through one of the valve arrangements employed to effect closure of the aperture of the partition means within the circuit interrupter of FIG. 1; and

FIG. 3 is a modified type of valve closure means, similar to that of FIG. 2, but responsive to a differential pressure extending in either direction.

With reference to FIG. 1, it will be noted that the circuit-interrupter casing is subdivided into four separate chambers. The two interrupting chambers 1 and 2, each of which contains a pair of separate contacts 7, 8, represent two of the four mentioned chambers. The other two chambers of the circuit-interrupting structure include the actuating chamber 3, which carries the interrupting chambers 1 and 2, and the insulating supporting casing 4, which supports the actuating chamber 3.

The rod-shaped movable contacts 9 may be lowered downwardly away from the stationary contacts 7 by rotation of a pair of actuating bell-cranks 5. The bell-cranks 5 are preferably stationary mounted, by any suitable means, to the side walls of the actuating chamber 3.

Links 9 pivotally connect the bell-cranks 5 to a horizontally extending yoke member 14, which is operated vertically, in a reciprocal manner, by an insulating operating rod 19. The lower end of the insulating operating rod 19 may be connected to any suitable operating mechanism, as shown.

As shown in FIG. 1, the individual chambers 1—4 communicate with each other through valves 6, as indicated in FIG. 1, any two of the individual chambers having associated therewith a pair of such valves. It is to be remembered, however, that the number of closure valves 6 employed is of significance only so far as a certain cross-sectional area of orifice can be obtained, either by providing one large valve, or a plurality of smaller valves. Smaller valves may be more simple to produce, and also may be more reliable in operation, so that it would be desirable to use a number of smaller valves instead of one large valve.

The valves, indicated in FIG. 1, are so constructed that they will move to their closed positions only in the presence of a pressure gradient acting in a certain direction.

As illustrated in FIG. 1, closure of the valves 6 will occur when the pressure gradient is in the direction of the interrupting chambers 1, 2. Thus, for example, if the interrupting chamber 1 develops a leak accompanied by a consequent pressure drop therein, this interrupting chamber 1 will be isolated from the other portions, or chambers of the circuit-interrupting structure by the valves 6, associated with interrupting chamber 1, whereby the gas pressure in the other chambers 2—4 will remain normal.

FIG. 2 shows, in enlarged fashion, one of the valves indicated in FIG. 1 in greater detail. With reference to FIG. 2, the valve, generally designated by the reference numeral 16, is inserted in a wall portion, indicated as the reference numeral 11. The valve 16 comprises the plate 12 consisting, for example, of sheet metal, and a flexible diaphragm 13, for example, formed of synthetic rubber. For reasons of simplicity in the manufacture of the plate 12, it may be formed with a circular shape, but may also have any other desired configuration. The partition plate 12 is provided with a centrally disposed communicating aperture 15, and the diaphragm 13 is positioned underneath the partition plate 12, as shown. As illustrated in FIG. 2, the diaphragm 13 is provided with a pair of openings 16 and 17. Mounted upon the diaphragm 13 is an annular valve member 18 preferably formed of an elastic material, the inner diameter of which is at least as large as the diameter of the aperture 15. A compression spring 20 is disposed between the diaphragm 13 and the plate 12, the compression spring being arranged to bias the diaphragm 13 downwardly away from the partition plate 12. As shown, the compression spring 20 is centered by the annular valve member 18.

The valve 16, hereinbefore described, functions as follows: If the pressure P1 above the partition plate 12 is substantially equal to the pressure P2 below the partition plate 12, the diaphragm 13 will be biased downwardly away from the partition plate 12 by the compression spring 20. In this position of the valve 16, a small flow of gas is permissible from the space above the partition plate to the space below the partition plate, as indicated by the arrows. If, however, the pressure in the space above the plate suddenly drop, as caused by a sudden leak, the diaphragm 13 will be pressed against the partition plate 12 after a short transitional period, in which the diaphragm 13 will be acted upon by suction forces. The contacting pressure thereby becoming effective will be equal to the pressure differential P1 minus P2, multiplied by the cross-sectional area F of the aperture 15. This contacting pressure, or force, acts upon the relatively small area of the annular valve member 18 engaging partition plate 12. This results in a high contact pressure resulting in hermetically sealing the aperture 15 provided in apature plate 12.

The gas at pressure P3, which enters the space 21 between partition plate 12 and diaphragm 13 through the openings 16 and 17 produces no force tending to move the diaphragm away from the partition plate 12. Therefore, the contact pressure is dependent only upon the pressure differential and the size of the aperture 15. In order to properly adjust the valve, the pressure gradient, a diaphragm 13 may be provided on each side of the partition plate 12, as illustrated in FIG. 3 of the drawing. As shown, this modified valve arrangement 22 may be perfectly symmetrical relative to the partition plate 12, so that either of the two diaphragms 13 will be pressed against partition plate 12 in order to close the aperture 15 in response to the same pressure differential. However, the two valve portions may also be designed to have different characteristics, for example, by providing springs 20 of different strengths between the two diaphragms 13 and the plate 12.

In this instance, the valve will be closed in response to pressure differentials which differ depending upon the direction of the pressure gradient.

From the foregoing description of the invention, it will be apparent that there is provided novel means for compartmentalizing gas-filled electrical apparatus in such manner that a loss of pressure in one compartment will not affect the normal functioning of other compartments of the same gas-filled apparatus. As shown in FIG. 2, the valve arrangements provided in the partition means may be effective in one direction, or, as shown in FIG. 3, the valve means may be provided to act in both directions depending upon which side of the partition loses its pressure.

The invention has particular importance when it is remembered that should one of the interrupting chambers lose its gas pressure, and hence might be ineffective to cause circuit interruption, nonetheless, the presence of the other interrupting chamber would be effective to cause circuit interruption.

Although there has been shown and described specific structures, it is to be clearly understood that the same
were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the invention.

We claim as our invention:

1. A gas-filled power circuit interrupter of substantially Y-shaped configuration comprising, in combination, a substantially enclosed hollow actuating chamber, an upstanding hollow supporting insulator for supporting said hollow actuating chamber up in the air an adequate distance above ground potential, a pair of divergently extending enclosed gas-filled serially-related interrupting chambers each of which has a pair of separable contact means disposed therein, each of the two interrupting chambers being invented, operating means disposed within said hollow actuating chamber for simultaneously effecting opening and closing movements of the two serially-related separable contact means, operating rod means extending upwardly through said supporting insulator to actuate said operating means, communicating passage means including an apertured partition plate between the hollow actuating chamber and each of the gas-filled interrupting chambers, and differential pressure-acting valve means including a valve having a raised portion adapted to surround the aperture in the partition plate upon valve closure whereby the valve seating pressure will be increased, the arrangement functioning to control the flow of gas through each communicating passage means, whereby loss of gas pressure through leakage in one interrupting chamber will effect closure of the respective valve means and so permit the remaining interrupting chamber to be effective in circuit interruption.

2. The combination of claim 1, wherein additional such passage means and such differential-pressure-acting valve means are provided between the actuating chamber and the hollow supporting insulator.

References Cited in the file of this patent

UNITED STATES PATENTS

2,219,408 Benz et al. Oct. 29, 1940
2,623,331 Greening Dec. 30, 1952
2,824,937 Strom Feb. 25, 1958
2,964,605 Schulz Dec. 13, 1960
2,981,815 Leeds et al. Apr. 25, 1961

FOREIGN PATENTS

1,156,275 France Dec. 9, 1957
1,182,791 France Jan. 19, 1959