

[54] **SILENCER FOR HIGH-VOLTAGE
GAS-BLAST CIRCUIT BREAKER**

[75] Inventors: **Wilhelm Krämer, Sandhausen;
Dieter Schnee, Mannheim, both of
Germany**

[73] Assignee: **Aktiengesellschaft Brown, Boveri &
Cie., Baden, Switzerland**

[22] Filed: **May 19, 1972**

[21] Appl. No.: **254,963**

[30] **Foreign Application Priority Data**

June 9, 1971 Germany..... P 21 28 632.8

[52] U.S. Cl. **200/148 C, 200/150 H**

[51] Int. Cl. **H01h 33/58**

[58] Field of Search **200/148 C, 148 R,
200/150 H**

[56] **References Cited**

UNITED STATES PATENTS

702,584 6/1902 Paquette..... 200/150 H

2,302,592 11/1942 Amer 200/148 C
2,807,329 9/1957 Caldwell 200/150 H
3,617,667 11/1971 Kirschner et al. 200/148 C

FOREIGN PATENTS OR APPLICATIONS

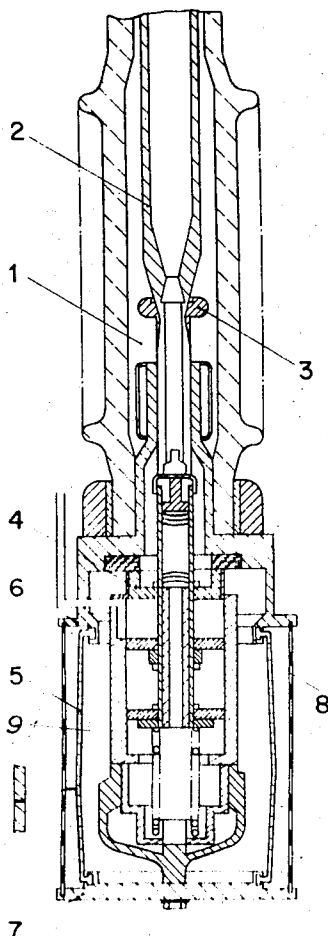
924,279 4/1963 Great Britain 200/148 C

Primary Examiner—Robert S. Macon
Attorney—Pierce, Scheffler & Parker

[57] **ABSTRACT**

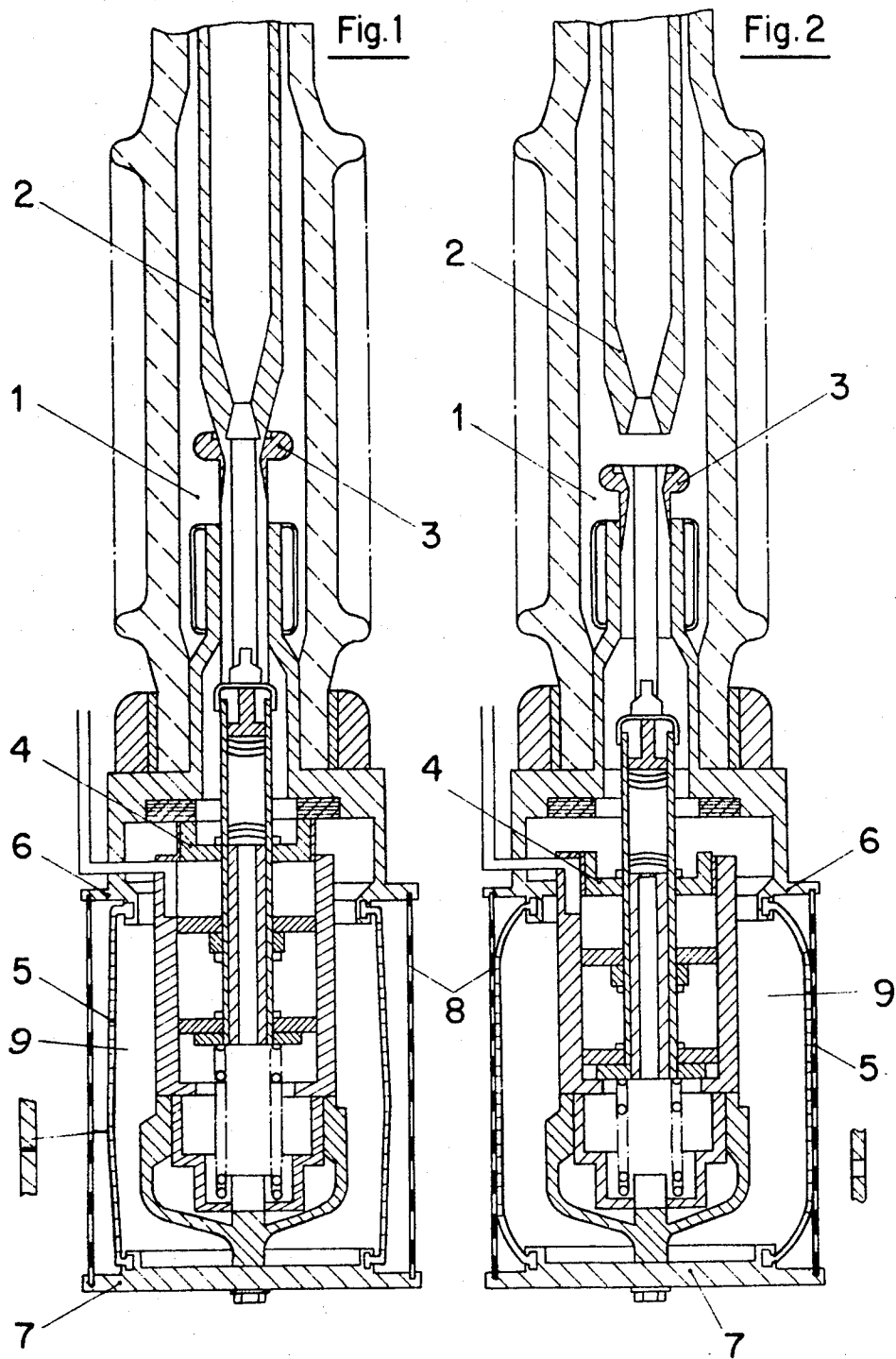
A silencer for a high-voltage circuit breaker of the gas-blast type includes an expansion chamber into which pressurized gas from the switch contact chamber flows after passing through one of the contact members and a discharge valve. The wall of the expansion chamber is at least partially constructed from a rubber-elastic material having pores which open only when back pressure builds up within the chamber thus appreciably silencing the gas as it escapes from the chamber into the surrounding atmosphere. In order to prevent damage to the expandable wall, its expansion is limited by enclosing it within a rigid perforated jacket.

7 Claims, 2 Drawing Figures



Patented July 10, 1973

3,745,285



SILENCER FOR HIGH-VOLTAGE GAS-BLAST CIRCUIT BREAKER

The present invention relates to an improved construction for a silencer for use in conjunction with high-voltage circuit breakers of the gas-blast type for the purpose of reducing the level of the noise created by discharge of the pressurized gas to the atmosphere after performing its work in blasting the arc generated by the circuit breaker contacts as they disengage. More particularly, the improved silencer structure features an expansion chamber for the gas, the wall of the chamber being made at least in part from a rubber-elastic material having pores which open up to pass the gas as back-pressure builds within the chamber.

Unless damped, pressure waves are built up in the gas and these lead to formation of explosive sounds as the gas escapes from the circuit breaker structure into the surrounding atmosphere. This is particularly so in the case where the circuit breaker is called upon to interrupt high-level currents, i.e., currents having short-circuit magnitudes, for the reason that the volume of the compressed gas, i.e., air, is greatly increased as a result of the intense heating imparted to it in the contact chamber by the arc created between the breaker contacts as they disengage.

Several measures have been disclosed in the past designed to reduce the noise level created by the escaping gas, this being necessary in the case of high-voltage gas-blast breakers since the noise level, undamped, has been known to reach approximately 140 decibels (dB) at a distance of 10 meters. The gas escaping from the nozzle contact member of the breaker is collected in a receiver and slowly expanded through small cross-sections after completion of the contact disengaging operation. An additional valve releases a larger cross-section to permit more rapid expansion of the gas present in the receiver when currents of short-circuit magnitude are interrupted. It is a disadvantage of such a silencing arrangement that due to lack of space in the case of outdoor switchgear installations, it is not possible for expansion volumes of the appropriate size to be positioned in the zones of the gas discharge apertures. Furthermore, special safety valves must be provided for interruption of short-circuit currents so that the expansion volumes may be rapidly exhausted in the event of a rapid switching sequence. The second contact interruption in a frequency occurring "off-on-off" switching sequence is performed practically without damping of the noise.

Another prior known expedient for reducing the noise level of the escaping gas is by way of an electromagnetic control of the discharge valve for the gas in dependence upon the level of the current to be interrupted by the breaker. However, this necessitates considerable expense in terms of the complicated control mechanism which becomes involved. Moreover, even this expedient is not entirely satisfactory and effects a reduction in the noise level only in the case of relatively low currents since the valve cross-sections must be fully opened for currents exceeding approximately triple the nominal current for which the circuit breaker is rated. Interruptions, in which the arc must be intensively blown due to the high current level, therefore must take place without any damping of the noise level.

It is also known to dispose an absorption silencer behind the discharge valve, such silencer containing min-

eral wool, steel wool or similar noise suppression materials. Such silencers are characterized by a very simple construction but their effect is insufficient. For example, the noise level achieved by such a silencer at a distance of 10 meters could be reduced only from approximately 135 dB to 125 dB in a known air-blast circuit breaker operating with an operating pressure of 22 atm gauge, so that the threshold of pain was exceeded despite the presence of the silencer.

It is therefore the principal object of the invention to avoid the disadvantages of known silencers for high-voltage gas-blast circuit breakers, that is to say, to provide a silencer which, although simply constructed, provides substantially improved reduction of the noise level which occurs during switching operations of such gas-blast circuit breakers.

The invention is based on a silencer for high-voltage air-blast circuit breakers, of novel construction featuring an expansion chamber through which the pressurized gas escapes to atmosphere, and is principally characterized in that the wall of the expansion chamber is at least partially constructed as a rubber-elastic membrane provided with pores which open as back pressure is built up within the chamber.

It is appropriate if the rubber-elastic membrane is disposed within a rigid, perforated vessel in order to limit the expansion of the membrane due to back pressure and thereby prevent possible damage to it due to excess expansion.

The silencer according to the invention is based on the principle that the sound power of a free nozzle is proportional to the square of the nozzle cross-section and the eighth power of air velocity. Since the air velocity may be reduced by a subdivision of a larger discharge cross-section into a large number of small cross-sections it will be clear that the noise level may be substantially reduced while the first shock wave is absorbed by the rubber-elastic expansion of the membrane.

It has been found possible to reduce the noise level at a distance of 10 meters from 140 dB by 90 dB, i.e., to 50 dB in a cylindrically constructed silencer according to the invention, having a length of approximately 40 cm and a diameter of 35 cm, and in which only the cylindrical side wall was constructed as a rubber-elastic membrane provided with many thousands of pores.

A preferred embodiment of the invention will now be described and is illustrated in the accompanying drawings wherein:

FIG. 1 is a view in central longitudinal section of a circuit breaker of the air blast type with a silencer attached thereto in accordance with the invention, this view showing the contact members and discharge valve in their closed positions, and

FIG. 2 is a view similar to FIG. 1 but with the contact members and discharge valve in their open positions.

With reference now to the drawings, the air pressurized chamber for enclosing the relatively movable, hollow contact members 2 and 3 is indicated at 1. A discharge valve, which opens when the contact members are disengaged so as to permit discharge of the pressurized air to blast the arc and flow through the interior of contact member 3, is indicated at 4 and is spring-loaded to its closed position as depicted in FIG. 1. However, when valve 4 is opened as the contact members 2 and 3 disengage, the air flows through contact member 3 and the open valve 4 into an essentially an-

nular expansion chamber 9 which surrounds the spring-load support mechanism of the discharge valve 4, the ends of this chamber being terminated by rigid flanged end walls 6 and 7. The silencer component in accordance with the invention is constituted by the cylindrical wall portion 5 of the expansion chamber 9 and is made from a rubber-elastic material clamped at its ends to flanges provided on the rigid end walls 6 and 7 of the chamber. The cylindrical rubber-elastic membrane can be made from a material sold by the Dunlop Company under the trade designation "Membran 15 .393." The principal characteristic of such material is that it contains a large number of very small pores which open to a significant extent only when the cylindrical membrane 5 is expanded by the back pressure which is built up after the valve 4 has opened. For example, a cylindrical membrane having a length of approximately 40 cm. and a diameter of approximately 35 cm. can have from 50,000 to 200,000 pores. As a minimum, there should be at least one pore per cm² of surface and the diameters of the pores, in the expanded state of the membrane are preferably smaller than 1 mm.

In order to avoid over-expansion and therefore possible damage to the membrane 5, it can be encased within a rigid cylindrical perforated jacket 8, the ends of which are likewise secured to the end walls 6 and 7. Jacket 8, which therefore serves to limit expansion of the cylindrical membrane 5, can be constructed from perforated plate material but can also be made from wire or from a grid, in the form of a cage.

In FIG. 1, and with the contact members 2,3 engaged, the rubber-elastic membrane 5 is depicted in its static state, i.e., at rest in a non-stressed position in which the pores are also closed. In FIG. 2, however, which depicts the contact members 2, 3 in their disengaged position and with discharge valve 4 open, pressurized air heated by the arc has already flowed into the expansion chamber 9 from the switch contact chamber 1 and has effected a bulge-like expansion of the rubber-elastic membrane 5 in essentially a radial direction which likewise effects opening of the pores therein so that the air can now escape through the pores into the surrounding atmosphere, becoming partly silenced in the process of so doing. Since expansion of the membrane 5 increases with the increase in back pressure, the cross-section of the pores which open as expansion takes place, also depends upon the pressure. Optimum

damping of the noise level therefore takes place at all times substantially independently of the pressure.

We claim:

1. A silencer for a high-voltage circuit breaker of the gas-blast type comprising an expansion chamber into and through which pressurized gas flows from the contact chamber of the circuit breaker as the contacts disengage, the wall of said expansion chamber being at least partially constructed from an expandable rubber-elastic material provided with a pore structure wherein the pores open as back pressure builds up within said expansion chamber and release the gas to the atmosphere.
2. A silencer as defined in claim 1 for a high-voltage circuit breaker of the gas-blast type and which includes a perforated rigid jacket surrounding the rubber-elastic wall portion of said expansion chamber to limit the expansion thereof.
3. A silencer as defined in claim 1 for a high-voltage circuit breaker of the gas-blast type wherein said rubber-elastic wall portion of said expansion chamber includes at least one pore per cm².
4. A silencer as defined in claim 1 for a high-voltage circuit breaker of the gas-blast type wherein the pores of said rubber-elastic wall portion of said expansion chamber are smaller than 1 mm. in the expanded state.
5. A silencer as defined in claim 1 for a high-voltage circuit breaker of the gas-blast type wherein said expansion chamber includes a cylindrical wall portion made from said rubber-elastic material and rigid end walls having flanges to which the opposite ends of said cylindrical wall portion are secured.
6. A silencer as defined in claim 5 for a high-voltage circuit breaker of the gas-blast type and which further includes a perforated jacket secured to the end walls of said expansion chamber and which surrounds said rubber-elastic cylindrical wall in radial spaced relation to limit radially outward expansion thereof.
7. A silencer as defined in claim 5 for a high-voltage circuit breaker for the gas-blast type and wherein said cylindrical wall portion of the rubber-elastic material surrounds and constitutes a housing for at least a part of the operating mechanism of valve means provided to control flow of the pressurized gas from said contact chamber to said expansion chamber.

* * * * *

50

55

60

65