

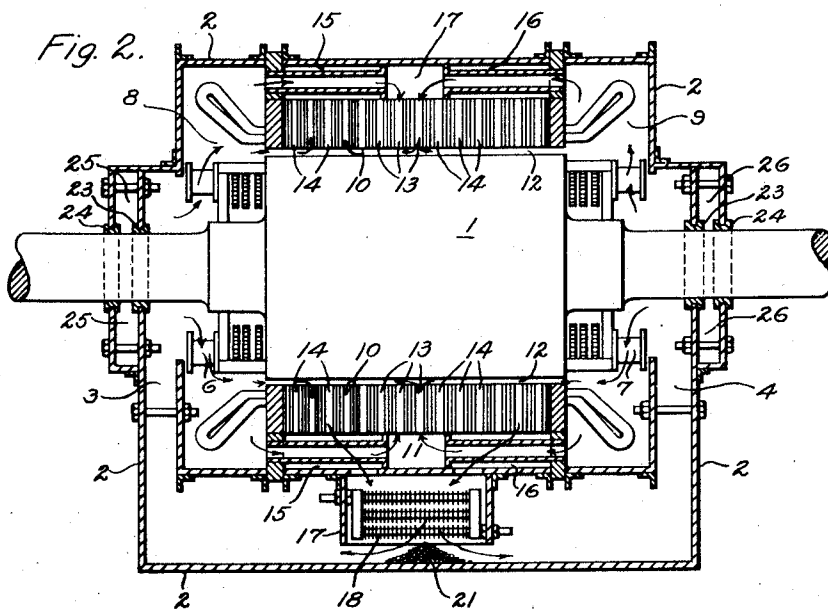
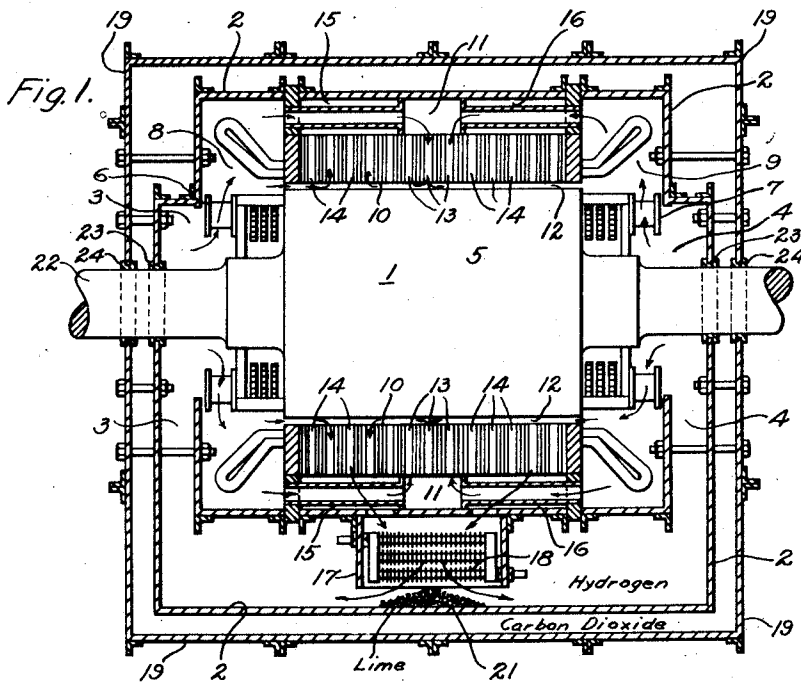
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INERT GAS PROTECTIVE CHAMBER FOR HYDROGEN COOLED MACHINES

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WITNESSES:

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INERT-GAS PROTECTIVE CHAMBER FOR HYDROGEN-COOLED MACHINES.

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My invention relates to the cooling or ventilation of dynamo-electric machines and it has particular relation to such machines having a closed ventilating system utilizing hydrogen or other gases which, if mixed with air in suitable proportions, would form an explosive mixture.

The utilization of hydrogen has obvious advantages as a cooling medium for completely enclosed generators equipped with a closed ventilating system, but, while its use has been discussed for the past several years, no practical application thereof has been made, principally because of the danger of explosion and fire.

In carrying out my present invention, I completely surround the generator, together with its ducts and the cooler, with a chamber in which can be maintained an inert gas, such as carbon dioxide or nitrogen, which is preferably maintained under a pressure somewhat above that of the atmosphere. With such an arrangement, any gas leaking into the machine will be an inert gas which cannot form an explosive mixture with the hydrogen that is utilized in the closed ventilating system of the machine.

In a modification of my invention, the inert gas chamber is limited to the immediate neighborhood of the generator shaft, which is the only place where a gas-tight joint is impossible.

Another object of my invention is to provide means for conserving or preventing the loss of the hydrogen, and to this end I maintain the pressure of the gas in the inert-gas chambers higher than the pressure of the hydrogen in the closed ventilating system, whereby any leakage will take place from the inert-gas chambers to the hydrogen chamber, rather than vice versa.

A further object of my invention is to provide means for continuously purifying the hydrogen, and to this end I provide, within the closed ventilating system of the machine, a quantity of lime or other substance which has the property of absorbing the carbon dioxide or other gas which surrounds the

machine. This phase of my invention is not necessarily limited to the utilization of an inert-gas chamber, as the gas-absorbing substance may be such as to absorb the oxygen or other constituents of the air, in case the machine is surrounded by air, or in case any material quantity of air is present in the surrounding enclosure. The gas-absorbing substance or mixture may also be such as to absorb the product of combustion of hydrogen and air, as it is believed that a continuous process of combustion takes place, at a slow rate, in an atmosphere of hydrogen which contains very small quantities of oxygen, in the presence of sparking, such as obtains in the dynamo-electric machine. For this reason, a small quantity of lime inside of the ventilating system will have a very beneficial effect in keeping the machine dry.

With the foregoing and other objects in view, my invention consists in the elements and combinations hereinafter described and claimed, reference being had to the accompanying drawing, wherein

Figs. 1 and 2 are longitudinal sectional views showing a turbo-generator embodying my invention in slightly modified forms.

In the embodiment of my invention illustrated in Fig. 1, I utilize a turbo-generator 1 having an enclosing casing 2, within which is disposed a closed ventilating system of any desired type. In the illustrated embodiment, the closed ventilating system comprises chambers 3 and 4, at the two ends of the rotor member 5, from which the gaseous cooling medium is sucked by means of fans 6 and 7, whence it is discharged into end bells or chambers 8 and 9 at the two ends of the stator member 10.

A part of the air from the two end bells 8 and 9 is led to an annular intake chamber 11, surrounding the central portion of the stator member 10, and a part of the air from the end bells discharges directly into the ends of the air gap 12. The stator member is provided with radial intake ducts 13, which communicate with the annular intake chamber 11, and radial discharge ducts 14, which communicate

with two annular discharge chambers 15 and 16 surrounding the end portions of the stator member. The paths of the air currents are clearly indicated by the arrows in Fig. 1.

5 The two annular discharge ducts 15 and 16 discharge into a common discharge pipe 17 which communicates with the two chambers 3 and 4 at the ends of the rotor member, whence the ventilating medium is again
10 forced through the machine by the fans. Disposed within the discharge pipe 17 is a cooling device 18, which may comprise pipes carrying water or other cooling medium.

I preferably utilize hydrogen as the cooling medium which is circulated by the closed ventilating system within the machine, on account of the fact that many kilowatts of energy may be saved, in a large machine, when hydrogen is circulated therethrough
15 instead of the denser air which is commonly used for such purposes.

Surrounding the main casing of the machine is a second enclosure 19, which is preferably spaced from the main casing at all
20 points and is filled with a suitable inert gas, preferably carbon dioxide. I preferably maintain the inert-gas pressure higher than the pressure of the hydrogen in the closed ventilating system of the machine, in order
25 to conserve the hydrogen by preventing its loss or escape from the machine, and also to guard against the possibility of the accumulation of hydrogen in the engine room where it would be likely to explode or ignite.

30 I also preferably maintain the inert-gas chamber at a pressure higher than that of the atmosphere for the purpose of preventing the infiltration of air into the inert-gas chamber and thence into the machine. It
35 will be obvious that any suitable means may be utilized for supplying quantities of the inert gas, either continuously or at periodic intervals, for the purpose of maintaining its pressure, in accordance with the above-described method of operation.
40

An important feature of my invention is the utilization of means whereby the costly hydrogen is conserved, and whereby any leakage that takes place is from the outer gases
45 into the interior of the machine, rather than vice-versa.

In carrying out the last-mentioned phase of my invention, I preferably utilize means for automatically and continuously purifying
50 the hydrogen gas within the machine, and to this end, I place a quantity of a suitable chemical reagent 21 or absorbing material in the bottom of the vent pipe 17 of the closed ventilating system. When the gaseous medium
55 surrounding the machine is carbon dioxide, a suitable material for the purifying substance is lime, which has the quality of absorbing not only carbon dioxide but also any water vapor which may be formed by the slow
60 combination of hydrogen with such small

quantities of air as may enter the machine with the carbon dioxide. Mixed with the lime may also be added a substance which will absorb the oxygen, or other ingredients of the air, directly, rather than in combination with the hydrogen, as in the case of the water vapor just referred to.
70

The principal source of gas leakage is at the junction of the casing and the shaft 22, and for this reason an efficient type of seal
75 should be utilized, such, for example as the gaskets shown at 23 and 24, for both the main generator casing 2 and the outer enclosure 19. Such seals may be of the mechanical type, or they may be steam or water seals such as have been developed in connection with steam turbines.
80

As the principal source of gas-leakage is in the neighborhood of the generator shaft, I may limit my inert-gas chamber thereto,
85 as indicated in Fig. 2, wherein exterior inert-gas chambers 25 and 26 are disposed only around the ends of the machine, adjacent to the shaft. The other parts of the apparatus shown in Fig. 2 are the same as in Fig. 1.
90

While I have shown my invention in two embodiments and have illustrated, in each case, a certain type of a closed ventilating system utilizing shaft fans, it is obvious that a separate motor-driven fan, or other means,
95 may be utilized for circulating the hydrogen, and other types of ventilating ducts within the machine may be employed, as will be obvious to those skilled in the art. I desire, therefore, that the following claims shall not
100 be limited to the exact construction shown except as may be required by the specific language of the claims or the disclosures of the prior art.

I claim as my invention:

1. The combination with an electric machine having a tightly closed ventilating system utilizing a gas consisting, in whole or in part, of hydrogen, of an enclosure providing a chamber or chambers surrounding at least
105 such portions of said machine as may admit of material gas leakage, a gas, in said enclosure, which is substantially inert to hydrogen but not altogether chemically inert, and a substance or substances disposed within said ventilating system for chemically selectively
110 absorbing any of such inert gas as may enter said system.

2. A dynamo-electric machine having a gas-tight, hydrogen-filled casing entirely
115 surrounding the same, a rotatable shaft extending through said casing, a seal for preventing the passage of a gas between said rotatable shaft and said casing, an external chamber surrounding said shaft on the outer side of said seal, and a filling of inert gas in said external chamber at a pressure higher than atmospheric for maintaining said external chamber substantially free of oxygen.
120

3. A dynamo-electric machine having a
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gas-tight, hydrogen-filled casing entirely surrounding the same, a rotatable shaft extending through said casing, a seal for preventing the passage of a gas between said
5 rotatable shaft and said casing, and an external, gas-tight casing substantially surrounding said first-mentioned casing and having a seal surrounding said shaft, the space between said casings being filled with a gaseous medium which is substantially free of oxygen.

In testimony whereof, I have hereunto subscribed my name this 11th day of July, 1925.

FRANK DAVIES NEWBURY.