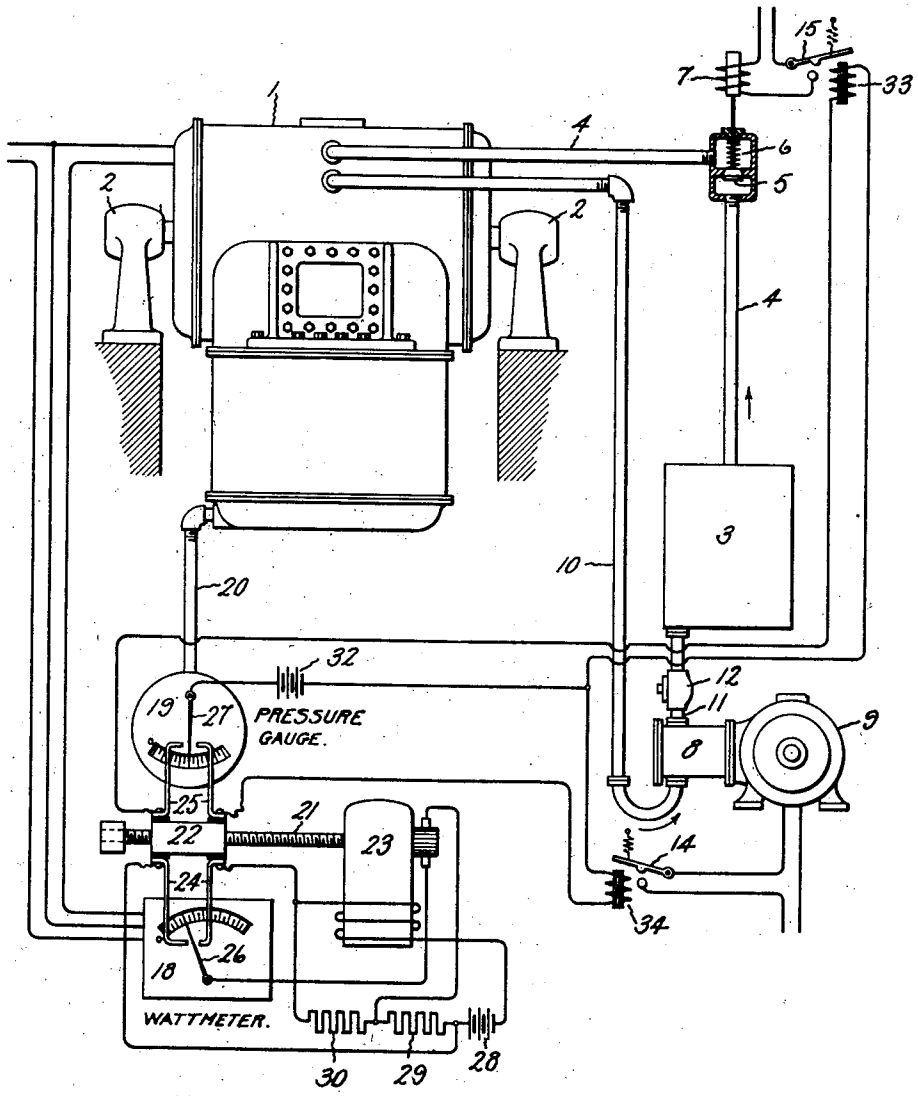
Dec. 25, 1928. 1,696,612

C. W. RICE

COOLING SYSTEM FOR DYNAMO ELECTRIC MACHINES

Filed Oct. 17, 1925



Inventor:
Chester W. Rice,
by Alexander S. Lunt.
His Attorney.

Patented Dec. 25, 1928. 1,696,612

UNITED STATES PATENT OFFICE.

CHESTER W. RICE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

COOLING SYSTEM FOR DYNAMO-ELECTRIC MACHINES.

Application filed October 17, 1925. Serial No. 63,153.

My invention relates to dynamo electric machines and more particularly to cooling systems therefor of the type in which the cooling gas is caused to circulate in a closed path in the enclosing casing of the machine.

In such systems the cooling gas in passing over the more highly heated parts of the machine in one part of its circuit absorbs heat and subsequently in passing over other parts or over cooling devices arranged in the casing gives up heat. Since the heat-dissipating properties of a gas increases with its pressure, the greater amount of heat produced in the machine as a result, for example, of a greater load thereon, may be dissipated by an increase in the pressure at which the gas is maintained. However, a disadvantage appears when the pressure of the cooling gas is increased by reason of the fact that a greater windage loss results therefrom, which loss is independent of the load.

An object of my invention therefore is to provide an improved cooling system of the type referred to in which the pressure of the cooling gas may be varied with changes in the load on the machine. I am thus able to take advantage of the greater heat-transfer properties of the cooling gas at higher pressures at times of increased loads without sustaining the greater windage loss incident to higher pressure during times of normal or subnormal load.

In carrying out my invention I may increase or decrease the pressure of the cooling gas in accordance with observed changes in the load or I may cause the pressure of gas to be varied automatically in response to variations in the load. Where air is used as the cooling gas, the pressure may be increased from atmospheric pressure to a pressure something like one and a half atmospheres. Where lighter gases are used involving less windage losses, higher pressures may be used advantageously; for example with hydrogen, the pressure may be varied from atmospheric or slightly thereabove to a pressure of five to ten atmospheres. Whether or not the actual pressure of gas in the machine casing is above or below atmospheric pressure is, however, immaterial to my invention.

In the accompanying drawing forming a part of my application, I have illustrated by way of example only one form of apparatus embodying my invention. A dynamo electric machine of the enclosed type is shown at 1, having bearings 2 for supporting the rotating element. Cooling gas is circulated through the casing and over the parts of the dynamo electric machine in any well known manner. The reservoir 3 in which the cooling gas is stored under pressure is connected to the casing of the dynamo electric machine by the pipe 4 in which is the valve 5 by means of which the flow of gas from the reservoir to the machine is controlled. The valve is normally held closed by the spring 6 and is adapted to be opened by the energization of the solenoid 7. For withdrawing gas from the machine to the reservoir, I have shown the pump 8 operated by the electric motor 9, the pump being connected to the machine by the pipe 10 and to the reservoir by the pipe 11 in which is inserted the check valve 12 to prevent a return flow of the gas. I have shown a switch 14 in the circuit of the pump motor 9 for controlling the operation of the pump and have shown a switch 15 in the circuit of the solenoid 7 by which the valve 5 is controlled. These two switches may be manually operated in response to observed changes in the load on the machine to increase the pressure of the cooling gas when the load increases and to decrease the pressure when the load decreases.

In the apparatus now to be described I have illustrated a method by which the pressure of the cooling gas may be automatically varied with changes in load. In this apparatus the wattmeter 18 is connected to the dynamo electric machine so as to register the load on the machine and the pressure gauge 19 having a pipe connection 20 with the lower part of the machine casing containing the usual cooling devices registers the pressure of the cooling gas therein. Arranged between the wattmeter and the pressure gauge I have shown a long screw 21 carrying the nut 22 and direct-connected with the shaft of an electric motor 23. Two pairs of spring contacts 24 and 25 are secured to but insulated from the nut, the contacts 24 which form one pair having their free ends lying on opposite sides and close to the pointer 26 of the wattmeter and the contacts 25 which form the other pair having their free ends lying on opposite sides

and close to the pointer 27 of the pressure gauge. I have shown the field circuit of the motor connected to a source of current 28 through two resistances 29 and 30, and the armature connected in circuit with the resistances, the pointer of the wattmeter and the spring contacts 24 associated therewith. The arrangement is such that movement of the wattmeter pointer a sufficient amount to engage either contact causes the motor to rotate in a direction to move the contact engaged away from the pointer. The pointer 27 of the pressure gauge and the spring contacts 25 cooperating therewith are shown connected in circuit with a source of current 32 and with the electromagnet 33 adapted to close switch 15 and with the electromagnet 34 adapted to close switch 14.

The operation of the apparatus for the automatic control of the gas pressure in accordance with the load is as follows: Assuming the parts to be in the positions shown, any substantial increase in the load on the machine causes the wattmeter pointer 26 to swing to the right and touch the right spring contact 24. The motor armature circuit thus being closed, the armature and screw 21 rotate in a direction to move the nut to the right until the contact with the wattmeter pointer is broken. If this movement of the nut 22 is sufficient to cause the left contact spring 25 to touch the pressure gauge pointer 27, the electromagnet 33 will be energized to close the valve switch 15 whence additional gas will be admitted to the machine casing from the reservoir. When the pressure in the machine has risen enough to cause the pressure gauge pointer to swing to the right sufficient to break connection with the left contact 25, the valve switch 15 is released. In a similar manner any substantial decrease in load causes the wattmeter pointer 26 to touch the left spring contact 24. This also closes the circuit of motor armature but reverses the direction of the flow of current therethrough whereupon the screw is rotated in the opposite direction until the contact is broken. The resulting movement of the nut 22 to the left may cause the right contact 25 to touch the pressure gauge pointer 27 thereby and close the circuit of electromagnet 34. This closes the pump switch 14 whence gas is pumped out of the machine into the reservoir until the pressure has fallen to the point where the pressure gauge pointer 27 breaks connection with the right contact 25. The pressure in the machine casing obviously will be maintained substantially constant with the constant load since variations in pressure due to any leaks in the valve 6 or in the machine will be corrected automatically by the apparatus associated with the pressure gauge pointer.

While I have described only one embodiment of my invention, I do not wish to be limited to the particular form shown and described, as it will be apparent that many modifications therein may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In combination, a dynamo electric machine comprising a closed casing, means for circulating a cooling gas therethrough, and means responsive to a decrease in load on the machine for withdrawing a portion of the gas to lower the pressure in said casing.

2. In combination, a dynamo electric machine comprising a closed casing, means for circulating a cooling gas therethrough, means responsive to an increase in the load on the machine for admitting gas to the casing to raise the pressure therein, and means responsive to the gas pressure in the casing for rendering said means ineffective.

3. In combination, a dynamo electric machine comprising a closed casing, means for circulating a cooling gas therethrough, means responsive to a decrease in the load on the machine for withdrawing gas therefrom to decrease the pressure thereof, and means responsive to the gas pressure in the casing for rendering said means ineffective.

4. In combination, a dynamo electric machine comprising a closed casing, means for circulating a cooling gas therethrough, a gas reservoir, a connection between the reservoir and the casing including a valve, controlling means therefor, a device having a movable contact responsive to the pressure of gas within the casing, a load responsive device, a contact controlled thereby adapted to engage said movable contact, and circuit connections between said contacts and the valve controlling means.

5. In combination, a dynamo electric machine comprising a closed casing, means for circulating a cooling gas therethrough, a gas reservoir, a connection including a valve between the reservoir and the casing, a pump connected between the casing and the reservoir, controlling means therefor, a pressure device having a movable contact responsive to the pressure of gas within the casing, a load responsive device connected to the machine, a contact controlled thereby and adapted to be engaged by said movable contact, and circuit connections between said contacts and said pump controlling means.

In witness whereof, I have hereunto set my hand this 16th day of October, 1925.

CHESTER W. RICE.