

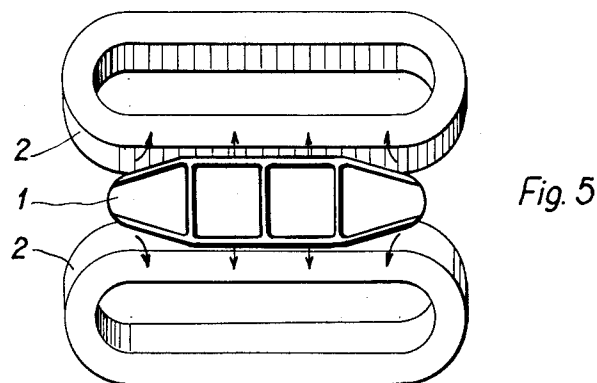
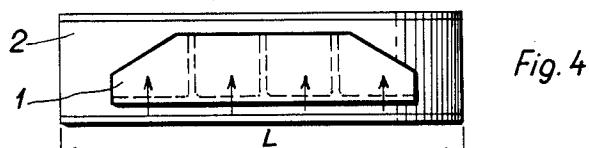
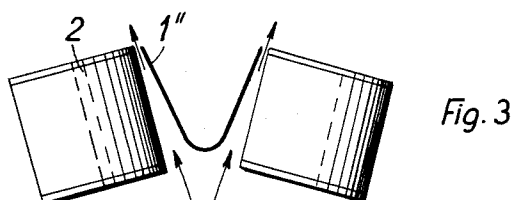
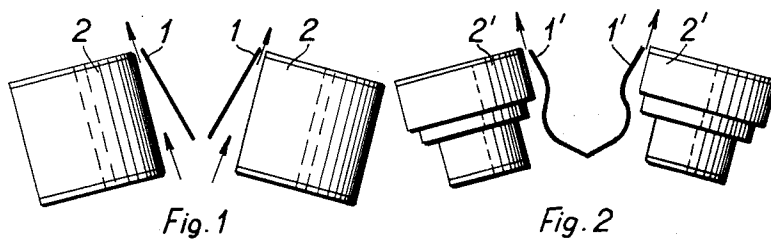
March 7, 1961

K. HAVELKA ET AL
ARRANGEMENT FOR DISSIPATING HEAT GENERATED
IN THE FIELD COILS

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Filed Sept. 17, 1958

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

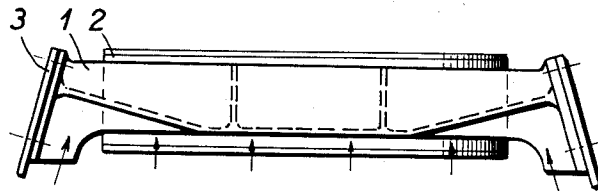


Fig. 6

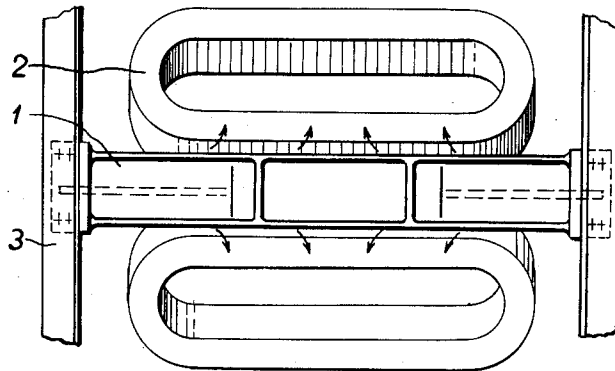


Fig. 7

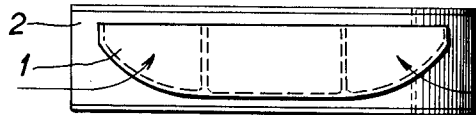


Fig. 8

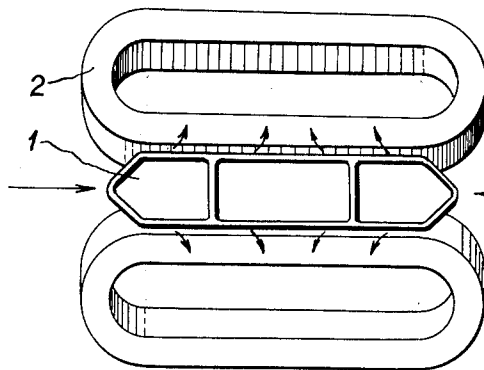


Fig. 9

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4 Sheets-Sheet 3

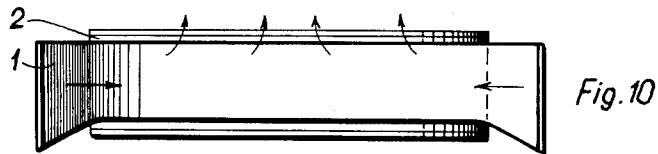


Fig. 10

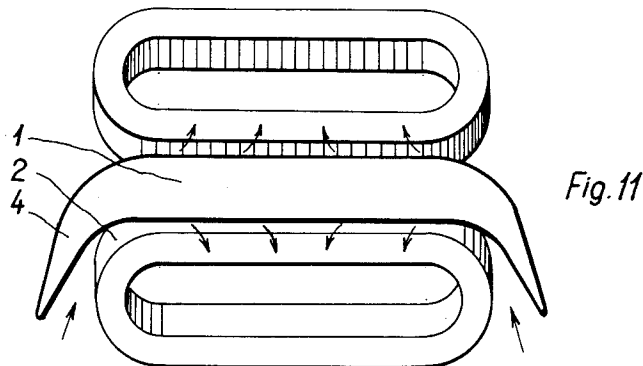


Fig. 11

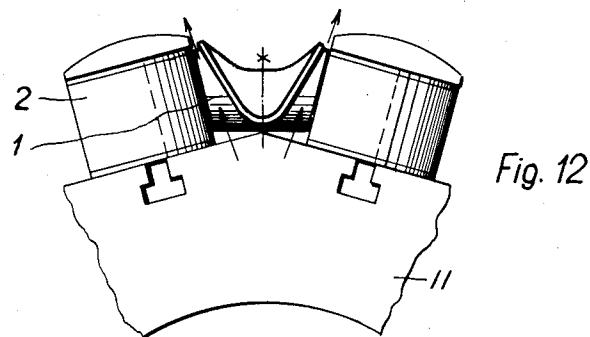


Fig. 12

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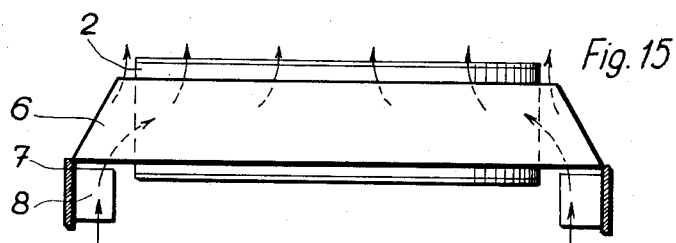
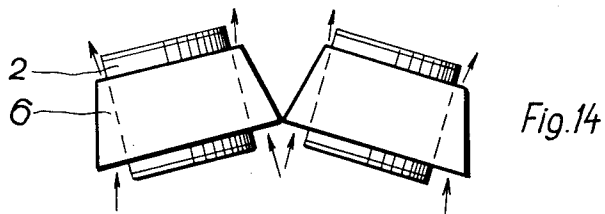
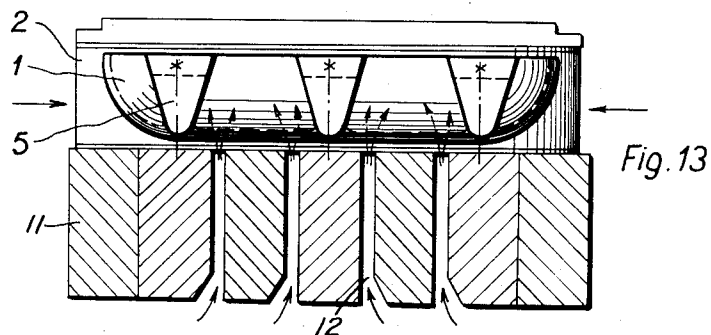
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4 Sheets-Sheet 4



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2,974,239

ARRANGEMENT FOR DISSIPATING HEAT GENERATED IN THE FIELD COILS

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4 Claims. (Cl. 310—61)

This invention relates to an arrangement for dissipating heat generated in the field coils provided on pole pieces of rotors of electric machines and more particularly in coils cooled by a flowing gaseous fluid.

It is an object of this invention to provide a cooling system for such coils which efficiently utilizes the heat transmitting properties of the cooling fluid and which is particularly adapted to cooling electric machines of substantial axial dimensions.

A preferred embodiment of this invention is shown by way of example in the accompanying drawings, in which Figs. 1, 2 and 3 are schematic views of a pair of field coils arranged on pole pieces, taken in the direction of the axis of rotation of the rotor, with a body, the surfaces of which distribute the cooling fluid; Figs. 4 and 5 are a side view, and a plan view respectively, of an arrangement of the body distributing the cooling fluid; Figs. 6 and 7, 8 and 9, and 10 and 11 show similar respective views of three other embodiments of this invention; Fig. 12 illustrates a view in the direction of the axis of rotation of the rotor, and Fig. 13 a longitudinal cross section of a part of the rotor including another example of the distributing body for the cooling fluid; and Figs. 14 and 15 show similar views of another alternative arrangement of these bodies.

Referring to Fig. 1, there is shown a pair of field coils of windings 2 mounted in pole pieces of a rotor of an electric machine, not shown on the drawing. In the space between these adjacent coils 2 there are two baffles 1 somewhat inclined with respect to the surface of the corresponding coil, the distance between the surface of the coil 2 and the baffle sheet 1 decreasing with increasing distance from the axis of rotation. Arrows to indicate the direction of flow of the cooling gaseous fluid. The baffles 1 hold the flowing fluid close to the surfaces of the coils 2. When the distance between the baffle and the surface of the coil is uniform, the velocity of fluid flow remains substantially uniform. Since the gap between the baffle and the surface of the coil decreases in width with increasing distance from the axis of the rotor, the velocity of the cooling fluid increases.

In Fig. 2 there is shown a similar arrangement with coils 2' having a stepped cross section. The baffles 1' form a substantially U-shaped body which conforms to a certain extent to the shape of the coils 2'. The cooling fluid passes through the spaces between the body 1' and the coils 2' similarly as in Fig. 1.

Fig. 3 shows another alternative arrangement similar to that of Fig. 1, the baffles 1'' being connected at their base nearer to the axis of the rotor, and forming a V-shaped body.

Whether the baffles which form the coolant distributing body should be connected at their base or whether a gap should remain between them depends upon the need for supplying cooling fluid for cooling the stator.

It is understood that the baffle sheets 1 may be replaced by a solid body if so desired in certain cases.

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The distributing body may extend either over the entire axial length L of the coil 2 or only over a part thereof, as shown in Figs. 4 and 5, or it may extend beyond this length, as shown in Figs. 6 and 7, and the bodies arranged between different pairs of coils 2 may be linked outside the coils 2 by radial or tapering rings 3 forming a fan. In that case the portions of the body extending beyond the coils may be shaped to form fan blades.

When the cooling fluid is intended to pass the spaces between the coil surfaces and the adjacent surfaces of the distributing body in an axial direction, the front ends of said body may receive the shape of a boat's bow, as shown in Fig. 8.

Alternatively the projecting ends of the distributing body 1 may be bent forward as shown in Figs. 10 and 11 to form scoops drawing air into the space between the surfaces of the coils 2 and the surfaces of said body in the direction indicated by arrows in Fig. 11.

It is sometimes required to provide spacers between adjacent coils, when the coils have a considerable axial length, to maintain the coil windings in their proper place. These spacers, in accordance with this invention, are combined with the distributing body in the way shown in Figs. 12 and 13 to form a single body. The spacers 5 are each an integral part of the distributing body 1 and are maintained in their position by bolts and nuts indicated schematically on the drawing by a dash and dot line and a cross. The direction of the flow of the cooling fluid is indicated by arrows. In Figs. 12 and 13, the cooling fluid flows radially through ducts 12 of the rotor body 11, parts of the rotor body being shown in cross section in Figs. 12 and 13.

In the embodiment of the invention illustrated in Figs. 14 and 15, the distributing body 6 surrounds the field coils 2 also on their front ends, and forms a ring which defines an annular space between the coil 2 and the ring 6. The width of this annular space decreases in a direction away from the axis of the rotor. Adjacent rings 6 are connected along their lower axial edges and the portions of the rings which axially extend beyond the coils 2 are linked by radial or tapering rings 7 to which fan blades 8 are attached so that a strong current of coolant gas is generated and is directed into the annular space between the coils 2 and the rings 6.

The arrangement according to this invention provides substantial improvements in the cooling of field coils arranged on pole pieces of rotors of electric machines. When the distance between the surfaces of adjacent coils increases with increasing distance from the axis of the rotor, the velocity of the radially flowing cooling fluid decreases, so that the efficiency of cooling equally decreases as the heat cannot be efficiently transmitted to the gas stream without the distributing bodies of the invention.

The arrangement of this invention considerably increases the cooling efficiency and particularly for rotors of substantial axial dimensions. It is understood that the different elements described and shown in the drawings may be combined. It is, for instance, possible to combine the arrangement of Figs. 4 and 5 with the arrangement of the distributing body according to Figs. 8 and 9 to provide an adequate axial stream of the cooling fluid. The same applies to the arrangements of Figs. 10 and 11 or 13.

The distributing body may be made of metal, of insulating material or a non magnetic material, or of metal with an insulating layer. Where metal or other electrically conductive material is used for parts of the distributing body, insulating elements have to be inserted between the several parts to prevent the flow of undesirable electric currents.

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What we claim is:

1. In a cooling arrangement for an electric machine, in combination, a rotor body having an axis and formed with radially extending passages for the flow of a fluid coolant; a plurality of radially extending pole pieces on said rotor body; magnet windings on each of said pole pieces, the axial length of said windings being substantially greater than the circumferential width thereof, said windings having radially extending flanks, and the axial flanks of adjacent windings defining axially elongated spaces which taper in a radially inward direction; a coolant distributing member in each of said spaces, said member being of substantially V-shaped radial cross section, the legs of the V and said axial flanks defining a duct communicating with one of said passages; a plurality of spaced projections on said member respectively abutting against the axial flanks of said adjacent windings; and means for fixedly fastening said members to said rotor body, whereby said windings are held in place by said members and said fluid coolant is made to flow over said flanks.

2. In a cooling arrangement for an electric machine, in combination, a rotor body having an axis and formed with radially extending passages for the flow of a fluid coolant; a plurality of radially extending pole pieces on said rotor body; magnet windings on each of said pole pieces, the axial length of said windings being substantially greater than the circumferential width thereof, said windings having radially extending flanks, and the axial flanks of adjacent windings defining axially elongated spaces which taper in a radially inward direction; a coolant distributing member in each of said spaces, said member being of substantially V-shaped radial cross section, the legs of the V and said axial flanks defining a duct having an end portion communicating with one of said passages and tapering in a radially outward direction from said end portion; a plurality of spaced projections on said member respectively abutting against the axial flanks of said adjacent windings; and means for fixedly fastening said members to said rotor body, whereby said windings are held in place by said members and said fluid coolant is made to flow over said flanks.

3. In a cooling arrangement for an electric machine, in combination, a rotor body having an axis and formed with radially extending passages for the flow of a fluid coolant; a plurality of radially extending pole pieces on said rotor body; magnet windings on each of said pole pieces, the axial length of said windings being substan-

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tially greater than the circumferential width thereof, said windings having radially extending flanks, and the axial flanks of adjacent windings defining axially elongated spaces which taper in a radially inward direction; a coolant distributing member in each of said spaces, said member being of substantially V-shaped radial cross section, the legs of the V and said axial flanks defining a duct communicating with one of said passages, said member axially projecting beyond said windings, the projecting portion thereof having the shape of a boat bow; a plurality of spaced projections on said member respectively abutting against the axial flanks of said adjacent windings; and means for fixedly fastening said members to said rotor body, whereby said windings are held in place by said members and said fluid coolant is made to flow over said flanks.

4. In a cooling arrangement for an electric machine, in combination, a rotor body having an axis and formed with radially extending passages for the flow of a fluid coolant; a plurality of radially extending pole pieces on said rotor body; magnet windings on each of said pole pieces, the axial length of said windings being substantially greater than the circumferential width thereof, said windings having radially extending flanks, and the axial flanks of adjacent windings defining axially elongated spaces which taper in a radially inward direction; a coolant distributing member in each of said spaces, said member being of substantially V-shaped radial cross section, the legs of the V and said axial flanks defining a duct communicating with one of said passages, said member axially projecting beyond said windings; a plurality of spaced projections on said member respectively abutting against the axial flanks of said adjacent windings; scoop means on the projecting portion of said member and circumferentially extending therefrom; and means for fixedly fastening said members to said rotor body, whereby said windings are held in place by said members and said fluid coolant is made to flow over said flanks.

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