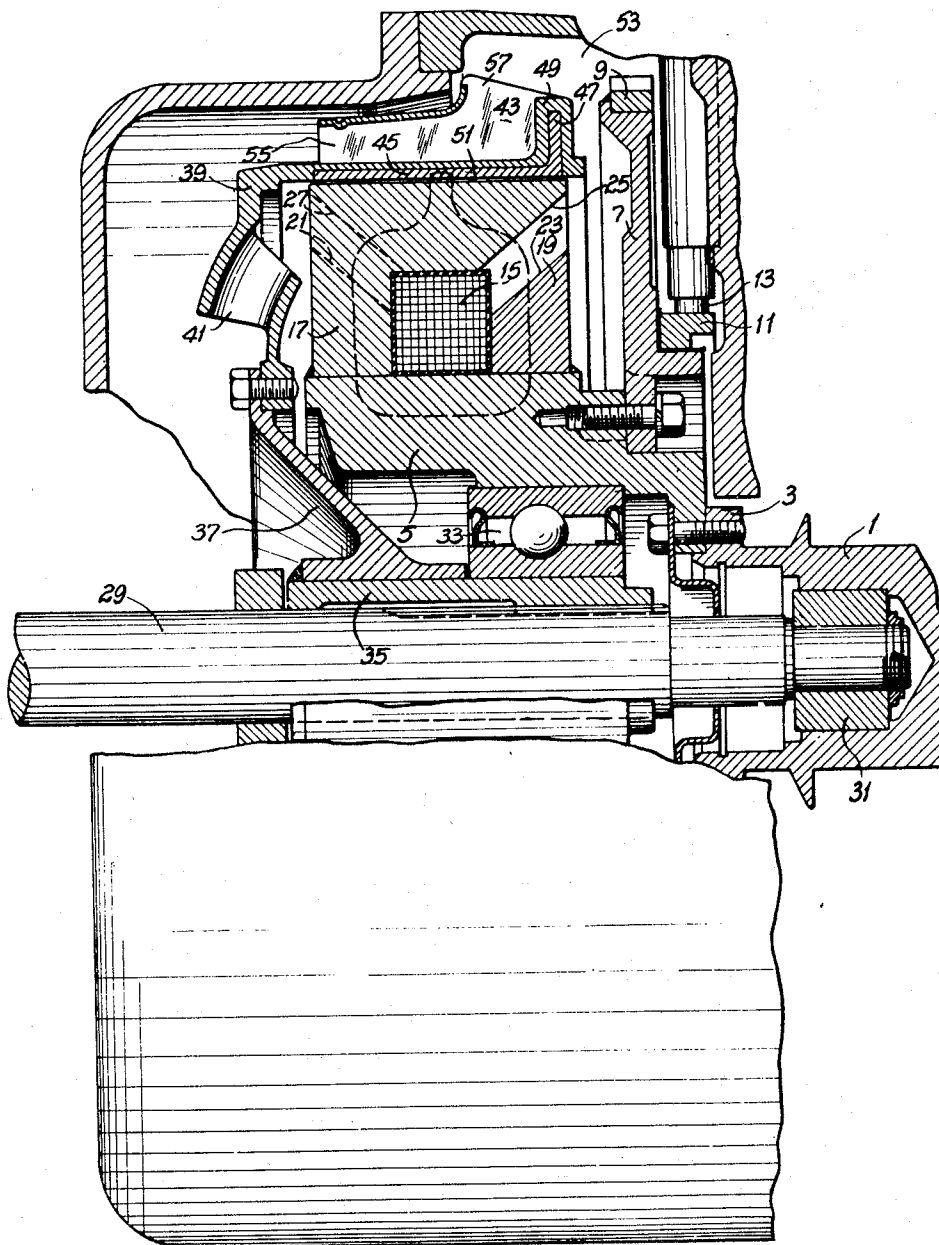


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M. P. WINTHER
DYNAMOELECTRIC MACHINE

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Martin P. Winther,
Inventor.
Haynes and Koenig,
Attorneys.

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DYNAMOELECTRIC MACHINE

Martin P. Winther, Waukegan, Ill., assignor to
himself as trustee

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This invention relates to dynamoelectric machines, and with regard to certain more specific features, to eddy-current clutches, brakes, dynamometers and the like.

Among the several objects of the invention may be noted the provision of a dynamoelectric machine employing an eddy-current inductor which is of light weight yet electrically efficient; and the provision of apparatus of the class described wherein the inductor is improvedly cooled. Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, the single figure is an axial section through an eddy-current clutch for automotive practice embodying the invention.

Referring to the drawing, numeral 3 indicates the flared end of a driving engine crankshaft 1. To the flange 3 is bolted a magnetic drum 5. The drum 5 also carries a flywheel 7 upon the periphery of which is the usual starting gear 9. The flywheel is lighter than usual, since the parts to be described in connection with the drum 5 aid in providing any necessary flywheel effect. The flywheel member 7 also carries a collector ring 11 with which is associated a collector brush 13 for feeding current to an annular field coil 15 carried around the drum 5.

Welded to the drum 5 are two magnetic rings 17 and 19, located on opposite sides of the coil 15. These rings 17 and 19 are notched as shown respectively at 21 and 23. Between the notches are claw-shaped interdigitated and staggered teeth 25 and 27, respectively, which envelope the outside of the coil 15 and provide successive north and south peripheral poles.

At numeral 29 is shown a driven shaft which leads to the vehicle transmission. This shaft is supported in pilot bearings 31 and 33. Attached to the shaft 29 by a splined quill 35 is a supporting spider 37. Bolted to the spider is an aluminum cup 39. This cup is cast with radial inlet openings 41. Exteriorly it is cast with air-circulating fins forming passages 43. In the interior of the cup, opposite the poles formed by the teeth 25 and 27, is a cylindric magnetic sleeve member 45 which forms an armature or eddy-current inductor, being composed, for example, of magnetic iron. The inductor sleeve or cylinder 45 has a flange 47

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which is enveloped by aluminum having a U-shaped axial section, as shown at numeral 49.

The fact that the cast cup 39 is made of aluminum lightens the rotary parts associated with the driven shaft 29, thus desirably reducing its moment of momentum. The aluminum being a good heat conductor and provided with passages 41 and 43, provides for effective cooling. Being non-magnetic, however, it is required that the pre-formed inductor sleeve 45 be employed as an insert. If such an insert does not have proper heat-conductive contact with the aluminum cup, the advantageous cooling characteristics of the latter are lost. In order to provide for effective heat transmission from the inductor 45 to the aluminum of the cup 39, these parts are bonded together by first coating the sleeve 45 in a hot aluminum bath, using any necessary flux. This is sometimes referred to as "tinning" the sleeve, although aluminum is the thinly applied material. The thin aluminum coat has a chemical bond with the sleeve forming an interfacial interlock or bond. The "tinning" is carried out so that the aluminum forms a good heat-conductive attachment to the iron, although it is only in a thin layer thereon. The aluminum-coated inductor is then quickly inserted into a mold and molten aluminum is cast into the mold. The mold is such that the aluminum takes the form around the inductor sleeve 45 as shown by the cross section in the drawing of parts 39, 41, 43 and 49. This method of pre-coating and casting around the insert 45 provides for a chemical interfacial bond between the aluminum and the iron which is effective to prevent undue temperature drop across the bond in transferring heat from the iron to the aluminum. In view of the above it will be seen that the inductor may be referred to as a cast insert in the member 39 although it itself may be other than a casting, such as for example a forging, pressing or the like.

Operation of the device will be clear from the above. Upon rotation of the crankshaft 1, the field member is rotated, including the interdigitated poles 25 and 27. Then by exciting the coil 15, a toroidal flux field, the mean path of which is suggested by dotted lines, is generated. This has a strength according to the excitation of the coil. It interlinks the interdigitated poles and the inductor drum 45. Eddy currents are induced in the drum, causing magnetic reactions with the poles tending to drive the cup 39, spider 37 and driven shaft 29.

Under conditions of acceleration, considerable heat may be generated in the inductor sleeve 45

and this is readily transmitted through the bond with the aluminum cup 39. This heat radiates into the spaces 43 and is carried off by flow of air induced by centrifugal action. A flow of air also enters the inlets 41, being induced by centrifugal action, and flows between the poles and across the magnetic gap 51 formed between the pole ends and the inductor. This air escapes at point 53, along with the air from the passages 43.

It will be noted that the inductor sleeve 45 is relatively thin and therefore constitutes small obstruction to heat flow toward the good heat-conducting aluminum. Such a thin inductor is feasible, since the eddy currents induced by the flux field are limited to a very short distance within the inside surface of an inductor of this nature. For example, on a clutch having a 15-inch diameter at the gap 51, a thickness of the sleeve 45 of the order of $\frac{3}{4}$ of an inch is satisfactory.

From the above it will be seen that the weight of the rotating parts on the driven member is held to a low value, which is desirable. Also, the heat transfer from the inside eddy-current surfaces of the inductor is rapid and quickly carried off from the aluminum cup.

While the invention is shown as used in connection with a slip clutch or coupling, it will be understood that the same principles can be used in the cases of eddy-current brakes, dynamometers and the like wherein one of the relatively movable members is stationary with respect to the earth.

It will be observed that the flange 47 functions to key the inductor axially in the cast aluminum container. Also, the aluminum of U-shaped section 49 around the flange 47 forms an elbow in the air passages 43 for ejecting air radially which has been drawn in axially at the other end. It is clear from the drawing that the length of the magnetic armature or inductor sleeve 45 is approximately equal to the width of the peripheral track of the pole faces of the field member. Such a length is all that is required of the sleeve, the non-magnetic aluminum parts of the cup 39 extending beyond the sides of the field member. The flange construction at 47 not only provides for a reliable structural connection between the sleeve 45 and the cup 39, but strengthens both of them against failure due to centrifugal forces. This strengthening is augmented by the members 55 and 57.

It will be observed that the air passages 43 are L-shaped with their inlets 55 axially located and their outlets 57 radially located. Although only one each is shown of the air passages 41 and 43, a multiplicity of these are spaced around the apparatus. The same is true of the interdigitated teeth 25 and 27. The passages 41 may be referred to as being in the bottom of the cup-shaped form of member 39, the passages 43 being on the outside of this cup-shaped form with the part 49 determining the L-shape of the passages 43.

It is to be understood that the term cast insert as used in the claims to qualify the inductor 45 refers to the means by which it is brought into assembly with the surrounding cast material and does not mean that the inductor 45 is itself necessarily cast (although it may be), since as above pointed out it may be pressed, forged or otherwise constructed.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope

of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. Dynamoelectric apparatus of the class described, comprising relatively rotary field and inductor members, the inductor member comprising an aluminum casting surrounding the field member and formed as a cup having a bottom, cylindrical sides and an open end, a flanged inductor cylinder forming an insert in said cup-shaped casting and having its inner surface separated from the field member by a magnetic gap, the flange of said inductor being surrounded by cast aluminum at the open end of the cup, said cup-shaped casting including air inlet openings in its bottom and L-shaped air passages on its outside, the inlets of said last-named passages being axial and the outlets radial.

2. Dynamoelectric apparatus of the class described, comprising relatively rotary field and inductor members, one of which surrounds the other, the inductor member comprising an open-ended cylindric casting of relatively thin section and located adjacent to the periphery of the field member, a cylindric flanged magnetic inductor cylinder forming a cast insert for said cylindric casting and having an exposed surface adjacent the field member and separated therefrom by a magnetic gap, said inductor member being composed of a non-magnetic material which is relatively light in weight as compared to the material of the inductor, the flange of said inductor being located near the open end of the aluminum cylinder and toward one side of the field member and being directed away from the field member, said flange being surrounded by a U-shape of said cast non-magnetic material, which shape is also of a relatively thin section.

3. Dynamoelectric apparatus of the class described, comprising relatively rotary field and inductor members, one of which surrounds the other, the inductor member comprising an open-ended cylindric casting of relatively thin section and located adjacent to the periphery of the field member, a cylindric flanged magnetic inductor cylinder forming a cast insert for said cylindric casting and having an exposed surface adjacent the field member and separated therefrom by a magnetic gap, said inductor member being composed of a non-magnetic material which is relatively light in weight as compared to the material of the inductor, the flange of said inductor being located near the open end of the aluminum cylinder and toward one side of the field member and being directed away from the field member, said flange being surrounded by a U-shape of said cast non-magnetic material, which shape is also of a relatively thin section, the surfaces between the magnetic and aluminum cylinders having an interfacial chemical bond adapted to produce a good heat-conductive attachment, located in a relatively thin multi-layer heat-conductive arrangement.

MARTIN P. WINTHER.

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