28

"A CORELESS MOTOR"

This invention relates to coreless motors.

Conventionally, it has been difficult to provide a small, flat, coreless motor having a tachometer incorporated within the motor casing because of its structure and, therefore, the tachometer is usually provided on the outside of the motor casing by extending a spindle of the motor out through the motor casing. This is disadvantageous since it increases the thickness of the motor.

According to the present invention there is provided a coreless motor including a disc-shaped rotor mounted on a spindle which is rotatably mounted in at least one bearing, and a tachometer having a stationary part and a rotatable part, the stationary part being mounted in a bearing housing which houses the bearing or said one of the bearings, and the rotatable part being mounted on the spindle between the rotor and the or one of the bearings, the tachometer being arranged to produce an output signal indicative of the speed of rotation of the rotor.

The rotatable part of the tachometer may include a permanent magnet and the stationary part may include a coil.

Preferably the coil is held between two stator yokes each of which has a plurality of projecting fingers, the fingers of one stator yoke interleaving with the fingers of the other stator yoke. The stator yokes may be held in a predetermined position relative to one another by at least two projections on a first ring-shaped member located between the two stator yokes.

Preferably the permanent magnet is held between two rotor yokes each of which has a plurality of projecting fingers, the fingers of one rotor yoke interleaving with the fingers of the other rotor yoke. The rotor yokes are held in a predetermined position relative to one another by a second ring-shaped member located between the two rotor yokes.

Preferably the magnet is made of a ferrite material, or a material based on a rare earth element, and is magnetised anisotropically in the axial direction.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a sectional view of a conventional coreless motor with a tachometer;

Figure 2 is a sectional view of a coreless motor according to the present invention;

Figure 3 is an enlarged sectional view of the tachometer portion of the coreless motor shown in Figure 2;

Figure 4 is a perspective view of a stationary part of the tachometer of the coreless motor shown in Figures 2 and 3, the stationary part being shown mounted in a bearing housing; and

Figure 5 is a perspective view of a rotatable part of the coreless motor shown in Figures 2 and 3.

Figure 1 shows a sectional view of a conventional coreless motor in which a tachometer is mounted on the outside of a casing 3 of the motor. The casing 3 consists of a cup-shaped part 3a and

a plate 4. The coreless motor comprises: a disc-shaped rotor, which consists of a plurality of coreless coils 6 mounted on a coil frame 7; a stator magnet 18 which is held by the plate 4; a varistor 8; a commutator 10; a balance ring 9; a brush frame 11; brushes 12; and a spindle 1. The rotor and the commutator 10 are mounted on the spindle 1 which is rotatably mounted in bearings 2 and 5. The bearing 2 is mounted in the part 3a of the motor casing 3, and the bearing 5 is mounted in the plate 4 which forms the side of the casing 3 opposite the bearing 2.

The spindle 1 of the motor projects through the plate 4 of the motor casing 3. A disc-shaped tachometer rotor 14, made of an isotropic magnet which is magnetised so as to have a plurality of poles around its outer periphery, is mounted on the projecting part of the spindle 1. A tachometer stator 15 and a coil 16, are mounted on the outside of the plate 4 of the motor casing 3 and are positioned around the rotor 14. The tachometer thus projects from the motor casing and the thickness of the motor is thereby increased. Leads 13 and 17 are provided for the motor and tachometer respectively.

Figure 2 shows a sectional view of a coreless motor according to the present invention in which a tachometer is provided within a casing 23 of the motor. The casing 23 consists of a cup-shaped part 23a and a plate 24. The coreless motor in Figure 2 is also comprised of a disc-shaped rotor which consists of a plurality of disc-shaped coreless coils 26 mounted on a coil frame 27; a stator magnet 38 which is held by the plate 24; a varistor 28; a commutator 10;

a balance ring 29; a brush frame 31; brushes 32; and a spindle 21. The coil 26, together with the coil frame 27, and the commutator 10 are mounted on the spindle 21 which is rotatably mounted in bearings 22 and 25. The bearing 22 is held by the part 23a of the motor casing 23 but the bearing 25 is housed in a cup-shaped bearing housing 39 which is mounted in the plate 24 which forms the side of the casing 23 opposite the bearing 22.

As shown in Figure 2, a tachometer rotor 34, which includes a permanent magnet 34c, is mounted on the spindle 21 so that is positioned between the disc-shaped rotor 26, 27 of the motor and the bearing 25.

The tachometer also has a ring-shaped stationary part which is mounted in the bearing housing 39 which extends into the interior of the motor casing 23. The stationary part includes a stator 35 and a coil 36a and is positioned around the rotor 34 so that the inner face of the stationary part and the outer face of the rotor 34 are separated from each other by an air gap.

Figure 3 shows an enlarged sectional view of the tachometer portion of the motor shown in Figure 2, and Figures 4 and 5 show perspective views of the stationary part of the tachometer and the tachometer rotor respectively. The stationary part of the tachometer is shown mounted in the bearing housing 39 in Figure 4.

The stationary part of the tachometer is comprised of first and second stator yokes 35a and 35b, and a coil frame 36b made of resin, and a coil 36a which is wound within the coil frame 36b.

32

The first and second stator yokes 35a and 35b are made of a soft magnetic material and each have a plurality of projecting fingers which form the poles of the stator 35. The stator yokes 35a and 35b are positioned about and hold the coil frame 36b and coil 36a so that the fingers of one stator yoke interleave with the fingers of the other stator yoke. The stationary part of the tachometer is mounted in a sleeve portion 39a of the bearing housing 39 and is held in place by crimping the end of the sleeve 39a as shown in Figure 4.

The coil frame 36b is ring-shaped and has a channel-shaped cross-section. The side of the coil frame 36b which faces the rotor is provided with at least two projections 36c which interpose between fingers of the stator yokes 35a and 35b so as to hold the stator yokes in a predetermined position relative to one another so that adjacent fingers are at a fixed distance from each other. The coil frame 36b has a portion 36d which extends through the bearing casing 39 and away from the tachometer. Leads 37 are provided for the tachometer coil 36a and are connected to terminals on the portion 36d of the coil frame. Leads 33 (see Figure 2) are provided for the motor.

The tachometer rotor 34 comprises: a ring-shaped permanent magnet 34c, which is magnetised anisotropically in the axial direction and is made of a ferrite material or a material based on a rare earth element; first and second rotor yokes 34a and 34b which are made of a soft magnetic material and which each have a

plurality of projecting fingers which form the poles of the rotor; a ring-shaped rotor yoke spacer 34e; and a rotor bush 34d. The rotor yokes 34a and 34b are positioned about, and hold the magnet 34c and the spacer 34e, so that the fingers of one rotor yoke interleave with the fingers of the other rotor yoke. The spacer 34e is positioned around the magnet 34c and has at least two projections 34f which interpose between fingers of the rotor yokes so as to hold the rotor yokes in a predetermined position relative to one another so that adjacent fingers are at a fixed distance from each other. The rotor yokes have the same number of projecting fingers as the stator yokes. The magnet 34c and the rotor yokes 34a and 34b are held together and fixed onto the spindle 21 by the rotor bush 34d. A thrust plate 40 (see Figure 3) is provided by the end of the spindle 21, between the bearing 25 and the bearing housing 39. The tachometer is arranged to produce an output signal which is indicative of the speed of rotation of the rotor of the motor in a manner well-known in the art.

A flat coreless motor as shown in Figures 2 to 5 can be made very small and its structure is simplified by using a multi-polar rotor which has an anisotropic magnet; rotor and stator yokes made of soft magnetic material and which have a plurality of projecting fingers; and a coil frame with projections for holding the stator yokes in position, and by mounting the stator in a bearing housing. The rotor shown in Figure 5 can be made as

small as 3 mm in diameter. By using a tachometer with a structure as described with reference to Figures 2 to 5 and by mounting the tachometer as described the tachometer can be incorporated within the motor casing and the motor can be made thinner than prior art motors such as that shown in Figure 1.

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CLAIMS

1. A coreless motor including a disc-shaped rotor mounted on a spindle which is rotatably mounted in at least one bearing, and a tachometer having a stationary part and a rotatable part, the stationary part being mounted in a bearing housing which houses the bearing or said one of the bearings, and the rotatable part being mounted on the spindle between the rotor and the or one of the bearings, the tachometer being arranged to produce an output signal indicative of the speed of rotation of the rotor.

2. A motor as claimed in claim 1 in which the rotatable part of the tachometer includes a permanent magnet and said stationary part includes a coil.

3. A motor as claimed in claim 2 in which the coil is held between two stator yokes each of which has a plurality of projecting fingers, the fingers of one stator yoke interleaving with the fingers of the other stator yoke.

4. A motor as claimed in claim 3 in which the stator yokes are held in a predetermined position relative to one another by at least two projections on a first ring-shaped member located between the two stator yokes.

5. A motor as claimed in any of claims 2 to 4 in which the permanent magnet is held between two rotor yokes each of which has a plurality of projecting fingers, the fingers of one rotor yoke interleaving with the fingers of the other rotor yoke.

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36

6. A motor as claimed in claim 5 in which the rotor yokes are held in a predetermined position relative to one another by a second ring-shaped member located between the two rotor yokes.

7. A motor as claimed in any of claims 2 to 6 in which the magnet is made of a ferrite material, or a material based on a rare earth element, and is magnetised anisotropically in the axial direction.

8. A coreless motor substantially as herein described with reference to and as shown in Figures 2 and 3 of the accompanying drawings.

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