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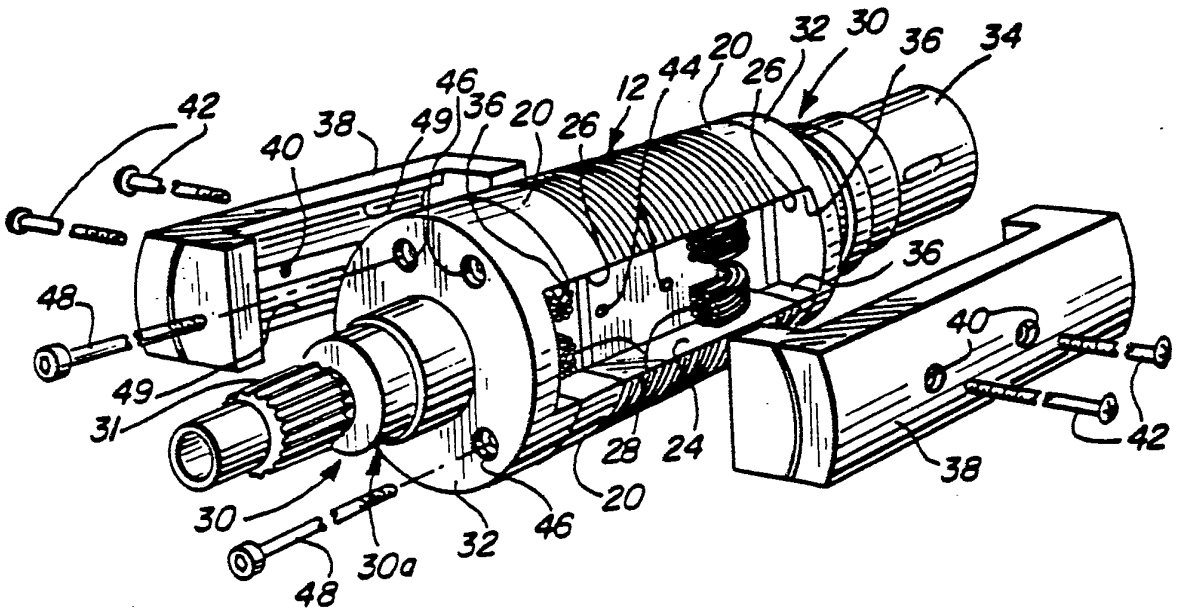

(57) Abstract

A salient pole rotor (10) for use with a generator or other electrical apparatus, including a solid core (12) extending lengthwise of the rotor and through the axis of rotation thereof. The core provides an unimpeded magnetic flux path through the axis of the rotor. A pair of end shafts (30) are provided with end plates (32) at opposite ends of the core. A pair of wedges (38) of non-magnetic material are axially disposed in grooves (24) on opposite sides of the rotor core. The wedges extend axially beyond each core end and are secured in complementary grooves (36) on opposite sides of the end plates.

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SALIENT POLE ROTOR

Description

Field Of The Invention

This invention generally relates to electrical apparatus and particularly to a salient pole rotor for use with a generator or other electrical machine.

Background Of The Invention

In electrical apparatus, such as a two salient pole synchronous generator rotor, a stator having an A.C. winding is arranged to provide a pulsating or rotating multi-pole magnetic field, and a rotor is provided with an electrical winding in which magnetic material is arranged so that when in one position relative to the magnetic field provided by the stator winding, termed the direct axis position, a low reluctance path is provided for magnetic flux from the stator, while when the rotor is 90° electrical relative to this position, termed the quadrature axis position, a path of high reluctance to magnetic flux from the stator is provided. In most forms of reluctance motors, two salient poles are provided but, in general, the rotor is provided with salient pole sections equal in number to the number of poles of the stator magnetic field.

Conventionally, a rotor core and winding assembly is positioned between a pair of end shafts and/or end plates which connect the rotor in driving relationship with other components of the electrical apparatus. The rotor core is connected to the end shafts and/or end plates by some structural means for transmitting torque thereto. Frequently, the structural means comprises a

torque tube or shaft extending generally axially through the rotor core. The torque tube or shaft for supporting the rotor structure extends between the end plates or may comprise an extension of the end shaft means itself. This type of structural support is adequate in relatively low power electrical apparatus. However, it creates a critical magnetic flux path problem by impeding the flux path through the axis of the rotor. In high power electrical apparatus where a highly saturated magnetic field is required, it is most often necessary to provide an unimpeded magnetic flux path through the axis of the rotor. This is particularly true when the core is fabricated of laminations which cannot be used as structural or torque transmitting components. This problem can be understood when designing generators, for instance, in the 30-90 KVA range.

Some electrical apparatus such as generators employ a "can" for retaining cooling oil about the rotor components and retaining lamination of the rotor core. Attempts have been made to employ the can itself as the structural component or framework for the rotor extending between the end plates thereof. However, with high power or highly saturated generators, for instance, the can must be relatively thick and thereby creates an inefficient air gap between the rotor core and the armature core.

This invention is directed to providing a new and improved rotor construction which employs novel structural support means between the end shafts of the rotor and which obviates the problems described above.

Summary Of The Invention

An object, therefore, of the invention is to provide a rotor structure having unique support means

providing an unimpeded magnetic flux path through the axis of the rotor.

In the exemplary embodiment of the invention, a two salient pole rotor is disclosed for use with a generator or other electrical apparatus. A solid core extends lengthwise of the rotor and through the axis of rotation thereof to provide an unimpeded magnetic flux path through the axis of the rotor. The core has a pair of diametrically disposed, axially extending grooves along the peripheral length thereof. A pair of end shaft means including end plate means have complementary groove means in line with the grooves in the core. A pair of structural support wedge members extend lengthwise of the rotor, radially spaced from the axis thereof, and disposed in the grooves in the core and the groove means in the end plate means.

The core is of laminated construction to provide a highly saturated magnetic field. The wedge members are secured in the groove means of the end plate means by welding.

The rotor includes end support means secured to opposite ends of the laminations between the core and the end plate means to control squareness of the core to the outside diameter of the rotor. The end support means include groove means for accommodating the wedge members. The end plate means and the end support means are generally disc-shaped and of substantially equal diameters to provide cylindrical bounds for the rotor. The depth of the groove means in the plate means and in the end support means, and the thickness and outer surface configuration of the wedge members are such that the outside surface of the wedge members form a continuation of the circular periphery of the end plate means.

A cylindrical "can" is positioned about the rotor extending between the end plate means. The can is relatively thin and minimizes the air gap between the rotor core and the stator armature because the can does not comprise a structural or torque transmitting component of the rotor.

Other objects, features and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings.

Description Of The Drawings

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIGURE 1 is a perspective view of the rotor core and end supports for the rotor of this invention;

FIGURE 2 is a perspective view of the rotor in assembled condition, except for an exploded illustration of the supporting wedge members of the rotor;

FIGURE 3 is a view similar to that of Figure 2, with the wedge members secured in assembly;

FIGURE 4 is a perspective view similar to that of Figure 3, with a can in assembled condition surrounding the major rotor components; and

FIGURES 5-7 are views similar to that of Figures 1-3 of an alternate form of the invention.

Detailed Description Of
The Preferred Embodiment

Referring to the drawings in greater detail, the rotor of this invention is illustrated in the form of a two salient pole rotor for use with a generator or other electrical apparatus. The completed rotor assembly, generally designated 10, is illustrated in final assembled condition in Figure 4. Referring to Figure 1, the rotor includes a solid core, generally designated 12, which has a central core body portion 14 and two integral pole sections 16 diametrically opposed to each other to form the North and South poles of the salient pole rotor core.

It immediately should be pointed out that the invention is particularly adapted for use as a high power or highly saturated magnetic device. Consequently, core 12, including central body portion 14 and pole sections 16,18 are fabricated of laminations bonded together, and the term "solid" core is used herein and the claims hereof as contemplating a core having an unimpeded magnetic flux path through the axis of the rotor.

End support members 20 are provided at opposite ends of core 12 whereby the axially outer faces thereof can be machined to control the squareness of the core to the outside diameter of the rotor. Bores 22 are provided through end support members 20 and the pole sections 16,18 of laminated core 12 for receiving threaded rods to hold the components in assembly, as described hereinafter.

It can be seen in Figure 1 that laminated core 12 is formed with a pair of diametrically disposed, axially extending grooves 24 along the outer peripheral length thereof. End support members 20 actually comprise

sections of disc-shaped members defining groove means 26 in line with grooves 24 of core 12. Rotor windings 28 are wound about central core section 14 within grooves 24 of the core and groove means 26 defined by end support sections 20.

Referring to Figure 2, end shaft means, generally designated 30, are provided at opposite ends of rotor 12 and end support sections 20. End shaft means 30 may include a shaft and spline section 31 at one end of the rotor as well as a bearing that is not shown but the location of which is indicated generally at 30a and an end shaft 34 which will have fitted thereon a bearing (not shown) at the other end of the rotor. Each end shaft means 30 includes an end plate 32. It should be understood herein that the use of the term "shaft means" is used in contemplation of rotor assemblies wherein the actual end shaft sections or end bearings may be separate from the end plates themselves. Other power transmitting components are known to be coupled to end plate means, such as end plates 32 in a rotor assembly.

Each end plate 32 is provided with groove means 36 in line with grooves 24 of core 12 and groove means 26 between core end support sections 20. These grooves and groove means receive and position a pair of structural support wedge members 38 which extend lengthwise of the rotor, radially spaced from the axis thereof. Each wedge member 38 has bores 40 for receiving threaded bolts 42 which extend through apertures 44 in central core section 14 and which are threaded into the opposite wedge member to hold the wedge members in position within the groove means 24,26,36. Figure 2 also shows axial holes 46 in end plates 32 in line with bores 22 (Fig. 1) in core end support sections 20 for receiving rods 48 which are

threaded into the opposite end plate to hold the components in axial assembly. Each wedge member 38 has a pair of elongated recesses 49 on the inside thereof for accommodating windings 28.

Figure 3 shows wedge members 38 positioned within grooves 24 in core 12, groove means 26 in end support sections 20 and groove means 36 in end plates 32 of the end shaft means 30. It can be seen in Figures 2 and 3 that the outer surface of each wedge member 38 is generally cylindrical. End plates 32 and end support sections 20 are generally disc-shaped. The outer surfaces of the wedge members are circular to complement the shape of the end plates and the end support sections, as shown. When assembled, as shown, wedge members 38 are permanently secured within the rotor assembly by welding, as indicated generally at 50, to end plates 32.

Figure 4 shows the complete salient pole rotor 10 in final construction and includes a "can" 52 about the rotor and extending between end plates 32. The can is secured in sealed condition to the outer periphery of end plates 32, and by a press fit, to the outer periphery of rotor core 12 and end supports 20. The can is provided only for retaining cooling oil within the rotor for the core components and for retaining the lamination of the rotor core. The can is thin and does not provide a torque carrying function which is provided by wedge members 38. Access means for the supply and/ withdrawal of oil is provided, as conventional, but not shown.

Figures 5-7 show an alternate form of the invention wherein wedge members 38A extend all the way through end plates 32 to the outer faces thereof. Groove means 36A, likewise, extend axially through the width of the end plates for receiving the longer wedge members.

Otherwise, like numerals have been applied to like components described in relation to the embodiment of Figures 1-3.

From the foregoing, it can be seen that a salient pole rotor has been provided with a novel support structure which provides an unimpeded magnetic flux path through the axis of the rotor. The support structure, including wedge members 38, are confined within the outer peripheral bounds of the core end support sections and shaft end support means. The structure affords the use of a relatively thin oil cover 52 which simply needs to be secured in sealed position and, not being a structural component of the rotor assembly, the thinness of the oil cover minimizes the air gap between the rotor core 12 and the stator armature.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

CLAIMS

1. A salient pole rotor for use with a generator or other electric apparatus, comprising:

a solid core extending lengthwise of the rotor and through an unimpeded magnetic flux path through the axis of the rotor;

a pair of end shaft means at opposite ends of the core; and

structural support means extending lengthwise of the rotor, radially spaced from the axis thereof and rigidly secured at opposite ends to the end shaft means.

2. The salient pole rotor of claim 1 wherein said core comprises a two pole lamination.

3. The salient pole rotor of claim 1 wherein said support means comprises at least one elongated wedge member extending between and secured at opposite ends to the end shaft means, and the core includes an axially extending groove along the peripheral length thereof for accommodating the wedge member.

4. The salient pole rotor of claim 3 wherein said end shaft means each include end plate means having groove means for receiving and securing opposite ends of the wedge member.

5. The salient pole rotor of claim 4 wherein the wedge member is secured in the groove means of the end plate means by welding.

6. The salient pole rotor of claim 4, including end support means secured to opposite ends of the core between the core and said end plate means, the end support means including groove means for accommodating the wedge member.

7. The salient pole rotor of claim 6 wherein the wedge member is secured in the groove means of the end plate means by welding.

8. The salient pole rotor of either claims 6 or 7 wherein the end plate means and the end support means are generally disc shaped.

9. The salient pole rotor of claim 8 wherein the outside surface of the wedge member is annular complementary to the circular periphery of end plate means.

10. The salient pole rotor of claim 4, including a relatively thin, non-structural, cylindrical can about the rotor and extending between the end plate means.

11. The salient pole rotor of claim 3 wherein said wedge member is recessed on the inside thereof for accommodating the winding of the rotor about said core.

12. The salient pole rotor of claim 3, including a pair of said wedge members diametrically disposed on opposite sides of the rotor.

13. A salient pole rotor for use with a generator or other electric apparatus, comprising:

a solid core extending lengthwise of the rotor and through an unimpeded magnetic flux path through the axis of the rotor, the core having a pair of diametrically disposed, axially extending grooves along the peripheral length thereof;

a pair of end shaft means including end plate means at opposite ends of the core having complementary groove means in line with the grooves in the core; and

a pair of structural support wedge members extending lengthwise of the rotor, radially spaced from the axis thereof, and disposed in the grooves in the core and the groove means in the end plate means, the wedge members being rigidly secured to the end plate means.

14. The salient pole rotor of claim 13 wherein said core comprises a two pole lamination.

15. The salient pole rotor of claim 13 wherein the wedge members are secured in the groove means of the end plate means by welding.

16. The salient pole rotor of claim 13, including end support means secured to opposite ends of the core between the core and said end plate means, the end support means including groove means for accommodating the wedge members.

17. The salient pole rotor of claim 16 wherein the wedge members are secured in the groove means of the end plate means by welding.

18. The salient pole rotor of either claims 16 or 17 wherein the end plate means and the end support means are generally disc shaped.

19. The salient pole rotor of claim 18 wherein the outside surfaces of the wedge members are annular complementary to the circular periphery of end plate means.

20. The salient pole rotor of claim 13, including a relatively thin, non-structural, cylindrical can about the rotor and extending between the end plate means.

21. The salient pole rotor of claim 13 wherein said wedge members are recessed on the inside thereof for accommodating the winding of the rotor about said core.

22. In a salient pole rotor for use in a generator or other electric apparatus, in which the rotor includes end plates at opposite ends of a rotor core, support means comprising a pair of wedges of non-magnetic material axially disposed in grooves on opposite sides of the rotor core, the wedges extending axially beyond each core end and secured in complementary groove means on opposite sides of the end plates.

23. The salient pole rotor of claim 22 wherein said core comprises a two pole lamination.

24. The salient pole rotor of claim 22 wherein the wedges are secured in the groove means of the end plates by welding.

25. The salient pole rotor of claim 22 wherein the end plates are generally disc shaped.

26. The salient pole rotor of claim 25 wherein the outside surfaces of the wedges are annular complementary to the circular peripheries of the end plates.

27. The salient pole rotor of claim 22 wherein said wedges are recessed on the insides thereof for accommodating the winding of the rotor about the core.

28. The salient pole rotor of claim 22, including a relatively thin, non-structural, cylindrical can about the rotor and extending between the end plates.

AMENDED CLAIMS

[received by the International Bureau on 18 May 1987 (18.05.87);
original claims 1-17 replaced by amended claims 1-17; other claims unchanged (3 pages)]

1. A salient pole rotor for use with a generator or other electric apparatus, comprising:

a solid core extending lengthwise of the rotor and through an unimpeded magnetic flux path through the axis of the rotor, the core having an axially extending groove along the peripheral length thereof;

a pair of end shft means substantially abutting opposite ends of the core; and

an elongated structural wedge member shaped complementary to said groove and extending lengthwise of the rotor, radially spaced from the axis thereof, and disposed in said groove, the wedge member being rigidly secured at opposite ends to the end shaft means to provide structural support means for the rotor between the end shaft means.

2. The salient pole rotor of claim 1 wherein said core comprises a two pole lamination.

3.

4. The salient pole rotor of claim 1 wherein said end shaft means each include end plate means having groove means for receiving and securing opposite ends of the wedge member.

5. The salient pole rotor of claim 4 wherein the wedge member is secured in the groove means of the end plate means by welding.

6. The salient pole rotor of claim 4, including end support means secured to opposite ends of the core between the core and said end plate means, the end support means including groove means for accommodating the wedge member.

7. The salient pole rotor of claim 6 wherein the wedge member is secured in the groove means of the end plate means by welding.

8. The salient pole rotor of either claims 6 or 7 wherein the end plate means and the end support means are generally disc shaped.

9. The salient pole rotor of claim 8 wherein the outside surface of the wedge member is annular complementary to the circular periphery of end plate means.

10. The salient pole rotor of claim 4, including a relatively thin, non-structural, cylindrical can about the rotor and extending between the end plate means.

11. The salient pole rotor of claim 1 wherein said wedge member is recessed on the inside thereof foraccommodating the winding of the rotor about said core.

12. The salient pole rotor of claim 1, including a pair of said wedge members diametrically disposed on opposite sides of the rotor.

13. A salient pole rotor for use with a generator or other electric apparatus, comprising:

a solid core extending lengthwise of the rotor and through an unimpeded magnetic flux path through the axis of the rotor, the core having a pair of diametrically disposed, axially extending grooves along the peripheral length thereof;

a pair of end shaft means including end plate means substantially abutting opposite ends of the core having complementary groove means in line with the grooves in the core; and

a pair of elongated structural support wedge members extending lengthwise of the rotor, radially spaced from the axis thereof, and disposed in the grooves in the core and the groove means in the end plate means, the wedge members being rigidly secured to the end plate means to provide structural support means for the rotor between the end shaft means.

14. The salient pole rotor of claim 13 wherein said core comprises a two pole lamination.

15. The salient pole rotor of claim 13 wherein the wedge members are secured in the grooove means of the end plate means by welding.

16. The salient pole rotor of claim 13, including end support means secured to opposite ends of the core between the core and said end plate means, the end support means including groove means for accommodating the wedge members.

17. The salient pole rotor of claim 16 wherein the wedge members are secured in the groove means of the end plate means by welding.

FIG. 1

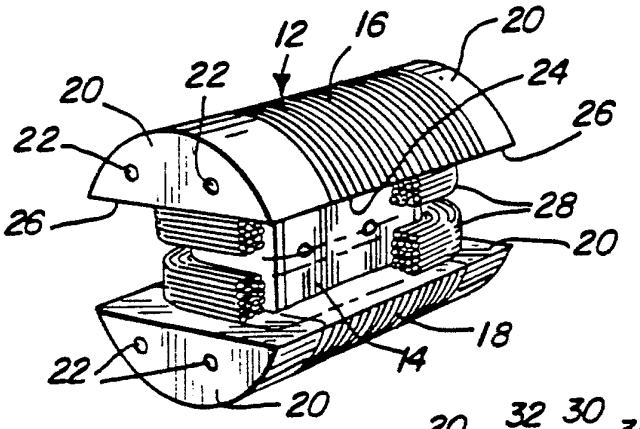


FIG. 2

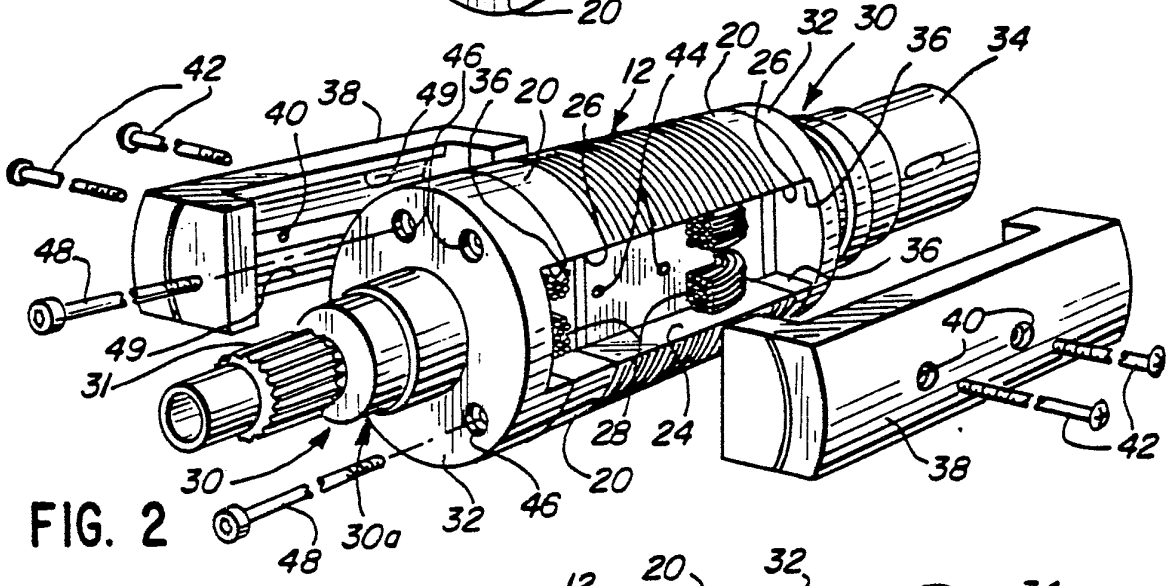


FIG. 3

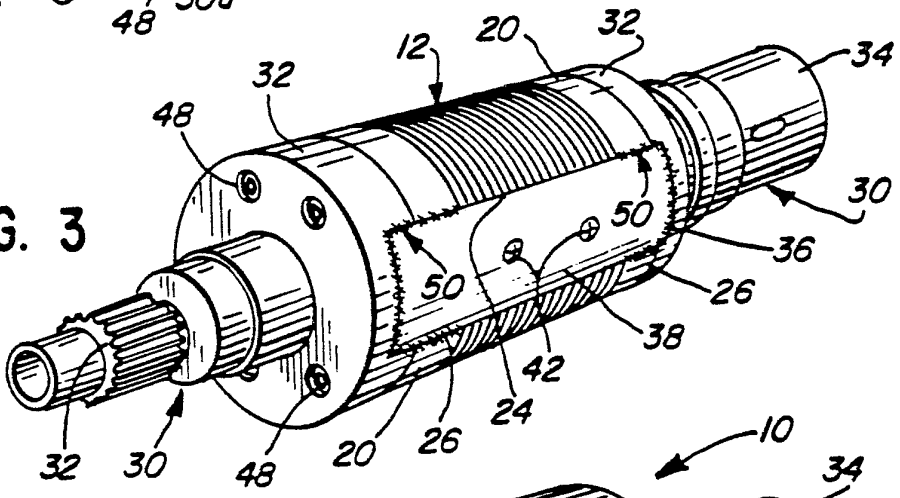


FIG. 4

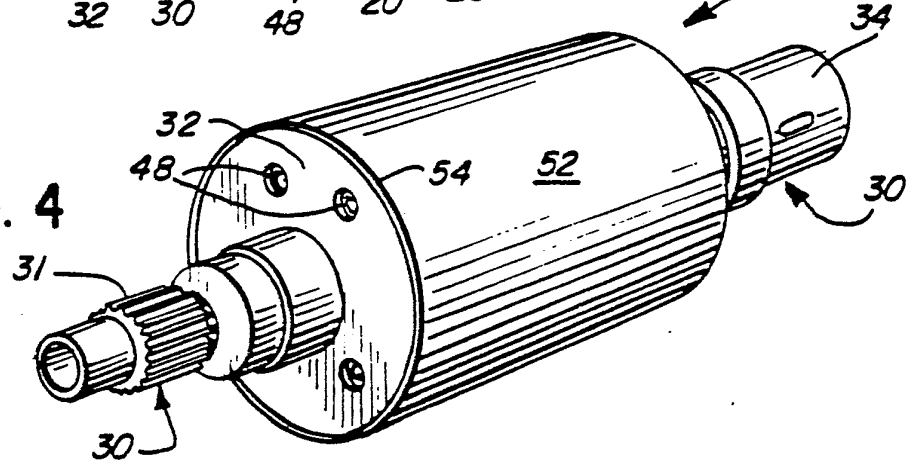


FIG. 5

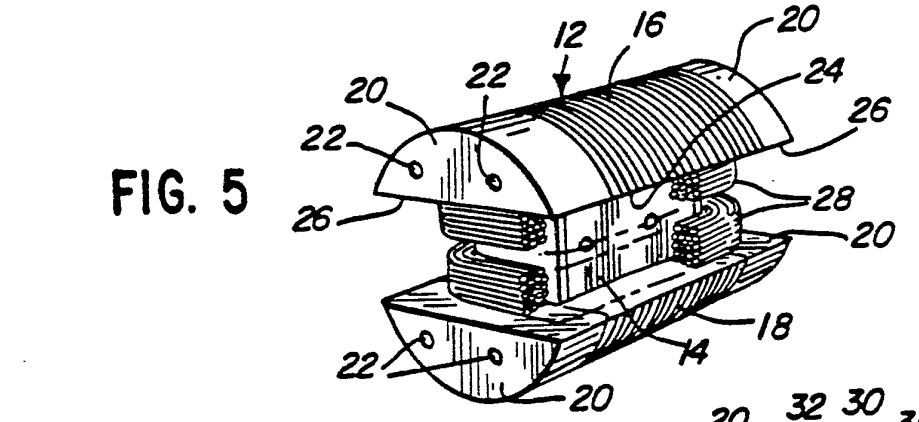


FIG. 6

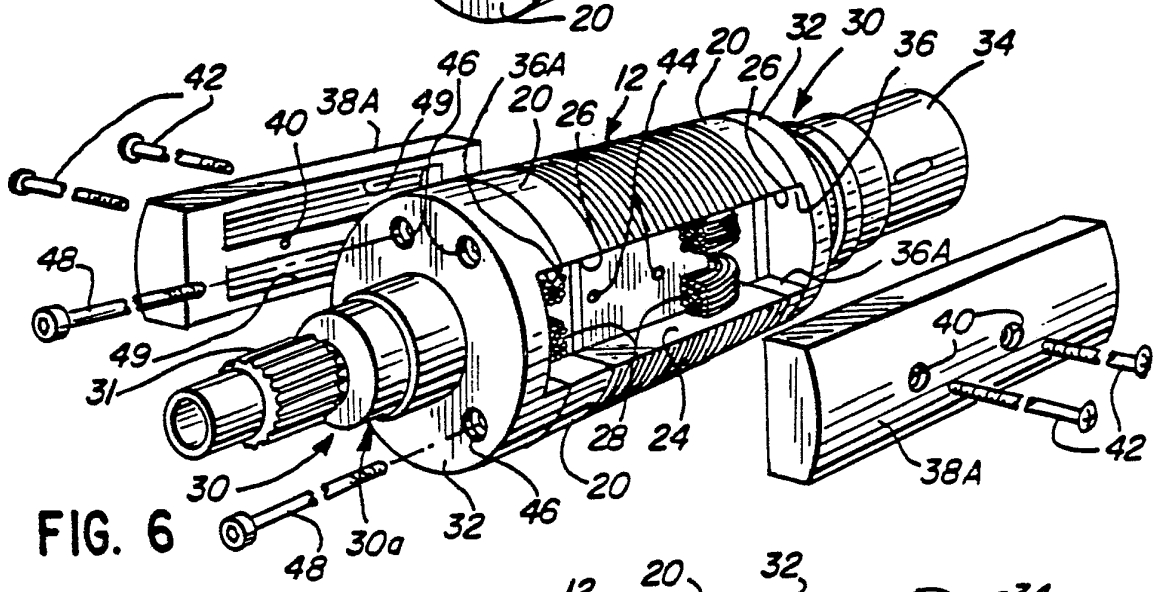
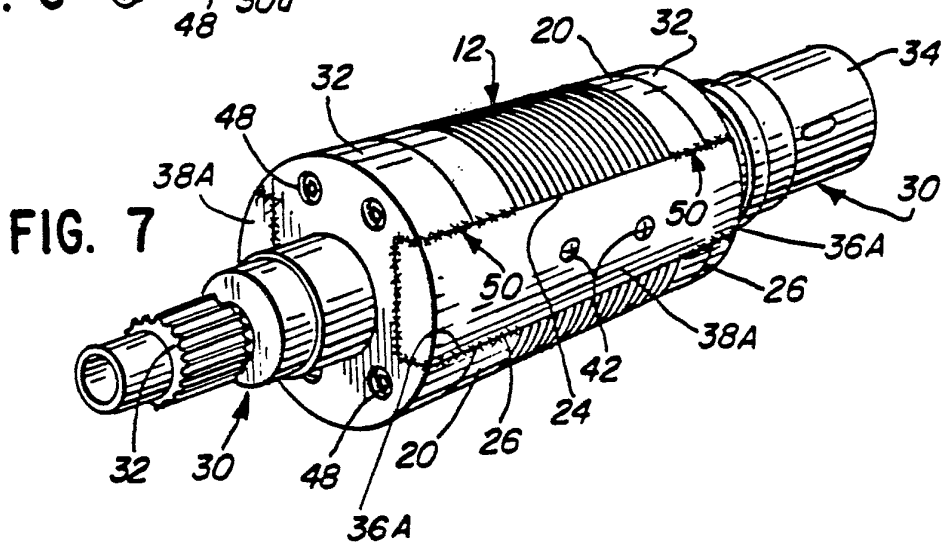


FIG. 7



INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/02769

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (4): H02K 1/24, 15/00

U.S. Cl. 310/42, 269

II. FIELDS SEARCHED

Minimum Documentation Searched 4

Classification System	Classification Symbols
U.S.	310/42, 214-218, 194, 156, 261, 269

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 5

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X, P	US, A, 4,562,641 (MOSHER ETAL) 7 Jan 1986, See the entire document	1-28
A	US, A, 1,593,230 (VARLEY) 20 July 1926 See the entire document	1-28
A	US, 2,632,123 (KOBER) 17 MARCH 1953 See the entire document	1-28

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IV. CERTIFICATION

Date of the Actual Completion of the International Search 2	Date of Mailing of this International Search Report 2
03 March 1987	18 MAR 1987
International Searching Authority 1	Signature of Authorized Officer 20
ISA/US	Donovan F. Duggan