

MAGNETIC ROTOR AND METHOD OF ASSEMBLYDescriptionTechnical Field

5 This invention relates to rotors for use in electrical generators and more particularly to a sequentially built rotor and a method of assembly.

Background Art

10 High speed, high performance generator rotors are generally built without center shafts to provide maximum magnetic material. To maintain the structural integrity of this type rotor, one possible course is to complete the rotor and associated shafts as a unit, as taught in U.S. Patent 4,024,628, to Crites. However, because the rotor assembly is an integral unit, any
15 defect or failure in any portion of the rotor renders the entire structure useless.

As an alternative to a single piece construction, rotors may be sequentially built up and the parts permanently joined as by welding. The welding
20 operation is intricate and demands a great amount of care and precision. This necessarily results in a time-consuming process and the performance of a great number of steps. Further reworking of the rotor is precluded by the welded joints.

25 A rotor assembled with bolts or rivets generally has one main drawback. To withstand the large stresses encountered, large bolts or rivets must be used requiring large bores through the assembled elements. The possibility of air gaps about the fastener raises the
30 problem of disruption of the magnetic path which, in turn, lowers generator efficiency.

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A further drawback with sequentially built rotors is that contaminants are likely to find their way between mated parts, which may be permanently engaged. Rotor operation may be impaired. Because the parts are not readily separable, the entire rotor may be unusable.

The present invention is directed to overcome the problems enumerated above.

10 Disclosure of the Invention

The present invention provides a method for sequentially building up a rotor for an electric machine comprising the steps of:

removably attaching a turn support to each axial end of a rotary magnetic core to define a core subassembly and machining the core subassembly to match the core and turn supports;

removing the turn supports from the core;
providing an axial shaft fitting for each of the ends of the core subassembly;

aligning and assembling each of the turn supports with one of the shaft fittings;

machining the aligned turn supports and shaft fittings to effect matching;

disassembling the shaft fittings and turn supports;
reattaching the turn supports at the ends of the core; and

removably attaching a shaft fitting at each end of the core subassembly;

whereby the rotor can be readily disassembled for reworking and reassembled with the alignment of the core, turn supports and shaft fittings precisely maintained.

The present invention permits the assembly of a rigid rotor that is capable of high rotational speeds and which can be

disassembled for reworking without loss of precise alignment between elements.

Upon removal of the sleeve housing, the elements can be successively separated by releasing the bolts joining the end shaft fittings and in turn those mounting the end turn supports with the core. This feature is particularly advantageous in that it permits precise machining in various stages of assembly after which the entire assembly can be disassembled, deburred and cleaned to remove contaminants as machining chips, grinding dust, etc. prior to winding the field coil.

While the process facilitates assembly and disassembly, the end product of the process is a high quality structure. The bores for the bolts are machined to close tolerances. The bolts employed are precision ground, high strength, high permeability bolts which become part of the final assembly and positively retain the elements. Further, the bolts, which are selected for high magnetic permeability, account for low magnetic loss.

Brief Description of the Drawings

Fig. 1 is a perspective view of a completed rotor assembly according to the present invention;

Fig. 2 is a perspective view of the rotor core;

Fig. 3 is an exploded view of the core assembly with mated end turn supports;

Fig. 4 is an end shaft fitting for the core matched with an end turn support;

Fig. 5 is the opposite end shaft fitting from that in Fig. 4 matched with an end turn support; and

Fig. 6 is an exploded view of the end shaft fittings and field wound core subassembly.

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Best Mode for Carrying Out the Invention

Fig. 1 depicts a completed rotor assembly 10 made according to the invention and comprising generally a main core assembly 12 surrounded by a cylindrical sleeve 14 and oppositely directed and axially aligned end shaft fittings 16, 18.

The main core assembly 12 is detailed in Figs. 2 and 3 and comprises an I-shaped core 20 made from bonded lamination layers 22. At each end of the core 20 is an end turn support 24 configured to nominally match the cross section of the core 20. The end turn supports 24 have axially oppositely opening rectangular recesses 26 which, with oppositely opening rectangular recesses 28 in the core 20 and end turn supports 24, provide a continuous undercut about the main core assembly 12, for the inclusion of the field windings 30 (Fig. 6).

A bore 32 is axially machined to close tolerances through each of the end turn supports 24 and the core 20 threadably receives a bolt 35. A single bolt 35 is inserted axially through each end turn support at substantially diametrically opposing regions of the core assembly 12 and is of sufficient length to extend into the opposite end turn support 24 so as to prohibit relative rotation between the core 20 and end turn supports 24.

M-shaped wedges 34 are closely mated in the core recesses 28, and have lengthwise, rectangular pathways 36 for the field windings 30 defined by spaced axial flanges 38 of a length equal to the distance between opposed faces of the end turn supports 24.

Machining of the core 20 and assembled end turn supports 24 constituting the core subassembly 12, can take place before the addition of the wedges 34. The

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wedges 34 are assembled to the core 20 by suitable fasteners (not shown) before completion of the final machining of the outside diameter thereof.

5 The end turn supports 24 are then removed from
the core and matched with the end shaft fittings, 16, 18
illustrated in Figs. 4 and 5. Because the matching of
the end turn supports 24 is the same for both end shaft
fittings 16, 18, like reference numerals are used to
designate parts at each end of the core. Each of the
10 end shaft fittings 16, 18 has a circular cast base 46
with an integrally formed, axially directed collar 48.
The collars are concentric with the rotational axis of
shafts 17, 19 which are integral with and extend
oppositely from the bases 46.

15 Alignment between the end turn supports 24 and
shaft fittings 16, 18 is maintained by a pair of dowels
50 extending within diametrically opposed axial bores 52
and 53 in the end turn supports 24 and in the bases 46,
respectively. When properly matched, the end turn
20 supports 24 and end shaft fittings 16, 18 are machined to
desired tolerances.

 The end shaft fittings 16, 18 and end turn
supports 24 are then separated and the end supports 24
rebolted with the core 20. The shaft fittings 16, 18 and
25 core assembly 12 are mated as illustrated in Fig. 6.
Bores 54 are machined to close tolerances through the
bases 46, the end turn supports 24 and into the core 20.
A second set of precision ground bolts 56 are threadably
received in the bores 54 and are tightened to secure the
30 end shaft fittings 16, 18, to the core subassembly.
Additional machining of the collars 48 and the end turn
supports 24 proceeds if required.

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5 Bolts 56 and end turn bolts 35 are then withdrawn so that all the aggregate elements can be separated, deburred and cleaned to remove any machining chips or grinding dust or any other contamination that may have accumulated.

10 The end turn supports 24 are then reassembled to the core 20, the field coil 30 wound and the wedges 34 replaced. The shaft fittings 16, 18 are then reassembled to the end turn supports 24 after such reassembly. The cylindrical sleeve 14 is interference fit with the peripheral surfaces of the commonly machined core, end turn supports and end shaft fittings and secured in a conventional manner to complete the rotor 10.

15 From the foregoing it can be seen that the bolts 35, 56 simply and positively maintain the core 20, end turn supports 24 and end shaft fittings 16, 18 in assembled relationship. By simply releasing in turn bolts 56 and 35, the core 20 end turn supports 24 and end shaft fittings 16, 18 can be freed to accomplish cleaning reworking or replacement of parts.

20 Precise alignment of the core end turn supports and end shaft fittings during reassembly is assured by the bolts 35, 56.

25 Because bolts 35, 56 and the receiving bores 32, 54 are machined to close tolerances, air gaps are minimized so that little disruption of the magnetic path occurs. Generator efficiency is further enhanced by the use of bolts with high magnetic permeability which accounts for reduced magnetic loss in the rotor.



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CLAIMS:

1. A method for sequentially building up a rotor for an electric machine comprising the steps of:
 - removably attaching a turn support to each axial end of
 - 5 a rotary magnetic core to define a core subassembly and machining the core subassembly to match the core and turn supports;
 - removing the turn supports from the core;
 - providing an axial shaft fitting for each of the ends
 - 10 of the core subassembly;
 - aligning and assembling each of the turn supports with one of the shaft fittings;
 - machining the aligned turn supports and shaft fittings to effect matching;
 - 15 disassembling the shaft fittings and turn supports;
 - reattaching the turn supports at the ends of the core; and
 - removably attaching a shaft fitting at each end of the core subassembly;
 - 20 whereby the rotor can be readily disassembled for reworking and reassembled with the alignment of the core, turn supports and shaft fittings precisely maintained.
2. A method according to claim 1, wherein a subsequent
- 25 machining operation is performed after the shaft fittings are attached at the ends of the core subassembly to make the rotor a finished size.
3. A method according to claim 1 or claim 2, wherein each
- 30 turn support is removably attached to the core by at least one bolt extending axially through the turn support and into the core.



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4. A method according to any preceding claim wherein each shaft fitting is attached to the core subassembly by at least one bolt extending axially through the shaft fitting, through an end turn support and into the core.

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5. A method according to any preceding claim, including the step of providing a cylindrical sleeve over the core subassembly after the shaft fittings are attached at the ends of the core subassembly.

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6. A method according to claim 3 or claim 4, wherein the bolts are made from a material having a high magnetic permeability for low magnetic loss.
