(12) UK Patent Application (19) GB (11) 2 224 399 (13) A

(43) Date of A publication 02.05.1990

(21) Application No 8923359.7

(22) Date of filing 17.10.1989

(30) Priority data
(31) 8825071 (32) 26.10.1988 (33) GB

(51) INT CL⁴
H02K 1/18

(52) UK CL (Edition J)
H2A ACH

(56) Documents cited
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(58) Field of search
UK CL (Edition J) H2A ACB ACG ACH
INT CL⁴ H02K 1/08 1/14 1/18

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(54) **A stator assembly having yoke segments interconnected by pole pieces**

(57) An electrical stator (1) comprises a plurality of yoke segments constituted by a stack of similar laminations (2) interconnected by a plurality of pole pieces constituted by a stack of similar laminations (3). Segments and pole pieces have complementary parts such that consecutive yoke segments interfit with and are coupled by a respective pole piece. The yoke segments define a yoke in the form of a polygonal figure and in the preferred embodiment the stator comprises four yoke segments and four pole piece segments. Each yoke segment comprises a plurality of straight parallel sided legs (2a, 2b, 2c), the inner side (5) of each segment being substantially complementary to the outer side (6) thereof. Each pole piece may include a pair of inclined slots (21) receiving complementary terminal portion (23) of a yoke segment and defining a dovetail part.

FIG .1

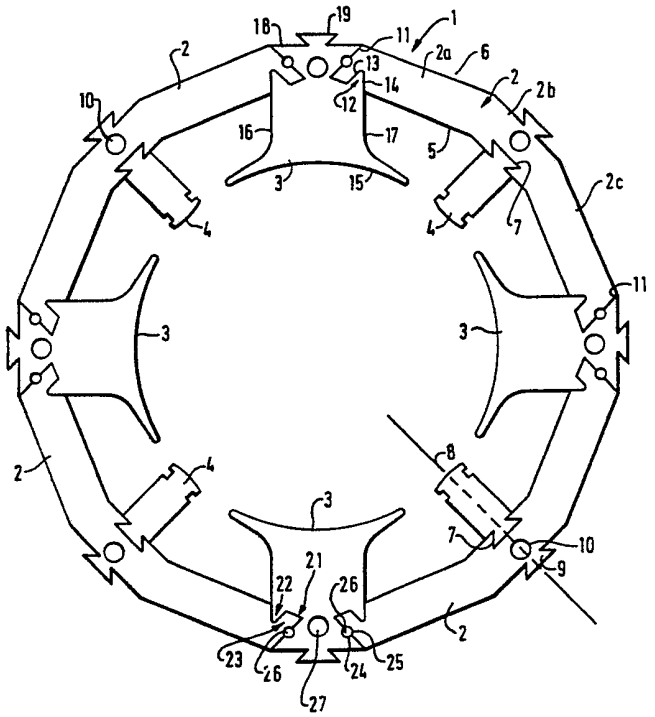

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FIG .1

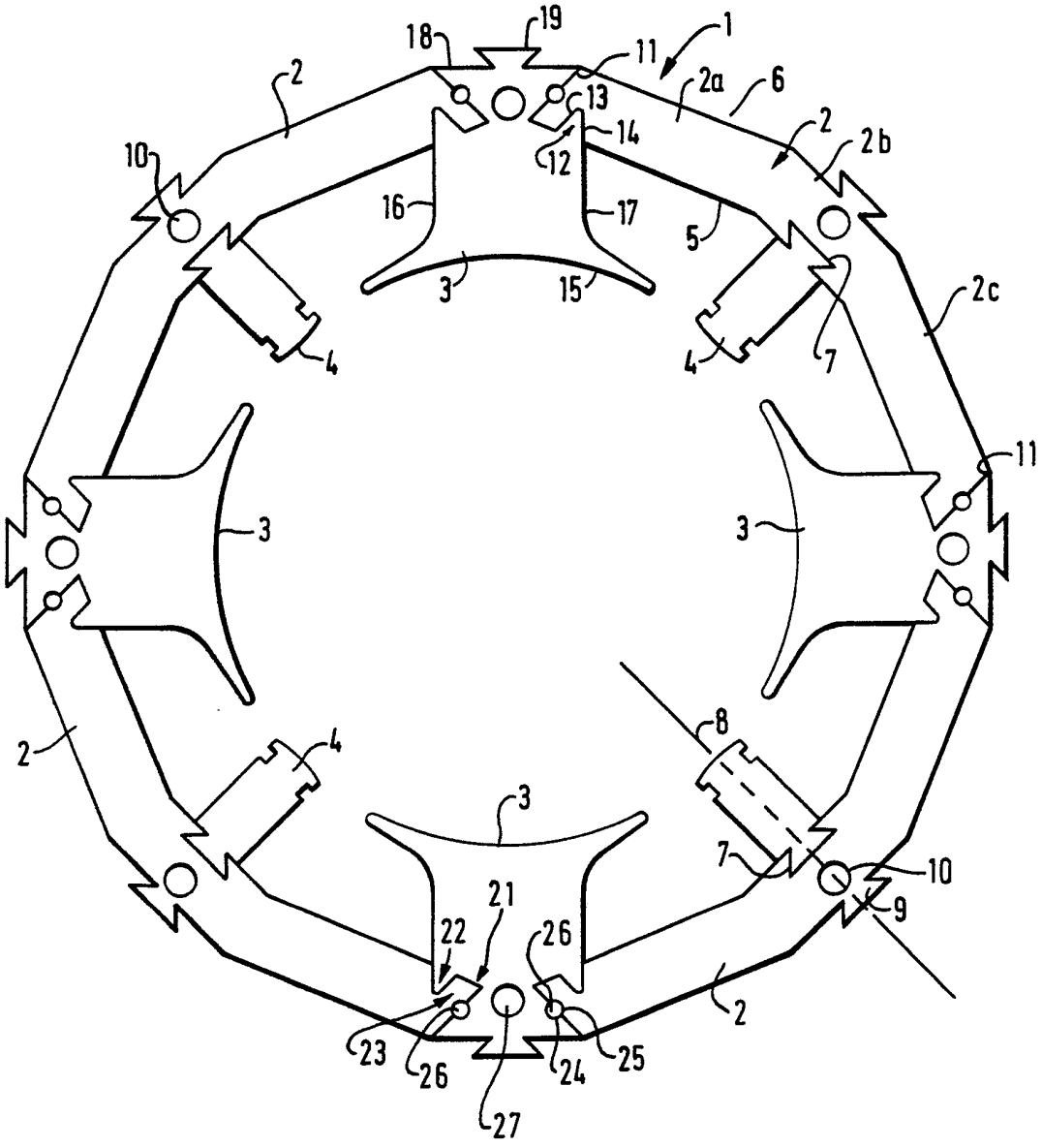

FIG.2

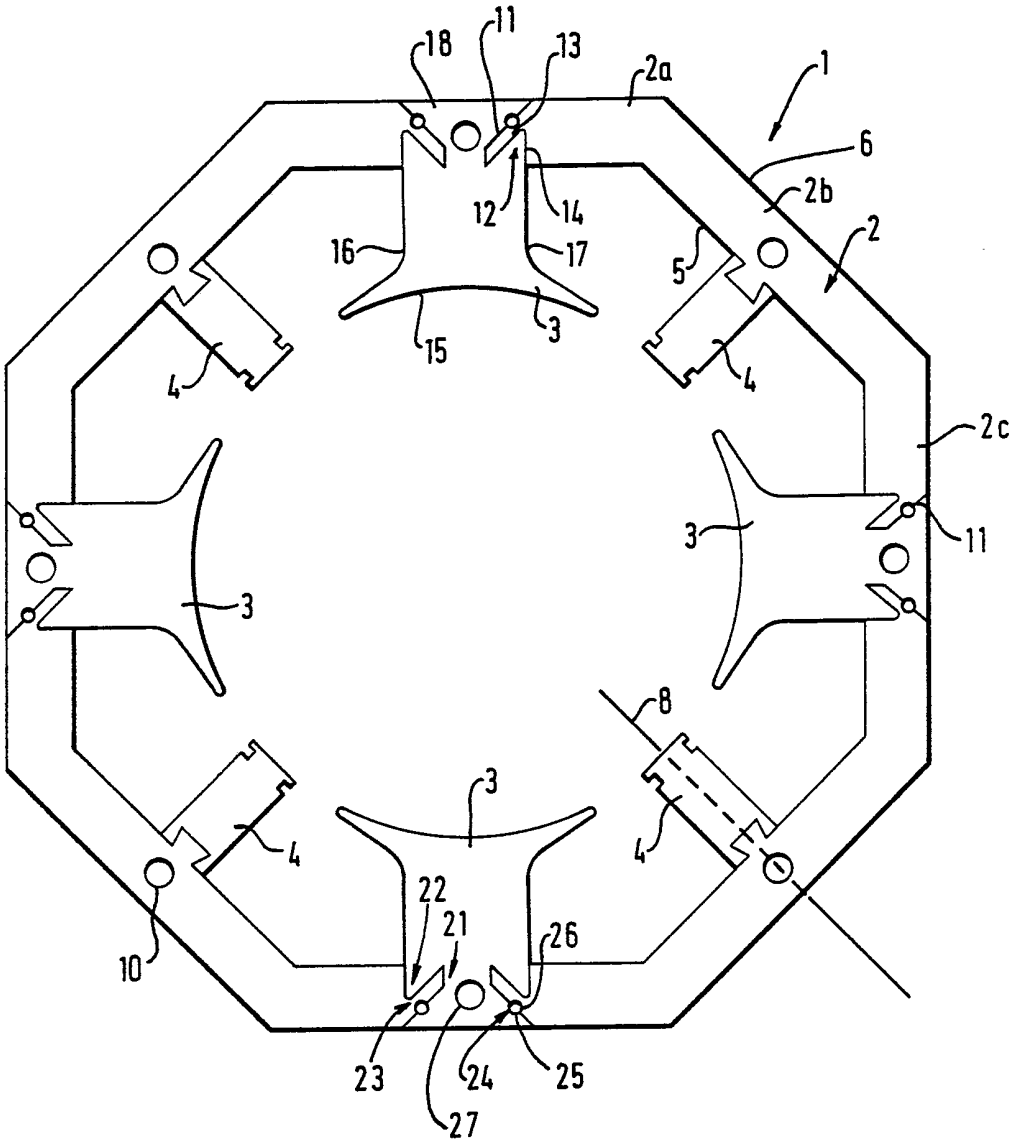
18
11
13
2a
1
6
2b
2
12
14
16
17
5
15
3
4
4
2c
3
11
3
8
3
4
4
22
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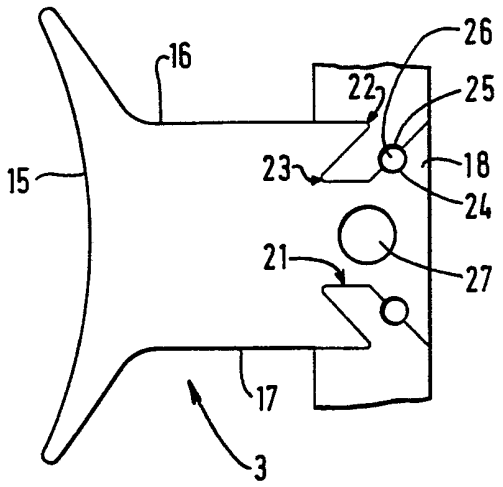
FIG.3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LAMINATED STATORS FOR DYNAMO-ELECTRIC MACHINES

This invention relates to dynamo-electric machines and particularly to a technique for the manufacture and assembly of a stator composed of a plurality of pairs of pole pieces and a yoke.

It is known to make a laminated stator from laminar segments which are disposed in interleaved fashion so as to constitute a yoke which has a generally tubular form. In known practice the tubular form may be octagonal, laminated pole pieces being keyed or otherwise affixed to the inside of each of the eight legs of the octagon. Normally there are two pairs of main pole pieces and four interpoles. However, other arrangements having a greater number of pairs of poles are possible.

Manufacture by an interleaving technique can achieve a reasonably efficient utilisation of material, but assembly of the interleaved stacks of laminations is inconvenient and comparatively expensive, normally requiring welding.

Moreover, existing designs do not provide sufficient space for the convenient use of round wire for the field windings of the machine.

It is known to make yokes from circular laminations and to secure pole pieces of main poles and interpoles by means of drilling the yoke and employing threaded fittings. However there is poor utilization of material and the cost of assembly is comparatively high.

It is a general object of the invention to provide a technique of making and assembling laminations for the laminated yoke and pole pieces of the dynamo-electric machine. It is a preferred object to provide a technique which is versatile and facilitates substantial economic savings in the manufacture of the motor as well as a general improvement in the construction and performance of the motor.

SUMMARY OF THE INVENTION

In one aspect of the invention an electrical stator comprises a plurality of yoke segments each constituted by a respective stack of similar laminations and a plurality of pole pieces each constituted by a respective stack of similar laminations, the segments and pole pieces having complementary parts such that consecutive yoke segments interfit with and are coupled by a respective pole piece.

Preferably the yoke segments define a yoke in the form of a polygonal figure. The segments may be coupled by respective pole pieces at corners of the polygon. Alternatively, the segments may be coupled by respective pole pieces disposed in the middle of alternate legs of the polygon. Such a construction maximizes the space available for winding round wire on the pole pieces.

The yoke segments may each comprise a plurality of straight, parallel sided legs, the inner side of the segments being substantially complementary to the outer side thereof.

Each pole piece may include a pair of inclined slots receiving a complementary terminal portion of a yoke segment and defining a dovetail part. The slots may be parallel sided, and symmetrical with respect to a centre line of the respective pole piece.

The invention also provides a method of making an electrical stator, comprising forming a multiplicity of first laminations each of which has the cross section of a yoke segment, forming a multiplicity of second laminations each

of which corresponds to the cross section of the pole piece, forming the first and second laminations with complementary paths such that a pole piece lamination may act as a connector for two yoke laminations, constituting forming a plurality of yoke segments and a plurality of pole pieces from stacks of respective laminations, and connecting the yoke segments in a closed magnetic circuit by means of the pole pieces which alternate with the yoke segments.

A particular pole piece lamination may comprise a tip portion having an arcuate edge, a shank portion having two generally parallel edges and a terminal portion including two opposite slots inclined symmetrically with respect to a centre line of the shank and inwardly from the terminal portion, the slots defining a dovetail at the terminal portion. A particular yoke segment lamination may comprise a plurality of generally straight parallel sided leg portions, the two longer sides of the laminations being substantially complementary, and having near each end a recess defining a terminal portion which is parallel to, or symmetrically inclined relative to, the access of symmetry of the yoke segment lamination.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a plan view of part of a stator of an electric motor, the figure showing interfitting yoke laminations and pole piece laminations;

Figure 2 is a plan view of an alternative embodiment of the stator shown in Figure 1; and

Figure 3 shows in detail a pole piece according to the second embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows in plan or end view part of a stator, that is to say the yoke and pole pieces, of a four pole direct current motor. The stator 1 is laminated and in its completely assembled form consists of four non-interleaved stacks of yoke laminations 2, four non-interleaved stacks of main pole piece laminations 3 and, preferably, four non-interleaved stacks of interpole laminations 4. The interpoles and their manner of affixing to the yoke laminations 2 are not important to the present invention but they are described herein because it is usual, in order to aid commutation, to provide such intervals in a direct current machine.

Each of the segmental yoke laminations 2 preferably comprises a plurality of legs (2a, 2b and 2c) which are preferably straight and are defined between an inner side 5 and an outer side 6, which are parallel and of matching shape throughout substantially the whole length of each

segment. An advantage of making the segments in this way is that they can be cut without significant wastage from a strip of suitable metallic sheet.

On the inner side of the central part 2b of the stator segment 2 is a dovetail groove 7 for engagement by the dovetail of an interpole 4. The dovetail groove is aligned, along a line 8 which is radial with respect to the axis of the stator, with a dovetail 9 on the outer side of the segment. This dovetail will, of course, form a dovetail ridge running lengthwise along the outside of the yoke and may be used for securing the yoke in a frame. It will be understood that preferably the dovetail groove 7 and the dovetail 9 are of corresponding form.

At a convenient location (or locations), but in this embodiment in the centre of the central portion 2b of each segmental lamination, there is an aperture 10. This aperture can be aligned with the corresponding apertures of the segments in the same stack of laminations and is used to receive a stake or peg for securing together the laminations in the stack.

The yoke lamination 2 has end sides 11. It is convenient for these two sides to be parallel on each segmental lamination in order to facilitate the stamping of the laminations from a strip without wastage. At each end the yoke lamination has a recess 12 with sides 13 and 14, as explained later.

An important feature of the present invention is the disposition of the pole piece such that it fits between and couples two consecutive yoke segments. Each pole piece

lamination has an inner curved side 15, which will form part of the pole face. The pole piece lamination has sides 16 and 17 which are preferably generally parallel. At its outer end the pole piece lamination is formed with a dovetail 18. This dovetail may carry an outer, smaller dovetail 19 which is used for affixing the yoke to a machine frame in a similar manner to that in which dovetail 9 is used.

When the respective stacks of laminations are assembled, the sides of the main dovetail correspond to and closely abut the sides 11 of adjacent laminations.

Preferably, each pole piece lamination is recessed adjacent the dovetail so that there is a slot 21 formed between each side of the dovetail and a respective triangular lip 22 of which one side is parallel to the confronting side of the dovetail, and of which the other side is a continuation of the side 16 or 17 of the pole piece lamination as the case may be. This lip 22 conforms to the recess 12 formed near the ends of each yoke lamination. The obliquity of the slot 21 is preferably parallel to the radial line 8 passing through the centre of the respective yoke lamination, the tab 23 formed between the recess and the end of the yoke lamination fitting into the slot 21.

This feature enables the yoke stack to be inserted in a pole piece stack by means of a simple radial movement. The interfitting of the pole pieces and the yoke segments resists movement of the yoke segments relative to the pole segment except in a radial outward direction. In order to resist this movement and secure the parts of the stator together, the sides of the dovetail on the pole piece

laminations and the end sides of the yoke laminations are provided with small, mutually registering recesses 24 and 25 so as to define between respective adjacent sides the small circular hole 26. This hole may then receive a stack or peg which will act as a common detent for the adjacent pole pieces and yoke segments and thereby resist any outward movement of the assembled stator.

Each pole piece lamination has a hole 27 which is used for pegging the stack of pole piece laminations together in the same manner as the hole 10 is used for the stack of yoke laminations.

In the embodiment shown in Figure 1, the pole pieces are provided at corners of the polygon formed by the yoke segments. The radial distance of the corners to the inner circular periphery of the pole pieces is thus at its greatest and accordingly the construction allows for the maximum length of shank on the pole pieces and thereby facilitates the use of round wire to the maximum number of turns. However, an alternative is shown in Figure 2. The description of Figure 2 is substantially the same as that of the embodiment of Figure 1 and will not be repeated. The essential difference of the embodiment of Figure 2 is that the pole pieces are provided in the middle of each side of the polygon formed by the yoke segments 6. Although the length of the shank on the pole piece is shorter in the embodiment of Figure 2, a right angle is defined between the side 16 or 17 of the shank and the respective yoke segment and accordingly it is easier to wind the round wire on the shank, and the winding may have a greater multiplicity of layers throughout the length of the shank than in the embodiment shown in Figure 1.

Figure 3 shows in detail, for greater clarity, a pole piece according to the second embodiment of the stator, as illustrated in Figure 2.

A further advantage of the construction is that there is an absence of interleaving. The number of joints in the magnetic circuit of the yoke is minimal.

CLAIMS

1. An electrical stator comprising a plurality of yoke segments each constituted by a respective stack of similar laminations and a plurality of pole pieces each constituted by a respective stack of similar laminations, the segments and pole pieces having complementary parts such that consecutive yoke segments interfit with and are coupled by a respective pole piece.

2. A stator according to claim 1 in which the yoke segments define a yoke in the form of a polygonal figure.

3. A stator according to claim 2 in which the segments are coupled by respective pole pieces at corners of the polygon.

4. A stator according to claim 2 in which the segments are coupled by respective pole pieces at the centre of each side of the polygon.

5. A stator according to any of claims 2 to 4 in which each lamina of the stator comprises four yoke segments and four pole piece segments.

6. A stator according to any of claims 2 to 5, in which the yoke segments each comprise a plurality of straight parallel sided legs, the inner side of each segment being substantially complementary to the outer side thereof.

7. A stator according to any foregoing claim in which each pole piece includes a pair of inclined slots defining a

dovetail part, and each slot receiving a complementary terminal portion of a yoke segment.

8. A stator according to claim 7 in which the slots are parallel sided and symmetrical with respect to a centre line of the respective pole piece.

9. A method of making an electrical stator, comprising forming a multiplicity of first laminations each of which has the cross section of a yoke segment, forming a multiplicity of second laminations each of which corresponds to the cross section of a pole piece, forming the first and second laminations with complementary parts such that a pole piece lamination may act as a connector for two yoke laminations, constituting forming a plurality of yoke segments and a plurality of pole pieces from stacks of respective laminations, and connecting the yoke segments in a closed magnetic circuit by means of the pole pieces which alternate with the yoke segments.

10. A pole piece lamination comprising a tip portion having an arcuate edge, a shank portion having two generally parallel edges, and a terminal portion including two opposite slots inclined symmetrically with respect to a centre line of the shank and inwardly from the terminal portions, defining a dovetail at the terminal portion.

11. A yoke segment lamination comprising a plurality of generally straight parallel sided leg portions, the two longer sides of the laminations being substantially complementary, and having near each end a recess defining a terminal portion which is parallel to the axis of symmetry of the yoke segment lamination.

12. A yoke segment lamination according to claim 11 in which the recess is substantially triangular.

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