SPACER FOR CASTING SQUIRREL CAGE ROTORS

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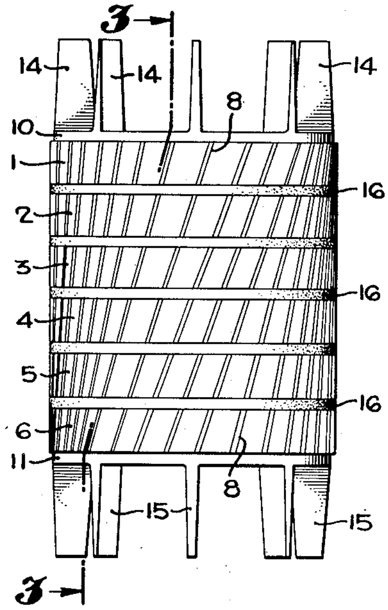

Fig. 1.

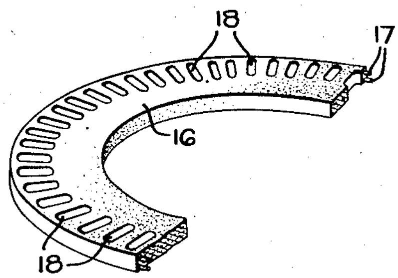

Fig. 2.

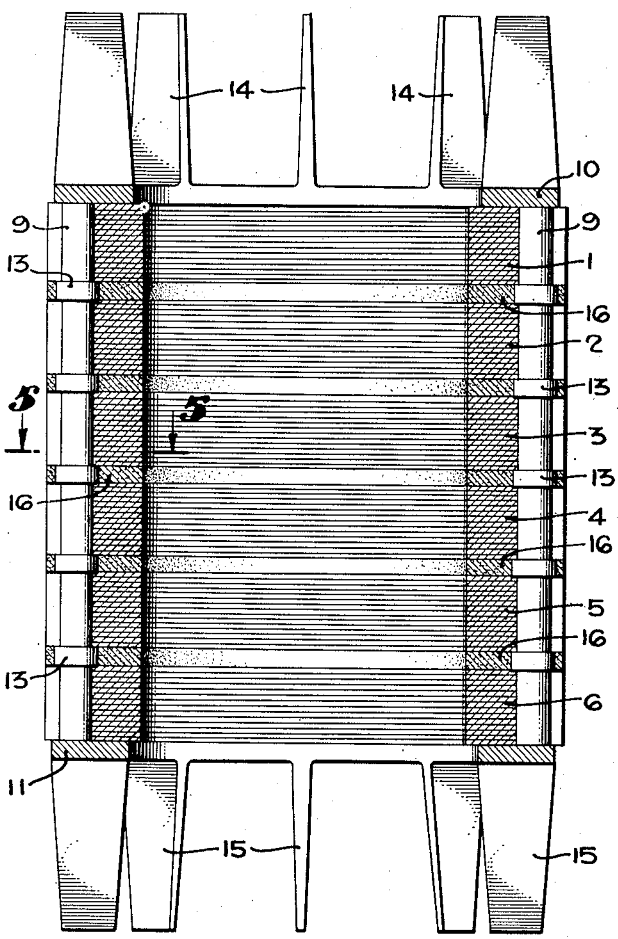

Fig. 3.

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Aug. 26, 1952 W. M. EVANS ET AL 2,607,969

SPACER FOR CASTING SQUIRREL CAGE ROTORS

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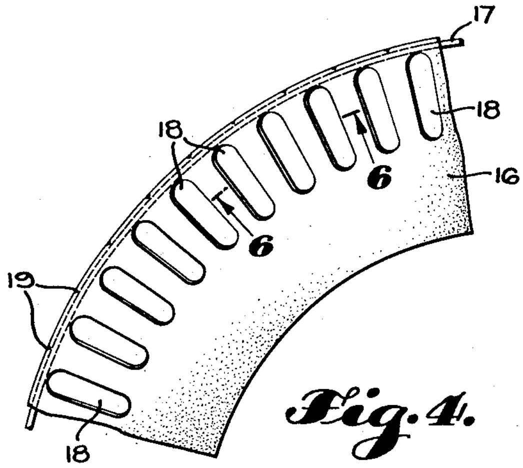

Fig. 4.

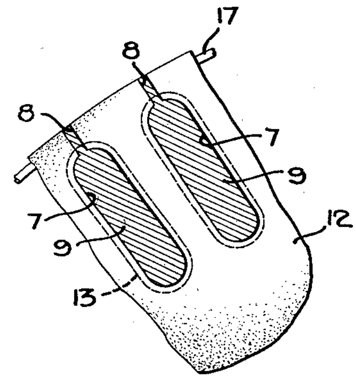

Fig. 5.

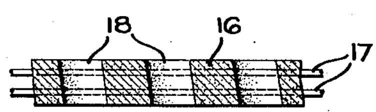

Fig. 6.

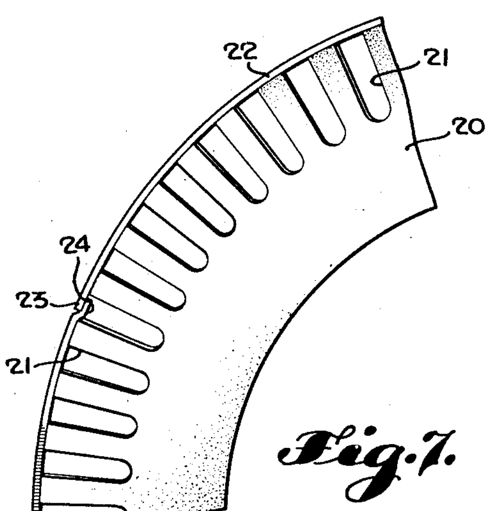

Fig. 7.

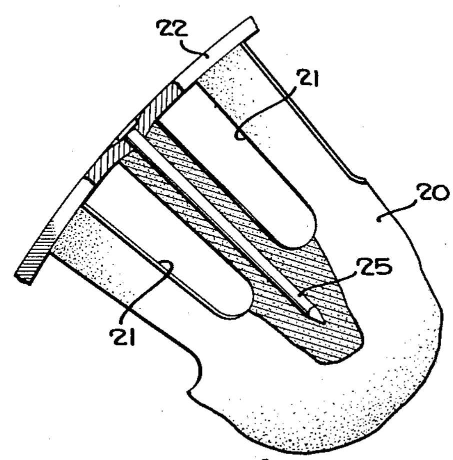

Fig. 8.

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SPACER FOR CASTING SQUIRREL CAGE ROTORS

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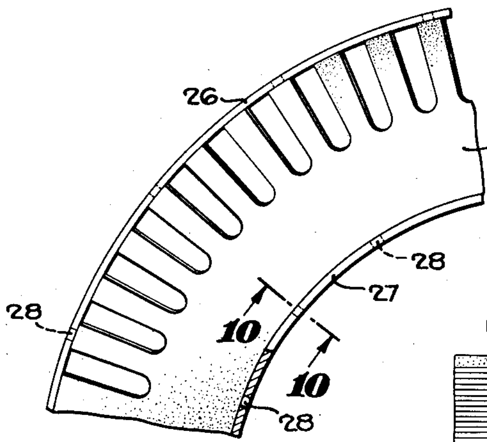


Fig. 9.

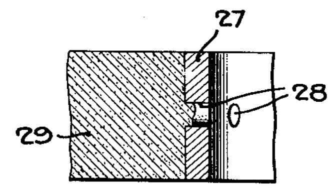


Fig. 10.

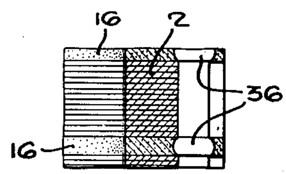


Fig. 13.

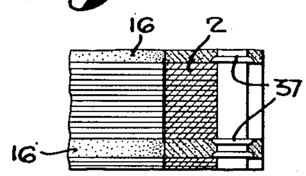
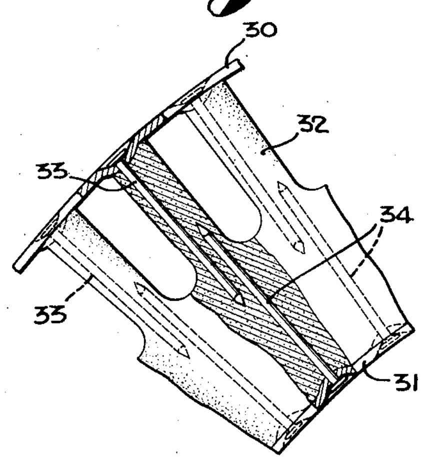


Fig. 14.

Fig. 12.



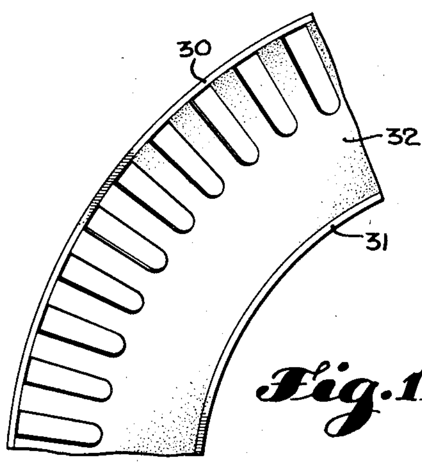
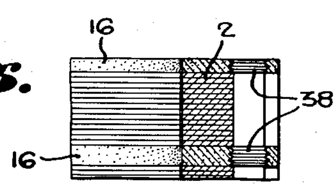


Fig. 11.

Fig. 15.



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SPACER FOR CASTING SQUIRREL CAGE ROTORS

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Application November 19, 1948, Serial No. 61,092

2 Claims. (Cl. 22—116)

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This invention relates to the casting of metallic conductors to form a squirrel cage of an induction motor rotor.

Rotors of this character are formed of a stack of laminations having slots at the periphery for the reception of conductor bars. These bars are joined at their ends by rings of conducting material.

It is common to cast such conductors to form the completed squirrel cage including the end rings, by pouring molten metal into a mold that accommodates the assembled stack of laminations. Copper, aluminum, or other conducting metal may be used; and often the entire mold and the laminations are rotated to cause the metal to be cast centrifugally.

One form of apparatus for centrifugally casting the squirrel cage is described in Patent 2,381,616, granted August 7, 1945, to George T. Pfleger.

It is often required to provide air vents or ducts at intervals along the stack of laminations; these provide passages for ventilation when the motor is operating, and aids in maintaining the temperature of the motor at a desired low value.

To ensure that these ventilating ducts will be left intact during the casting operation, spacers are utilized that can be removed after the casting is completed. These spacers have a thickness corresponding to the space to be left between the sections of the stack.

It is one of the objects of this invention to provide a spacer such that it can be very readily removed after the casting operation is completed.

It is another object of this invention generally to improve the process of casting the squirrel cage conductors in the stack of laminations.

In order to maintain the spacing between the sections of the laminations, the cast bars are preferably provided with enlargements operating as spacers between the sections. It is another object of this invention to provide such enlargements, the dimensions of which may be kept to close tolerances. In this way, it is assured that the enlargements, while adequate to provide the abutments, yet offer only a slight resistance to the flow of cooling air. Furthermore, the exterior surface of the spacer portions can be arranged to provide increased heat radiating surfaces.

This invention posesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

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Referring to the drawings:

Figure 1 is a side elevation of a stack of laminations utilizing the invention, and showing the squirrel cage conductors;

Fig. 2 is a pictorial view of one of the spacers utilized in connection with the casting operation;

Fig. 3 is a sectional view, taken generally along a surface corresponding to the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary plan view of the spacer shown in Fig. 2;

Fig. 5 is a fragmentary sectional view, taken along a plane corresponding to line 5—5 of Fig. 3;

Fig. 6 is a sectional view, taken generally along a plane corresponding to line 6—6 of Fig. 4;

Fig. 7 is a view similar to Fig. 4 of a modified form of the spacer incorporating the invention;

Fig. 8 is an enlarged fragmentary view, partly in section, of the spacer shown in Fig. 7;

Fig. 9 is a view, similar to Fig. 4, of a further modified form of the spacer;

Fig. 10 is an enlarged sectional view, taken along a plane corresponding to line 10—10 of Fig. 9;

Figs. 11 and 12 are views similar to Figs. 4 and 5, and illustrating a further modified form of the spacer; and

Figs. 13, 14, and 15 are fragmentary sectional views, similar to Fig. 3, of modified forms of the invention.

In Figs. 1 and 3 there are illustrated the sections 1, 2, 3, 4, 5, and 6 of laminations comprising the core of an induction motor squirrel cage rotor. This core, it is understood, is arranged to be mounted on a spider or a shaft.

One lamination 12 is shown in Fig. 5 and illustrates the slots 7 adjacent the periphery of the lamination. These slots, in the present instance, are shown as nearly closed, there being peripheral narrow slots 8 communicating respectively with the slots 7. As shown most clearly in Fig. 1, the laminations may be stacked in such manner that the squirrel cage conductors in the slots are oblique to the axis, producing the desired skew arrangement.

Cast within the slots 7 and 8 are the squirrel cage bars 9. These bars are integrally joined with the end rings 10 and 11. These end rings may carry the fan blades 14 and 15.

In order to cast the bars 9 and the end rings 10 and 11 as a unit and to form the air spaces between the stacks of laminations, use is made of spacers 16 that are disposed between the sections of the stack and that may readily be disintegrated after the casting operation is completed. These spacers are shown in Figs. 1 and 3; but, since the bars 9 and the end rings 10 and 11 have already been cast, these spacers are to be removed in order to complete the manufacture of the rotor.

To prepare the laminations for the casting operation, they are carefully stacked with the slots 7 and 8 of the laminations properly aligned. As shown in Figs. 1 and 3, the sections 1 to 6 inclusive are spaced apart by the spaced rings 16. The complete stack is clamped in proper assembled relation, and then the entire stack assembly is preheated at a temperature neighboring 1100° F. The assembly is then transferred to a casting mold which may be made of metal, and the mold is rotated during the process of casting. Molten metal, such as aluminum or copper, is then poured into the revolving mold.

The cast rotor may then be removed from the mold for proper machining of the cast metal bars and end rings. However, before this is accomplished, the spacer rings 16 are removed, forming the vents or ducts between the sections of the laminations.

In order that these spacer rings 16 may be readily disintegrated, they are made from a special plaster material, or plaster composition, which, upon the application of heat, changes its characteristics and will disintegrate upon contact with water. The disintegrated spacers may then be completely removed by washing or brushing as, for example, by a stream of water flowing from a nozzle.

Plaster compositions capable of being thus disintegrated include gypsum and crystobalite. The composition is in the form of a fine powder. When heat is applied to a casting of this material, it expands, and disintegrates readily when plunged into water.

Since the plaster material is quite brittle, provisions are made for reinforcing these plaster spacers. This is essential because of the handling of these spacers; after they are once in the stack, they are properly maintained in place by the reinforcing effect of the adjacent sections. In the form shown in Figs. 2, 4, 5 and 6, metal reinforcing wires 17 may be embedded in the plaster composition near the periphery thereof. Furthermore, in this instance, the slots 18 of the spacer are shown as skewed (Fig. 6) to correspond with the skew formation of the slots defined by the laminated stack. These slots may be entirely closed to provide additional strength. They may be made somewhat larger than slots 7 of the laminations, so as to overlap them. In this way they provide for the formation of the enlarged portions 13 of the bars 9. Furthermore, in order to assist in aligning the slots 18 of the spacer 16 with the slots 7, marks in the form of small depressions 19 (Fig. 4) may be provided on the outer periphery of the spacer 16.

The enlarged ends 13 can be precisely cast, and their dimensions are maintained with small tolerances, because the plaster spacers 16 are not affected by the high temperatures during the casting operations. Sharp and smooth surfaces are therefore formed on these enlargements, and there is no danger that the metal will flow so as to block the air duct substantially entirely. A free flow of cooling air is maintained.

The forms of the bars between the sections 1 to 6 may be different. In Fig. 13, the enlarged parts 36 are substantially spherical. In Fig. 14, the enlargements are in the form of narrow flanges 37; and in Fig. 15, corrugations 38 are formed to increase the radiation of heat while the motor is in operation.

These forms are merely examples capable of being produced by appropriate shaping of discs 16.

The plaster discs or spacers 16 are conveniently formed by a molding operation. A master mold of plastic material, such as a rubber mold, can be formed by pouring the molten plastic material over a master pattern corresponding to the disc 16. The molten plastic, when it cools, is sufficiently flexible so that it can be stripped from the master pattern. This plastic mold can then be used for the casting of the plaster discs or spacers 16.

The material used for casting these discs, as heretofore stated, is a plaster mixture, preferably including cristobalite, having an ingredient that permits the plaster material to be readily disintegrated in water.

The plaster discs or spacers 16 are preferably coated on each side with a graphite and oil mixture. In this way leakage or flash of the molten metal at the joint between the spacer and the laminations is prevented. When the plaster spacers 16 are removed from the stack, as shown in Fig. 3, the enlarged portions 13 of the bars 9 are recessed below the outer periphery of the rotor. The effect of this is to reduce windage noise while the motor is operating.

The spacers 16, being made from brittle cast plaster material, must be carefully handled when assembling the stack of laminations. Just as soon as the stack is completed with the spacers interposed between the sections of laminations, it is not important to keep the plaster discs from cracking. In order to ensure that the plaster discs can be handled without premature cracking or breaking, the reinforcements 17 are provided.

After the molding operation is completed, the entire rotor is immersed in water, and the plaster spacers are removed.

Other forms or reinforcements may be used.

In the form shown in Figs. 7 and 8, the plaster spacer 20 is shown as having the open slots 21 and a reinforcing band 22 of metal at the outside periphery. This band of metal is so arranged that it presents no radial protuberances. Thus, where the edges 23 and 24 overlap, they are arranged to form a substantially continuous circular form. Furthermore, if desired, the metal band 22 can be attached to the plaster disc as by appropriate fastening means, such as the nails 25. These nails 25 are cast into the plaster between the slots 21. Recesses are formed in the band 22 to accommodate the heads of these nails.

In the form shown in Figs. 9 and 10, reinforcement is provided by the aid of either the outer band 26 or the inner band 27, or both. In this case these bands may be formed of thin micarta, or equivalent materials. As shown most clearly in Fig. 10, apertures 28 in the bands may provide for the keying in of the plaster disc 29. The micarta bands are thus keyed firmly in place.

During the step of preliminary heating the assembled stack utilizing the micarta reinforced rings or spacers 29, these micarta bands 26 and 27 are burned away, leaving merely the plaster discs **29**. These, in turn, are readily disintegrated by the aid of water after the casting operation.

In the form shown in Figs. 11 and 12, metal bands **30** and **31** on the inner and outer peripheries of the plaster spacer **32** are utilized. Here the metal bands are held in place by the nails **33** and **34**, embedded when the spacers **32** are molded. The heads of these nails are appropriately recessed within the bands.

After the plaster materials are disintegrated, the reinforcing metallic elements, such as the nails **33** and **34** and the bands **30** and **32**, are easily removed from the completed rotor.

The inventors claim:

1. A spacer for use between sections of laminations of a dynamo-electric machine for providing ventilating spaces in the stack of laminations, said spacer being made from a composition of gypsum and cristobalite.

2. A spacer for use between sections of laminations of a dynamo-electric machine for providing ventilating spaces in the stack of laminations, said spacer being made from a composition of gypsum and cristobalite, and having a general

ly annular form with an outer peripheral edge and an inner edge; and a reinforcing band disposed over one of said edges and attached thereto.

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