Feb. 24, 1931. C. E. JOHNSON 1,793,854

APPARATUS FOR FORMING CAST ROTORS

Filed Aug. 31, 1927

Fig. 1.

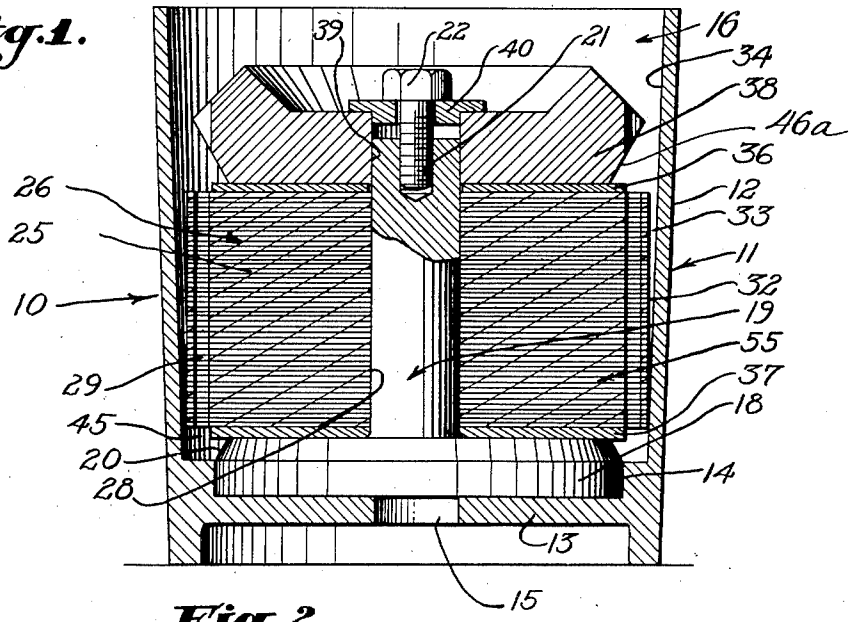


Fig. 2.

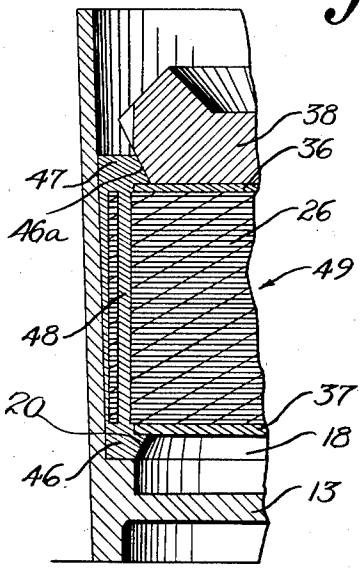


Fig. 3.

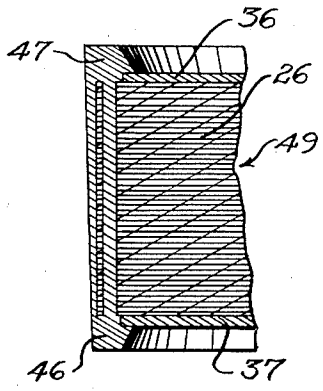


Fig. 4.

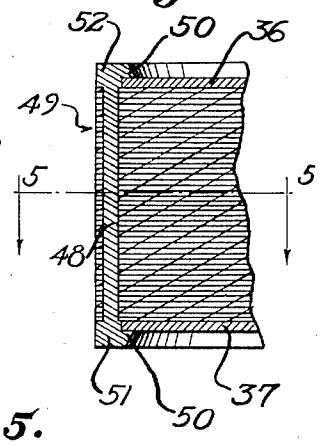


Fig. 5.

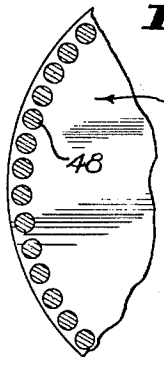
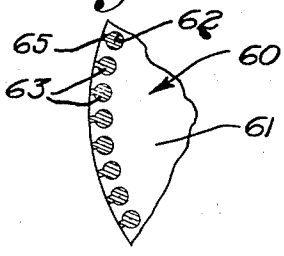


Fig. 6.



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Patented Feb. 24, 1931 1,793,854

UNITED STATES PATENT OFFICE

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APPARATUS FOR FORMING CAST ROTORS

Application filed August 31, 1927. Serial No. 216,547.

My invention relates to the foundry art and particularly to methods and apparatus for casting rotors of induction motors.

In my U. S. Patent No. 1,603,544, issued October 19, 1926, I have disclosed a mold for casting the rotor of an induction motor. In the use of this mold a body of rotor laminations is clamped rigidly to the mold in the interior thereof and the entire mold and body of laminations is heated, after which molten metal is poured into the mold so as to form a winding in the body of laminations and thus complete the rotor. After cooling, the rotor is then removed from the mold and placed in a lathe where the excess metal is removed.

In using the above mold, the heating of the mold and body of laminations secured therein must be done from the outside. As the body of laminations must be heated to a fairly high temperature, the heating step of the process is a fairly long and expensive one.

It is an object of my invention to provide a method of and apparatus for casting the rotor for an induction motor which will require a relatively small amount of preheating.

It is a further object to provide a mold for casting rotors which is simple in construction, economical to build, and which may be economically and easily operated.

Further objects and advantages will be made manifest in the following description and in the accompanying drawings in which a preferred embodiment of my invention is illustrated. In the drawings:

Fig. 1 is a vertical sectional view of a preferred embodiment of my invention.

Fig. 2 is a fragmentary view of a portion of Fig. 1, illustrating the pouring of molten metal in the mold.

Fig. 3 is a fragmentary sectional view illustrating the cast rotor immediately after being taken from the mold.

Fig. 4 is a fragmentary sectional view similar to Fig. 3, showing the rotor after the excess metal has been removed therefrom in a lathe.

Fig. 5 is a horizontal sectional view taken on the line 5—5 in Fig. 4, illustrating the winding cast in the rotor.

Fig. 6 is a view similar to Fig. 5, illustrating the modified form of rotor cast by the method and apparatus of my invention.

Referring specifically to the drawings:

The apparatus 10, illustrated in Fig. 1, includes a mold 11 having upwardly diverging walls 12, and a floor 13. Formed in the floor 13 is a seat 14 and a central knock-out hole 15. The walls 12 define a cavity 16 in which the casting takes place.

Adapted to rest in the seat 14 is a base plate 18 of a mandrel 19. The upper portion of the periphery of the plate 18 is beveled to form a molding surface 20. Formed centrally in the upper end of the mandrel 19 is a threaded hole 21 which is adapted to receive a heavy cap screw 22. The mandrel 19 is adapted for clamping a plurality of laminations 25 against the base plate 18 so as to assemble these laminations in a single body 26.

Each of the laminations 25 comprises a disc having a central hole and peripheral holes, which holes combine when the laminations are assembled, as shown in Fig. 1, to form a central hole 28 and peripheral holes 29 which pass throughout the length of the body 26 of laminations 25. The laminations 25 being circular and of uniform diameter, the peripheral surface 32 of the body 26 is cylindrical. Thus an annular upwardly tapering space 33 is formed between the peripheral surface 32 and the internal surface 34 of the walls 12.

Reinforcing the upper and lower portions of the body 26 so as to permit a clamping pressure to be applied thereto are discs 36 and 37 which are perforated centrally to fit over the mandrel 19, as clearly shown in Fig. 1. Resting upon this disc 36 is a compression block 38 which has a central bore 39 adapted to slidably receive the upper end of the mandrel 19. Resting upon the block 38 in the upper end of the opening 39 is a bushing 40 through which the cap screw 22 passes and against which the head of the cap screw 22 bears as this is screwed downward into the threaded hole 21 of the mandrel 19.

The operation of the apparatus 10 in carrying out the method of my invention is as follows.

The body 26 of laminations 25 is clamped upon the mandrel 19 against the base plate 18, as shown in Fig. 1, before the mandrel 19 has been placed within the mold 11. The body 26, while thus clamped upon the mandrel 19, is heated to a sufficient temperature to prevent molten metal from coagulating during its passage through the holes 29. The mold 11 is also heated to substantially the same temperature as the body 26. The mandrel 19 carrying the body 26 is then dropped into place within the mold 11 so that the base plate 18 rests in the seat 14, the base plate and seat cooperating to form an inter-engaging means between the shell and the mandrel clamping means.

Molten metal is now poured into the space between the block 38 and the walls 12, this metal flowing down through the holes 29 and through the annular space 33, The metal fills an annular space 45 formed between the bottom 13 of the mold 11, the lower surface of the body 26, and the molding surface 20, the metal in this space 45 forming a rough cast ring of metal 46. The pouring is continued so that the holes 29 and annular space 33 are filled with metal and until the molten metal contacts a molding surface 46*a* of the compression block 38 in a manner to form a rough cast ring of metal 47 at the upper end of the holes 29. The metal solidying in the holes 29 forms conductor bars 48 which are integral at their opposite ends with the rings 46 and 47. The bars 48 and the rings 46 and 47 thus bind the body 26 together to form a rotor 49. The mandrel 19 and the rotor 49 are now lifted out of the mold 11 by a suitable pair of tongs engaging the pressure block 38. The rotor 49 is then removed from the mandrel 19 and placed in a lathe (not shown).

As shown in Fig. 3, the discs 36 and 37 are retained in place upon the upper and lower bases of the body 26 by overlapping shoulders 50 of the rings 47 and 46 respectively. While the rotor 49 is rotated in the lathe, a tool is applied to the periphery thereof so as to remove all of the metal cast in the space 33, and the rough cast rings 46 and 47 are reduced in size so as to leave only the annular lower and upper conductor rings 51 and 52 respectively, which are disposed opposite the lower and upper ends of the holes 29 so as to connect the opposite ends of the conductor bars 48 cast in these holes. The shoulders 50 remain a part of the rings 51 and 52 so that the discs 36 and 37 permanently reinforce opposite ends of the body 25 of laminations 26.

In using the apparatus of my invention it is intended to have a fairly large number of mandrels 19 and to clamp bodies of laminations on these, as shown in Fig. 1, before the casting operation commences. These bodies as assembled on the mandrels 19 may be referred to as cores 55 and are preheated so that as soon as one rotor 49 is removed from the mold 11 another core 55, already preheated, may be dropped into the mold and another rotor 49 cast.

Thus the mold 11 needs to be preheated but once for casting an entire lot of rotors 49, for the heat of the metal poured into it in successive castings maintains the mold 11 at a sufficiently high temperature for good casting. This is a great improvement over the old method where an individual mold had to be heated and cooled in the casting of each rotor.

The provision of the upwardly tapering space 33 produces another advantage, in that slight inaccuracies in the diameter of the body 26 of laminations 25 do not cause the jamming of the rotor in the mold 11, which would make its withdrawal difficult.

The metal usually used for casting the conductor bars and collector rings of the rotor 49 is aluminum or a suitable alloy thereof. It is to be understood however that any other suitable metal such as copper might be used for this purpose.

For purposes of economy the molds 11 may be grouped together in batteries of four which are formed integral and in which four rotors are cast simultaneously at a single pouring of metal.

In Fig. 6 I show a rotor 60 in which the body of laminations 61 is provided with holes 62 in which conductor bars 63 are cast. The holes 62 are connected by narrow slots 65 to the periphery of the rotor and these slots are filled with metal when the conductor bars are cast so that a relatively thin web is formed radially on the main body of the conductor bars 63. The process and apparatus of my invention are especially well adapted for the casting of the rotors 60 as molten metal may flow inwardly through the narrow slots of the holes 62 almost throughout the length of the rotor. Thus bubbles in the casting are prevented and a high-grade product is assured.

I claim as my invention:

1. An apparatus for forming the rotor of an induction motor and comprising: a base plate; a mandrel provided thereon and adapted to receive a plurality of laminations; clamping means provided upon said mandrel to clamp said laminations, as a body, against said base plate; and a mold adapted to receive the aforementioned elements after the application of said clamping means to said laminations, said mold also being adapted to confine a molten metal adjacent to said body of laminations.

2. A combination as defined in claim 1 in which said mold provides a seat for said base plate, said seat positioning said body in said mold.

3. A combination as defined in claim 1 in

which said clamping means comprises a compression block fitting over said mandrel, together with means for moving said compression block relative to said mandrel.

4. In an apparatus for forming a cast rotor, the combination of: means for clamping a plurality of laminations together in a manner to form a unitary body; and a mold having a cavity therein adapted to receive said body in a manner to define an annular space between the periphery of said body and the walls of said mold into which space a molten metal may be introduced.

5. A combination as defined in claim 4 in which said walls of said mold are tapered in a manner to permit easy withdrawal of said body and the metal cast thereon from said cavity.

6. A combination as defined in claim 4 in which said clamping means and said mold are provided with inter-engaging means for positioning said body of laminations in a desired position in said cavity.

7. In an apparatus for forming a cast rotor, the combination of: a base plate; means for clamping a plurality of laminations adjacent said base plate; a mold having a cavity therein of greater diameter than said laminations in a manner to form an annular space between said laminations and the walls of said cavity when said laminations are positioned therein; and means for positioning said base plate relative to said cavity.

8. In an apparatus for forming a cast rotor, the combination of: a base place; means for clamping a plurality of laminations adjacent said base plate; a mold having a cavity therein of greater diameter than said laminations in a manner to form an annular space between said laminations and the walls of said cavity when said laminations are positioned therein; and means for positioning said base plate relative to said cavity, said base plate extending across the lower end of said annular space and being contacted by molten metal poured into said annular space.

9. An apparatus for forming the rotor of an induction motor and comprising: a base plate; a mandrel provided thereon and adapted to receive a plurality of laminations; clamping means provided upon said mandrel to clamp said laminations, as a body, against said base plate; and a mold having walls providing a tapering cavity adapted to receive said body of laminations, said cavity being of greater diameter than said laminations in a manner to form an annular space between said walls and said body of laminations into which molten metal may be poured.

10. In an apparatus for casting rotors, the combination of: a mandrel providing a base plate; means for clamping a plurality of laminations against said base plate; a mold having a cavity therein of larger diameter than the outer diameter of said laminations so that an annular space is formed between said laminations and the walls of said cavity; and a floor in said mold against which said base plate rests, said base plate communicating with the lower end of said annular space in a manner to be contacted by molten metal poured into said annular space.

11. In an apparatus for casting rotors, the combination of: a mandrel providing a base plate; a compression block for clamping a plurality of laminations against said base plate; and a mold having a cavity therein of larger diameter than the outer diameter of said laminations so that an annular space is formed between said laminations and the walls of said cavity, said base plate and said compression block having molding surfaces adapted to be contacted by a molten metal poured into said annular space in a manner to determine the shape of a portion of the finished rotor.

12. In an apparatus for forming a cast rotor, the combination of: a base plate having a molding surface thereon; a compression block having a molding surface thereon; means for clamping a plurality of laminations between said base plate and said compression block; and a mold having a cavity therein adapted to receive said laminations, said compression block and said base plate, said molding surfaces cooperating with said mold to determine the shape of a portion of the rotor.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 25th day of August, 1927.

CARL E. JOHNSON.