May 20, 1941. R. A. BAUDRY 2,242,339

SQUIRREL-CAGE DYNAMOELECTRIC MACHINE

Filed May 26, 1938

Fig. 1.

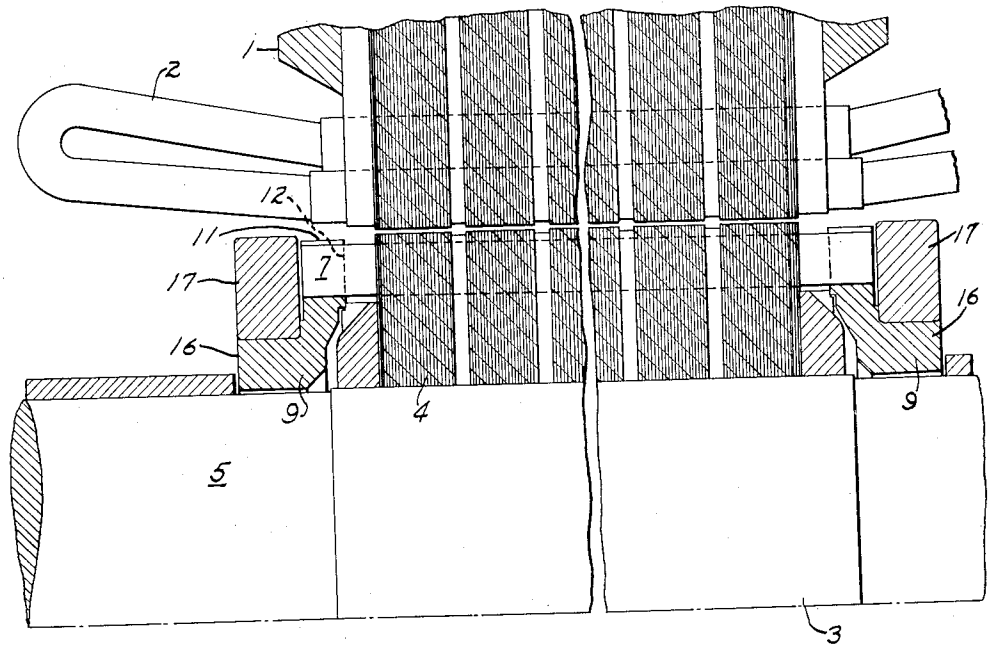
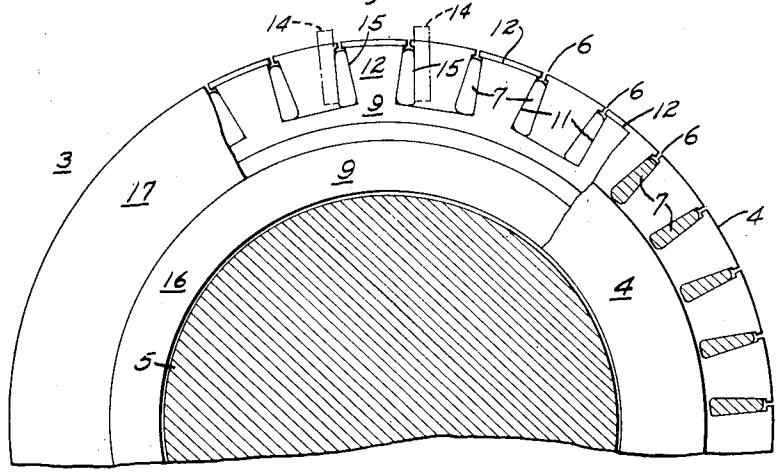


Fig. 2.



WITNESSES:

Leon M. Garman

Mrs. C. Groome

INVENTOR

René A. Baudry.

BY O. B. Buchanan

ATTORNEY

Patented May 20, 1941

2,242,339

UNITED STATES PATENT OFFICE

2,242,339

SQUIRREL-CAGE DYNAMOELECTRIC MACHINE

René A. Baudry, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 26, 1938, Serial No. 210,189

4 Claims. (Cl. 172—120)

My invention relates to squirrel-cage dynamoelectric machines and it has particular relation to high-speed squirrel-cage induction motors, such as 3600 R. P. M. machines, in which considerable trouble has been experienced heretofore as a result of failure of the damper bars. I have attributed this trouble to the diametrical expansion of the damper-ring, produced by the large amount of heat which is generated during the starting period, at which time the entire ultimate kinetic energy of the rotor member is introduced into the damper or squirrel-cage winding in the form of heat produced therein. During normal running conditions, the rate of heat-generation is smaller, and the heat-transfer conditions are more favorable; but in the course of repeated starting operations, the ends of the squirrel-cage bars have been heretofore subjected to considerable bending back and forth in a radial direction, as a result of excessive temperatures produced in the damper-rings during the starting operations.

Large machines of the type to which my invention particularly relates generally have squirrel-cage bars of a massive cross-section which is larger in the radial direction than in the circumferential direction, and in order to braze a flat side of each of these bars to the periphery of the end-rings, it has been commonly necessary to bend or twist the ends of the bars, so that a flat side of each would lie against the outer cylindrical periphery of the end-ring, to which it would be brazed. It is an important object of my invention to provide a novel arrangement, including a notched end-ring, whereby the flat sides of the damper-bars may be brazed to the substantially radial sides of the notches, without having to weaken the bars by bending or twisting the same, as heretofore.

A contributory cause for breakage of the damper-bars, in previous constructions, has also been the inadequate space for banding-rings around the ends of the damper-bars or damper-rings, so as to reduce the radial heat-expansion of the damper-rings, the size of these banding-rings being limited by the condition that the outer periphery of the banding-ring should not exceed the outer periphery of the rotor-core, so that the rotor-member may be readily assembled in the stator-member. An important object of my invention is to provide a damper-ring which has an angular cross-section, including a cylindrical shoulder disposed at the inner periphery of the ring and extending axially outwardly from the ring, so as to provide a large space surrounding said cylindrical shoulder, making it possible to utilize a large massive shrink-ring around said shoulder, thus reducing the radial heat-expansion of the damper-ring, and also reducing the centrifugal forces acting on the damper-ring by reason of the transfer of some of the material of the damper-ring to the inner periphery thereof, where it becomes a part of the aforementioned cylindrical shoulder.

With the foregoing and other objects in view, my invention consists of the combinations, structures and methods hereinafter described and claimed, and illustrated in the accompanying drawing, wherein:

Figure 1 is a longitudinal sectional view through a squirrel-cage motor embodying my invention; and

Fig. 2 is an end view of the rotor-member, with parts broken away to show the construction.

My invention is shown applied to a large high-speed three-phase induction motor comprising a stator-member 1 having primary windings 2 thereon, and a rotor-member 3 comprising a rotor-core 4 mounted on a shaft 5, the outer periphery of the rotor-core being provided with substantiallly longitudinally extending slots 6 for receiving copper squirrel-cage or damper-bars 7 which are shown as being trapezoidal in cross-section, being widest in a substantially radial direction.

At each end of the machine, the ends of the damper-bars 7 extend out beyond the rotor-core 4 so as to be free of said core, and these free ends are secured to a specially constructed copper end-ring 9, which is spaced from the core 4, and the periphery of which is provided, in effect, with approximately radially disposed notches 11 separated by approximately radially projecting teeth 12. There are twice as many bars 7 as teeth 12. According to my invention, each pair of adjacent bars 7 is brazed to opposite sides of one of said teeth 12 in each of the end-rings 9, the brazed joint being made between one of the approximately radially disposed flat sides of each bar 7 and a corresponding side of one of the teeth 12, as indicated at 15; and if desired, the bottoms of the bars 7 may also be brazed to the bottoms of the slots 11.

It will be observed that the slots 11 are sufficiently wide to permit two of the bars 7 to extend, substantially unbent, into each slot 11, with a wide free space between these two. This construction facilitates the brazing operation, which can be conveniently carried out by applying two

brazing-electrodes 14 on opposite sides of the two bars 7 which are associated with each tooth 12, after having applied suitable brazing material to the contacting surfaces 15 of the bars and tooth, after which the electrodes 14 may be squeezed together, while causing an electric current to flow from one to the other, in order to perfect the brazed or fused-metal joint between the tooth 12 and each of the bars 7. It will be observed that the ends of the bars 7, which extend beyond the rotor-core 4, are free to yield or bend the very slight amount necessary to press the welded surfaces of the bars against the corresponding sides of the slots 11 during the welding operation.

In accordance with my invention, the damping-rings 9 are given an angular cross-section, as shown in Fig. 1, including a cylindrical shoulder 16 disposed at the inner periphery of the ring and extending axially outwardly from the ring. The outer periphery of this cylindrical shoulder 16 is tightly engaged by a massive, weldless-steel banding-ring or shrink-ring 17 which is shrunk onto the cylindrical shoulder 16.

As a result of the above-described constructions, it will be observed that I have provided a means whereby the squirrel-cage bars 7 may be brazed to the sides of notches 11 in the end-rings 9, without requiring substantially any bending or twisting of the bars 7. It will further be observed that I have reduced the centrifugal forces acting on the banding-ring by placing much of the material of the ring in the cylindrical shoulder 16 at the inner periphery, where the centrifugal forces are the least, and at the same time I have provided adequate room, in the space around the cylindrical shoulder 16, for accommodating a massive shrink-ring 17 without exceeding the outer peripheral diameter of the rotor-core 4. The shrink-ring 17 thus serves adequately to reduce the radial heat-expansion of the copper damper-ring 9, correspondingly reducing the radial bending stresses in the damper-bars 7.

While I have illustrated my invention in a preferred form of embodiment, and have described the same in connection with a preferred method of carrying out the invention, it will be obvious that such illustration and description should be taken only by way of illustration and not by way of limitation of the invention. I desire, therefore, that the appended claims shall be accorded the broadest scope consistent with their language and the prior art.

I claim as my invention:

1. A dynamoelectric machine comprising a stator-member and a rotor-member, said rotor-member having a rotor-core and having a plurality of squirrel-cage bars extending through and beyond the rotor-core and disposed substantially longitudinally of the machine, a plurality of said squirrel-cage bars having such cross-sections as to provide a substantially flat side, disposed in an approximately radial direction, said side being wider, in a radial direction, than the circumferential width of the bottom of the bar, an end-ring disposed at each end of the bars in spaced relation to the rotor-core, each end-ring having, in effect, approximately radially disposed openings, the openings being circumferentially wider than the bars, the bars and end-rings being so mounted and disposed that there is a capability of a slight relative lateral displacement between the ends of the bars and the respective end-rings, each bar having one of its sides pressed into fused-metal connection with an approximately radially disposed wall of its opening, there being an open space big enough for the insertion of a welding-electrode on the other side of each bar, and each bar being secured to each end ring at only the fused-metal connection.

2. A dynamoelectric machine comprising a stator-member and a rotor-member, said rotor-member having a plurality of squirrel-cage bars disposed substantially longitudinally of the machine, a plurality of said squirrel-cage bars having such cross-sections as to provide a substantially flat side, disposed in an approximately radial direction, said side being wider, in a radial direction, than the circumferential width of the bottom of the bar, an end-ring disposed at each end of the bars, each end-ring having, in effect, approximately radially disposed openings, a fused-metal connection between at least one side of each bar of said plurality of bars and an approximately radially disposed wall of one of said openings, each end-ring having an angular cross-section including a cylindrical shoulder disposed at the inner periphery of the ring and extending axially outwardly from the ring, and a massive banding-ring of relatively stronger material seated on each of said cylindrical shoulders and substantially occupying the available space around said cylindrical shoulder.

3. A dynamoelectric machine comprising a stator-member and a rotor-member, said rotor-member having a rotor-core and having a plurality of squirrel-cage bars extending through and beyond the rotor-core and disposed substantially longitudinally of the machine, a plurality of said squirrel-cage bars having such cross-sections as to provide a substantially flat side, disposed in an approximately radial direction, said side being wider, in a radial direction, than the circumferential width of the bottom of the bar, an end-ring disposed at each end of the bars in spaced relation to the rotor-core, each end-ring having, in effect, approximately radially disposed openings, the openings being circumferentially wider than the bars, there being half as many openings as said bars, two bars being disposed within each opening with an open space between said two bars, each bar being slightly laterally bent and having one side pressed into fused-metal connection with an approximately radially disposed wall of its opening, there being an open space big enough for the insertion of a welding-electrode between the two bars within each opening, and each bar being secured to each end ring at only the fused-metal connection.

4. A dynamoelectric machine comprising a stator-member and a rotor-member, said rotor-member having a plurality of squirrel-cage bars disposed substantially longitudinally of the machine, an end-ring disposed at each end of the bars, fused-metal connections between each bar and the respective end-rings, each end-ring having an angular cross-section including a cylindrical shoulder disposed at the inner periphery of the ring and extending axially outwardly from the ring, and a massive banding-ring of relatively stronger material seated on each of said cylindrical shoulders and substantially occupying the available space around said cylindrical shoulder.

RENÉ A. BAUDRY.