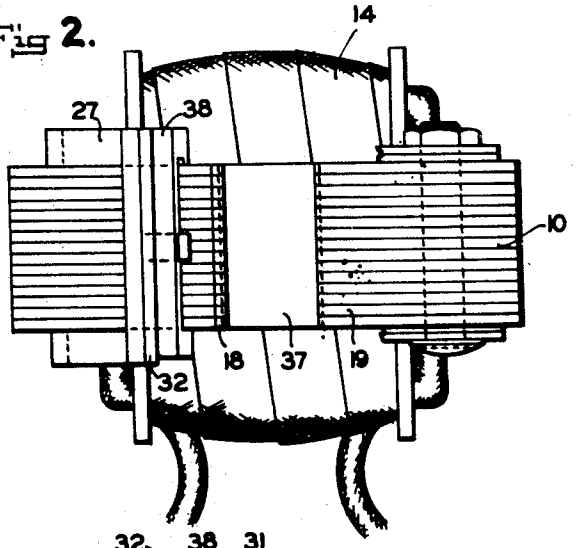
Dec. 13, 1949 J. B. HARDIE 2,490,905

MULTIPLE SHADING COIL ASSEMBLY FOR ELECTROMAGNETIC DEVICES

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Fig 2.



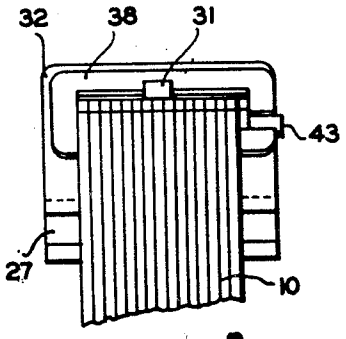


Fig 3.

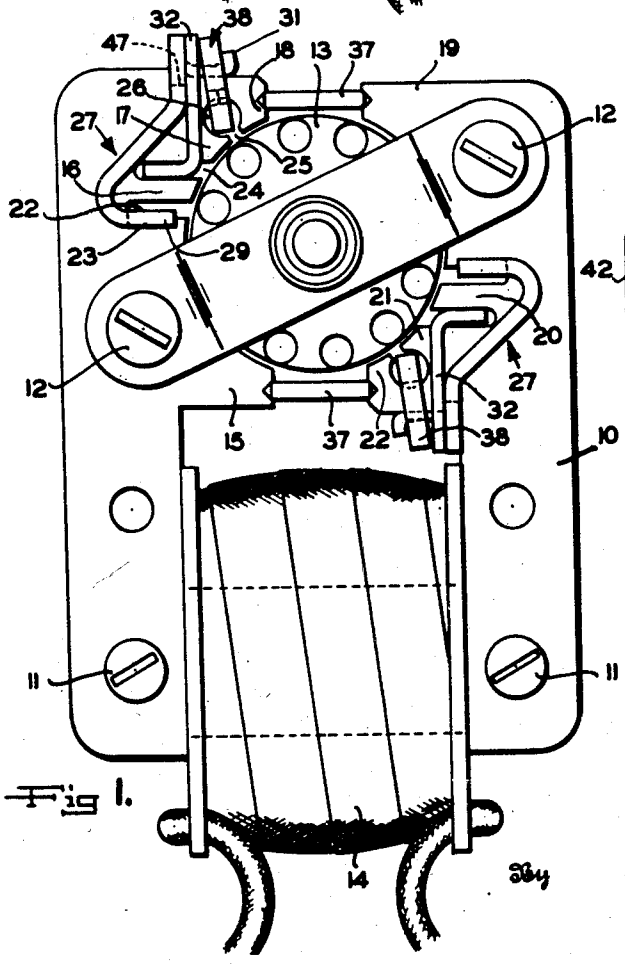


Fig 1.

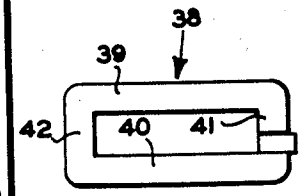


Fig 10.

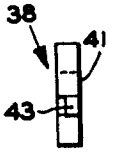


Fig 11.

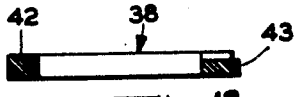


Fig 12.

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MULTIPLE SHADING COIL ASSEMBLY FOR ELECTROMAGNETIC DEVICES

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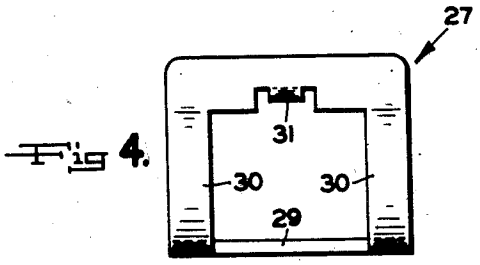


Fig 4.

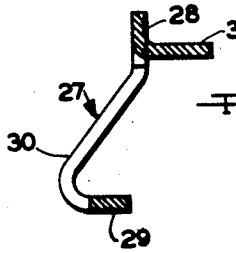


Fig 5.

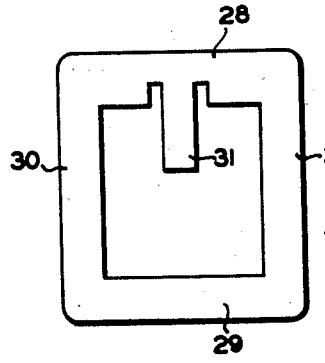


Fig 6.

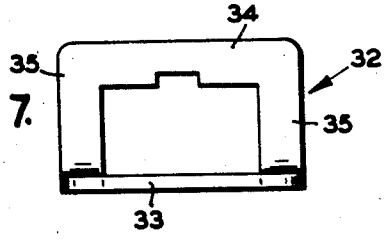


Fig 7.

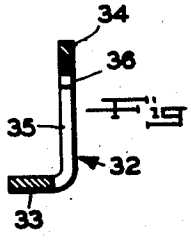


Fig 8.

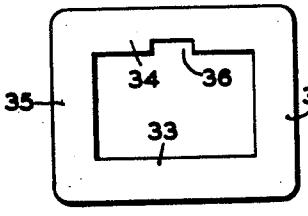


Fig 9.

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2,490,905

MULTIPLE SHADING COIL ASSEMBLY FOR ELECTROMAGNETIC DEVICES

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Application October 31, 1947, Serial No. 783,403

11 Claims. (Cl. 172—278)

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This invention relates to the electromotive art and more particularly to the art of constructing and assembling multiple shading coils on a magnetic pole of an electromotive device. Flux delaying or shading arrangements for pole pieces of electromagnetic devices have found widespread use, the most common of which is in single phase induction motors; and as these motors are usually of the inexpensive fractional horsepower type, it is desirable to provide in them a simple and inexpensive yet efficient arrangement for shading a portion or portions of the magnetic poles of the motors. An economical method of shading sections of a magnetic pole is to simply encircle the iron flux path leading to the section to be shaded with a closed turn of highly conductive material as, for example, a closed turn of heavy soft copper wire. Various arrangements have heretofore been proposed for locating and securing such turns or coils on the poles of an electromagnetic device.

The primary object of my invention is the provision of improved designs for shading coils useful on the poles of electromagnetic devices and of improved arrangements for locating and positioning the shading coils on the magnetic poles and for securing or locating the coils in proper position whereby substantial economies may be effected in the production and assembly of electromagnetic devices as small induction motors, for example. The invention accomplishes this general object primarily by teaching how the shading coils can be individually produced complete by simple stamping operations and how such produced coils can be readily inserted in the pole pieces and secured with the aid of means formed integrally with the shading coils. A more specific aspect of the invention is the particular shape or form of the shading coils and the particular manner in which the pole pieces of the electromagnetic device are shaped or prepared to receive the pre-formed shading coils.

It is therefore a further object of the invention to provide an improved form of electromagnetic poles having segregated sections to be shaded whereby the application thereto of shading coils and the securing thereon of shading coils is materially facilitated.

The above and other objects and advantages of the invention will become apparent upon consideration of the following detailed specification and the accompanying drawing wherein there is disclosed a preferred embodiment of the invention. While the application of my invention to a bi-polar single phase induction motor has been

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selected herein for illustration purposes, it should be understood that the invention is equally applicable to other types of electrical equipment.

Figure 1 is a side elevation of a small bi-polar shaded pole single phase induction motor embodying the principles of my invention;

Figures 2 and 3 are plan and end views, respectively, of the motor of Figure 1;

Figures 4 and 5 are elevation and sectional views, respectively, of one of the shading coils of the motor of Figure 1;

Figure 6 is a plan view of the material blank from which the coil of Figures 4 and 5 is formed;

Figures 7 and 8 are elevation and sectional views, respectively, of another of the shading coils of the assembly of Figure 1;

Figure 9 is a plan of the blank from which the coil of Figures 7 and 8 is formed; and

Figures 10, 11 and 12 are plan, end, and sectional views, respectively, of the third shading coil used on each pole in the assembly of Figure 1.

The motor of Figure 1 has a magnetic circuit comprised of the stacked U-shaped laminations 10 which are stamped out of electrical steel and held together by the rivets 11 and the bolts 12 which latter also mounts the straps carrying the supporting bearings for the rotor 13. In the design of the specific motor illustrated the outer end portions of the legs of the laminations have their inner edges recessed and curved to provide poles for fitting closely about a substantial part of the circumferential extent of the rotor and as the laminations are initially assembled there is sufficient clearance between the opposing legs of the U to allow the field coil 14 to be wound directly on the base strut of the assembled laminations. Each of the poles thus provided is divided into a principal or unshaded section and three successive shaded sections and for convenience the unshaded section of the left pole of Figure 1 will be designated by the reference numeral 15 while the successive shaded sections of this pole will be designated by the reference numerals 16, 17 and 18. The unshaded section of the right pole of Figure 1 is marked with reference numeral 19 while the successively shaded sections are designated by reference numerals 20, 21 and 22.

In accordance with usual practice, the portions or sections of the poles to be shaded are segregated by forming grooves or slots in the walls of the poles extending parallel to the axis of rotation of the rotor and the shading coils are properly installed with one of their reaches lying in these grooves or slots with the remaining portions of

the rings encircling the flux paths leading to the pole sections to be shaded. In order that efficient flux distribution be had it is desirable that the width of the grooves or slots at their points of intersection with the pole face be kept relatively small, and in order that the shading coils have exceptionally low resistance as is desirable for maximum shading effect it is necessary that the cross-secional area of the highly conductive section making up the coils be relatively large. These two conflicting requirements are normally met by making the pole section dividing slot relatively narrow and by forming an enlarged longitudinally extending recess in the bottom of it to receive a round wire length of considerable cross-sectional area which constitutes one reach of the complete shading loop or coil. In accordance with my invention, however, these conflicting requirements are met by employing for the conductors of the shading coils a flat wide section which can readily be slipped sideways into a relatively narrow dividing slot or groove and in this manner the assembly of the pole unit may be very materially facilitated. Thus in the motor illustrated the pole sections 15 and 16 are separated by a horizontally disposed slot 22 and for a reason to be later described the inward portion of the bottom wall of the slot 22 is recessed longitudinally as shown at 23. The slot 24 which separates the pole sections 16 and 17 is also horizontally disposed and is generally parallel to the slot 22. Separating the pole sections 17 and 18 is a slot 25 at the base of which is an enlarged cylindrical recess 26. The same construction is employed for the opposite pole comprised of the sections 19—22, as shown in Figure 1.

Encircling the pole section 16 and having one of its reaches housed in the slot 22 is a ring or coil designated generally by reference numeral 27 and shown in detail in Figures 4 and 5. Referring now to Figures 4 and 5 as well as to Figure 6 the coil 27 consists of a single loop of flat material, preferably stamped of dead soft copper, and formed to the shape shown in Figures 4 and 5. The blank of which the coil 27 may be constructed is approximately square about its outer periphery and is blanked out in its center portion to provide an upper rail 28, a lower rail 29, and side rails 30. As shown, the width of these rails in plan is much greater than the thickness of the parent stock. Projecting inwardly from the rail 28 is a tab 31 which in the formation of the coil 27 from the blank of Figure 6 is bent forwardly at right angles to the plane of the rail 28 as shown in Figure 5. The side rails 30 are bent rearwardly at a point immediately below the rail 28 and are bent forwardly at their lower ends to position the rail 29 in a horizontal relation normal to the plane of the rail 28 and rearwardly thereof. Thus the rail 29 and the tab 31 are parallel to each other and in assembling the motor it is possible to simply slide the coil 27 over the prejecting ends of the pole sections 16, 17 and 18. The width of recess 23 in slot 22 is only slightly larger than the width of the rail 29 of the coil 27 to allow the rail to seat in this recess thereby locking the rail 29 against outward movement. To allow the coil 27 to drop downwardly whereby rail 29 enters recess 23 and to lock the outer end of this coil against movement the outer end surface of the pole is slotted transversely at 47 to receive the inner edge of the outer rail 28 of this coil.

Positioned in the slot 24 is a reach of a second shading coil 32 which is shown in detail in Figures 7 and 8 and which may be constructed from the

blank shown in Figure 9. The stock material for this shading coil is also preferably a sheet or plate of dead soft copper and as shown in Figure 9 the cut-out blank comprises a frame having a lower rail 33, an upper rail 34, and side rails 35. The lower end portions of the rails 35 are bent rearwardly to position the rail 33 in a plane normal to the rails 34 and 35 whereby the completed coil may be assembled on the pole of the electromagnetic device simply by passing the coil over the pole sections 17 and 18 with the rail 33 sliding into the slot 24. The inner edge of the top rail 34 is notched as at 36 to receive the tab 31 of the first applied shading coil 27, it being understood that in applying and assembling the coils on the pole piece the coil 27 is first put in position after which the coil 32 is inserted. It can be seen that the engagement of notch 36 of the second shading coil 32 over the tab 31 of the first inserted shading coil 27 serves to lock shading coil 27 in recess 23 and recess 47 against vertical motion thereby preventing any vertical looseness of the assembly. Inserted in opening 26 is a reach of a third shading coil 38 which is shown in detail in Figures 10, 11 and 12. Coil 38 is in the form of a ring blanked from flat copper stock and having an upper rail 39, lower rail 40, and side rails 41 and 42. A portion of one of the side rails as 41, for example, adjacent the bottom rail 40 is flattened in a longitudinal direction as shown at 43 by a suitable coining operation and the thickness of the reduced portion 43 is made slightly less than the width of the slot 25. Thus, by longitudinally aligning the rail 40 with the longitudinal axis of the enlargement 26 of the slot 25 and by orienting the thus aligned coil 38 so that the portion 43 is located within the longitudinal projection of the outer portion of the slot 25 the coil 38 may be slid endwise to position the rail 40 within he enlargement 26 of the slot 25. This construction and manner of assembly is more fully described and is claimed generally in my co-pending application Ser. No. 728,359, filed February 13, 1947, now Patent No. 2,481,113, issued September 6, 1949. The parts are so dimensioned that the flattened portion 43 may pass longitudinally out of the slot 25 and when this relative position is reached the coil 38 may be rotated about the longitudinal axis of the cylindrical enlargement 26 to swing the rail 39 of the coil 38 up against the rail 34 of the coil 32 and over the tab 31 of the coil 27. Thereafter the free end of the tab 31 which projects beyond the upper rail 39 of the coil 38 may be bent upwardly and rearwardly to securely clamp the rails 28, 34 and 39 together thus securely locking the three shading coils in the pole of the magnetic circuit.

The laminations 10 of the field core of the motor illustrated are so formed that the pole section 18 is separated from pole section 19 by a substantial interval and the same is true as regards the pole sections 15 and 22. This construction allows the coil 14 to be wound directly on the assembled laminations of the magnetic core and it also permits the shading coils to be applied to the poles in the manner explained above. During assembly of the motor and after the insertion of the shading coils and gaps between the above-mentioned pole sections are bridged by wedge members 37 which are of suitable magnetic material and which are driven into the gaps and held therein by friction.

It should now be apparent that I have provided an improved shading coil assembly for a pole of an electromagnetic device which accomplishes the

objects initially set out. My invention greatly simplifies the application of shading coils to the pole or poles of an electromagnetic device and the securing of such coils on the pole or poles. Further, the construction permits the provision for the required coil-receiving recesses and the pole section segregating slots to be readily accomplished in the blanking operations performed on the core laminations during their process of manufacture. Also, the coils themselves may be readily produced by economical high-speed production processes and while I prefer to make these parts by means of stamping operations in the manner outlined above it should readily be apparent that the same may be economically produced by automatic casting or other preforming operations with substantially equal facility. While I have more or less limited the above discussion to the construction of but a single pole of an electromagnetic device it should be understood that the same principles of construction and assembly are equally applicable in many multipolar machines. In Figures 1, for example, the pole unit comprised of the sections 19—22 is identical with the above described pole unit and duplicate coils are shown for shading the pole sections 20, 21 and 22.

It should also be readily apparent that the principles of my invention may be employed for any multiple number of shading coils assembled on a single pole of any electromagnetic device. Therefore the above specifically described embodiment of my invention should be considered as illustrative only and reference should be made to the appended claims in determining the scope of the invention.

What I claim is:

1. In an electromagnetic device having an iron field core with converging edges defining a pole piece and one of said edges constituting the pole face, said core being formed with spaced parallel slots in said face thereby dividing said face into separate sections, shading coils encircling the mass of said pole piece intermediate each of said slots and the other of said edges, each of said shading coils comprising a flat conductor ring bent along axes parallel with said slots whereby the principal planes of the conductor portions housed in said slots are angularly disposed with respect to the principal planes of the conductor portions overlying said other edge, and clamping means integral with one of said shading coils to clamp together the conductor portions of said coils overlying said other edge thereby locking said coils in position on said pole piece.

2. Structure according to claim 1 further including a longitudinal recess in a side wall of one of said slots inwardly of said face for at least the partial reception of the conductor portion lying in one of said slots.

3. In an electromagnetic device having an iron field core with converging edges defining a pole piece and one of said edges constituting the pole face, said core being formed with a deep narrow slot extending longitudinally across said face, a second slot in said face extending parallel with but spaced from said first mentioned slot and having a longitudinally extending cylindrical enlargement at its base, a shading coil comprising a flat conductor ring having a portion of its peripheral extent housed in said first mentioned slot and being bent along an axis parallel with said slots to provide a peripheral portion overlying the other of said edges, a second shading coil comprising a metallic rectangular ring with one of the rails thereof received in said enlargement but being of greater dimension than the width of said second slot whereby said rail is locked against sidewise movement out of said second slot, one of the side rails of said second coil being flattened at a point adjacent said first mentioned rail to permit said first rail to be moved longitudinally into said enlargement, said second coil having a further rail adapted to overlie the said other of said edges in close proximity to the last mentioned peripheral portion of the first mentioned shading coil.

4. Structure according to claim 3 further including a longitudinal recess in a side rail of the said first mentioned slot inwardly of said face for the reception of at least a portion of the first mentioned peripheral portion of the first mentioned shading coil, and means to clamp together the adjacent portions of said coils overlying said other edge thereby securely locking said coils in position on said pole piece.

5. In an electromagnetic device having an iron field core with converging edges defining a pole piece and one of said edges constituting the pole face, said core being formed with spaced parallel slots in said face thereby dividing said face into separate sections, and shading coils encircling the mass of said pole piece intermediate each of said slots and the other of said edges, each of said coils comprising a looped conductor having a portion insertable in one of said slots and a second spaced portion overlying the other of said edges of said pole pieces, means integral with one of said shading coils to clamp said second spaced portions of said coils together, and means to restrain movement of said clamped portions in a direction toward the convergence of said edges whereby said coils are securely retained on said pole piece.

6. Structure according to claim 5 further characterized in that one of said slots is provided in its side wall with a recess extending longitudinally of the slot and inwardly from said face to receive at least part of the first mentioned portion of one of said coils.

7. In an electromagnetic device having an iron field core with converging edges defining a pole piece and one of said edges constituting the pole face, said core being formed with a pair of spaced parallel slots extending longitudinally across said face thereby dividing said face into separate sections, a shading coil having a reach housed in the slot furthermost from the point of convergence of said edges and having a second reach overlying the other of said edges, a second shading coil having a reach housed within the other of said slots, means in said other slot cooperating with said reach of said second coil to restrain movement of said last mentioned reach sidewise out of said other slot, said second coil having a reach overlying said other edge in close proximity to the adjacent reach of said first mentioned coil, and means integral with one of said shading coils to clamp said adjacent reaches together.

8. Structure according to claim 7 further including means in the slot furthermost from said point of convergence to restrain sidewise movement of said first mentioned reach of said first mentioned coil out of said last mentioned slot.

9. A shading coil assembly for a wedge-shaped magnetic pole piece having a pair of narrow deep slots in its pole face and an outer end portion provided with an end surface angularly related to said face comprising a pair of closed rings

of flat conductors each having a reach positioned flatwise in one of said slots and an outer loop portion encompassing said outer end portion in edgewise relation, the loop portion of one of said rings having an integral tab operative to clamp together the outer loop portions of said rings.

10. A shaded pole assembly for an electromagnetic device comprising a rectangular pole piece arcuately recessed in one of its side edges adjacent its free end to provide an arcuate pole face, a pair of narrow deep slots formed in said face and extending parallel with respect to each other and with respect to the end surface of said piece and being variably spaced from said end surface, shading coils comprising flat conductors received in said slots and extending across said end surface, said coils being deformed in such manner that the portions thereof which are housed in said slots lie in planes angularly related to the principal planes of the portions thereof which traverse said end surface, the larger of said coils being formed intermediate its portions in the slot and on the end surface with an offset,

the smaller of said coils having its portion received in the slot bent in a direction to be nested in said offset.

11. Structure according to claim 10 further characterized in that the portions of said coils overlying said end surface are in flat overlying relation with respect to each other, and means to clamp said last mentioned portions together.

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The following references are of record in the file of this patent:

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