

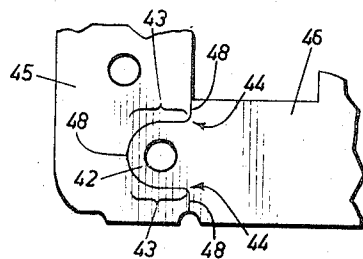
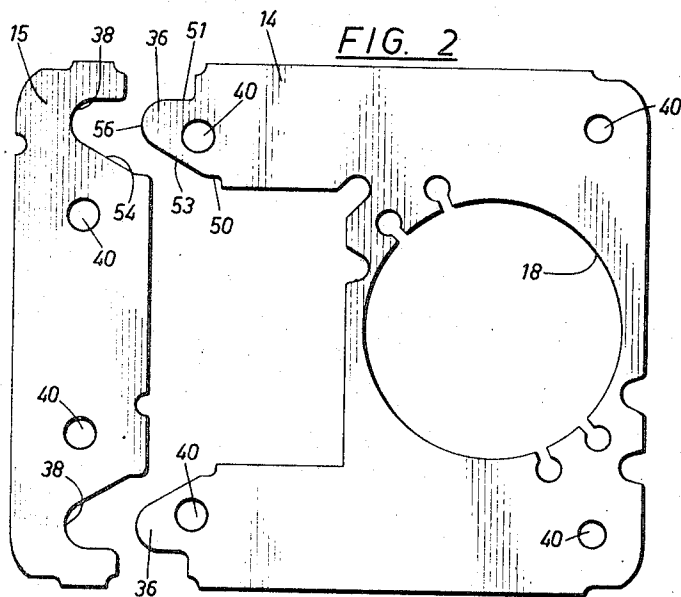
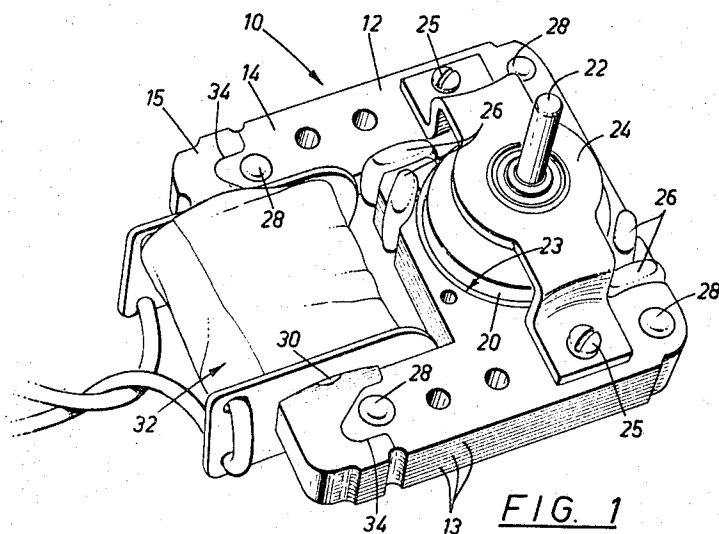
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LAMINATIONS AND MAGNETIC CORE FOR MOTOR STATORS AND TRANSFORMERS

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(PRIOR ART)

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LAMINATIONS AND MAGNETIC CORE FOR MOTOR STATORS AND TRANSFORMERS

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ABSTRACT OF THE DISCLOSURE

A two-part lamina of which one part has a protuberance and the other part has a complementary recess for receiving said protuberance. The protuberance is defined by two parallel side walls, and an outward wall consisting of a straight portion forming an obtuse angle with one side wall and a rounded portion between the straight portion and the other side wall. The lamina may be used to construct magnetic cores for motor staters and transformers.

This invention relates generally to laminated magnetic cores and staters such as are used in the construction of transformers and fractional horsepower electrical motors. More particularly, this invention relates to a two-part lamina for a magnetic core which, due to the necessity of applying an electrical winding thereto, must consist of two separate portions which are fitted complementally together after one of the portions has received the electrical winding.

Certain prior constructions for the above purpose have been attended by disadvantages, which it is the object of this invention to overcome. As is known, the steps in constructing a laminated magnetic core from a plurality of identical, two-part laminae are: (a) dividing the two-part laminae into two stacks, all of the first parts in one stack and all of the second parts in the other, (b) riveting or otherwise securing the stacks together into rigid, laminated core portions, (c) wrapping the one portion with the requisite electrical winding, and (d) press-fitting the two portions together under high pressure. In one prior art construction, one part of each lamina has a protuberance, and the other part of each lamination has a complementary recess into which the protuberance is adapted to be received during the press-fitting. Although the protuberance and the recess are complementary, and are often stamped in assembled relation simultaneously from the same piece of metal, there are nonetheless edge contortions and burrs which interfere in such a way that considerable pressure must be exerted to force the parts together. This ensures that, once assembled, the magnetic core will not part. At the same time, however, the interference of the burred and contorted edges during press-fitting causes a certain amount of material displacement to take place, and the displaced material often bridges across adjacent laminae and forms a cross-path for magnetic flux, setting up undesirable eddy currents. Furthermore, displaced material can accumulate between the two assembled parts of the magnetic core, and prevent surface-to-surface contact at some locations where this should occur. The resultant air gaps introduce reluctance into the magnetic path, and this of course is undesirable.

Besides reducing or eliminating the disadvantages listed in the foregoing paragraph, it is a further object of this invention to reduce the fitting pressure necessary to press-fit the two portions of the magnetic core together.

Accordingly, this invention provides a lamina for use in a laminated magnetic core, the lamina comprising two parts, one of the said parts having a protuberance projecting outwardly therefrom and the other of said parts

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having a recess complementary with said protuberance, such that the parts can fit complementally together, said protuberance being defined by two substantially parallel, outwardly non-convergent side walls and an outward wall which consists of a rectilinear portion forming an angle between 90° and 175° with one of said side walls and a curvilinear portion to which said rectilinear portion and the other of said side walls are both tangent.

One embodiment of this invention is shown in the accompanying drawings, in which like numerals refer to like parts throughout the several views, and in which:

FIGURE 1 is a perspective view of a fractional horsepower electric motor incorporating a core made from laminations according to this invention;

FIGURE 2 is a plan view of the two parts of the lamina to which this invention is directed; and

FIGURE 3 shows a portion of a prior art lamina in assembled condition.

Turning now to FIGURE 1, a fractional horsepower electric motor 10 includes a laminated core 12 consisting of a plurality of identical laminae 13. Each lamina 13 consists of two parts, a stator lamination 14 and a field lamination 15. The stator lamination 14 is the larger of the two, and is generally U-shaped in outline. As is best seen in FIGURE 2, the stator lamination 14 has a modified circular portion 18 removed from it, such that the periphery of the circular portion 18 can constitute the "poles" of the stator. Returning to FIGURE 1, it will be seen that a rotor 20 containing a secondary winding is fixed to a shaft 22 and is mounted to rotate freely within the cylindrical opening 23 provided by the alignment of the modified circular removed portions 18 of the several laminations 14. The shaft 22 has one end journaled in a support member 24, and the other end journaled in a similar support member (not visible). The support member 24 can be secured by conventional means 25, such as rivets or bolts and nuts, to the core 12. The core 12 also incorporates the conventional shading coils 26 antipodally adjacent the cylindrical opening 23.

Rivets 28 hold the U-shaped stator laminations 14 together. The field laminations 15 are likewise held together by rivets 30 (of which a portion of only one is visible in FIGURE 1) and the assembly so formed constitutes the core for an electrical winding 32 of conventional kind, which is intended to have an alternating current applied to it. Throughout the remainder of this specification, the assembled field laminations 15 will be referred to collectively as the field portion of the core, and the assembled stator laminations 14 as the stator portion of the core.

It will be noted that the stator and field laminations 14 and 15 contact each other along junction lines 34. As best seen in FIGURE 2, the junction lines 34 constitute the outlines of two protuberances 36, each adapted to be received in a complementary recess 38 in the lamination 15. This invention lies in the particular shape given to the profile of the protuberances 36, and this particular profile will be dealt with in more detail after a brief explanation of the sequence of assembly of the motor shown in FIGURE 1, and of the disadvantages of the prior art profile shown in FIGURE 3.

The steps in assembling the laminated magnetic core of FIGURE 1 are as follows. First, the two-part laminae 13 are divided into two stacks, with all of the stator laminations 14 in one stack, and all of the field laminations 15 in the other stack. Then each stack is riveted together through rivet holes 40 to form the field and stator portions of the laminated core.

The field portion, comprising the field laminations 15, then receives the requisite electrical winding 32, follow-

ing which the two portions of the laminated core are press-fitted together under high pressure.

The shape of the prior art protuberance 42 shown in FIGURE 3 has the following disadvantages. Firstly, because of contortions and burrs along the rectilinear surfaces 43, a considerable amount of material displacement is found to take place along the surfaces 43. The displaced material tends to accumulate at the points 44 and prevent the one portion 45 from closing completely against the other portion 46. Thus, air-gaps occur at the places marked 48, and air-gaps increase the reluctance of the magnetic path between the portions 45 and 46. Another problem relating to the displaced material is that the laminae, which are intended to be insulated from one another magnetically by means of a thin layer on either side of each lamination, are "short-circuited" magnetically by the displaced material, in such a way that undesirable eddy currents and counter-flux are set up in the magnetic path. Moreover, a considerable amount of force must be exerted to urge the two portions 45 and 46 together, due to the considerable amount of material displacement that takes place as a result of the interference of the burred and contorted edges, this force being of the order of four tons. The interference created by the up-standing burr extending over the elongated straight and well-supported side walls 43 makes it impossible to assemble units having a total lamination assembly thickness of .50 inch and less without causing considerable distortion to the thin-walled sections in the stator, thus rendering the assembly useless.

In view of the above disadvantages, the protuberance profile of this invention was evolved, and its basic features are the following:

(a) The protuberance has two opposite side walls 50 and 51 which are substantially parallel, thus permitting the assembled core portion 15 to apply a pincer-like grip to the composite protuberance 36. Some departure from exact parallelism in the two side walls can be tolerated, but such departure can only be towards an outwardly diverging orientation. If the side walls 50 and 51 are made to diverge outwardly, the divergence should be kept to a minimum, for otherwise the assembly pressure required would be too high. If the side walls 50 and 51 were made to converge outwardly, little or no grip could be sustained by the recess 38 on the protuberance 36.

(b) Between the two side walls 50 and 51, there must be a rectilinear portion 53 which is adapted to achieve line-to-line contact with a complementary portion 54 on the recess. The angle formed between the side wall 50 and the rectilinear portion 53 can be from 90° to 175°, but it should not be more than 175° in order to avoid material displacement along the rectilinear portion 53 during assembly.

(c) The "nose" portion of the protuberance 36, i.e. the portion between the side wall 51 and the rectilinear portion 53, should not have any sharp points in it. Thus, the remaining part of the profile of the protuberance 36 is a curvilinear portion 56 to which the rectilinear portion 53 and the side wall 51 are both tangent. Preferable, the curvilinear portion 56 is circular in curvature, but this is not essential. If any points occurred along the curvilinear portion 56, these would be areas of high stress and considerable material displacement.

Preferably, the angle between the side wall 50 and the rectilinear portion 53 is obtuse, and lies between 140° and 150°, as this creates an optimum situation which permits a long line of contact (portion 53) along which no material displacement takes place during assembly.

In the embodiment shown in FIGURE 2, the side wall 51 extends further outwardly than does the side wall 50, and the side wall 50 extends further inwardly than the side wall 51. This is due to the sloping portion 53. If the side wall 51 extended as far inwardly as the side wall

50, the distance through which assembly pressure would have to be exerted would be too long, because this distance is the same as the length of the longest side wall. Thus, since side wall 51 begins further outwardly than the side wall 50, the inner limit of wall 51 is likewise further outward than the inner limit of wall 50.

In FIGURE 2, the curvilinear portion 56 is shown to be circular, but this is not essential.

It was found that with the construction shown in FIGURE 2, the assembly pressure required was reduced from about four tons to about two tons, and that the general performance of the motor was improved over similar motors utilizing the design of FIGURE 3.

While a preferred embodiment of this invention has been disclosed herein, those skilled in the art will appreciate that changes and modifications may be made therein without departing from the spirit and scope of this invention as defined in the appended claims.

What I claim as my invention is:

1. A lamina for use in a laminated magnetic core, the lamina comprising two parts, one of said parts having a protuberance projecting outwardly therefrom and the other of said parts having a recess complementary with said protuberance, such that the parts can fit complementally together, said protuberance being defined by two substantially parallel, outwardly non-convergent side walls and an outward wall which consists of a rectilinear portion forming an angle between 90° and 175° with one of said side walls and a curvilinear portion to which said rectilinear portion and the other of said side walls are both tangent.

2. A lamina as claimed in claim 1, in which said angle is between 140° and 150°.

3. A lamina as claimed in claim 2, in which said curvilinear portion is circular.

4. A lamina as claimed in claim 1, in which said one of said parts is substantially U-shaped and has one said protuberance at each of its free ends, the mean direction of the substantially parallel sides of one of said protuberances being substantially parallel to the mean direction of the substantially parallel sides of the other of said protuberances, said other of said parts bridging between said free ends and having two said recesses positioned to receive simultaneously said two protuberances.

5. A lamina as claimed in claim 4, in which said obtuse angle is between 140° and 150°.

6. A lamina as claimed in claim 1, in which said other of said side walls extends further outwardly than does said one of said side walls.

7. A lamina as claimed in claim 6, in which said one of said side walls extends further inwardly than does said other of said side walls.

8. A lamina as claimed in claim 5, in which the two protuberances are disposed enantiomorphically.

9. A laminated magnetic core comprised of a plurality of identical laminations according to claim 4.

10. A lamina as claimed in claim 8, in which said other of said side walls extends further outwardly than does said one of said side walls, and in which said one of said side walls extends further inwardly than does said other of said side walls.

References Cited

UNITED STATES PATENTS

2,064,090	12/1936	Sullivan et al. -----	310—259
2,291,013	7/1942	Wheeler -----	310—259 X
2,487,258	11/1949	Morris -----	310—254 X
3,365,687	1/1968	Capell -----	336—210

70 WARREN E. RAY, *Primary Examiner.*

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310—259; 336—210, 216