

Description

The invention relates to a core for an electric coil or transformer which includes a number of concentric turns of a ferromagnetic strip material and in which an inner core portion which includes at least one turn consists of a non-amorphous material whilst an outer core portion which encloses the inner core portion consists of an amorphous material.

A core of this kind is known from GB—A—2 111 316. The inner core portion, which is made of a non-amorphous material, serves for reinforcement and increased rigidity of the core. It has been found that the transition between the inner and the outer core portion requires special attention. The material of the outer core portion should preferably be attached to the inner core portion so that tensile forces can be exerted during the winding of the outer core portion. Attachment should be performed in a reliable manner which is also suitable for mass production. It is the object of the invention to provide a core of the kind set forth which satisfies the above requirements.

To achieve this, the core in accordance with the invention is characterized in that the transition between the inner and the outer core portion is formed by a welded joint between the overlapping outer and inner end portions of the outer turn of the inner core portion with the inner end portion of the inner turn of the outer core portion disposed therebetween.

The core in accordance with the invention is preferably wound on a mandrel. On the mandrel there is first of all disposed the inner core portion, after which the inner end portion of the inner turn of the outer core portion is slid underneath the outer end portion of the outer turn of the inner core portion. The stack thus formed is joined by way of a welded joint. This welded joint is preferably formed by a spot weld. During welding, the (metal) winding mandrel can form a lower welding electrode, so that in order to realize the spot weld it is sufficient to press a number of pin-shaped upper welding electrodes onto said stack. Consequently, the welding operation is very brief and the entire procedure, involving the winding of the inner core portion, the welding and the winding of the outer core portion, can be mechanized.

The inner core portion preferably consists of a single turn, so that the volume of the core consists mainly of an amorphous material. Consequently, the magnetic field extends mainly through the amorphous material. In order to increase the magnetic resistance of the inner core portion so that the magnetic field is forced even further to the outer core portion, a further preferred embodiment of the core in accordance with the invention is characterized in that the strip-like material of the inner core portion is provided with at least one cut-out. The thickness of the non-amorphous strip material used to form the inner core portion is preferably at least ten times greater than the thickness of the amorphous strip

material used to form the outer core portion. The inner core portion, which preferably consists of one turn, thus is comparatively rugged. It may then be constructed as a preformed cylinder which can be bent open in a resilient manner in order to be arranged around the winding mandrel.

The invention will be described in detail hereinafter with reference to the accompanying diagrammatic drawing. Therein:

Figure 1 is a cross-sectional view of a winding mandrel during the manufacture of an embodiment of a ferromagnetic core in accordance with the invention,

Figure 2 is a side elevation of the winding mandrel shown in Figure 1,

Figure 3 is a front view of an embodiment of a ferromagnetic core in accordance with the invention,

Figure 4 shows a detail (on an increased scale) of the core shown in Figure 3, and

Figure 5 is a side elevation of an embodiment of a part of a ferro-magnetic core in accordance with the invention.

Figure 1 is a cross-sectional view and Figure 2 is a side elevation of a metal winding mandrel 1 which has a winding space which is bounded by two flanges 3 and 5. The winding mandrel 1 and the first flange 3 are rigidly mounted on a shaft 7 which can be rotated in the direction of the arrow 9 by means of a motor (not shown). The second flange 5 is detachably connected to the free end of the shaft 7 by means of a wing nut 11.

During the manufacture of a ferromagnetic core for a coil or transformer, first an inner core portion 13 is disposed on the winding mandrel 1, which portion consists in the present embodiment of a single turn of a non-amorphous, ferromagnetic strip material, for example silicon-iron. This turn includes an inner end portion 15 overlapped by an outer end portion 17. The free end 19 of a strip 21 of amorphous ferromagnetic material is arranged between said two end portions. Subsequently, pin-shaped welding electrodes 23 are pressed onto the stack of three layers of ferromagnetic material thus formed. To this end, these electrodes are movable in the vertical direction as denoted by the bidirectional arrow 25. The electrodes 23 are electrically connected to one pole of an electric welding generator (not shown) whose other pole is electrically connected to the winding mandrel 1. The two end portions 15 and 17 of the inner core portion 13 and the free end 19 of the strip 21 are thus spot-welded together. If desired, after the welding operation the welding electrodes 23 may be displaced in the axial direction as denoted by the reference numeral 23' in Figure 2, after which further spot welds can be made in the same manner.

After the spot welds have been made, the shaft 7 is rotated in the direction denoted by the arrow 9, so that the strip 21 is unwound from a feed reel (not shown) in order to be wound around the inner core portion 13, thus forming an outer core

portion 27 (see Figure 3). After formation of the number of turns required for the outer core portion 27 and after the outer free end of the strip 21 has been secured, for example by means of adhesive tape (not shown), the second flange 5 is removed from the shaft 7 so that the core can be removed from the winding mandrel 1. The space previously occupied by the winding mandrel then forms a core window 29. The core can subsequently be subjected to a number of known further operations, such as a heat treatment and an impregnation process, after which the core can be divided (if desired) into two portions along a plane 31, for example by sawing or grinding, after which the free end faces of the two core portions are polished. The plane 31 extends perpendicularly to the turns of the two core portions 13 and 27. During these operations the inner core portion 13 forms a support for the outer core portion 27 which has a lower mechanical strength.

Figure 4 shows the transition between the inner core portion 13 and the outer core portion 27 on an increased scale. This Figure shows that the free end 19 of the strip 21 is situated between the inner end portion 15 and the outer end portion 17 of the single turn of the inner core portion 13. The free end 19 constitutes the inner end portion of the inner turn 33 of the outer core portion 27. The further course of the inner turn 33 at the area of the transition between the two core portions is also shown in Figure 4.

The inner core portion 13 of the described embodiment includes only a single turn of a non-amorphous strip material whose thickness is at least ten times greater than that of the strip 21 of amorphous material used to form the outer core portion 27. In one embodiment the strip 21 consists of an amorphous iron tape having a thickness of 22 μm and the inner core portion 13 consists of a silicon-iron strip having a thickness of 350 μm . The inner core portion 13 then consists of a preformed cylinder which is shown in a side elevation in Figure 5 and whose ends can be resiliently bent away from each other in order to arrange the cylinder around the winding mandrel 1. The strip-like material used to form this cylinder is provided with cut-outs 33 in order to increase the magnetic resistance of the inner core portion 13 so that the magnetic field extends substantially completely through the outer core portion 27 which consists of amorphous material having very attractive magnetic properties. In the present embodiment the cut-outs 33 are formed by two holes at each of the four corners of the cylinder. It is alternatively possible to use a strip material having a small thickness for the inner core portion 13, in which case it may be desirable to form more than one turn, for example from a feed reel in the same way as described for the winding of the outer core portion 27. The free end 15 of the outer turn of the inner core portion 13 then continues in the turns which are situated further inwards.

Claims

1. A core for an electric coil or transformer which includes a number of concentric turns of a ferromagnetic strip material and in which an inner core portion (13) which includes at least one turn consists of a non-amorphous material whilst an outer core portion (27) which encloses the inner core portion consists of an amorphous material, characterized in that the transition between the inner and the outer core portion is formed by a welded joint between the overlapping outer (17) and inner (15) end portions of the outer turn of the inner core portion (13) with the inner end portion (19) of the inner turn of the outer core portion (27) disposed therebetween.

2. A core as claimed in Claim 1, characterized in that the welded joint is a spot weld.

3. A core as claimed in Claim 1 or 2, characterized in that the inner core portion (13) consists of a single turn.

4. A core as claimed in any one of the Claims 1 to 3, characterized in that the strip material of the inner core portion is provided with at least one cut-out (33).

5. A core as claimed in Claim 3 or 4, characterized in that the thickness of the non-amorphous strip material used to form the inner core portion (13) is at least ten times greater than the thickness of the amorphous strip (21) material used to form the outer core portion (27).

6. A core as claimed in any one of the Claims 1 to 5, characterized in that the core is divided into two portions along a plane (31) which intersects the turns perpendicularly to the longitudinal direction of the strip material.

Patentansprüche

1. Kern für eine elektrische Spule oder für einen Transformator, der eine Anzahl konzentrischer Windungen eines ferromagnetischen Bandmaterials enthält, und in dem ein innerer Kernteil (13) mit wenigstens einer Windung aus einem nicht-amorphen Werkstoff besteht, während ein äußerer Kernteil (27), der den inneren Kernteil einschließt, aus einem amorphen Werkstoff besteht, dadurch gekennzeichnet, daß der Übergang zwischen dem inneren und dem äußeren Kernteil durch eine Schweißverbindung zwischen den überlappenden äußeren (17) und inneren (15) Endabschnitten der Außenwindung des inneren Kernteils (13) mit dem dazwischen angeordneten inneren Endabschnitt der Innenwindung des äußeren Kernteils (27) gebildet wird.

2. Kern nach Anspruch 1, dadurch gekennzeichnet, daß die Schweißverbindung eine Punktschweißung ist.

3. Kern nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der innere Kernteil (13) aus nur einer Windung besteht.

4. Kern nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Bandmaterial des inneren Kernteils wenigstens eine Aussparung (33) aufweist.

portion 27 (see Figure 3). After formation of the number of turns required for the outer core portion 27 and after the outer free end of the strip 21 has been secured, for example by means of adhesive tape (not shown), the second flange 5 is removed from the shaft 7 so that the core can be removed from the winding mandrel 1. The space previously occupied by the winding mandrel then forms a core window 29. The core can subsequently be subjected to a number of known further operations, such as a heat treatment and an impregnation process, after which the core can be divided (if desired) into two portions along a plane 31, for example by sawing or grinding, after which the free end faces of the two core portions are polished. The plane 31 extends perpendicularly to the turns of the two core portions 13 and 27. During these operations the inner core portion 13 forms a support for the outer core portion 27 which has a lower mechanical strength.

Figure 4 shows the transition between the inner core portion 13 and the outer core portion 27 on an increased scale. This Figure shows that the free end 19 of the strip 21 is situated between the inner end portion 15 and the outer end portion 17 of the single turn of the inner core portion 13. The free end 19 constitutes the inner end portion of the inner turn 33 of the outer core portion 27. The further course of the inner turn 33 at the area of the transition between the two core portions is also shown in Figure 4.

The inner core portion 13 of the described embodiment includes only a single turn of a non-amorphous strip material whose thickness is at least ten times greater than that of the strip 21 of amorphous material used to form the outer core portion 27. In one embodiment the strip 21 consists of an amorphous iron tape having a thickness of 22 μm and the inner core portion 13 consists of a silicon-iron strip having a thickness of 350 μm . The inner core portion 13 then consists of a preformed cylinder which is shown in a side elevation in Figure 5 and whose ends can be resiliently bent away from each other in order to arrange the cylinder around the winding mandrel 1. The strip-like material used to form this cylinder is provided with cut-outs 33 in order to increase the magnetic resistance of the inner core portion 13 so that the magnetic field extends substantially completely through the outer core portion 27 which consists of amorphous material having very attractive magnetic properties. In the present embodiment the cut-outs 33 are formed by two holes at each of the four corners of the cylinder. It is alternatively possible to use a strip material having a small thickness for the inner core portion 13, in which case it may be desirable to form more than one turn, for example from a feed reel in the same way as described for the winding of the outer core portion 27. The free end 15 of the outer turn of the inner core portion 13 then continues in the turns which are situated further inwards.

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6. A core as claimed in any one of the Claims 1 to 5, characterized in that the core is divided into two portions along a plane (31) which intersects the turns perpendicularly to the longitudinal direction of the strip material.

Patentansprüche

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2. Kern nach Anspruch 1, dadurch gekennzeichnet, daß die Schweißverbindung eine Punktschweißung ist.

3. Kern nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der innere Kernteil (13) aus nur einer Windung besteht.

4. Kern nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Bandmaterial des inneren Kernteils wenigstens eine Aussparung (33) aufweist.



5. Kern nach Anspruch 3 oder 4, dadurch gekennzeichnet, daß die Dicke des nicht-amorphen Bandmaterials zur Bildung des inneren Kernteils (13) wenigstens das Zehnfache der Dicke des amorphen Bandmaterials (21) zur Bildung des äußeren Kernteils (27) beträgt.

6. Kern nach einem der mehreren oder Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der Kern entlang einer Ebene (31) in zwei geteilt ist, die die Windungen senkrecht zur Längsrichtung des Bandmaterials schneidet.

Revendications

1. Noyau destiné à une bobine électrique ou à un transformateur et comportant une pluralité de spires concentriques en matériau ferromagnétique en forme de bande, noyau dans lequel une partie intérieure (13) comportant au moins une spire est constituée par un matériau non amorphe, tandis qu'une partie extérieure (27) du noyau, entourant la partie intérieure, est constituée par un matériau amorphe, caractérisé en ce que la transition entre les parties intérieure et extérieure du noyau est formée par un joint soudé entre les parties terminales extérieure (17) et intérieure (15) superposées de la spire extérieure

de la partie intérieure (13) du noyau, la partie terminale intérieure (1a) de la spire intérieure de la partie extérieure (27) du noyau étant interposée entre celles-ci.

2. Noyau selon la revendication 1, caractérisé en ce que le joint soudé est une soudure par points.

3. Noyau selon la revendication 1 ou 2, caractérisé en ce que la partie intérieure (13) du noyau est constituée par une seule spire.

4. Noyau selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le matériau en forme de bande de la partie intérieure du noyau présente au moins un évidement (33).

5. Noyau selon la revendication 3 ou 4, caractérisé en ce que l'épaisseur du matériau non amorphe en forme de bande constituant la partie intérieure (13) du noyau est au moins dix fois plus grande que l'épaisseur du matériau amorphe en forme de bande (21) constituant la partie extérieure (27) du noyau.

6. Noyau selon l'une quelconque des revendications 1 à 5, caractérisé en ce qu'il est divisé en deux parties suivant un plan (31) qui coupe les spires perpendiculairement au sens longitudinal du matériau en forme de bande.

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