

Description

The present invention relates to a core of a magnetic head, and a process of manufacturing the magnetic head core, and more particularly to a structure of a magnetic head core made of ferrite which is easy to manufacture and high in quality. The present invention is also concerned with a process of manufacturing such magnetic head cores, particularly with an advantageous process of manufacturing a composite magnetic head core which consists of two ferrite cores in combination.

In the art of magnetic heads, a core made of ferrite has been known, which generally consists of a pair of ferrite core elements joined together to form a structure of ring-shaped or toric cross section having a centrally located aperture or opening which facilitates winding of coils around the core elements. More specifically stated referring to Fig. 1 which shows a common type of magnetic head core, a pair of generally C-shaped ferrite core halves 2, 4 are butted together to form the core with a central aperture 6 which serves as a space for winding coils 8 around the core halves 2, 4. In this manner, an generally annular or toric magnetic path (magnetic circuit) is constituted by the two C-shaped ferrite core halves 2, 4. In the meantime, the toric magnetic core structure is formed with a magnetic gap 10 at one end portion of the core. The gap 10 is formed to extend across the torus of the toric magnetic circuit and has a suitable width α . As is well known in the art, a magnetic tape 12, magnetic disk or other magnetic recording medium is slidably moved on outer contact surfaces on the core halves 2, 4 in the proximity of the magnetic gap 10 defined by these two halves 2, 4, whereby magnetic recording (writing) and reproducing (reading) operations are executed. As indicated above, the ends of the core halves 2, 4 at one end of the core define the magnetic gap 10, while the other ends of the core halves 2, 4 are bonded together with suitable bonding glass so as to maintain a generally annular or toroidal cross sectional shape of the magnetic core as a whole. In this manner of bonding of the core elements 2, 4, it is inevitable that a very small gap, so called a rear or back gap 14, is formed between the bonded surfaces of the core elements 2, 4.

In such a ferrite core as described above, a writing, reading or erasing track or tracks of a suitable width is/are provided on the contact surface on which a magnetic recording medium (12) is moved in sliding contact, i.e., on the outer surfaces of the opposed end portions of the two ferrite core elements 2, 4 in the vicinity of the magnetic gap 10. The track is formed so as to extend in the direction of movement of the recording medium. The width of the track is selected depending upon

the specific magnetic recording medium (12) used. In a commonly known ferrite core, the width of the track is usually defined or determined by a central or middle groove or side grooves formed in the opposed end portions of the core elements 2, 4 defining the gap 10. The middle groove is located in the middle of the contact surface as viewed in the width direction perpendicular to the direction of sliding movement of the recording medium, so that two tracks are formed on both sides of the middle groove. On the other hand, a single track is defined by two side grooves which are formed on both sides of the track.

Examples of such grooves are shown in Figs. 2(a) and 2(b), wherein two side grooves 16, 16 are formed in the opposed portions of the core elements 2, 4 which are located on both sides of the magnetic gap 10 to define the gap 10. The two side grooves 16, 16 define therebetween a track 18 having a suitable width w as measured perpendicularly to the direction of sliding movement of a magnetic recording medium. The two side grooves 16, 16 are filled with masses of glass 20 in order to protect the track 18 and its vicinities, and prevent otherwise possible breakage, chipping or similar damage to the corner portions defining the grooves 16, 16.

In this type of ferrite core wherein the grooves 16, 16 determine the width w of the track 18, the grooves 16, 16 are formed in each of the opposed end portions of the elements 2, 4 defining the magnetic gap 10 over a sufficient length. Further, each of the core elements 2, 4 should be processed, prior to bonding thereof, to provide two cutouts which eventually form the grooves 16, 16 when the elements 2, 4 are bonded together. This requires a cutting process to be done in each of the individual core elements 2, 4, and needs accurate controls of the widths of the cutouts and the spacings between the cutouts in each core element 2, 4, so that the two halves of the track 18 are exactly aligned with each other to provide the predetermined width w on both of the core elements 2, 4.

In the above case wherein the two core elements 2, 4 are subjected to cutting operations to form the individual cutouts for the grooves 16, 16, it is required to precisely position the two elements 2, 4 upon bonding thereof to form an integral core structure, such that the two halves of the track 18 defined by the grooves 16, 16 are accurately aligned with each other. This alignment is a difficult and cumbersome step in the conventional process of manufacturing a known ferrite core. In other words, inaccurate relative positioning of the two core elements 2, 4 results in relative misalignment of the two halves of the track 18 at the interface of the core elements 2, 4 as illustrated in Fig. 2(c),

thus leading to reduced quality of the ferrite core.

There is also known a ferrite core as shown in Fig. 2(d). Unlike the above-discussed ferrite core having the grooves 16, 16, this ferrite core has side grooves 22, 22 which are cut to extend along the length of the track 18. These parallel grooves 22, 22, are formed after the two core elements 2, 4 are bonded together. Thus, the grooves 22, 22 define a track 18 having a suitable width w and a desired length. However, since the grooves 22, 22 on both sides of the track 18 should have a depth sufficient to reach the coil-winding aperture 6, the uncut portions (lands) of the core elements 2, 4 providing the track 18 and defined by the deep parallel grooves 22, 22 tend to have a large height relative to its width. Stated the other way, it is difficult to form the track 18 as designed, by cutting such deep parallel grooves without breakage or chipping of the uncut portions. This problem is aggravated as the width w of the track 18 is reduced. While the side parallel grooves 22, 22 defining the track 18 are filled with glass 20, as in the examples of Figs. 2(a) and 2(b), it is recognized as another drawback that the glass 20 in its molten phase will easily flow down over the side end surfaces of the core elements 2, 4 beyond the longitudinal ends of the grooves 22 in the direction along the length of the track 18. Thus, the ferrite core of Fig. 2(d) has various drawbacks in its process of manufacture.

A ferrite magnetic head core as described above is used either alone, or as one of two elements of a composite magnetic head core which consists of a pair of such ferrite cores. Some examples of a composite core are illustrated in Figs. 3(a) through 3(d). Each of composite cores shown in Figs. 3(a) and 3(b) is a composite which consists of a ferrite writing head core 106 consisting of an integral assembly of a C-shaped core element 102 and a rectangular core (I-shaped core) element 104, and a ferrite reading head core 108 consisting of another integral assembly of the same cores 102, 104. Figs. 3(c) and 3(d) show composite cores each of which is a composite of a ferrite writing/reading head core 110 and a ferrite erasing head core 112, each core 110, 112 consisting of core elements 102, 104 which are similar to the core elements 102, 104 of the ferrite cores 106, 108 of Figs. 3(a) and 3(b).

Each of the ferrite cores 106, 108, 110 and 112 has a magnetic gap 114 defined by opposed end portions of the core elements 102, 104 which provide contact surfaces on which a magnetic recording medium is moved in sliding contact. These contact surfaces on the opposed end portions in the vicinity of the magnetic gap 114, that is, the outer surfaces of the opposed end portions on both sides of the magnetic gap 114, is formed with a track or tracks 116 which extend in the direction of

sliding movement of the magnetic recording medium, so that the recording medium moves in sliding contact with the tracks 116 for magnetic writing and reading operations. The width w of the tracks 116 is determined depending upon the specific kind of the recording medium. In known writing and/or reading head cores indicated at 106, 108, 110, the width of the track 116 is determined by two side grooves 118 which are formed in the opposed end portions of the core elements 102, 104 on both sides of the magnetic gap 114 such that the grooves 118 are located on both sides of the track 116 to define the track 116 therebetween, i.e., in the middle of the width of the contact surfaces as measured in the direction perpendicular to the direction of sliding movement of the recording medium. In erasing head cores as indicated at 112, a middle groove (recess) 118 is formed in the middle of the width of contact surfaces through the opposed end portions of the core elements 102, 104 so that the middle groove 118 defines the two tracks 116 on its both sides. The side grooves 118 or the middle groove 118 are/is filled with glass 120 to protect the track or tracks 116, and prevent breakage or chipping of corner portions of the grooves. In each of the ferrite cores 106, 108, 110 and 112, a coil-winding aperture 122 is formed between the core elements 102, 104.

In the aforementioned composite magnetic head cores wherein the middle groove 118 or side grooves 118 define the width w of the track or tracks 116, the grooves 118 are formed in both of the opposed portions of the core elements 102, 104, over a relatively long distance. Further, all of the core elements 102, 104 should be processed, prior to bonding thereof, to form recesses or cutouts which eventually form the grooves 118 when the core elements 102, 104 are bonded together. This requires repetitive cutting operations on the individual core elements 102, 104, and needs accurate controls of the widths of the recesses and spacings between the recesses, so that the two halves of each track 116 are exactly aligned with each other to provide the predetermined width w on both of the core elements 102, 104.

An exemplary process of manufacturing ferrite cores used to form a composite magnetic head core as introduced above is disclosed in Japanese Patent Application laid open in 1976 under Publication No. 51-96308. This process comprises the steps of: cutting slant or straight grooves in each of a pair of ferrite core elements in the form of blocks; melting a glass material to fill the grooves with the molten glass; finely grinding surfaces of the core elements defining a magnetic gap; cutting a groove in one of the core elements so as to define a central aperture for winding coils; applying a layer

of glass of a suitable thickness, with a sputtering method, to at least one of the surfaces defining the magnetic gap; assembling the two core elements in mutually abutting relation; and heating the assembly to bond the two core elements to obtain an integral ferrite core structure. Thus, ferrite core structures are produced. Then, a pair of these core structures are bonded together with bonding glass, whereby a desired composite magnetic head core is manufactured.

Such a known manufacturing process as described above, however, is very much complicated and cumbersome. Apparently, the individual grooves or cutouts formed in the core elements should be accurately cut to tight dimensional tolerances. Further, the processed core elements with the grooves should be precisely aligned with each other upon assembling the blocks in mutually abutting relation. This is also an extremely troublesome and difficult step. If the relative alignment of the core elements is not sufficiently accurate, two halves of each track 116 are displaced laterally from each other as depicted in Fig. 3(e). This alignment error will reduce the quality of the ferrite cores, and consequently results in degrading the quality of the composite core using the ferrite cores. In addition, even if the core elements are accurately aligned with each other, it is further necessary to accurately align the two ferrite cores, otherwise the tracks on one of the ferrite cores are not aligned with the tracks on the other ferrite core as shown in Fig. 3(f).

Also known in the art is a ferrite core which is formed with grooves 124 which, unlike the above discussed grooves 118, are formed in parallel with the track 116 as shown in Fig. 4.

This ferrite core is produced by bonding two ferrite core elements 102, 104 into an integral assembly, and then cutting the grooves 124 in the opposed portions of the core elements 102, 104 defining magnetic gaps 114, such that the grooves 124 are formed on both sides of and in parallel with the track 116 in order to define the track 116 with a desired length and a desired width w . Since these grooves 124 should have a depth sufficient to reach a central coil-winding aperture 122, the uncut portions (lands) of the core elements 102, 104 providing the track 116 and defined by the deep parallel grooves 124 tend to have a relatively large height relative to its width, as previously indicated in association with the grooves 20 of Fig. 2(d). In other words, it is hard to form the track 116 as intended, without breakage or chipping of the uncut portions during the cutting of such deep grooves. This problem is serious when the width w of the track 116 is relatively small.

While the side grooves 124, 124 on both sides of the track 116 are filled with glass, this causes

another problem that the glass in its molten phase will easily flow down over the opposite side end surfaces of the core elements 102, 104 beyond the longitudinal ends of the grooves 124. Thus, the ferrite core of Fig. 4 suffer various inconveniences in its process of fabrication. The above indicated flow of the molten glass raises a particularly serious problem in the production of a composite core consisting of a pair of ferrite cores each consisting of a C-shaped core element 102 and a rectangular core element 104, because the two ferrite cores are butted together at the side end surfaces of the rectangular core elements 104, 104, and the side end surfaces of the C-shaped core elements 102, 102 are exposed. That is, the glass lying on the side end surfaces of the core elements 102, 104 will lead to failures to obtain satisfactorily high manufacturing accuracy and good appearance of the product.

EP-A-116451, published 22.8.84 and thus state of the art by virtue of Art. 54(3) EPC. discloses prefilling of notches of a core element with a non-magnetic material, prior to bonding a transducing gap. It also discloses the bonding of a transducing gap before filling the notches with non-magnetic material. Fig. 17 of this EP-A-116451 discloses at least one groove formed in a side portion of the core elements and having a bottom portion which is inclined in the direction towards one of the core elements. It is however not disclosed that the depth of the bottom portion of the groove at the position of the gap is greater than the depth of the gap. The process disclosed comprises the steps of cutting notches in ferrite core material, filling the notches under pressure and removing the excess filling material. Subsequently, slices of the core material comprising one notch are cut.

The present invention was developed in view of the foregoing state of the prior art. It is accordingly an object of the invention to provide a magnetic head core with improved quality consisting of plural ferrite core elements bonded together into a generally ring-shaped integral core assembly, which is easy to manufacture, simple in construction, and free of relative positioning of the core elements to establish alignment of two halves of a track formed on the opposed portions defining a magnetic gap.

It is another object of the invention to provide a process of manufacturing such a magnetic head core.

It is a further object of the invention to provide a simple process by which it is possible to easily manufacture a high-quality composite magnetic head core consisting of two ferrite cores each consisting of two ferrite core elements which are bonded together into a generally ring-shaped integral core assembly as indicated above, wherein it is not necessary to align the core elements of each

ferrite core for alignment of two halves of a track or tracks on the opposed end portions of the core elements defining a magnetic gap, and wherein the two ferrite cores are easily aligned for precise alignment of the tracks.

The present invention is set out in claim 1.

In the magnetic head core constructed according to the invention, at least one groove which determines the width of the track is formed along the length of the track and is inclined in the direction from one of the gap-defining opposed portions toward the other. In other words, the inclined groove may be cut in an integral assembly of plural ferrite core elements in the direction of sliding movement of a magnetic recording medium, from one of the two ferrite core elements defining the magnetic gap, such that the groove is inclined toward the other of the gap-defining ferrite core elements, after the plural ferrite core elements are butted and bonded together into the integral assembly having an annular magnetic circuit. Thus, the track of a suitable width is formed by the inclined groove cut in the core assembly.

According to one embodiment of the magnetic head core of the invention, the magnetic circuit consists of two core elements, and magnetic gap is defined by and formed between the opposed portions of the two core elements at first ends thereof. The two core elements are butted together at the other ends thereof so as to form the coil-winding aperture, and bonded together into an integral core assembly.

Preferably, the plural core elements are butted together so as to form the generally annular magnetic circuit, and directly bonded together at the mutually abutting surfaces by means of solid-solid reaction.

Preferably also, there is a single groove formed in the middle of said opposed portions of the two core elements as viewed in the direction of the width of the track, the single groove defining two tracks its opposite sides.

In an alternative embodiment, there are two grooves formed on both opposite sides of a single middle track.

According to the invention, there is also provided a process as set out in claim 6.

According to one embodiment of the process of the invention, the two core elements are two elongate core blocks of ferrite, respectively, which core blocks are bonded together into an elongate integral ferrite structure, there being a plurality of the grooves which are cut in the elongate integral ferrite structure at predetermined intervals along the length of the elongate integral ferrite structure. This elongate integral ferrite structure is cut in parallel planes which are perpendicular to its length and spaced from each other along the length.

According to a further aspect of the invention, there is provided a process as set out in claim 9.

In accordance with the process of claim 9, the inclined groove or grooves defining the track or tracks is/are cut in each of the two integral core assemblies which consists of two ferrite core elements bonded together to form a generally annular magnetic circuit. Therefore, it is not necessary to process the individual core elements to form cutouts which eventually define a groove or grooves for a track or tracks when the two core elements are bonded together, as practiced in the prior art process. Stated differently, the instant process allows concurrent cutting of a groove or grooves in both of the first and second core elements of the integral core assembly. This concurrent groove cutting eliminates the conventional need of positioning the first and second core elements for alignment of the track or tracks when the core elements are bonded together. A further advantage of the present process stems from the concurrent operations of filling the inclined grooves with molten glass, and bonding the two core assemblies by filling the clearance therebetween with the molten glass. This concurrence of filling and bonding operations means automatic completion of the bonding step by executing the step of filling the inclined grooves, and thus leads to substantive elimination of one of such two otherwise different steps. Thus, the instant process is simplified.

Further, the first and second integral core assemblies are butted together at the rectangular portions of their second core elements upon bonding of the two core assemblies. Hence, the inclined grooves are open on the side of the second core elements which abut on each other. This arrangement permits easy alignment of the two core assemblies for establishing the intended positional relation between the tracks on the two core assemblies. Accordingly, otherwise possible misalignment of the core assemblies as illustrated in rig. 3(f) is effectively prevented.

Furthermore, the inclined grooves defining the tracks on the integral core assemblies do not have a large depth over the entire areas of the opposed end portions of the core elements providing the contact surfaces for a magnetic recording medium. In other words, the uncut portions serving to provide the tracks have a relatively small height and therefore suffer from reduced or minimum breakage or chipping. In addition, the molten glass for filling the inclined grooves will not flow down over the side end surfaces of the C-shaped first core elements. Thus, the instant process offers an effective solution to the conventionally encountered troubles due to such flow of the molten glass in the course of production of the composite ferrite core.

In the process of the invention, the first and

Second core elements are preferably directly bonded together by means of solid-solid reaction into the core assembly with the generally annular magnetic circuit.

Suitably, the magnetic gap in the integral core assembly is filled with a glass material before the inclined groove or grooves are cut.

In a preferred embodiment of the process, in order to form a plurality of the magnetic head cores simultaneously each of the first core elements of the first and second integral core assemblies is an elongate ferrite block having a portion of C-shaped transverse cross section, and each of said second core elements of the first and second integral core assemblies is an elongate ferrite block having a portion of rectangular transverse cross section. The first and second elongate ferrite blocks of the first integral core assembly are bonded together into a first elongate integral core assembly, while the first and second elongate ferrite blocks of the second integral core assembly are bonded together into a second elongate integral core assembly. The first and second elongate integral core assemblies are bonded together into an elongate integral composite core structure, and this elongate integral composite core structure is cut at spaced parallel planes which are perpendicular to the length of the elongate integral composite core structure.

In another preferred embodiment of the process, the first core elements of the first and second integral core assemblies are constituted by a first ferrite member having a first and a second portion of C-shaped section symmetrical with each other, and the second core elements of the first and second integral core assemblies are constituted by a second ferrite member having a first and a second portion of rectangular section symmetrical with each other. The first and second elongate ferrite members are bonded together into an integral twin-core structure wherein the first C-shaped portion cooperates with the first rectangular portion to form a first generally annular magnetic circuit, while the second C-shaped portion cooperates with the second rectangular portion to form a second generally annular magnetic circuit symmetrical with the first magnetic circuit. The integral twin-core structure is cut thereafter into two integral core assemblies having the first and second magnetic circuits, respectively.

In one form of this embodiment, the first and second ferrite members are elongate ferrite members which are bonded together into an elongate integral twin-core structure. This elongate integral twin-core structure is cut into two elongate integral core assemblies. Preferably, the two elongate integral core assemblies may be butted together at the first and second rectangular portions and bonded

together into an elongate integral composite core structure. This elongate integral composite core structure is cut at spaced parallel planes which are perpendicular to its length,

Embodiments of the present invention are described below by way of example in connection with the accompanying drawings in which:

Fig. 1 is an illustration of a magnetic head arrangement known in the prior art;

Figs. 2(a), 2(b) and 2(d) are perspective views of known magnetic head cores;

Fig. 2(c) is a fragmentary plan view of the cores of Figs. 2(a) and (b), showing misalignment of core elements at the top of the core on which a track is formed;

Figs. 3(a), 3(b), 3(c) and 3(d) are perspective views of composite magnetic head cores known in the art;

Fig. 3(e) is a fragmentary plan view of these known composite cores, showing misalignment of core elements at the top of the core on which tracks are formed;

Fig. 3(f) is a fragmentary plan view of a composite core structure, showing misalignment of tracks on two elongate core assemblies;

Fig. 4 is a perspective view of a known elongate core assembly prepared according to a known method;

Figs. 5(a) and 5(b) are perspective and elevational views, respectively, showing one embodiment of the ferrite magnetic head core of the invention;

Figs. 6(a) and 6(b) are perspective views of different forms of a composite core consisting of two cores of the invention;

Fig. 7 is a view illustrating the process of assembling one form of the core of the invention;

Fig. 8 is a view illustrating the process of manufacturing the cores of the invention according to one preferred embodiment of the process of the invention;

Fig. 9 is a view illustrating one embodiment of a process of the invention for manufacturing an elongate magnetic head core;

Fig. 10 is a view showing an exemplary process of the invention for manufacturing composite magnetic head cores using two ferrite core assemblies;

Fig. 11 is an elevational view corresponding to Fig. 5(b), showing a ferrite core assembly after inclined grooves are cut therein;

Figs. 12(a) and 12(b) are perspective views corresponding to Figs. 6(a) and 6(b), showing different forms of a composite magnetic head core produced according to the process of the invention;

Fig. 13 is a view illustrating another embodiment of the process of the invention for producing

composite magnetic head cores; and

Fig. 14 is a fragmentary view showing elongate ferrite members of Fig. 13 in their mutually abutting condition.

Referring to Figs. 5(a) and 5(b), there is shown an example of the ferrite magnetic head core of the invention, wherein a C-shaped ferrite core element 2 and a rectangular ferrite core element 4 are bonded together into an integral core assembly, and the core assembly is subjected to a groove-cutting operation wherein two inclined grooves 24, 24 are cut from the side of the rectangular core element 4, such that the bottom of the grooves 24, 24 slant upwardly at a predetermined angle toward the C-shaped core element 2. As a result of the formation of these two inclined grooves 24, 24, a track 18 having a desired width w is formed between the grooves 24, 24.

The inclined grooves 24, 24 described above are formed with ease after the ferrite core elements 2, 4 have been bonded together into the integral core assembly. This eliminates the need of forming cutouts in each of the individual core elements 2, 4 before they are bonded together. That is, the inclined grooves 24, 24 are formed simultaneously the single core assembly of the two elements 2, 4, whereby the groove-cutting process is remarkably simplified. Further, the concurrent cutting of the two inclined grooves 24, 24 removes the positioning of the core elements 2, 4 to establish alignment of two halves of the track 18 on the originally separate core elements 2, 4. Accordingly, the possibility of such a misalignment trouble as shown in Fig. 2(c) is totally removed, whereby the quality of the ferrite core is stabilized.

In the present invention, the angle of inclination of the inclined grooves 24, 24 is properly determined depending upon the depth d of the magnetic gap, thickness of the core element 4 (2) in the direction of the width w , etc. In the illustrated example of Figs. 5(a) and 5(b) consisting of a combination of the C-shaped and rectangular core elements 2, 4, it is preferred that the grooves 24, 24 be cut in the direction from the rectangular core element 4 toward the C-shaped core element 2, such that the depth D of the grooves 24 as measured at the position of the magnetic gap 10 is greater than the depth d of the magnetic gap 10. The reason for this lies in that the grooves 24 having the depth D smaller than the depth d do not substantiate a stock removal of the core elements sufficient to define the effective width w of the track 18 at the magnetic gap 10.

In the ferrite magnetic head core wherein the track width is determined by the inclined grooves 24, no deep grooves are cut over the entire length of the contact surface with which a magnetic recording medium slidably contacts. That is, it is not

necessary to form a relatively high land to provide a track. Therefore, the conventionally experienced breakage or chipping of the track 18 is effectively eliminated or minimized. In addition, a mass of glass 20 in the molten phase to fill the inclined grooves 24 will not flow over the end surface of the C-shaped core element 2 (beyond the left ends of the grooves, as seen in the figures). In particular, the problem of flow of the glass 20 is more effectively solved in the case where the invention is embodied in the form of a composite magnetic head core as depicted in Figs. 6(a) and 6(b). Stated in greater detail, a composite ferrite core of Fig. 6(a) is an integral core assembly consists of a ferrite writing/reading (recording/reproducing) head core 26, and a ferrite erasing head core 28, while a composite ferrite core of Fig. 6(b) is an integral core assembly consisting of a ferrite writing head core 30, and a ferrite reading head core 32. In these composite cores, the separate cores 26 and 28, or 30 and 32 are butted together at the rectangular core elements (4), such that the inclined grooves 24 in the separate cores are closed at their ends by the surfaces of the rectangular core elements (4) or aligned with each other to cooperate to form Vee-shaped grooves, as shown in Fig. 6(b). In this condition, the bonding of the separate cores 26, 28, and 30, 32 is effected, and the molten glass 20 is poured into the grooves 24, or Vee-shaped grooves defined by the grooves 24. Accordingly, the sidewise leakage or flow of the glass 20 is substantially eliminated.

In the present invention as illustrated so far, the ferrite core assembly which consists of plural core elements and in which the inclined grooves 24 are formed, is obtained by bonding the core elements with suitable bonding glass as used in a conventional manufacturing process, and thereby forming an integral ring-shaped structure having an annular magnetic circuit. However, it is possible to form such an integral ring-shaped structure by directly bonding the core elements by means of solid-solid reaction or solid-phase reaction at the abutting surfaces of the core elements.

For example, two core elements 2, 4 made of ferrite are butted together to form a generally ring-shaped structure with a generally annular magnetic path (magnetic circuit), as shown in Fig. 7. Then, the abutting portions (surfaces) 34 of the two core elements 2, 4 are directly bonded together by means of solid-solid reaction. As a result, an ring-shaped integral assembly 36 as shown on the right-hand side of Fig. 7 is obtained with substantially no interface boundary (34) present between the two core elements. In this integral core assembly 36, a magnetic gap 10 is formed between opposed surfaces of the two core elements at one end of the assembly 36, while the two elements

define a centrally located void or opening serving as a coil-winding aperture 6 for facilitating winding of coils. Subsequently, molten glass 10 is caused to fill the magnetic gap 10 for protective purpose.

The two ferrite core elements 2, 4 are butted and bonded together through solid-solid reaction, preferably in the following manner. At first, a ferrite-dissolving acid such as hydrochloric acid, nitric acid or sulfuric acid is applied to the mutually abutting surfaces of the elements. Then, the core elements 2, 4 are butted together and heated for a suitable period of time at an elevated temperature, preferably not lower than about 1100°C, in an atmosphere whose oxygen partial pressure is equal to that of the ferrite, i.e., in the atmosphere having an equilibrated oxygen partial pressure. The application of the ferrite-dissolving acid to the abutting surfaces is intended to form salts of the ferrite component such as iron nitrate, manganese nitrate and zinc nitrate, which serve to secure the core elements 2, 4 relative to each other, and which are decomposed into oxides upon subsequent heat application. These oxides function to accelerate the solid-solid or solid-phase reaction of the core elements 2, 4, which results in the bonding of the two elements. In place of the above indicated acids, it is possible to use a solution of inorganic salt including a ferrite component, which solution produces almost the same effects and results as the above indicated acids, upon abutting bonding of the two core elements 2, 4.

The integral core assembly 36 thus prepared through abutting bonding by means of solid-solid reaction has a substantially integrated structure without a hetero-phase at the abutting portions (34). The solid-solid reaction bonding of the core elements permits substantial elimination of a rear gap or back gap (indicated at 14 in Fig. 3) which is inevitably present between the abutting portions (34) if bonded together with bonding glass as practiced in the prior art. Accordingly, the magnetic circuit is made substantially free from magnetic resistance due to the existence of such a rear gap. Thus, the present invention provides an effective measure to improvements in sensitivity and S/N ratio of the magnetic head.

While it is possible to bond the ferrite core elements 2, 4 with glass, it is preferred that the temperature at which such bonding glass becomes into a molten state be higher than the melting temperatures of glass 38, 20 which are used in the subsequent steps to fill the magnetic gap 10 and the inclined grooves 24, respectively.

Since the ferrite core elements are heated when the glass is melted by heating, usually to a temperature within a range of 600-800°C, the heating should be conducted in an atmosphere which is neutral to the ferrite, or in an atmosphere of equili-

brated oxygen partial pressure, so that the properties of the ferrite are not deteriorated by heat.

While the above illustrated specific examples are associated with the production of a single ferrite core from the core elements 2, 4, it is appreciated and advantageous, from the standpoint of production efficiency, to manufacture the ferrite cores of the invention in the manner which will be described below referring to Fig. 8.

To begin with, two elongate planar workpieces of ferrite are prepared as starting materials. These workpieces are processed to prepare an elongate block (bar) 42 of C-shaped cross section, and an elongate block (bar) 44 of rectangular cross section. Successively, these elongate blocks 42, 44 are butted together so that a magnetic gap 10 is formed between opposed end portions of the blocks 42, 44 at one end of the assembly. Then, the two blocks 42, 44 are bonded together into an elongate integral ferrite structure 40 of generally ring-shaped cross section. In the next step, the integral structure 40 is subjected to a process of forming plural inclined grooves 24 from one of the two blocks (from the rectangular block 44 in this example), so that the inclined grooves 24 are evenly spaced from each other by a predetermined distance along the length of the elongate integral structure 40. As a result, a plurality of tracks 18 defined by the inclined grooves 24 are formed in spaced-apart relation with each other in the longitudinal direction of the elongate integral structure 40.

The thus obtained elongate integral ferrite structure 40 with the grooves 24 is cut in parallel planes which are spaced from each other along the length of the structure 40 and perpendicular to the length, whereby plural ferrite cores of the same dimensions are produced. As described in greater detail, it is possible to bond two elongate ferrite structures 40 to form an elongate composite structure, which is cut in the same manner as indicated above. In this instance, plural composite ferrite cores are obtained. The cutting operation may be performed either before or after the inclined grooves 24 are filled with protective glass.

Further, a ferrite core of the invention having an annular magnetic path (circuit) may consist of three or more ferrite core elements, rather than a pair of core elements used in the illustrated embodiments. Of course, it is possible to change the shape of the individual ferrite core elements used in combination to constitute a ferrite core of the invention.

As described hitherto, the instant magnetic head core which is an integral core assembly of two or more ferrite core elements which are bonded together so as to provide a generally annular or toric magnetic circuit, is provided with a track defined by at least one groove which is formed in

the integral core assembly so as to be inclined from one of the two core elements defining a magnetic gap, toward the other. Hence, the core is easy to manufacture, simple in construction, subject to minimum breakage or chipping of the track and its vicinities, and free from relative misalignment of the core elements which cause misalignment between the two halves of the track, thereby assuring significant improvement in quality, and increased consistency in quality between the individual magnetic head cores.

Referring next to Figs. 9-12, a process of manufacturing a composite magnetic head core will be described in detail.

At first, it is noted that ferrite core elements used to form core assemblies according to the invention are made of ferrite materials such as Mn-Zn ferrite and Ni-Zn ferrite, which are selected depending upon the specific applications of the core assemblies (composite ferrite cores). As a rule, the core elements of a core assembly are made of the same ferrite materials. Further, the crystal structure of ferrite of the core elements may be a single crystal or a polycrystal, or a composite of a single crystal and a polycrystal. It is possible that the core of the invention be made from ferrite core elements of mutually different crystal structures in combination.

In this embodiment, a ferrite block of C-shaped cross section, i.e., a first core element 130, and a ferrite block of rectangular cross section, i.e., a second core element 132, are first butted together so as to close the C-shaped opening of the first core element 130 with the flat surface of the second core element 132 and thereby define a coil-winding aperture 34 between the first and second core elements 130, 132, as illustrated in Fig. 9. Mutually abutting surfaces (portions) 136 of the two core elements 130, 132 are then bonded together to form an annular magnetic path (circuit). In the meantime, a magnetic gap 138 having a predetermined width α is defined between opposed end portions of the core elements 130, 132 at their one end, such that the magnetic gap 138 is formed transversely across the annulus of the magnetic circuit. Thus, an intended elongate ferrite core assembly 140 is prepared.

The first core element 130 of C-shaped cross section is prepared by cutting a groove 128 and then forming a gap-defining surface 127, in or on an elongate rectangular ferrite block 126, as shown in the figure. The groove 128 is cut along the length of the block 126 to define the coil-winding aperture 134 in cooperation with the second core element 132. The gap-defining surface 127 is formed by removing stock from the ferrite block 126 to a suitable depth β , for example by chemical etching with an acid, or by grinding with a diamond

blade. While the C-shaped, first core element 130 is subjected to a process of forming the gap-defining surface 127, the rectangular second core element 132 may be ground or chemically etched to provide a gap-defining surface. In short, the magnetic gap 138 is defined by and formed between a pair of opposed portions of the first and second core elements 130, 132 at their one end, while another pair of opposed portions at the other end of the elements 130, 132 have the mutually abutting surfaces 136 which are bonded together so as to form the elongate integral ferrite core assembly 140 of generally ring-shaped transverse cross section.

In this process of the invention, a suitable bonding glass may be used, according to a known method, to bond the first and second ferrite core elements 130, 132 to prepare the integral ferrite core assembly 140 with a generally annular magnetic circuit. However, it is advantageous to induce solid-solid reaction at the boundary interface, i.e., at the mutually abutting surfaces 136 of the first and second core elements 130, 132 to directly bond these elements together into the ring-shaped assembly 140. This direct bonding by means of solid-solid reaction or solid-phase reaction at the abutting surfaces (136) permits the core assembly 140 to have a substantially continuous structure without a hetero-phase at the boundary interface between the first and second core elements 130, 132.

The two ferrite core elements 130, 132 are butted and bonded together through solid-solid reaction, preferably in the following manner. At first, a ferrite-dissolving acid such as hydrochloric acid, nitric acid or sulfuric acid is applied to the mutually abutting surfaces of the elements. Then, the core elements 130, 132 are butted together and heated for a suitable time at an elevated temperature, preferably not lower than about 1100°C, in an atmosphere whose oxygen partial pressure is equal to that of the ferrite, i.e., in the atmosphere having an equilibrated oxygen partial pressure. The application of the ferrite-dissolving acid to the abutting surfaces is intended to form salts of the ferrite component such as iron nitrate, manganese nitrate and zinc nitrate, which serve to secure the core elements 30, 32 relative to each other, and which are decomposed into oxides upon subsequent heat application. These oxides function to accelerate the solid-solid or solid-phase reaction of the core elements 130, 132 which results in the bonding of the two elements. The above indicated acids may be replaced by a solution of inorganic salt including a ferrite component, which solution produces almost the same effects and results as the above indicated acids, upon abutting bonding of the two core elements 130, 132.

In the integral ferrite core assembly 140 which is prepared by directly bonding the first and second core elements 130, 132 by means of solid-solid reaction, there is found no hetero phase at the boundary interface (136), that is, each one of the core elements is a substantially integral part of the other. Unlike the bonding of the core elements 130, 132 with bonding glass, the direct solid-solid reaction bonding thereof permits substantial elimination of a rear or back gap which is inevitably present between the rear opposed portions of the core elements 130, 132 if bonded together with glass. Accordingly, the magnetic circuit is made substantially free from magnetic resistance due to the existence of such a rear gap. Thus, the sensitivity and S/N ratio of the magnetic head are improved.

In the case where the ferrite core elements 130, 132 are bonded directly by means of solid-solid reaction, the gap-defining surface 127 must be subjected to a stock removal to a depth β as previously stated, before the two core elements are assembled in abutting relation.

When the ferrite core elements 130, 132 are bonded with glass as previously indicated, a spacer of an appropriate thickness β is formed, as with a sputtering method, on the gap-defining surface 127 on the C-shaped first or rectangular second core element 130 or 132, and then the two core elements are bonded together with suitable glass such that the magnetic gap 110 of a width β is formed between the gap-defining surfaces 127 of the two core elements. The magnetic gap 110 is filled with glass, as described later, after the core elements 130, 132 are bonded with glass. Since the glass bonding the two core elements is heated when later described inclined grooves for defining tracks are filled with glass, the temperature at which the bonding glass becomes into a molten state should preferably be higher than the melting temperature of the glass used to fill the inclined grooves.

As the ferrite core elements 130, 132 are heated when the glass is melted usually at a temperature of 600-900°C, the heating should be conducted in an atmosphere which is neutral to the ferrite material, or in an atmosphere of equilibrated oxygen partial pressure, so that the properties of the ferrite will not be deteriorated by heat.

In the next step, a glass rod 142 is inserted into the coil-winding aperture 134 in the elongate integral ferrite core assembly 140 in order to fill the magnetic gap 138. The glass rod 142 is located above the magnetic gap 138, and then heated so that the magnetic gap 138 is filled with molten glass to protect the gap during the subsequent steps of manufacture and during the service of the product.

Successively, inclined grooves 146 are formed in the thus prepared ferrite core assembly 140, in

parallel with each other, such that the grooves 146 are evenly spaced from each other at predetermined intervals (equal to the width of tracks 150 which will be described) in the direction along the length of the assembly 140, as shown in Fig. 10. The grooves 146 are cut in a corner portion of the assembly 140 in the vicinity of the magnetic gap 138, more precisely, in the opposed portions of the core elements 130, 132 that define the magnetic gap 138 and provide contact surfaces 148 on which a magnetic recording medium is moved in sliding contact. More specifically stated, the grooves 146 are formed in the direction from the portion of the rectangular second core element 132 on one side of the magnetic gap 138 toward the portion of the C-shaped first core element 130 on the other side of the magnetic gap 138, so that the bottom of the inclined grooves 146 is inclined with its depth decreasing toward the first core element 130. Each of the inclined grooves 146 is open at one end thereof in the side end surface of the second core element 132, and at the other end in the top surface of the first core element 130, i.e., in the contact surface 148.

The inclined grooves 146 cut in the corner portion of the ferrite core assembly 140 in the vicinity of the magnetic gap 138, serve to define the parallel tracks 150 which extend over a suitable distance between the first and second core elements 130, 132. As is apparent from the above description, each of the inclined grooves 146 is cut at one time in both of the opposed portions of the two core elements 130, 132 of the integral core assembly 140, there arises no problem of misalignment between the two halves of the tracks 150 on the respective core elements 130, 132.

It is noted that the depth D of each inclined groove 146 at the position of the magnetic gap 138 should be greater than the depth d of the magnetic gap 138, as shown in Fig. 11. The reason for this lies in that the grooves 124 having the depth D smaller than the depth d do not substantiate a stock removal of the core elements sufficient to determine the effective width w of the track 150 at the magnetic gap 138. The angle of inclination of the inclined grooves 146 is suitably selected depending upon the depth d of the magnetic gap 138, thickness of the second core element 132 (thickness of the magnetic circuit), etc.

According to the instant process, an intended composite magnetic head core is produced by using the two ferrite core assemblies 140 which are provided with the inclined grooves 146. In more detail, the two ferrite core assemblies 140 having a predetermined pattern of the inclined grooves 146, i.e., pattern of tracks 150, are butted together so that the rectangular second core elements 132 face each other with a suitable clearance 152 there-

between. This clearance 152 between the two core assemblies 140 is left to accommodate a layer of bonding glass, and usually held within a range of about 10-500 microns. When the two core assemblies 140 are butted together, they are positioned such that the inclined grooves 146 in one assembly 140 are held in a predetermined positional relation with those in the other assembly 140. In the embodiment of Fig. 10, the grooves 146 and consequently the tracks 150 of the two core assemblies 140 are completely aligned, so that individual composite cores obtained from the assembly of the two core assemblies 140 take the form of a composite core 158 illustrated in Fig. 12(a). Alternatively, the two core assemblies 140 may be assembled so as to obtain a composite core 168 consisting of a ferrite writing/reading head core 164 and a ferrite erasing head core 166 as shown in Fig. 12(b). In this instance, the inclined grooves 146 of the erasing head core 166 are disposed in a zigzag fashion with respect to the inclined grooves 146 of the writing/reading core 164.

After the two ferrite core assemblies 140, 140 are butted together as described above, a block of glass 154 is placed over the inclined grooves 146, and heated and melted so that the molten glass 154 is poured into the grooves 146 and further into the clearance 152 between the two core assemblies 140, 140. Thus, the bonding of the two core assemblies is achieved concurrently with the filling of the grooves 146 with the glass.

Thus, an elongate composite core structure 156 is prepared by bonding of the two core assemblies 140, 140. The elongate structure 156 is cut with a suitable means such as a diamond cutter, in parallel planes which are perpendicular to, and spaced from each other along, the length of the structure 156, as needed. More particularly, the elongate structure 156 is cut into plural composite magnetic head cores 158 each of which includes at least one track 150 for magnetic association with a magnetic recording medium. The composite core 158 shown in Fig. 10 is a combination of a writing core head 160 and a reading head core 162.

The contact surfaces 148 of the composite core 158 in which the magnetic gaps 138 are formed, in other words, the top surface of the composite core 158, is finished as illustrated in Fig. 12(a), to a desired profile, usually to a convex shape of a suitable curvature, for effective and smooth sliding contact with the recording medium. An alternative form of a composite magnetic head core produced according to the invention is indicated at 168 in Fig. 12(b). This composite core 168 is a combination of the writing/reading head core 164 and the erasing head core 166 as previously indicated. The composite core 168 is produced in the same manner as the composite core

158.

While the process of the invention has been described in detail referring to the specific examples of Figs. 9 and 10, it is more advantageous to simultaneously prepare two elongate ferrite core assemblies in the manner as illustrated in Fig. 13.

In the figure, numerals 170, 172 designate rectangular plates of ferrite having dimensions sufficient to provide two C-shaped portions, and corresponding two rectangular portions, respectively. Two parallel grooves 174 for defining coil-winding apertures are cut in one of the opposite surfaces of the ferrite plate 170 along the length, in symmetric relation with each other, whereby a first ferrite member 178 having two symmetric C-shaped portions 176 is prepared.

In the meantime, two partition grooves 182 are cut in a middle portion of the other ferrite plate 172 so as to define a central protrusion 180 therebetween. Further, two auxiliary recesses 184 are formed parallel to the partition grooves 182. The partition grooves 182 and the auxiliary recesses 184 cooperate to define two parallel protrusions 186, which are subjected to a stock-removing process to remove a predetermined amount (β) of stock necessary to define a magnetic gap. These protrusions 186 serve as gap-defining surfaces. Thus, a second ferrite member 190 is formed with two rectangular portions 188 corresponding to the C-shaped portions 176.

The two ferrite members 178 and 190 are butted together as shown in Fig. 14, such that the central protrusion 180 of the second ferrite member 190 abuts on the first ferrite member 178, whereby magnetic gaps equal to the stock removal β are formed between the first ferrite member 178 and the protrusions (gap-defining surfaces) 186 adjacent to the partition grooves 182. The two ferrite members 178, 190 in abutting contact with each other are then bonded together, preferably by means of solid-solid reaction of the mutually abutting portions under heat. In this manner, an elongate integral twin-core assembly 190 is prepared, which includes two symmetrical magnetic circuits. The magnetic gaps in this twin-core assembly 190 are filled with glass 194.

Subsequently, the twin-core assembly 190 with the magnetic gaps filled with the glass 194 is cut into two halves along the central protrusion 180. These two halves correspond to the ferrite core assemblies 140, 140 of Fig. 10. These core assemblies 140, 140 are then subjected to a step of cutting inclined grooves 196 in the previously described manner, and bonded together into an elongate composite core structure 198 as shown in Fig. 13.

In the thus prepared composite core structure 198, the inclined grooves 196 in one of the core

assembly 140 are disposed in a staggered relation with respect to those in the other core assembly 140, so that each of composite magnetic head cores to be obtained from the composite core structure 198 consists of a writing/reading head core and an erasing head core, as shown in Fig. 12(b). These composite magnetic head cores are finally produced by cutting the elongate composite core structure 190 in parallel planes perpendicular to its length.

As described above, the instant process of Fig. 13 permits simultaneous preparation of the two elongate ferrite core assemblies 140, 140 which are bonded together into the elongate composite core structure 198, which in turn is cut into the intended composite magnetic head cores.

Claims

1. A magnetic head core of generally ring-shaped structure consisting of a plurality of core elements of ferrite (2,4) having a coil-winding aperture (6) and forming a generally annular magnetic circuit, wherein a magnetic gap (10) of a predetermined width (w) and predetermined depth (d) is formed transversely across the annulus of the magnetic circuit, and wherein at least one track (18) of a suitable width for sliding contact with a magnetic recording medium is defined by at least one groove (24) which is formed in opposed portions of the core elements (2,4) defining the magnetic gap (10), the bottom of said groove or grooves (24) being inclined in the direction from one of said opposed portions toward the other and its depth (D) at the position of said magnetic gap being greater than the depth (d) of said magnetic gap.
2. A magnetic head core according to claim 1, wherein said magnetic circuit consists of two said core elements (2,4), said magnetic gap (10) being defined by and formed between the opposed portions of said two core elements at first ends thereof, the two core elements being butted together at the other ends thereof so as to form said coil-winding aperture and bonded together into an integral core assembly.
3. A magnetic head core according to claim 1 or claim 2, wherein said plural core elements (2,4) are directly bonded together at mutually abutting surfaces by means of solid-solid reaction.
4. A magnetic head core according to any one of claims 1 to 3 having a single said groove (24) formed in the middle of said opposed portions as viewed in the width direction of the track or tracks, said single groove defining two tracks on its opposite sides.
5. A magnetic head core according to any one of claims 1 to 3 having two said grooves (24) respectively on opposite sides of a single middle track.
6. A process of manufacturing a magnetic head core of generally ring-shaped structure consisting of two core elements (2,4) of ferrite, having a coil-winding aperture (6) and forming a generally annular magnetic circuit, there being a magnetic gap (10) formed transversely across the annulus of the magnetic circuit, and at least one track (18) of suitable width for sliding contact with a magnetic recording medium defined by at least one groove (24) formed in opposed end portions of said two core elements which define the magnetic gap, wherein the process comprises the steps of:-
bonding said two core elements (2,4) into a generally ring-shaped integral assembly having said generally annular magnetic circuit; and
forming said groove or grooves (24) in said generally ring-shaped integral assembly such that the bottom of the or each groove is inclined from one of said opposed portions toward the other and such that a depth (D) of the or each groove (24) at the position of said magnetic gap (10) is greater than the depth (d) of said magnetic gap.
7. A process according to claim 6, wherein a single said groove (24) of the head core is formed in the middle of said opposed portions as viewed in the width direction of the said track or tracks, said single groove defining two tracks on its opposite sides.
8. A process according to claim 6, wherein two said grooves (24) of the head core are formed on both sides of a single central track.
9. A process according to any one of claims 6 to 8 wherein a plurality of magnetic head cores are formed simultaneously, said two core elements are two elongate core blocks (42,44;130,132;178,190) of ferrite which are bonded together into an elongate integral ferrite structure (140), and a plurality of said grooves (146;196) are cut transversely in said elongate integral ferrite structure at predetermined intervals along the length thereof, whereafter said elongate integral ferrite structure is cut at parallel transverse planes spaced along its length.



assembly 140 are disposed in a staggered relation with respect to those in the other core assembly 140, so that each of composite magnetic head cores to be obtained from the composite core structure 198 consists of a writing/reading head core and an erasing head core, as shown in Fig. 12(b). These composite magnetic head cores are finally produced by cutting the elongate composite core structure 190 in parallel planes perpendicular to its length.

As described above, the instant process of Fig. 13 permits simultaneous preparation of the two elongate ferrite core assemblies 140, 140 which are bonded together into the elongate composite core structure 198, which in turn is cut into the intended composite magnetic head cores.

Claims

1. A magnetic head core of generally ring-shaped structure consisting of a plurality of core elements of ferrite (2,4) having a coil-winding aperture (6) and forming a generally annular magnetic circuit, wherein a magnetic gap (10) of a predetermined width (w) and predetermined depth (d) is formed transversely across the annulus of the magnetic circuit, and wherein at least one track (18) of a suitable width for sliding contact with a magnetic recording medium is defined by at least one groove (24) which is formed in opposed portions of the core elements (2,4) defining the magnetic gap (10), the bottom of said groove or grooves (24) being inclined in the direction from one of said opposed portions toward the other and its depth (D) at the position of said magnetic gap being greater than the depth (d) of said magnetic gap.
2. A magnetic head core according to claim 1, wherein said magnetic circuit consists of two said core elements (2,4), said magnetic gap (10) being defined by and formed between the opposed portions of said two core elements at first ends thereof, the two core elements being butted together at the other ends thereof so as to form said coil-winding aperture and bonded together into an integral core assembly.
3. A magnetic head core according to claim 1 or claim 2, wherein said plural core elements (2,4) are directly bonded together at mutually abutting surfaces by means of solid-solid reaction.
4. A magnetic head core according to any one of claims 1 to 3 having a single said groove (24) formed in the middle of said opposed portions as viewed in the width direction of the track or tracks, said single groove defining two tracks on its opposite sides.
5. A magnetic head core according to any one of claims 1 to 3 having two said grooves (24) respectively on opposite sides of a single middle track.
6. A process of manufacturing a magnetic head core of generally ring-shaped structure consisting of two core elements (2,4) of ferrite, having a coil-winding aperture (6) and forming a generally annular magnetic circuit, there being a magnetic gap (10) formed transversely across the annulus of the magnetic circuit, and at least one track (18) of suitable width for sliding contact with a magnetic recording medium defined by at least one groove (24) formed in opposed end portions of said two core elements which define the magnetic gap, wherein the process comprises the steps of:-
bonding said two core elements (2,4) into a generally ring-shaped integral assembly having said generally annular magnetic circuit; and
forming said groove or grooves (24) in said generally ring-shaped integral assembly such that the bottom of the or each groove is inclined from one of said opposed portions toward the other and such that a depth (D) of the or each groove (24) at the position of said magnetic gap (10) is greater than the depth (d) of said magnetic gap.
7. A process according to claim 6, wherein a single said groove (24) of the head core is formed in the middle of said opposed portions as viewed in the width direction of the said track or tracks, said single groove defining two tracks on its opposite sides.
8. A process according to claim 6, wherein two said grooves (24) of the head core are formed on both sides of a single central track.
9. A process according to any one of claims 6 to 8 wherein a plurality of magnetic head cores are formed simultaneously, said two core elements are two elongate core blocks (42,44;130,132;178,190) of ferrite which are bonded together into an elongate integral ferrite structure (140), and a plurality of said grooves (146;196) are cut transversely in said elongate integral ferrite structure at predetermined intervals along the length thereof, whereafter said elongate integral ferrite structure is cut at parallel transverse planes spaced along its length.



10. A process of manufacturing a composite magnetic head core, which comprises the steps of:

(a) butting and bonding together a first core element (130;178) of ferrite having a portion of C-shaped section, and a second core element (132;190) of ferrite having a portion of rectangular section, so as to close the recess (128;174) of the C-shaped section by the rectangular section, and thereby forming a first integral core assembly with a generally annular magnetic circuit which has a coil-winding aperture (134) defined by and between the first and second core elements and a magnetic gap (138) of a predetermined width (w) and a predetermined depth (d) defined by opposed end portions of the first and second core elements at one end of the first integral core assembly and formed transversely across the annulus of the magnetic circuit, said opposed end portions providing contact surfaces on which a magnetic recording medium is moved in sliding contact;

(b) cutting at least one inclined groove (146;196) in the opposed end portions of the first and second core elements to define the width of at least one track for sliding contact with said magnetic recording medium, said at least one inclined groove being formed in the direction from one of said opposed portions which corresponds to the second core element, toward the other corresponding to the first core element, such that the bottom of the inclined groove is inclined with its depth decreasing toward the first core element and such that a depth (D) of the inclined groove at the position of said magnetic gap is greater than the depth of the magnetic gap;

(c) preparing a second integral core assembly with at least one inclined groove (146;196) by the above steps (a) and (b), and butting together the first and second integral core assemblies at the second core elements thereof with a predetermined clearance left therebetween so that said groove or grooves in the first integral core assembly are kept in predetermined positional relation with said groove or grooves in the second integral core assembly in the direction along the length of said at least one track; and

(d) placing a glass material over the inclined grooves, melting the glass material to fill said inclined grooves with molten glass, and concurrently fill said clearance with molten glass to bond the first and second integral core assemblies into the composite mag-

netic head core.

11. A process according to claim 10 wherein said first and second core elements (128,130;178,190) are directly bonded together by means of solid-solid reaction into the core assembly with the generally annular magnetic circuit.

12. A process according to claim 11, wherein said magnetic gap in the integral core assembly is filled with a glass material before said inclined groove or grooves are cut.

13. A process according to claim 10, wherein, in order to form a plurality of magnetic head cores simultaneously, each of said first core elements (130) of the first and second integral core assemblies is an elongate ferrite block having a portion of C-shaped transverse cross-section, and each of said second core elements (132) of the first and second integral core assemblies is an elongate ferrite block having a portion of rectangular transverse cross-section, said first and second elongate ferrite blocks of the first integral core assembly being bonded together into a first elongate integral core assembly (140), said first and second elongate ferrite blocks of the second integral core assembly being bonded together into a second elongate integral core assembly (140), said first and second elongate integral core assemblies being bonded together into an elongate integral composite core structure (156) which is thereafter cut at spaced parallel planes which are perpendicular to the length of said elongate integral composite core structure.

14. A process according to claim 10, wherein said first core elements of the first and second integral core assemblies are constituted by a first ferrite member (178) having a first and a second portion of C-shaped section symmetrical with each other, and said second core elements of the first and second integral core assemblies are constituted by a second ferrite member (190) having a first and a second portion of rectangular section symmetrical with each other, said first and second elongate ferrite members (178,190) being bonded together into an integral twin-core structure (192) wherein said first C-shaped portion cooperates with said first rectangular portion to form a first generally annular magnetic circuit, while said second C-shaped portion cooperates with said second rectangular portion to form a second generally annular magnetic circuit symmetrical



with said first magnetic circuit, said integral twin-core structure being thereafter cut into two integral core assemblies (140) having said first and second magnetic circuits, respectively.

15. A process according to claim 14, wherein said first and second ferrite members (178,190) are elongate ferrite members which are bonded together into an elongate integral twin-core structure (192), said elongate integral twin-core structure being thereafter cut into two elongate integral core assemblies (140).

16. A process according to claim 15 wherein said two elongate integral core assemblies (140) are butted together at said first and second rectangular portions and bonded together into an elongate integral composite core structure (198), said elongate integral composite core structure being thereafter cut at spaced parallel planes which are perpendicular to its length.

Revendications

1. Noyau de tête magnétique de structure en forme générale d'anneau, consistant en une pluralité d'éléments de noyau de ferrite (2, 4) ayant une ouverture d'enroulement de bobine (6) et formant un circuit magnétique de forme générale annulaire, dans lequel un vide magnétique (10) d'une largeur prédéterminée (w) et d'une profondeur prédéterminée (d) est formé transversalement à travers l'anneau du circuit magnétique, et dans lequel au moins une piste (18) d'une largeur appropriée pour un contact coulissant avec un moyen d'enregistrement magnétique est définie par au moins une rainure (24) qui est formée dans les parties opposées des éléments de noyau (2, 4) définissant le vide magnétique (10), le fond de ladite rainure ou bien des rainures (24) étant incliné dans la direction à partir de l'une desdites parties opposées en direction de l'autre et sa profondeur (D) à la position dudit vide magnétique étant plus grande que la profondeur (d) dudit vide magnétique.
2. Noyau de tête magnétique selon la revendication 1, dans lequel ledit circuit magnétique consiste en les deux éléments de noyau (2, 4), ledit vide magnétique (10) étant défini par et formé entre les parties opposées des deux éléments de noyau à leurs premières extrémités, les deux éléments de noyau étant aboutés l'un par rapport à l'autre à leurs autres extrémités de façon à former ladite ouverture d'enroulement de bobine et reliés ensemble en un assemblage de noyau intégral.
3. Noyau de tête magnétique selon la revendication 1 ou 2, dans lequel ladite pluralité d'éléments de noyau (2, 4) sont directement reliés ensemble aux surfaces d'aboutement de l'une par rapport à l'autre au moyen d'une réaction solide-solide.
4. Noyau de tête magnétique selon l'une quelconque des revendications 1 à 3, comportant une unique rainure (24) formée dans le milieu desdites parties opposées lorsque vu dans la direction de la largeur de la piste ou bien des pistes, ladite rainure unique définissant deux pistes sur ses côtés opposés.
5. Noyau de tête magnétique selon l'une quelconque des revendications 1 à 3, ayant deux rainures (24) respectivement sur les côtés opposés d'une unique piste médiane.
6. Procédé de fabrication d'un noyau de tête magnétique de structure en forme générale d'anneau consistant en deux éléments de noyau (2, 4) de ferrite, ayant une ouverture d'enroulement de bobine (6) et formant un circuit magnétique de forme générale annulaire, se trouvant un vide magnétique (10) formé transversalement à travers l'anneau du circuit magnétique, et au moins une piste (18) de largeur appropriée pour un contact coulissant avec un moyen d'enregistrement magnétique défini par au moins une rainure (24) formée dans les parties d'extrémité opposées desdits deux éléments de noyau qui définissent le vide magnétique, dans lequel le procédé comprend les étapes de :
 - liaison desdits deux éléments de noyau (2, 4) en un assemblage intégral en forme générale d'anneau comportant ledit circuit magnétique de forme générale annulaire; et
 - formation de ladite ou desdites rainure(s) (24) dans ledit assemblage intégral en forme générale d'anneau, de sorte que le fond de la ou de chaque rainure soit incliné à partir de l'une desdites parties opposées en direction de l'autre et de telle façon qu'une profondeur (D) de la ou bien de chaque rainure (24) à la position dudit vide magnétique (10) soit plus grande que la profondeur (d) dudit vide magnétique.
7. Procédé selon la revendication 6, dans lequel une unique rainure (24) du noyau de tête est formée dans le milieu desdites parties opposées, lorsque vu dans la direction de la largeur de ladite piste ou bien desdites pistes, ladite



rainure unique définissant deux pistes sur ses côtés opposés.

8. Procédé selon la revendication 6, dans lequel deux rainures (24) du noyau de tête sont formées sur les deux côtés d'une piste centrale unique.

9. Procédé selon l'une quelconque des revendications 6 à 8, dans lequel une pluralité de noyaux de têtes magnétiques sont formés simultanément, lesdits deux éléments de noyau sont deux blocs de noyau allongés (42,44;130,132; 178,190) de ferrite qui sont reliés ensemble en une structure de ferrite intégrale et allongée (140), et une pluralité desdites rainures (146;196) sont découpées transversalement dans ladite structure de ferrite intégrale et allongée à des intervalles prédéterminés le long de sa longueur, après quoi ladite structure allongée de ferrite intégrale est découpée en des plans parallèles transversaux espacés le long de sa longueur.

10. Procédé de fabrication d'un noyau de tête magnétique composite, qui comprend les étapes consistant à :

(a) abouter et relier ensemble un premier élément de noyau (130;178) de ferrite ayant une partie de section en forme de C, et un second élément de noyau (130;190) de ferrite ayant une partie de section rectangulaire, de façon à fermer l'évidement (128;174) de la section en forme de C par la section rectangulaire, et de ce fait former un premier assemblage de noyau intégral avec un circuit magnétique de forme générale annulaire qui comporte une ouverture d'enroulement de bobine (134) définie par, et entre les premier et second éléments de noyau et un vide magnétique (138) d'une largeur prédéterminée (w) et d'une profondeur prédéterminée (d) défini par les parties d'extrémité opposées des premier et second éléments de noyau à une extrémité du premier assemblage de noyau intégrale et formé transversalement à travers l'anneau du circuit magnétique, lesdites parties d'extrémité opposées procurant les surfaces de contact sur lesquelles un moyen d'enregistrement magnétique est déplacé en contact coulissant;

(b) découper au moins une rainure inclinée (146;196) dans les parties d'extrémité opposées des premier et second éléments de noyaux pour définir la largeur d'au moins une piste pour un contact coulissant avec ledit moyen d'enregistrement magnétique,

ladite au moins une rainure inclinée étant formée dans la direction à partir d'une desdites parties opposées qui correspond au second élément de noyau, en direction de l'autre correspondant au premier élément de noyau, de façon que le fond de la rainure inclinée soit incliné avec sa profondeur décroissant en direction du premier élément de noyau et de façon qu'une profondeur (D) de la rainure inclinée à la position dudit vide magnétique soit plus grande que la profondeur du vide magnétique;

(c) préparer un second assemblage de noyau intégral avec au moins une rainure inclinée (146;196) par les étapes ci-dessus (a) et (b), et abouter ensemble les premier et second assemblages de noyau intégraux à leurs seconds éléments de noyau avec un évidement prédéterminé autorisé entre, de sorte que ladite rainure ou bien les rainures dans le premier assemblage de noyau intégral sont maintenues dans une relation positionnelle prédéterminée avec ladite rainure ou bien lesdites rainures dans le second assemblage de noyau intégral dans la direction de la longueur de ladite au moins une piste; et

(d) placer un matériau de verre au-dessus des rainures inclinées, fondre le matériau de verre pour remplir lesdites rainures inclinées avec du verre fondu, et concouramment remplir ledit évidement avec du verre fondu pour relier les premier et second assemblages de noyau intégraux en le noyau de tête magnétique composite.

11. Procédé selon la revendication 10, dans lequel lesdits premier et second éléments de noyau (128,130; 178;190) sont directement reliés ensemble au moyen d'une réaction solide-solide en l'assemblage de noyau avec le circuit magnétique de forme générale annulaire.

12. Procédé selon la revendication 11, dans lequel ledit vide magnétique dans l'assemblage de noyau intégral est rempli avec un matériau de verre avant que ladite ou lesdites rainures inclinées ou bien lesdites rainures soient découpées.

13. Procédé selon la revendication 10, dans lequel de façon à former une pluralité de noyaux de têtes magnétiques simultanément, chacun desdits premiers éléments de noyau (130) des premier et second assemblages de noyau intégraux est un bloc de ferrite allongé comportant une partie de section transversale en forme de C, et chacun desdits seconds éléments de



noyau (132) des premier et second assemblages de noyau intégraux est un bloc de ferrite allongé ayant une partie de section transversale rectangulaire, lesdits premier et second blocs de ferrite allongés du premier assemblage de noyau intégral étant reliés ensemble en un premier assemblage de noyau intégral allongé (140), lesdits premier et second blocs de ferrite allongés du second assemblage de noyau intégral étant reliés ensemble en un second assemblage de noyau intégral allongé (140), lesdits premier et second assemblages de noyau intégraux et allongés étant reliés ensemble en une structure de noyau composite intégrale allongée (156) qui est après ceci découpée en des plans parallèles espacés qui sont perpendiculaires à la longueur de ladite structure de noyau composite intégrale allongée.

14. Procédé selon la revendication 10, dans lequel lesdits premiers éléments de noyau des premier et second assemblages de noyau intégraux sont constitués par un premier membre de ferrite (178) ayant une première et une seconde parties de section en forme de C symétriques l'une par rapport à l'autre, et lesdits seconds éléments de noyau des premier et second assemblages de noyau intégraux sont constitués par un second membre de ferrite (190) ayant une première et une seconde parties de section rectangulaire symétriques l'une par rapport à l'autre, lesdits premier et second membres de ferrite allongés (178,190) étant reliés ensemble en une structure à double noyau intégrale (192) dans laquelle ladite première partie en forme de C coopère avec ladite première partie rectangulaire pour former un premier circuit magnétique de forme générale annulaire, tandis que ladite seconde partie en forme de C coopère avec ladite seconde partie rectangulaire pour former un second circuit magnétique de forme générale annulaire symétrique par rapport audit premier circuit magnétique, ladite structure à double noyau intégrale étant après ceci découpée en deux assemblages de noyau intégraux (140) ayant lesdits premier et second circuits magnétiques, respectivement.

15. Procédé selon la revendication 14, dans lequel lesdits premier et second membres de ferrite (178,190) sont des membres de ferrite allongés qui sont reliés ensemble en une structure à double noyau intégrale allongée (192), ladite structure à double noyau intégrale allongée étant après ceci découpée en deux assemblages de noyau intégraux allongés (140).

16. Procédé selon la revendication 15, dans lequel lesdits deux assemblages de noyau intégraux allongés (140) sont aboutés l'un avec l'autre aux première et seconde parties rectangulaires et reliés ensemble en une structure de noyau composite intégrale allongée (198), ladite structure de noyau composite intégrale et allongée étant après ceci découpée en des plans parallèles espacés, qui sont perpendiculaires à sa longueur.

Patentansprüche

1. Magnetkopfkern von im allgemeinen ringförmiger Struktur, der aus einer Vielzahl von Kernelementen (2,4) aus Ferrit mit einer Spulenumwicklungsöffnung (6) besteht und einen im allgemeinen ringförmigen Magnetkreis bildet, worin ein Magnetspalt (10) von vorgegebener Breite (w) und vorgegebener Tiefe (d) quer durch den Ringraum des Magnetkreises gebildet wird und worin wenigstens eine Spur (18) von geeigneter Breite für einen Gleitkontakt mit einem Magnetaufzeichnungsmedium von wenigstens einer Nut (24) definiert bzw. begrenzt wird, die in gegenüberliegenden Abschnitten der Kernelemente (2,4) ausgebildet ist, die den Magnetspalt (10) begrenzen, wobei der Boden der genannten Nut(en) (24) in Richtung von einem der genannten gegenüberliegenden Abschnitte auf den anderen zu geneigt ist und seine Tiefe (D) an der Position des genannten Magnetspaltes größer ist als die Tiefe (d) des genannten Magnetspaltes.
2. Magnetkopfkern nach Anspruch 1, worin der genannte Magnetkreis aus zwei der genannten Kernelemente (2,4) besteht, der genannte Magnetspalt (10) zwischen den gegenüberliegenden Abschnitten der genannten beiden Kernelemente an ersten Enden derselben gebildet und von diesen begrenzt wird und die beiden Kernelemente an deren anderen Enden aneinandergesetzt sind, um die genannte Spulenumwicklungsöffnung zu bilden und aneinander gebunden sind, um eine einstückige Kernanordnung zu bilden.
3. Magnetkopfkern nach Anspruch 1 oder 2, worin die genannten mehrfachen Kernelemente (2,4) direkt an gegenseitig anliegenden Oberflächen mittels einer Festkörper-Festkörper-Reaktion aneinander gebunden sind.
4. Magnetkopfkern nach einem der Ansprüche 1 bis 3, mit einer einzelnen genannten Nut (24), die in der Mitte der genannten gegenüberliegenden Abschnitte betrachtet in der Breiten-



richtung der Spur(en) ausgebildet ist, wobei die genannte einzelne Nut zwei Spuren an ihren gegenüberliegenden Seiten begrenzt.

5. Magnetkopfkern nach einem der Ansprüche 1 bis 3 mit zwei der genannten Nuten (24) jeweils auf gegenüberliegenden Seiten einer einzelnen Mittelspur.

6. Verfahren zur Herstellung eines Magnetkopfkernes von im allgemeinen ringförmiger Struktur, der aus zwei Kernelementen (2,4) aus Ferrit besteht, eine Spulenwicklungsöffnung (6) aufweist und einen im allgemeinen ringförmigen Magnetkreis bildet, wobei ein Magnetspalt (10) quer durch den Ringraum des Magnetkreises ausgebildet ist und wenigstens eine Spur (18) von geeigneter Breite für den Gleitkontakt mit einem Magnetaufzeichnungsmedium von wenigstens einer Nut (24) begrenzt wird, die in gegenüberliegenden Endabschnitten der genannten beiden Kernelemente ausgebildet ist, die den Magnetspalt begrenzen, worin das Verfahren folgende Schritte umfaßt:

Binden der genannten beiden Kernelemente (2,4) zu einer im allgemeinen ringförmigen, einstückigen Anordnung, die den genannten im allgemeinen ringförmigen Magnetkreis aufweist; und

Ausbilden der genannten Nut(en) (24) in der genannten im allgemeinen ringförmigen einstückigen Anordnung auf solche Weise, daß der Boden der oder jeder Nut von einem der genannten gegenüberliegenden Abschnitte auf den anderen zu geneigt ist und daß eine Tiefe (D) der oder jeder Nut (24) an der Position des genannten Magnetspaltes (10) größer ist als die Tiefe (d) des genannten Magnetspaltes.

7. Verfahren nach Anspruch 6, worin eine einzelne genannte Nut (24) des Kopfkernes in der Mitte der genannten gegenüberliegenden Abschnitte betrachtet in der Breitenrichtung der genannten Spur(en) ausgebildet wird und die genannte einzelne Nut zwei Spuren auf ihren gegenüberliegenden Seiten begrenzt.

8. Verfahren nach Anspruch 6, worin zwei der genannten Nuten (24) des Kopfkernes auf beiden Seiten einer einzelnen zentralen Spur ausgebildet werden.

9. Verfahren nach einem der Ansprüche 6 bis 8, worin eine Vielzahl von Magnetkopfkernen gleichzeitig ausgebildet wird, die beiden genannten Kernelemente zwei langgestreckte

Kernblöcke (42, 44; 130, 132; 178, 190) aus Ferrit sind, die aneinander zu einer langgestreckten einstückigen Ferritstruktur (140) gebunden sind und eine Vielzahl der genannten Nuten (146; 196) in Querrichtung in die genannte langgestreckte einstückige Ferritstruktur in vorgegebenen Abständen entlang der Länge derselben eingeschnitten sind, worauf die genannte langgestreckte einstückige Ferritstruktur in parallelen Querebenen geschnitten wird, die im Abstand entlang ihrer Länge angeordnet sind.

10. Verfahren zur Herstellung eines Verbund-Magnetkopfkernes, das folgende Schritte umfaßt:

(a) Aneinanderlegen und Aneinanderbinden eines ersten Kernelementes (130; 178) aus Ferrit mit einem Abschnitt von C-förmigem Querschnitt und eines zweiten Kernelementes (132; 190) aus Ferrit mit einem Abschnitt von rechteckigem Querschnitt, um die Ausnehmung (128; 174) des C-förmigen Querschnittes durch den rechteckigen Querschnitt zu verschließen und dadurch eine erste einstückige Kernanordnung mit einem im allgemeinen ringförmigen Magnetkreis zu bilden, der eine Spulenwicklungsöffnung (134) aufweist, die durch die und zwischen den ersten und zweiten Kernelementen begrenzt ist und einen Magnetspalt (138) von einer vorgegebenen Breite (w) und einer vorgegebenen Tiefe (d) bildet, der von gegenüberliegenden Endabschnitten der ersten und zweiten Kernelemente an einem Ende der ersten einstückigen Kernanordnung begrenzt wird und quer durch den Ringraum des Magnetkreises ausgebildet ist, wobei die genannten gegenüberliegenden Endabschnitte Kontaktflächen schaffen, auf denen ein Magnetaufzeichnungsmedium in Gleitkontakt bewegt wird;

(b) Schneiden wenigstens einer geneigten Nut (146; 196) in die gegenüberliegenden Endabschnitte der ersten und zweiten Kernelemente, um die Breite wenigstens einer Spur für den Gleitkontakt mit dem genannten Magnetaufzeichnungsmedium zu begrenzen, wobei die genannte wenigstens eine geneigte Nut in Richtung von einem der genannten gegenüberliegenden Abschnitte, der dem zweiten Kernelement entspricht, auf den anderen Abschnitt zu ausgebildet ist, der dem ersten Kernelement entspricht, sodaß der Boden der geneigten Nut so geneigt ist, daß seine Tiefe auf das erste Kernelement zu abnimmt und daß eine Tiefe (D) der geneigten Nut an der Position des genannten Magnetspaltes grö-



ßer ist als die Tiefe des Magnetspaltes;

(c) Herstellen einer zweiten einstückigen Kernanordnung mit wenigstens einer geneigten Nut (146;196) nach den vorstehenden Schritten (a) und (b) und Aneinanderlegen der ersten und zweiten einstückigen Kernanordnungen an den zweiten Kernelementen derselben, wobei ein vorgegebener Freiraum zwischen ihnen freigelassen wird, sodaß die genannte(n) Nut(en) in der ersten einstückigen Kernanordnung in einem vorgegebenen Positionsverhältnis mit der (den) genannten Nut(en) in der zweiten einstückigen Kernanordnung in Richtung entlang der Länge der genannten wenigstens einen Spur gehalten wird bzw. werden; und
(d) Aufbringen eines Glasmaterials über die geneigten Nuten, Schmelzen des Glasmaterials, um die genannten geneigten Nuten mit geschmolzenem Glas zu füllen und gleichzeitiges Füllen des genannten Freiraumes mit geschmolzenem Glas, um die ersten und zweiten einstückigen Kernanordnungen in den Verbund-Magnetkopfkern zu binden.

11. Verfahren nach Anspruch 10, worin die genannten ersten und zweiten Kernelemente (128, 130; 178, 190) direkt mittels Festkörper-Festkörper-Reaktion in die Kernanordnung mit dem im allgemeinen ringförmigen Magnetkreis aneinandergebunden werden.

12. Verfahren nach Anspruch 11, worin der genannte Magnetspalt in der einstückigen Kernanordnung mit einem Glasmaterial gefüllt wird, bevor die geneigte(n) Nut(en) geschnitten wird bzw. werden.

13. Verfahren nach Anspruch 10, worin, um eine Vielzahl von Magnetkopfkernen gleichzeitig zu bilden, jedes der genannten ersten Kernelemente (130) der ersten und zweiten einstückigen Kernanordnungen ein langgestreckter Ferritblock mit einem Abschnitt von C-förmigem, in Querrichtung verlaufenden Querschnitt ist und jedes der genannten zweiten Kernelemente (132) der ersten und zweiten einstückigen Kernanordnungen ein langgestreckter Ferritblock mit einem Abschnitt von rechteckigem, in Querrichtung verlaufenden Querschnitt ist, die genannten ersten und zweiten langgestreckten Ferritblöcke der ersten einstückigen Kernanordnung zusammen zu einer ersten langgestreckten einstückigen Kernanordnung (140) gebunden werden, die genannten ersten und zweiten langgestreckten Ferritblöcke der zweiten einstückigen Kernanordnung zusammen

men zu einer zweiten langgestreckten einstückigen Kernanordnung (140) gebunden werden, die genannten ersten und zweiten langgestreckten einstückigen Kernanordnungen zusammen zu einer langgestreckten einstückigen Verbund-Kernstruktur (156) gebunden werden, die danach in im Abstand voneinander angeordneten parallelen Ebenen geschnitten wird, die senkrecht zur Länge der genannten langgestreckten einstückigen Verbund-Kernstruktur stehen.

14. Verfahren nach Anspruch 10, worin die genannten ersten Kernelemente der ersten und zweiten einstückigen Kernanordnungen von einem ersten Ferritelement (178) gebildet werden, das einen ersten und einen zweiten Abschnitt von C-förmigem Querschnitt aufweist, die symmetrisch in bezug aufeinander sind, und die genannten zweiten Kernelemente der ersten und zweiten einstückigen Kernanordnungen von einem zweiten Ferritelement (190) gebildet werden, das einen ersten und zweiten Abschnitt von rechteckigem Querschnitt aufweist, die symmetrisch in bezug aufeinander sind, daß die genannten ersten und zweiten langgestreckten Ferritelemente (178, 190) zusammen zu einer einstückigen Zwillingsskernstruktur (192) gebunden werden, worin der genannte erste C-förmige Abschnitt mit dem genannten ersten rechteckigen Abschnitt zusammenwirkt, um einen ersten im allgemeinen ringförmigen Magnetkreis zu bilden, während der genannte zweite C-förmige Abschnitt mit dem genannten zweiten rechteckigen Abschnitt zusammenwirkt, um einen zweiten im allgemeinen ringförmigen Magnetkreis zu bilden, der symmetrisch mit dem genannten ersten Magnetkreis ist und die genannte einstückige Zwillingsskernstruktur danach in zwei einstückige Kernanordnungen (140) zerschnitten wird, die jeweils die genannten ersten und zweiten Magnetkreise aufweisen.

15. Verfahren nach Anspruch 14, worin die genannten ersten und zweiten Ferritelemente (178, 190) langgestreckte Ferritelemente sind, die zu einer langgestreckten einstückigen Zwillingsskernstruktur (192) aneinandergebunden werden, wobei die genannte langgestreckte einstückige Zwillingsskernstruktur danach in zwei langgestreckte einstückige Kernanordnungen (140) zerschnitten wird.

16. Verfahren nach Anspruch 15, worin die genannten beiden langgestreckten einstückigen Kernanordnungen (140) an den ersten und zweiten rechteckigen Abschnitten aneinander-

gelegt und zu einer langgestreckten einstückigen Verbund-Kernstruktur (198) aneinandergelungen werden und die genannte langgestreckte einstückige Verbund-Kernstruktur danach in im Abstand voneinander angeordneten parallelen Ebenen zerschnitten wird, die senkrecht zu ihrer Länge stehen.



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