

SPECIFICATION

Core laminations particularly for transformers

- 5 The invention relates to core laminations for iron cores, particularly for transformers, comprising a plurality of core laminations arranged in layers, each of said core laminations having at most 3 spaced apart, parallel legs of equal length and two yokes connecting the ends of said legs, one yoke, which will be called the integral yoke, being connected without joints to said legs, the other yoke, which will be called the separated yoke, having joints provided between itself and one end of each leg for interleaving in windings and the width of the integral yoke being greater than the separated yoke. This corresponds, so far, to an earlier patent application by the same applicant.

As a rule, the laminations in cores comprising these known core laminations are interleaved alternately, being arranged in the finished core in such a way that their outer edges always lie one on top of the other in a common plane, which means that cores of this kind appear no different externally from customary types.

- 15 By means of the measures according to the above-named application the invention achieves the object of improving so-called M core laminations and so-called EI core laminations in such a way that in a shell-type core comprised of these laminations, the more advantageous, integral yoke cross-section is enlarged at the cost of the less advantageous separated yoke cross-section, thereby reducing the reluctance and magnetic leakage and improving the efficiency.

- 20 The EI core laminations according to the above-named application are preferably comprised of types equivalent to M core laminations so that such cores can also be utilized with the commonly used coil formers taken for M cores like, for instance, the DIN M series.

- There are, however, EI core laminations for cores having two windows, each of which has a length three times as long as, and a width as wide as, half the width of the centre leg. Dimensioning the windows in this way provides a very good ratio of copper-to-iron in the transformer. EI core laminations dimensioned in this way can be produced without waste, by stamping the E parts in pairs so that the window parts exactly form the I parts. The latter thus have the same material graining orientation as in the legs, i.e. they are provided with a grain orientation in the preferred direction of magnetic flux, therefore making these EI core laminations more advantageous than M core laminations. Consequently, transformers having EI core laminations of such dimensions can be manufactured very economically, which is why these laminations have been standardized in the waste-free DIN EI series.

- However, these EI core laminations still have drastic shortcomings, such as increased magnetic bottle-necks at the abutting joints and unfavourably dimensioned yokes and outer legs, which call for an output to cost ratio improvement. It is the object of a further patent application, to provide an optimum solution to the problem, and to set out to remedy these shortcomings, while preserving the existing benefits.

- 35 Apart from the above-named M and EI core laminations, we additionally find so-called UI core laminations for single-phase transformers and so-called 3UI core laminations for three-phase transformers (these are also EI core laminations but have different dimensions, namely the legs are of equal width). These core laminations are standardized in the DIN UI series and DIN 3UI series, respectively.

- 40 Here again, these core laminations, and the cores comprising them, exhibit relatively high reluctance at the abutting joints and in the yokes, and hence call for an improved efficiency. So-called Pu, PI and Pu/PI cores having widened yokes have in fact helped improve the magnetic characteristics and the degree of efficiency, but they are still in need of improvement as regards the utilization of material and furthermore cannot be stamped without waste.

- 45 The object of the invention is, therefore, to improve and optimize conventional UI core laminations respectively 3UI core laminations (EI core lamination types), in order that the reluctance and the magnetic leakage are reduced, and the magnetic characteristics and degree of efficiency are improved, without having to abandon their inherent advantages. In particular, the invention sets out to improve and optimize the output to cost ratio by means of providing more favourable winding proportions, which are possible.

- 50 According to the invention this object is achieved in that, in UI core laminations or EI core laminations having legs of equal width, the width c_1 of the integral yoke is at least 1.1 times, and at most 2.1 times, the width f of each leg and wherein the width c_2 of the separated yoke is at least 1.0 times, and at most 1.5 times the width f of each leg, such that the width c_1 of the integral yoke, minus the width c_2 of the separated yoke, is at least 0.1 times, and at most 0.6 times the width f of each leg ($1.1f \leq c_1 \leq 2.1f$ and $1.0f \leq c_2 \leq 1.5f$ and $0.1f \leq c_1 - c_2 \leq 0.6f$).

- 55 Quite favourable dimensions are obtained when the width c_1 of the integral yoke is at least 1.2 to at most, 1.7 times the width f of each leg and the width c_2 of the separated yoke is at least 1.1 to at most 1.3 times the width f of each leg, so that the width c_1 of the integral yoke, minus the width c_2 of the separated yoke, is at least 0.1 to at most 0.4 times the width f of each leg ($1.2f \leq c_1 \leq 1.7f$ and $1.1f \leq c_2 \leq 1.3f$ and $0.1f \leq c_1 - c_2 \leq 0.4f$).

Core laminations according to this invention can be produced with no waste at all. This is achieved by means of the following additional measures, which are moreover of advantage for other reasons.

- The distance h between adjacent legs is equal to the width c_2 of the separated yoke, this provides that UI core laminations can be stamped without waste when in addition the length e of each leg is equal to the distance h between the two legs plus twice the width f of each leg ($h = c_2$ and $e = h + 2f$). Thus the window

area stamped out from the U part exactly forms the I part.

These dimensions (with $h = c_2$ and $e = h + 2f$) do not, in fact, result in completely waste-free EI core laminations, i.e. 3UI types, that is a small waste of $h \cdot f$ is obtained, totalling just 5%, for each EI pair. Nonetheless these dimensions are advantageous because they enable a three-phase EI transformer to utilize the same coil former and winding specification as a UI transformer.

Coil formers having an overall bobbin length of 3 times the width f of each leg can be used when the length e of each leg is equal to the width c_1 of the integral yoke minus the width c_2 of the separated yoke plus 3 times the width f of each leg ($e = c_1 - c_2 + 3f$). Within the limits of conventional margins and tolerances, DIN UI and DIN 3UI coil formers may be utilized with this dimensioning.

Quite favourable dimensions are provided on this basis when, exactly or approachingly, the width c_1 of the integral yoke is 1.4 times, the width c_2 of the separated yoke is 1.2 times, and the length e of each leg is 3.2 times the width f of each leg ($c_1 = 1.4f$ and $c_2 = 1.2f$ and $e = 3.2f$).

This configuration provides an overall ratio 3 of coil length to leg width, enabling DIN UI and DIN 3UI coil formers to be used. Additionally, this configuration creates a more favourable overall ratio 5 (instead of 6) of coil length to coil height and an equally more favourable overall ratio 0.6 (instead of 0.5) of coil height to leg width.

A waste-free EI core lamination having legs of equal width f is provided when the distance h between adjacent legs is equal to the width c_2 of the separated yoke and the length e of each leg is equal to the distance h plus 1.5 times the width f of each leg ($h = c_2$ and $e = h + 1.5f$).

Quite favourable dimensions are provided on this basis when, exactly or approachingly the width c_1 of the integral yoke is 1.5 times, the width c_2 of the separated yoke is 1.2 times, and the length e of each leg is 2.7 times, the width f of each leg ($c_1 = 1.5f$ and $c_2 = 1.2f$ and $e = 2.7f$). This arrangement produces a very advantageous overall ratio 4 of coil length to coil height and an equally favourable overall ratio 0.6 of coil height to leg width; moreover, this configuration provides a core of square outline.

These UI and EI core lamination proportions are quite advantageous because the yoke cross-section, being larger than the leg cross-section by the factor $\frac{1}{2}(c_1 + c_2)/f$, serves to improve and even optimize the magnetic characteristics, to reduce the losses and to provide excellent output to cost ratios. Cores of this kind provide that they require even less magnetizing power than, for instance, continuous strip C-cores of the same leg cross-section and material. Particularly big improvements are obtained for grain-oriented material in which the preferred direction of magnetic flux is parallel to the legs and hence parallel to the yoke I part.

Even though these dimensions, which for reasons of optimization, are specifically favourable, moreover provide further advantages without any additional expense.

Firstly, the disturbance of the crystal structure along the stamped edges is of practically no consequence in the yokes because the latter are far wider than the width of the disturbed areas.

Secondly, fixing holes which may be provided, have practically no adverse influence because even the areas in the region of these holes are wider by about 10% to 30%.

Thirdly, the influence of the abutting joints in a core comprised of alternately interleaved layers of laminations is considerably reduced by the fact that - since the ends of the legs are partly overlapped by adjacent laminations by the yoke width difference $c_1 - c_2$ - the undivided steel cross-section is $(\frac{1}{2} + \frac{1}{2}(c_1 - c_2)/f)$ times the leg cross-section. A very substantial, additional advantage is provided with the use of Goss (grain-oriented silicon steel) material in particular, actually obtaining, for the first time, the full benefit of this material: The inner yoke parts of the integral yoke are wider than the separated yoke c_2 by the width $c_1 - c_2$ and overlap the ends of the lamination legs by this width ($c_1 - c_2$). The direction of grain orientation of said overlapping part of the integral yoke is in the preferred flux direction, whereas the grain orientation of the separated yoke c_2 is crosswise to the preferred direction for about half the length. A fraction of the magnetic flux therefore already diverts from the separated yoke and ends of the legs through the wider internal part of the integral yoke thus providing reduced magnetic flux in the outer part of the smaller width separated yoke c_2 . In a fully utilized core therefore, effectively many times the currently normal magnetizability is provided.

Fourthly, rounded corners of the I parts, having a radius smaller than the yoke width difference $c_1 - c_2$, do not cause magnetic flux path bottlenecks in cores with alternately interleaved laminations, in contrast to DIN UI and DIN 3UI cores in which rounding gives rise to magnetic flux path bottlenecks. Therefore in core laminations of the invention rounded window corners are possible. Rounding of this kind (about 0.4mm in radius) of the window corners and the corresponding I-part ends are very desirable because tool life is increased.

It is advantageous when the distance k_1 between fastening holes provided in the integral yokes and the outer edge of this yoke is equal to the distance k_2 between fastening holes provided in the separated yoke and the outer edge of the latter yoke, where fastening holes in the separated yoke are advantageously located along the centre line of this yoke ($k_1 = k_2 = \frac{1}{2}c_2$). This configuration is of advantage magnetically and avoids manufacturing problems which would be caused by the accidental mix-up of one side for the other.

It is additionally advantageous when the corner fastening hole locations are spaced from the side edges by distances k_3 which are equal to either half the width c_2 of the separated yoke or to half the width f of each leg ($k_3 = \frac{1}{2}c_2$ or $k_3 = \frac{1}{2}f$). The former requires the least magnetizing power whereas the latter provides reduced magnetic leakage.

Two embodiments of the invention are represented in plan views in the drawings, in which the dashed line

denotes the inner edge of the integral yoke of alternately interleaved core laminations shown under a layer of core laminations.

The embodiments according to Figure 1 and Figure 2 show particularly advantageous UI core laminations (Figure 1) and respectively EI core laminations (Figure 2), having two and respectively three legs 1, 2 or 3 of equal width f and with an integral yoke 5 having a greater width c_1 than the width c_2 of the separated yoke 4.

In these embodiments the width c_1 of the integral yoke is 1.4 times the width f of each leg ($1.1f \leq c_1 \leq 2.1f$ preferably $1.2f \leq c_1 \leq 1.7f$); the width c_2 of the separated yoke is 1.2 times the width f of each leg ($1.0f \leq c_2 \leq 1.5f$ preferably $1.1f \leq c_2 \leq 1.3f$); the yoke width difference $c_1 - c_2$ is 0.2 times the width f of each leg ($0.1f \leq c_1 - c_2 \leq 0.6f$ preferably $0.1f \leq c_1 - c_2 \leq 0.4f$); and the distance h of one leg from the next leg is equal to the width c_2 of the separated yoke. In both embodiments according to Figure 1 and Figure 2 the length e of each window is not only equal to this distance h plus twice the width f of each leg ($e = h + 2f$) but also equal to the yoke width difference $c_1 - c_2$ plus three times the width f of each leg ($e = c_1 - c_2 + 3f$); put in definite terms, $e = 3.2f$.

The embodiment according to Figure 1 shows waste-free UI stampings. The embodiment according to Figure 2 shows EI stampings, which, although not completely waste-free nevertheless form - that is legs 1 and 2 respectively 2 and 3 together with the connecting yoke parts 5 and 4 - stampings equivalent to the UI shape embodiment of Figure 1, and therefore enabling the use of the same coil formers and coil specifications. In particular, the use of DIN UI coil formers are made possible by means of which additionally, an advantageous coil height tolerance reserve is obtained (of $0.1f$) which provides more space for the coil.

An embodiment providing waste-free EI core laminations is obtained when each leg is of length e , shortened - as compared with the embodiment of Figure 2 - by half the width f of each leg; $e = h + 1.5f$ denoted by $e = 2.7f$. Moreover an embodiment of a waste-free EI shape having a square section and an extremely good output to cost ratio is obtained when, the width c_1 of the integral yoke is equal to 1.5 times the width f of each leg. This waste-free stamping provides two E parts stamped at the one time, the pairs abutting at their leg ends and forming I parts from their common windows.

The embodiments of Figure 1 and Figure 2 show fastening holes 16 spaced from the outer edges by the distances k_1 respectively k_2 , respectively k_3 , which are all equal to half the width c_2 of the parted yoke 4 ($k_1 = k_2 = k_3 = 1/2c_2$). Furthermore, the embodiment of Figure 2 shows two fastening holes which are located along the centre line 9 of the centre leg 2, spaced from the outer yoke edges by the same distance $1/2c_2$.

CLAIMS

1. Core laminations for iron cores, particularly for transformers, comprising a plurality of core laminations arranged in layers, each of said core laminations having at most 3 spaced apart, parallel legs of equal length and two yokes connecting the ends of said legs, one yoke, which will be called the integral yoke, being connected without joints to said legs, the other yoke, which will be called the separated yoke, having joints provided between itself and one end of each leg for interleaving in windings and the width of the integral yoke being greater than the separated yoke characterized in that in UI core laminations or EI core laminations having legs of equal width (1, 2 or 3), the width (c_1) of the integral yoke (5) is at least 1.1 times, and at most 2.1 times the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) is at least 1.0 times, and at most 1.5 times, the width (f) of each leg; such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) is at least 0.1 times, and at most 0.6 times, the width (f) of each leg (1, 2 or 3) ($1.1f \leq c_1 \leq 2.1f$ and $1.0f \leq c_2 \leq 1.5f$ and $0.1f \leq c_1 - c_2 \leq 0.6f$).

2. Core laminations as claimed in Claim 1, characterized in that the width (c_1) of the integral yoke (5) is at least 1.2 times, and at most 1.7 times, the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) is at least 1.1 times, and at most 1.3 times, the width (f) of each leg (1, 2 or 3), such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) is at least 0.1 times, and at most 0.4 times, the width (f) of each leg (1, 2 or 3) ($1.2f \leq c_1 \leq 1.7f$ and $1.1f \leq c_2 \leq 1.3f$ and $0.1f \leq c_1 - c_2 \leq 0.4f$).

3. Core laminations as claimed in Claim 1 or Claim 2, characterized in that the distance (h) between adjacent legs (1 and 2 respectively 2 and 3) is equal to the width (c_2) of the separated yoke (4) and wherein the length (e) of each leg (1, 2 or 3) is equal to the distance (h) plus twice the width (f) of each leg ($h = c_2$ and $e = h + 2f$).

4. Core laminations as claimed in Claim 1 or Claim 2 or Claim 3, characterized in that the length (e) of each leg (1, 2 or 3) is exactly or approachingly equal to the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) plus three times the width (f) of each leg ($e = c_1 - c_2 + 3f$).

5. Core laminations as claimed in Claim 2 or Claim 3 or Claim 4, characterized in that exactly or approachingly, the width (c_1) of the integral yoke (5) is 1.4 times, the width (c_2) of the separated yoke (4) is 1.2 times, and the length (c) of each leg (1, 2 or 3) is 3.2 times, the width (f) of each leg ($c_1 = 1.4f$ and $c_2 = 1.2f$ and $e = 3.2f$).

6. Core laminations as claimed in Claim 1 or Claim 2, characterized in that the distance (h) between adjacent legs (1 and 2 respectively 2 and 3) is equal to the width (c_2) of the separated yoke (4) and wherein the length (e) of each leg (1, 2 or 3) is equal to the distance (h) plus 1.5 times the width (f) of each leg ($h = c_2$ and $e = h + 1.5f$).

7. Core laminations as claimed in Claim 2 or Claim 6, characterized in that exactly or approachingly the



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denotes the inner edge of the integral yoke of alternately interleaved core laminations shown under a layer of core laminations.

The embodiments according to Figure 1 and Figure 2 show particularly advantageous UI core laminations (Figure 1) and respectively EI core laminations (Figure 2), having two and respectively three legs 1, 2 or 3 of equal width f and with an integral yoke 5 having a greater width c_1 than the width c_2 of the separated yoke 4.

In these embodiments the width c_1 of the integral yoke is 1.4 times the width f of each leg ($1.1f \leq c_1 \leq 2.1f$ preferably $1.2f \leq c_1 \leq 1.7f$); the width c_2 of the separated yoke is 1.2 times the width f of each leg ($1.0f \leq c_2 \leq 1.5f$ preferably $1.1f \leq c_2 \leq 1.3f$); the yoke width difference $c_1 - c_2$ is 0.2 times the width f of each leg ($0.1f \leq c_1 - c_2 \leq 0.6f$ preferably $0.1f \leq c_1 - c_2 \leq 0.4f$); and the distance h of one leg from the next leg is equal to the width c_2 of the separated yoke. In both embodiments according to Figure 1 and Figure 2 the length e of each window is not only equal to this distance h plus twice the width f of each leg ($e = h + 2f$) but also equal to the yoke width difference $c_1 - c_2$ plus three times the width f of each leg ($e = c_1 - c_2 + 3f$); put in definite terms, $e = 3.2f$.

The embodiment according to Figure 1 shows waste-free UI stampings. The embodiment according to Figure 2 shows EI stampings, which, although not completely waste-free nevertheless form - that is legs 1 and 2 respectively 2 and 3 together with the connecting yoke parts 5 and 4 - stampings equivalent to the UI shape embodiment of Figure 1, and therefore enabling the use of the same coil formers and coil specifications. In particular, the use of DIN UI coil formers are made possible by means of which additionally, an advantageous coil height tolerance reserve is obtained (of $0.1f$) which provides more space for the coil.

An embodiment providing waste-free EI core laminations is obtained when each leg is of length e , shortened - as compared with the embodiment of Figure 2 - by half the width f of each leg; $e = h + 1.5f$ denoted by $e = 2.7f$. Moreover an embodiment of a waste-free EI shape having a square section and an extremely good output to cost ratio is obtained when, the width c_1 of the integral yoke is equal to 1.5 times the width f of each leg. This waste-free stamping provides two E parts stamped at the one time, the pairs abutting at their leg ends and forming I parts from their common windows.

The embodiments of Figure 1 and Figure 2 show fastening holes 16 spaced from the outer edges by the distances k_1 respectively k_2 , respectively k_3 , which are all equal to half the width c_2 of the parted yoke 4 ($k_1 = k_2 = k_3 = 1/2c_2$). Furthermore, the embodiment of Figure 2 shows two fastening holes which are located along the centre line 9 of the centre leg 2, spaced from the outer yoke edges by the same distance $1/2c_2$.

CLAIMS

1. Core laminations for iron cores, particularly for transformers, comprising a plurality of core laminations arranged in layers, each of said core laminations having at most 3 spaced apart, parallel legs of equal length and two yokes connecting the ends of said legs, one yoke, which will be called the integral yoke, being connected without joints to said legs, the other yoke, which will be called the separated yoke, having joints provided between itself and one end of each leg for interleaving in windings and the width of the integral yoke being greater than the separated yoke characterized in that in UI core laminations or EI core laminations having legs of equal width (1, 2 or 3), the width (c_1) of the integral yoke (5) is at least 1.1 times, and at most 2.1 times the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) is at least 1.0 times, and at most 1.5 times, the width (f) of each leg; such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) is at least 0.1 times, and at most 0.6 times, the width (f) of each leg (1, 2 or 3) ($1.1f \leq c_1 \leq 2.1f$ and $1.0f \leq c_2 \leq 1.5f$ and $0.1f \leq c_1 - c_2 \leq 0.6f$).

2. Core laminations as claimed in Claim 1, characterized in that the width (c_1) of the integral yoke (5) is at least 1.2 times, and at most 1.7 times, the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) is at least 1.1 times, and at most 1.3 times, the width (f) of each leg (1, 2 or 3), such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) is at least 0.1 times, and at most 0.4 times, the width (f) of each leg (1, 2 or 3) ($1.2f \leq c_1 \leq 1.7f$ and $1.1f \leq c_2 \leq 1.3f$ and $0.1f \leq c_1 - c_2 \leq 0.4f$).

3. Core laminations as claimed in Claim 1 or Claim 2, characterized in that the distance (h) between adjacent legs (1 and 2 respectively 2 and 3) is equal to the width (c_2) of the separated yoke (4) and wherein the length (e) of each leg (1, 2 or 3) is equal to the distance (h) plus twice the width (f) of each leg ($h = c_2$ and $e = h + 2f$).

4. Core laminations as claimed in Claim 1 or Claim 2 or Claim 3, characterized in that the length (e) of each leg (1, 2 or 3) is exactly or approachingly equal to the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) plus three times the width (f) of each leg ($e = c_1 - c_2 + 3f$).

5. Core laminations as claimed in Claim 2 or Claim 3 or Claim 4, characterized in that exactly or approachingly, the width (c_1) of the integral yoke (5) is 1.4 times, the width (c_2) of the separated yoke (4) is 1.2 times, and the length (e) of each leg (1, 2 or 3) is 3.2 times, the width (f) of each leg ($c_1 = 1.4f$ and $c_2 = 1.2f$ and $e = 3.2f$).

6. Core laminations as claimed in Claim 1 or Claim 2, characterized in that the distance (h) between adjacent legs (1 and 2 respectively 2 and 3) is equal to the width (c_2) of the separated yoke (4) and wherein the length (e) of each leg (1, 2 or 3) is equal to the distance (h) plus 1.5 times the width (f) of each leg ($h = c_2$ and $e = h + 1.5f$).

7. Core laminations as claimed in Claim 2 or Claim 6, characterized in that exactly or approachingly the



width (c_1) of the integral yoke (5) is 1.5 times, the width (c_2) of the separated yoke (4) is 1.2 times, and the length (e) of each leg (1, 2 or 3) is 2.7 times, the width (f) of each leg ($c_1 = 1.5f$ and $c_2 = 1.2f$ and $e = 2.7f$).

8. Core laminations as claimed in Claim 2 or Claim 3 or Claim 6, characterized in that corners of the separated yoke (4) and the window corners located at the integral yoke (5) are rounded at a radius that is preferably smaller than the yoke width difference ($c_1 - c_2$).

9. Core laminations as claimed in Claim 2 or Claim 4 or Claim 6, characterized in that the distance (k_1) between the fastening holes (16) of the integral yoke (5) and the outer edge of this yoke is the same as the distance (k_2) between the fastening holes (16) of the separated yoke (4) and the outer edge of the separated yoke, where the fastening holes in the separated yoke are located along the centre line (17) of this yoke ($k_1 = k_2 = 1/2c_2$).

10. Core laminations as claimed in Claim 9, characterized in that the corner fastening hole locations are spaced from the outside side edges by distances (k_3) equal either to half the width (c_2) of the separated yoke (4) or to half the width (f) of each leg (1, 2 or 3) ($k_3 = 1/2c_2$ or $k_3 = 1/2f$).

11. A magnetic core for transformers comprising a plurality of core laminations arranged in layers, at least some of which being arranged in alternately reversed configuration, each said core laminations comprising a maximum of three parallel legs of substantially equal length and spaced apart at a distance and two yokes connecting the ends of said legs, one yoke, which will be called the integral yoke, being connected without joints to said legs, the other yoke, which will be called the separated yoke, having abutting joints being provided between one end of each leg and the adjacent separated yoke for insertion of windings and said two yokes being provided with inner edges facing in the direction of winding space, and the width of the integral yoke being greater than the separated yoke characterized in that in UI core laminations or EI core laminations having legs of substantially equal width (1, 2 or 3), the width (c_1) of the integral yoke (5) is at least 1.1 times, and at most 2.1 times the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) is at least 1.0 times, and at most 1.5 times, the width (f) of each leg; such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) is at least 0.1 times, and at most 0.6 times, the width (f) of each leg (1, 2 or 3) ($1.1f < c_1 < 2.1f$ and $1.0f < c_2 < 1.5f$ and $0.1f < c_1 - c_2 < 0.6f$) and wherein in said plurality of said layers of core laminations arranged in alternately reversed configuration, the inner edges of said integral yoke (5) being located nearer windings than the inner edges of said separated yoke (4) which are located spaced outwardly at a distance away from windings and said integral yoke overlapping said abutting joints and said abutting joints being displaced into the interior of the magnetic core yoke, which is that portion of the assembled separated yoke and integral yoke beyond windings.

12. A magnetic core as claimed in Claim 11, characterized in that the width (c_1) of the integral yoke (5) is at least 1.2 times, and at most 1.7 times, the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) is at least 1.1 times, and at most 1.3 times, the width (f) of each leg (1, 2 or 3), such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) is at least 0.1 times, and at most 0.4 times, the width (f) of each leg (1, 2 or 3) ($1.2f < c_1 < 1.7f$ and $1.1f < c_2 < 1.3f$ and $0.1f < c_1 - c_2 < 0.4f$).

13. A magnetic core as claimed in Claim 11 or Claim 12, characterized in that the distance (h) between adjacent legs (1 and 2 respectively 2 or 3) is equal in width (c_2) of the separated yoke (4) and wherein the length (e) of each leg (1, 2 or 3) is equal to the distance (h) plus twice the width (f) of each leg ($h = c_2$ and $e = h + 2f$).

14. A magnetic core as claimed in Claim 11 or Claim 12 or Claim 13, characterized in that the length (e) of each leg (1, 2 or 3) is exactly or approachingly equal to the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) plus three times the width (f) of each leg ($e = c_1 + 3f$).

16. A magnetic core as claimed in Claim 11 or Claim 12, characterized in that the distance (h) between adjacent legs (1 and 2 respectively 2 and 3) is equal to the width (c_2) of the separated yoke (4) and wherein the length (e) of each leg (1, 2 or 3) is equal to the distance (h) plus 1.5 times the width (f) of each leg ($h = c_2$ and $e = h + 1.5f$).

17. A magnetic core as claimed in Claim 12 or Claim 16, characterized in that exactly or approachingly the width (c_1) of the integral yoke (5) is 1.5 times, the width (c_2) of the separated yoke (4) is 1.2 times, and the length (e) of each leg (1, 2 or 3) is 2.7 times, the width (f) of each leg ($c_1 = 1.5f$ and $c_2 = 1.2f$ and $e = 2.7f$).

18. A magnetic core as claimed in Claim 12 or Claim 13 or Claim 16, characterized in that corners of the separated yoke (4) and the window corners located at the integral yoke (5) are rounded at a radius that is preferably smaller than the yoke width difference ($c_1 - c_2$).

19. A magnetic core as claimed in Claim 12 or Claim 14 or Claim 6, characterized in that the distance (k_1) between the fastening holes (16) of the integral yoke (5) and the outer edge of this yoke is the same as the distance (k_2) between the fastening holes (16) of the separated yoke (4) and the outer edge of the separated yoke, where the fastening holes in the separated yoke are located along the center line (17) of this yoke ($k_1 = k_2 = 1/2c_2$).

20. A magnetic core as claimed in Claim 9, characterized in that the center fastening hole locations are spaced from the outside edges by the distance (k_3) equal either to half the width (c_2) of the separated yoke (4) or to half the width (f) of each leg (1, 2 or 3) ($k_3 = 1/2c_2$ or $k_3 = 1/2f$).

21. A magnetic core comprising core laminations arranged in layers as claimed in any one of the preceding claims, characterized in that said core laminations being interleaved in an alternately reversed configuration, such that abutting joints (8) between the separated yoke (4) and said other ends of said legs (2 and 3) are covered over by the integral yoke (5) of an adjacent alternately reversed core lamination and are

spaced from the ends of the legs adjoining the integral yoke at a distance equal to the difference between the width (c_1) of the integral yoke (5) and the width (c_2) of the separated yoke (4) ($c_1 - c_2$).

22. Core laminations substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

5 23. A magnetic core substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings. 5

24. Core laminations as claimed in any one of Claims 1 to 10, characterized in that the separated yoke is formed from the stamped out window parts of the stamping forming the integral yoke and attached legs.

10 25. A magnetic core as claimed in any one of Claims 11 to 21 characterized in that the separated yoke is formed from the stamped out window parts of the stamping forming the integral yoke and attached legs. 10

26. A method of manufacturing core laminations, particularly for transformers comprising a plurality of core laminations arranged in layers, each of said core laminations having a maximum of three parallel legs spaced apart at a distance of substantially equal length and two yokes connecting the ends of said legs, one yoke, which will be called the integral yoke, being connected without joints to said legs, the other yoke, 15 which will be called the separated yoke, having joints provided between itself and one end of each leg for interleaving in windings and the width of the integral yoke being greater than the separated yoke and the separated yoke being formed from the stamped out window parts of the stamping forming the integral yoke and attached legs, the dimensions of the UI core laminations or EI core laminations being selected as follows: having legs of substantially equal width (1, 2 or 3), the width (c_1) of the integral yoke (5) being at 20 least 1.1 times, and at most 2.1 times the width (f) of each leg (1, 2 or 3) and wherein the width (c_2) of the separated yoke (4) being at least 1.0 times, and at most 1.5 times, the width (f) of each leg; such that the width (c_1) of the integral yoke (5) minus the width (c_2) of the separated yoke (4) being at least 0.1 times, and at most 0.6 times, the width (f) of each leg (1, 2 or 3) ($1.1f < c_1 < 2.1f$ and $1.0f < c_2 < 1.5f$ and $0.1f < c_1 - c_2 < 0.6f$).

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