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(54) MAGNETIC CORE AND METHOD OF FORMING THE SAME

(71) We, BERESFORD CLAIR JOSEPH and ROGER LEWIS JOSEPH, both Australian citizens, of 378 Victoria Street, Brunswick, in the State of Victoria, Commonwealth of Australia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to magnetic cores and specifically, but not exclusively, to such cores for use in ballast or like inductive components.

There have been proposed many different forms of cores for inductive components, these normally being laminated from a stack of steel pressings which are held together such as by clamping.

Previous cores have generally suffered from one or a number of disadvantages, depending on the design. One disadvantage was that, by their design, the components making up such cores needed to be handled a number of times during construction and the cost of labour in manufacturing the core was high. Secondly, it was often difficult, by virtue of the construction used, to consistently achieve correct air gaps where required. Thirdly, the metal pressings forming the laminations were frequently inefficient in their use of steel and required complex tools for their production.

It is an object of the invention to provide a core which at least partly avoids the above disadvantages.

A further object of the invention is to provide an efficient method of forming the core of the invention, and a third object is to provide an efficient method for forming metal laminations which can be used in cores of the invention.

According to the invention there is provided a core of magnetically permeable material formed from first, second, third and fourth lengthwise extending parts, said parts having transverse cross-sections each defining two legs arranged in a respective L-shape form, the first and second parts being juxtaposed so that, together, in transverse cross-section, they present a T-shape form, with a trunk portion of the T-shape comprised by adjacent side-by-side first legs of said first and second parts, a cross portion of the T-shape extending across one end of said trunk portion, said cross portion being formed by aligned second legs of said first and second parts; said third and fourth parts being juxtaposed so that in transverse cross-section they present a U-shape form with second legs of the third and fourth parts in aligned end-to-end juxtaposition to form an intermediate portion of the U-shape and with first legs of said third and fourth sections forming respective opposed end portions of the U-shape, each end portion extending transversely to the intermediate portion; said parts being assembled together so that said trunk portion is parallel to, between, and spaced from the said end portions and with free ends of the end portions terminating at or adjacent respective free ends of said cross portion, and with said trunk portion terminating at or adjacent said intermediate portion, said parts being formed of stacks of laminations having the shape of said respective L-shape forms. Such a core may be held together by adhesive, or by welding. An air gap may readily be provided between the intermediate portion and the trunk portion by appropriate selection of the trunk portion length.

In one construction of core in accordance with the invention, the cross portion of said T-shape form extends between opposed inner sides of the respective said end portions, and such that, as viewed in the lengthwise direction of said core, the ends of the cross portion fit with small clearance from the respective inner sides of said end portions whereby the first and second parts, comprising the T-shape form, may prior to final assembly be slid, in the direction of extent of said inner sides relative to the parts comprising said U-shape form to vary the said air gap. This permits accurate setting of the air gap by use, for example, of a temporary spacer during manufacture. In an alternative construction, as viewed in the lengthwise direction of said core, the ends of the cross portion of said T-shape form are spaced apart a distance greater than the distance between opposed inner sides of the respective said end portions so that the ends of said end portions abut against the side of the cross portion at locations towards respective ends thereof. In this arrangement any required air gap between the intermediate por-

tion and trunk portion can also be accurately set, provided reasonable care is taken in maintaining manufacturing tolerances of the laminations and in alignment of the sections to form the said T-shape form and U-shape form. More particularly, if the T-shape form and U-shape form are first assembled as separate members the free ends of the end portions of the U-shape form will form lengthwise extending bearing faces along the length thereof and these can be accurately engaged with the corresponding lengthwise extending surfaces of the T-shape form; the selection of a required air gap can be simply made by making a corresponding reduction in the length of the trunk portion as compared with the lengths of the said end portions.

In a further particularly preferred embodiment, at least one leg of each of one pair of said parts has a respective recess, extending in the direction of extent of that part, and at least one leg of each of the other pair of said parts is provided with a respective protrusion, extending in the lengthwise direction of that part, each protrusion being engaged in a respective separate cooperating one of said recesses so that the cooperating protrusions and recesses key the parts of said one pair to respective ones of said other pair. This arrangement provides for accurate keying together of the T-shape and U-shape forms and, furthermore, effects a considerable improvement in the magnetic properties of the core since it results in a relative increase in the contact area between T-shape and U-shape forms at the locations of the cooperating protrusions and recesses.

The core of the invention lends itself to particularly simple assembly since the said core parts may be easily assembled in first operations, such as by use of an adhesive or by welding, the parts then assembled to form the aforementioned members, the member having the T-shape form then provided with a winding around the trunk part and the two members then joined together by welding or by use of an adhesive. Alternatively, only the T-shape form may be first assembled and wound and the said third and fourth parts then simply secured in position to define the U-shape form at the core itself.

In a further aspect of the invention there is provided a method for forming a core of magnetically permeable material comprising,

forming laminations, each lamination being of L-shaped configuration having first and second legs which extend normally away from a junction thereof to free ends thereof the first and second legs having respective first and second linear outer edges which extend from an outer corner of the laminations to the free ends of the legs, and respective first and second inner edges extending from an inner corner of the lamination to the free ends of the legs, the first and second inner efdes being parallel to the respective first and second outer edges, the legs terminating in first and second end edges extending between the inner and outer edges of the respective first and second legs, said forming of the lamination being effected by stamping or otherwise cutting the laminations from a strip of magnetically permeable material, with the said inner and outer edges being cut at substantially 45° to the direction of extent of the strip, the cutting being effected such that the or each cut forming, to one side of this cut, an inner edge of a said lamination also forms, to the other side of that cut, at least part of an outer edge of an adjacent lamination which is formed at a location on said strip spaced from the first mentioned lamination in the direction of extent of the strip;

assembling said laminations in stacks to form first, second, third and fourth lengthwise extending core parts, said parts having transverse cross-sections each defining two legs arranged in a respective L-shape form corresponding to the shape of said laminations;

juxtaposing the first and second parts so that, together, in transverse cross-section, they present a T-shape form, with a trunk portion of the T-shape comprised by adjacent side-by-side first legs of said first and second parts, a cross portion of the T-shape extending across one end of said trunk portion, said cross portion being formed by aligned second legs of said first and second parts;

juxtaposing said third and fourth parts so that in transverse cross-section they present a U-shape form with second legs of the third and fourth parts in aligned end-to-end juxtaposition to form an intermediate portion of the U-shape and with first legs of said third and fourth sections forming respective opposed end portions of the U-shape, each end portion extending tranversely to the intermediate portion; and

assembling said parts together, after said juxtaposing, to define said T-shape and U-shape forms so that said trunk portion is parallel to, between, and spaced from the said end portions and with free ends of the end portions terminating at or adjacent respective free ends of said cross portion, and with said trunk portion terminating at or adjacent said intermediate portion.

For a better understanding of the present invention, and to show how the same way be put into effect, the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a diagrammatic perspective view showing the manner of stamping of laminations in accordance with the invention;

Figure 2 shows a diagrammatic perspective view of a ballast choke core constructed in accordance with the invention;

Figure 3 shows a diagrammatic plan view illustrating the positioning of punches in the method as illustrated by Figure 1;

Figures 4, 5, 6 and 7 show diagrammatic plan views of alternative punch configurations

or placements for forming laminations in accordance with the invention;

Figures 8, 9 and 10 show, respectively, the arrangement of laminations in a ballast choke core like that of Figure 2 but using the lamination portions formed as shown in Figures 5, 6 and 7 respectively;

Figure 11 shows an alternative method of forming a magnetic core in accordance with the invention;

Figure 12 shows an alternative manner of forming laminations;

Figure 13 shows a perspective view of a complete ballast formed in accordance with another aspect of the invention;

Figure 14 shows the configuration of laminations in the ballast of Figure 13;

Figure 15 shows a view like Figure 14 but illustrating the manner of assembly of the core of the ballast of Figure 13;

Figure 16 shows a perspective view of an end piece incorporated into the ballast of Figure 13;

Figure 17 shows a diagram showing the manner of punching of laminations for the ballast of Figure 13; and

Figure 18 shows another core of the invention.

In Figures 1 and 3, a strip 10 of grain oriented steel of high magnetic permeability is shown in the process of being stamped to form laminations 12 for the core of an electrical ballast choke. The grain direction is, as in each described embodiment herein, in the direction of extent of the strip. Each lamination 12 is of L-shape form having two legs 12*a*, 12*b* which extend from a junction to separate free ends. Leg 12*a* has inner and outer linear and parallel edges 30, 32 and leg 12*b* has inner and outer linear parallel edges 34, 36, edges 34, 36 being at right angles to edges 30, 32. The legs 12*a*, 12*b* terminate in transverse end edges 38, 40.

The laminations 12 are formed by the use of three punches 14, 16, 18 past which the strip is advanced by a mechanism not shown. Punches 16 and 18 are of triangular transverse section and operate simultaneously to remove, from either side of strip 10, respective series of triangular cut out portions 20. These portions are waste, but form corresponding triangular cut outs 21, 23 in the respective side edges of the strip these each presenting two edges which are at right angles to each other and 45° to the side edges of the strip 10. The cut outs 21 each form, at the forward part thereof, an end edge 40 for a lamination 12 and at the rear part thereof, a portion 36*a* of the outer edge 36 for a succeeding lamination 12. Similarly, the cut-outs 23 each form, at the forward part thereof, an end edge 38 of a lamination 12 and, at a rear part thereof, a portion 32*a* of the outer edge 32 for a succeeding lamination 12. The edge portions 32*a*, 36*a* formed by punches 16, 18 extend from end edges 38, 40 a part of the way along the outer edges 32, 36 when these are completed as now described.

The punch 14 is of L-shaped cross-section and operates to stamp laminations 12 from the forward end of strip 10 after the cut out portions 20 have been removed. The punch 14 has rear edges arranged in a "V" configuration and extending at 45° to the direction of extent of strip 10. When punch 14 is operated it forms, simultaneously, the inner edges 30, 34 of a lamination 12 and outer edge portions 32*b*, 36*b* of the next succeeding lamination 12. Laminations 12 are, thus, cut off the forward end of strip 10, the strip being advanced forward after each cutting by an amount equal to the distance D shown in Figure 3, which is equal to the dimension of the cut out portions 20 in the direction of the length of strip 10.

Laminations 12 can be assembled into a core 45 for a ballast choke or other inductive device as shown in Figure 2. When viewed in transverse section, the core 45 presents four laminations arranged as shown. Thus two first laminations 12 are arranged back to back with longer outer legs 12*b* touching and so that shorter legs 12*a* extend away from each other. These together form a member 47 which extends lengthwise of the core 45, having a T-shape form when viewed in cross-section, this member thus also comprising two side by side lengthwise extending parts each comprising a stack of laminations 12. Member 47 has a trunk portion 47*a* formed by the legs 12*b* of the laminations 12 and a cross portion 47*b* formed by the legs 12*a* of its laminations. Two second laminations 12 are arranged with end edges 40 abutting so that the shorter legs 12*a* extend away from each other in aligned relationship. These laminations together form a member 49 which extends lengthwise of the core, having a U-shape form when viewed in cross-section. Member 49 thus also comprises two side-by-side lengthwise extending parts each comprising a stack of laminations 12. Member 49 has an intermediate portion 49*a* formed by legs 12*a* of its laminations 12 and two opposed end portions 49*b* formed by respective legs 12*b* of its laminations 12. The laminations 12 are assembled so that free ends of end portions 49*b* abut against sides of the cross portion 47*b*, at location towards opposite ends of the cross portion, and so that trunk portion 47*a* is parallel to and spaced between end portions 49*b* and extends from cross portion 47*b* almost to intermediate portion 49*a*. The core thus has trunk portion 47*a* positioned centrally with two adjacent windows 51 positioned between, on the one hand, the cross portion 47*a* and intermediate portion 49*a* and, on the other hand, between the end por- 49*b*. Two side by side magnetic paths 53 are formed in the core, these both passing through trunk portion 47*a* and around the respective windows 51, as shown in Figure 2. If, as shown, the length of legs 12*b* on the laminations in member 47 is less than the length of legs 12*b* of laminations in member 49 an air gap 29 is read-

ily produced in the paths 51, 53. The members 47, 49 may be separately assembled first, a winding being positioned around the trunk portion 47*a* and the two members then assembled together.

The core 45 may be held together in any desired manner but it is preferred that it be held together by use of a suitable adhesive such as epoxy resin. The laminations may thus be assembled to form stacks to which the resin is applied, the stacks then being assembled to form the members 47, 49 and held together by further resin and the assembled members being, again, held together by still further resin. Alternatively welding could be employed such as seam welds 46, 48, 50, 52 as shown.

Of course, it is possible to form a number of laminations 12 across the width of strip 10, and Figure 4 shows an arrangement in which a wider strip 60 of transformer steel is arranged such that four laminations 12 may be blanked across the width thereof. L-shaped punches 62, 64, 66, 68 of the same form as the punch 14 shown in Figure 1 are employed together with the edge punches 16, 18. It will be observed that the only material wastage here is from the cut out portions produced by punches 16, 18 at the edges of strip 60, there only being two of these portions for each four laminations produced.

The laminations may be of different form to that shown in Figures 1 to 4. For example, Figures 8, 9 and 10 show laminations 12A, 12B, 12C respectively of slightly differing configurations. In Figure 8 the laminations have bevelled edges 84, 86 these being at junctions between the outer edges of the section arms and the end edges thereof. The laminations 12B are similar to laminations 12A and each have additional bevelled edges 88 at the corners between the outer edges and an internal fillet 90 at the junction between the inner edges of the lamination legs. The laminations 12C each have only one bevelled edge 86 this being on the shorter legs thereof at the corner between the outer and end edges.

As shown in Figure 5 the laminations 12A can be produced from a strip 10 by using two small triangular punches 70, 72 in place of punches 16, 18 these having a forward to rearward extent E less than the corresponding dimension D shown in Figure 3, together with a punch 74 like punch 14 but having bevelled corners 76, 78. As shown in Figure 6, laminations 12B can similarly be produced from a strip 10 using punches 70, 72 and a punch 79 somewhat like punch 74, having bevelled corners 76, 78, 82 and a corner fillet 80. The laminations 12C can be produced from a wide strip 92 (Figure 7) by the use of the two punches 70, 72 together with two sidewardly displaced punches 94, 96 which are like punch 14 but have bevelled corners 78. As shown in Figures 8, 9 and 10, the laminations 12A, 12B, 12C can be used to form transformer cores of substantially identical configuraion to the core 45 of Figure 2.

In Figure 11 a member 100 of T-shape cross-sectional form made up of L-shape laminations 102, generally like laminations 12, is shown assembled with member 104 of U-shape cross-sectional form to form a core 106, member 104 also being made up of L-shaped laminations 108. Here the distance M across the cross portion 109 of member 100 is made such that the cross portion 109 fits within the U-shape member 104 and extends between the inner edges 107 of end portions 111 of the U-shape form, rather than abutting against the ends of such end portions as in the preceding embodiments. This arrangement permits the T-shape member 100 to be slid in the direction indicated by arrow 113 during assembly of the core to permit accurate setting of the air gap 115, such as by interposition of a removable spacer element.

Whilst in the above, laminations 12 are stamped from strip 10 with the corner between legs 12*a*, 12*b* leading, they could of course be stamped with such corners trailing as shown in Figure 12.

The completed ballast 150 shown in Figure 13 has a core 152 formed in an analogous manner to that described above. Here, as shown in Figures 14 and 15, the core is formed of two lengthwise extending members 154, 156 respectively. Member 154 has laminations 158 of L-shape configuration arranged with long legs 158*a* adjacent to form a trunk portion 160 and with legs 158*b* outwardly directed and aligned to form a cross portion 162. Member 156 is made from differently configured L-shape laminations 164 these being arranged with legs 164*a* abutting and aligned to form an intermediate portion 166 of member 156 and with legs 164*b* presenting end portions 168 of the member 156. Inner edges 159 of legs 158*b* are provided with recesses 161 of rectangular configuration and the free ends of legs 164*b* are provided with correspondingly shaped protrusions 163. The protrusions 163 are positioned adjacent inner edges 165 of legs 164*b* and are so positioned that, when the members 154, 156 are assembled together, as shown in Figure 14, the protrusions 163 are received in respective ones of the recesses 161 to key together accurately the members 154 and 156. To facilitate entry of the protrusions into the recesses, the recesses may have slightly bevelled mouth portions 167.

The laminations 158 are also provided, adjacent outer corners thereof, with small circular openings 170. In this connection, it will be appreciated that ballast 150 provides two magnetic paths 53 of the same form as described in relation to Figure 2. That is to say, these paths 53 extend in core 152 side-by-side through trunk portion 160, thence through respective legs 158*b*, respective legs 164*b*, respective legs 164*a* and back through an air gap 172 to the

trunk portion 160. The purpose of the openings 170 is to provide an area of low magnetic permeability in the corners of the magnetic paths 53 where these pass from trunk portion 160 to the legs 158*b*, openings 170 being so positioned as to deflect the magnetic flux away from the outer corners of the laminations 158 thereby assisting in minimizing leakage at these corners of the magnetic flux paths. The described configuration of the laminations 158 thereby assisting in minimizing leakage at these corners of the magnetic flux paths. The described configuration of the laminations 158, 164 with cooperating recesses 161 and protrusions 163, aside from providing the described keying together of the laminations also provides a greater length of line contact between the legs 164*b* and 158*b* where these touch. This considerably improves the performance of the magnetic circuit provided by core 152.

The assembly operations for the core 152 may be the same as previously described, the stacks of laminations 158 to form member 154 first being formed, and located together; thereafter the winding 180 is wound around the trunk portion 160. The member 154 could have its component parts and laminations secured together before such winding or may be temporarily held in position until after winding is effected and the parts then adhered or welded together. After winding, the member 154 can then be positioned on the previously formed member 156 as described.

In order to facilitate winding, the extremities of the core 152 may be provided with T-shape plastics end pieces 182 as shown in Figure 16 each having a cross portion 184 and a depending tail portion 186. End pieces 182 are arranged at the opposite ends of the core 152, the tail piece 186 against the opposed ends of the trunk portion 160. The cross portions 184 are arranged at the ends of the core against the core cross portion 162. Winding 180 may then pass around the tail portions 186 at either end of the core. Mounting brackets 190 may be provided at either end of the core 152. These may, again, be simply adhered to opposed ends of the core. Electrical connections to the winding 180 may be made by way of terminals 185, 187 on one or both of the pieces 182.

The laminations 158, 164 may be formed from a strip 60 of grain oriented steel by a process analogous to that shown in Figure 4. That is to say, as shown in Figure 17, four L-shaped punches 200, 202, 204, 206 are positioned across the width of the strip. The outermost punches 200, 206 form the laminations 164 as the material 60 is advanced therepast. End edges of legs 164*b* are formed by notching punches 208, 210 at the side edges of the strip 60. The inner punches 202, 204 form the laminations 158, the openings 170 and recesses 161 being formed by separate punches 212, 214. As shown, the punches 200, 202, 204, 206 form the entirety of the inner edges of laminations 158, 164. The outer edges of lamination legs 158*a*, 158*b* are formed entirely by punches 200, 206. The outer edges of the legs of the laminations 164 are partly formed by punches 202, 204 and partly, in the case of laminations formed by punch 202, by punch 200, and in the case of laminations formed by punch 204, by punch 206.

Whilst, in the arrangement described in Figures 13 to 16, the laminations 158, 164 are interconnected by a single cooperating protrusion 163 and recess 161, the end of each leg 146*b* could be provided with further protrusions to cooperate with corresponding recesses on legs 158*b*. Again, the location of the or each protrusion and recess may be interchanged so that the or each recess is on leg 164*b* and the or each protrusion is on arm 158*b*.

In the described constructions, the cores have air gaps, but for some applications, such an air gap is not necessary. Figure 18 shows a core similar to core 152, like parts being designated with like reference numerals, in which the laminations 158, 164 are so modified that the legs 158*a* have protrusions 163 at the free ends of which engage recesses 161 in legs 164*a*. This results in the trunk portion 160 of the core being magnetically continuous with intermediate portion 160 of the core being magnetically continuous with intermediate portion 166 with no air gap being provided. This is a particularly sturdy and magnetically effective structure which could be used for a transformer.

Whilst the described protrusions 163 and recesses 161 are rectangular, and the described openings 170 are circular, other configurations could of course be used.

In each described arrangement, the direction of grain orientation of the steel used to form the lamination sections is, as illustrated by arrows 201 in Figure 14, at 45° to the direction of extent of the lamination legs. This provides a particularly satisfactory magnetic circuit, particularly when the directions within individual sections are oriented as shown in Figure 14.

The described construction has been advanced merely by way of explanation and many modifications may be made thereto without departing from the scope of the invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A core of magnetically permeable material comprising first, second, third and fourth lengthwise extending parts, said parts having transverse cross-sections each defining two legs arranged in a respective L-shape form, the first and second parts being juxtaposed so that, together, in transverse cross-section, they present a T-shape form, with a trunk portion of the T-shape comprised by adjacent side-by-side first legs of said first and second parts, a cross portion of the T-shape extending across one end of said trunk portion, said cross portion being

formed by aligned second legs of said first and second parts; said third and fourth parts being juxtaposed so that in transverse cross-section they present a U-shape form with second legs of the third and fourth parts in aligned end-to-end juxtaposition to form an intermediate portion of the U-shape and with first legs of said third and fourth sections forming respective opposed end portions of the U-shape, each end portion extending transversely to the intermediate portion; said parts being assembled together so that said trunk portion is parallel to, between, and spaced from the said end portions and with free ends of the end portions terminating at or adjacent respective free ends of said cross portion, and with said trunk portion terminating at or adjacent said intermediate portion, said parts being formed of stacks of laminations having the shape of said respective L-shape forms.

2. A core according to Claim 1, wherein the core is held together by adhesive.

3. A core according to Claim 1 or 2, which core has an air gap between said intermediate portion and said trunk portion.

4. A core according to Claim 3, wherein the cross portion of said T-shape form extends between opposed inner sides of the respective said end portions, and such that, as viewed in the lengthwise direction of said core, the ends of the cross portion fit with small clearance from the respective inner sides of said end portions whereby the first and second parts, comprising the T-shape form, may prior to final assembly be slid in the direction of extent of said inner sides relative to the parts comprising said U-shape form to vary the said air gap.

5. A core according to any one of Claims 1 to 3, wherein, as viewed in the lengthwise direction of said core, the ends of the cross portion of said T-shape form are spaced apart a distance greater than the distance between opposed inner sides of the respective said end portions so that the ends of said end portions abut against the side of the cross portion at locations towards respective ends thereof.

6. A core according to any one of Claims 1 to 5, wherein at least one leg of each of one pair of said parts has a respective recess, extending in the direction of extent of that part, and at least one leg of each of the other pair of said parts is provided with a respective protrusion, extending in the lengthwise direction of that part, each protrusion being engaged in a respective separate cooperating one of said recesses so that the cooperating protrusions and recesses key the parts of said one pair to respective ones of said other pair.

7. A core according to Claim 6, wherein said recesses are provided in sides of said second legs of said first and second parts and said protrusions are provided in the free ends of said first legs of said third and fourth portions.

8. A core according to Claim 7 when dependent on Claim 4, wherein said recesses are of substantially rectangular configuration when viewed in the direction of extent of said first and second parts and said protrusions are of complementary configuration, having one side colinear and constituting an extension to a respective one of said opposed inner sides.

9. A core according to Claim 8, wherein cut out portions are provided in the laminations comprising said first and second parts, said cut outs being provided adjacent the junction between the first and second legs of each such lamination and positioned close to the outer corner of the respective said L-shape form.

10. A core according to Claim 9, wherein said cut outs are circular.

11. A core according to any one of the preceding claims, wherein each said lamination is formed from grain oriented steel with the direction of said grain substantially 45° to the direction of extent of each said leg.

12. An inductive component formed from a core according to any one of the preceding claims and with an electrical winding around said trunk portion.

13. A method for forming a core of magnetically permeable material, which method comprises:

forming laminations, each lamination being of L-shaped configuration having first and second legs which extend normally away from a junction thereof to free ends thereof the first and second legs having respective first and second linear outer edges which extend from an outer corner of the lamination to the free ends of the legs, and respective first and second inner edges extending from an inner corner of the lamination to the free ends of the legs, the first and second inner edges being parallel to the respective first and second outer edges, the legs terminating in first and second end edges extending between the inner and outer edges of the respective first and second legs, said forming of the lamination being effected by stamping or otherwise cutting the laminations from a strip of magnetically permeable material, with the said inner and outer edges being cut at substantially 45° to the direction of extent of the strip, the cutting being effected such that the or each cut forming, to one side of this cut, an inner edge of a said lamination also forms, to the other side of that cut, at least part of an outer edge of an adjacent lamination which is formed at a location on said strip spaced from the first mentioned lamination in the direction of extent of the strip;

assembling said laminations in stacks to form first, second, third and fourth lengthwise extending core parts, said parts having transverse cross-sections each defining two legs arranged in a respective L-shape form corresponding to the shape of said laminations;

juxtaposing the first and second parts so that, together, in transverse cross-section, they present a T-shape form, with a trunk portion of the T-shape comprised by adjacent side-by-side

first legs of said first and second parts, a cross portion of the T-shape extending across one end of said trunk portion, said cross portion being formed by aligned second legs of said first and second parts;

juxtaposing said third and fourth parts so that in transverse cross-section they present a U-shape form with second legs of the third and fourth parts in aligned end-to-end juxtaposition to form an intermediate portion of the U-shape and with first legs of said third and fourth sections forming respective opposed end portions of the U-shape, each end portion extending transversely to the intermediate portion; and

assembling said parts together, after said juxtaposing to define said T-shape and U-shape forms so that said trunk portion is parallel to, between, and spaced from the said end portions and with free ends of the end portions terminating at or adjacent respective free ends of said cross portion, and with said trunk portion terminating at or adjacent said intermediate portion.

14. A method according to Claim 13, wherein said outer edges are formed by a punch having a pair of cutting edges arranged in a V-shape configuration.

15. A method according to Claim 13 or 14, wherein part only of said outer edges is formed by the or each said cut and the remainder of each outer edge is formed by a separate punching or other cutting operation.

16. A method according to Claim 15, wherein a single lengthwise row of laminations is formed along the length of said strip, and the said remainders are formed by punches arranged to cut notches from either side of the strip, the edges of the notches then defining the said remainders as well as the end edges of the laminations.

17. A method according to Claim 14, wherein more than one lengthwise extending side-by-side row of said laminations is formed from said strip; and part of the outer edge, and the end edge of one said leg of each lamination in each outermost row is formed by punching a notch in the corresponding edge of said strip; the end edges of the other said legs of the laminations of said outermost rows and all the end edges of the laminations of inner ones of said rows being formed by punches which produce to opposite sides of single cuts thereof these end edges and parts of the outer edges of laminations in respective adjacent said rows.

18. A method according to Claim 17, wherein four said side-by-side rows of laminations are formed from said strip and the said end edge of said one leg of each lamination in an outermost said row is so configured as to form a protrusion on the end of each such leg and a punch is provided to form in an inner edge of each lamination of said innermost rows a cut out portion so configured and positioned as to enable it to accommodate a said protrusion neatly so that a lamination from said outer row can, by engagement of its protrusion with the cut out portion of a lamination of an innermost one of said rows locate these two laminations so that the legs of these two laminations are keyed together and the laminations form a laminar element of a rectangular shape.

19. A method of forming an inductive component having a core according to Claim 1 and an electrically conductive winding thereon, which method comprises

forming said first, second, third and fourth parts;

juxtaposing said first and second parts to define said T-shape form;

winding said winding around said trunk part; and

assembling said first members together with said third and fourth parts to define said component.

20. A method according to Claim 19, wherein adhesive is applied to bond said core together.

21. A method according to Claim 19, wherein said first and second parts are secured together before said winding is effected, to form a first member whose cross-section defines said T-shape form, said third and fourth parts being separately secured together to form a second member whose cross-section defines said U-shape form and said assembly being effected by securing said first and second members together.

22. A method according to Claim 19, 20 or 21, wherein each said part is formed by adhering the laminations thereof together, said members are formed by adhering the said component parts together and the core is formed by adhering said members together.

23. A core of magnetically permeable material, substantially as hereinbefore described with reference to, and as shown in, Figures 1 to 3 of the accompanying drawings.

24. A core of magnetically permeable material, substantially as hereinbefore described with reference to, and as shown in, Figures 5 and 8 of the accompanying drawings.

25. A core of magnetically permeable material, substantially as hereinbefore described with reference to, and as shown in, Figures 6 and 9 of the accompanying drawings.

26. A core of magnetically permeable material, substantially as hereinbefore described with reference to, and as shown in, Figures 7 and 10 of the accompanying drawings.

27. A core of magnetically permeable material, substantially as hereinbefore described with reference to, and as shown in, Figure 11 of the accompanying drawings.

28. A core of magnetically permeable material, substantially as hereinbefore described with reference to, and as shown in, Figures 13 to 17 of the accompanying drawings.

29. A core of magnetically permeable material, substantially as hereinbefore described

with reference to, and as shown in, Figure 18 of the accompanying drawings.

30. A core whenever prepared using the method of any one of Claims 13 to 22.

31. An inductive component comprising the core of any one of Claims 23 to 30.

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1591131 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

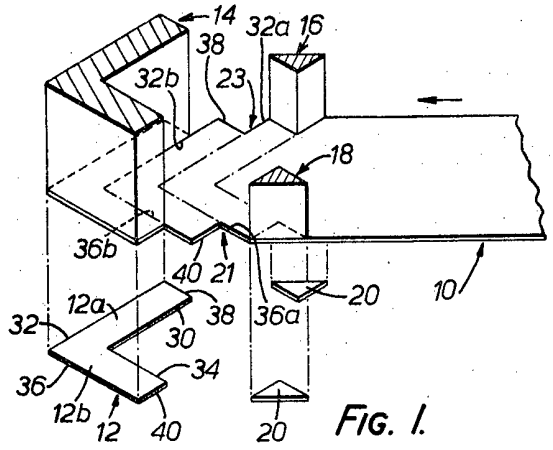


FIG. 1.

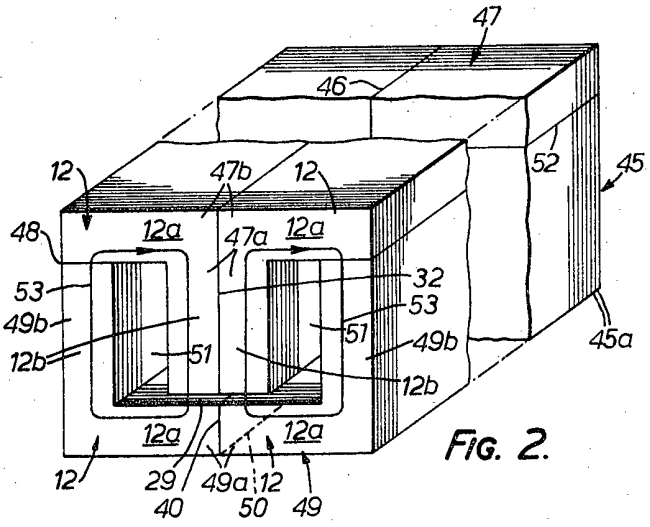


FIG. 2.

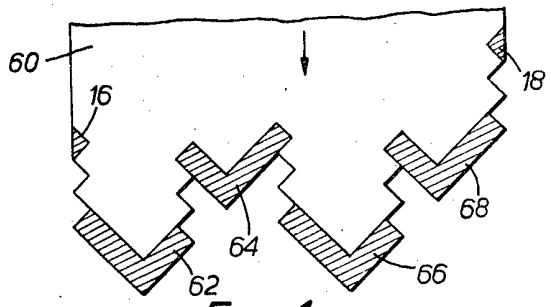


FIG. 4.

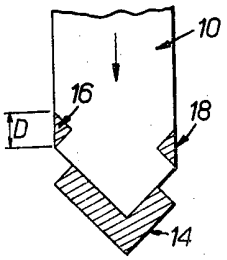


FIG. 3.

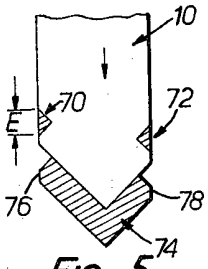


FIG. 5.

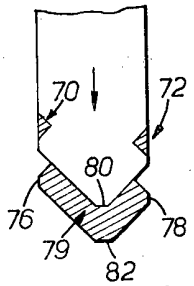
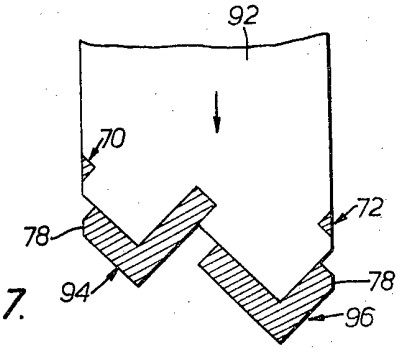


FIG. 6.



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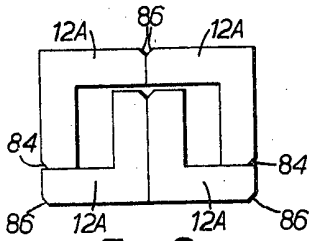


FIG. 8.

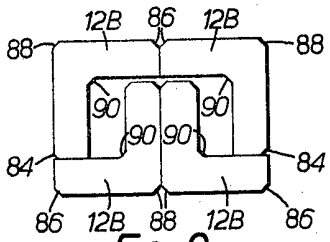


FIG. 9.

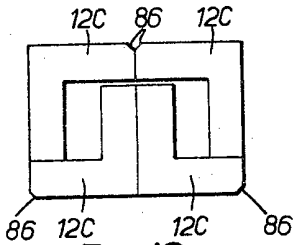


FIG. 10.

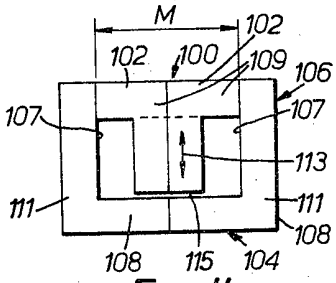


FIG. 11.

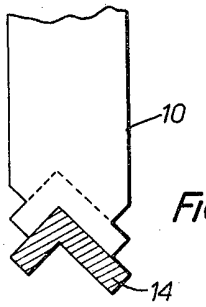


FIG. 12.

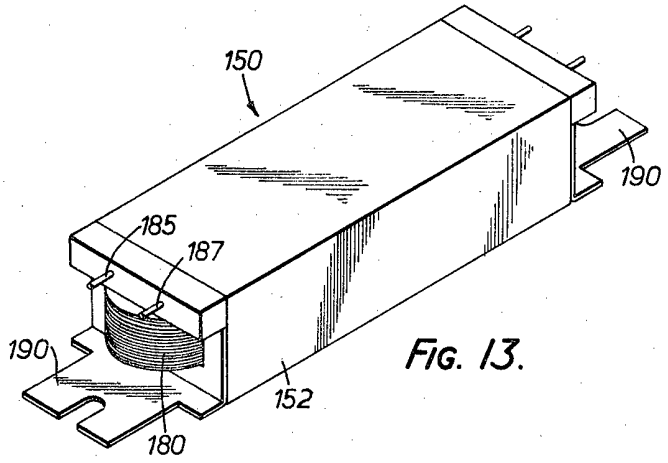


FIG. 13.

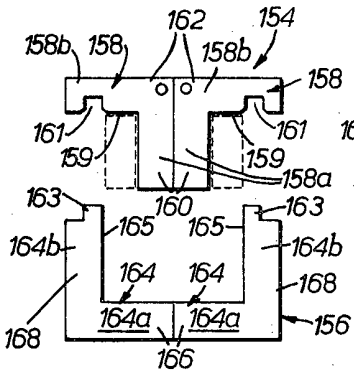
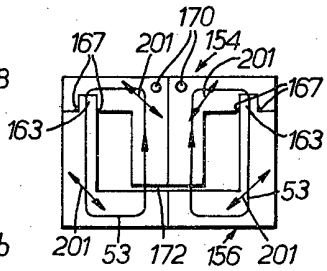


FIG. 15.



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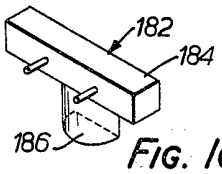

FIG. 16.

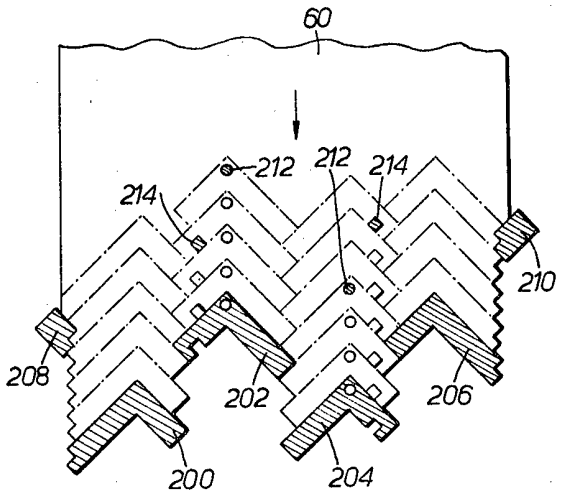
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FIG. 17.

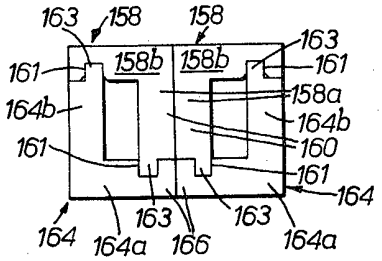
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FIG. 18.