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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) MANUFACTURING METHOD OF TRANSFORMER CIRCUIT BOARD AND TRANSFORMER THEREOF

(57) A manufacturing method of transformer circuit board (100) includes following steps: plate stamping (S1), forming a plurality of metal plates (10) with a stamping mold; primary layering (S2), layering the metal plates (10) that are in alignment with each other between two outer insulation layers (20), with an inner insulation layer (21) disposed between the two metal plates (10); primary pressing (S3), hot pressing the metal plates (10) to fix the metal plates (10) between the two outer insulation layers (20); secondary layering (S4), layering another metal plate (10) on the outer side of the two outer insulation layers (20), respectively, corresponding to the positions of the previously layered metal plates (10); secondary pressing (S5), hot pressing the metal plates (10) on the outer side of the outer insulation layers (20), and printing to form a solder mask layer (30) on the outer insulation layers (20). Finally, cutting to form a transformer circuit board (100) with low leakage inductance and high EMI shield.

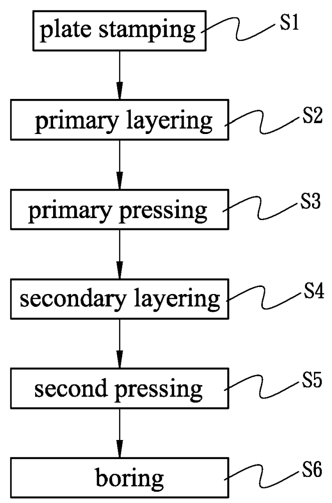

FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

[0001] The present invention relates to transformers, and more particularly, to a manufacturing method of transformer circuit board and transformer thereof.

2. Description of the Related Art:

[0002] Generally, the manufacturing process of a transformer will set up the copper wire diameter, the amount of wire rounds, and a plurality of windings according to the demands upon performance, voltage, current, inductance, leakage inductance, magnetic saturation efficiency, and layout.

[0003] A conventional manufacturing method of a transformer circuit board applies a photographing technique for manufacturing the layout. During the manufacturing process, exposing, developing, etching, boring, and electroplating operations are carried out on a copper foil, so as to manufacture the needed layout of each layer structure. Then, the layout of each layer structures are pressed to be combined into a complete printed circuit board, which is then combined with magnetic core. During the layout manufacturing process, a chemical agent is applied for etching the surface of the copper foil. However, a lateral etching might be caused during the etching process. In other words, the upper layer of the layout is etched for a duration longer than the bottom portion of the layout. As a result, the upper layer of the layout becomes narrower than the bottom portion of the layout. Therein, the diameter of the copper foil layout varies due to lateral etching effect, thus affecting the property of the transformer.

[0004] Specifically, the lateral etching of the copper foil surface easily causes an uneven flow of glue during the combination process. As a result, recess is easily produced on the copper foil of different layer structures. More seriously, bubbles or incomplete adherence might be caused between layer structures, which might even cause the separation of layer structures, leading to the discard of products and failing to achieve a stabilized manufacturing process.

[0005] Also, the manufacturing of the copper foil layout is complicated with the use of various chemical agents, which might cause danger upon the manufacturing environment. Further, the application of chemical agents is unable to effectively control the manufacturing quality of the layout, and might also cause the lateral etching effect of the copper foil. As a result, the manufacturing efficiency and yield rate of the transformer circuit board is affected.

SUMMARY OF THE INVENTION

[0006] For improving the manufacturing issues of the transformer circuit board, a manufacturing method of transformer circuit board is disclosed. With the layout on the copper foil being stamping molded without the operations of exposing, developing, and etching, the lateral etching issues is resolved, and the yield rate of the transformer circuit board is improved.

[0007] For achieving the aforementioned objectives, the manufacturing method of transformer circuit board is provided, comprising steps of:

plate stamping, forming a plurality of metal plates with a stamping mold, the metal plates having an alignment hole, respectively, the alignment holes being arranged in an axial alignment;
primary layering, layering the metal plates between two outer insulation layers and placing the metal plates in axial alignment with each other by use of the alignment holes, with an inner insulation layer disposed between two neighboring metal plates, so as to form a multi-layer structure having a plurality of metal plates and inner insulation layer;
primary pressing, hot pressing to combine the outer insulation layers and the inner insulation layer in a thermal melting manner to fix the metal plates between the two outer insulation layers;
secondary layering, layering another metal plate on an outer side of the two outer insulation layers, respectively, at a position corresponding to positions of the alignment holes of the previously layered metal plates; and
secondary pressing, hot pressing the metal plates on the outer side of the outer insulation layers to achieve a tight combination thereof, and printing to form a solder mask layer on each of the outer insulation layers, and cutting to form a transformer circuit board.

[0008] A transformer in accordance with an embodiment of the present invention is provided, comprising the transformer circuit board formed by the manufacturing method aforementioned.

[0009] Therefore, the metal plates of the present invention are stamped to be formed with corresponding mold, so as to replace the conventional operations of exposing, developing, and etching by use of chemical agents, thus preventing lateral etching upon copper foil from occurring and improving the yield rate of the manufacturing process of transformer circuit board. Also, consistency of the layouts on each metal plate is enhanced, thus improving the production quality and efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a flow chart of operation steps in accordance with an embodiment of the present invention.
Fig. 2 is a schematic view illustrating the structure

of a singular transformer circuit board.

Fig. 3 is a schematic view illustrating the structure of each layer of metal plate.

Fig. 4 is a schematic view of the operation of primary layering Step in accordance with the present invention, illustrating the second metal plate and the third metal plate placed on two sides of the inner insulation layer.

Fig. 5 is a schematic view of the operation of primary layering Step, illustrating two outer insulation layers placed on the second metal plate and the third metal plate, respectively.

Fig. 6 is a schematic view of the operation of primary pressing Step.

Fig. 7 is a sectional view of the present invention after the primary pressing Step.

Fig. 8 is a schematic view of the operation of secondary layering step, illustrating the first metal plate and the fourth metal plated placed on the outer insulation layer, respectively.

Fig. 9 is a schematic view of the operation of secondary pressing step.

Fig. 10 is a schematic view of the operation of boring Step.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The aforementioned and further advantages and features of the present invention will be understood by reference to the description of the preferred embodiment in conjunction with the accompanying drawings.

[0012] Referring to **Fig. 1** to **Fig. 10**, a manufacturing method of transformer circuit board **100** and transformer thereof are provided, the method comprising following steps: plate stamping **S1**, primary layering **S2**, primary pressing **S3**, secondary layering **S4**, secondary pressing **S5**, and boring **S6**.

[0013] In plate stamping **S1** step, as shown by **Fig. 1** to **Fig. 3**, a plurality of metal plates **10** are formed by use of a stamping mold, wherein each metal plate **10** is allowed to be formed in a different shape. In an embodiment of the present invention, each metal plate **10** is a self-adhesive copper foil, and the stamping mold for stamping each metal plate **10** is manufactured by CNC lathe or laser engraving. Therein, each metal plate **10** has an alignment hole **101** disposed at the center of the metal plate **10**, respectively, and the alignment holes **101** are arranged in an axial alignment. As for different metal plates **10**, the inner layout of each metal plate **10** will differ according to different layering orders.

[0014] In primary layering **S2** step, as shown by **Fig. 1** to **Fig. 5**, a plurality of metal plates **10** of each layer are equidistantly placed in a horizontal alignment, and the metal plate **10** of two neighboring layers are placed in a vertical alignment, so as to manufacture a plurality of transformer circuit boards **100** in a single time. Therefore, the manufacturing efficiency is significantly improved. However, the embodiment of the present invention is illustrated with a singular transformer circuit board **100**. Therein, the primary layering **S2** step of the transformer circuit board **100** is illustrated below. First, a plurality of metal plates **10** are vertically layered between two outer insulation layers **20**, and the metal plates **10** are arranged in alignment by the alignment holes **101**, with an inner insulation layer **21** disposed between each two neighboring metal plate **10**, so as to form a plurality of metal plates **10** and inner insulation layer **21** that are alternately layered. In an embodiment of the present invention, two layers of metal plates **10** are layered between two outer insulation layers **20**, with a singular inner insulation layer **21** disposed between the two metal plates **10**. However, the present invention is not limited to such disclosure. The metal plates **10** between the two outer insulation layers **20** are allowed to be layered to more than two layers. Also, the outer insulation layer **20** and the inner insulation layer **21** are glass fiber resin sheets having consistent area and thickness.

[0015] Notably, the corresponding vertical positions of the metal plates **10** on each layer are important, such that any deviation will invalidate the conduction between the layouts. Therefore, the self-adhesive metal plates **10** of each layer are allowed to be manually layered or layered by use of automatic equipment. Therein, regarding to the manually layering manner, the relative positions are projected on two sides of the corresponding inner insulations through infrared rays with a layout patterns in a 1:1 scale. Next, each self-adhesive metal plate **10** is adhered on the target position on each inner insulation layer **21**. Finally, the outer insulation layers **20** are placed on each corresponding metal plate **10**, such that the metal plate **10** are layered between two outer insulation layers **20**. Regarding the automatically layering manner, each metal plate **10** is grabbed by mechanical arm of the automatic equipment, so as to be placed on the relative position corresponding to each inner insulation layer **21**. Therefore, two metal plate **10** are accurately layered, and the outer insulation layers **20** are then placed on each metal plate **10** by the mechanical arm.

[0016] In the primary pressing **S3** step, as shown by **Fig. 1** and **Fig. 6**, the neighboring outer insulation layers **20** and the inner insulation layer **21** are hot-pressed by a hot press machine **40**, so as to fill the gap between the outer insulation layer **20** and the inner insulation layer **21** by thermal melting. Therefore, the metal plate **10** is fixed between the two outer insulation layers **20**, and the thermally melted combination between the outer insulation layer **20** and the inner insulation layer **21** is evenly distributed.

[0017] In the secondary layering **S4** step, as shown by **Fig. 1**, **Fig. 7**, and **Fig. 8**, after the primary pressing **S3**, the aforementioned manually or automatically layering process is repeated, so as to layer another metal plate **10** on the outer side of each outer insulation layer **20** with the alignment holes **101** of each metal plate **10** being arranged in alignment. No additional insulations are needed to be placed. Therefore, the metal plate **10** is formed in a four-layer structured. For further improving the accuracy of the layering position of metal plates **10** on each layer, when the layering process is complete, the layering positions and layouts of the metal plates **10** are scanned by X-ray for preventing any deviations from existing, thus precisely improving the accuracy of the layering position of the metal plates **10**.

[0018] More specifically, the metal plate **10** of the present invention comprises a first metal plate **11**, a second metal plate **12**, a third metal plate **13**, and a fourth metal plate **14**, wherein the first metal plate **11** and the fourth metal plate **14** are disposed on the outer side of the two outer insulation layers **20**, respectively, and the second metal plate **12** and the third metal plate **13** are disposed on the inner side of the two outer insulation layers **20** and the two sides of the inner insulation layer **21**, respectively. Therefore, the inner insulation layer **21** is positioned between the second metal plate **12** and the third metal plate **13**. Therein, the layout of the first metal plate **11** is identical to the layout of the fourth metal plate **14**, and the layout of the second metal plate **12** is identical to the layout of the third metal plate **13**, while the layout of the first metal plate **11** is different from the layout of the second metal plate **12**. As shown by **Fig. 2**, **Fig. 3**, and **Fig. 8**, when the metal plate **10** is alternately layered with each outer insulation layer **20** and each inner insulation layer **21**, the first metal plate **11** and the fourth metal plate **14** are horizontally presented in a mirror image; also, the second metal plate **12** and the third metal plate **13** are horizontally presented in a mirror image. Therefore, after the vertical layering process, the first metal plate **11** and the fourth metal plate **14** are structurally reversed; the second metal plate **12** and the third metal plate **13** are structurally reversed.

[0019] In the secondary pressing **S5** step, as shown by **Fig. 1** and **Fig. 9**, the hot press machine **40** is applied again for assuring that the first metal plate **11** and the fourth metal plate **14** are stably adhered on the two outer insulation layers **20**, respectively.

[0020] In the boring **S6** step, as shown by **Fig. 10**, an amount of through bores for electrical conduction are formed according to different demands. An automatic boring machine is applied for boring the layout of each metal plate **10**, so as to form the needed through bores, and the through bores of the metal plates **10** of each layer are then electroplated by a horizontal electroplating equipment. Then, a solder mask ink is coated on the outer side of each outer insulation layer **20** to undergo a screen printing process, so as to form a solder mask layer **30** on each outer insulation layer **20** for protecting the metal plates **10** exposed on the outer side of the outer insulation layer **20**, thus preventing short cut or open cut due to scrape from occurring, and achieving a solder mask function. Subsequently, the solder mask layer **30** is plated with an anti-oxidative layer for preventing the exposed solder mask layer **30** and through bores from oxidation, facilitating further soldering operation. Then, the whole metal plate **10** is cut by a forming machine to form a transformer circuit board **100** in the target size.

[0021] Subsequently, each through bore is soldered with a connection pillar **50** for fixing the structure of the transformer circuit board **100**. In an embodiment of the present invention, each connection pillar **50** is formed in a column shape tapering from the bottom to the top. Also, each connection pillar **50** has a helical surface which is favorable for the solder to flow into a guide groove **51** of each connection pillar **50**.

[0022] Finally, the transformer circuit board **100** is glued with a matched magnetic core to form a transformer, which subsequently undergoes various property tests of different inspection instruments, including inductance, coils ratio, leakage inductance, voltage, and pressure resistance. Therefore, a transformer with low leakage inductance and high electro-magnetic interference shield is acquired.

[0023] To sum up, the present invention achieves several advantages.

[0024] The metal plates **10** of the present invention are stamped to be formed with corresponding mold, so as to replace the conventional operations of exposing, developing, and etching by use of chemical agents, thus preventing lateral etching upon copper foil from occurring and improving the yield rate of the manufacturing process of transformer circuit board **100**. Also, consistency of the layouts on each metal plate **10** is enhanced, thus improving the production quality and efficiency.

[0025] Also, with an accurate alignment during the layering process, the metal plates **10** of each layer are arranged in a precise alignment for preventing positional deviation between the metal plates **10** from occurring. In addition, the manufacturing process of the metal plates **10** of the present invention eliminates the issues of lateral etching, so as to further increase the stability of transformer circuit board **100**. Also, the transformer circuit board **100** is combined with corresponding magnetic core, thus forming a transformer having low leakage inductance and high electro-magnetic interference shield.

[0026] Although particular embodiments of the invention have been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

Claims

1. A manufacturing method of transformer circuit board (100), comprising following steps:

   plate stamping (S1), forming a plurality of metal plates (10) with a stamping mold, each metal plate (10) having an alignment hole (101), respectively, the alignment holes (101) of the metal plates (10) being arranged in an axial alignment;

primary layering (S2), layering the metal plates (10) between two outer insulation layers (20) and placing the metal plates (10) in axial alignment with each other by aligning the alignment holes (101), with an inner insulation layer (21) disposed between two neighboring metal plates (10), so as to form a multi-layer structure having a plurality of metal plates (10) and inner insulation layer (21) alternately arranged;
primary pressing (S3), hot pressing to combine the outer insulation layers (20) and the inner insulation layer (21) in a thermal melting manner to fix the metal plates (10) between the two outer insulation layers (20);
secondary layering (S4), layering another metal plate (10) on an outer side of the two outer insulation layers (20), respectively, at a position corresponding to positions of the alignment holes (101) of the previously placed metal plates (10); and
secondary pressing (S5), hot pressing the metal plates (10) on the outer side of the outer insulation layers (20) to achieve a tight combination thereof, and screen printing to form a solder mask layer (30) on each of the outer insulation layers (20), and cutting to form a transformer circuit board (100).

2. The method of claim 1, wherein in the primary layering (S2) step and the secondary layering (S4) step, the metal plates (10) of each layer are placed in a vertical alignment; also, relative positions between the metal plates (10) and layouts on the metal plates (10) are scanned with X-ray for calibrating any deviations thereof.

3. The method of claim 2, wherein in the primary layering (S2) step, the metal plates (10) of each layer are self-adhesive and manually layered up; the relative positions of the metal plates (10) are projected on corresponding target positions on the inner insulation layers (21) through infrared rays with a layout patterns in a 1:1 scale, and each self-adhesive metal plate (10) is manually adhered on target positions of each inner insulation layer (21), with each outer insulation layer (20) being disposed afterward.

4. The method of claim 3, wherein in the secondary layering (S4) step, each self-adhesive metal plate (10) is manually positioned and adhered to a target position on the outer insulation layer (20) and arranged in alignment with the metal plate (10) on an inner side of the outer insulation layer (20); each metal plate (10) comprises a first metal plate (11), a second metal plate (12), a third metal plate (13), and a fourth metal plate (14), wherein the first metal plate (11) and the fourth metal plate (14) are disposed on the outer side of the two outer insulation layers (20), and the second metal plate (12) and the third metal plate (13) are orderly disposed on the inner side of the two outer insulation layers (20) between the two outer insulation layers (20), with the inner insulation layer (21) disposed in the second metal plate (12) and the third metal plate (13); when the metal plates (10) are alternately layered with the outer insulation layers (20) and the inner insulation layer (21), the first metal plate (11) and the fourth metal plate (14) are structurally reversed, and the second metal plate (12) and the third metal plate (14) are structurally reversed.

5. The method of claim 2, wherein in the primary layering (S2) step, the metal plates (10) of each layer are self-adhesive and automatically layered up, wherein each metal plate (10) is grabbed by a mechanical arm of an automatic equipment, so as to be placed and adhered on the relative position corresponding to the position of the metal plate (10) on each inner insulation layer (21), and then the outer insulation layers (20) are placed.

6. The method of claim 5, wherein in the secondary layering (S4) step, each self-adhesive metal plate (10) is positioned to a target position on the outer insulation layer (20) and arranged in alignment with the metal plate (10) on an inner side of the outer insulation layer (20); each metal plate (10) comprises a first metal plate (11), a second metal plate (12), a third metal plate (13), and a fourth metal plate (14), wherein the first metal plate (11) and the fourth metal plate (14) are disposed on the outer side of the two outer insulation layers (20), and the second metal plate (12) and the third metal plate (13) are orderly disposed on the inner side of the two outer insulation layers (20) between the two outer insulation layers (20), with the inner insulation layer (21) disposed in the second metal plate (12) and the third metal plate (13); when the metal plates (10) are alternately layered with the outer insulation layers (20) and the inner insulation layer (21), the first metal plate (11) and the fourth metal plate (14) are structurally reversed, and the second metal plate (12) and the third metal plate (13) are structurally reversed.

7. The method of claim 1, wherein after the secondary pressing (S5) step, a boring (S6) step is further comprised, in which a through bore is formed on a layout of each metal plate (10), and a solder mask layer (30) is printed on each outer insulation layer (20), with a connection pillar (50) soldered for each through bore for fixedly connecting the metal plates (10).

8. The method of claim 7, wherein each connection pillar (50) is formed in a column shape tapering from a bottom portion to a top portion thereof, and each connection pillar (50) has a helical surface for solder material to flow into a guide groove (51) of the connection pillar.

9. The method of claim 1, wherein in the alternately layered up metal plates (10), outer insulation layers (20), and the inner insulation layer (21), a plurality of metal plates (10) of each layer are equidistantly placed in a horizontal alignment, and the metal plates (10) of two neighboring layers are placed in a vertical alignment, so as to manufacture a plurality of transformer circuit boards (100) in a single processing time.

10. A transformer, comprising the transformer circuit board (100) formed by the method of claim 1.

Amended claims in accordance with Rule 137(2) EPC.

1. A manufacturing method of transformer circuit board (100), comprising following steps:

plate stamping (S1), forming a plurality of metal plates (10) with a stamping mold, each metal plate (10) having an alignment hole (101), respectively, the alignment holes (101) of the metal plates (10) being arranged in an axial alignment;
primary layering (S2), layering the metal plates (10) between two outer insulation layers (20) and placing the metal plates (10) in axial alignment with each other by aligning the alignment holes (101), with an inner insulation layer (21) disposed between two neighboring metal plates (10), so as to form a multi-layer structure having a plurality of metal plates (10) and inner insulation layer (21) alternately arranged;
primary pressing (S3), hot pressing to combine the outer insulation layers (20) and the inner insulation layer (21) in a thermal melting manner to fix the metal plates (10) between the two outer insulation layers (20);
characterized by
secondary layering (S4), layering another metal plate (10) on an outer side of the two outer insulation layers (20), respectively, at a position corresponding to positions of the alignment holes (101) of the previously placed metal plates (10);
secondary pressing (S5), hot pressing the metal plates (10) on the outer side of the outer insulation layers (20) to achieve a tight combination thereof; and
boring (S6), forming a through bore on a layout of each metal plate (10), and screen printing to form a solder mask layer (30) on each outer insulation layer (20), with a connection pillar (50) soldered for each through bore for fixing the metal plates (10), and cutting to form a transformer circuit board (100).

2. The method of claim 1, wherein in the primary layering (S2) step and the secondary layering (S4) step, the metal plates (10) of each layer are placed in a vertical alignment; also, relative positions between the metal plates (10) and layouts on the metal plates (10) are scanned with X-ray for calibrating any deviations thereof.

3. The method of claim 2, wherein in the primary layering (S2) step, the metal plates (10) of each layer are self-adhesive and manually layered up; the relative positions of the metal plates (10) are projected on corresponding target positions on the inner insulation layers (21) through infrared rays with a layout patterns in a 1:1 scale, and each self-adhesive metal plate (10) is manually adhered on target positions of each inner insulation layer (21), with each outer insulation layer (20) being disposed afterward.

4. The method of claim 3, wherein in the secondary layering (S4) step, each self-adhesive metal plate (10) is manually positioned and adhered to a target position on the outer insulation layer (20) and arranged in alignment with the metal plate (10) on an inner side of the outer insulation layer (20); each metal plate (10) comprises a first metal plate (11), a second metal plate (12), a third metal plate (13), and a fourth metal plate (14), wherein the first metal plate (11) and the fourth metal plate (14) are disposed on the outer side of the two outer insulation layers (20), and the second metal plate (12) and the third metal plate (13) are orderly disposed on the inner side of the two outer insulation layers (20) between the two outer insulation layers (20), with the inner insulation layer (21) disposed in the second metal plate (12) and the third metal plate (13); when the metal plates (10) are alternately layered with the outer insulation layers (20) and the inner insulation layer (21), the first metal plate (11) and the fourth metal plate (14) are structurally reversed, and the second metal plate (12) and the third metal plate (14) are structurally reversed.

5. The method of claim 2, wherein in the primary layering (S2) step, the metal plates (10) of each layer are self-adhesive and automatically layered up, wherein each metal plate (10) is grabbed by a mechanical arm of an automatic equipment, so as to be placed and adhered on the relative position corresponding to the position of the metal plate (10) on each inner insulation layer (21), and then the outer insulation layers (20) are placed.

6. The method of claim 5, wherein in the secondary layering (S4) step, each self-adhesive metal plate (10) is positioned to a target position on the outer insulation layer (20) and arranged in alignment with the metal plate (10) on an inner side of the outer insulation layer (20); each metal plate (10) comprises a first metal plate (11), a second metal plate (12), a third metal plate (13), and a fourth metal plate (14), wherein the first metal plate (11) and the fourth metal plate (14) are disposed on the outer side of the two outer insulation layers (20), and the second metal plate (12) and the third metal plate (13) are orderly disposed on the inner side of the two outer insulation layers (20) between the two outer insulation layers (20), with the inner insulation layer (21) disposed in the second metal plate (12) and the third metal plate (13); when the metal plates (10) are alternately layered with the outer insulation layers (20) and the inner insulation layer (21), the first metal plate (11) and the fourth metal plate (14) are structurally reversed, and the second metal plate (12) and the third metal plate (13) are structurally reversed.

7. The method of claim 1, wherein each connection pillar (50) is formed in a column shape tapering from a bottom portion to a top portion thereof, and each connection pillar (50) has a helical surface for solder material to flow into a guide groove (51) of the connection pillar.

8. The method of claim 1, wherein in the alternately layered up metal plates (10), outer insulation layers (20), and the inner insulation layer (21), a plurality of metal plates (10) of each layer are equidistantly placed in a horizontal alignment, and the metal plates (10) of two neighboring layers are placed in a vertical alignment, so as to manufacture a plurality of transformer circuit boards (100) in a single processing time.

9. A transformer, comprising the transformer circuit board (100) formed by the method of claim 1.

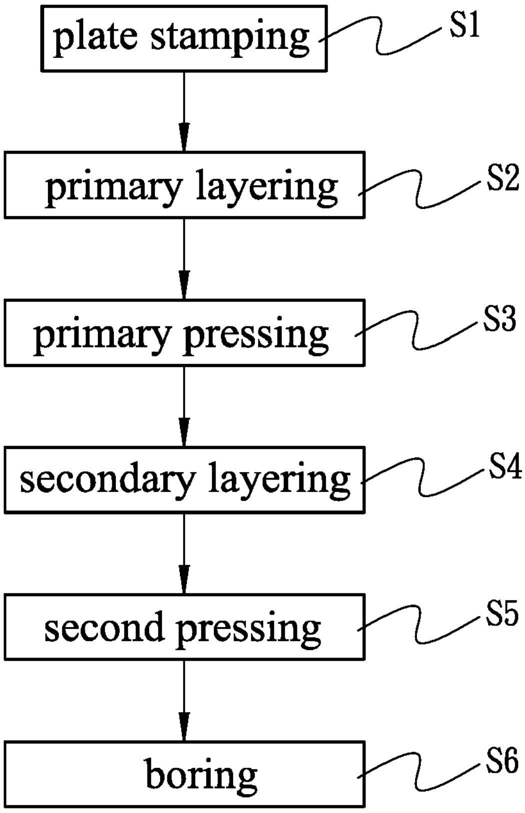
plate stamping
S1
primary layering
S2
primary pressing
S3
secondary layering
S4
second pressing
S5
boring
S6

FIG. 1

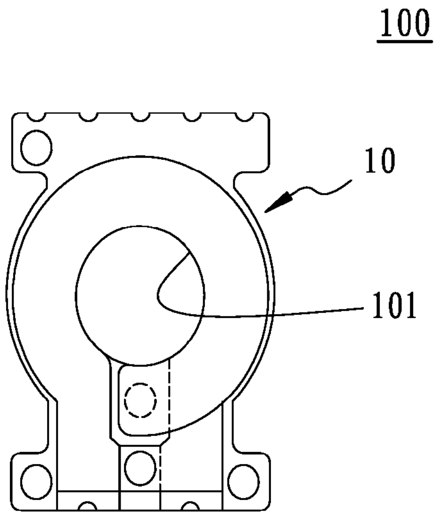

FIG. 2

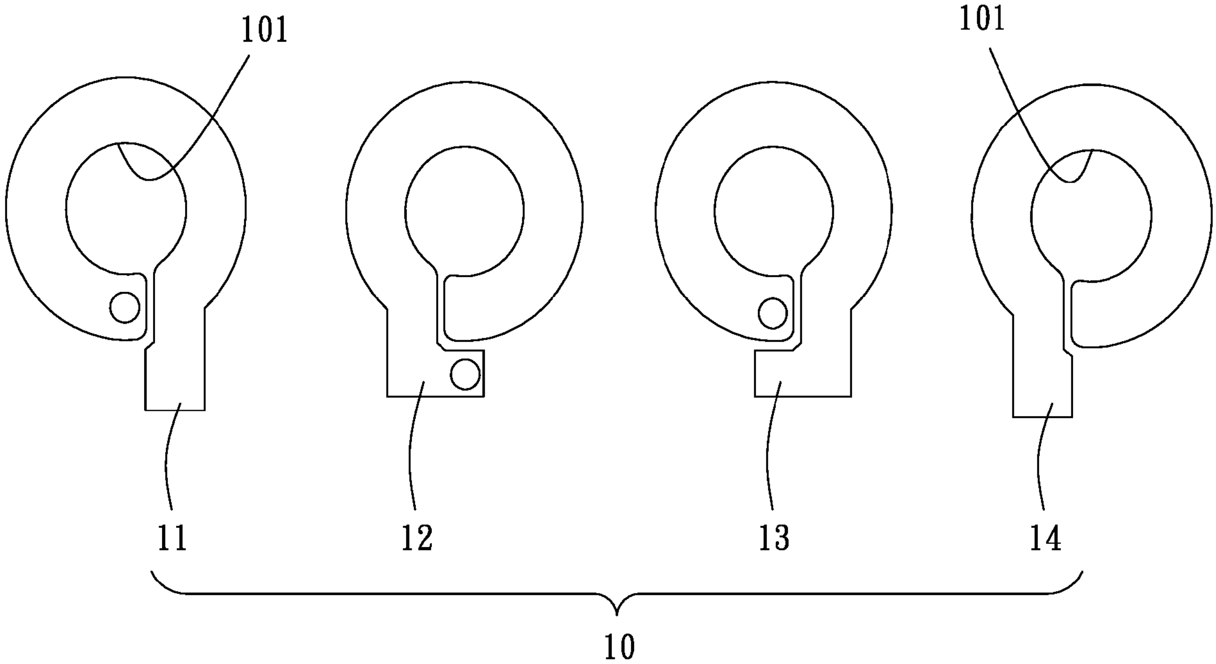

FIG. 3

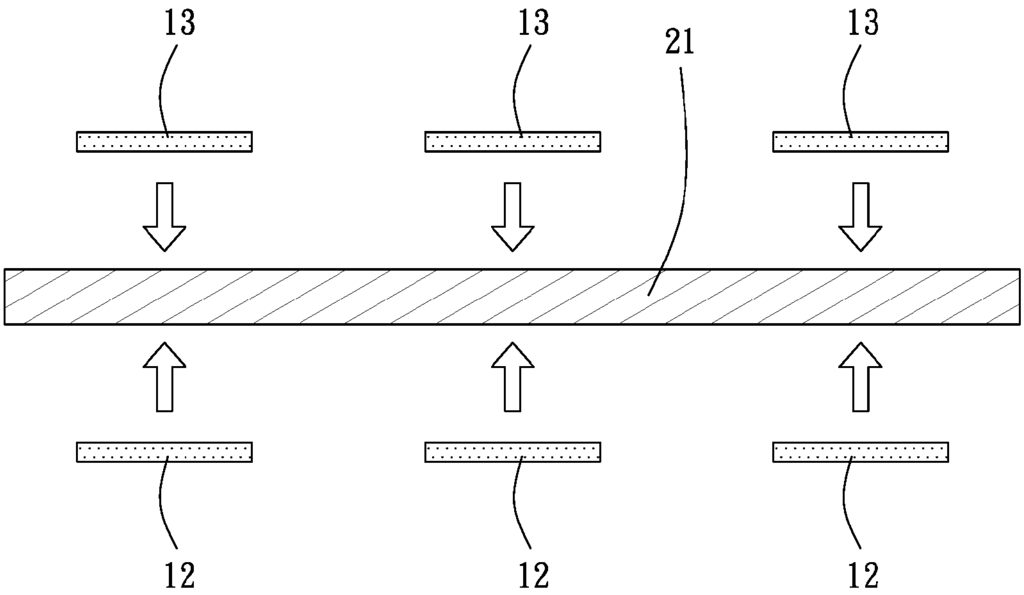

FIG. 4

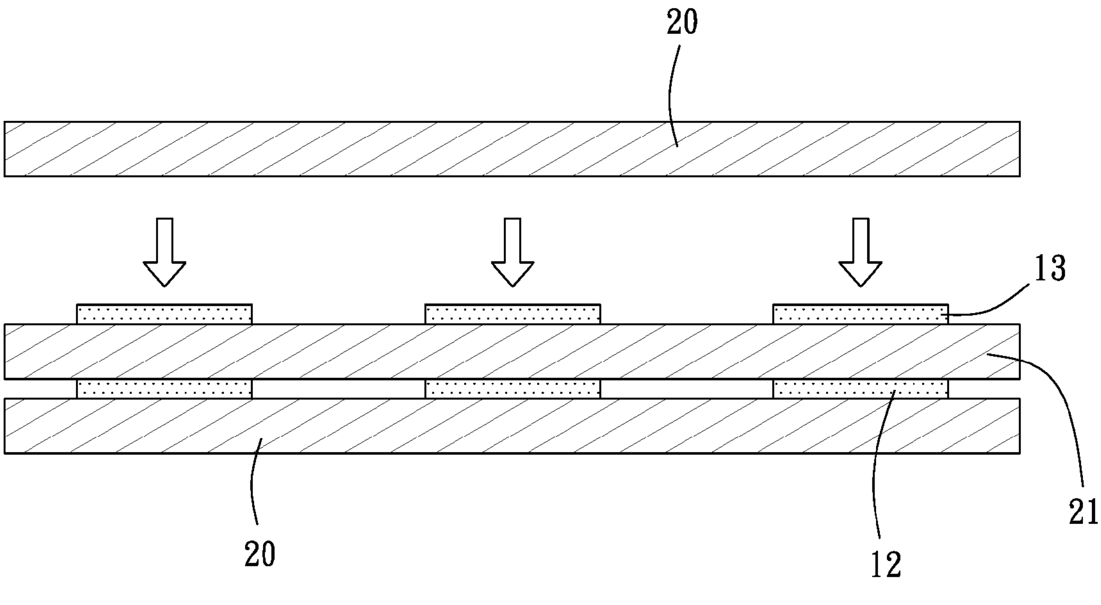

FIG. 5

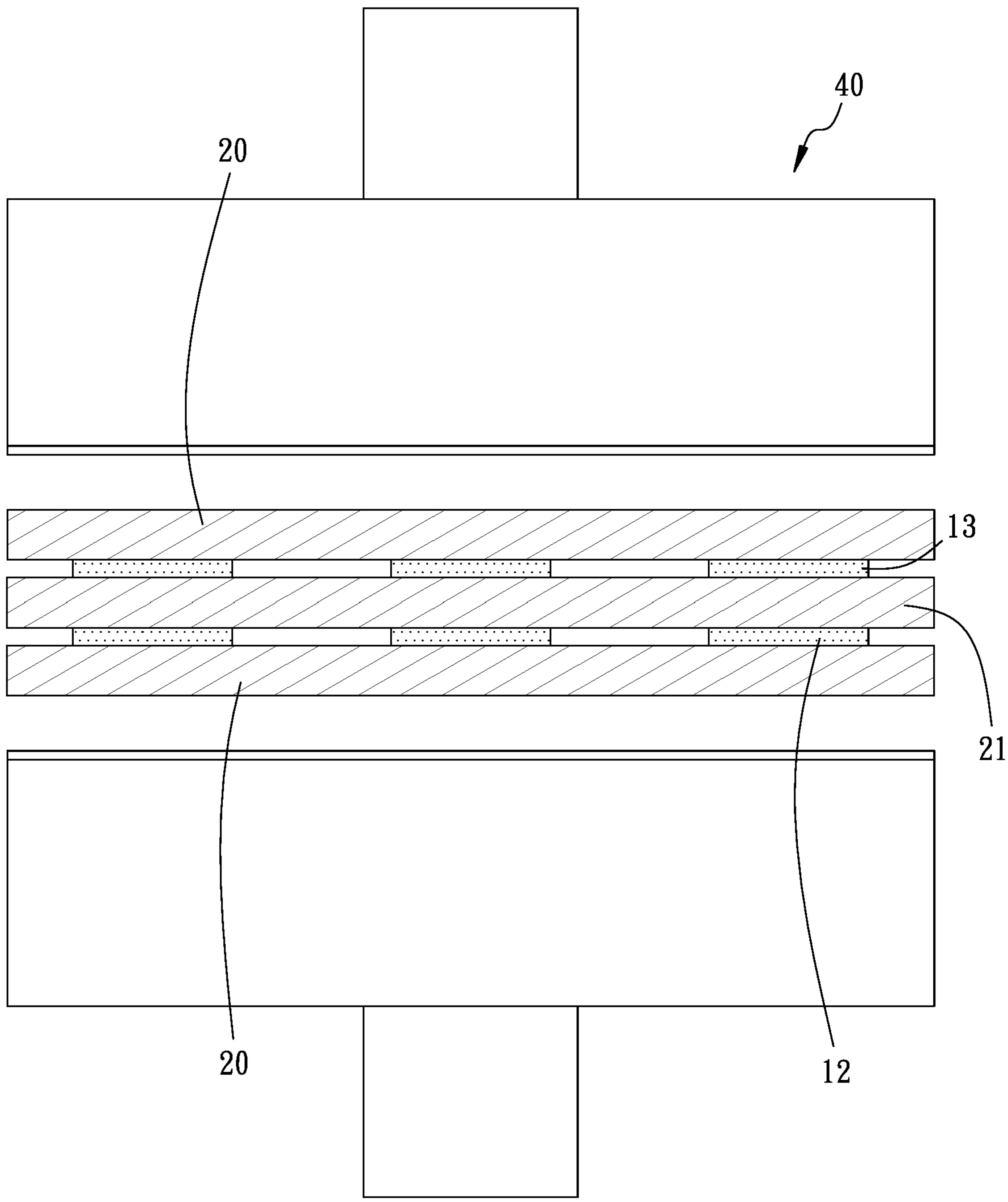

FIG. 6

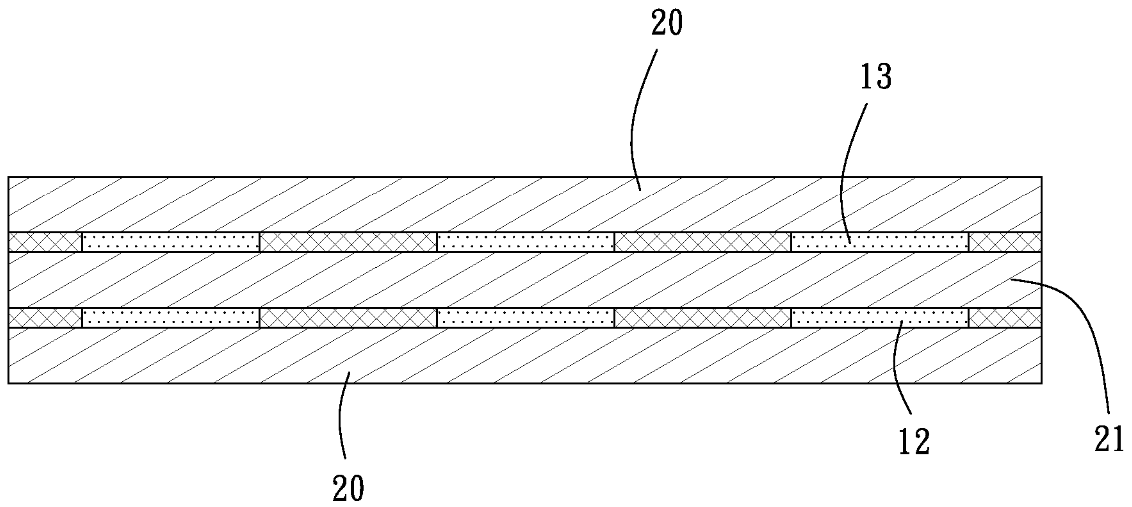

FIG. 7

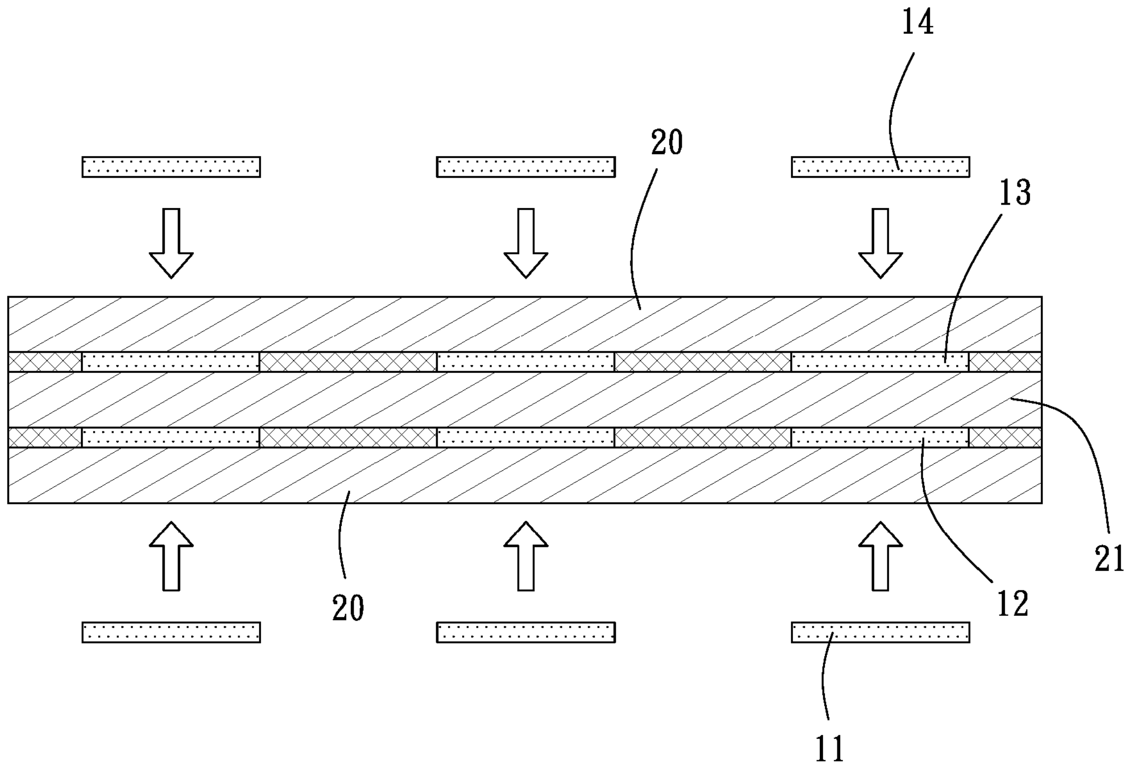

FIG. 8

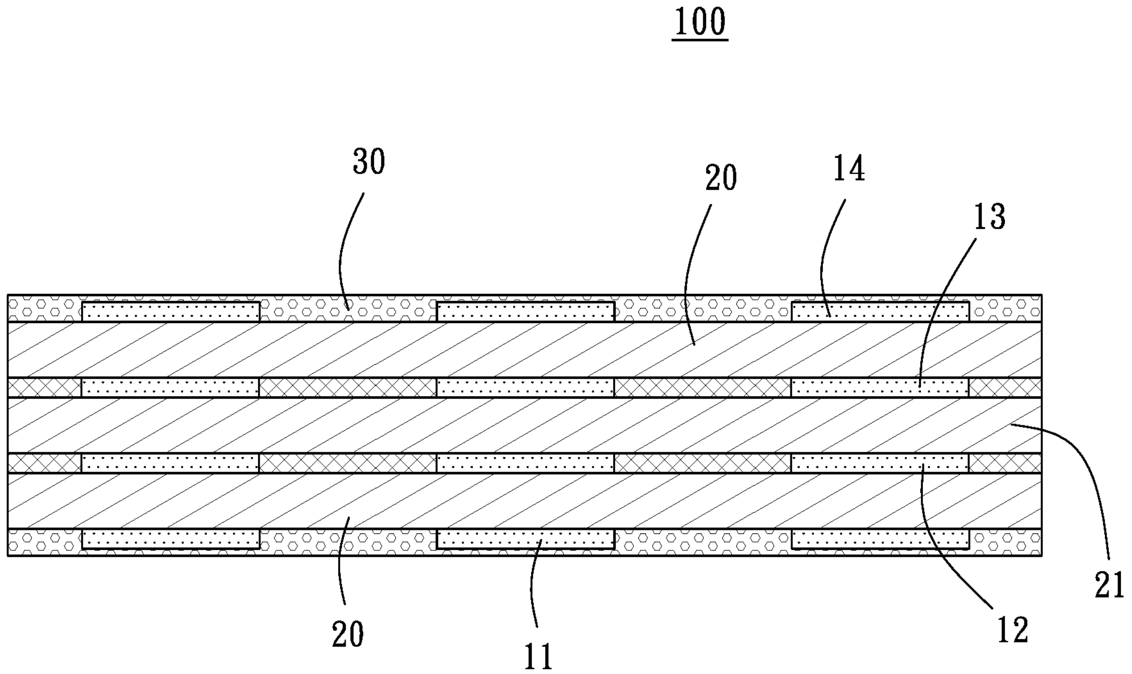

FIG. 9

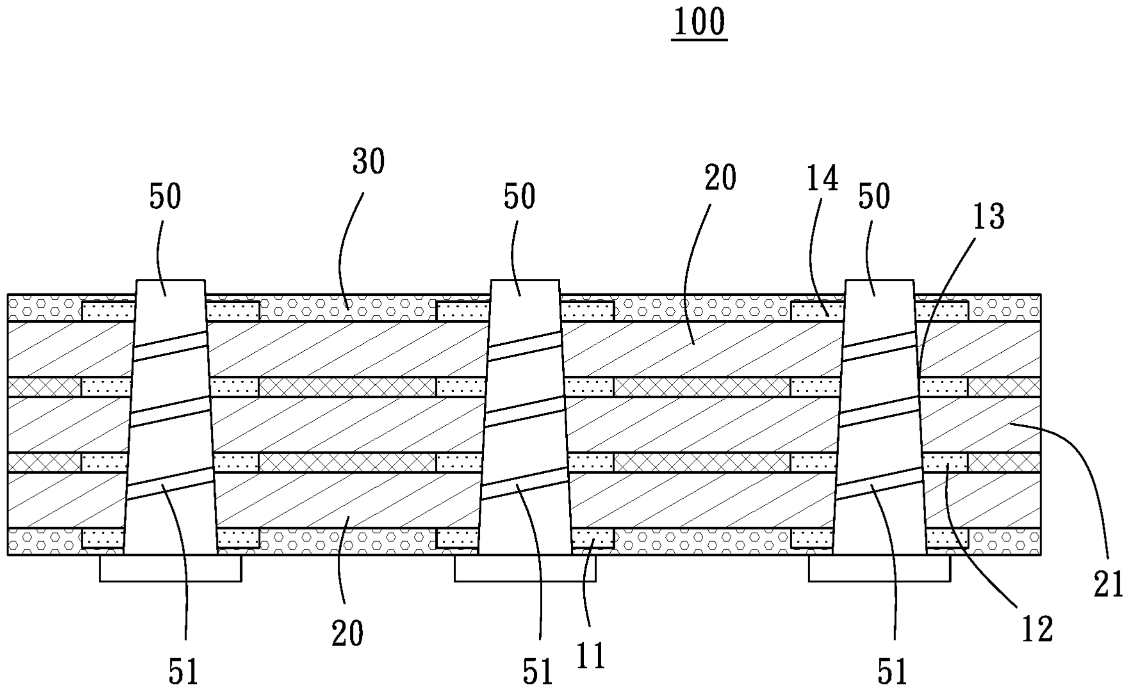

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 5834

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Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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