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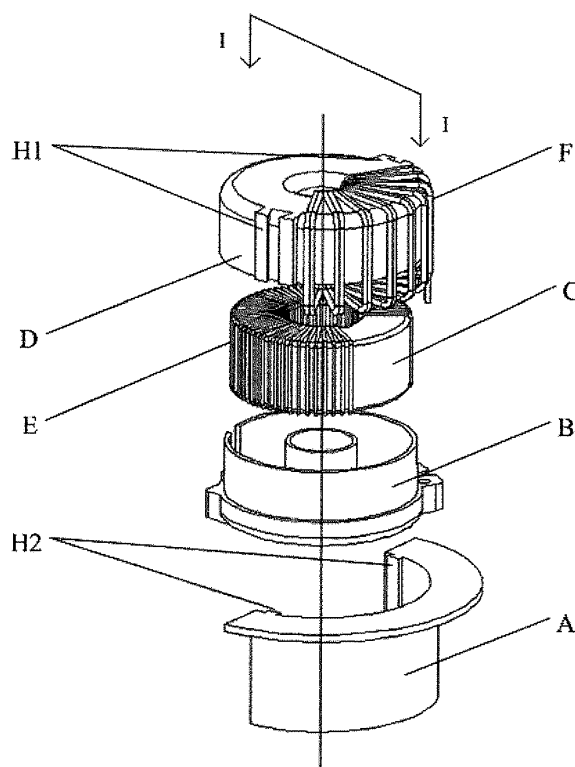
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(54) **Transformer and drive device including the same**

(57) An embodiment of the present invention relates to a transformer and a product following SELV requirement including the transformer and a drive device thereof. The transformer includes: a magnetic core; a frame; at least one winding wound over the frame; and an insulating spacer unit coupled with the frame and configured to offer compliance between the winding and another electrically conductive component outside the transformer with a predetermined electrical isolation standard. This can make the entire circuit including the transformer compact, reduce the volume of an apparatus and reduce a production cost thereof. An embodiment of the invention further relates to a method for manufacturing the transformer.

Fig. 1



Description

Field of the Invention

[0001] The present invention generally relates to the field of electrical technologies and particularly to a transformer and a drive device and a product following Safety Extra Low Voltage (SELV) requirement including the transformer and more particularly to a ballast including the transformer and a low voltage halogen lamp or Light Emitting Diode (LED) driven with such a ballast.

Background of the Invention

[0002] A transformer is widely adopted in a product following SELV requirement. However in the prior art, various electrical isolation standards have to be complied with between a winding of the transformer and other electrical components over a Printed Circuit Board (PCB) other than the transformer, for example, a creepage distance and an electrical clearance are required to be sufficient (for example, a creepage distance and an electrical clearance shall be at least 6mm as regulated in IEC61347-2-2 and SELV requirement).

[0003] The creepage distance refers to the shortest path measured over an isolation surface between two electrically conductive components or an electrically conductive component and an apparatus guard interface. That is, such a phenomenon occurs in different usage scenarios that an isolation material around a conductor is polarized to be charged, and the radius of this charged area, which is annular when the conductor is circular, is referred to as the creepage distance.

[0004] The electrical clearance refers to the shortest spatial distance between two electrically conductive components or an electrically conductive component and an apparatus guard interface, i.e., the shortest distance over which isolation can be achieved in the air while ensuring electrical performance stability and safety.

[0005] In the prior art, the electrical clearance and the creepage distance are generally increased using a winding wire with three layers of isolation lines or an isolation sheet arranged on the PCB.

[0006] Even with these methods in the prior art, the electrical clearance and the creepage distance are required to comply with the safety regulation, and consequently other electrically conductive components in a product or apparatus with a transformer still can not be arranged immediately to the transformer, thus hindering the entire product or apparatus from being compact and also making it costly to manufacture.

Summary of the Invention

[0007] In view of the foregoing problem, the inventors of the invention have made the invention.

[0008] According to an aspect of an embodiment of the invention, there is provided a transformer including:

a magnetic core; a frame; at least one winding wound over the frame; and an insulating spacer unit coupled with the frame and configured to offer compliance between the winding and another electrically conductive component outside the transformer with a predetermined electrical isolation standard.

[0009] In the transformer according to an embodiment of the invention, the insulating spacer unit can be fixed at the external side of the area of the frame wound with the winding, and the insulating spacer unit can be further located between the area of the frame wound with the winding and the other electrically conductive component arranged proximate to the area.

[0010] In the transformer according to another embodiment of the invention, the insulating spacer unit can completely or partially encircle the external side of the frame and can extend at the upper and lower ends of the insulating spacer unit respectively over a first predetermined length and a second predetermined length at a first predetermined angle and a second predetermined angle relative to the external side of the frame. The insulating spacer unit can be an insulating sheet which can extend over the first predetermined length inward or outward radically along the frame at the upper edge of the external side of the frame and which can over the second predetermined length inward or outward radically along the frame at the lower edge of the external side of the frame.

[0011] In the transformer according to another embodiment of the invention, a lock structure can be arranged in the area of the frame unwound with the winding to fix the insulating spacer unit and the frame. The lock structure and the insulating spacer unit can be further arranged so that there is at least a predetermined creepage distance between the winding and the other electrically conductive component along the contact surface of the lock structure and the insulating spacer unit.

[0012] In the transformer according to another embodiment of the invention, the insulating spacer unit can be formed integrally with the frame.

[0013] The transformer according to still another embodiment of the invention can be a transformer following SELV requirement.

Moreover according to another embodiment of the invention, the transformer can be an annular transformer following SELV requirement including a first winding wound over the magnetic core and a second winding wound over the frame as the at least one winding wound over the frame; and the frame surrounds the outside of the magnetic core.

[0014] According to another aspect of the invention, there is provided a method for manufacturing a transformer, which includes: preparing a magnetic core and a frame; winding at least one winding over the frame; and coupling the frame and an insulating spacer unit configured to offer compliance between the winding and another electrically conductive component outside the transformer with a predetermined electrical isolation standard.

[0015] According to a further aspect of the invention, there is provided a drive device for an apparatus following SELV requirement, which includes the transformer, to drive the apparatus following SELV requirement to operate and an apparatus following SELV requirement including the drive device.

[0016] In an embodiment of the invention, the apparatus following SELV requirement can be low voltage halogen lamp or an LED and the drive device can be a ballast.

Brief Description of the Drawings

[0017] The foregoing and other objects and advantages of the embodiments of the invention will be further described below with reference to the embodiments and the drawings in which identical or corresponding technical features or components are denoted with identical or corresponding reference numerals. In the drawings:

[0018] Fig.1 illustrates an exploded view of a transformer according to an embodiment of the invention;

[0019] Fig.2 illustrates a sectional view of the transformer according to the embodiment of the invention;

[0020] Fig.3 illustrates a top view of the transformer according to the embodiment of the invention;

[0021] Fig.4a-Fig.4d are schematic diagrams of various specific configurations of an insulating spacer unit in the transformer according to the embodiment of the invention; and

[0022] Fig.5 is a flow chart of a method for manufacturing a transformer according to an embodiment of the invention.

Detailed Description of the Invention

[0023] Various embodiments of the invention to be presented below are intended to merely detail the embodiments of the invention but shall not be construed in any sense of limiting the invention.

[0024] According to an embodiment of the invention, there is provided a transformer including a magnetic core, a frame, at least one winding wound over the frame, and an insulating spacer unit coupled with the frame and configured to offer compliance between the winding and another electrically conductive component outside the transformer at least with a predetermined electrical isolation standard.

[0025] The embodiments of the invention will be detailed below by way of an example.

[0026] Fig.1 illustrates an exploded view of an annular transformer, e.g., an annular transformer for a drive device of a low voltage halogen lamp and an LED, according to an embodiment of the invention. The annular transformer in Fig.1 includes a magnetic core C, a primary winding E wound over the magnetic core C, parts B and C of a frame surrounding outside the magnetic core C while snapping thereon, a secondary winding F wound outside the frame and an isolation sheet A coupled with

the frame. Particularly, the isolation sheet A is configured to offer compliance between the secondary winding and another electrically conductive component outside the annular transformer at least with a predetermined electrical isolation standard, e.g., a creepage distance (with a typical value of 6mm) and an electrical clearance as regulated in the standard of IEC61347-2-2. The insulating sheet A in the embodiment of the invention is merely an example of the insulating space unit, and the insulating space unit can alternatively be formed appropriately into another shape, e.g., a bump shape, as needed for a design. Alternatively, the secondary winding E can be wound over the frame instead of being wound directly over the magnetic core C.

[0027] Fig.3 is a top view of the annular transformer in Fig.1 after being assembled. It shall be noted that the secondary winding F is wound over only a part of the area of the frame as can be apparent in Fig.1 and Fig.3, but the invention will not be limited thereto, and a secondary winding can alternatively be wound over the entire frame as needed in practice.

[0028] As illustrated in Fig.1 and Fig.3, the insulating sheet A covers only the external side of the areas of the frame B and D wound with the secondary winding and parts of the adjacent areas thereof. However, the invention will not be limited thereto, and the insulating sheet A can cover the external side of other areas of the frame unwound with the secondary winding and even the external side of the entire frame (that is, encircle the frame circumferentially). In other words, the insulating sheet A can partially or completely encircle the external side of the frame, which can be dependent upon a site where an electrically conductive component other than the annular transformer is to be arranged with respect to the annular transformer.

[0029] Since one of functions of the insulating sheet A in use is to increase, for example, a creepage distance and an electrical clearance between the secondary winding of the annular transformer and another electrically conductive component outside the annular transformer (e.g., an electrically conductive component arranged on a PCB (not illustrated) where the annular transformer is located) to comply with the predetermined electrical isolation standard, the insulating sheet A can be provided only at a site where the electrically conductive component is to be arranged proximate to the area of the frame wound with the secondary winding. Of course, the insulating sheet A can alternatively be provided at another appropriate site dependent upon another matter of design so long as the desired electrical isolation standard can be complied with.

[0030] Since the electrically conductive components may be more than one, an insulating sheet A can be arranged to cover the above sites as a whole, or a plurality of insulating sheets A can be arranged to cover the respective sites. Alternatively, a plurality of discrete insulating sheets A can be arranged dependent upon another matter of design.

[0031] Fig.2 is a sectional view of the annular transformer in Fig.1 taken along the line I-I (see Fig.1) after being assembled, where the reference numeral "G" schematically represents another electrically conductive component that may be arranged in the area adjacent to the transformer and therefore is not illustrated in the I-I sectional view. As illustrated in Fig.2, the insulating sheet A covers the external side of the frame while abutting against the latter or while being arranged proximate to the latter. Specifically, the insulating sheet A is arranged encircling the external side of the frame of the annular transformer with its upper end extending outward radially along the frame of the annular transformer at the upper edge of the external side of the frame relative to the frame and its lower end extending inward radially along the frame at the lower edge of the external side of the frame relative to the frame, but the invention will not be limited thereto. As illustrated in Fig.4a and Fig.4b, the upper end of the insulating sheet A can extend upward or inward radially along the frame at the upper edge of the frame and the lower end of the insulating sheet A can extend outward radially along the frame at the lower edge of the frame in an alternative embodiment. The upper and lower ends of the insulating sheet A can extend in any appropriate direction relative to the external side of the frame at the upper or lower edges of the frame in another alternative embodiment. In other words, the upper and lower ends of the insulating sheet A can extend at any predetermined angle (e.g., the angles α and β in Fig.4a to Fig.4d) relative to the external side of the frame. For example, the angles α and β in Fig.4a are approximately 90 degrees, the angle α in Fig.4b is approximately 0 degree (that is, the upper end of the insulating sheet A extends in the direction along the external side of the frame). Moreover, as illustrated in Fig.4c and Fig.4d, the upper and lower ends of the insulating sheet A may not extend at the upper or lower edge of the frame but can extend from another site in any appropriate direction relative to the external side of the frame. It shall be noted that the lengths over which the upper and lower ends of the insulating sheet A extend and the angles α and β at which they extend relative to the external side of the frame B and D can be the same as or different from one another. Moreover in Fig.4a to Fig.4d, the two parts B and D of the frame have not been distinguished and the secondary winding F wound over the frame has not been illustrated for the sake of conciseness.

[0032] Regardless of how the insulating sheet A extends, it will suffice if the extending parts extend over such a predetermined length that the electrical isolation standard, e.g., a creepage distance, an electrical clearance, etc., can be complied with between an electrically conductive components arranged proximate to the external side of the insulating sheet A and the secondary winding F. In the present embodiment, the creepage distance and the electrical clearance of 6mm as regulated in the standard of IEC61347-2-2 are taken as an example of the distance compliance with the electrical isolation

standard, as illustrated in Fig.2. With this configuration, the electrically conductive component G as schematically illustrated in Fig.2 can be arranged proximate to the insulating sheet A while being spaced from the secondary winding F by at least the predetermined creepage distance and electrical clearance. This can make the entire circuit including the transformer compact, reduce the volume of an apparatus and lower the production cost thereof.

[0033] As described above, Fig.3 is a top view of the annular transformer in Fig.1 after being assembled. A lock structure H arranged in the area of the frame unwound with the secondary winding to fix the frame and the insulating sheet A is illustrated in both Fig.1 and Fig.3. The lock structure H is formed of a lock part H1 (Fig.1) on the frame and a lock part H2 (Fig.1) on the insulating sheet A, but the invention will not be limited thereto. For example, the frame and the insulating sheet A can alternatively be coupled to one another in any other appropriate way, for example, connected to one another through a pin, etc.. Moreover, in the case that the insulating sheet A surrounds the external side of the entire frame, for example, the frame and the insulating sheet A can be fixed to one another in another way instead of being fixed through the lock structure H arranged in the area of the frame unwound with the secondary winding.

[0034] As illustrated in Fig.3, at the lock structure H, the contact line, which is the projection of the contact face between the insulating sheet A and the frame onto the top view, as indicated by the thick solid line in Fig.3, is of such a length that the creepage distance between the secondary winding and another electrically conductive component outside the annular transformer is at least the predetermined length as regulated in the relevant electrical isolation standard. In the present embodiment, the creepage distance of 6mm as regulated in the standard of IEC61347-2-2 is taken as an example, as illustrated in Fig.3, but the invention will not be limited thereto. For example, the lock structure can be arranged in the area of the frame unwound with the secondary winding at a site sufficiently distant from the secondary winding so that the creepage distance between the secondary winding and the other electrically conductive component is at least the predetermined length regardless how long the contact line, which is the projection of contact face between the insulating sheet A and the frame onto the top view, will be. With this configuration, the electrically conductive component G as schematically illustrated in Fig.3 can be arranged proximate to the boundary between the insulating sheet A and the frame while being spaced from the secondary winding F by at least the predetermined creepage distance. This can make the entire circuit including the transformer compact and reduce the production cost thereof.

[0035] It shall be noted that the embodiment of the invention has been described taking the transformer following SELV requirement as an example, but the invention will not be limited thereto. An embodiment of the

invention can also be applicable to a transformer following another voltage requirement for compliance with an electrical isolation stand corresponding to the transformer.

[0036] In another embodiment of the invention, the frame and the insulating sheet can alternatively be formed integrally.

[0037] It shall be noted that the embodiment has been described above taking the annular transformer as an example, but the invention will not be limited thereto. An embodiment of the invention can also be applicable to a transformer in another form than the annular transformer.

[0038] With the transformer described above, an electrically conductive component other than the transformer can be arranged proximate to the transformer as needed while ensuring the original functionality and performance of the circuit so that the entire product or component including the transformer can be downsized at a lower cost.

[0039] Fig.5 illustrates a method for manufacturing a transformer according to an embodiment of the invention. The method includes the steps of: preparing a magnetic core and a frame (S10); winding at least one winding over the frame (S20); and coupling the frame with an insulating spacer unit configured to offer compliance between the winding and another electrically conductive component outside the transformer at least with a predetermined electrical isolation standard (S30).

[0040] With the transformer manufactured according to the method, an electrically conductive component other than the transformer can be arranged proximate to the transformer as needed while ensuring the original functionality and performance of the circuit so that the entire product or component including the transformer can be downsized at a lower cost.

[0041] The transformer according to the embodiments of the invention can be applicable to a product following SELV requirement and a drive device thereof and particularly to a low voltage halogen lamp and an LED and a drive device thereof (e.g., a ballast). Such a product following SELV requirement and a drive device thereof shall also be construed as coming into the scope of the invention, and they will also similarly have the advantages of a small size and a low cost.

[0042] Although the embodiments of the invention have been described above taking a transformer as an example, those skilled in the art will appreciate that the configuration of the insulating spacer unit in the invention can also be applicable similarly to another electrical configuration. Such an application shall also be construed as coming into the scope of the invention.

[0043] Although the preferred embodiments of the invention have been illustrated and described, those skilled in the art can make various modifications, substitutions and combinations to the invention depending on design requirements and other factors insofar without departing from the spirit and scope of the appended claims.

Claims

1. A transformer, comprising:

a magnetic core;
a frame;
at least one winding wound over the frame; and
an insulating spacer unit coupled with the frame and configured to offer compliance between the winding and another electrically conductive component outside the transformer with a predetermined electrical isolation standard.

2. The transformer according to claim 1, wherein:

the insulating spacer unit is fixed at the external side of the area of the frame wound with the winding.

3. The transformer according to claim 1 or 2, wherein:

the insulating spacer unit is located between the area of the frame wound with the winding and the other electrically conductive component arranged proximate to the area.

4. The transformer according to any one of claims 1 to 3, wherein:

the insulating spacer unit completely or partially encircles the external side of the frame, and the upper and lower ends of the insulating spacer unit extend respectively over a first predetermined length and a second predetermined length at a first predetermined angle and a second predetermined angle relative to the external side of the frame.

5. The transformer according to claim 4, wherein:

the insulating spacer unit is an insulating sheet extending over the first predetermined length inward or outward radially along the frame at the upper edge of the external side of the frame.

6. The transformer according to claim 4 or 5, wherein:

the insulating spacer unit is an insulating sheet extending over the second predetermined length inward or outward radially along the frame at the lower edge of the external side of the frame.

7. The transformer according to any one of claims 1 to 6, wherein:

a lock structure is arranged in the area of the frame unwound with the winding to fix the insu-

lating spacer unit and the frame.

8. The transformer according to claim 7, wherein:

the lock structure and the insulating spacer unit
are arranged so that there is at least a predeter-
mined creepage distance between the winding
and the other electrically conductive component
along the contact surface of the lock structure
and the insulating spacer unit.

9. The transformer according to any one of claims 1 to 6, wherein:

the insulating spacer unit is formed integrally
with the frame.

10. The transformer according to any one of claims 1 to 9, wherein:

the transformer is a transformer following Safety
Extra Low Voltage, SELV, requirement.

11. The transformer according to claim 10, wherein the
transformer is an annular transformer following
SELV requirement comprising:

a first winding wound over the magnetic core
and a second winding wound over the frame as
the at least one winding wound over the frame;
and wherein
the frame surrounds the outside of the magnetic
core.

12. A method for manufacturing a transformer, compris-
ing:

preparing a magnetic core and a frame;
winding at least one winding over the frame; and
coupling the frame and an insulating spacer unit
configured to offer compliance between the
winding and another electrically conductive
component outside the transformer with a pre-
determined electrical isolation standard.

13. A drive device for an apparatus following Safety Ex-
tra Low Voltage, SELV, requirement, comprising the
transformer according to any one of claims 1 to 11
and configured to drive the apparatus following
SELV requirement to operate.

14. The drive device according to claim 13, wherein:

the apparatus following SELV requirement is a
low voltage halogen lamp or a Light Emitting Di-
ode, LED, and the drive device is a ballast com-
prising the transformer and configured to drive
the low voltage halogen lamp or the LED to op-

erate.

15. An apparatus following Safety Extra Low Voltage,
SELV, requirement, comprising the drive device ac-
cording to claim 13 or 14 and configured to drive the
apparatus following SELV requirement to operate.

16. The apparatus following SELV requirement accord-
ing to claim 15, wherein:

the apparatus following SELV requirement is a
low voltage halogen lamp or a Light Emitting Di-
ode, LED.

Fig. 1

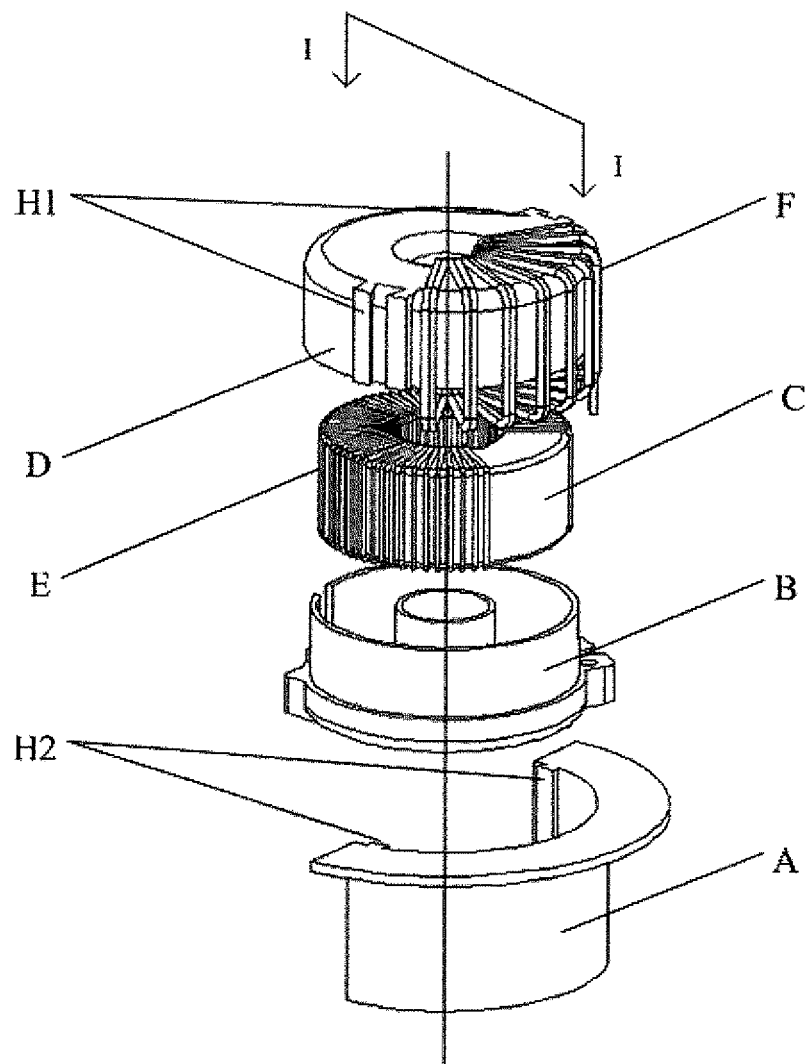


Fig. 2

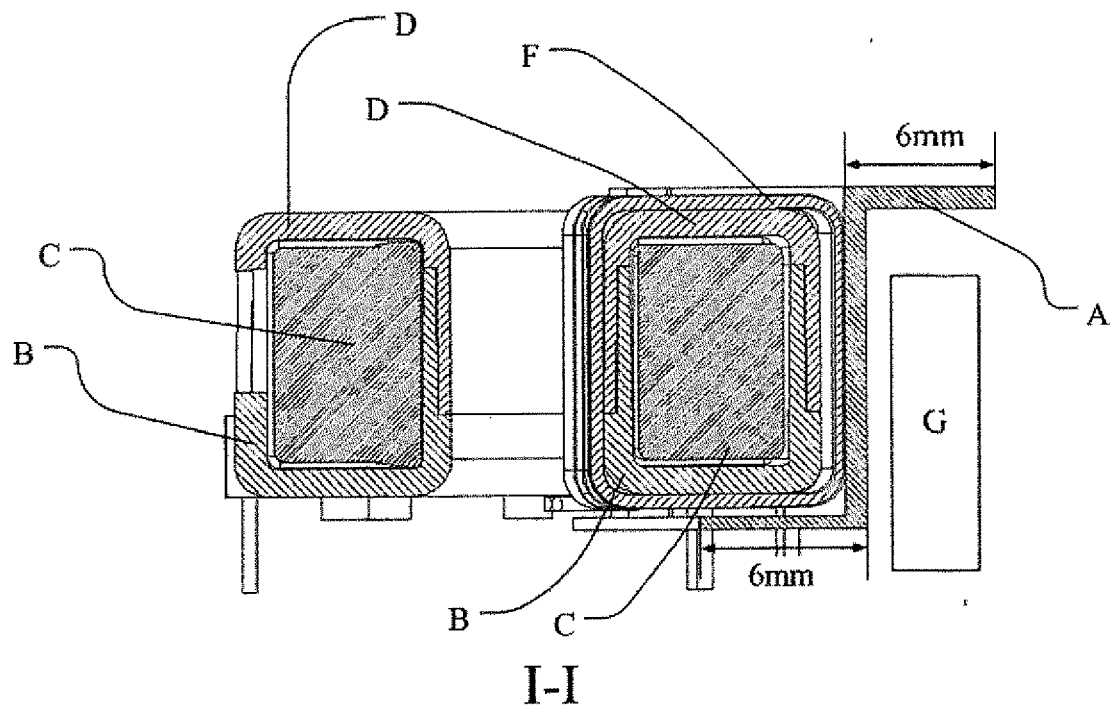


Fig. 3

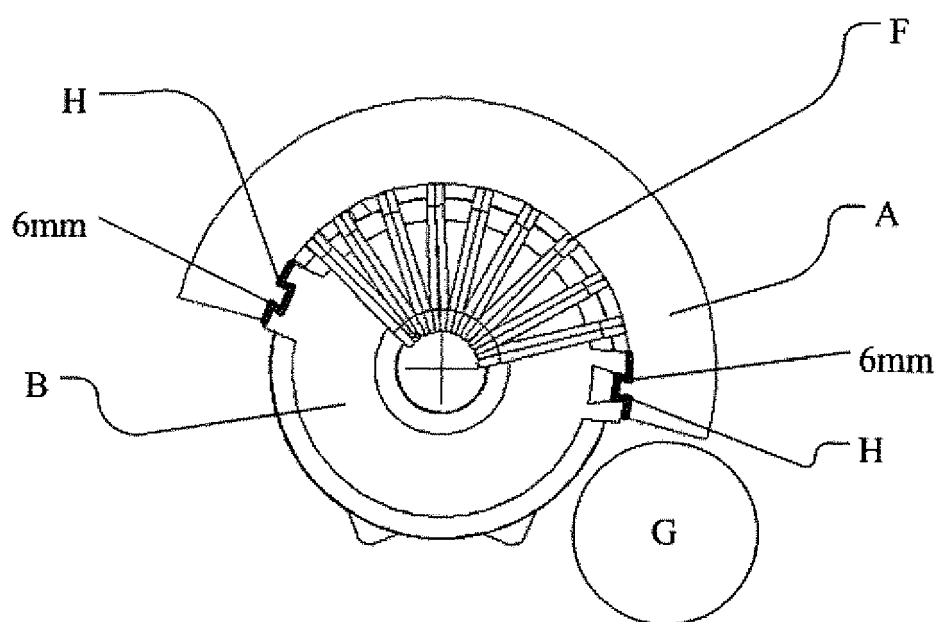


Fig. 4

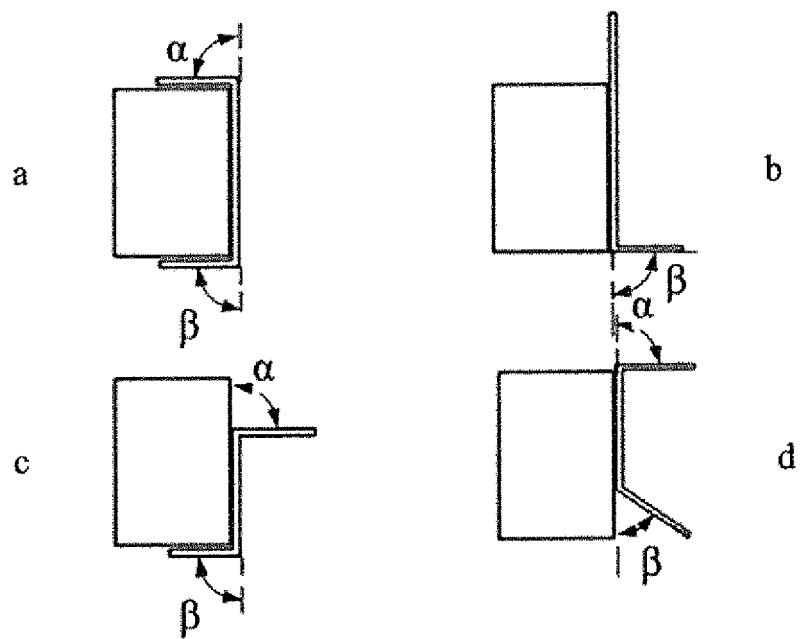


Fig. 5

