(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 884 966 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.02.2008 Bulletin 2008/06

(51) Int Cl.:
***H01F 30/16** (2006.01)* *H01F 27/32 (2006.01)*
F21V 23/02 (2006.01)

(21) Application number: **06425554.0**

(22) Date of filing: **01.08.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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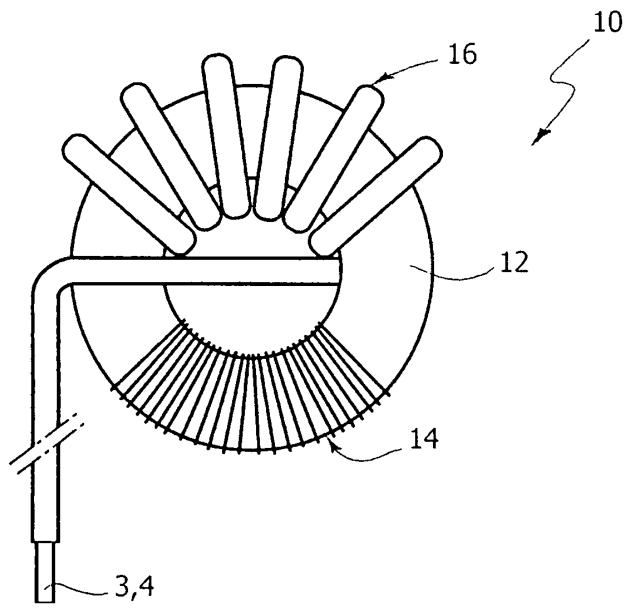
(54) Insulator transformer

(57) An insulating transformer (10), e.g. for halogen lamps, includes a toroidal core (12) having wound thereon a primary winding (14) and a secondary winding (16). The primary winding (14) and the secondary winding (16) are wound on nonoverlapping sectors of the toroidal core (12), preferably at diametrically opposed locations across the toroidal core (12). The secondary winding (16) is comprised of an insulating wire providing the insulating feature of the transformer (10). Alternatively, the transformer (10) includes an insulating bobbin for the core (12) and the secondary winding (16) is wound over the bobbin, whereby the bobbin provides the insulating feature of the transformer (10).

FIG. 1



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Description

Field of the invention

[0001] The invention relates to insulating transformers and was developed with specific attention paid to its possible use in electronic drive units for halogen lamps.

Description of the related art

[0002] Insulating transformers for use in driving halogen lamps currently employ two different types of ferrite cores, namely "toroidal" cores or "E-shaped" cores.

[0003] A basic drawback of toroidal cores lies in their low leakage inductance. This leads to more complicated drive and protection circuitry and to the need of using higher-rated power transistors.

[0004] Transformers including "E-shaped" cores, or cores having more complex geometries, typically exhibit sufficiently high values of leakage inductance. They must however be provided with a plastic bobbin to ensure proper insulation (e.g. in conformity with IEC 61347-2-2) and their construction is inevitably more complicated.

Object and summary of the invention

[0005] Especially in the area of AC/AC converters but also in some topologies of DC/DC converters, the need is therefore felt for insulating transformers which may couple the intrinsic simplicity of toroidal core arrangements with the possibility of providing sufficient values of leakage inductance. This while also dispensing with the need of resorting to complicated drive and protection circuitry and/or using high rated power transistors and plastic bobbins.

[0006] The object of the invention is to provide such an insulating transformer.

[0007] According to the present invention, that object is achieved by means of an insulated transformer having the features set forth in the claims that follow.

[0008] The claims are an integral part of the disclosure of the invention provided therein.

Brief description of the annexed representations

[0009] The invention will now be described, by way of example only, with reference to the annexed representations, wherein:

- Figure 1 is a schematic plan view of an insulating transformer as described herein;
- Figure 2 is corresponding front elevational view of an insulating transformer as described herein, and
- Figure 3 is a side elevational view of an insulating transformer as described herein.

Detailed description of preferred embodiments

[0010] In the annexed representations, reference 10 designates as a whole an insulating transformer for use e.g. in electronic drivers for halogen lamps.

[0011] In the exemplary embodiment shown, the transformer 10 is essentially comprised of a ferrite toroidal core 12 having wound thereon (as better detailed in the following) a primary winding 14 and a secondary winding 16. The ends of the wires comprising the primary winding 14 and the secondary winding 16 are designated 1,2 and 3, 4, respectively.

[0012] While a ferrite core 12 having a closed toroidal shape is presently preferred, use of a ferromagnetic material different from ferrite and/or toroidal cores that are not completely closed (e.g. with a "split- ring" geometry) falls within the scope of the invention.

[0013] The exemplary arrangement described herein is a step-down transformer arrangement, wherein the primary winding 14 includes a number of turns that is (much) higher than the number of turns in the secondary winding 16. Typically, the primary winding 14 is comprised of an enamelled wire of smaller gauge than the sheathed wire comprising the secondary winding 16.

[0014] A feature of the arrangement described herein lies in that the windings 14 and 16 are wound on the core 12 in such a way that they are not angularly superposed, in that they are wound on distinct circular sectors (i.e. "slices") of the core 12.

[0015] As exemplified herein, the primary winding 14 is not wound over the entire toroidal surface of the core 12, but only over a sector having an angular width of e.g. typically less than 90 degrees.

[0016] Similarly, the secondary winding 16 is wound on another angular sector of the toroidal core 12 extending over an angular width again of less than 90 degrees and not overlapping with the primary winding 14.

[0017] Preferably, the two windings 14 and 16 are wound over angular sectors of the core at locations that are approximately diametrically opposed across the core 12. The fact that the two windings 14 and 16 are not angularly superposed, and are preferably diametrically opposed to each other, maximizes the leakage inductance. This is due to the fact that the leakage inductance increases as the winding angles of the windings 14 and 16 decrease. In fact, as the two windings 14 and 16 become increasingly apart from each other, an increasing amount of flux lines close "in air" without concatenating the other winding.

[0018] The primary inductance is always normally about 100 times bigger than its leakage inductance and more than 1000 times bigger than that obtained without a ferrite core (it means to wound the wires direct in the air). This means that almost all the primary flux lines are "driven" inside the ferrite core concatenating the secondary winding and creating the desired coupling effect between primary and secondary windings.

[0019] In this way an also big percentage in the variation of the leakage inductance (that means in the primary flux lines not concatenating the secondary winding) has a very negligible effect in the percentage of primary flux lines confined in the ferrite, that means not considerable effect on the coupling between the two windings

[0020] The availability of a higher value for the leakage inductance makes it unnecessary to use complicated drive and protection circuitry and/or higher-rated power transistors.

[0021] The insulating properties of the transformer 10 is achieved by using for the secondary winding 16 an insulating wire, such as an sheathed wire with a sheath of at least 0.4 millimetres complying with IEC 61347-2-2.

[0022] Resorting to this arrangement makes it possible to avoid using an insulating bobbin for the core 12.

[0023] Such a "bobbin-less" arrangement represents at the moment a preferred embodiment. However, the invention lends itself to be practiced by resorting to an alternative embodiment wherein the primary winding 14 is wound on the core 12 and an insulating plastics bobbin (e.g. PET class F or equivalent) is then applied - in a manner known per se - over the assembly thus formed. The secondary winding 16 (comprised in this case of a simple enamelled wire which is normally considered not having any isolation from the safety requirements point of view) is then wound over the insulating bobbin. This while preserving the non-overlapping arrangement of the windings 1 and 16, that is by ensuring that the two windings 14 and 16 are wound over distinct sectors of the core 12, preferably diametrically opposed to each other to maximize the leakage inductance.

[0024] It will be appreciated that the arrangement shown exhibits a very simple, cheap-to-produce structure wherein the required insulating property is achieved in a thoroughly reliable manner, possibly without using a plastic bobbing.

[0025] Specifically, the transformer described herein can be used in connection with arrangements integrating thermal and overload protections as described e.g. in EP-A-0 800 334.

[0026] The transformer described herein can be used with lower-rated power transistors (for instance Dpack transistors with output power of the electronic transformer up to 100W, in the place of e.g. TO-220 or D^2 pack or SOT-82).

[0027] Finally, the non-overlapping features of the windings 14 and 16 enables i.a. locating the secondary winding 16 with a good degree of freedom in fulfilling the requirements of EN55015 without affecting the value of the leakage inductance while having the opportunity of using a cheaper input filter.

[0028] Extending the arrangement described herein to transformers including plural secondary and/or primary windings falls within the scope of the present invention. Similarly, the criteria adopted for ensuring the insulation properties of the transformer can be exchanged between the primary and the secondary winding with respect to the exemplary embodiment shown. Consequently, without prejudice to the underlying principles of the invention, the details and embodiments may vary, even significantly, with respect to what has been described herein merely by way of example without departing from the scope of the invention as defined by the annexed claims.

Claims

1. An insulating transformer (10), including a toroidal core (12) having wound thereon a primary winding (14) and a secondary winding (16), wherein said primary winding (14) and said secondary winding (16) are wound on non-overlapping sectors of said toroidal core (12).

2. The transformer of claim 1, **characterized in that** said primary winding (14) and said secondary winding (16) are wound at diametrically opposed locations of said toroidal core (12).

3. The transformer of either of claims 1 or 2, **characterized in that** said primary winding (14) is wound over an sector of said core (12) having an angular width of less than 90 degrees.

4. The transformer of any of claims 1 to 3, **characterized in that** secondary winding (16) is wound over a sector of said toroidal core (12) having an angular width of less than 90 degrees.

5. The transformer of any of the previous claims, characterizes in that said toroidal core (12) is a ferromagnetic core.

6. The transformer of any of previous claims, **characterized in that** at least one (16) of said primary (14) and said secondary winding (16) is comprised of an insulating wire with the right thickness that permits to provide the insulating feature of the transformer.

7. The transformer of claim 6, **characterized in that** said insulating wire (16) is comprised of a sheathed wire.

8. The transformer of claim 7, **characterized in that** said insulating wire (16) is comprised of a wire insulated with a sheath of at least 0.4 millimetres.

9. The transformer of any of claims 6 to 8, **characterized in that** the other (14) of said primary (14) and said secondary winding (16) is comprised of enamelled wire.

10. The transformer of any of claims 6 to 9, **characterized in that** said secondary winding (16) is comprised of said insulating wire providing the insulating feature of the transformer.

11. The transformer of any of claims 1 to 5, **characterized in that** it includes an insulating construction bobbin for said core (12) and **in that** at least one of said primary (14) and said secondary winding (16) is wound over said insulating construction bobbin, whereby said bobbin provides the insulating feature of the transformer (10).

12. The transformer of claim 11, **characterized in that** it includes said secondary winding (16) wound over said insulating construction bobbin for said core.

13. The transformer of claim 11, **characterized in that** it includes said primary winding (14) wound over said insulating construction bobbin for said core.

14. The transformer of either of claims 11 or 12, **characterized in that** said bobbin is a plastics bobbin.

15. The transformer of claim 11, **characterized in that** said insulating construction bobbin for said core (12) and the isolation of said primary (14) or secondary (16) windings provide the insulating feature of the transformer (10).

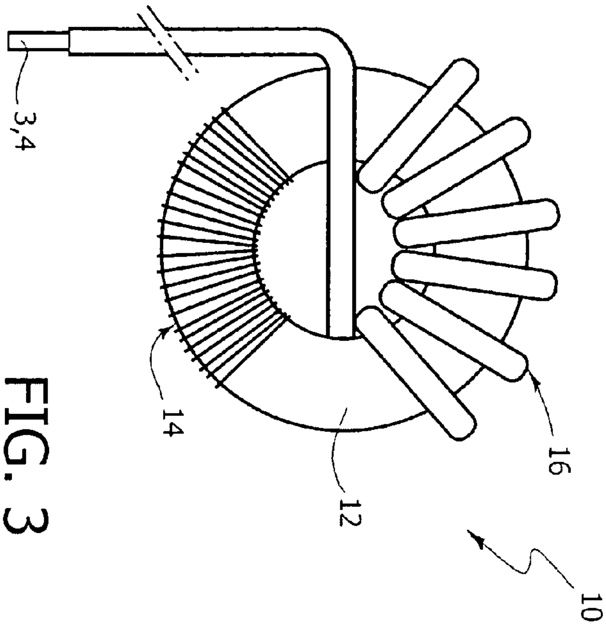

FIG. 1

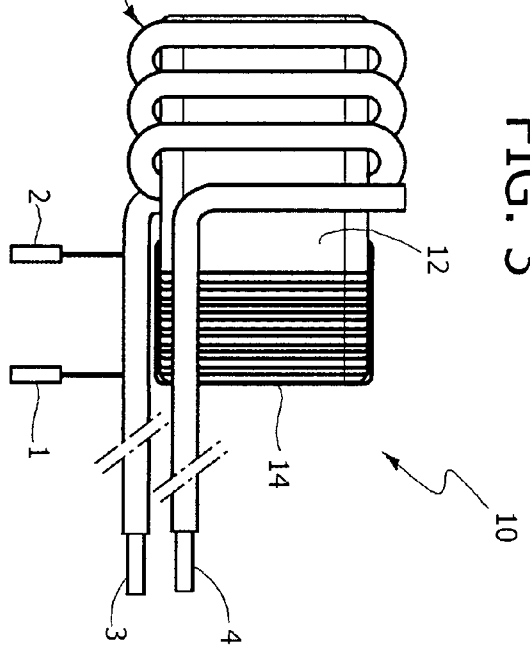

FIG. 3

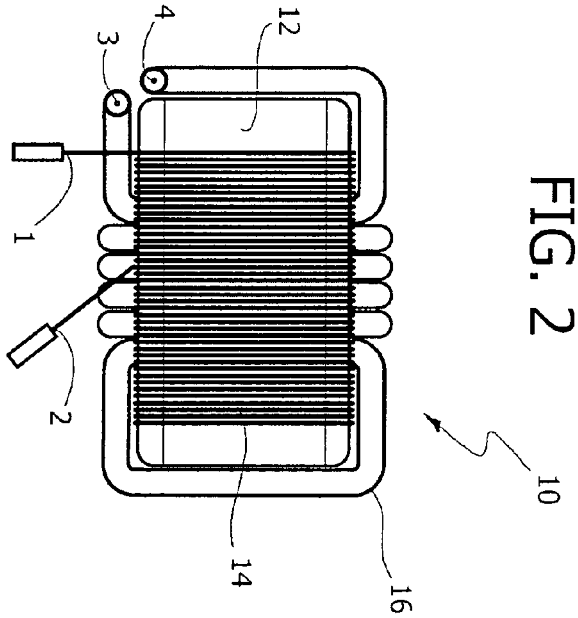

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5554

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X	WO 99/17016 A2 (ALLIED SIGNAL INC [US]) 8 April 1999 (1999-04-08) * page 7, lines 1-6; figure 3 * * page 10, line 23 - page 11, line 3 * * page 15, line 11 - page 16, line 14 * -----	1-6, 11-15	
X	US 5 377 652 A (NOBLE GARDINER A [US] ET AL) 3 January 1995 (1995-01-03) * column 10, line 65 - column 11, line 29; figures 3-5 * * column 12, lines 31-59 * -----	1,3,5, 11-14	TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 January 2007	Reder, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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T : theory or principle underlying the invention
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D : document cited in the application
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 42 5554

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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