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(54) High voltage diode split half bulk transformer

(57) The invention relates to a process for winding the coils of a high-voltage transformer for a cathode-ray tube. According to the invention the tertiary windings are coiled by imparting a locally oscillatory motion, in an axial direction of the coil former, to a wire-guide which guides the wire to be coiled towards a rotating coil former. The tertiary windings of a transformer made according to the invention are such that neighbouring turns constituting the winding overlap one another. As a result a larger number of turns can be coiled on the same length of coil. The transformer according to the invention therefore includes a smaller number of diodes 10 and of intermediate insulating layers 24 between windings of the tertiary. The electromagnetic coupling quality remains good. The process allows good reproducibility of the product.

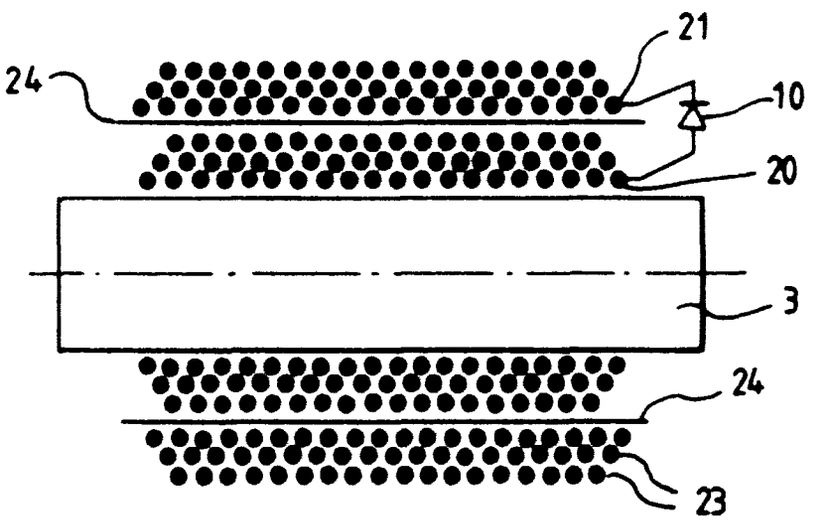

FIG. 4

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Description

The invention lies in the field of processes for winding the coils of high-voltage transformers used in particular for the high-voltage supply to the grids of the cathode-ray tube of monitors or televisions.

Such transformers may be divided from the manufacturing technology viewpoint into two major families, chamber-type transformers and layered transformers. The transformers of these two families include a ferromagnetic circuit and primary and secondary windings coiled around a part at least of the magnetic circuit. In chamber-type transformers the primary and secondary windings are galvanically insulated from one another on account of the fact that they are respectively accommodated in primary and secondary chambers separated by insulating partitions. These chambers are distributed along an axial line of the magnetic circuit. In layered transformers the primary and secondary windings are mounted around a part of the magneto circuit, in concentric coaxial layers. The transformer according to the invention lies in this latter category, that of layered transformers. These transformers are already widely known and have been described in numerous publications. Patent No. FR 2,726,686 in the name of the applicant or alternatively Patent Application GB 2298318-A, in the name of Murata, may be cited by way of examples of such publications.

An exploded view of a known layered transformer is represented in Figure 1 and will be discussed below:

The high-voltage transformer 100 represented in Figure 1 is intended for the supply to a cathode-ray tube (not represented). It comprises, around a core made of ferromagnetic material (not represented), a first coil former 1 carrying primary and secondary windings globally referenced 2. A second coil former referenced 3 carries windings referred to as tertiary 4 so as to distinguish them from the secondary windings carried by the coil former 1. It is this second coil former which carries the high-voltage windings for supplying the grids of the cathode-ray tube. The two coil formers 1 and 3 are in the mounted position, concentric with one another, the primary coil former 1 being situated inside the tertiary coil former 3. Together, the two coils as well as that part of the core around which the coils 1 and 3 are mounted is accommodated in a casing 5 generally made of an insulating plastic material. This casing 5 includes two output pillars for the high voltages referenced 6 and 7 respectively, a first output 6 for the anode high voltage and a second output 7 for the focusing high voltage. The latter can be adjusted by means of a potentiometric block 8 mounted removably on an open face 9 of the insulating casing 5.

It will also be noted that the second coil former 3 carries diodes 10. These diodes 10 serve to unite the ends of the windings forming the tertiary as will be explained below in conjunction with Figure 2.

This figure represents the arrangements for connecting up various windings represented physically in Figure 1. Naturally, the diagram of Figure 2 is given merely by way of example and there are numerous variants which are also known. The primary winding of the transformer consists of the winding 11 connected between contacts P labelled 1 & 2. When contacts rather than reference numbers are involved, the numerals of the label are circled in Figure 2. This primary winding 11 is coupled across a magnetic circuit 30 represented diagrammatically in Figure 2 by two vertical lines, to several secondary windings, secondary windings referred to as auxiliary since they produce auxiliary voltages, and high-voltage secondary windings since they produce the high voltage necessary for the operation of the cathode-ray tube. The auxiliary secondary windings are referenced 12 to 15 in Figure 2. The winding 12 connected between contacts 3, 4 is intended to produce a regulated voltage of 4 volts. The windings 13, 14 and 15 are intended to produce respectively voltages of 40, 14 volts and a Heater voltage intended for heating the cathode of the tube. The windings 11 to 15 are physically situated around the first coil former 1. Together, they constitute the primary and secondary windings which have been referenced 2 in Figure 1.

The high-voltage secondary windings are referenced 16 to 18. A first end 19 of the first winding 16 is connected by way of a contact 7 of the transformer to earth. The second end 20 of the winding 16 is connected by way of a diode 10 to a first end 21 of the second winding 17. The second end 22 of this same winding 17 is connected by way of a second diode 10 to the third winding 18 of the tertiary 4. For the sake of clarity the diagram of Figure 2 is limited to three windings connected together by two intermediate diodes 10, and likewise in Figure 1 only three intermediate diodes 10 have been represented. However, it is well known to a person skilled in the art that these windings are present in larger numbers and that the tertiary windings generally include diodes numbering between 5 and 7. These diodes are represented for example in the figure enclosed with the abstract of Patent GB 2298318-A already cited. The focusing voltages have been represented as tapped off from the first end 21 of the second tertiary winding 17. These voltages are intended after adjustment by means of the potentiometer 8 for the supply to the grids G2 and those for focusing the tube. Finally, an example which will not be discussed of a circuit for supplying the primary of such transformers 100 has been represented between the contacts 1 and 2 of the primary winding 11. Examples have also been represented of load circuits between the contacts 3, 4 and 6, 8 of the auxiliary windings 12 and 13 respectively.

The manner in which the tertiary windings are in a known manner physically installed on the coil former 3 is represented in Figure 3. This figure diagrammatically represents an axial section through the coil former 3 which is intended to show the windings carried by this former. The cross-sections of the wires wound around

the former 3 are represented by black dots 23. The wires are wound in the form of adjoining turns. This means that the pitch at which the wire advances during winding is equal to a cross-sectional diameter of the wire, per winding loop. This pitch is obtained in a known manner by programming the motion of a wire-guide almost parallel to the axis of the coil. The wire-guide presents the wire substantially perpendicularly to the axis of the coil. If a large number of loops is required then the length of the coil former 3 must be equal to the number of loops multiplied by the diameter of the wire used to make the winding. This leads to former lengths which are incompatible with the jigs for inserting transformers into power supplies. In order to satisfy the constraint of low bulk, it is known to superimpose several winding layers lying one above the other. Each winding layer is separated from the subajacent layer by an insulating foil 24. Each end of a winding is connected to an end of the succeeding winding by a diode 10, so that the voltages present at the ends of each winding are added together and that high voltages of the order of 30 kV are obtained, necessary for example for the anode voltage of the cathode-ray tube. Only two winding layers connected together by a diode 10 and insulated from one another by an insulating layer 24 have been represented in Figure 3. However, it is clear as already indicated above that a transformer of this type generally includes layers numbering between 6 and 8 and that there are therefore between 5 and 7 diodes 10 and as many separating layers 24.

On account of their concentric layered assembly, transformers of the layer type such as that just described exhibit good electromagnetic qualities and in particular small leakage inductance. The excitation of the stray capacitances between layers is very small. For these reasons, they are free of disturbing signals visible on the screen of the cathode-ray tube. On the other hand they are relatively expensive as compared with chamber-type transformers because of the manner in which they are coiled and because of the number of diodes. Chamber-type transformers are cheaper because of their ease of coiling, which can be carried out entirely automatically. Their stray capacitance is low. On the other hand they have by construction greater magnetic leakage, this-being manifested as a visible disturbance on the screen and known as "ringing".

In order to decrease bulkiness and reduce the number of layers it has been proposed in Japanese Patent Application No. JP 59 041811 to undertake the winding by means of a wire-guide whose pitch per winding loop of the wire around the coil former is less than the diameter of the wire. Such a method of winding makes it possible as explained in this patent application to obtain a compact winding having a lowish number of diodes and allowing easy adjustment of the point of connection of the outputs for the intermediate voltages such as for example the focusing voltage. However, the process leaves a certain element to chance, even if precautions are taken as explained in this patent application to comply with the angle and distance of the wire-guide relative to the axis of the coil former. The precaution consisting in coating the wire with a resin which hardens under the action of ultraviolet rays so as to avoid the slippage of the overlaid windings does not reduce this chance effect but increases the costs, complicates the manufacture and thickens the winding. Since the chance element remains, there is no certainty that transformers of one production line are indeed similar to one another and similar to the specimens which served in the assessment of production.

The object of the present invention is to make in a reproducible manner a transformer of the layer type at a lower cost than the known layer-type transformers and which exhibits rather good electromagnetic qualities so that the "ringing" disturbances are not perceptible on the screen.

This object is achieved according to the invention by making the layers in a controlled manner, so that each layer includes for one and the same diameter of wire and for one and the same length of coil former a larger number of turns. In this way the number of layers can be reduced and consequently the number of diodes and of intermediate insulating layers between layers. To do this the inventors have envisaged coiling each layer by imparting a local fore to aft followed by aft to fore oscillatory motion to the wire-guide during winding. The various neighbouring turns overlap one another in a manner which seems a prior disordered but which is in fact controlled and which the Inventors have dubbed "loose lay" ["en vrac range" in French] . Owing to the overlapping of the various neighbouring turns the number of turns per layer is larger, this having the advantages indicated above.

To summarize, the invention relates to a process for making a high-voltage transformer which includes wire windings, primary windings and windings intended for the production of high voltages, each of these windings having two ends, a first and a second, the windings intended for the production of high voltages being located in concentric layers lying one above the other, each preceding layer being separated from a succeeding layer by a layer of electrically insulating material, an end of a succeeding winding being connected to an end of a preceding winding by way of a diode, in which process the windings intended for the production of a high voltage are made by rotating a coil former around an axis, the wire of the winding to be made being guided by a wire-guide which presents the wire substantially perpendicularly to the axis of rotation of the coil, the wire-guide being movable in a direction parallel to the axis of rotation of the coil with an advance equal to one diameter of the wire per coiling loop, a process characterized in that for one at least of the windings intended for the production of high voltages the wire-guide has a motion in a direction parallel to the axis of rotation of the coil which is locally oscillatory.

The expression locally oscillatory is understood to mean a motion according to which the wire-guide progressing along the axis of the coil so as to go from one extremity to the other of the coil performs this motion with periodic reversals relative to its direction of progress from one extremity to the other of the coil.

The invention will now be described in greater detail with the aid of the appended drawings in which Figures 1 to 3 (already described) represent respectively:

- Figure 1, an exploded perspective view of the main components of a transformer according to the prior art.
- Figure 2, an electrical diagram showing the arrangement for connecting the various windings of the transformer.
- Figure 3, an axial diagrammatic section through a coil former carrying windings intended for the production of high voltages and fitted to a layered transformer according to the prior art.
- Figure 4 represents an axial diagrammatic section through a coil former carrying windings intended to produce high voltages and included in a transformer made according to the invention.

It should firstly be noted that the invention relates only to the coiling of the windings intended to produce high voltages. Consequently, although Figures 1 and 2 are representative of the prior art, they are also representative as regards the architecture of and arrangements for connecting a transformer made according to a process complying with the present Invention.

Figure 4 diagrammatically represents an axial section through a coil former 3 carrying windings intended for the production of high voltages. By comparison with Figure 3 it may be seen that the novelty introduced by the invention relates to the arrangement for coiling the winding. The fact that the neighbouring turns overlap one another makes it possible to obtain a larger thickness of winding. The expression neighbouring turns will now be clarified. A turn is a length of wire substantially equal to the circumference of the coil on which the wire is wound. One turn may neighbour another since it is very close axially to this other turn. Two turns which are neighbours in this first sense alone may however be formed by wire windings separated from one another by a large length of wire. In the present patent application two turns are said to be neighbours not only when they are separated from one another by a small axial distance but also when the distance of wire separating the ends of the two turns is small, for example and to establish an order of magnitude, less than 20 coil circumferences. This means that the reversing of the wire-guide will be limited for each reversal to 20 times the diameter of the wire. Thus Figure 4 depicts 3 sub-layers of wires, the 3 sub-layers together forming a layer, separated from the succeeding layer by an insulating foil 24. As in the prior art one end 20 of the wire forming a winding is connected to one end 21 of the wire forming the succeeding winding by way of a diode 10. However, since for one and the same length of coil each winding includes a larger number of turns, the number of layers can be reduced, bringing about a corresponding decrease in the number of intermediate insulating foils 24 and in the number of diodes 10. A less expensive transformer 100 is thus obtained. Trials undertaken by the Applicant have shown that the transformer thus obtained did not exhibit any "ringing" perceptible to the eye on a screen of a cathode-ray tube and that production was homogeneous.

Claims

1. Process for making a high-voltage transformer (100) which includes wire windings, primary windings and windings (16,17,18) intended for the production of high voltages, each of these windings having two ends, a first and a second, the windings intended for the production of high voltages being located in concentric layers lying one above the other, each preceding layer being, with the exception of a last layer, separated from a succeeding layer by a layer (24) of electrically insulating material, an end of a succeeding winding being connected to an end of a preceding winding by way of a diode, in which process the windings intended for the production of a high voltage are made by rotating a coil former (3) around an axis, the wire of the winding to be made being guided by a wire-guide which presents the wire substantially perpendicularly to the axis of rotation of the coil, the wire-guide being movable in a direction parallel to the axis of rotation of the coil with an advance equal to one diameter of the wire per coiling loop, a process characterized in that for one at least of the windings intended for the production of high voltages the wire-guide has a motion in a direction parallel to the axis of rotation of the coil which is locally oscillatory so that neighbouring turns overlap one another and so that the winding made includes several layers of wires lying one above the other.

2. Television or monitor fitted with a transformer made according to the process of Claim 1.

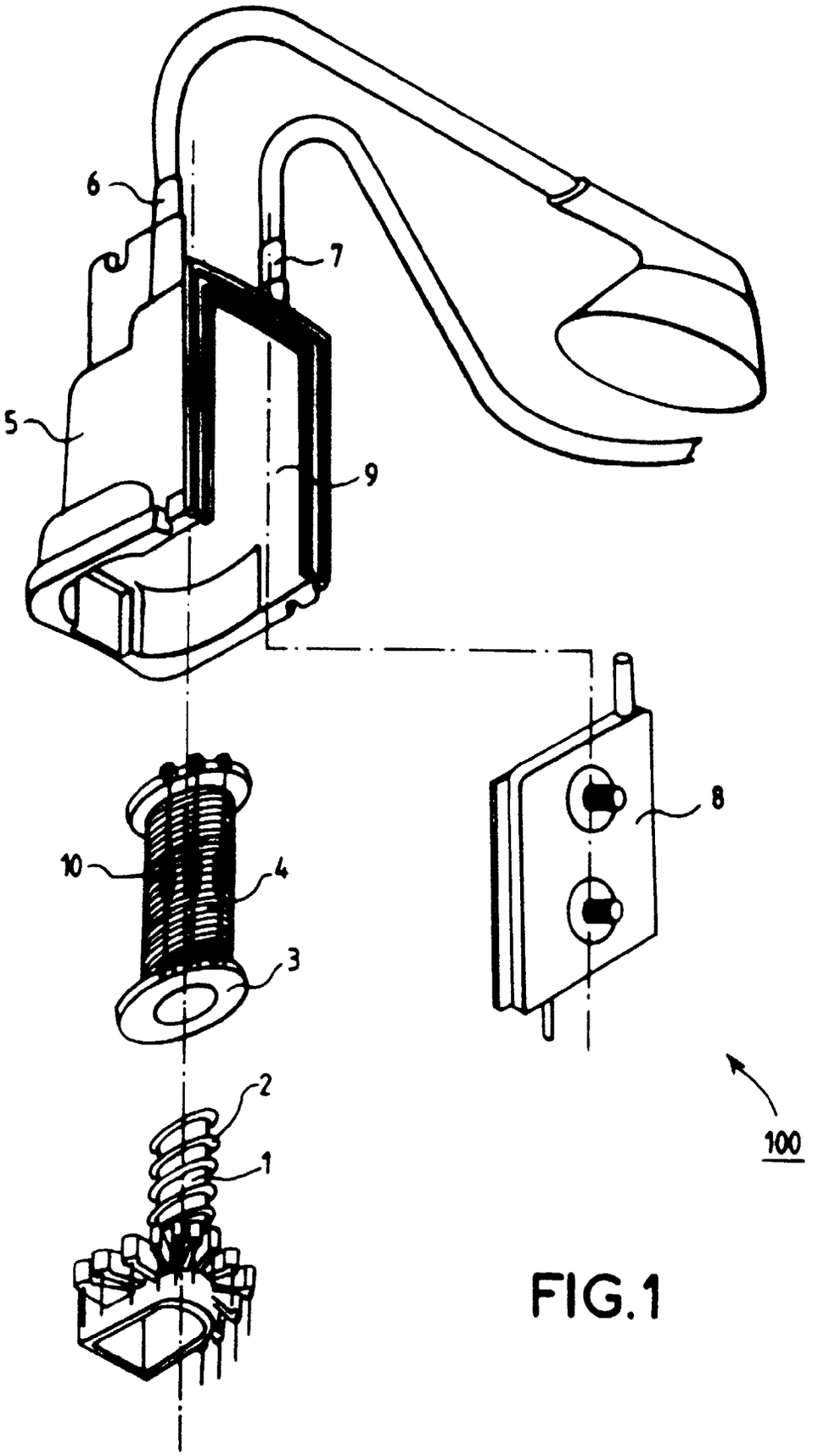
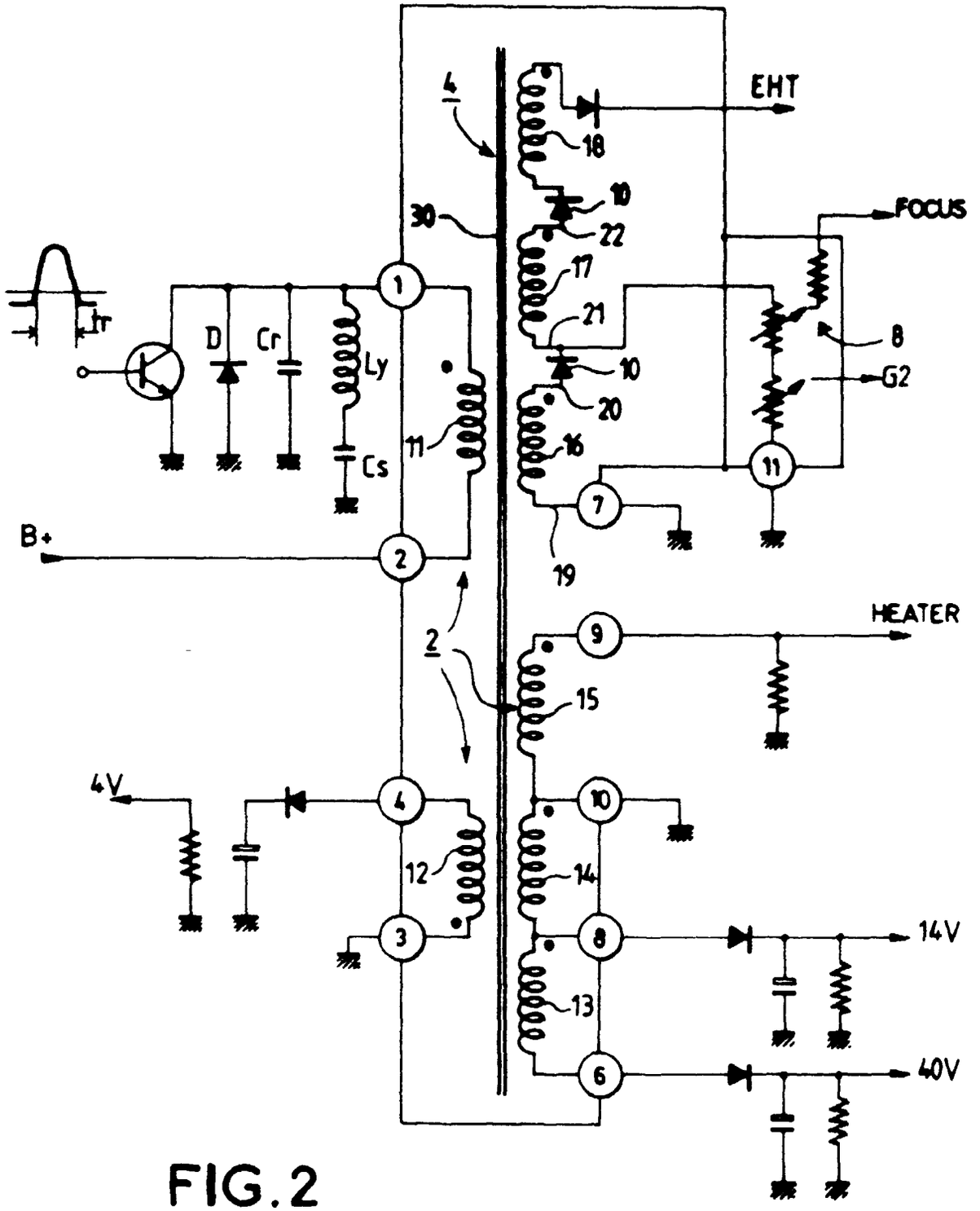


FIG.1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G2
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Cs
16
7
11
B+
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19
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4
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12
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3
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14V
13
6
40V

FIG. 2

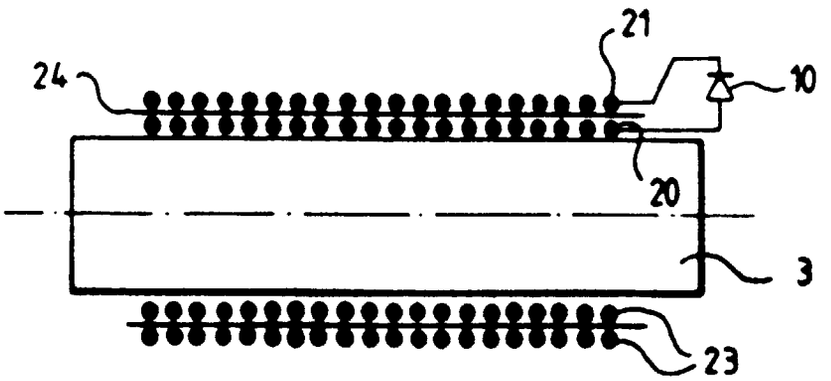

FIG. 3

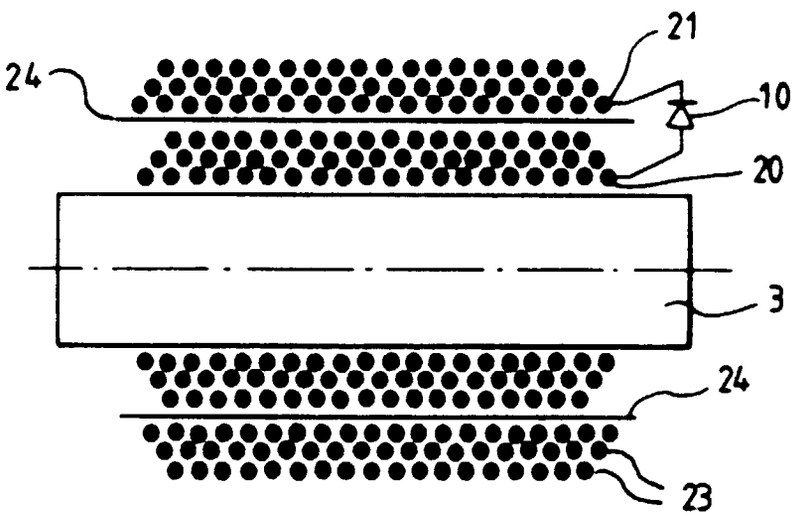

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 97 40 2967

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US 2 180 208 A (F. N. JACOB) 14 November 1939 * page 3, right-hand column, line 52 - page 4, left-hand column, line 6 * * line 54 - line 73; figures 12,13 *	1,2	H01F38/42 H01F41/06
D,Y	PATENT ABSTRACTS OF JAPAN vol. 008, no. 131 (E-251), 19 June 1984 & JP 59 041811 A (DENKI ONKIYOU KK), 8 March 1984, * abstract *	1,2	
A	FR 1 569 889 A (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) 6 June 1969		
A	US 5 448 216 A (KUZE YOSHIKAZU ET AL) 5 September 1995 * column 2, line 31 - line 54; figure 9 *		
A	US 5 209 414 A (CLEMENS DOUGLAS J ET AL) 11 May 1993		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 April 1998	Marti Almeda, R

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