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(54) **Transformer**

(57) Described herein is a transformer comprising: a bobbin (5) on which there are formed at least two windings of the transformer; on said bobbin, two sets of seats (7A, 7B) for two corresponding sets of terminals (9A, 9B), to which the ends of the wires (F1; F2) forming the windings are electrically connected; a ferromagnetic

core (3) defining a magnetic circuit and developing around the bobbin and through it. There are further provided two insulating elements 15 applied to the bobbin in positions corresponding to said two sets of terminals for separating the terminals electrically from the ferromagnetic core.

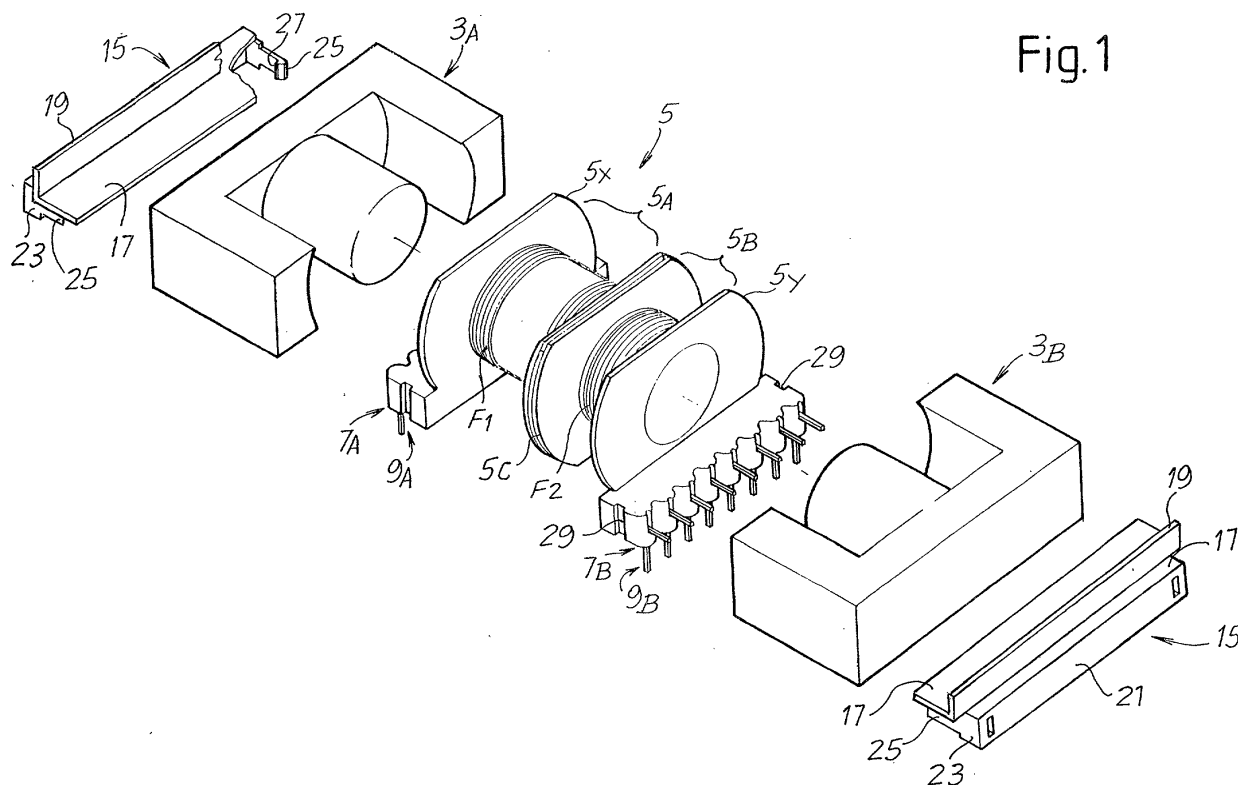


Fig.1

Description

[0001] The present invention relates to a transformer and, in particular, to a transformer of small dimensions designed to be applied on a card carrying an electronic circuit.

[0002] In producing these components, it is necessary to contain the dimensions of the transformer as much as possible, since the transformer constitutes one of the components of largest overall dimensions and hence one of the most critical components as regards miniaturization of circuits. The reduction in the overall dimensions of the transformer encounters a limit also in current safety standards, which require a minimum air gap between the primary winding and the secondary winding. In other words, the two windings must be separated from one another by an air gap that is equal to or greater than a minimum currently fixed at six millimetres. This requirement imposes large dimensions on the component, in so far as each point of the two windings must come to be at a large distance from the ferromagnetic core. This applies also, and in particular, to the connection terminals between the windings and the circuit in which the transformer is used.

[0003] Described in US-A-5,010,314 is a particular system which takes into account this requirement imposed by current safety standards for the production of a planar transformer, i.e., of a transformer in which the windings are formed by sheared plates.

[0004] The present invention relates more specifically to the production of a transformer in which the windings are made in a traditional way using metal wires wound on a bobbin. In these transformers there are provided for each winding respective terminals, which are normally L-shaped, to which the ends of the wires of the respective windings are knotted and then soldered. Each terminal is inserted in a seat made from the same plastic material that forms the bobbin for supporting the windings. Currently, transformers of this type are known in which, in order to obtain a sufficient air gap between each terminal and the ferromagnetic core, a laminar plate is associated to the bobbin, the said plate covering the face of the ferromagnetic core that faces the terminals, and furthermore the bobbin has a particularly large dimension as regards its height. The terminals are inserted in seats made in the bobbin, said seats being at a large distance from the ferromagnetic core. This involves a large size of the transformer. More in particular, the transformer proves particularly high on account of the need for distancing the terminals from the ferromagnetic core.

[0005] A reduction in overall dimensions is rendered problematical by the fact that it is not possible to close the terminals in housing seats, but instead it is necessary for them to protrude from said seats to be, on the one side, accessible for connection to the electronic circuit and, on the other, accessible for creating the connection between each terminal and the respective end

of the conductor that forms the winding, this in so far as said connection calls for a manual binding to be carried out first, followed by tin soldering. Both of the operations call for ease of accessibility to the terminal.

[0006] The purpose of the present invention is to provide a transformer that will enable observance of the conditions imposed by safety standards, with overall dimensions of the transformer that are sufficiently contained and, on the other hand, will maintain ease of accessibility to the terminals for making the necessary electrical connections.

[0007] These and further purposes and advantages, which will emerge clearly to persons skilled in the art from the ensuing text, are basically obtained with a transformer comprising: a bobbin on which at least two windings of the transformer are formed; on said bobbin, two sets of seats for two corresponding sets of terminals to which the ends of the wires forming the windings are electrically connected; and a ferromagnetic core defining a magnetic circuit and developing around the bobbin and through it. Characteristically, there are further provided two insulating elements applied to the bobbin after formation of the windings and after joining of the components forming the ferromagnetic core. The insulating elements are arranged in positions corresponding to the two sets of terminals carried at the ends of the bobbin in order to separate the terminals electrically from the ferromagnetic core with an air gap that is sufficiently large to meet the safety standards, for instance with an air gap of at least 6 mm. The use of these insulating elements applied around the terminals enables the necessary insulation to be achieved without increasing the overall dimensions of the transformer as will appear clearly from the description of an example of the embodiment.

[0008] In practice, both the winding bobbin and the two insulating elements can be made of moulded plastic. In particular, each of these components can be made with a single piece of moulded plastic with minimal costs.

[0009] According to a practical embodiment of the invention, in order to facilitate mounting of the insulating elements, each of these is constrained to the respective end of the bobbin by means of a pair of elastic tabs. Said tabs may be made of a single piece with the respective insulating element.

[0010] In order to surround the terminals in a suitable way with the plastic insulating material of the insulating elements applied to the ends of the bobbin so as to form the necessary air gap between the terminals of the two windings, it is advantageous to envisage that each insulating element will have a pair of walls which are mutually orthogonal and which define a contrast sectional strip against an edge of said ferromagnetic core. A first one of said walls extends between the ferromagnetic core and the corresponding seats of the terminals of the bobbin, whilst the second wall develops parallel to a face of the ferromagnetic core orthogonal to the axis of the

bobbin and orthogonal to the first wall of the insulating element.

[0011] Further advantageous features and embodiments of the invention are specified in the attached claims and in the ensuing description, as well as being illustrated in the attached drawings.

[0012] A better understanding of the invention will be obtained from the ensuing description and from the attached drawings, which illustrate a non-limiting practical embodiment of the invention. In the drawings, where like parts are designated by the same reference numbers:

Fig. 1 is an exploded view of the transformer and of its various components;

Fig. 2 is a partially sectioned perspective view from beneath of the transformer; and

Fig. 3 is a side view and partial longitudinal section of the transformer during the step of application thereof on an electronic card.

[0013] The transformer, which is designated as a whole by 1, comprises a ferromagnetic core 3, made for example of ferrite and consisting of two portions 3A and 3B, each of which is E-shaped. On the central element or pillar - designated by 3C - of the ferromagnetic core 3 there is fitted a bobbin 5 on which the primary and secondary windings are formed. The bobbin 5 is made of moulded synthetic plastic material and has a first winding area 5A and a second winding area 5B. The area 5A is delimited between a terminal flange 5X and an annular projection 5C, whilst the area 5B is delimited between this annular projection 5C and a second flange 5Y.

[0014] In the areas 5A and 5B there are formed windings by coiling one or more conductive wires. In the drawing, these windings are indicated only partially and limitedly to a wire-shaped conductor F1 and F2 for the windings in the area 5A and in the area 5B, respectively. However, it shall be understood, that in each of the two areas there may be provided more than one winding and that the turns formed thereby are greater in number than the ones represented.

[0015] At each end the bobbin is equipped with seats for respective connection terminals of the windings to the external circuit in which the transformer is inserted. As may be seen in the drawings, two sets of seats are provided, designated by 7A and 7B, for a corresponding number of L-shaped terminals 9A and 9B. Each seat consists of a cylindrical sleeve with a through hole and a side opening, within which the terminals 9A and 9B are inserted. The number of terminals for each set is sufficient for making the connection for all the windings that can be made on the corresponding area 5A or 5B of the winding bobbin 5.

[0016] Between adjacent seats of each set there is defined a passage 11, through which the respective end of the wire that is to be connected to one of the two terminals adjacent to the passage itself can come out of

the winding area to be knotted and then soldered to the stretch of the terminal 9A or 9D, which develops parallel to the axis A-A of the bobbin 5. The stretch of the terminal 9A or 9B orthogonal to the axis A-A of the winding bobbin forms the connection to the circuit in which the transformer is to be inserted.

[0017] The configuration so far described is substantially known and is made on transformers that are currently produced also by the holder of the present patent application.

[0018] In order to separate each terminal 9A of the first set from each terminal 9B of the second set with an air gap of at least 6 mm, or in any case of a size that reflects current safety standards, at the ends of the transformer there are applied two insulating elements, indicated as a whole by 15, which are substantially the same as one another, only one of which will be described in detail in what follows.

[0019] The insulating elements 15 have a basically box-like conformation open on two sides. Each of the aforesaid insulating elements has a first wall 17, which extends between a face of the ferromagnetic core 3 and the portion of the bobbin 5 that forms the respective seats 7A or 7B for the terminals 9A or 9B. Developing from this first wall 17, in a direction opposite to the terminals 9A or 9B, is a second wall 19 parallel to the corresponding face of the ferrite core, orthogonal to the axis A-A of the winding bobbin 5. The wall 17 extends, in a direction opposite to the ferromagnetic core 3, beyond the second wall 19, and connects to a side 21 that develops orthogonally to the wall 17 and parallel to the second wall 19. The side 21 extends with two small lateral sides that are orthogonal thereto, these being designated by 23. Each of the two small lateral sides 23 terminates with a respective elastic tab 25 provided with a tooth 27 that engages with a projection 29 made on the outside of the end seat 7A or 7B. The wall 17 extends laterally beyond the sides 23 and beyond the elastic tabs 25 so as to prevent there being an air gap that is too small between the terminals and the ferromagnetic core underneath the elastic tabs 25, which must project from the small lateral sides 23.

[0020] As may be noted from the drawings, the portions of the terminals 9A and 9B, parallel to the axis A-A of the winding bobbin 5, are in this way surrounded by the wall 17 and by the sides 21, 23 of the respective insulating element 15. The air gap that separates each terminal 9A, 9B from the ferromagnetic core can in this way be sufficiently large to meet current safety standards, without any need for increasing the overall dimensions of the transformer. In particular, it is possible to provide an air gap of at least 3 mm between each terminal 7A, 9A and the ferromagnetic core 3.

[0021] The process of construction of the transformer involves the steps described in what follows. First of all, the conductors are wound on the bobbin 5, which is separate from the ferromagnetic core 3 and is without the insulating elements 15. The ends of each conductor are

knotted to the respective terminals 9A, 9B of the two sets of terminals housed in the seats 7A and 7B of the bobbin 5. The next step is tinning, i.e., soldering of the ends of the conductors onto the respective terminals. Once soldering has been carried out, the two portions 3A and 3B of the ferromagnetic core 3 can be fitted onto the bobbin. Finally, the two insulating elements 15 are applied, which are inserted with the walls 17 between the ends of the bobbin 5 that form the seats 7A and 7B and the ferromagnetic core 3. The transformer thus assembled is ready to be installed on a card S (Fig. 3) of an electronic circuit, to which it is connected by means of the ends of the terminals 9A and 9B oriented so that they are orthogonal to the axis A-A of the winding bobbin.

[0022] It is understood that the drawing only shows an example of embodiment provided purely as a practical demonstration of the invention, since the invention may vary in its forms and arrangements without thereby departing from the scope of the idea underlying the invention itself. The possible presence of reference numbers in the attached claims has the purpose of facilitating reading thereof with reference to the description and to the plate of drawings, and in no way limits the scope of protection represented by the claims.

Claims

1. A transformer comprising: a bobbin (5) on which there are formed at least two windings of the transformer; on said bobbin, two sets of seats (7A, 7B) for two corresponding sets of terminals (9A, 9B) to which the ends of the wires (F1; F2) forming the windings are electrically connected; a ferromagnetic core (3) defining a magnetic circuit and developing around the bobbin and through it;

characterized by two insulating elements 15 applied to the bobbin in positions corresponding to said two sets of terminals for separating the terminals electrically from the ferromagnetic core.

2. The transformer according to Claim 1, **characterized in that** said insulating elements define an air gap for separating between the terminals of the two sets of terminals which is equal to at least 6 mm.
3. The transformer according to Claim 1 or Claim 2, **characterized in that** each of said insulating elements is formed by a single piece of moulded plastic.
4. The transformer according to Claim 1, Claim 2 or Claim 3, **characterized in that** each of said insulating elements is constrained to said bobbin by a pair of elastic tabs (25).
5. The transformer according to Claim 4, **characterized in that** said elastic tabs are formed from the

material constituting the respective insulating element.

6. The transformer according to one or more of the foregoing claims, **characterized in that** each insulating element has a pair of walls (17, 19) that are orthogonal to one another and that define a sectional strip that surrounds a corresponding edge of said ferromagnetic core, one first (17) of said walls extending between the ferromagnetic core and the bobbin.
7. The transformer according to Claim 6, **characterized in that** said first wall develops beyond the second wall (19) on the side opposite to the bobbin and to the ferromagnetic core.
8. The transformer according to Claim 7, **characterized in that** said first wall (17) is provided with a side (21, 23) surrounding said terminals (9A, 9B), the side developing from said first wall on the side opposite to said second wall.
9. The transformer according to Claims 5 and 8, **characterized in that** said side defines, at its own end, said elastic tabs (25).
10. The transformer according to Claim 9, **characterized in that** said first wall (17) and said second wall (19) extend beyond said elastic tabs.
11. The transformer according to Claim 1 or 2, **characterized in that** said terminals have an L-shaped conformation and **in that** each of said insulating elements has:
 - a first wall (17), which is substantially plane and which develops between the ferromagnetic core and the corresponding set of seats of said terminals, said first wall projecting with respect to the ferromagnetic core parallel to the axis of the bobbin and parallel to the end of the terminals on which the wires of the corresponding winding or windings are soldered;
 - a second wall (19), developing from a face of said first wall (17) and orthogonally thereto, said second wall extending parallel to an external face of the ferromagnetic core orthogonal to the axis of the bobbin;
 - a side (21), developing from a face of said first wall (17), opposite to the face from which there develops said second wall (19), said side extending orthogonally to the axis of the bobbin and parallel to the direction along which said terminals are aligned.
12. The transformer according to Claim 11, **characterized in that** said side (21) is connected, at its own

ends, to two small lateral sides 23, orthogonal thereto and parallel to the axis of the bobbin.

13. The transformer according to Claim 12, **characterized in that** said two small lateral sides extend until they form two elastic tabs (25) for hooking of the insulating element to the bobbin.. 5
14. The transformer according to Claim 13, **characterized in that** said first wall (17) and said second wall (19) extend laterally, in the direction of alignment of the terminals, beyond the length of said side (21). 10
15. The transformer according to one or more of Claims 1 to 5, **characterized in that** said insulating elements (15) have an approximately box-like development, with an opening of length approximately equal to the length of alignment of the corresponding terminals. 15

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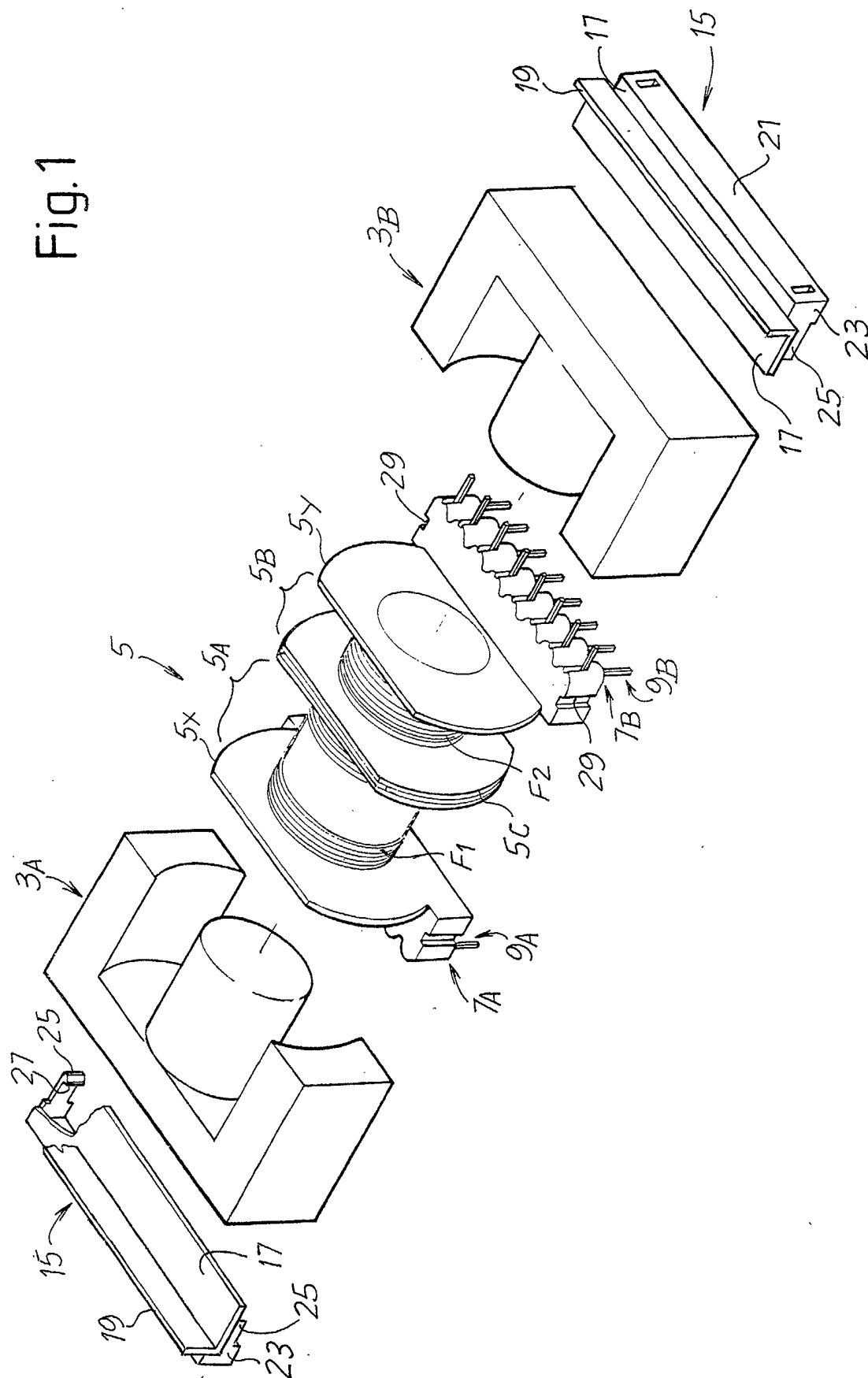
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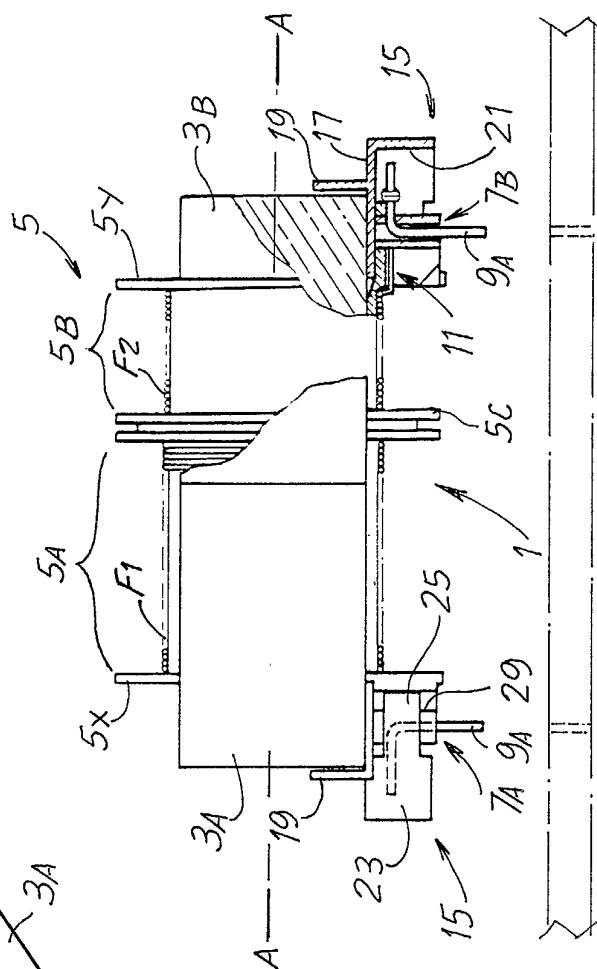
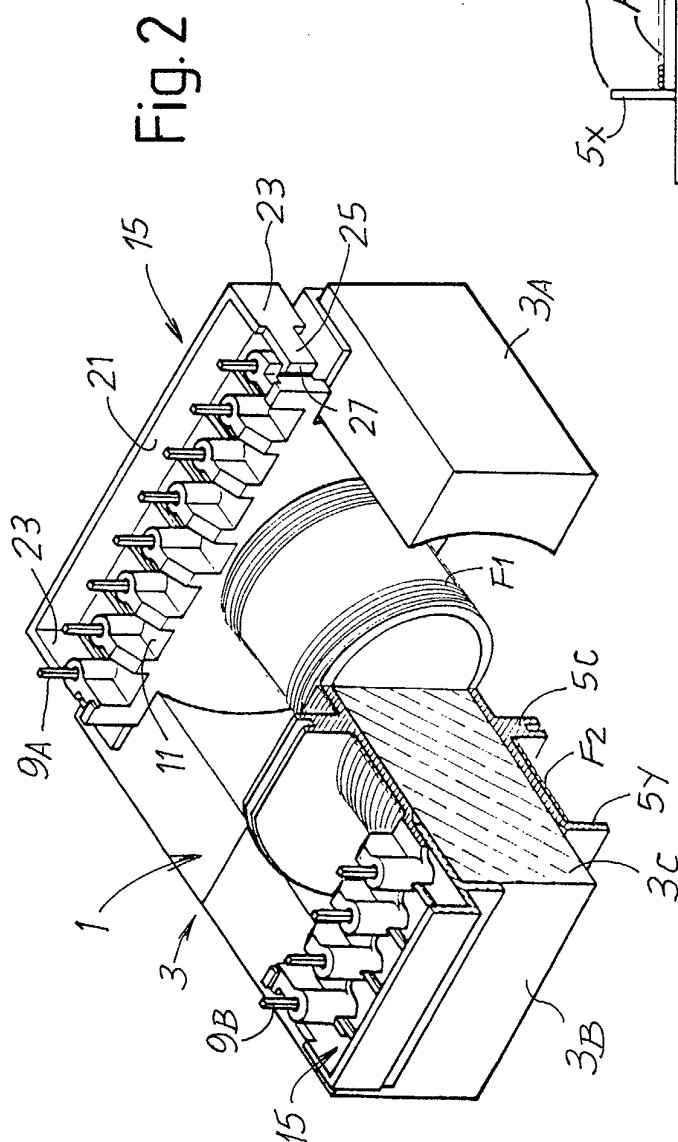
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EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5094

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 June 2002	Examiner Durville, G
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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 02 42 5094

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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