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(54) **Transformer having an air gap and an insulation foil packet.**

(57) The transformer (1) comprises a ferromagnetic core (3), which is interrupted by an air gap (11), and a coil former (5), which is provided with a winding packet (7). The coil former (5) surrounds the core (3) at the area of the air gap (11). The winding packet

(7) comprises an electrically conducting foil winding packet (17) and spacer elements (15) which are located between the coil former (5) and the foil winding packet (17) and reduce the formation of eddy currents due to the magnetic stray field (13).

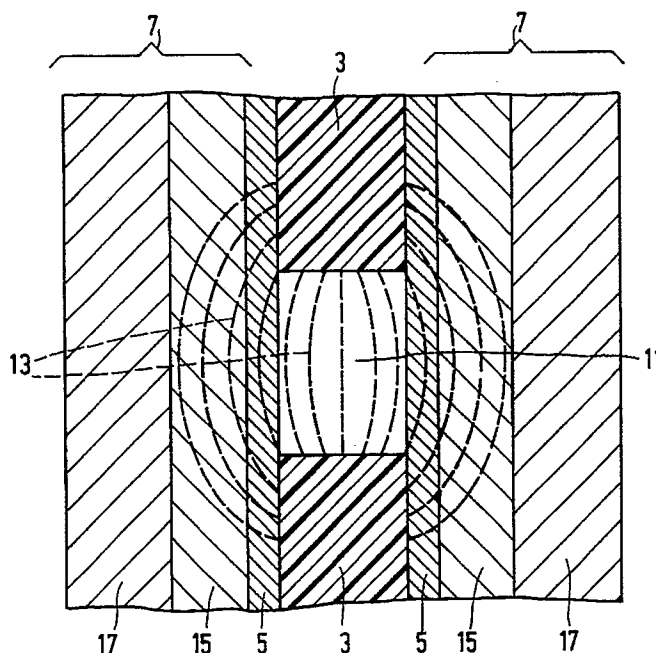


FIG.2

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The invention relates to a transformer comprising a ferromagnetic core, which constitutes a magnetic circuit, which is interrupted by at least one air gap, and a coil former, which is provided with an electrically conducting foil winding packet, which coil former surrounds the core at the area of the air gap. The term "foil winding packet" is to be understood to mean any winding packet comprising at least one layer of electrically conducting foil.

Such a transformer is known from GB-A 2,037,089. In the presence of an air gap in a magnetic circuit, magnetic stray fields are formed, which produce eddy currents in the winding and whose strength increases with the size of the air gap. In the aforementioned document, in order to limit the lateral expansion of the magnetic stray field, the air gap is subdivided into partial air gaps, which is constructively complicated, however.

The invention has for its object to provide a transformer of the kind mentioned in the opening paragraph, in which the construction is simple and the magnetic stray field does not act in a disturbing manner upon the foil winding packet. The transformer according to the invention is for this purpose characterized in that a number of electrically insulating spacer elements are arranged between the coil former and the foil winding packet. The spacer elements hold the coil former and the winding packet at a certain relative distance, as a result of which the formation of eddy currents in the winding packet due to the magnetic stray field is prevented. Consequently, the construction can be considerably simplified in that the number of air gaps is limited to one large air gap.

The invention is based on the recognition of the fact that, in order to achieve the aforementioned object, the commonly used construction is not employed. In such a construction the windings of the transformer are located as close to the core as possible and thus the transformer is kept as compact as possible.

A preferred embodiment of the transformer according to the invention is characterized in that the spacer elements are windings of insulation foil. The foil winding packet generally occupies only a part of the winding space available. The winding space not required for the coils is first filled with insulation winding foil. Subsequently, the coils are wound.

The invention will now be described more fully with reference to the drawing.

Figure 1 shows diagrammatically a side elevation of a transformer comprising a ferromagnetic core with an air gap, and

Figure 2 shows in detail a sectional view of the transformer at the area of the air gap in the core.

Fig. 1 shows a transformer 1 comprising a ferromagnetic core 3 consisting of two parts, which

is made, for example, of ferrite and constitutes a magnetic circuit. The transformer 1 further comprises a coil former 5. This coil former 5, which is made, as usual, of electrically insulating material, is provided with a winding packet 7 comprising primary and secondary coils. The ferro-magnetic core 3 has an air gap 11, which is located within the coil former 5.

Fig. 2 shows in detail a representation of the cross-section of the coil former 5 and the winding packet 7 at the area of the air gap 11. In the proximity of the air gap 11, a magnetic stray field is produced, whose lines of force 13 are indicated by dotted lines. The lateral extent of the lines of force 13 is large on account of the dimension of the air gap 11. As a result, if a winding is wound directly onto the coil former 5, eddy currents will be produced in this winding, which leads to an increase of the operating temperature of the transformer. This can be avoided in that electrically insulating spacer elements 15 are arranged between the coil former 5 and the winding. For this purpose, the winding packet 7 comprises a packet 15, which is wound from insulation foil and is located directly on the coil former 5, and a foil winding packet 17 comprising primary and secondary coils. The foil winding packet 17 can be wound from layers of electrically conducting foil, such as, for example, copper foil or aluminium foil, which are mutually separated by insulation foil. If desired, one or more of the coils may consist of a winding of copper wire. It is also possible that all coils are wound from electrically conducting wire and that the packet of electrostatic screenings consists of electrically conducting foils.

Figure 1 shows a transformer 1 comprising a bi-partite ferromagnetic core 3, for example of ferrite, which constitutes a magnetic circuit. The transformer 1 further comprises a coil former 5, which is provided with a winding packet 7, which comprises primary and secondary coils, which are wound, for example, from layers of copper foil or aluminium foil mutually separated by insulation foil. If desired, one or more of the coils may consist of a winding of copper wire. It is also possible that all coils are wound from electrically conducting wire and that the packet of electrostatic screenings consists of electrically conducting foils. All these variations of the winding packet 7 are designated as foil winding packet. The ferromagnetic core 3 comprises an air gap 11, which is located within the coil former 5.

Figure 2 shows in detail the sectional view of the coil former 5 and the winding packet 7 at the area of the air gap 11. In the proximity of the air gap 11, a magnetic stray field is produced, whose lines of force 13 are indicated by dotted lines. The winding packet 7 comprises a packet 15, which is wound from insulation foil and which is directly

disposed on the coil former 5, and a foil winding packet 17 consisting of layers of electrically conducting foil, for example aluminium foil, which are mutually separated by insulation foil. The lateral expansion of the lines of force 13 is large because of the dimension of the air gap 11, as a result of which, when the foil winding packet 17 is directly wound onto the coil former 5, eddy currents will be produced in this packet 17. This leads to an increase of the operating temperature of the transformer.

Due to the choice of the type of transformer, the winding space available for the winding packet 7 is fixed. In general, the foil winding packet 17 does not require the whole winding space. As a result, there is place for the packet 15 serving as spacer element between the coil former 5 and the foil winding packet 17. In this manner, the foil winding packet 17 is kept at a certain distance from the coil former 5, as a result of which the lines of force 13 of the magnetic stray field do not reach the packet 17 so that the formation of eddy currents is prevented and consequently the operating temperature of the transformer 1 is reduced.

Instead of providing the coil former 5 with insulation foil 15 in order to avoid eddy currents in the foil winding packet 17, the same effect may be achieved in that spacer elements are arranged in a different manner between the coil former 5 and the foil winding packet 17. This may be obtained, for example, by choosing a coil former having a larger diameter. As a result, however, the flexibility of the size of the winding space for the winding packet 7 is limited.

The consequences for the operating temperature as a function of the number of layers of insulation foil are illustrated with reference to the following measuring data. With an output power of 200 W and for an insulation foil thickness of 6 μm : without additional insulation foil, the temperature increase = 60° C, with 450 additional layers of insulation foil, the temperature increase = 50° C, and with 650 additional layers of insulation foil, the temperature increase = 44° C.

Claims

1. A transformer comprising a ferromagnetic core, which constitutes a magnetic circuit, which is interrupted by at least one air gap, and a coil former, which is provided with an electrically conducting foil winding packet, which coil former surrounds the core at the area of the air gap, characterized in that a number of electrically insulating spacer elements are arranged between the coil former and the foil winding

packet.

2. A transformer as claimed in Claim 1, characterized in that the spacer elements are windings of insulation foil.

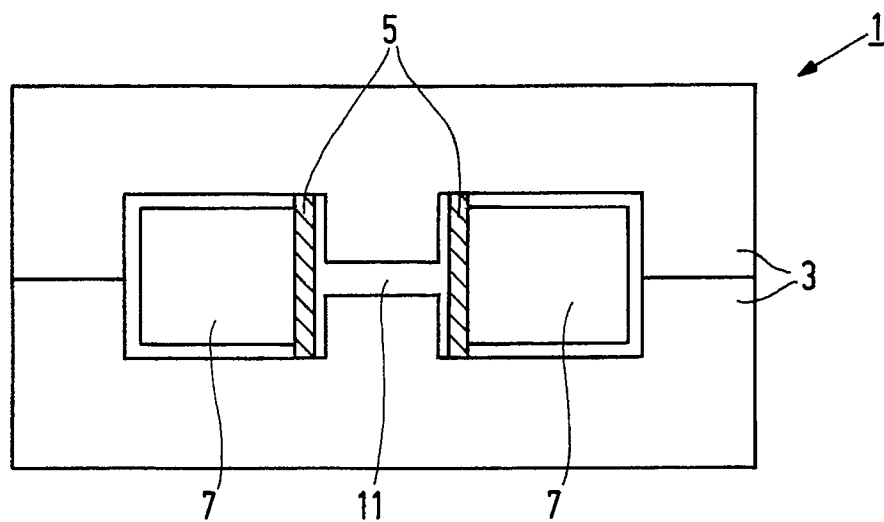


FIG.1

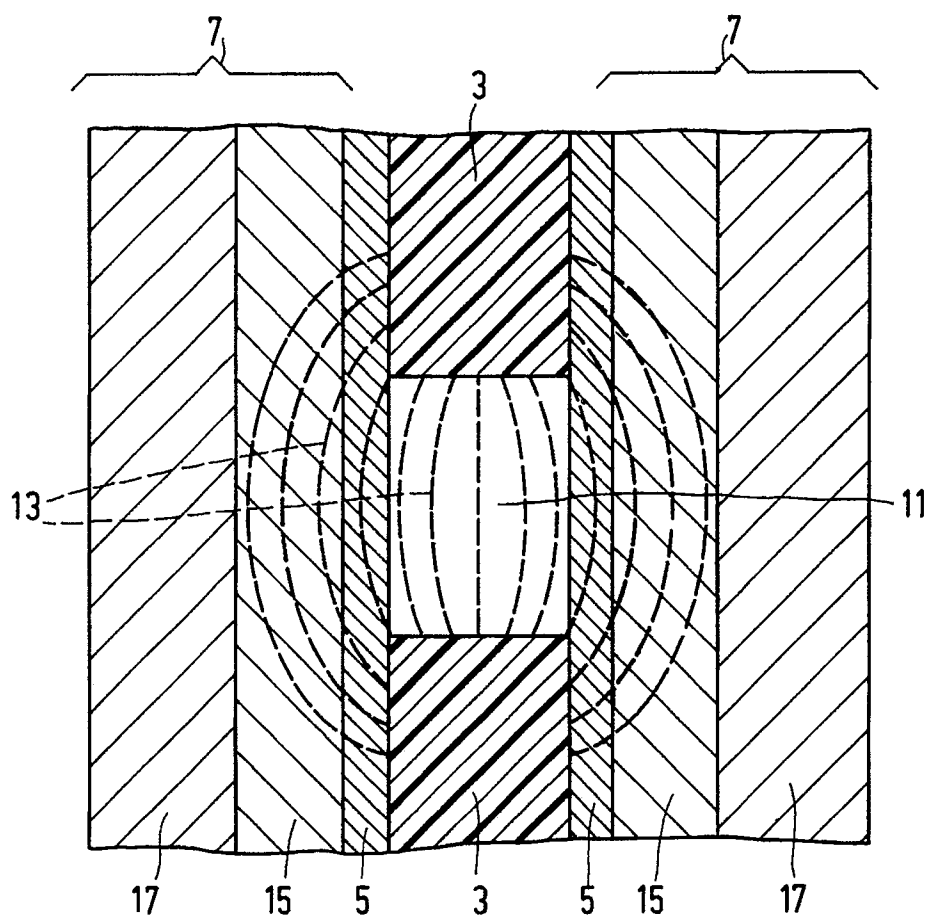


FIG.2



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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 1393

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.5)		
Y	GB-A-2 052 166 (N.V.PHILIPS' GLOEILAMPEN-FABRIEKEN) * page 1, lines 66 - 107 * -- --	1	H 01 F 3/14 H 01 F 27/34		
Y,A	DE-A-3 625 964 (SCHRACK ELEKTRONIK-AKTIENGESELLSCHAFT) * column 3, lines 40 - 51 * -- --	1,2			
A	EP-A-0 315 527 (OREGA ELECTRONIQUE & MECANIQUE) -- --				
A	EP-A-0 108 921 (VACUUMSCHMELZE GMBH) -- --				
A	DE-A-2 305 957 (SIEMENS AKTIENGESELLSCHAFT) -- -- -- --				
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)		
			H 01 F		
The present search report has been drawn up for all claims					
Place of search The Hague		Date of completion of search 03 September 91	Examiner VANHULLE R.		
<table><tr><td>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 O: non-written disclosure P: intermediate document T: theory or principle underlying the invention</td><td>E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons ----- &: member of the same patent family, corresponding document</td></tr></table>				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 O: non-written disclosure P: intermediate document T: theory or principle underlying the invention	E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons ----- &: member of the same patent family, corresponding document
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