

Switched power supplies, as they are predominantly used in television receivers, video recorders and the like, need a transformer which ensures the galvanic separation of the receiver circuitry from the mains and, on the secondary side, delivers operating voltages of different magnitudes and polarities via rectifying circuits. It is known to synchronise switched power supplies with the line frequency of a television receiver. The switched power supply then operates at a frequency of about 16 kHz.

In the transition to high definition television systems, one encounters line frequencies in the order of magnitude of 32 kHz. If a switched power supply works at this increased frequency then skin effect problems become noticeable, namely, in the form of higher losses which have to be reduced by using larger amounts of copper. For the avoidance of the skin effect, it is known to use litz wire as wire for the windings. However, litz wire causes considerable difficulties when manufacturing the windings with automatic machines because, relative to a solid copper wire, it has a lower rigidity and therefore is more difficult to handle. Moreover, a greater space for the winding is necessary.

For the avoidance of the skin effect, it is also known to form a winding from several parallel connected wires e.g. in the form of two winding strands or a bifilar winding. When using such a method, the two winding strands or wires inevitably do not have the same positioning relative to the magnetic field of the transformer. This means, that the voltages induced in them are not exactly equal. Due to the difference in the induced voltages, equalising currents therefore occur in the parallel circuit of the two wires and thus lead to an undesired loss of performance.

The object of the invention is to construct a transformer, in which, for the elimination of the skin effect, a winding consists of two parallel connected strands or wires, such that no equalising currents appear in the said parallel circuit.

This object is achieved by the invention defined in the claim 1. Advantageous developments of the invention are specified in the appendant claims.

Due to the solution in accordance with the invention, it is thus ensured that the two parallel connected winding strands or wires are equal as regards their positioning vis a vis the effective magnetic field of the transformer and thereby the voltages induced in them are equal. If these voltages are equal, no equalising currents can flow in the parallel circuit of the two

winding strands or wires so that the losses created by the equalising currents do not occur. The optimal arrangement of the winding sections can be determined empirically for example in that one separates the parallel circuit and ensures, for a predefined field of the transformer, that the voltages induced in the two windings are equal.

The invention is particularly advantageous in connection with a compartmentalised coil former. In this, the successive sections of the winding in the axial direction of the coil former are located in individual chambers of the compartmentalised coil former.

The invention will be explained hereinafter with the help of the drawing. Therein,

- Fig. 1 shows in principle, the solution in accordance with the invention having two winding strands, each with two winding sections,
- Fig. 2 a modification of the arrangement according to Fig. 1 with three winding sections per winding strand,
- Fig. 3 a further development with five winding sections per winding strand and
- Fig. 4 a formation of the windings as a compartmentalised winding for a primary winding and a secondary winding.

In Fig. 1, the winding of a transformer located between the connecting terminals A and B includes a first winding strand having the winding sections 1a and 1b and a second winding strand having the winding sections 2a and 2b. The two winding strands 1a, 1b, and 2a, 2b are connected in parallel. The winding sections 1a and 2b have a large spacing from the core K and the winding sections 2a and 1b a small spacing. The total number of the turns of a winding strand is distributed over the two winding sections such that each contains half. It is apparent that the two winding strands 1a, 1b, and 2a, 2b are equivalently positioned relative to the core K and to the magnetic field. Each winding strand is located with one half near the core K and the other half further away from the core K. Due to these geometrically equivalent positionings relative to the core K, the voltages induced in the two winding strands are also equal so that equalising currents cannot flow in the closed circuits formed by the windings 1a, 1b, 2a, 2b.

In Fig. 2, the first winding strand includes three winding sections 1a, 1b, 1c and likewise, the second winding strand, three winding sections 2a, 2b, 2c. Again, as in Fig. 1, the winding sections of the two strands are arranged crosswise displaced to the core K and are thus equivalent in their positioning relative to the magnetic field. Half the winding strand 1, namely the winding section 1b, is located very close to the core and the other half, namely the winding sections 1a and 1c, is far away from the core K. Analogously, half the second winding strand 2, namely the winding sections 2a and 2c, is located very close to the core and the other half, namely the winding section 2b, is far away from the core K.

Fig. 3 shows a corresponding arrangement for five winding sections per winding strand. The winding strand 1 with its winding sections 1a, 1c and 1e, each having $1/6$ of the total number of turns of the winding strand - that means half of the total number of turns, is located far away from the core and, with its winding sections 1b and 1d, each having $1/4$ of the total number of turns i.e. likewise with half, is very close to the core. Analogously, the winding sections 2b and 2d, each having $1/4$ of the number of turns i.e. likewise with half of the total number of turns, are located away from the core and the winding sections 2a, 2c and 2e, each having $1/6$ i.e. likewise with half of the total number of turns, very close to the core. Again, the two winding strands 1a, 1b, 1c, 1d, 1e and 2a, 2b, 2c, 2d, 2e are thus equivalently positioned relative to the core K and to the magnetic field.

Fig. 4 shows a construction for a compartmentalised coil former for a primary winding P and a secondary winding S. The successive, in total 11, chambers contain alternately, one winding section of the primary winding P and one of the secondary winding S. Again, all the winding sections of P and of S are arranged as in Figs. 1 - 3, i.e. they are located alternately at a great and a small distance from the core. The primary winding P formed by two winding strands each having six winding sections has the connecting terminals A and B. The secondary winding S formed by two winding strands each having five winding sections has the connecting terminals C and B. Such an interlaced arrangement of the primary winding and the secondary winding in a compartmentalised coil former for a switched power supply is known and more fully described in the DE_OS 31 29 381.

Preferably, the complete winding in accordance with Fig. 4 is arranged in a compartmentalised coil former. This means, that the successive winding sections in the axial direction of the primary winding P and the secondary winding S are located in chambers of a compartmentalised coil former. The vertical lines between the winding parts P and S in Fig. 4 thus each signify the separating walls forming the chambers of a compartmentalised coil former.

Claims

1. Transformer, especially for a switched power supply, having a winding including two parallel connected winding strands (1a, 1b or 2a, 2b) each with several winding sections connected in series, characterised in that, the winding sections (1a, 1b, 2a, 2b) of the two strands are arranged, displaced in opposite directions radially of the transformer core (K), in such a way that the voltages induced in the strands by the magnetic field are approximately equal, in that, successive winding sections (1a, 1b) of the first strand in the axial direction have alternately a first and a second radial spacing from the core (K) and, in complementary manner thereto, successive winding sections (2a, 2b) of the second strand have alternately the second and the first radial spacing from the core (K).

2. Transformer in accordance with claim 1, characterised in that, for three successive winding sections (1a - c, 2a - c) in the axial direction per strand, the two outer winding sections (1a, 1c; 2a, 2c) each have $1/4$ and the central winding sections (1b, 2b) each have $1/2$ of the total number of turns of a strand (Fig. 2).

3. Transformer in accordance with claim 1, characterised in that, the successive winding sections in the axial direction of the strands are arranged in chambers of a compartmentalised coil former.



* C L H S *