



High tension transformer for a television receiver

The invention is based on a high tension transformer in accordance with the first part of claim 1. A transformer of this type is known from DE-OS 35 14 308. Transformers of this type produce a high tension for television receivers having an order of magnitude of 25 kV.

In television receivers having larger picture tubes e.g. having an aspect ratio of 16:9 or a picture tube diagonal of 85 cm, higher voltages in the order of magnitude of 35 kV are needed. Transformers for a very high voltage of this kind inevitably have an increased power dissipation whereby the heat generated, and the necessary geometrical dimensions for carrying away the heat, rise.

The object of the invention is to reduce the power dissipation occurring at the transformer in a high tension transformer of this type. This object is achieved by the invention defined in claim 1. Advantageous developments of the invention are specified in the appendant claims.

The invention is based initially on an analysis of the overall kinds of losses occurring in a transformer of this type. A first kind of loss consists of the losses in the ferrite due to the reversal of the magnetisation of the core in correspondence with the areas defined by the hysteresis curve. These kinds of loss can only be reduced by means of ferrite materials of higher quality. A second kind of loss consists of the losses in the copper due to the ohmic resistance of the wire and the skin effect. A third kind of loss consists of the losses in the high tension rectifying diodes, that is to say, due to the breakdown voltage and the forward current, the blocking voltage and the blocking current and the switching loss when switching from the blocked to the conductive state and vice versa. A fourth kind of loss consists of the losses in the dielectric due to displacement currents in the dielectric medium which is generally formed of a cast resin. In the case of the first three kinds of loss, lower limits are set, in particular, for

technical reasons and by virtue of the available components. The invention addresses itself now to the fourth kind of loss. The invention is thereby based on the following considerations. The dielectric losses occur in particular, in the region between the primary winding and the secondary winding or high tension winding because it is here that the largest differences in voltage exist. The dielectric losses can be considerably reduced if one can succeed in forming this region to be, in so far as possible, electrically field-free. In the case of the invention, this is achieved merely by means of a particularly advantageous distribution of the pulse voltages on the primary winding and on the secondary winding, that is to say, in such a way that the pulses on the primary winding and on the secondary winding have approximately the same amplitude and polarity in the said region. The difference between the pulse voltages on the two windings then practically disappears so that, as desired, an electrically field-free space is achieved and losses due to dielectric displacement currents are avoided to the greatest extent. A substantial advantage consists in that the field-free space is not achieved by virtue of additional means, but rather, by means of a skilful arrangement of the parts that are in any case needed. Moreover, due to the reduction of the dielectric displacement currents in the dielectric medium surrounding the windings, the harmonic content of the voltages produced is reduced. Thereby, there are fewer self-resonances which are otherwise triggered-off by the displacement currents. This reduction of the harmonics produces an improvement in the internal resistance and, moreover, a reduction of the acoustical noise emanating from the transformer. Taken as a whole, the material surrounding the windings, preferably a cast resin, is also subjected to less stress.

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

Fig. 1 shows the constructional arrangement of a high tension transformer in accordance with the invention and

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Fig. 2 an equivalent circuit for the transformer in accordance with Fig. 1.

Only the pulse voltages that are effective on the transformer are considered in the description. The dc voltages occurring thereby are not taken into consideration because these have no effect upon the dielectric displacement currents and hence upon the power dissipation.

In Fig. 1, the coil former 7, which carries the primary winding 3, is mounted on the core 1. The primary winding 3 consists of six layers. The end of the winding from the lower layer is connected to the terminal b at the operating voltage $+U_B$. The end of the winding from the upper layer is connected to the terminal d and to the switching transistor 13 which is controlled by a line frequency switching voltage Z on the terminal c. The pulse voltage on the terminal b is zero. The pulse voltage on the terminal d has the full value of the flyback voltage of +1200 volts. The pulse voltage thus rises continuously, from winding to winding, from the value zero on the terminal b up to the maximum value on the terminal d. This means that the pulse voltage declines by approximately 16 % over the axial length of the upper layer of the winding 3 and the pulse voltage amounts to +1000 volts at the right hand end of the upper layer. Thus, the pulse voltage in the upper layer of the winding 3 is, to a large extent, constant over the axial length of the coil former 7 and has an average value of 1100 volts.

The chambered coil former 2, which comprises in toto 16 chambers K_a to K_p that are formed by the walls 8 and are filled with partial windings 4a to 4p of the secondary winding or high tension winding 4, is arranged above the coil former 7 carrying the primary winding 3. The end of the winding from the upper layer of the first partial winding 4a is connected to earth. The end of the respective winding at the base of a chamber K is connected to the anode of a high tension rectifying diode 6 whose cathode is connected to the end of the winding at the upper end of the next respective partial winding 4. The end of



the winding from the base of the last partial winding 4p in the chamber Kp forms the high tension terminal a. The winding sequence for the total secondary winding 4 begins at the base of the chamber Kp. In the case of a total of 16 chambers K, there are provided in toto 15 diodes 6 since a respective diode 6 is located between each two chambers. A high tension UH of 32 kV occurs on the terminal a. In the case of these assumed values, there results a respective pulse of +1100 volts at the base of a chamber K, this being of the same magnitude for each of the chambers. A pulse of -1300 volts occurs at the upper end of the winding 4.

Thus, pulses having an amplitude that is largely constant at +1100 volts occur across the upper layer of the winding 3. On the other hand, as has been described, pulses having the constant amplitude of +1200 volts likewise occur through the secondary winding 4 in the region associated with the winding 3, i.e. in the vicinity of the lower ends of the chambers. Moreover, the pulses in the winding 3 and in the winding 4 are contemporaneous. Hence, there is practically no longer any difference in voltage between the pulses in the winding 3 and the pulse in the winding 4 so that there results the electrically field-free space indicated by the dash-dotted line F.

Of course, the pulses at the upper end of the windings 4 have the wrong, negative, polarity for forming the field-free space. However, the pulses occurring there are so far distant from the primary winding 3 that they no longer cause any displacement currents worth mentioning through the dielectric medium.

The upper end of the first winding 4a is earthed and thus does not lead to any pulse voltage while, on the other hand, the lower end of the last winding 4p, which is earthed via the capacitance of the picture tube, likewise does not lead to any pulse voltage. Thus, the voltage ratios for these two windings are different from the other windings 4b to 4o. It is advantageous to only half wind the chambers Ka and Kp vis a vis the other chambers in order to produce the wanted amplitude

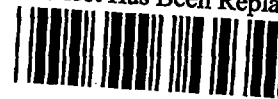
ratios between the pulse voltages in this area too. The primary winding 3 is preferably wound from stranded wire in order to keep the losses due to the skin effect low.

Fig. 2 shows the equivalent circuit appertaining to Fig. 1. The capacitor 14, which is basically formed by the anode coating of the picture tube 15, is connected to the terminal a carrying the high tension UH. The diode 6b thus corresponds to the first diode between the base of the chamber Ka and the end of the winding at the upper end of the chamber Kb in Fig. 1. The last diode 6p corresponds to the diode between the lower end of the winding in chamber Ko and the upper end of the winding in the last chamber Kp.

It is also possible to subdivide the primary winding 3 into a plurality of partial windings which are located adjacent to one another in an axial direction on the core 1 and which are connected in parallel between the terminals b and d. The amplitude in the upper layer of the primary winding 3 generally differs over the axial length. This can be taken into account by filling the chambers Ka to Kp in correspondingly different manners so that the respective pulses in the partial windings 4a to 4p at the base of the respective chamber also have correspondingly different amplitudes. The filling factor for the chambers K including the partial windings 4 would then decline from the left hand end to the right hand end of the coil formers 7, 2 in the same way that the amplitude of the pulse declines in the upper layer of the winding 3 i.e. from +1200 volts to +1000 volts in Fig. 1.

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Claims

1. High tension transformer for a television receiver including a primary winding (3) and a secondary winding (4) which is arranged thereabove and whose partial windings (4a - 4p) are located in chambers (K) of a chambered coil former (2) and are connected together by diodes (6), characterised in that, the primary winding (3) and the secondary winding (4) are subdivided and poled in such a way that pulses of approximately equal amplitude and polarity occur in the mutually facing regions of the windings (3, 4) and an electrically, virtually field-free space is formed between the windings (3, 4).
2. Transformer in accordance with Claim 1, characterised in that, the primary winding (3) is formed as a layered winding having a plurality of superimposed layers and the end of the winding (b) from the lower layer is provided as the connection terminal for the operating voltage (UB) and the end of the winding (d) from the upper layer is provided as the connection terminal for a cyclical switch (13).
3. Transformer in accordance with Claim 2, characterised in that, the partial windings (4a - 4p) are poled such that a positively directed pulse is present on the respective ends of the windings at the base of a chamber (K).
4. Transformer in accordance with Claim 3, characterised in that, the number of chambers (K) and partial windings (4a - 4p) is made so large that the positively directed pulse at the base of a chamber (K) has approximately the same amplitude as the positively directed pulse in the upper layer of the primary winding (3).
5. Transformer in accordance with Claim 1, characterised in that, a respective diode (6) is connected at its anode to the end of the winding at the base of a chamber (K) and at its cathode to the end of the winding from the upper layer of the partial winding (4) in the next chamber (K).



6. Transformer in accordance with Claim 1, characterised in that, the start of the winding of the secondary winding (4) forms the terminal (a) which delivers the high tension (UH).

7. Transformer in accordance with Claim 1, characterised in that, the primary winding (3) consists of a plurality of partial windings (3a - 3c) that are connected in parallel and are adjacent to one another in the axial direction of the coil former (2).

8. Transformer in accordance with Claim 1, characterised in that, the transformer is constructed as a diode-split transformer.

9. Transformer in accordance with Claim 1, characterised in that, the chambers (K) are filled in different manners with the partial windings in such a way that the respective pulse at the base of the chamber has approximately the same amplitude as the pulse on the adjacent winding of the primary winding (3).

10. Transformer in accordance with Claim 1, characterised in that, the first (Ka) and last (Kp) chamber are only half filled with the partial windings (4) relative to the other chambers (Kb - Ko).

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