

Nov. 22, 1938.

K. SCHLESINGER

2,137,356

HIGH-VOLTAGE TRANSFORMER FOR TELEVISION APPARATUS

Filed Dec. 9, 1935

2 Sheets-Sheet 1

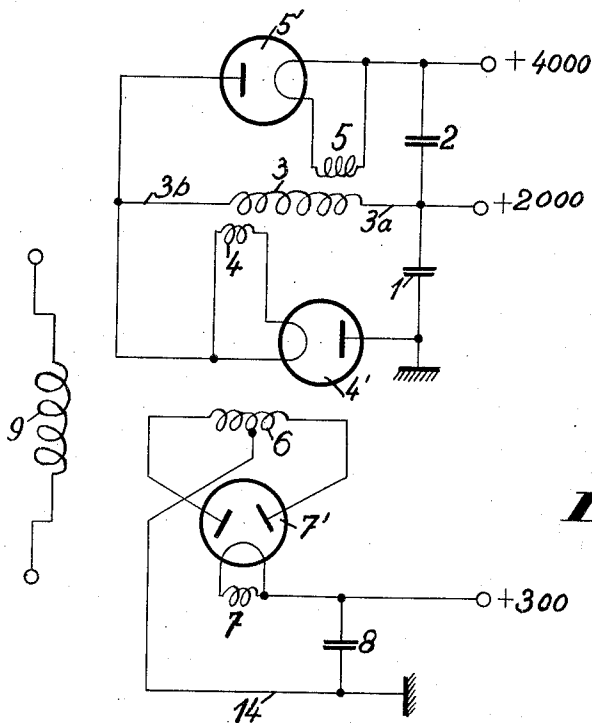


Fig. 1

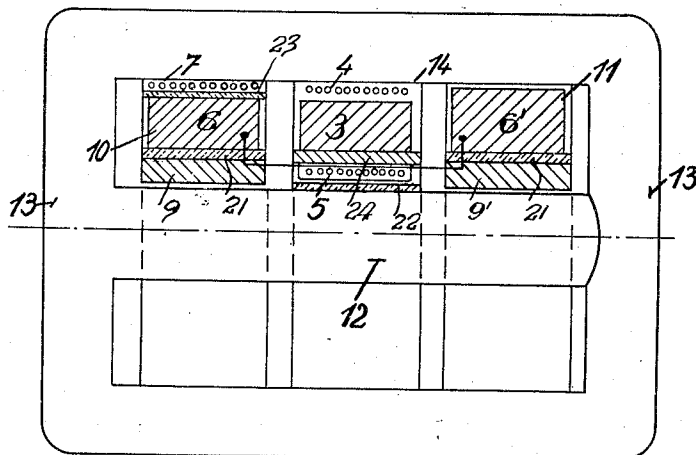


Fig. 2

INVENTOR

K. Schlesinger

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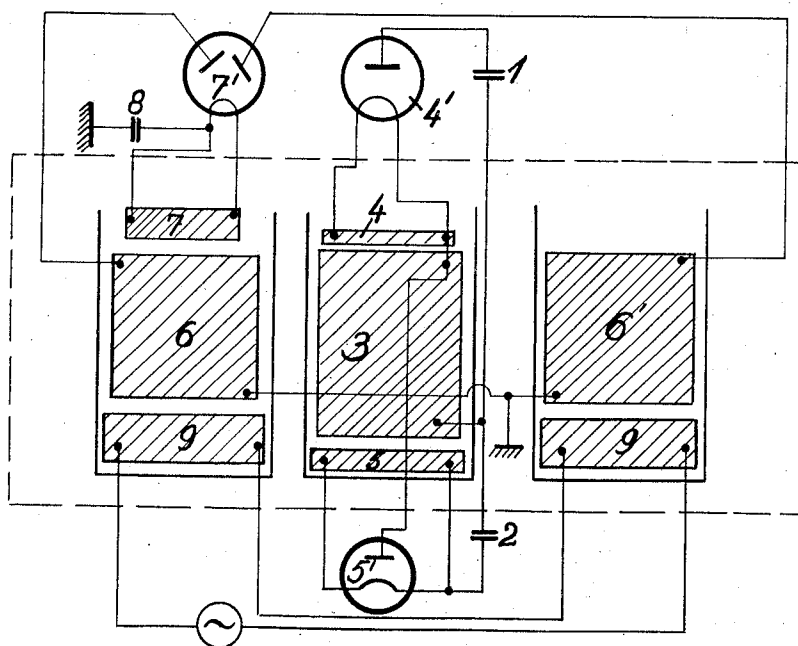
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Inventor:

Kate Gillingham.

UNITED STATES PATENT OFFICE

2,137,356

HIGH-VOLTAGE TRANSFORMER FOR
TELEVISION APPARATUS

Kurt Schlesinger, Berlin, Germany, assignor to
Radioaktiengesellschaft D. S. Loewe, Berlin-
Steglitz, Germany

Application December 9, 1935, Serial No. 53,535
In Germany December 12, 1934

1 Claim. (Cl. 175—363)

The present invention describes a convenient arrangement of the windings of a supply transformer in a television receiver, which is furnished in a cathode ray tube with an anode potential amounting to approximately 4000–10,000 volts, the arrangement being very suitable for reliable operation in practice and for cheap construction. The invention permits of the construction of a transformer of this kind with a minimum of intermediate insulating layers within the windings and accordingly having very small dimensions. There is taken as a basis the known potential doubling connection according to Fig. 1, which, as set forth in an earlier application, offers particular advantages in the operation of cathode ray tubes, because the potentials connected with the steadying condensers 1 and 2 represent in each case merely one-half of the anode potential occurring at the cathode ray tube, and because the one of the same, viz., the potential at 1, may be employed as operating potential for the relaxation apparatus, for which approximately one-half of the potential of the television tube is sufficient.

Figure 1 represents a potential doubling circuit employing my invention.

Figure 2 represents a cross sectional view of the transformer.

Figure 3 shows the linking up of the transformer windings with the rectifying connection system shown in diagram in Figure 1.

The transformer consists of a unitary high-voltage winding 3, and furthermore is called upon to heat two rectifying tubes 4' and 5', which is done by means of the windings 4 and 5. The one transformer can take over the task of supplying the anode potential for a built-in television receiver, for which purpose it requires to be furnished with a low-voltage counter-cadence winding 6, and must heat a rectifying tube 7' by means of the winding 7. It is also required of a transformer of this kind that the different circuits, i. e., the potentials at the condensers 1, 2 and 8, should be as independent as possible of the relative loads on the other circuits. This will only be attainable if the coupling between the primary windings 9, which are connected with the mains, and the secondary windings 3 or 9 are as free of dispersion as possible.

The transformer according to Fig. 2 satisfies these requirements, and more particularly also the requirement for ensurity against disruption, in the following manner:

According to the invention, the low voltage for the receiving portion is accommodated in two

coil members 10 and 11 together with the primary winding 9, 9', and at the same time these low-voltage or excitation windings are provided on the two ends of the transformer, so that the iron core 12 is magnetized at the points of entry into the sheet metal yoke 13. The flux is then held together in the iron 12 and traverses the third coil member 14, which carries the high-voltage windings 3, without dispersion. The primary winding 9, 9' is distributed over the two outer members 10 and 11 in each case with half the number of turns. The potential of these windings, which are connected with the mains, is so small as compared with the earthed iron core that the box insulation against earth is not subjected to any load. The winding 6, 6' is in each case one-half of the anode potential winding 6 of the receiver illustrated in Fig. 1. According to the invention, the two halves are connected with each other in the inner layers, since this connecting line 14 according to the connection system in Fig. 1 is passed to earth, and since the inner layers, therefore, do also not possess any full potential against earth or the mains winding 9. The intermediate insulation 21 is, therefore, also subjected to merely very little load, and may accordingly consist of thin paper. The windings 7 for the rectifier 7' of the receiver must be insulated by means of the insulation 23 somewhat better, viz., towards approximately 500 volts alternating potential peaks against the winding 6 situated thereunder. As proved by the normal radio art, however, this problem can still be solved reliably in practice with a dry transformer without impregnating substances.

According to the invention, impregnation is required only in respect of the middle winding, which is situated in the case 14 and will now be described. In accordance with the invention the arrangement of the windings is in this case such that all insulations are subjected to load only in respect of direct potential, since it is known that a direct potential insulation is much more simple to accomplish than an insulation with continuously varying polarization. As lowermost winding there is accordingly located the rectifier winding 5 of the tube 5' in Fig. 1, which is embedded in a thick insulating member 22. This winding requires to withstand in relation to its surroundings a direct potential of 4000 volts, but on the other hand no alternating potential, as it is earthed in respect of alternating current by the condenser 2 or 1. Following on 5 there is the high-voltage winding 3, which may be wound in

laminations without any kind of tappings. The insulation 24 also requires to withstand merely a direct potential of 2000 volts, since in accordance with the invention the winding is commenced at the point 3a in Fig. 1, which is earthed for alternating potential by the condenser 1. It ends at the point 3b. This point is in direct connection with the rectifier winding 4 of the tube 4' and may, therefore, pass into the rectifier winding without intermediate insulation. This point requires to withstand in relation to its surroundings an alternating potential amounting in effect to 2000 volts. According to the invention, either merely the middle winding case 14 is impregnated in vacuum, viz., with an insulating substance which remains hard at all operating temperatures, i. e., either with a hard paraffine or with Bakelite or with paraffine, or the entire transformer after it has been packed with iron may be placed in a large impregnating vessel and impregnated in vacuum at a sufficiently high temperature above the melting point of the insulating substance. Measurements in respect to a transformer of this kind in the connection set forth in Figs. 1 and 2 result in an independent nature of the single circuits for the receiver on the one hand and tube screen apparatus on the other hand better than 5%. In a television receiver having built-in receiving superhet with an amplification of more than 100,000 there were also no longer noticed crackling noises such as frequently occurs by spluttering action in high-frequency transformers. This is due primarily to the lack of alternating potential load on the insulation of the transformer. The thickness of wire of the single high-voltage windings 9, 6 and 3 is, in the manner known per se, in proportion to the currents traversing the same. A transformer of this kind mastered in practice 150 watts with a primary current intake of 1 ampere or a supply of 0.1 ampere to the receiving portion, 0.015 ampere to the screen and 0.05 ampere to the television tube. The thickness of the wire was, in

respect of the primary winding 9, 0.6 mm., in respect of the receiving winding 6, 0.2 mm., and in respect of the high-voltage winding 3, 0.1 mm. and, as may readily be calculated, are in proportion to the roots of the stated current loads. In spite of the high output referred to the temperature accordingly also remained below 60°.

I claim:

In a supply apparatus containing two rectifier devices including rectifier tubes having cathodes and anodes, a transformer having an iron core, a primary winding and several secondary windings for supplying the heating circuits and the anode circuits of said rectifier tubes, one of said rectifier devices furnishing a direct current potential of several thousand volts and consisting of a potential doubling rectifier circuit with two rectifier tubes and two condensers and the other furnishing a direct current potential of several hundred volts by a single rectifier with two anodes, three separate winding spaces arranged side by side on the iron core, the middle space containing only the secondary winding corresponding to said high potential rectifier and the outer spaces containing said primary winding and said secondary windings corresponding to the low potential rectifier, the high potential secondary winding being arranged between two halves of the corresponding heating current winding, each half of said primary winding being arranged next to the iron core, the two halves of the low potential secondary windings being arranged over said primary winding and the corresponding heating winding being arranged over said anode current winding, the two halves of said anode-current windings connected together on the inside next to said primary windings in order that all insulations between said secondary windings will be loaded only in respect to high direct potentials but not to high alternating potentials.

KURT SCHLESINGER.