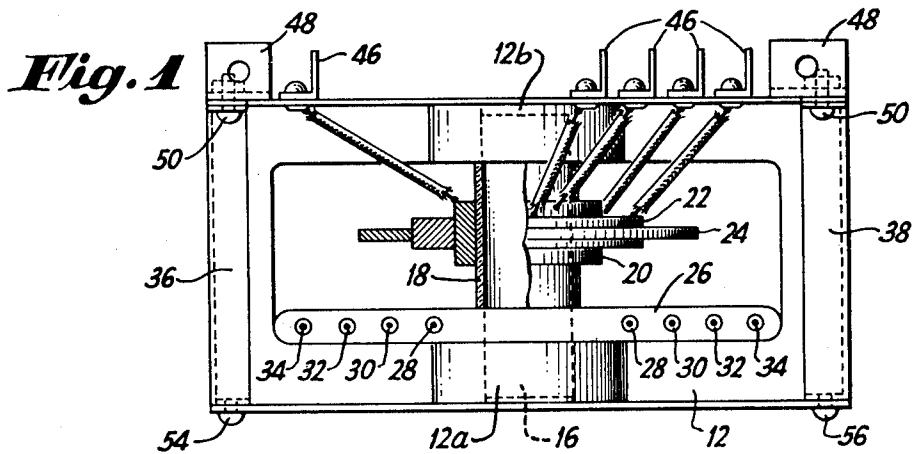
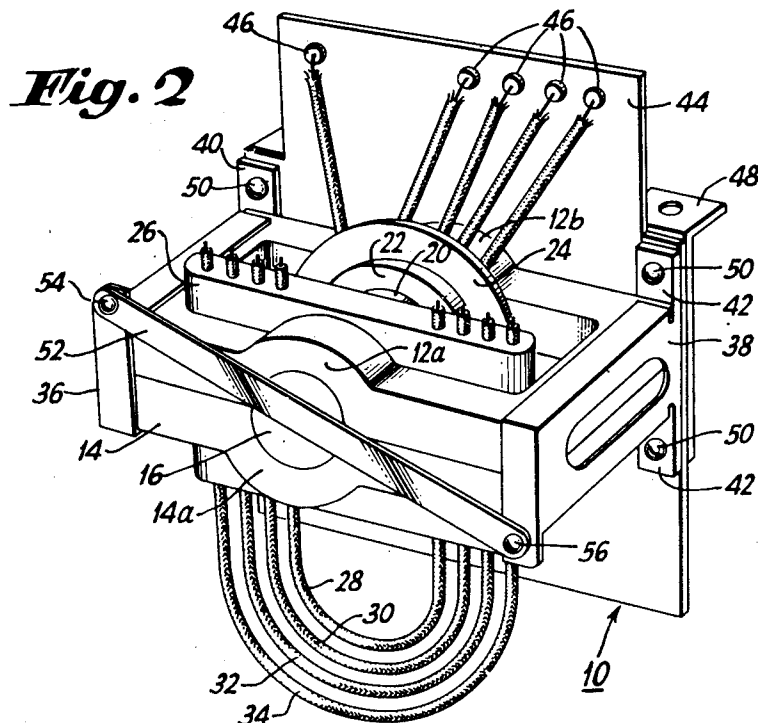


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ELECTRICAL TRANSFORMER

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INVENTORS
MAXIMILIAN J. OBERT
EDWIN L. CLARK
BY
H. S. Brown
ATTORNEY

UNITED STATES PATENT OFFICE

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ELECTRICAL TRANSFORMER

Maximilian J. Obert, North Merchantville, and
Edwin L. Clark, Collingswood, N. J., assignors
to Radio Corporation of America, a corporation
of Delaware

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The present invention relates to electrical transformers, especially coupling or output transformers of the type employed in television receiving systems which include a cathode ray image-reproducing tube. More particularly, the invention relates to a television coupling or output transformer in which two or more coil windings are arranged as a unitary assembly which is readily replaceable in the event of an open-circuiting or other electrical failure in any one of the coils.

In a co-pending United States patent application of Albert W. Friend, Serial No. 619,870, filed October 2, 1945, there is disclosed a transformer having a core which is molded of finely-divided ferro-magnetic material, such as powdered or comminuted iron, in combination with a suitable binder. The advantages accruing from the use of such material in transformer cores include high permeability, low heat losses, efficient power transfer, and low acoustic energy radiation.

A transformer of the above nature is particularly adapted for use in television systems for the purpose of coupling a power output tube, or tubes, to the cathode ray beam deflection coils. In television systems employing a so-called "surge-type" high-voltage supply, a step-up winding (which may in effect be an extension of the primary coil) is utilized to make available output pulses of relatively high amplitude during the retrace, or snapback, periods of the cathode ray scanning beam. These pulses may then be rectified to obtain a substantially smooth D. C. potential for application to the cathode ray tube accelerating electrodes. If desired, the peak voltage of the pulses developed across the transformer step-up winding may be multiplied by means of a plurality of rectifying units arranged in cascade. Such a system is disclosed, for example, in a co-pending United States patent application of Otto H. Schade, Serial No. 578,678, filed February 19, 1945, now Patent No. 2,439,223, issued April 6, 1948.

When a voltage-multiplying surge-type rectifier is employed, such, for example, as that set forth in the above-mentioned Schade application, Serial No. 578,678, it may be desirable to energize the filament of each rectifier tube individually from one or more turns on the output transformer. When the voltage multiplier is a quadrupler, there are four rectifier tubes and consequently four filament windings. Although each such winding consists of but a single turn of wire, nevertheless the problem of providing adequate

insulation for the windings has been troublesome due to the presence of high voltage differentials. According to a feature of the present invention, therefore, these rectifier filament windings are so arranged that a minimum voltage stress exists between windings, and, furthermore, so that the insulating covering of the wire is protected from distortion or other damage at the necessarily high operating temperature of the transformer.

It occasionally happens, furthermore, that either an open or a short circuit occurs in one or more of the transformer windings. With many transformer designs heretofore in use, it then becomes necessary to replace the complete transformer assembly, as a convenient replacement of the defective coil elements alone cannot be made. Such a replacement involves the incidental discarding of the undamaged core section, terminal board, etc., and increases repair costs to a considerable degree.

It is another feature of the present invention to provide a coupling or output transformer in which a section of the core may be separated from the remainder of the transformer assembly by disengaging a single holding member which, when in place, acts to secure this separable core section in operating position. Upon a removal of this core section, the coil windings, preferably formed as a unit which encircles the core section in substantially co-axial relationship, may be readily taken out and replaced with a new set of coils, it being only necessary to disconnect the original coil leads from the terminal board and to connect to such board the leads of the replacement coil unit. As a result, the original core, terminal board, and mounting structure remain in use, with a consequent decrease in repair and maintenance expense.

The principal object of the present invention, therefore, is to provide an electrical transformer particularly adapted for use in television deflection circuits and possessing the advantages enumerated in part above.

Other objects and advantages will be apparent from the following description of a preferred form of the invention and from the drawing, in which Figs. 1 and 2 are plan and perspective views, respectively, of a transformer constructed in accordance with the principles of the present invention.

Referring now to Figs. 1 and 2 of the drawings, there is shown a coupling, or output, transformer generally indicated by the reference numeral 10. The core of transformer 10 is com-

posed of two matching frame pieces 12 and 14, best shown in Fig. 2, and one central leg section 16. Each of these core components 12, 14, and 16 is preferably molded of some suitable finely-divided ferro-magnetic material, such as powdered or comminuted iron, in combination with a binder. A transformer core constructed in this manner is described in the above mentioned Friend application, Serial No. 619,870. Each of the matching frame pieces 12, 14, is preferably rectangular in shape, with the central portion of the two long sides of each frame piece being curved away from the plane of the frame piece, as shown at 12a, 12b and 14a, respectively. (The curved portion of the frame piece 14 corresponding to the curved portion b of the frame piece 12 is not visible in the drawing due to the manner of taking the plan and perspective views.) The inner surface of each of the curved central portions of the frame pieces 12 and 14 is semi-cylindrical in shape, so that when the matching frame pieces 12 and 14 are in face-to-face relation, as best shown in Fig. 2, then the inner surfaces of the curved portions 12a and 14a define an aperture of cylindrical outline, as do also the inner surfaces of the curved portion 12b and the corresponding curved portion of frame piece 14.

The central leg section 16 is cylindrical in shape, and is so dimensioned as to fit securely but removably in the apertures of cylindrical outline defined by the curved portions of the frame pieces 12 and 14. Encircling the cylindrical leg section 16 is an insulating tube 18 (best shown in Fig. 1) on which two or more coils are wound one upon the other, these coils being arranged to be substantially centered within the "window" of the core structure formed by the frame pieces 12 and 14. While three coils, designated by the reference numerals 20, 22, and 24, respectively, are shown in the drawing, it will be appreciated that the number of such coils employed will depend upon the particular use to which transformer 10 is to be put. For example, the coils 22, 24, and 20 illustrated in the drawing may represent the primary winding, a step-up extension of the primary winding, and the deflection secondary winding, respectively, of a power output transformer as used in the horizontal deflection circuit of a television system employing a surge-type rectifier. However, it should be clearly understood that the number and arrangement of the coils themselves form no specific part of the present invention, and that any suitable number and type of coils may be used if desired in place of those illustrated.

Mounted on the core 16, is a holder 26 for supporting and positioning a plurality of further windings 28, 30, 32, and 34. Each of these further windings 28, 30, 32 and 34 consists of a single turn of insulated wire equally spaced with respect to adjacent turns, and so disposed as to be within the electromagnetic field surrounding the core of the transformer.

As seen from the drawing, the windings 28, 30, 32, and 34 are respectively received in a plurality of substantially parallel openings formed in the holder 26. The latter is preferably composed of a high grade insulating material, having high dielectric strength and low dielectric losses, and the parallel openings therein are formed with rounded edges so as to leave no sharp surfaces which might cut into or otherwise damage the insulating covering of the windings 28, 30, 32, 34.

When the windings 28, 30, 32 and 34 are uti-

lized for heating the filaments of rectifier tubes in a voltage-multiplying unit of the type mentioned above, it will be apparent that the voltage between any two adjacent windings is never greater than the total voltage of the multiplying unit divided by the number of such windings utilized, provided that such windings are connected to the filaments of the voltage-multiplying rectifier tubes in proper sequence. In other words, when a voltage quadrupler is used which requires four rectifier filament windings (such as shown in Figs. 1 and 2), then the voltage stress between any two adjacent turns 28, 30, 32 and 34 will not be greater than one-fourth the total voltage of the quadrupler. This results from the fact that the windings 28, 30, 32 and 34 are equally spaced apart in a linear fashion. In this manner the possibility of voltage breakdown between filament windings is greatly reduced by comparison with arrangements in which the filament windings are not disposed linearly. Furthermore, due to the relatively large surface area of each filament winding which is enclosed within its respective openings in the holder 26, a rigid support for these windings is provided which protects the latter against twisting, bending, or other damage.

A pair of sheet-metal clips or retaining members 36 and 38 respectively partially enclose the matching ends of the transformer frame pieces 12 and 14. These sheet-metal clips 36 and 38 are each bent over, or flanged, so as effectively to clamp the frame pieces together. Each of the clips 36 and 38 is additionally provided with a pair of tabular extending portions 40 and 42, respectively, which are designed to lie flat against the rear surface of an insulating terminal board or support panel 44 which has a number of binding posts or connectors 46 mounted thereon. The terminal board or support panel 44, as best shown in Fig. 2, lies in a plane substantially perpendicular to the axis of the cylindrical core section 16, and is of such dimensions as to extend substantially beyond the outer edges of the transformer core pieces 12, 14.

A mounting bracket 48 lies on the opposite side of the terminal board 44 from the clips 36 and 38, this mounting bracket 48 being provided with an extending portion having a number of openings therein and designed to adapt the transformer 10 for mounting, such, for example, as on a television receiver chassis. A plurality of bolts or screws 50 respectively pass through openings in the bracket 48, terminal board 44, and through threaded openings in the tabular portions 40 and 42 of the clips 36 and 38, in the manner best shown in Fig. 2, so that the terminal board 44 is securely clamped between the mounting bracket 48 and the clips 36 and 38.

In order to insure that the sheet-metal clips 36 and 38 securely hold the frame pieces 12 and 14 in face-to-face relation, a metal tie strap 52 is provided which lies diagonally across the rear surface of the frame pieces 12 and 14, and also across one end surface of the cylindrical core section 16. This tie strap 52 is secured by means such as the screw 54 to one point on the flanged portion of clip 36, and to a diagonally opposite point on the flanged portion of clip 38 by means such as the screw 56, so that when the tie strap 52 is in the position illustrated in Fig. 2, the cylindrical core section 16 is effectively held in place between the curved inner surfaces of the frame pieces 12 and 14.

However, upon removal of either of the screws

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54 or 56, the tie strap 52 may be moved away from its position overlying the end surface of the cylindrical core section 16. The latter is then free so that it can be removed from the remainder of the transformer assembly. This permits the insulating tube 18, together with the elements mounted thereon (that is, the coils 20, 22, and 24 and the holder 26 with its windings 28, 30, 32, 34) to be taken out as a unit to allow a replacement or substitution, it being only necessary to disconnect the coil leads from the binding posts 46.

The binding posts 46 on the terminal board 44, as above stated, are respectively connected either to taps on the coils 20, 22, and 24 or to the ends of these windings. The position of any such taps may be chosen in accordance with the design of the particular circuit with which the transformer 10 is employed. They may be utilized, for example, to permit a proper matching of the secondary coil 22 with any one of a number of deflection yokes having various impedances.

We claim:

1. An electrical transformer including a core formed as a pair of matching frame pieces of substantially rectangular configuration, the central portion of two opposite sides of each frame piece of said pair being curved away from the plane of that frame piece in such a manner that the inner surface of each curved portion is substantially semi-cylindrical in shape, said two frame pieces being adapted for positioning in face-to-face relation so that the adjacent curved portions of the two frame pieces together define an aperture of approximately cylindrical outline, a core leg section removably positioned in the apertures of cylindrical outline defined by the curved portions of said frame pieces when the latter are positioned in face-to-face relation, a support panel formed of insulating material, a pair of retaining members respectively partially enclosing the matching ends of the said pair of frame pieces when the latter are positioned in face-to-face relation, means securing each of said pair of retaining members to said support panel so that said panel lies adjacent one of the matching curved sides of said pair of frame pieces and also so that said support panel prevents withdrawal of said core leg section in one axial direction, and means for tying together said pair of retaining members at a point on each removed from the point at which said retaining member is secured to said support panel, the last mentioned means having a portion which prevents withdrawal of said core leg section in the other axial direction.

2. A transformer according to claim 1, in which said means for tying together said pair of retaining members comprises a bar respectively secured at its ends to each of said pair of retaining members, and extending diagonally across one of the matching curved sides of said pair of frame pieces.

3. A transformer according to claim 1, in which said means for tying together said pair of retaining members comprises a bar releasably secured at its ends respectively to each of said pair of retaining members, and extending diagonally across one of the matched curved sides of said pair of frame pieces, whereby, when said bar is released from engagement with either of said retaining members, said core leg section may be withdrawn from its position within the aper-

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tures defined by the curved portions of said frame pieces.

4. An electrical transformer including a core formed as a pair of matching frame pieces adapted to lie in face-to-face relation and when so lying to define a pair of apertures of substantially cylindrical outline, a core leg section removably receivable in said apertures, a coaxial coil assembly adapted to encircle said core leg section when the latter is in position in said apertures, a support panel, a pair of clips secured to said support panel and respectively adapted to clamp thereagainst one of the matching ends of said pair of frame pieces, and detachable means for tying together said pair of clips, said detachable means when in position acting in co-operation with said panel to retain said core leg section in said apertures and when detached acting to permit said core leg section to be removed from said apertures, thereby allowing replacement of said coaxial coil assembly without requiring the separation of said pair of frame pieces.

5. An electrical transformer according to claim 4, further comprising an insulating support for a plurality of windings, said insulating support having an opening therein of approximately cylindrical outline and being adapted to surround said core leg section so that the plane of said support is substantially parallel to the plane of said support panel, said support being formed with a plurality of linearly-disposed substantially parallel openings for respectively receiving said windings, whereby, when said core section is removed from said apertures, said support may be withdrawn from its operating position along with said coaxial coil assembly.

6. An electrical transformer in accordance with claim 1, further comprising a substantially rectangular winding support composed of insulating material, said support being formed with a central aperture therein of substantially cylindrical outline and being adapted to encircle said core leg section so that the plane of said support is substantially parallel with the plane of said panel, said support being formed with a plurality of parallel openings therein adapted to receive respectively a plurality of windings in such manner that all of said windings lie substantially in a single plane.

7. An electrical transformer comprising a core leg, a coil assembly thereon, a core frame engaging opposite ends of said core leg and forming a magnetic return path around said coil assembly, a plurality of separate windings each having not more than one turn around said core leg, and insulating means supporting said windings in fixed relation to said core leg and frame with a portion of each winding inside said frame, said windings being spaced apart and progressively further from said core leg relative to each other.

8. An electrical transformer according to claim 7, wherein said insulating means comprise a body of insulating material having a series of spaced-apart holes therethrough in which portions of said windings are disposed respectively.

9. An electrical transformer according to claim 7, wherein said insulating means comprise a body of insulating material having a hole therethrough by which it is supported on said core leg and having a portion of its surface engaging said frame.

MAXIMILIAN J. OBERT.

EDWIN L. CLARK.

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