April 17, 1951 W. H. BOSTICK 2,549,366

PULSE TRANSFORMER WITH MAGNETRON WELL

Filed Aug. 2, 1945 2 Sheets-Sheet 1

FIG.1

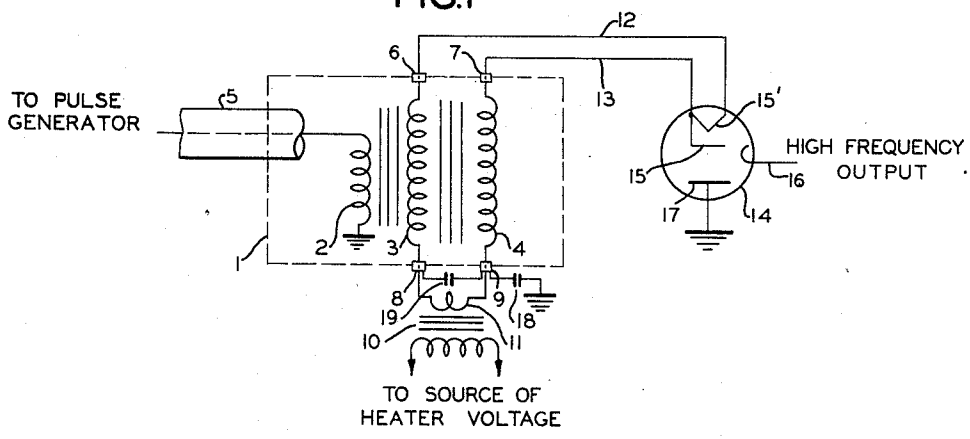
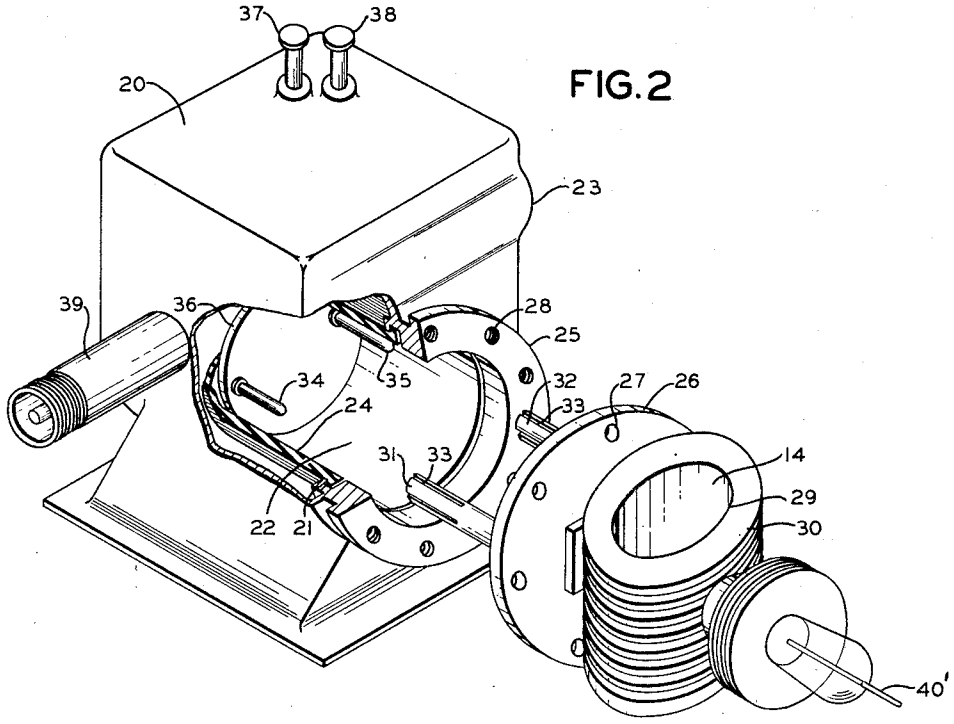


FIG.2



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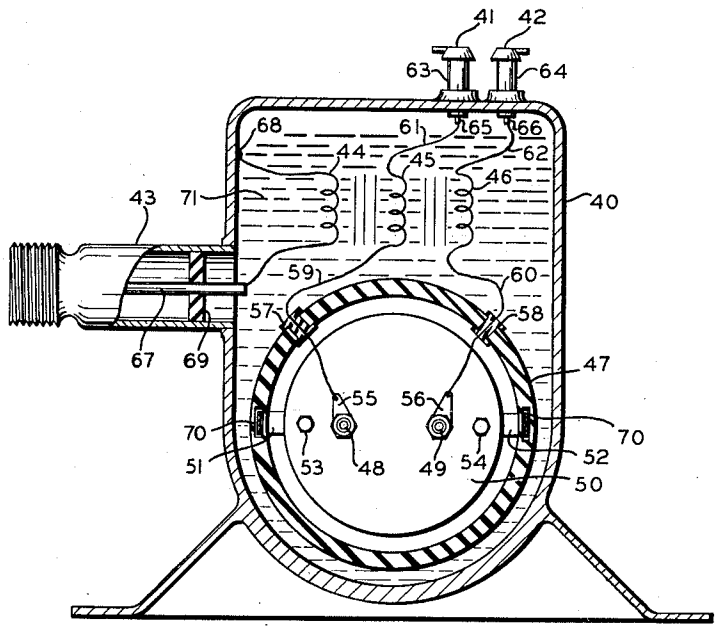
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April 17, 1951 W. H. BOSTICK 2,549,366

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FIG. 3



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UNITED STATES PATENT OFFICE

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PULSE TRANSFORMER WITH MAGNETRON WELL

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11 Claims. (Cl. 250—16)

1

This invention relates in general to the combination in a single structure of a transformer and a socket for an electron tube, and in particular to such a combination of pulse transformer and a socket for a magnetron type electron tube together with a mechanical support for such a tube.

In systems for the transmission of pulses of high frequency radio energy produced by an electron tube oscillator, it is usual to apply modulation voltage simultaneously to both filament leads of the electron tube oscillator through a high voltage pulse transformer. Magnetron type electron tubes are commonly used, the anode of the electron tube being kept at ground potential. The electron tube oscillates when a negative voltage pulse is applied to the cathode. In such a system the cathode heater leads thus also carry highly negative voltage pulses and require substantial insulation as well as careful shielding. So also, the socket holding the electron tube must be carefully insulated.

It is a specific object of my invention to provide a single structure for holding a pulse transformer and a socket for a magnetron type electron tube.

It is a further object of my invention to eliminate long cathode leads and to provide efficient shielding for the short leads remaining.

It is a still further object of my invention to provide a mechanical support for a magnetron type electron tube oscillator, while at the same time providing in the same structure a socket and transformer therefor.

Other objects and features of my invention will become apparent upon a careful consideration of the following detailed description when taken together with the accompanying drawings, the figures of which illustrate typical embodiments of the invention.

Fig. 1 is an electrical schematic diagram of a pulse transformer and magnetron oscillator tube showing means for modulating that tube through its cathode;

Fig. 2 shows a combined transformer, socket and support of my invention with a magnetron type oscillator tube being inserted into the socket; and

Fig. 3 shows in cross section another transformer and socket combination of my invention showing the structure, in electrical scheme, of a transformer in the outer housing thereof.

Referring now to Fig. 1, a transformer 1 having a primary winding 2, and two secondary windings 3 and 4, has its primary winding 2 connected

2

at one end to ground and at the other end to a coaxial high frequency type cable 5 which is fed by signals from a pulse generator, not shown in Fig. 1. Each secondary winding 3 and 4 is connected at one end to a first terminal connector 6 or 7 respectively and at the other end to a second terminal connector 8 or 9 respectively. A filament transformer 10 has its secondary 11 connected to the second pair 8 and 9 of the aforementioned connectors. One terminal 9 is connected to ground, usually through a by-pass capacitor 18. A second by-pass capacitor 19 is connected between the two terminals 8 and 9. The first pair 6 and 7 of the aforementioned connectors are brought to a pair of filament leads 12 and 13 respectively. An electron tube 14 which may be of the magnetron type has its cathode heater 15' connected to the aforementioned filament leads 12 and 13, and its cathode 15 connected directly to one of said leads 13. The electron tube 14 has its anode 17 grounded, and is arranged to oscillate at high frequency when the voltage on the cathode 15 is dropped below a predetermined negative potential. When oscillations take place, they are taken from the electron tube 14 by means of a high frequency pick-up 16.

The system illustrated in Fig. 1 operates as follows. When a voltage pulse of the proper polarity is applied to the transformer 1 through the cable 5, a negative voltage pulse appears at each of the first pair of the aforementioned connectors 6 and 7 and is applied through the leads 12 and 13 to the cathode 15 of the electron tube 14. Simultaneously filament heating voltage from the transformer 10 is applied to the same filament or cathode 15 through the two secondary windings 3 and 4 of the transformer 1. It is the electrical organization or circuit of Fig. 1 that I have placed into a common structure with a socket and support for the electron tube 14, as illustrated in Figs. 2 and 3.

In Fig. 2 a transformer, socket and mounting combination 20 of my invention is shown together with the magnetron type electron tube 14. The magnetron 14 is about to be inserted into the socket 22 of the structure 20. The transformer 20 has an outer metallic liquidtight housing 23 and a cylindrical non-conductive liquidtight socket housing 24, preferably made of porcelain, rubber or other suitable insulating material. The two housings 23 and 24 are liquidtight at their common junction 21. A flat annulus 25 is provided for holding the base 26 of the magnetron type oscillator tube 14 in firm

supported relationship by means of bolts, not shown, and holes 27 and 28, the latter of which are threaded. The flat annulus 25 is electrically and mechanically a part of the housing 23, which housing 23 is normally grounded in the radio system in which it may be installed. The magnetron tube 14 has for its anode 29 the outer shell or casing thereof. The cylindrical portion 29 of the magnetron tube 14 is the anode. Cooling fins 30 are arranged about this anode 29. The anode 29 is electrically and mechanically connected to the base mounting plate 26. Thus, when the mounting plate 26 and the flat annulus 25 are brought together in fixed mechanical relation, the anode 29 is grounded through the case or housing 23 of the transformer socket combination 20. Cathode heater voltage is brought to the magnetron 14 by means of two leads 31 and 32 coming out of the bottom of the base plate 26 and insulated therefrom. The ends of the two leads 31 and 32 may have spring-like fingers formed by cutting slots 33 in those ends. In the socket 22 of the transformer 20, there are two plugs or connectors 34 and 35, which may be of many forms, such as for example banana plugs, arranged to cooperate with the ends of the two aforementioned leads 31 and 32 respectively when the magnetron tube 14 is inserted therein. The plugs 34 and 35 will preferably make firm electrical contact with the respective ends of the leads 31 and 32. The two plugs 34 and 35 are mounted upon a flat disc-shaped plate 36 of non-conductive material such as mica, for example, which may be resiliently mounted in the socket 22 in a manner not shown in Fig. 2, but shown in Fig. 3. Two external binding posts 37 and 38 are connected to the two plugs 34 and 35 respectively through transformer secondary windings not shown in Fig. 2, but similar to the secondary windings 3 and 4 of Fig. 1. The binding posts 37 and 38 are used to bring cathode heater power to the cathode of the magnetron 14, and correspond to the second pair of terminals 8 and 9 of Fig. 1. The two plugs 34 and 35 correspond to the first pair of terminals 6 and 7 of Fig. 1. Voltage pulses are brought into the combined transformer and socket 20 through a coaxial connector 39 which corresponds to the coaxial high frequency line 5 of Fig. 1. The apparatus illustrated in Fig. 2 will operate in a manner identical to the apparatus illustrated in Fig. 1. High frequency oscillatory energy is taken from the electron tube 14 through the terminal 40' of the output coupling mechanism of that tube.

In Fig. 3 is illustrated partly in cross-section a transformer and socket combination of my invention, showing therein a schematic diagram of a pulse transformer and structurally a socket for an electron tube and a housing for the said transformer and socket. An outer housing 40 encloses the entire structure with the exception of external lugs 41 and 42 for bringing filament voltage for a magnetron tube into the structure, and with the further exception of a coaxial connector 43 for bringing modulation voltage pulses into the structure. A transformer, similar to the transformer 1 of Fig. 1, having a primary winding 44 and two secondary windings 45 and 46 is in the upper portion of the housing 40. A cylindrically shaped socket 47, made of non-conducting material which may be porcelain or rubber as aforementioned in connection with the apparatus of Fig. 2, is inserted in the lower portion of the outer housing 40. Two plugs 48 and 49, similar to and for the same purpose as the two corresponding plugs 34 and 35 of the apparatus of Fig. 2, are supported upon a resiliently mounted non-conductive disc-shaped plate 50. The disc-shaped plate 50 serves the same purpose as the corresponding disc-shaped plate 36 of the apparatus of Fig. 2, and is resiliently mounted on spring members 51 and 52 which are fastened to the socket 47 by means of detents 70 therein. The spring members 51 and 52 are fastened to the disc-shaped member 50 by means of bolts 53 and 54 respectively. Lugs 55 and 56 are bolted to the plugs 48 and 49 respectively and serve as connectors for wires 59 and 60 respectively for bringing electric current to those plugs. Liquid-tight seals, which may comprise insulating liquid-tight bushings 57 and 58 are provided to pass said wires 59 and 60 through the wall of the socket 47. Alternatively, the wires 59 and 60 may be simply sealed into the wall of the socket 47. The wires 59 and 60 are further connected each to one end of a secondary winding 45 and 46, respectively, of the transformer mounted in the upper part of the housing 40. The other end of each of these secondary windings 45 and 46 is further connected to another wire 61 and 62 respectively, and these respective wires 61 and 62 are each further brought to and connected to the aforementioned external lugs 41 and 42 respectively. The lugs 41 and 42 are mounted upon the housing 40 by means of insulating bushings 63 and 64, respectively, and current is passed through the housing 40 by means of conductors 65 and 66 respectively carried by these insulating bushings 63 and 64. The respective wires 61 and 62 from the secondary windings 45 and 46 are electrically connected to these conductors 65 and 66 respectively. The primary winding 44 of the transformer is at one end connected to the inner conductor 67 of the coaxial connector 43, and at the other end 68 to the housing 40 in firm electrical contact therewith, thus forming a ground connection for one end of the primary winding 44. A non-conductive, liquid-tight support 69 is furnished for the inner conductor 67 of the coaxial connector 43. Liquid-tight fittings 69, 57, and 58 having been provided where appropriate, the outer housing 40 of the structure of apparatus, Fig. 3 may be filled with oil 71 if desired. Thus the transformer may be surrounded with oil if desired and have its high voltage characteristics improved.

It should be apparent that the transformer in the apparatus of Fig. 3 is substantially identical to the transformer 1 of the apparatus of Fig. 1. Likewise the transformer-socket combination 20 of Fig. 2 and the apparatus of Fig. 3 are two different views of substantially the same apparatus.

Although I have shown and described only certain specific embodiments of my invention, I am fully aware of the many modifications possible thereof. For example, the invention may, if desired, be used with electron tubes other than the magnetron type electron tube which has been illustrated. Therefore this invention is not to be limited except insofar as is necessitated by the prior art and the spirit of the appended claims.

What is claimed is:

1. In combination, a transformer and a socket for an electron tube comprising, a first liquid-tight housing structure having an opening formed in the wall thereof, a second liquid-tight housing structure of insulating material, open at one end and smaller than said first structure, and inserted therein open end outward through said opening in said wall, the junction between said housing structures being liquid-tight, and a transformer

including a primary and two secondary windings in a space in said first housing not occupied by said second housing, each of said secondary windings being terminated at one end outside said first housing and at the other end inside the closed end of said second housing, and said primary winding being terminated at one end outside said first housing and connected at the other end to said housing.

2. The apparatus of claim 1 in which said transformer is surrounded with oil contained within said first housing.

3. In combination a modulation transformer, mounting, and socket for a magnetron type electron tube comprising, a metallic housing having a circular opening in a side thereof, a substantially flat annulus mounted on the outside of said housing concentric with said opening, said annulus being drilled and threaded to cooperate with bolts to provide a mounting base for a magnetron type electron tube, a cylinder of nonconducting material open at one end and closed at the other end and inserted open end outward into said housing, a transformer having a primary winding and two secondary windings in said housing in space not occupied by said cylinder, a concentric cable connector and two lugs mounted on one or more walls of said housing, said lugs and the inner conductor of said connector being insulated from said housing, and two connectors resiliently mounted in the closed end of said cylinder and directed toward the said open end thereof, said primary winding being at one end connected to said inner conductor and at the other end to said housing, and said secondary windings being each connected at one end to one of said lugs and at the other end to one of said connectors.

4. In combination, a modulation transformer mounting and socket for a magnetron type electron tube having a substantially circular flange rigidly secured to the outer anode structure thereof, said combination comprising, a metallic housing having a circular opening in a side thereof, a substantially flat annulus formed on the outside of said housing concentric with said opening, said annulus being formed with threaded openings adapted to receive bolts passing through corresponding openings in said flange, said annulus cooperating with said flange and said bolts rigidly to secure said tube to said housing, a cylinder of non-conducting material open at one end and closed at the other end and inserted open end outward into said housing, a transformer having a primary and secondary windings in said housing in space not occupied by said cylinder, terminal means located externally of said housing and insulated therefrom providing means for connecting to said primary and secondary windings, a plurality of connectors resiliently mounted in the closed end of said cylinder and directed toward the said open end thereof, said connectors being adapted to engage inwardly extending terminals on said electron tube, and means connecting said connectors to said transformer windings through said cylinder.

5. In combination, a transformer, mounting and socket for an electron tube provided with a substantially flat mounting plate and a plurality of electrode leads extending through said plate, said combination comprising, a metallic housing having an opening formed therein, a boss formed on said housing and surrounding said opening, said boss having a flat surface adapted to engage said mounting plate of said electron tube

with said electrode leads extending within said opening, said boss being adapted to receive fastening means for securing said mounting plate to said boss, a cylinder open at one end and closed at the other end, said cylinder being disposed within said housing with the open end of said cylinder coincident with the opening in said housing, a plurality of connectors resiliently and insulatively mounted in the closed end of said cylinder and directed toward said open end thereof, said connectors being adapted to engage said electrode leads of said electron tube, a transformer having a primary winding and at least one secondary winding disposed in said housing in space not occupied by said cylinder, electrical connection means mounted on said housing and electrically connected to said primary winding, additional electrical connection means mounted on said housing, selected terminals of said secondary windings being connected to said additional electrical connection means, and selected terminals of said transformer windings being connected to said insulatively mounted connectors.

6. In combination, a transformer, mounting and socket for an electron tube provided with a substantially flat mounting plate and a plurality of electrode leads extending through said plate comprising, a metallic housing having an opening formed therein, a boss formed on said housing and surrounding said opening, said boss having a flat surface adapted to engage said mounting plate of said electron tube with said electrode leads extending within said opening, said boss being adapted to receive fastening means for securing said mounting plate to said boss, a cylinder of nonconducting material open at one end and closed at the other end disposed within said housing, said cylinder being joined at its open end to said housing in the region surrounding said opening in said housing, a plurality of connectors resiliently mounted in the closed end of said cylinder and directed toward the open end thereof, said connectors being adapted to engage said electrode leads of said electron tube, a transformer having a primary winding and at least one secondary winding disposed within said housing in the space not occupied by said cylinder, a plurality of electrical connectors mounted on said housing, first and second terminals of said primary winding being electrically connected to first and second of said electrical connectors on said housing, selected terminals on said secondary windings being connected to selected ones of said electrical connectors on said housing, and selected terminals of said transformer windings being electrically connected to said connectors mounted in said cylinder.

7. In combination, a transformer, mounting and socket for an electron tube provided with a substantially flat mounting plate and a plurality of electrode leads extending through said plate comprising, a metallic housing having an opening formed therein, a boss formed on said housing, said boss completely surrounding said opening, said boss being formed with a flat surface adapted to engage said mounting plate of said electron tube with said electrode leads extending within said opening, said boss being adapted to receive fastening means for rigidly securing said mounting plate to said boss, a cylinder of nonconducting material open at one end and closed at the other end disposed within said housing, said cylinder being joined at its open end to said

housing in the region surrounding said opening in said housing, a plurality of connectors resiliently mounted in the closed end of said cylinder and directed toward the open end thereof, said connectors being adapted to engage said electrode leads of said electron tube, a transformer having a primary winding and at least one secondary winding disposed within said housing in the space not occupied by said cylinder, a concentric cable connector mounted on said housing, the terminals of said primary winding being electrically connected to said concentric cable connector, and at least one electrical connector insulatively mounted on said housing, at least one terminal of each of said secondary windings being connected to a separate one of said electrical connectors mounted on said housing, at least one terminal of each of said secondary windings being electrically connected to a separate one of said connectors mounted in the closed end of said cylinder.

8. In combination, a transformer, mounting and socket for an electron tube provided with a substantially flat, circular mounting plate and a plurality of electrode leads extending through said mounting plate comprising, a metallic housing having a circular opening formed therein, a substantially flat annulus mounted on the outside of said housing concentric with said opening, said annulus being formed to receive fastening means for rigidly securing said mounting plate to said annulus with said electrode leads extending within said opening, a cylinder of nonconducting material open at one end and closed at the other end disposed within said housing with the open end coincident with said opening, a transformer having a primary winding and at least first and second secondary windings disposed within said housing in the space not occupied by said cylinder, a concentric cable connector and at least first and second electrical connectors mounted on said housing, said electrical connectors and the inner conductor of said coaxial connector being electrically insulated from said housing, and a plurality of detachable connectors corresponding in number to said plurality of electrode leads of said electron tube, one terminal of said first and second secondary windings being electrically connected to said first and second electrical connectors respectively, selected terminals of said secondary windings being electrically connected to said detachable connectors mounted on said cylinder.

9. In combination, a transformer mounting and socket for an electron tube provided with a mounting flange, and a plurality of electrode leads extending through said mounting flange, said combination comprising, a housing formed with an opening therein, said housing and said flange being formed with complementary shaped portions, said flange being adapted to engage said complementary shaped portion of said housing and to overlie said opening, said flange and said

housing being formed to receive fastening means for securing said flange to said housing, a socket disposed within said housing in spaced relationship to said opening, said socket being adapted to receive said electrode leads of said electron tube, a transformer having a plurality of winding terminals, said transformer being disposed within said housing in the space not occupied by said socket, selected ones of said winding terminals of said transformer being connected to said socket, a plurality of electrical connectors disposed on the exterior of said housing, and means electrically connecting selected ones of said transformer winding terminals to said electrical connectors.

10. In combination, a transformer mounting and socket for an electron tube provided with a mounting flange, and a plurality of electrode leads extending through said mounting flange, said combination comprising, a housing formed with an opening therein, said housing and said flange being formed with complementary shaped portions, said flange being adapted to engage said complementary shaped portion of said outer housing and to overlie said opening, said flange and said housing being formed to receive fastening means for securing said flange to said housing, a socket disposed within said housing and joined to said housing in the region surrounding said opening, a portion of said socket disposed in spaced relationship to said opening being adapted to receive said electrode leads of said electron tube, a transformer having a plurality of winding terminals, said transformer being disposed within said housing in the space not occupied by said socket, selected ones of said winding terminals of said transformer being connected to said socket, a plurality of electrical connectors disposed on the exterior of said housing, and means electrically connecting selected ones of said transformer winding terminals to said electrical connectors.

11. The combination of claim 10 wherein said housing and said socket cooperate to form a fluid-tight enclosure for said transformer.

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