

Sept. 8, 1925.

1,552,828

J. C. DAVIDSON

RADIO FREQUENCY TRANSFORMER

Filed June 2, 1923

2 Sheets-Sheet 1

Fig. 1.

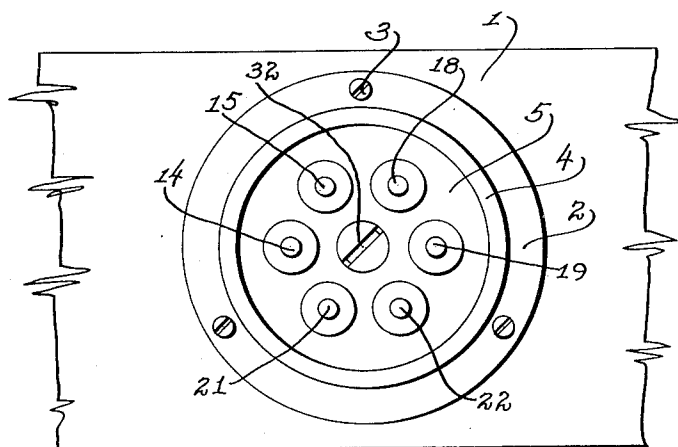


Fig. 2.

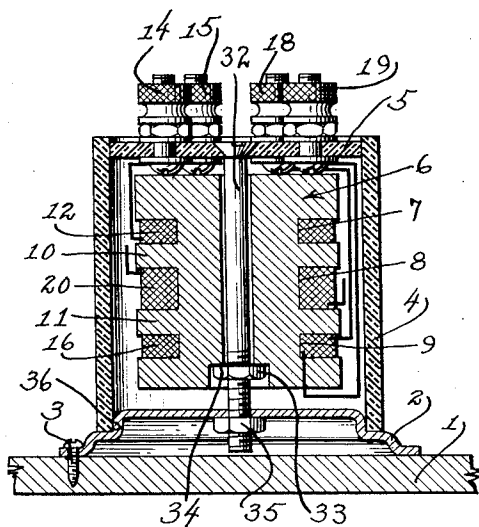
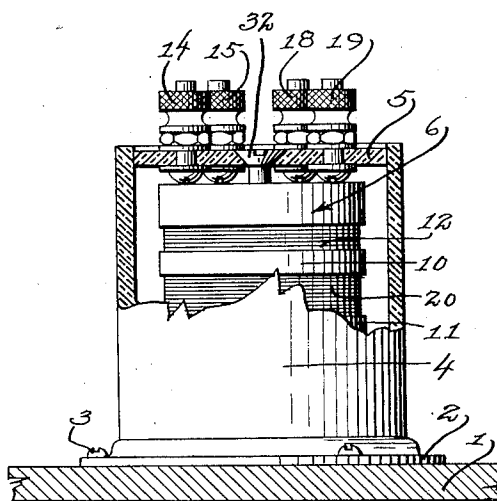


Fig. 3.



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Fig. 4.

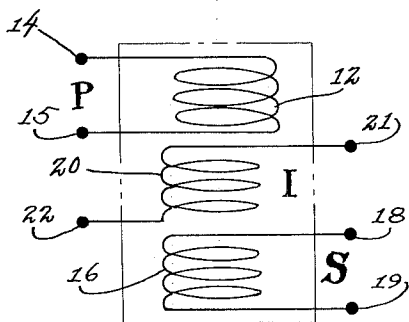


Fig. 5.

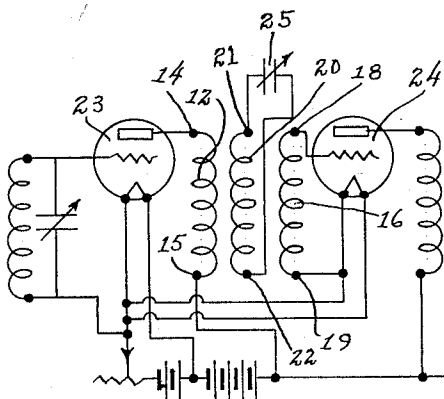


Fig. 6.

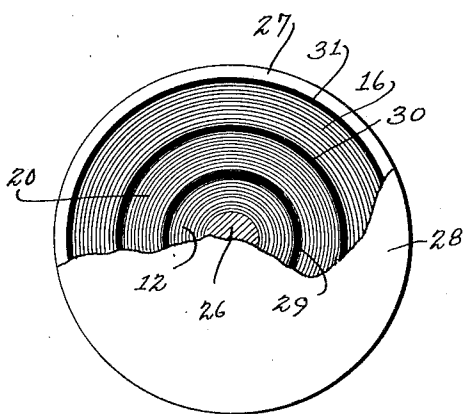
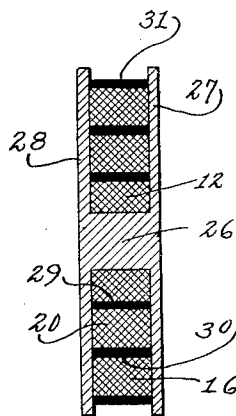


Fig. 7.



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UNITED STATES PATENT OFFICE.

JOHN C. DAVIDSON, OF BROOKLYN, NEW YORK, ASSIGNOR TO DAVIDSON RADIO CORPORATION, OF NEW YORK, N. Y.

RADIO FREQUENCY TRANSFORMER.

Application filed June 2, 1923. Serial No. 642,954.

To all whom it may concern:

Be it known that JOHN C. DAVIDSON, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, has invented certain new and useful Improvements in Radio Frequency Transformers, of which the following is a specification.

My invention relates broadly to means for coupling the input and output circuits of electron tube amplifiers, and more particularly to a construction for a radio frequency transformer for use in radio frequency electron tube amplification circuits.

One of the objects of my invention is to provide a radio frequency transformer construction wherein the transformer has the characteristic of high efficiency in transferring energy from the output plate circuit of one electron tube to the input grid circuit of a succeeding electron tube.

Another object of the invention is to provide a radio frequency transformer construction with means for reducing the tendency of regeneration between the windings.

Another object of the invention is to provide a transformer construction which will transfer a broad band of frequencies from one electron tube circuit to a succeeding electron tube circuit.

Another object of the invention is to provide a triple coil transformer so arranged that the circuits connected with said coils are not extremely critical to slight changes in load or capacity in one circuit relative to another circuit connected with said windings.

A still further object of my invention is to provide means supplemental to the usual windings in a radio frequency transformer for tuning the transformer to a particular frequency or over a range or band of frequencies over which the electron tube amplifier in which the transformer is employed is required to operate.

Other and further objects of my invention will be pointed out in the following specification by reference to the accompanying drawings, in which:

Figure 1 is a plan view of my transformer assembled; Fig. 2 is a cross-sectional view of my radio frequency transformer; Fig. 3 is a side elevation of my radio frequency transformer construction with the casing partially broken away and partially in section to illustrate the interior construction of

the transformer; Fig. 4 is an elementary diagram showing the relation of the three windings employed in my transformer construction; Fig. 5 is a wiring diagram showing a plurality of electron tubes with their input and output circuits inductively coupled by means of my transformer; and Figs. 6 and 7 are views of a modified form of transformer embodying my invention.

Heretofore in the art transformers employed between the stages of a radio frequency electron tube amplifier have had many inherent disadvantages, including large capacity between the windings, a tendency for the associated circuits to oscillate or regenerate, and the transformers have only been effective over a very narrow band of frequencies and very critical to the affect of changes in load or capacity in the primary part of the transformer circuit with respect to another part of the circuit.

In my present construction of transformer I provide a third coil between the primary and secondary coils or in such a position that the energy from the output circuit of one electron tube is transmitted indirectly from the primary to the secondary coil in the input circuit of a succeeding electron tube and not directly. This middle or additional coil is not connected to either the primary or secondary winding but is inductively associated therewith. The third or intermediate winding tends to slightly change the phase between the current passing in the primary circuit and the current induced in the secondary circuit, thereby reducing the tendency for the circuits to oscillate or regenerate. The intermediate winding also adds to the effective resistance of the primary and secondary coils, thereby broadening out the transmission band range. The intermediate coil also induces additional degrees of freedom in the coupling of the two circuits, thereby lessening the critical effect of changes in load or capacity in one part of the circuit with respect to any other part of the circuit.

The ends of the intermediate winding are open or closed through a tuning device, such as a variable condenser or a variometer, and when tuned permits a sharp discrimination against frequencies slightly off that frequency which is to be transferred from one circuit to the other, although the transformer gives nearly equal efficiency for the

passage of frequencies over a broad band. The inductively coupled intermediate coil when tuned to the desired frequency to be transferred from the primary coil to the secondary coil permits the associated circuits to operate on the peak of the resonance curve and therefore gives maximum sensitivity irrespective of frequency over a broad band of frequencies.

Referring more particularly to the drawings, my radio frequency transformer may be mounted on a base 1 by means of a stamped metal support 2 with fastening screws 3 secured to the base 1. A cylindrical insulated case 4 is provided carrying a disc shaped panel 5 in its upper end which serves as a terminal board for the ends of the several windings of my transformer.

The radio frequency transformer is formed upon insulated cylindrical member 6 provided with three grooves 7, 8 and 9 separated by insulated partition walls 10 and 11. In the groove 7 I wind a primary coil 12 and bring out the ends of the winding to binding posts 14 and 15 carried on the panel 5. The secondary coil is formed by a winding 16 in groove 9 of the insulated support 6, the ends of the winding being brought out to binding posts 18 and 19. The intermediate winding is formed by a coil 20 wound in groove 8 between the insulated partition walls 10 and 11 and between the primary coil 12 and the secondary coil 16. The ends of the third or intermediate coil are brought out to binding posts 21 and 22 on the panel 5.

The transformer is assembled by passing a binding screw 32 vertically through the center of the insulated groove support 6 and solidly positioning the support 6 against the heads of the binding screws carried by the panel 5 by drawing the member 6 against the screw heads of the several binding posts by means of nut 33 acting upon screw 32 in countersunk portion 34 of the insulated support 6. The transformer unit is then secured to the base 2 by passing the screw 32 through a central aperture in the base 3 and anchoring the same by means of nut 35. The insulated cylindrical casing 4 is forced over the vertical cylindrical wall portion 36 of the stamped metallic support member 2 resulting in a substantial apparatus assembly. The insulated support 6 is rigidly mounted with respect to the terminal board 5 by reason of the fact that the upper end of the support 6 bears against the heads of the screws which form a part of the binding posts which provide the connections on the top of the terminal board for wires leading to the electron tube circuits and the intermediate tuning circuit. The screw 32 binds the support 6 against the heads of these terminal screws by the nut 33 working in the countersunk portion 34.

As illustrated in Fig. 5, the connections of my transformer are such that the output circuit of electron tube 23 is inductively linked with the input circuit of electron tube 24. The intermediate winding 20 may have its terminals 21 and 22 connected with a tuning device 25, represented as a variable condenser in Fig. 5, but which may be a variometer, or both may be employed. The modification illustrated in Figs. 6 and 7 represent how the transformer windings may be mounted one concentric with the other upon a spool shaped support 26 having a pair of flat circular walls 27 and 28. The primary coil 12 is wound near the center of the spool. The intermediate winding 20 is then wound over the primary coil and separated therefrom by insulation material 29. The secondary coil 16 is then wound over the intermediate coil 20 separated by insulation material 30 from the intermediate coil 20. An insulated wrapping 31 is wound over the secondary coil 16 for protecting the transformer coils. The ends of the coils are brought out from the support 26 and the entire unit may be mounted in a casing similar to that illustrated in Fig. 3. When my coupling system is used between the electron tubes in an amplification circuit, the intermediate winding may be tuned to the particular frequency which it is desired to receive and thereby render the amplification circuit selective to a desired frequency, and at the same time enabling the transformer to be an efficient transmitter of different frequencies over a relatively broad band with negligible tendency for the circuit to oscillate or regenerate.

My circuit arrangement has been more fully described in my copending application, Serial Number 642,953 filed June 2, 1923, to which reference should be made for a further understanding of the application of my invention herein described.

While I have described my invention in certain particular embodiments, it is to be understood that various changes may be made within the scope of the appended claims without departing from the spirit of my invention.

What I claim and desire to secure by Letters Patent of the United States is as follows:

1. A radio frequency transformer comprising in combination an insulating cylindrical support, a plurality of grooves in said support, a primary winding carried in one of said grooves, a secondary winding carried in another of said grooves, and a third radio frequency winding carried in another groove intermediate the grooves carrying said primary and secondary windings all of said windings being disposed upon the same straight central axis.

2. A radio frequency transformer com-

prising in combination a circular metallic base having a vertical wall portion thereon circumferentially positioned about the base, an insulated cylindrical casing positioned over said wall portion on said base, an insulated terminal board in the upper end of said casing, terminal posts carried by said terminal board, a grooved insulated transformer coil support positioned beneath said terminals board and within said casing, said transformer coil support providing a mount for a primary coil, a secondary coil, and a third coil independent of said primary and secondary coils, and connections between each of said coils and separate terminal posts on said terminal board.

3. A radio frequency transformer comprising in combination an insulated support containing three circumferential grooves, a primary winding positioned in one of said grooves adjacent one end of said support, a secondary winding positioned in another of said grooves adjacent the opposite end of said support, and an independent winding positioned in a groove centrally located on said support with respect to said other grooves, a circular metallic base having a vertical cylindrical wall portion, an insulated casing mounted on said wall portion,

a terminal board in one end of said casing, and a binding screw passing through said terminal board and the axis of said insulated support and terminating in said base.

4. A radio frequency transformer comprising an insulated coil support, a plurality of grooves carried by said support, a primary coil in one of said grooves adjacent one end of said support, a secondary coil in another of said grooves adjacent the opposite end of said support, and a separate coil in a groove intermediate said other grooves, a countersunk portion in one end of said insulated support, a terminal board adjacent the opposite end of said insulated support, binding posts forming terminals for each of said windings carried by said terminal board with one end of each of said binding posts serving as a support for said insulated support, and a binding screw passing through said terminal board and the axis of said insulated support and terminating in said countersunk portion for rigidly securing the support with relation to said terminal board.

In testimony whereof I affix my signature.

JOHN C. DAVIDSON.