

Aug. 19, 1924.

1,505,085

C. E. BRIGHAM

RADIO RECEIVING APPARATUS

Filed July 15, 1922

2 Sheets-Sheet 1

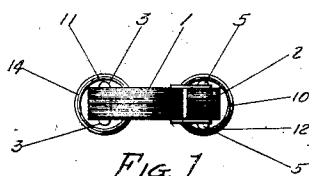


Fig. 1

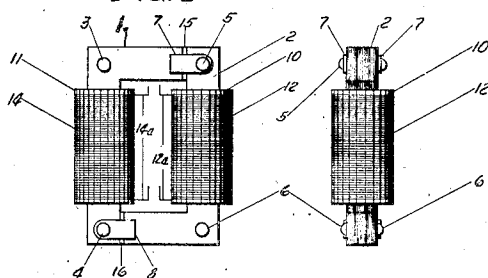


Fig. 2

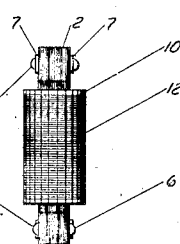


Fig. 3

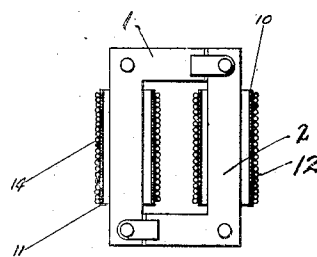


Fig. 4

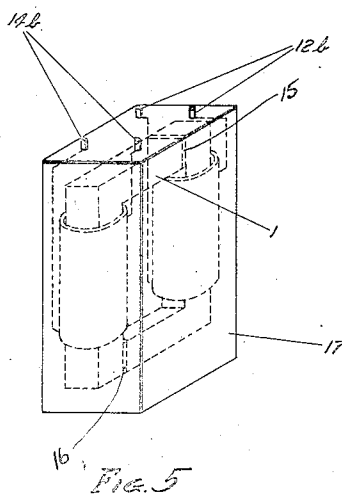


Fig. 5

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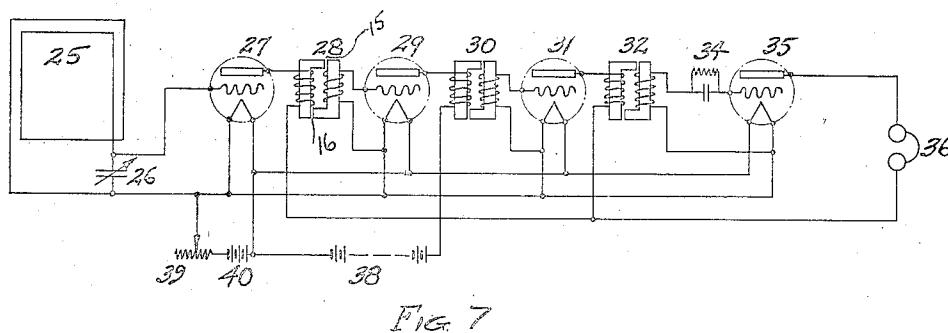
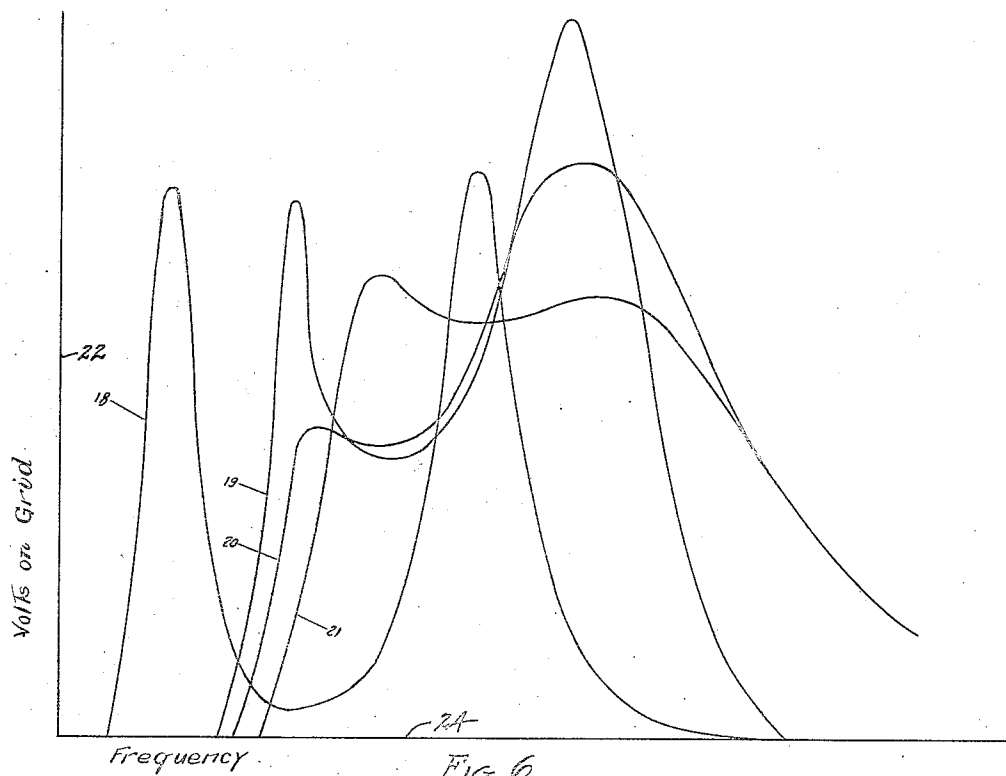
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RADIO RECEIVING APPARATUS

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2 Sheets-Sheet 2



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Patented Aug. 19, 1924.

1,505,085

UNITED STATES PATENT OFFICE.

CECIL E. BRIGHAM, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO DUBILIER CONDENSER & RADIO CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

RADIO RECEIVING APPARATUS.

Application filed July 15, 1922. Serial No. 575,140.

To all whom it may concern:

Be it known that I, CECIL E. BRIGHAM, a citizen of the United States, residing at Washington, in the District of Columbia, have invented a certain new and useful Improvement in Radio Receiving Apparatus, of which the following is a specification.

My invention relates broadly to radio receiving apparatus and more particularly to a radio frequency transformer for operating between the electron tube circuits of a radio frequency electron tube amplifier.

The object of my invention is to provide means in a radio frequency electron tube amplification circuit for reducing the interference offered by the tendency of the respective electron tube circuits to oscillate.

Another object of the invention is to provide means between the respective electron tube circuits of a radio frequency amplifier responsive to a broad band of frequencies.

Another object of the invention is to provide a construction of intervalve radio frequency transformer having low distributed capacity.

A still further object of the invention is to provide a construction of radio frequency transformer of simple design and capable of manufacture in quantity production at minimum cost.

Another object of the invention is to provide a radio frequency transformer which may be mounted in a composition or metal casing and suitably insulated therein, and a terminal block provided on the casing.

Other and further objects of the invention will appear in the following specification and by reference to the accompanying drawings in which:

Figure 1 is a top plan view of my transformer drawn to actual size; Fig. 2 is a side elevation of the transformer; Fig. 3 is an end view of the transformer; Fig. 4 is a view of the transformer showing the primary and secondary windings in section; Fig. 5 is a perspective view of the transformer within a casing; Fig. 6 is a chart showing the characteristic curve of my transformer plotted with grid voltage amplification as ordinates against frequency or wavelength in meters as abscissa as compared to the characteristic curves of transformers of usual construction; and Fig. 7 is a wiring diagram of a radio receiving

apparatus showing the connection of my transformers between the electron tube radio frequency amplification circuits.

The present embodiment of the invention has been found to be quite practical and capable of efficient operation.

Heretofore in the art radio frequency amplifiers having the intervalve circuits coupled by transformers have been limited for efficient operation to an extremely narrow band of frequencies. The characteristic curves for such transformers show maximum amplification on sharp peaks over a limited band of frequencies. In multistage radio frequency amplification such characteristics of the intervalve circuits tend to produce undesired interference by oscillation reacting between the circuits. In my present invention, I have designed a transformer which eliminates these undesired peak characteristics and responds to a broad band of frequencies. I employ a set of L shaped laminations opposite each other. I provide magnetic leakage gaps between the adjacent ends of the L shaped core members. On opposite legs of the core I wind primary and secondary windings, each consisting of a single layer of insulated wire. By this construction I secure an extremely low distributed capacity. The magnetic leakage paths at the ends of the L shaped laminations are chosen with respect to the size of the core and the size of the primary and secondary windings to insure operation of the transformer at maximum efficiency over a relatively wide band of frequencies. The transformer may be mounted in a composition or metal container serving to mechanically support the transformer, to provide terminals for the connection of the primary and secondary windings with the electron tube circuits, and to electrically insulate the transformer.

Referring more particularly to the drawings, reference character 1 indicates the L shaped core laminations for one leg of the transformer, and numeral 2 indicates the L shaped laminations for the opposite leg of the transformer. The core laminations 1 are secured as a unit at 3 and 4. The core laminations 2 are mechanically connected at 5 and 6. Insulated members 7 and 8 are secured at 4 and 5 respectively to maintain the core members in position and providing

magnetic leakage gaps 15 and 16. The primary winding 14 and secondary winding 12 are wound on insulated members 11 and 10 respectively and the coils mounted on opposite legs of the core. These coils are designed for low distributed capacity and comprise a single layer of enamel covered copper wire. The ends of primary winding 14 are represented at 14^a and are electrically connected to terminal posts on the transformer. The ends of secondary winding 12 are indicated at 12^a and connect to terminal posts of the transformer.

The transformer may be mounted within a container as shown in Fig. 5 where the container 17 mechanically supports the transformer 1 and provides a terminal block for posts 14^b and 12^b of the primary and secondary windings respectively and at the same time provides an electrically insulated casing for the transformer.

The present construction of radio frequency transformer is the result of extensive research. An adjustment is made in my radio frequency transformer by the proper change of the air gap in such a way that the coupling between the primary and secondary coil assumes the right magnitude. At the same time the number of turns and the distributed capacity of the coils determine the wave length at which the two resonance points of the windings take place. There are certain losses introduced in the iron and in the coils in such manner that the resonance points of the windings are not sharp but give a substantially flat amplification curve over the entire range of desired wave lengths. I have determined that the critical dimension of this magnetic leakage gap is .04 inches which is the value affording such losses as to flatten the characteristic curve between the resonance points of each winding. Fig. 6 shows the relative characteristic curves of my transformer and other types of radio frequency transformers. The ordinate 22 represents values of grid voltage amplification. The abscissa 24 represents wavelength in meters or frequency. All of these curves were determined by connecting the different transformers in the same electron tube test circuit. Curve 21 is the characteristic of my transformer. Curves 18, 19 and 20 are the characteristic curves of other types of radio frequency transformers. It will be apparent that my construction of radio frequency transformer enables operation of a radio frequency amplification circuit over a broad band of wavelengths and does not have the disadvantage of sharp peaks as compared to the characteristic curves of other transformers which show undesired sharp peaks and which operate over a more narrow band of wavelengths.

Fig. 7 represents a radio receiving apparatus showing the connection of a radio frequency amplifier employing my radio frequency transformers. A loop collector 25 is employed tuned by condenser 26. Electron tube 27 is connected to amplify the incoming energy at radio frequency. Radio frequency transformer 28 has its primary winding connected in the output circuit of electron tube 27 and its secondary winding connected to the input circuit of electron tube 29. The output circuit of electron tube 29 includes the primary winding of radio frequency transformer 30. The secondary winding of radio frequency transformer 30 connects to the input circuit of electron tube 31 which includes in its output circuit the primary winding of radio frequency transformer 32. The secondary winding of radio frequency transformer 32 connects to electron tube circuit 35 arranged as a rectifier with grid condenser and grid leak 34 in the grid circuit thereof. Telephone receivers 36 are represented in the output circuit of the detector. The plate circuits of all of the electron tubes are supplied from B battery 38. The filament heating current for all of the electron tubes is supplied from A battery 40. Rheostat 39 controls the filament temperature of the electron tubes. I have only represented the radio frequency amplification circuit with detector, but it will be understood that a multistage audio frequency amplifier may be connected after the detector circuit.

While I have described the invention in specific terms I intend no limitations other than are imposed by the scope of the appended claims.

Having described my invention, what I claim is,—

1. A radio frequency transformer comprising in combination a substantially closed magnetic core, a primary winding, and a secondary winding on said core in coupled relation, said windings having extremely small distributed capacity at the frequencies for which they are designed to operate, the core having a magnetic leakage gap therein of a size designed for introducing losses to a degree necessary to enable said transformer to operate effectively over a broad band of frequencies.

2. In a radio receiving apparatus, a radio frequency transformer, comprising a pair of L shape core members arranged opposite each other, magnetic leakage gaps between the ends of said core members for broadening the amplification characteristic of said transformer, and single layer primary and secondary windings disposed one on each of said core members whereby extremely low distributed capacity between said windings exists at the frequency at which said windings are designed to operate.

3. In a radio receiving apparatus, a radio frequency transformer, comprising in combination a substantially closed magnetic core, a magnetic leakage gap in said core, a single layer primary winding on one side of said magnetic core and a substantially similar secondary winding on the other side of said magnetic core, said windings being arranged in such position that extremely small distributed capacity exists between said windings at radio frequencies with said magnetic leakage gap operating to flatten the amplification characteristic curve of said transformer.
4. In a radio receiving apparatus, a radio frequency transformer comprising L shape core members arranged opposite each other, magnetic leakage gaps, separating the ends of said core members, a coil support carried on each of said core members and a single layer primary winding on one support and a similar secondary winding on the other support and arranged to have low distributed capacity at radio frequencies with a relatively flat amplification characteristic curve.
5. A radio frequency transformer for coupling the input and output circuits of electron tubes, comprising in combination a substantially closed magnetic core, a single layer primary winding on one side of said core and a substantially similar secondary winding on the other side of said core closely coupled to said primary winding, said windings having extremely small distributed capacity at the frequencies for which they are designed to operate, and a magnetic leakage gap in said magnetic core of a size for introducing a degree of losses operating to flatten the characteristic curve of said transformer between the resonance curves of each of said windings whereby said transformer effectively transfers a broad band of frequencies.
6. A radio frequency transformer comprising in combination a substantially closed magnetic core, and single layer primary and secondary windings on the core in coupled relation, said windings having small distributed capacity at frequencies for which they operate, said core including a magnetic leakage gap designed to introduce losses to a degree to enable the transformer to operate effectively over a broad band of frequencies.

CECIL E. BRIGHAM.