June 14, 1927. 1,632,104

D. F. WHITING

TRANSMISSION CIRCUITS

Filed July 31, 1926

Fig. 1.

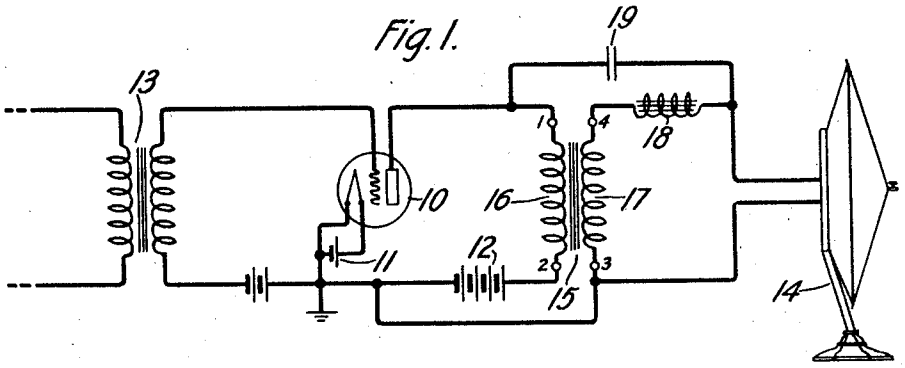


Fig. 2.

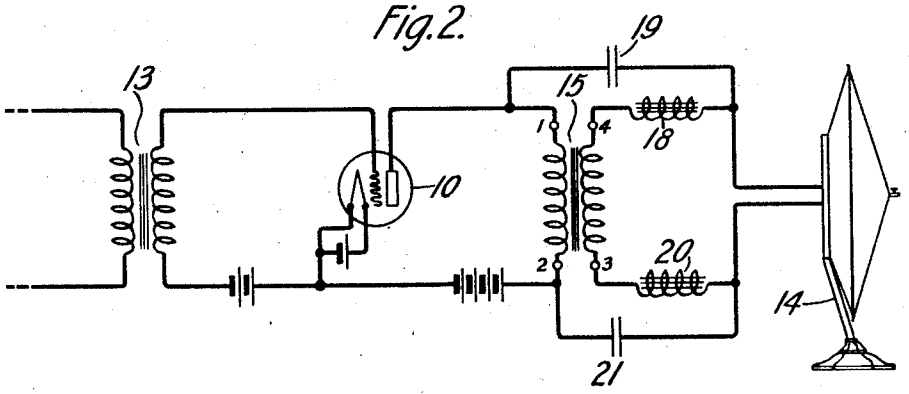
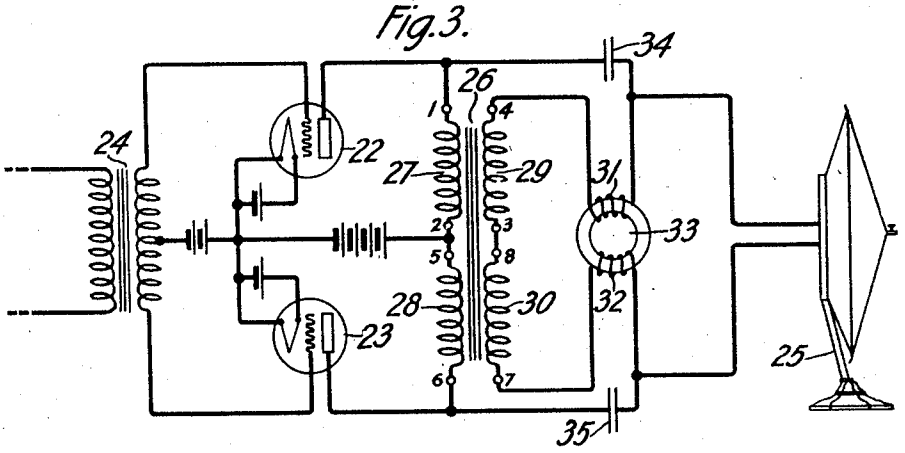


Fig. 3.



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UNITED STATES PATENT OFFICE.

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TRANSMISSION CIRCUITS.

Application filed July 31, 1926. Serial No. 126,155.

This invention relates to circuits for transmitting electrical waves of a wide frequency range and has for an object to improve the uniformity of transmission of such waves between circuits having different impedance characteristics.

A further object of this invention is to improve the coupling between an electron discharge device and an electromagnetic receiver.

In the copending application of H. A. Whitehorn, Serial No. 609,881, filed December 20, 1922, there is disclosed and claimed an arrangement for coupling two circuits of different impedance-frequency characteristic. This application discloses in one form a condenser shunted by a transformer having an inductance coil connected in series with both of its windings.

In accordance with this invention, there is provided between two circuits having different impedance frequency characteristics a coupling consisting of a condenser shunted by a transformer having an inductance coil in series with only one of its windings. The transformer is designed to have an impedance ratio which will give efficient transmission for frequencies in the lower portion of the range to be transmitted. At low frequencies where the impedance of the condenser is high, coupling is provided by means of the transformer alone, while at high frequencies the impedance of the transformer and inductance coil is high and waves are directly transmitted through the condenser.

This invention can be more readily understood by reference to the following detailed description in connection with the drawing, in which Fig. 1 shows diagrammatically an embodiment of the invention in a single tube amplifier; Fig. 2 shows a modification of the circuit of Fig. 1 employing a balanced coupling arrangement; and Fig. 3 shows an embodiment of the invention in a push-pull amplifier.

Fig. 1 shows a vacuum tube 10 provided with the usual cathode heating battery 11 and plate battery 12 and connected to operate as an amplifier. Waves to be amplified are impressed on the grid circuit through an input transformer 13. The output of the tube is connected to a loud speaking electromagnetic receiver 14 through a coupling circuit according to this invention. This circuit comprises a transformer 15 having a primary winding 16 and a secondary winding 17. The terminals of the primary and secondary windings 16 and 17 are numbered 1—2 and 3—4 respectively in which 1, 2, 3, 4 is the series aiding connection. The primary 16 is connected to the output of the tube 10 and the secondary 17 to the receiver 14. A retardation coil 18 is connected in series between the terminal 4 of the secondary 17 and the receiver 14. The terminal of the receiver 14 is connected to terminal 3 of the secondary 17 is connected to the cathode of the tube 10. A condenser 19 is connected in shunt to the transformer between terminal 1 of the primary 16 and the terminal of the retardation coil 18 adjacent the receiver 14.

The transformer 15 is designed to have an impedance ratio which will give efficient transmission between the tube 10 and the receiver 14 for frequencies in the lower portion of the range to be transmitted. If the circuit is to be used for amplifying waves representing speech and music this impedance ratio preferably should be such that the tube 10 works into an impedance equal to twice its output impedance as set forth in application Serial No. 96,418, filed March 22, 1926. The condenser 19 is practically opaque to frequencies in the lower portion of the range and waves of these frequencies are transmitted through the transformer 15. At the higher frequencies the impedance of the primary winding 16 of transformer 15 and the retardation coil 18 is high and waves are directly transmitted from the tube 10 to the receiver 14 through the condenser 19. In the intermediate portion of the range, part of the transmission takes place through the condenser and part through the transformer.

The arrangement shown in Fig. 2 is similar to that of Fig. 1 except that instead of the direct connection between the receiver 14 and the cathode of the tube 10 the connection is made through a condenser 21 and a retardation coil 20 is connected between terminal 3 and the receiver 14, in a similar manner to condenser 19 and coil 18, to give a balanced circuit arrangement. If desired coils 18 and 20 may be wound on the same core.

Fig. 3 shows a push pull amplifier comprising two tubes 22 and 23 connected in the usual manner to receive waves to be amplified through an input transformer 24. The plates of the tubes are connected to a loud speaking electromagnetic receiver 25 through a coupling arrangement according to this invention. This coupling comprises a transformer 26 having primary windings 27 and 28 and secondary windings 29 and 30. The terminals of these windings are numbered in a similar manner to the terminals of the windings of Figs. 1 and 2, 1, 2, 3, 4, 5, 6, 7, 8 representing the series aiding connection. The primaries 27 and 28 are connected in the plate circuits of the tubes 22 and 23 respectively, in the usual manner. The secondaries 29 and 30 are connected in series with the windings 31 and 32 of the balanced retardation coil 33 to the receiver 25. Condensers 34 and 35 of approximately equal value are connected from the terminals of the primaries 27 and 28 to the terminals of the windings 31 and 32 adjacent the receiver. This circuit operates in a similar manner to the circuit of Fig. 2, the transformer 26 functioning to couple the amplifier and receiver at the lower frequencies while the waves are directly transmitted through condensers 34 and 35 at the higher frequencies.

While satisfactory results for the extreme frequencies may be obtained by other connections it has been found that the circuits operate to the best advantage when the transformers are poled in the manner indicated in the drawings.

What is claimed is:

1. In combination two circuits having different impedance-frequency characteristics and means for coupling said circuits to substantially uniformly transmit a wide range of frequencies, said means comprising a transformer having windings connected to said circuits and of such an impedance ratio as to efficiently couple the circuits for frequencies in the lower portion of said range, an inductance element connected in series between one terminal of one of said windings and the circuit connected to said winding, a capacity element connected in shunt to said transformer and inductance element between a terminal of the other of said windings and the terminal of said inductance element adjacent said circuit, and connections between the other terminals of said windings.

2. In an electric circuit for transmitting waves of a wide range of frequencies, two circuit branches, one of said branches having an impedance substantially lower than the other of said branches for frequencies in the lower portion of said range and substantially equal to the impedance of said other branch for frequencies in another portion of said range, a transformer having windings connected to said circuit branches and of such an impedance ratio as to provide efficient transmission between said branches for frequencies in the lower portion of said range, an inductance element connected in series between one terminal of one of said windings and the circuit branch connected thereto, a capacity element connected in shunt to said transformer and inductance element between a terminal of the other of said windings and the terminal of said inductance element adjacent said circuit branch, and connections between the other terminals of said windings whereby said windings are connected in series aiding relation.

3. A combination according to the next preceding claim in which one of said circuit branches comprises the output circuit of an electron discharge device and the other of said circuit branches comprises an electromagnetic receiver.

4. In combination two electron discharge devices connected in push-pull relation, a receiving circuit, a transformer having a winding connected to the output terminals of said devices and a second winding connected to said receiving circuit, inductive windings connected in series between each terminal of said second winding and said receiving circuit, and condensers connected in shunt to said transformer and said inductive windings between the terminals of said first winding of the transformer and the terminals of said inductive windings adjacent the receiving circuit.

5. A combination according to the next preceding claim in which said receiving circuit comprises an electromagnetic receiver.

In witness whereof, I hereunto subscribe my name this 28th day of July A. D., 1926.

DONALD F. WHITING.