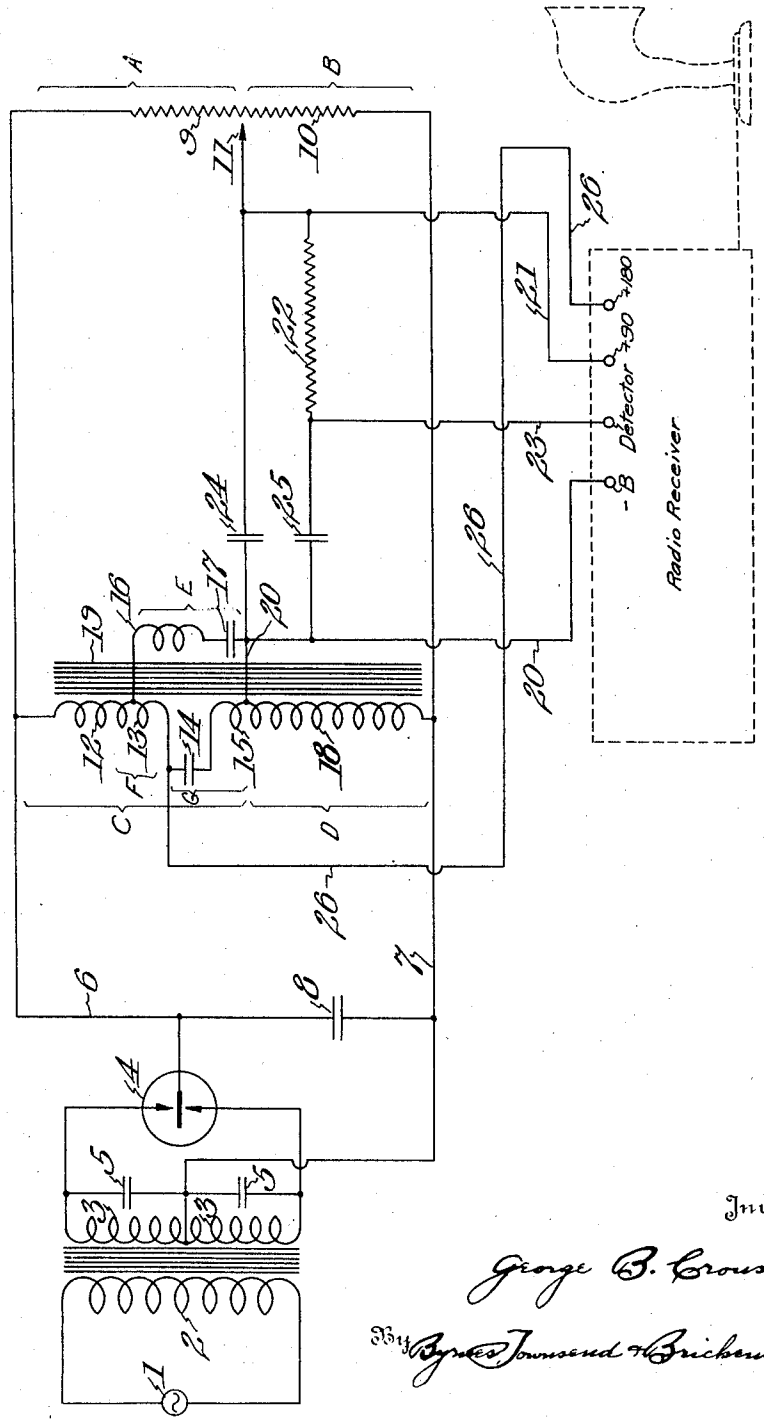
Dec. 10, 1929. G. B. CROUSE 1,738,760

ELECTRICAL FILTER

Filed Jan. 19, 1928



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UNITED STATES PATENT OFFICE

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ELECTRICAL FILTER

Application filed January 19, 1928. Serial No. 247,953.

This invention relates to an electrical filter for removing alternating components from rectified or pulsating current, and more particularly to a filter capable of suppressing alternating components to the degree required for the satisfactory operation of radio receivers.

The filter network is of the same general type and has the same suppression characteristic as the filter described in my copending application, Serial No. 680,096, filed December 19, 1923.

An object of the invention is to provide a simple and economical filter for use between a source of rectified current and the plate circuits of a radio receiver. A further object is to provide an economical filter for supplying direct current of different degrees of freedom from alternating components to a plurality of associated direct current load circuits. A further object is to provide a filter circuit of the Wheatstone bridge type in which one balancing arm of the bridge is a phantom arm formed by the mutual effect of inductive elements in three physical arms of the bridge.

These and other objects of the invention will be apparent from the following specification when taken with the accompanying drawing in which the single figure is a schematic diagram of one embodiment of the invention.

In the drawing, the numeral 1 identifies a source of alternating current for energizing the primary 2 of an iron core transformer having a pair of secondaries 3 which are associated with a rectifier 4 to effect full wave rectification. The usual buffing condensers 5 are preferably connected across the secondaries 3 to eliminate radio frequency radiation. A positive lead 6 and negative lead 7 supply energy to the filter network in the form of rectified current.

It is to be noted that the details of this converter system for securing rectified current from the alternating current source form no part of the present invention. The construction of any particular filter is of course dependent upon the frequencies and magnitudes of the alternating components present in the rectified current, but the same circuit arrangement may be employed with full or half-wave rectified alternating current or with the pulsating direct current output of a generator.

A storage condenser 8, when desirable or necessary because of the characteristics of the rectifier 4, is connected across the leads 6, 7 in shunt with the impedances which form the adjacent pairs of balancing arms A, B and C, D, of the primary bridge network.

Arms A and B are comprised by resistances 9, 10, respectively, which are preferably formed as a single resistance unit along which the positive direct current terminal 11 has a limited range of adjustment to compensate for manufacturing variation in the impedance arms.

Arm C of the primary bridge is composite and comprises an inductance 12 in series with the complex impedance formed by the serially connected inductance 13, capacity 14 and inductance 15, across which are shunted the inductance 16 in series with capacity 17.

Arm D of the primary bridge comprises the inductance 18.

All of the inductive elements of arms C and D are wound on the same iron core 19 and have mutual inductance between them in addition to their self inductance.

The negative direct current lead 20 extends from the junction of inductances 15 and 18 to the −B terminal of the radio receiver. A lead 21 connects the positive terminal 11 to the intermediate voltage tap of the receiver, which terminal is identified on the drawings as "+90." A resistance 22 is included in the lead 23 which extends from terminal 11 of the bridge to the "detector" terminal of the receiver, and the usual by-pass condensers 24, 25 provide low impedance paths for the signal currents.

The impedance of the balancing arms of the primary bridge network are so proportioned that the bridge is substantially balanced for alternating current components of the most disturbing frequency present in the rectified current. The direct current supplied through the intermediate voltage lead 21 and the return lead 20 is free from alter-

nating components in quantity sufficient to cause noticeable effect, and the current supplied to the detector through lead 23 is additionally filtered by the resistance-capacity network 22, 24, 25.

The direct current supplied to the plate circuit of the power amplifier stage does not require the degree of filtering which is essential for the earlier stages. Energy for the power stage is obtained by a lead 26 which extends from the positive side of condenser 14 in arm C of the primary network to the radio receiver tap +180; the negative lead being the lead 20 which is common to all of the plate circuits. The filter network for the power stage comprises the section formed by capacity 8 and series inductance 17, and the secondary bridge network formed by the three physical arms E, F, G and a phantom arm provided by the mutual effect of the inductive elements in the three physical arms. As indicated on the drawing, arm E comprises inductance 16 and capacity 17; arm F comprises inductance 13, and arm G comprises capacity 14 and inductance 15.

The network is of course so designed that both the primary and secondary Wheatstone bridges are balanced to suppress alternating components to the extent necessary for satisfactory operation. In general, the networks are balanced for the same frequency but it is of course possible to balance the networks for different frequencies to meet the special requirements of a particular radio receiver or the particular group of associated load circuits which are to be supplied with filtered current. Since the secondary bridge network does not include any pure resistance elements, approximately the full direct current voltage across the rectified current leads 6, 7 is available across leads 20 and 26.

It is to be understood that the invention is not limited to the particular embodiment shown in the drawings as various changes may be made in the network without departure from the spirit of my invention as set forth in the following claims.

I claim:

1. In apparatus for energizing an audion circuit from a source of rectified current, a plurality of impedances arranged as the balancing arms of an alternating current Wheatstone bridge across which said source and said circuit may be connected as conjugate arms, one of said balancing arms having the reactance of a composite impedance and including a pair of dissimilar shunt impedances.

2. The invention as set forth in claim 1, wherein one of said shunt impedances includes inductance in series with capacity.

3. The invention as set forth in claim 1, wherein each of said shunt impedances includes inductance in series with a capacity.

4. The invention as set forth in claim 1, wherein each of said shunt impedances includes inductance in series with a capacity, the said arm including an inductance in series with the said pair of shunt impedances.

5. In apparatus for energizing an audion circuit from a source of rectified current, a plurality of impedances arranged as the balancing arms of a Wheatstone bridge across which said source and said circuit may be connected as conjugate arms, one of said arms being composite and including impedances forming a secondary Wheatstone bridge across which said source and a second audion circuit are connected as the conjugate arms.

6. The invention as set forth in claim 5, in which said secondary Wheatstone bridge comprises three physical arms and a phantom arm provided by mutual reactance between said three physical arms.

7. In apparatus for energizing an audion circuit from a source of rectified current, an impedance network providing a Wheatstone bridge across which said source and said circuit are connected as the conjugate arms, said bridge network comprising three physical reactive arms and a phantom arm provided by the mutual reactance between said physical arms.

8. Apparatus as set forth in claim 7, wherein each of said physical arms includes an inductance reactance.

In testimony whereof, I affix my signature.

GEORGE B. CROUSE.