July 9, 1935. E. L. KOCH 2,007,764

CIRCUIT FOR AUDION TUBES

Filed June 1, 1926

Fig. 1.

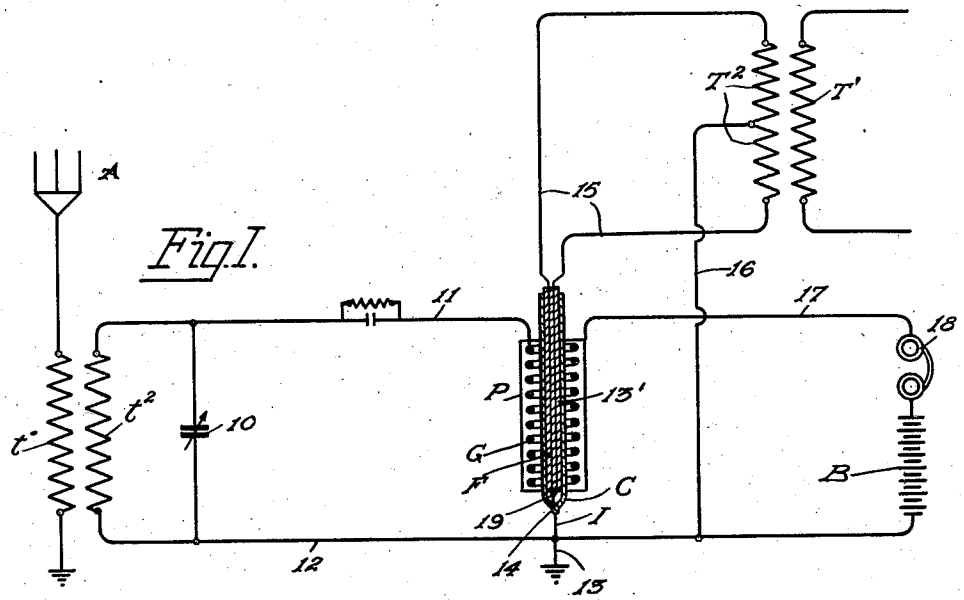
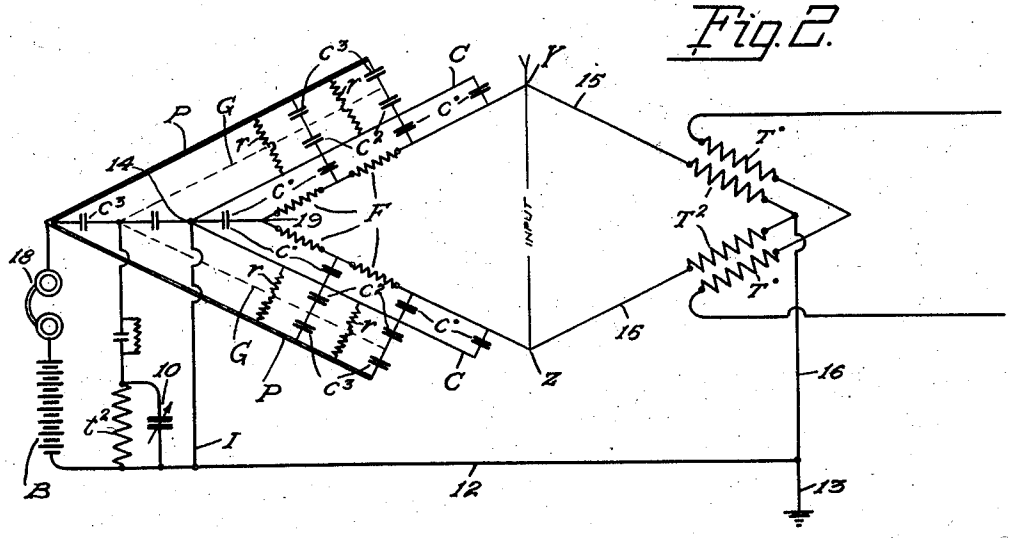


Fig. 2.



Inventor:
Earl L. Koch.
By S. A. Yarnall Jr.
Attorney.

Patented July 9, 1935 2,007,764

UNITED STATES PATENT OFFICE

2,007,764

CIRCUIT FOR AUDION TUBES

Earl L. Koch, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill., a corporation of Illinois

Application June 1, 1926, Serial No. 112,737

10 Claims. (Cl. 250—27)

This invention relates to a circuit for audion tubes and particularly to an arrangement of circuit connections for balancing out certain undesirable inductive effects.

In tubes wherein the cathode is heated by a resistance element through which alternating current is flowing, the operation of the tube is sometimes injuriously affected by the alternating current due to an inductive action.

The object of the present invention is the provision of a tube structure of the above character, and circuit connections therefor, whereby the undesirable inductive effect of the alternating current passing through the heating element will be balanced out and eliminated when using alternating current tubes in a receiving set.

It is believed the invention will be understood most readily from a detailed description thereof taken in connection with the accompanying drawing, in which:

Fig. 1 is a schematic diagram showing the essential elements of a receiving set employing an audion tube of the above mentioned character, and

Fig. 2 is a diagrammatical representation of the electrical analysis of the circuit of Fig. 1.

Referring now to the drawing, in which like reference characters indicate the same parts in both the figures, A represents the antenna which is joined to ground through the primary t' of the inductive connection. Associated with the coil t' is the secondary t^2 in parallel with which is the variable condenser 10. One end of the coil t^2 is joined by conductor 11 to the grid G, the other end of the coil t^2 being joined to conductor 12 which is connected to ground by the lead 13.

The tube herein indicated is of the character in which the cathode C is formed as a tube or shell heated by a resistance element F positioned within the cathode, refractory material 13' being provided within the cathode tube around the filament F. The cathode shell C is closed at one end, as indicated at 14 and is joined to the conductor 12 by means of the lead I.

At T' is shown the primary of a transformer in series with a source of alternating current, as for instance the usual 110 volt current of the Public Service Company. Associated with the primary T' is the secondary T^2, the opposite ends of which are joined to the ends of the resistance loop F by means of the conductors 15. The transformer T', T^2 is adapted to give an output of about three volts across the terminals of the coil T^2, the electrical mid point of which is joined by tap 16 to the grounded conductor 12. Surrounding the spiral grid G is a tubular plate P which is joined by conductor 17 to the receiver 18. In series with the receiver 18 is the battery B.

Referring now to Fig. 2, which, as above explained, shows the electrical analysis of the circuit of Fig. 1, it will be noted that the various elements above described are shown as arranged in the form of a Wheatstone bridge. On one side of this bridge is the secondary coil T^2, the mid point of which is joined to ground through conductor 16. On the opposite side of the bridge are the various elements of the tube. For instance, it will be noted that the several zig zag lines F indicate the resistance heating element. The diverging lines C indicate the cathode shell. The diverging dotted lines G schematically indicate the grid; while the diverging double lines P represent the plate. It will also be noted that the tip point 14 of cathode C (Fig. 1) is joined to the electrical center of the secondary T^2 of the transformer through the medium of conductors I, 12 and 16. Electrically, this is the equivalent of connecting the wire I to the point 19 midway of the resistance loop F.

In Fig. 2 the condensers c' indicate the capacity between the heating element F and the cathode shell C. The condensers c^2 indicate the capacity between the cathode C and the grid G; while the condensers c^3 indicate the capacity between the grid and the plate P. At r is schematically indicated the resistance between the cathode C and plate P.

If we analyze this circuit arrangement as a Wheatstone bridge with the points Y and Z as the input and considering that the resistance and inductance are equal on the opposite sides of the bridge, that is on opposite sides of the points Y and Z, we have a balanced condition and no current will flow in the wire I. By a careful construction of the tubes this balance may be obtained sufficiently nearly to eliminate, for all practical purposes, the inductive effect of the alternating current passing through the heating element F.

It will be noted that the conductor I, together with conductors 12 and 16, act to complete the bridge. It has been found desirable to ground the wire I in order to reduce so far as possible any charges which might tend to unbalance the circuit.

While in the accompanying drawing only a simplified circuit is schematically illustrated, it is to be understood that the principle of the present invention may be applied to circuits of widely different characters. The invention,

therefore, should be limited only by the scope of the appended claims.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In a vacuum tube circuit, the combination of a tubular plate, a tubular grid within said plate, a cathode within said grid, a resistance element insulatingly mounted within said cathode for heating said cathode, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, and an electrical conductor joining substantially the mid-point of said secondary coil to said cathode.

2. In a vacuum tube circuit, the combination of a tubular plate, a tubular grid within said plate, a cathode within said grid, a resistance element extending into said cathode but insulated therefrom for heating said cathode, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, an electrical conductor joining substantially the mid-point of said secondary coil to said cathode, and means for grounding the said electrical conductor.

3. In a vacuum tube circuit, the combination of a tubular plate, a tubular grid within said plate, a tubular cathode within said grid, a resistance element out of electrical contact with said cathode but within said cathode for heating it, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, and an electrical conductor joining substantially the midpoint of said secondary coil to one end of said cathode.

4. In a vacuum tube circuit, the combination of a tubular plate, a tubular grid within said plate, a tubular cathode within said grid, a resistance element out of electrical contact with said cathode but within said cathode for heating it, one end of said tubular cathode being closed, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, and an electrical connection joining substantially the mid-point of said secondary coil to the closed end of said cathode.

5. In a vacuum tube circuit, the combination of a tubular plate, a grid within said plate, a tubular cathode within said grid, a looped resistance element within said cathode but out of electrical engagement therewith for heating said cathode, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, and an electrical conductor joining substantially the mid-point of said secondary coil to said cathode.

6. In a vacuum tube circuit, the combination of a tubular plate, a tubular grid within said plate, a tubular cathode within said grid, a resistance element extending through a refractory rod within said cathode but out of electrical engagement therewith for heating said cathode, one end of said cathode being closed, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, and an electrical conductor joining substantially the mid-point of said secondary coil to the closed end of said cathode.

7. In a vacuum tube circuit, the combination of a tubular plate, a tubular grid within said plate, a tubular cathode within said grid, a looped resistance element extending through a refractory rod within said cathode but out of electrical engagement therewith for heating said cathode, a transformer comprising a primary coil adapted to be arranged in series with a source of alternating current and a secondary coil, said secondary coil being in series with said resistance element, an electrical conductor joining substantially the mid-point of said secondary coil to said cathode and means for grounding said electrical conductor.

8. In a vacuum tube circuit, the combination of a plate, a grid within the plate, a tubular cathode extending into said grid, a resistance element out of electrical engagement with said cathode but exending therein to render said cathode electronically active, a transformer having its primary connected to a source of alternating current and its secondary connected in circuit with said resistance element, and circuit connections connecting said apparatus in the arms of a Wheatstone bridge circuit to balance out the inductive effect of the current passing through said resistance element.

9. In a vacuum tube circuit, the combination of a plate, a grid within the plate, a tubular cathode extending into said grid, a resistance element out of electrical engagement with said cathode but extending therein to render said cathode electronically active, a transformer having its primary connected to a source of alternating current and its secondary connected in circuit with said resistance element, and circuit connections connecting said secondary and said tube elements in the arms of a Wheatstone bridge circuit to render ineffective the inductive effect of current passing through said resistance element.

10. In a vacuum tube circuit, the combination of a tubular electron emitter, a resistance element out of electrical engagement with said tubular electron emitter for rendering the same active, a transformer having a primary connected to a source of alternating current and a secondary connected to said resistance element, and circuit connections connecting said secondary and said electron emitter in a Wheatstone bridge circuit to render ineffective the inductive effect of the alternating current passing through said resistance element.

EARL L. KOCH.