April 27, 1937. D. D. KNOWLES 2,078,672

INVERTER TUBE

Filed Jan. 31, 1934

Fig. 1.

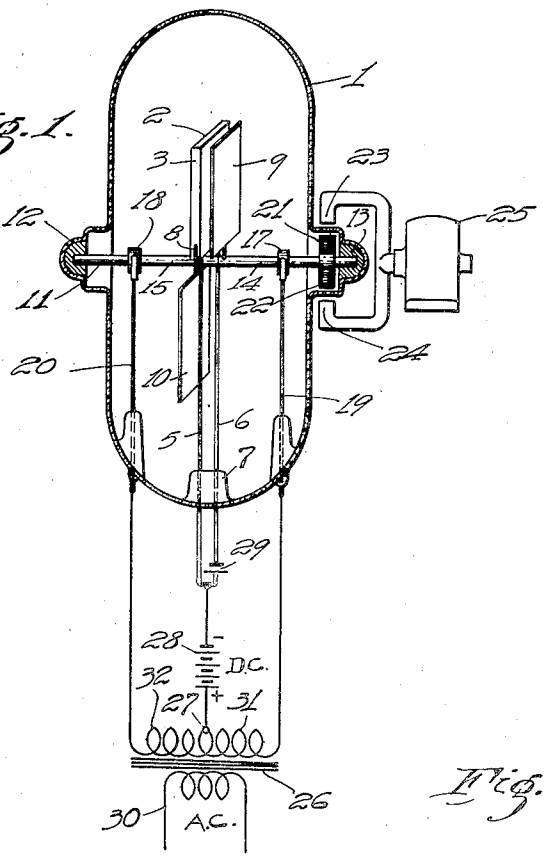


Fig. 2.

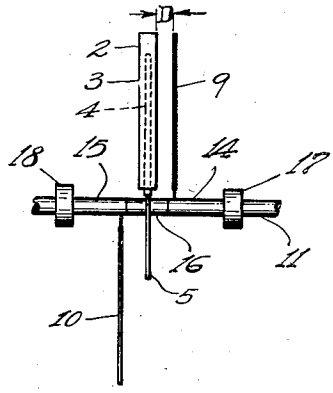
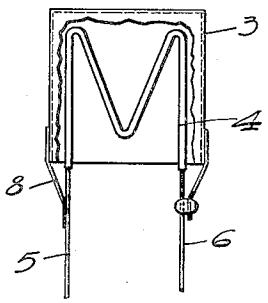


Fig. 3.



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INVERTER TUBE

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2 Claims. (Cl. 175—363)

My invention relates to inverter tubes and circuits therefor, and especially to an inverter tube having a movable main electrode.

An object of my invention is to provide an inverter circuit having a perfect sine wave alternating current and thus avoiding the need for filters which are a necessity in most forms of inverters.

More specifically stated, it is an object of my invention to provide an inverter tube having a stationary cathode and two revolving anodes, said anodes being alternately revolved across the face of the cathode whereby a discharge will alternate from the cathode first to one anode and then to the other anode. This alternation of discharges will produce an alternating current in a coil connected in series to the anodes.

Other objects and advantages of my invention will become apparent from the following description and drawing wherein:

Figure 1 is a view partly in perspective and partly diagrammatic of an inverter tube and circuit therefor embodying my invention;

Fig. 2 is a view disclosing the mechanical connection between the two revolving anodes;

Fig. 3 is a view in elevation, with part of the wall broken away, of a preferred form of cathode.

The tube comprises a vacuum container 1 having located therein a stationary cathode 2. This stationary cathode is preferably of the oxide coated indirectly-heated type and as disclosed in Fig. 3, preferably comprises a hollow rectangular box like casing 3 coated with the oxides of strontium and barium, and having located therein a filament 4 for indirectly heating the oxide coating to provide electron emission therefrom. The filament 4 may be of any suitable size and shape. It is preferable to have the filament leads 5 and 6 support the cathode structure in the tube from a suitable press 7. A connection 8 from one portion of the filament or its leads to the casing 3 will make the surface thereon an equipotential surface.

It is preferred to provide two plate-like anodes 9 and 10 supported on a rod 11 pivoted in the sides 12 and 13 of the tube 1. This rod 11 comprises two conducting parts 14 and 15 joined by an insulating portion 16. The plate 9 is connected to the conductor portion 14 and the plate 10 is connected to the conducting portion 15, but the two plates or anodes are insulated from each other by the portion 16. Brushes 17 and 18 bear respectively on the portions 14 and 15, and the connections 19 and 20 connected to these brushes provide lead-ins to the anodes 9 and 10, respectively. The rod 11 is revolved by any suitable means. As disclosed in the drawing, a set of two or more oppositely disposed magnetic poles 21 and 22 are secured to the rod 11 and opposite poles 23 and 24 are spaced adjacent thereto on the outside of the tube. These outside poles are revolved by any desirable means such as the motor 25, and pull the innerpoles 21 and 22 around with them with the result that the rod 11 and the plates 9 and 10 are also revolved about the axis of the rod. The rate of rotation will naturally determine the frequency of the alternating current output and the motor will have the desired speed and gear ratio connection to the poles 23 and 24 to provide the desired frequency in the alternating current output circuit.

The primary winding of the transformer 26 is connected at one end to the anode lead connection 19 and at the other end to the anode lead connection 20. The midpoint 27 of this winding is connected through a source of potential 28 to the cathode 2. A source of heating current 29 for the cathode is preferably placed in this connection in conjunction with the heating leads 5 and 6.

A suitable secondary 30 of the transformer 26 is connected to the alternating current output circuit.

It will be noted that the primary of the transformer 26 is practically divided into the two parts 31 and 32 on either side of the midpoint 27. As the anode plate 9 revolves about its axis, it comes within the distance D, as shown in Fig. 2, of the cathode 2. This distance D is such that the space charge will not prevent a discharge. At first a very small area of the plate 9 is within the distance D of the cathode 2, but this area is increased as the plate revolves until its entire area is within the distance D as disclosed in Fig. 1. Due to this gradual increase of area of electrode surface adjacent the cathode, there will be a gradually increasing quantity of electron discharge between the two electrodes up to a maximum at the position illustrated in Fig. 1. From this point on a gradually increasing portion of the plate 9 will leave the spacing D from the cathode until the plate 9 has revolved out of this distance D from the cathode. Due to this gradual withdrawal of the anode, the quantity of electron discharge to the plate 9 will gradually decrease until there is no substantial discharge between the cathode 2 and the anode 9. At this point, however, the anode 10 is increasing its area within the distance D of the cathode 2 and the electron discharge is transferred thereto in ever increasing quantity to the plate 10. The quantity of

electron discharge to the plate 10 reaches a maximum and then decreases to a point where the discharge is transferred back to the plate 9.

Due to the gradual increase in electron discharge from the cathode 2 to the plate 9, I have a gradually increasing current flowing through the circuit formed by the cathode to the midpoint 27 of the transformer 26, through the portion 31 of the primary coil, back through connection 19 to the anode 9 and across the electron discharge to the cathode 2. After reaching a maximum, this current gradually decreases to the point where the discharge transfers from the anode 9 to the anode 10. The current then flows in the opposite direction from the midpoint 27 of the transformer 26 through the portion 32 to the anode 10. Accordingly there is a gradually increasing current, first in one direction in the primary coil of the transformer 26, up to a maximum value, and then decreasing to the point where a current travels in the reverse direction up to a maximum and then decreases. This reversal of current passing to a maximum will produce an alternating current of sine wave in the output secondary coil 30 of the transformer 26. It will be seen that the electrodes can be shaped to provide a very accurate sine wave in the output circuit. The frequency of this alternating output circuit can also be accurately selected by careful selection of the speed at which the two anodes are revolved about the cathode.

By properly proportioning the anodes and cathodes to the constants of the circuit a perfect sine wave alternating current may be produced, thus eliminating the need for filters which is a necessity in most forms of converters. By using the vacuum tube, there are no troubles due to arc back which is inherent in gas and vapor flow devices, and furthermore, there is no radial interference as is the case with these gas filled tubes.

The invention is particularly adapted for high voltage output such as of the order of 100,000 volts and at frequencies below which the conventional vacuum tube oscillator is comparatively inefficient. The invention accordingly avoids the voltage limitation on gas filled tubes.

The size and shape of the elements of the tube may obviously be modified to a considerable extent without departing from the invention. Various equivalent means may also be substituted for the specific preferred form disclosed in the drawing. Accordingly I desire no limitations upon my invention except as necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. An inverter system comprising a vacuum tube having a cathode and an anode therein, said cathode being thermally activated, means moving said anode across the face of said cathode, a source of direct current potential connected to said anode and cathode whereby an electron discharge occurs while said anode is passing across the face of said cathode, an output circuit electrically connected to said anode and cathode to receive the impulse current from the electron discharge.

2. An inverter system comprising a vacuum tube having a cathode and two anodes therein, said cathode being thermally activated, means moving said anodes alternately adjacent to and away from said cathode, means causing an electron discharge between the cathode and the anode adjacent thereto, a winding connected in series with said anodes and receiving pulsating current from said anodes, and an output circuit electrically connected to said winding.

DEWEY D. KNOWLES.