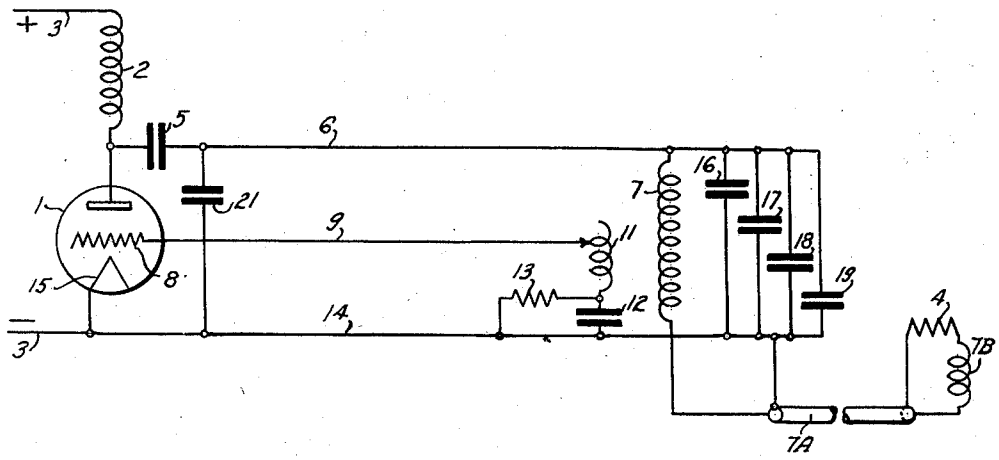
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ELECTRICAL DISCHARGE TUBE CIRCUITS

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ELECTRICAL DISCHARGE TUBE CIRCUITS

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My invention relates to circuits for electrical discharge tubes and, in particular, relates to such circuits in which anti-resonant tank circuits are to be located at substantial distances from electrical discharge tubes with which they exchange power.

In the electrical discharge tube art, it is frequently desirable to use tank or other anti-resonant circuits in power-exchanging combination with electrical discharge tubes from which these tank circuits are separated by substantial lengths of interconnecting line conductors. For example, such tank circuits may be connected in the output circuit of an oscillation generator, the whole arrangement being of very substantial size and output power. A specific instance would be an oscillation generator supplying power to an induction heating furnace of considerable capacity. The size of the circuit elements involved make it desirable that the oscillation generator shall be located at some distance from the tank circuit. There must, accordingly, be a transmission line of substantial length connecting the oscillation generator to its tank circuit. Such a line necessarily has a substantial amount of distributed inductance and capacity which causes the line wires to act in some degree like a capacitance and inductance shunted across the main terminals of the tube. Under such circumstances, parasitic currents of substantial magnitude and of frequency quite different from that of the tank circuit for the furnace may be caused to flow in the system including the oscillation generator tube. These parasitic currents represent a waste of energy and constitute an undesirable and disturbing factor in the system.

One object of my invention is, accordingly, to provide an arrangement by means of which the flow of substantial amounts of parasitic currents through the distributed inductance and capacitance of a transmission line connected to an electrical discharge tube is minimized.

Another object of my invention is to provide an arrangement in which a tank circuit may be connected to an electrical discharge tube through a transmission line of substantial length without the generation of substantial amounts of parasitic currents.

A third object of my invention is to provide an arrangement in which a tank circuit may be made to exchange energy with both an oscillation generator and a load located at a substantial distance therefrom without the generation of substantial amounts of parasitic currents.

Still another object of my invention is to in-

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crease the efficiency of operation of a system in which a tank circuit supplies a load located at a substantial distance from an electrical discharge tube with which the tank circuit exchanges power.

Other objects of my invention will become apparent upon reading the following description, taken in connection with the drawing in which the single figure is a diagrammatic illustration of an electrical discharge tube circuit embodying the principles of my invention.

Referring in detail to the drawing, an electrical discharge tube 1, which may, for example, be an electron tube having a control electrode, is connected through an inductance 2 to a direct-current source 3. The tube 1 is used to generate alternating currents which may be of a relatively high frequency to supply energy to a load 4 which may for example, be a high frequency induction electric heater. The anode of the tube 1 is connected through a capacitor 5 to one side 6 of a transmission line, to which one terminal of the load 4 is connected through an impedance 7, one side of a suitable connecting line 7A and an inductor 7B. The control electrode 8 of the tube 1 is likewise connected through a conductor 9 of the above-mentioned transmission line to an inductance 11 which is in mutually inductive relation with the impedance 7. The other terminal of the inductance 11, which may be of the variable type, is connected through a capacitor 12 shunted by a bypass resistor 13 and a third conductor 14 of the above-mentioned transmission line to the cathode 15 of the tube 1. The conductors 6 and 14 are shunted by a capacitance to form a tank circuit supplying energy to the load 4 through the other side of line 7A and the inductor 7, and said capacitance also serves as the tank circuit for the oscillation generator tube 1, the mutual inductance between the inductances 7 and 11 providing the feedback necessary to cause the tube 1 to generate oscillations in the tank circuit. Where the power and current to be supplied to the load 4 are of substantial magnitude, it may be convenient to have the capacitance made up of a plurality of capacitances 16, 17, 18, 19 connected in multiple with each other.

The arrangement so far described would be typical of the prior art in which a tank circuit comprising the inductance 7 and its associated capacitance is located closely adjacent a load, or at least at a substantial distance from the generator tube. The mutual capacitance of the lines 6, 9 and 14 may be considered to form a

shunt capacitance between them additional to the capacitance 16, 17, 18, 19, and through this additional capacitance, together with the inductance of the lines 6, 9 and 14, parasitic currents may be generated and flow through the tube 1, thereby causing substantial energy losses and other undesirable effects.

In accordance with my invention, I subdivide the total capacitance for the tank circuit above mentioned into a major portion and a minor portion, the major portion being located closely adjacent the inductance 7, and a minor portion comprising a separate capacitor 21, I connect in parallel with the remainder of the capacitance 16, 17, 18, 19, but at the end of the transmission lines 6 and 14 which is closely adjacent the generator tube 1. To take a specific example, the capacitance 21 may be one-fifth of the total capacitance to be connected into an anti-resonant circuit with the inductance 7 to produce the desired frequency of alternating current to be supplied to the load 4. In the arrangement shown in the drawing, for example, the capacitances 16, 17, 18, 19 and 21 might all be equal to each other, in which case one-fifth of the total capacitance which would resonate with the inductance 7 would be connected at the point 21 adjacent the generator tube 1.

The capacitance 21 will, in installations of any substantial size, be large compared with the mutual distributed capacitance of the lines 6, 9, 14 and will, in fact, act substantially as a short-circuit across the tube 1 for any parasitic currents which might otherwise tend to flow through the distributed capacitance and inductance of lines 6 and 14 through tube 1. In this way, the flow of such parasitic currents in the tube 1 is so minimized as to be substantially eliminated.

It would, of course, be equally possible to minimize the parasitic currents through the tube 1 due to the distributed capacitance and inductance in the transmission lines 6, 9 and 14 by positioning the capacitances 16, 17, 18 and 19 (in other words, the entire capacitance of the anti-resonant circuit) at the same end of the transmission lines 6 and 14 as the capacitance 21 is shown in the drawing. If this were done, the transmission lines 6 and 14 would have to carry the entire current of the tank circuit. On the other hand, while a portion of the tank circuit current generated and flowing through the inductance 7 passes through the capacitance 21 by way of the transmission lines 6 and 14, in the arrangement shown in the drawing herein, this is a relatively small fraction (in the example just given, one-fifth) of the total tank circuit current, so that the transmission lines 6 and 14 are not required to carry anything like the entire tank circuit current.

By transferring a minor fraction of the tank circuit capacitance from the load end of the transmission line to the generator-tube end, I have provided an arrangement in which parasitic currents are eliminated without greatly increasing the cost of the apparatus or the required current-carrying capacity of the transmission lines 6 and 14.

While I have described a specific embodiment of the principles of my invention, it will be evident to those skilled in the art that these principles are capable of broader application in many obvious ways.

I claim as my invention:

1. In combination with an electrical discharge tube and a tank circuit having elements which it is desirable to locate at a substantial distance therefrom, a transmission line having a first end connected to exchange power with said discharge tube and its other end connected to a tank circuit comprising an inductance shunted by a portion of the capacitance required to resonate with said inductance at a desired frequency, the remainder of the capacitance required to resonate with said inductance at the required frequency being positioned adjacent said first end of said transmission line.

2. In a system for supplying alternating currents to a load, a grid-controlled electrical discharge tube positioned remote from said load, a transmission line connected at its first end to said discharge tube and connected at its second end to an inductance located nearer said load and shunted by a capacitance to constitute an anti-resonant circuit, and an additional capacitance shunted across said transmission line at said first end thereof.

3. In a system for supplying alternating current of a desired frequency to a load, a grid-controlled electrical discharge tube connected to the first end of a transmission line, the other end of said transmission line being connected to an inductance, capacitance of sufficient size to resonate with said inductance at said desired frequency, a major portion of said capacitance being located in close proximity to said inductance, and a minor portion of said capacitance being located at said first end of said transmission line.

4. In a system for supplying alternating current of a desired frequency to a load, an electrical discharge tube having a control-electrode connected to the first end of a transmission line, the other end of said transmission line being connected to an inductance, a secondary winding in mutually inductive relation with said inductance and connected to supply voltage to said control-electrode, capacitance of sufficient size to resonate with said inductance at said desired frequency, a major portion of said capacitance being located in close proximity to said inductance, and a minor portion of said capacitance being located at said first end of said transmission line.

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