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MAGNETRON DISCHARGE TUBE APPARATUS

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Fig. 1

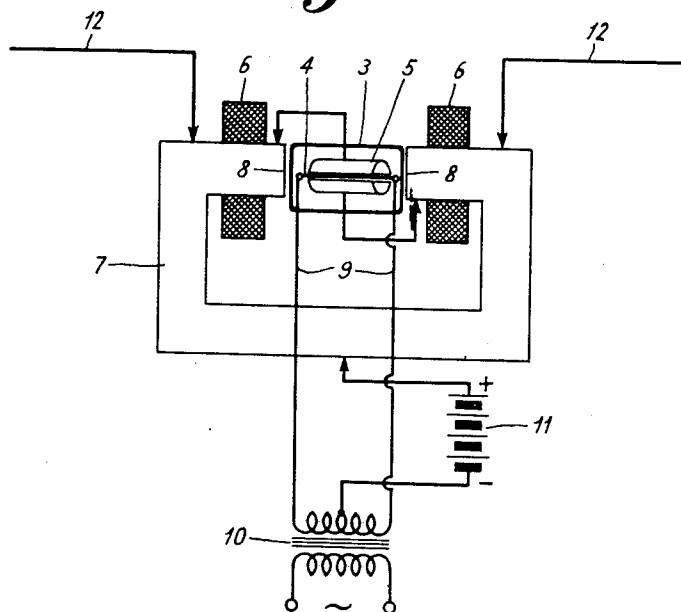
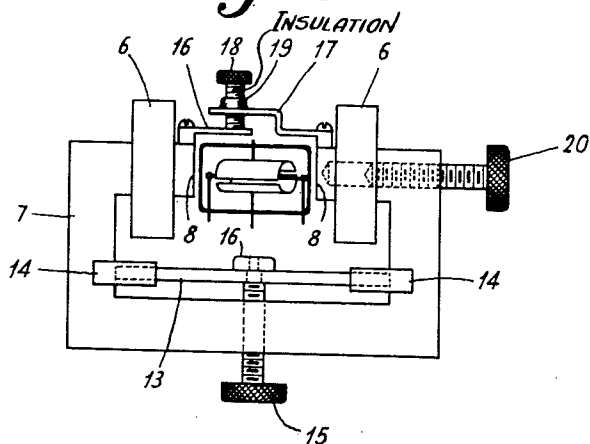


Fig. 2



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MAGNETRON DISCHARGE TUBE
APPARATUS

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10 Claims. (Cl. 250—36)

This invention relates to magnetron discharge tube apparatus and has particularly to do with arrangements calculated to improve the efficiency of such apparatus when used in an oscillatory circuit.

It is among the objects of my invention to provide the means for combining with the essential elements of a magnetron tube and its magnetic field producer, a resonant circuit connected between the cathode and the anode segments of the magnetron, such a resonant circuit being readily adjustable to a desired frequency response.

It is another object of my invention to provide apparatus of the type mentioned in which the core of the magnet for producing a magnetic field within the magnetron tube is utilized as a resonant loop or tank circuit interconnecting the anode segments of the magnetron.

Other objects of my invention will be made manifest in the following description which will be best understood upon reference to the accompanying drawing wherein:

Figure 1 shows diagrammatically certain details of structure of the apparatus which forms a preferred embodiment of my invention; and

Fig. 2 shows also diagrammatically further details of structure of the same embodiment.

It will be understood at the outset that I have shown only one preferred embodiment of my invention in the two figures of the drawing and that certain details have been omitted in each of these figures merely for the sake of clearness of delineation. In certain instances, however, it may be found feasible to dispense with some of the details without departing from the spirit and scope of my invention.

Referring first to Fig. 1, I show a magnetron discharge tube having an envelope 3 which contains the usual linear cathode 4, at least partially surrounded by a plurality of anode segments 5. The means for holding these electrodes in place have not been shown since they are well known to those skilled in the art.

In order to produce a magnetic field within the zone of electronic action bounded by the anodes 5, I preferably employ an electromagnet having windings 6 and a core structure 7 which is formed into an open loop. The opening between the pole faces 8 is sufficient for insertion therein of the discharge tube envelope 3.

Now in order to utilize the magnetic core structure simultaneously as a tank circuit tunable to the frequency of oscillations to be generated, I make connection therewith adjacent the pole faces 8 to the respective anode segments 5. In

other words one of the anode segments is connected to one of the pole pieces and the other anode segment to the other of the pole pieces. The dimensions of the magnetic core member 7 are predetermined with respect to the desired frequency of oscillation and obviously an inductive loop is provided by this structure.

In order to supply the cathode 4 with heating current I preferably connect the terminals of the cathode through the conductors 9 with the secondary winding 10 of a transformer, the primary of which may be connected to any suitable source of power. The anode current is supplied by a battery 11, the positive pole of which is connected to the core member 7, preferably at the midpoint thereof, where theoretically there should be a node of oscillations at the high frequency to be generated. The negative pole of the battery 11 is connected to a mid-tap of the secondary of the transformer 10. It will thus be seen that the battery 11 supplies a suitable difference of potential between the anodes and the cathode for producing electronic emission. This potential is also to be understood as having a suitable value in respect to the strength of the magnetic field so that self-sustained oscillations will be produced. The means for producing the magnetic field of proper intensity includes, as has been stated, the magnet coils 6, but connections thereto have not been shown since it is obvious that they may be energized from any suitable source.

In order to utilize the oscillatory energy produced by the system as shown in Fig. 2, I may, if desired, make connections between different points on the core member 7 with each of two arms respectively of a dipole antenna 12. Thus the energy generated by the oscillator may be radiated into space, if desired. On the other hand, if the apparatus is to be used for reception, then energy may be collected by the dipole antenna and utilized for controlling the oscillations in the magnetron tube 3. In this case the magnetron becomes a detector and can be used for demodulating signals in a well known manner.

Where it becomes impractical to predetermine exactly the necessary dimensions of the magnetic core structure 7, it is desirable to provide suitable adjustments for varying the resonant conditions to meet any desired requirements. The inductive characteristics of the core member 7 may, therefore, be varied by the combination with the core member of a short circuiting bridge 13 having clips 14 which engage conductively with opposite sides of the core member. The short circuiting

bar 13 may be slid along the ends of the core member by means of a thumb screw 15 which is threaded into the core member and is swiveled in a hole at the center of the bridge member 13.

5 A button 16 on the end of the thumb screw permits the bridging member to be retracted if it has been moved too far toward the pole faces. The bridge 13 is preferably of non-magnetic material.

10 It will be understood, of course, that the oscillations set up in the inductive loop, which includes the core member 7, will tend to be conducted across the shortest possible path which includes the bridging member 13. That portion

15 of the core member 7 which lies below the bridging member 13 will be automatically excluded from the resonant circuit.

In case it is desired to provide additional tuning facilities which are capacitive in their reactions, I may, if desired, mount an ultra-high frequency capacitor on the core member 7 adjacent the pole faces thereof. The capacitor as shown is constituted by a stator plate 16 and a movable plate 17. While this movable plate 17 may be

20 rigidly mounted on one end of one of the pole pieces, it can be made sufficiently flexible so that the other end can be adjusted in its space separation from the stator plate 16. One simple means for accomplishing this result is as shown

25 in Fig. 2, wherein the movable plate 17 will be understood to have a certain amount of resiliency tending to urge it toward the stator plate 16. The proper spacing between the two plates is therefore maintained by means of a thumb screw 18

30 threaded into a button 19 on the movable plate 17 and having the shank of the thumb screw pressed against the stator plate 16. The thumb screw 18, or at least the shank thereof, must, of course, be made of insulating material, such,

35 for instance, as bakelite or hard rubber.

It will be seen from the foregoing description that both the inductive and capacitive reactions in the tank circuit of my magnetron discharge tube apparatus can be varied within suitable limits for obtaining resonance at a desired ultra-

40 high frequency of the oscillations to be generated.

In place of the capacitor structure 16-17 as shown in Fig. 2, I may, if desired, adopt a more

45 conventional type of stator and rotor plates for adjusting the capacitive value of the resonant circuit. While such an arrangement has not been shown in the drawing it is clear that the stator plate or plates may be affixed to one of the pole

50 pieces 8 while the rotor plate or plates may be mounted in any suitable manner and conductively connected to the other of the pole pieces 8.

A still further adjustment in respect to the density of the magnetic field may be provided by

55 means of a thumb screw 20, the shank of which must, of course, be made of magnetic metal. When the screw 20 is turned outwardly the gap between the end of its shank and the bottom of the screw hole is increased, thereby increasing

60 the magnetic reluctance and decreasing the magnetic flux across the pole pieces 8. The proper flux density is therefore to be found empirically by adjusting the thumb screw 20 inwardly or outwardly.

70 It will be understood by those skilled in the art that many modifications of my invention may be made, and that the foregoing description, to-

gether with the diagrammatic figures of the drawing are merely illustrative of the underlying ideas on which I base my claims as follows:

I claim:

1. An oscillation generator of the magnetron type comprising a magnetron discharge tube, an energy source for producing an electron discharge across the electrodes of said tube, means for producing a magnetic field in the discharge zone and a resonant circuit tunable to the oscillation frequency of said generator, said resonant circuit including the magnetic core of said field-producing means.
2. A generator according to claim 1 and having means for adjusting both the inductive and capacitive values of said resonant circuit.
3. In a magnetron oscillation generator, a field producing device having magnetic pole pieces co-operatively disposed with respect to the electron discharge tube of said generator, and a yoke the terminals of which contact with said pole pieces respectively, said yoke being so characterized that a resonant circuit at the oscillation frequency of said generator is formed through said pole pieces and through said yoke.
4. A device in accordance with claim 3 and having a short-circuiting bridge of non-magnetic material contacting with points on said yoke which are symmetrically located with respect to the pole faces of said field-producing device.
5. A device in accordance with claim 3 and having in combination, means for variably adjusting the inductive and capacitive characteristics of said resonant circuit without disturbing the reluctance of the magnetic circuit of said field producing device and means for variably adjusting said reluctance without disturbing the reactive values of said resonant circuit.
6. Ultra-high frequency apparatus comprising an electron discharge tube having a linear cathode and a plurality of surrounding anode segments, means including a magnet having a magnetic metal core structure extending in a loop and having pole faces for exerting a magnetic force substantially longitudinally of said cathode, and means connected across said anode segments for enabling said core structure to function as a reactance tuned to the operating frequency of said apparatus.
7. Apparatus in accordance with claim 6 and having a source of energy connected between said cathode and a nodal point in said tuned reactance for impressing a positive potential upon said anode segments with respect to said cathode.
8. Apparatus in accordance with claim 6 and having an adjustably positionable short-circuiting bar interconnecting two points along said loop substantially equi-distant from the mid-point on said loop.
9. Apparatus in accordance with claim 6 and having means including capacitive members connected respectively to different ends of said core structure for adjusting the capacitive reactance across said anode segments.
10. Apparatus in accordance with claim 6 and having means including an adjusting screw of magnetic material threaded into a screw hole in said core structure for varying the reluctance of said magnet.

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