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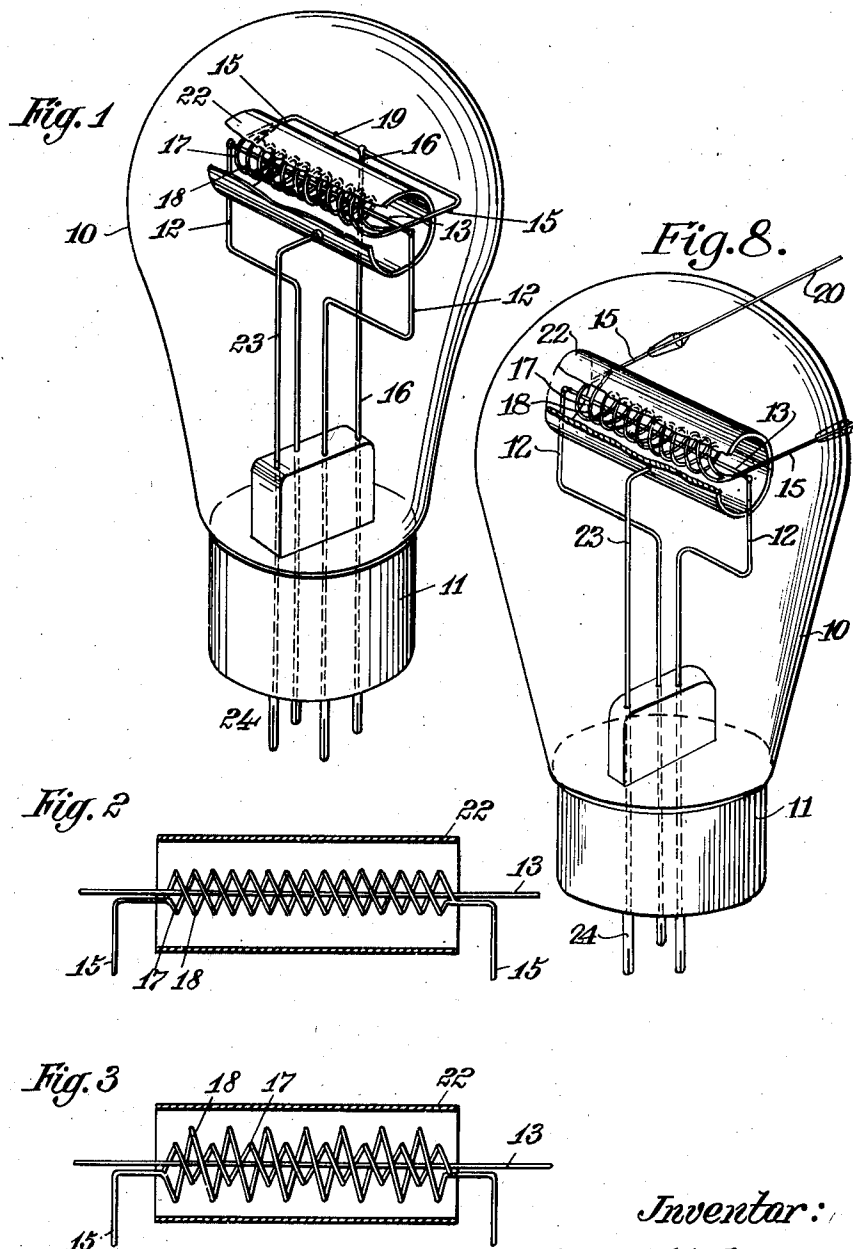
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1,991,282

ELECTRON TUBE

Filed April 6, 1932

2 Sheets-Sheet 1



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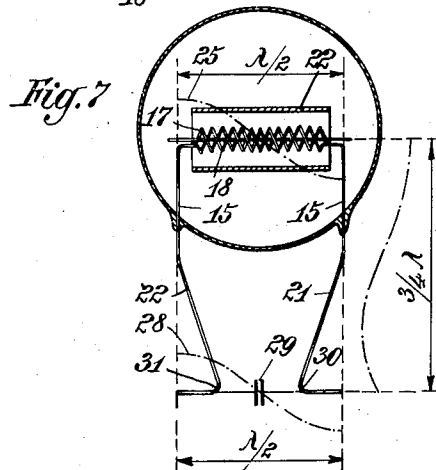
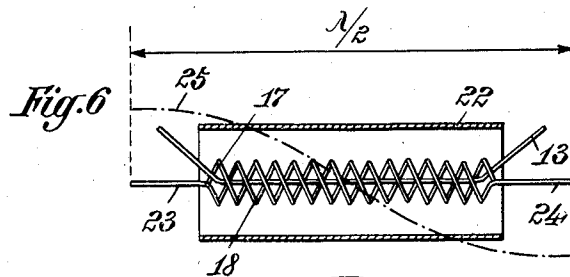
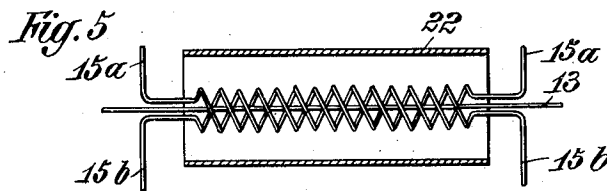
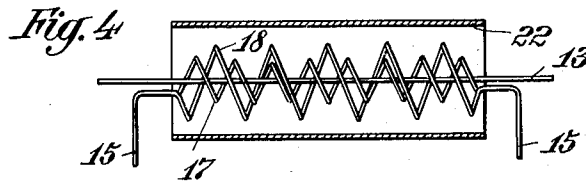
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ELECTRON TUBE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ELECTRON TUBE

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Application April 6, 1932, Serial No. 603,659
In Germany June 12, 1930

6 Claims. (Cl. 250—27.5)

The invention relates to an electron tube for generating short waves and operating on the so-called retarding or braking field circuit. For this purpose an incandescent cathode is used which is surrounded by a second electrode, a positive tension being applied to the second electrode. This second electrode may also be termed the grid electrode, but it must be borne in mind that it has nothing in common with the control grids of the ordinary electron tubes. Further, a third electrode is provided, the so-called braking electrode, which has a small voltage relatively to the grid electrode. The emission of electrons from the cathode is accelerated by the grid electrode. After passing through the grid electrode the acceleration ceases and an auxiliary deceleration or a braking of the speed of the electrons occurs due to the auxiliary electrode, the braking electrode. This third electrode can be replaced in an equivalent manner by a magnetic field. In this way the same effect is attained in principle as with the braking electrode which has a small voltage relatively to the grid electrode. The tube is connected in the oscillation circuit so as to produce oscillations as one of the natural frequencies thereof, the grid electrode acting as a self-induction in this circuit.

In particular the invention is concerned with a definite construction of the grid electrode of the tubes described above. The new grid is so constructed that it consists of a number of helically extending coils of wire which are arranged coaxially and interpenetrating. As the frequency of the waves emitted is determined substantially by the grid electrode and as it has further been found to be advantageous in order, to avoid inhomogeneities in the field, to wind the grid electrode as densely as possible, the mode of winding in accordance with the present invention affords the possibility of constructing a grid with particularly small self-induction, which is not possible in the case of simple wound helices which have hitherto been used as grid. The mode of grid winding can be used advantageously with the various oscillation aggregates with which it is possible to transmit short waves.

The grid arrangement according to the invention can be used with the same advantage for oscillation circuits of the di-pole construction, as also for oscillation circuits coupled with a Lecher system as well as in an oscillating system consisting of a grid coil the ends of which are short-circuited by a yoke. In all these oscillation systems the advantages of the smaller self-induction are operative. If an oscillation aggregate with a

short-circuited yoke is used then according to the further development of the invention it is possible to short-circuit this yoke either inside or outside the tube.

Further it falls within the ambit of the invention to use double helices of varying form, for example, in that one winding is of a smaller diameter than the other and that one of the two coils has a larger or smaller number of turns than the other. Finally it is also possible for each helix which is provided to be short-circuited separately by means of a short circuit yoke. In this way it is, for example, possible to sub-divide the emission stream so as to obtain a further modulation of the short waves. Here also each of the short circuit yokes may be short-circuited either inside or outside the tube.

It should also be noted that the grid may be subdivided into three or more individual helices instead of two. In the subsequent description, as in the drawings, only the sub-division of the grid into two helices will be discussed.

Certain embodiments of the invention are described in greater detail with reference to the accompanying drawings, in which:—

Fig. 1 shows a tube in perspective in which the braking electrode is partly cut away so that the double arrangement of the grid helices is apparent.

Fig. 2 shows the same arrangement but in schematic representation in order to make it more readily understood.

Fig. 3 shows a grid winding in which the diameter of one helix is larger than that of the other but the number of turns is the same in each.

Fig. 4 shows a modification of the mode of winding of Fig. 3 in that the number of turns is different.

Fig. 5 shows the provision of separate leads for each helix.

Fig. 6 shows the use of the grid in an oscillation aggregate in the form of a di-pole.

Fig. 7 shows the arrangement of the grid in an oscillation aggregate to which is coupled a Lecher system to the ends of which di-poles are coupled and it should be borne in mind that the particular modes of winding the coil shown in Figs. 2 to 5 could also be used in Figs. 6 and 7, and

Fig. 8 is a perspective view of the tube showing modified details.

In Figs. 2 to 6 the question as to how the ends of the grid are short-circuited has been left open.

In the perspective representation of Fig. 1 the grid arrangement is furnished with a short circuit yoke. At the same time attention must be di-

rected to the fact that in this case the retarding field is created by means of an auxiliary electrode (the braking electrode) whereas it is also possible in known manner to generate the retarding field by a suitable magnet arrangement.

10 is the glass bulb of the tube which is mounted on a base 11. The cathode 13 is carried on a supporting yoke 12 with corresponding connections passing through the base. The grid also is held in position by means of a yoke 15 by way of a corresponding supporting device 16. In accordance with the invention the grid is subdivided into two helices 17 and 18. In this embodiment the two ends of the helices are closed by the yoke 15. However the connection to the yoke 15 might not be effected by way of the wire 16 and it would also be possible, for example, for the grid yoke to be left open within the tube and omitting the connection 19 to lead the ends out to the outside by way of two wires, the connection then being provided outside the tube, as shown in Fig. 8. The braking electrode 22 can also be carried on a supporting wire 23 which can be passed through the base of the tube at 24.

In the embodiment shown the arrangement comprising the cathode, grid electrode and the braking electrode is disposed horizontally within the tube. Obviously the entire arrangement could be rotated through 90° or accommodated in other positions within the tube.

For the sake of clarity the grid helix is again shown schematically in Fig. 2 from which it can be clearly seen that the helices 17 and 18 are arranged co-axially and interpenetrating, the two helical windings having the same diameter.

A second arrangement is shown in Fig. 3 in which the helix 18 is of greater diameter than the helix 17.

In Fig. 4 the outer helix 18 has fewer turns than the inner helix 17. If desired, the arrangement may be the inverse.

In Fig. 5 the unitary connection of the two helices as shown in Figs. 1 to 4 is divided. The further connections 15a and 15b can be separately short-circuited, for example, by means of a yoke or can be connected each separately to a di-pole or coupled with a Lecher system. Corresponding to Figs. 3 and 4 the helices shown may have separate connections exactly as shown in Fig. 5. These arrangements are not shown separately in the drawings as they can be readily understood.

If the oscillation circuit of Fig. 1 which is shown with a short circuit yoke is replaced by an open oscillation aggregate according to Fig. 6 then a di-pole is obtained. For this purpose it is only necessary to continue rectilinearly the extensions 23 and 24 of the grid electrode. The length of this continuation is determined in accordance with the wave-length emitted. The total length of the oscillation aggregate is $\lambda/2$.

The line 25 indicates schematically the oscillation in the open oscillation aggregate.

In Fig. 7, the grid electrode according to the application is used in the so-called Lecher circuit. The grid connections 15 are led out through the glass bulb. The lead-through wires 21, 22 are bent at their free ends to form a di-pole. The lengths of the lead-through wires are also determined in accordance with the wave-length. In this figure also, the wave is indicated schematically by 25. From this it will be seen that there is a point of maximum amplitude (anti-node) at each end of the grid. The points of bending 30, 31 are preferably so disposed as to correspond to a node. The total length of the connected di-pole also amounts to $\lambda/2$ as indicated schematically in the figure. Preferably the wires 21, 22 approach each other towards their ends in order to prevent instability of the di-pole. Further a condenser 29 can be included in the di-pole.

What I claim is:—

1. Improvement for generating ultra-short electrical waves on the Barkhausen-Kurz principle, comprising a cathode, a braking electrode, and coaxial helical coils adapted to be applied with equal high positive voltage and connected in parallel for the ultra-short waves, said helices being connected together with each other at their ends.

2. Improvement for generating ultra-short electrical waves on the Barkhausen-Kurz principle, comprising a cathode, a braking electrode, and coaxial helical coils adapted to be applied with equal high positive voltage and connected in parallel for the ultra-short waves, said helices being connected together with each other at their ends and forming a tuning system together with the outer electrical connections.

3. Improvement for generating ultra-short electrical waves on the Barkhausen-Kurz principle, comprising a cathode, a braking electrode, and coaxial helical coils adapted to be applied with equal high positive voltage and connected in parallel for the ultra-short waves, said helices being connected together with each other at their ends and forming a tuning system together with the outer electrical connections and the helices each having the same number of turns.

4. Improvements for generating ultra-short electrical waves according to claim 3, in which the helices have the same diameters.

5. Improvements for generating ultra-short electrical waves according to claim 3, in which the helices have different diameters.

6. Improvement for generating ultra-short electrical waves on the Barkhausen-Kurz principle, comprising a cathode, a braking electrode, and coaxial helical coils adapted to be applied with equal high positive voltage and connected in parallel for the ultra-short waves.

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