Jan. 23, 1951 J. L. H. JONKER ET AL 2,538,873

ELECTRIC DISCHARGE TUBE

Filed March 11, 1946

Fig. 1.

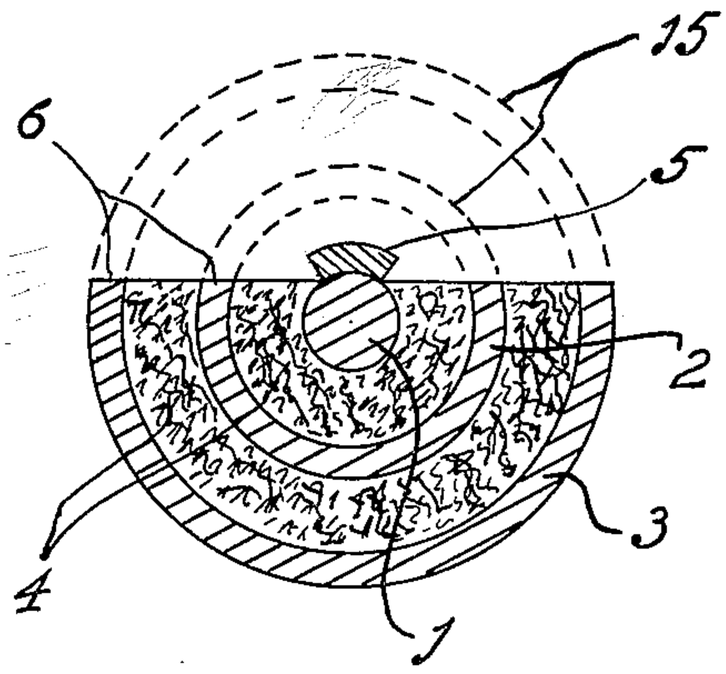
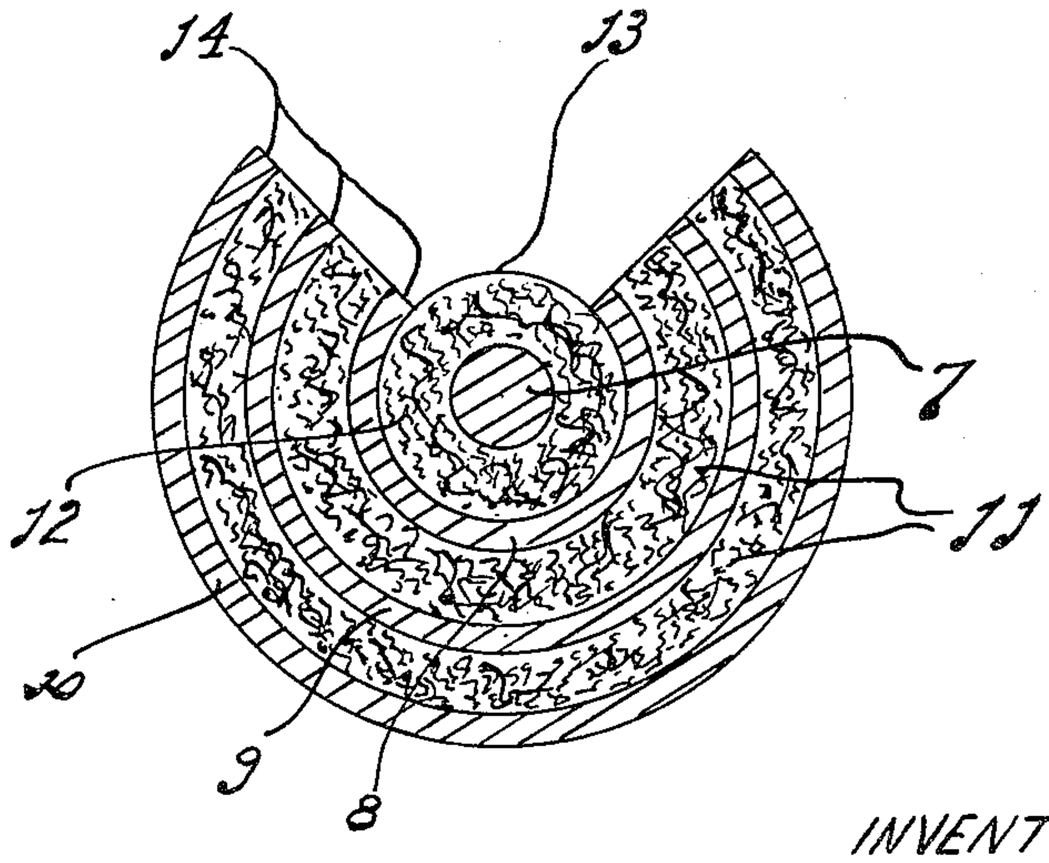


Fig. 2.



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ELECTRIC DISCHARGE TUBE

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1 Claim. (Cl. 29—25.17)

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This invention relates to an electric discharge tube and particularly to the construction of the electrode system comprising a cathode and one or more electrodes acting as grids and/or as the anode.

The electrode system of the tube according to the invention has been obtained by starting with two or more concentric conductors separated from each other by insulating material, by decreasing the dimensions of this structure by drawing, hammering or similar operations and finally by removing one or more of the conductors and the intermediate insulating material for part of the circumference. Thus, an inner conductor is ultimately caused to lie open and this conductor constitutes the cathode of the electrode system concerned, the other electrodes of the system being formed by the edges of the partly removed conductors concentrically arranged around this inner conductor. For the purpose here described the inner conductor may be coated with emitting material for at least part of its length; it is, however, also possible to constitute the pulverulent insulating material contained between this inner conductor and the next following conductor by readily emitting material, for example barium oxide, the outer conductors being removed as far as the barium oxide layer just mentioned, after the structure of conductors separated from each other by insulating material is drawn out.

The system thus obtained has very important advantages; first of all there is here the possibility of uniting any number of electrodes, such as a cathode, several grids and an anode to form a rigid aggregate, the various electrodes being arranged so as to be very closely spaced. This is, for example, important in connection with discharge tubes for short and ultra-short wave purposes. In this case the beam of electrons emerging from the cathode passes the edges of the various concentric conductors and may impinge for example on an individual anode arranged to surround the latter.

A further very important advantage of the invention resides in that the system may be formed in any shape, so that the distance between the various electrodes cannot be altered; particularly is to be borne in mind the use of this system in gasfilled tubes for example for advertisement purposes in which the cathode is arranged opposite a fluorescent electrode and a structure according to the invention, which in this case acts as a cathode and a focusing electrode, can be

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shaped in any form whatever such as letters, given figures or the like.

Whereas hereinbefore the use of a tube according to the invention containing an electrode system comprising one or more grids as a transmitting or receiving valve or as a tube for advertisement purposes was referred to, another possibility of application is to be found with Braun tubes having a line-shaped focus, it being possible to use the structure of two or more concentric conductors and it being possible for these conductors successively to form a cathode, a Wehnelt cylinder, a suppressor anode and so forth.

The materials from which the layers built up to form such an electrode system are made may be formed by various metals and insulating materials; generally speaking, it is advantageous to choose as such respectively the metals that are usually employed as electrode material such as nickel, tungsten, molybdenum or the like and inorganic insulating substances as intermediate layers such as magnesia, alumina, beryllia, zirconium oxide or the like, use being made in the above-mentioned case, for at least one layer, of barium oxide which also constitutes the emitting substance.

The layers may be removed in various ways; preferably, however, this is effected by mechanical means, for example by grinding since this permits of the correct dimensions being adhered to for the system to be made. These dimensions may be very small; it is possible to obtain an electrode system in which the structure of cathode and grids constitutes a solid aggregate and the distances between the various electrodes are of the order of magnitude of 0.1 mm.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawing, in which two forms of construction of the electrode system of a discharge tube according to the invention are shown and with reference to a possibility of construction for the manufacture of such a system. Fig. 1 and Fig. 2 show two modifications of the electrode system.

Referring to Figure 1, 1 designates an inner conductor surrounded by conductors 2 and 3. The space between the various conductors is provided with insulating material 4, for example magnesia or alumina. The various conductors are arranged concentrically and are removed for part of the circumference so that the inner conductor 1 is caused to lie open. At that open part this conductor is coated with emitting ma-

terial 5 and acts as the cathode. In this case, the conductors 2 and 3 form, at the edges 6, the grids of this system. The electrode system is enclosed in an envelope 20. In the system shown in Figure 2 an inner conductor is surrounded by three conductors 8, 9, 10. The intermediate spaces 11 between the conductors 8 and 9 and between 9 and 10 are provided with insulating material, for example magnesia or alumina, a readily emitting substance, for example barium oxide, being provided between 7 and 8, and hence in the space 12, and acting as the cathode on that side (13) where the outer conductors and the intermediate insulating material are removed. The electrode system is enclosed in an envelope 20. In this case the edges 14 of the various tubular conductors arranged to surround the inner conductor form the auxiliary electrodes which may influence the beam issuing from the cathode.

The structure of electrodes of the kind here described may be made in the following manner: internally of a tube made for example of nickel and whose length is 1 m., its diameter being 12 mms. and its wall thickness 1 mm., is arranged another equally long tube which has a diameter of 6 mms. and a wall thickness of 0.5 mm. and which has arranged inside it a wire which is also made of nickel and whose thickness is 2 mms. The intermediate spaces between the various conductors are provided with magnesia, this operation being preferably effected in vacuo and the said filling being rigidly compressed or shuffled. This aggregate is then hammered until an appreciable increase in length is obtained and then drawn until the desired dimensions are reached; these dimensions may be for example a length of 100 m., an external diameter of 1.0 mm., a wire thickness of the inner conductor of 0.2 mm., a wall thickness of the outer conductor of 0.1 mm. and a distance between the various conductors of 0.125 mm. The outer conductors and the intermediate insulating material are then removed for part of the circumference, it being possible to effect this operation for example by grinding. The part of the inner conductor which is thus caused to lie open is coated with emitting material and the aggregate thus obtained is to be used as an electrode system. In this case, a wire coated with emitting material constitutes a directly heated cathode. As an alternative, however, the outer conductors may be removed as far as the inner conductor but one

and then the first conductor that is concentric with the inner conductor may therefore be coated with emitting material. Thus, an indirectly heated cathode is formed. Finally, in order to avoid interference from the magnetic field, the combination of the two inner conductors may be used as a heating element, the current being supplied through one of the conductors and being discharged through the other. In this case the next following conductor towards the outside forms the cathode body.

For the purpose of strengthening the ground conductors the latter may, if desired, not be removed throughout the entire length so that small bridges of the outer conductor are left, as is schematically denoted in the figure by 15. It is also important that the filling of the intermediate spaces should be constituted by an insulating powder capable of being sintered, for example a mixture of silica, alumina and magnesia.

What we claim is:

The method of making an electrode structure to be enclosed in the envelope of an electric discharge tube comprising the steps of arranging a central conductor and a second conductor around said central conductor in spaced substantially concentric relationship, filling the space between said spaced conductors with a pulverulent insulating material to form a body, pressing the body to reduce the transverse dimensions thereof, removing a sector-shaped portion of the reduced body to expose a part of the central conductor, and thereafter coating a portion of the exposed central conductor with electron emissive material.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,618,499	White	Feb. 22, 1927
1,700,454	Schumacher	Jan. 29, 1929
1,719,988	Myers	July 9, 1929
2,107,945	Hull et al.	Feb. 8, 1938
2,175,345	Gaidies et al.	Oct. 10, 1939
2,199,879	Deroche	May 7, 1940
2,389,060	Kurtz	Nov. 13, 1945