Aug. 20, 1935. J. G. W. MULDER 2,011,981

ELECTRIC DISCHARGE TUBE

Filed July 7, 1931

Fig. 1.

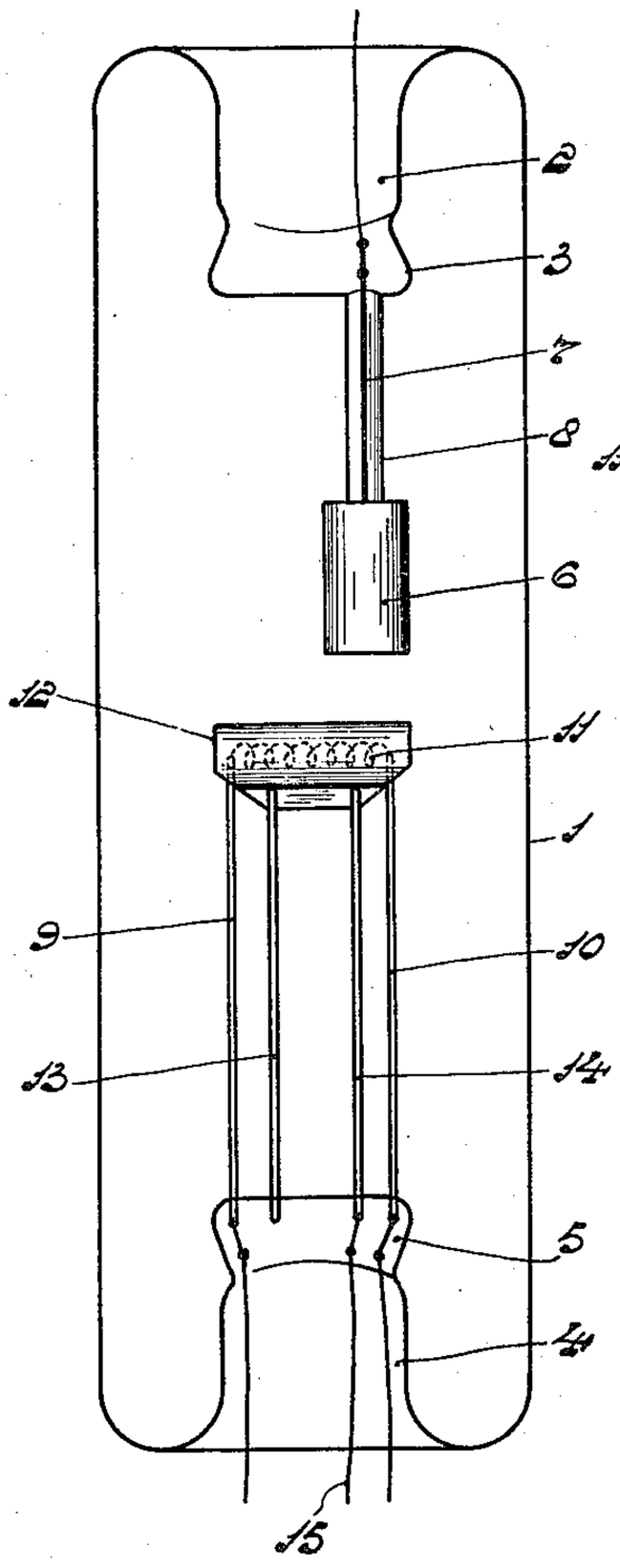


Fig. 2.

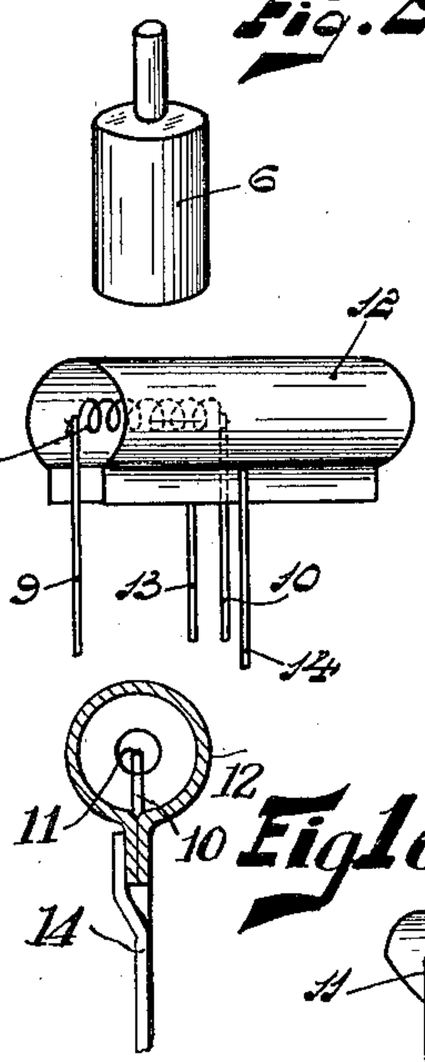


Fig. 3.

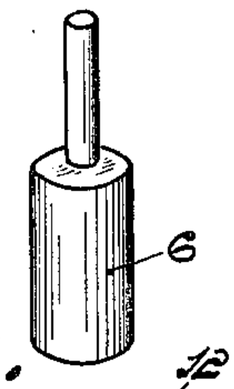
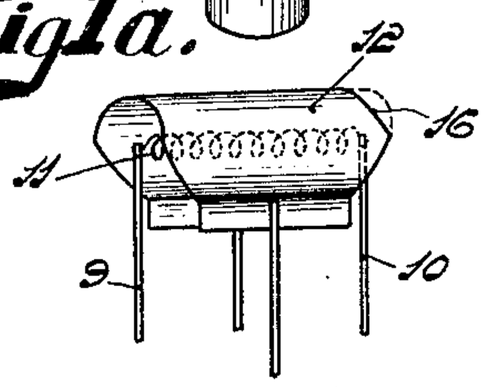


Fig. 1a.



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Patented Aug. 20, 1935 2,011,981

UNITED STATES PATENT OFFICE

2,011,981

ELECTRIC DISCHARGE TUBE

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Application July 7, 1931, Serial No. 549,277
In the Netherlands July 9, 1930

12 Claims. (Cl. 250—27.5)

This invention relates to electric discharge tubes and more particularly to a rectifying tube in which one or more shields are provided between the cathode and one or more anodes, the hollow side of said shields being turned towards the cathode.

Notwithstanding the presence of shields in discharge tubes of this type in which the shield often entirely surrounds the cathode like a sleeve, which is apertured only at ends turned away from the anode, there occurs sometimes a discharge in the wrong direction between the anode and cathode, which is probably not due to phenomena occurring outside the tube.

According to the invention this drawback is avoided by positioning each anode and the corresponding shield or shields in such a manner with respect to each other and to the cathode that the distance traversed by the electrons passing from the cathode around the shield to the anode varies at different points of the shield in such a sense that one definite path is shorter than the other paths.

In a suitable form of construction of a discharge tube according to the invention, the shield is mounted symmetrically relative to the cathode, while the anode is mounted asymmetrically with respect to the shield. Good results may be also obtained if the anode is placed symmetrically relative to the cathode, whereas the shield is mounted asymmetrically with respect to the cathode.

If the shield longitudinally surrounds the cathode like a sleeve which is either closed or which has only a slit in a portion turned away from the anode, according to the invention, the anode is preferably so disposed with respect to the cathode, that its axis falls outside of the plane which is perpendicular to the cathode and passes through the centre thereof, said axis however being parallel to said plane. A similar result is obtained if one end of the sleeve extends further beyond its incandescent cathode than the other end.

The desired asymmetry may also be obtained by shaping either the anode or the shield themselves.

Furthermore, in order to obtain or to improve the asymmetry, it is advantageous to use one or more additional shields, by which the anode is screened with respect to part of the cathode or with respect to the shield surrounding the cathode.

The invention will be more clearly understood by reference to the accompanying drawing, representing, by way of example, some embodiments thereof.

Fig. 1 shows an electric discharge tube in which the anode is mounted asymmetrically.

Fig. 1—*a* is a sectional side view of the cathode portion of Figure 1.

In Fig. 2 a shield is positioned asymmetrically.

In Fig. 3 the shield itself is shaped asymmetrically.

In Fig. 1 the discharge tube is denoted by 1. One end of this tube is provided with a stem 2 having a pinch 3, and the other end comprises a stem 4 having a pinch 5. An anode 6 consisting, for example, of graphite or metal, is mounted on the pinch 3. The terminal wire 7 is surrounded by an envelope 8 which permits of avoiding disintegration of said wire. This envelope is constituted, for example, by a tube made of steatite, one end of which is sealed to the glass of the pinch 3, whereas the other end is attached to the back wall of the anode by means of a baked fireproof ceramic material. It is also possible to form the whole coating of ceramic material which is baked on the pole wire. The incandescent cathode 11 is mounted on the pinch 5 of the stem 4 by means of the wires 9 and 10 which serve at the same time as supply conductors. This cathode may be constituted, for example, by a core wire, on which a material, for example barium oxide is provided in a suitable manner, said oxide material emitting electrons at a low temperature. If desired, the filament itself may be so prepared, for example by being allowed at the surface with metals emitting electrons at a low temperature, that the emission of the filament is sufficient without the provision of a separate oxide layer. Though the drawing shows a directly heated cathode, the invention may be likewise applied when using an indirectly heated cathode.

The cathode is surrounded by a sleeve 12 which is made, for example, of metal such as molybdenum and which is secured at the bottom to the supporting wires 13 and 14. As shown in Fig. 1—*a* the sleeve 12 has a closed cross section. One of these supporting wires is connected to a wire 15 which is sealed into the pinch and leads out of the tube and by means of which a definite potential may be applied to the sleeve. The sleeve may be used, for example as an ignition device by producing a separate discharge between the sleeve and the incandescent cathode, or by connecting the sleeve to the main anode 6 across a resistance or a condenser. It is known that such a sleeve permits close spacing of the anode and the cathode relative to each other, if the

discharge tube serves to rectify a relatively high tension and without the risk of a back discharge. It has been found, however, that in some rare cases such discharges may yet occur. This drawback may be entirely avoided, when the anode is not positioned centrally above the sleeve, but is disposed outside of such central position. In this case the path of the electrons passing from one open end of the shield to the anode is consequently materially shorter than that of the electrons passing from the other end. The same result is obtained in Fig. 2 in which one end of the shield extends further beyond the cathode 11 than does the other end. In the drawing corresponding parts are given the same numerals.

Fig. 3 shows a form of construction in which the screen 12 has substantially the same shape as that shown in Fig. 1 but at the bottom end a slit of considerable width is provided. The asymmetry or in other words the shorter path for the electrons passing from one end of the shield to the anode as compared with the path of the electrons passing from the other end is obtained by removing a part of the shield at 16 so that the path to the anode is shortened at this point.

Though the forms of constructions illustrated relate to discharge tubes having only one anode it will be obvious, that these forms of construction are also possible if a plurality of anodes is provided.

Furthermore various other modifications are possible, for example, different shapes of the anode or of the shield 12, without departing from the principle of the invention. Finally the shields used for increasing the asymmetry referred to in the preamble of the description may be given various different constructions.

What I claim is:

1. An electric discharge device comprising an envelope, an anode, an elongated cathode and a cylindrical shield around said cathode, said shield intercepting the discharge path between the cathode and the anode with an imperforate portion which, regarded from the side of the anode, extends over an arc in excess of 120° on each side of that line which represents the shortest distance between the anode and the cathode, said shield being open at its two ends to provide around said open ends two definite discharge paths between the cathode and the anode, one of which is considerably shorter than the other.

2. An electric discharge device comprising an envelope, an anode, an elongated cathode and a cylindrical shield around said cathode, said shield intercepting the discharge path between the cathode and the anode and having an imperforate portion which extends in the direction opposite to the anode considerably beyond a plane which passes through the axis of the cathode and which plane is substantially perpendicular to the discharge path, said shield being open at its two ends to provide two definite discharge paths between the cathode and the anode, one of which is considerably shorter than the other.

3. An electric rectifier tube comprising a container, electrodes therein, including an anode and an incandescible cathode, and an open-ended and closed cross-section shield disposed between the anode and the cathode, said shield preventing discharge between said anode and the cathode except at its two open ends, the discharge path between the cathode and the anode being greater around one end of the shield than around its other end.

4. An electric discharge device comprising a container, an elongated incandescible cathode, and an anode disposed perpendicularly to the axis of said cathode, an elongated sleeve having a closed cross-section interposed between said cathode and said anode and extending substantially to the full length of said cathode and being open at its two ends, said anode, cathode and sleeve being in an asymmetrical arrangement relative to each other and providing for a longer discharge path between the cathode and the anode at one end of the sleeve than at the other end.

5. An electric discharge device comprising a container, electrodes therein including an elongated anode and an incandescible cathode, and a sleeve surrounding the cathode and being placed symmetrically with respect to the cathode, the axis of said anode being outside that plane which is perpendicular to the axis of the cathode and which passes through the middle of the cathode, said anode-axis being parallel to said plane.

6. An electric rectifier device comprising a container, electrodes therein including an elongated anode and an incandescible cathode and a cylindrical sleeve surrounding the cathode and being placed symmetrically with respect to the cathode, the axis of said anode lying outside of that plane which is perpendicular to the axis of the cathode and which plane passes through the middle of the cathode, said sleeve having an imperforate portion which viewed from the anode extends over an arc in excess of 120° on each side of the unintercepted discharge path between the anode and the cathode.

7. An electric discharge device comprising a container, electrodes therein including an anode and an elongated cathode, and a shield mounted between the anode and the cathode and extending along the full length of the cathode, said shield having a curved surface turned towards the cathode, the axis of the anode substantially passing through the center of the cathode, said shield being mounted asymmetrically with respect to said axis, and providing a single definite discharge path.

8. An electric rectifier tube comprising a container, electrodes therein including an anode and a cathode, and a cylindrical imperforate shield provided between the anode and the cathode, said shield having a curved surface turned towards the cathode and being mounted asymmetrically relative to the cathode, the anode being placed symmetrically with respect to the cathode.

9. An electric discharge device comprising a container, electrodes therein including an anode and a cathode, and a shield provided between the anode and the cathode, said shield having a curved surface turned towards the cathode and having a completely closed cross section, and being mounted asymmetrically with respect to the cathode.

10. An electric discharge device comprising a container, electrodes therein including an anode and an incandescible cathode, and a shield provided between the anode and the cathode, said shield having a curved surface turned towards the cathode and being mounted asymmetrically with respect to both electrodes, to define a single discharge path.

11. An electric discharge device comprising a container, electrodes therein including an anode and an incandescible cathode, and a sleeve surrounding the cathode, said sleeve being imperforate except at its portion farthest away from the anode, one end of the sleeve extending far-

ther beyond the cathode than the other end, the anode being placed symmetrically relative to the cathode.

12. An electric discharge device comprising an envelope, an anode, a cathode and an imperforate screening sleeve having a substantially closed cross-section and being interposed between the anode and the cathode, and disposed around said cathode, said shield being open at its two ends, and at one end being shortened to provide two discharge paths between the cathode and the anode around said open ends, the discharge path around the shortened end being shorter than the discharge path around the other end.

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