Dec. 16, 1930. F. MEYER ET AL 1,784,877

GAS FILLED DISCHARGE DEVICE

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Fig. 1.

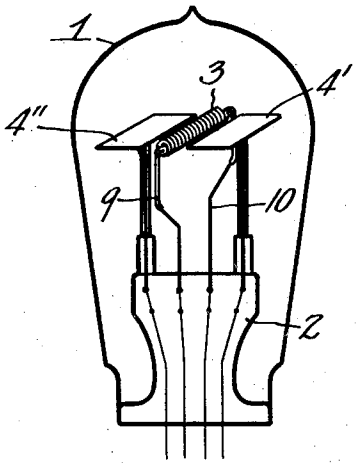


Fig. 1a.

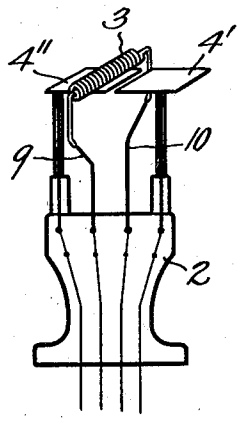


Fig. 2.

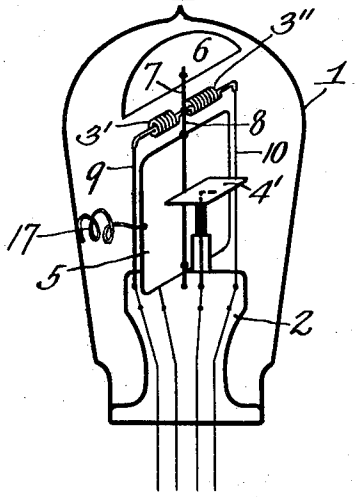


Fig. 2a.

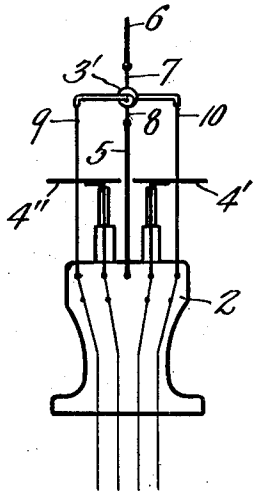


Fig. 2b.

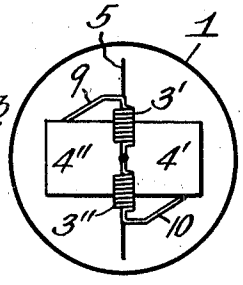


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Fig. 3.

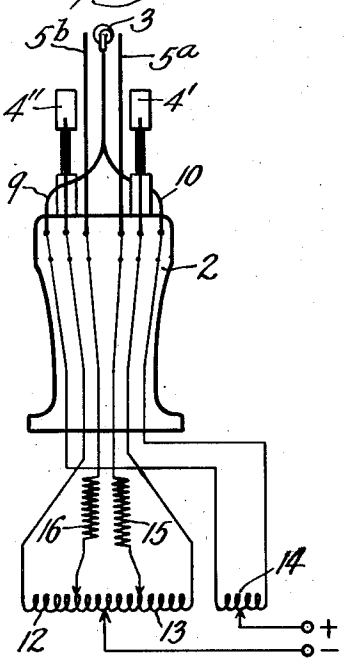



Fig. 4.

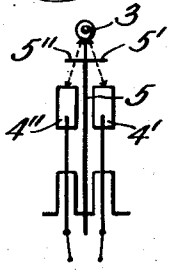



Fig. 5

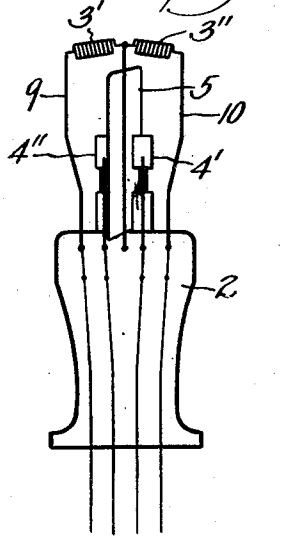
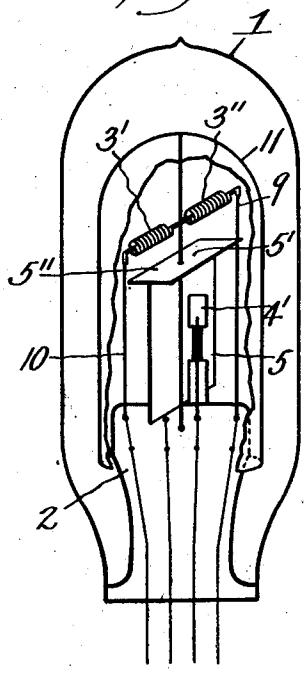



Fig. 6.

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1,784,877

# UNITED STATES PATENT OFFICE

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## GAS-FILLED DISCHARGE DEVICE

Application filed August 19, 1927, Serial No. 214,192, and in Germany for a part August 20, 1926, and for a part October 15, 1926, and for another part November 15, 1926.

The invention relates to a rectifier comprising an incandescent cathode and a gaseous filling, more particularly to a rectifier designed for differences of potential with which a discharge in inverse direction between electrodes is to be feared.

Figure 1 shows in perspective one embodiment of our full wave rectifier in which the cathode is between the anodes.

Figure 1*a* illustrates a modification of Figure 1, in which the cathode is above the anodes.

Figure 2 illustrates in perspective our full wave rectifier in which a shield is interposed between the anodes.

Figure 2*a* is an elevation in part of the tube of Figure 2.

Figure 2*b* is a cross sectional view of Figure 2*a*.

Figure 3 is a modification of the arrangement in Figure 2 in which a potential is applied to the screens.

Figure 4 is a fragmentary showing of a full wave rectifier in which provision is made for screening for higher voltages.

Figure 5 illustrates a full wave rectifier in which a separate cathode is provided for each anode.

Figure 6 illustrates a rectifier tube in which provision is made for a screen surrounding the electrode independent of the tube wall.

The figures herein shown are for the purpose of illustrating our invention. Accordingly, the claims, although broadly covering the constructions shown, are not limited to the specific construction thereof, these constructions being the subject matter of other applications.

The figures of the accompanying drawings, in which like reference characters indicate corresponding parts thereof insofar as possible, and particularly Figs. 1 to 6, indicate various modifications of our invention.

According to the invention, as shown in the accompanying drawings, rectifiers with an incandescent cathode and a gaseous filling are characterized by screens or barriers 5, 5*a*, 5*b*, 5*c* and 6 of conducting or insulating material or any other anode isolating medium arranged between the cold electrodes or anodes 4′, 4″ and 4*a*. These screens may be arranged close to and between the anodes while the cathode 3 may be arranged between or, in the case of not too high differences of potential, beside the edges of the screens as shown in Figs. 1 and 3.

A very good arrangement is obtained when the screens 5, 5*a*, 5*b*, 5*c* and 6 divide the preferably cylindrical vessel 1 of the rectifier in as many chambers as there are anodes as shown in Figs. 2, 2*a*, 3, 5, and 6. This separation into a plurality of discharge chambers need not be complete because narrow interspaces between the wall of the tube and the screens as shown in Fig. 2 will not occur at the usual operating potentials of such tubes. The cathode should preferably be mounted in the free space above the screens as shown in Figs. 2, 2*a*, 2*b*, 5, and 6. In the case of a tube to be used at relatively low differences of potential the parts should be arranged in such a fashion that a straight line can be drawn from each of the anodes 4′, 4″ and 4*a* to the cathode 3, 3′, 3″ without cutting a screen as shown in Figs. 2, 2*a*, 5 and in the case of a tube to be used at higher differences of potential, the parts should be arranged in such a fashion that a straight line drawn from each of the anodes to the cathode cuts a screen as shown in Figs. 3, 4 and 6,

Parts of the wall 1 of the tube should preferably also serve as screens. With rectifiers designed for high differences of potential and currents it is not advisable to use the wall of the tube as a screen. In that case the anodes are protected relatively to one another and to the cathode by the structures of the anodes themselves which preferably are flat. In this case the cathode may be arranged be-

tween the anodes as shown in Fig. 1 or above the anodes as shown in Fig. 1*a*.

In many cases the pressure of the gas should be so chosen as to be low, in some cases so low that the distance between the anodes and the screens is comparable to the mean length of the free path of the electrons within the gas filling. Under these conditions screens 5*a*, 5*b*, the potentials of which are not controlled are charged very rapidly so that even with potential differences of several hundreds of volts between the anodes and cathodes, no discharge in inverse direction is initiated. When not too high potential differences are used, it is possible to utilize insulated thin metal plates or mirrored non-conducting plates between the anodes as screens. This may be done in the mass production of small rectifiers when use is made of getters. Rectifiers according to this invention afford the advantage that disintegration of the cold electrodes due to an ion bombardment can be avoided. In this respect better results can be obtained when one or more of the screens, instead of being insulatingly arranged, are conductively connected to the cathode as shown in Figs. 1 to 3 and 4 to 6. Throughout the various modifications the screens preferably are arranged at a distance from the anodes which is comparable to the mean length of the free path of the electrons within the gas filling. Constructed as herein disclosed, rectifiers possess the property that due to the neutralization of the static fields there is no tendency to the production of internal oscillations, owing to which these rectifiers are especially suited for the generation of smoothed direct currents free from any ripple.

The cathode should preferably consist of several parts 3′, 3″ as shown in Figs. 2, 2*a*, 2*b*, 5, and 6 which are connected in series or in parallel and each of which cooperates with an anode, the various discharges thus produced being limited to spaces separated by screens.

In addition to screens such as described, a rectifier according to the invention may also comprise conducting auxiliary electrodes which do not serve as screens. These electrodes may be connected to the cathode and serve to neutralize the static fields between the electrodes and/or to counteract the influence exerted by these fields on the discharge.

In many cases it is not advisable to insulate the screens or the auxiliary electrodes or to connect them to the cathode but to impress on them a determined auxiliary potential as shown in Fig. 3 owing to which potential the positive ions are deviated from their normal paths in such a manner that disintegration of the cold electrodes is avoided. In some cases the screens or the auxiliary electrode, for example screen 11 of Fig. 6, should preferably surround, entirely or partly, the electrodes of the rectifier.

Disintegration of the electrodes not only occurs with high-tension rectifiers but also with low-tension rectifiers for heavy currents in which, due to the ion current the electrodes are excessively heated. In order to avoid a useless heating of the electrodes and to increase the efficiency, it is therefore advisable to take the measures above described also in the case of low-tension rectifiers.

What we claim is:

1. An electric discharge tube containing a gas, a plurality of anodes, a barrier interposed between said anodes, said barrier being spaced a distance from said anodes comparable to the mean free distance of said gas and a solid thermionic cathode interposed between said anodes.

2. An electric discharge tube containing a plurality of anodes, a barrier extending between said anodes the surface of which barrier extends beyond all edges of said anodes for substantially, completely electrically isolating said anodes from each other and a solid thermionic cathode between said anodes and forming with each of said anodes an unobstructed straight line electron path.

3. An electric discharge tube comprising a plurality of anodes, a barrier extending between said anodes and having a lead-in wire, a cathode between said anodes and forming with each of said anodes an unobstructed straight line electron path and a conductive coating on the inner surface of said tube adjacent to said electron path and conductive means connecting said barrier with said coating for controlling the electrical charges on said coating.

4. An electric discharge tube comprising a purality of anodes, a solid thermionic cathode between said anodes, a barrier extending between said anodes, the surface of which barrier extends beyond all edges of said anodes for substantially, completely, electrically, isolating said anodes from each other, and a conductor within said tube connecting said barrier to said cathode.

5. A space discharge device comprising the combination of an envelope, a gas filling within said envelope, a member dividing said envelope into a plurality of compartments, an anode within each of said compartments and spaced from said dividing member a distance comparable to the mean free path distance of said gas and an electron emissive incandescible cathode within said gas filling in the free space opposite said dividing member so that a straight line can be drawn from each of the anodes to the cathode without cutting a screen.

6. A space discharge device comprising the combination of an envelope, a gas filling within said envelope, a conductive member dividing said envelope into a plurality of

compartments, an anode within each of said compartments and spaced from said dividing member a distance comparable to the mean free path distance of said gas and an electron emitting solid thermionic cathode within said gas filling and exposed to each compartment.

7. An electric discharge tube containing a gas, an electron emitting cathode, a cooperating anode in an unobstructed straight line relation with said cathode to provide a positive ionizing gas path therebetween and a conductive element spaced from said anode a distance comparable to the mean free path of the gas and a conductor connecting said element to the cathode whereby said element permits ionization in the discharge path only in the direction of cathode to anode.

8. An electric discharge tube comprising a plurality of anodes, a screen interposed between said anodes, a cathode within said tube and exposed to each of said anodes and conductive auxiliary electrodes connected to the cathode for neutralizing the static field between the anodes and counteracting the influence exerted by these fields on the discharge.

9. An electric discharge tube containing a gas, a plurality of anodes, a barrier extending between said anodes spaced therefrom a distance comparable to the mean free path of the gas, a solid thermionic cathode in the free space above the screen and a conductor connecting said barrier to said cathode.

10. An electric discharge tube containing a gas, a plurality of anodes, a barrier interposed between said anodes, said barrier being spaced a distance from said anodes comparable to the mean free distance of said gas, lead in means to said barrier for charging it to a predetermined potential and a solid thermionic cathode interposed between said anodes.

11. An electric discharge tube containing a gas, a plurality of anodes, a barrier interposed between said anodes, said barrier being spaced a distance from said anodes comparable to the mean free path distance of said gas and a solid electron-emitting cathode having a plurality of sections, each section being principally juxtaposed with an individual anode.

12. An electric discharge tube containing a plurality of anodes, a barrier extending between said anodes, the surface of which barrier extends beyond all edges of said anodes for substantially completely electrically isolating said anodes from each other, and a solid thermionic cathode having a plurality of sections, each section being individual to one of said anodes.

13. An electric discharge tube containing a gas, a plurality of anodes, a plurality of barriers interposed between said anodes, each of said barriers being associated with an individual anode and spaced therefrom a distance comparable to the mean free distance of said gas and a solid thermionic cathode interposed between said anodes.

In testimony whereof we affix our signatures, at the city of Berlin, and at Stockholm, Sweden.

DR. FRIEDRICH MEYER.
DR. HANS JOACHIM SPANNER.

## CERTIFICATE OF CORRECTION.

Patent No. 1,784,877. Granted December 16, 1930, to

FRIEDRICH MEYER ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 95, claim 3, before the word "barrier" insert the word conductive; same page, line 106, claim 4, for the misspelled word "purality" read plurality; and that the said Letters Patent should be read with these corrections that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of January, A. D. 1931.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)