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GAS FILLED DISCHARGE TUBE

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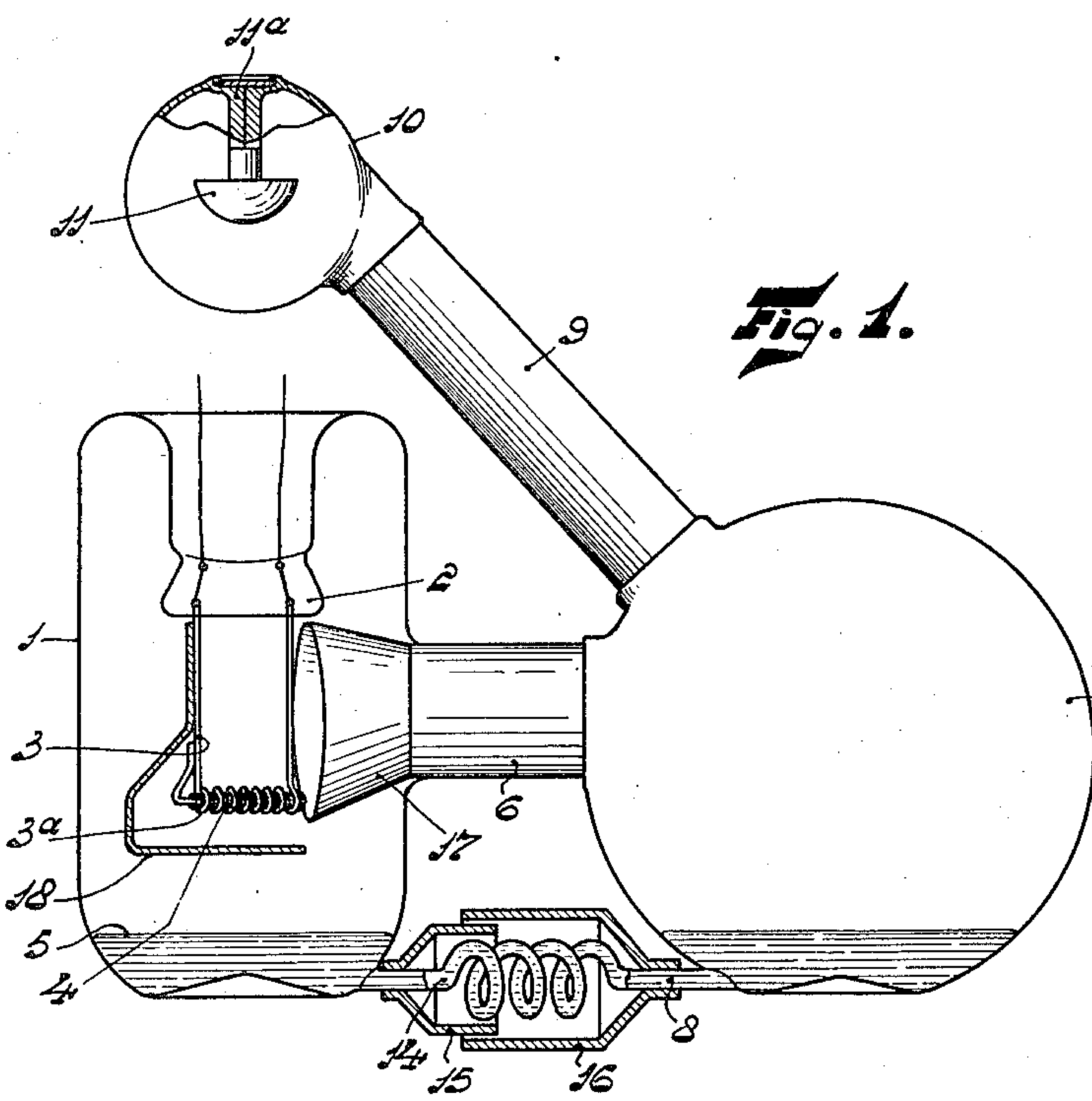

Fig. 1.

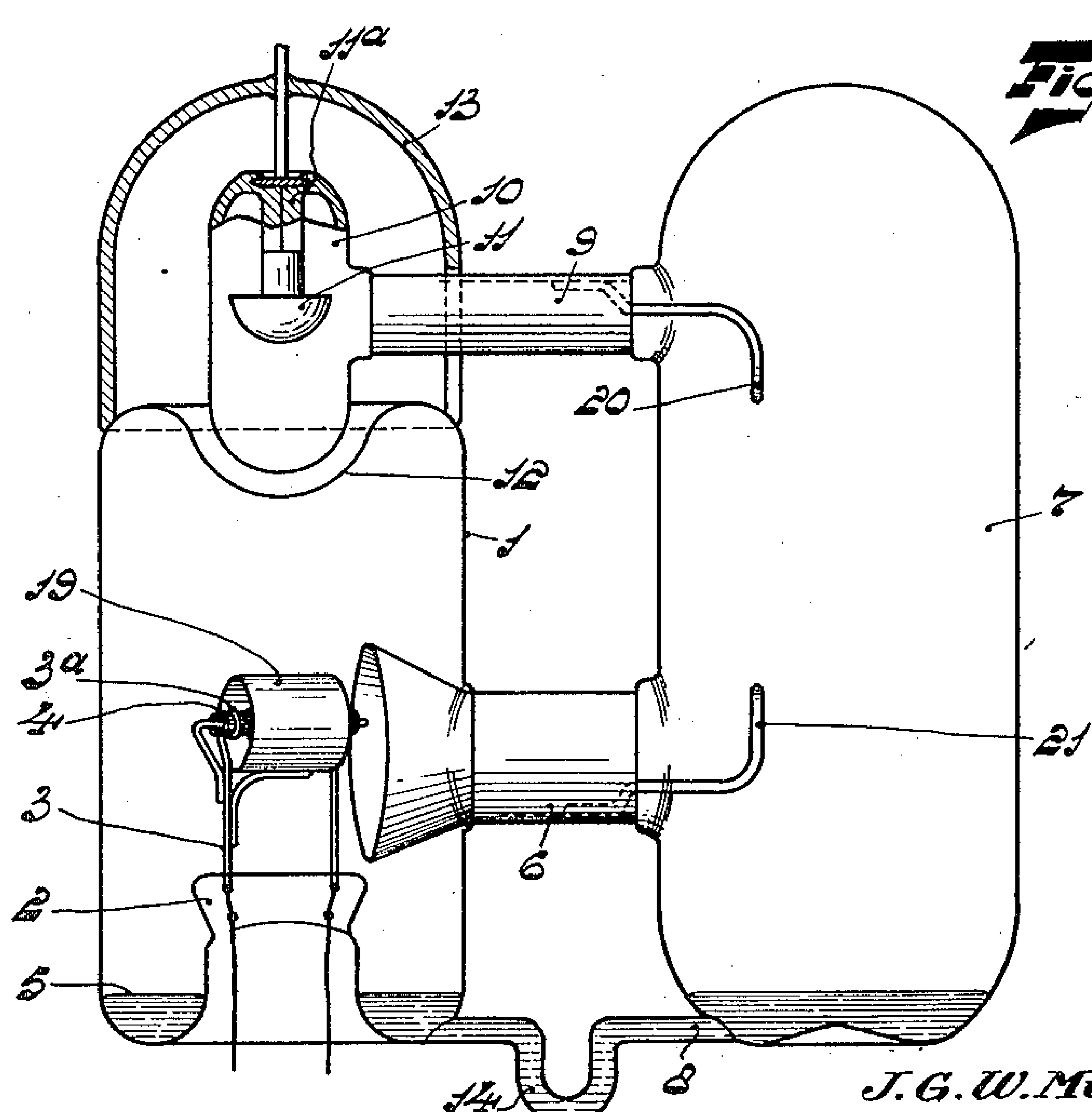

Fig. 2.

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GAS FILLED DISCHARGE TUBE

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6 Claims. (Cl. 250—27.5)

This invention relates to an electric discharge tube comprising one or at least more anodes and an incandescent cathode, preferably an oxide cathode. The filling of the discharge tube consists entirely or partly of a vapour, for example, mercury vapour; or it may consist of a mixture of vapours, the discharge produced between anode and cathode passing through one or more condensation spaces for the vapour.

Such tubes have the great advantage that very high tensions, for example, of several ten thousands volts, may be rectified, while the losses occurring in the tube are very small since the space charge is neutralized by the vapour filling. Moreover, the incandescent cathode has a sufficient life since the vapour pressure in the cathode chamber is kept high, whereas despite this there is no risk of back discharges since the vapour condenses in the condensation space between the anode and cathode, so that the pressure in the anode chamber is very low and prevents the production of back discharges.

It has been found that in such a tube the drawback may be encountered under certain conditions that mercury vapour condenses in the anode chamber when the tube is placed out of service. When the tube is again placed in service, initially only a low tension may be applied, since the vapour pressure in the anode chamber is too high to permit the application of the full tension.

This drawback is more particularly encountered when the tube is switched off for a short period, in which case the incandescent cathode usually remains switched on.

In this case the temperature in the anode chamber falls to such an extent that vapours condense in this chamber.

The present invention avoids this drawback.

According to the invention the anode chamber is provided for this purpose with a heating device. In most cases it will be sufficient to arrange the anode chamber directly above the cathode chamber, the condensation space being preferably arranged beside these chambers.

If the operating current of the tube is switched off but the incandescent cathode remains heated, the heat ascending from the cathode chamber heats the anode chamber, so that the condensation space remains the coldest part of the tube and all mercury condenses therein.

In order to improve such heating of the anode chamber, this chamber may be partly sunk into the cathode chamber. A cap consisting, for example, of glass, is preferably arranged above the anode chamber, said cap retaining the ascending hot air around the anode chamber and moreover limiting the heat radiation.

The anode chamber may also be surrounded by a heat insulating envelope. This envelope may consist, for example, of asbestos. It is also possible to provide the anode chamber with a double wall and to exhaust the space formed between the two walls.

In this case it is not necessary to arrange the anode chamber above the cathode chamber, as due to the insulating envelope a sufficiently high temperature of the anode chamber is maintained for a long time.

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

Fig. 1 shows a form of construction in which the condensation space is arranged alongside the cathode chamber and communicates with the anode chamber, arranged above the cathode chamber, through an inclined tube.

Fig. 2 shows a discharge tube in which the condensation space is arranged sidewise relative to the cathode and anode chambers and communicates with these chambers through horizontal tubes.

In Fig. 1 an incandescent cathode **3** is placed on a press **2**. The cathode is constituted by a piece of wire net **4** which is rolled up and in which a space is provided between the successive turns of the roll. The windings of a heating spiral *3a* are provided around the whole body and the inner and outer sides of the body and the heating spiral are coated with a material having a highly electron emitting capacity.

On the bottom of the cathode chamber is provided a quantity of mercury **5** which by means of a tube **8** is connected to a quantity of mercury provided on the bottom of the condensation space **7**, so that the chambers **1** and **7** constitute a communicating vessel.

Furthermore the cathode chamber communicates with the condensation chamber **7** through a tube **6** consisting of ferrochromium. In the same way the condensation space **7** communicates with the anode chamber **10** through a tube **9** consisting of ferrochromium. The anode **11** is placed for example, on a ferrochromium plate **11***a* which is sealed on every side to the glass of the tube.

In the cathode chamber the temperature of the mercury and consequently the vapour pressure is rather high due to the presence of the incandescent cathode.

The mercury vapour which tends to move from the cathode chamber to the anode chamber **10** previously condenses in the space **7**. In fact, this space remains cool since the walls are widely spaced apart, so that this space is only slightly heated by the discharge. Moreover, the chamber **7** has a large heat radiating surface. The mercury condensed in chamber **7** returns to the cathode chamber through the tube **8**.

This tube 8 is helically wound over part of its length 14 so as to provide an elastic arrangement. The helix 14 is protected by cylindrical caps 15 and 16 consisting of glass.

The anode chamber always remains warmer than the condensation space 7, since the discharge produces more heat in the anode chamber and its heat radiating surface is smaller. Also when the operating current of the tube is switched off while the incandescent cathode remains switched on, the anode chamber remains warmer than the condensation space since the anode chamber is heated by the warm air ascending from the cathode chamber. Consequently no mercury will condense in this chamber.

The metal tubes 6 and 9 serve to conduct away the electric charge from the tube wall, for which purpose a proper potential is applied to them. Furthermore the tubes may be used as ignition electrodes, so as materially to reduce the ignition voltage. They may also be used as a grid for influencing the discharge.

The tube 6 comprises an extension 17 which extends around the cathode and by which the ignition is still further improved. Furthermore as shown a screen 18, shown in cross section, may be provided which screen is connected to the supply conductor of the cathode. This screen, to which cathode potential is applied, attracts a large part of the quick ions coming from the tube 6, which otherwise would strike the cathode. By this construction the life of the cathode is increased.

In order to avoid the bombardment of the ions as much as possible, the cathode is arranged outside of the axis of the tube 6.

In Fig. 2 corresponding parts are denoted by the same reference numerals as in Fig. 1, so that the operating of the parts shown therein will be readily understood. The difference from the form of construction referred to above essentially consists in that the anode chamber 10 is partly sunk in a recess 12 of the cathode chamber owing to which the heat of the cathode chamber may still better be transferred to the anode chamber.

Moreover a cap 13 is provided by which the ascending hot air is intercepted and which serves at the same time as heat insulation. The cap 13 also improves the general appearance of the discharge tube which in such construction consists essentially of two uniform cylindrical bodies interconnected by cross tubes.

The elastic portion of the tube 8 consists only of a U-shaped flexure 14.

The cathode is surrounded by a screen 19 which serves for catching the ions and by which at the same time the heat radiation of the cathode is reduced.

In this form of construction the tubes 6 and 9 are furthermore provided with metal points 21 and 20 by which the ignition is improved.

It is also possible to use other heating means for example a heating helix arranged around the anode chamber. Various other forms of construction are possible without deviating from the principle of the invention.

What we claim is:

1. A discharge tube comprising at least two electrodes one of which is an electron-emitting incandescent cathode and the other an anode, a chamber around each electrode, a filling consisting at least partly of a vapor, and a condensation chamber in the discharge path between the anode chamber and the cathode chamber, the anode chamber being disposed substantially directly above the cathode chamber and the condensation chamber being disposed sidewise with regard to the cathode chamber.

2. A discharge tube comprising an incandescible electron-emitting cathode and a chamber therefor, an anode and a chamber therefor, a filling consisting at least partly of a vapor, a condensation chamber for the vapor disposed sidewise with regard to the anode and cathode chambers, the anode chamber partly projecting into the cathode chamber.

3. A rectifier tube comprising an incandescible electron-emitting cathode and a chamber therefor, an anode and a chamber therefor, a filling consisting at least partly of a vapor, a condensation chamber for the vapor disposed sidewise with regard to the anode and cathode chambers, said condensation chamber being connected with said chambers by means of metal tubes, and a separate connection between the condensation chamber and the cathode chamber for the back flow of the condensate from the condensation chamber to the cathode chamber.

4. A rectifier tube comprising an electron source consisting of an incandescible cathode, and a chamber for the cathode, an anode and an anode chamber, a filling consisting at least partly of a vapor, a condensation chamber for the vapor disposed sidewise with regard to the anode and cathode chambers and connected to said chambers by means of metal tubes, and metal ignition rods extending through said tubes into the condensation chamber.

5. A rectifier tube comprising an incandescible cathode and a cylindrical chamber therefor, an anode and a cylindrical chamber therefor, said anode chamber being disposed on top of the cathode chamber without direct communication between the cathode and anode chambers, said cathode chamber having a larger diameter than the anode chamber, and an envelope surrounding said anode chamber and having substantially the same diameter as the cathode chamber and axially aligned therewith, and a condensation chamber disposed sidewise relative to said anode and cathode chambers and connected with both chambers, the discharge between said cathode and anode taking place through said condensation chamber.

6. A rectifier tube comprising a cathode and a chamber therefor, an anode and a chamber therefor, said anode chamber being disposed on top of said cathode chamber, and a condensation chamber sidewise disposed with regard to said anode and cathode chamber and interconnected with said anode and cathode chambers respectively by means of tubular metal members, the discharge between said cathode and anode passing through said condensation chamber, the metal member between the condensation chamber and the cathode chamber extending within the cathode chamber close to the cathode, said cathode being disposed outside of the axis of this metal member.

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