Sept. 24, 1940. C. HAILER 2,215,787

APPARATUS FOR THE PRODUCTION OF RAPIDLY MOVING IONS

Filed Aug. 2, 1938

Fig. 1.

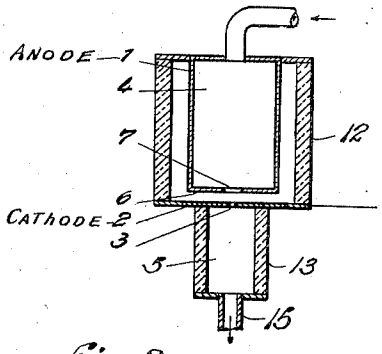



Fig. 2.

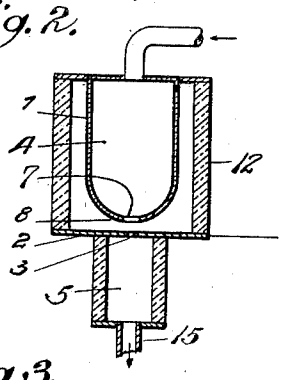
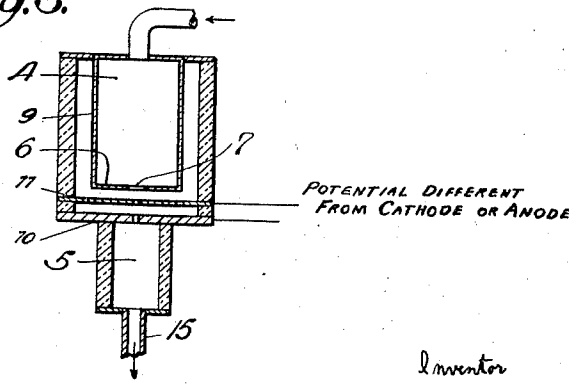



Fig. 3.

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# UNITED STATES PATENT OFFICE

2,215,787

## APPARATUS FOR THE PRODUCTION OF RAPIDLY MOVING IONS

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3 Claims. (Cl. 250—162)

This invention relates to apparatus for the production of rapidly moving ions.

In apparatus for the production of rapidly moving ions, it is customary to produce the ions in a gas-filled discharge space, to remove them from such space and to accelerate them in a further highly evacuated space. The gas-filled ionisation space generally constitutes a more or less pot-shaped anode and is separated from the highly evacuated space by a substantially disc-shaped cathode provided with an aperture for the passage of the ions. The vacuum in the evacuated space must be constantly maintained by a pump. However, a good vacuum can only be produced when the gas in the ionisation space is prevented, as far as possible, from entering the evacuated space. There must, therefore, be a high resistance to gas flow during the passage of the ions through the cathode aperture. If it is desired to produce useful results in such known apparatus, the aperture in the cathode must not be made too small and accordingly a relatively long channel aperture must be used although this has been found to reduce the economy of the arrangement.

The main object of the present invention is to provide improved apparatus in which this disadvantage is avoided. In the improved apparatus according to this invention the anode enclosing the ionisation space has the side facing towards the cathode so shaped or so provided with additional diaphragm-like surfaces that the stream of ions is concentrated in the form of a beam before passing through the aperture or channel of a cold-type cathode diaphragm. It has been found that the yield of rapidly moving ions can in this way be considerably increased. However, the most important advantage of the focussing of the stream of ions is that the diameter of the cathode channel can be relatively small, so that sufficient resistance to gas flow can be obtained with short channels.

Preferably the diameter of the channel is made equal to or greater than its axial length. This results in a considerable improvement in the economy of the arrangement, whilst the disadvantages of the known apparatus are overcome.

Three convenient arrangements according to the invention will now be described, by way of example, with reference to the accompanying drawing, the three figures of which are somewhat diagrammatic sectional side elevations of three forms of anode-cathode structures.

The arrangement shown in Fig. 1 has an anode 1 enclosed in an envelope 12 of insulating material, and a cathode 2 closing the envelope and provided with a cathode orifice 3 for connecting the gas chamber 4 within the anode with an evacuated chamber 5, the evacuation of which can be maintained by the exhaust pipe 15. The side of the anode 1 adjacent to the cathode constitutes a diaphragm 6 and is provided with an aperture 7 for the passage of the ions. The stream of ions is concentrated into the form of a beam by the diaphragm-like part 6, so that it has only a small cross-section and can without difficulty also pass through the narrow aperture 3 of the cathode.

The anode forming the diaphragm may have any other suitable shape, for example an anode having a curved surface 8 as shown in Fig. 2 may be employed. It is also possible to separate the part which acts as a diaphragm from the actual anode and to impress thereon a potential differing from the anode potential. Such an arrangement is shown in Fig. 3 in which there is disposed between an anode 9 and a cathode 10 an insulated diaphragm 11, the potential of which may be higher or lower than the anode potential.

What is claimed is:

1. In a device for producing rapidly moving ions, an envelope enclosing a highly evacuated space, an anode enclosing a gas-filled ionisation chamber, a cold-type cathode having a cathode diaphragm arranged so as to separate said ionisation chamber from said evacuated space, said cathode diaphragm having an aperture forming a passage for the ions, and at least one apertured diaphragm disposed between said ionisation chamber and said cathode diaphragm for concentrating the ion stream into a beam directed towards said aperture of said cathode diaphragm.

2. In a device for producing rapidly moving ions, an envelope enclosing a highly evacuated space, an anode enclosing a gas-filled ionisation chamber and having an outlet opening for the emission of ions, a cold-type cathode consisting of a diaphragm separating said ionisation chamber from said evacuated space and having an aperture for the passage of the ions, an intermediate diaphragm disposed between and insulated from said anode and said cathode, said intermediate diaphragm having an aperture arranged opposite said aperture of said cathode diaphragm for concentrating the stream of ions emitted from said anode into a beam directed through said aperture of said cathode diaphragm, and means for applying to said intermediate diaphragm a potential different from that of said anode.

3. In a device for producing rapidly moving ions, an envelope enclosing a highly evacuated space, an anode enclosing a gas-filled ionisation chamber, a cold-type cathode forming a diaphragm separating said ionisation chamber from said evacuated space and having an aperture forming a passage for the ions, said aperture having its axial length not greater than its diameter, and at least one intermediate diaphragm disposed between said ionisation chamber and said cathode and having an aperture for concentrating the ion stream into a beam directed through said cathode aperture.

CURT HAILER.