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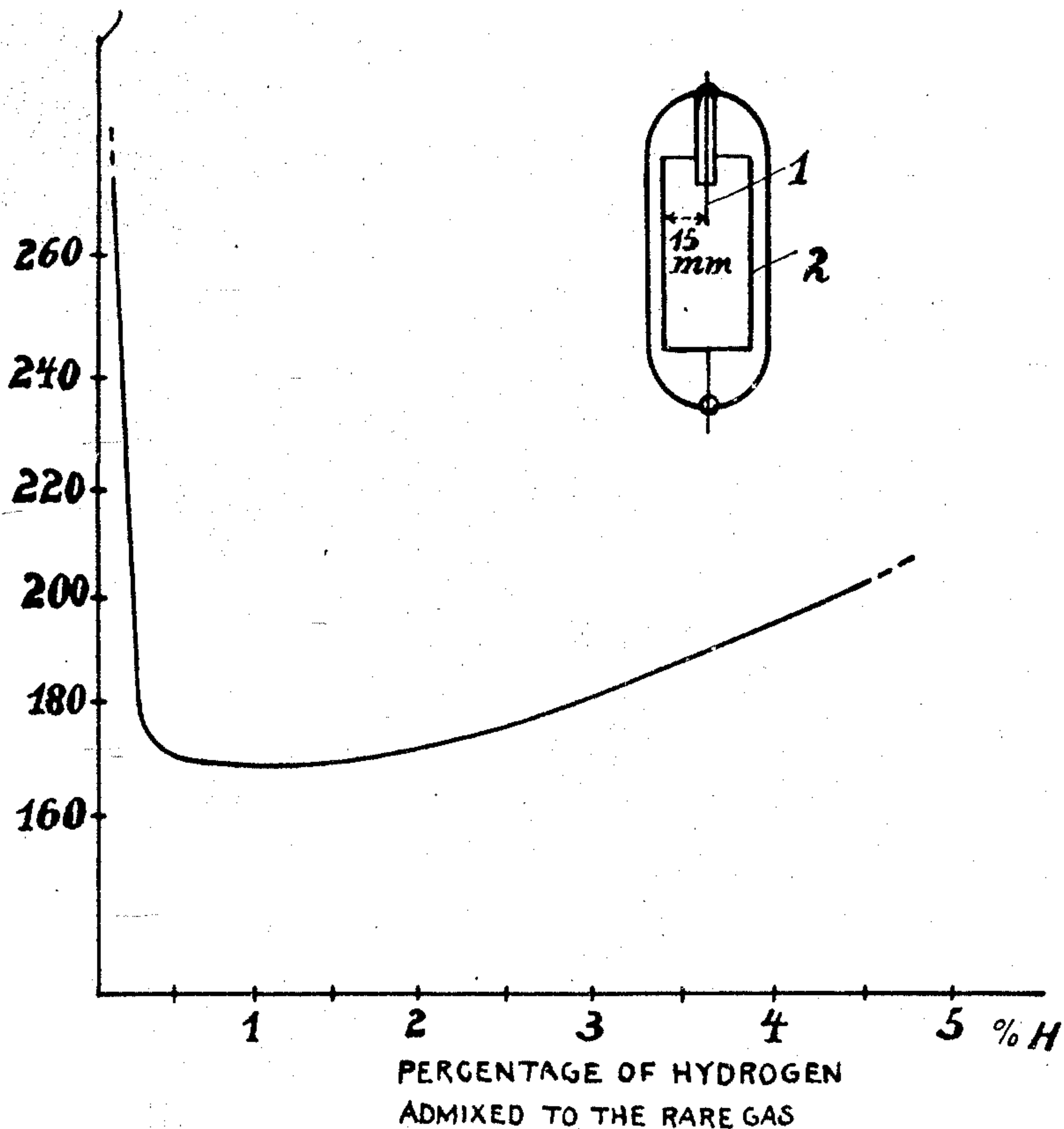
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GLOW DISCHARGE VALVE

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STARTING POTENTIAL



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GLOW-DISCHARGE VALVE.

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The present invention relates to improvements in discharge tubes, which contain rare gases or rare gas mixtures, such, for instance, as helium, neon, argon and the like, under a reduced pressure, and in which a so-called glow-discharge takes place on a non-incandescent cathode, the main portion of the voltage consumption occurring in the Crookes' dark space. The invention has for its object to facilitate the starting of such tubes in lighting and power circuits of ordinary voltage (for instance, 110 to 220 volts), and to produce tubes working safely and having a long life, so that they are capable of serving as rectifiers for alternating currents, for choking strong voltages and similar purposes.

When I refer to the choking of strong voltages I have in mind cases in which the tube is connected in series with one or more weak current apparatuses, which, owing to the choking effect of the tube, receive reduced voltage from the lighting or power supplying circuit. In the following it is supposed that in all tubes of this kind the distance of the electrodes from one another is so small that they are capable of being started with as low a voltage as possible.

The invention starts from the recognition of the fact that in glow discharge tubes of the kind mentioned, after a short time of use, the rare gas charge may attain a state of very high purity, which results from the large area of the cathode to be used in order to obtain sufficiently strong discharge currents. This is in turn due to the occlusion of all gaseous impurities, such, for instance, as hydrocarbon, hydrogen, nitrogen and the like, originally present in the rare gas. Now the effect of this automatic purification of the rare gas by means of the discharge is a strong increase of the starting potential of the tube. It may reach so high a figure that finally the tube can no longer be rendered active by the supplying current voltages employed.

I will hereafter explain my invention with reference to the accompanying drawing in which it is diagrammatically illustrated, and showing, what occurs if a small amount of hydrogen is fed to the tube which is filled with a mixture of neon and helium under a pressure (vacuum) of 10 m/m. mercury, and

in which the anode consists of a pointed iron wire 1 and is placed within a large-surface iron sheet metal tube 2 at a distance of about 15 m/m. from the tube walls. The concentration of the hydrogen is shown in percentages of the total quantity as abscissæ and the starting potential in volts as ordinates. The shape of the curve, which shows the dependency of the starting potential upon the concentration of the hydrogen, can be indicated only approximately in the neighborhood of the ordinate axis, since the voltage also depends on the quality of the surface of the electrode substance used. Nevertheless the curve shows pretty well the approximate shape of the starting potential. It will be seen that, as soon as the hydrogen contents approach zero, the starting potential increases considerably and finally surpasses the voltage values at disposal on the supplying circuit. Like conditions exist when additional gases other than hydrogen, and likewise metal vapours are used. It will be noted that the cathode 2 is a so-called "cold" cathode, as distinguished from filamentary cathodes heated by the passage of a current from an external source, as used in certain other types of vacuum tubes. The action in tubes having such heated or incandescent cathodes is materially different from that occurring with a "cold" cathode such as used in my invention.

Now the invention consists in that in glow discharge tubes of the kind specified such an amount of a suitable activating gaseous agent such as one or more chemically reactive gases or vapors, as, for instance, hydrogen, nitrogen, or gases acting in a similar manner is admixed to the rare gas that occlusion will not cause the whole amount of the admixed gas to disappear so that consequently the rare gas within the tube cannot be in a pure state. In case the cathode of the tube consists of iron, nickel, copper, tungsten or a like metal, difficult of volatilization, hydrogen, nitrogen, gaseous carbonaceous compounds, phosphorus vapors are especially suitable as chemically reactive gases, and, as metal vapors, mercury or volatile metal compounds are mainly used. Hydrogen especially is used advantageously in a concentration of from 1 to 3%. The concentration is selected in accordance with the size of the

electrodes, their location in relation to each other, and the potential of the current to be used. A portion of the hydrogen admixed is absorbed by the electrodes, but at the ratio indicated a certain part always remains effective in a free state.

If strongly electropositive substances, such, for instances, as alkaline metal or substances containing alkaline metal, are used for the cathode, hydrogen and nitrogen have proven particularly suitable. It is true, these gases are entirely absorbed by the cathode surface as long as the discharge passes through the tube, but after the discharge has been interrupted, traces of the same are again freed; therefore, for carrying the invention into effect it is sufficient to use alkaline metals containing hydrogen or nitrogen. As long as no current passes through the tube such metals always give off to the gas filling very small quantities of hydrogen or nitrogen, which are effective in the manner described.

For carrying out the invention it is not necessary to admix the additional gases to the rare gas prior to admitting the same to the discharge tube. Such admixtures to the rare gas may also be effected by using the electrode substance in a porous state and allowing it to remain in touch with the

additional gas or vapor for some time, so that it absorbs a sufficient quantity of the same. In some cases it has proved sufficient to free electrodes or other inner parts of the tube only partially from gaseous impurities when exhausting the same.

The additional gases mentioned not only secure in tubes of the kind as specified the starting with the voltage of ordinary lighting or power supplying circuits but at the same time they retard the disintegration of the cathode and thereby ensure an increased life of the tubes.

I claim as my invention:—

1. A glow discharge device comprising an enclosing vessel, a cold cathode and an anode separated therefrom by a small unobstructed gap, said vessel containing argon under reduced pressure mixed with hydrogen.

2. A glow discharge device comprising an enclosing vessel, a cold cathode and an anode separated therefrom by a small unobstructed gap; one of said electrodes being composed of a strongly electro-positive substance, said vessel containing argon under reduced pressure mixed with hydrogen.

In testimony whereof I have affixed my signature.

FRITZ SCHRÖTER