SYMMETRICAL SUBDIVISION OF ANODE GLOW IN HELIUM DISCHARGE TUBES.

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SYNOPSIS.

Symmetrical Luminous Patterns formed on Anode by Electrical Discharge through Helium. Description of Experiment.—When a continuous electrical discharge passes through *helium* at a *pressure* of 2 cm., the *anode glow* may break up into a number of *spots* more or less regularly distributed. The most striking arrangement is the three ring type with one spot at the center of a regular pentagon, which in turn is surrounded by eleven other spots uniformly distributed about the circumference of the circular anode, which is 2.7 cm. in diameter.

WHILE investigating the characteristics of the electrical discharge in helium at different pressures, a rather peculiar phenomenon was noticed at the surface of the anode. Luminous dots, often symmetrically arranged and very sharply defined, appeared on the face of this electrode, under various conditions of pressure, current density,

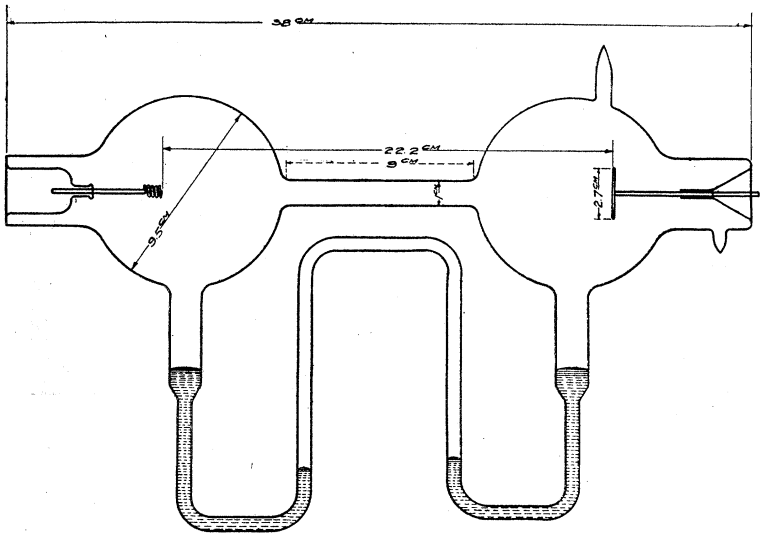

Fig. 1.

and shape of apparatus. The most regular grouping, however, was shown in the device illustrated in Fig. 1, which was designed for another purpose. This is a tube of Pyrex glass fitted with mercury manometers

and equipped with a tungsten filament cathode, and a circular anode of sheet tungsten 2.7 cm. in diameter.

After a good exhaust treatment, helium, obtained from Mr. P. E. Haynes, of the Linde Air Products Company, was admitted to the bulb through a tube containing charcoal immersed in liquid air, and the apparatus sealed off at a pressure of 2 cm.

The discharge was produced by a 1,500-volt direct current generator using a Kenotron with different filament temperatures as a regulating resistance. The cathode of the helium tube was not separately excited, the voltage being sufficient to start the glow with the cold filament. As the current was changed, various arrangements of spots appeared on the anode as shown by the photographs in Fig. 2, taken at an angle

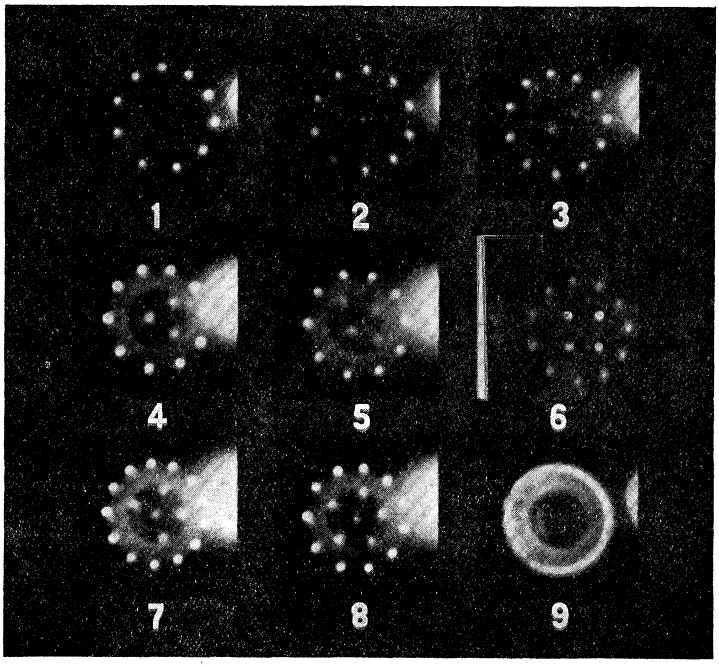

Fig. 2.

of about 30° to the axis of the tube.[1] In the order of the number of the dots, the volt-ampere characteristics were as follows:

(1) 420 volts .023 amp.	(4) 440 volts .016 amp.	(7) 440 volts .025 amp.
(2) 460 .012	(5) 435 .018	(8) 440 .020
(3) 430 .011	(6) 440	(9) 430 .085

[1] The four inner spots of No. 6 have been intensified since otherwise they would be hardly perceptible.

The first two and last two were apparently the most stable combinations, the others occurring only momentarily. It was quite easy, however, to reproduce the series from time to time. At the higher currents, as shown in the last picture, the separate spots merged into what appeared to be a rotating ring.

The spectrum of the glow showed mercury to be present as well as helium, but in other types of apparatus where mercury was excluded, phenomena of like nature were observed.

The arrangement of these spots is interesting on account of their general similarity to the configurations shown by Mayer's magnets used by Sir J. J. Thompson as an analogy in his conception of atomic structure.

Somewhat similar figures have been obtained in air at low pressures (.0144 mm.) by O. Lehmann[1] but of not so elaborate pattern.

Even at atmospheric pressure, with helium, there is a tendency for the anode glow to break up into a number of separate dots, though the current may be an ampere or more, and the arc gap less than a centimeter. This, in connection with other phenomena, makes it appear that helium at comparatively high pressures shows characteristics which normally occur in other gases only at relatively low pressures.

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[1] Ann. d. Physik, 7, 8, 1902.

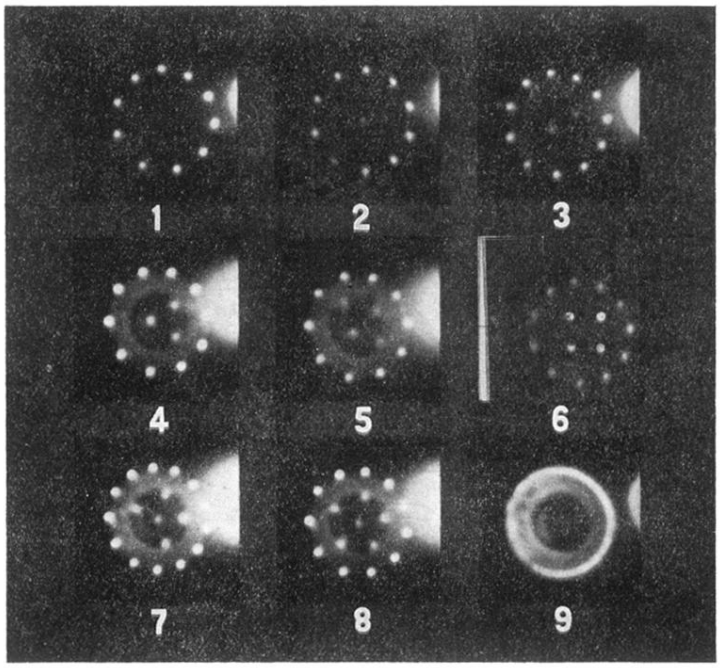

Fig. 2.