THE SPARKING POTENTIAL IN ARGON AT REDUCED PRESSURES.

BY E. R. STOEKLE.

IN the course of some experiments with an arc between calcium electrodes in a pressure of 40 mm. of argon, it was found that the potential required to start an arc decreased to unexpectedly low values after the arc had been allowed to run for some time. For example, such a discharge tube filled with argon purified in an auxiliary calcium arc discharge, would require a starting potential of 300 volts shortly after being sealed from the line, but after being run at 3 amperes for about an hour, and then being allowed to cool, it restarted at only 108 volts. After running for several hours at this current, the arc could be cooled and restarted at a potential of only 90 volts. Even after standing cold for 15 hours the arc could be restarted at 120 volts. These values of the potential required to start a discharge in argon are far below the minimum sparking potential of 240 volts given for argon by Townsend.[1]

The most probable explanation of these low sparking potentials lies in the progressive purification of the argon by the calcium vapor formed in the arc discharge. There is, however, a probability that some slow chemical action between the calcium electrode and a trace of oxygen or other gas might cause the emission of electrons after the manner described by Haber and Just, and thus facilitate the starting of a discharge. In order to avoid such an effect, the sparking potential between brass electrodes in argon purified by a calcium discharge was studied.

The apparatus consisted of a discharge tube containing two circular brass electrodes of 35.5 mm. diameter, whose opposing faces were spherical surfaces of 10 cm. radii of curvature, and distant 3.20 mm. at their nearest points.

Two calcium electrodes were mounted in the same tube for the purpose of purifying the argon. The tube was connected to a mercury vapor pump and a supply of argon, and could be shut off from both lines by means of a mercury valve. After being thus shut off the pressure in the tube could be varied over a range of about 50 per cent. by means of an attached bulb, whose volume could be changed by adjusting the level of the mercury within it. A McLeod gauge reading up to 2.5 mm. pressure and a manometer for reading the higher pressures were attached to the tube.

In order to get rid of adsorbed gases in the apparatus, it was baked at 360° C. for three hours and the electrodes were heated by passing a discharge between them in argon, which was pumped out while the discharge was going on. Argon which had been purified by exposing it to a calcium arc discharge for a period of 10 hours and dried by passing it through a trap surrounded by carbon dioxide snow was then admitted to the apparatus. The calcium arc in the discharge tube itself served for the final purification, and this was performed after the tube had been shut from the line.

The sparking potential was observed by slowly raising the voltage between the electrodes by increasing the field excitation of a 500-volt generator. A

[1] Electricity in Gases (1915), p. 329.

resistance of 3,000 ohms was placed in series with the electrode gap, in order to limit the current and as soon as the discharge passed the circuit was opened to prevent unnecessary heating of the electrodes, which might cause the evolution of electrode gases. For each observation three readings were taken, about four minutes apart, and in general these agreed to within 3 per cent. All observations were taken in rather dim diffused daylight and no special means for initiating ionization was provided.

A minimum sparking potential of 176 v. for this relatively impure argon was found to occur at a value of $p \times d = 8$, when p is the pressure in millimeters of mercury and d is the distance between the electrodes in millimeters. For the argon purified by the calcium arc in the discharge vessel a minimum sparking potential of 137 volts occurred at $p \times d = 7$.

The values of sparking potential obtained in this apparatus, although lower than any known to the writer, may not be as low as could be obtained in still purer argon. The slightest trace of impurity, such as an air bubble liberated from the mercury in the gauges or in the mercury valve would produce a marked change in sparking potential with no observable change in the pressure. A series of such bubbles, which were allowed to enter the apparatus, changed the pressure about 1 per cent., but changed the sparking potential by 7.5 per cent. It is, therefore, thought that by devising special means for measuring and varying the pressure of the argon without introducing impurities a lower minimum sparking potential than the observed 137 volts may be found to exist.

PHYSICAL LABORATORY,
THE CUTLER-HAMMER MFG. CO.

"THE ACTION OF LIGHT ON A PHOTOGRAPHIC FILM."

BY JAY W. WOODROW.

IT is a well-known fact that there is a remarkable similarity between the photoelectric and photographic properties of the silver halides. This has suggested to several writers (cf. Allen's "Photoelectricity," Chap. XIV.) the possibility of explaining the action of light on the photographic film as due to some sort of photoelectric action.

Now it has been shown that when plane-polarized light is incident upon a photoelectrically sensitive surface, more electrons are emitted when the electric vibration in the incident light is normal to the surface than when it is parallel to it. Consequently a very narrow line if photographed through a Nicol's prism should appear sharper when the direction of the electric vibration is parallel to the line than when at right angles to it. This was tried experimentally and found to be the case.

The source of light consisted of a very carefully ruled set of rectangular lines on a plane white background. Between this source and the camera lens was a high-grade Nicol's prism. The lens was a good anastigmatic lens, and fine-grained, contrast photographic plates were used.

Several photographs were taken with the Nicol so oriented as to make the