CXXXIV.—*The Dielectric Constant of Desiccated Oxygen.*

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IT has been shown that the prolonged drying of oxygen leads to a pronounced decrease in its chemical activity. Dry oxygen does not combine with dry carbon, sulphur, phosphorus, hydrogen, carbon monoxide, etc., at temperatures at which normally combination takes place readily. This change in chemical activity is accompanied by an alteration in the dielectric strength of a gas : Thomson (*Phil. Mag.*, 1893, **36**, 313) has shown that the potential necessary to cause an electric spark to pass through a gas which has been dried by phosphoric oxide is considerably greater than that required in an ordinary gas.

This investigation was undertaken in order to determine whether or no this change in chemical and electrical properties is accompanied by some fundamental change in the structure of a gaseous molecule, of such a nature as to alter the specific inductive capacity. The thermionic valve enables the electrical capacity of a condenser to be measured with extreme accuracy, and it was therefore decided to compare the capacities of two condensers, one containing ordinary dry oxygen, and the other, oxygen that had been subjected to the action of phosphoric oxide over a prolonged period.

Two similar electrical condensers, consisting of cylindrical silver plates (0·5 mm. thick), enclosed in glass tubes, were constructed. The plates were held rigidly apart at each end by means of four tapering glass plugs, which fitted tightly in holes bored through the inner cylinder (see Figs. 1 and 2). Before the cylinders were introduced into the glass tubes, the latter were thoroughly cleaned and heated to dull redness in a current of dry air. After being etched with dilute nitric acid, washed with water, and dried, the silver cylinders were introduced into the glass tubes, and the platinum leads sealed through the glass. The condenser which was to contain desiccated oxygen as dielectric was then placed in an air-bath and heated at 350° for 48 hours while it was alternately evacuated and

filled with pure dry oxygen. The oxygen, which was prepared by the electrolysis of specially purified baryta, was passed over heated copper oxide, to remove hydrogen, and dried by passing through tubes containing caustic potash and redistilled phosphoric oxide. After this treatment, the side-tube A of the condenser was opened, and some pure, redistilled phosphoric oxide introduced, the tube being quickly resealed. The condenser was again evacuated, filled with pure dry oxygen, and the process repeated six times, the vessel being finally closed by sealing. The other condenser was filled in a

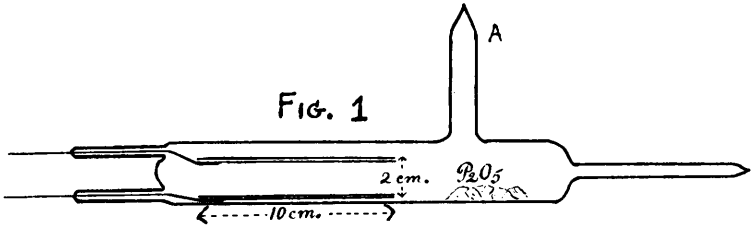

FIG. 1

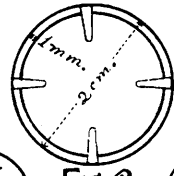

FIG. 2

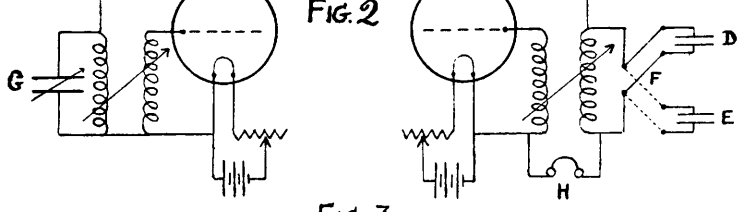

FIG. 3

similar manner, but no phosphoric oxide was introduced, and the oxygen was dried by passing over calcium chloride.

The method employed in comparing the capacities of the two condensers was essentially that described by Whiddington (*Phil. Mag.*, 1920, **40**, 634). The apparatus, shown in diagram in Fig. 3, consists of two oscillating valve circuits, A and B; D and E are the two condensers and either can be placed in the circuit B by means of the switch F. In carrying out a comparison, one of the condensers is placed in circuit and the variable condenser G tuned until a suitable note is produced in the telephones H. By turning the switch F, the other condenser can be brought into circuit and the note produced compared with the original one. The two condensers used were of the same dimensions (capacity 0·00005 micro-

farad), and gave notes of almost identical pitch. The capacities of the two condensers have been compared at intervals during 10 months, and not the slightest change in capacity of the condenser containing phosphoric oxide has been detected. Considering the accuracy of the method, this result appears to indicate that the action of very small traces of water vapour in promoting chemical activity is not to be explained by any change in the structure of the molecule on drying.

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