Frank-Condon diagram. Thus, there is a concentration of the atoms A $^3\Sigma$[8,11] as the details have not been published, it is difficult to form an accurate judgement of the value of this hypothesis.

From the foregoing short review it will appear that the existing theories of molecular structure are quite insufficient to explain the phenomenon. More well-planned experiments are needed to throw light on the subject. Lord Rayleigh's recent work proves that the surface has a strong catalytic action in accelerating the destruction of the glow. He finds that the poisoning action of the walls can be removed by treating the surface with Sulphuric Acid or Meta-phosphoric Acid. The glow then persists for 5½ hours at least. Unfortunately, no details have yet been published regarding the spectroscopy of the segregated glow. The total intensity of the light radiated after segregation during the whole period of decay, and the absorption spectrum of the glow should be carefully measured. It has been ascertained that the decay of the glow is either bi- or tri-molecular which proves that the emission of light is provoked by collisions of two bodies or three bodies and Lord Rayleigh prefers the two-body collision. It appears to us that the phenomenon can be explained if we suppose that two excited atoms of Nitrogen N ^2D or N ^2P form an extremely stable state of the molecule in the following way:

$$N\ ^2D + N\ ^2D = N_2\ ^1\Sigma.$$

The state produced is such that it does not easily transit to any of the levels A or X being forbidden by two or three selection principles. The energy of this stable state is very nearly 9·77 volts and when this collides with a normal nitrogen molecule it gives its energy to it raising it to the B_{12} or B_{11} state or the B_6 state. These excited molecules then make the transitions according to the Frank-Condon principle giving rise to the especially enhanced bands. When the molecule collides with foreign atoms or foreign molecules it communicates its energy to the latter in exactly the same way by collision of the second type.

Attempts are being made to verify some of the suggestions.

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63. A NEW MODEL DEMOUNTABLE VACUUM FURNACE

M. N. Saha and A. N. Tandon

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A vacuum graphite furnace suitable for high temperature research has been described in this paper. A special feature of the apparatus is that the parts can be taken out and set again for experimental work in a very short time. Temperatures up to 2500°C can be very quickly attained within a vacuum of 10^{-4} mms. A photograph of the apparatus and four diagrams explaining its action are given.

INTRODUCTION

For some time past we have been using in this laboratory a new model vacuum furnace of which the parts are demountable. This has been found to be extremely useful for researches on Thermal Ionisation of elements and salts and other high temperature work. With this apparatus it has been possible to attain temperatures up to 2500°C within a graphite tube very quickly. The special feature of the apparatus is that it can be taken to pieces in no time and set again for a fresh experiment. A sketch of the apparatus showing the important parts is shown in Fig. 1.

DESCRIPTION

The working of the apparatus will be clear from figures (2 and 3) which represent its horizontal and vertical

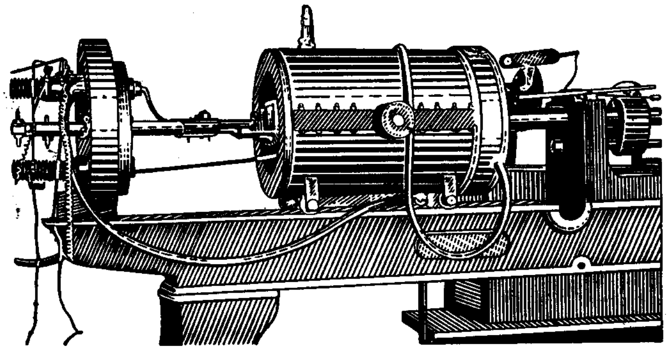

Fig. 1

sections. The main furnace consists of a water-cooled cylindrical drum C of cast iron and two hollow cast iron plates A and B which close the open ends of the drum when the furnace is working. A, B and C are all vertically mounted on a horizontal lathe bed. The plate A is fixed on one extremity of the lathe bed by the support SS as shown in figures 1 and 2. The drum C is mounted on four small wheels which enable it to slide easily over the lathe bed. The plate B is carried on the axle of a shaft which can be moved by means of a differential screw. When all internal connections and adjustments have been mades, the drum C is moved to make contact with A, and B is moved by means of the differential screw and finally

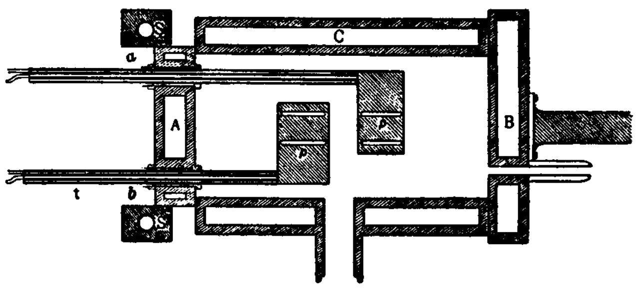

Fig. 2

tightened till the contact faces become vacuum tight. In order to ensure better contact between A and C, the support S of the plate A has been so designed that on slightly loosening the screws it itself adjusts its face in contact with that of the drum C when the vacuum is started. The apparatus is then ready for use. Although the contact faces between A, B and C are very accurately ground, in practice it is sometimes found necessary to apply a little plasticine round the edges. As all the parts A, B and C are water cooled, the contact faces remain quite cool even when the furnace is heated for hours at the highest temperature.

The fixed plate A contains four holes *a*, *b*, *c*, *d* as shown in figures 2 and 3. Through the holes *a* and *b* are inserted two water-cooled annular tubes *t* which are insulated from A by mica. The brass tubes *t* are scooped out from solid brass rods. On the water-cooled end they carry exactly fitting heavy copper collars ending in horizontal copper plates *p* provided with slots as shown in fig. 2. Over the plates *p* are put Acheson graphite blocks G (fig. 4), to receive the furnace tube in the hollow cylindrical space. After the graphite tube is put in position, the upper

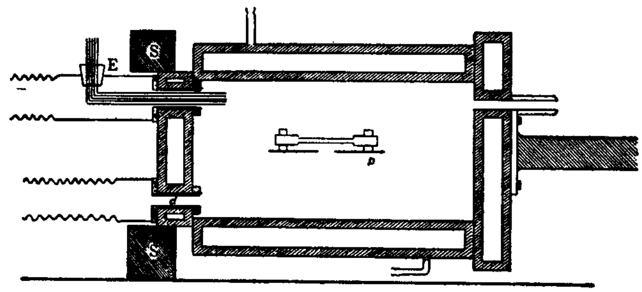

Fig. 3

part of the graphite blocks G are put over it, and the tube is then tightened by means of iron bolts. It is very important that the graphite tube should exactly fit in the blocks. The slightest loose contact between the tube and the graphite blocks causes arcing and makes the temperature of the furnace unsteady. For this reason it becomes necessary sometimes to insert some thin copper foils round the ends of the Acheson graphite tube before putting it between the graphite blocks.

The manner in which the electrodes are attached to the plate A becomes clear from fig. 5. which shows an enlarged drawing of this coupling. A brass tube having threads on one end and a collar K on the other is carefully soldered to the scooped out rod *t* at the desired distance. Over this is wrapped some mica *m* and is then put inside the hole *a* of the plate A. The collar is also insulated from the plate A by mica washers *m*. In order to make perfect vacuum-tight coupling a rubber washer R is put on the other side and the electrode is fixed in position by tightening the nut N. This arrangement is specially advantageous for two reasons, firstly that the electrodes can be taken out whenever required; secondly, the thick copper plates *p* which are attached to the electrodes can be brought out to the same level by slight adjustments of the nuts N. This precaution is particularly necessary for the fact that if the electrode plates are not in the same level, the furnace tube which is put on them by means of the graphite plugs G, as described above, encounters a mechanical strain which very often breaks it.

Through the holes *c* and *d*, each 2·5 cms. in diameter are connected two four-stage mercury pumps. For our climate (Allahabad) we have found it useful to increase the length of the cast-iron tube which is placed over the conical mouthpiece of the pump. This can be cooled by a freezing mixture. The connection is taken by means of a side tube on the top. The connecting pieces between the pumps and the holes *c* and *d* are Tombac tubings provided with brass end pieces. The coupling between the Tombac tubing and the plate A is done in the same way as that of the electrodes and the vacuum-tight contact is obtained by rubber washers. On the pump side the Tombac tube is connected by carefully ground brass cones. With such arrangement the pumps are very quick acting and even with one pump a vacuum of 10^{-4} mms is reached within a short time after starting the pump.

The brass piece of one of the Tombac tubings is bigger in length and has a hole through which passes an ebonite block E (fig. 3) which can carry all the electrical connections inside the furnace.

The water-cooled sliding drum C contains a side-tube through which the inside of the furnace can be inspected.

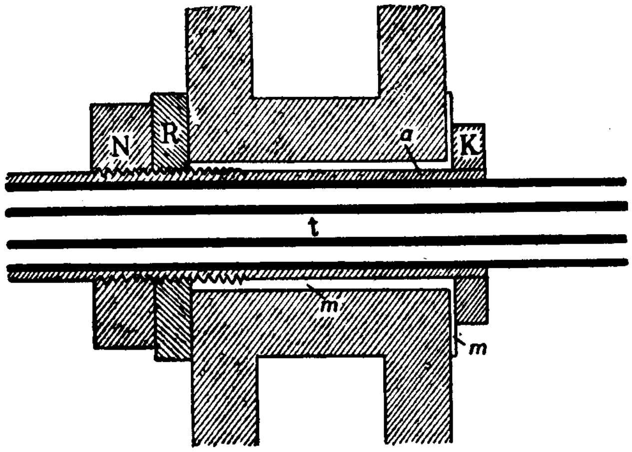

Fig. 5

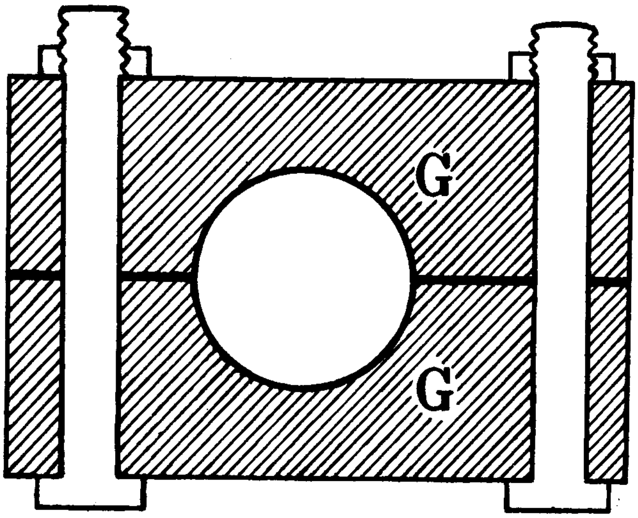

Fig. 4

This also enables the temperature of the furnace to be measured from outside by means of a disappearing-filament type of pyrometer. A thermo-couple can be inserted through this hole whenever required.

The movable plate B has a single hole through which a discharge tube can be inserted for giving an indication of the degree of vacuum.

The electrodes are connected by thick copper leads to a low-tension transformer (capacity 12 K. W.). A current of the order of 1000 amperes is allowed to flow through the graphite tube to raise it to a high temperature. The transformer has got four other ranges for giving less temperature.

We wish to express our sincere indebtedness to the Royal Society of London for giving us a grant of £150 which has enabled us to construct the furnace and to buy its accessories. Our thanks are also due to Messrs Allahabad Foundry for the casting of the plates and the water-cooled drum.

64. A STRATOSPHERE SOLAR OBSERVATORY

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It is well known that our observations on the spectra of the Sun and the stars are limited to the redward side of λ2900, the ultraviolet part being absorbed in the upper atmosphere, at a height of between twenty and fifty kilometers, by a layer of ozone (equivalent to 3 mm. of gas at N.T.P.) now known to arise from the photochemical action of the ultraviolet rays of the Sun on oxygen molecules. This amount of ozone, tiny as it is, is sufficient however to cut off the spectrum between λλ2900 and 2200 almost completely, though absorption begins to be perceptible from λ3200. Below λ2060, the extinction of the spectrum is due to absorption by molecular oxygen and nitrogen. According to some investigators, there is a so-called window between λλ2300 and 2100, but evidence on this point is divergent.

The abrupt termination of solar and stellar spectra below λ2900 has been a great handicap to the advancement of our knowledge of the heavenly bodies, because the information gained from study of the spectrum beyond λ2900 is not sufficient to explain the problems of stellar mechanisms operative there. To take one example: the great intensity of the Balmer series and the associated