center of the anode. For a given current through the aperture the total discharge current will be relatively small and likewise the anode heating.

The chief difficulty in operating a glow discharge at high voltage is in maintaining stability. An increase in gas pressure produces a rise in discharge current, which in turn causes this pressure to increase. The effect is cumulative until the current spreads over the entire area of the electrodes, thereby destroying the conditions necessary for the production of a good beam. This effect can be eliminated and stable operating conditions maintained by carefully regulating the gas pressure.

The usual practice for the control of pressure is to use a variable leak and fixed pumping speed but it was found that a fixed leak and a variable pumping speed permitted greater control of the pressure over widely varying operating conditions. Fixed leaks attached to the cathode end of the tube were easily made by drawing out glass thermometer capillary tubing; rapid pumping was accomplished with an oil diffusion pump of the Hickman type. The anode arrangement for the control of pumping speed on a glow discharge tube is shown in Figs. 1 and 2. The circular

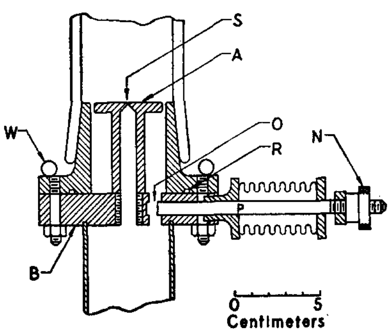

FIG. 1. The anode arrangement of a glow discharge tube showing provision for the control of the pumping speed. W is a water cooling line; R, a rubber gasket; and S, a circular slit 0.1 mm in diameter. The anode A screws into B. All metal parts are of brass.

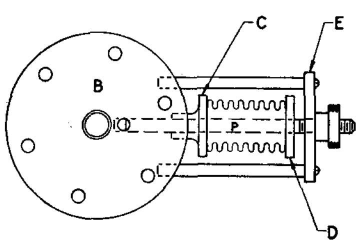

FIG. 2. Plan showing details of the sylphon assembly. P is soldered to D but slides freely through B, C, and E.

passage O, 7 mm in diameter, could be partially or completely closed by means of the plunger P, whose position was regulated with the nut N. The sylphon arrangement is simpler than a conical joint and in addition there is no tendency for the sylphon to leak if warmed. To minimize the effect of sudden gas bursts in the discharge it is necessary to have low impedance to gas flow between the tube at about 10^{-3} mm of mercury and remainder of the vacuum system at 10^{-5} mm. The fixed leak should be of such size that at the highest voltage applied O is completely open.

A glow discharge is very sensitive to surface conditions inside the tube. Those conditions necessary for stability could be quickly established by admitting certain hydrocarbon vapors through the fixed leak. Benzene gave good results whereas all alcohols had a bad effect and in addition formed carbon on the edge of the slits. Distillation of zinc onto the lower part of the glass wall of the tube by temporary overheating of the brass anode A had the same beneficial effect as the introduction of benzene.

The arrangement shown was used on an electron diffraction camera. It was found possible to operate the discharge at 60 kv without attention. Some of the suggestions might be helpful in the operation of gas x-ray tubes.

A Dewpoint Meter Using Cooling by Expansion of CO_2

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FOR use in certain aerodynamical problems a dewpoint meter using the Joule-Thompson effect, with CO_2 as cooling agent, has been developed. The instrument described here has some advantages over the common instrument which depends upon the evaporation of ether. Two slightly different devices have been used successfully.

Type I. The intake channel of this device consists of the copper tube CT (Fig. 1) which is soft soldered to the

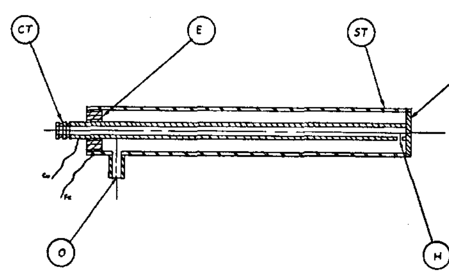

FIG. 1.

copper disk D. Near the disk a small hole H is drilled into the copper tube. The carbon dioxide from a tank passes through the copper tube and expands through H. Then, the cool CO_2 flows in the annular space between CT and the steel tube ST, and finally escapes through the opening O.

The outer surface of the disk D is polished and the condensation is observed on this surface. The temperature at which a water film begins to form on D is measured by

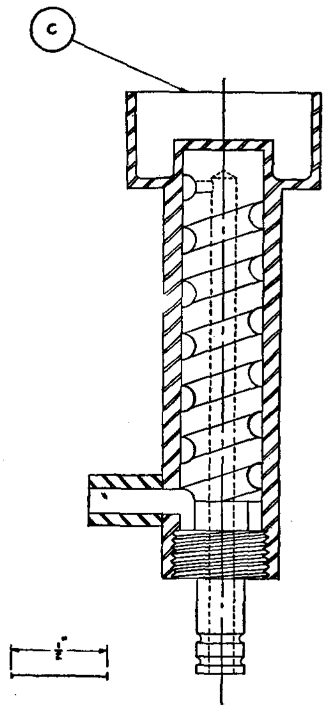

FIG. 2.

means of the copper-iron thermojunction formed between *ST* and *D*. The ebonite ring *E* insulates *CT* from *ST* at the other end; the reference junction is made with the copper and the iron wires indicated in the figure. The rate of cooling is controlled easily by the throttling valve at the CO_2 tank.

The instrument has a very small heat capacity and therefore works rapidly. The device built was about 6″ long, the outer diameters of *ST* and *CT* were $\frac{3}{4}$″ and $\frac{1}{4}$″, respectively. The inner diameter of *CT* was $\frac{1}{8}$″ and the hole *H* $\frac{1}{16}$″. Cooling to −20°C could be accomplished in about 2 minutes. To facilitate the observation of the film formation on the disk, it was found convenient to put a small strip of transparent cellulose tape across the polished surface. Since the vapor does not condense on the tape, the contrast in light reflection at the dewpoint between the bare surface and the tape is very marked. To check the thermocouple calibration a drop of water can be frozen on the surface of the disk and the melting point observed.

Type II. Figure 2 shows the second type of instrument used. The main difference is that the reflecting surface is formed by mercury contained in the steel cup *C*. The dew temperature in this instrument can thus be measured directly by a thermometer inserted in the mercury. Since the heat capacity of the unit is somewhat larger than that of Type I, the return circuit of the CO_2 after throttling was improved. The CO_2 returns through a helical channel between the outer steel tube and inner thick walled brass tube. The channel is made by cutting a helical groove in the brass tube, which is a slip fit in the steel tube. The rest of the figure is self-explanatory. In this type it is also advantageous to wind a few turns of resistance wire around *C* in order to permit more rapid reheating of the unit.