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A Diffusion Cloud Chamber Cooled with Circulating System

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The principles of operation of the diffusion cloud chamber are well investigated, and several authors¹⁻³⁾ have published the papers concerning the practice of operation, such as the methods of cooling of the base of the chamber, or the upkeep expenses of the cloud chamber operation.

We constructed a 10 cm diameter diffusion cloud chamber of cylindrical glass wall, as illustrated in Fig 1. The top window (A) is made as wide as possible so as to enlarge the camera view. This top window consists of two glass plates and water is contained between them in order to make the top temperature distribution as uniform as possible.

The chamber is operated with air and the vapour of the methyl alcohol at atmospheric pressure. In order to cool the base of the chamber, we adopted the liquid-circulating system, where acetone is cooled by passing through a heat exchanger (M) containing the mixture of dry ice and ethyl alcohol, and then passes through the ducts soldered to the base of the chamber (B).

To prevent the wall from freezing, an air-tight box (I), in which a flash lamp (H) and desiccants (G) are placed, is pressed against the chamber wall with rubber-gaskets.

Fig 2. shows a relation between time and temperature. Curves I, II, and III, correspond to the relation at the top, at 3 cm high from the base and at the bottom of the chamber, respectively.

It takes 30-50 minutes to attain the steady state from starting the circulating pump, and about 2.5 kg of dry ice is consumed. After attaining the steady state, it is sufficient to supply dry ice at the rate of about 0.5 kg/hr. These conditions are, of course, dependent upon the heat insulation of the apparatus.

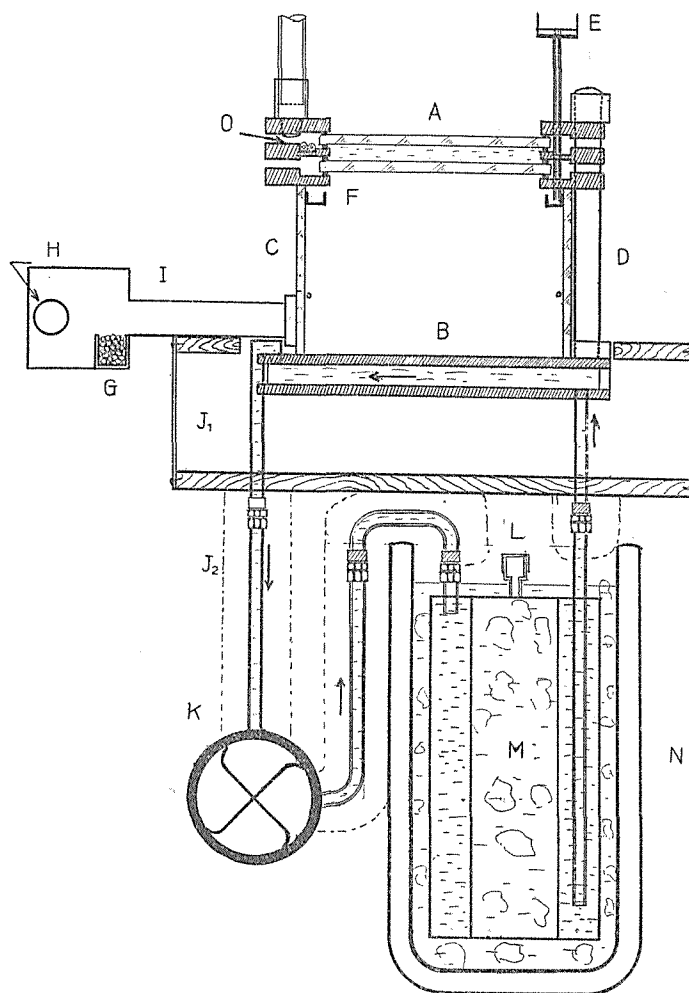
When the top temperature is 15°C (room temperature) the sensitive region is approximately 2.5 cm deep from the base of the chamber. When the top temperature is raised to 30°C, the height of sensitive region varies scarcely, but background fogs somewhat increase and the tracks become very diffuse³⁾.

The electric clearing field is applied between the top of the chamber and a

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NOTES

circular piece of wire placed just above the sensitive region, with the top negative with respect to the wire. The strength of the clearing field is about 50 Volt/cm. This clearing field is one of the most important conditions to obtain useful tracks. We observed that the reversed clearing field produced very diffused cluster of drops³⁾.



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|---------------------------|------------------------------|
| A : top glasses. | B : base plates. |
| C : cylinder glass. | D : ebonite rod. |
| E : alcohol entrance. | F : alcohol tray. |
| G : desiccants. | H : flash lamp. |
| I : lamp holder. | J ₁ : wooden box. |
| J ₂ : asbestos | K : gear pump. |
| L : acetone entrance. | M : heat exchanger. |
| N : Dewar vessel. | O : heater. |
| ← : acetone flow. | |

Fig. 1

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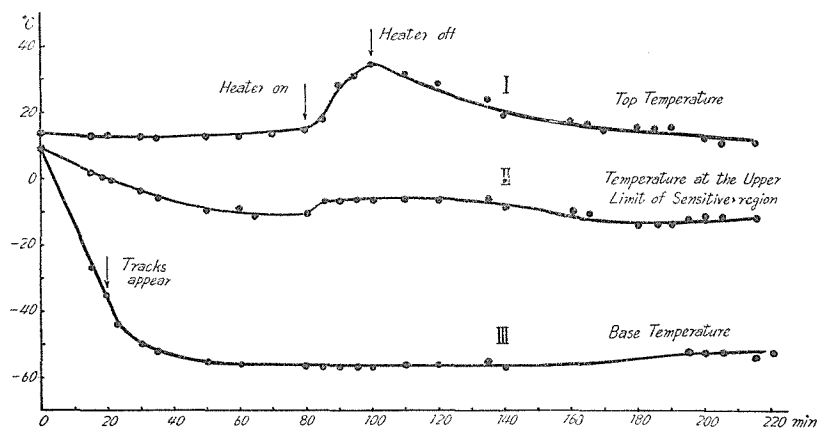


Fig. 2

Temperature gradients are $3.2^{\circ}\text{C}/\text{cm}$ from the top plate to 3 cm above the base of the chamber, and $18.6^{\circ}\text{C}/\text{cm}$ from this level to the bottom. The average temperature gradient for the entire depth of the chamber is about $7^{\circ}\text{C}/\text{cm}^{(1)(2)}$.

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