United States Patent [19]

Lechner

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[54] **COVER FOR MICROTOME AND ULTRAMICROTOME FREEZING CHAMBER**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **62/320,** 83/915.5

[51] **Int. Cl.** **B26d 7/08**

[58] **Field of Search** 62/320; 83/915.5, 170, 171

[56] **References Cited**

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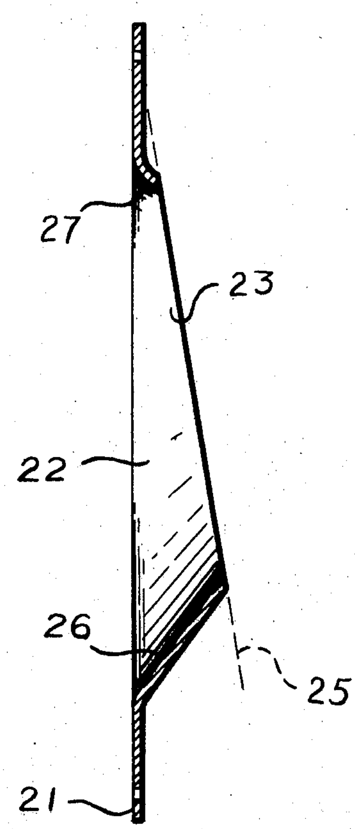
[57] **ABSTRACT**

A transparent cover having a conical depression with an elliptical opening to control the passage of coolant gas from the freezing chamber of a microtome or ultramicrotome provides improved cooling with increased versatility and permits microtome techniques to be practiced heretofore not considered practical.

9 Claims, 3 Drawing Figures



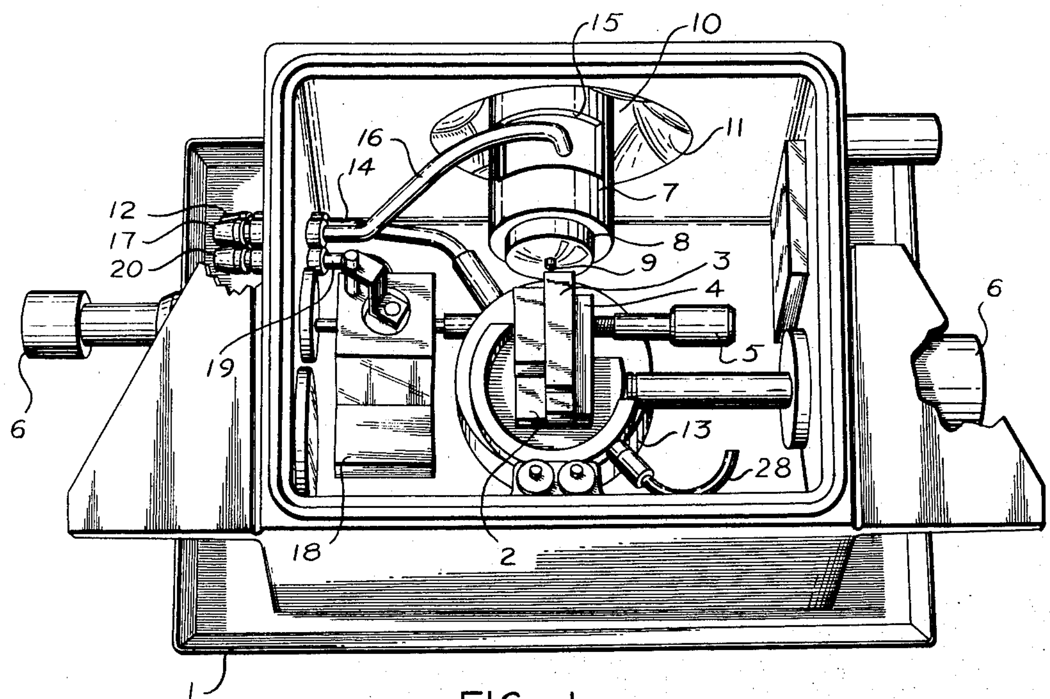


FIG. 1

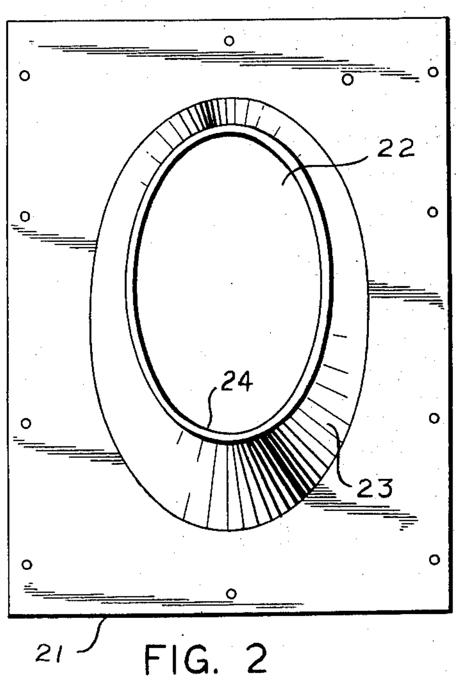


FIG. 2

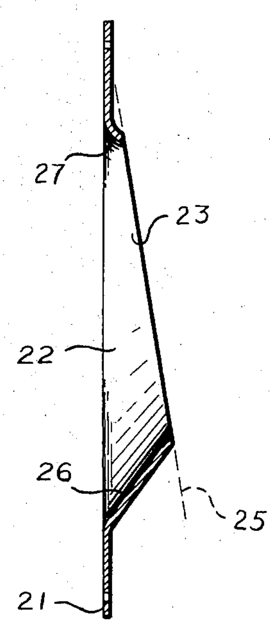


FIG. 3

COVER FOR MICROTOME AND ULTRAMICROTOME FREEZING CHAMBER

BACKGROUND OF THE INVENTION

Freezing chambers for microtomes and ultramicrotomes generally comprise a rectangular box shaped chamber with an external control and coolant supply. The chamber may be cooled to a pre-selected temperature, which may be as low as about −160°C, by the controlled evaporation of a liquid coolant such as nitrogen. One, and usually two or three, evaporation units are located in the chamber. Preferably, one unit is so located as to cool the knife and one unit is so located as to cool the specimen arm with an optional unit to assist the first two in rapidly cooling the chamber.

Two basic techniques have been heretofore used. A closed freezing chamber is conventionally used when it is possible to support, by a float liquid, specimens as they are cut. Such float liquids must be selected from materials which remain liquid at the selected temperature and dimethyl sulfoxide mixed with water is an example of such a float liquid. It is apparent that the liquid, or mixture of liquids, selected must not only remain liquid at the selected temperature, but should not react with or otherwise adversely affect the specimens cut. The closed chamber is the most efficient and effective device since the escape of the coolant is restricted and effects of variations in the medium surrounding the chamber are not significant. However, severe limitations caused by interaction between the float liquid and specimen as well as providing float liquids which do not freeze at extremely low temperatures significantly restrict the usefulness of closed chamber devices. British patent No. 1,170,796 is one example of such a device and discloses some of the problems inherent therein.

The open chamber is used for the dry knife technique which requires removal of specimen sections as they are cut. This technique is used when sections may react with or be otherwise affected by liquids used to float sections as described above. The open chamber is substantially the same as the closed chamber with the top removed to permit access to remove the sections as they are cut. Such chambers are extremely inefficient since the unrestricted flow of gas escaping from the open topped chamber requires large quantities of coolant to maintain even nominally reduced temperatures in the area of the specimen and knife. Such open chambers are also highly susceptible to fluctuations in temperature caused by air currents in the room, opening of doors and the like. The aforementioned British patent further discloses disadvantages of an open type chamber including the formation of ice crystals caused by condensation from the surrounding medium.

BRIEF DESCRIPTION OF THE PRESENT INVENTION AND DRAWINGS

It is one object of the present invention to provide a freezing chamber overcoming the disadvantages of the prior art chambers.

It is a further object of the present invention to provide a freezing chamber having the advantages of the closed chamber as well as the advantages of the open chamber, while substantially eliminating or minimizing the disadvantages of each.

It is still a further object of the present invention to provide an efficient freezing chamber substantially unaffected by variations in the surrounding medium and

using substantially less coolant than prior art open chambers.

The freezing chamber of the present invention is distinguished by its cover having an elliptical opening in a conical depression in the cover. The elliptical opening is defined by a plane bisecting the conical depression at an angle with respect to the cover and positioned to provide working access to remove sections as they are cut while sumultaneously minimizing the escape of coolant by having the area with the greatest depression near the rapid cooling unit of the freezing chamber to deflect the evaporating liquid away from the opening.

FIG. 1 is a top view of a freezing chamber in perspective;

FIG. 2 is a top view of the cover for such a chamber; and

FIG. 3 is a side view in cross-section of the cover.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **1**, a chamber body **1** of a conventional insulating material has a knife holder **2** mounted therein. Knife **3** is held in the holder by clamp **4** which may be manually tightened by locking screw **5**. Knife adjustments are made by conventional micrometer means **6**. Specimen arm **7** has a specimen clamp **8** mounted thereon to carry a specimen **9** to be sectioned. The specimen arm extends through an opening **10** in the side of body **1** and the opening is closed by flexible seal **11** which permits movement of the arm **7** during the cutting operation. Coolant for the knife is introduced through inlet **12** and conducted to knife cooling unit **13** by tubing **14**. Specimen arm **7** is cooled by unit **15** which is connected by passage **16** with coolant inlet **17**. Rapid cooling unit **18** is connected to the coolant supply via tubing **19** and inlet **20** primarily to assist units **13** and **15** during the initial cooling cycle.

The selected reduced temperature for the sample is obtained by introducing coolant such as liquid nitrogen through inlets **12, 17** and **20** to cooling units **13, 15** and **18** where heat is absorbed by evaporation. The cooling units and controls therefor may be of a conventional type including those taught in the aforementioned British patent and are well-known to those skilled in the art.

Cover **21**, in FIG. **2**, has an ellipsoidal opening **22** located therein at the base of a conical depressed area **23**. The edge **24** of depressed area **23** which defines opening **22** is asymmetrically located and in a plane which bisects cover **21** at an angle of about 5° to 15°. Referring to FIG. **3**, the location of opening **22** and the angle α of plane **25** provide a major lip area **26** and a minor lip area **27**. The larger depression in area **26** deflects the gas evaporating from rapid cooling unit **18** away from opening **22** without significant restriction of operator manipulating space within the area of the cutting knife. Similarly, gas evaporating from the specimen cooling unit **15** is deflected away from the opening. Deflection of gas evaporating from cooling unit **18** and opening. Deflection of gas evaporating from cooling units **18** and **15** increases the efficiency of the cooling chambers by causing the cool gas to force warm gas from the chamber in the minor lip area **27** without significant direct loss of gas from these cooling units. Gas evaporating in knife cooling unit **13**, which is closed, is vented through tubing **28**. In a chamber having approximate dimensions of 150 millimeters × 120 millimeters

× 100 millimeters, a cover with an elliptical conical depression having a major base axis of approximately 121 millimeters and a minor base axis of **82** millimeters is formed with the major and minor axes bisecting substantially in the center of the cover are satisfactory. The edge of the depression lies in a plane which bisects the cover at an angle of approximately 9.5° to produce a major lip having a maximum depth of about 20 millimeters from the cover surface and a minor lip having a maximum depth of about 5 millimeters from the cover surface. These dimensions provide desirable flow paths and restriction of gas escape in a chamber of the above size with an arrangement according to FIG. **1** if the cover is placed on the chamber with the major lip between the rapid cooling unit and window. In operation, slight positive pressure is maintained by the expansion of gas in the chamber which is in the order of about 0.5 atmospheres or less than above ambient atmospheric pressure. While the flow of a cooling gas, such as nitrogen, through the chamber varies with the selected chamber temperature, the flow is generally between 0.07 grams per second to 3.5 grams per second for the temperatures from about 0°C to −160°C from each of cooling units **13** and **15**. Since cold nitrogen is heavier than room temperature air, the air is rapidly displaced through the window as the chamber fills with cold gas and the formation of condensation ice is prevented by the displacement of moisture containing air. The window opening, being of a proportional size to the chamber volume and gas flow substantially eliminates mixing of air with the coolant within the chamber during the cooling and/or cutting operations.

I claim:

1. In a freezing chamber for a microtome or ultramicrotome having a cooling unit to absorb heat by the evaporation of a liquefied gas in an area proximate to the knife and specimen, the improvement comprising a cover for said chamber, said cover having an upper surface, a conical depression in said upper surface, said depression having a continuous depending sidewall and a lowermost edge defining a passage through said cover, said edge being spaced from said upper surface and being in a plane bisecting the plane of said upper surface at an angle less than about 15° whereby the flow of evaporating gas within said chamber displaces the atmosphere through said passage from the chamber without significant mixing.

2. The improvement of claim **1** wherein said cover has a rectangular peripheral border, said conical depression said passage have major and minor axes.

3. The improvement of claim **2** wherein said major axes are coincident.

4. The improvement of claim **3** wherein said passage is egocentrically displaced within said depression.

5. The improvement of claim **4** wherein the ratio of the planar area of the chamber closed by said cover to the planar area of said depression to the planar area of said passage is about 1:0.5 : 0.2.

6. The improvement of claim **5** wherein said angle is about 10°.

7. The improvement of claim **6** wherein the distance between said lowermost edge and said upper surface varies continuously between a maximum and a minimum providing large and small portions of said sidewall.

8. The improvement of claim **7** wherein the large portion of said sidewall is intermediate said cooling unit and said passage.

9. The improvement of claim **8** wherein said chamber has a plurality of cooling units.

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