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REFRIGERATED TABLE FOR MICROTOMES

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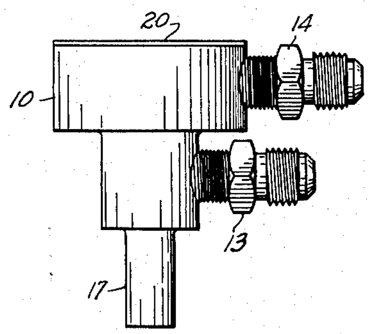

FIG. 1

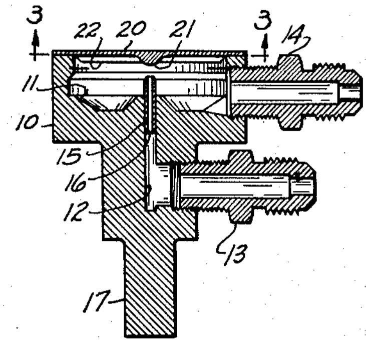

FIG. 2

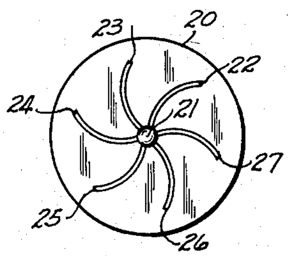

FIG. 3

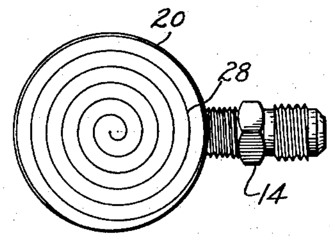

FIG. 4

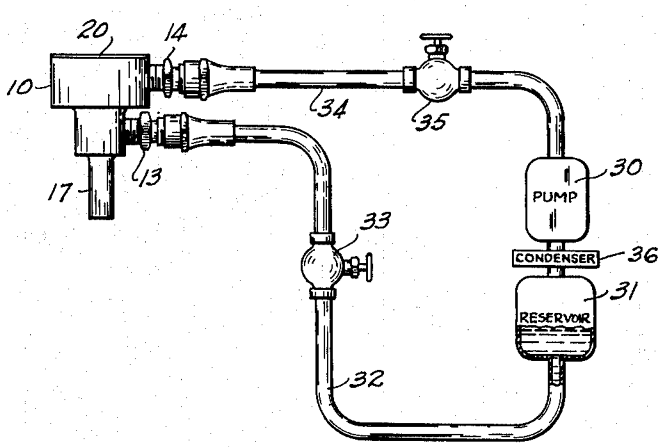

FIG. 5

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REFRIGERATED TABLE FOR MICROTOMES

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4 Claims. (Cl. 62—11)

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This invention relates to freezing devices and particularly to a cyclic freezing table for microtomes.

Conducive to a better understanding of this invention, it may be well to point out that the freezing of soft tissue so that it may be rendered rigid enough to be cut into thin sections is an old expedient in the art of microscopic sectioning.

Fresh tissue may be directly transferred to the table of a microtome without previous imbedding, and sectioned after freezing. This affords a ready means of rapidly determining the nature of a given tissue, and is very serviceable, especially to the pathologist. The freezing agents may vary from ordinary ice and salt brine to highly volatile fluids such as liquid carbon dioxide, ether and rhigolene.

In every case the freezing agent is used only once and is permitted to escape after it has served its purpose. This is especially true of carbon dioxide, which is the refrigerant most commonly used.

In a large pathology laboratory running hundreds of tissue examinations a day, one or more cylinders of liquid carbon dioxide may be used. This is not only a continuing expense but facilities must be provided for the periodic replacement of the heavy cylinders as they become empty.

The primary object of this invention therefore is to provide a freezing device for microtomes that embodies a refrigerating table which employs a fixed quantity of refrigerant which is cyclically passed through its liquid and vapor stages.

Another object is to provide a freezing device of the type which permits the freezing of the object readily and conveniently and of holding it firmly in place.

A further object is to provide a freezing surface whose rate of temperature change can be accurately regulated so that the tissue cells are not distorted by ice crystals which form when the freezing rate is uncontrolled.

Still another object is to provide an apparatus of this class which is very simple and economical of construction, easy to operate, efficient in its action and which will not readily deteriorate or get out of order.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination and arrangements of parts and portions as will be hereinafter described in detail and partic-

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ularly set forth in the appended claims, reference being had to the accompanying drawing and to the characters of reference thereon which form a part of this application in which:

Figure 1 is a side elevation of my improved refrigerated table for microtomes;

Figure 2 is a vertical sectional view of the same;

Figure 3 is a bottom view of the top wall taken substantially along the line and in the direction of the arrows **3—3** of the Figure 2;

Figure 4 is a top plan view of the device; and

Figure 5 is a schematic view showing the refrigerated table connected in the closed compressor circuit.

Referring to the drawing there is seen in the Figures 1 and 2 a refrigerated table made in accordance with this invention.

The body **10** is made of a suitable non-corrosive metal such as brass or stainless steel and has sufficient wall thickness to function properly under the pressures used as set forth hereinafter. The body **10** may be of any desired shape but is preferably cylindrical in form for reasons of ease of machining, a suggested size is 1¼ inches in diameter. A smooth stem **17** is formed integral with the bottom of the body **10** and is intended to interfit a mating socket in the base of the microtome with which the table is intended to be used. The table is held in an upright position by the stem **17** and is easily removable from the microtome socket when desired.

The upper part of the body is bored out to form the cavity **11** having side and bottom walls. Reference numeral **12** indicates an inlet bore formed along the vertical axis of the body **10** and having an inlet nipple **13** seated in its horizontal arm as shown in the Figure 2.

A nozzle or jet tube **15** is mounted in the upper end of the inlet bore **12**. The nozzle has a bore **16** therethrough. The diameter of this bore may be varied between .010 inch and .0007 inch. The preferred orificial diameter, in the model shown, being .007 inch.

Reference numeral **14** indicates an outlet nipple mounted in the side wall of the cavity **11**. The nipple **14** is connected to an outlet tube **34** including a control valve **35** leading to the compresser pump **30**, condenser **36** and reservoir **31**. Nipple **13** is connected to the outlet of the reservoir **31** through the inlet tube and valve **32** and **33** respectively.

A cover plate or top wall **20** made of stainless steel or other non-corrosive metal is seated on top of the circular side wall of the cavity 11 and forms a closure therefor.

The cover plate 20 is relatively thin and together with the side and bottom walls forms a cavity 11 that is approximately .625 inch deep in the preferred form illustrated. Reference numeral 21 indicates a centrally located dependent solid conical diffuser formed integral with the bottom surface of the cover plate 20. The mass of the solid metal cone 21 is made equal to or greater than the mass of the table 20, apart from the area immediately above the cone. The table being made very thin so that the heat transfer from the specimen resting thereon will be practically instantaneous. A plurality of arcuate equi-spaced dependent fins 22, 23, 24, 25, 26 and 27 extend from the bottom surface of the plate 20 and radiate toward the periphery thereof from the cone 21 as a center. The plate 20 has a spiral groove 28 cut in its upper surface as shown in the Figure 4. The plate 20 is brazed or welded in place as shown in the Figure 2. When the plate 20 is in place the apex of the diffuser cone 21 is aligned with the orificial opening 16 of the nozzle 15.

The refrigerant used may be methyl chloride or one of the so-called Freon refrigerants such as: Freon-12 (dichloro-difluoro methane), Freon-22 (difluor-monochler methane) or Freon-114 (dichloro-tetrafluoro ethane).

In the case of Freon-12 approximately 1½ pounds of the liquid Freon is used in the closed refrigeration system.

The Freon gas is liquified by the pump 30 and stored in the reservoir 31 from whence it is delivered to the jet tube 15 at a pressure of 90 pounds p. s. i. Vapor present in the cavity 11 is removed under suction through the tube 34 to the suction side of the compressor 30 as is well known to those skilled in the art.

In the freezing of tissue a few drops of water are placed on the center of the cover plate 20 and the specimen to be frozen is positioned on the plate on the water. The valve 35 is adjusted so that the proper pressure is created in the chamber cavity 11 consistent with the temperature desired.

When using liquid Freon-12 injected at a pressure of 90 pounds p. s. i., the following temperatures can be maintained at will by adjusting the pressure in the cavity 11 as follows:

23" of mercury, vacuum 75° Fahrenheit.
15.4" of mercury, vacuum 50° Fahrenheit.
.6 lb. of pressure p. s. i. 20° Fahrenheit.
9.2 lbs. of pressure p. s. i. 0° Fahrenheit.

In the case of Freon-22, the values are as follows:

18.5" of mercury, vacuum 75° Fahrenheit.
6.0" of mercury, vacuum 50° Fahrenheit.
10.3 lbs. pressure p. s. i. 20° Fahrenheit.
24.2 lbs. pressure p. s. i. 0° Fahrenheit.

After the desired pressure in the cavity is established with reference to the temperature desired, the valve 33 is opened and the liquid refrigerant is introduced into the cavity 11 by being forceably ejected from the nozzle 15 in the form of a jet directed against the apex of the diffuser cone 21.

The conical shape of the deflector 21 causes the liquid stream to be dispersed at right angles and radially over the undersurface of the cover 20. Uniform distribution is further insured by the radial fins 22 to 27 inclusive. The fins also

increase the surface area of the plate 20 and hasten the heat-transfer rate, thereby bringing about the quick cooling of the tissue positioned on the upper surface of the plate 20.

The water associated with the tissue and laying in the spiral groove 28 quickly freezes. The spiral configuration of the groove 28 provides anchorage against shearing stress in all directions so that the table may be oriented in any direction with reference to the microtome cutting knife. The relatively great mass of the deflector cone with reference to the thickness of the table top 20 provides for less heat transfer at the point where the greatest quantity of liquid is momentarily available for evaporation. This makes for a uniform temperature over the entire table top surface without any localized cold spots. The vaporized refrigerant is drawn back into the compressor through the tube 34 and re-liquified. This closed circuit uses the same refrigerant over and over, therefore making for economy of operation.

By varying the pressure in the cavity 11, as outlined in the tables hereinabove, the rate of vaporization and consequently the rate of freezing of the tissue can be accurately controlled as the freezing progresses. Thus the splitting and distortion of tissue cells can be prevented.

It is also possible to produce frozen tissues of the proper rigidity to suit the type of cutting knife used, thereby making for the more accurate, speedier and economical sectioning of soft tissues.

It will now be clear that there is provided a device which accomplishes the objectives heretofore set forth. While the invention has been disclosed in its preferred form, it is to be understood that the specific embodiment thereof as described and illustrated herein is not to be considered in a limited sense as there may be other forms or modifications of the invention which should also be construed to come within the scope of the appended claims.

I claim:

1. A refrigerated table for microtomes, comprising in combination, a vapor tight expansion chamber having top, bottom and side walls, the said top wall being heat conductive and having a plane upper surface adapted to support tissue to be frozen, a solid conical diffuser positioned centrally of the underside of the top wall and formed integral therewith, the mass of said cone being greater than the mass of the top wall exclusive of that area immediately above the cone, means for projecting a jet of liquid refrigerant against the said solid conical diffuser, and means for maintaining the pressure of the chamber below that of the introduced liquid refrigerant so that the liquid refrigerant will be caused to pass into its vapor phase thereby absorbing heat from the chamber top wall.

2. A refrigerated table for microtomes, comprising in combination, a vapor tight expansion chamber having top, bottom and side walls, the said top wall being heat conductive and having a plane upper surface adapted to support tissue to be frozen, a solid conical diffuser positioned centrally of the underside of the top wall and formed integral therewith, the mass of said cone being greater than the mass of the top wall exclusive of that area immediately above the solid cone, a plurality of dependent fins formed integral with the underside of said top wall and extending radially from the cone as a center to the periphery of the top wall, means for pro-

jecting a jet of liquid refrigerant against the said solid conical diffuser, means for maintaining the pressure of the chamber below that of the introduced liquid refrigerant so that the liquid refrigerant will be caused to pass into its vapor phase thereby absorbing heat from the chamber top wall, and means for recovering the vaporized refrigerant and reliquefying it for return to the projecting means.

3. A refrigerated table for microtomes, comprising in combination, a vapor tight expansion chamber having top, bottom and side walls, the said top wall being heat conductive and having a plane upper surface adapted to support tissue to be frozen, a solid conical diffuser positioned centrally of the underside of the top wall and formed integral therewith, the mass of said cone being greater than the mass of the top wall exclusive of that area immediately above the solid cone, a plurality of equi-spaced arcuate dependent fins formed integral with the underside of the top wall and extending radially from the solid conical diffuser as a center to the periphery of the said top wall, means for projecting a jet of liquid refrigerant against the apex of the said solid cone diffuser, means for maintaining the pressure of the chamber below that of the introduced liquid refrigerant so that the liquid refrigerant will be caused to pass into its vapor phase thereby absorbing heat from the chamber top wall, and means for recovering the vaporized refrigerant and reliquefying it for return to the projecting means.

4. A refrigerated table for microtomes, comprising in combination, a vapor tight expansion chamber having top, bottom and side walls, the said top wall being heat conductive and having

a plane upper surface adapted to support tissue to be frozen, a solid conical diffuser positioned centrally of the underside of the top wall and formed integral therewith, the mass of said cone being greater than the mass of the top wall exclusive of that area immediately above the solid cone, a plurality of equi-spaced arcuate dependent fins formed integral with the underside of the top wall and extending radially from the solid conical diffuser as a center to the periphery of the said top wall, an inlet nozzle mounted on the bottom of the chamber below the said solid cone, and having its orifice aligned with the apex of the cone, an inlet tube carried by the said nozzle, an outlet nipple in the side wall, an outlet tube carried by the said nipple, a closed compression system connected between the said inlet and outlet tubes and including a fixed volume of refrigerant, and valving means for selectively adjusting the pressure ratio between the liquid and vapor phases of the refrigerant whereby its rate of vaporization in the expansion chamber may be controlled.

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