Aug. 17, 1965 G. S. BIRD, JR 3,200,601

HEAT EXCHANGER

Filed Oct. 25, 1962 2 Sheets-Sheet 1

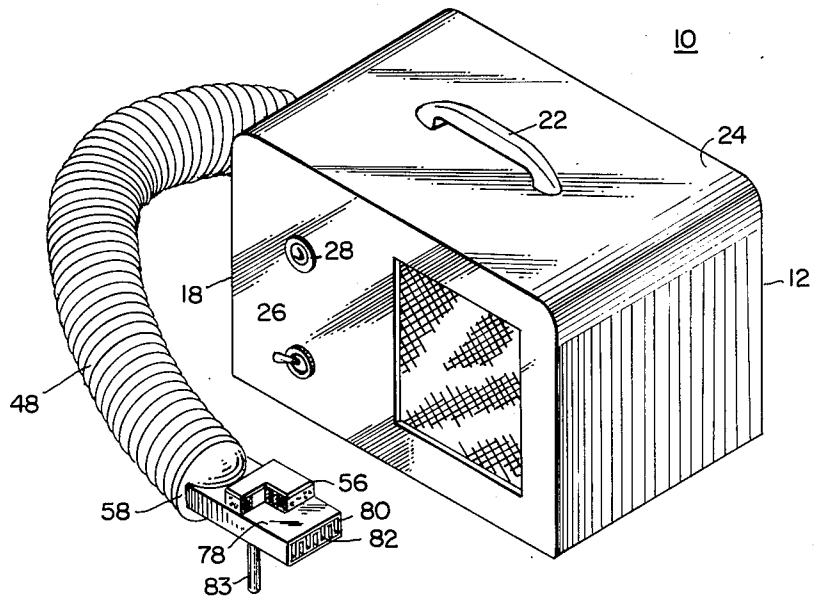

FIG. 1

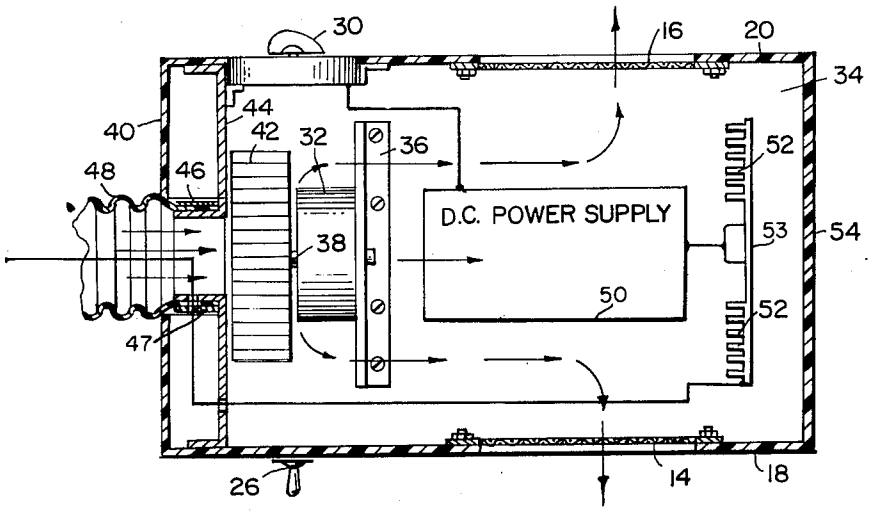

FIG. 2

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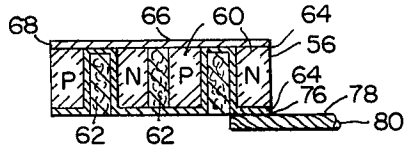

FIG. 3

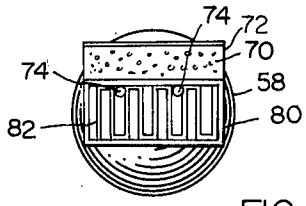

FIG. 5

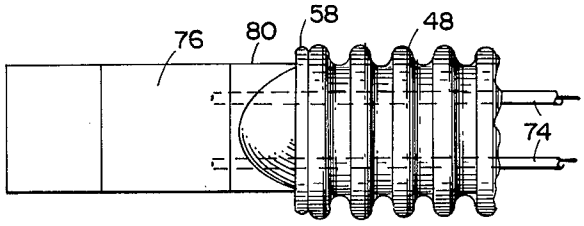

FIG. 4

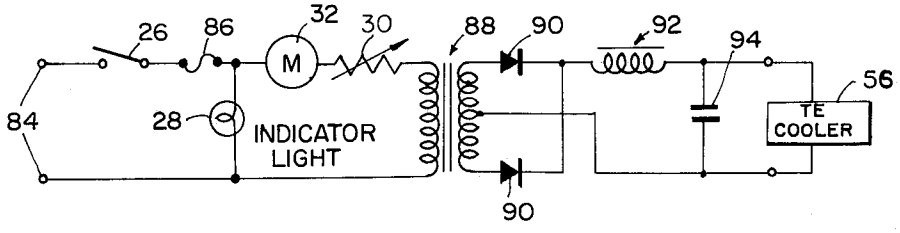

FIG. 6

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3,200,601

HEAT EXCHANGER

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1 Claim. (Cl. 62—3)

This invention relates generally to medical instruments and in particular to a thermoelectric device for use as a heat exchanger in the preparation of histological specimens prior to microtomic operations.

In the preparation of organic tissues for microscopic examination, it is essential that sections of an extremely thin nature are sliced from the original sample. Since the tissue sample is normally at room temperature, a method must be provided to maintain the tissue sample in a rigid state for the proper operation of a microtome.

Heretofore in medical technology two methods are in use to maintain a sample in a rigid state. One method involves the employment of hot paraffin to permeate the sample, allowing the paraffin to cool to present an inflexible paraffin tissue structure. There are several disadvantages with this method, the major one being that tissue slices in the magnitude of six microns or less are virtually impossible to obtain and secondly it is a time consuming operation. The other method utilizes carbon dioxide gas applied directly to tissue samples from a cylinder in such a manner as to freeze the sample and change it to a rigid state. However, cylinders of carbon dioxide gas are extremely bulky and are more or less in a fixed position within the laboratory thus requiring all preparation of slides to be made in a predetermined location.

Furthermore in both the paraffin and carbon dioxide methods of preparing tissues, special jigs must be provided to hold the sample during the operation of the microtome.

Therefore it is an object of this invention to provide a thermoelectric medical instrument which will quickly freeze tissue samples into a rigid state.

Another object of this invention is to provide a portable, compact and light-weight thermoelectric medical instrument adapted to prepare organic tissues for sectioning by a microtome.

It is another object of this invention to provide a medical instrument for the preparation of organic tissues for sectioning which will quickly accomplish its ultimate purpose and which has relatively few moving parts.

A further object of the invention is to provide a universal tissue preparing instrument which can be readily used with existing microtomes without the use of special adapters.

Another object of this invention is to provide a medical instrument in which the degrees of freezing of tissue specimens may be varied.

Other objects of the invention will, in part, be obvious and will, in part, appear hereinafter.

Broadly stated one feature of this invention is to provide a medical instrument which is capable of lowering the temperature of an organic tissue sample to −32° C. in three minutes and maintaining this temperature so that slices having a thickness in the magnitude of six microns may be taken with a microtome. Since time is an important factor in biopsy examinations, on smaller specimens the temperature can be reduced to zero degrees centigrade in 25–30 seconds enabling a report to be returned to the surgeon during the actual operation.

To the accomplishment of this and the foregoing related ends, the present invention then consists of the means hereinafter fully described and particularly pointed out in the claim, the annexed drawings and the following description setting forth in detail certain means in the carrying out of the invention, such disclosed means illustrating, however, but one of the various ways in which the principle in the invention may be employed.

In the drawings:

FIG. 1 is a view in perspective of the apparatus embodying the feature of this invention;

FIG. 2 is a top plan view, partly broken away of the power supply of the apparatus;

FIG. 3 is a view in section of the operational head of the apparatus;

FIG. 4 is a top plan view partly in section of the operational head of the apparatus;

FIG. 5 is an end view of the operational head and cooling duct of this invention; and

FIG. 6 is an electrical schematic of this invention.

Reference is now to be had to the drawings wherein an illustrative embodiment of the medical instrument, a construction made in accordance with the present invention and designated by the reference numeral **10** is shown. The medical instrument consists primarily of a cabinet **12** having outlet ports **14** and **16** on the front and rear sides **18** and **20**. A carrying handle **22** is positioned on the upper surface **24** to permit transporting the apparatus to various locations.

As illustrated in FIGS. 1 and 2 the front panel **18** of the cabinet **12** contains an on-off switch **26** and an indicator light **28**. The rear surface **20** of the cabinet **12** contains a variable rheostat at **30** for a purpose to be more fully described hereinafter.

Certain operating components of the invention are positioned within the cabinet as shown in FIG. 2 and included therein is a fan motor **32** secured to the base **34** of the cabinet **12** by a transversely extending bracket **36**. Attached to the shaft **38** of the fan motor **32** and extending in the direction of one end **40** of the cabinet **12** is a rotary impeller **42**. A partition **44** extends transversely across the interior of the cabinet **12** having a port **46** formed therein so as to be in alignment with the intake of the impeller **42**. Extending laterally away from the partition **44** and contiguous with the edges of the port is a circular flange **47** having an external diameter less than the diameter of a flexible duct **48** which is inserted thereover. Located within the cabinet **12** is a conventional direct current power supply **50** having the capability of providing 10 amperes and either 142 or 184 volts. A plurality of thermal dissipating heat sinks **52** are mounted on a panel **53** adjacent the other end **54** of the cabinet **12**.

As illustrated in FIGS. 3–5 the operational head **56** which is positioned at a point remote from the cabinet **12** is disposed adjacent the free end **58** of the flexible duct **48**. As shown in FIG. 3 the operational head includes N and P types of thermoelectric couples **60** which are composed of a quaternary alloy of Bismuth Teluride. The thermoelectric couples **60** are arranged alternately and spaced from each other by a fibrous glass wool insulation **62**. The couples **60** are connected by a copper strip **64** to effectuate the flow of electric current therethrough and an aluminum plate **66** acts as the freezing plate and is secured to the upper surface **68** of the connecting copper strip **64**. The exterior of the thermocouples **60** are surrounded by a poly-urethane foam **70** to insulate the sides from a chrome plated outer housing **72**. The leads **74** coming from the power supply **50** are directly connected to the lower copper strip **64** as illustrated in FIGS. 3 and 5.

The operational head **56** is bonded by an epoxy resin **76** to the upper surface **78** of an air cooled heat sink **80**. The heat sink **80** comprises a hollow rectangular box having a plurality of heat conducting folded metal fins **82** positioned therein adapted to conduct heat away from the operational head **56** and conventionally carried away from the area through the flexible duct **48**. A mounting

jig 83 is secured to the under surface of the heat sink 80 for a purpose to be set forth hereinafter.

In FIG. 6 there is illustrated an electrical schematic having the line voltage connected by a conventional plug (not shown) at 84 with the on-off switch 26 positioned in the line. The remainder of the circuit includes a fuse port 86, indicator light 28, fan motor 32, rheostat 30 and a transformer 88. The secondary of the transformers is adapted to deliver 10 amperes at either .42 or .84 volt to the rectifiers 90 which in turn passes through a choke 92 across a capacitor 94 to the leads 74 which convey the D.C. current to the thermo-couples 60.

In operation the mounting jig 83 is inserted in the microtome holder in an upright position and an organic sample placed on the aluminum plate 66. The on-off switch energizes the power supply 50 and simultaneously the fan motor 32. Due to the action of the thermo-couples 60 heat is drawn from the sample and radiated over the metal fins 82 and due to the action of the induction fan drawn in the direction of the cabinet 12 through the flexible duct 48. Under optimum operating conditions i.e., where the room temperature is at approximately 25° C., the following time and temperature relationships have been established:

Time:	Temperature, ° C.
25–30 seconds	0
1 minute	—10
1½ minutes	—15
2 minutes	—20
3 minutes	—25
4 minutes	—32

When the temperature is reduced sufficiently for the proper operation of the microtome, the jig may be rotated in the clamp so as to present the specimen for slicing without the necessity of removing the sample from the operating head.

With smaller samples of tissue the variable rheostat 30 may be adjusted to regulate the power supply and vary the time required to freeze the sample.

Furthermore it will be seen that utilizing an induction type air flow through the heat sink 80 provision is made to cool off the components disposed within the cabinet with particular emphasis on the rectifiers 80 as to maintain the temperature there within a 50–55° C. range.

While there have been described herein what are at present considered preferred embodiments of the invention, it will be obvious to those skilled in the art that modifications and changes may be made therein without departing from the essence of the invention. It is therefore to be understood that the exemplary embodiments are illustrative and not restrictive of the invention, the scope of which is defined in the appended claim, and that all modifications that come within the meaning and range of equivalency of the claim is intended to be included therein.

I claim:

A refrigerating attachment for microtomes, comprising in combination, an operational head, a thermo couple assembly having hot and cold junctions, the cold junction being mounted in heat exchange relationship with the bottom of the operational head, a heat sink consisting of an air heat transfer sinuous fin means adjacent to and in thermal exchange with the hot junction, a mounting jig secured to the under side of the heat sink, a cabinet containing a central power supply and air induction means, said cabinet remotely disposed from the operational head, a flexible duct means connecting the heat sink to the cabinet to maintain an air flow through said heat sink.

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