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TISSUE MACERATOR

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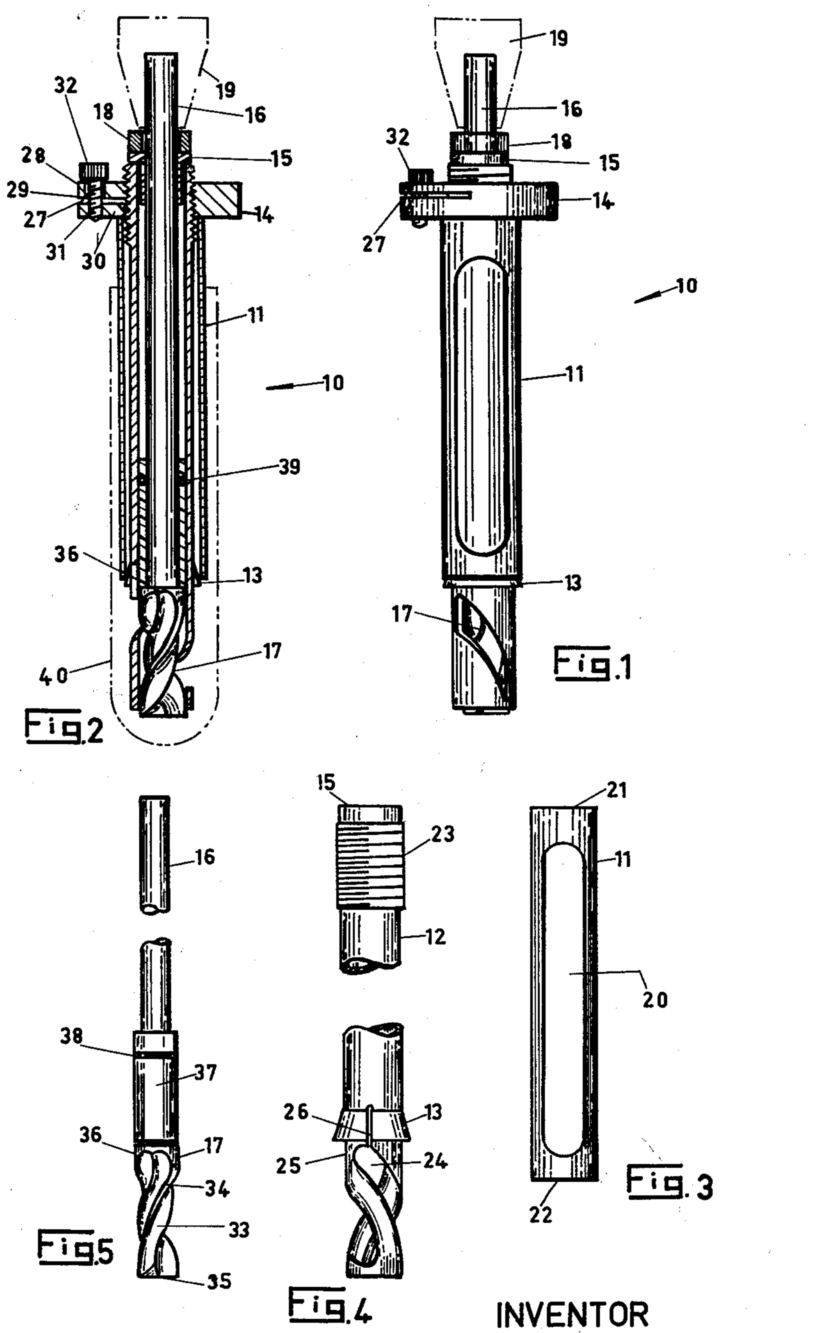

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TISSUE MACERATOR

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This invention relates to improvements in medical laboratory equipment, and more particularly to improvements in equipment utilized to rapidly macerate small quantities of tissue or the like.

It is conventional practise to reduce animal tissue or the like to very fine particles for experimental purposes by utilizing a type of mincing machine normally used in the reduction of large quantities of meat and the like to a ground consistency. These machines have the disadvantages that they are large and normally heavy and, being designed for use with bulk material, are unsuitable for preparing small samples.

Other attempts to overcome these difficulties have resulted in the invention of a tissue macerator which, although relatively efficient in the maceration of small quantities of tissue, has certain mechanical disadvantages in that its rotary shaft runs in and is supported by a tube having no anti-frictional bearing surfaces and therefore "picking up" occurs between the shaft and the tube. Furthermore, the efficiency of the machine depends upon a very close tolerance fit between rotating cutting edges and stationary cutting edges, these wear very quickly and as there is no method of adjusting these clearances the efficiency of the machine is reduced to a point where the components must be replaced. Also, during the maceration process, a certain amount of liquid is freed, this liquid under the influence of the cutting blades is forced upwardly and eventually works through the small annular space between the rotating centre shaft and the outer tube to emerge under pressure through the upper end of the machine, thus resulting in the loss of valuable liquid and a somewhat distasteful cleaning job to be carried out.

It is an object of this invention to provide a tissue macerator that may be utilized to minutely subdivide small amounts of animal tissue or the like.

It is another object of this invention to provide a tissue macerator that will fit easily within a standard container such as, for instance, a test tube.

It is yet another object of this invention to provide a tissue macerator that may be driven by an electric motor or the like.

It is a further object of this invention to provide a tissue macerator the rotating portion of which is supported in anti-friction bearings, thus preventing any "picking up" between it and the outer body.

It is another object of this invention to provide a tissue macerator, that, by the provision of suitable sealing means, will prevent the loss of any fluid released during the maceration process.

It is still another object of this invention to provide a tissue macerator that may have provision for adjusting the working clearance between the stationary blades thereof and the rotary blades thereof.

It is a further object of this invention to provide a tissue macerator whose adjusting mechanism for blade clearance may be locked in any predetermined position.

It is yet another object of this invention to provide a tissue macerator that may be quickly and easily dissembled for the purposes of washing, sterilizing and the like.

These and other objects and features of this invention will become apparent when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevation of a tissue macerator embodying this invention, the chuck of a driving motor being shown in phantom.

FIG. 2 is a mid vertical section of the tissue macerator as illustrated in FIG. 1.

FIG. 3 is a side elevation of a compression tube embodied in this invention.

FIG. 4 is a fractional side elevation of the outer tube embodied in this invention showing in particular the stationary cutting blades and the tapered collar adjustment.

FIG. 5 is a fractional side elevation of the rotary blade assembly embodied in this invention.

Referring to FIGS. 1 and 2, a macerator, indicated generally by arrow **10**, comprises a compression sleeve **11** having a tubular stationary blade carrier **12** retainably located therein. A tapered collar **13** is located adjacent the lower end of blade carrier **12** and limits the upward movement thereof within compression tube **11**, and a compression nut **14** is threadably received on the upper end of blade carrier **12**, thereby restraining it from downward movement within tube **11**.

The upper end of carrier **12** also supports a flanged bush **15** adapted to rotatably support the upper end of a spindle **16** of a rotary blade assembly **17**.

A collar **18** is freely fitted over the upper end of a spindle **16** and is adapted to limit the downward travel of a chuck **19** of an electric drill or the like, and, at the same time protect the upper surface of flanged bush **15** from damage from the rotating jaws of chuck **19**.

Referring to FIG. 3, compression tube **11** as illustrated in FIGS. 1 and 2 is formed of rigid tubular material such as, for instance, steel, two oppositely located, longitudinal slots **20** being formed therein, adapted to impart lightness and resiliency under compressive stresses to tube **11**. The side of slots **20** also provide a non slip grip for the operator of macerator **10**.

The upper edge **21** of compression tube **11** is substantially flat and is adapted to provide a working surface upon which the lower surface of compression nut **14** may rotate. The lower edge **22** of compression tube **11** is slightly chamfered to accommodate the tapered collar **13** of blade carrier **12**.

Referring to FIGS. 1, 2 and 4, stationary blade carrier **12** is tubular and formed of steel or the like.

A plurality of screw threads **23** are formed on the outer surface of blade carrier **12** at the upper end thereof, their crest diameter being such as to permit them to be substantially sliding fit within the bore of compression tube **11** as illustrated in FIG. 3.

To oppositely disposed helical slots **24** are formed in the lower walls **25** of tubular blade carrier **12**, terminating adjacent the end of blade carrier **12** so that the end circumference remains intact and the lower ends of slots **24** are retained in fixed relationship and will neither spring inwardly or spread outwardly.

Tapered collar **13** as illustrated in FIG. 1 is located immediately above slots **24** and is adapted to taper upwardly and inwardly therefrom. Two oppositely located slits **26** are formed in the walls of tubular blade carrier **12** and extend longitudinally upwardly from the upper edges of slots **24** to terminate above the upper edges of collar **13**. Slits **26** are adapted to permit the diameter of tubular blade carrier **12** to be reduced in the area adjacent the upper ends of slots **24**.

It should be noted that the minor diameter of tapered collar **13** is less than the internal diameter of compression tube **11** as illustrated in FIG. 3, and the major diameter of collar **13** is greater than the internal diameter of compression tube **11**.

Upon assembly of blade carrier **12** as shown in FIG. 4 within compression tube **11** as illustrated in FIG. 3, tapered collar **13** is adapted to partially fit within lower end **22** of tube **11** and screw threads **23** of blade carrier

12 are substantially equally disposed above and below upper edge 21 of compression tube 11.

Referring also to FIGS. 1 and 2, blade carrier 12 may be retained within compression tube 11 by means of compression nut 14, nut 14 being adapted to threadably engage screw threads 23 of blade carrier 12 extending outwardly from upper edge 21 of compression tube 11.

Compression nut 14 is substantially circular having a disc like configuration, a horizontal slit 27 being formed in substantially parallel, equally spaced apart relationship with the upper and lower surfaces thereof, and extending from the periphery substantially half way therethrough. The upper portion 28 of nut 14 above slit 27 carries a clearance hole 29 formed vertically therein and the oppositely located lower portion 30 carries a female thread 31 formed therein in axial alignment with clearance hole 29. A lock screw 32 is adapted to pass downwardly through clearance hole 29 to threadably engage with threads 31 and, upon further rotation to cause upper portion 28 and lower portion 30 to distort downwardly and upwardly respectively, closing horizontal slit 27 and thereby compressing the female threads of compression nut 14 upon threads 23 of blade carrier 12 and thereby locking compression nut 14 in relation to blade carrier 12.

Referring to FIGS. 1, 2 and 5 rotary blade assembly 17 comprises spindle 16 terminating in two oppositely located fluted, helical blades 33 of an opposite configuration to slots 24 of blade carrier 12. The outer edges 34 of blades 33 are sharpened and, upon assembly within blade carrier 12, are adapted to be a close working fit within the lower portion 25 of blade carrier 12 defined by helical slots 24.

Helical blades 33 of rotary blade assembly 17 terminate in horizontal, chisel like edges 35.

Referring to FIGS. 2 and 5, it may be seen that the diameter of spindle 16 is somewhat less than the diameter of blades 33, a shoulder 36 being formed therebetween. Shoulder 36 is adapted to support a cylindrical bearing block 37, block 37 being adapted to fit tightly around spindle 16 and to be a running fit in the bore of blade carrier 12.

It may be seen, therefore, that bearing block 37 rotates with spindle 16 of rotary blade assembly 17 and supports the lower portion of spindle 16 within blade carrier 12. An annular groove 38 is formed in the external surface of bearing block 37 and is adapted to accommodate an O-ring 39 as illustrated in FIG. 2. O-ring 39 is adapted to provide a fluid tight seal between bearing block 37 of rotary blade assembly 17 and the bore of blade carrier 12.

Upon assembly, blade carrier 12 is installed and locked within compression tube 11 as previously described and rotary blade assembly 17 is slidably inserted within blade carrier 12. Spindle 16 is supported at its lower end by bearing block 37 and at its upper end by flanged bush 15 as illustrated in FIGS. 1 and 2. Bottom edges 35 of helical blades 33 are substantially aligned with the lower edge of blade carrier 12, collar 18 is interposed between chuck 19 and flanged bush 15, thereby limiting the downward movement of spindle 16 and preventing edges 35 of blades 33 from extending excessively below blade carrier 12.

In operation, macerator 10 is assembled as illustrated in FIGS. 1 and 2 and, as illustrated in FIG. 2, it may be inserted in a test tube 40 shown in phantom. Material to be macerated is placed in the vicinity of blades 33 of rotary blade assembly 17 and, upon rotating blade assembly 17 bottom edges 35 of blades 33 both chop the material and cause it to move upwardly in the flutes of helical blades 33. Upon reaching the upper limits of blades 33 the material is ejected through helical slots 24 in blade carrier 12. The edges of slots 24 are also sharpened so that a guillotine action takes place between edges 34 of helical blades 33 and slots 24 and the material is chopped still further, before being ejected outwardly through slots 24 to return to the bottom of test tube 40.

This process may be repeated indefinitely until the material is completely macerated. O-ring 39 effectively blocks the upward passage of any liquid matter which may be formed during the maceration process, thus, the specimen remaining in test tube 40 is completely representative of the original material.

It may be seen that the majority of the cutting action takes place between the upper ends of helical blades 33 and the corresponding upper ends of slots 24 and, therefore the maximum amount of wear takes place in this area. This excessive clearance may be reduced by slackening lock screw 32 and screwing down on compression nut 14, thereby drawing blade carrier 12 further into compression tube 11 and causing taper collar 13 to move upwardly and inwardly of end 22 of compression tube 11. Pressure exerted on collar 13 through the walls of compression tube 11 causes slits 26 to be reduced in width and therefore reduces the diameter of blade carrier 12 in this area. In this manner the working clearance between the internal diameter of blade carrier 12 and the external diameter of helical blades 33 is reduced and the cutting action therebetween remains at maximum efficiency.

Upon completion of the macerating action, macerator 10 may be removed from test tube 40 and quickly and easily disassembled for the washing or sterilizing process.

The general design of the individual parts of this invention as explained above may be varied according to requirements in regards to manufacture and production thereof, while still remaining within the spirit and principle of the invention, without prejudicing the novelty thereof.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A macerator device comprising an inner shaft member, an outer tubular member, said inner shaft member adapted to be rotatable within said outer member, helical cutting flutes located at one end of said inner shaft member, said helical cutting flutes having a solid central portion, contra-helical guillotine blades formed in one end of said outer tubular member adjacent said flutes, and fluid sealing means located between said inner member and said outer member.

2. A macerator device comprising an inner shaft member, an outer tubular member, said inner shaft member adapted to be rotatable within said outer member, helical cutting flutes located at one end of said inner shaft member, said helical guillotine blades formed in one end of said outer tubular member adjacent said flutes, said helical guillotine blades defining helical slots therebetween, a tapered collar formed on said outer member adjacent to said helical slots, a clearance adjustment slit extending from one end of said helical slots substantially axially through said collar, screw-adjustable sleeve means adapted to compress said tapered collar for contraction of said slit, and fluid sealing means located between said inner member and said outer member.

3. A macerator device as claimed in claim 1 having bearing means located between said outer member and said inner member and a thrust bearing located on said inner member adjacent to said outer member.

4. A macerator device as claimed in claim 2 wherein said screw adjusting means is provided with a locking device.

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