Sept. 16, 1969 P. O. CARY 3,467,075

HAND OPERATED SECTIONING MACHINE

Filed Dec. 5, 1966 2 Sheets-Sheet 1

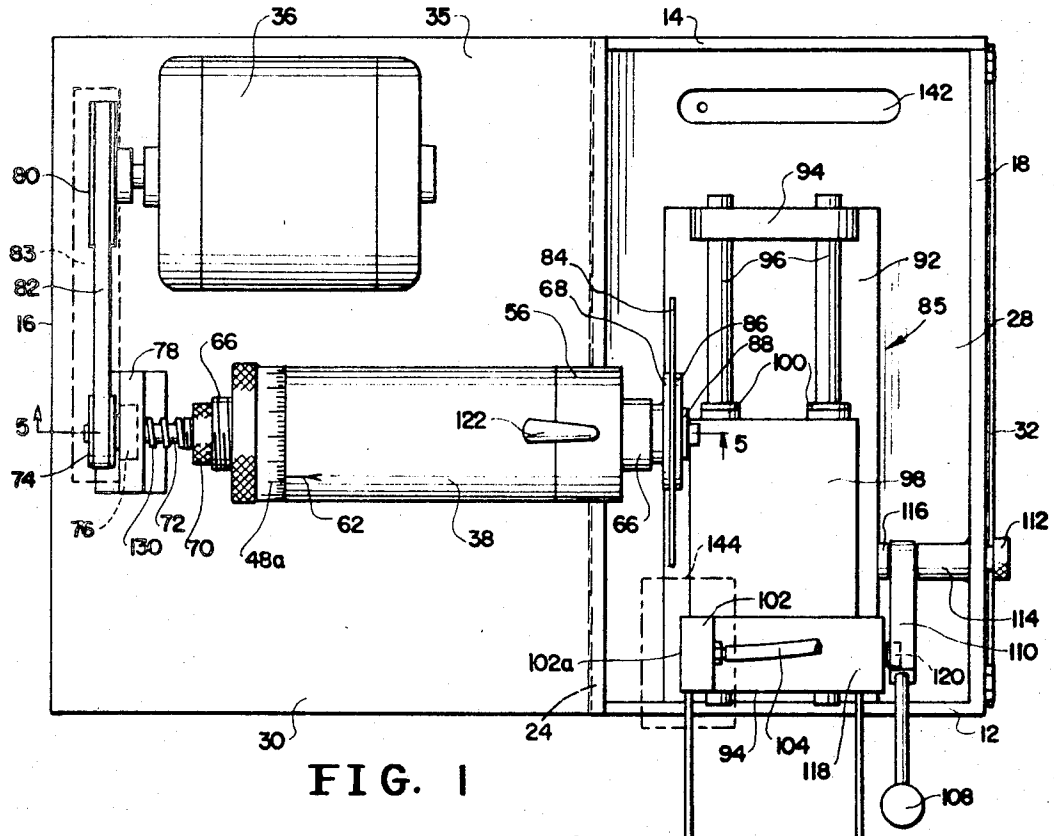


FIG. 1

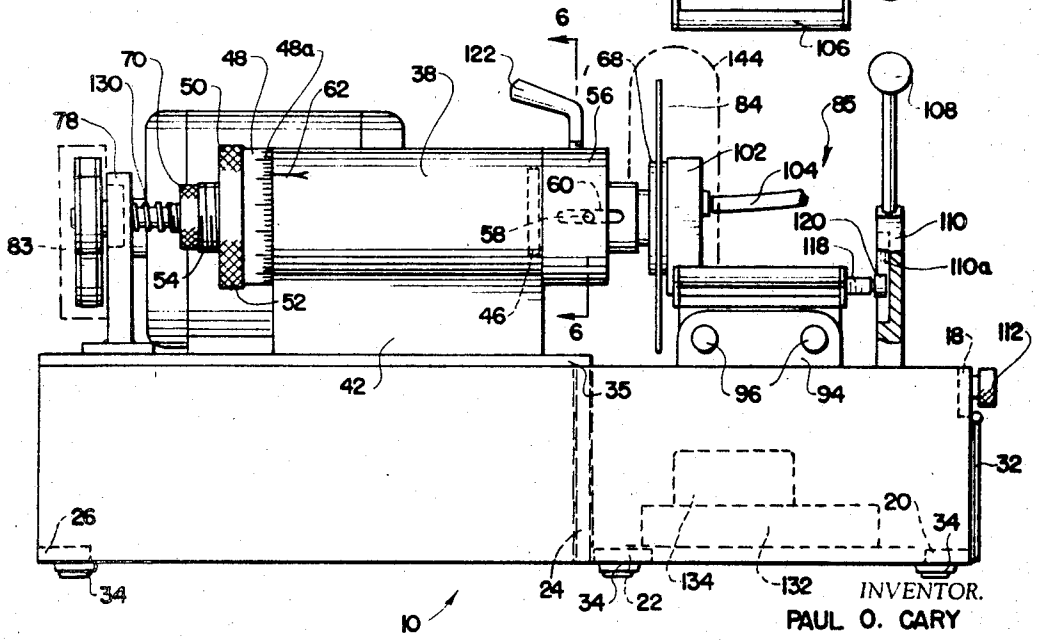


FIG. 2

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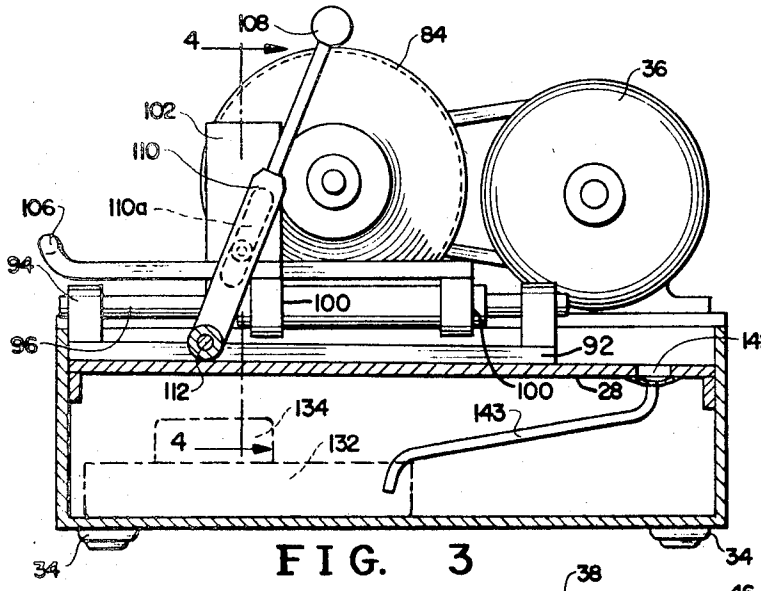


FIG. 3

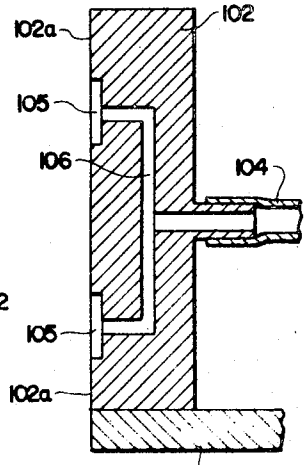


FIG. 4

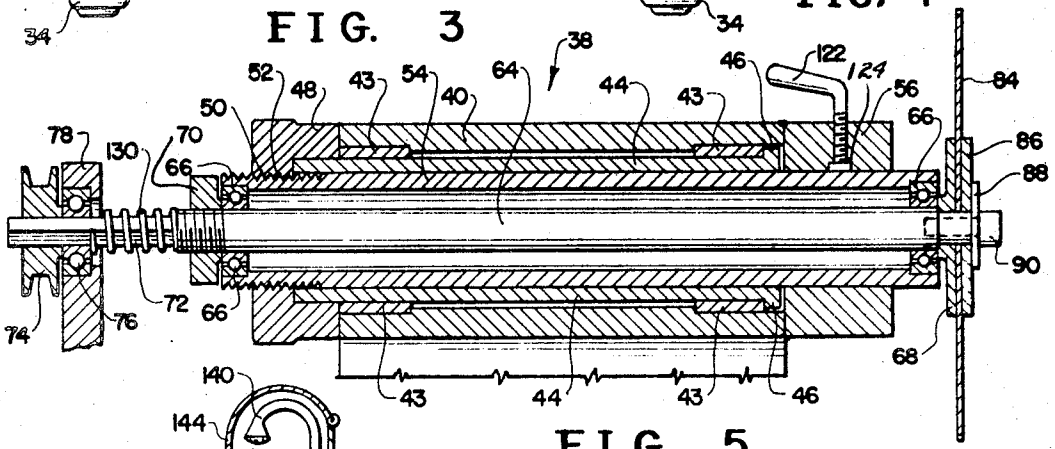


FIG. 5

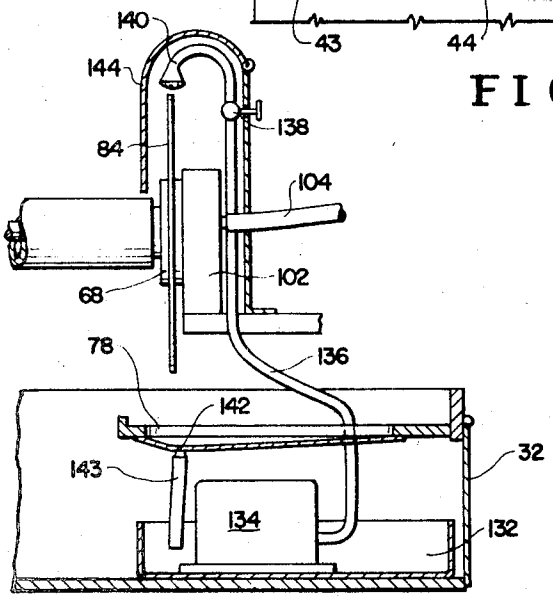


FIG. 7

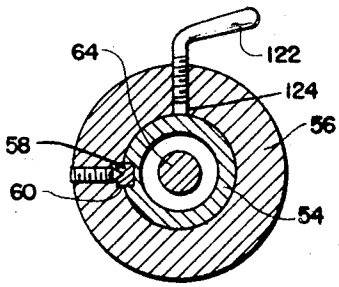


FIG. 6

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HAND OPERATED SECTIONING MACHINE

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Continuation-in-part of application Ser. No. 380,172, July 3, 1964. This application Dec. 5, 1966, Ser. No. 599,260.

Int. Cl. B28d *1/04;* B27b *5/34*

U.S. Cl. 125—13

10 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates generally to machines utilized to process solid material into cross sections for analysis, quality control and the production of products. The present apparatus is particularly adaptable for the processing of ore into thin section analysis specimens used by mineralogists and geologists to determine the mineral content and grain structure of any given sample. This apparatus is designed to cut or saw very thin slabs from a piece of rock or the like to be subsequently examined for mineral content.

The present invention is a continuation-in-part of application Ser. No. 380,172, filed July 3, 1964, now U.S. Patent No. 3,289,663 issued Dec. 6, 1966.

Such analysis specimens must possess certain physical characteristics which will render said specimens useful. They must be very thin, normally about .0012" thick, and must be in a plane as nearly parallel to the surface of the glass slide as possible. It is usually very desirable that the surface of such specimens be as smooth as possible and polishing is sometimes employed to obtain this feature.

The conventional way of producing such specimens, as heretofore practiced, is to clamp the rock, boulder or lump from which the specimen is to be taken in a large slabbing saw well-known in the prior art and in wide use. A cut is taken through said rock to establish a flat surface, then the rock is reclamped and a second cut taken in order to slab off a piece that is from ⅛" to ⅜" of an inch thick and that has two roughly parallel faces. From said piece, a specimen is cut that will suitably fit upon a glass slide.

The specimen is then placed upon a lapping plate and one side lapped to obtain a smooth, flat surface. Said lapped surface is then impregnated with a suitable bonding agent, such as a clear epoxy cement, and then bonded to the glass slides so that the flat surface of the glass and the lapped surface of the specimen fit together as closely as possible in a plane.

The specimen, now mounted upon the slide, goes through subsequent trimming, lapping and polishing operations in order to obtain the finished specimen. Said subsequent operations, as heretofore practiced, have involved the use of a different machine or device for each operation, for instance, a small slabbing saw for trimming, a lapping or grinding machine, and a polishing machine. Employing the means as heretofore practiced involves a great deal of operator time and skill as the specimens are, for the most part, clamped, trimmed, fed, lapped or ground, and polished by hand. Skill on the part of the operator is very important because the operator must correct any errors induced in prior operations.

Since specimens are usually worked through the above

mentioned operations by hand and through different machines, the heretofore practiced process does not lend itself very well when production of said specimens is in large quantities. The making of such specimens has been ever increasing, due to the search for more and better materials.

Accordingly, an object of the present invention is to provide an improved device for producing thin section specimens on a large scale production basis.

A second object of the invention is to provide a single device for surfacing, trimming, grinding and polishing the thin section specimens.

Another object of the invention is to provide a device whereby a specimen is accurately positioned on a chuck and securely held during the subsequent trimming, grinding and polishing operations.

Still another object of the invention is to proivde a device whereby the thickness of cut is easily and accurately adjusted.

Other objects of the invention are to provide a machine that is portable, clean operating, easy to maintain and safe to use.

In order to understand the invention, reference is directed to the accompanying drawings, wherein:

FIGURE 1 is a top plan view of the invention;

FIGURE 2 is a side elevational view of the invention with parts broken away;

FIGURE 3 is an elevational view from the front of the invention;

FIGURE 4 is a view in partial cross section of the vacuum chuck assembly taken on line 4—4 of FIGURE 3;

FIGURE 5 is a cross section of the spindle assembly taken along line 5—5 of FIGURE 1;

FIGURE 6 is a view in partial cross section taken along line 6—6 of FIGURE 2 showing the lock screw arrangement; and

FIGURE 7 is a diagrammatic view of the invention showing the spray system and the protection shield.

With reference to the drawings, the supporting base **10** having a rectangular configuration includes the side panels **12**, **14** and **16**, and cross members **18**, **20**, **22**, **24** and **26**. The coolant drain floor **28** comprises the front portion of the base, whereas the control panel **30** and adjacent mounting deck **35** form the rear portion of the base **10**. These parts are preferably welded, but may be joined by any other means, including bolting. The flap door **32** pivotally mounted on the front of cross member **18** allows easy access to the area beneath drain floor **28**. Mounted on the deck **35** are the drive motor **36** and the quill assembly indicated generally as **38**.

Six rubber feet **34** are attached to the bottom edge of cross members **20**, **22** and **26** near each corner to provide support for the entire machine base **10**. The feet compensate for any unevenness of surface and resist slippage.

The quill assembly **38**, as shown best in FIGURES 1, 2 and 5, comprises a cylindrical quill housing **40** which is mounted to the deck **35** by the mounting block **42**. Within each end of the quill housing **40** are two sleeve bearings indicated as **43**, and within the sleeve bearings **43** is fitted a tubular shaft **44**. It is to be noted that tubular shaft **44** has the flange **46** which runs against the face of its bearing **43**, while the other end of tubular shaft **44** has a graduated micrometer dial **48**, described hereinafter, attached thereto, and said shaft **44** also runs against the face of sleeve bearing **43**. Thus, it is clear that the tubular

shaft **44** is free to rotate in its sleeve bearing **43** and is at the same time retained against longitudinal movement.

The micrometer dial **48** is provided with internal threads **50** which engage the external threads **52** on the quill **54**. Quill **54** would be otherwise a slip fit inside tubular shaft **44** and the housing cap **56**. Housing cap **56** carries a key **58** which engages a key way **60** provided in quill **54**. It is easily seen that, when the micrometer dial **48** is turned, the threads **50** engage the threads **52** on quill **54**, thus imparting longitudinal movement to the quill **54**. However, quill **54** is prevented from rotating by means of key **58** and key way **60**. It will also be noted that the micrometer dial **48** is provided with numerous graduations **48***a* engraved around its circumference which are easily set in relation to the witness mark **62**, thus closely controlling longitudinal movement of quill **54**.

Referring to FIGURES 2 and 5, lock screw **122** provides a means of locking the quill **54** once adjustment is established. As will be seen, the lock screw **122** threads into the housing cap **56**. However, between screw **122** and quill **54** is a brass pad **124**. It will be seen that the screw **122** can force pad **124** against quill **54** with sufficient pressure to clamp quill **54**. The pad **124** prevents the marring of the surface of quill **54**.

The spindle **64**, shown best in FIGURE 5, is rotatably journaled inside quill **54** and runs in the two ball bearings indicated as **66**. The spindle **64** has amounting flange **68** and threaded thrust collar **70**, both acting to retain the spindle **64** longitudinally and to pre-load the bearings **66** in order to eliminate spindle end shake. The thrust collar **70** is threadably engaged with the spindle shaft **64** and provides a manner of adjusting the amount of bearing pre-load.

The mounting flange **68** provides a suitable surface for mounting a circular saw blade and other processing tools. The saw blade **84** is retained against the flange **68** by the clamp disc **86**, washer **88** and screw **90**.

Extending from the spindle shaft **64** out of the quill **54** is the drive rod **72** which possesses a square cross section. The square drive rod **72** engages a square hole in pulley **74** which is rotatably journaled in ball bearing **76** so that pulley **74** is free to turn, but longitudinally retained. Ball bearing **76** is mounted in housing **78** which is mounted on deck **35**. It is clear then that, since pulley **74** engages the square drive rod **72** with a square hole, a means is provided for pulley **74** to transmit rotary power to the spindle shaft **64** and at the same time allowing the spindle to be longitudinally moved in relation to the pulley **74**. Thus, it is obvious that, by rotating the spindle shaft **64**, the mounting flange is also rotated.

Drive motor **36** is provided with pulley **80** and a V-belt **82** between pulley **74** and **80** to provide a transfer of power. A belt guard **83** is provided for safety considerations.

An important and patentably distinct part of this invention is the cross slide assembly **85** which is mounted on the coolant drain floor **28** (see FIGURES 1 and 2). The cross slide assembly includes cross slide base **92** which is mounted on the drain floor **28**. At each end of base **92** are positioned shaft mounting blocks **94** in which are mounted two parallel shafts **96**. A cross slide plate **98** is mounted upon shafts **96** utilizing four ball bushings **100** for linear movement. Thus, the slide plate **98** is able to slide along the length of shafts **96** under a very small amount of applied pressure.

Mounted upon the cross slide **98** is a chuck **102**, the face of which is employed to hold microscope slides upon which have been mounted rock specimens. The preferred manner of holding the specimens on the chuck face is by vacuum; however, the invention is not limited to this and other prior art holding methods may also be used. Since vacuum is the preferred manner of holding specimens on the chuck, it is supplied to the chuck **102** by the tubing **104** and reaches the chuck's face **102***a* by means of drilled ports **106** shown in FIGURE 4. It is seen that only two recessed specimen holding areas **105** are shown in the drawing; however, it is apparent that more speciment holding areas could be added. It is pointed out that other processing equipment can be mounted on the cross slide other than the specimen holding chuck, such as a vise.

Referring mainly to FIGURES 1 and 2, it is noted that a handle **106** is provided for hand feeding the cross slide **98** toward the blade **84** during sawing operations. An auxiliary fine feeding lever **108** is also provided for more closely controlled feeding of the cross slide **98**. It includes the lever block **110** which is pivotally mounted at its lower end to the cross slide base **92** by pivot screw **112** and spacer blocks **114** and **116**. Pivot screw **112** threads into the cross slide base **92**. The holes in spacers **114** and **116** and the lever block **110** are clearance holes. It is obvious, therefore, that the lever handle **108** can be moved in an arc.

Attached to the cross slide plate **98** is a feed block **118** on which is mounted a ball bearing **120**. The ball bearing **120** engages a slot **110***a* milled in block **110**. The width of slot **110***a* closely fits the diameter of ball bearing **120**. It can be seen that, when the feed lever **108** is removed in its arc, motion is transmitted from the lever block **110** to the cross slide plate **98** by means of the slot **110***a* and ball bearing **120**, the movement of the cross slide being parallel to the axis of shafts **96**.

The apparatus of this invention also includes a spray coolant system, since spraying lengthens the life of the cutting mechanism by facilitating its work. Spraying also enhances the finished product. Such a spraying system would include a coolant tray **132** inside of which is a pump **134**. Both of these are easily removed or replaced by lifting flap door **32** and sliding tray **132** and pump **134** in or out of the apparatus. The pump **134** will deliver a water spray or other spray material to the cutting area through a hose **136** through deck **35** to valve **138** and thence to spray nozzle **140** positioned at the said cutting area. The spray material floods the processing area and drains down to the drain floor **28**. Since the drain floor **28** is slightly lower in elevation at the drain area, spray material will run toward the drain opening **142** and drain through hose **143** to the tray **132**. A hinged coolant shield **144** confines the spray material to the cutting area. The shield is constructed preferably of a transparent material in order to allow ample viewing of the cutting operation.

The operation of the machine is as follows: In place of the vacuum chuck **102**, a vise (not illustrated) may be mounted on the cross slide **98**, a diamond blade **84** is mounted on the machine spindle. With the machine set up thus, a rock can be clamped in the vise and sectioned by feeding it through the saw blade **84**. In this case, the sawing handle **106** is used in order to feed the rock quickly and so the operator can feel the cutting pressure and resistance of the rock. The object of this operation is to saw a first flat surface on the rock. As many rocks as necessary can be run through this first surface operation. The lock lever **122** is tightened when cutting to prevent the spindle **64** from moving longitudinally.

After all the rocks are sawed, the first surface is bonded to glass microscope slides. The vise is removed and the vacuum chuck **102** is mounted on the cross slide **98**. The mounted rock is then gripped on the chucking face **102***a* of the chuck **102** by means of vacuum. The excess rock can now be sawed off by moving the cross slide **98** into the saw blade **84**. All rock is cut off the microscope slide except for a paper thin section. The amount of rock removed is controlled by adjusting the micrometer dial **48** until the correct amount is removed. Then the lock lever **122** is tightened to retain the setting. All the slide mounted rock is trimmed as aforementioned, leaving a number of slide mounted specimens. Saw blade **84** can now be removed from the machine spindle **64** and a diamond grinding cup wheel can be mounted in its place.

Each mounted specimen that has been previously trimmed by the saw blade **84** can now be rechucked and brought to "finish" by means of grinding. During the grinding operation, the feed lever **108** is utilized instead of handle **106**, since it is important to have more closely controlled feeding during grinding.

The grinding operation removes any irrgularities introduced by sawing, removes saw marks and brings the specimen to final thickness of 30 microns (.0012").

During the grinding operation, the quill lock screw **122** is loosened and the amount of material to be removed is controlled by adjusting the micrometer dial **48**. In practice, the specimen is passed by the grinding wheel several times, each pass taking off a small amount of rock until the specimen is brought to finished thickness.

A spring **130** is provided to remove all "backlash" from the micrometer adjustment. Since the micrometer dial **48** is of large diameter with a large number of graduations **48***a* around its circumference and, since the threads **50** engaging the quill **54** are fine, very close control of the amount of quill **54** movement is established.

It is pointed out that the feed lever **108** can be easily removed from the machine during the first surface and trim sawing operations by removing the pivot screw **112**, and then easily replaced for the later grinding operation.

Having thus described the several useful and novel features of the instant invention, it will be apparent that the many worthwhile objectives for which it was developed have been achieved. I realize that a certain changes and modifications in the invention may well occur to those skilled in the art within the broad teaching hereof; hence, it is my intention that the scope of protection afforded hereby shall be limited only insofar as said limitations are expressly set forth in the appended claims.

What is claimed is:

1. A thin sectioning machine comprising:
- a support base;
- a rotatable cutting system mounted on said support base, said cutting system having a spindle adaptable to rotational movement and a cutter mounted thereon at one end;
- a micrometer means positioned on said cutting system and designed to accurately adjust the said cutting system in a longitudinal direction;
- a power means mounted on said support base adjacent said cutting system and designed to transmit rotational power to said spindle;
- a sliding cross slide plate mounted on said support base and designed to be manually moved both toward and away from said rotating cutting system;
- a specimen holder removably mounted on said cross slide plate and designed to bring a specimen positioned thereon into contact with said cutter when the said cross slide plate is moved toward said cutting system.

2. The thin sectioning machine as defined in claim **1** wherein:
- the said specimen holder has a plurality of suction positions on the face thereof; each suction position being connected to a series of ducts within the said specimen holder; and
- means to provide vacuum to said specimen holder and thence to said suction positions enabling a specimen to be held thereon.

3. The thin sectioning machine as defined in claim **1** wherein:
- spray means are mounted adjacent the cutter to provide a cooling spray on both the cutter and the specimen; and
- a coolant shield means mounted over the cutting area to retain the said spray therein.

4. A thin sectioning machine comprising:
- a support base;
- a quill positioned on said support base;
- a spindle mounted for rotational movement inside said quill but restrained against longitudinal movement;
- a mounting flange positioned at one end of said spindle;
- a cutter removably mounted on said mounting flange;
- a micrometer threadably mounted on said quill designed to move the quill in an accurately measured longitudinal direction and simultaneously prevent rotational movement of said quill;
- a power means mounted on said support base and adapted to transmit rotational power to said spindle;
- a pair of spaced parallel shafts mounted on said support base positioned transversely and adjacent to said spindle and said cutter;
- a sliding cross plate slidably mounted on said spaced parallel shafts, said cross slide plate designed to manually slide along said parallel shafts both toward and away from said rotating cutter;
- a specimen holder removably mounted on said cross slide plate and designed to bring a specimen positioned thereon into contact with said rotatable cutter.

5. The thin sectioning machine as defined in claim **4** wherein:
- the said specimen holder has a plurality of suction positions on the face thereof; each suction position being connected to a series of ducts within the said specimen holder; and
- means to provide vacuum to said specimen holder and hence to said suction positions enabling a specimen to be held thereon.

6. The thin sectioning machine as defined in claim **4** wherein:
- spray means are mounted adjacent the cutter to provide a cooling spray on both the cutter and the specimen; and
- a coolant shield means mounted over the cutting area to retain the said spray therein.

7. A thin sectioning machine comprising:
- a support base;
- a quill housing mounted on said support base;
- a quill positioned inside said quill housing and adaptable for longitudinal movement;
- a spindle mounted for rotational movement inside said quill but restrained against longitudinal movement;
- a mounting flange positioned at one end of said spindle;
- a cutter removably mounted on said mounting flange;
- a micrometer threadably mounted on said quill designed to move the quill in an accurately measured longitudinal direction and simultaneously prevent rotational movement of said quill;
- a power means mounted on said support base and adapted to transmit rotational power to said spindle;
- a pair of spaced parallel shafts mounted on said support base positioned tranversely and adjacent to said spindle and said cutter;
- a sliding cross slide plate slidably mounted on said spaced parallel shafts, said cross slide plate designed to manually slide along said parallel shafts both toward and away from said rotating cutter;
- a specimen holder removably mounted on said cross slide plate and designed to bring a specimen positioned thereon into contact with said rotatable cutter.

8. The thin sectioning machine as defined in claim **7** wherein:
- the said specimen holder has a plurality of suction positions on the face thereon; each suction position being connected to a series of ducts within the said specimen holder; and
- means to provide vacuum to said specimen holder and hence to said suction positions enabling a specimen to be held thereon.

9. The thin sectioning machine as defined in claim **7** wherein:
- spray means are mounted adjacent the cutter to provide a cooling spray on both the cutter and the specimen; and

a coolant shield means mounted over the cutting area to retain the said spray therein.

10. The thin sectioning machine as defined in claim **7** wherein:

an auxiliary feed lever engages and cooperates with said cross slide plate to provide fine manual feed control.

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U.S. Cl. X.R.

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