

[54] ROCK CUTTING AND POLISHING DEVICE

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[58] Field of Search 125/13, 35; 269/130, 131;
51/3

[56] References Cited

UNITED STATES PATENTS

784,561	3/1905	Grice	125/13 R
1,826,056	10/1931	Denmead	125/13 R
2,021,602	11/1935	Jackson	51/3 X

2,431,671	12/1947	Arms	51/3 X
2,491,047	12/1949	Hunt et al.	125/13 R
2,557,251	6/1951	Baker et al.	125/13 R
2,795,984	6/1957	Sladek	269/131 X
2,822,710	2/1958	Hiaman	269/131 X
2,948,088	8/1960	Jepson	51/3 X
3,671,032	6/1972	Gettinger	269/131 X

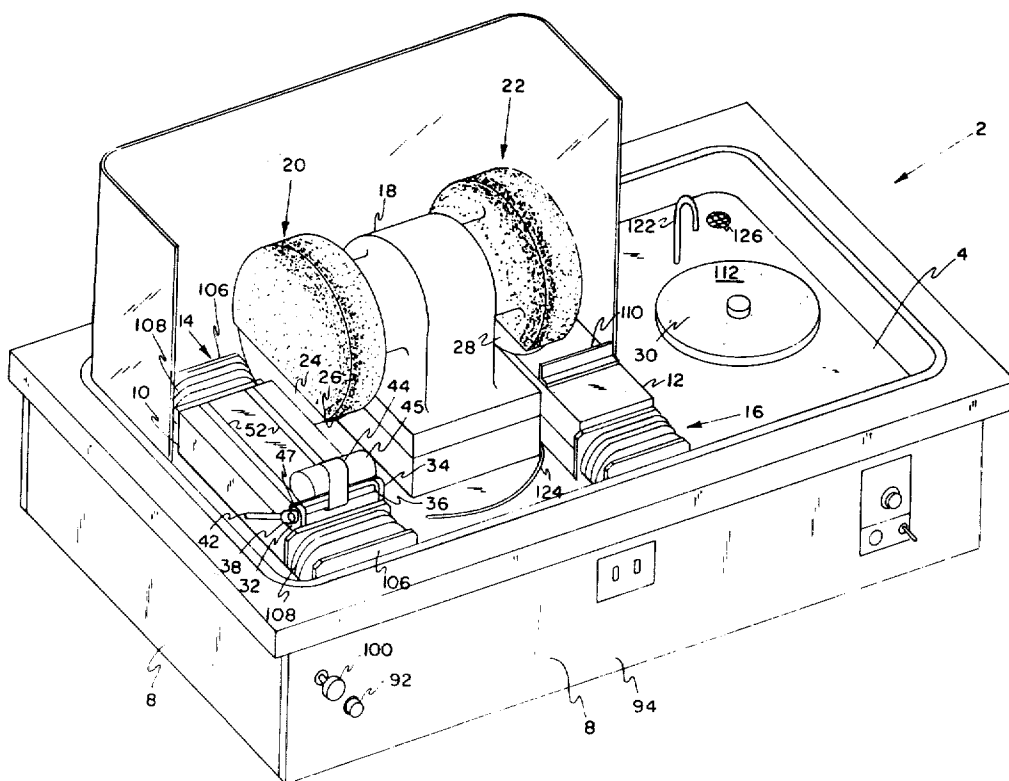
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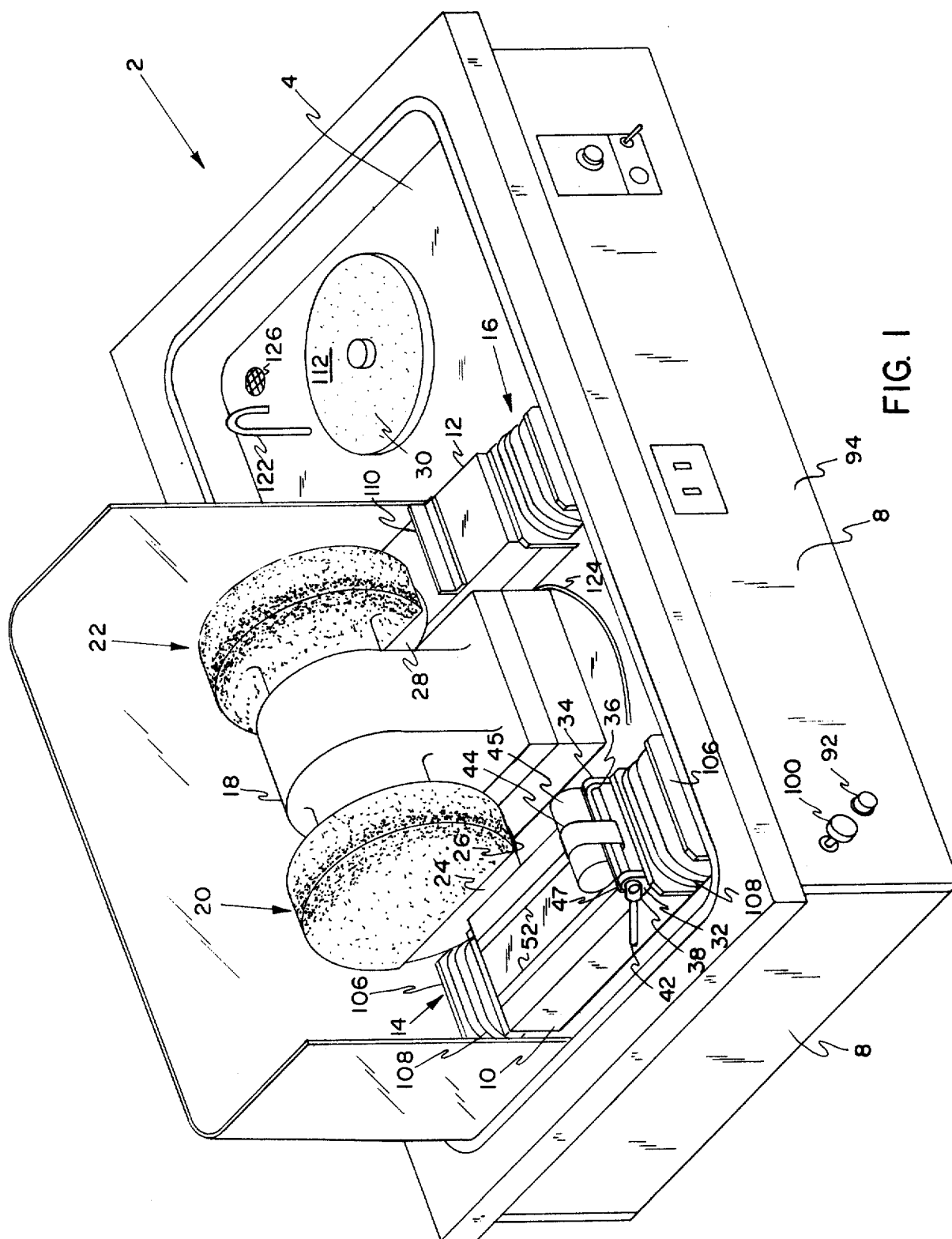
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ABSTRACT

A rock cutting and polishing device comprising a plurality of rock cutting saws, a plurality of cutting tables each mounted for movement adjacent to a respective one of said saws, hydraulic means for moving at least one of said cutting tables at a rate responsive to variations in cutting pressure, flexible means for securing a rock sample to at least one of said cutting tables, and one or more rotatable lap tables for polishing and grinding rock specimens cut by said saws.

7 Claims, 7 Drawing Figures





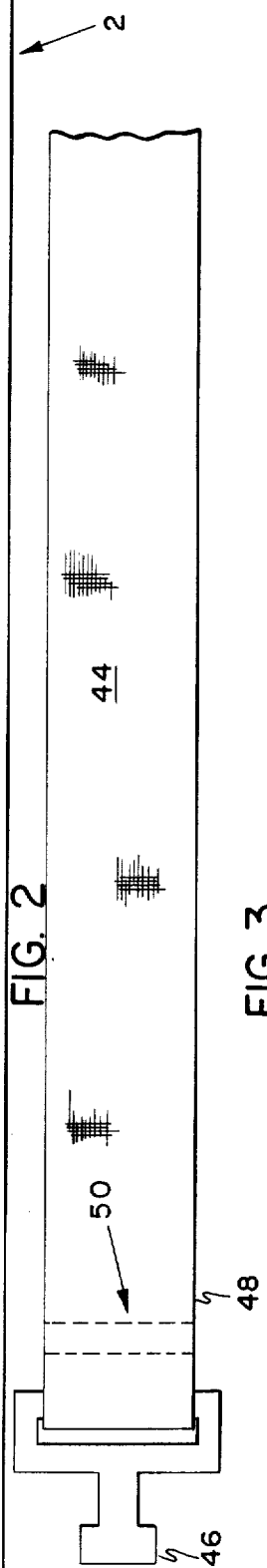
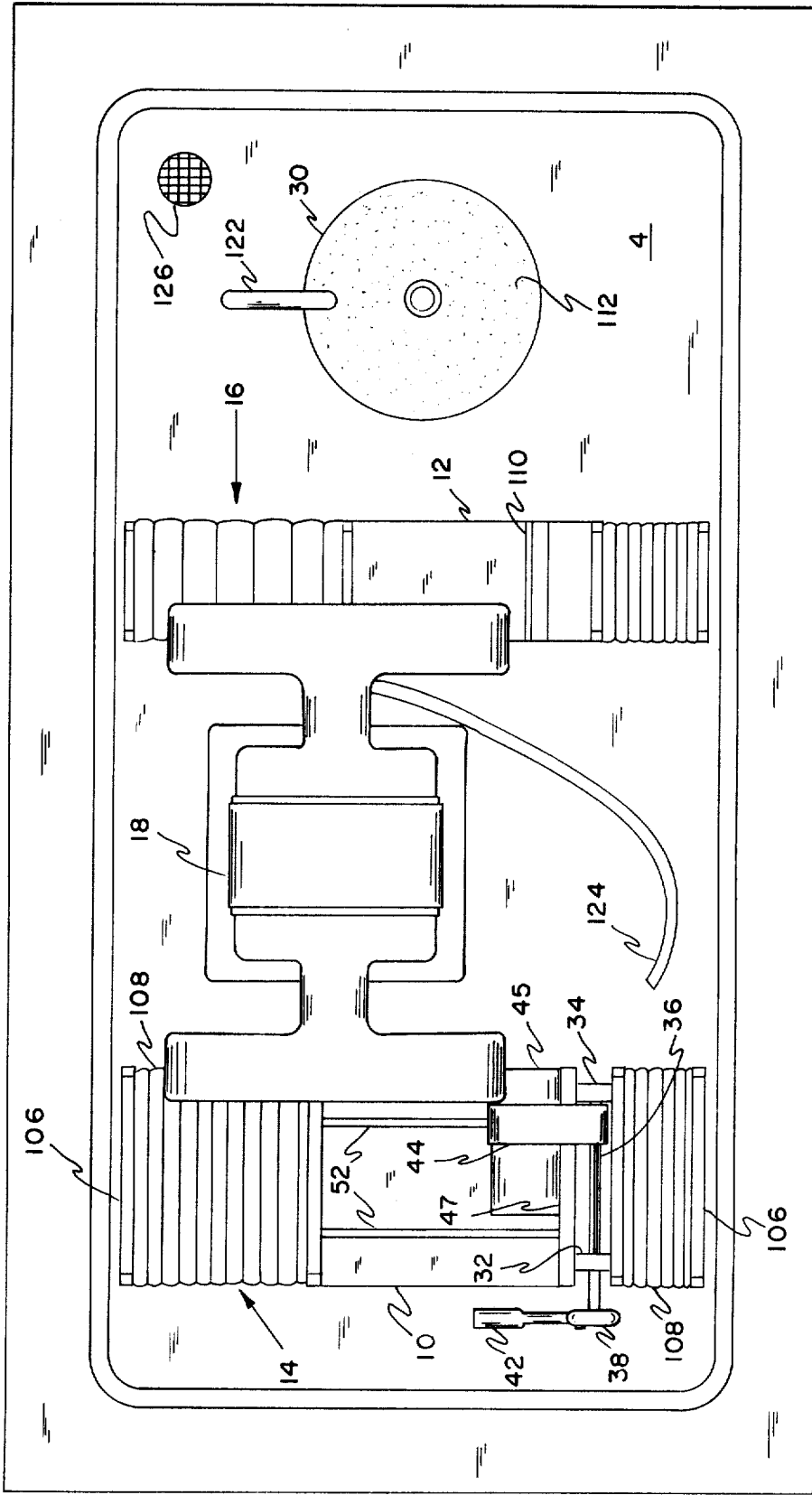


FIG. 2

FIG. 3

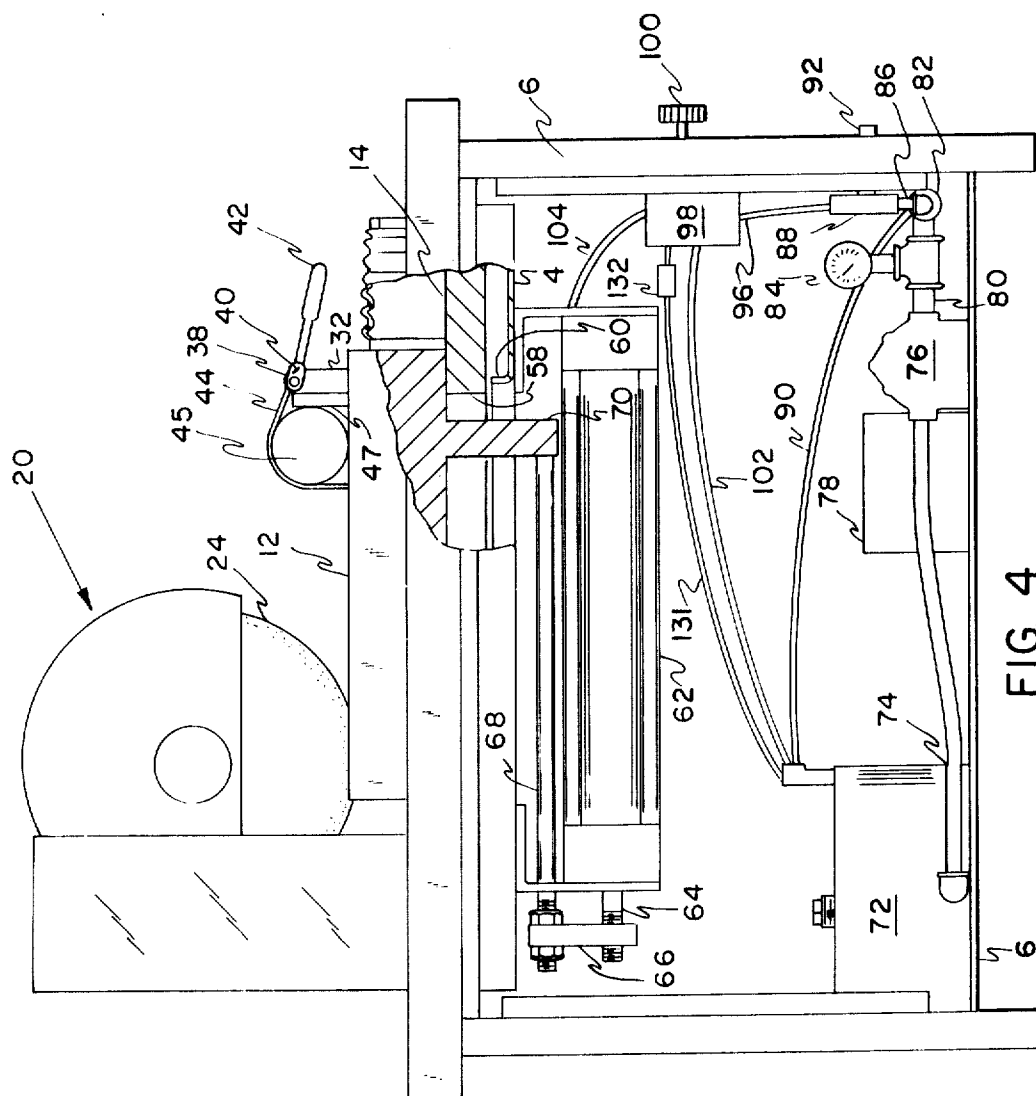


FIG. 4

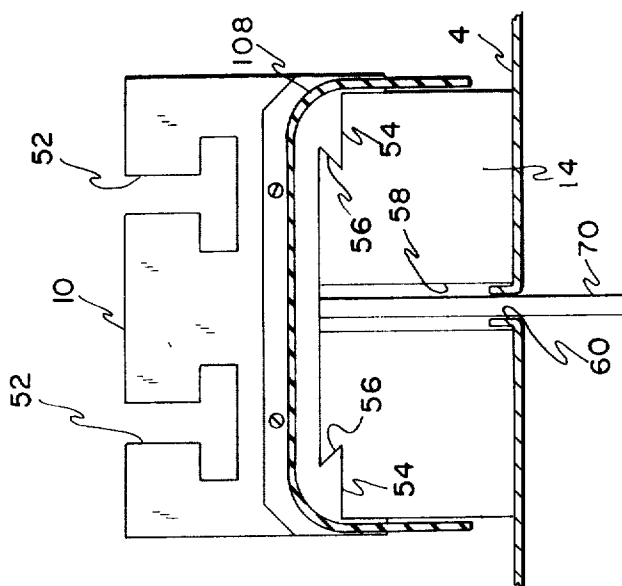


FIG. 5

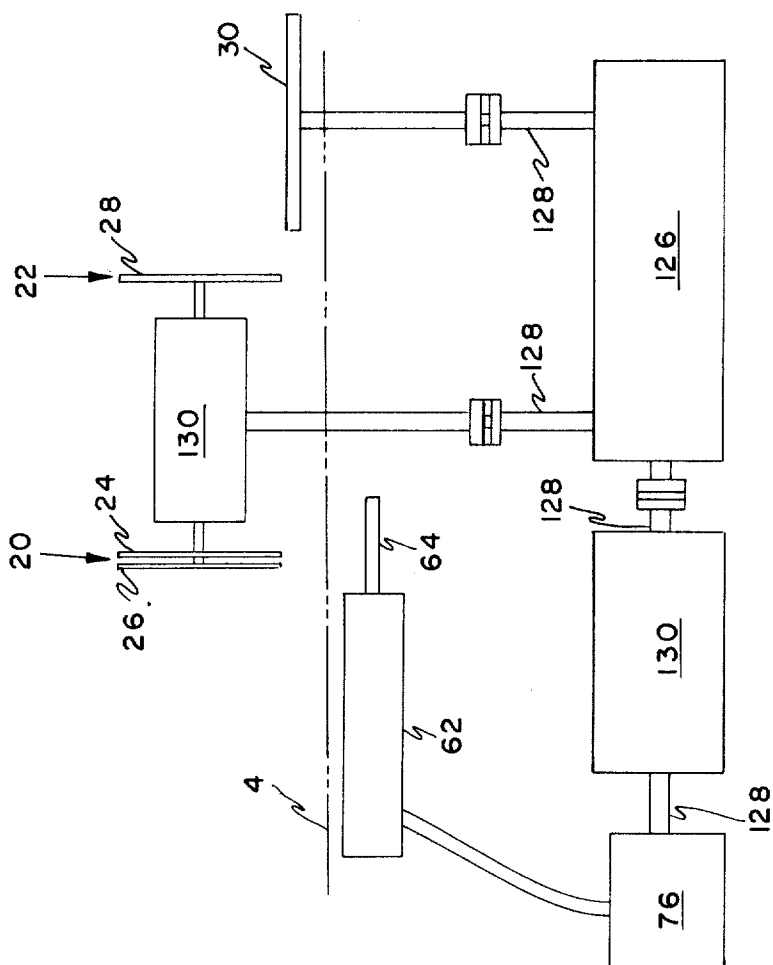


FIG. 7

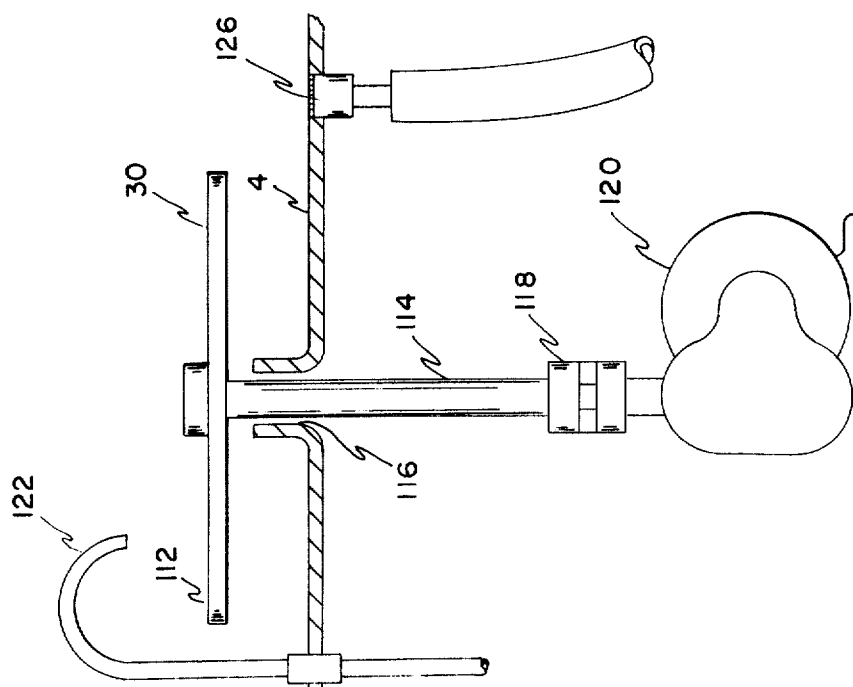


FIG. 6

ROCK CUTTING AND POLISHING DEVICE

This application is a division of our copending U.S. Patent Application Ser. No. 194,218, filed Nov. 1, 1971, now abandoned.

BACKGROUND**1. Field of Invention**

This invention relates to rock cutting and is particularly directed to novel rock cutting and polishing means for use in the preparation of geologic specimens and the like.

In the study of geology, it is frequently necessary or desirable to cut rock samples into slabs for chemical or microscopic analysis. Unfortunately, rocks are quite hard and generally do not cut easily. Moreover, the rock samples may be generally cylindrical, as obtained by core drilling, or may be irregular in shape and variable in hardness and toughness, and are difficult to hold during the cutting process.

2. Prior Art

Numerous devices have been proposed heretofore for holding and cutting rock samples. However, none of the prior art devices have been entirely satisfactory. Attempts have been made to secure rock samples in a conventional vise. However, where irregularly shaped samples are used, the vise often is unable to get a firm hold and, when pressure is applied during the cutting operation, the samples frequently become displaced. Also, some rock samples are quite brittle and may shatter when squeezed by the jaws of a vise. In addition, the moving of the sample past the saw is often performed manually, which is obviously not precise. In other instances, mechanical feed means have been provided to traverse the rock past the saw. However, such mechanical feed means generally feed at a constant rate which is unaffected by the pressure between the saw blade and the rock and, hence, may cause jamming or breakage of the saw blade, or irregular cuts. Another disadvantage of previous art forms has been that the saw blades have been operated at a fixed number of revolutions per minute (RPM) causing irregularity of the cut surface, damage to the rock or mineral sample, and damage to the diamond cutting edge of the saws because of the variable toughness and hardness of the samples being cut.

BRIEF SUMMARY AND OBJECTS OF INVENTION

These disadvantages of the prior art are overcome with the present invention; and a novel rock cutting and polishing device is proposed which can readily and firmly secure rock samples of substantially any configuration, together with a fluid drive system for traversing the rock sample past the saw, at an adjustable rate of feed appropriate to the properties of the specimen being cut, which hydraulic system has an overload compensating device that can be set to restrict the maximum pressure against the blades, and one or more lap tables for polishing the cut samples; also proposed in the present invention is a hydraulic or other drive system for the saw blades and polishing lap or laps to insure variable speed control of these elements.

The advantages of the present invention are preferably attained by providing a cutting table having one or more inverted T-slots formed therein together with a flexible strap having a T-shaped fitting provided at one end of said strap and slidably receivable within said slots and a winch means secured to the other end of

said strap and operable to wind the strap onto and off of said winch means, fluid drive means operable to drive said cutting table past one or more saw blades, one or more lap tables, and means for driving the blades and lap tables to cut and polish a rock sample, these means having variable speed controls.

Accordingly, it is an object of the present invention to provide improved means for cutting and polishing rock samples.

Another object of the present invention is to provide improved means for securing a rock sample during a cutting operation.

A further object of the present invention is to provide improved means for traversing a rock sample past a cutting blade.

A specific object of the present invention is to provide improved means for cutting and polishing rock samples comprising a cutting table having at least one inverted T-slot formed therein, a flexible strap, a T-shaped fitting secured to one end of said strap and slidably receivable within said T-slot, winch means carried by said table and secured to the other end of said strap operable to wind said strap onto and off of said winch means, a saw blade, or blades, means for rotating said saw blade or blades, fluid drive means operable to cause said cutting table to traverse past said saw blade, or blades, a lap table, or tables, and means for rotating said lap tables, with variable speed and pressure controls.

These and other objects and features of the present invention will be apparent from the following detailed description, taken with reference to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an isometric view of a rock cutting and polishing device embodying the present invention;

FIG. 2 is a plan view of the device of FIG. 1 showing a rock sample secured to the cutting table for a cutting operation;

FIG. 3 is an enlarged fragmentary view showing the T-shaped fitting secured to the flexible strap of the device of FIG. 1;

FIG. 4 is an elevation, partly in section, showing the left end of the device of FIG. 1, with the end panel of the table removed;

FIG. 5 is a vertical section through the device of FIG. 1, taken on the line 5-5 of FIG. 4;

FIG. 6 is a vertical section through the device of FIG. 1, taken on the line 6-6 of FIG. 2; and

FIG. 7 is a diagrammatic representation showing an alternative form of the device of FIG. 1.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

In that form of the present invention chosen for purposes of illustration in FIG. 1, a rock cutting and polishing device is shown, indicated generally at 2, having a recessed table top 4 supported by a suitable frame, as seen at 6 in FIG. 4, which is enclosed by suitable panels 8. Within the recessed table top 4, a pair of cutting tables 10 and 12 are positioned in spaced relation and are each mounted for movement along a respective hooded guideway 14 and 16, as more fully described hereinafter. Between the guideways 14 and 16 is mounted a motor 18 which serves to drive a combination of saws 20 and 22 each mounted adjacent a respective one of

the guideways 14 and 16. Saw 20 is preferably a double-bladed saw having the blades 24 and 26 spaced apart so as to cut a slab of desired thickness from a rock sample, while saw 22 preferably has only a single saw blade 28. In addition, a lap table 30 is disposed within the recessed table top 4 and is mounted for rotation about a vertical axis.

As best seen in FIGS. 1-5, the cutting table 10 has a pair of bosses 32 and 34 projecting upwardly from its opposite edges adjacent one end thereof and a shaft 36 extends between the bosses 32 and 34 and is rotatably mounted in the bosses 32 and 34 (boss 34 contains a second ratchet) by a ratchet mechanism 38 and at 34, similar to that of a ratchet wrench, having a control lever 40 in each ratchet, which determines the direction of rotation, and a handle 42 to facilitate rotation of the shaft 36. As shown, the shaft 36 and ratchet mechanisms 38 and 34 form a winch for a flexible strip 44, such as a webbed belt of cotton or nylon, which has one end thereof secured to the shaft 36, while a rigid, generally T-shaped member 46 is secured to the free end 48 of the strip 44, as by sewing, indicated by stitches 50 in FIG. 3. The cutting table 10 is provided with one or more slots 52 extending longitudinally thereof and having an inverted T-shaped configuration so as to slidably receive the member 46 to assist the strip 44 in securing a rock sample 45 to the cutting table 10 and a plate 47 is secured to the vertical edges of the bosses 32 and 34 to support the rock sample 45 during the cutting operation.

To translate the cutting table 10 past the saw 20, the cutting table 10 is formed with foot portions 54 which extend along the opposite edges of the cutting table 10 and project downwardly and inwardly therefrom to engage flanges 56 formed on the guideway 14, as best seen in FIG. 5. The guideway 14 is also formed with an elongated central opening 58 which communicates with a corresponding opening 60, formed in the bottom of the recessed table top 4, and, hence, with the interior of the base 6. Within the base 6 is mounted a hydraulic cylinder 62 which serves to drive a piston rod 64 and an actuating bar 66. The actuating bar 66 is coupled to an actuating arm 68 which, in turn, is coupled to a boss 70 which is formed on the underside of the cutting table 10 and projects downward through openings 58 and 60. To actuate the hydraulic cylinder 62, a fluid reservoir 72 is mounted within the base 6 and is connected, by conduit 74, to the inlet side of a suitable pump 76, which is driven by a prime mover, such as motor 78. Pressurized fluid from pump 76 is supplied through conduit 80 to the base of T-joint 82 and a suitable pressure gauge 84 is connected to conduit 80. One arm of the T-joint 82 is coupled, by conduit 86, to a speed control valve 88, while the other arm of T-joint 82 is coupled by return line 90 to the fluid reservoir 72. The speed control valve 88 is regulated by a speed control knob 92 mounted on the front panel 94 of the base 6 and serves to control the rate of fluid flow through conduit 96 to control valve 98. Control valve 98 is actuated by knob 100 on front panel 94 of base 6 and serves to direct the flow of fluid during reverse action through return line 102 to the fluid reservoir 72 or through conduit 104 to actuate hydraulic cylinder 62 and cutting table 10. Pressure valve 132 restricts the fluid pressure through line 104 actuating table 10 by allowing fluid pressure excess to return via line 131 to reservoir 72. To prevent jamming of the cutting table

10 by rock chips and the like, the guideway 14 is provided, at each end thereof, with end plates 106 and flexible hoods 108 are connected to each of the end plates 106 and to the adjacent end of the cutting table 10. The hoods 108 are formed generally in the shape of an inverted U and extend completely across the top of the guideway 14 and downward in proximity with the edges thereof.

Cutting table 12 and guideway 16 may be substantially identical with cutting table 10 and guideway 14. However, as shown, the winch, formed by shaft 36 and ratchet mechanism 38, is omitted on cutting table 12 and, instead, a brace plate 110 is mounted on cutting table 12, extending transversely thereacross, to permit rock samples to be manually held during the cutting operation. Moreover, if desired, cutting table 12 may be moved manually along guideway 16. Obviously, when this is done, no actuating mechanism is required for cutting table 12, but may be desired for special materials.

As best seen in FIGS. 1, 2 and 6, the lap table, or tables, 30 comprises a flat disc having the upper surface 112 coated with diamond chips, or the like, to facilitate grinding and polishing of rock samples. The lap table 30 is mounted, for rotation about its axis, on a shaft 114 which extends through an opening 116 in the recessed table top 4 to a suitable drive coupling 118 and motor 120. A spray nozzle 122 is mounted adjacent the lap table 30 and is positioned to spray water or other suitable coolant onto the upper surface 112 of the lap table 30 to cool the rock sample and upper surface 112, during a grinding or polishing operation, and to carry away rock dust and chips resulting therefrom. A hose 124 is provided adjacent the saws 20 and 22 to provide for washing fluid during the cutting operations. Saw blades are cooled as normally done by mist, or water, or other coolant jets under the guard shields 20 and 22. In addition, a drain 126 is provided in the recessed table top 4 to dispose of coolant fluid which has been discharged into recessed table top 4 by nozzle 122, hose 124, and other coolant jets.

In use, the cutting and polishing device of FIGS. 1-6 serves to cut a slab from a rock sample or core, cut the slab to provide a specimen of desired size and shape, and to grind or polish the specimen for microscopic analysis or the like. To accomplish this, a rock sample or core 45 is placed on the cutting table 10 in engagement with plate 47 and is positioned to extend beyond the side of cutting table 10 in line with blades 24 and 26 of double saw 20. The flexible strip 44 is, then, disposed over the rock sample 45 and the T-member 46 of strip 44 is slid into an appropriate one of the slots 52. Thereafter, ratchet mechanism 38 is actuated to rotate shaft 36 to wind the strip 44 about shaft 36, causing the strip 44 to firmly retain the rock sample 45 in the desired position. Thereafter, motor 18 is energized to rotate saw blades 24 and 26, speed control knob 92 is appropriately adjusted, and control knob 100 is actuated to cause hydraulic cylinder 62 to drive cutting table 10 along guideway 14. As the rock sample 45 engages saw blades 24 and 26, resistance to further movement of cutting table 10 will create back pressure through cylinder 62, conduit 104, control valve 98, and pressure valve 132, which, controls the rate of flow of fluid to the hydraulic cylinder 62 when under excess load. Obviously, the speed of movement of cutting table 10 will be a function of the pressure-flow of the driving fluid

supplied through speed control valve 88 minus the pressure-flow released through pressure valve 132 which returns to reservoir 72 via line 131. Thus, although a constant fluid pressure is applied through speed control valve 88, the actual speed of movement of the cutting table 10 will be varied to accommodate changes in the resistance between rock sample 45 and the saw blades 24 and 26 caused, for example, by variations in the composition of the rock sample 45. Thus, the likelihood of breakage of the saw blades 24 and 26 and uneven cuts is greatly reduced.

It will be seen that saw blades 24 and 26 cooperate to cut a slab from the rock sample 45 having two flat parallel surfaces. To cut this slab into a cube or other shape suitable for use, the slab is placed, on one of its flat surfaces, on cutting table 12 and is held against the brace plate 110, extending over the edge of cutting table 12 in line with the single blade 28 of saw 22, while cutting table 12 is traversed along guideway 16. When a rock specimen of desired shape has been cut from the slab, the lap table 30 is actuated and the specimen is held against the upper surface 112 of the lap table 30 for polishing or grinding.

FIG. 7 illustrates an alternative form of the device of the present invention wherein a single prime mover 126 serves to drive the saws 20 and 22, the hydraulic pump 76, and the lap table 30. The prime mover 126 may be an electric or fluid motor which acts through respective drive shafts 128 and transmissions 130 to drive the various components.

Obviously, numerous variations and modifications may be made without departing from the present invention. Accordingly, it should be clearly understood that the forms of the present invention described above and shown in the accompanying drawing are illustrative only and are not intended to limit the scope of the invention.

What is claimed is:

1. An apparatus for preparing rock specimens for microscopic study comprising:
 - support structure;
 - a first rock cutting site at the top of the support structure comprising:
 - first rock cutting means having as least one blade, spanning a vertical distance between first and second elevations, for cutting a planar surface in a sample rock;
 - first carriage means mounted for linear reciprocable movement along first track means horizontally adjacent the first rock cutting means, the first track means being juxtaposed and essentially parallel to the cutting blade, the first carriage means defining a rock receiving site at an intermediate elevation between the first and second elevations;
 - first specimen securing means, carried by the carriage means at the rock receiving site, for anchoring a sample rock in a secure position at the rock receiving site at said intermediate elevation with the rock sample being markedly cantilevered out from the first carriage means into cutting alignment with the blade whereby displacement of the carriage means along the track means will cause the blade to cut a planar surface in the cantilevered portion of the sample rock and ultimately a relatively thin specimen is obtained;

a second rock cutting site at the top of the support structure comprising:

- second rock cutting means having at least one blade spanning a vertical distance between spaced elevations for cutting planar surfaces in a rock specimen;
 - second carriage means mounted upon and linearly reciprocable along second track means horizontally adjacent the second rock cutting means, the second track means being juxtaposed and essentially parallel to the cutting blade of the second rock cutting means the second carriage means defining a second rock receiving site located at an elevation between the spaced elevations;
 - second specimen securing means, carried by the carriage means at the second rock receiving site, for holding a rock specimen in a stable position at the second rock receiving site at said between elevation accommodating cantilevering of the rock specimen out from the second carriage means into cutting alignment with the blade of the second rock cutting means whereby displacement of the second carriage means along the second track means will cause the last-mentioned blade to cut a planar surface in the cantilevered portion of the rock specimen and ultimately a trimmed specimen for microscopic examination is obtained;
 - at least one lap table at the top of the support structure disposed in sink structure comprising a vertical shaft and a grinding disc non-rotatably secured to the shaft for rotation in a generally horizontal plane within the sink structure whereby polishing of cut surfaces of a rock specimen is accomplished; and
 - power means for rotating said blades and disc upon command.
2. The apparatus of claim 1 further comprising: fluid drive means for causing said first carriage means to reciprocate along the associated track means.
 3. The apparatus of claim 2 wherein said fluid drive means comprises:
 - a hydraulic cylinder,
 - means axially coupling the piston rod of said hydraulic cylinder to said first carriage means, and
 - means for supplying pressurized fluid at a selected constant rate to said cylinder.
 4. The apparatus of claim 1 wherein said first rock cutting means comprises two parallel cutting blades adapted to simultaneously cut a specimen of predetermined thickness from said cantilevered portion of a sample rock in a single pass of the first carriage means.
 5. The apparatus of claim 1 wherein said anchoring means comprises:
 - ratchet-actuated winch means mounted on said first carriage means,
 - a flexible strap of material having one end secured to said winch means to permit said strap to be wound onto and off of said winch means, and
 - means for securing the free end of said strap to said first carriage means to permit said strap to extend about a rock sample to secure said rock sample to said first carriage means.
 6. The apparatus of claim 1 further comprising: expandable hood means secured between each end of at least one of said carriage means and the adjacent ends of the corresponding track means extending over said track means and downward in proximity with each side of said track means.
 7. The apparatus of claim 1 wherein:
 - said power means is a single motor.