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(54) **Apparatus for cutting thin slabs or slices from thicker quarry stone slabs, and method for making panels covered with said slices**

(57) The invention relates to an apparatus for cutting stones, such as marbles, granites or the like, and particularly for cutting thin slabs or slices from thicker slabs (3), comprising at least one cutting device (7, 8) having at least one endless flexible diamond impregnated tool (8). In the apparatus of the invention, said cutting device (7, 8) is oriented along a horizontal or substantially horizontal cutting plane, the slab to be cut (3) being

itself oriented along a horizontal plane, and there being provided means (4) for relative displacement of the cutting device (7, 8) and the slab (3) to be sliced in the forward cutting direction into the slab (3). The invention also relates to a method for making laminate panels having at least one substrate layer and at least one covering layer joined together, the covering layer consisting of a thin slab or slice made of a stony material, and fabricated by the apparatus of the invention.

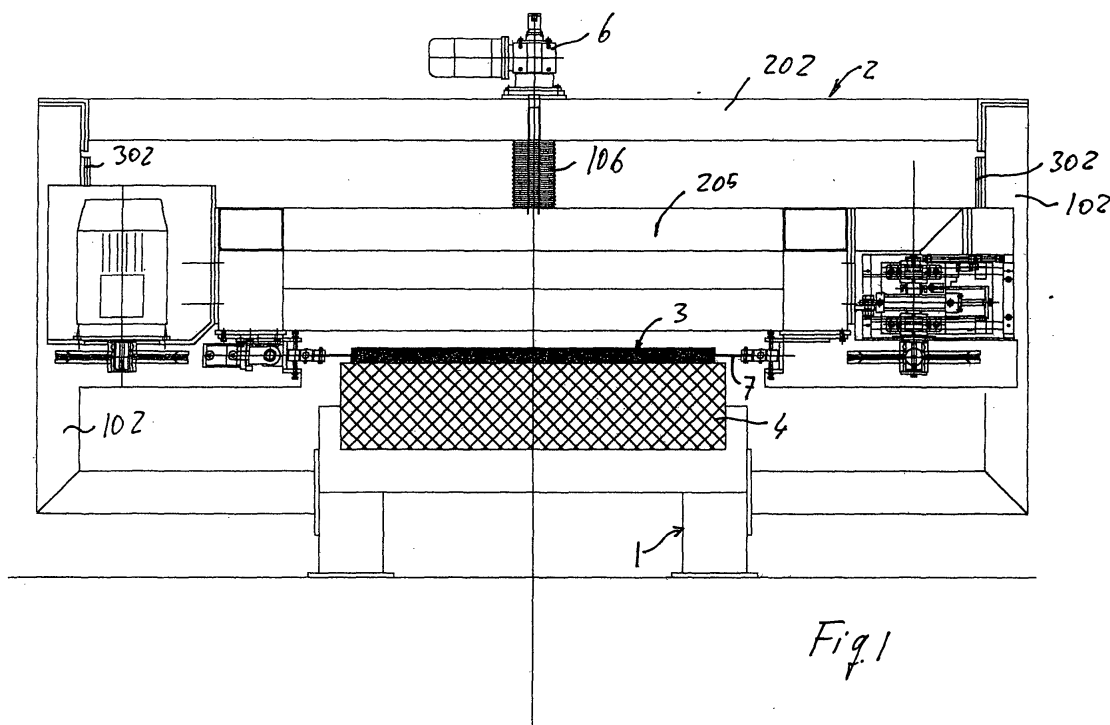


Fig. 1

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Description

[0001] The invention relates to an apparatus for cutting stones, such as marbles, granites or the like, and particularly for cutting thin slabs or slices from thicker slabs, which comprises at least one cutting device having at least one endless flexible diamond impregnated tool. The invention also relates to a method for making laminate panels having at least one substrate layer and at least one covering layer joined together, the covering layer consisting of a thin slab or slice made of a stony material.

[0002] As is known, the need to cut thin slabs or slices having a very small thickness from thicker slabs made of a valuable rock material, such as marble, arises from the need to reduce the amount and weight of such material in coverings and particularly from the need of covering support panels made of materials that combine stiffness properties to extra-lightness properties. These panels are typically used for external and/or internal wall covering of architectural structures of any type. When the panel is installed, the valuable material is exposed outside and the achieved aesthetic effect is identical to the one that might be obtained by using thicker stone slabs. All this is achieved at a considerably lower cost, and with a much easier installation, the covered panels being lighter and much easier to handle.

[0003] Nevertheless, the making of stone slices, generally having a thickness of the order of a few millimeters is hampered by heavy problems, associated to the need to fabricate very large sized laminate panels, with an accordingly large, hence intrinsically brittle covering slice. In prior art, these slices are typically cut from thicker slabs, which are in turn obtained by dividing a stone block, by large-diameter disk apparatuses which typically perform cutting along a vertical plane and have the drawback of being highly expensive, cumbersome and noisy as well as inaccurate in cutting operations. These apparatuses require support structures and drive motors whose size corresponds to the large size of the cutting disk. Moreover, even when the blade is supported eccentrically, the cut obtained thereby is limited in height, whereby processing widths are restricted due to the structural limits of prior art apparatuses. Actually, the width of the resulting slices is always considerably smaller than the width of the slab obtained by cutting the block. Hence, slabs are typically further sliced to obtain a useful width as allowed by the cutting width of the disks. As a result, prior art laminate covering panels have insufficient sizes or, when they are of the desired size, they are covered with smaller slices attached in adjacent positions. The resulting exterior appearance is obviously not the same as obtained by using slices having substantially the same size as those of the slab cut from the block and an additional processing step is anyway required. On the other hand, in guided diamond impregnated wire apparatuses, which generally also perform cutting along a vertical cutting plane, the wire

guiding and supporting system only allows to cut slabs of the order of a few centimeters' thickness with an acceptable accuracy, but does not allow to perform cuts like those required to obtain extra thin slices. The vertical cutting direction is also not optimal, particularly with reference to the structural brittleness of the resulting slices.

[0004] Therefore, this invention has the object of obviating the above drawbacks of prior art apparatuses and to allow an easy and inexpensive fabrication of an apparatus as described hereinbefore, allowing to obtain a cutting width substantially corresponding to the width of the pre-cut thicker slab cut from the block, and to obtain, by a single processing step, stone slices of an acceptable size, i.e. corresponding to the slab size. This cut must be made in a quiet, fast, accurate and safe manner, and allows the manufacture of large laminate panels, particularly made of a honeycomb plastic material, which are stiff and light and have a very high market value. Obviously, even smaller panels may be obtained, by simply cutting them from larger panels or by using smaller slabs.

[0005] The invention achieves the above purposes by providing an apparatus as described hereinbefore, wherein the cutting device is oriented along a horizontal or substantially horizontal cutting plane, and the slab to be sliced is also oriented along a horizontal plane, and wherein means are provided for relative displacement of the cutting device and the slab to be sliced in the forward cutting direction into the slab. The horizontal position of the slab allows to more easily preserve the structural integrity of the slices cut from the slab. The apparatus of this invention is preferably designed for slicing slabs cut from blocks, but the parts of the apparatus may be possibly sized to allow direct block slicing, particularly small block slicing, thereby skipping a processing step.

[0006] In accordance with a preferred embodiment of the invention, means are provided for feeding the slab in the cutting direction, whereas the cutting device is stationary with reference to said cutting direction.

[0007] Means may be further provided for relative displacement of the cutting device and the slab to be sliced, for height or level adjustment of the cutting device relative to the slab to be sliced. According to the above mentioned preferred embodiment, means are provided for vertical translation of the cutting device parallel to itself, i.e. for adjusting its height position relative to the slab to be sliced, whereas the slab is stationary with reference to said vertical direction.

[0008] The means for feeding the slab in the cutting direction may consist of a movable bogie, running on rails, or of a roller track, but preferably consist of a conveyor belt having an essentially horizontal supporting surface. This belt is driven in such a manner as to feed the slab in the cutting progression direction, at a speed adapted to the cutting speed.

[0009] The cutting device may include an endless, i.

e. closed-loop diamond belt, which is driven in such a manner as to run in its longitudinal direction around two return pulleys, at least one being a driving pulley. Said belt is guided transversely and pressed in operating contact with the stone at the cutting line by a guiding and pressing horizontal blade. As is better explained below, said belt has a strong and durable construction and is also relatively cost-effective, though performing accurate cutting operations even at high speeds, and thereby ensuring a high productivity.

[0010] The guiding and pressing blade may extend transverse to the cutting direction to such an extent as to slightly exceed the length of the cutting line, i.e. the width of the slab to be sliced, and to be shorter than the overall extension of the closed diamond belt. The blade is situated in the intermediate position between the pulleys and ends at a certain distance therefrom, whereby at each of the two opposite ends of the blade, the belt runs freely through a small length, anyway beyond the cutting blade.

[0011] The blade may be substantially coplanar to the common horizontal plane of rotation of the return pulleys, which are arranged so that their axes of rotation are vertical. Its shape may be symmetrical with respect to its greater center axis, which is coincident with the line joining the centers of rotation of the pulleys.

[0012] The blade may have two opposite longitudinal edges for slidably guiding the cutting diamond belt, the one turned toward the slab to be sliced and the other turned in the opposite direction. Typically, in prior art apparatuses having a diamond belt cutting blade, the blade has one single guiding and pressing edge turned toward the slab, corresponding to the active portion of the belt, whereas, in the other portion, the belt is guided in an intrinsically less accurate manner, e.g. on rollers or small pulleys.

[0013] According to an advantageous improvement, at least the diamond belt guiding edge turned toward the slab, but preferably both guiding edges may be slightly outwardly arched, with reference to the greater center axis of the blade. This arrangement allows the two branches of the belt whose ends are tangential to the pulley, to follow a certain slightly arched path, which ensures a perfect adherence of the belt against the guiding edges, also thanks to the axial pulling force exerted on the belt by means which will be described in better detail in the description of the drawings. This results in optimized tensioning and compression of the belt against the stone to be cut in the cutting progression direction, i.e. transverse to the tool, while avoiding any difficulties and scraps at the end of the cutting operation. If the two opposite guide edges were rectilinear, as provided in prior art apparatuses, the adherence of the belt to the blade would not be absolutely assured, on the contrary a slightly arched shape, in combination with an adequate axial pulling action assures a constant belt holding force against the guide edges. The arched shape also allows a much more homogeneous distribution of forces, and

the lack of sharp edged ends reduces belt wear.

[0014] According to a further improvement, the blade is larger, at its center portion, and in the cutting direction, than the diameter of the return pulleys, whereas at the ends turned toward the pulleys it is substantially as large as the diameter of the pulleys. Thanks to this arrangement, the blade extends for a great portion of the cutting surface inside the slab and ensures an accurate and constant coplanarity of the two guided branches of the belt. This is particularly important to the purpose of cutting accuracy and in relation to the very small thickness of the slice to be obtained.

[0015] The blade may have such a width that the cutting width in the transverse direction with respect to the slab feed direction is of 1.5 to 2 m, and particularly of about 1.7 m.

[0016] The flexible endless diamond impregnated tool used in the inventive apparatus may be made in any manner fit for the purpose and may substantially comprise a flexible support closed-loop body, e.g. made of rubber or plastic. The tool has a flexible core, which may consist of one or more wires, typically twisted metal wires, but may also consist of an appropriate plastic material, embedded in the flexible material of the body. This body may include a succession of spaced metal segments, embedded therein and fixed to the body and/or the core, and having diamond impregnated surfaces which are conformed in such a manner as to project at least slightly out of the body of the belt, at least on its operating front surface, turned toward the slab to be cut. Regarding the rest, the shape, profile, arrangement of the diamond impregnated segments and the way they are fastened to the flexible support body may be selected in any manner, i.e. the best adapted to specific needs. The diamond tool assembly itself, i.e. its flexible body supporting the diamond impregnated segments, may have any cross sectional profile. For instance, the body of the diamond belt may have, on its outer side, a substantially flat surface wherefrom the spaced diamond impregnated segments slightly project in the longitudinal direction of the belt, and are inserted in holes passing through the rigid segments, on the longitudinal wire/s of the core and partly embedded in the body. The diamond impregnated surface of each rigid segment may consist, for instance, of a corresponding sintered diamond impregnated element attached to the body of the rigid segment. The width of the segments may be slightly greater than the width of the body, so as to slightly project on one or both sides of the body, thereby forming a portion of the sharp edge of the respective longitudinal edge/s of the belt.

[0017] In accordance with a preferred embodiment, the diamond belt may have, on its operating front surface, in coincidence with the intervals between the metal segments, transverse grooves, preferably joined at their ends to side grooves formed in the sides of the belt and extending on at least a portion of the belt height, to facilitate the flow of the cooling fluid and material removed

from the stone in the cutting operation.

[0018] According to a preferred embodiment, the non-operating inner side of the belt, i.e. the side of the flexible support body turned toward the guiding and pressing blade and having no diamond surfaces and the two associated edges of the guiding and pressing blade slidably cooperating with said non-operating inner side of the diamond belt, may have complementary and coincident particularly V or U-shaped cross sectional profiles, which are slidably and at least partly engaged in each other, in such a manner as to assure a certain and accurate diamond belt transverse guiding action.

[0019] Advantageously, the guiding and pressing blade may have a minimized thickness, as allowed by the mechanical and functional requirements of the blade and the diamond belt, and particularly it may have a slightly smaller thickness than the operating cutting thickness of the diamond belt, so as to minimize the sliding friction of the blade in the cutting direction. Particularly, the blade may have a thickness of 6 mm, whereas the belt may have an operating cutting thickness of 8 mm, to determine a cutting width of 9 mm.

[0020] According to an additional improvement, the guiding and pressing blade may include at least one gap and/or at least one piping system, to be formed, for instance by milling, and to be connected to a source, particularly a pump, of pressurized fluid, particularly water. These pipes communicate with a succession of outlet ports appropriately distributed on the bottom of the two V-shaped longitudinal slide edges. During cutting operations, pressurized water is injected between the guiding and pressing blade and the diamond belt, to form an anti-grip water cushion between the blade and the belt and, with a strong lubricating action, to control the temperature whereat cinders are removed from the cutting slot.

[0021] The minimum thickness of the slab to be sliced may be such that, once the cutting thickness or width is deducted therefrom, two thin rock slices are obtained. These slices may have a thickness substantially of the order of a few mm to about two centimeters, and particularly of 4 to 6 mm. In the typical case of an intermediate slicing of a 20 mm thick slab, two 5,5 mm thick slices may be obtained.

[0022] According to a preferred embodiment, the guiding and pressing blade and the diamond belt return pulleys may be supported in a cantilever fashion at the bottom of a substantially horizontal beam or beam structure. Said beam is in turn supported in a slidable manner on at least one pair of vertical posts, provided each at an opposite end of the beam. Said beam also carries the means for rotatably driving the driving pulley, particularly a motor reducer.

[0023] The blade may be supported at the two opposite ends, particularly by hinge means and have, at least at one of said ends, means for blade tensioning adjustment.

[0024] One of the return pulleys may be fitted on a

stationary support to the beam, whereas the support of the other return pulley, particularly the idle pulley, may be mounted so as to slide horizontally on the beam and transverse to the cutting direction by means of appropriate actuators, so as to vary its distance from the support of the opposite return pulley and to adjust the diamond belt tension.

[0025] The upper ends of the vertical posts may be connected by at least one longitudinal member carrying the means for controlling the height displacement of the beam for supporting the blade, belt, pulleys and motor assembly.

[0026] These control means may consist of at least one motor which acts on a drive, e.g. a worm which causes the upward or downward displacement of the beam.

[0027] As mentioned at the beginning of the introduction, this invention also relates to a method for making laminate panels having at least one substrate layer and at least one covering layer joined together, the covering layer consisting of a thin slab or slice made of a stony material.

[0028] The substrate layer may be made of any suitable material, either solid or having lightening apertures, particularly of one or more honeycomb materials, with open or closed, or partly open or closed cells. These materials may include, for instance, high density polystyrene, wood, particle boards, metal or rigid plastic grids or any other high stiffness and low elasticity material.

[0029] The method of the invention may include the following steps:

attaching by glue or the like, on at least one face of a rock slab, whose thickness is greater, particularly much greater than the cutting thickness, and more particularly on one face of a block, a substrate panel whose extension is substantially identical to that of said face;

making a cut within the thickness of the rock slab or block, to separate from said slab or block a very thin slice, considerably thinner than both the overall rock slab or block and the substrate panel, to obtain a laminate panel composed of a substrate layer and a thin stony slice joined together;

applying on the stone slab or block face, wherefrom the previous thin layer was removed a new substrate panel and making a new cut within the thickness of said stone slab or block to obtain a new laminate panel.

[0030] When the remaining thickness of the slab or block is substantially reduced to the sum of the cutting thickness and of two covering slices, the method may include the following steps:

attaching by glue or the like, on both faces of the remaining slab, a substrate panel whose extension

is substantially identical to that of the face.
making a substantially intermediate cut in the slab
to obtain two identical laminate panels.

[0031] The above method advantageously allows to directly cut stony material from a block, this arrangement being nevertheless an extreme solution. The preferred arrangement, especially for workpiece handling reasons, includes precutting of blocks into a certain number of slabs of a predetermined thickness, particularly about 20 mm, covering the latter on both faces with substrate panels, and making an intermediate cut to obtain two identical panels covered with one 5,5 mm thick stone slice. It shall be noted that, even though the preferred application of the apparatus is intended to obtain thin slices, the apparatus may be advantageously used to obtain slabs having any thickness.

[0032] The advantages of this invention are self-evident from the above description and consist in providing an apparatus as described hereinbefore, which allows to obtain a cutting width substantially equal to the width of the precut slab obtained from the block, and to obtain, in a single processing step, stone slices and panels covered with said slices, having a sufficient width. Thanks to all the above characteristics, especially to the fact that the diamond belt is guided by a rigid guiding and pressing blade on a well-defined cutting plane, and also due to the considerable surface of said blade, in the inventive apparatus, the diamond belt is allowed to cut in the best conditions and a high cutting accuracy is achieved, in combination with low noise and high cutting speed. Moreover, the method of the invention advantageously allows to provide the thin slice, during cutting operations, with a valid support element which prevents it from breaking and allows the direct production of laminate panels.

[0033] Further characteristics and improvements will form the subject of the dependent claims.

[0034] The characteristics of the invention and the advantages derived therefrom will be more apparent from the following detailed description of a preferred embodiment of the invention, in which:

Fig. 1 is a front elevational view of a preferred embodiment of an apparatus according to this invention.

Fig. 2 is a top plan view of the apparatus of Fig. 1, in an intermediate condition during the slab slicing operation.

Fig. 3 is a front elevational, larger scale view of the lower left corner of the guiding and pressing blade of the apparatus as shown in Figs. 1 and 2, comprising the motor driven pulley and the means for tensioning the guiding and pressing blade.

Fig. 4 is a top plan view of the detail as shown in Fig. 3.

Fig. 5 is a front elevational, larger scale view of the lower right corner of the guiding and pressing blade,

comprising the idle pulley and the means for displacing the latter to tension the cutting belt.

Referring to Figures 1 and 2, an apparatus according to this invention is composed of a footing 1 whereon a bridge frame 2 is fitted. This frame 2 consists of a pair of vertical posts 102 at each side of the apparatus, the lower ends of said vertical posts 102 being connected to the footing 1. At the upper ends of the vertical posts 102, at least one transverse longitudinal member 202 is disposed horizontally. Means for feeding the slab 3 in the cutting direction are provided on the footing 1, said direction being indicated by the arrow in Fig. 2. Said means may consist, for instance, of a movable bogie, running on horizontal rails, or of a roller track, but preferably consist of a conveyor belt 4 having a horizontal supporting surface, which is driven in such a manner as to feed the slab 3 in the cut progression direction at a speed adapted to the cutting speed. A horizontal beam structure 5 is slidably vertically guided on end rollers 105 on corresponding vertical guides 302 provided on the inner side of each vertical post 102 of the bridge frame 2. This beam structure 5 which, in the embodiment of the Figures essentially consists of four longitudinal members 205, may be lifted and lowered parallel to itself and to the longitudinal member 202 by means of a motor 6 which is disposed substantially in the substantially intermediate position of the transverse longitudinal member 202, which motor acts on a drive of any suitable type, e.g. a worm, a screw-and-nut, or recirculating-ball drive.

[0035] The beam structure 5 carries a preferably metal blade 7 at its bottom, which blade extends horizontally and is fastened by its side ends to the beam structure 5 by cantilever support means. This blade 7 is as thin as possible in so far as the mechanical and functional requirements of the blade 7 itself and of a closed-loop cutting diamond belt 8 allow, which blade 7 acts as a guiding and pressing member in contact with the slab 3 in a horizontal cutting plane. A hinge connecting element 7 is provided at each of the two opposite side edges of the blade 7, which element is integral with the blade 7 on one side and is fitted in a cantilever manner to an element of the beam structure 5. With particular reference to Fig. 4, one of the two hinge elements 107 is provided with means for adjusting the tension of the blade 7, consisting of a motor-driven actuator 207 which acts on a sliding slab 307, the hinge 107 being fitted on the edge thereof turned toward the blade 7.

[0036] The guiding and pressing blade 7 extends transverse to the cutting direction to such an extent as to slightly exceed the width of the slab 3 to be sliced, and to be shorter than the overall extension of the closed diamond belt 8 and is provided in the intermediate position between two opposed return pulleys 9, 9', at a certain distance therefrom. The blade 7 is substantially co-

planar to the common horizontal plane of rotation of the return pulleys 9, 9', and is symmetrical with respect to its greater center axis III which coincides with the line joining the centers of rotation of the pulleys 9, 9'. The blade 7 has two opposite longitudinal edges for slidably guiding the cutting diamond belt 8, the one 407 turned toward the slab 3 to be sliced and the other 507 turned in the opposite direction. Both guiding edges 407, 507 are slightly arched outwards, with reference to the greater center axis of the blade 7 so as to ensure a perfect adherence of the two opposite guided parts of the belt 8 to the edges 407, 507 of the blade 7. With particular reference to Fig. 2, the center portion of the blade 7 is very wide in the cutting direction, anyway larger than the diameter of the return pulleys 9, 9', whereas the ends thereof turned toward the pulleys 9, 9' are substantially as large as the diameter of the pulleys.

[0037] Referring now to Fig. 3, one 9' of the two pulleys is supported in a cantilever fashion by a vertical rotating shaft 109' which is also the rotating shaft of a motor 10 carried by the beam structure 5, to rotatably drive the pulley 9'. On the opposite side (see Fig. 5), the other idle pulley 9 is supported in a cantilever manner by a vertical shaft 109 which is held by two axially separated bushes 209, mounted on a saddle 309 sliding on guides 409, whose displacement is controlled by a linear actuator 509. Thanks to these arrangements, the rotating shaft 109 of the idle pulley 9 may be drawn away from or closer to the rotating shaft 109' of the motor-driven pulley, in the direction transverse to the cutting direction, in such a manner as to control the tension of the diamond belt 8.

[0038] The two opposite edges 407, 507 for guiding the diamond belt 8, as well as the peripheral outer edges of the pulleys 9, 9' have a continuous substantially V- or U- shaped groove which is complementary to the inner, non-operating surface of the diamond belt 8 so as to accurately and safely guide said belt 8 inside the slab 3 to be cut up.

[0039] Cutting operations are performed by running the belt 8 lengthwise thanks to its motor-driven return pulley 9', whereas the beam structure 5 is displaced in such a manner as to carry the blade 7 to the desired height relative to the slab 3, which is out of the cutting area, in this step. Then, the slab 3 is fed in the cutting direction thanks to the conveyor belt 4 at a uniform speed, which is adapted to the cutting speed.

[0040] Obviously, the invention is not limited to the embodiment described and illustrated herein, but may be greatly varied, especially as regards construction and in the range of mechanical equivalents, without departure from the guiding principle disclosed above and claimed below.

Claims

1. An apparatus for cutting stones, such as marbles,

granites or the like, and particularly for cutting thin slabs or slices from thicker slabs (3), comprising at least one cutting device (7, 8) having at least one endless flexible diamond impregnated tool (8), **characterized in that** said cutting device (7, 8) is oriented along a horizontal or substantially horizontal cutting plane, the slab to be cut (3) being itself oriented along a horizontal plane, and there being provided means (4) for relative displacement of the cutting device (7, 8) and the slab (3) to be sliced in the forward cutting direction into the slab (3).

2. An apparatus as claimed in claim 1, **characterized in that** means (6, 106, 105, 302, 5) are provided for relative displacement of the cutting device (7, 8) and the slab (3) to be sliced for height or level adjustment of the cutting device (7, 8) relative to the slab (3) to be sliced.

3. An apparatus as claimed in claims 1 and 2, **characterized in that** means (4) are provided for feeding the slab (3) in the cutting direction, whereas the cutting device (7, 8) is stationary with reference to said cutting direction.

4. An apparatus as claimed in one or more of the preceding claims, **characterized in that** means (6, 106, 105, 302, 5) are provided for vertical translation of the cutting device (7, 8) parallel to itself, i.e. for adjusting its height position relative to the slab (3) to be sliced, whereas the slab (3) is stationary with reference to said vertical direction.

5. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the means for feeding the slab (3) in the cutting direction may consist, for instance, of a movable bogie, running on horizontal rails, or of a roller track, but preferably consist of a conveyor belt (4) having a substantially horizontal supporting surface, which is driven in such a manner as run in the cut progression direction at a speed adapted to the cutting speed.

6. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the cutting device includes an endless, i.e. closed-loop diamond belt (8), which is driven in such a manner as to run in its longitudinal direction around two return pulleys (9, 9'), at least one (9') being a driving pulley, and is guided transversely and pressed in operating contact with the slab (3) at the cutting line by a guiding and pressing horizontal blade (7).

7. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the guiding and pressing blade (7) extends transverse to the cutting direction to such an extent as to slightly exceed the length of the cutting line, i.e. the width of

the slab (3) to be sliced, and to be shorter than the overall extension of the closed diamond belt (8) and is provided in the intermediate position between two opposed return pulleys (9, 9'), at a certain distance therefrom.

8. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the blade (7) is substantially coplanar to the common horizontal plane of rotation of the return pulleys (9, 9') disposed with their axes of rotation in the vertical position, and is symmetrical with respect to its greater center axis (III) which coincides with the line joining the centers of rotation of the pulleys (9, 9').
9. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the blade (7) has two opposite longitudinal edges (407, 507) for slidably guiding the cutting diamond belt (8), the one (407) turned toward the slab to be sliced and the other (507) turned in the opposite direction.
10. An apparatus as claimed in one or more of the preceding claims, **characterized in that** at least the diamond belt (8) guiding edge (407) turned toward the slab (3), but preferably both guiding edges (407, 507) may be slightly outwardly arched, with reference to the greater center axis (III) of the blade (7).
11. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the center portion of the blade (7) is larger in the cutting direction than the diameter of the return pulleys (9, 9'), whereas the ends thereof turned toward the pulleys (9, 9') are substantially as large as the diameter of the pulleys (9, 9').
12. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the blade (7) has such a width that the cutting width in the transverse direction with respect to the slab (3) feed direction is of 1.5 to 2 m.
13. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the diamond belt (8) comprises a flexible support closed-loop body, e.g. made of rubber or plastic with a flexible core, consisting of one or more wires, typically twisted metal wires, embedded in the flexible material of the body, which body includes a succession of spaced metal segments, having diamond impregnated surfaces which project at least partly and at least slightly out of the body of the belt, at least on its operating front surface, turned toward the slab (3) to be cut.
14. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the diamond

belt (8) has, on its operating front surface, in coincidence with the intervals between the metal segments, transverse grooves, joined at their ends to side grooves formed in the sides of the belt (8) and extending on at least a portion of the height of the belt (8).

15. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the non-operating inner side of the belt (8), i.e. the side of the flexible support body turned toward the guiding and pressing blade (7) and having no diamond surfaces and the two associated edges (407, 507) of the guiding and pressing blade (7) slidably cooperating with said non-operating inner side of the diamond belt (8), may have complementary and coincident particularly V or U-shaped cross sectional profiles, which are slidably and at least partly engaged in each other, in such a manner as to assure a certain and accurate diamond belt (8) transverse guiding action.
16. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the guiding and pressing blade (7) has a slightly smaller thickness than the operating cutting thickness of the diamond belt (8).
17. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the blade (7) has a thickness of 6 mm, whereas the belt (8) has an operating cutting thickness of 8 mm, to determine a cutting width of 9 mm.
18. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the guiding and pressing blade (7) includes at least one gap and/or at least one piping system, which are connected to a source of pressurized fluid, particularly water, which piping system communicates with a succession of outlet ports appropriately distributed on the bottom of the two V-shaped longitudinal slide edges (407, 507) at such a pressure as to obtain a water cushion effect for lubrication, temperature control and cinder removal purposes.
19. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the minimum thickness of the slab (3) to be sliced is such that, once the cutting thickness or width is deducted therefrom, two thin, particularly 20 mm thick, rock slices are obtained.
20. An apparatus as claimed in one or more of the preceding claims, **characterized in that** said slices have a thickness substantially of the order of a few millimeters to about two centimeters, and particularly of four to six millimeters.

21. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the guiding and pressing blade (7) and the diamond belt (8) return pulleys (9, 9') are supported in a cantilever fashion at the bottom of a substantially horizontal beam or beam structure, which beam is in turn supported in such a manner as to slide on at least one pair of vertical posts (102) disposed each at an opposite end of the beam, and which beam (5) also carries the means for rotatably driving the driving pulley, particularly a motor reducer (10).
22. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the blade (7) is supported at the two opposite ends, particularly by hinge means (107) and has, at least at one of said ends, means (207, 307) for adjusting the tension of the blade (7).
23. An apparatus as claimed in one or more of the preceding claims, **characterized in that** one (9') of the return pulleys is fitted on a stationary support (109') to the beam (5), whereas the support of the other return pulley (9), particularly the idle pulley (9), is mounted so as to slide horizontally on the beam (5) and transverse to the cutting direction by means of appropriate actuators (109, 209, 309, 409, 509), so as to vary its distance from the support (109') of the opposite return pulley (9') and to adjust tension of the diamond belt (8).
24. An apparatus as claimed in one or more of the preceding claims, **characterized in that** the upper ends of the vertical posts (102) are connected by at least one longitudinal member (202) carrying the means (6) for controlling the height displacement of the beam (5) for supporting the blade (7), belt (8), pulleys (9, 9') and motor (10) assembly.
25. An apparatus as claimed in one or more of the preceding claims, **characterized in that** said control means consist of a motor (6) which acts on a drive, e.g. a worm which causes the upward or downward displacement of the beam (5).
26. A method for making laminate panels having at least one substrate layer and at least one covering layer joined together, the covering layer consisting of a thin slab or slice made of a stony material, **characterized in that** it includes the following steps:
- attaching by glue or the like, on at least one face of a rock slab (3), whose thickness is greater, particularly much greater than the cutting thickness, a substrate panel whose extension is substantially identical to that of said face;
 - making a cut within the thickness of the rock slab (3), to separate from said slab (3) a very thin slice, considerably thinner than both the overall rock slab and the substrate panel, to obtain a laminate panel composed of a substrate layer and a thin stony slice joined together;
 - applying on the stone slab (3) face, wherefrom the previous thin layer was removed a new substrate panel and making a new cut within the thickness of said stone slab (3) to obtain a new laminate panel.
27. A method for making laminate panels having at least one substrate layer and at least one covering layer joined together, the covering layer consisting of a thin slab or slice made of a stony material, **characterized in that** it includes the following steps:
- attaching by glue or the like, on both faces of a slab (3), whose thickness is greater than the cutting width, a substrate panel whose extension is substantially identical to that of the face;
 - making a substantially intermediate cut in the slab (3) to obtain two identical laminate panels.
28. A method as claimed in claim 26, **characterized in that**, when the remaining thickness of the slab is substantially reduced to the sum of the cutting thickness and of two covering slices, it includes the additional step as claimed in claim 27.
29. A method as claimed in one or more of claims 26 to 28, **characterized in that** it is implemented by using an apparatus as claimed in one or more of claims 1 to 25.
30. A method as claimed in one or more of the preceding claims 26 to 29, **characterized in that** the minimum thickness of the rock slab (3) is such that, once the cutting thickness is deducted therefrom, two thin rock slices are obtained.
31. A method as claimed in one or more of the preceding claims 26 to 30, **characterized in that** said slices have a thickness substantially of the order of a few millimeters to about two centimeters, and particularly of four to six millimeters.
32. A method as claimed in one or more of the preceding claims 26 to 31, **characterized in that** the slab (3) to be sliced has a width of 1.5 m to 2 m.
33. An apparatus for cutting thin slabs or slices from thicker rock slabs, and method for making laminate panels with said slices wholly or partly as described, illustrated and for the purposes stated herein.

