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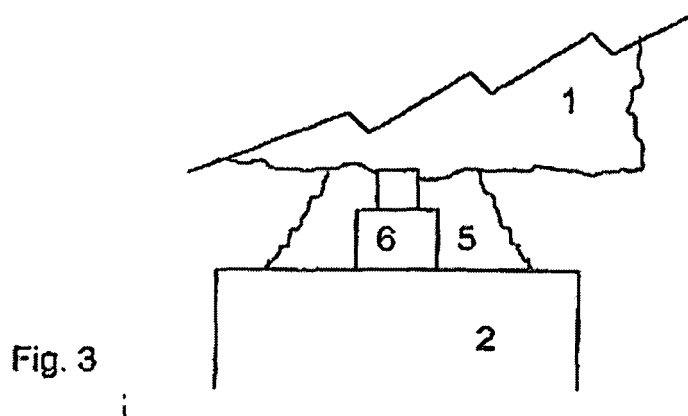
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(54) **IMPROVED GRANITE CUTTING**

(57) The wooden wedges for supporting the blocks are dispensed with, the blocks resting only on concrete, where they are seated more easily with the aid of four jacks; the strip alignment is corrected frequently to ensure that the sawing grooves are not too wide; mud with

less sawing detritus than usual is used; all the limewater used in the sawing and plate washing processes is recovered; the shot is recovered more easily from the waste, and a controlling device easier to mount and handle, is used to control the shot content in the mud.



Description**Technical sector**

- 5 **[0001]** The aim of sawing granite is to obtain slabs that are 1 cm thick or more for use in the construction of buildings and public works, on the floors or walls, and also for decoration purposes. The starting point is blocks ranging from 1 to 12 m² that weigh up to 32 tonnes. The sawing process is carried out with alternately moving multi-strip machines. This patent makes the following six sawing improvements: the way the blocks to be sawn are positioned, the alignment of the sawing strips, the content of the sawing detritus in the sawing mud, the complete recovery of the limewater in the waste, the way of saving shot and the way of controlling the shot content in the sawing mud.
- 10 **[0002]** This activity falls into the category of construction materials.

Previous technique

- 15 **[0003]** Positioning the blocks.- This is currently done by placing, aligning and truing up the stone blocks, supporting them on wooden wedges or chocks that are positioned under the four corners. As soon as this is done, the blocks are raised and separated with the aid of a crane, stones or mortar are thrown between the two wedges on each support bench, forming a wall that will prevent the slabs from falling once the sawing process is completed, and then the blocks are lowered, which crush the mortar, until they once again lie on the four chocks, wedges or piles of wooden chocks. A few hours later the load enters the sawing machine and the operation is completed about 24 hours or more after the start of the sawing process. In winter, once the operation is completed the mortar is still not very strong. There are no known patents in this field.
- 20 **[0004]** Aligning the strips.- The first strip that is mounted on each frame is positioned under some notches or signs made by the manufacturer of the machine, in such a way that the strip runs parallel to the movement of the machine, and the rest of them are mounted parallel to the first one, with the aid of calibrated separators. However, the frame becomes misshapen with the passage of time or because of repairs or adjustments made to the machine, in such a way that there could be a deviation of several millimetres with respect to the direction in which the frame is moving. There are no known patents in this field either.
- 25 **[0005]** Mud.- A mud composed of water and the sawing detritus is still used as the mud to support the shot. None of the same applicant's patents such as PCT9400009, S9801558, ES99100102, PT101357, IT1261207, P200200842 apply, and neither does the noiseless saw patent E200201529. It can be seen that either the applicant does not have the ability to convince the users or the users refuse to understand him.
- 30 **[0006]** The complete recovery of the limewater contained in the mud.- In the industries for which information is available the limewater is not completely recovered, so problems are caused in the water course where it is discharged because of its high pH. Some industries correct this situation by adding carbon dioxide into the waste to neutralise the pH. There are no known patents in this field either.
- 35 **[0007]** Saving shot.- An explanation of how to save it is given in Patent 200200010 (7). This patent describes a new technique that is easier to apply.
- 40 **[0008]** Controlling the shot in the mud.- In Patent Euro PCT 99913325 there is a method that claims to explain how to carry out this control without washing the mud and weighing the separated shot automatically, as in Spanish patent 8700697, or manually.

Diffusion

- 45 **[0009]** Positioning the blocks.- The problem involved in positioning the blocks on wooden wedges revolves around the fact that wood has a low modulus of elasticity, which is sometimes even lower than 1,000 Kp/cm² for some types of pinewood transversally to the fibres, when wet, and 11,000 Kp/cm² for harder and dry wood (a circumstance that never occurs under the blocks that are sawn). Furthermore, as the actual surface area of contact between block and wedges is very small, this brings about variations in pressure between these points of contact, caused by the alternative dragging forces that the strips transmit to the blocks, giving rise to slipping and rolling of the blocks, which has an adverse effect upon the quality of the sawn slabs, especially on the upper parts. Furthermore, when the sawing process is finished, the strips have to cut the wedges to complete the sawing, and as they are not designed to carry out this work, they bend, and the slabs are damaged, unless the progress of the machine is halted.
- 50 **[0010]** It is proposed that a material with a high modulus of elasticity be used to support the blocks and that the support surface be increased in order to avoid these problems, and it is also recommended that the use of wood be dispensed with.
- 55 **[0011]** When wooden wedges are used the actual surface contact can range from 6 to 30 cm² at each corner, causing pressures of up to 500 Kp/cm² to be exerted and sawing variations of up to 200 Kp/cm², which has a harmful effect on the quality of the slabs, even rendering them useless, although this hardly ever happens, because if the personnel are

watchful this limits the progress or the problem is solved in some other way, with the consequent increase in cost and loss of production.

[0012] The best solution involves letting each block lie on two large concrete blocks, one at each head, ensuring that their modulus of elasticity is greater than 200,000 Kp/cm², this concrete being of the quick-set type, reaching its maximum strength in four hours, approximately 16 cm wide at the top and whose length is the same as the width of the block. The guarantee of a more rigid seating will be

$$\frac{E_c}{E_w} \times \frac{S_c}{S_w} \text{ times greater than the seating on wooden wedges}$$

where:

E = Modulus of elasticity c = Concrete
S = Support surface w = Wood

[0013] On average about 2,000 times greater, which guarantees secure sawing with hardly any movement at all, thereby dispensing with the need to saw the wedges and the drawbacks involved. The personnel will no longer have to be deployed and there will be a production increase of approximately 3%, plus a reduction in cost of 2%, with only a cost increase of 0.4% as a result of the greater amount of concrete used for the bases.

[0014] Alignment of the strips.- The width of the groove that is required for sawing is the sum total of the following factors:

a) Thickness of the strip	4 mm
b) Twice the maximum size of the shot	2 mm
c) Excess due to different reasons	0.3 mm
	6.3 mm

[0015] However, in almost every sawmill the groove ranges from 6.5 to 8 mm, with an average 10% extra cost of sawing, and a loss of initial material amounting to 3%, as well as a longer sawing time.

[0016] The manufacturers of sawing machinery put reference marks on the frames to align the strips with the required precision, but with the passage of time the frames become slightly misshapen, which becomes worse after repairs and readjustments, leading to a misalignment of a few millimetres in the 6 m that separate the supports from the strips and to the aforementioned excess groove. To prevent this from occurring, the strips are realigned frequently once they are mounted, using a precision comparator whose degree of precision is similar to the ones used by lathe operators, which will be fitted to a tripod either supported on a rigid platform on the floor, or directly onto a piece of steel plating placed on the blocks, if the attachment is magnetic. The comparator will be wheeled, and it will be fitted with its shaft lying vertically, in contact with each strip that has to be checked or in contact with a magnetic plate stuck to the strip, if the latter happens to be grooved the machine will then be moved slowly so that the side deviation can be observed, the alignment is then corrected so that it is negligible or non-existent.

[0017] Mud.- The ideal sawing mud is a substance with a viscosity that is suitable for supporting the shot and flowing into the grooves, without any detritus at the inlet, and the shot must also be suitable for the machine and type of stone, but this mud without detritus requires costly facilities for recovery and treatment purposes, so, to demonstrate the noiseless sawing method and other sawing techniques, and in general to avoid having to make large investments, it is necessary to saw with mud containing sawing detritus, but in lower proportions than usual, achieving the right viscosity by adding fine and soft dust, in such a way that the shot remains in suspension and goes easily down the grooves 6 or more millimetres wide. To achieve this, it has been checked that the amount of sawing detritus can be reduced in the mud that is generally used in the industry, by adding fine and soft materials in proportions that will vary depending upon the stone blocks that are being sawn, maintaining the shot support qualities and facilitating its passage down the grooves. Thus, in one sawing case it could be observed that a mud with a 21 % volume of sawing detritus, with 7% of a specific clay, containing 1% quicklime and 71% water, always in volume, behaved in a suitable way. Therefore, it is possible to apply the sawing method with no acute noise with a consumption rate of less than 6 kg of dry clay for every m² sawn, and to do so in conditions that are almost ideal.

[0018] Total recovery of the limewater.- To save on the expense involved in purchasing carbon dioxide equipment and the subsequent cost of gas, it is proposed that a device be used for preventing any loss of limewater coming from both the sawing process and the washing of the plates and the places where these tasks are performed. The water coming from other services and the rainwater must be prevented from mixing with the limewater. All the limewater will be taken to a tank that regulates the water loaded with detritus, and then it will flow to a decanter or to a filter, before flowing back to a clear-water tank, from which it will either be extracted for the sawing process or for washing purposes. These two storage facilities for limewater containing particles and clear limewater can be combined into one single tank, the lower part being used to store the unfiltered water, with inflow and outflow through the bottom, and the top part for the clear or filtered water, with inflow and outflow through the upper part, near the upper end, so that there is a volume reserved for irregularities. When there is a demand for water for use it will flow out of the upper part with the clear water and not long after it returns unfiltered to the lower part, and when unfiltered water flows into the decanter or filter in the lower part, it is returned clear to the top part. The tank may either be split into two parts with a dividing membrane, but it is essential. It is similar to blood circulation. The losses due to evaporation will be replaced by an extra inflow at the top of the tank, plus a device for guaranteeing that the level does not fall below the minimum permitted.

[0019] Saving shot.- In the patented referred to, 200200010 (7), reference was made to the saving of shot but it was inconvenient to apply and besides, it required certain material resources whose use is now avoided.

[0020] The mud that does not fit in the auxiliary tank at the end of a sawing session, builds up in another supplementary tank, in such a way that no mud is discharged without the shot in it being recovered. Furthermore, all the water containing shot and the water that comes from washing the plates, the trucks and the water collected in the sawing and washing zones, flows into these supplementary tanks, where it settles, the shot being retained and only water free of shot is allowed to drain away. If possible, the size of the auxiliary tanks could be increased, if not, large tanks will have to be constructed in the future.

[0021] Once a new sawing session begins all the mud that is required goes back into the machine shaft, and the rest flows into the same shaft or the shaft on a different machine, this process being gradual when fresh shot is added, or ongoing, in such a way that when the sawing process is completed or about to finish, all of it has returned to the shaft. It must not flow back in quickly at any stage during the new sawing process, otherwise the proportion of fine shot will increase, and this could give rise to greater local thickness of the slabs.

[0022] Controlling the shot content in the mud.- The shot content in the sawing mud can be measured in a vertical tube that takes the mud to the cyclone, which has a small diameter, made of non-magnetic material, one or several commercial inductive proximity switches being arranged around it, either running parallel or one after another, their secondary currents or voltages being processed in an automaton or small computer nearby, with a display or screen for observing the measurement and controls for programming, equipped with outlets for an alarm if the content is very low, for starting the shot feeder if the content is the minimum programmed, for stopping it if the maximum level is reached and for another outlet for an alarm if the amount is excessive, as well as other outlets for connecting up to a general computer linked to the sawing machine.

Figures

[0023] All the figures are side views of the blocks in the support zones.

Figure 1 shows the usual method for supporting a corner of the block, where 1 is the block, 2 is the truck, 3 is one or several wooden wedges and 4 is the support wall for the sawn slabs, made up of mortar and stones.

Figure 2 is the wedge-free support that is proposed, with an extensive concrete base 5.

Figure 3 shows the support for Figure 2 before lowering the jacks 6 that support the block to true it up.

Advantages

[0024] The rigid positioning of the blocks allows for a total saving of 4% on the cost of sawing, including the labour charges. The alignment of the strips makes it possible to save an average of 10% on sawing and 4% on material. The mud mixture containing detritus and fine or soft dust saves on having to invest more than 30,000 Euros for every 400 strips working, which would be required to obtain the ideal mud, without detritus at the intake, although the same effect is not achieved and the fine and soft dust is used up. The technique for recovering all the limewater amounts to a slight saving on carbon dioxide gas. The recovery of the shot saves on having to invest on equipment and paying labour charges, and the technique for measuring the shot content saves on having to invest and on expenses, because the equipment is cheap and manageable.

Application method

[0025] The method for applying it can easily be deduced from the diffusion and claims. We would only add that the blocks would be positioned in the following way: putting the required concrete at the base of the trucks, at a height that adapts to the irregularities of the support zone for the blocks, leaving a gap for four hydraulic jacks at the ends of the support zones; placing the four jacks in extended form and closed if they are hydraulic; moving the block with the help of the crane close to its position a few centimetres from the height of the jacks; if necessary putting some devices below one or two of the jacks to raise their height; after that, lowering the block until it lies on the jacks; if it is observed that by lowering the jacks it is only possible to true up the block, the slings are moved away; if this is not the case, the block is raised a few centimetres and further supplementary items are placed under the jacks, and the operation is repeated; the truing up is then done with the jacks; finally, the jacks are lowered from one head, and they are closed again if they are hydraulic, and the jacks from the other head are lowered, and then they are opened and the jacks are removed, and the holes left by the jacks are filled with concrete.

[0026] It must be said that it is advisable to dry the fine and soft dust before adding it, because that makes it easier to handle, and it can be added in an ongoing way or intermittently, in such a way that 6 Kg or another suitable amount is added for each m² sawn, depending on the rock concerned. A programmed endless-screw feeder can be used, and the excess mud can also be recirculated with the aid of a pump with programmed operation, or with a tank equipped with an inverted siphon emptying system, whose level goes down as the sawing process advances, in such a way that at the end of the process the tank is completely empty.

How to operate with the invention

[0027] It is proposed that operating licences be granted or that collaboration contracts are entered into with a view to sharing the savings that are obtained.

Claims

1. st.- An improved granite sawing process **characterised by** the fact that the blocks lie only on two large concrete basis, without there being any wood between the blocks and the truck, an operation that can be performed with the aid of four jacks, also **characterised by** the fact that if the grooves between plates are more millimetres thick than the thickness of the strip plus twice the maximum size of the shot and three tenths of a millimetre more, the alignment of the strips will be corrected; also **characterised by** the fact that the sawing mud contains less detritus than usual yet conserves its characteristics of being able to support the shot and fluidity, owing to the addition of fine and soft materials; also **characterised by** the fact that the water content in the mud, which has a pH of 12 is not poured away but is totally recovered and remains in the sawing and washing circuit except for the percentage that evaporates away, and also **characterised by** the fact that at the end of the sawing process all the mud and the material settled from the washing water is kept in one or more auxiliary tanks, and the part that is not required at the beginning of the next sawing session is gradually added to the shaft during the session, and finally also **characterised by** the fact that the shot content in the mud is controlled by one or several proximity switches / sensors and a small automaton or computer.
2. nd.- An improved granite sawing process like the one described in the 1st Claim, **characterised by** the fact that each block is positioned on suitable quick-set concrete, whose aggregates, of a suitable size for the room they are to take up, are easier to saw than the block, lying on the bases of the truck, at a height that is suited to the irregularities of the block support zone, and lowering the block with the crane until it rests on four extended jacks, supported on the truck, set as far apart from each other as possible, some of which can have a suitable height increase in order to ensure that the block is almost trued up and also **characterised by** the fact that two of the jacks from one side are slowly lowered sufficiently to ensure that the block is eventually trued up, and after it has been checked that this is so, the two jacks are lowered from one head of the block until they rest on the concrete and the jacks are closed if they are hydraulic, and then the jacks from the other head are lowered and removed, then the rest of the jacks and supplements are loosened and removed, and, finally, the holes left by the jacks are filled with concrete.
3. rd.- An improved granite sawing process like the one described in the 1st Claim, **characterised by** the fact that if the sawing grooves exceed the limit indicated, before the next sawing session begins, the alignment of several strips is checked with the help of a wheeled comparator like the ones used by lathe operators, supported securely on a block or tripod, in such a way that the wheel with its axle in a vertical position is touching the strip or in contact with a rigid magnetic sheet adhered to the strip, and if the frame is moved by hand or moved slowly, it will correct the

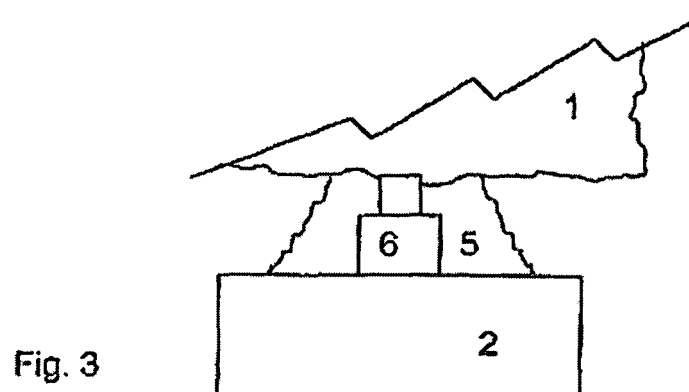
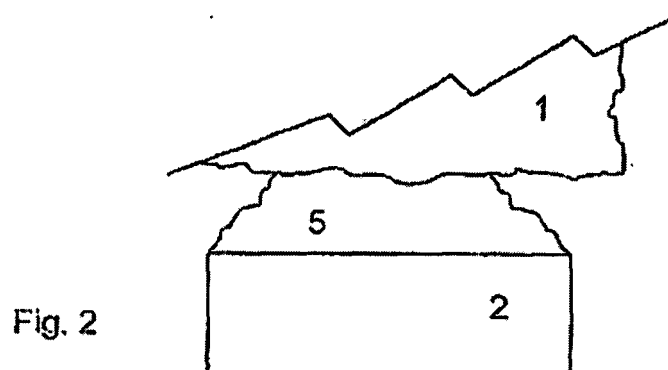
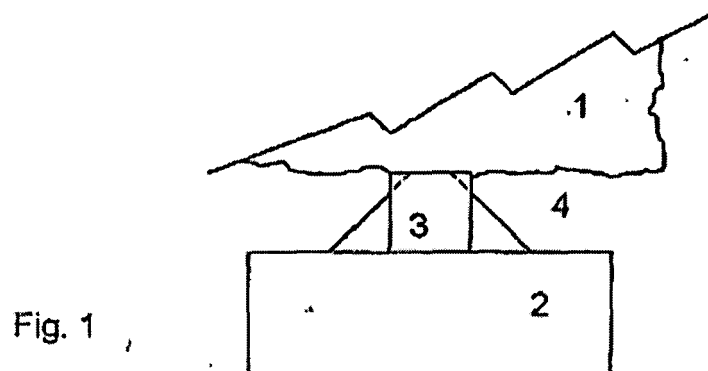
alignment if the variations are greater than 0.1 mm and also **characterised by** the fact that this checking process will take place whenever the machine is repaired or adjusted.

4. th.- An improved granite sawing process like the one described in the 1st Claim, **characterised by** the fact that sawing mud is preferably composed of 21 % sawing detritus, 1% lime, 7% clay and 71% water, % volume, approximately, depending on the characteristics of the stones and the clays that are used, regardless of the shot.

5. th.- An improved granite sawing process like the one described in the 1st Claim, **characterised by** the fact that the water full of sawing detritus and the clear water that comes from the decanter or the filter is kept in one single regulating tank with or without a dividing membrane, the clear water at the top and the unfiltered water at the bottom, with the intake and outlet in the lower part for the unfiltered water, and the intake and outlet near the upper part for the clear water, plus one further intake for replacing the losses, farther up, with an intake controlled by a buoy or some similar gauging device that is suitable for the purpose.

6. th.- An improved granite sawing process like the one described in the 1st Claim, **characterised by** the fact that the material containing shot and the excess mud from the previous sawing process is recycled at the same time as the new shot is added, or in an ongoing way with a smaller quantity per second, in such a way that the last of the shot is added approximately when the sawing process is completed, also **characterised by** the fact that the tank that contains the settling material and the excess mud is equipped with an outlet which can be at different levels, whose level is controlled by the frame.

7. th.- An improved granite sawing process like the one described in the 1st Claim, **characterised by** the fact that the centreline of the pipe, in which the proximity switches / sensors are placed, is vertical or almost vertical, has a thin wall and is made of non-magnetic material, also **characterised by** the fact that the detectors, if there is more than one, are connected parallel to each other or one after another and are, in turn, connected to an automaton or small computer nearby, which is equipped with a direct-reading display and equipped with outlets for an alarm if the values detected exceed the maximum or minimum limits, and outlets for starting and stopping the shot feeder at narrower margins, with a programming system, and perhaps equipped with outlets for connecting up to a general computer on the sawing machine.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/ ES 2005/000418

A. CLASSIFICATION OF SUBJECT MATTER		
See supplementary sheet		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
B28D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
MISTRAL, EPODOC, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ES 2192977 A (CASTRO) 16.10.2003. Columnas 4-6; figura 1.	1
A	GB 807420 A (SKANDINAVISKA GRANIT) 14.01.1959.	2
A	Todo el documento.	
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A	ES 2088478 A (MAGGI) 16.08.1996. Reivindicaciones 1-6; figura 1.	1, 5-7
A	WO 9417969 A (CASTRO) 18.08.1994. Páginas 2-5; Figuras 10-11.	1-2
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search (02.12.2005)		Date of mailing of the international search report (14.12.2005)
Name and mailing address of the ISA/ S.P.T.O.		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International Application No

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B28D7/00 (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

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- ES 8700697 [0008]