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(54) Laser treatment method of the surface of granite slabs or similar

(57) The method is conceived for superficially treating granite slabs or pieces, being based on a laser beam irradiation for obtaining a rough or bushhammered surface of the granite slab. The method is flexible in its application, permitting obtaining different types of surfacings on the same granite piece without needing to change the equipment or tool, it only being necessary to modify the processing parameters. The method involves a significant improvement compared to the traditional methods, such as the mechanical bushhammering, considerably reducing the noise produced by the process and the treatment or bushhammering of thinner granite slabs being possible. The granite slabs treated by means of the method can be used in both sidings of buildings and in pavements, and as a decorative piece in general.

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Description

OBJECT OF THE INVENTION

[0001] The invention refers to a treatment method of granite slabs by means of a laser radiation application, permitting the superficial modification of granite slabs for using in both facades and floorings, obtaining a bushhammered-type surfacing, in other words a surface with a rough surfacing giving the impression of being more rustic and natural.

[0002] By means of the method of the invention, it is possible to bushhammer thin granite slabs with thicknesses of less than 20 millimeters, practically eliminating the risk of breaking them, permitting obtaining different types of surfacing with the same equipment without needing to change tools.

BACKGROUND OF THE INVENTION

[0003] Granite has been used for a long time in constructing large public works, buildings, etc., although granite is currently widely used as a decorative element, in other words as a facade siding of large buildings and as both indoor and urban flooring.

[0004] Regardless of the different handling stages of granite, up to its definitive surfacing, the most frequently used surfacings in the case of granites are the following:

- Bushhammered: it is the oldest superficial treatment of rocky materials for outdoor sidings and artisan works. The rock surface is struck with a special hammer whose head is provided with small, pyramid shaped teeth. This mechanism permits obtaining different grain sizes on the worked surfaces.
- Buffed: with this treatment, a shiny surface is obtained due to the high degree of crystallinity of the granites it is applied to.
- Sawn: it is the surfacing obtained by means of using machines for sawing the blocks. The surface is marked with parallel gutters produced by the strips.
- Flamed: a flame is applied to the surface of the granite, which provokes the release of small sized rocks and chips. This treatment gives the rock a rough and glossy appearance with typical chromatic effects, and it increases the stability of the granite against atmospheric chemical alteration.

[0005] In the past few years, using granite for siding detached single-family homes or townhouses and for floorings (both indoors and in the urban setting) and a certain aesthetic change in the siding of large buildings (a certain "boredom" with buffed granite) have significantly increased the demand for slabs with a rough superficial surfacing.

[0006] As we have just explained, the alternative to buffed granite is the bushhammered or flamed surfacing since the sawn surfacing is too rough for some applications.

[0007] The bushhammered granite can successfully be applied to practically all granite varieties and it gives the stone a more rustic and natural surfacing. There are two fundamental types of machines on the market dedicated to these tasks: the mechanical bushhammer machines and those that bushhammer by means of a jet of water.

[0008] The drawbacks of the mechanical bushhammer machine are the following:

- The hammering of the bushhammers on the stone introduces an enormous amount of stresses on it that break the granite slabs on numerous occasions.
- The noise in these facilities is deafening (120 dB).
- Enormous amounts of dust are released.
- The bushhammering machines are more expensive than the merely flaming machines.
- The wearing of the bushhammers is very great. They must be regularly sharpened and frequently replaced.

[0009] Flaming consists of a thermal treatment of the surface by means of oxyacetylene burners applied at a 45º inclination with the surface and an approximate flame temperature of 2,800º C. The drawbacks of flaming are the following:

- It is a fairly slow process.
- Not all granite varieties can be flamed with commercially acceptable results.
- It is necessary to cool the rock by means of water immediately after applying the flame so that it does not burst.

[0010] These drawbacks are the reason the bushhammered surfacing is the most extended rough surfacing.

[0011] Recently, bushhammering machines by means of a jet of water have been developed. These machines solve some of the drawbacks of the mechanical bushhammering machines:

- It is possible to bushhammer thinner slabs (of up to 10 mm thick) without breaking the rock.
- Noise reduction.
- Dust elimination.

[0012] However, the bushhammers by a jet of water have other drawbacks:

- The surfacing is not always the desired one.
- It is necessary to use pure water to prevent the nozzles from blocking up.
- The cost of the machine is much higher (two to three times more than a mechanical bushhammer).
- Higher maintenance costs.

DESCRIPTION OF THE INVENTION

[0013] The proposed method has been conceived to solve the previously explained drawbacks, being based on a simple yet no less efficient solution, since it is the laser application for treating a natural rock such as granite.

[0014] Concerning this, certain clarifications must previously be made in relation to the term "granite", given that geologically, it is an irruptive rock of igneous origin, of coarse grain, fundamentally constituted of quartz, feldspar and micas. This is a scientific definition that does not comprise more than some decorative granites, those which, therefore, would be the only ones that could be called granites in "*stricto sensu".*

[0015] From the commercial point of view, the term "decorative granite" or simply "granite" is used to refer to all igneous rock with a granitoid or porphyroid texture, as well as some metamorphic rocks of a similar structure (gneisses, etc...) *(see for example the work: M. Bustillo Revuelta and C. López Gimeno "Recursos Minerales" ("Mineral Resources"). Gráficas Arias Montano, S.A. Madrid (1996)).* In this way, the commercial definition of granite encompasses not only the rocks geologically considered granites (Rosa Porriño, sylvan varieties), but also others such as gneisses (Rojo Guadajira), gabbros (Negro Villar), diorites (Gris Mondariz, Negro Badajoz) etc..., until reaching more than 80 exploited varieties in Spain alone.

[0016] Having made these clarifications, the treatment method of the invention basically consists of the following:

- Placing the granite slab or piece to be treated on a support adjusted to its dimensions, on a mobile system, which will be connected to automatic control means of the placement of the piece.
- The granite slab or piece located on the support is irradiated by means of a laser beam, the laser beam coming from a laser resonator and driven to the work area by means of mirrors or fiber optic, depending on the system used and the wavelength of the laser radiation.
- The irradiated surface of the granite slab or piece is modified by the laser beam, said laser radiation coming from an equipment of any wavelength, such as a laser, for example, from CO_2, CO, N_2, Nd:YAG, Er:YAG, Nd:glass, Ruby, HeNe, HeCd, HeHg, Cu, I, Ar, Kr, diode, chemicals, excimers, alexandrite, emerald, coloring, or any other type of laser.

[0017] The basic required condition is that the density of power reached on the granite piece be enough, which is why the most suitable lasers are those from CO_2, CO, Nd:YAG or diode.

[0018] In the method, three possibilities are considered concerning the incidence angle of the laser, perpendicular, with the fixed angle regarding the normal one and with a continuous angle modification; with the particularity of it being advisable to use a cooling fluid immediately after the laser treatment, depending on the nature of the granite, and among those to mention are N_2, Ar, He, Ne, CO_2, O_2, compressed air, etc., or a liquid such as water, liquid N_2, or some organic liquid.

[0019] Likewise, after the laser treatment, it may be necessary to brush the surface of the granite slab to remove partially released grains, it being possible to brush by means of circular or linear metallic brushes.

[0020] The bushhammering or the thus called treatment is carried out by moving either the granite slab or piece against the laser beam or the laser beam in relation to the granite slab or piece, such that, due to the large mass of the commercial granite boards, it is preferable to move the laser beam, the slab remaining stationary, for the purpose of the laser beam sweeping the surface of the granite slab or piece in those areas in which a transformation of the surface condition is desired to be obtained.

[0021] It has also been mentioned that the laser incidence to the surface of the granite slab can be normal or form a certain angle with it, such that by varying this angle, the type of surfacing can be modified, it even being possible to carry out a continuous modification of that incidence angle, obtaining a surfacing different from the one obtained by maintaining the fixed beam orientation.

[0022] Said method involves a considerable improvement in the work conditions of the operator processing the granite slabs, greatly eliminating the acoustic and environmental contaminants suffered during the traditional granite slab bushhammering methods.

[0023] More specifically, among the benefits derived from the method of the invention, the following can be mentioned:

- It is possible to treat thin granite slabs with thicknesses of less than 20 mm, practically eliminating the risk of breaking.
- It is possible to obtain different surfacings with the same equipment without needing to change the tool.
- The noise produced during processing is drastically reduced in comparison to the most widely used method, the mechanical bushhammering.
- The granite piece or slab undergoes no wearing nor corrosion as no contact between the piece and the tool is established, for this reason, it is not necessary to sharpen or replace said tool.
- The vibrations of the granite slab being treated are eliminated, likewise reducing the amount of dust released in the environment.

[0024] Regarding said treatment, it can be carried out directly after extracting the block from the quarry, although the best results are obtained once the granite slab or piece has been cut to the desired thickness.

PRACTICAL EMBODIMENT EXAMPLE

[0025] Bushhammering by means of a laser beam was experimentally carried out on granite slabs of the "rosa porri ñ̲o" variety, these bushhammerings being by means of a continuously working, high-powered diode laser (λ= 940 nm), with an optic system of a 100 mm focal distance, focusing on the slab surface in normal incidence, without any gas contribution and with a 900 W power. With these conditions, the surface of said granite slabs was bushhammered at a speed of 10 mm/s, the use of a cooling fluid not being necessary.

[0026] Different types of surfacings on the same piece were obtained without needing to change the equipment or tool, it only being necessary to modify the processing parameters.

[0027] It is worth mentioning the fact that a continuous variation of said processing parameters (power, frequency, pulse width, focal distance, relative beam/piece speed) can be carried out without needing to stop the bushhammering process, obtaining gradually varying surfacings on the granite piece.

Claims

1. A laser treatment method of the surface of granite slabs or the like, **characterized in that** it comprises the following operative phases:

   - Positioning the granite slab to be treated on a support adjusted to its dimensions;
   - Irradiating the granite slab located on the support by means of a laser beam;
   - Modifying the surface of the granite slab irradiated by the laser beam.

2. A laser treatment method of the surface of granite slabs or the like according to claim 1, **characterized in that** after the laser treatment, the surface of the granite slab is brushed by means of circular or linear metallic brushes in order to remove partially released grains.

3. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** the support on which the granite slab is located on is mobile and is connected to plate positioning control means.

4. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** a cooling of the granite slab is used, capable of being gas or liquid, any chemical composition.

5. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** the mobile means for the support on which the granite slab to be treated is placed, associated to plate positioning control means, consist of a robot, any type of coordinates table, or a combination of both systems.

6. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** the laser radiation applied on the granite slab comes from an equipment of any wavelength, for example a laser from CO_2, CO, N_2, Nd:YAG, Er:YAG, Nd:glass, Ruby, HeNe, HeCd, HeHg, Cu, I, Ar, Kr, diode, chemicals, excimers, alexandrite, emerald, coloring, or any other type of laser.

7. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** the laser beam is applied to the granite slab in either a manner perpendicular to it, with a fixed angle with respect to the normal one, or forming a continuously modified incidence angle.

8. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** the laser radiation parameters, such as power, frequency, pulse width, focal distance and relative beam/piece speed, are continuously modified without stopping the process, obtaining gradually varying surfacings on the granite slab.

9. A laser treatment method of the surface of granite slabs or the like according to the previous claims, **characterized in that** the granite slab can have any shape, be of any variety, type, chemical composition and dimensions, and it is bushhammered following any trajectory.

10. A granite slab or similar treated by means of a method according to claims 1 to 9.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 38 0152

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 October 2002	Rijks, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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EUROPEAN SEARCH REPORT

Application Number
EP 02 38 0152

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims

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THE HAGUE	11 October 2002	Rijks, M

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O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 38 0152

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