(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 393 872 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
03.03.2004 Bulletin 2004/10

(21) Application number: **02720025.2**

(22) Date of filing: **10.04.2002**

(51) Int Cl.[7]: **B28D 1/02**

(86) International application number:
PCT/ES2002/000176

(87) International publication number:
WO 2002/081165 (17.10.2002 Gazette 2002/42)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **10.04.2001 ES 200100842**

(71) Applicant: **Castro Gomez, Luis**
36201 Vigo (ES)

(72) Inventor: **Castro Gomez, Luis**
36201 Vigo (ES)

(74) Representative: **Temino Ceniceros, Ignacio et al**
Calle Covarrubias, 9 2o d
28010 Madrid (ES)

(54) **METHOD FOR MILLING HARD ROCKS**

(57) The method involves homogeneously mixing the sludges removed from the cutting machine with water before reaching the hydrocyclone separating the minute grains. Said mixture is carried out in an ejector (4) which receives the sludges through an inlet (7) and pressurized water through the injector (5). In vertical position, it sends the mixture jet into the interior of a body (1), wherein a partition wall (8) is placed inside said body to support a bridge (9) defining an impact surface (10), which provokes a first homogenization of the mixture together with subsequent impact of the fragmented jet against the side wall of a body (1). The jet then goes through perimeter holes (11) of the partition (8) into a lower chamber (13) in which the jets passing through said holes impact a slanted plane (14) thereby generating a second homogenization phase before reaching the outlet (15) defmed by the slanted plane (14) in the direction of the tube (17) communicating the ejector-mixer with the hydrocyclone.

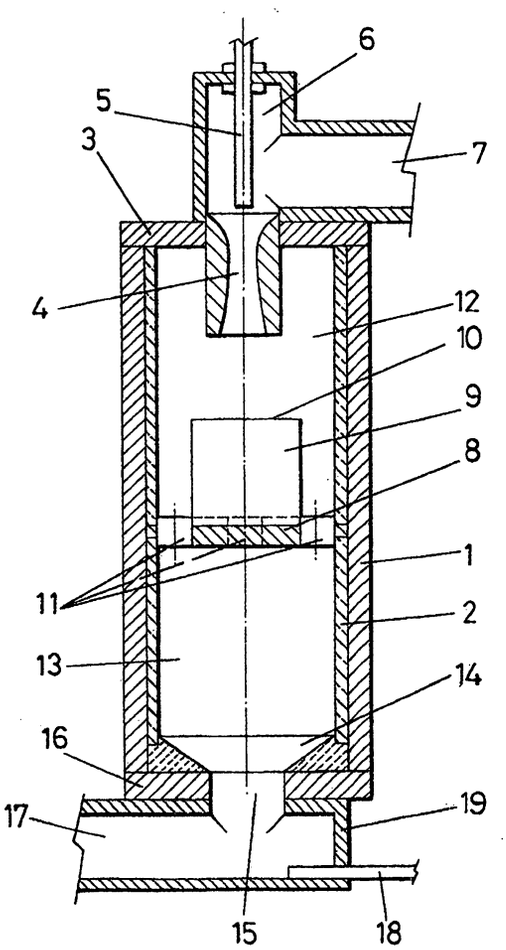

FIG.1

EP 1 393 872 A1

Description

OBJECT OF THE INVENTION

[0001] This invention refers to a method for milling hard rocks, in which the action of the cutting elements is facilitated by the incorporation to the cutting groove of minute grains functioning as an abradant, suspended in a sludge which acts not only as the support for the minute grains but also as a coolant in the cutting zone, whereas the aim of this procedure is to improve recovery of minute grains and particularly, to reduce the cost of such milling.

[0002] The invention also concerns an ejector - mixer device which is used to perform the aforementioned procedure.

BACKGROUND TO THE INVENTION

[0003] The process consists of eliminating continually or intermittently part of the water with residues or milling detritus and the lime with its derivatives where the case may be, without reaching the maximum concentration limit that allows to maintain the abradant in suspension, in other words, that the suspension of the abradant is largely due to the milling detritus. Therefore, the sludge processing method is the factor that most limits the possibility of advancement in milling, due to the high content of milling detritus in the sludge, and is the cause for the excessive consumption of energy, abradant and metal strips.

[0004] Patent no. ES 9300185/PCT 9400009, among others, described the possibility of milling with sludge containing low percentages of milling detritus where the supporting power is due to the presence of fine, soft powders that allow to reduce the total cost of the milling to a third and simultaneously treble the production, but this solution has not been applied yet due to the high investment needed for its application.

[0005] After that, as may be seen in Patent no. ES 9801558, there was a proposal for a method based on maintaining a high content of rock particles, pouring out part of the sludge containing the rock particles produced in the milling, whereas this latter operation may be performed on a continuous or frequent basis, as may the replacement of adequate amounts of water, lime and fine, soft materials that have been removed from the sludge circuit.

[0006] In this patent, the composition of the sludge entering the machine, excluding the minute grains, would be less than 66% for rock particles, over 28% for lime water and more than 6% for fine, soft materials; with the volume and according to the characteristics of the rock to be milled.

[0007] This patent described and claimed an installation to implement the aforementioned method, whereas the addition of the installation method allowed to improve the results in the cutting operations.

[0008] Nonetheless, the ratio between the volumes of water and fine, soft materials, in accordance with the aforementioned conditioning factors, should be approximately 3.5 to sustain the minute grains and allow the latter to flow through the grooves, so that the 21% of water corresponds to 6% of fine, soft materials, meaning that the maximum volume of milling detritus is limited to 73%, also in volume and excluding the minute grains.

[0009] Furthermore, the difficulty in recovering the minute grains from a sludge with the aforementioned proportions of fine, soft materials/ water, i.e. 3.5, in the hydrocyclones that are normally used in hard rock milling industries is so important that the loss of minute grains could be excessively increased.

DESCRIPTION OF THE INVENTION

[0010] In accordance with the procedure of this invention, the minute grains are recovered in the sludge that is continuously or intermittently separated from the circuit to recover the rock residues that are continuously produced in the milling process. More specifically, the invention provides for dilution of the sludge for evacuation and that it shall be re-mixed uniformly with water or lime water before passing through the hydrocyclone, whereas in this regard the amount of water used may go from one part water to three of sludge as far as more than ten parts water to one of sludge.

[0011] Moreover, the invention provides that the content of lime water in the sludge may oscillate between 21% and 28% and that the milling detritus content may also account for between 73% and 66%.

[0012] In order to achieve correct recovery of the minute grains, as explained before, the invention provides for a vertical ejector-mixer, with descending flow, in which the ejected jet impacts against a horizontal wall, either regular or irregular, made of wear-resistant material, such as virgin rubber or other such material, easily replaceable by fitting and sticking; a horizontal wall situated inside a chamber with a vertical axis, preferably cylindrical and also lined with wear-resistant material; whereas on the horizontal wall and outside the impact area, there are several holes through which jets of the product pass on their way to a lower chamber, in which they also impact on a tronco-conical or tronco-pyramidal surface with an inverted vertical axis, which is also wear-resistant and defines an outlet for the mixture, where there is a waterjet or pressurised drag system, which shall preferably function after the ejector-mixer stops, for several seconds, but which could also function simultaneously with the latter if necessary.

DESCRIPTION OF THE DRAWINGS

[0013] In order to complement the description and with the aim of allowing for a better understanding of the characteristics of this invention, according to an example of the preferred embodiment of same, a single map

sheet is included, representing schematically in a single figure and in an illustrative and non-restrictive manner, a side elevation and diameter section of an ejector — mixer according to the object of the present invention.

PREFERRED EMBODIMENT OF INVENTION

[0014] In the aforementioned figure, it may be observed that the ejector-mixer device that participates in the invention is formed by a cylindrical body (1), with a vertical axis, whose side and internal surface is covered by a layer (2) of wear-resistant material, for example, virgin rubber or other such material, whereas this body receives through its upper base (3) an ejector (4), also with a vertical axis, whereas a water injector (5) is placed coaxially opposite the latter, crossing a small chamber (6) also associated to the upper base (3) of the body (1) and to which the inlet (7) for sludge to be evacuated accesses radially.

[0015] Inside the body (1), there is a transversal partition (8) which constitutes the means of support and attachment for a bridge (9), also materialised in a piece of wear-resistant material, like the aforementioned, whereas such bridge defines a horizontal surface (10), which shall initially be flat, but in which there shall be irregularities due to the effect of the impact of the sludge on same, whereas this piece (9) shall preferably be fixed to the partition (8) with adhesive, allowing for replacement.

[0016] In the perimeter zone of the partition (8), outside the body (9), there is a circumferential line of holes (11) communicating the upper chamber (12) defined in the body (1) by the intermediate partition (8), with the lower chamber (13), the lower end of which is a tronco-conical surface (14), also with a vertical axis, defining the outlet hole (15) established in the lower base (16) of the body (1) and which establishes communication between the ejector-mixer itself and the outlet pipe (17) for the mixture.

[0017] A water injector (18) is situated on the closed end (19) of the tube (17), at the lower level, to drag the minute grains that might be deposited in the tube (17) and ensure their entry in the hydrocyclone in which the aforementioned tube enters (17), not represented in the figure.

[0018] In accordance with this structure, the functioning of the ejector — mixer is as follows:

[0019] The sludge enters same through the pipe (7), reaching the small input chamber (6) at an appropriate, properly regulated flow, from which it is displaced towards the ejector (4) on which the water jet generated by the injector (5) acts parallel and simultaneously, so that there is a jet that impacts at high speed on the surface (10) of the bridge (9) from which, by the effect of the slope in its route determined by the downwardly diverging configuration of the ejector (4), the mixture suffers a sudden change in its route and is directed at the lining (2) of the side wall of the body (1), thereby achieving a high degree of agitation inside the chamber (12), after which the mixture is passed to the lower chamber (13) through the holes (11), where it impacts on the slanted plane (14), producing a new agitation with the consequent increase in the homogeneity in said chamber (13), from where the mixture finally accesses, through the outlet (15), the evacuation pipe (17) towards the hydrocyclone.

[0020] Thus, more minute grains are recovered in the said hydrocyclone and there is a reduction in the cost of milling at the aforementioned sludge composition stages.

[0021] The ejector-mixer should be installed to function in the vertical position shown in the figure, so that the flow of the mixture may descend and it should also be situated as close as possible to the entrance to the hydrocyclone for recovery of the minute grains.

Claims

1. A procedure for milling hard rocks with minute grains and supporting sludge, in which said sludge is composed by more than 6% volume of fine, soft materials purified on a continuous, frequent basis, whereas a flow of sludge is evacuated, from which only the minute grains are recovered, **characterised by** the fact that the flow that is evacuated is homogeneously mixed with water or lime water before passing through the hydrocyclone that separates the minute grains and also **characterised by** the fact that the content of water or lime water in the sludge may be between 21 % and 28% of the volume and that the content of milling detritus may in turn account for between 73% and 66% of the volume.

2. An ejector-mixer device to implement the procedure described in the 1st claim, **characterised by** the fact that it is formed by a body (1), preferably cylindrical in shape, with a vertical axis, in whose upper base (3) there is an ejector (4), also with a vertical axis, accessed by the sludge to be evacuated through a side inlet (7) and the pressurised water through an axial injector (5), whereas inside the body (1) there is an intermediate compartmented partition wall (8), defining a horizontal front (10) upon which the sludge-water mixture should impact, outside which there is a circumferential line of holes (11) to pass the mixture from the chamber (12) above said partition (8) to a lower chamber (13), the lower end of which is a slanted plane (14), preferably inverted and of a tronco-conical shape, defining the outlet (15), towards the pipe (17) communicating with the hydrocyclone used to recover the minute grains.

3. An ejector-mixer device, according to the 2nd claim, **characterised by** the fact that the body (1) contains

a side and internal lining (2) made of wear-resistant material, such as virgin rubber or other such material, whereas the partition (8) incorporates on its central area a piece (9), made of a material of similar characteristics, defining the front (10) for impact of the mixture jet, whereas the upper chamber (12) acted as the homogenisation chamber, where the jet of the mixture, after impacting on the surface (10) and thanks to the downwardly divergent configuration of the lower area of the ejector (4), forms an elbow in its route towards the lining (2) of the side wall of the body (1), before finally reaching the holes (11) to pass through to the lower chamber (13), where there is another homogenisation phase when the jets of the mixture from the holes (11) impact on the slanted plane (14).

4. An ejector-mixer device, according to the 2nd and 3rd claims, **characterised by** the fact that the pipe (17) communicating the ejector-mixer with the hydrocyclone has, on its closed end opposite the latter, a water injector, situated at the lower level, to drag the minute grains that may be deposited on the lower part of said pipe (17).

5. An ejector-mixer device, according to the 2nd, 3rd and 4th claims, **characterised by** the fact that the ejector-mixer is situated beside the inlet to the hydrocyclone for recovery of the minute grains.

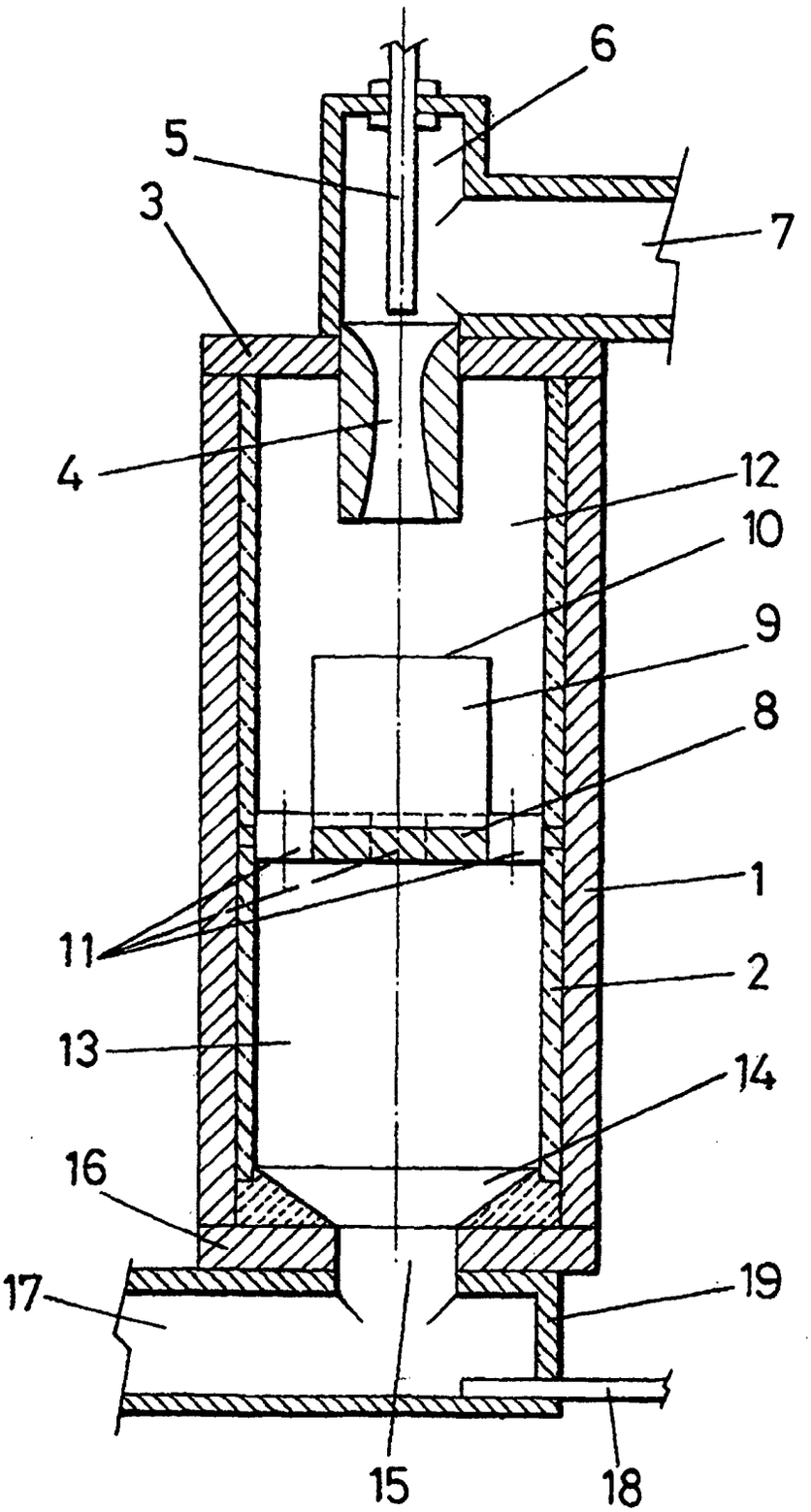

FIG.1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES 02/00176

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7] B28D 1/02

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)

IPC[7] B28D, B24B

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)

EPODOC, WPI, PAJ, CIBEPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ES 8702220 A (CASTRO) 16 October 1986 (16.10.86), pages 7-8; figures 6-9	1
A		2
Y	WO 0005048 A (CASTRO) 03 February 2000 (03.02.00), the whole document	1
A	ES 8603145 A (CASTRO) 01 September 1985 (01.09.85), the whole document	2
A	ES 2004387 A (TONCELLI) 01 January 1989 (01.01.89)	
A	FR 2578470 A (S.A.R.L.) 12 September 1986 (12.09.86)	

☐ 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	Date of mailing of the international search report
10 June 2002 (10.06.02)	24 June 2002 (24.06.02)
Name and mailing address of the ISA/ S.P.T.O	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/ES 02/00176

Patent document cited in search report	Publication date	Patent familiy member(s)	Publication date
ES 8702220 A	16.10.1986	NONE	
WO 0005048 A	03.02.2000	AU 3148799 A	14.02.2000
		ES 2140353 A	16.02.2000
		EP 1063069 A	27.12.2000
ES 8603145 A	01.09.1985	NONE	
ES 2004387 A	01.01.1989	PT 84469A	01.04.1987
		DE 3707037 A	17.09.1987
		IT 1191597 A	23.03.1988
		US 4762422 A	09.08.1988
		CA 1273082 A	21.08.1990
FR 2578470 A	12.09.1986	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)