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(54) **Steam condensation system for a granulation installation.**

(57) Abstract : The present invention concerns a granulation installation (10) for granulating molten material produced in a metallurgical plant, said installation comprising: a water injection device (20), for injecting granulation water into a flow of molten material (14) and thereby granulating the molten material; a granulation tank (18) for collecting the granulation water and the granulated material; and a steam condensation system comprising a steam collecting hood (24) located above said granulation tank (18), for collecting steam generated in said granulation tank (18), a gas conduit (38) arranged between said steam collecting hood (24) and a water column, and a gas compressor (40) arranged within said gas conduit (38) for compressing said steam before feeding it into said water column. (Fig. 1)
92891

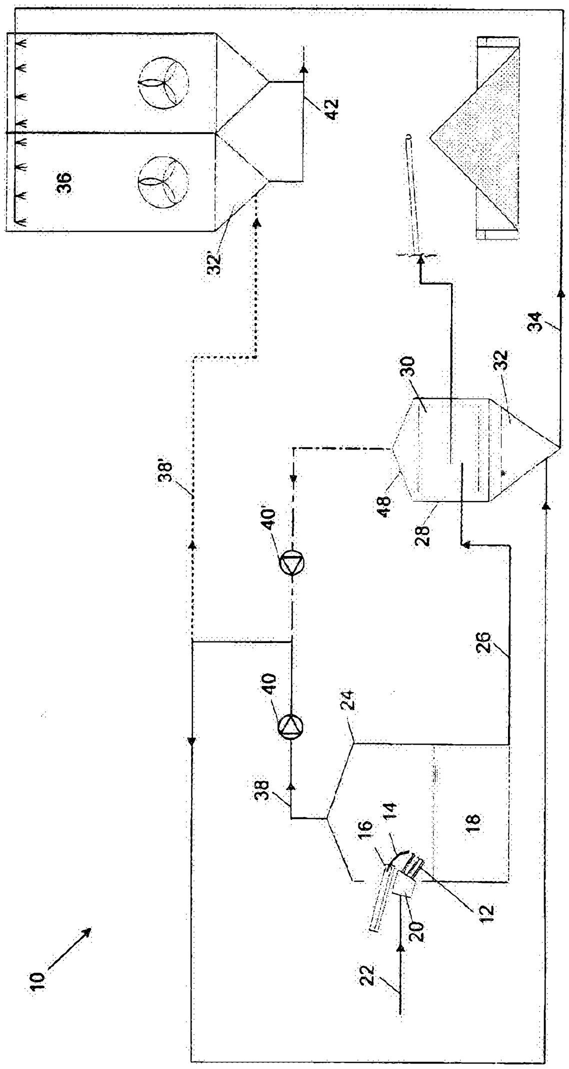

Fig. 1

STEAM CONDENSATION SYSTEM FOR A GRANULATION INSTALLATION

Technical field

[0001] The present invention generally relates to a granulation installation for molten material, especially for metallurgical melts such as blast furnace slag. It relates more particularly to an improved steam condensation system design for use in such an installation.

Background Art

[0002] An example of a modern granulation installation of this type, especially for molten blast furnace slag, is illustrated in appended Fig.2 that is part of a paper entitled "INBA® Slag granulation system – Environmental process control" published in Iron&Steel Technology, issue April 2005. As seen in Fig.2, this kind of installation typically comprises: a water injection device [2] (also called blowing box), for injecting granulation water into a flow of molten material, e.g. slag that is received via a runner tip [1]. Thereby, granulation of the molten material is achieved. The installation further has a granulation tank [3] for collecting the granulation water and the granulated material and for cooling down the granules in a large water volume beneath the water injection device [2]. A steam condensation tower, typically having a cylindrical shell closed by a top cover, is located above the granulation tank for collecting and condensing steam generated in the granulation tank. In fact, due to the high temperatures of the molten material and the huge amount of quenching water required, a considerable amount of steam is typically produced by installations according to Fig.2. To avoid pollution by simple emission of steam into the atmosphere, the steam condensation tower includes a steam condensing system, typically of the counter-current type. The steam condensing system has a water-spraying device [5] for spraying water droplets into steam that rises inside the steam condensation tower and a water-collecting device [6] located below the water injection device [5], for collecting sprayed condensing droplets and condensed steam.

[0003] Production of molten material in metallurgical processes is typically cyclic and subject to considerable fluctuations in terms of produced flow rates. For instance, during a tapping operation of a blast furnace, the slag flow rate is far from being constant. It shows peak values that may be more than four times the slag flow rate averaged over the duration of the tapping operation. Such peaks occur, occasionally or regularly, during short times, e.g. several minutes. It follows that, in a typical state of the art water-based granulation installation, there are important fluctuations in the incoming heat flow rate due to the incoming slag, accordingly, equivalent fluctuations in the amount of steam generated over time. In order to find a suitable compromise between installation size and costs, the steam condensation capacity is often not designed to handle the full steam flow, which might be generated during peak slag flows. Overpressure relief flaps are foreseen (as seen in the top cover shown in Fig.2) to open in such cases, in order to evacuate excessive steam to the atmosphere. These overpressure relief flaps are also opened for evacuating hydrogen and in case of sudden deflagration.

[0004] However, observation has shown that, in practice, such overpressure flaps do not always reliably open at excess melt flow rates. It is theorized that steam is partially blocked from leaving through the overpressure flaps because, among others, of the "barrier" formed by the "curtain" of water constantly produced by the water injection device [2]. Possibly, at high steam rates, there is also resistance to steam flow formed by the water-collecting device [6]. Accordingly, excess steam remains inside the tower, and overpressure is subsequently generated. This can lead to partial backflow of steam at the lower inlet of the condensation tower, at the entrance of the granulation tank [3]. An internal hood is especially foreseen to separate the inside from the outside, and thus avoiding unwanted air to enter the tower and also preventing steam from being blown out of the tower.

[0005] Such reverse steam flow may lead, at the very least, to bad visibility in the casthouse, which is obviously a serious safety risk for operating personnel. Much more adversely, steam blowing back through the internal hood can lead to considerable generation of low-density slag particles (so-called "popcorn") when the steam comes into contact with the liquid hot melt inside the slag runner spout.

Such hot particles, when projected into the casthouse, generate an even more severe safety risk.

[0006] WO2012/079797 A1 addresses this problem as well and proposes to selectively evacuate the excess steam via a stack to the atmosphere. This stack has an inlet communicating with the lower zone of the condensation tower and an outlet arranged to evacuate steam to the atmosphere above the condensation tower. Furthermore, the stack is equipped with an obturator device for selective evacuation of steam through the stack.

[0007] Under some circumstances, it has been noted that the amount of air in the condensation tower is considerably more important than usually expected. As a consequence, the temperature inside the condensation tower is indeed significantly lower than what is usually expected. Instead of having a temperature close to 100℃ due to the presence of "pure steam", the temperature may be very close to ambient temperature due to the presence of less steam and a lot of false air. A significant amount of false air is thus seen as obstructive for the good functioning of the condensation tower.

Technical problem

[0008] Accordingly, it is a first object of the present invention to provide a steam condensation system, which enables more reliable evacuation of excessive steam during granulation at peak flow rates, while being compatible with existing granulation plant designs at comparatively low additional cost. This object is achieved by a granulation installation and a steam condensation system as claimed in claim 1.

[0009] It is another object of the invention to provide a steam condensation system that enables reduction in installation and operating costs of the plant.

General Description of the Invention

[0010] The present invention generally relates to a granulation installation and to a steam condensation system as set out in the pre-characterizing portion of claim 1.

[0011] In order to overcome the above-mentioned problem, the present invention proposes a steam condensation system comprising a steam collecting hood located above the granulation tank, for collecting steam generated in the granulation tank, a gas conduit arranged between the steam collecting hood and a water column, and a gas compressor arranged within the gas conduit for compressing the steam before feeding it into the water column.

[0012] The present invention thus proposes to use a steam collecting hood to collect the steam and air and any other components arranged therein, such as hydrogen or sulphur. The condensation tower is replaced by a gas compressor arranged within a gas conduit feeding the compressed steam and gas mixture to a water column.

[0013] The gas compressor sucks the steam and air from the steam collecting hood, raises the pressure of the gas mix and injects it into the water column of an already existing water reservoir such as e.g. the water recovery tank of a dewatering unit (often referred to as "hot water tank") or the water recovery tank of a cooling tower (often referred to as "cold water tank"). Although the use of already existing water reservoirs is of course preferred for cost, space and maintenance reasons, the provision of a new dedicated water reservoir may also be envisaged and is encompassed herewith.

[0014] The pressure created by the gas compressor may be adapted and should be sufficient to overcome the pressure of the water column in these tanks such that the gas mix rises as bubbles inside these water volumes. This movement creates a significant surface for efficient condensation and sulphur dissolution. The condensation does thus no longer take place in a separate condensation tower but it is switched to an already existing water tank, thus resulting in lower investment costs and potentially better results due to an increased surface for efficient condensation.

[0015] The lower temperature of the gaseous mixture makes it possible to inject the gas into the bottom of the water recovery tank of the dewatering unit. Given that the temperature of the water in the water recovery tank is usually elevated and the temperature of the gaseous mixture is close to ambient, a significant temperature difference between these two substances is guaranteed. This temperature difference and the low concentration of vapor and sulphur in the gaseous mixture facilitates the dissolution and condensation of inside the water volume. Any sulfurous compounds contained in the steam will be dissolved and neutralized in the water. Calculation showed that about 385 l of water are needed to dissolve H_2S contained in one 1 t steam and about 142 l are needed to dissolve the complete SO_2 contained in one 1 t steam.

[0016] Furthermore, with the injection of the vapor and the gaseous sulphur in the water recovery tank of the dewatering unit, the gaseous mixture is in contact with solidified blast furnace slag, thus enabling a reaction between the gaseous sulphur and the solid slag to form gypsum through ionic recombination with Ca2+.

[0017] Although the above mainly discusses the injection of the gas mixture into the hot water tank, the injection of the gas mixture into the cold water tank is also envisaged, either as an alternative or as an addition.

[0018] In a further refinement of this invention, deviation plates may be arranged in the water column, in the area where the gaseous mixture is injected, in order to deviate the gases and thus create a longer residence time inside the liquid surroundings.

[0019] Also, the gas conduit may be connected to a distribution tube with perforations arranged within the water column. Such perforations are preferably arranged so as to distribute the steam into the water column at different locations, thereby obtaining an improved repartition of the steam in the water column.

[0020] A further steam collecting hood may be associated with the dewatering unit. A further gas compressor may be used to feed steam and gas mixture collected from the dewatering unit into the stream of gas mixture collected from above the granulation tank.

[0021] The gas compressor above the granulation tank has a volume flow of at least 20.000 Nm^3/h, preferably at least 40.000 Nm^3/h. The further gas compressor of the dewatering unit may have a lower volume flow of 5.000 to 10.000 Nm^3/h.

[0022] It has been found that during the granulation of slag, hydrogen gas may under some circumstances be formed. Indeed, the hot liquid slag may contain iron and, in contact with the hot iron contained in the slag, water molecules may be split up into hydrogen and oxygen. This hydrogen gas is extremely explosive and since the condensation tower is basically air tight, the hydrogen gas, which is much lighter than air, may accumulate in the upper zone of the condensation tower. Under specific circumstances, this mixture may ignite and an explosion or a fire may be the consequence. Calculations have shown that during a granulation run, the hydrogen production may vary between about 0.5 m^3 H_2/min and 8 m^3 H_2/min, depending on the iron content of the slag and the diameter of the granules produced. Prior art solutions have suggested using overpressure relief flaps for evacuating hydrogen.

[0023] The installation of the present invention allows removing the hydrogen from the area above the granulation tank and transport it to a location further away from the hot melt flow, thus reducing the risk of fire or explosion.

[0024] The proposed steam evacuation system has the incontestable merit of safely evacuating any undesired and potentially harmful excess of steam and hydrogen from the granulation plant and thereby considerably increasing operation safety. Moreover, the proposed system allows to condensate the evacuated steam and to dissolve and neutralize the sulfur containing compounds in water, thus reducing the environmental effect of the plant. The use of already existing water reservoirs for carrying out the condensation process obviously leads to cost reduction.

[0025] The present invention also relates to a method for condensing steam generated in a granulation installation, the method comprising collecting steam generated in the granulation tank via the steam collecting hood; compressing the steam within the gas conduit; and feeding the steam into the water column and condensing the steam therein.

[0026] Preferred embodiments of the installation are defined in dependent claims. As will be understood, while not being limited thereto, the proposed installation is especially suitable for a blast furnace plant.

Brief Description of the Drawings

[0027] Further details and advantages of the present invention will be apparent from the following detailed description of a not limiting embodiment with reference to the attached drawings, wherein:

Fig.1 is a block schematic diagram of an embodiment of a granulation installation equipped with a steam condensation system according to the invention;

Fig.2 illustrates a known granulation installation according to prior art.

Description of Preferred Embodiments

[0028] For illustrating an embodiment of the present invention, Fig.1 shows a diagrammatic view of a granulation installation 10 designed for slag granulation in a blast furnace plant (the plant not being shown). Generally speaking, the installation 10 thus serves to granulate a flow of molten blast furnace slag 14 by quenching it with one or more jets 12 of comparatively cold granulation water. As seen in Fig.1, a flow of molten slag 14, inevitably tapped with the pig iron from a blast furnace, falls from a hot melt runner tip 16 into a granulation tank 18. During operation, jets of granulation water 12, which are produced by a water injection device 20 (often also called a "blowing box") supplied by a supply conduit 22, preferably comprising one or more parallel high-pressure pump(s) (not shown), impinge onto the molten slag 14 falling from the hot runner tip 16. A suitable configuration of a water injection device 20 is e.g. described in patent application WO 2004/048617. In older granulation installations (not shown, but encompassed), molten slag falls from a hot runner onto a cold runner, with jets of granulation water from a similar water injection device entraining the flow on the cold runner towards a granulation tank. Irrespective of the design, granulation is achieved when the granulation water jets 12 impinge on the flow of molten slag 14.

[0029] By virtue of quenching, the molten slag 14 breaks up into grain-sized “granules”, which fall into a large water volume maintained in the granulation tank 18. These slag “granules” completely solidify into slag sand by heat exchange with water. It may be noted that the jets of granulation water 12 are directed towards the water surface in the granulation tank 18, thereby promoting turbulence that accelerates cooling of the slag.

[0030] As is well known, quenching of an initially hot melt (>1000°C) such as molten slag results in important quantities of steam (i.e. water vapor). This steam is usually contaminated, among others, with gaseous sulfur compounds. In order to reduce atmospheric pollution, steam released in the granulation tank 18 is collected in a steam collection hood 24 (hereinafter in short "hood 24") that is located vertically above the granulation tank 18. As seen in Fig.1, the hood 24 is a small edifice compared to a traditional condensation tower as shown in Fig.2. The hood 24 has an external shell, which is typically but not necessarily a welded steel plate construction. The hood 24 has a certain height and diameter dimensioned for a volume of emitted steam/min. The hood 24 does not contain any water-spraying devices to condensate the steam as in a conventional condensation tower. During operation, steam rises from the granulation tank 18 into the hood 24.

[0031] As seen in Fig.1, at the bottom of the granulation tank 18, solidified slag sand mixed with granulation water is evacuated via a drainage conduit 26. The mixture (slurry) is fed to a dewatering unit 28. The purpose of this dewatering unit 28 is to separate granulated material (i.e. slag sand) from water, i.e. to enable separate recovery of slag sand and process water. A suitable general configuration of a dewatering unit 28 is well known from existing INBA® installations or described e.g. in US patent no. 4,204,855 and thus not further detailed here. Such a dewatering unit comprises a rotary filtering drum 30, e.g. as described in more detail in US patent no. 5'248'420. Any other static or dynamic device for dewatering fine solidified melt granules may also be used. As further shown in Fig.1, a granulation water recovery tank 32 (often called a "hot water tank") is associated with the dewatering unit 28 for collecting water that is separated from the granulated slag sand. In most cases, this water recovery tank 32 is conceived as a settling tank with a settling compartment and a clean water compartment (not shown), into which the largely sand-free ("clean") water overflows. The water from the water recovery tank 32 is feed through conduit 34 to a cooling system 36 that has one or more cooling towers.

[0032] Cooled process water from the cooling system 36 may be evacuated via an evacuation conduit 42 for disposal or for use elsewhere. Preferably, the evacuation conduit 42 is connected to the supply conduit 22 of the water injection device 20 via a recirculation conduit (not shown), thus forming a "closed-circuit" configuration for process water.

[0033] According to an important aspect of the present invention, the hood 24 is connected to a gas conduit 38 comprising an evacuation device 40 for extracting steam and gas from the hood 24. The evacuation device 40, as schematically illustrated in Fig.1, is preferably a gas compressor compressing the steam and gas collected from the hood 24 and feeding the compressed gas down the gas conduit 38.

[0034] The gas conduit 38 is connected to a lower portion of the water recovery tank 32 of the dewatering unit 28 at a pressure superior to the pressure reigning in the water recovery tank 32. Upon entering the water recovery tank 32, the compressed steam and gas expands and bubbles up through the water in the water recovery tank 32 while interacting therewith.

[0035] According to the present invention, condensation of the steam is not carried out in a large condensation tower. Instead, condensation of the steam is effected in a water column, preferably in a water column that is already present in the granulation installation 10 anyway. The water recovery tank 32 of the dewatering unit 28 is a good candidate for providing the water column needed for condensation of the steam. The pressure created by the gas compressor should be sufficient to overcome the pressure of the water column and said gas mix should then rise as bubbles inside the water volume. This movement creates a significant surface for efficient condensation and sulphur dissolution. The condensation does thus no longer take place in a separate condensation tower but it is switched to an already existing water tank, thus resulting in lower investment costs and potentially better results due to an increased surface for efficient condensation.

[0036] Deviation plates (not shown) may be arranged in the lower part of the water recovery tank 32 in the area where the gaseous mixture is injected in order to deviate the gases and thus create a longer residence time inside the liquid surroundings.

[0037] A distribution tube (not shown) connected to the gas conduit may be arranged within the water column. Such a distribution tube may comprise a number of perforations arranged so as to distribute the steam into the water column at different locations. This may further improve the repartition of the steam in the water column.

[0038] A further gas compressor 40' may be used to extract steam and gas from the dewatering unit 28 via a further steam collection hood 48 above the rotary filtering drum 30. The gas compressor 40' may be installed so as to suck off steam and gas from the dewatering unit 28 and/or from the steam collection hood 48. This configuration has the benefit of properly evacuating steam and gas from the dewatering unit 28 and condensing the steam and thus reducing visibility problems in the surroundings of the dewatering unit 28 and the installation 10 in general.

[0039] Preferably, the gas compressor(s) 40, 40' is (are) connected to a controller, which can be integrated into the process control system of the entire plant. The gas compressors are preferably controlled by frequency converters and an adjustable flow rate valve for keeping the same pressure at differing flow rates. The flow rate adjustment may be based on a pressure measurement inside the steam collecting hood, in particular the steam collecting hood 24.

[0040] In conclusion, it will be appreciated that the present invention not only enables an important increase in operational safety of a water-based granulation installation 10, especially for blast furnace slag. In addition, the invention permits reliable operation at lower capital and operating expenditure.

Legend:

10	granulation installation	30	rotary filtering drum
12	water jets	32	water recovery tank (of 28)
14	melt flow	32'	water recovery tank (of 36)
16	hot runner tip	34	conduit
18	granulation tank	36	cooling system
20	water injection device	38	gas conduit
22	supply conduit (of 20)	40	gas compressor
24	steam collecting hood	40'	further gas compressor
26	drainage conduit	42	evacuation conduit
28	dewatering unit	48	further steam collecting hood

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P-PWU-732/LU

Revendications

1. Installation (10) de granulation pour granuler un matériau fondu produit dans une usine métallurgique, ladite installation comprenant :
un dispositif (20) d'injection d'eau, pour injecter de l'eau de granulation dans un écoulement de matériau fondu (14) et granulant ainsi le matériau fondu ;
une cuve (18) de granulation pour collecter l'eau de granulation et le matériau granulé ;
caractérisée par un système de condensation de vapeur comprenant :
une hotte (24) de collecte de vapeur située au-dessus de ladite cuve (18) de granulation, pour collecter une vapeur générée dans ladite cuve (18) de granulation,
une conduite (38) de gaz agencée entre ladite hotte (24) de collecte de vapeur et une colonne d'eau,
un compresseur (40) de gaz agencé à l'intérieur de ladite conduite (38) de gaz pour compresser ladite vapeur avant de l'alimenter dans ladite colonne d'eau.

2. Installation (10) de granulation selon la revendication 1, comprenant en outre une unité (28) de déshydratation, en particulier une unité (28) de déshydratation avec un tambour (30) rotatif de filtrage, ayant une cuve (32) de récupération d'eau, caractérisée en ce que ladite colonne d'eau à laquelle ladite conduite (38) de gaz est connectée est ladite cuve (32) de récupération d'eau de ladite unité (28) de déshydratation.

3. Installation (10) de granulation selon la revendication 1 ou 2, comprenant en outre un système (36) de refroidissement, en particulier une tour (36) de refroidissement, ayant une cuve (32') de récupération d'eau, caractérisée en ce que ladite colonne d'eau à laquelle ladite conduite

(38) de gaz est connectée par l'intermédiaire d'une dérivation (38') est ladite cuve (32') de récupération d'eau dudit système (36) de refroidissement.

4. Installation (10) de granulation selon la revendication 1, caractérisée en ce que ladite colonne d'eau à laquelle ladite conduite (38) de gaz est connectée est un réservoir d'eau dédié.

5. Installation (10) de granulation selon l'une quelconque des revendications précédentes, comprenant en outre des plaques de déviation agencées dans ladite colonne d'eau, de façon à dévier un courant entrant pour une durée de résidence plus longue à l'intérieur de la colonne d'eau.

6. Installation (10) de granulation selon l'une quelconque des revendications précédentes, dans laquelle ladite conduite (38) de gaz est connectée à un tube de distribution agencé à l'intérieur de ladite colonne d'eau, ledit tube de distribution comprenant un certain nombre de perforations pour distribuer ladite vapeur dans ladite colonne d'eau en différents emplacements.

7. Installation (10) de granulation selon l'une quelconque des revendications 2 à 6, comprenant en outre
une autre hotte (48) de collecte de vapeur située au-dessus de ladite unité (28) de déshydratation, pour collecter une vapeur générée dans ladite unité (28) de déshydratation,
un autre compresseur (40') de gaz agencé à l'intérieur d'une conduite de gaz se connectant à ladite conduite (38) de gaz.

8. Installation (10) de granulation selon l'une quelconque des revendications précédentes, dans laquelle ledit compresseur (40, 40') de

gaz est connecté à un contrôleur pour commander ledit compresseur (40, 40') de gaz.

9. Installation (10) de granulation selon l'une quelconque des revendications précédentes, dans laquelle ledit compresseur (40) de gaz a un débit volumique d'au moins 20,000 Nm^3/h, préférablement au moins 40,000 Nm^3/h.

10. Installation (10) de granulation selon l'une quelconque des revendications précédentes, dans laquelle ledit autre compresseur (40') de gaz a un débit volumique d'entre 5,000 Nm^3/h et 10,000 Nm^3/h.

11. Procédé de condensation de vapeur générée dans une installation de granulation, ladite installation de granulation comprenant un système de condensation de vapeur avec une hotte (24) de collecte de vapeur située au-dessus d'une cuve (18) de granulation et une conduite (38) de gaz comprenant un compresseur (40) de gaz connecté entre ladite hotte (24) de collecte de vapeur et une colonne d'eau ;
dans lequel ledit procédé comprend :
- la collecte d'une vapeur générée dans ladite cuve (18) de granulation par l'intermédiaire de ladite hotte (24) de collecte de vapeur ;
- la compression de ladite vapeur à l'intérieur de ladite conduite (38) de gaz ; et
- l'alimentation de ladite vapeur dans ladite colonne d'eau et la condensation de ladite vapeur à l'intérieur de ladite colonne d'eau.

12. Procédé selon la revendication 11, dans lequel ladite vapeur est alimentée dans une cuve (32) de récupération d'eau d'une unité (28) de déshydratation et/ou dans une cuve (32') de récupération d'eau d'un système (36) de refroidissement et/ou dans un réservoir d'eau dédié.

13. Procédé selon la revendication 11 ou 12, comprenant les étapes suivantes de :
- collecte d'une vapeur générée dans une unité (28) de déshydratation par l'intermédiaire d'une autre hotte (48) de collecte de vapeur ;
- compression de ladite vapeur à l'intérieur de ladite conduite (38) de gaz au moyen d'un autre compresseur (40') de gaz ; et
- alimentation de ladite vapeur dans ladite colonne d'eau et condensation de ladite vapeur à l'intérieur de ladite colonne d'eau.

14. Usine de haut-fourneau comprenant une installation (10) de granulation selon l'une quelconque des revendications 1 à 10.

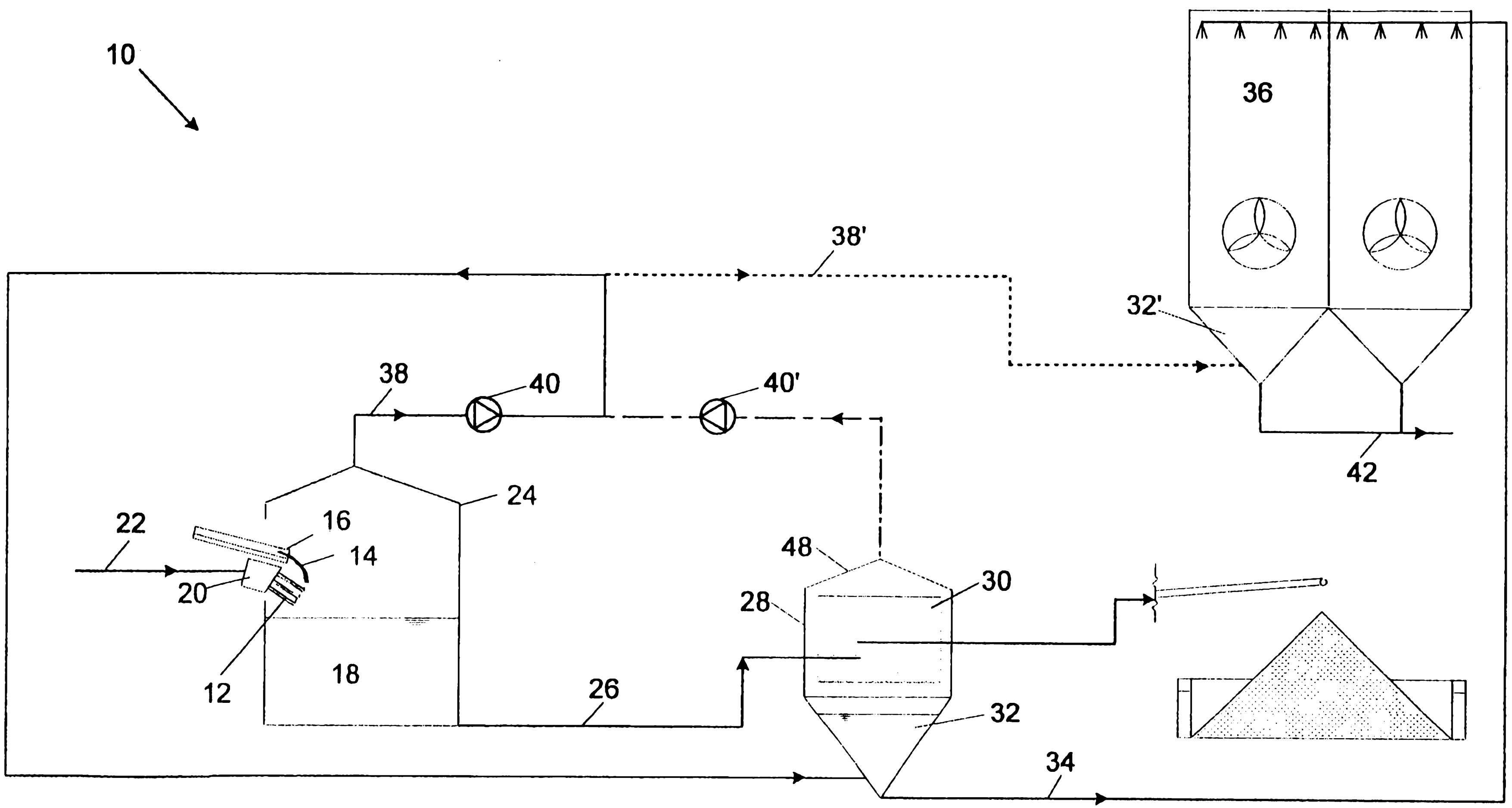

Fig. 1

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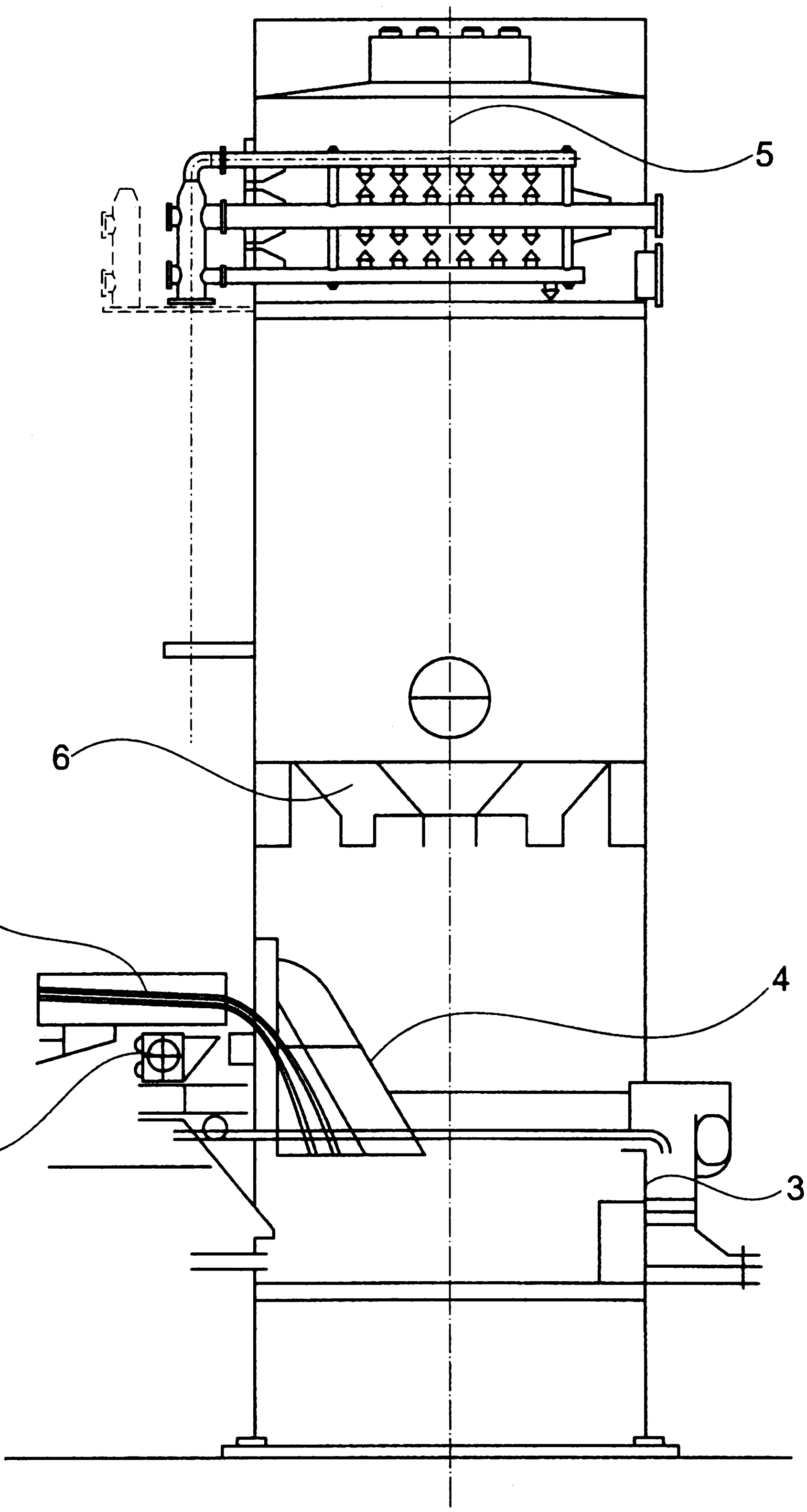

Fig. 2
(PRIOR ART)

Abstract

The present invention concerns a granulation installation (10) for granulating molten material produced in a metallurgical plant, said installation comprising:
a water injection device (20), for injecting granulation water into a flow of molten material (14) and thereby granulating the molten material; a granulation tank (18) for collecting the granulation water and the granulated material; and
a steam condensation system comprising a steam collecting hood (24) located above said granulation tank (18), for collecting steam generated in said granulation tank (18), a gas conduit (38) arranged between said steam collecting hood (24) and a water column, and a gas compressor (40) arranged within said gas conduit (38) for compressing said steam before feeding it into said water column.

(Fig. 1)

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DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie
et du Commerce extérieur

National Application Number

LO 1225
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SEARCH REPORT

in accordance with Article 35.1 a)
of the Luxembourg law on patents
dated 20 July 1992

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 202 063 926 U (SICHUAN DAXI GREEN TECHNOLOGY CO LTD) 7 December 2011 (2011-12-07) * figure 1 * -----	1-6, 9-11,14	INV. C21B3/08
X	CN 202 322 871 U (WUXI DONGYOU ENVIRONMENTAL PROT TECHNOLOGY CO LTD) 11 July 2012 (2012-07-11) * figure 1 * -----	1,11,14	
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TECHNICAL FIELDS SEARCHED (IPC)

C21B

The present search report has been drawn up for all claims

	Date of completion of the search	Examiner
	16 August 2016	Gimeno-Fabra, Lluis

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C55)

ANNEX TO THE SEARCH REPORT
ON LUXEMBOURG PATENT APPLICATION NO.

LO 1225
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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16-08-2016

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie
et du Commerce extérieur

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
LO1225	01.12.2015		LU92891

International Patent Classification (IPC)
INV. C21B3/08

Applicant
Paul Wurth S.A.

This report contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☐ Box No. VII — Certain defects in the application
- ☐ Box No. VIII — Certain observations on the application

Examiner
Gimeno-Fabra, Lluis

WRITTEN OPINION

Box No. I Basis of the opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	2-10, 12, 13
	No:	Claims	1, 11, 14
Inventive step	Yes:	Claims	7, 8, 12, 13
	No:	Claims	1-6, 9-11, 14
Industrial applicability	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 CN 202 063 926 U (SICHUAN DAXI GREEN TECHNOLOGY CO LTD) 7 December 2011 (2011-12-07)

D2 CN 202 322 871 U (WUXI DONGYOU ENVIRONMENTAL PROT TECHNOLOGY CO LTD) 11 July 2012 (2012-07-11)

D3 WO 2015/000809 A1 (WURTH PAUL SA [LU]) 8 January 2015 (2015-01-08)

The present application does not meet the criteria of patentability, because the subject-matter of claim 1 is not new.

D1 discloses a granulation installation of the "tank type" wherein slag is granulated by water jets in a tank (Fig. §, Ref. 1, 2, 48).

In D1, the tank evacuation takes place through (33) under the hood of tank (48) and the evacuated gas, that comprises intrinsically steam is compressed by electric compressor (35) prior to further processing in heat exchangers (27) onwards and re-injection as water through nozzle (2).

D2 discloses a similar installation, the details of which can be seen in Fig. 1, in which gas compression takes place in (11) prior to being passed to (12) and condensation in (16).

The Division notes that claim 1 of the present application does not define any particularity or even reference the water column, would the applicant come to the thought that the condensation of the steam after compression in D1 and D2 respectively by compressors (35) and (11) does not take place in a water column.

Claim 1 is therefore not novel.

The same applies mutatis mutandis in corresponding method claim 11 and claim 14.

D3 is from the same applicant, describes a similar problem as the present application where alternative ejector pumps are used to compressors and yet is not cited nor discussed by the applicant. This Authority considers that the document is of relevance, because apart from the substitution of the compressors by ejector pumps the aggregates of claim 1 are identical to those of D3.

This Authority has considered the subject-matter of claims 2-7. At this stage of the procedure, only claims 7 and 10 and corresponding method claim 13 seem not directly derivable by any of the cited documents as they add a further compressor cycle.

Claims 2-6, 9 and 10 and corresponding method claim 12 however seem to focus on the usual features of known devices (see D3, corresponding features of Fig. 1). As such they are not inventive.