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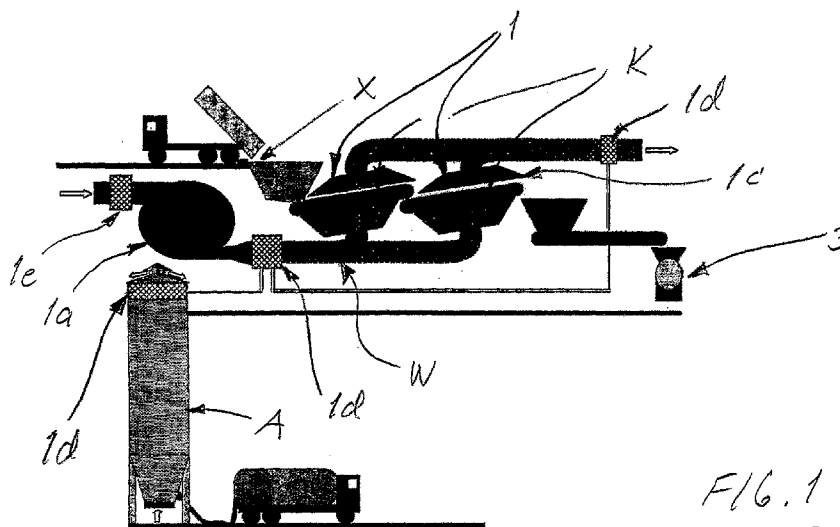
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(54) Title: APPARATUS FOR THE UTILIZATION OF WET WASTE MATERIAL



(57) Abstract: Apparatus for the utilization of wet waste material, which apparatus comprises at least a dryer arrangement for drying of wet waste material and a press arrangement (3) for pelletizing dried wet waste material. The apparatus is meant particularly for the utilization of the deinked mass (x), such as waste material comprising flour or like, in pelletized form by combustion, wherein the dryer arrangement comprises one or several dryers (1) in order to dry the deinked mass by an air flow (w) to be led therethrough, and/or one or several mixers (2) in order to dry the deinked mass by adding a drier ingredient (m) among the same.

# Apparatus for the utilization of wet waste material

The invention relates to an apparatus for the utilization of wet waste material, which apparatus comprises at least a dryer arrangement for drying of wet waste material and a press arrangement for pelletizing of dried waste material.

Particularly in board and paper industry a vast amount of deinked mass is produced every year e.g. as so called zero-fiber or flour waste material, which is flour mass, being separated from a process. This kind of waste material includes usually also small amounts of kaoline and latex, being used as coating materials. Furthermore particularly in pulp factories, corresponding deinked mass may be found e.g. from a sewage basin in a waste water plant as deinked solid material, which discloses typically short, usually < 5 mm long wood sticks, flour mass and to some extent other substances as well, such as sand, clay etc. Today this kind of waste material can be exploited mainly in pulp boilers only, in which the waste in question can be burnt in small amounts among other combustible materials. In factories that do not have a pulp boiler, this possibility for combustion does not exist, wherein e.g. required process steam for the factory's needs is usually produced by natural gas. Thus the deinked mass that gets generated will be left totally without exploitation. Due to a high humidity of the deinked mass, combustion thereof as such does not succeed, which is why the only alternative at present is usually its utilization e.g. for soil improvement purposes. This kind of deinked mass is, however, particularly well applicable for energy purposes thanks to its high caloric value, which has not decreased due to decomposition, which is the case e.g. with peat.

Transportation of deinked mass outside a factory area causes in addition to transportation costs also e.g. remarkable dumping area fees, in addition to which the material in question causes furthermore odor harms in composting plants, which are nowadays considered environmental nuisances. At present pressing of deinked mass as such into pellets does not succeed, because flour material, being e.g. separated from a process, has typically a humidity of 40 - 80 %.

In this connection e.g. in publication US 2006/0108459 there has been presented a solution for drying e.g. of different kinds of organic waste materials in a way that they could be used as fuel, whereby the main point is particularly exploitation of cow and pig manure. In the publication in question there has been suggested on the other hand also use of pulp or paper sludge, being generated particularly in paper manufacturing, as one waste material applicable for the solution in question. In this solution waste sludge is being poured into a mixing chamber, in which by influence of a mechanic rotor, when the solid material in the waste sludge hits the chamber walls as well as flow plates therein, so much kinetic energy is generated that the temperature of the waste sludge raises and the humidity thereof gets evaporated. Solid material that has been partly dried by air flow, is being transported furthermore for a final drying into a cyclone, whereby as a result of the process combustible material is achieved the humidity of which is about 15 %. In this solution there has also been suggested e.g. mixing of manure with sawdust, wood chips, straws or hay before the drying process. In this publication there has not, however, been suggested pelletizing of the dried waste material.

The solution presented in publication US 5,431,702 concerns particularly use of waste sludge and municipal waste in the manufacturing of fuel pellets,

whereby there has been suggested particularly waste paper, slack coal or chalice to be added among the waste material in question. As a binding agent in the mixture there has been suggested exploitation of black  
5     liquour, which is resulted from paper industry. This is why a waste sludge having e.g. 50-75 % water needs not to be dried before pressing thereof into pellets. In this solution there must be used, however, more coal than the waste material itself.

10     Furthermore in publication US 4,363,636 there has been presented particularly the drying of sugar cane bagasse in successive phases from a humidity of 48 % first to humidity of 30-40 % and after that into a humidity of  
15     8-18 % that is suitable for pelletizing. The sugar plant's own hot air flows are being used for drying.

Furthermore according to what has been presented in publication DE 361 3398, it is possible to produce  
20     particularly fuel briquets from paper or some other organic waste, such as e.g. from paper sludge. The solution being presented in this connection is based on the use of oxygen and ultrasound obviously with the intention particularly to eliminate bacteria and to  
25     oxidize smelling substances, such as sulphur compounds.

From a technical point of view the publication US 2006/0108459 discloses a complicated separator construction, the power demand of which is very high  
30     due to the mechanic rotor and the cyclone as well as the preheating of the air, being exploited therewith for the drying. Thus use of the solution in question as such for the purpose described above does not bring about a decisive relief on the costs that are nowadays  
35     caused particularly due to handling of flour.

Furthermore e.g. the solutions presented in patent publications US 5,431,702 and US 4,363,636 are

disadvantageous, since they are based on processes or process flows, being exploited in a process plant, which can not be exploited in every case. The solution presented in the publication DE 361 3398 as such does not as such bring any kind of help for the present context, either.

It is an aim of an apparatus for the utilization of wet waste material according to the present invention to achieve a decisive improvement in the problems described above and thus to raise essentially the level of prior art. In order to carry out this aim the apparatus according to the invention is mainly characterized in that the apparatus is meant particularly for the utilization of deinked mass, such as waste material comprising flour or like, in pelletized form by combustion, wherein the dryer arrangement comprises one or several dryers in order to dry the deinked mass by an air flow to be led therethrough, and/or one or several mixers in order to dry the deinked mass by adding a drier ingredient among the same.

As the most important advantages of the apparatus according to the invention may be mentioned the simplicity and efficiency of its operating principle and the equipmentation included therein, whereby as deinked mass it is first of all possible to exploit flour, which at present in most cases only causes costs, in pelletized form, even as a commercially exploitable fuel. In the apparatus according to the invention it is first of all possible to dry the deinked mass by means of an air flow being led therethrough, thanks to which water therein will be evaporated into the drying air. The drying efficiency can be furthermore increased by heat recovery, whereby it is possible to recover heat from the drying air, being blown through e.g. a flour waste material, which

is usually still warm after a process by means of a heat exchanger, whereby the heat can be transferred furthermore e.g. for preheating of the drying air e.g. by means of a second heat exchanger, being placed e.g. in a drying air channel. When applying the invention furthermore advantageously by placing a separate air dryer in a drying air channel before the blower, the efficiency of the drying influence of the air blow can be furthermore increased. In addition to or instead of the above, in an apparatus according to the invention it is possible to dry deinked mass also by decreasing its moisture by mixing a drier material among the same, whereafter the formed mass is being mixed as a homogeneous fiber mass suitable for pelletizing. In this connection as mixable raw materials may be used e.g. sawdust, sorting waste of grain, core of rape-seed, reed canary grass, grain straw, waste paper, cutter chips etc. Deinked mass, being produced with an apparatus according to the invention, such as e.g. flour pellet and the substances mentioned above mixed therewith, are all bio-based materials, which enables combustion of the pellets in question without a need for emission permits.

Thanks to the invention the deinked mass being treated can be brought into a commercially exploitable form for energy purpose, by virtue of which it is possible to substitute e.g. oil and gas operated energy production. By means of an apparatus according to the invention it is furthermore possible to promote employment and improve the image of factories that nowadays cause environmental problems.

Other advantageous embodiments of the apparatus meant for the utilization of wet waste material according to the invention have been presented in the dependent claims related to the same.

In the following description the invention is being illustrated in detail with reference to the accompanying drawings, in which

5 in figure 1

is shown a general operating principle of an apparatus being based particularly on air drying,

10 in figure 2

is shown an advantageous embodiment of the apparatus according to the invention, when exploiting a dryer carried out on a so called interchangeable platform principle,

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in figure 3

is shown furthermore an advantageous embodiment of the apparatus according to the invention, which is based on drying of deinked mass by mixing a drier substance therewith, and

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in figure 4

is shown furthermore an advantageous supplementary heat recovery embodiment according to the invention.

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The invention relates to an apparatus for the utilization of wet waste material, which apparatus comprises at least a dryer arrangement for drying of wet waste material and a press arrangement 3 for pelletizing of dried waste material. The apparatus is meant particularly for the utilization of deinked mass x, such as waste material comprising zero-fiber or flour or like, in pelletized form by combustion, wherein the dryer arrangement comprises one or several dryers 1 in order to dry the deinked mass e.g. on the principle shown in figure 1 by an air flow w to be led

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therethrough and/or one or several mixers 2 in order to dry the deinked mass e.g. on the principle shown in figure 3 by adding among the same a drier ingredient e.g. ground in a crushing device M.

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According to the embodiment shown in figure 3 it is possible to use as a main raw material of the pellets to be produced e.g. zero-fiber or flour, whereby the maximum amount of drier ingredient is 50 %.

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Particularly with reference to figure 1, as an advantageous embodiment the drying air w, being brought to the air dryer 1 belonging to the dryer arrangement as an advantageous embodiment with over pressure from one or several blowers 1a, is led e.g. from below through the deinked mass, which passes on conveyors K through two successive dryers. In this connection as an advantageous alternative it is possible also to arrange the air dryer operable by under pressure by coupling the same on a suction side of one or several blowers.

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Furthermore as an advantageous embodiment particularly with reference to the embodiment shown in figure 2, the dryer arrangement comprises at least one moveable air dryer 1, being carried out by such as an interchangeable platform, which has coupling and air flow arrangements 1b for drying air w that is to be led from below through the deinked mass x existing in the air dryer.

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As a further advantageous embodiment, in connection with an air dryer 1 belonging to the dryer arrangement is arranged furthermore e.g. on the principle shown in figures 1 and 2 an assembly 1c, such as an overhead extractor hood for collecting of drying air, being led through the deinked mass. The apparatus comprises furthermore as an advantageous embodiment an assembly

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ld for heat recovery from the air flow being led through the deinked mass s and/or from the manufactured pellets, and for transmitting the recovered heat further particularly for the drying or preheating of the drying air w and/or for a corresponding purpose.

Furthermore advantageously as a complementing embodiment particularly with respect to the one shown in figure 2, in the apparatus according to the invention e.g. on the principle shown in figure 4 it is possible to exploit also a supplementary heat recovery assembly 1d1 in order to transmit externally recovered heat particularly for drying or preheating of the drying air w and/or for a corresponding purpose. The supplementary heat recovery assembly 1d1 comprises as a further advantageous embodiment one or several solar cells, heat pumps and/or the like, an energy storing unit 1d1' and/or transmitting means 1d1" for the recovered heat.

It is naturally possible to exploit the supplementary heat recovery assembly 1d1, being shown in figure 4, as such without the type of basic heat recovery assembly as shown in figure 2. The supplementary heat recovery assembly 1d1 as shown in figure 4 can be carried out advantageously e.g. by using an air heat pump operated with circulated liquid, such as e.g. water, as a heat recovery device, whereby the recovered heat can be stored e.g. in a boiler 1d1' in order to transfer the recovered heat therefrom further e.g. by an adjustable mixer valve 1d1" to the drying air w by means of a second heat exchanger 1d.

In the solution shown e.g. in figure 2, a dryer platform, such as e.g. a so called interchangeable platform with a hook, has been used as a dryer, which has five segments, into which drying air is led as shown with a cross section in the middle of the picture

by suction and flow assemblies 1b existing under an intermediate bottom v of the dryer platform. The upper surface of the intermediate bottom is advantageously a perforated plate, on top of which there is placed e.g.  
5 a dryer wire. Furthermore according to the embodiment shown in figure 4, it is also possible to exploit the type of dryer wire - perforated plate-embodiment described above also as the upper wall of the dryer platform, which during drying efficiently prevents  
10 spreading of dust to the environment or the like emissions as well as noise.

The intermediate bottom v of the interchangeable platform is furthermore inclined towards the blow  
15 openings, which openings have e.g. plugs during transportation of the interchangeable platform, thanks to which water drifting from the deinked mass to be dried may not leak from the platform onto the road. During a drying situation blow pipes, being connected  
20 with a centrifugal blower, are coupled into the blow openings e.g. by camlock-fasteners.

When the dry matter content is e.g. 70-85 %, the drying is interrupted and the interchangeable platform is  
25 being emptied into a mixer of a pelletizing apparatus, which mixes the mass into homogeneous quality for pelletizing. Also in this context it is furthermore possible as an advantageous embodiment to make the drying more efficient by heat recovery as described  
30 above, whereby heat, which has been recovered by a heat exchanger from the exhaust air, is being transferred by means of a second heat exchanger to the drying air. In this way the preheated air speeds up the drying. Furthermore as an advantageous embodiment particularly  
35 a so called matrix press is being used as the pressing assembly 3, by means of which it is possible to produce pellets, when the pressing moisture is e.g. 25 - 30 %. For example with the embodiment shown in figure 3, it

has been possible to produce with this type of a press pellets out of a mixture, which has 50 % flour waste material and 50 % reed canary grass.

5 Ventilation of a storage silo A is carried out furthermore advantageously e.g. in a way that at the bottom thereof is a blower, which blows air through a cone, existing at the bottom of the silo and being manufactured from perforated plate. In this case hot  
10 pellets are cooled and heat/end moisture is relieved into air, whereby heat can be recovered from the upper part of the silo with a heat exchanger 1d.

The apparatuses shown e.g. in figures 1 and 3, which  
15 include additionally a dryer 1e for the drying air, being placed furthermore advantageously before the blower 1a and by means of which the humidity of incoming air is being eliminated e.g. by electrical condensing, and the storage silo A, are advantageously  
20 placed e.g. in the factory area, where the waste is produced. In this case waste transportation does not cause any costs, whereby only supplementary material that is possibly needed in the process needs to be brought to the pelletizing plant from outside.

25 Ash, being generated due to the combustion of the deinked mass pellets can be used furthermore as soil improvement material, which as such decreases the need for liming of the soil.

30 It is clear that the invention is not limited to the embodiments shown or described above, but instead it can be varied within the basic idea of the invention in the best possible way at any given time. Thus it is  
35 first of all clear that the alternative embodiments shown in figures 1 and 3 as such can be exploited also simultaneously in one and the same process e.g. with arrangements operated with under pressure and/or by

drying air flows taking place from top to bottom. In addition to the above it is also possible to produce the pellets directly onto the drying platform, on which they are cooled, in which case a full pellet platform will be transported to a combustion plant after cooling.

## Claims:

1. Apparatus for the utilization of wet waste material, which apparatus comprises at least a dryer arrangement for drying of wet waste material and a press arrangement (3) for pelletizing of dried waste material, **characterized** in that the apparatus is meant particularly for the utilization of deinked mass (x), such as waste material comprising flour or like, in pelletized form by combustion, wherein the dryer arrangement comprises one or several dryers (1) in order to dry the deinked mass by an air flow (w) to be led therethrough, and/or one or several mixers (2) in order to dry the deinked mass by adding a drier ingredient (m) among the same.
2. Apparatus according to claim 1, **characterized** in that drying air (w) that is brought to an air dryer (1) belonging to the dryer arrangement by one or several blowers (1a), is led through the deinked mass (x) to be dried.
3. Apparatus according to claim 2, **characterized** in that an air dryer (1) belonging to the same is arranged operable by over pressure by coupling the same on a pressure side of one or more blowers (1a).
4. Apparatus according to claim 2, **characterized** in that an air dryer (1) belonging to the same is arranged operable by under pressure by coupling the same on a suction side of one or several blowers (1a).
5. Apparatus according to any of the preceding claims 1-4, **characterized** in that the dryer arrangement comprises at least one moveable air dryer (1), being carried out by such as an interchangeable platform, which has coupling and air flow arrangements (1b) for

drying air (w) that is to be led from below through the deinked mass (x) existing in the air dryer.

5           6.           Apparatus according to any of the preceding claims 1-5, **characterized** in that in connection with an air dryer (1) belonging to the dryer arrangement is arranged an assembly (1c), such as an overhead extractor hood for collecting of drying air, being led through the deinked mass.

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          7.           Apparatus according to any of the preceding claims 1-6, **characterized** in that in connection with an air dryer (1) belonging to the dryer arrangement and/or the pellets being manufactured, there has been arranged and assembly (1d) for heat recovery from the air flow being led through the deinked mass (s) and/or from the manufactured pellets, and for transmitting the recovered heat further particularly for the drying or preheating of the drying air (w) and/or for a corresponding purpose.

20

          8.           Apparatus according to any of the preceding claims 1-7, **characterized** in that in connection with an air dryer (1) belonging to the dryer arrangement, there has been arranged a supplementary heat recovery assembly (1d1) in order to transmit externally recovered heat particularly for drying or preheating of the drying air (w) and/or for a corresponding purpose.

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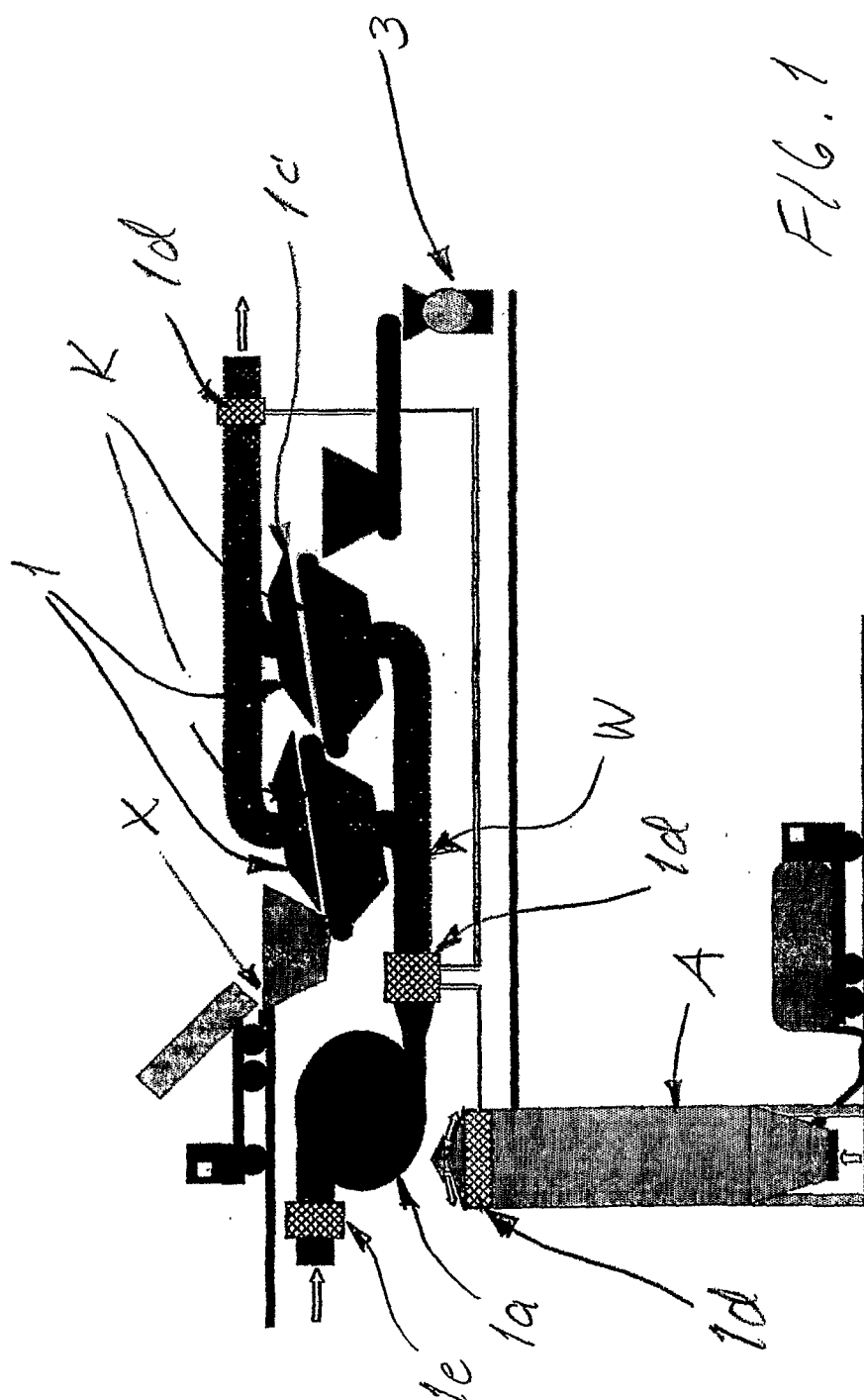
          9.           Apparatus according to claim 8, **characterized** in that the supplementary heat recovery assembly (1d1) comprises one or several solar cells, heat pumps and/or the like.

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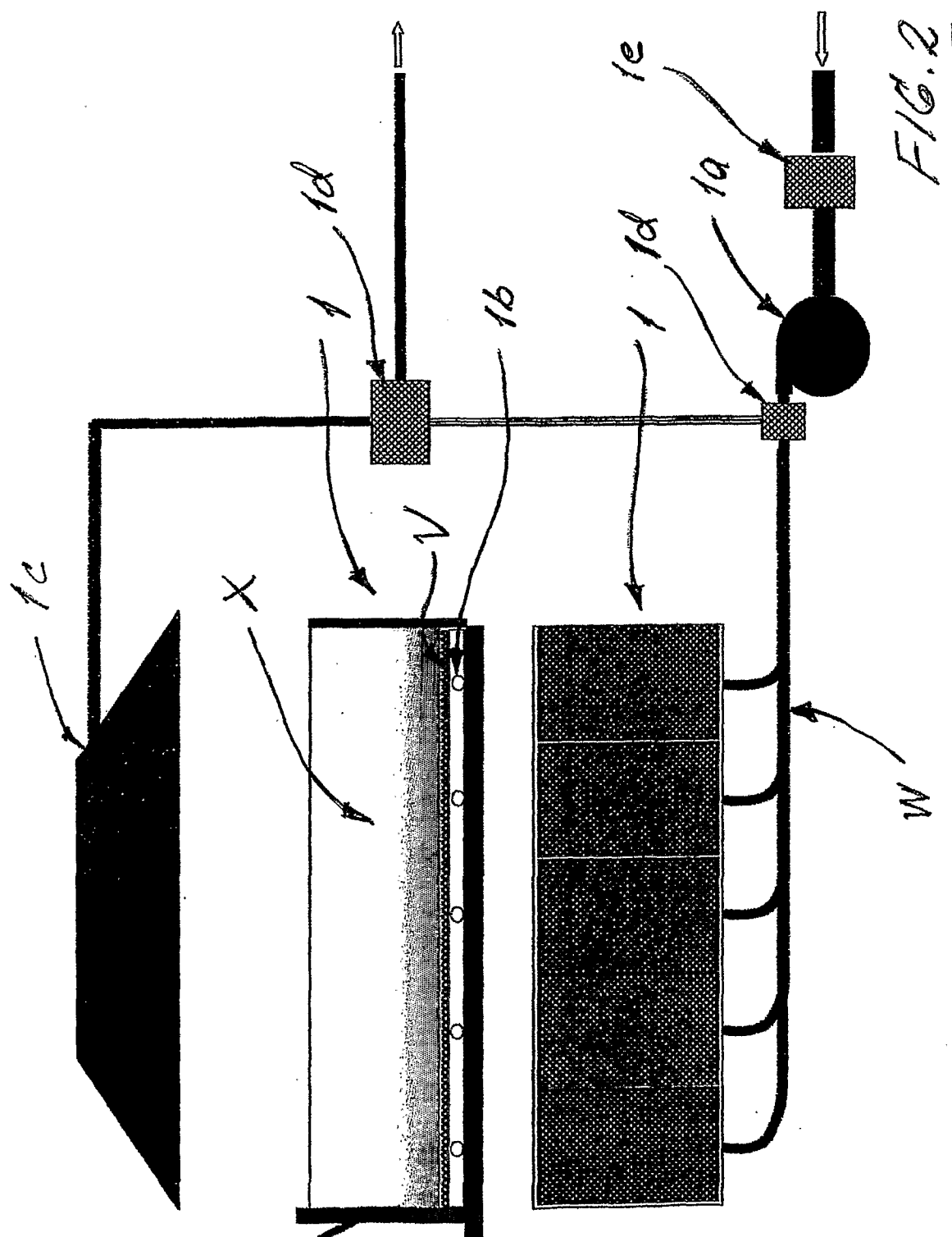
          10.          Apparatus according to claim 8 or 9, **characterized** in that the supplementary heat recovery assembly (1d1) comprises an energy storing unit (1d1') and/or transmitting means (1d1'') in order to transmit

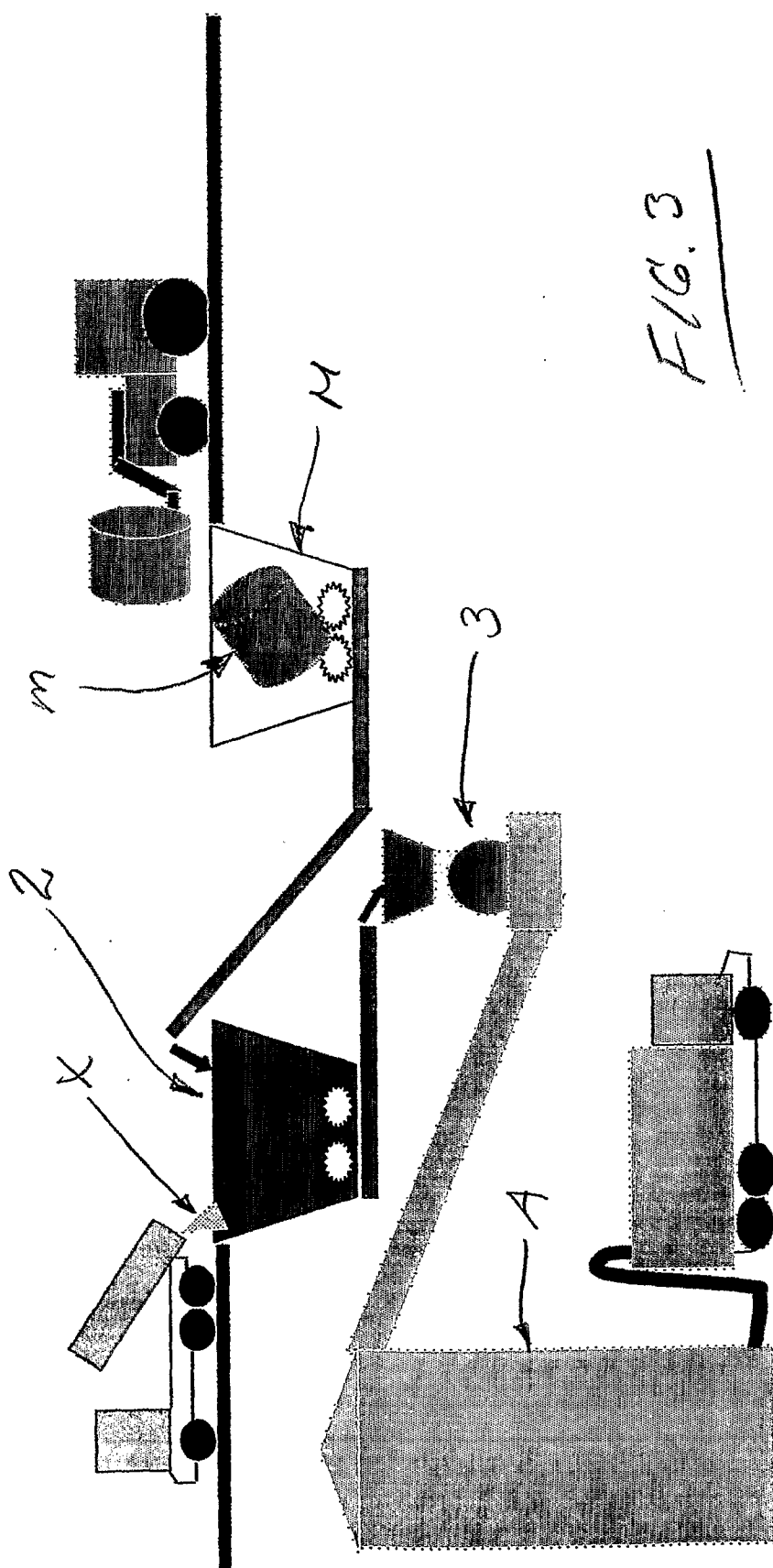
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the energy produced by the supplementary heat recovery assembly particularly for the drying or preheating of the drying air (w) and/or for a corresponding purpose.









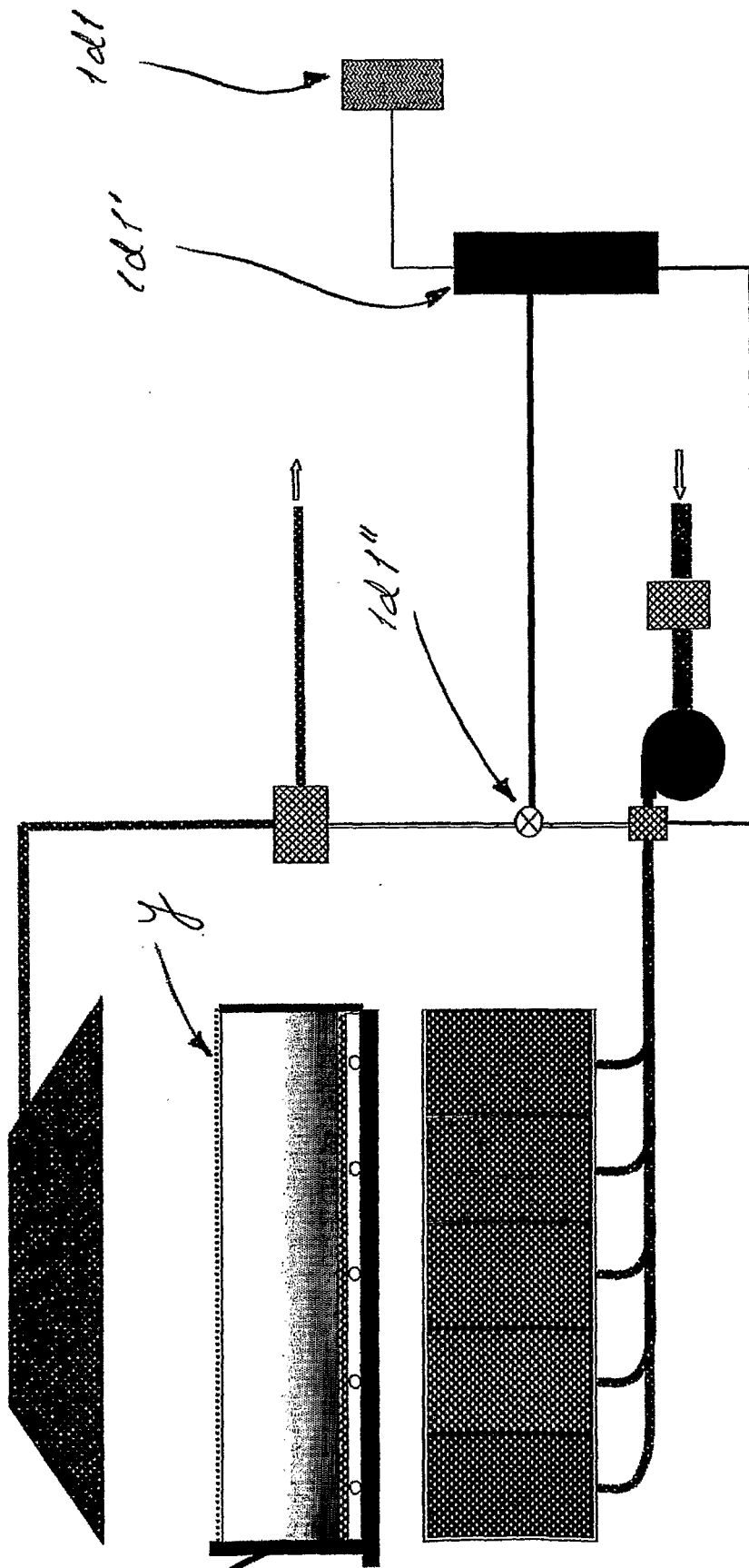


FIG. 4

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2008/050248

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra 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)

IPC: C10L, C02F, F26B, B09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20030186052 A1 (CREWS, JERRY W. ET AL), 2 October 2003 (02.10.2003), paragraphs [0009], [0011], [0021], [0022], [0027]	1
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

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**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/FI2008/050248****C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

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**International patent classification (IPC)****C10L 5/48** (2006.01)**C02F 11/12** (2006.01)**C10L 5/40** (2006.01)**F26B 3/06** (2006.01)**Download your patent documents at [www.prv.se](http://www.prv.se)**

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Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

28/06/2008

International application No.

PCT/FI2008/050248

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