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(54) **A METHOD AND EQUIPMENT FOR MANUFACTURING PREDETERMINED LOW BARK CONTENT WOOD CHIPS AND A HIGH BARK CONTENT FUEL FRACTION FROM WOOD CHIPS WITH BARK ATTACHED**

VERFAHREN UND VORRICHTUNG ZUR HERSTELLUNG VON HOLZSCHNITZEL MIT BESTIMMTEM NIEDRIGEM RINDENGEHALT UND HOHEM RINDENENTHALTENDEN KRAFTSTOFF AUS RINDENENTHALTENDENHOLZSCHNITZEL

PROCEDE ET INSTALLATION DE PRODUCTION DE COPEAUX DE BOIS PRESENTANT UNE TENEUR FAIBLE, PREDETERMINEE, EN ECORCE ET D'UNE FRACTION COMBUSTIBLE A TENEUR ELEVEE EN ECORCE, A PARTIR DE COPEAUX DE BOIS COMPORTANT DES MORCEAUX D'ECORCE

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Description

[0001] The object of the invention is a method and equipment for manufacturing predetermined low bark content wood chips and a high bark content fuel fraction from wood chips with bark attached, which method incudes the following stages:

- a mechanical bark removal process,
- pre-cleaning of wood chips with bark attached, and
- the final cleaning of the flow of wood chips, with the aid of an optical separator.

[0002] The above-mentioned type of manufacturing method is known from the international patent publication WO 93/25324. According to this, the wood chips with bark attached are ground initially either with a special plate grinder, or with a vibrating cone crusher, when the bark separates from the wood chips and the size of the bark particles diminishes. By means of this, the bark can be separated more easily during later separation stages. A grinder or a vibrating cone crusher is followed by pneumatic separation, especially to separate outer birch bark, after which sawdust is removed using a vibrating sieve. The bark content has now dropped to considerably less than 10 %, when the final cleaning can be carried out using an optical sorter. According to the patent, two optical sorters are used in series, but can, however, be replaced by a single more powerful device. The accepted fraction from the second optical sorter is led to grinding and the reject to the fuel fraction.

[0003] Equipment that is essentially that described by the application has been built in Kankaanpää in Finland, the supplier being BMH Wood Technology Oy. In the commercial equipment, a magnetic separator and a pneumatic separator are used in the pre-cleaning to separate metal scrap and stones. Sawdust is removed from the commercial equipment before grinding, and after grinding the vibrating sieve has been replaced by a so-called pocket-roll sieve (a roller sieve developed especially for sieving sawdust). In the commercial equipment, a good yield is achieved with a bark content of about 1 %, which is sufficiently clean for the manufacture of certain grades of cellulose. The yield varies between 60 - 70 %, depending on the species of timber and other factors. If cleaner chips are wanted, the yield drops, and correspondingly improves with a poorer level of cleanliness.

[0004] The intention of this invention is to achieve a better yield than previously at each corresponding level of cleanliness. The characteristic features of the method according to the invention are presented in the accompanying Patent Claim 1 and the features of corresponding equipment are presented in Patent Claim 8. The distribution values of the wood chip fractions according to the accompanying table are, to a great extent, the point of departure of the invention:

Sieve gap mm	Fraction remaining in sieve %	Clean wood chips in fraction	Wood chips with bark	Bark % of wood chips with bark
0	5,03			
2	16,73	79,03	1,96	3,61
4	37,94	89,98	2,72	8,57
6	25,37	85,54	7,15	16,78
8	8,01	74,54	14,83	19,98
10	6,92	69,00	25,51	18,30

[0005] It is surprising, that in the smallest fractions (sieve gap 4 mm, or less), there is not much bark attached to the chips, whereas in chips above this size the proportion of chips with bark attached is considerable. Because mechanical processing in any event reduces the size of the wood chips across the board, it is advantageous to separate this fairly clean part of the wood chips and have it bypass the mechanical processing. There is bark as such even in the smallest chips, but it is loose, and most of it leaves during the separation of the sawdust, which has been moved so that it takes place after the mechanical processing.

[0006] In what follows, the invention is illustrated by reference to the accompanying Figures, which show schematically one plant according to the invention and the method used in it.

Figure 1 shows the method according to the invention, as a block diagram.
Figure 2 shows equipment according to the invention, as a plant diagram.

[0007] In the diagram in Figure 1, the wood chips with bark attached can be considered as having been obtained by

conventional methods, using a known cutter. In the first stage of processing, the wood chips are cleaned in pre-separation 3, 4, 5, which comprises among, other things, magnetic devices for removing scrap iron and a pneumatic separator 4, 4' for removing stones and sand. In pre-separation, oversize wood chips are separated by means of disc sieve 5, and in practice are most advantageously led to the fuel fraction, but if necessary they can be led, for example, to a crusher and then back to pre-separation. The fraction accepted in pre-separation 3, 4, 5 is led to thickness sieving 6, which is intended to separate the thin wood chip fraction, generally less than 6 mm, from the part of the flow of wood chips travelling through the thickness sieve. This part is led to the following stage, i.e. past mechanical bark separation 7. Mechanical bark separation can take place by means of either a plate grinder, a crusher, or in a blade ring chipper, which has been shown to be the most advantageous, because it does not defibrate the wood material unnecessarily.

[0008] The mechanically processed fraction, together with the smaller fraction obtained from the bypass line 8, is led to pocket-roll sieve 9, which effectively removes the sawdust from the flow of material. After this, the accepted fraction is led to a pneumatic separator, to remove light birch bark, leaves, needles, and other easily airborne particles from the flow of material. After this, the pre-cleaned wood chips already have a bark content of less than 10 %, when it can be led to optical sorter 10, from which wood chips with a bark content of about 1 % can be obtained, even at a large yield. Reject from the optical sorter is led through selection 15 in a regulated manner either to the fuel fraction, or back to mechanical processing. In order to prevent a so-called 'mad cycle', 20 - 100 % is always led to the fuel fraction, and only 80 - 0 % is led to the mechanical processing. Certain species of timber or other conditions will mean that there is not necessarily any benefit from mechanical processing, in which case it is better to lead the reject from the optical sorter directly to the fuel fraction.

[0009] The plant diagram, Figure 2, shows cutter 1 and reception funnel 2, in which the wood chips are collected, or into which wood chips from external sources are poured. From here the flow of wood chips is led through magnetic separator 3 to disc sieve 5. Between these there is a pneumatic separator 4', which removes stones and a second pneumatic separator 4, which sucks light birch bark, leaves, and fine dust into the airflow, see also stone store 3.1. A disc sieve 5 removes oversized pieces from the wood chips, which are led to the fuel fraction 13, together with reject from the pneumatic separator. Beneath the disc sieve there is thickness sieve 6, which separates the smallest fraction and the sawdust in it, these being led to mechanical bark separation, going past grinder 7, whereas the rest of this part is led to grinder 7. Experiments have, however, shown that bark can be effectively separated by cutting the chips. The mechanically processed chip fraction obtained from the plate grinder and the thin fraction obtained from the bypass line 8 are led to the Pocket-Roll sieve 9, which removes sawdust and fine bark material from the flow of chips. After the Pocket-Roll sieve, there is a pneumatic separator 11, which removes light birch bark, leaves, needles, and other easily airborne material.

[0010] The accepted fraction is led to optical sorter 10, from which a good yield of good quality cellulose wood chips 12 are obtained. The reject is led through selection member 15 either to the fuel fraction 13 or to the grinder 7. Using selection member 15, 0 - 100 % can be taken from the flow of materials into the fuel fraction. It is advantageous to take at least 20 %, to prevent a so-called 'mad cycle' in the process. With certain grades of wood chips part of the material would remain to circulate continuously through the process, unless part of the reject is removed to the fuel fraction. All of the removed rejects are led in the Figure to fuel fraction 13, by means of conveyor 16.

[0011] Because the optical sorter uses a pneumatic conveyor, the reject flow is not homogeneous. A divider plate 18 set in the exit area can separate the part with the greatest bark content from the rest of the reject, it then being advantageously led directly to the fuel fraction with the aid of conveyor 19. The figure shows this alternative by broken lines.

[0012] The pulverization of the wood is reduced with the aid of the method according to the invention, which increases the cellulose chip yield from the previous yield by 5 - 10 percentage units, while share of the fraction of cellulose chips remaining in the 13 mm particle size perforated sieve increases substantially (by 15 - 35 percentage units).

[0013] In equipment according to the invention, a thickness sieve is used to separate the fraction with the desired value, 4 - 8 mm, for example, thinner than 6 mm, which is led past the barking separation and the thicker wood chips are fed to the mechanical bark separation. These fractions are combined and the sawdust and light birch bark is sieved out and sorted optically, the accepted fraction of which is clean wood chips and the reject is returned to mechanical bark separation, in which the bark is ground to a smaller size, so that it can be distinguished in the sawdust discharge.

[0014] Improvement of the cellulose wood chip yield by 5 percentage units improves the profitability of the plant by about FIM 20/m^3, which represents FIM 3 000 000 p.a. in a plant producing 150 000 m^3 p.a.. The effect of the chip size of cellulose wood chips on the sales price varies from case to cases, but at its greatest it too is about FIM 25/m^3. Together these correspond, in magnitude, to the operating and capital costs of the plant, so that the economy of the method improves substantially.

Claims

1. A method for manufacturing predetermined low bark content wood chips (12) and a high bark content fuel fraction (13) from wood chips with bark attached, which method includes the following stages:

   - mechanical bark removal treatment (7), in which the bark is removed from the chips and their size is reduced, and
   - pre-cleaning (6, 9, 11) of the flow of chips with bark attached, into a flow of chips with a bark content of less than 10 % and high bark content rejects, with the aid of pneumatic and mechanical sieving,
   - final cleaning of the aforesaid wood chip flow from the pre-cleaning, with the aid of an optical separator (10), to create low bark content wood chips (12) and a fraction with a higher bark content,
   - collection of the rejects leaving the process, to create the aforementioned high bark content fuel fraction,

   characterized in that before the aforesaid mechanical bark removal process (7) a predetermined thin fraction of the chips, for example, pieces less than 6 mm, is sieved (6) out of the flow of wood chips, and then bypasses the aforesaid debarking process (7).

2. A method according to Claim 1, **characterized in that** the mechanical bark removal process (7) takes place by means of a grinder, press-rollers, or a crusher.

3. A method according to Claim 1, **characterized in that** the mechanical bark removal takes place using a blade ring chipper, which cuts the wood chips into smaller pieces, while removing the bark.

4. A method according to Claim 1, **characterized in that** 20 - 100 % of the aforementioned fraction with a higher bark content obtained from the optical separator (10) is directed to the fuel fraction (13), and correspondingly 80 - 0 % is returned to the mechanical bark removal process (7).

5. A method according to Claim 4, **characterized in that** the optical separator includes a pneumatic conveyor and a division plate (18), by means of which the flow of chips is divided first into the aforesaid wood chips with a low bark content and wood chips with a higher bark content and further the latter part is divided with the aid of the division plate (18) directly into a fuel fraction and the aforesaid part that is returned.

6. A method according to Claim 1, **characterized in that** it includes pre-separation (5) before the aforesaid thickness sieving (6), in which the oversized wood chips, stones, and metals are removed from the wood chips with bark attached.

7. A method according to one of Claims 1 - 5, **characterized in that** the flow of wood chips from the mechanical bark removal process (7) and the aforesaid thin chip fraction from the thickness sieving (6) are sieved using a mechanical sieve (9), to remove sawdust as a third reject and using a pneumatic separator (11) to remove light birch bark, leaves, needles, and other airborne material as a fourth reject.

8. Equipment for manufacturing wood chips with a low bark content from wood chips with bark attached, which equipment includes mechanical bark removal devices (7), pre-cleaning devices consisting of a mechanical and a pneumatic separator (9, 11), and an optical sorter (10), **characterized in that** the equipment includes a wood chip thickness sieve (6) located before the mechanical bark removal devices (7) and a bypass line (8) connected to the exit of the thin fraction obtained, by means of which the thin fraction is taken past the mechanical bark removal devices (7) to the pre-cleaning devices (9, 11).

9. Equipment according to Claim 8, **characterized in that** the mechanical bark removal devices (7) consist of one or more blade ring chippers, a grinder (7), a press roller, or a crusher.

Patentansprüche

1. Zur Herstellung vorgegebener rindenarmer Holzhackschnitzel (12) und einer rindenhaltigen Brennstofffraktion (13) aus Hackschnitzeln mit Rinde dienendes Verfahren, das folgende Stufen umfasst:

   - mechanisches Ablösen der Rinde (7), bei dem die Hackschnitzelstücke von der Rinde befreit und zerkleinert

werden,

- durch pneumatisches und mechanisches Sortieren erfolgendes Vorreinigen (6, 9, 11) der Hackschnitzel mit Rinde zu Hackgut mit einem Rindengehalt unter 10 % und zu stark rindenhaltigen Rejekten,
- mit Hilfe einer optischen Trenneinrichtung (10) erfolgendes definitives Reinigen des vorgereinigten Hackgutes zwecks Gewinnung der besagten rindenarmen Hackschnitzel (12) und einer rindenhaltigeren Fraktion, und
- Sammeln der aus dem Prozess zu nehmenden Rejekte zwecks Gewinnung der besagten rindenhaltigen Brennstofffraktion,

dadurch gekennzeichnet, dass vor dem besagten mechanischen Rindenablösen (7) aus dem Hackschnitzelstrom eine vorgegebene Dünnhackschnitzelfraktion, zum Beispiel die Stücke von weniger als 6 mm Dicke, herausgesiebt (6) wird, die an der besagten Rindenablösestufe (7) vorbeigeführt wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das mechanische Ablösen (7) der Rinde mit einer Mühle, mit Druckwalzen oder einem Brecher erfolgt.

3. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das mechanische Ablösen der Rinde mit einem Messerringzerspaner erfolgt, der die Hackschnitzel unter gleichzeitigem Ablösen der Rinde in kleinere Teile zerschneidet.

4. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** 20 bis 100 % der in der optischen Trenneinrichtung (10) anfallenden besagten rindenhaltigeren Fraktion der Brennstofffraktion (13) zugeschlagen und entsprechend 80 bis 0 % dieser rindenhaltigeren Fraktion erneut der mechanischen Rindenablösestufe (7) zugeführt werden.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** die optische Trenneinrichtung einen Druckluftförderer und ein Trennblech (18) umfasst, mit denen der Hackschnitzelstrom zunächst in die besagte rindenarme Hackschnitzelfraktion und die rindenhaltigere Hackschnitzelfraktion aufgeteilt und die letztere Fraktion mit Hilfe des Trennblechs (18) dann direkt in eine Brennstofffraktion und eine zurückzuleitende Fraktion getrennt wird.

6. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** es vor der besagten Dickensortierung (6) eine Vortrennung umfasst, in der übergroße Hackschnitzel sowie Steine und Metallteile von den Hackschnitzeln mit Rinde abgetrennt werden.

7. Verfahren nach irgendeinem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** der Hackschnitzelstrom aus der mechanischen Rindenablösestufe (7) und die besagte Dünnhackschnitzelfraktion aus der Dickensortierstufe (6) in einem mechanischen Sieb (9) zwecks Abscheidens der Sägespäne als drittes Rejekt und in einer pneumatischen Trenneinrichtung (11) zwecks Abscheidens von Birkenrinde, Blättern, Nadeln und anderem schwebenden Material als viertes Rejekt behandelt werden.

8. Zur Herstellung rindenarmer Holzhackschnitzel aus Holzhackschnitzeln mit Rinde dienende Anlage mit mechanischen Rindenablöseeinrichtungen (7) und Vorreinigungseinrichtungen bestehend aus einer mechanischen und einer pneumatischen Trenneinrichtung (9, 11) und einem optischen Sortierer (10), **dadurch gekennzeichnet, dass** die Anlage eine vor den mechanischen Rindenablöseeinrichtungen (7) angeordnete Hackschnitzel-Dickensortiereinrichtung (6) und eine an die Austragsstelle der Dünnhackschnitzelfraktion angeschlossene Umgehungsförderlinie (8) hat, über welche die Dünnhackschnitzelfraktion an den Rindenablöseeinrichtungen (7) vorbei direkt in die Vorreinigungseinrichtungen (9, 11) transportiert wird.

9. Anlage nach Anspruch 8, **dadurch gekennzeichnet, dass** die mechanischen Rindenablöseeinrichtungen (7) aus einem oder mehreren Messerringzerspanern, einer Mühle (7), einer Druckwalze oder einem Brecher bestehen.

Revendications

1. Procédé permettant d'obtenir des copeaux de bois prédéterminés à faible teneur en écorce (12) et des déchets pour fraction combustible à haute teneur en écorce (13) à partir de copeaux de bois avec écorce, procédé comprenant les phases suivantes :

- écorçage mécanique (7), lors duquel l'écorce est ôtée des copeaux et ceux-ci sont réduits à une taille inférieure, et

- prénettoyage (6, 9, 11) du dégagement de copeaux avec écorce en un dégagement de copeaux avec moins de 10 % d'écorce et en déchets à forte teneur en écorce grâce à un criblage pneumatique et mécanique,
- nettoyage final dudit dégagement de copeaux prénettoyés grâce à un séparateur optique (10) en vue d'obtenir des copeaux à faible teneur en écorce (12) et une fraction à plus forte teneur en écorce,
- collecte des déchets éjectés du traitement pour obtenir la fraction combustible à forte teneur en écorce susmentionnée,

caractérisé par le fait que, en amont dudit processus mécanique d'écorçage (7), une fraction fine prédéterminée - par exemple copeaux de moins de 6 mm - est recueillie par criblage (6) à partir du dégagement des copeaux et contourne le processus d'écorçage (7).

2. Procédé conforme à la revendication 1, **caractérisé par le fait que** l'écorçage (7) est effectué par un broyeur, des presses à rouleaux ou un concasseur.

3. Procédé conforme à la revendication 1 **caractérisé par le fait que** l'écorçage mécanique se fait par un déchiqueteur à aubage, qui réduit les copeaux en morceaux de taille inférieure tout en en ôtant l'écorce.

4. Procédé conforme à la revendication 1 **caractérisé par le fait qu'**une proportion de 20 à 100% de la fraction à plus haute teneur en écorce susmentionnée obtenue par le séparateur optique (10) est dirigée vers la fraction combustible (13), tandis que de 80 à 0% respectivement sont réintroduits dans le processus d'écorçage mécanique.

5. Procédé conforme à la revendication 4, **caractérisé par le fait que** le trieur optique comprend un convoyeur pneumatique et une plaque de séparation (18), grâce auxquels le dégagement de copeaux est séparé d'abord en copeaux de bois à faible teneur en écorce tel que décrit ci-dessus et en copeaux à plus forte teneur en écorce, ces derniers étant ensuite divisés grâce à la plaque de séparation (18) en une fraction combustible et en une partie renvoyée dans le processus comme mentionné plus haut.

6. Procédé conforme à la revendication 1 **caractérisé par le fait qu'**il comporte une préséparation (5) avant le criblage (6), lors de laquelle les copeaux surdimensionnées, les pierres et les métaux sont séparés des copeaux de bois avec écorce.

7. Procédé conforme à l'une des revendications 1 à 5 **caractérisé par le fait que** le dégagement de copeaux provenant du processus d'écorçage mécanique (7) et la fraction fine provenant du criblage (6) sont triés par un tamis mécanique (9) pour recueillir la sciure comme troisième déchet et par un séparateur pneumatique (11) pour recueillir comme quatrième déchet les pelures de bouleau, les feuilles, les aiguilles de conifères et autres matériaux légers.

8. Dispositif servant à fabriquer des copeaux de bois à faible teneur en écorce à partir de copeaux de bois avec écorce, comprenant des dispositifs d'écorçage mécanique (7) et des dispositifs de prénettoyage composés d'un séparateur mécanique et d'un séparateur pneumatique (9, 11) ainsi que d'un trieur optique (10), **caractérisé par le fait que** ledit dispositif comprend, situé en amont des écorceurs mécaniques (7), un crible de calibrage (6) et une ligne de dérivation (8) reliée à la sortie de la fraction fine, par laquelle la fraction fine est amenée directement par contournement de l'écorceur (7) vers les prénettoyeurs (9, 11).

9. Dispositif conforme à la revendication 8 **caractérisé par le fait que** les écorceurs mécaniques (7) comprennent un ou plusieurs déchiqueteurs à aubage, un broyeur (7), une presse à rouleaux ou un défibreur.

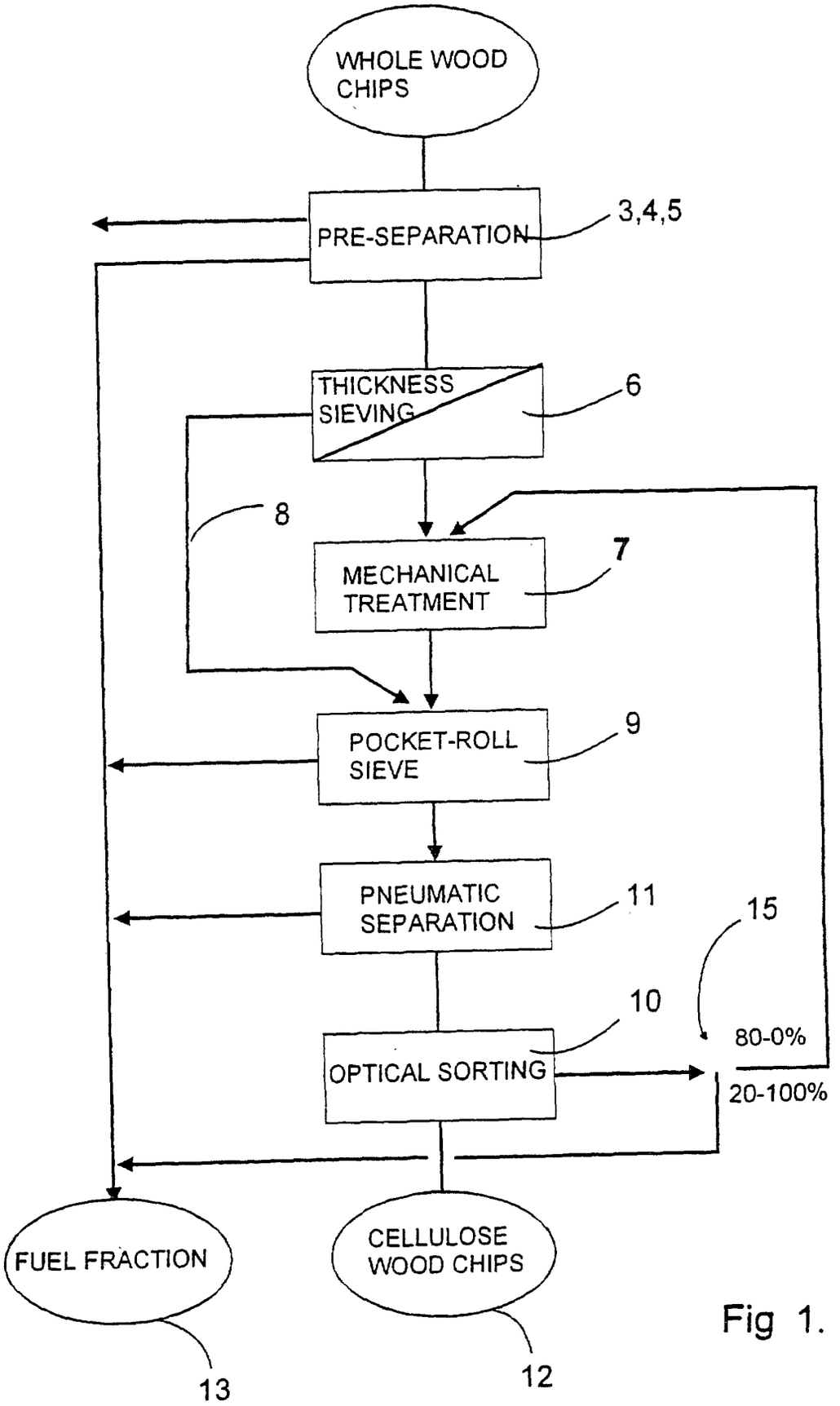
WHOLE WOOD CHIPS
PRE-SEPARATION
3,4,5
THICKNESS SIEVING
6
8
MECHANICAL TREATMENT
7
POCKET-ROLL SIEVE
9
PNEUMATIC SEPARATION
11
15
10
OPTICAL SORTING
80-0%
20-100%
FUEL FRACTION
CELLULOSE WOOD CHIPS
13
12

Fig 1.

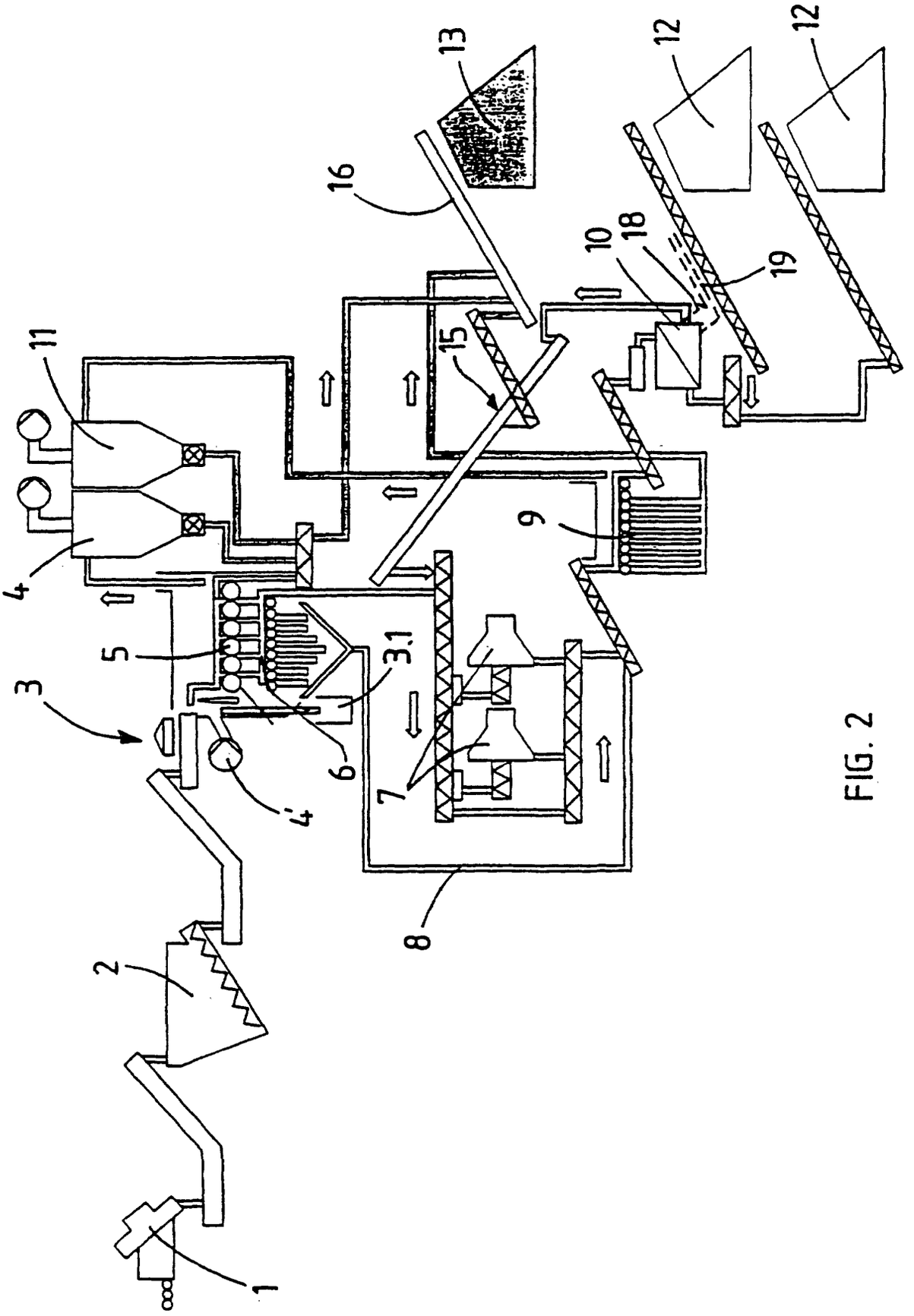

FIG. 2