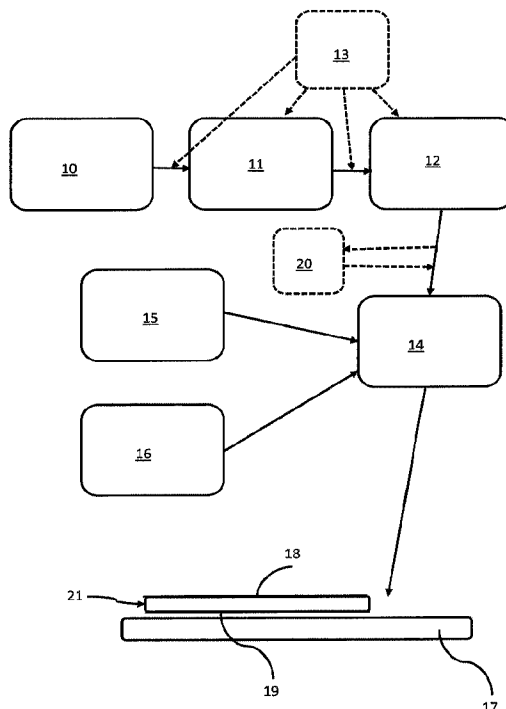




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(54) Title: METHOD OF PRODUCING A GYPSUM SLURRY FOR FORMING GYPSUM PRODUCTS AND METHOD OF
MANUFACTURING A GYPSUM PRODUCT



(57) Abrégé/Abstract:

A method of producing a gypsum slurry for forming gypsum products, in particular gypsum boards, preferably gypsum paper boards, comprising the steps of: a) providing a gypsum paper product comprising a gypsum and a paper component, in particular a gypsum paper board, and/or broken parts thereof; b) wet grinding the gypsum paper product and/or the broken parts thereof containing at least parts of the paper component to form a wet ground gypsum paper component.

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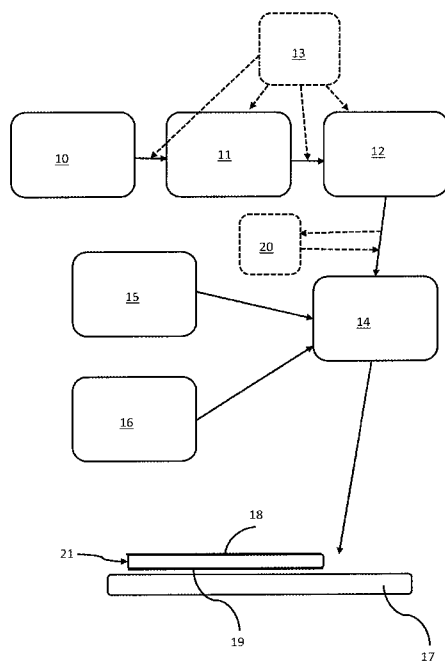


Fig. 1

(57) Abstract: A method of producing a gypsum slurry for forming gypsum products, in particular gypsum boards, preferably gypsum paper boards, comprising the steps of: a) providing a gypsum paper product comprising a gypsum and a paper component, in particular a gypsum paper board, and/or broken parts thereof; b) wet grinding the gypsum paper product and/or the broken parts thereof containing at least parts of the paper component to form a wet ground gypsum paper component.

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5 **Method of producing a gypsum slurry for forming gypsum products
and method of manufacturing a gypsum product**

10 The present invention relates to a method of producing a gypsum slurry for forming
gypsum products, in particular gypsum boards, to a method of manufacturing a
gypsum product, in particular gypsum board, to a gypsum slurry for forming
gypsum products, in particular gypsum boards, to a gypsum product, in particular,
gypsum board and to a system for manufacturing a gypsum product, in particular
gypsum board.

15 Methods for producing gypsum products, in particular gypsum boards are well-
known. Furthermore, it is known to at least partially recycle manufactured gypsum
paper products, such as gypsum paper boards, by forming new gypsum products.
For example, EP 2 641 886 A2 describes a gypsum powder containing
hemihydrate gypsum powders and type II anhydrous gypsum powders. The type II
20 anhydrous gypsum is obtained by calcining dihydrate gypsum recovered from
gypsum board waste. EP 2 641 886 A2 describes further that a part of the type II
anhydrous gypsum may be replaced by dihydrate. Also, this dihydrate may be
obtained from recycling material. Powders of gypsum board waste are obtained by
pulverising board waste and letting the pulverised product passing through a sieve
25 to remove the board papers. EP 2 030 693 B1 and US 2016/0124895 A1 also
describe recycling of gypsum products in which devices (such as sieves) are
provided in order to separate the paper waste from the rest of the gypsum product
waste. WO 2009/064602 A1 describes wet grinding a dihydrate together with a
specific dispersant. The ground gypsum is to be used for cosmetics, paper or
30 coatings as a filler. However, WO 2009/064602 A1 is not related to recycling of
gypsum product waste.

The known methods of use of recycling gypsum products such as gypsum paper boards are rather complex, in particular due to the removal of paper components. However, the step of removing the paper cannot simply be omitted because the paper fibres cause problems in the calcining process (calcining aggregates)

5 performed in the prior art. Moreover, the paper fibres may reduce a heat transfer in the calciner (if the paper sticks to the walls).

It is now an object of the present invention to propose a method of producing a gypsum slurry for forming gypsum products, in particular gypsum boards,
 10 preferably gypsum paper boards or gypsum fibre boards, a method of manufacturing a gypsum product, in particular a gypsum board, preferably a gypsum paper board or gypsum fibre board, a gypsum slurry for forming gypsum products, in particular gypsum boards, preferably gypsum paper boards or gypsum fibre boards and a gypsum product, in particular a gypsum board, preferably
 15 gypsum paper board or gypsum fibre board, and a system for manufacturing a gypsum product, in particular gypsum board, preferably gypsum paper board or gypsum fibre board, wherein an efficient and simple recycling of gypsum paper products (i.e. products having a gypsum and a paper component) or parts thereof (including parts of the gypsum component and parts of the paper component) can
 20 be achieved.

According to the invention, a method of producing a gypsum slurry for forming gypsum products, in particular gypsum boards, preferably gypsum paper boards or
 25 gypsum fibre boards, is proposed, comprising the steps of:

- a) providing a gypsum paper product comprising a gypsum and a paper component, in particular a gypsum paper board, and/or broken parts thereof (comprising parts of the gypsum and the paper component);
- 30 b) wet grinding (milling) the paper products and/or the broken parts thereof containing at least parts of the paper component to form a wet ground gypsum paper component.

A core idea of the invention is to disintegrate (grind) the gypsum paper product together with the paper component (i.e. without a previous removal of the paper component). In this regard, it has been recognised that the problems of a calcination of disintegrated gypsum board waste including paper fibres can be avoided by (directly) feeding the (non-calcined) ground material into a gypsum slurry for forming (new) gypsum products. Surprisingly, correspondingly manufactured new gypsum products (gypsum paper boards) showed reliable and satisfying material characteristics. In essence, an efficient and simple recycling of gypsum paper products (or leftovers thereof) can be achieved.

A gypsum product is in particular a product with a gypsum component (which may form at least 50 wt% or at least 80 wt% of the gypsum product). A gypsum board is a gypsum product having a board shape (i.e. being in particular, at least substantially, flat). The gypsum board may have a rectangular shape and a thickness of between 1 mm and 5 cm. A gypsum paper board is a gypsum board with a paper component, in particular as a surface layer. In embodiments, one or both sides of the gypsum paper boards may be formed by a paper layer. A gypsum paper product is a product comprising a gypsum and a paper component. The paper component forms preferably at least parts of an outer surface of the gypsum paper product, for example at least 20% or at least 50% or at least 80% of the outer surface thereof. The paper component may define less than 20 wt%, preferably less than 10 wt%, further preferably less than 2 wt% of the gypsum paper product in relation to the gypsum component. Further, the paper component may define more than 0.1 wt%, preferably more than 1 wt%, further preferably more than 3 wt% of the gypsum paper product in relation to the gypsum component. Broken parts of the gypsum paper product, in particular gypsum paper board are in particular any parts comprising at least parts of the gypsum and the paper component of the gypsum paper product. The broken parts can be leftovers, waste or unused/non-usable gypsum paper products, in particular gypsum paper boards. The amount of the paper component in relation to the gypsum component in the broken parts can be (in weight percent) as explained with respect to the gypsum paper product, in particular gypsum paper board. The broken parts may be parts which are incidentally and/or purposively broken, e.g. by shredding

gypsum paper products, in particular gypsum paper boards or (larger) broken parts thereof. The wet grinding may comprise utilisation of one or more mills. An (average) sieve particle size of the wet ground gypsum paper component is preferably below 3 mm, further preferably below 1 mm. A diameter of the broken parts (counting at least 50 wt% or at least 90 wt % of the broken parts being involved, in relation of the weight of all broken parts being involved) may be between 2 cm and 50 cm, in particular between 10 cm and 40 cm. The diameter may be a maximum diameter of the respective broken part (e.g. for a cuboid the space diagonal).

Wet grinding means in particular that the gypsum paper product and/or the broken parts thereof is ground in a wet state (for example, wherein the amount of water in the wet gypsum paper product and/or the broken parts thereof to be ground is at least 10 wt%, preferably at least 20 wt%) and/or adding water during (at least a certain time period of) the grinding process.

It is preferred to mix the wet ground gypsum paper component with stucco (calcined gypsum).

The gypsum part of the wet ground paper component is preferably dihydrate (to at least 50 wt%, preferably at least 80 wt%, even further preferably at least 95 wt%).

In addition or alternatively to stucco, further components may be added to the gypsum slurry such as a retarder, a foaming agent, an accelerator and/or further gypsum types. Further, stucco and/or dihydrate can be added stemming from different sources.

The wet ground gypsum paper component is preferably a paper gypsum slurry containing water, paper (particles), in particular paper fibres, and gypsum (powder).

The paper gypsum slurry may have a solid component of at least 2 wt%, preferably at least 5 wt%, further preferably at least 15 wt% and/or not more than

50 wt%, preferably not more than 30 wt%, further preferably not more than 20 wt%. This allows for a reliable and efficient manufacturing of gypsum products, in particular gypsum (paper or fibre) boards. In particular, a reliable and efficient pumping of the material is possible.

5

The gypsum paper slurry may be fed into a container (in particular a silo). Preferably, the gypsum paper slurry is stored in the container (silo). In particular, the gypsum paper slurry is fed into the container (silo) before mixing the gypsum paper slurry with stucco. Collecting the gypsum paper slurry in a container (silo) allows to store a certain amount of gypsum paper slurry in order to feed it to a manufacturing process at an appropriate time. Stirring avoids sedimentation.

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The solid content of the wet ground gypsum paper component, in particular gypsum paper slurry, with respect to the stucco may be at least 0.5 wt%, preferably at least 1 wt%, further preferably at least 2 wt% and/or not more than 10 wt%, preferably not more than 5 wt%, further preferably not more than 4 wt%. Thereby, the reliability of the process can be improved, in particular a reliable paper bonding can be achieved. The broken parts may be obtained by shredding the gypsum paper products. Further, (smaller) broken parts may be obtained by shredding (larger) broken parts of the gypsum paper product. This improves the efficiency of the method.

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The wet ground gypsum paper product is preferably not calcined. The gypsum component of the ground gypsum paper product is preferably dihydrate.

30

According to a further aspect of the invention, a method of manufacturing a gypsum product, in particular gypsum board, preferably gypsum paper board or gypsum fibre board comprising the above method of producing a gypsum slurry and comprising removing water from the gypsum and forming (molding or otherwise configuring or arranging) the gypsum product, is proposed. If the gypsum product is a gypsum paper board, the method comprises preferably adding at one or both sides of the paper board an (outer) paper layer.

In the method of manufacturing a gypsum product, the wet ground gypsum paper product is preferably not calcined in particular to avoid problems with the paper components and calcination at this point or stage is not necessary for the later product quality, especially if the ground gypsum paper product is (basically) used as a filler.

According to another aspect of the invention, a use of a wet ground gypsum paper component as ingredient of a gypsum slurry for forming a gypsum product, in particular a gypsum board, preferably gypsum paper board or gypsum fibre board, is proposed.

According to a further aspect of the invention, a gypsum slurry for forming gypsum products, in particular gypsum boards produced by the above method is proposed.

According to another aspect of the invention, a gypsum product, in particular gypsum board, preferably gypsum paper board or gypsum fibre board, produced by the above method is proposed.

When shredding the gypsum paper product or broken parts thereof to be recycled, these may be done in a wet or dry state or partially in a wet state and partially in a dry state. In a shredder, the material may be shredded into parts of (about) 20 x 20 cm. The shredded parts may be delivered into a mill. There, the material may be milled (with addition of water).

A slurry including water, paper fibres and (fine) gypsum may be the output of such milling step. The solid content of the slurry may be between 15 to 20 wt%. Further, the slurry may be pumped into one or more containers (one or more silos). In these containers (silos), the slurry may be stirred to avoid sedimentation.

Out of the container (silo) the slurry may be pumped into a main mixer. In the mixer, the slurry may be mixed with stucco and optionally other raw materials for the production of gypsum boards. The solid content of the slurry in relation to the

stucco fed into the mixer may be 2 wt% to 4 wt%. Thereby, paper bonding may be improved.

According to another aspect of the invention, a system for producing a gypsum slurry, in particular according to the above method, for forming gypsum products, in particular gypsum boards, preferably gypsum paper boards, is proposed, comprising:

a mill for wet grinding a gypsum paper product comprising a gypsum and a paper component, in particular gypsum paper board, and/or broken parts thereof to a wet ground gypsum paper component; a first feeding device for feeding the wet ground gypsum paper component to a mixer; and a second feeding device for feeding further components, in particular stucco to the mixer for mixing the slurry for forming gypsum products.

The system for producing a gypsum slurry for forming gypsum products may comprise a shredder for breaking (waste) gypsum paper boards or broken parts thereof. Moreover, the system may comprise means for feeding water for the wet grinding in the mill (for example before the shredder or in the shredder or between the shredder and the mill or in the mill). Moreover, the system may comprise a container (in particular silo) for storing the output of mill.

According to another aspect of the invention, a system of manufacturing a gypsum product, in particular gypsum board, preferably gypsum paper board, is proposed, comprising the above system for producing the gypsum slurry and a forming device for forming the gypsum product, in particular gypsum board, preferably gypsum paper board.

The forming device may comprise a forming table and/or forming band where the (final) gypsum product, in particular gypsum board, preferably gypsum paper board may settle and be formed.

In the following, a preferred embodiment of the invention is described with reference to the following drawing:

Fig. 1: A schematic of a method of producing a gypsum paper board.

Fig. 1 shows a schematic of a method of producing a gypsum paper board. At reference sign 10, waste gypsum paper boards 10 are provided. The waste gypsum paper boards 10 are fed to a shredder 11, where the waste gypsum paper boards are shredded (e.g. into pieces of approximately 20 x 20 cm). From the shredder 11, the broken parts of the waste gypsum paper boards are fed to a mill 12 wet grinding the broken parts. Water 13 for the wet grinding can be provided before the shredder 11, within the shredder 11, between the shredder 11 and/or the mill 12 or in the mill 12 as indicated by broken arrows. From the mill 12, a paper gypsum slurry containing water, paper particles (fibres) and gypsum particles (powder) is fed to a (main) mixer 14. Furthermore, stucco 15 and (optionally) further additive 16 (such as other gypsum varieties, such as calcium sulphate at certain and / or different states of hydration, and/or retarders and/or foaming agents and/or accelerators) are fed to the mixer 14. In the mixer 14 a gypsum slurry is mixed and fed onto a forming device 17 (such as forming table or forming band). There, paper layers 18 and 19 are added to the slurry. The slurry together with paper layers 18 and 19 settles on the forming device 17. Next, the settled layer can be cut into boards 21 of an appropriate shape by a corresponding cutting device (such as a saw) so that a (new) gypsum paper board 21 is produced.

A silo 20 may be (optionally) provided between the mill 12 and the mixer 14 for storing the slurry coming from the mill 12 and for feeding the stored slurry to the mixer 14.

5

Reference signs

- | | | |
|----|----|--------------------------|
| | 10 | waste gypsum paper board |
| | 11 | shredder |
| | 12 | mill |
| 10 | 13 | water |
| | 14 | mixer |
| | 15 | stucco |
| | 16 | other material |
| | 17 | forming device |
| 15 | 18 | paper layer |
| | 19 | paper layer |
| | 20 | silo |
| | 21 | (new) gypsum paper board |

CLAIMS

1. A method of producing a gypsum slurry for forming gypsum products comprising the steps of:

5 a) providing a gypsum paper product comprising a gypsum and a paper component, and/or broken parts thereof;

b) wet grinding the gypsum paper product and/or the broken parts thereof containing the paper component to form a wet ground gypsum paper component; and

c) mixing the wet ground gypsum paper component with stucco.

10 2. The method of claim 1, wherein step b) comprises forming a paper gypsum slurry containing water, paper particles and gypsum, wherein the wet ground gypsum paper component is the paper gypsum slurry.

3. The method of claim 2, wherein the paper particles are paper fibres.

4. The method of claim 2 or claim 3, wherein the gypsum is gypsum powder.

15 5. The method of any one of claims 2 to 4, wherein the paper gypsum slurry has a solid content between 2 wt% and 50 wt%.

6. The method of claim 5, wherein the paper gypsum slurry has a solid content between 5 wt% and 30 wt%.

20 7. The method of claim 6, wherein the paper gypsum slurry has a solid content between 15 wt% and 20 wt%.

8. The method of any one of claims 2 to 7, wherein the gypsum paper slurry is fed into a container.

9. The method of claim 8, wherein the gypsum paper slurry is stirred in the container.

25 10. The method of claim 8, wherein the gypsum paper slurry is stirred before mixing it with stucco.

11. The method of any one of claims 8 to 10, wherein the container is a silo.
12. The method of any one of claims 5 to 11, wherein the solid content of the wet ground gypsum paper component with respect to the stucco is between 0.5 wt% and 10 wt%.
- 5 13. The method of claim 12, wherein the solid content of the wet ground gypsum paper component with respect to the stucco is between 1 wt% and 5 wt%.
- 10 14. The method of claim 13, wherein the solid content of the wet ground gypsum paper component with respect to the stucco is between 2 wt% and 4 wt%.
- 15 15. The method of any one of claims 1 to 14, wherein the broken parts are obtained by shredding the gypsum paper product.
16. The method of any one of claims 1 to 15, wherein the wet ground gypsum paper product is not calcined.
- 15 17. The method of any one of claims 1 to 16, wherein the gypsum products are gypsum boards.
18. The method of claim 17, wherein the gypsum boards are gypsum paper boards or gypsum fibre boards.
- 20 19. The method of any one of claims 1 to 16, wherein the gypsum paper product is a gypsum paper board.
20. A method of manufacturing a gypsum product comprising the method of producing a gypsum slurry of any one of claims 1 to 19, and comprising removing water from the gypsum slurry and forming the gypsum product.
- 25 21. The method of claim 20, wherein the wet ground gypsum paper product is not calcined.
22. The method of claim 20 or claim 21, wherein the gypsum product is a gypsum board.

23. The method of claim 22, wherein the gypsum board is a gypsum paper board.

24. A use of a wet ground gypsum paper component as ingredient of a gypsum slurry for forming a gypsum product.

5 25. The use of a wet ground gypsum paper component as ingredient of a gypsum slurry of claim 24, wherein the gypsum product is a gypsum board.

26. The use of a wet ground gypsum paper component as ingredient of a gypsum slurry of claim 25, wherein the gypsum board is a gypsum paper board or gypsum fibre board.

10 27. A system for producing a gypsum slurry for forming gypsum products comprising:

a mill for wet grinding a gypsum paper product comprising a gypsum and a paper component, and/or broken parts thereof to a wet ground gypsum paper component;

15 a first feeding device for feeding the wet ground gypsum paper component to a mixer; and

a second feeding device for feeding stucco to the mixer for mixing the slurry for forming gypsum products.

20 28. The system of claim 27, wherein the gypsum products are gypsum boards.

29. The system of claim 28, wherein the gypsum boards are gypsum paper boards or gypsum fibre boards.

30. The system of claim 29, wherein the gypsum paper product is a gypsum paper board.

25 31. The system of any one of claims 27 to 30, wherein the second feeding device is provided for feeding further components to the mixer, wherein the further components comprise one or more of a retarder, a foaming agent, an accelerator and/or further gypsum types.

32. A system for manufacturing a gypsum product comprising the system for producing the gypsum slurry of any one of claims 27 to 31 and a forming device for forming the gypsum product.

33. The system of claim 32, wherein the gypsum product is a gypsum board.

5 34. The system of claim 33, wherein the gypsum board is a gypsum paper board or gypsum fibre board.

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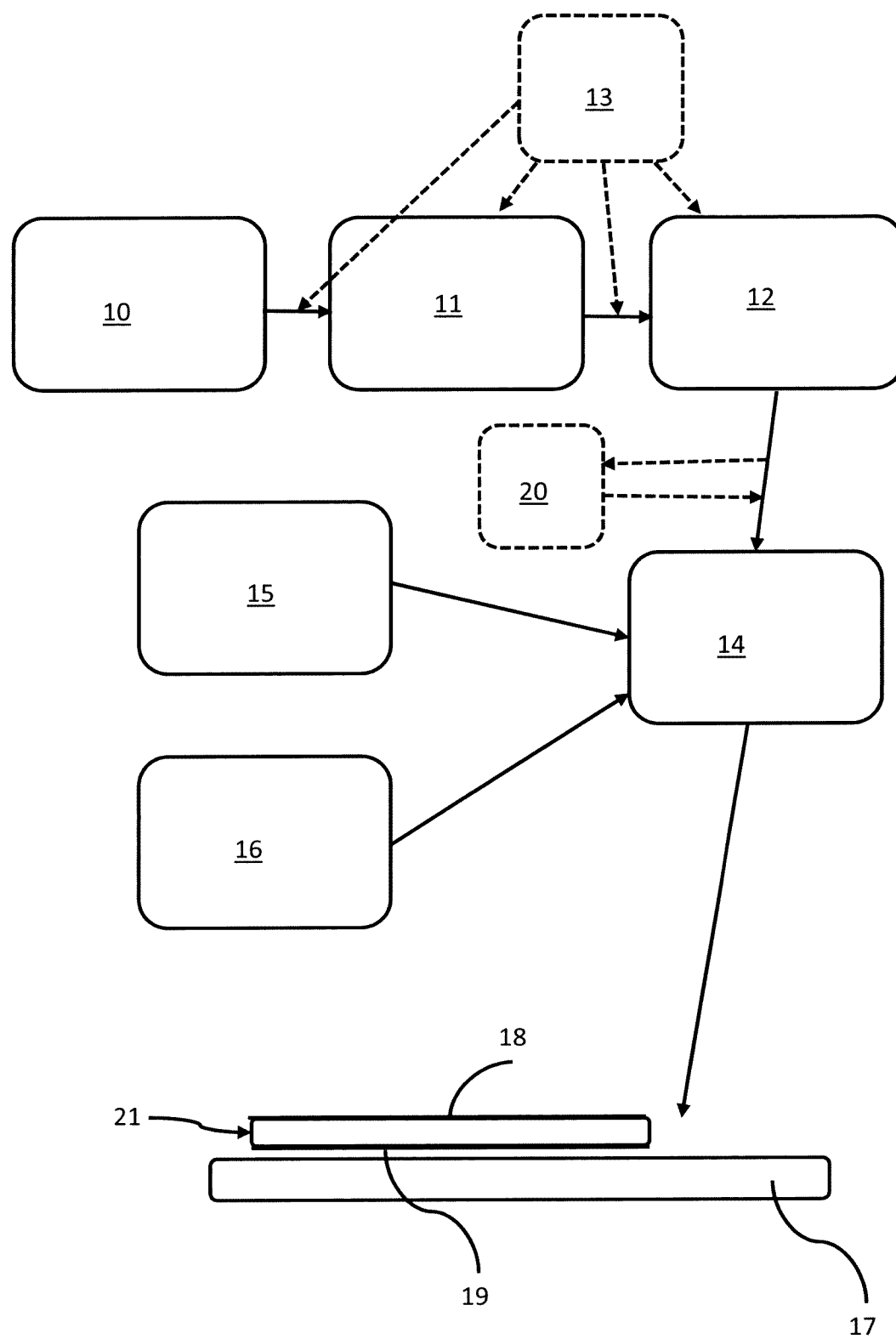


Fig. 1

