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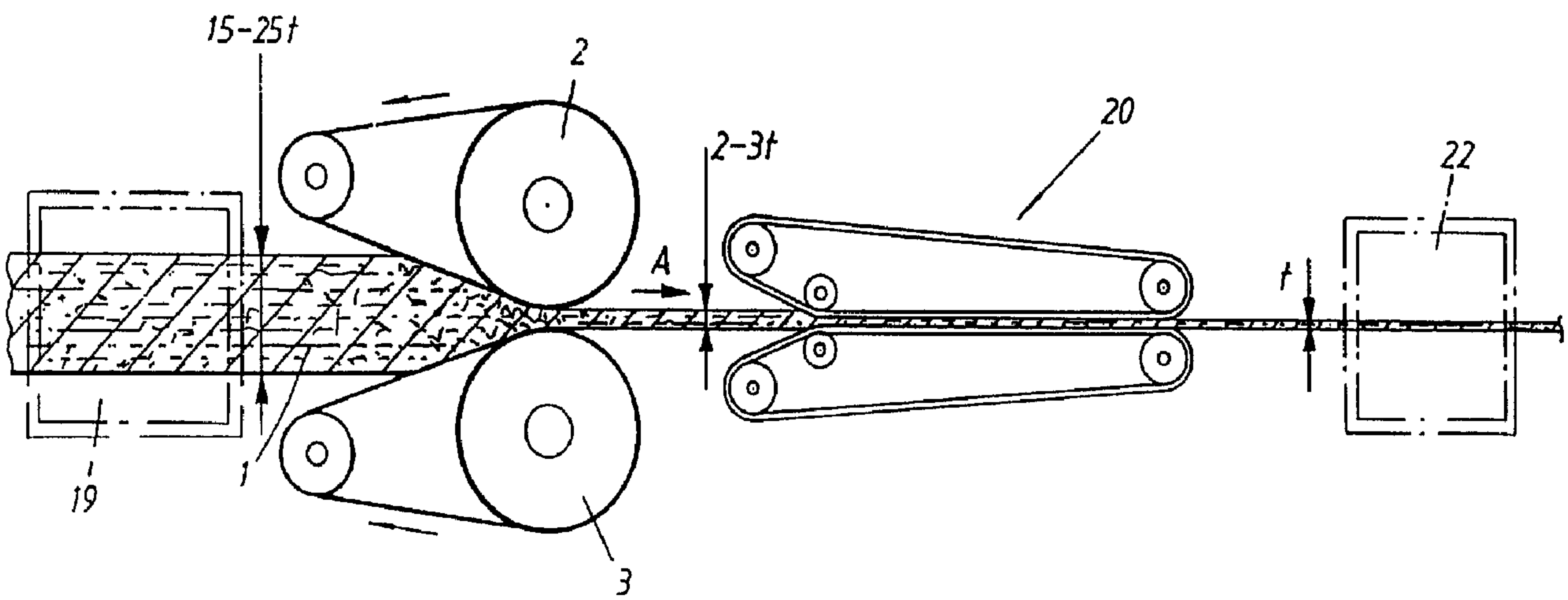
(54) Title: A METHOD OF CONTINUOUS PRODUCTION OF LIGNOCELLULOSIC BOARDS



(57) Abrégé/Abstract:
A method for the continuous production of boards having a lignocellulosic fiber material wherein the material is broken up into particles and/or fibers that are dried, glued and formed and pressed to a finished board. The mat is pre-compressed while steam is introduced in such a limited amount during the pre-compression that the temperature of the fibrous mat increases to a value within an interval of 60-95 °Celsius. In this way, the spring back characteristics of the fiber mat is reduced so that its resistance to compression is reduced and the thickness can be reduced more in the pre-compression while the temperature is not so high to initiate a curing process.

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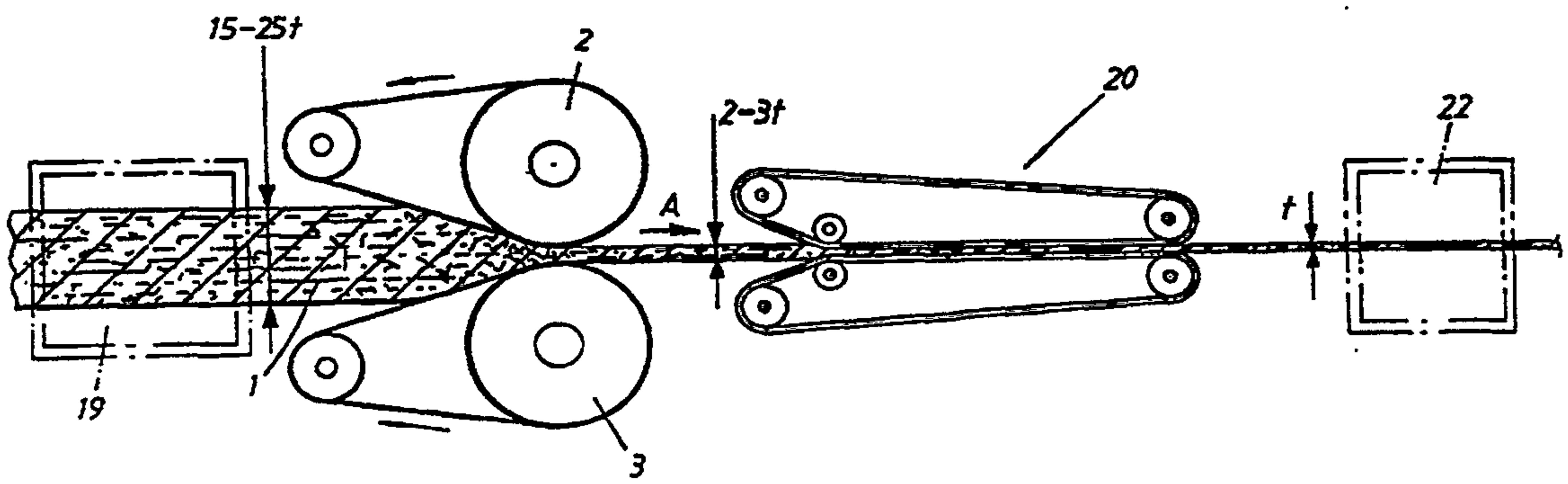
(54) Title: A METHOD OF CONTINUOUS PRODUCTION OF LIGNOCELLULOSIC BOARDS



(57) Abstract

A method for the continuous production of boards having a lignocellulosic fiber material wherein the material is broken up into particles and/or fibers that are dried, glued and formed and pressed to a finished board. The mat is pre-compressed while steam is introduced in such a limited amount during the pre-compression that the temperature of the fibrous mat increases to a value within an interval of 60-95 °Celsius. In this way, the spring back characteristics of the fiber mat is reduced so that its resistance to compression is reduced and the thickness can be reduced more in the pre-compression while the temperature is not so high to initiate a curing process.

A Method of Continuous Production of Lignocellulosic Boards

The present invention relates to a method of producing lignocellulosic boards.

Methods of producing boards of lignocellulosic material are well known and have significant practical applications. The manufacturing includes the following main steps: breaking up of the raw material to particles having a suitable size and/or fibers, drying to a predetermined moisture ratio and gluing of the material before or after the drying, forming of the glued material into a mat which may be constructed of several layers, possible cold pre-compressing, pre-heating, water spraying of surfaces etc. and heat compressing under pressure and heat in a stroke compressor or a continuous compressor until the board is finished.

During conventional heat compressing, the compressed material is heated mainly by using heat coils from adjacent heating plates or the steel bands. These have a temperature of 150-200° Celsius depending on the type of product that is being compressed, the type of glue used, desired capacity etc. In this way, the moisture in the material is evaporated closest to the heat sources so that a dry layer is developed in this area and the steam front gradually moves towards the center of the board from each side as the compression continues. When the dry layer has been developed this means that the temperature in this layer is at least 100° Celsius which initiates the curing of conventional glues. When the steam front has reached the center, the temperature at the center has reached at least 100° Celsius and the boards even starts to cure at its center so that the compression can be stopped within a couple of seconds. This applies to situations when conventional urea formaldehyde glue (UF) and similar glues are used such as melamine fortified (MUF) glue. When other glues, having a higher curing temperature, are used then a higher temperature and a greater steam pressure is required in the board before any curing can start.

To achieve the desired density, a compressor must apply a high surface pressure at a high temperature. This is not a problem for non-continuous compression in a so called stroke compressor but such compressors have other drawbacks such as worse thickness tolerances etc. When continuous compressors are used, the requirement for high surface pressures and high temperatures at the same time have led to expensive high precision solutions with regard to the roller felt between the steel band and the heating plate positioned below. The method of providing heat to the board via heat coils makes the heating relatively time consuming which results in long compression lengths (large compression surfaces).

The heating can also be achieved by delivering steam to the mat to be compressed. In this way, the heating time is drastically shortened and, in addition, the resistance of the material to compression is drastically reduced when steam is introduced so that less compression forces and smaller compression surfaces are required. An injection box may be used to inject steam into the material mat which has certain drawbacks though. To avoid these drawbacks, compression rollers have been developed that are perforated and functions as a steam delivery member. Such an apparatus is disclosed in SE 502,810.

The use of steam injection for heating the material is well known in the industry. For example, EP 383 572, U.S. 2 480 851, GB 999 696, DE 2 058 820, DE 36 40 682, DE 40 09 883 and AU 57390/86 show different examples of how steam is injected at continuous processes to produce fiber boards.

According to the method of DE 36 40 682, the steam injection is applied at a pre-compression stage. Immediately after the pre-compression, the material mat is passed by a steam box or a similar device where it is exposed to a steam flow to such an extent that the curing temperature of the binders are not exceeded which normally means a temperature of 65-90° Celsius. The material is then compressed to a completed form while being exposed to additional heat so that it cures.

Because the steam in this method is injected after the actual pre-compression and is mainly a preparation for subsequent treatment steps, it does not affect the condition of the material mat in the pre-compression step.

According to the method of DE 20 58 820, the steam is introduced during the actual pre-compression step. This can result in that the temperature of the fiber mat is increased so much that the glue or binders start to cure which with conventual glues occurs at a temperature exceeding 100° Celsius. This creates problems for performing the subsequent treatment steps.

The object of the present invention is to achieve a pre-compression with steam delivery in such a way that the subsequent steps are not made more difficult to perform.

According to the invention there is provided a method for the continuous production of boards of a lignocellulosic fibrous material wherein a material is broken up into particles and/or fibers that are dried, glued and formed to a mat and pressed to a finished board so that the mat is pre-compressed while steam is introduced characterized therein that the steam is introduced in such a limited amount during the pre-compression that the temperature of the fibrous mat increases to a value within an interval of 60-95° Celsius.

By introducing steam in the pre-compression step at a temperature as specified in the mentioned interval the spring back characteristics of the fibers are reduced due to the increase in temperature and to a certain extent due to the increase in the moisture content without causing any substantial curing of the glues that are used which does not make the final compression more difficult to perform.

Thanks to the described method of the present invention, it is possible to achieve a pre-compression to a smaller thickness compared to pre-compression according to the prior art. In the alternative, the effect on the fiber material that is accomplished may be used by being able to build a pre-compressor that has smaller dimensions compared to today's pre-compressors.

In addition, the finishing compressor may be built with a shorter compression zone thanks to the smaller thickness of the fiber member after it has been pre-compressed according to the present invention. By raising the temperature at the pre-compression step, the finishing compressor can otherwise be built with a shorter curing zone.

In summary, these advantages result in a manufacturing process that is substantially more cost effective compared to the conventional technology of the prior art.

According to a preferred embodiment, the steam is directly introduced through the roller or the rollers that are used for the pre-compression. In this way, the drawbacks are avoided that are associated with delivering steam the conventional way, such as by using a steam box or a similar device. In conventional steam delivery systems, the fiber mat/weave may slide relative to the steam box so that a substantial wear occur resulting in that the sliding surfaces of the box have to be replaced at regular intervals and where problems with the sealing of the edges may occur as a result of the sliding of the fiber mat/weave relative to the steam box.

In an alternative embodiment of the present invention, the advantages the method are utilized by substantially reducing the thickness of the mat at the pre-compression stage so that the thickness corresponds to a thickness that is 2-3 times the final thickness of the fiber board.

The above mentioned advantages and other preferred embodiments of the method of the present invention are described in the dependent claims.

The method of the present invention are described in more detail below in the detailed description of a preferred embodiment of the invention with reference to the appended figures wherein

fig. 1 is a schematic cross sectional view along the length of an apparatus for using the method of the present invention,

fig. 2 is a schematic cross sectional view through a roller through which steam is introduced,

fig. 3 is a cross sectional view through a portion of the roller of fig. 2.

fig. 4 is an axial cross sectional view of a portion of the roller of fig. 3.

The mat 1, as shown in fig. 1, includes particles of a suitable size and/or fibers, glue etc. that are conveyed in the direction of an arrow A of the figure. Before any kind of compression takes place, the mat 1 is passed through a pre-conditioning zone 19 where it is conditioned to a predetermined temperature, moisture content and density. The mat is then conveyed in between a pair of rollers 2, 3 to be pre-compressed and is there compressed from a thickness that corresponds to 15-25 times the thickness of the final board to a thickness that corresponds to 2-3 times the thickness of the final board, that is, the mat is compressed down to about 10% of its initial thickness. During the pre-compression, steam is introduced, which according to a conventional way is done by a steam box. According to the preferred embodiment of the present invention, the steam is directly introduced through one or both of the pre-compression rollers 2, 3.

The introduction of steam is regulated so that the temperature of the fiber mat is between 60-95° Celsius, preferably 80-90° Celsius, due to the introduction of the steam. Due to the temperature increase and to a certain extent due to an increase in the moisture content that the introduction of the steam provides, the spring back characteristics of the fiber mat are reduced so that its resistance to compression is reduced. By making sure that the temperature increase is does not exceed the mentioned temperatures, it, at the same time, prevents the curing of the glues that are normally used because a temperature exceeding 100° Celsius must be reached before any considerable curing of the glues takes place. When the steam is injected, the fiber mat should have a density of 100-500 kilogram/cubic meter, preferably about 300 kilogram/cubic meter. Any air contained in the fiber mat is push backwardly by the steam, i.e. in the opposite direction of the conveyance of the mat.

From the pre-compression, the mat is conveyed further to a finishing compressor 20 to be compressed to the thickness of the finished board. The distance between the pre-compressors 2, 3 and the finishing compressor 20 should be as small as possible to minimize the cooling that occurs during the transportation therebetween.

The finishing compressor 20 has a shorter compression zone than what is normal thanks to the substantial reduction of the thickness of the fiber mat that takes place in the pre-compression step according to the method of the present invention. In addition, the curing zone is shorter than what is normal because the inlet temperature in the finishing compressor 20 is higher than what is common according to the prior art techniques.

After the finishing compressor 20, the board material is passed through an after conditioning zone of a conventional type where the board is also cooled.

Both of either of the rollers 2, 3 can be constructed according to the method that is described in SE 502,810 and that is illustrated in figs. 2, 3 and 4.

The compression and injection roller 2 that is shown in fig. 3 is constructed with a perforated casing surface 6 for delivering steam to the mat 1. An axial channel system 7 is disposed inside the casing surface 6 around the roller 2. The channel system 7 is adapted to distribute the steam over the roller 2 and thus along the width of the mat 1. An adjustable sliding shoe (fig. 4) is arranged to sealing engage an end of the roller 2 to introduce steam into the channel system 7. The introduction of steam is thus performed to a limited section (fig. 2) of the roller 2 where the mat 1 is compressed. The limited sector 9 is surrounded at both sides, as seen in the periphery, by sealing zones 10 where the roller 2 is in contact with the mat 1. The channel system 7 can be closed at the opposite end of the roller 2. In the alternative, a sliding shoe 8 can be disposed at each of the ends.

The sliding shoe 8 is held in place by an adjustable stand so that the sliding shoe is adjustable along the direction of the periphery. In the way, the position of the injection sector 9 can be varied. The sliding shoe 8 is preferably includes a replaceable wear part 14 made of a low friction material that bears against a treated surface on the end of the roller 2. Thus, the sliding shoe 8 is held and pushed against the end of the roller 2 by, for example, springs, compressed air or hydraulically, so that any leakage in the sealing surface is minimized.

The sliding shoe 8 can be constructed with one or more channels 11, 12, 13 that can have different surface areas. Even replaceable wear parts 14 having different openings defined therein may be used such as a sliding plate having an opening that can be varied. Thus, the size of the injection sector 9 can be varied. What is more, different flows and pressures can be maintained in different parts of the injection sector 9. The channels of the sliding shoe 8 can also be used for cleaning and suction.

Fig. 4 schematically shows the contact surface of the sliding shoe 8 against the end of the roller 2. In this way, the sliding shoe 8 is equipped with injection channels 11 for steam, cleaning channel 12 and suction channel 13.

The perforated casing surface 6 on the roller 2 can be a stamped or drilled sheet metal having the shape of rings that have been heat shrunk onto the roller. Axial support moldings 15 for the sheet metal can be shaped into the casing sheet metal 16 on the roller by milling or casting or the sheet metal may be constructed as separate moldings that are attached to recesses in the casing sheet metal 16. These moldings can at the same time limit the channel system 7 disposed inside the casing surface 6.

The openings of the channel system 7 at the end of the roller that have not been covered by the sliding shoe 8 can be sealed by pressing an adjustable sliding ring made of a low friction material against the end.

CLAIMS:

1. A method for the continuous production of boards of a lignocellulosic fibrous material wherein a material is broken up into particles and/or fibers that are dried, glued and formed to a mat and pressed to a finished board so that the mat is pre-compressed while steam is introduced characterized therein that the steam is introduced in such a limited amount during the pre-compression that the temperature of the fibrous mat increases to a value within an interval of 60-95° Celsius.

2. The method according to claim 1, wherein the value is within the interval of 80-90° Celsius.

3. The method according to claim 1 or 2, wherein at least one nip roller is used for pre-compression and the steam is introduced through at least one of the nip rollers.

4. The method according to any one of claims 1-3, wherein the fibrous mat is brought, during the introduction of the steam, to a density within an interval of 100-500 kilograms/cubic meter.

5. The method according to claim 4, wherein the density is approximately 300 kilograms/cubic meter.

6. The method according to any one of claims 1-5, wherein the mat is pre-compressed to a thickness that is 2-5 times the finished thickness of the fibrous board.

7. The method according to any one of claims 1-6, wherein the mat is conditioned prior to being pre-compressed.

8. The method according to claim 7, wherein the conditioning includes conditioning to a predetermined temperature, moisture content and density.

9. The method according to any one of claims 1-8, wherein the amount of steam introduced is controlled.

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PATENT AGENTS

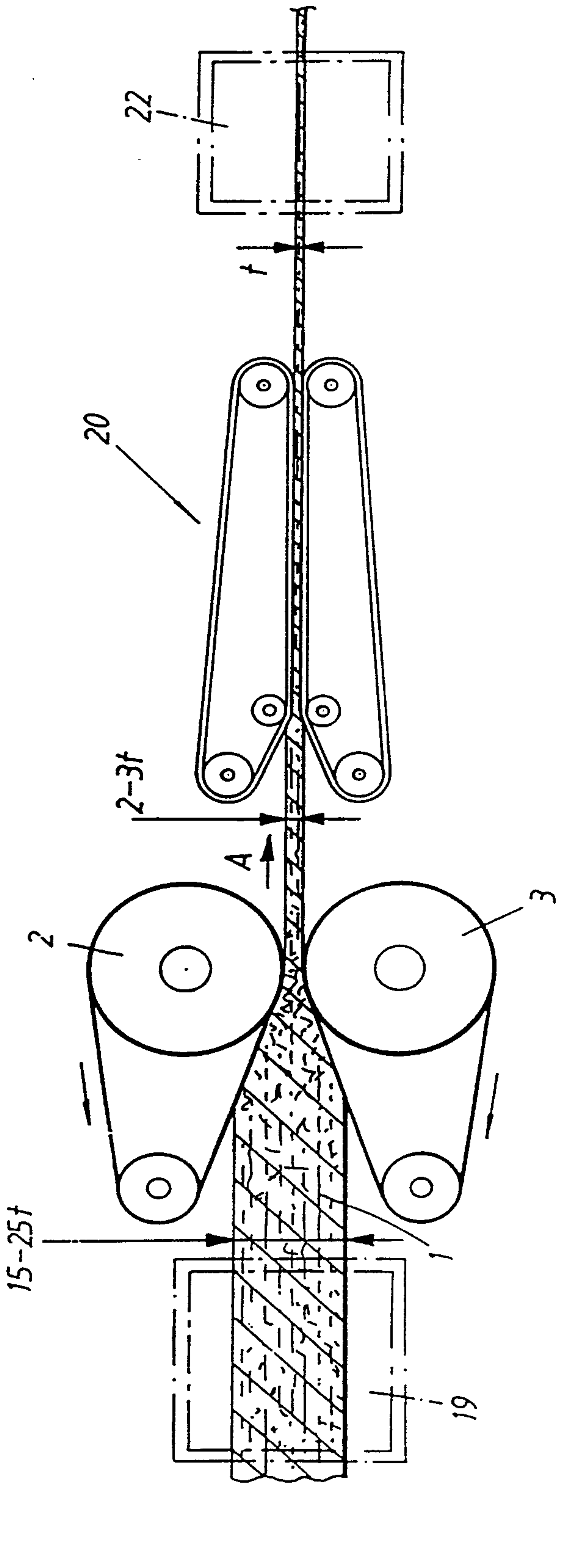


Fig. 1

Fig. 2

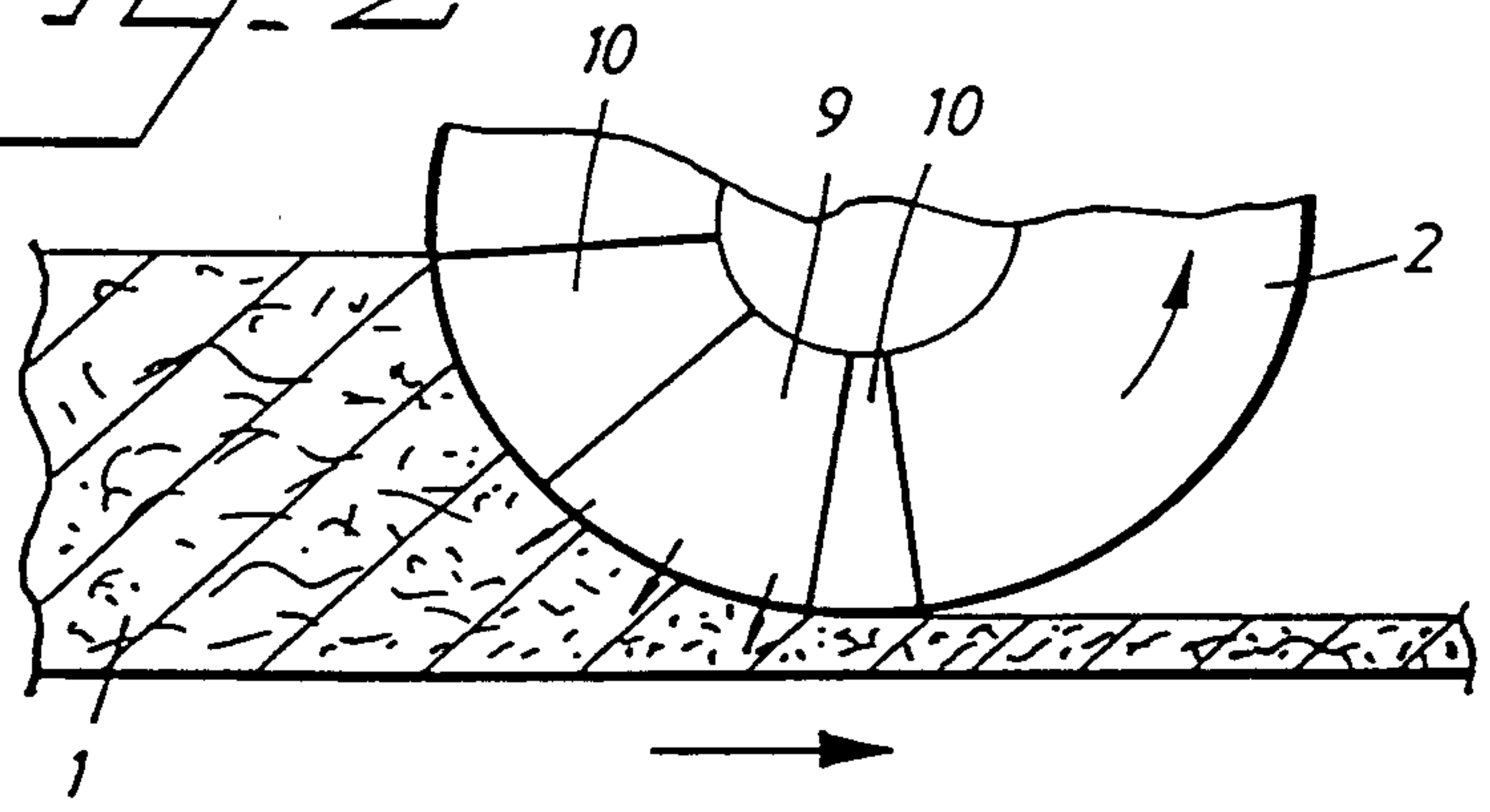


Fig. 3

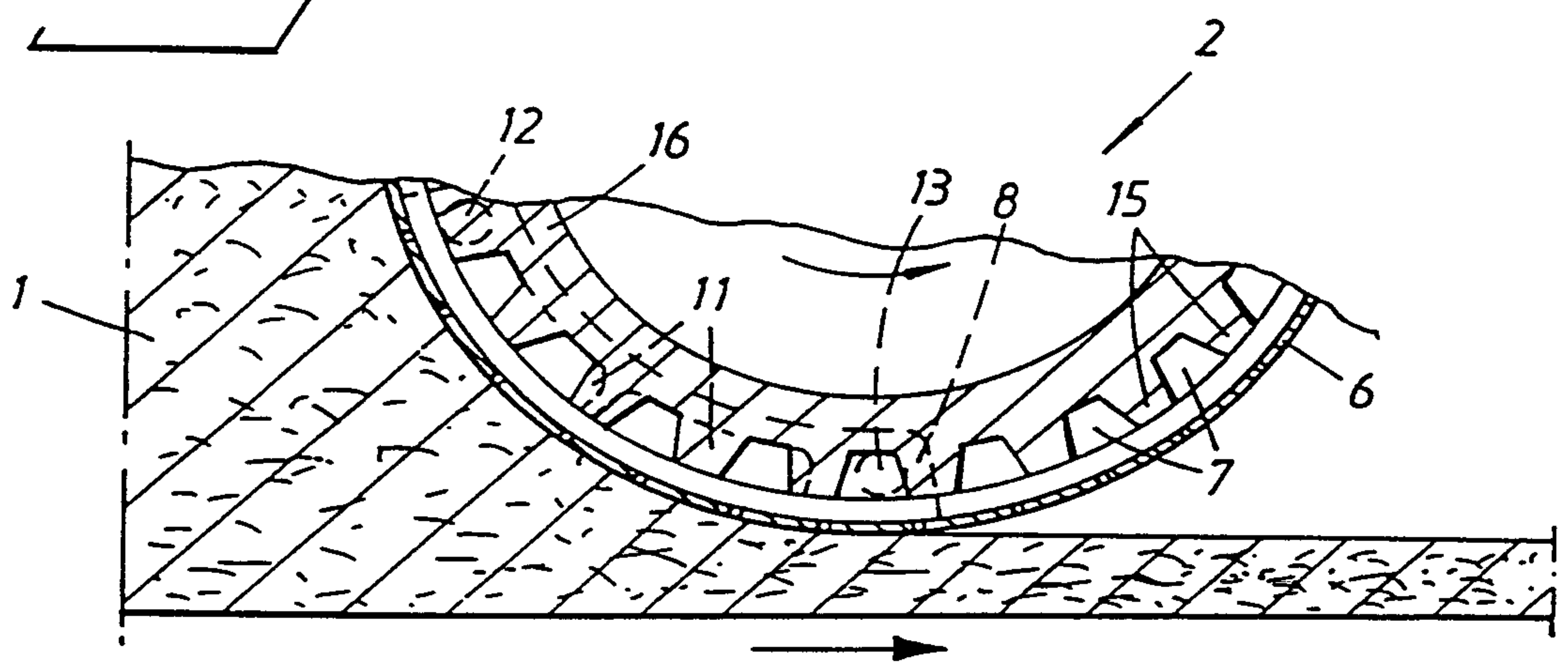
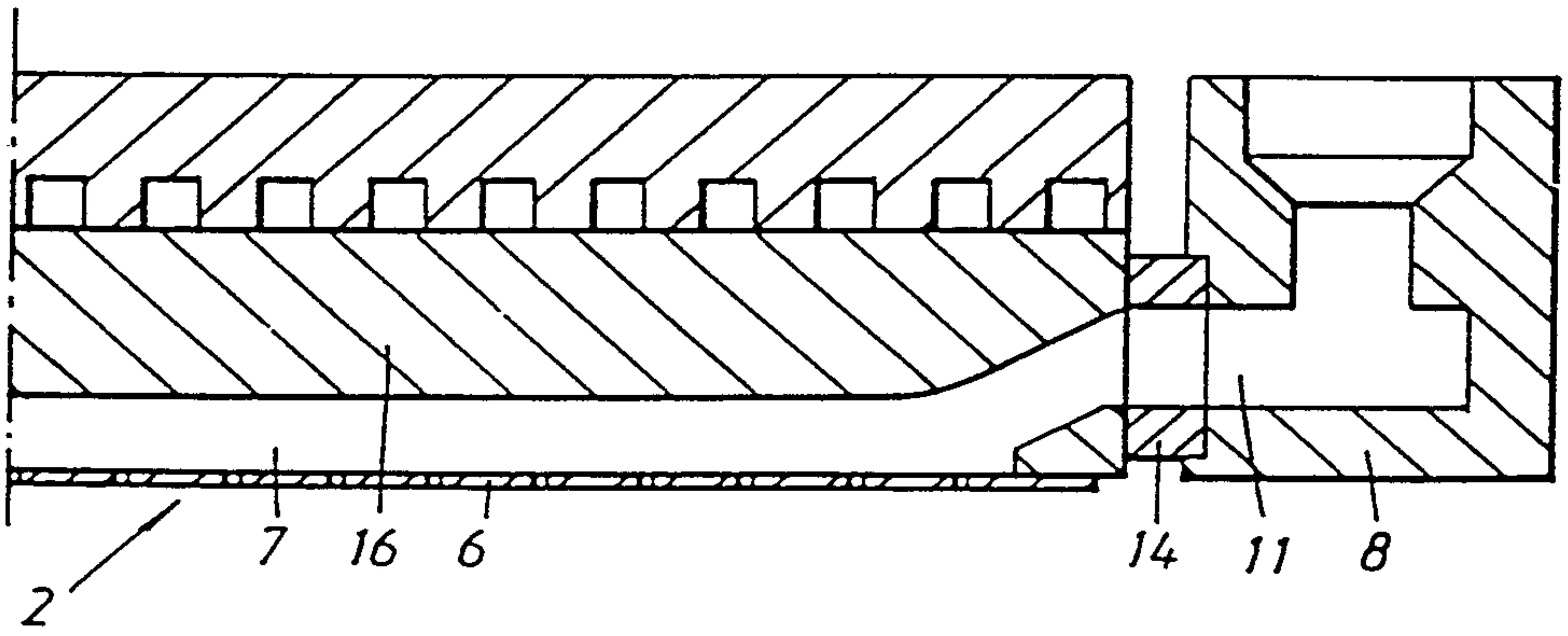
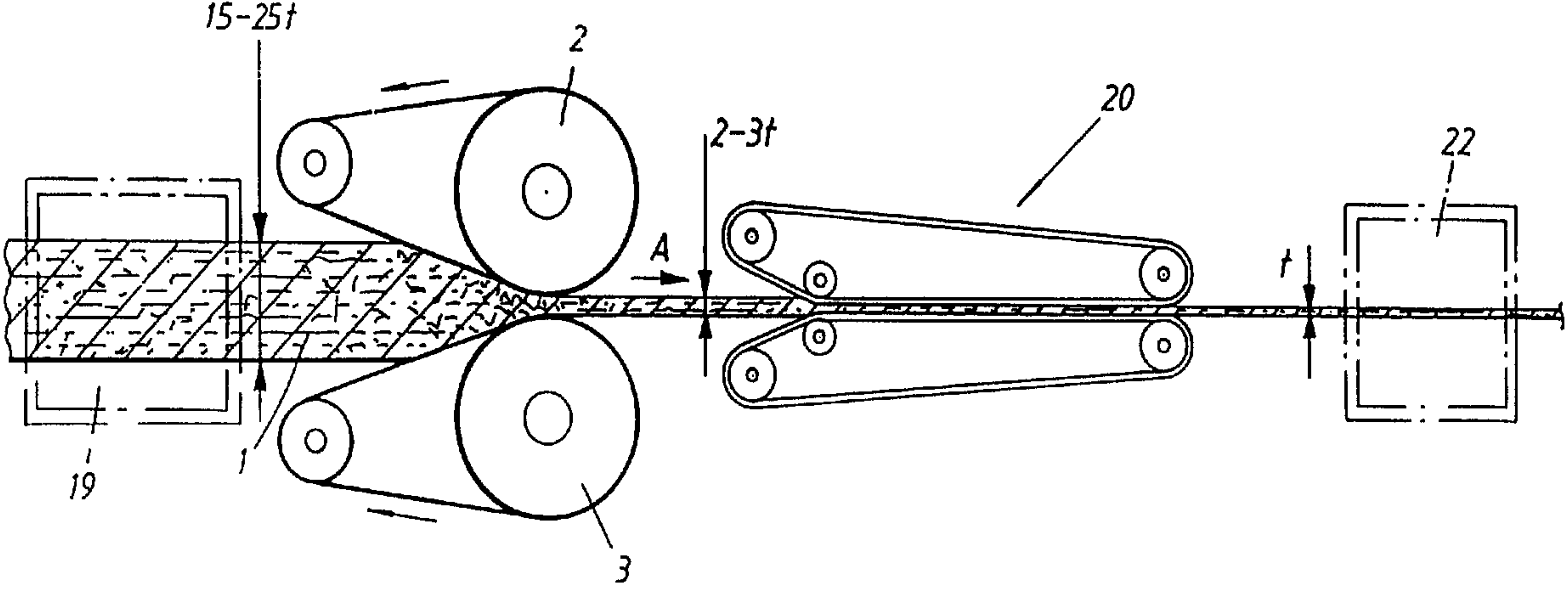


Fig. 4





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