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(54) Method and apparatus for the production of a particle based element with precompression of a portion of the particles

(57) The present invention relates to a method for the production of a particle based element, with the following steps. Particles 1 are dispersed to form at least one particle mass 3. A portion of the particles is precompressed to form a precompressed first particle portion 9,10. The first particle portion 9,10 is combined with a second particle portion 11, which is of a lower compression grade than the first particle portion 9,10, and the combined first and second particle portions 9,10,11 are compressed together, such that the density of both the first particle portion 9,10 and the second particle portion 11 is increased. The present invention further relates to an apparatus for the production of a particle based element.

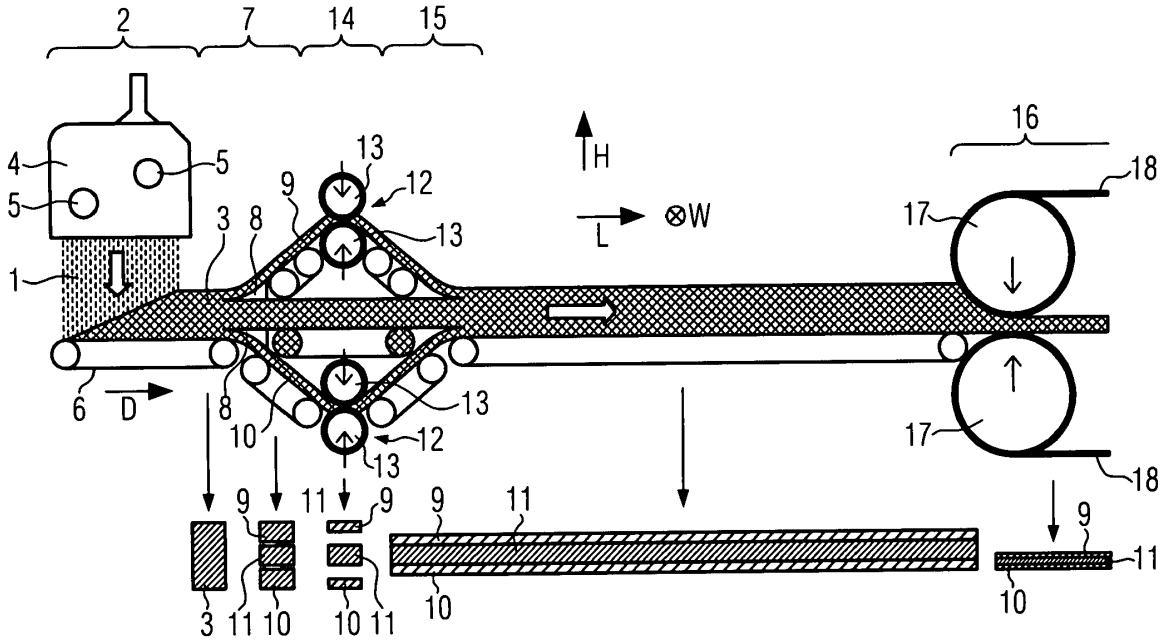

FIG. 1

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Description

[0001] The present invention relates to a method and apparatus for the production of a particle based element.

[0002] Particle based elements can be manufactured from particles such as wood chips, wood fibers, saw mill shavings, sawdust, or other organic or non-organic fibers. The most common form of particle based elements are particle boards, but also more complicated geometries may be realized. Particle based elements comprise particle boards, fiber boards, medium-density fiber boards, and hard boards.

[0003] The manufacture of particle based elements is usually carried out by mixing a particle mass with a resin, such as amino, formaldehyde based resins, urea melamine, phenol formaldehyde or resorcinol resins. Other components may be mixed into the particle mass, such as wax, dyes, wetting agents, and release agents. After the resin has been mixed into the particle mass, the particle mass is arranged for further processing and pressed under high temperature to form a particle based element.

[0004] For some applications of particle based elements, it is beneficial if they can be provided with different densities in different regions. This may reduce the material consumption, increase the rigidity, and lower the weight of the particle based element. It is known from International patent application WO 2011/079 934 A1 to arrange different parts of a particle mass in a desired matrix with respect to each other, wherein the different parts comprise different compressive properties, such that during compression of the particle based element, a desired density structure can be formed in the particle based element. Furthermore, it is known from International patent application WO 2011/079 920 A2 to initially produce a three-dimensionally shaped first structural element and then complementary shape a second structural element, which is connected to the first structural element. The particle mass has already hardened to form the first structural element when it is combined with the particles of the second structural element, such that during a further pressing step, no further compression takes place for the first structural element.

[0005] The object of the invention is to provide a method and apparatus for the production of a particle based element, which allows an economic production of a stable particle based element with a desired density distribution therein.

[0006] This object is attained by a method for the production of a particle based element with the following steps: Particles are dispersed to form at least one particle mass. A portion of the particles is precompressed to form a precompressed first particle portion. The first particle portion is combined with a second particle portion, which is of a lower compression grade than the first particle portion. The combined first and second particle portions are compressed together, such that the density of both the first particle portion and the second particle portion is increased.

[0007] By providing only a precompressed first particle portion and not a fully compressed structural element, as in prior art, and compressing the precompressed particle portion together with another particle portion of a lower compression grade, a better connection of the particle portions can be attained. In particular, the precompressed first particle portion is still flexible enough in its connection interface to the second particle portion, such that the first particle portion and second particle portion are fully in contact and no local stress concentration is present in the particle based element. In particular, the density increase in the first particle portion and the second particle portion in the compressing step is at least 2%, more preferably at least 5% and in some embodiments, at least 10%.

[0008] After the particles have been dispersed, the particle mass may have a density of about 30 to 90 kg per cubic meter for particle masses comprised of fibers, and of about 60 to 270 kg per cubic meter for particle masses comprised of wood chips. During the precompression, the density of the first particle portion may be increased by up to 50 times, preferably up to 60 times. In particular the precompressed first particle portion may have a density of up to 1500 kg per cubic meter. For wood particles, the theoretical highest compressability enables a compression to about 1600 kg per cubic meter.

[0009] In some embodiments, the precompressed first particle portion may be subject to relaxation after the precompression. This is due to the fact that, preferably, the precompressed first particle portion is not yet fully internally bonded. In particular, the precompressed first particle portion is still an at least partially internally unbonded particle mass, and not an internally bonded structural element. In particular, the precompressed first particle portion may increase its volume by more than 10%, more than 20%, or preferably, more than 40%, in particular, around 50% during relaxation.

[0010] After the combined first and second particle portions have been compressed together, the density of the first particle portion is preferably about 30% to about 255% higher than the density of the second particle portion. Particularly, for a particle based element mainly comprising wood chips, the first particle portion has a density that is 30% to 75% higher than the density of the second particle portion. For particle based elements mainly comprising fibers, the first particle portion preferably has a density that is 60% to 255% higher than the density of the second particle portion. During the compression of the first and second particle portions heat may be applied to the first and second particle portions, to enable hardening of the adhesive distributed therein, such that the particles of the particle mass are bonded to form to a structural element.

[0011] In particular, the particles may already be provided with a bonding means, such as adhesive before, during, or immediately after dispersing. However, the precompression is preferrably carried out in a manner that the first particle portion is not fully internally bonded

to a structural element. In particular, the precompression may be carried out with only little or no heat, or for a time that is not sufficient to allow a bonding of the particles of the first particle portion. More in particular, the precompression may be carried out substantially at ambient temperature.

[0012] In some embodiments, the second particle portion is uncompressed. In particular, the second particle portion is not increased in its density by a precompression means, such as a press or roller, before being combined with the first particle portion. In other embodiments, the second particle portion may be precompressed to a lower compression grade than the first particle portion. In particular, the second particle portion is compressed at least 10%, 20%, 30%, 40%, or 50% less than the first particle portion regarding their respective density increases.

[0013] In one embodiment, after the dispersing of the particles, the particle mass is separated into at least two particle portions, wherein at least one particle portion is precompressed to form the precompressed first particle portion, while at least another particle portion is maintained at a lower compression grade than the first particle portion, to form the second particle portion. In particular, the separation of the particle mass into two particle portions may be obtained by subjecting the particle mass to a cutting means. The cutting means may be a blade or a circular saw. The cutting means may be stationary or moving. Furthermore, the particle mass may be conveyed with respect to the cutting means, such as by moving the particle mass towards the cutting means on a conveyer. Separate conveying means for the different portions of the particle mass may be arranged after the cutting means.

[0014] In one embodiment, the dispersing of particles comprises the dispersing of particles at subsequent stages, and the combining of the first and second particle portions comprises dispersing particles on the first particle portion to form the second particle portion. In particular, particles of the first particle portion may be provided initially, and after the precompression of the first particle portion, the particles of the second particle portion may be directly dispersed on the precompressed first particle portion. More in particular, the particles of the first particle portion may be conveyed on a conveying means, such as a conveyer belt after the precompression, and the second particles may be dispersed on the moving precompressed first particle portion.

[0015] In some embodiments, the dispersing of particles comprises the dispersing of particles to form several different particle masses, wherein at least a portion of at least one of the particle masses is precompressed to form the first particle portion. In particular, at least one of the particle masses may be precompressed to form the first particle portion. The dispersing of particles to form several different particle masses relates to dispersing the particles at different locations and conveying the different dispersed particle masses separately. At least one of the particle masses may be precompressed and accordingly forms at least one first particle portion.

[0016] Preferably, the first particle portion is arranged on the second particle portion. Thus, the first particle portion may provide an upper layer of increased density in the particle based element. Furthermore, the precompression facilitates the arrangement of a particle portion on another particle portion, as the precompressed particle portion is more stable than the second particle portion, which may be uncompressed or is only precompressed to a lower grade than the first particle portion.

[0017] Preferably, several first particle portions are precompressed and combined with at least one second particle portion, and the combined particle portions are compressed to create a multi-layer particle based element. In particular, the first particle portions may form upper and lower layers of the multilayer particle based element.

[0018] More in particular, the first particle portions form an uppermost and lowermost layer of the multilayer particle based element. Thus, the rigidity of the surfaces of the particle based element, in particular a particle based board, can be increased.

[0019] In preferred embodiments, the precompression of the first particle portion comprises creating a surface profile in the first particle portion of the particle mass. The surface profile relates in particular to a structure in which the height of the first particle portion is varied in the length and/or width direction of the particle mass. In particular, recessions or protrusions can be created in the surface of the first particle portion. The surface profile may be regular or irregular.

[0020] Preferably, during or after the step of precompressing a portion of the particles to form a precompressed first particle portion, adhesive is applied on the surface of the first particle portion. The surface of the first particle portion may be relatively closed in its surface structure and flat due to the precompression, which may be detrimental regarding the connection of the first and second particle portions during the later compression step. However, by means of additional adhesive provided on the surface of the first particle portion, an improved connection between the first and second particle portions can be obtained. The adhesive may correspond to the adhesive that is already comprised throughout the particle mass. The adhesive may be provided on the surface, before particles of the second particle portion are dispersed on the surface or before the second particle portion is combined with the first particle portion by contacting this surface.

[0021] In some embodiments, the adhesive already comprised in the particle mass during the precompression may involuntarily stick and remain on a precompression element, such as a roller or a pressing plate, during the precompression. This is particularly due to the fact that the first particle portion is not fully hardened to a structural element at the end of the precompressing, but is still a particle portion with liquid adhesive being provided therein. Thus, an adhesive removing means can

be provided on the precompression element to remove the adhesive and particles from the precompression element. In particular, a scratching element in the form of a blade or edge may be provided in contact with a precompression roller. Similarly, for a precompression press plate, a moveable blade may be provided that removes adhesive from the pressing plate after every precompression. A container for collecting the removed adhesive and particles may be arranged below the adhesive removing means.

[0022] In particular, the adhesive may be removed from the precompression element mechanically, as specified by means of examples beforehand. Alternatively, it is also possible to remove the adhesive chemically, or by means of heat, such that the adhesive either melts or burns. The production of the particle based element, and in particular the dispersing, precompression, and compression, is carried out continuously.

[0023] The object of the invention is further attained by an apparatus for the production of a particle based element, comprising a particle dispersing section in which particles are arranged to form a particle mass, a precompressing section comprising a precompression element with a contact surface adapted to precompress at least a portion of the particle mass to form a precompressed first particle portion, a joining section adapted to enable joining of the first particle portion and a second particle portion, and a compressing section, adapted to compress the first particle portion and the second particle portion, such that the density of both the first and second particle portions is increased.

[0024] In particular, several particle dispersing sections may be provided in which several particle masses are dispersed. In some embodiments, one of the particle dispersing sections may be arranged downstream of the precompression section, such that particles are dispersed on the precompressed first particle portion.

[0025] A separation section may be provided between the particle dispersing section and the precompressing section, such that only a portion of the particle mass is conveyed to the precompressing section, while the other portion bypasses the precompressing section, such that it forms an uncompressed particle portion. Alternatively, after the separating section, the separated different portions of the particle mass may be subjected to precompression with different compression grades before being joined again in the joining section.

[0026] Preferably, the precompression element is in the form of at least one roller that is adapted to apply pressure with its circumferential contact surface to the first particle portion. Preferably, the portion of the particle mass is conveyed through the precompression element that may be stationary or only moveable in the height direction of the particle portion.

[0027] Alternatively, the precompression element may be at least one pressing plate. The pressing plate may be moveable in the height direction to precompress the first particle portion. In particular, the conveying of the first particle portion may be stopped during precompression, while the first particle portion is subjected to pressure by means of the pressing plate. Alternatively, the precompression element may be an inclined surface that compresses the first particle portion, while the first particle portion is conveyed along the surface. Further, the precompression element may be at least one belt that precompresses the first particle portion by means of its outer surface.

[0028] The precompression element may be arranged on both sides of the first particle portion, in particular above and below the first particle portion. In some embodiments, one larger roller on one side may be combined with several smaller rollers on the other side of the first particle portion to form the precompression element.

[0029] In one embodiment, the contact surface of the precompression element has a profile that varies in the length direction of the first particle portion. When the precompression element comprises a roller, the profile varies in the circumferential direction of the roller. In some embodiments, the profile may be constant in the width direction of the first particle portion. Thus, the surface structure provided in the first particle portion would only vary in the length direction thereof, while being constant in the width direction.

[0030] In some embodiments, the contact surface of the precompression element has a profile that varies in the width direction of the first particle portion. In the case of a roller comprised in the precompression element, the profile provided therein varies in particular in the axial direction. In some embodiments, the contact surface of the precompression element has a profile that varies in both the width and length direction of the first particle portion. Thus, a three dimensional surface profile can be provided in the first particle portion.

[0031] In one embodiment, the contact surface of the precompression element comprises at least one opening for enabling the treatment of at least some of the particles of the first particle portion. In particular, fluid, steam, chemical additives, or additional energy, such as heat, may be provided through the at least one opening of the precompression element. In particular, the precompression element comprises several openings that are preferably arranged in a predetermined pattern on the contact surface of the precompression element. In some embodiments, the pattern may be regular, while in other embodiments, the pattern may be irregular, depending on the desired treatment of the surface of the first particle portion. The treatment may allow increasing the density in at least one outside layer, particularly in the upper and/or lower layer of the first particle portion. This may increase the rigidity of the first particle portion and, therefore, of the whole particle based element. Furthermore, adhesive may be provided through the openings in the precompression element.

[0032] In the following, the invention will be described by means of exemplary embodiments of the invention, which are shown in the following figures.

Figure 1 shows a schematic side view of an apparatus according to an embodiment of the invention.

Figure 2 shows a schematic side view of an apparatus according to another embodiment of the invention.

Figure 3 shows a schematic side view of a precompressing section of an apparatus according to an embodiment of the invention.

Figure 4 shows a schematic side view of a precompressing section of an apparatus according to an embodiment of the invention.

Figure 5 shows a schematic side view of a precompressing section of an apparatus according to an embodiment of the invention.

Figure 6 shows a perspective view of a precompression element of an apparatus according to an embodiment of the invention.

Figure 7 shows a perspective view of a precompression element of an apparatus according to an embodiment of the invention.

Figure 8 shows a perspective view of a precompression element of an apparatus according to an embodiment of the invention.

Figure 9 shows a perspective view of a precompression element of an apparatus according to an embodiment of the invention.

Figure 10 shows a perspective view of a precompression element of an apparatus according to an embodiment of the invention.

[0033] In an apparatus according to an embodiment of the invention as shown in figure 1, initially, particles 1, particularly in the form of wood chips or fibers, are dispersed in a particle dispersing section 2 to form a particle mass 3. In the dispersing section 2, a particle distributing means 4 is provided which distributes the particles by means of rotating drums 5 provided therein, such that the particles 1 are distributed on a conveying means, such as a conveyer belt 6. The conveyer belt 6 is continuously conveying the particles in the downstream direction D. At the end of the dispersing section 2, the particle mass 3 has a relatively low density, in particular between 30 and 90 kg per cubic meter for wood fibers and between 60 and 270 kg per cubic meter for wood chips.

[0034] Downstream from the dispersing section 2, a separating section 7 is provided. In the separating section, blades 8 may be arranged in the height of the particle mass 3, such that the particle mass 3 is conveyed against the blades 8 and is split into two first particle portions 9, 10, and a second particle portion 11. In particular, the first particle portions 9, 10 correspond to the upper and lower layer of the particle mass 3. The second particle portion 11 corresponds to an inner layer of the particle mass 3. The particle mass 3 is in the form of a plate having a substantially constant height along the length direction L in the downstream direction D, and the width direction W, perpendicular to the height direction H and length direction L.

[0035] The first particle portions 9, 10 are conveyed by means of additional conveyer belts to precompression elements 12, which are particularly in the form of parallelly arranged rollers 13, in a precompression section 14. While the first particle portions 9, 10 are continuously conveyed through the precompression elements 12, the height of the first particle portions 9, 10 is reduced due to precompression pressure that is applied from both sides by means of the rollers 13. In particular, the first particle portions 9, 10 may be significantly compressed, that is to a density of about 1500 kg per cubic meter. However, as the pressure in the precompressing section 14 is only applied for a relatively short time, the first particle portions 9, 10 expand after the precompression and, thus, the density of the precompressed first particle portion 9, 10 is again lowered. Finally, after this relaxation the precompressed first particle portion 9, 10 may be increased in its density between 30% and 200%, usually around 100%. The precompressed first particle portion 9, 10 is then joined again with the second particle portion 11 in a joining section 15. In the joining section 15, before the first and second particle portions 9, 10, 11 are joined, adhesive may be provided on the contact surfaces between the first particle portions 9, 10, and the second particle portion 11. In the joining section 15, the first particle portions 9, 10 may be supported by conveyer belts.

[0036] Then, the combined first and second particle portions 9, 10, 11 are further conveyed on a conveyer belt until they reach a compressing section 16, in which the first particle portions 9, 10, and the second particle portion 11 are compressed and hardened together to form the particle based element. In particular, the density of both the first and the second particle portions 9, 10, 11 is increased during the compression of the compression section 16. Furthermore, the particles in the first and second particle portions 9, 10, 11 are bonded, in particular by hardening of the adhesive comprised in the particle mass. The hardening of the adhesive may be supported by additional heat applied to the particle mass in the compressing section 16 and by holding the particle mass for a sufficient time under high compression pressure. Rollers 17 and belts 18 may be provided as compressing elements in the compressing section 16. The belt 18 enables to maintain a high pressure in the pressing section for a sufficiently long time.

[0037] Below the apparatus as shown in figure 1, a cross section of the particle mass 3 and the respective first particle portions 9, 10 and second particle portion 11 can be seen in cross section in the different sections of

the apparatus according to the embodiment of the invention.

[0038] In figure 2, a further embodiment of an apparatus according to the invention is shown in a schematic side view. In this embodiment, the particles are dispersed at subsequent stages, as several particle distributing means 4 are arranged subsequently at different stages of the apparatus in the downstream direction D. In a first dispersing section 2, particles are distributed by means of the particle distributing means 4 on a conveying means, in particular by a conveyer belt 6. The accordingly formed particle mass 3 is then subjected to a precompressing element 12, in particular in the form of two rollers 13 in a first precompressing section 19. Accordingly, the whole particle mass 3 forms the first particle portion 9, which is precompressed. The precompressed first particle portion 9 is then further conveyed to a second dispersing and joining section 20. In section 20, the steps of dispersing and joining are carried out simultaneously, as particles 1 forming a second particle portion 11 are dispersed on top of the precompressed first particle portion 9. Thus, at the end of the dispersing and joining section 20, a particle mass comprising a precompressed first particle portion 9 and an uncompressed second particle portion 11, arranged on top of the first particle portion 9, is provided. The first particle portion 10 and the second particle portion 11 are then further conveyed. A third dispersing section 21 is arranged separately from the conveying means of the first and second particle portions 9, 10. In third dispersing section 21, a particle distributing means 4 disperses particles 1 on a conveying means, in particular in the form of a belt, to form a further particle mass that corresponds to a further first particle portion 10. The first particle portion 10 is precompressed in a second precompressing section 22, in which a precompression element 12 in the form of rollers 13 is provided. The precompressed first particle portion 10 is further conveyed on a further conveyance means, until it is joined with the first and second particle portions 9, 10 in a joining section 23. Thus, after the joining section 23, a particle mass is arranged on the conveying means, which comprises a lowermost first particle portion 9, an inner second particle portion 11, and an uppermost first particle portion 10. The particle mass is then subjected to rollers 17 and heat provided by a heating means in a compressing section 16, such that it is compressed to a particle based element in the form of a particle board. The particle board is then cut into the desired sizes for further processing.

[0039] In figure 3, an alternative precompression element is shown in a schematic side view. A first particle portion 9 or 10 is conveyed towards the precompression element 12, which comprises a belt 24, which is supported by several rollers 25 that are arranged subsequently in the downstream direction D. By means of the rollers 25 that are, in particular, adjustable in the height direction and able to apply a precompression pressure in the height direction H to the first particle portion 9, 10, the first particle portion 9, 10 is precompressed. In particular, the precompression element 12 may comprise belts 24 and rollers 25, both above and below the first particle portions 9, 10 to compress the first particle portions 9, 10 from both sides. Alternatively, the precompression element may be provided only on one side of the first particle portions 9, 10, and at the other side, a stationery compression counter element, such as a plate or a conveyer belt may be arranged.

[0040] In figure 4, a further precompression element 12 is shown in a schematic side view. The precompression element 12 comprises two pressing plates 26, which can be moved in the height direction H of the first particle portions 9, 10. In particular, an upper and a lower pressing plate 26 are arranged above and below the first particle portions 9, 10, respectively. Before the pressing plates 26 are moved towards the first particle portion 9, 10, the conveying of the first particle portion 9, 10 is stopped. Then, the pressing plates 26 are moved towards each other and compress the first particle portion 9 to the desired compression level. Thus, with the precompression element 12, the manufacturing process is only semi-continuous. However, the compression of the individual parts of the first particle portions 9, 10 can be carried out with a very high accuracy.

[0041] In figure 5, a further embodiment of a precompression element 12 is shown in a schematic side view. The precompression element 12 combines a larger roller 27 arranged on one side of the first particle portions 9, 10, and several smaller rollers 18 arranged on the other side of the first particle portions 9, 10. Thus, the first particle portion 9, 10 can be compressed while being conveyed in the downstream direction D. In particular, the smaller rollers 28 are arranged in a distance along the circumference of the larger roller 27. The distance between the several smaller rollers 28 and the larger roller 27 is substantially the same. The smaller rollers 28 are particularly movable in the radial direction of the larger roller 27 to apply the necessary compression pressure to the first particle portion 9, 10.

[0042] In figure 6, a roller for a precompression element 12 according to the embodiments as shown in figures 1 and 2 is shown in a perspective view. The roller 13 has a substantially cylindrical form and, therefore, enables to precompress the first particle portion 9, 10 to a precompressed particle portion with a substantially flat surface.

[0043] However, in some embodiments, a structure in the upper or lower surface of the first particle portion is desired. Therefor, a roller 13 as shown in figures 7 to 9 can be used. The roller as shown in figure 7 comprises protrusions 29 that extend in the axial direction of the roller 30. Thus, a profile that varies in the length direction L of the first particle portions 9, 10 can be created. In particular, the arrangement of several equidistant protrusions 29 as shown in figure 7 enables the creation of a wavelike pattern on the surface of the first particle portion 9, 10.

[0044] In figure 8, a roller 13 with several protrusions

30 extending in the circumferential direction of the roller 13 is shown in a perspective view. Thus, the first particle portion 9, 10 can be provided with a profile that varies in the width direction W of the first particle portion 9, 10. Thus, a wavelike formed pattern perpendicular to the wavelike formed pattern as created with the roller according to figure 7 can be created.

[0045] Furthermore, it is also possible to create profiles which vary in the length and width direction of the first particle portion 9, 10, in particular with a roller as shown in figure 9 that comprises an irregularly arranged protrusion 31. However, in contrast to irregularly arranged protrusions, it is also possible to provide regularly arranged protrusions that vary in the circumferential and axial direction of the roller 13, for example by combining or overlaying the profiles of figures 7 and 8.

[0046] In figure 10, a roller 13 is shown in which a multitude of openings 32 are arranged. The openings allow treating at least some of the particles of the first particle portion 9, 10. In particular, additional fluid, such as liquid or steam, can be provided through the openings onto and into the first particle portion 9, 10. Thus, the compressibility of the first particle portion 9, 10 can be locally varied, or additional adhesive can be provided to the first particle portion 9, 10. Thus, the mechanical characteristics of the particle based element can be significantly influenced. In particular, the openings 32 according to figure 10 can as well be combined with the profiles as shown in any of the previous figures or with any other profile.

Claims

1. Method for the production of a particle based element, comprising the following steps:

   i) dispersing particles (1) to form at least one particle mass (3),
   ii) precompressing a portion of the particles to form a precompressed first particle portion (9,10),
   iii) combining the first particle portion (9,10) with a second particle portion (11), which is of a lower compression grade than the first particle portion (9,10), and
   iv) compressing the combined first and second particle portions (9,10,11) together, such that the density of both the first particle portion (9,10) and the second particle portion (11) is increased.

2. Method according to claim 1, wherein the second particle portion (11) is uncompressed.

3. Method according to claim 1 or 2, wherein after step i) the particle mass (3) is separated into at least two particle portions, wherein at least one particle portion is precompressed to form the precompressed first particle portion (9,10), while at least another particle portion is maintained at a lower compression grade than the first particle portion (9,10), to form the second particle portion (11).

4. Method according to any one of the previous claims, wherein step i) comprises the dispersing of particles (1) at subsequent stages, and wherein step iii) comprises dispersing particles (1) on the first particle portion (9,10) to form the second particle portion (11).

5. Method according to any one of the previous claims, wherein step i) comprises the dispersing of particles (1) to form several different particle masses (3), wherein at least a portion of at least one of the particle masses (3) is precompressed to form the first particle portion (9,10).

6. Method according to claim 5, wherein step iii) comprises arranging the first particle portion (9,10) on the second particle portion (11).

7. Method according to any one of the previous claims, wherein several first particle portions (9,10) are precompressed and combined with at least one second particle portion (11) and the combined particle portions are compressed to create a multilayer particle based element.

8. Method according to claim 7, wherein the first particle portions (9,10) form an uppermost and lowermost layer of the multilayer particle based element.

9. Method according to any one of the previous claims, wherein step ii) comprises creating a surface profile in the first particle portion (9,10) of the particle mass.

10. Method according to any one of the previous claims, wherein during or after step ii) adhesive is applied on the surface of the first particle portion (9,10).

11. Apparatus for the production of a particle based element, comprising a particle dispersing section (2,20,21), in which particles (1) are arranged to form a particle mass (3), and
    a joining section (15,20) adapted to enable joining of a first particle portion (9,10) and a second particle portion (11),
    characterized by
    a precompressing section (14,19,21) comprising a precompression element (12) with a contact surface adapted to precompress at least a portion of the particle mass (3) to form the first particle portion (9,10), which is precompressed, and
    a compressing section (16), adapted to compress the first particle portion (9,10) and the second particle portion (11), such that the density of both the first and second particle portions (9,10) is increased.

12. Apparatus according to claim 11, wherein the precompression element (12) is in the form of at least one roller (13,27,28), which is adapted to apply pressure with its circumferential contact surface to the first particle portion (9,10).

13. Apparatus according to claim 11 or 12, wherein the contact surface of the precompression element (12) has a profile which varies in the length direction of the first particle portion (9,10).

14. Apparatus according to any one of claims 11 to 13, wherein the contact surface of the precompression element (12) has a profile which varies in the width direction of the first particle portion (9,10).

15. Apparatus according to any one of claims 11 to 14, wherein the contact surface of the precompression element (12) comprises at least one opening (32) for enabling a treatment of at least some of the particles of the first particle portion (9,10).

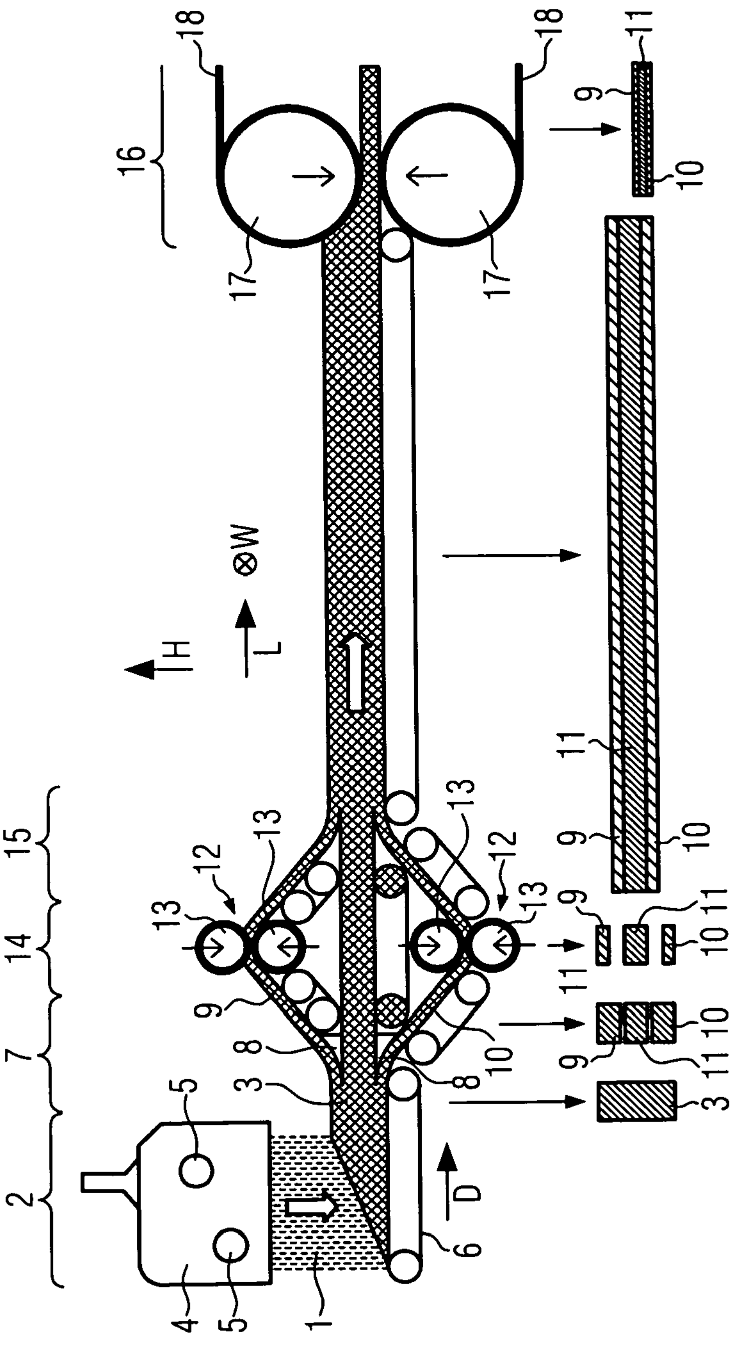

FIG. 1

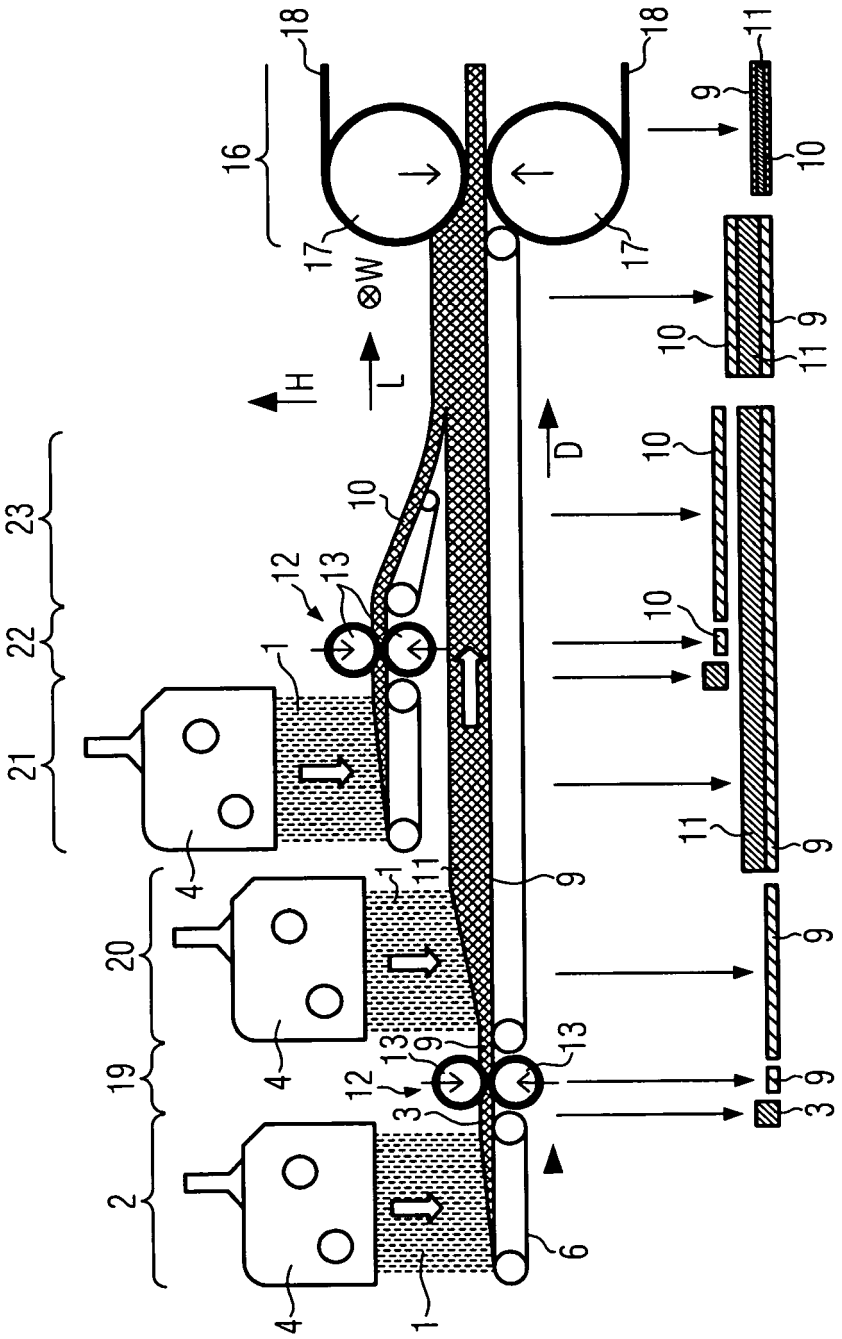

FIG. 2

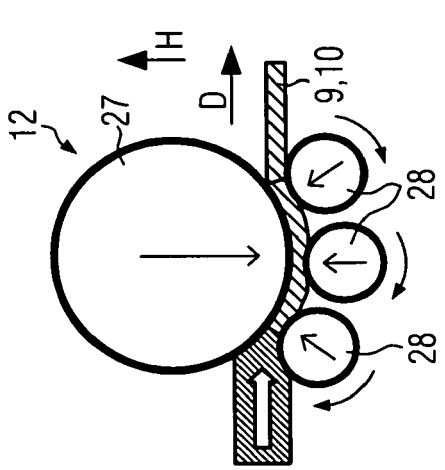

FIG. 5

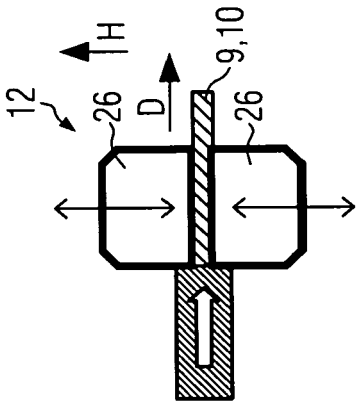

FIG. 4

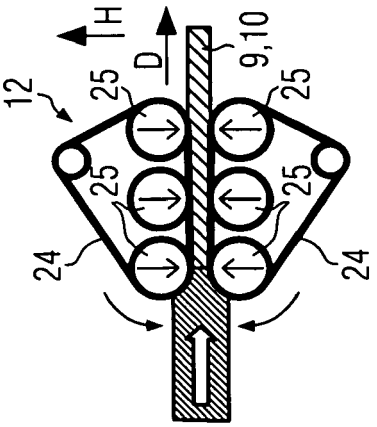

FIG. 3

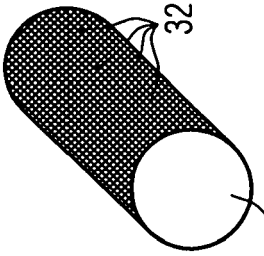

FIG. 10

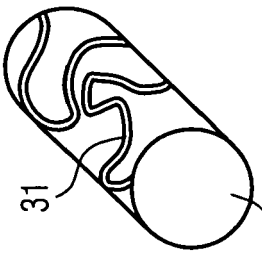

FIG. 9

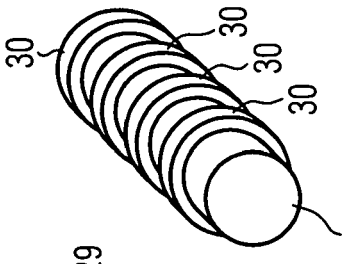

FIG. 8

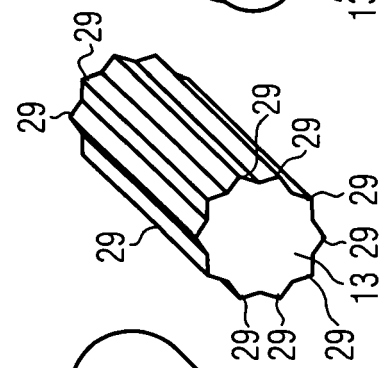

FIG. 7

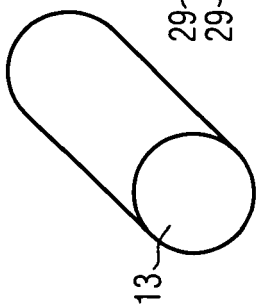

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 12 00 5788

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 January 2013	Söderberg, Jan-Eric

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