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(54) **Rotor body for a sorting screen apparatus for sorting waste**

(57) A rotor body (3) for a sorting screen has an outer circumference with a plurality of radial projections (4) circumferentially distributed around a central axis of rotation and projecting radially outwardly from the axis of rotation relative to intermediate recessed portions of the outer

circumference. The rotor body has a central portion of a first material and at least outermost parts (8) of the radial projections are of a second material. The first material is more elastic than the second material. A sorting screen including such rotor bodies is also described.

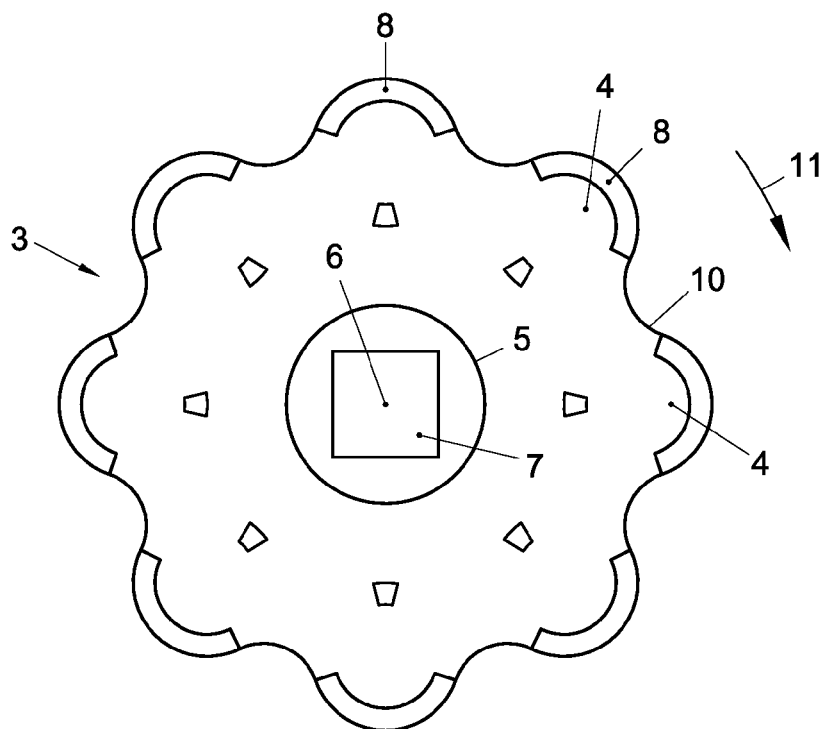


Fig. 2

Description

FIELD AND BACKGROUND OF THE INVENTION

[0001] The invention relates to a rotor body for a sorting screen for sorting waste according to the introductory portion of claim 1 and to a sorting screen including such a rotor body. Such a rotor body and such a sorting screen are known from German Auslegeschrift 1 021 200 in the form of a sorting screen for removing mud and the like from agricultural products such as sugar beets.

[0002] Sorting screens with rotor bodies for sorting material generally comprise a row of rotatable, driven shafts mutually spaced in a conveying direction. The shafts each extend transversally to the conveying direction and each carry a row of radially extending rotor bodies for intermittently urging material on the sorting screen upward and in conveying direction. The rotor bodies of each of the rows are mutually spaced in longitudinal direction of the respective shaft and rotary trajectories of the rotor bodies carried by each of the shafts project between rotary trajectories of the rotor bodies carried by a neighboring one of the shafts. Such rotor bodies are also known as star bodies but are not necessarily star-shaped in a narrow-sense. Typically the rotor bodies have circumferentially distributed radial projections, such as fingers or top portions of a wavy pattern, for effectively entraining material over the sorting screen as the rotor bodies are rotated in a common sense of rotation.

[0003] European patent 0 773 070 and European patent 0 925 847 disclose sorting screens that can for instance be used for sifting waste, wherein the waste has to be separated in a crude and fine fraction or in a stiff (e.g. cardboard) and flexible (e.g. paper) fraction. The sizes and shapes of the passages between most adjacent rotor bodies and between the rotor bodies and most adjacent shafts determine the maximum dimensions and/or stiffness of the objects that drop through the sorting screen. Usually, all the shafts of the sorting screen rotate in the same sense of rotation, so that material moves over the screen and the fraction which is left on the screen is separated from the fraction of the material that drops through the sorting screen. In this way it is also effected that an object which is too large for the passage will not block the passage, because adjacent to every passage a rotor body section is present which moves upwardly, so that the object is engaged and entrained upwardly away from the passage.

[0004] However, when sorting material including particles or clusters of particles of great stiffness, such as stone, ceramic material, metal or wood, large forces are exerted onto the rotor body since such particles or clusters of particles sometimes become clamped between adjacent flanks of rotor bodies and particles hitting the rotor bodies exert substantial impact forces, in particular if the objects are of a hard material of a high specific weight. To avoid premature damage and wear due to the exertion of such large forces, the rotor bodies and the

axles and bearings have to be of a strong construction, but this entails a costly, heavy construction, not only for the rotor bodies, axles and bearings, but also for the drive structure and the frame of the sorting screen. Large rotor body and axle weights also make assembly of the sorting screen and replacement or rearrangement of the rotor bodies for a different sorting task more difficult.

SUMMARY OF THE INVENTION

[0005] It is an object of the invention to provide a solution which allows a lighter construction of the sorting screen, yet does not entail a significantly reduced life span.

[0006] According to the invention, this object is achieved by providing a rotor body according to claim 1. The invention can also be embodied in a sorting screen according to claim 14.

[0007] By providing that the first material of the central portion is more elastic than the second material of which at least the outermost parts of the radial projections are made, a resilient rotor body is obtained, that can bend sideways relatively easily when objects become stuck between adjacent rotor bodies and thereby allow such object to be expelled from between the rotor bodies without exerting excessively high forces onto the rotor bodies. Also, the resilient characteristics of the rotor bodies allow impact energy of heavy hard items hitting the rotor bodies to be absorbed relatively smoothly, such that the exertion of high peak loads onto the rotor bodies is avoided. Accordingly, the rotors may be of a lighter construction. Also, noise emissions due to impacts of objects against the rotor bodies are reduced. Nevertheless, due to the relatively less elastic second material of which at least outermost parts of the radial projections are made, the rotor bodies are wear resistant and have a long life span.

[0008] Particular embodiments of the invention are set forth in the dependent claims.

[0009] Further objects, features, effects and details of the invention are described below.

BRIEF DESCRIPTION OF THE DRAWING

[0010]

Fig. 1 is a schematic top view of a part of an example of a sorting screen according to the invention;
Fig. 2 is a side view of a first example of a rotor body according to the invention;
Fig. 3 is a side view of the rotor body according to Fig. 2 with hidden contours of the inserts shown;
Fig. 4 is an exploded view of the rotor body according to Figs. 2 and 3; and
Fig. 5 is a side view of a second example of a rotor body according to the invention.

DETAILED DESCRIPTION

[0011] First, an example of a sorting screen 1 as shown in Fig. 1 is described. The sorting screen 1 is equipped with a row of rotatable shafts 2 mutually spaced in a conveying direction 18 and drivable in a common sense of rotation. Each shaft 2 extends transversally to the conveying direction 18. For driving rotation of the shafts 2, the shafts are coupled in a manner known per se to a motor via a drive train. Each of the shafts 2 carries a row of radially projecting rotor bodies 3 for intermittently urging material on the sorting screen conveyor upward and in conveying direction 18 when the shafts 2 are driven for rotation in a sense in which the upper parts of the rotor bodies 3 move with a directional component in the conveying direction 18. The rotor bodies 3 of each of the rows are mutually spaced in longitudinal direction 19 of the respective shaft 2. In operation, the circumference of each rotor body 3 moves rotationally along a rotary trajectory and the rotary trajectories of the rotor bodies 3 carried by each of the shafts 2 project between rotary trajectories of the rotor bodies 3' carried by a neighboring one of the shafts 2. Between neighboring rotor bodies and between rotor bodies and shafts, open passages are left through which waste material that is sufficiently small and/or flexible can drop. The sorting screen thus sieves material that is sufficiently small and/or flexible to pass through the openings from larger and/or stiffer materials that are passed over the sorting screen sieve in the conveying direction. Meanwhile, the intermitted motion imparted onto the material to be sorted loosens material that is clinging together and brings objects of the material that has not dropped through above next openings in different orientations, so that most objects that can drop through when in a suitable orientation do eventually drop through the sorting screen.

[0012] In Fig. 2, a first example of a rotor body 3 is shown, having a hub 5 and an outer circumference 10 having a number of radial projections 4. The hub 5 forms a central body portion extending around a square hole 7 forming a central passage for receiving a shaft 2. The square shape of the hole 7 locks the rotor body 3 against rotation relative to the square shaft 2, so that the rotor body 3 is reliably entrained with rotation of the shaft 2. In operation, the rotor body 3 rotates with the shaft 2 around a central axis 6 of the shaft 2, the rotor body 3 and the square hole 7. Instead of a square hole 7, the central passage may have any other form. However, a form other than circular, such as hexagonal or triangular, is advantageous for providing a form locked fixation about a shaft that is suitably shaped to project outside a largest circular contour within the passage. If the hole is circular a key or room for a key may be provided to reliably entrain the rotor body with rotation of the shaft.

[0013] The rotor body 3 according to the present example is provided with eight rotor projections 4 projecting radially outwardly from the hub 5 and oriented along a common plane of rotation. Instead of with eight rotor pro-

jections, the rotor body may be provided with a different number of rotor projections 4. However, to keep variations in the size of the passage along the perimeter of the rotor bodies fairly limited, while providing a high frequency of upward impulses to material on the screen adjacent to each passage, it is preferred that the number of rotor fingers of each rotor body is at least four and more preferably, at least five or six.

[0014] In operation, the sorting screen 1 can for instance sort waste material, such as general household waste, dry co-mingled waste mainly composed of paper, cardboard, glass and plastic waste, or waste paper and cardboard, including flexible, elongated, material, such as fiber, tape, ribbon, rope, cable, wire and/or string material. The shafts 2 and the rotor bodies 3 mounted thereto are rotated in the first sense of circulation 11 in which upper portions of the rotor bodies move in the direction of transport 18. When waste material is deposited onto an upstream end portion 20 of the sorting screen 1, the rotating shafts 2 convey the waste material in the conveying direction 18. A relatively fine and/or flexible fraction of the material falls through the sorting screen 1 and is collected underneath and a relatively coarse and/or stiff fraction of the material is displaced over the sorting screen 1 and discharged from a downstream end portion 21 of the sorting screen 1.

[0015] For waste sorting, at least the surfaces of the projections of rotor body that are leading in the sense of rotation preferably have a width larger than 5 mm and more preferably a width larger than 10 mm. The width is preferably smaller than 100 mm and more preferably smaller than 70 mm. For waste sorting, the diameter of the rotary trajectory of the outer contour of the rotor body is preferably larger than 100 mm and more preferably larger than 150 mm and preferably smaller than 1000 mm and more preferably smaller than 700 cm.

[0016] The central portion of the rotor body 3 is made of a first material, which preferably is a plastic or elastomeric material, for instance rubber. More in general, it is preferred that the first material is quite elastic and preferably has an e-modulus of less than 0.1 GPa and more than 15 MPa, the e-modulus preferably being between 20 - 30 MPa,. For resiliently absorbing impacts and reducing noise emissions, the first material is preferably quite soft and preferably has a hardness between 30 Shore A and 90 Shore A, the hardness preferably being between 70 Shore A and 80 Shore A, preferably 73+/-5° Shore A.

[0017] The outermost parts 8 of the radial projections 4 are of a second material, which is stiffer than the first material. The outermost parts 8 have an exposed portion of the second material and an enclosed portion 9 (indicated in Figure 3) of the second material that is embedded and surrounded by the first material of the central portion, so that the parts of the second material are fixed relative to the part of the first material.

[0018] A ring shaped zone inside of the outermost parts 8 of a second material is exclusively made of the first

material, to achieve a high degree of compressibility and flexibility of the rotor body 4.

[0019] Since, as is illustrated by way of example in Figure 4, the outermost parts of the second material are constituted by inserts 13, the rotor bodies can be manufactured efficiently by molding the first material around the inserts of the second material. For this purpose, it is also preferred that the second material has a melting temperature higher than the melting temperature of the first material.

[0020] The inserts 13 are generally ring-shaped bodies, of which an outermost ring section, having a first width, forms the exposed portion 8 of each insert 13 and constitutes a portion of the circumferential outer surface 10 of the rotor body 3. Other ring sections of the inserts 13, having a second width smaller than the first width, form the enclosed portions 9 of each insert. Such ring-shaped inserts with only one or more sections of a reduced width can be manufactured efficiently, also in relatively small numbers, from tube material.

[0021] To properly orient and hold the inserts 13 prior to and during molding of the first material of the rotor body 3, the inserts 13 include projections 15 having axially exposed ends which leave corresponding openings 16 in the rotor body 3 during molding and are held between opposite molding surfaces of the mould during molding.

[0022] The outer parts of the radial projections of the second material are evenly distributed over the circumference rotor body to ensure a balanced rotation of the rotor body 3 during operation.

[0023] In an alternative embodiment (not shown in the drawings) the inserts may have anchoring portions that are inserted into the part of the rotor body of the first material and for instance retained in place by one or more snap fit anchorings in an axial passage in the rotor body part of the first material, preferably allowing the snap fit top engage by temporary elastic deformation of the first material until it snaps back as the anchoring reaches its end position.

[0024] Preferably, the second material is a metal, to provide an advantageous combination of wear resistance and impact resistance. To achieve a high wear resistance, the second material (being a metal or other material) preferably has a hardness of more than 300 HB and preferably less than 350 HB, the hardness preferably being about 335 HB (T=25°C).

[0025] In Fig. 5 a second example of a rotor body 53 according to the invention with a hub 55 and a number of rotor projections, in the case rotor fingers 54 is shown. The hub 55 forms a central body portion extending around a square hole 57 forming a central passage for receiving a square shaft 52. The square shape of the hole 57 prevents the rotor body 53 from rotating about a matching square shaft extending through the hole 7, so that the rotor body 53 is reliably entrained with rotation of the shaft.

[0026] The rotor body 53 is provided with six rotor fin-

gers 54 projecting radially outwardly from the hub 55 and oriented along a common plane of rotation. Regarding diameter and widths, the preferred dimensions for waste sorting are the same as those for the example according to Figures 2-4, although for specific applications small differences between optimal widths and diameters may occur.

[0027] Each rotor finger 54 has a proximal end 58 from where the rotor finger 54 projects radially away from the hub 55 and a distal end 59 opposite its proximal end 58. Between the proximal end 58 and the distal end 59, each rotor finger 54 has a leading surface 60 facing in a first circumferential sense 61, and a trailing surface 62 facing in a second circumferential sense 63 opposite to the first circumferential sense 61 as well as side surfaces between the leading and trailing surfaces 60, 62.

[0028] Each leading surface 60 is curved in the second circumferential sense 63 from at least closely adjacent to the proximal end 68 to the distal end 69. Seen in side view, planes 64-66 intersecting the central axis 66 intersect the leading surface 60 at angles α , α' and α'' respectively. These angles are measured relative to a respective tangent of the curved leading surface 60 at the point of intersection with the respective intersecting plane 64-66. The curvature of the leading surfaces 60 is such that along each leading surface 60, from the proximal end 68 to the distal end 69, the angles α , α' and α'' are continuously larger than 45°. Because of the relatively large minimum angle between the leading surfaces of the rotor fingers and the planes intersecting the axis of rotation of the rotor body, during rotation, the angle between each leading surface portion and its current direction of movement is relatively small, so any stringy material prone to clinging to the rotor fingers easily slides along the leading surface 60 towards the distal end of the respective rotor finger and off that rotor finger. Thus, the extent to which stringy material tends to cling to the rotor fingers is reduced. Because the outermost parts 78 of the fingers are made of a second material that is stiffer and harder than the first material of which a further part of the rotor body 54 is made, a more wear resistant rotor body 54 is achieved which is nevertheless flexible and impact resistant to avoid exertion of large forces when large stiff items are caught between neighboring rotor bodies. For maintaining a high degree of flexibility and impact resistance, it is advantageous that the proximal portions of the fingers are made of the first material only. The extent to which stringy material tends to cling to the rotor fingers is further reduced, because the second material has a smaller coefficient of friction relative to plastic materials than the first material. Also in this example a ring-shaped portion of the rotor body 54 extending radially inside of the parts 78 of the second material is made exclusively of the relatively flexible first material.

[0029] The distal ends 69 of the rotor fingers 64 define a circumference of a rotary trajectory 67 of the rotor body 63 if the rotor body 63 is rotated about the central axis 66 and are evenly distributed over the circumference of

the rotary trajectory 67. Thus, the maximum distance between successive rotor fingers of a rotor body at a given number of rotor fingers of given dimensions is minimized.

[0030] For each rotor finger 64, the distal end 69 is parallel to a nearest section of the circumference of the rotary trajectory 67. Thus, each rotor finger has a distal end that constitutes a cylindrical roller surface portion over which waste can move in conveying direction temporarily without being imparted any vertical displacement. This results in a more smooth movement of the waste, which is also advantageous for reducing the tendency of material to cling to the rotor fingers.

[0031] An even more smooth movement of the waste can be achieved if, for each rotor finger 64, the distal end 69 coincides with a section of the circumference of the rotary trajectory 67.

[0032] The outermost parts 78 of the second material are constituted by inserts. The inserts 78 have a curved outer surface, having a first width, which forms the exposed portion 79 of each insert 78. When inserted into slits in the rotor body 53 the curved outer surface of the exposed section 79 constitutes a smooth continuation of the circumferential outer surface 60 of the rotor body 53. The inserts 78 further comprise an anchoring portion opposite the outer surface, in this embodiment having a linearly extending surface, having a second width smaller than said first width, which anchoring portion forms the enclosed portion 80 of the insert. As a result of the smaller width the enclosed portion can be inserted into the slits of the rotor body 53. To removably fix the inserts 78 in the rotor body 53, the inserts 78 include projections 81 having axially exposed ends which snap fit in corresponding openings in the rotor body 53.

[0033] In alternative, not shown embodiments, the fixation of the inserts within the rotor body can be realized by other means than projections and corresponding openings, for example by bolts or screws.

Claims

1. A rotor body for a sorting screen, the rotor body having an outer circumference with a plurality of radial projections (4) circumferentially distributed around a central axis of rotation and projecting radially outwardly from the axis of rotation relative to intermediate recessed portions of the outer circumference, wherein the rotor body has a central portion of a first material and wherein at least outermost parts of the radial projections (4) are of a second material, **characterized in that** the first material is more elastic than the second material.
2. A rotor body according to claim 1, wherein the first material is a plastic or elastomeric material.
3. A rotor body according to claim 2, wherein the first material has an e-modulus of less than 0.1 GPa and more than 15 MPa, the e-modulus preferably being between 20 - 30 MPa.
4. A rotor body according to claim 2 or 3, wherein the first material has a hardness between 30 Shore A and 90 Shore A, the hardness preferably being between 70 Shore A and 80 Shore A, more preferably about 73+/-5° Shore A.
5. A rotor body according to any of the preceding claims, wherein the second material is a metal, preferably G26 CrMo4 steel.
6. A rotor body according to any of the preceding claims, wherein the second material has a hardness of more than 300 HB and preferably less than 350 HB, the hardness preferably being about 335 HB (T=25°C).
7. A rotor body according to any of the preceding claims, wherein the outermost parts of the second material comprise an exposed portion and an enclosed portion that is enclosed by the first material of the central portion.
8. A rotor body according to claim 7, wherein the outermost parts of the second material are constituted by inserts.
9. A rotor body according to claim 8, wherein the first material is moulded around the enclosed portions.
10. A rotor body according to claim 8 or 9, wherein the inserts include projections having axially exposed ends.
11. A rotor body according to claim 7, 8 or 9, wherein the inserts are generally ring-shaped bodies, the exposed portion of each insert being formed by at least one ring section having a first width and the enclosed portion being formed by at least one ring section having a second width smaller than said first width, a circumferential outer surface of the exposed section constituting a circumferential outer surface portion of the rotor body.
12. A rotor body according to any of the preceding claims, wherein the outer parts of the radial projections of the second material are evenly distributed over the circumference rotor body.
13. A rotor body according to any of the preceding claims wherein at least a ring shaped zone inside of the outermost parts of a second material is exclusively of the first material.
14. A sorting screen for sorting material, comprising a row of rotatable, driven shafts (2) mutually spaced

in a conveying direction (18) and each extending transversally to said conveying direction (18), said shafts (2) each carrying a row of radially extending rotor bodies (3) according to any one of the preceding claims for intermittently urging material on the sorting screen (1) upward and in conveying direction (18), the rotor bodies (3) of each of said rows being mutually spaced in longitudinal direction (19) of the respective shaft (2) and rotary trajectories of the rotor bodies (3) carried by each of said shafts (2) projecting between rotary trajectories of the rotor bodies (3) carried by a neighbouring one of said shafts (2).

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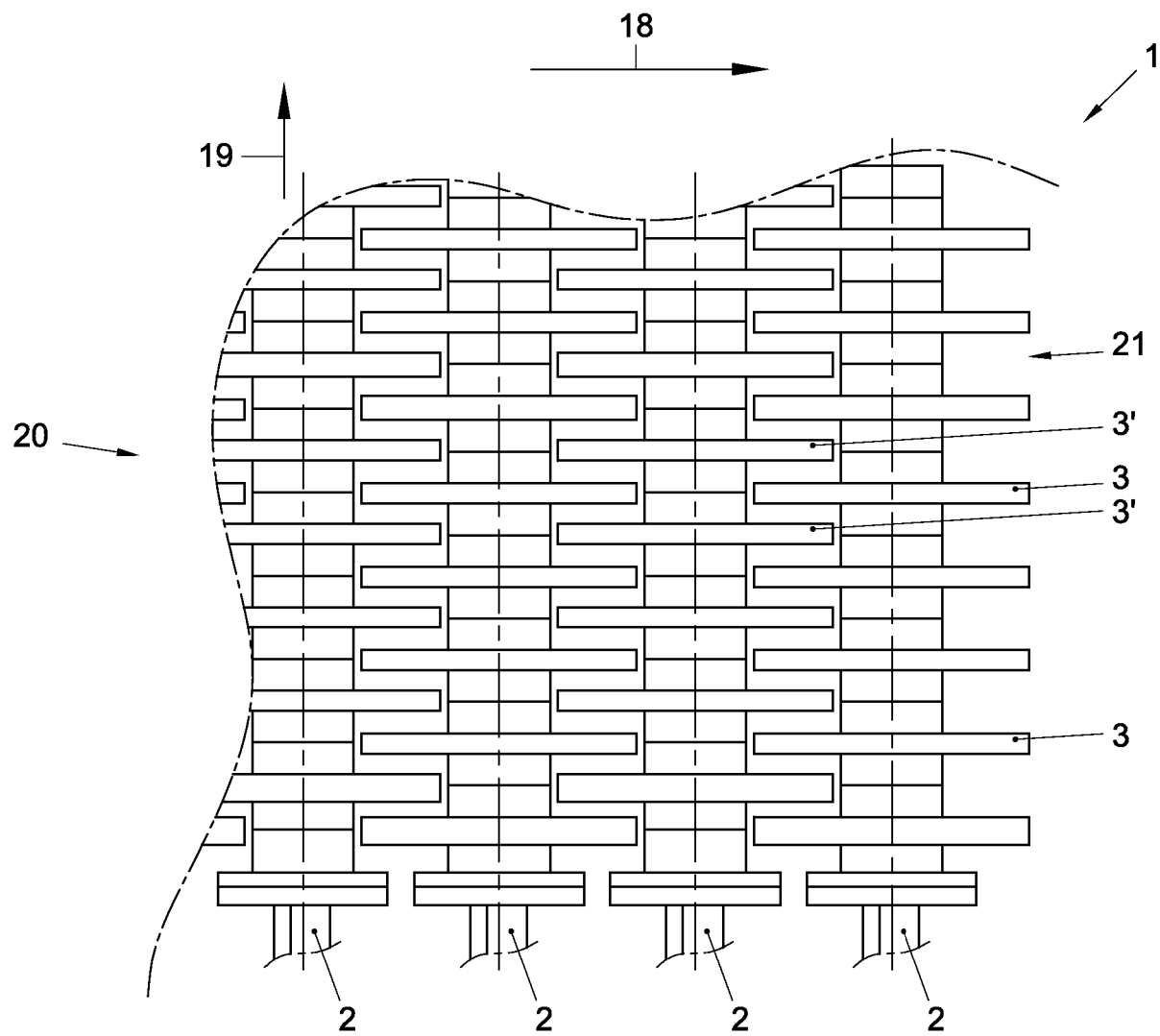


Fig. 1

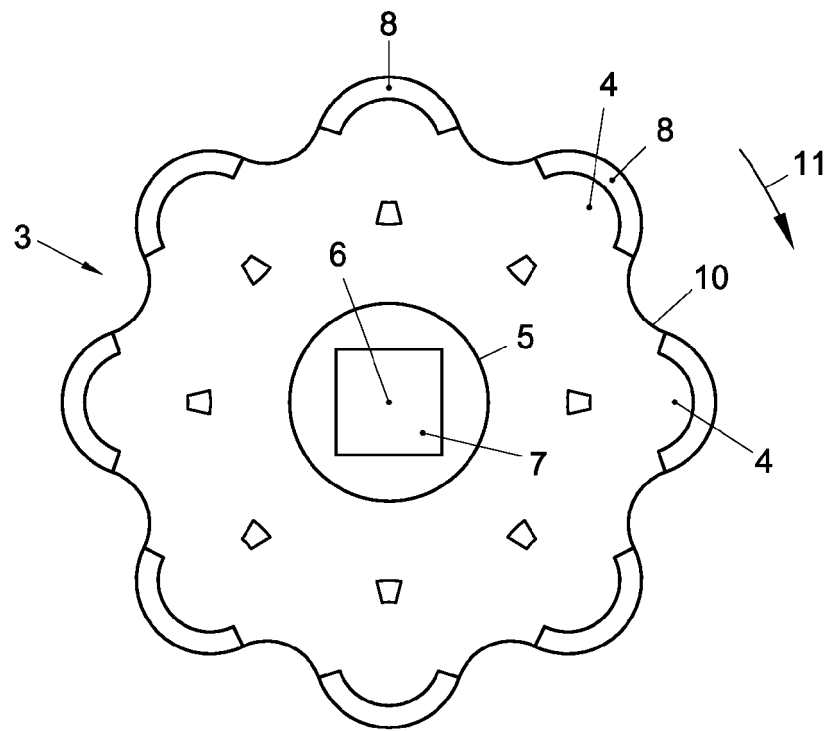


Fig. 2

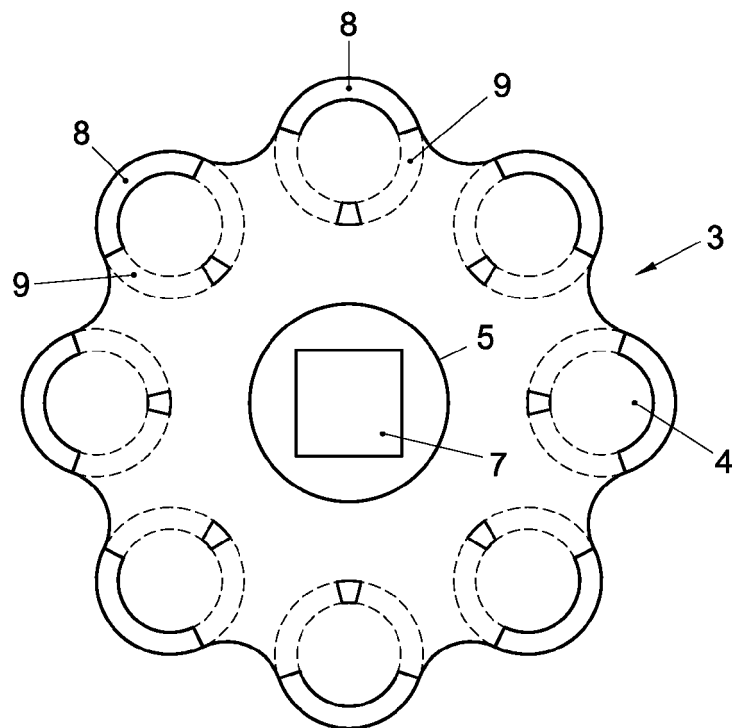


Fig. 3

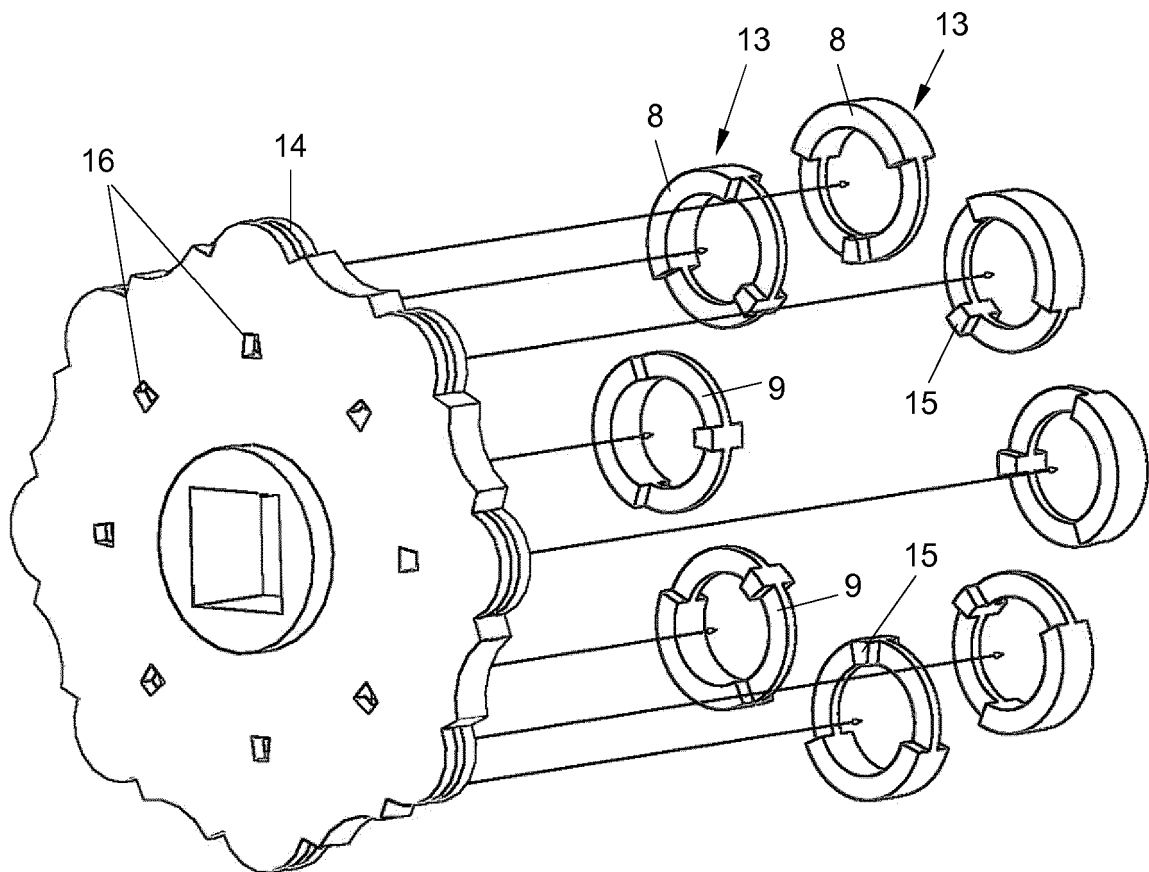


Fig. 4

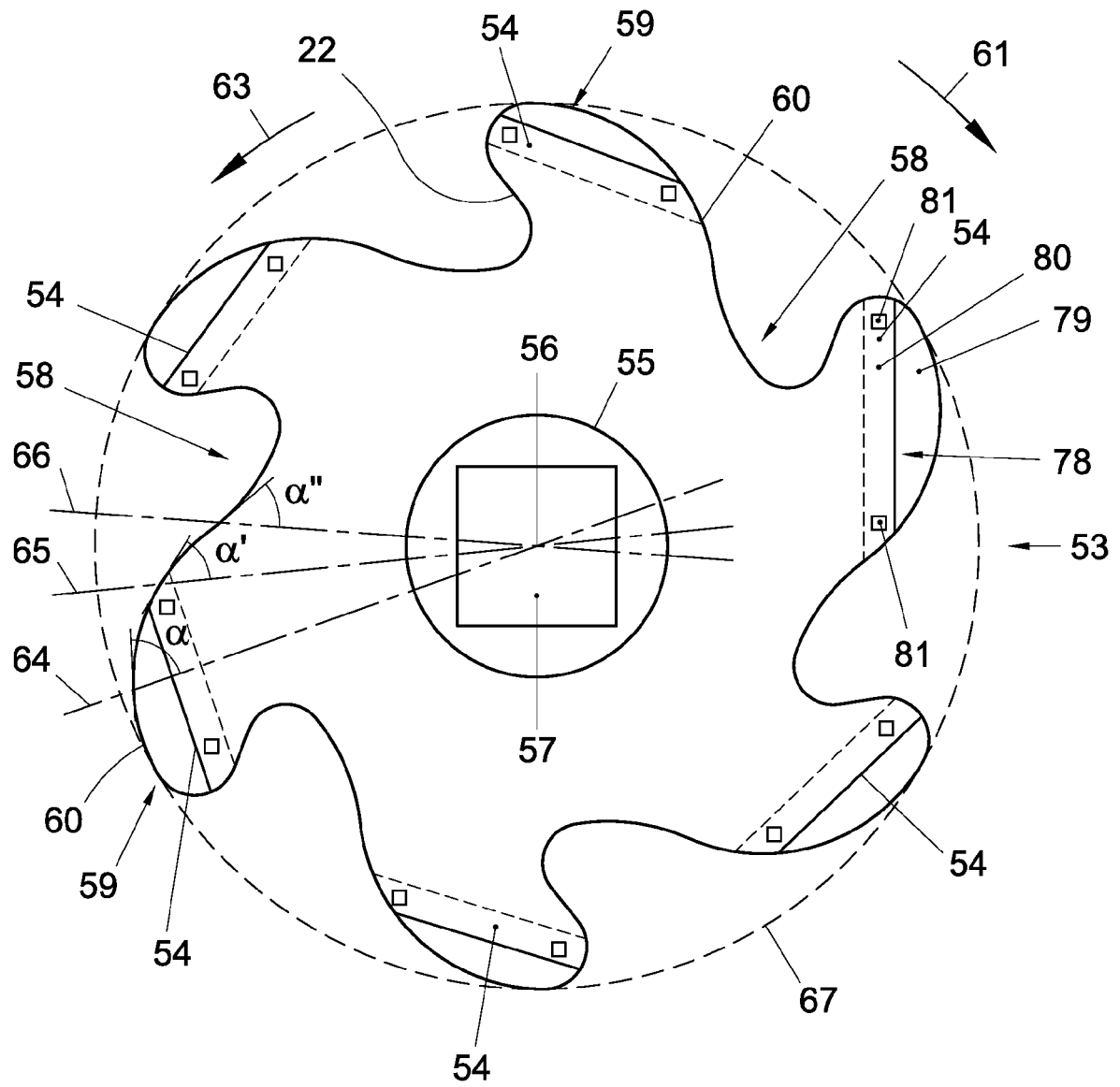


Fig. 5



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Application Number
EP 12 17 0723

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A	* abstract *; figures 3,4,7,12 * * paragraphs [0065], [0068] * * paragraph [0075] - paragraph [0083] * -----	9,11	
			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 December 2012	Examiner Plontz, Nicolas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 12 17 0723

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-12-2012

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