(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 252 925 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.10.2023 Bulletin 2023/40

(21) Application number: **23165247.0**

(22) Date of filing: **29.03.2023**

(51) International Patent Classification (IPC):
B07B 1/14 *(2006.01)* ***B07B 15/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B07B 1/14; B07B 15/00; B07B 2201/04

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **29.03.2022 IT 202200006128**

(71) Applicant: **Ecostargreen S.r.l.**
36066 Sandrigo (VI) (IT)

(72) Inventor: **CAPPOZZO, Domenico**
36066 Sandrigo (VI) (IT)

(74) Representative: **Caldon, Giuliano et al**
Gallo & Partners S.r.l.
Via Rezzonico, 6
35131 Padova (IT)

(54) PLANT FOR SEPARATING SOLID MATERIALS INTO MULTIPLE FRACTIONS AND PROCESS FOR SEPARATING SOLID MATERIALS INTO MULTIPLE FRACTIONS BY MEANS OF SAID PLANT

(57) Plant for separating solid materials into multiple fractions (in particular four), which comprises a first disc screen (100) arranged to receive material to be separated to carry out a first screening operation, and a second disc screen (200) arranged below the first disc screen (100) to carry out a second screening operation on the material which drops from the first disc screen (100). The second disc screen (200) comprises a work frame (201) with a screening plane (V2) tilted upwards by a certain tilting angle (α). The configuration of the two disc screens (100, 200) of the plant is particularly compact and it allows to operate very efficiently in the separation of materials made up of different types of objects (having different shapes, dimensions and physical properties), in particular for separating light and soft materials (such as sheets, films, plastic bags, etc.) from more rigid materials (such as bottles, containers, jars, boxes, etc.), thus guaranteeing the exploitation of the same and substantial energy savings.

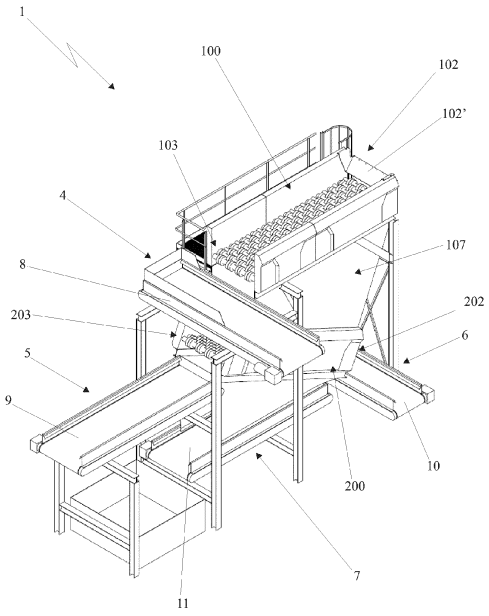

Fig. 1a

EP 4 252 925 A1

Description

Field of the invention

[0001] The present invention relates to a plant for separating solid materials into multiple fractions and a process for separating solid materials into multiple fractions by means of said plant.

[0002] The plant in question is arranged to be used for separating solid materials into multiple fractions (in particular four fractions), depending on the physical and mechanical characteristics (such as piece size, weight, shape, size, flexibility, etc.) of the objects that form such materials. In particular, the plant in question is arranged to operate on various kind of material, such as for example: urban solid waste, fluvial inerts, products of the organic fractions of sorted waste collection, compost (for refinement thereof), recycled wood, biomass, inert material, demolition material, land and landfills reclamation material, glasses, plastic, assorted materials (collected with several types of plastic), metal scrap and other materials.

[0003] The disc screen in question is particularly adapted to efficiently separate materials formed by objects of different sizes and types, given that materials can be screened, both as a function of their dimensions and as a function of their mechanical properties (for example separating light and soft materials from more rigid and/or heavy materials).

[0004] The plant in question is particularly advantageously used in the collection and separation of solid plastic waste, in particular assorted waste coming from sorted waste collection.

State of the art

[0005] Hereinafter, the expression "residues" will be used to indistinguishably and for the sake of brevity to indicate any solid material that requires to be separated in the components thereof, based on the dimensions or mass.

[0006] Available on the market are different equipment arranged to be used for the separation of solid residues in various fields of application, which adopt different construction and operating principles. Some examples of such equipment comprise disc screens, mesh screens, screw screens, drum screens, ballistic separators, fluid bed separators, electrostatic separators, magnetic separators and other equipment.

[0007] In particular, disc screens comprise a support structure which carries - mounted rotatably - several shafts which are equally spaced in succession, parallel to each other and which can be driven to rotate in the same rotation direction. On each shaft, there is axially fixed an assembly of discs separated from each other by a distance at least equal to, and preferably greater than, the thickness of the individual discs so as to allow to interpose the discs mounted on the adjacent shafts so that each disc of any shaft is interposed between two discs of the adjacent front and rear shafts.

[0008] In the present technical field, a factor that distinguishes the characteristics of the disc screen is the screening section. The latter is defined as the area of the delimited openings between the discs and the rotary shafts, and it is therefore indicative of the piece size of the residues that are separated by the screen dropping - by gravity - below the screening plane.

[0009] Patent EP 1106264 discloses a disc screen provided with idler sleeves mounted around each shaft and interposed between the discs, having the function of preventing or at least limiting the clogging of the screening plane.

[0010] In greater detail, each sleeve is mounted axially on the shaft between two discs with clearance adapted to allow it to idly rotate freely on the shaft or on a tubular body provided for outside the shaft.

[0011] Functionally, any thread-like elements which could potentially be twisted outside the idler sleeves up to affecting the discs mounted on the adjacent shafts, would not jeopardize the operation of the screen nor stop it, given that each sleeve, being idle with respect to the shaft on which it is mounted, would not hinder the rotation of the shaft. Although they can significantly reduce the problem of clogging stemming from thread-like or sheet-like materials, disc screens of the known type described above are not always capable of performing efficient separation between materials consisting of objects of different sizes and types, such as light sheet-like materials (in particular paper sheets, envelopes or plastic bags, films, cellophane sheets, etc.) and more rigid materials (such as plastic bottles, wood, etc.).

[0012] Document DE 102012012979 A1 describes a plant for the separation of solid materials comprising two tilted disc screens, including an upper disc screen adapted to carry out a first coarse screening to select a large-sized fraction of the material, and a second lower disc screen to carry out a finer screening of the material which drops from the upper screen. However, even this latter solution of known type is not always able to properly separate the materials to be screened, in particular in the presence of sheet-like light materials mixed with more rigid and heavy materials.

Summary of the invention

[0013] In this situation, the problem underlying this invention is therefore to eliminate the problems of the prior art mentioned above by providing a plant for separating solid materials into multiple fractions and a process for separating solid materials into multiple fractions, which allow a highly efficient operation, in particular in the separation of materials consisting of various types of objects (for example, having different shapes, dimensions and physical properties), allowing a particular exploitation of the materials (for example in subsequent processes for recycling, reuse and/or disposal).

[0014] A further object of the present invention is to provide a plant for separating solid materials into multiple fractions, which allows to efficiently separate sheet-like/thread-like materials and soft materials from more rigid solid materials from each other.

[0015] A further object of the present invention is to provide a plant for separating solid materials into multiple fractions, which allows efficient operation with various types of solid residues.

[0016] A further object of the present invention is to provide a plant for separating solid materials into multiple fractions, which guarantees significant energy saving.

[0017] A further object of the present invention is to provide a plant for separating solid materials into multiple fractions, which allows a highly efficient separation of materials with different piece size.

[0018] A further object of the present invention is to provide a plant for separating solid materials into multiple fractions, that is particularly compact and easy to construct.

[0019] A further object of the present invention is to provide a plant for separating solid materials into multiple fractions, that is cost-effective to build.

Brief description of the drawings

[0020] The technical characteristics of the invention, according to the aforementioned objects, are clearly observable from the content of the claims outlined below and the advantages thereof will be more apparent from the detailed description that follows, provided with reference to the attached drawings, which represent an embodiment thereof provided purely by way of non-limiting example, wherein:

- figure 1a shows a perspective schematic view of a plant for separating solid materials into multiple fractions, according to the present invention;
- figure 1b shows a schematic view from a different perspective of the plant in question;
- figure 2a shows a schematic lateral view of the plant in question;
- figure 2b shows a more detailed lateral view of the plant in question;
- figure 3 shows a perspective view of a first disc screen of the plant in question;
- figure 4 shows a schematic lateral view of the first disc screen of figure 3;
- figure 5 shows a top plan view of a detail of the first disc screen of figure 3, relating to a portion of the screening plane;
- figure 6 shows a schematic lateral view of a second disc screen of the plant in question;
- figure 7 shows a top plan view of a detail of the second disc screen of figure 6, relating to a portion of the screening plane.

Detailed description of a preferred embodiment

[0021] With reference to the attached drawings, a plant for separating solid materials into multiple fractions subject of the present invention was indicated in its entirety with 1.

[0022] The plant 1 according to the present invention is suitable to be used for separating solid materials of various types such as for example: urban solid waste, fluvial inerts, products of the organic fractions of sorted waste collection, compost (for refinement thereof), recycled wood, biomass, inert material, demolition material, land and landfills reclamation material, glasses, plastic, metal scrap and other materials.

[0023] In particular, the plant 1 in question is particularly suitable for efficiently separating solid materials, in particular plastic, consisting of different types of objects, having different shapes, dimensions and physical properties, such as for example sheet-like or thread-like materials (such as plastic or paper sheets, envelopes or plastic bags, films, cellophane sheets, etc.) from more rigid materials (such as bottles, containers, jars, boxes, glasses, cassettes, etc.).

[0024] With reference to the examples in figures 1a,b and 2a,b, the plant in question comprises a first disc screen 100, adapted to receive the material to be screened and to select a first piece size, and a second disc screen 200 arranged below the first disc screen 100, and adapted to further separate smaller-sized material which drops from the latter, as outlined in detail below.

[0025] With reference to figures 3-5, the first disc screen 100 comprises a first work frame 101, which extends between an inlet end 102 and an outlet end 103 along a first advancement direction A1, along which the solid materials to be screened are susceptible to proceed.

[0026] At the aforementioned inlet end 102, the first disc screen 100 is adapted to receive material to be screened to convey a fraction thereof (consisting of objects larger than a given piece size) up to the outlet end 103, while a remaining fraction (with smaller piece size) will drop below the first disc screen 100.

[0027] Furthermore, the first work frame 101 defines a first screening plane V1 extending between the inlet end 102 and the outlet end 103 of the first work frame 101, preferably parallel to the first advancement direction A1.

[0028] Advantageously, according to the particular example shown in the attached figures, the first screening plane V1 of the first disc screen 100 is arranged horizontally.

[0029] Advantageously, with reference to figure 2a, the plant 1 comprises loading means 2 arranged at the inlet end 102 of the first disc screen 100 and arranged to convey and load the material to be separated on the first screening plane V1 of the latter. For example, the aforementioned loading means 2 comprise at least one conveyor belt 3 adapted to pick up the material to be screened (for example from a storage box 3') and convey

it up to the inlet end 102 of the first disc screen 100. Preferably, the latter is provided with an inlet chute 102' arranged at the inlet end 102 and adapted to convey the material which exits from the conveyor belt to the first screening plane V1 of the first disc screen 100.

[0030] With reference to figures 3-5, the first disc screen 100 further comprises several first rotary shafts 104, which are rotatably mounted on the first work frame 101 parallel to each other, and they are arranged in succession along the first advancement direction A1, one spaced apart from the subsequent one, particularly with constant spacing pitch. The first rotary shafts 104 are arranged on the first screening plane V1 of the first work frame 101 and they are substantially orthogonal to the first advancement direction A1. Advantageously, each of the first rotary shafts 104 extends longitudinally according to its first extension axis X1 orthogonal to the first advancement direction A1 and preferably parallel to the first screening plane V1.

[0031] According to the present invention, the first disc screen 100 further comprises several first discs 105, which are axially and rigidly fixed in succession along the first rotary shafts 104 to receive rotary motion from the latter.

[0032] In greater detail, each first rotary shaft 104 carries - fixed (and preferably splined) - several corresponding first discs 105 arranged in succession along the first extension axis X1 of the first rotary shaft 104.

[0033] The first discs 105 are positioned along the corresponding first rotary shaft 104 one spaced apart from the subsequent one, preferably with constant pitch.

[0034] Particularly, for example as observable in the view of figure 5, the distance between each first disc 105 and the subsequent one is greater than the thickness (according to the first extension axis X1) of each individual first disc 105, in order to allow interposition - between two adjacent first discs 105 mounted on the first rotary shaft 104 - of a first disc 105 mounted on the subsequent first rotary shaft 104 according to the first advancement direction A1, and simultaneously leave a lateral space between each of the two first discs 105 of the first rotary shaft 104 and the interposed first disc 105 of the subsequent first rotary shaft 104.

[0035] To this end, the first discs 105 mounted on each first rotary shaft 104 are mounted staggered with respect to the first discs 105 mounted on the subsequent first rotary shaft 104, so that they can be interposed between each other.

[0036] In this manner, the first discs 105 and the first rotary shafts 104 define with respect to each other, on the first screening plane V1, a first screening section, which defines the piece size of the materials to be separated.

[0037] Particularly, the distance between the first rotary shafts 104 along the first advancement direction A1 and the distance between the first discs 105 along the first extension axis X1 (and particularly the aforementioned lateral space) define the first screening section of the first disc screen 100, which determines the maximum piece size (dimension) of the materials which are screened (passing under the first rotary shafts 104), while the larger materials are conveyed to the outlet end 103 of the first disc screen 100. According to the invention, the disc screen 100 comprises first drive means 106 mechanically connected to the first rotary shafts 104 to drive each first disc 105 to rotate around the first extension axis X1 in a given first rotation direction R1 (shown for example in figure 4).

[0038] Particularly, the rotation of the first discs 105 in the aforementioned first rotation direction R1 is such to determine a direction of advancement of the material to be screened along the first advancement direction A1 from the inlet end 102 to the outlet end 103 of the first work frame 101 of the first disc screen 100. During this operation, a first fraction of material, consisting of objects with piece size larger than the first screening section of the first disc screen 100 (for example cassettes, bulky tarpaulins, etc.), advances on the first screening plane V1 up to the outlet end 103, while a second fraction of material, consisting of objects with piece size smaller than the first screening section of the first disc screen 100, passes through the screening slits dropping below the first screening plane V1 of the first disc screen 100.

[0039] According to the invention, the plant comprising a first discharge station 4 arranged at the outlet end 103 of the first disc screen 100, in order to receive the first fraction of material conveyed by the first rotating first discs 105 to the outlet end 103.

[0040] As mentioned above, the second disc screen 200 of the plant 1 in question is arranged below the first disc screen 100 to receive the second fraction of material dropping below the first screening plane V1 of the latter through the first screening section of the first disc screen 100.

[0041] The second disc screen 200 is adapted to carry out - on such second fraction of material - further separation operations of the present description outlined in detail hereinafter. With reference to the example in figures 6 and 7, the second disc screen 200 comprises a second work frame 201, which extends between a lower end 202 and an upper end 203 along a second advancement direction A2.

[0042] Furthermore, the second work frame 201 defines a first screening plane V2 extending between the lower end 202 and the upper end 203 of the second work frame 201, advantageously parallel to the second advancement direction A2.

[0043] Particularly, the second screening plane V2 is provided with an upper side L1 (facing upwards, on which the material to be screened is intended to advance), and an opposite lower side L2 (facing downwards), below which the screened material drops. Particularly, on the upper side L1 of the second screening plane V2, the second disc screen 200 is adapted to receive the second fraction of material dropping from the first disc screen 100.

[0044] Advantageously, the second disc screen 200 is arranged fully below the first disc screen 100, particularly with the upper end 203 of the second disc screen 200 positioned at a height lower than the outlet end 103 of the first disc screen 100, and preferably positioned at a height lower than both the inlet end 102 and the outlet end 103 of the first disc screen 100.

[0045] Particularly, between the first disc screen 100 and the second disc screen 200 there extends the dropping space 50 which is susceptible to be passed through by the second fraction of material that dropped below the first screening plane V1 of the first disc screen 100.

[0046] In detail, this dropping space 50 is arranged below the first disc screen 100 and above the second disc screen 200 and, particularly, it extends height-wise between the first screening plane V1 and the second screening plane V2.

[0047] Preferably, the dropping space 50 extends from a front side 51, which extends (top to bottom) between the inlet end 102 of the first disc screen 100 and the lower end 202 of the second disc screen 200, to a rear side 52 which extends (top to bottom) between the outlet end 102 of this first disc screen 100 and the upper end 203 of said second disc screen 200.

[0048] The second disc screen 200 further comprises several second rotary shafts 204, which are rotatably mounted on the second work frame 201 parallel to each other, and they are arranged in succession along the second advancement direction A2, one spaced apart from the subsequent one, particularly with constant spacing pitch.

[0049] The second rotary shafts 204 are arranged on the second screening plane V2 of the second work frame 201 and they are substantially orthogonal to the second advancement direction A2.

[0050] Advantageously, each of the second rotary shafts 204 extends longitudinally according to its second extension axis X2 orthogonal to the second advancement direction A2 and preferably parallel to the second screening plane V2.

[0051] Particularly, the second extension axes X2 of the second rotary shafts 204 may all be substantially arranged on the second screening plane V2 (like in the example of the attached figures), or they may be staggered with respect to each other according to the screening plane V2, for example with some second rotary shafts 204 arranged toward the upper side L 1 and others toward the lower side L2 of the second screening plane V2. According to the present invention, the second disc screen 200 further comprises second discs 205, which are axially and rigidly fixed in succession along the second rotary shafts 204 in order to receive rotary motion from the latter.

[0052] In greater detail, each second rotary shaft 204 carries - fixed (and preferably splined) - several corresponding second discs 205 arranged in succession along the second extension axis X2 of the first rotary shaft 204.

[0053] The second discs 205 are positioned along the corresponding second rotary shaft 204 one spaced apart from the subsequent one, preferably with constant pitch.

[0054] Each second disc 205 is provided with its own rotation axis RD parallel to the second extension axis X2 of the corresponding second rotary shaft 204 and preferably coincident with such second extension axis X2.

[0055] Particularly, for example as observable in the view of figure 7 (similarly to the first disc screen 100), the distance between each second disc 205 and the subsequent one is greater than the thickness (according to the second extension axis X2) of each individual second disc 205, in order to allow interposition - between two adjacent second discs 205 mounted on the second rotary shaft 204 - of a second disc 205 mounted on the subsequent second rotary shaft 204 according to the second advancement direction A2, and simultaneously leave a lateral space between each of the two second discs 205 of the second rotary shaft 204 and the interposed first disc 205 of the subsequent second rotary shaft 204.

[0056] To this end, the second discs 205 mounted on each second rotary shaft 204 are mounted staggered with respect to the first discs 205 mounted on the subsequent second rotary shaft 204, so that they can be interposed between each other.

[0057] In this manner, the second discs 205 and the second rotary shafts 204 define with respect to each other, on the second screening plane V2, a second screening section, which defines the piece size of the materials to be separated.

[0058] Particularly, the distance between the second rotary shafts 204 along the second advancement direction A2 and the distance between the second discs 205 along the second extension axis X2 (and particularly the aforementioned lateral space) define the second screening section of the second disc screen 200, which determines the maximum piece size (dimension) of the materials which are screened (passing under the second rotary shafts 204), while the larger materials are conveyed to the second screening plane V2.

[0059] Advantageously, the first screening section of the first disc screen 100 is larger than the second screening section of the second disc screen 200, particularly in the sense that the first screening section allows larger objects to pass through with respect to the second screening section. For example, the first screening section is comprised between 100 mm and 250 mm, and the second piece size section is comprised between 10 mm and 40 mm.

[0060] According to the invention, the second disc screen 200 comprises second drive means 206 mechanically connected to the second rotary shafts 204 to drive each second disc 205 to rotate around its rotation axis RD in a given second rotation direction R2 (shown for example in figure 6).

[0061] In greater detail, the second drive means 206 are arranged to drive each second rotary shaft 204 in rotation around its second extension axis X2 in the aforementioned second rotation direction R2, in a manner

such that each second rotary shaft 204 dives the second discs 205 fixed thereon in rotation.

[0062] Particularly, the rotation of the second discs 205 in the aforementioned second rotation direction R2 is such to determine a direction of advancement of the material to be screened along the second advancement direction A2 towards the upper end 203 of the second work frame 201 of the second disc screen 200.

[0063] The second work frame 201 is arranged with the upper end 203 at a height higher than that of the lower end 202, in a manner such that the screening plane V2 is tilted upwards by a certain tilt angle α (moving toward the upper end 203). Particularly, the second screening plane V2 extends ascending from the lower end 202 to the upper end 203 (at which the screened material exits from the second screening plane V2).

[0064] The second drive means 206 of the second disc screen 200 are arranged to drive the second discs 205 in rotation in the aforementioned second rotation direction R2 which, on the upper side L1 of the second screening plane V2, is oriented towards the upper end 203. Therefore, in this manner, the rotating second discs 205 tend to advance the material ascending towards the upper end 203 of the second disc screen 200.

[0065] The aforementioned tilted configuration of the second screening plane V2 entails that the second discs 205 (driven in rotation in the aforementioned second rotation direction R2) are capable of raising a third fraction of material up to the upper end 203 (of the aforementioned second fraction which drops from the first disc screen 100) substantially consisting of softer and light materials, particularly sheet-like or thread-like. Otherwise, a fourth fraction of material, consisting of more rigid materials and larger than the second screening section of the second disc screen 200 (for example bottles, containers, jars, etc.), cannot be driven by the rotating second discs 205 and bounce off the latter going down - by gravity - along the upper side L1 of the second screening plane V2 up to the lower end 202 of the second work frame 201. Furthermore, a fifth fraction of material, consisting of rigid materials smaller than the second screening section of the second disc screen 200 (for example residues of broken objects), given that they cannot also be driven upwards by the second discs 205, drop into the screening slits.

[0066] As a matter of fact, due to the tilt of the screening plane V, the material to be screened is subjected to the effect of the force of gravity which hinders the ascent thereof. However, the softer light materials of the aforementioned third fraction (like the sheet-like ones), due to their deformable conformation, cling more easily to the rotating second discs 205 which therefore drive them towards the upper end overcoming the force of gravity. Otherwise, the more rigid materials of the aforementioned fourth and fifth fraction are not capable of adhering to the shape of the second discs 205 and therefore find it more difficult to be driven upwards and, as a result, depending on whether they are larger or smaller than the second screening section, descend towards the lower end 202 or drop into the screening slits before reaching the upper end 203 of the second disc screen 200. Advantageously, the tilt angle α of the second screening plane V2 of the second disc screen 200 is comprised between 20° and 45° with respect to a horizontal plane, preferably between 30° and 40°.

[0067] Particularly, the tilt angle α is defined with respect to a horizontal reference plane. Preferably, the tilt of the second screening plane V2 can be set (preferably adjustably, as addressed below) as a function of the characteristics of the material to be screened. Advantageously, the second drive means 206 are arranged to drive the second discs 205 in rotation with a speed substantially comprised between 20 revolutions/minute and 180 revolutions/minute. Suitably, the rotation speed is set appropriately (as a function of the characteristics of the material to be screened) in a manner such that the second discs 205 can advance the soft and flexible material up to the upper end 203 without the more rigid material reaching the latter.

[0068] With reference to figures 1a,b and 2a,b, the plant 1 in question comprises a second discharge station 5 arranged at the upper end 203 of the second disc screen 200, to receive the aforementioned third fraction of material (soft and light objects) conveyed by the second discs 205 up to such upper end 20.

[0069] Furthermore, the plant 1 comprises a third discharge station 6, arranged at the lower end 202 of the second disc screen 200 to receive the fourth fraction of material (rigid objects larger than the second screening section) that goes down - by gravity - along the second screening plane up to such lower end 202.

[0070] The plant 1 further comprises a fourth discharge station 7 arranged below the second screening plane V2 of the second disc screen 200 to receive the fifth fraction of material (rigid residues smaller than the second screening section) that dropped below the second screening plane V2 through the second screening section of the second disc screen 200. In this manner, the plant 1 in question can operate highly efficiently in the screening of materials consisting of objects of different size and nature, particularly in order to separate sheet-like materials from more rigid materials, preferably in the separation of plastic materials.

[0071] Furthermore, advantageously, the materials can be separated even without using aeraulic systems, resulting in significant saving in terms of energy consumption and plant costs.

[0072] Also advantageously, in applications where optical sensors are used to identify particular types of materials, the specific material separation operations carried out by the plant 1 in question significantly simplify the activity of the optical readers, particularly requiring the use of a smaller number of such readers, with ensuing further saving.

[0073] Advantageously, the plant 1 comprises conveyor means 8, 9, 10, 11 arranged in one or more discharge

stations 4, 5, 6, 7 and adapted to receive the corresponding fraction of material to convey it to a corresponding destination zone, for example in a storage area or a treatment station downstream of the plant 1.

[0074] Particularly, the plant 1 comprises first, second, third and fourth conveyor means 8, 9, 10, 11 arranged respectively, in the first, second, third and fourth discharge station 4, 5, 6, 7.

[0075] Preferably, the conveyor means 8, 9, 10, 11 comprise respective conveyor belts adapted to receive the fraction of material released into the corresponding discharge station 4, 5, 6, 7 and convey it up to the destination zone.

[0076] Advantageously, the plant 1 comprises a support structure 12 provided with an upper portion 13, on which the first disc screen 100 is suspended, and a lower portion 14 arranged below the upper portion 13 and in which the second disc screen 200 is arranged.

[0077] Preferably, the aforementioned support structure 12 comprises a framework (for example consisting of a metal frame), which extends upwards and carries - fixed in its upper portion 13 - the first disc screen 100. Below the latter, the framework defines, in the lower portion 14 thereof, a volume of housing in which the second disc screen 200 is arranged.

[0078] Particularly, the configuration of the support structure 12 with the disc screens 100, 200 superimposed, makes the plant 1 in question simple and compact.

[0079] Advantageously, the first disc screen 100 comprises a conveyor chute 107 arranged below the first screening plane V1 to convey the second fraction of material which drops from the latter onto the underlying second disc screen 200.

[0080] In greater detail, the conveyor chute 107 extends (starting from an upper end portion thereof) from the first work frame 101 of the first disc screen 100 up to the lower end portion thereof arranged above the second screening plane V2 of the second disc screen 200. In this manner, the conveyor chute 107 is arranged to intercept the objects of the second fraction of material dropping from the first disc screen 100 and convey them to the second screening plane V2 of the second disc screen 200.

[0081] Particularly, the upper end portion of the conveyor chute 107 is arranged at the inlet end 102 of the first disc screen 100.

[0082] Preferably, the lower end portion of the conveyor chute 107 is arranged (above the second screening plane V2) between the lower end 202 and the upper end 203 of the second disc screen 200 and spaced from the upper end 203, for example such lower end portion being positioned at the lower end 202.

[0083] Advantageously, the conveyor chute 107 comprises a bottom wall 107' which particularly delimits the front side 51 of the dropping space 50. Particularly, such bottom wall 107' is arranged transversely to the first and to the second advancement direction A1, A2 (that is it extends over a plane that intercepts such advancement directions A1, A2) and it is tilted downwards. In detail, advantageously, the bottom wall 107' extends from the aforementioned upper end portion to the aforementioned lower end portion approaching the second discharge station 5.

[0084] Preferably, the conveyor chute 107 comprises two side walls 107", which extend by an angle from opposite edges of the bottom wall 107' towards the second discharge station 5, advantageously parallel to the advancement directions A1, A2) so as to laterally close (at least partly) the dropping space 50 between the first and the second disc screen 100, 200, particularly for at least a determined section of their respective screening planes V1, V2. Preferably, such side walls 107' each extend vertically from the first disc screen 100 to the second disc screen 200.

[0085] Advantageously, the plant 1 in question comprises ventilator means 15 arranged to generate, in the dropping space 50 (which extends between the first disc screen 100 and the second disc screen 200), at least one airflow directed toward the upper end 203 of the second disc screen 200 and adapted to intercept the second fraction of material which, dropping from the first screening plane V1 of the first disc screen 100, passes through such dropping space 50. In this manner, the aforementioned airflow diverts at least one part of the second fraction towards the upper end 203 of the second disc screen 200, so that such part drops closer to the upper end 203 with respect to a remaining part of the second fraction of material. Particularly, the part of the second fraction diverted forward by the airflow is formed by softer and light materials (in particular sheet-like or thread-like) which, as mentioned above, when they drop on the second screening plane V2 of the second disc screen 200, are driven towards the upper end 203 of the latter forming the aforementioned third fraction of material (which is discharged into the second discharge station 5). As a matter of fact, due to its lightness and sheet-like shape, when descending through the dropping space 50, such part of material is subject to be displaced by the airflow dropping on the second screening plane V2 to a position more advanced towards the upper end 203 of the second disc screen 200, with respect to a condition of absence of such airflow. Otherwise, when dropping through the dropping space 50, the remaining part of the second fraction of material (consisting of more rigid and heavy materials) is not substantially affected by the airflow, or substantially less significantly with respect to the other part. Therefore, such remaining part will mainly drop into an area of the second screening plane V2 closer to the lower end 202 of the second disc screen 200 with respect to that of the area where the other part diverted by the airflow drops. Such remaining part will form the aforementioned fourth fraction of material which goes down - by gravity - along the second screening plane V2 up to the lower end 202 of the second disc screen 200 to enter into the third discharge station 6. As a result, most of the material

in the fourth fraction drops into an area of the second screening plane V2 that is lower (that is closer to the lower end 202) with respect to the area where the material of the third fraction drops. In this manner, the more rigid materials of the fourth fraction, when they descend along the second screening plane V, do not risk intercepting and overwhelming - downwards - part of the light materials which instead are to be conveyed towards the upper end 203 of the second disc screen 200.

[0086] This therefore allows to prevent part of the light materials from being driven downwards together with the heavier materials of the fourth fraction, therefore ensuring proper separation of the materials according to the desired purposes.

[0087] As stated above, the airflow generated by the ventilator means 15 is directed towards the upper end 203 of the second disc screen 200, it being understood that at least one component of the direction of the airflow is parallel to the second advancement direction A2 of the second disc screen 200 and oriented approaching the upper end 203 of the latter. Particularly, the airflow passes through the dropping space 50 from the front side 51 towards the rear side of the latter.

[0088] Advantageously, ventilation means 15 are arranged to generate the aforementioned low prevalence and high-volume airflow so as to move the light materials dropping towards the upper end 203 of the second disc screen 200 without creating turbulence which prevent the desired routing as described above.

[0089] Advantageously, the ventilator means 15 are configured as blowing means adapted to blow - under pressure - the airflow into the dropping space 50, preferably from the front side 51 towards the rear side 52 of the latter.

[0090] Particularly, to this end, the ventilator means 15 comprise at least one blowing mouth 16 arranged between the first disc screen 100 and the second disc screen 200 and facing towards the upper end 203 of the second disc screen 200 to blow the airflow into the dropping space 50 towards such upper end 203.

[0091] Preferably, the blowing mouth 16 of the ventilator means 15 is arranged on the front side 51 of the dropping space 50, so that the airflow is introduced into the latter at that front side 51 and flow into the dropping space 50 towards the rear side 52 of the latter. Advantageously, the ventilator means 15 are mounted, directly or indirectly, on the support structure 12 of the plant 1, particularly on the lower portion 14 of such support structure 12.

[0092] Preferably, the ventilator means 15 comprise one or more fans 17 which define, with the front part thereof, the blowing mouth 16 of the ventilator means 15.

[0093] Advantageously, the blowing mouth 16 extends horizontally substantially across the entire width of the second screening plane V2 (transversely to the second advancement direction A2).

[0094] In particular, the fans 17 are arranged side-by-side horizontally so as to substantially cover the entire width of the second screening plane V2.

[0095] Advantageously, the conveyor chute 107 is provided with at least one through opening 18 (shown schematically in figure 2b) substantially aligned with the blowing mouth 16 of the ventilator means 15, so as to allow the entry of the airflow into the dropping space 50.

[0096] Preferably, the aforementioned through opening 18 is obtained on the bottom wall 107' of the conveyor chute 107, the bottom wall 107' being delimited by the dropping space 50 on the front side 51.

[0097] For example, the ventilator means 15 are arranged at least partly outside the dropping volume 50 facing the through opening 18 to introduce the flow through the latter, or they are arranged passing through the through opening 18 with their blowing mouth 16 at least partially within the dropping space 50.

[0098] According to a different embodiment, the ventilator means 15 are arranged fully inside the dropping space 50 behind the bottom wall 107' of the conveyor chute 107, which, in this case, may be without the through opening 18.

[0099] According to a further embodiment not shown, the ventilator means 15 are arranged as suctioning means configured to generate the aforementioned airflow by vacuum suctioning air from dropping space 50 and they are for example arranged at the rear side 52 of the latter.

[0100] Advantageously, the discs 105, 205 of disc screens 100, 200 are provided with an external profile, preferably polygonal (for example hexagonal or octagonal), which is suitably shaped in order to facilitate the advancement of the solid material in the screening plane V1, V2 along the advancement direction A1, A2.

[0101] Suitably, each disc 105, 205 is made of rigid material (for example metal) which is sufficiently strong to withstand the stresses during the operation of the disc screen 100, 200 (in a per se known manner).

[0102] Advantageously, with reference to the examples in figure 4, the second disc screen 200 comprises a base frame 214 on which the second work frame 201 is mounted.

[0103] Suitably, the base frame 214 is arranged to rest on the ground and it is obtained, for example, by means of a metal frame.

[0104] Preferably, base frame 214 extends, according to an extension direction Y, between a front portion 215, at (particularly above) which the lower end 202 of the second work frame 201 is arranged, and a rear portion 216, at (particularly above) which the upper end 203 of the second work frame 201 is positioned.

[0105] Advantageously, the second work frame 201 comprises a flat frame 217, in particular quadrangular (for example square or rectangular-shaped), with a lying plane parallel to the second screening plane V2.

[0106] Preferably, the flat frame 217 comprises two side longitudinal members 218 parallel to each other and to the second advancement direction A2, and between which the second rotary shafts 204 are arranged. For

example, the two side longitudinal members 218 are connected by at least two crosspieces so as to form a substantially rectangular or square-shaped structure, or by an overlying structure of the second work frame 201 (such as a support structure 219 mentioned below).

[0107] Preferably, the second work frame 201 is provided, particularly between the side longitudinal members 218, with a through opening adapted to be passed through by the objects of the screened fifth fraction of material to which pass through the screening slits between the second discs 205.

[0108] Suitably, the second work frame 201 supports the second rotary shafts 204 and advantageously at least part of the second drive means 206.

[0109] Preferably, the second work frame 201 comprises a support structure 219, which rotatably supports - at the ends - the second rotary shafts 204, in a per se conventional manner in the field of disc screens and, therefore not described in detail in this document. Such to support structure 219 is fixed on the flat frame 217 of the second work frame 201, in particular at least to the side longitudinal members 218 of the latter. Advantageously, the second disc screen 200 comprises adjustment means 220, preferably mounted on the base frame 214, connected to the second work frame 201 and arranged to move the latter to change the tilt angle α of the second screening plane V2. In this manner, the tilt angle α of the second screening plane V2 can be adjusted in a variable manner, for example between about 20° and 45°, particularly as a function of the materials to be screened.

[0110] In particular, the adjustment means 220 can be actuated to change the height of the upper end 203 and/or of the lower end 202 of the second work frame 201 so as to change the tilt of the second screening plane V2.

[0111] According to the embodiment shown in figure 6, the adjustment means 220 are arranged to change the height of the upper end 203 of the second work frame 201.

[0112] Preferably, the second work frame 201 is provided (particularly on its flat frame 217) with at least one first attachment point 221, in which the second work frame 201 is hinged to the base frame 214, and a second attachment point 222, in which the second work frame 201 is connected to the adjustment means 220.

[0113] Advantageously, the first attachment point 221 is hinged to the base frame 214 by means of a first hinge 223 having a first hinging axis I1 parallel to the rotation axes RD of the second discs 205, in a manner such that the aforementioned adjustment means 220 can change the tilt of the second screening plane V2 rotating the second work frame 201 around the first hinging axis I1 of the first hinge 223.

[0114] Advantageously, the adjustment means 220 comprise at least one extensible arm 224, which is provided with a first end 225 hinged to the base frame 214 and with a second end 226 hinged to the second work frame 201 at the second attachment point 222. Preferably, the first and the second end 225, 226 of the extensible arm 224 are hinged (respectively to the base frame 214 and to the second work frame 201) respectively by means of a second hinge 227 and a third hinge 228, respectively having a second and a third hinging axis I2, I3 parallel to the first hinging axis I1 of the first hinge 223. Operatively, the extensible arm 224 can be actuated to extend or shorten to change the tilt of the second work frame 201.

[0115] Advantageously, the second attachment point 222 of the second work frame 201 is arranged closer to the upper end 203 with respect to the first attachment point 221 and it is positioned at a height greater than the first attachment point 221. In this manner, particularly, the adjustment means 220 are arranged to change the tilt angle α of the second screening plane V2 by changing the height of the second attachment point 222. Particularly, the extensible arm 224 can be operated extending and shortening to respectively increase and decrease the tilt angle α.

[0116] Advantageously, the extensible arm 224 comprises a linear actuator 229 extending along an extension axis Z substantially orthogonal to the rotation axes RD of the second discs 205 and preferably orthogonal to the hinging axes I1, I2, I3 of the hinges 223, 227, 228.

[0117] Particularly, the linear actuator 229 comprises a first member 230 (preferably elongated) hinged to the base frame 214 and a second member 231 (preferably elongated) hinged to the second work frame 201 and slidably constrained to the first member 230 according to the extension axis Z, in a manner such that one of the members 230, 231 can be actuated to move in an extending or retracting fashion with respect to the other so as to extend or shorten the extensible arm 224.

[0118] According to the embodiment shown in the attached figures, the linear actuator 229 comprises a hydraulic jack.

[0119] Preferably, the second work frame 201 is connected to the base frame 214 by means of two first attachment points 221 (aligned with respect to each other along the first hinging axis I1) and it is connected to the adjustment means 220 by means of two second attachment points 222 (aligned with respect to each other according to the third hinging axis I3). Particularly, each first and second attachment point 221, 222 is arranged on the corresponding side longitudinal member 218 of the second work frame 201.

[0120] Suitably, the adjustment means 220 comprise two aforementioned extensible arms 224 (and in particular two linear actuators 229), each of which is hinged, at the relative second end 226, to the respective second attachment point 222 of the second work frame 201.

[0121] Obviously, without departing from the scope of protection of the present invention, the adjustment means 220 can be implemented with different embodiments. For example, the adjustment means 220 can be implemented by means of one or more columns fixed to the base frame 214 and each provided, along the longitudinal extension thereof, with several engagement elements (for example holes) arranged at different heights,

to which there can be selectively engaged (for example by means of an engagement pin) a slider constrained to the second work frame 201 and it is capable of moving along the extension direction of the second work frame.

[0122] Furthermore, forming an object of the present invention is a method for separating solid materials into multiple fractions by means of the plant described up to now, whose reference numerals will be maintained hereinafter for the sake of ease of description. The method provides for a step of loading material to be screened onto the first screening plane V1 of the first disc screen 100. For example, the material to be screened is conveyed by the loading means at the inlet end 102 of the first work frame 101 of the first disc screen 100 and it is poured onto the first screening plane V1 of the latter (advantageously by means of the inlet chute 102').

[0123] Furthermore, the method provides for a first screening step, carried out by the first disc screen 100.

[0124] In greater detail, in this first screening step, the first discs 105 of the first disc screen 100, through the rotation thereof, force the material to be screened to proceed on the first screening plane V1 towards the outlet end 103 of the first disc screen 100.

[0125] In this manner, a first fraction of material, consisting of objects with piece size substantially larger than the first screening section of the first disc screen 100, reaches the outlet end 103 and it is deposited in the first discharge station 4, from where the first 8 conveyor means advantageously convey it to a respective destination zone (such as a storage area or a further processing station).

[0126] Furthermore, during such advancement of the material on the first screening plane V1, a second fraction of material, with piece size substantially smaller than the first screening section of the first disc screen 100, drops below the first screening plane V1 through the screening slits of the first screening section, entering into the underlying second disc screen 200.

[0127] Therefore, the method in question comprises a second screening step, carried out by the second disc screen 200.

[0128] Particularly, the second work frame 201 of the second disc screen 200 is arranged tilted with the upper end 203 positioned at a height greater than the lower end 202. In this manner, the second screening plane V2 is arranged tilted with a tilt angle α (preferably comprised between 20° and 45°) extending ascending from the lower end 202 to the upper end 203.

[0129] The second discs 205 of the second disc screen 200 are driven to rotate, by means of the aforementioned second drive means 206, in the second rotation direction R2 which, on the upper side L1 of the screening plane V, is oriented towards the upper end 203 of the second work frame 201.

[0130] When the second fraction of material, coming from the first disc screen 100, drops on the second screening plane V2 of the second disc screen 200, the second discs 205, which rotate in the aforementioned second rotation direction R2, they tend to advance the objects of such fraction towards the upper end 203 of the second disc screen 200.

[0131] In this manner, as previously mentioned, the second discs 205 substantially make only the softer and light materials, particularly the sheet-like materials, ascend up to the upper end 203, while the more rigid materials which find it difficult to ascend, depending on their piece size, descend along the second screening plane V2 up to the lower end 202 of the second disc screen 200 or they drop into the screening slits of the latter.

[0132] In greater detail, in the aforementioned second screening step, the second disc screen 200 receives the second fraction of material which drops from the first disc screen 100, and the rotating second discs 205 force such second fraction to proceed towards the upper end 203 of the second disc screen 200. In this manner, a third fraction of material, substantially with piece size substantially larger than the second screening section of the second disc screen 200 (substantially consisting of softer and light materials, particularly sheet-like or thread-like), is driven by the second discs 205 up to the upper end 203 and it is deposited in the second discharge station 5.

[0133] Furthermore, a fourth fraction of material, with piece size substantially larger than the second screening section of the second disc screen 200 (consisting of more rigid materials with piece size substantially larger than the second, for example bottles, jars, etc.), goes down - by gravity - along the second screening plane V2 up to the lower end 202 of the second disc screen 200 and it is deposited in the third discharge station 6. Furthermore, a fifth fraction of material, with piece size smaller than the second screening section of said second disc screen 200 (consisting of rigid materials, such as residues of broken objects), drops below said second screening plane V2 through the second screening section depositing on the fourth discharge station 7.

[0134] Advantageously, the second, third and fourth conveyor means 9, 10, 11 (respectively arranged at the second, third and fourth discharge station 5, 6, 7) convey the respective fractions of materials to their respective destination zones (such as storage areas or further processing stations).

[0135] Advantageously, as mentioned above, the second fraction of material, which drops from the first screening plane V1, passes through - dropping - the dropping space 50 which extends between the first disc screen 100 and the second disc screen 200.

[0136] Preferably, the method in question provides for that there be generated (particularly through the aforementioned ventilator means 15) an airflow which passes through the dropping space 50, it be directed towards the upper end 203 of the second disc screen 200 and intercepts the second fraction of material in order to divert at least part of the latter towards the upper end 203 of the second disc screen 200. Particularly, the aforementioned airflow is generated by blowing air into the dropping space 50.

[0137] As mentioned above, the generation of such airflow in the dropping space 50 allows to further improve the separation between light and soft materials and more rigid and heavy materials.

[0138] Therefore, the invention thus conceived attains the pre-set objects.

Claims

1. Plant (1) for separating solid materials into multiple fractions, which comprises:

- a first disc screen (100), comprising:
  - a first work frame (101), which extends, along a first advancement direction (A1), between an inlet end (102) and an outlet end (103), and defines a first screening plane (V1) which extends between said inlet end (102), at which said first disc screen (100) is adapted to receive material to be screened, and said outlet end (103);
  - first rotary shafts (104), which are rotatably mounted on said first work frame (101) and carry first discs (105) fixed thereon; said first discs (105) and said first rotary shafts (104) defining, between them, a first screening section of said first disc screen (100);
  - first drive means (106) mechanically connected to said first rotary shafts (104) and arranged to drive said first discs (105) to rotate in a first rotation direction (R1) in order to advance said material to be screened towards said outlet end (103);
- a first discharge station (4) placed at the outlet end (103) of said first disc screen (100), in order to receive a first fraction of material conveyed, by said rotating first discs (105), to said outlet end (103);
- a second disc screen (200), which is placed below said first disc screen (100) in order to receive a second fraction of material that dropped below said first screening plane (V1) through the first screening section of said first disc screen (100); said second disc screen (200) comprising:
  - a second work frame (201), which extends, along a second advancement direction (A2), between a lower end (202) and an upper end (203) placed at a height greater than said lower end (202), and defines a second screening plane (V2), which is placed tilted by a tilt angle (α) and is extended upward from said lower end (202) to said upper end (203), and is provided with an upper side (L1) on which it is adapted to receive said second fraction of material that dropped from said first disc screen (100);
  - multiple second rotary shafts (204), which are rotatably mounted on said second work frame (201) and carry second discs (205) fixed thereon; said second discs (205) and said second rotation shafts (204) defining, between them, a second screening section of said second disc screen (200);
  - second drive means (206) mechanically connected to said second rotary shafts (204) and adapted to rotate said second discs (205) in a second rotation direction (R2) which, on the upper side (L1) of said second screening plane (V2), is oriented towards said upper end (203), in order to force at least part of said second fraction of material towards said upper end (203);
- a second discharge station (5) placed at the upper end (203) of said second disc screen (200), in order to receive a third fraction of material conveyed, by said second discs (205), to said upper end (203);
- a third discharge station (6), placed at the lower end (202) of said second disc screen (200) in order to receive a fourth fraction of material that went down by gravity along said second screening plane (V2) up to said lower end (202);
- a fourth discharge station (7) placed below the second screening plane (V2) of said second disc screen (200) in order to receive a fifth fraction of material that dropped below the second screening plane (V2) through the second screening section of said second disc screen (200);

characterized in that said first disc screen (100) comprises at least one conveyor chute (107) placed below said first screening plane (V1), extending from said first work frame (101) up to a lower terminal portion thereof placed above the second screening plane (V2) of the second disc screen (200), and arranged to intercept the second fraction of material dropping from said first disc screen (100) and to convey it on the second screening plane (V2) of said second disc screen (200).

2. Plant (1) according to claim 1, **characterized in that** it comprises conveyor means (8, 9, 10, 11) placed in one or more of said discharge stations (4, 5, 6, 7) and adapted to receive the corresponding said fraction of material in order to convey it to a corresponding destination zone.

3. Plant (1) according to claim 1 or 2, **characterized in that** it comprises a support structure (12) provided

with an upper portion (13), on which said first disc screen (100) is suspended, and a lower portion (14) placed below said upper portion (13) and in which said second disc screen (200) is placed.

4. Plant (1) according to any one of the preceding claims, **characterized in that** it comprises ventilator means (15) arranged to generate, in a falling space (50) extending between said first disc screen (100) and said second disc screen (200), at least one airflow directed towards the upper end (203) of said second disc screen (200) and adapted to intercept said second fraction of material which passes through said falling space (50), to divert at least one part of said second fraction towards said upper end (203).

5. Plant (1) according to claim 4, **characterized in that** said ventilator means (15) comprise at least one blowing mouth (16) placed between said first disc screen (100) and said second disc screen (200) and facing towards the upper end (203) of said second disc screen (200), through which blowing mouth (16) said ventilator means (15) are adapted to blow said airflow into said dropping space (50).

6. Plant (1) according to claim 5, **characterized in that** the blowing mouth (16) of said ventilator means (15) is placed on a front side (51) of said dropping space (50), the front side (51) extending between the inlet end (102) of said first disc screen (100) and the lower end (202) of said second disc screen (200).

7. Plant (1) according to claim 5 or 6, **characterized in that** said conveyor chute (107) is provided with at least one through opening (18) substantially aligned with the blowing mouth (16) of said ventilator means (15).

8. Plant (1) according to any one of the preceding claims, **characterized in that** said second disc screen (200) comprises adjustment means (220) mechanically connected to said second work frame (201) and arranged to move said second work frame (201) in order to vary the tilt angle (α) of said second screening plane (V2).

9. Plant (1) according to claim 8, **characterized in that** said second disc screen (200) comprises a base frame (214) on which said second work frame (201) is mounted;
said second work frame (201) being provided with at least one first attachment point (221), in which said second work frame (201) is hinged to said base frame (214) by means of a first hinge (223), and with a second attachment point (222), in which said second work frame (201) is connected to said adjustment means (220).

10. Plant (1) according to claim 9, **characterized in that** said adjustment means (220) comprise at least one extensible arm (224), which is provided with a first end (225) hinged to said base frame (214) and with a second end (226) hinged to said second work frame (201) at said second attachment point (222).

11. Plant (1) according to claim 10, **characterized in that** said extensible arm (224) comprises a linear actuator (229).

12. Plant (1) according to any one of the preceding claims, **characterized in that** said tilt angle (α) is comprised between 20° and 45°.

13. Process for separating solid materials into multiple fractions by means of a plant (1) according to any one of the preceding claims, said process comprising:

- a step of loading material to be screened onto the first screening plane (V1) of said first disc screen (100);
- a first screening step, in which the rotating first discs (105) of said first disc screen (100) force said material to proceed on said screening plane (V1) towards said outlet end (103), such that:
  - a first fraction of material, having piece size substantially greater than the first screening section of said first disc screen (100), reaches said outlet end (103) and it is deposited in said first discharge station (4), and
  - a second fraction of material, having piece size substantially smaller than the first screening section of said first disc screen (100), drops below said first screening plane (V1) through said first screening section;
- a second screening step, in which said second disc screen (200) receives said second fraction of material which drops from said first disc screen (100) and the rotating second discs (205) of said second disc screen (200) tend to force said second fraction to proceed towards the upper end (203) of said second disc screen (200), such that:
  - a third fraction of material, having piece size substantially greater than the second screening section of said second disc screen (200), is driven - by said rotating second discs (205) - up to said upper end (203) and it is deposited in said second discharge station (5);
  - a fourth fraction of material, having piece size substantially greater than the second

screening section of said second disc screen (200), goes down by gravity along said second screening plane (V2) up to the lower end (202) of said second disc screen (200) and it is deposited in said third discharge station (6);

• a fifth fraction of material, having piece size substantially smaller than the second screening section of said second disc screen (200), drops below said second screening plane (V2) through said second screening section, being deposited on said fourth discharge station (7).

14. Process according to claim 13, wherein the second fraction of material, dropping from the first screening plane (V1), passes dropping through a dropping space (50) extending between said first disc screen (100) and said second disc screen (200); **characterized in that** an airflow is generated which passes through said dropping space (50), is directed toward the upper end (203) of said second disc screen (200) and intercepts said second fraction of material in order to divert at least part of said second fraction toward the upper end (203) of said second disc screen (200).

15. Process according to claim 14, **characterized in that** said airflow is generated by blowing air into said dropping space (50).

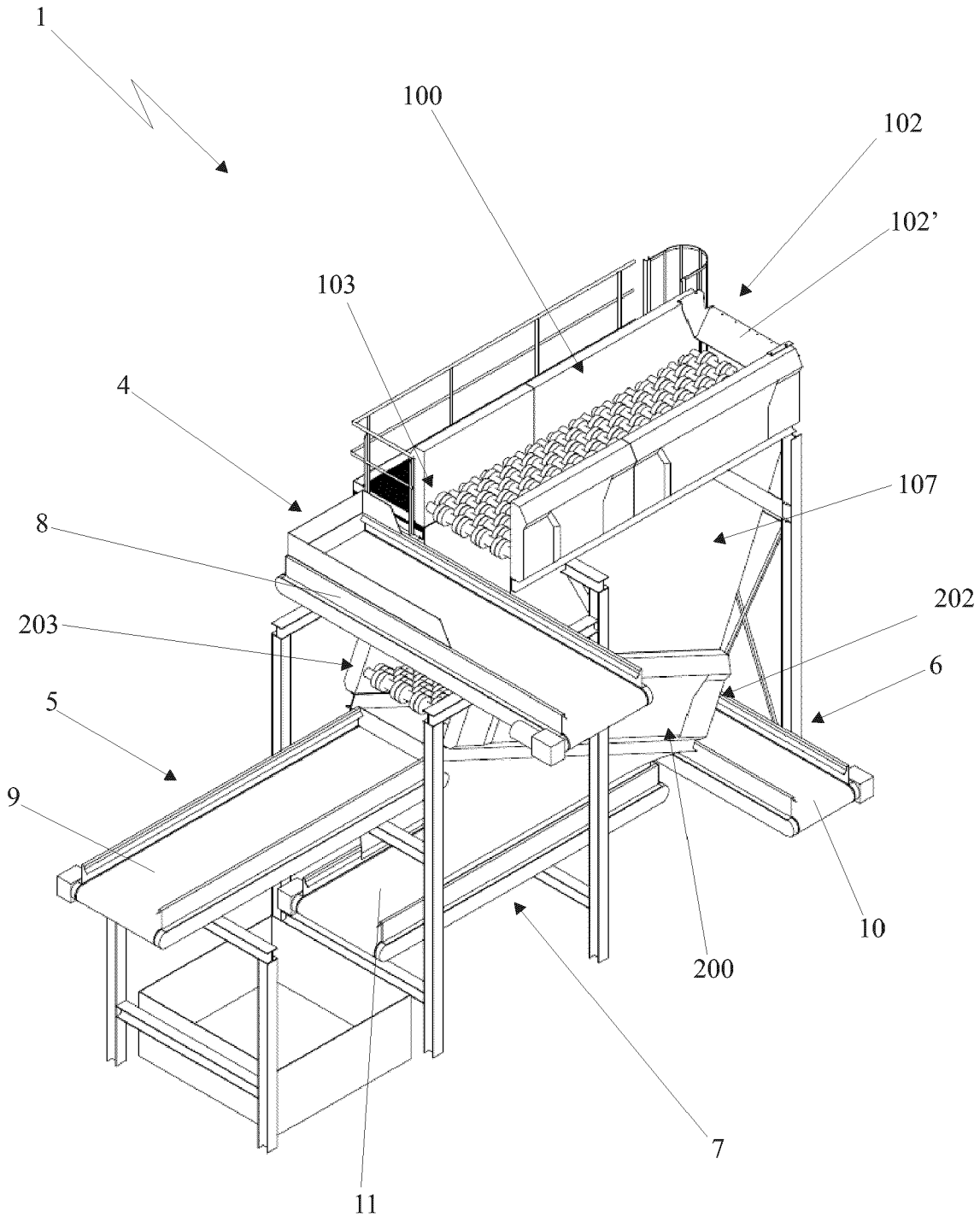

Fig. 1a

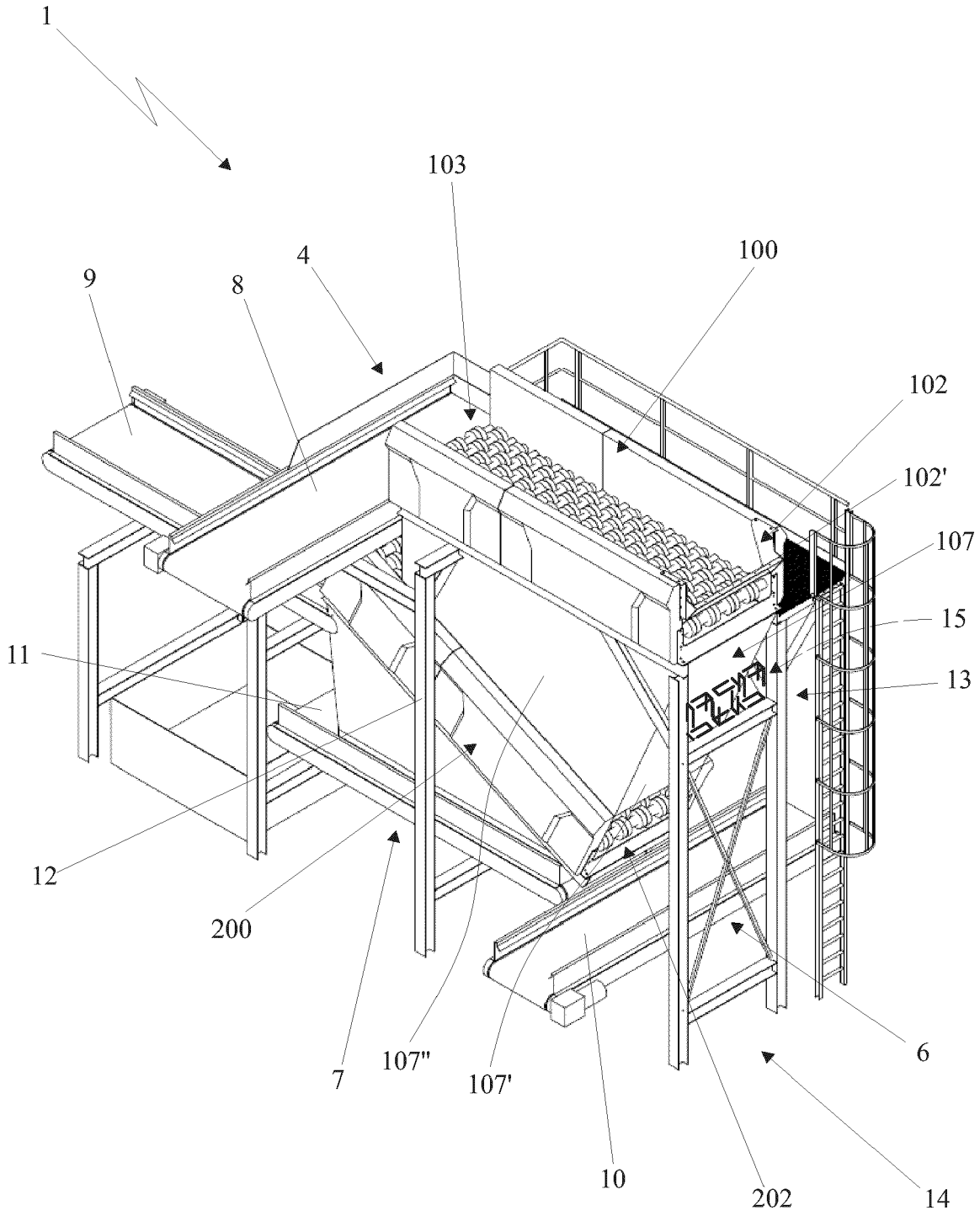

Fig. 1b

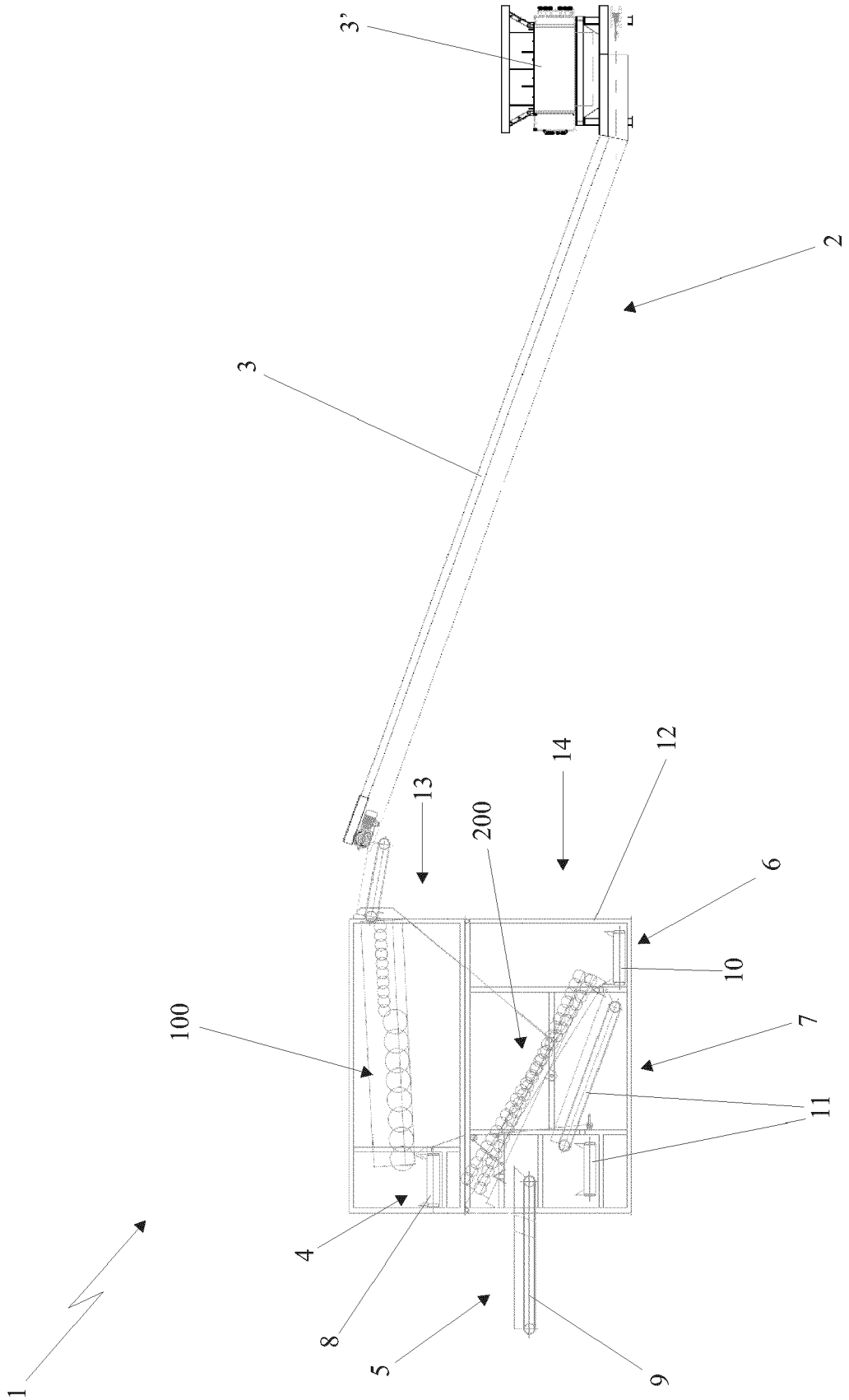

Fig. 2a

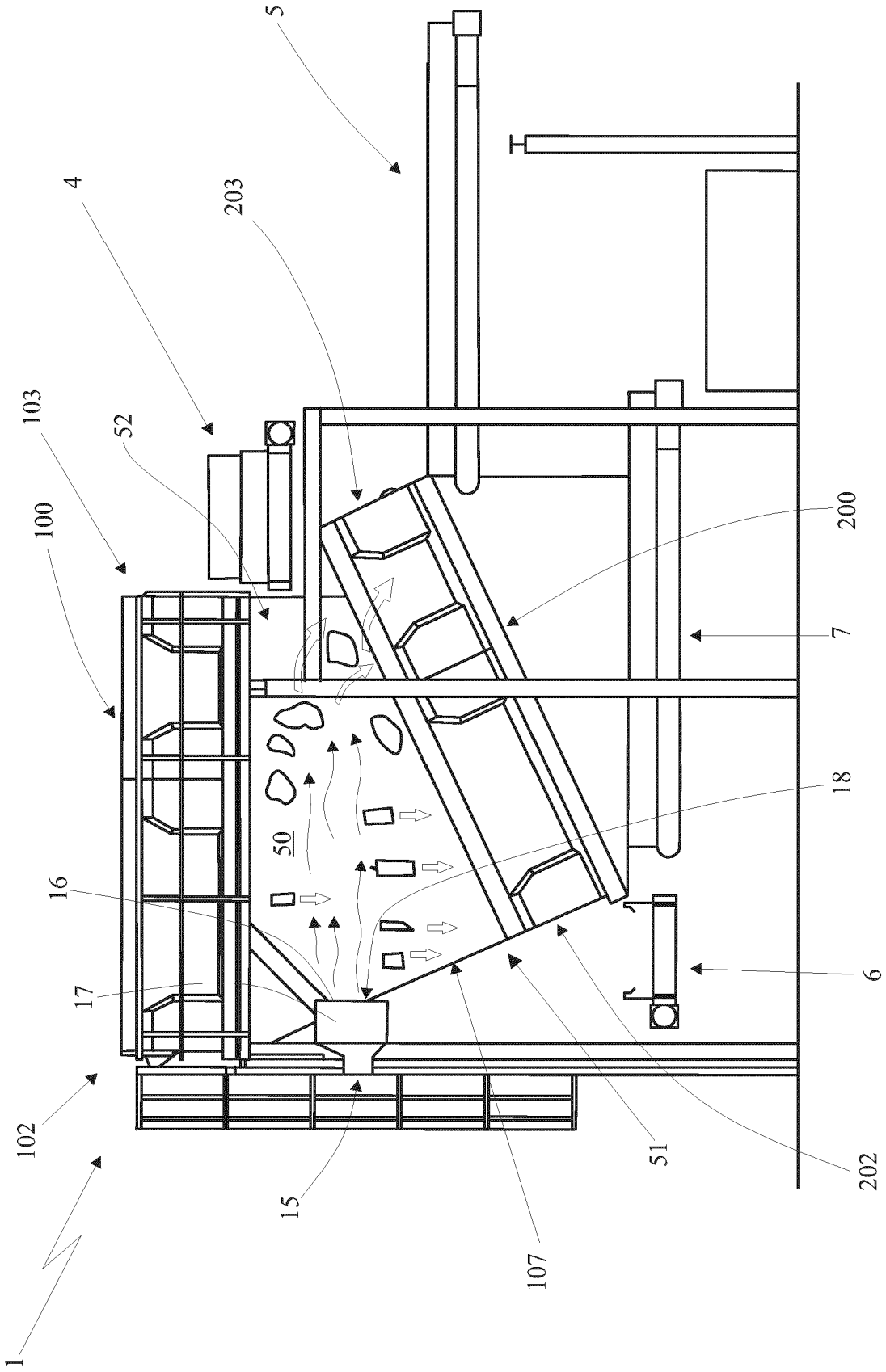

Fig. 2b

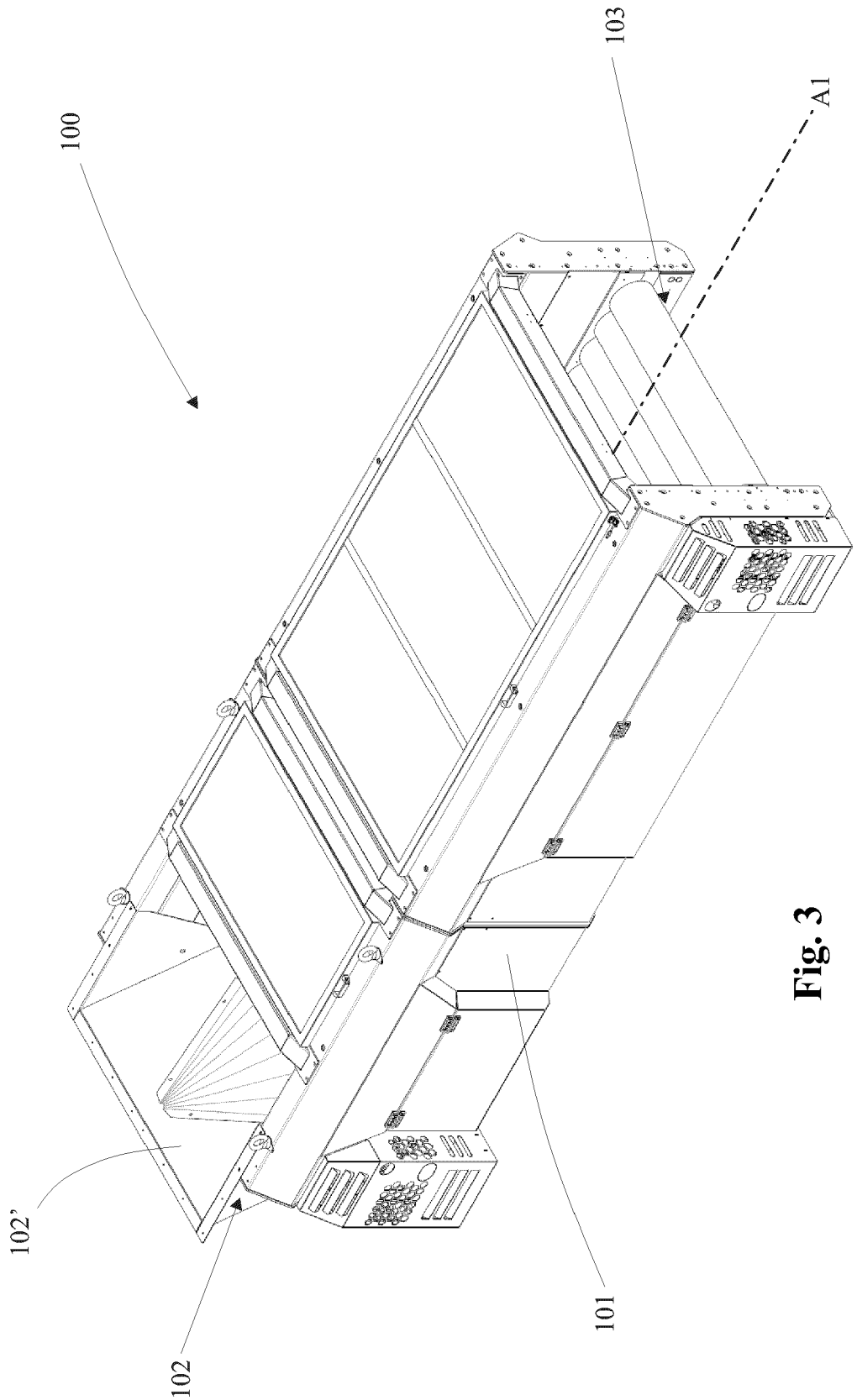

Fig. 3

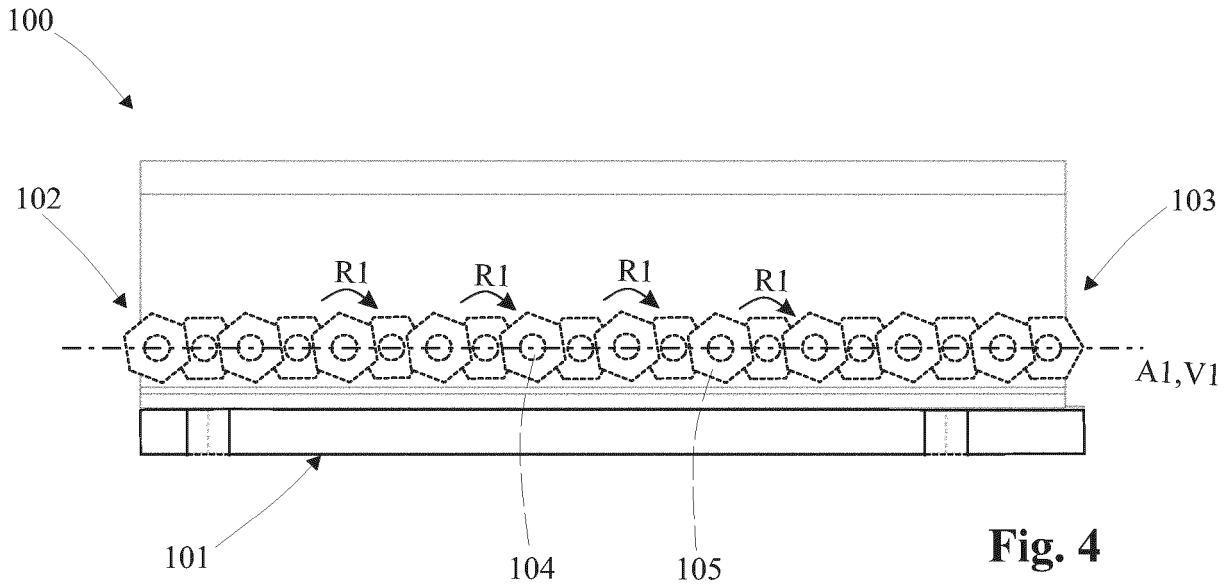
100
102
103
R1
R1
R1
R1
A1,V1
101
104
105

Fig. 4

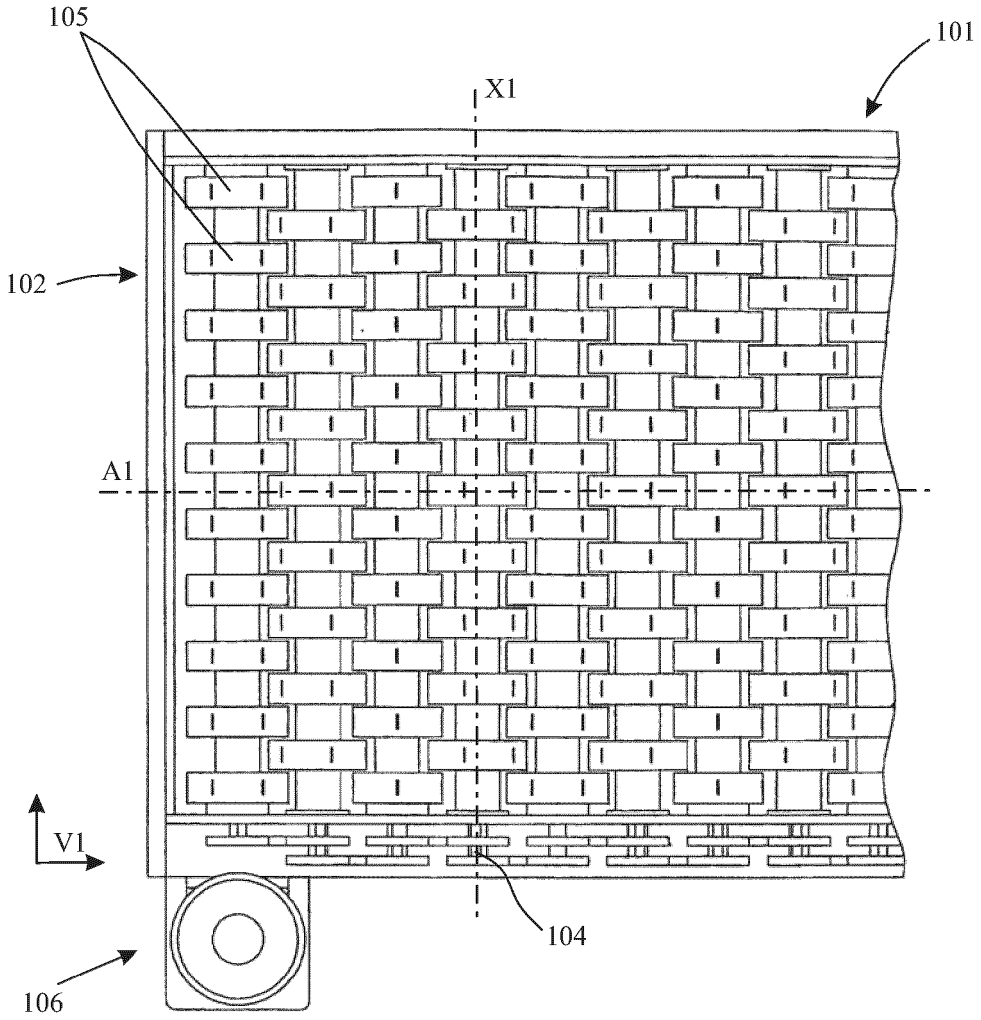
105
101
X1
102
A1
V1
104
106

Fig. 5

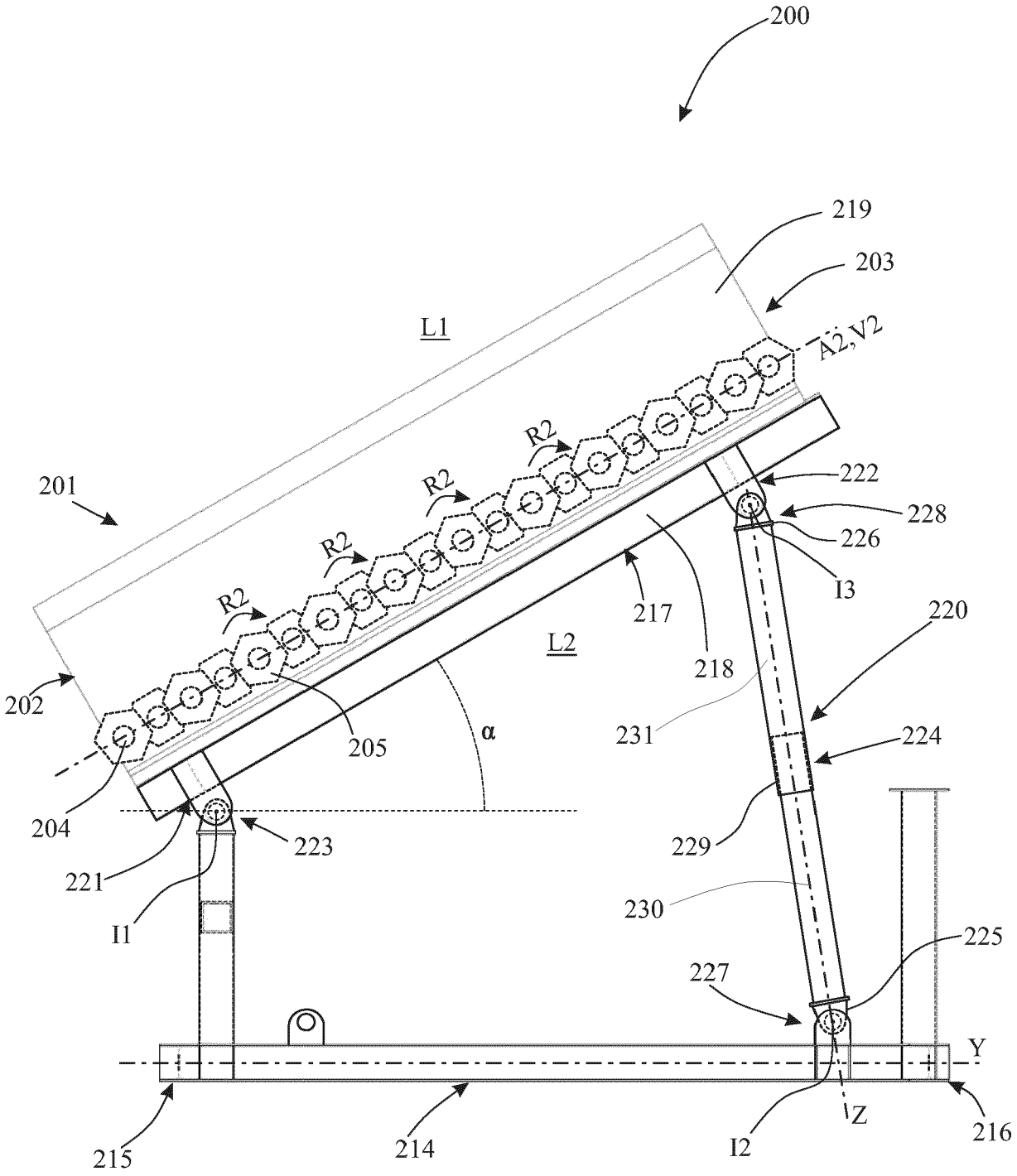
200
219
203
L1
A2,V2
R2
R2
R2
R2
201
222
228
226
I3
217
220
L2
218
231
202
205
α
224
204
223
229
221
230
I1
225
227
Y
Z
215
214
I2
216

Fig. 6

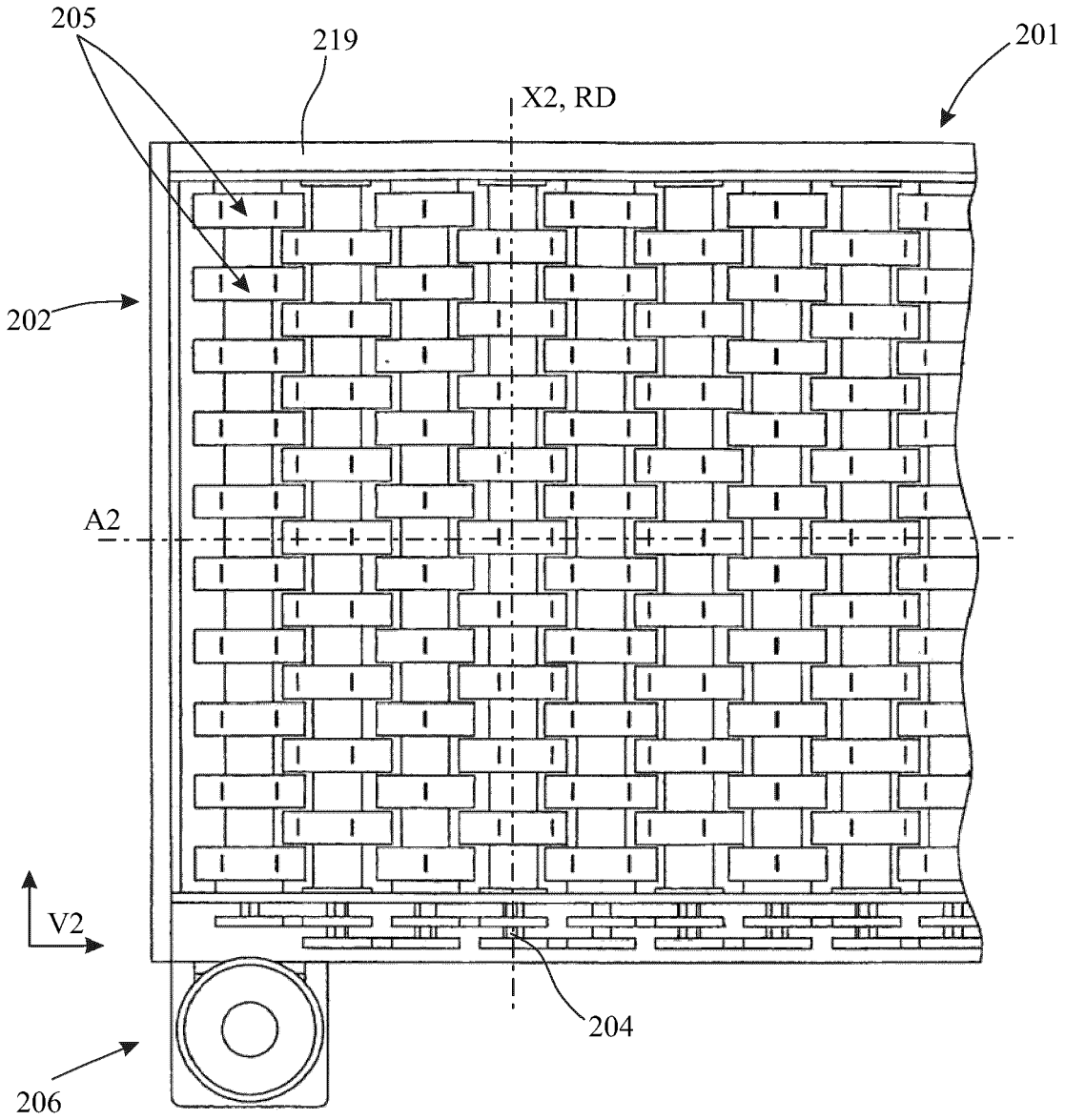

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 16 5247

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2012 012979 A1 (HIRSCHAUER MARTIN [DE]) 2 January 2014 (2014-01-02) * paragraph [0023] - paragraph [0027]; figures 1-4 *	1-15	INV. B07B1/14 B07B15/00
A	US 2013/168297 A1 (LYMAN MARK G [US]) 4 July 2013 (2013-07-04) * figures 1-3 *	1,13	
A	US 7 004 332 B2 (CP MFG INC [US]) 28 February 2006 (2006-02-28) * the whole document *	1,7-13	
A	CN 214 718 414 U (MIZUDA XINZHIZAO HUZHOU TECH CO LTD) 16 November 2021 (2021-11-16) * claims 1,2,8; figures 2,4 *	1,12,13	
A	US 2001/004059 A1 (DAVIS ROBERT M [US]) 21 June 2001 (2001-06-21) * paragraph [0029]; figure 1 *	1,12,13	
			TECHNICAL FIELDS SEARCHED (IPC)
			B07B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 August 2023	Cassiat, Clément

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 5247

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-08-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102012012979 A1	02-01-2014	DE 102012012979 A1	02-01-2014
		WO 2014000728 A1	03-01-2014
US 2013168297 A1	04-07-2013	US 2013168297 A1	04-07-2013
		WO 2013040314 A1	21-03-2013
US 7004332 B2	28-02-2006	NONE	
CN 214718414 U	16-11-2021	NONE	
US 2001004059 A1	21-06-2001	AU 2860000 A	25-08-2000
		US 6250478 B1	26-06-2001
		US 2001004059 A1	21-06-2001
		WO 0045966 A1	10-08-2000

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1106264 A **[0009]**
- DE 102012012979 A1 **[0012]**