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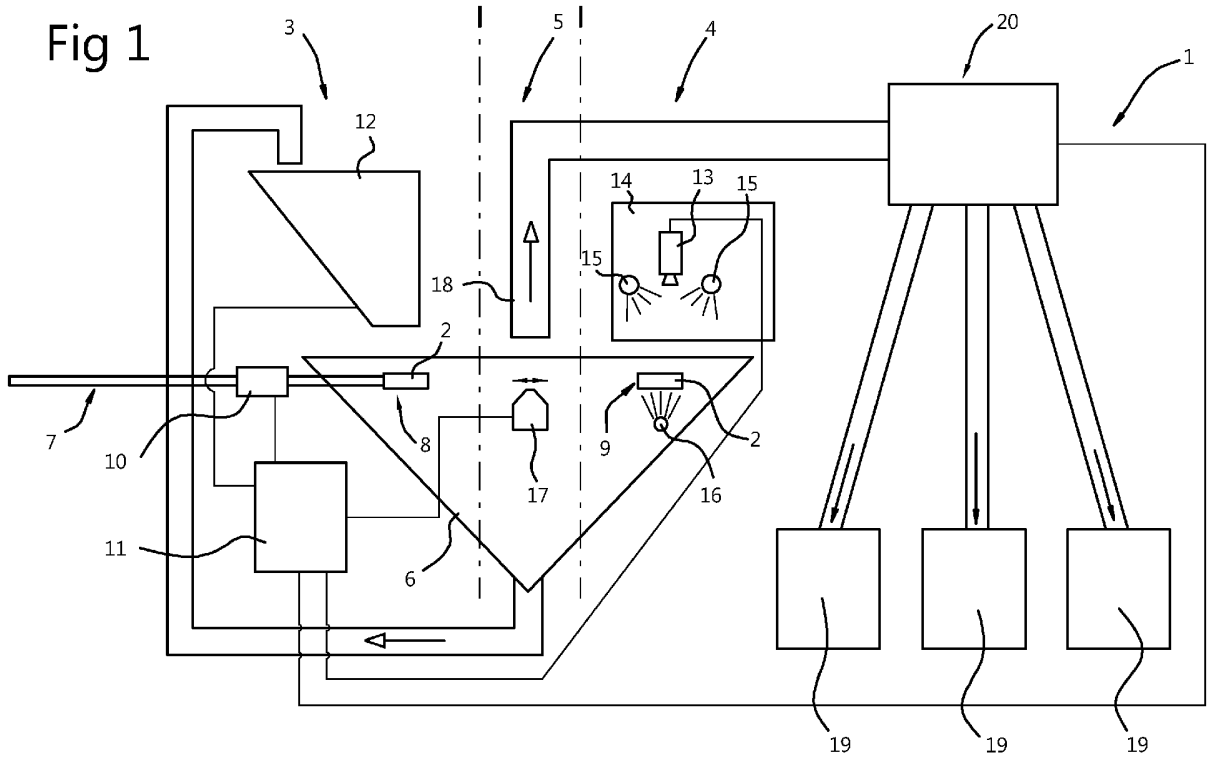
(54) SORTING DEVICE, MODULE AND METHOD OF SORTING

(57) The invention relates to a sorting device (1) for processing a batch of small light weight objects. The device comprises an object carrier (2) for carrying small light weight objects, a filling section (3) for depositing small light weight objects on a top surface of the object carrier, an inspection section (4) configured for determining one or more characteristics of each object on said object carrier, a removal section (5) comprising a blow unit (17) below and/or a suction unit (18) above the object carrier for generating an upward airflow to selectively remove objects from the object carrier; and, a control unit (11) configured for controlling, the transportation unit, the filling section, the inspection section and the removal section. The object carrier comprises an airflow permeable nonwoven fabric-like material on which the small light weight objects are deposited and the upward airflow flows through the airflow permeable nonwoven fabric-like material.

Fig 1



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Description

TECHNICAL FIELD

[0001] The subject disclosure relates to sorting technology and more particularly to a sorting device for processing a batch of small light weight objects, more particularly to a seed sorting device. The subject disclose further relates to an object carrier module and method of sorting, analyzing or grading small, lightweight objects.

BACKGROUND

[0002] US3980180 discloses a sorter for reclaiming particles, such as glass particles, of a predetermined color or transmissivity utilizes a belt conveyor having a longitudinal row of openings over which particles are positioned for being conveyed past a light source and light sensor on opposite sides of the belt to sense the transmissivity, or color of the particles. Glass particles having a predetermined transmissivity are separated by suitable facilities, such as an air jet directed through the openings in the belt.

[0003] NL2004406C2 discloses a sorting device for sorting objects. The device is configured to move at least one tray along a path between a blow unit positioned below said path and a suction unit positioned above said path. A tray comprises a topside and an underside. The topside is provided with an array of pockets. A pocket is coupled to an air channel from the underside to the pocket. A tray is disclosed used to irradiate objects by means of X-rays. An X-ray transparent layer comprising through holes is movable between a first position and a second position.

SUMMARY

[0004] It is an object of the invention to provide a sorting device for processing a batch of small light weight objects with an improved object carrier that can be used in a variety of application, allowing objects to be evaluated in various ways. The improved object carrier provides at least one of the following advantages: less complex structure, suitable for assessing objects using both visible light and X-rays, usable for objects of different sizes and shapes, less complex structure, and higher density of objects on carrier.

[0005] According to the invention, this object is achieved by a sorting device for processing a batch of small light weight objects having the features of Claim 1. Advantageous embodiments and further ways of carrying out the invention may be attained by the measures mentioned in the dependent claims.

[0006] According to an aspect of the invention, there is provided a sorting device for processing a batch of small light weight objects. The device comprises

- a transportation unit comprising an object carrier for carrying small light weight objects;
- a filling section configured for depositing small light weight objects on a top surface of the object carrier;
- an inspection section configured for determining one or more characteristics of each object on said object carrier;
- a removal section comprising a blow unit below and/or a suction unit (18) above the object carrier for generating an upward airflow to selectively remove objects from the object carrier; and,
- a control unit configured for controlling the transportation unit, the filling section, the inspection section and the removal section. The object carrier comprises an airflow permeable nonwoven fabric-like material on which the small light weight objects are deposited and the upward airflow flows through the airflow permeable nonwoven fabric-like material.

[0007] The concept of the invention is based on the desire to have an object carrier that can be use the well-known method of removing object from the object carrier with an upward flow of air and that is more widely applicable. It has been found that an airflow permeable nonwoven fabric-like material is suitable in sorting devices as described above. A blow unit below the airflow permeable nonwoven fabric-like material is capable to raise a small lightweight object above the blow unit to remove the object from the object carrier. If the blower unit can be used to generate a defined upward airflow at any position across the width and perpendicular to the object carrier's direction of transport in order to blow one object upwards, then pockets are no longer required and the objects can be distributed randomly and at an appropriate distance from each other in order to be individually removed from surface of the object carrier.

[0008] In an embodiment, the object carrier is a tray comprising a frame and the airflow permeable nonwoven fabric-like material is arranged in the frame. In a further embodiment, the object carrier further comprises an upper layer above the airflow permeable nonwoven fabric-like material; the upper layer comprises a number of openings. This feature provides an object carrier wherein small lightweight objects can be distributes randomly over the top surface of object carrier. In a further embodiment, each opening is dimensioned to accommodate one single small light weight object and the airflow permeable nonwoven fabric-like material forms the bottom of the opening. This feature has the advantage over the tray disclosed in NL2004406 that it does not have a hole in the bottom of the cavities through which dirt particles can fall, causing devices underneath the object carrier to become dirty.

[0009] In an embodiment of an object carrier, each opening is an elongated opening with a width to accommodate a single row of small light weight objects and the airflow permeable nonwoven fabric-like material forms the bottom of the elongated opening. This allows increasing the density of objects on the object carrier and con-

sequently the processing capacity of the sorting device.

[0010] In an embodiment, the object carrier further comprises a lower layer below the airflow permeable nonwoven fabric-like material; the lower layer comprises a multitude of openings, wherein each opening through the upper layer has a corresponding opening through the lower layer to form a channel for the upward airflow. This feature allows for a more focused and stronger airflow through the airflow permeable nonwoven fabric-like material. In a further embodiment, an opening through the upper layer has a circumference not exceeding the circumference of a corresponding opening through the lower layer. This characteristic ensures that an upward airflow is possible over the entire surface of the bottom of the cavity accommodating an object. As a result, it no longer matters where an object lies on the bottom to blow the object upwards. Another advantage is that when X-rays are used to determine the quality of an object, the entire object is exposed evenly. In a further embodiment, an opening through the lower layer narrows in direction of the upward airflow. This feature has the advantage that the air flow through airflow permeable nonwoven fabric-like material is accelerated and further improves the exposure of an object to an X-ray source.

[0011] In an alternative embodiment, the object carrier is in the form of an end-less belt and the filing section is configured to drop objects on the object carrier at a predefined minimum distance from each other. This feature provides an alternative object carrier wherein small lightweight objects can be distributes randomly over the top surface of object carrier. In a further embodiment, the object carrier comprises a top layer forming longitudinal grooves, whose bottoms are formed by the airflow permeable nonwoven fabric-like material. This feature allows the use of a blow unit with a relatively simple mechanical structure to blow objects off the object carrier.

[0012] In an embodiment, the inspection section comprises an X-ray source and an X-ray detector, the transportation unit being arranged to move the object carrier along a path between the X-ray source and X-ray detector.

[0013] In an embodiment, the airflow permeable nonwoven fabric-like material is a carbon fibre mat with a thickness in the range of 0,08 mm - 0,25 mm, consisting of filaments of carbon with a diameter of 7μm with polyvinyl alcohol as binding agent. This material has been found to be very suitable. The material is airflow permeable. Furthermore, the material causes minimal distortions in X-ray images taken of the small lightweight objects for analysing the quality of each object.

[0014] In an embodiment, the airflow permeable nonwoven fabric-like material is pervious to light. This feature makes it possible to illuminate an object from below with visible light and to determine the quality of each object on the basis of, for example, its contour, for example.

[0015] According to a second aspect of the invention, there is provided a module for use in a sorting device, comprising all technical features of an object carrier described above.

[0016] According to a third aspect of the invention, there is provided a Method of sorting, analyzing or grading small, lightweight objects, the method comprising, supplying a batch of small lightweight objects to an arrangement comprising all technical features of an embodiment of a sorting device described before, to obtain two or more batches of sorted small lightweight objects.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other aspects, properties and advantages will be explained hereinafter based on the following description with reference to the drawings, wherein like reference numerals denote like or comparable parts, and in which:

Fig. 1 illustrates a first embodiment of a sorting device;
Fig. 2 illustrates a top view of a first embodiment of an object carrier;
Fig. 3 illustrates a bottom view of the first embodiment of an object carrier;
Fig. 4 illustrates a cross sectional view of the first embodiment;
Fig. 5 illustrates an exploded view of the first embodiment;
Fig. 6 illustrates a top view of a second embodiment of an object carrier;
Fig. 7 illustrates a top view of a third embodiment of an object carrier;
Fig. 8 illustrates a profile of a selective removal section for use in a sorting device in a second embodiment of a sorting device; and,
Fig. 9 illustrates a third embodiment of a sorting device.

DETAILED DESCRIPTION

[0018] Fig. 1 illustrates an exemplar embodiment of a device for processing a batch of small light weight object. In the context of the present invention, small light weight objects are objects which can easily be moved in an air stream through a duct. Examples of small light weight object are seeds, pills and any other object in the form of a pill. The objects are preferably objects of a batch which comprises object of different quality, which value can be increased by dividing the batch in smaller batches of objects with a more constant quality. In the context of the present subject disclosure, processing means at least one of the following processes: counting, analyzing, grading and sorting. Counting is counting the number of objects in the batch. Analyzing is determining at least one characteristic of each object in the batch of objects or the batch of objects. Some characteristics of a batch of seed are: the distribution of size, distribution of surface colour, distribution of length/width of seed, distribution of estimated weight of objects. Grading is determining a

quality value for each object and subsequently determining the distribution of amount of objects having predefined quality values. Sorting is dividing the batch in to portions based on at least one characteristic.

[0019] The sorting device 1 comprises a filling section 3 configured for scattering small light weight objects on the top surface of an object carrier 2, an inspection section 4 configured for determining for each object on the top surface of the object carrier a quality measure and position on the top surface, and a selective removal section 5 configured for selectively removing objects from the object carrier in dependence of the quality measure of an object and the position of the object on the top surface of the object carrier, and a control unit 11 configured for controlling the filling section, the inspection section and the selective removal section. In the present embodiment the object carrier 2 is in the form of an object carrier.

[0020] The device further comprises transportation unit 7 configured for repeatedly vice versa and linearly moving the object carrier from a first position 8 to a second position 9. In the first position 8, the object carrier is positioned in the filling section 3. In the second position 9, the object carrier is in the inspection section 4. When moving from the first position 8 to the second position 9, the object carrier passes the selective removal section 5. In should be noted that the position of filling section 3, selective removal section 4 and inspection unit 5 could be changed without departing from the scope of the present invention.

[0021] The transportation unit 7 comprises a linear actuator 10 provided with an elongated body, for example a bar. The linear actuator 10 is configured to move the elongated body along its longitudinal axis. The object carrier 2 is attached to an end of the elongated body. The object carrier according to the present subject technology comprises a layer of airflow permeable nonwoven fabric like material.

[0022] The inspection section 4 includes one or more imaging devices 13 arranged for capturing images of the object carrier and the objects on the top surface of the object carrier. The imaging device 13 could be a camera, a line scanner, a laser scanner, X-ray detector or any combination thereof. In case of a camera to provide optimal image capturing conditions the camera is positioned in a housing 14 to shield ambient light. Furthermore, light sources 15 are positioned in the housing, to provide a homogenous exposure of light on the top surface of the object carrier. A camera, such as a RGB camera, may be used to capture colour images of the objects. From the images, the colour and/or contour of the objects may be used to determine characteristics and corresponding position of the objects on the top surface. With a laser scanner, a contour image is made from which the structure or shape of each of the objects on the top surface can be determined. In case the imaging device 13 is an X-ray detector, an X-ray source 16 is positioned such that the object carrier can be positioned in the beam of X-rays and the detector can detect the intensity of the X-rays passing through the objects. In this way, the internal structure of the object, e.g. seed, can be determined from the image, which provides further information about the quality of the seed. Furthermore, the outline of the seed can be derived from the X-ray image. The imaging device 13 may be any combination of a camera, laser scanner and X-ray detector. The images captured by the imaging device 13 are analysed and each object on the top surface of the object carrier will obtain a qualification value indicating the quality of the object. After calculation of a qualification value for each of objects and the corresponding position on the top surface, the object carrier is moved to the selective removal section 5. The selective removal section comprises a blow unit 17 below and/or a suction unit 18 above the object carrier. The removal section is configured for generating an upward airflow to selectively remove objects having a particular qualification value and passing an outlet or nozzle of the blow unit 17. The airflow flows upwardly through the airflow permeable nonwoven fabric-like material and moves an object in the stream of the airflow in upward direction. A suction unit 18 having a duct with an open end above the object carrier will suck the object blown in upward direction and transports the object by the air flow to a container 19 assigned to receive the objects with said particular qualification. By moving the object carrier one time between the blow unit and the inlet of the suction unit, all objects with a first qualification value can be removed from the object carrier and collected in a first container assigned to said particular qualification. By moving the object carrier a second, third time, etc. between the blow head and inlet of the suction unit 18, all object with a second, third, etc., qualification value are removed from the object carrier and collected in a container associated with said second, third, etc. qualification value. For example, the first time the object carrier passes along the blow head, the objects with the lowest quality are removed. The second time seed with a better quality are removed from the object carrier, and finally all remaining objects having the best quality are removed from the object carrier. It might be clear that the skilled person can choose any other order for selectively removing the objects from the object carrier. The control unit 11 is configured to control the blow unit independently in dependence of the qualification values. It should be noted that for the last movement of the object carrier between the blow unit 17 and suction unit 18, all outlets of the blow unit may continuously blow upwardly when the object carrier passes the blow unit to remove all remaining objects from the object carrier. After all objects have been removed from the object carrier, the transportation unit 7 will transport the object carrier to the begin position of the processing cycle described above, i.e. the position in the filling section 3 to scatter for a next cycle objects on the top surface of the object carrier.

[0023] The device 1 further comprises a collection unit 6 configured to collect all objects falling down from the

object carrier or along the object carrier when handling the object carrier as described above. The collection unit 6 forms a tapering bin which tapers from its topside to its underside. All objects falling along the object carrier will be collected at the bottom of the collection unit 6. An airflow will transport the objects collected at the bottom of the collection unit 6 to the storage 12 of the filling section. In this way, the objects not handled correctly can be handled again by the filling section such that they will arrive in one of the containers 19.

[0024] Directing unit 20 functions as a switch to direct the objects which have been selectively removed from the object carrier to a container 19 assigned to collect objects with a predefined characteristic. This makes it possible in one run, without user intervention, to divide one batch of objects with a width range of characteristics or quality into several smaller batches, each having objects having more similar characteristics or quality values.

[0025] Figs. 2 - 5 illustrate a first embodiment of an object carrier in the form of a tray 100. The object carrier 100 comprises an upper layer 104, a layer of the airflow permeable nonwoven fabric-like material 300, a lower layer 204, and a frame 200. Fig. 4 illustrates a cross sectional view of the tray 100. The layer of the airflow permeable nonwoven fabric-like material 300 is located between the upper layer 104 and the lower layer 204. The frame 200 comprises an inner rim cut-out in which the outer edge of the lower layer is placed. The layer of airflow permeable nonwoven fabric-like material 300 covers the upper side of the lower layer 204. The upper layer covers the frame and the layer of the airflow permeable nonwoven fabric-like material 300. A carbon fibre mat with a thickness in the range of 0,08 mm - 0,25 mm, consisting of filaments of carbon with a diameter of 7μm with polyvinyl alcohol as binding agent has been found a suitable material for the layer of the airflow permeable nonwoven fabric-like material.

[0026] Fig. 2 illustrates a top view of a first embodiment of an object carrier. The upper layer 104 comprises a multitude of openings 106. Each opening forms a cavity to accommodate a single object. The dimension of an opening depends on the size and form of the small light weight objects to be sorted by the sorting device. The bottoms of the cavities are formed by the airflow permeable nonwoven fabric-like material 300. The upper layer 106 comprises holes 108 for coupling to the frame by fastening means. The upper layer 106 further comprises additional holes 110 for coupling the lower layer 204 to the upper layer 104 by fastening means and sandwiching the layer of airflow permeable nonwoven fabric-like material 300 between the upper layer and the lower layer.

[0027] Fig. 3 illustrates a bottom view of the first embodiment of an object carrier 100. The frame 200 is composed of four parts 200A, 200B, 200C and 200D. The frame comprises two coupling structures 112, 114 to couple that frame to a transportation unit. The transportation unit may be in the form described above, an endless chain or any other suitable arrangement to transport a tray between a blow unit and suction unit. The frame 200 may also be one piece of material. The frame is the rigid part of the tray to prevent the upper layer and lower layer from sagging. The frame 200 comprises holes 208 for the fastening means to couple the upper layer to the frame. Fig. 3 further shows holes 210 in the lower layer 204 for the fastening means to couple the upper layer to the lower layer.

[0028] Fig. 4 shows that the upper layer 104 is thinner than the lower layer 204. The lower layer 204 below the airflow permeable nonwoven fabric-like material 300 comprises a multitude of openings 106. Each opening 106 through the upper layer 104 has a corresponding opening 206 through the lower layer 204 to form a channel for the upward airflow through the lower layer, layer of airflow permeable nonwoven fabric-like material 300 and upper layer 104. Fig. 5 illustrates an exploded view of the first embodiment. Arrows 400 indicate the direction of the air flow through the object carrier.

[0029] An opening 106 through the upper layer 104 has a circumference not exceeding the circumference of a corresponding opening 206 through the lower layer 204. As a result the velocity of the airflow through an opening of the upper layer 104 will be higher than the velocity of the air flow through the corresponding opening 206 of the lower layer 204. An opening through the lower layer narrows in direction of the upward airflow. This enables a light source or X-ray source below the tray to illuminate the whole area of the airflow permeable nonwoven fabric-like material 300 below the corresponding opening through the upper layer forming an airflow channel. A light source below the object carrier and an imaging device enables to analyse the shape of an object when the airflow permeable nonwoven fabric-like material is also light permeable.

[0030] Fig. 6 illustrates a top view of a second embodiment of an object carrier according the present subject technology. This embodiment comprises elongated openings 106A in the upper layer and corresponding elongated openings (not shown). Each elongated opening has a width to accommodate a single row of small light weight objects. The airflow permeable nonwoven fabric-like material forms the bottom of the elongated openings.

[0031] Fig. 7 illustrates a top view of a third embodiment of an object carrier according to the present subject technology. In this embodiment the upper layer comprises only one opening which corresponds to the opening formed by the frame. The layer of airflow permeable nonwoven fabric-like material is stretched across the opening defined by the frame and is sandwiched between the top layer and the frame. This embodiment enables to increase the density of objects to be scattered on the object carrier and consequently the processing capacity of the sorting device.

[0032] Fig. 8 illustrates a profile of a selective removal section 5 for use in a second embodiment of a sorting

device which may use an object carrier according to the present subject technology. The sorting section comprises two blow heads 17A, 17B and two suction units 18A, 18B. Object carriers 100 in the form of trays are coupled to an endless chain, not shown. The endless chain moves the object carriers 100 between the blow heads 17A, 17B and the suction units 18A, 18B. Only one object carrier 100 is shown in Fig. 8. The selective removal section 5 is described in more detail in NL2004406C. The design of the blow heads 17A, 17B determines which embodiment of an object carrier according to the present subject technology may be used to remove selectively objects from the object carrier 100.

[0033] Fig. 9 illustrates a third embodiment of a sorting device 1 which may use an object carrier according to the present subject technology. The sorting device 1 comprises a transportation unit 7, a filling section 3, an inspection section 4, a selective removal section 5 and a control unit 11. The sorting device comprises an object carrier 2 in the form of a flat belt conveyor, end-less belt, or a conveyor belt. The transportation unit 7 further comprises a number of pulleys 30. The object carrier 2 comprises a top surface suitable for carrying the objects. The transport direction of the conveyor belt 2 is indicated in Fig. 9 by arrow 31.

[0034] The filling section 3 is configured for dropping objects on the top surface of the object carrier. An embodiment of such a filling section is described in NL2011707C. The inspection section 4 and selective removal section 5 comprises components performing similar actions as the inspection section 4 and selective removal section of the embodiment disclosed in Fig. 1.

[0035] In a first embodiment of an object carrier in the form of an end-less belt, the object carrier is made of a strip of airflow permeable nonwoven fabric-like material and the airflow permeable nonwoven fabric-like material forms both the top surface and the lower side of the end-less belt. For this type of endless belt any type of filling section may be used that drops objects at a predefined minimum distance from each other on the top surface. If the objects are dropped randomly on the top surface, the blow unit 17 is more complex than when the objects are dropped on the top surface in parallel rows in direction of the transport direction of the endless belt. In the first case the blow unit shall be capable of generating a localised upward airflow through the airflow permeable nonwoven fabric-like material at any location along the width of the belt. In the latter case, the blow unit shall be capable of generating a localised upward airflow at the locations where the rows pass along the blow unit. Optionally, the edges of the airflow permeable nonwoven fabric-like material forming the belt are enforced with another flexible material to increase the durability of the endless belt.

[0036] In a second embodiment of an object carrier in the form of an end-less belt, the object carrier comprises a top layer of flexible material and a layer of airflow permeable nonwoven fabric-like material. The layers are connected to each other. The top layer forms longitudinal grooves in the top surface of the end-less belt, whose bottoms are formed by the airflow permeable nonwoven fabric-like material. The grooves ensure that the objects dropped on the object carrier are forced to remain in a line. As a result, the objects follow a more defined path between a nozzle of the blow unit and an inlet of the suction unit. For the second embodiment a filling unit as described in NL2011707C may be used. Optionally, the object carrier comprises a lower layer connected to the opposite side of the layer of airflow permeable nonwoven fabric-like material. The lower layer comprises grooves that are situated below the grooves in the top layer and form together a path for the airflow through the airflow permeable nonwoven fabric-like material.

[0037] In a third embodiment of an object carrier in the form of an end-less belt, the top layer comprises longitudinal rows of dimples or pockets, each dimple being configured to accommodate a single object. The bottom of the dimples or pockets is formed by the layer of airflow permeable nonwoven fabric-like material. Optionally, the object carrier comprises a lower layer connected to the opposite side of the layer of airflow permeable nonwoven fabric-like material. The lower layer comprises dimples or pockets that are situated below the dimples or pockets in the top layer and each pair of dimples form together a path for the airflow through the airflow permeable nonwoven fabric-like material.

[0038] A method of sorting, analyzing or grading small lightweight objects according the present subject technology comprises:

supplying a batch of small lightweight objects to an arrangement comprising all technical features described above, to obtain two or more batches of sorted small lightweight objects;
depositing small light weight objects on an airflow permeable nonwoven fabric-like material of an object carrier; and
selectively removing the small light weight object from the object carrier by an upward airflow flowing through the airflow permeable nonwoven fabric-like material.

[0039] While the invention has been described in terms of several embodiments, it is contemplated that alternatives, modifications, permutations and equivalents thereof will become apparent to those skilled in the art upon reading the specification and upon study of the drawings. The invention is not limited to the illustrated embodiments. Changes can be made without departing from the scope of the appended claims.

Claims

1. Sorting device (1) for processing a batch of small light weight objects, the device comprising

- a transportation unit (7) comprising an object carrier (2) for carrying small light weight objects;
- a filling section (3) configured for depositing small light weight objects on a top surface of the object carrier;
- an inspection section (4) configured for determining one or more characteristics of each object on said object carrier;
- a removal section (5) comprising a blow unit (17) below and/or a suction unit (18) above the object carrier for generating an upward airflow to selectively remove objects from the object carrier; and,
- a control unit (11) configured for controlling, the transportation unit, the filling section, the inspection section and the removal section,

characterized in that,
the object carrier (2) comprises an airflow permeable nonwoven fabric-like material on which the small light weight objects are deposited and the upward airflow flows through the airflow permeable nonwoven fabric-like material.

2. Sorting device according to claim 1, wherein the object carrier (2) is a tray (100) comprising a frame (200) and the airflow permeable nonwoven fabric-like material (300) is connected to the frame.

3. Sorting device according to claim 2, wherein the object carrier further comprises an upper layer (104) above the airflow permeable nonwoven fabric-like material (300), the upper layer (104) comprises a number of openings (106).

4. Sorting device according to claim 3, wherein each opening is dimensioned to accommodate one single small light weight object and the airflow permeable nonwoven fabric-like material forms the bottom of the opening.

5. Sorting device according to claim 3, wherein each opening is an elongated opening with a width to accommodate a single row of small light weight objects and the airflow permeable nonwoven fabric-like material forms the bottom of the elongated opening.

6. Sorting device according to any of the claims 3 - 5, wherein the object carrier further comprises a lower layer below the airflow permeable nonwoven fabric-like material, the lower layer (204) comprises a multitude of openings (206), wherein each opening (106) through the upper layer has a corresponding opening through the lower layer to form a channel for the upward airflow.

7. Sorting device according to claim 6, wherein an opening through the upper layer has a circumference not exceeding the circumference of a corresponding opening through the lower layer.

8. Sorting device according to claim 7, wherein an opening through the lower layer narrows in direction of the upward airflow.

9. Sorting device according to claim 1, wherein the object carrier (2) is in the form of an end-less belt and the filing section is configured to drop objects on the object carrier at a predefined minimum distance from each other.

10. Sorting device according to claim 9, wherein the object carrier comprises a top layer forming longitudinal grooves, whose bottoms are formed by the airflow permeable nonwoven fabric-like material.

11. Sorting device according to any of the claims 1 - 10, wherein the inspection section comprises an X-ray source (16) and an X-ray detector (13), the transportation unit being arranged to move the object carrier (2) along a path between the X-ray source and X-ray detector.

12. Sorting device according to any of the claims 1 - 11, wherein the airflow permeable nonwoven fabric-like material is a carbon fibre mat with a thickness in the range of 0,08 mm - 0,25 mm, consisting of filaments of carbon with a diameter of 7μm with polyvinyl alcohol as binding agent.

13. Sorting device according to any of the claims 1 - 12, wherein the airflow permeable nonwoven fabric-like material is pervious to light.

14. Module for use in a sorting device, comprising all technical features of an object carrier according to any of the claims 1 - 13.

15. Method of sorting, analyzing or grading small, lightweight objects, the method comprising, supplying a batch of small lightweight objects to an arrangement comprising all technical features of a sorting device according any of the claims 1 - 13, to obtain two or more batches of sorted small lightweight objects;

depositing small light weight objects on an airflow permeable nonwoven fabric-like material of an object carrier; and
selectively removing the small light weight object from the object carrier by an upward airflow flowing through the airflow permeable nonwoven fabric-like material.

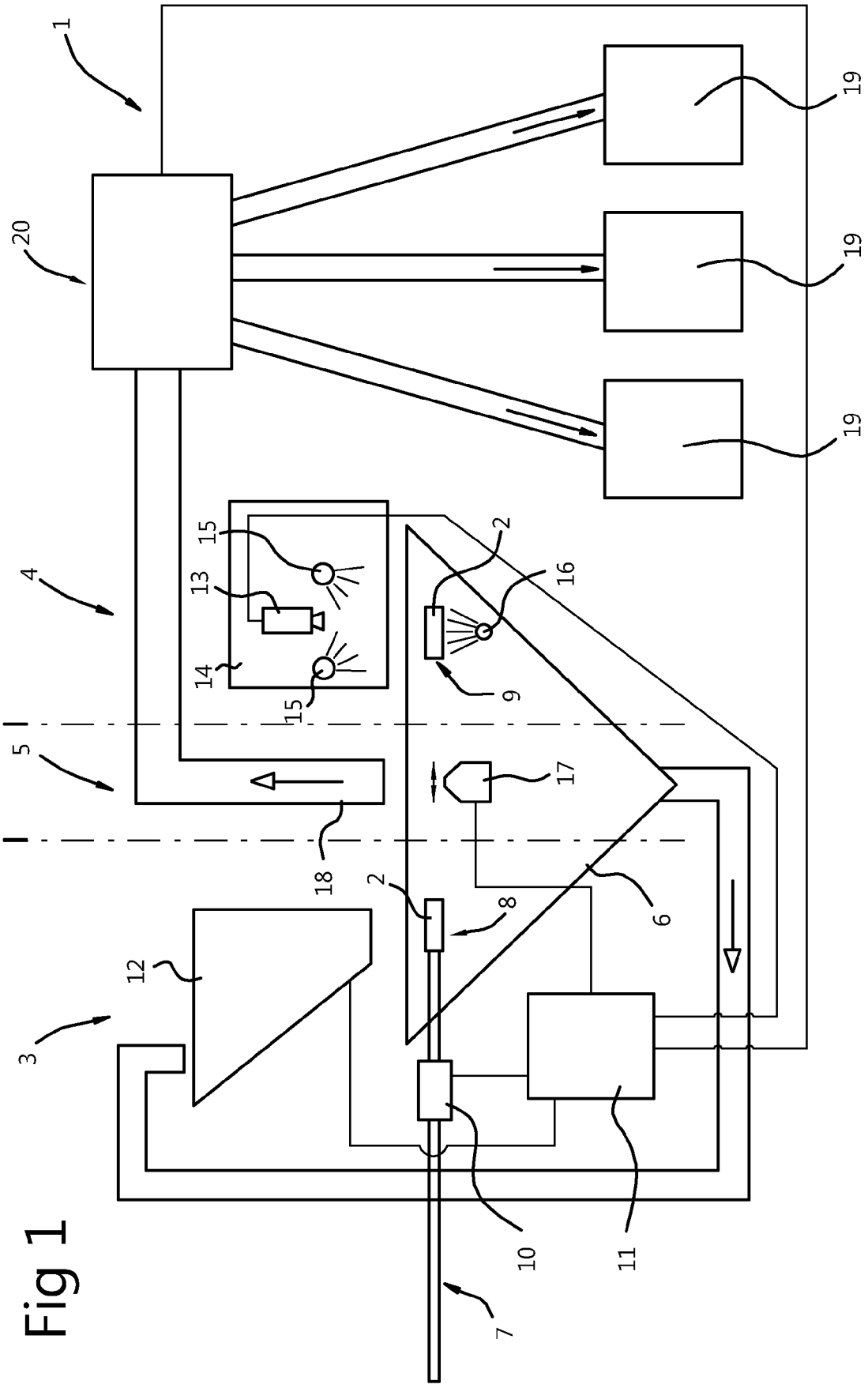


Fig 1

Fig. 2

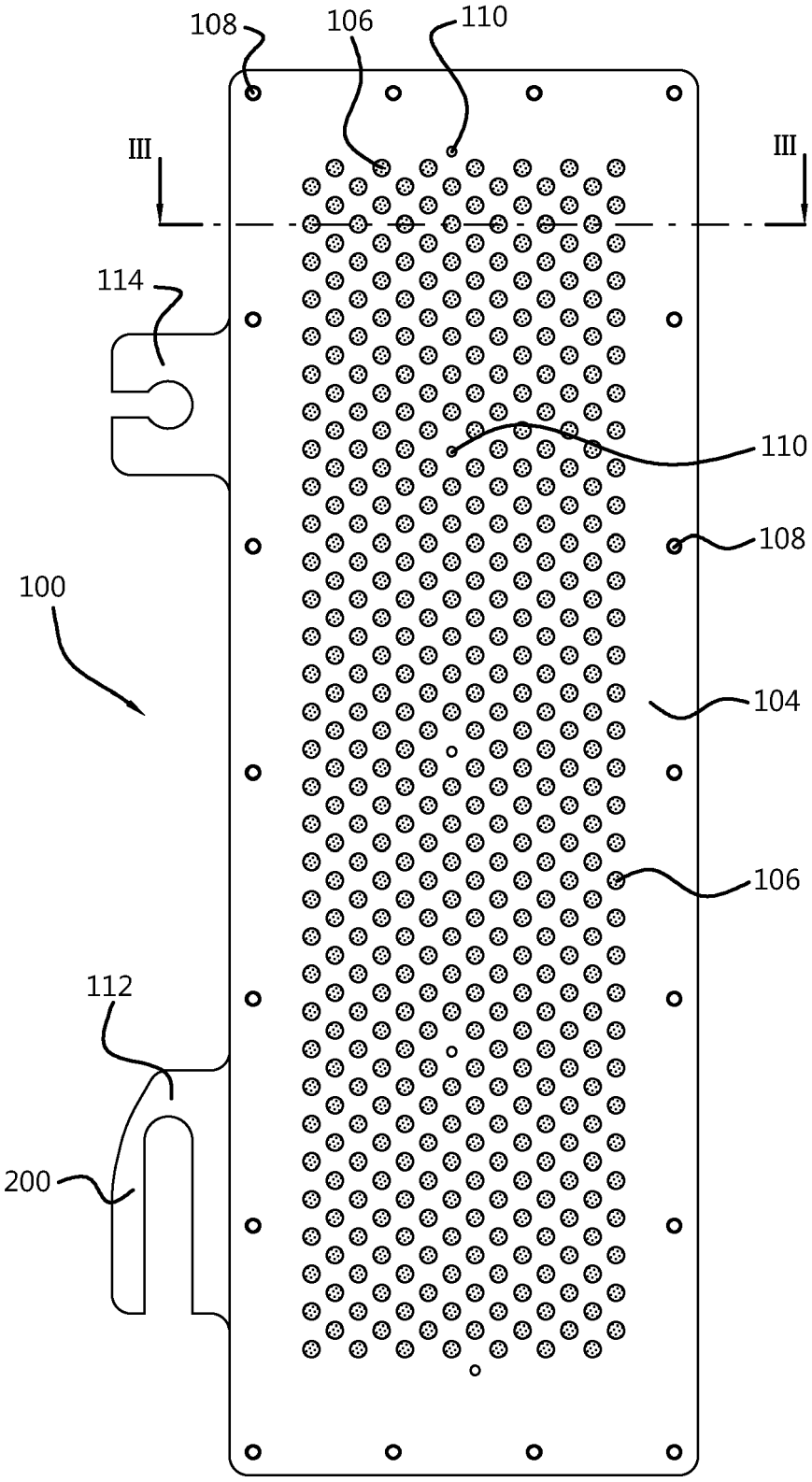


Fig. 3

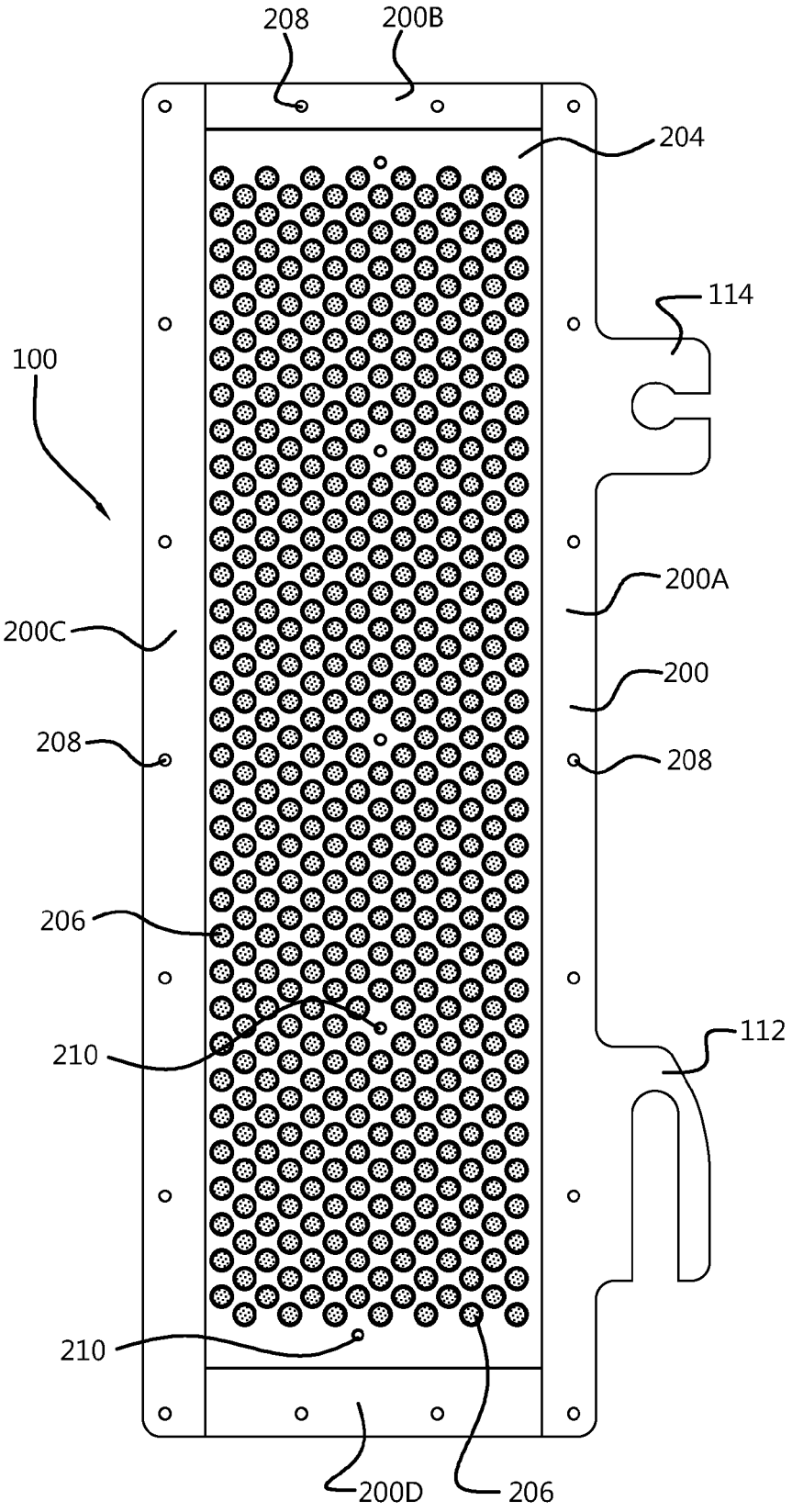

208
200B
204
114
100
200A
200C
200
208
208
206
210
112
210
200D
206

Fig. 4

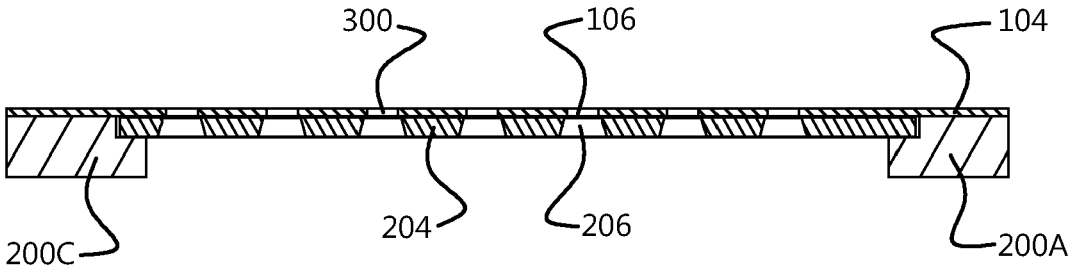


Fig. 5

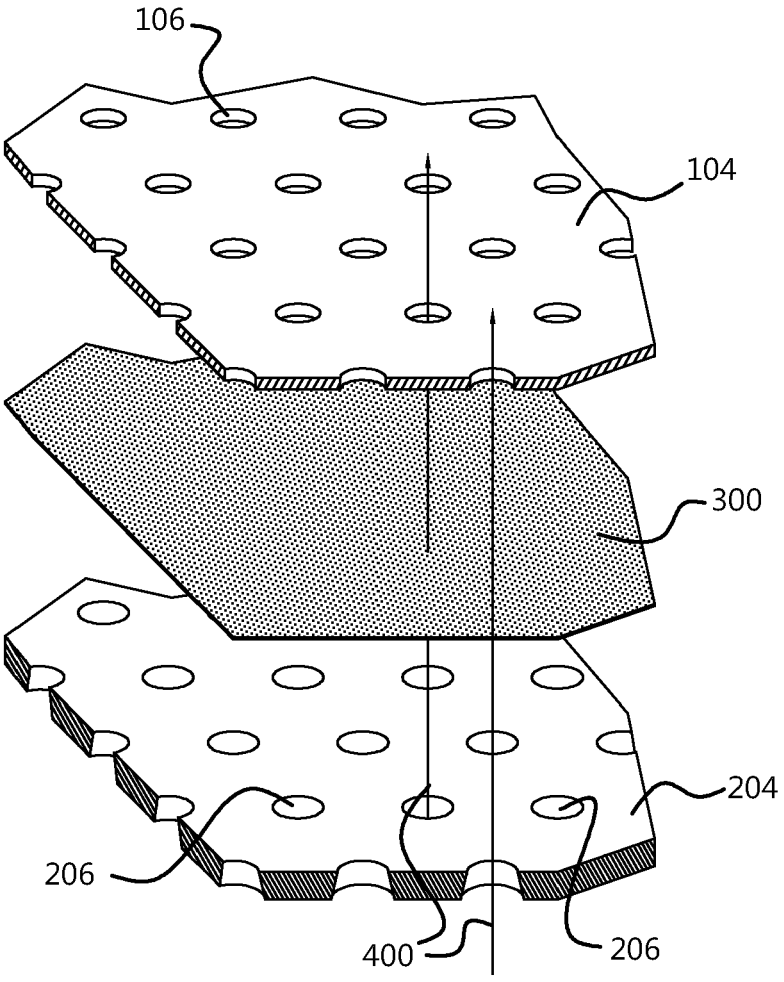


Fig. 6

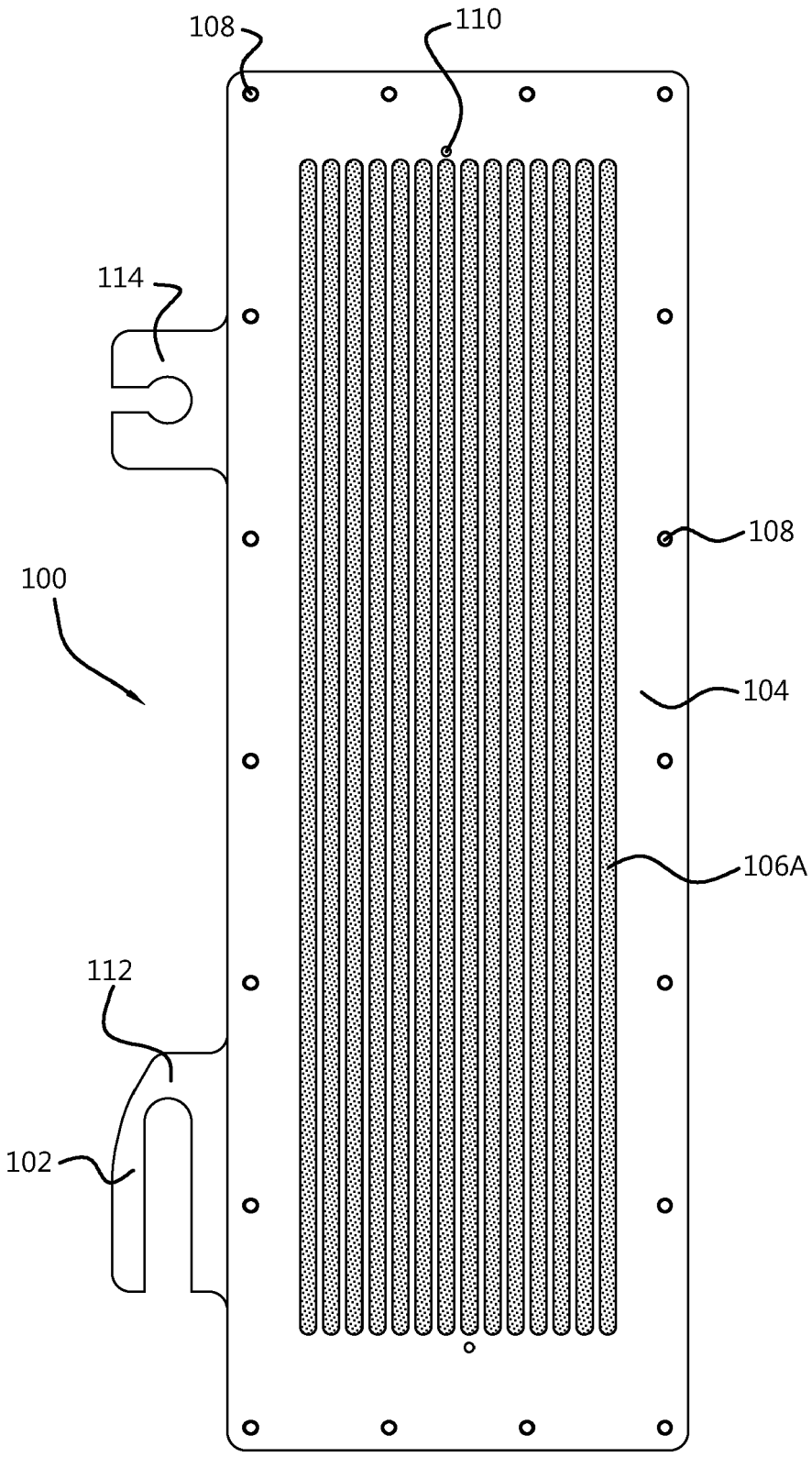


Fig. 7

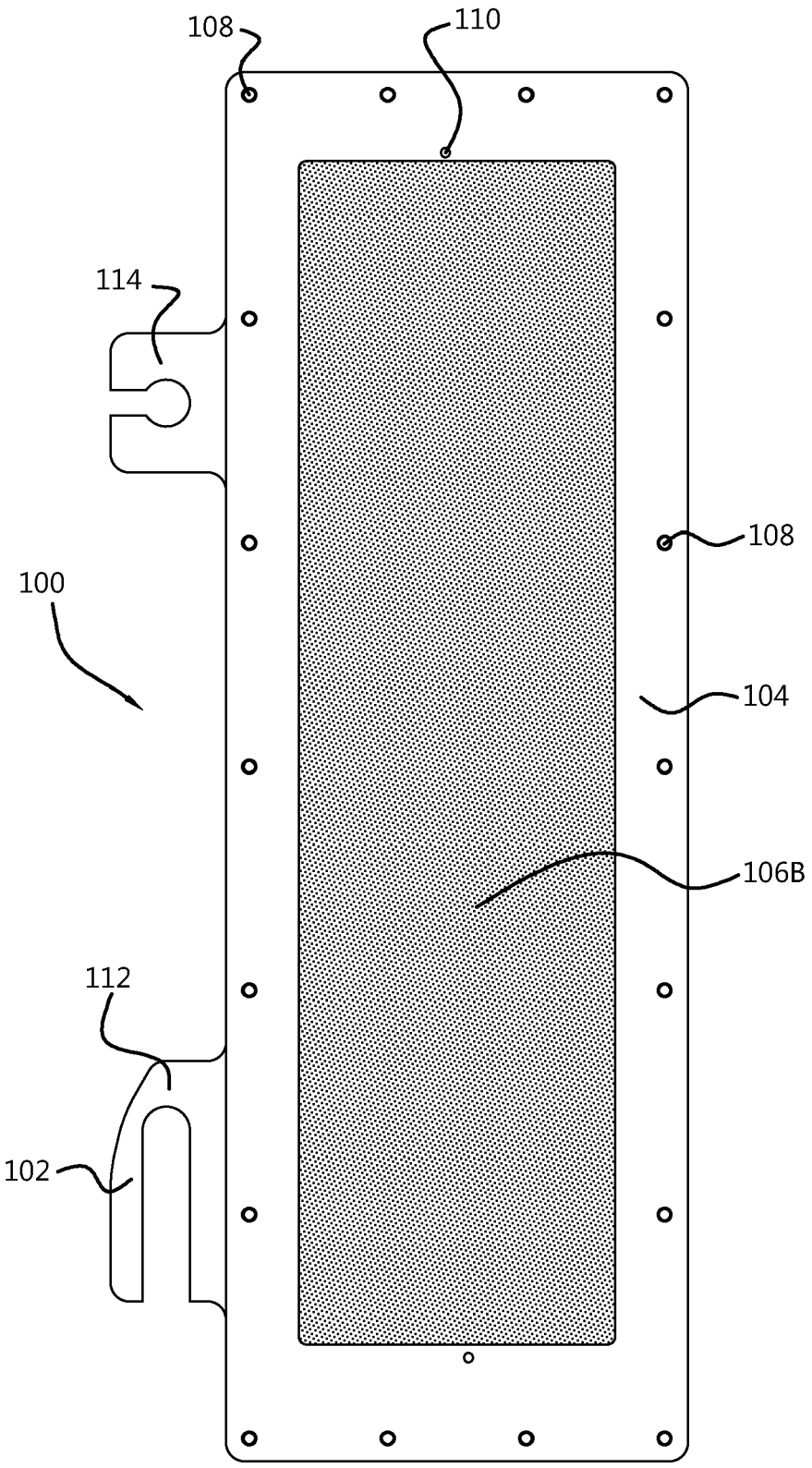


Fig. 8

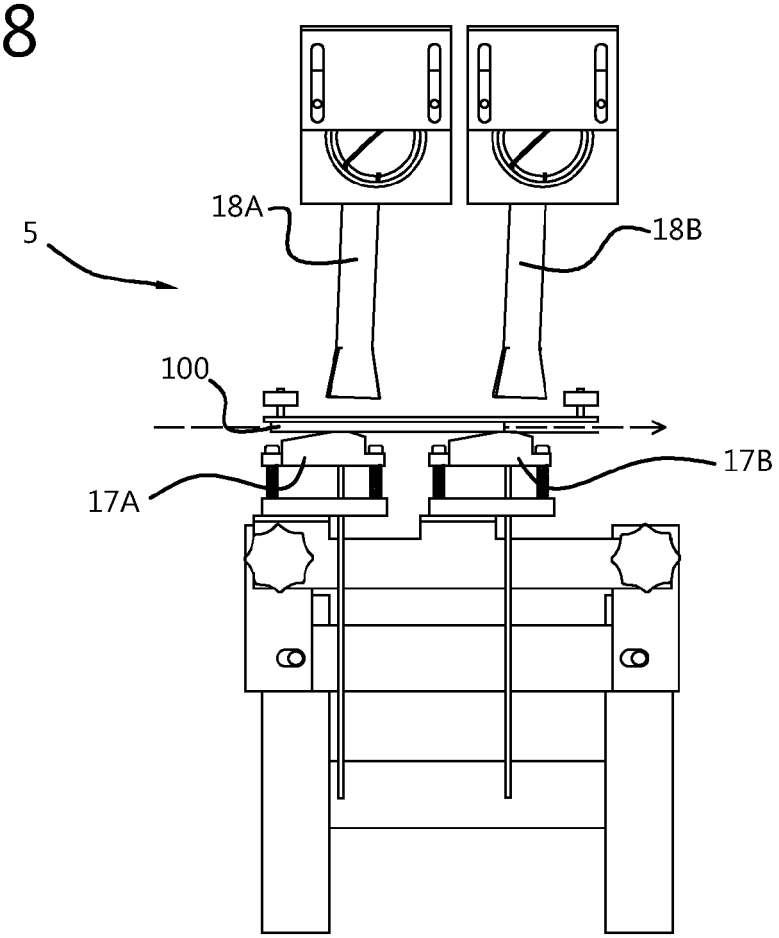
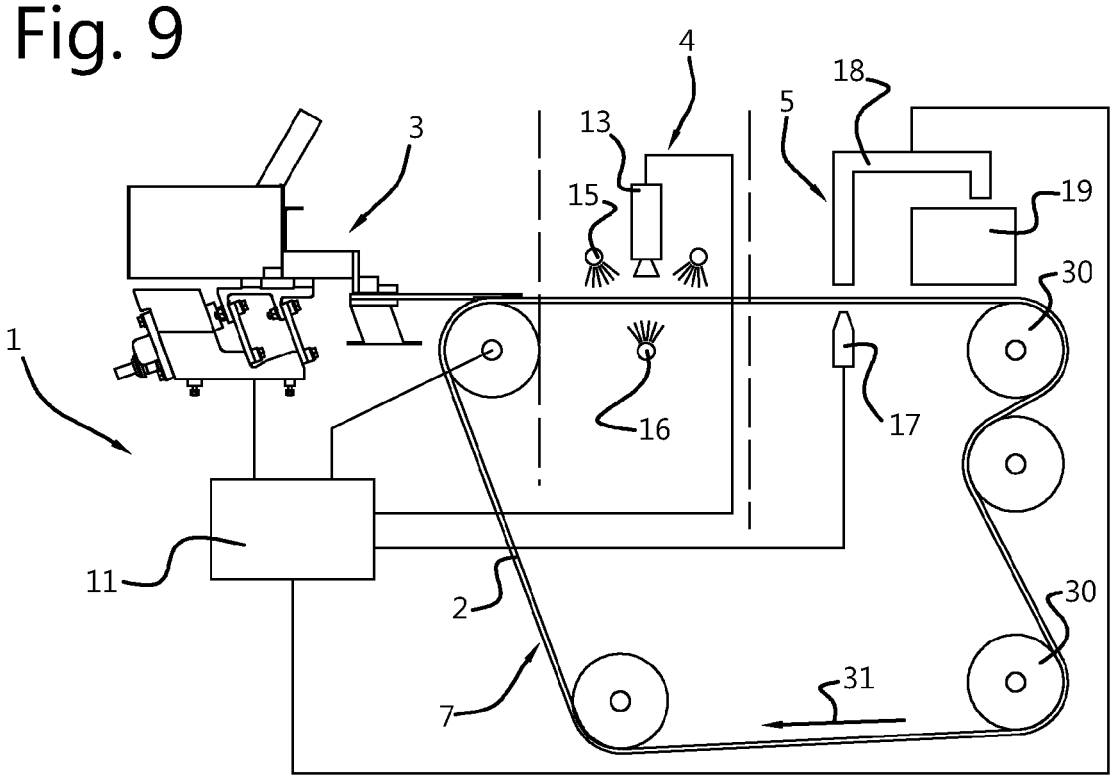


Fig. 9



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TECHNICAL FIELDS SEARCHED (IPC)

B07C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 May 2023	Wich, Roland

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