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

(11) **EP 4 234 226 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.08.2023 Bulletin 2023/35

(21) Application number: **22158345.3**

(22) Date of filing: **23.02.2022**

(51) International Patent Classification (IPC):
B31D 5/00 *(2017.01)*

(52) Cooperative Patent Classification (CPC):
B31D 5/0013

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **ASSEMBLY MACHINE OF HONEYCOMBED SEPARATORS**

(57) An assembly machine (1) of honeycombed separators (50) for the separation of objects to be packed is described; the honeycombed separators (50) comprising at least a first diaphragm (51) and at least a second diaphragm (52) assembled to one another so as to define a plurality of seats, each of which is adapted to house a respective object; the machine (1) comprising: a fixed frame (10); a drum (11) rotatable around a rotation axis (A) with respect to the frame (10); a plurality of templates (12) rotatable integrally with the drum (11) with a revolution motion with respect to the axis (A); each of the templates (12) comprising a seat (13) having a shape corresponding to the honeycombed separators (50) and adapted to house first and second diaphragms (50, 51); a plurality of magazines (14a, 14b) of the first diaphragms (51) and second diaphragms (52) rotationally fixed with respect to the drum (11); a plurality of transfer systems (15a, 15b) of the first and second diaphragms (51, 52) from the magazines (14) to the seats (13); and extraction means (16) of the first and second diaphragms (51, 52) from the seats (13).

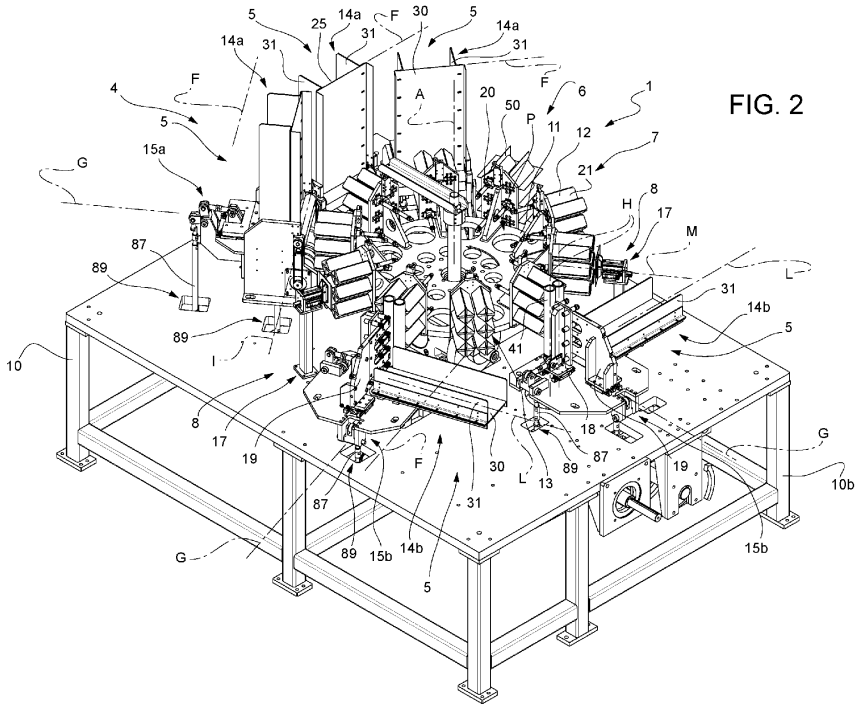

FIG. 2

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Description

[0001] The present invention relates to an assembly machine of honeycombed separators. The present invention also relates to a manufacturing system of honeycombed separators.

[0002] Honeycombed separators for packing objects to be transported, such as bottles, glasses or cups, inside containers of various type, for example boxes, are known. Such separators define a plurality of seats - called "cells" - and are inserted inside containers for dividing the inner volume thereof. In particular, at each of the seats a respective object to be transported can be inserted.

[0003] Generally, the honeycombed separators are made of cardboard and comprise a plurality of diaphragms assembled to one another so as to define the seats. Specifically, the number of seats depends on the number of diaphragms of which the separator is composed and on the relative arrangement between such diaphragms.

[0004] In particular, when a honeycombed separator is inserted in a box, at least one portion of one or more diaphragms is interposed between the objects inserted in the seats. Consequently, the use of the separators allows substantially reducing the risk that the objects can collide with each other during the transportation of the boxes and suffer damage.

[0005] Specifically, a diaphragm is an element made of cardboard with a preferably rectangular shape having:

- two base sides parallel to one another and to a first direction; and
- two further sides parallel to one another and to a second direction transverse to the first.

[0006] In a minimum configuration, a honeycombed separator comprises two diaphragms arranged in a transverse manner with respect to one another. Specifically, one of the two diaphragms comprises a notch for part of the extension of the diaphragm along the second direction and preferably made at an intermediate portion thereof along the first direction.

[0007] The assembling of the two diaphragms is thus obtained by engaging one of the two diaphragms in the notch of the other one.

[0008] In such minimum configuration, the separator defines four seats adapted to respectively accommodate four objects to be transported inside the box.

[0009] However, separators comprising six seats, nine seats, twelve seats or many more are known, which are obtained assembling to one another an increasing number of diaphragms.

[0010] Machines for the automated assembling of the honeycombed separators are also known. Such machines essentially comprise:

- a conveyor belt, on which first diaphragms each provided with one or more notches are translated parallel to a third direction; and
- a translating device, which handles second diaphragms along a fourth direction perpendicular to the third direction according to a reciprocating motion, so as to allow the second diaphragms to engage the respective notches of the first diaphragms.

[0011] The machines of known type further comprise a control unit and position sensors, by means of which the position of the first diaphragms along the third direction is detected instant by instant or calculated through numerical modes.

[0012] Specifically, with the aim to allow the correct insertion of the second diaphragms in the respective notches of the first diaphragms, the translation movement of the device along the fourth direction is controlled on the basis of the position of the first diaphragms along the third direction. More specifically, the reciprocating motion of the translating device is managed by means of consent signals sent from the control unit to the translating device.

[0013] However, such machines of known type do not allow maximizing the manufacturing volume of the honeycombed separators. This is particularly true in the case of honeycombed separators comprising a high number of diaphragms. In fact, at each reciprocating movement of the translating device it is possible to couple one single second diaphragm to one single first diaphragm. Therefore, it is not possible to obtain the simultaneous assembling of more honeycombed separators.

[0014] Therefore, the need is felt to have an assembly machine that allows assembling honeycombed separators comprising an also high number of seats in an efficient manner.

[0015] The object of the present invention is to embody an assembly machine, which allows satisfying the abovementioned need in a simple and cost-effective manner.

[0016] The abovementioned object is achieved by the present invention, since it relates to an assembly machine of honeycombed separators according to claim 1.

[0017] A preferred non-limiting embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

- Figure 1 illustrates a manufacturing system of honeycombed separators comprising an assembly machine according to the present invention and with parts removed for clarity;
- Figure 2 is a perspective view of the assembly machine of Figure 1 on an enlarged scale and with parts removed for clarity;
- Figure 3 is a perspective view of the machine of Figures 1 and 2 on an even more enlarged scale and with parts removed for clarity;
- Figures 4 and 5 are detailed perspective views of the machine of Figures from 1 to 3 with parts re-

moved for clarity;

- Figure 6 is a bottom view of the machine of Figures from 1 to 5 and with parts removed for clarity;
- Figure 7 is a bottom perspective view of the machine of Figures from 1 to 5 and with parts removed for clarity;
- Figure 8 is a block scheme of some parts of the machine of Figures from 1 to 7 and with parts removed for clarity.

[0018] With reference to Figure 1, reference numeral 100 indicates a manufacturing system of honeycombed separators 50 for the separation of objects to be packed (not illustrated).

[0019] As is known, honeycombed separators are understood as manufactured articles comprising at least two diaphragms 51, 52 assembled to one another so as to define a plurality of seats, also called cells, each of which is adapted to house a respective object. Furthermore, generally, the honeycombed separators are inserted inside containers of various type, for example cardboard boxes, intended for transporting the objects.

[0020] Specifically, a diaphragm 51, 52 is a body having prevailing extension along two dimensions, i.e. length and width, with respect to the extension along the third dimension, i.e. the thickness.

[0021] Preferably, the diaphragm 51, 52 is made of cardboard, but it could be made of materials different from paper (for example, of materials of plastic type).

[0022] In a minimum configuration, a honeycombed separator 50 comprises a diaphragm 51 and a diaphragm 52 oriented so that the directions defined by the lengths of the two diaphragms 51, 52 are transverse to one another. Furthermore, the two diaphragms 51 and 52 can be identical to one another, or have different dimensions.

[0023] The diaphragm 51 and/or the diaphragm 52 comprise, in turn, a notch (not illustrated) for part of the width of the diaphragm and preferably made at an intermediate portion of the diaphragm along the length thereof.

[0024] The assembling of the two diaphragms 51, 52 is thus obtained engaging one of the two diaphragms 51, 52 with the notch of the other diaphragm 52, 51.

[0025] In such minimum configuration, the separator 50 defines four seats adapted to respectively accommodate four objects (or more).

[0026] The manufacturing system 100 comprises (Figure 1):

- an assembly machine 1 of honeycombed separators 50; and
- a folding and transport device 2 of the honeycombed separators 50 assembled by the assembly machine 1.

[0027] The manufacturing system 100 can also comprise a stacking device 3 of the honeycombed separators 50, arranged downstream of the folding and transport device 2.

[0028] The illustrated assembly machine 1 is specifically designed, without thereby entailing any loss of generality, for the assembling of honeycombed separators 50 comprising twelve seats.

[0029] Specifically, as illustrated in Figure 5, each honeycombed separator 50 assembled by the assembly machine 1 comprises three diaphragms 51 and two diaphragms 52. The two diaphragms 51 are arranged so as to be spaced apart from one another along a direction D and so that the respective lengths of the diaphragms 51 are parallelly directed to a direction E; the three diaphragms 52 are arranged so as to be spaced apart from one another along the direction E and so that the respective lengths of the diaphragms 52 are parallelly directed to the direction D.

[0030] In the illustrated embodiment, the directions D and E are perpendicular to one another (Figure 5). Furthermore, considering the orientation of the assembly machine 1 with respect to the ground illustrated in Figures from 1 to 3, the direction D is horizontal and the direction E is vertical to the ground on which the assembly machine 1 rests.

[0031] However, the assembly machine 1 can be configured to assemble honeycombed separators 50 comprising a number of seats different from twelve (for example, six seats, nine seats or a number of seats greater than twelve).

[0032] As illustrated in Figure 2, the assembly machine 1 comprises a frame 10 which is fixed with respect to the ground.

[0033] The frame 10 comprises, in turn, a resting plane 10a arranged parallel to the ground and a structure 10b, which supports the resting plane 10a with respect to the ground (Figure 3).

[0034] Advantageously, the assembly machine 1 comprises (Figure 2):

- a drum 11 rotatable around a rotation axis A with respect to the frame 10; and
- a plurality of templates 12 rotatable integrally with the drum 11 with a revolution motion with respect to the axis A and each comprising a seat 13, which has a shape corresponding to the honeycombed separators 50 to be assembled and is adapted to house the diaphragms 51 and 52.

[0035] The assembly machine 1 further comprises:

- a plurality of storehouses 14a, 14b of the diaphragms 51, 52, which are fixed with respect to the frame 10;
- a plurality of transfer systems 15a, 15b of the diaphragms 51, 52 from the storehouses 14a, 14b to the seats 13; and
- extraction means 16 of the diaphragms 51, 52 from the seats 13.

[0036] In particular, the assembly machine 1 comprises a plurality of operating stations 4 angularly distributed with respect to the axis A, at each of which a respective operation with the diaphragms 51, 52 is carried out (Figure 2) .

[0037] Specifically, the operating stations 4 comprise:

- a plurality of filling stations 5, at which a diaphragm 51 or 52 is inserted in a respective seat 13; and
- a finished product discharge station 6, at which the honeycombed separator 50 assembled by the assembly machine 1 is discharged from the seat 13 by means of the extraction means 16.

[0038] Specifically, at each filling station 5 each seat 13 is adapted to receive a diaphragm 51 or 52. More specifically, each diaphragm 51, 52 is engaged in a respective portion of the seat 13. Each diaphragm 51, while being engaged with the seat 13, further engages one or more notches made in one or more diaphragms 52.

[0039] Additionally, in the finished product discharge station 6 the honeycombed separator 50 is discharged at the folding and transport device 2.

[0040] The operating stations 4 can further comprise a discard discharge station 7, in which the components to be discarded are ejected from the template 12 and/or one or more compaction stations 8, in which the diaphragms 51, 52 housed in a seat 13 are compacted to one another.

[0041] As illustrated in Figure 4, the drum 11 has a circular shape in a plane P orthogonal to the axis A and comprises a central portion 11a and a peripheral profile 11b.

[0042] Preferably, considering the orientation of the assembly machine 1 illustrated in Figure 1, the rotation of the drum 11 around the axis A is counter-clockwise.

[0043] The drum 11 further comprises a plurality of lightening holes 11c at the central portion 11a. In the illustrated embodiment, the lightening holes 11c are circular, through-holes and have respective axes parallel to the axis A.

[0044] Specifically, the movement of the drum 11 with respect to the axis A comprises several rotation steps alternated with waiting steps, in which the drum 11 is angularly fixed with respect to the axis A. More specifically, at each rotation step, the drum 11 is adapted to shift each template 12 from an operating station 4 to the angularly consecutive one; at each waiting step, the drum 11 waits at an operating station 4.

[0045] The temporal duration of the waiting step is compatible with the loading operations of the diaphragms 51 and/or 52 in the seats 13 in the filling stations 5, with the unloading operations in the finished product discharge station 6 and/or in the discard discharge station 7 and with the compacting operations in the compaction station 8.

[0046] The templates 12 are arranged at or anyway in the proximity of the peripheral profile 11b and are angularly equally spaced apart from one another with respect to the axis A (Figures 1 and 2) .

[0047] In the illustrated embodiment, the templates 12 are ten. Therefore, the rotation of the drum 11 at each rotation step occurs by an angle of 36° with respect to the axis A.

[0048] However, the assembly machine 1 could comprise a different number of templates 12, depending on the type of separator 50 to be assembled and/or on the desired manufacturing volume.

[0049] In turn, the templates 12 comprise a supporting element 20 fixed to the drum 11 and a plurality of assembling units 21 fixed to the supporting element 20 on the side of the supporting element 20 facing the parts of the assembly machine 1 radially external with respect to the drum 11 (Figure 2).

[0050] As illustrated in Figure 5, the supporting element 20 is a flat panel having a substantially rectangular shape and arranged perpendicular to the plane P. Furthermore, the assembling units 21 extend starting from the supporting element 20 along a direction B perpendicular to the supporting element 20.

[0051] Additionally, the directions B of the templates 12 are substantially radial with respect to the axis A (Figure 5).

[0052] It is also possible to define a direction C for each template 12 such as the direction orthogonal to the axis A and to the direction B of the relative supporting element 20. Furthermore, when the diaphragms 51, 52 are housed in a seat 13, the direction D coincides with the direction C defined by the relative template 12 (Figure 5).

[0053] Specifically, each assembling unit 21 comprises an end 21a at which it is fixed to the supporting element 20 and an end 21b, which is opposite the end 21a along the relative direction B and which is free. More specifically, the templates 12 are adapted to accommodate the diaphragms 51, 52 on the side of the end 21b (Figure 5).

[0054] Each assembling unit 21 comprises four elements 22a, 22b, 22c, 22d arranged so as to define between one another a gap 23 having an X-shaped section in a plane perpendicular to the direction B of the assembling unit 21. Each gap 23 comprises, in turn, a portion 23a parallel to the axis A and a portion 23b parallel to the direction C (Figure 5).

[0055] In particular, the gaps 23 of all the assembling units 21 of a template 12 define, in the whole, the seat 13 of the template 12.

[0056] In the illustrated embodiment, each element 22a, 22b, 22c, 22d is a parallelepiped with section having a right-angled triangle shape in a plane perpendicular to the direction B defined by the relative supporting element 20 (Figure 5).

[0057] Specifically, for each assembling unit 21, the elements 22a and 22b are aligned with and spaced apart from one another parallel to the direction C; the elements 22c, 22d are also aligned with and spaced apart from one another parallel to the direction C and are also spaced apart with respect to the elements 22a and 22b

parallel to the axis A.

[0058] More specifically, each element 22a, 22b, 22c, 22d of a same assembling unit 21 (for example the element 22a) is arranged so as to have:

- a cathetus of the triangular section aligned with a cathetus of the triangular section of a first element (in the illustrated case, the element 22b) between the elements 22a, 22b, 22c, 22d and directly facing a cathetus of the triangular section of a second element (in the illustrated case, the element 22c) between the elements 22a, 22b, 22c, 22d; and
- a cathetus of the triangular section aligned with a further cathetus of the triangular section of the second element (22c) and directly facing a further cathetus of the triangular section of the first element (22b).

[0059] For each assembling unit 21, the portion of space comprised between the element 22a and the element 22b and the portion of space comprised between the element 22c and the element 22d define the portion 23a; the portion of space comprised between the element 22a and the element 22c and the portion of space comprised between the element 22b and the element 22d define the portion 23b.

[0060] In other words, each assembling unit 21 substantially has a rhombus shape in a plane perpendicular to the relative direction B. Preferably, the gap 23 further has the shape of a right angled cross.

[0061] In the illustrated embodiment, the templates 12 comprise six assembling units 21, each shaped for housing at least in part a diaphragm 51 and a diaphragm 52. However, the templates 12 could comprise a different number of assembling units 21, depending on the type of separator 50 to be assembled.

[0062] Specifically, each template 12 comprises three pairs of assembling units 21, each arranged at three respective heights parallel to the axis A. The two assembling units 21 of each pair are further aligned with one another parallel to the direction C of the template 12.

[0063] More specifically, as illustrated in Figure 5, the portion 23b of each assembling unit 21 is aligned parallel to the direction C with the portion 23a of the assembling unit 21 adjacent along the direction C. Similarly, the portion 23a of each assembling unit 21 is aligned parallel to the axis A with the portion 23a of the other two assembling units 21 aligned with one another parallel to the axis A.

[0064] Preferably, the portions 23a of a same template 12 aligned with one another parallel to the axis A are adapted to house a respective diaphragm 51; the portions 23b aligned with one another parallel to the direction C are adapted to house a respective diaphragm 52.

[0065] The storehouses 14a, 14b are radially external the templates 12 with respect to the axis A and are fixed to the frame 10 (Figures 1 and 2). Specifically, the storehouses 14a, 14b are supported by the resting plane 10a.

[0066] A respective transfer system 15a, 15b is associated with each storehouse 14a, 14b. Additionally, each storehouse 14a, 14b and the transfer system 15a, 15b associated therewith define a filling station 5 intended for the insertion of a diaphragm 51 or 52 in the seat 13 of the template 12 placed at the filling station 5 during a waiting step.

[0067] In the illustrated embodiment, the assembly machine 1 comprises three storehouses 14a and two storehouses 14b angularly spaced apart from one another around the frame 10. In particular, the storehouses 14a are adapted to house the diaphragms 51 and the other two storehouses 14b are adapted to house the diaphragms 52. Additionally, the three storehouses 14a are angularly equally spaced apart from one another with respect to the axis A and the two storehouses 14b are angularly equally spaced apart from one another with respect to the axis A.

[0068] More specifically, proceeding in a counterclockwise circumferential direction around the drum 11 according to the orientation of the machine 1 illustrated in Figure 2, the machine 1 comprises three filling stations 5 (corresponding to the three storehouses 14a), a compaction station 8, two filling stations 5 (corresponding to the two storehouses 14b), a further compaction station 8, the discard discharge station 7 and the finished product discharge station 6 (Figure 2). However, the machine 1 could comprise a different number of filling stations 5 and/or of compaction stations 8.

[0069] Additionally, the angular distance with respect to the axis A between two angularly consecutive operating stations 4 is equal to the angular distance between two angularly consecutive templates 12.

[0070] One or more operating stations 4 could be deactivated, i.e. set so as not to perform any operation on the template 12 housed thereat during the waiting step. For example, a filling station 5 could be set so as not to insert any diaphragm 51, 52 in the seat 13 of the template 12 positioned thereat.

[0071] As illustrated in Figures 3 and 4, the storehouses 14a, 14b each comprise a housing 25 for the diaphragms 51, 52. In particular, in the storehouses 14a the diaphragms 52 are arranged parallel to the plane P and stacked on top of one another parallel to the axis A. Vice versa, in the storehouses 14b the diaphragms 51 are arranged transverse to the plane P and are drawn close to one another along a direction L transverse to the axis A and in particular tangential or substantially tangential to the drum 11 (Figure 4) .

[0072] In each storehouse 14a the housing 25 is defined by a panel 30 and two fins 31 extending from the panel 30 on the side opposite the drum 11 and spaced apart from one another along a direction F (Figures 2 and 3) . In each storehouse 14b the housing 25 is defined by a panel 30 and two fins 31 extending from the panel 30 on the side opposite the ground and spaced apart from one another along a direction F (Figure 4) .

[0073] The panel 30 of the storehouses 14a lies on a plane perpendicular to the plane P (Figure 3); vice versa, the panel 30 of the storehouses 14b lies on a plane par-

allel to the plane P (Figure 4).

[0074] Furthermore, the distance between the fins 31 is equal or substantially equal to the length of the diaphragms 51, 52.

[0075] Furthermore, the directions F of the storehouses 14a are preferably oriented in a substantially tangential manner to the drum 11 (Figure 3).

[0076] In the illustrated embodiment, the panels 30 of the two storehouses 14b preferably lie on the same plane.

[0077] Vice versa, the three storehouses 14a are arranged at different heights with respect to the frame 10. In particular, proceeding counter-clockwise from the finished product discharge station 6, the storehouses 14a are arranged at increasing heights with respect to the resting plane 10a.

[0078] As illustrated in Figure 2, the assembly machine 1 comprises five transfer systems 15a, 15b, each in the proximity of a respective storehouse 14a, 14b. Specifically, each transfer system 15a is placed in the proximity of a respective storehouse 14a and is configured to transfer a diaphragm 52 from the storehouse 14a to one or more portions 23b parallel to the plane P of a template 12; each transfer system 15b is placed in the proximity of a respective storehouse 14b, is configured to transfer a diaphragm 51 from the storehouse 14b to one or more portions 23a parallel to the axis A of a template 12.

[0079] Each transfer system 15a, 15b comprises (Figures 3 and 4) :

- a gripping device 18 adapted to grip a diaphragm 51 or 52 from the respective storehouse 14a, 14b; and
- a handling device 19 adapted to handle the diaphragm 51 or 52 gripped by the gripping device 18 towards a seat 13.

[0080] In particular, each handling device 19 is adapted to handle the diaphragm 51 or 52 along a direction G of the transfer system 15a, 15b transverse to said axis A. Preferably, each direction G is oriented radially or substantially radially with respect to the axis A (Figures from 2 to 5).

[0081] Each gripping device 18 comprises a plurality of intake elements 43 and a plate 49, which carries such intake elements 43.

[0082] The assembly machine 1 further comprises vacuum generating means 42 - only schematically illustrated in Figure 4 - operatively connected to the intake elements 43 of all the gripping devices 18.

[0083] The intake elements 43 are adapted to exert on the diaphragms 51, 52 housed in the storehouse 14a, 14b the vacuum action generated by the vacuum generating means 42. In particular, the action exerted by the intake elements 43 on the diaphragm 51, 52 closest to the intake elements 43 is such to bring such diaphragm into direct contact therewith.

[0084] To such end, each intake element 43 comprises at least one opening - not illustrated - adapted to put the vacuum generating means 42 into fluidic communication with a portion of the surface of the diaphragm 51, 52.

[0085] Specifically, the vacuum generating means 42 comprise a vacuum pump, not illustrated. Preferably, the vacuum pump is a Venturi pump.

[0086] Each gripping device 18 - and in particular, the plate 49 - describes a reciprocating rectilinear motion between a closest position and a farthest position with respect to the relative storehouse 14a, 14b.

[0087] Specifically, the reciprocating rectilinear motion of the gripping device 18 of each transfer system 15a occurs parallel to the axis A. The closest position and the farthest position from the respective storehouse 14a further respectively correspond to a greater distance and to a lesser distance with respect to the plane P.

[0088] The reciprocating rectilinear motion of the gripping device 18 of each transfer system 15b occurs parallel to the direction L.

[0089] More specifically, each transfer system 15a, 15b comprises guiding elements 45 of the gripping device 18, which are fixed with respect to the frame 10, and each gripping device 18 comprises sliding elements 46, which slidingly engage the guiding elements 45 (Figure 4). Additionally, each transfer system 15b can comprise a device - not illustrated - for the automatic approaching of the diaphragms 51 to the gripping device 18.

[0090] The guiding elements 45 of each transfer system 15a comprise two linear guides directed parallel to the axis A. The guiding elements 45 of each transfer system 15b comprise two linear guides directed parallel to the direction L of the respective storehouse 14b.

[0091] Furthermore, the sliding elements 46 of each transfer system 15a, 15b are integral with the respective plate 49.

[0092] In particular, the reciprocating rectilinear movement of each plate 49 is obtained by causing the sliding elements 46 to slide with respect to the respective guiding elements 45.

[0093] Each handling device 19 comprises a plate 44 movable along the direction G of the handling device 19. Specifically, the plate 44 describes a reciprocating rectilinear motion along the direction G between a radially more external position with respect to the drum 11 and a radially more internal position with respect to the drum 11.

[0094] The plates 44 and 49 of each transfer system 15a are spaced apart from one another parallel to the axis A. As illustrated in Figure 4, the plates 44 and 49 of each transfer system 15b are further spaced apart from one another parallel to the direction L of the relative storehouse 14b. In this manner, each plate 44 can move without interfering with the movement of the plate 49.

[0095] More specifically, each transfer system 15a, 15b comprises guiding elements 47 of the handling device 19, which are fixed with respect to the frame 10, and each handling device 19 comprises sliding elements 48, which slidingly engage the guiding elements 47. The sliding elements 48 are integral with the plate 44 of the relative handling device 19 and are interposed between the

plate 44 and the frame 10 parallel to the axis A (Figure 4).

[0096] In particular, the reciprocating rectilinear movement of each plate 44 along the direction G is obtained making the sliding elements 48 slide with respect to the respective guiding elements 47.

[0097] In the illustrated embodiment, the plate 44 comprises a flat face 44a facing the storehouse 14a, 14b and in particular the diaphragms 51, 52 to be handled.

[0098] Each plate 44 comprises a plurality of through openings 44b. Specifically, the openings 44b have a substantially rectangular shape and extend starting from the edge of the plate 44 facing the drum 11 (Figure 3). In other words, the edge of the plate 44 facing the drum 11 is interrupted by the openings 44b. The openings 44b are further parallel to one another and to the direction G of the transfer system 15a, 15b.

[0099] More specifically, for the transfer systems 15a the openings 44b parallelly pass through the axis A (Figure 3), whereas for the transfer systems 15b the openings 44b parallelly pass through the direction L (Figure 4).

[0100] Specifically, in each transfer system 15a the plate 44 is arranged so that the face 44a is parallel to the plane P and facing the diaphragms 51; in each transfer system 15b the plate 44 is arranged so that the face 44a is perpendicular with respect to the plane P, facing the diaphragms 52 and arranged radially to the axis A.

[0101] In the illustrated embodiment, each intake element 43 comprises a suction cup. Furthermore, the intake elements 43 of each gripping device 18 protrude beyond the face 44a of the respective handling device 19 on the side of the respective storehouse 14a, 14b or anyway on the side of the diaphragms 51, 52 to be transferred housed in the storehouses 14a, 14b.

[0102] Therefore, in the transfer systems 15a the intake elements 43 protrude with respect to the face 44a parallel to the axis A; in the transfer systems 15b the intake elements 43 protrude with respect to the face 44a parallel to the direction L of the transfer system 15b.

[0103] In the illustrated case, the gripping device 18 of each transfer system 15a comprises six intake elements 43 aligned in pairs parallel to the direction G of the transfer system 15a. Additionally, the pairs of intake elements 43 are spaced apart from one another parallel to the direction F of the transfer system 15a. The gripping device 18 of each transfer system 15b comprises eight intake elements 43 aligned in pairs parallel to the direction G of the transfer system 15b (Figure 3). Additionally, the pairs of intake elements 43 are spaced apart from one another parallel to the axis A (Figure 4).

[0104] More specifically, at least some of the intake elements 43 engage the openings 44b of the plates 44 of the respective handling devices 19.

[0105] Each transfer system 15a, 15b further comprises a pair of rollers 41 adapted to direct and transfer a diaphragm 51, 52 at the seat 13 of a template 12. In particular, the rollers 41 are adapted to transfer the diaphragm 51, 52 along the direction G of the respective transfer system 15a, 15b in the direction oriented by the respective handling device 19 towards the drum 11.

[0106] The rollers 41 of each pair of rollers are rotatable around respective rotation axes H, I transverse to the direction G and angularly spaced apart from one another with respect to the axis A. Specifically, each pair of rollers 41 is radially interposed with respect to the axis A between the drum 11 and a handling device 19. The axes H and I of the rollers 41 are further angularly fixed with respect to the drum 11.

[0107] More specifically, in each transfer system 15a the rollers 41 are rotatable around respective axes I parallel to the direction F of the transfer system 15a (Figure 5); furthermore, in each transfer system 15b the rollers 41 are rotatable around respective axes H parallel to the axis A (Figure 4).

[0108] The distance between each pair of rollers 41 is sufficient for defining a passage for a diaphragm 51, 52. As illustrated in Figure 2, the rollers 41 of each pair are arranged so that such passage is substantially aligned with the face 44a of the respective handling device 19.

[0109] The rollers 41 preferably rotate in a continuous manner around the respective rotation axes H, I during the entire working of the assembly machine 1. To such end, the assembly machine 1 comprises a plurality of electric motors 41a adapted to keep the rollers 41 in rotation (Figures 6 and 7). The two rollers 41 of a same pair further rotate in directions opposite to one another around the respective rotation axes H, I.

[0110] With reference to the transfer systems 15a, the plates 44 and the pairs of rollers 41 are arranged at respective heights which are different with respect to the frame 10. This is due to the fact that each of the three filling stations 5 corresponding to the storehouses 14a is configured to load a respective diaphragm 52 in a corresponding portion 23b and to the fact that the three pairs of portions 23b of the seats 13 are arranged at different heights with respect to the axis A.

[0111] With particular reference to Figure 5, the extraction means 16 comprise:

- a compressed air source 65, which is illustrated only schematically; and
- a plurality of nozzles 66 operatively connected to the compressed air source 65.

[0112] Specifically, each template 12 comprises a respective plurality of nozzles 66. In the illustrated embodiment, each template 12 comprises three nozzles 16.

[0113] The extraction means 16 further comprise valve means 69 - illustrated only schematically in Figure 8 - for adjusting the flow of compressed air directed from the source 65 to the nozzles 66 of one or more templates 12. Preferably, the valve means 69 comprise a pneumatic solenoid valve.

[0114] Specifically, the extraction means 16 of each template 12 are adapted to extract the diaphragms 51, 52 from the seat 13 of the template 12 by virtue of a flow of compressed air emitted from the nozzles 66 of the

template 12. More specifically, the extraction means 16 are adapted to extract the diaphragms 51, 52 when the template 12 is positioned in the finished product discharge station 6 or in the discard discharge station 7.

[0115] The nozzles 66 of each template 12 are arranged at the supporting element 20 of the template 12, on the side opposite the assembling units 21. Specifically, each supporting element 20 comprises a plurality of through holes - not illustrated - through which the flow of compressed air emitted from the nozzles 66 outflows at the supporting elements 20.

[0116] Preferably, the nozzles 66 are each arranged at a respective assembling unit 21. More in particular, the outflow opening of the nozzles 66 and the relative holes in the supporting element 20 are each arranged at the end 21a of a respective assembling unit 21 and in the center of the four elements 22a, 22b, 22c, 22d defining the gap 23.

[0117] As illustrated in Figures 6 and 7, the assembly machine 1 further comprises operating means 80 adapted to simultaneously operate:

- the drum 11 in rotation around the axis A with respect to the frame 10;
- the handling device 19 of each transfer system 15a, 15b along the relative direction G.

[0118] In particular, the fact that the operating means 80 simultaneously operate the drum 11 and the handling devices 19 implies that the movement of the drum 11 is correlated to the movement of the handling devices 19. In other words, the drum 11 cannot be driven into rotation without the handling devices 19 translating along the respective directions G and vice versa.

[0119] Additionally, the operating means 80 can be adapted to operate the gripping device 18 of each transfer system 15a, 15b between the closest position and the farthest position with respect to the relative storehouse 14a, 14b. In particular, in such case, the operating means 80 are adapted to simultaneously operate the gripping device 18 and the handling device 19 of each transfer system 15a, 15b and the drum 11.

[0120] The operating means 80 comprise (Figures 6 and 7):

- a source 81 of mechanical energy - illustrated only schematically - for example, an electric motor or an internal-combustion engine; and
- a main shaft 82 rotatable around a rotation axis X and operatively connected to the source 81 for receiving the mechanical energy thereof.

[0121] In particular, the operating means 80 comprise one single source 81, or a plurality of sources 81 operatively connected to one another.

[0122] The assembly machine 1 further comprises a control unit 70, operatively connected to the source 81 of mechanical energy and configured to control the operation thereof (Figures 6, 7 and 8).

[0123] The main shaft 82 is at least indirectly operatively connected to the drum 1 and to the handling means 19. The main shaft 82 can further be at least indirectly operatively connected to the gripping devices 18.

[0124] In the illustrated embodiment, the main shaft 82 is operatively connected to the drum 11 by means of a plurality of gears 83, which are schematically illustrated in Figures 6 and 7. However, the main shaft 82 could be operatively connected to the drum 11 by means of motion transmission devices of another type.

[0125] The operating means 80 further comprise:

- a plurality of secondary shafts 84a, 84b, 84c, 84d operatively connected to said main shaft 82 and rotatable around respective rotation axes J;
- a plurality of cams 85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851, keyed on only one of the secondary shafts 84a, 84b, 84c, 84d or on different secondary shafts 84a, 84b, 84c, 84d;
- a plurality of tappets 86a, 86b, 86c, 86d, 86e, 86f, 86g, 86h, 86i, 861 respectively cooperating with the cams 85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851 and operatively connected to the handling devices 19 and/or to the gripping devices 18.

[0126] Specifically, the operating means 80 comprise assemblies of rods 87 that connect the tappets 86 with the gripping devices 18 and/or the handling means 19.

[0127] In particular, the cams 85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851, the tappets 86a, 86b, 86c, 86d, 86e, 86f, 86g, 86h, 86i, 861 and the assemblies of rods 87 constitute a plurality of desmodromic motion transmission systems of the motion from the source 81 to the transfer systems 15a and 15b.

[0128] In the embodiment illustrated in Figures 6 and 7, the rotation axes J are parallel to one another and to the axis X.

[0129] The source 81, the main shaft 82, the secondary shafts 84a, 84b, 84c, 84d, the cams 85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851 and the tappets 86a, 86b, 86c, 86d, 86e, 86f, 86g, 86h, 86i, 861 are supported by the frame 10. Moreover, as it is possible to observe in Figure 6, such components are arranged underneath the resting plane 10a, i.e. on the opposite side of the drum 11 with respect to the resting plane 10a.

[0130] The operating means 80 further comprise a plurality of supports 88, which support the main shaft 82 and the secondary shafts 84a, 84b, 84c, 84d with respect to the resting plane 10a.

[0131] The resting plane 10a comprises, in turn, a plurality of through openings 89, which are passed through by the rods 87. In the illustrated embodiment, the openings 89 have a rectangular shape in a plane parallel to the plane P.

[0132] In the illustrated case, the secondary shaft 84a is operatively connected to the main shaft 82 for receiving the motion thereof deriving from the source 81 of me-

chanical energy. Specifically, the transmission of the motion between the main shaft 82 and the secondary shaft 84a is obtained by means of the gears 83.

[0133] Furthermore, proceeding from the axial end of the secondary shaft 84a arranged on the side of the source 81, the secondary shaft 84a comprises ten cams 85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851 rotatable integrally with the secondary shaft 84a and cooperating with respective ten tappets 86a, 86b, 86c, 86d, 86e, 86f, 86g, 86h, 86i, 861.

[0134] The interaction between the cams 85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851 and the respective tappets 86a, 86b, 86c, 86d, 86e, 86f, 86g, 86h, 86i, 861 determines the rotation of the tappets around respective rotation axes parallel to the axis J of the secondary shaft 84a.

[0135] The tappet 86a is operatively connected to the handling device 19 of a transfer system 15b (in particular, the transfer system 15b angularly closer to the finished product discharge station 6) by means of a rod assembly 87. More specifically, such rod assembly comprises a first rod connected to the tappet 86a and adapted to translate parallel to the axis A and a secondary rod connected to the plate 44 of the transfer system 15b for determining the reciprocating motion thereof along the relative direction G.

[0136] The tappet 86b is operatively connected to the secondary shaft 84b with the aim to transmit thereto the motion from the secondary shaft 84a.

[0137] The tappet 86c is operatively connected to the gripping device 18 of a transfer system 15b (in particular, the same transfer system 15b to which the tappet 86a is operatively connected) by means of an rod assembly 87. Similarly to the system of rods 87 connected to the tappet 86a, the rod assembly connected to the tappet 86c comprises a first rod connected to the tappet 86c and adapted to translate parallel to the axis A and a second rod connected to the plate 49 of the transfer system 15b for determining the reciprocating motion thereof along the direction L.

[0138] The tappet 86d is operatively connected to the secondary shaft 84c with the aim to transmit thereto the motion from the secondary shaft 84a.

[0139] The tappet 86e is operatively connected to the secondary shaft 84d with the aim to transmit thereto the motion from the secondary shaft 84a.

[0140] The tappet 86f is operatively connected to the gripping device 18 of a transfer system 15a (in particular, the third transfer system 15a according to the rotation direction of the drum 10) by means of one single rod 87 for determining the reciprocating motion thereof parallel to the axis A.

[0141] The tappet 86g is operatively connected to the gripping device 18 of a transfer system 15a (in particular, the first transfer system 15a according to the rotation direction of the drum 10) by means of one or more rods 87 for determining the reciprocating motion thereof parallel to the axis A.

[0142] The tappet 86h is operatively connected to the handling device 19 of a transfer system 15a (in particular, the second transfer system 15a according to the rotation direction of the drum 10) by means of a rod assembly 87 for determining the reciprocating motion thereof along the relative direction G.

[0143] The tappet 86i is operatively connected to the handling device 19 of a transfer system 15a (in particular, the same transfer system 15a to which the tappet 86f is operatively connected) by means of a rod assembly 87. Similarly to the system of rods 87 connected to the tappet 85c, the rod assembly connected to the tappet 86i comprises a first rod connected to the tappet 86i and adapted to translate parallel to the axis A and a second rod connected to the plate 44 of the transfer system 15a for determining the reciprocating motion thereof along the relative direction G.

[0144] The tappet 861 is operatively connected to the handling device 19 of a transfer system 15a (in particular, the same transfer system 15a to which the tappet 85h is operatively connected) by means of a rod assembly 87. Similarly to the system of rods 87 connected to the tappet 85i, the rod assembly connected to the tappet 861 comprises a first rod connected to the tappet 861 and adapted to translate parallel to the axis A and a second rod connected to the plate 44 of the transfer system 15a for determining the reciprocating motion thereof along the relative direction G.

[0145] Furthermore, the secondary shaft 84b is operatively connected to the handling device 19 of a transfer system 15b (in particular, the first transfer system 15b according to the rotation direction of the drum 10), for determining the translation thereof parallel to the direction G.

[0146] The secondary shaft 84c is operatively connected to the transfer device 18 of a transfer system 15b (in particular, the same transfer system 15b to which the secondary shaft 84b is connected), for determining the translation thereof parallel to the direction L.

[0147] The secondary shaft 84d is operatively connected to the handling device 19 of a transfer system 15a (in particular, the first transfer system 15a according to the rotation direction of the drum 10), for determining the translation thereof parallel to the direction G.

[0148] The assembly machine 1 further comprises position sensing means 90, configured to detect the angular position of each template 12 with respect to the axis A. Specifically, the position sensors 90 comprise (Figures 1 and 5):

- a detector 91 - illustrated only schematically - which is angularly fixed with respect to the drum 11; and
- a plurality of detectors 92, each integral with a respective template 12.

[0149] More specifically, the detector 91 is adapted to cooperate with one detector 92 at a time, during the rotation of the drum 11 around the axis A.

[0150] In the illustrated embodiment, the interaction between the detector 91 and the detectors 92 is of electro-mechanical type and occurs by contact. However, it is possible to envisage a contactless interaction.

[0151] Specifically, the machine 1 comprises a column 93 arranged coaxial to the axis A and a beam 94, extending cantilevered from the column 93 in a direction radial to the axis A. The detector 91 is arranged at the beam 94, preferably in the proximity of a free end thereof.

[0152] More specifically, each detector 92 is arranged at the most distant portion of the respective supporting element 20 from the drum 11 parallel to the axis A and the detector 91 is arranged on the side of the beam 94 facing the drum 11 parallel to the axis A.

[0153] The detectors 92, instead, are arranged at the supporting element 20 of each template 12.

[0154] The position sensors 90 are operatively connected to the control unit 70 and are configured to send, to the control unit 70, a signal relative to the position of the templates 12 (Figure 8).

[0155] The assembly machine 1 further comprises one or more protection nets - not illustrated - which limit the non-authorized access to the rotating parts.

[0156] The assembly machine 1 further comprises sensing means 67 - illustrated only schematically - configured to detect the correct assembling of the honeycombed separators 50 inside the seats 13 of each template 13 (Figures 4 and 8). Specifically, the sensing means 67 are configured to detect the presence of the correct number of diaphragms 51 and 52 inside the seat 13 of each template 12.

[0157] Such sensing means 67 are configured to generate:

- a first signal relative to the incorrect assembling of a honeycombed separator 50 inside a seat 13; or
- a second signal relative to the correct assembling of a honeycombed separator 50 inside a seat 13.

[0158] Specifically, the incorrect assembling of a honeycombed separator 50 is obtained when one or more diaphragms 51, 52 are inserted incorrectly inside the seat 13 or are lacking.

[0159] Preferably, the sensing means 67 are angularly interposed between the last filling station 5 and the discard discharge station 7 in the rotation direction of the drum 11. Additionally, the sensing means 67 are positioned at the peripheral profile 11b of the drum 11.

[0160] The control unit 70 is also operatively connected to the extraction means 16 and to the sensing means 67 (Figure 8). The control unit 70 is configured to receive the first or the second signal from the sensing means 67 and to consequently control the extraction means 16. Specifically, the control unit 70 is programmed for:

- commanding the extraction means 16 to extract the diaphragms 51 and 52 from the template 12 at the discard discharge station 7, if the sensing means 67 have sent the first signal relative to the template 12;
- commanding the extraction means 16 to extract the diaphragms 51 and 52 from the template 12 at the finished product discharge station 6, if the sensing means 67 have sent the second signal relative to the template 12.

[0161] As illustrated in Figures 2 and 4, each compaction station 8 comprises two compacting devices 17 of the diaphragms 51, 52 inside the seats 13. Such compacting devices 17 are arranged in a radially external position with respect to the drum 11 and to the templates 12.

[0162] Specifically, each compacting device 17 comprises (Figure 4):

- a main body 71 which is fixed with respect to the frame 10;
- an element 72 which is movable with respect to the main body 71 along a direction M radial to the drum 11; and
- operating means 73 adapted to handle the element 72.

[0163] Such operating means 73 are operatively connected to the control unit 70. The control unit 70, in turn, controls the handling of the element 72 through the operating means 73.

[0164] In the illustrated case, the element 72 is a plate. Alternatively, the element 72 could be a body having a concave shape and at least partially curved.

[0165] More specifically, the element 72 describes a rectilinear reciprocating motion between a radially more internal position with respect to the axis A, in which it is adapted to push the diaphragms 51 and/or 52 placed in the seat 13 of a template 12, and a radially more external position, in which it is spaced apart from the templates 12 and from the diaphragms 51 and/or 52.

[0166] The operating means 73 are preferably of pneumatic type. In particular, the operating means 73 are operatively connected to the compressed air source 65 or to another compressed air source. Additionally, the assembly machine 1 comprises valve means 74 - illustrated only schematically in Figure 8 - for adjusting the flow of compressed air directed from the source 65 to the operating means 73. Preferably, the valve means 74 comprise a pneumatic solenoid valve.

[0167] In the illustrated embodiment, the assembly machine 1 comprises a compacting device 17 angularly interposed between a storehouse 14a and a storehouse 14b and a further compacting device 17 angularly interposed between the last filling station 5 (in the rotation direction of the drum 11) and the finished product discharge station 6 or the discard discharge station 7.

[0168] The control unit 70 is also operatively connected to the valve means 74, with the aim to control the reciprocating motion of the elements 72, as a function of the signals received from the position sensing means 90

(Figure 8).

[0169] The control unit 70 is also preferably operatively connected to the electric motors 41a (Figure 8).

[0170] The folding and transport device 2 and the stacking device 3 are known per se and are not specifically described in the following.

[0171] Nonetheless, the folding and transport device 2 could comprise a deforming element - not illustrated - shaped for causing the folding of the honeycombed separator 50 during the ejection thereof at the finished product discharge station 6.

[0172] Such deforming element is, for example, a curved metal plate positioned in the proximity of the finished product discharge station 6.

[0173] In use, the drum 11 alternates rotation steps around the axis A with waiting steps. At each rotation step, the drum 11 transports the templates 12 from an operating station 4 to the one angularly subsequent.

[0174] When a template 12 is positioned in a filling station 5 during a waiting step, the transfer systems 15a, 15b of the station 5 transfer a diaphragm 51, 52 from the respective storehouse 14a, 14b to the seat 13 of the template 12.

[0175] When a template 12 is positioned in a compaction station 8, the diaphragms 51, 52 assembled at the template 12 are further compacted in the seat 13.

[0176] When a template 12 is positioned in a discard discharge station 7, if the sensing means 67 have sent the first signal to the control unit 70, the extraction means 16 eject the diaphragms 51, 52 housed in the seat 13.

[0177] When a template 12 is positioned in the finished product discharge station 6, the extraction means 16 eject the assembled honeycombed separator 50 housed in the seat 13.

[0178] During each waiting step, the operations on the templates 12 in the respective operating stations 4 occur simultaneously.

[0179] The honeycombed separators 50 ejected from the machine 1 are subsequently transported towards the stacking device 3 through the folding and transport device 2 (Figure 1).

[0180] During the working of the machine 1, the control unit 70 controls the operation of the source 81 of mechanical energy. The source 81, in turn, provides the mechanical energy necessary for the simultaneous operation of all the gripping devices 18 and of all the handling means 19.

[0181] Examining the characteristics of the assembly machine 1 according to the present invention, the advantages that the latter allows obtaining are evident.

[0182] Since the machine 1 comprises the drum 11, which drives into rotation the plurality of templates 12, at which the separators 50 are assembled, it is possible to assemble more honeycombed separators 50 simultaneously in an efficient manner.

[0183] Furthermore, the operating means 80 are adapted to simultaneously operate the gripping device 18 and the handling device 19 of each transfer system 15a, 15b and the drum 11. In other words, the drum 11 cannot be driven into rotation without the handling means 19 and the gripping devices 18 not being operated as well. Consequently, unlike the assembly machines described in the introductory part of the present description, the assembling of the honeycombed separators 50 is not governed by complex consent signals sent from the control unit to the translation device. On the contrary, the assembling is essentially governed by means of mechanical couplings between the cams, the tappets and the shafts of the operating means 80.

[0184] Since the assembly machine 1 comprises the compacting devices 17, it is possible to ensure that the diaphragms 51 and/or 52 previously inserted in the seat 13 are correctly positioned and assembled to one another.

[0185] Since the machine 1 comprises the sensing means 67, the control unit 70 can automatically command the extraction of the assembled components to be discarded in the discard discharge station 7, before they reach the finished product discharge station 6.

[0186] Finally, it is clear that modifications and variants can be made to the assembly machine 1 without thereby departing from the scope of protection of the present invention.

[0187] In particular, the assembly machine 1 could comprise more than one discard discharge station 7.

[0188] The operating means 80 could comprise a different number of shafts, cams and tappets. Furthermore, such shafts, cams and tappets could be arranged in a different manner from what illustrated in Figures 6 and 7.

[0189] Finally, the operating means 73 could not be of pneumatic type. For example, the operating means 73 could be of electric or hydraulic type.

Claims

1. Assembly machine (1) of honeycombed separators (50) for the separation of objects to be packed; said honeycombed separators (50) comprising at least a first diaphragm (51) and at least a second diaphragm (52) assembled to one another so as to define a plurality of seats, each of which is adapted to house a respective object;

   said machine (1) comprising a fixed frame (10) and being **characterized in that** it comprises:

   - a drum (11) rotatable around a rotation axis (A) with respect to said frame (10);
   - a plurality of templates (12) rotatable integrally with said drum (11) with a revolution motion with respect to said axis (A); each of said templates (12) comprising a seat (13) having a shape corresponding to a said honeycombed separator (50) and adapted to house said first and second diaphragms

(50, 51);

said machine (1) further comprising:

- a plurality of storehouses (14a, 14b) of said first diaphragms (51) and second diaphragms (52) rotationally fixed with respect to said drum (11);
- a plurality of transfer systems (15a, 15b) of said first and second diaphragms (51, 52) from said storehouses (14a, 14b) to said seats (13); and
- extraction means (16) of said first and second diaphragms (51, 52) from said seats (13).

2. The assembly machine according to claim 1, **characterized in that** it comprises a plurality of operating stations (4) angularly distributed with respect to said axis (A) ;
said operating stations (4) comprising:

- a plurality of filling stations (5), at which a first or a second diaphragm (51, 52) is inserted, in use, in a respective said seat (13); and
- a finished product discharge station (6), at which said assembled honeycombed separator (50) is discharged, in use, from a said seat (13) by means of said extraction means (16) .

3. The assembly machine according to claim 2, **characterized in that** said operating stations (4) further comprise:

- at least one discard discharge station (7), at which a component to be discarded is ejected, in use, from a said template (12); and/or
- at least one compaction station (8), at which said first and/or second diaphragms (51, 52) housed in a said seat (13) are, in use, compacted to one another.

4. The assembly machine according to any one of the preceding claims, **characterized in that** it comprises a control unit (70) and **in that** each said transfer system (15a, 15b) comprises:

- a gripping device (18) adapted to grip a first diaphragm (51) or a second diaphragm (52) from a respective storehouse (14a, 14b); and
- a handling device (19) adapted to handle said gripped first diaphragm (51) or said gripped second diaphragm (52), in use, from said gripping device (18) towards a said seat (3) .

5. The assembly machine according to claim 4, **characterized in that** each said handling device (19) is adapted to handle said gripped first diaphragm (51) or said gripped second diaphragm (52), in use, from said gripping device (18) along a first direction (G), which is radial or substantially radial to said axis (A).

6. The assembly machine according to claim 4 or 5, **characterized in that** it comprises operating means (80) operatively connected to said control unit (70); said operating means (80) being adapted to operate simultaneously:

- said drum (11) in rotation around said rotation axis (A) with respect to said frame (10);
- said handling device (19) of each said transfer system (15a, 15b); and/or
- said gripping device (18) of each said transfer system (15a, 15b).

7. The assembly machine according to claim 6, **characterized in that** said operating means (80) comprise:

- a source (81) of mechanical energy;
- a plurality of shafts (82, 84a, 84b, 84c, 84d) operatively connected to said source (81) and rotatable around respective rotation axes (X, J);
- a plurality of cams (85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851) fitted on only one of said shafts (84a, 84b, 84c, 84d) or on respective shafts different from said shafts (84a, 84b, 84c, 84d); and
- a plurality of tappets (86a, 86b, 86c, 86d, 86e, 86f, 86g, 86h, 86i, 861) respectively cooperating with said cams (85a, 85b, 85c, 85d, 85e, 85f, 85g, 85h, 85i, 851) and operatively connected to said handling devices (19) and/or to the gripping devices (18).

8. The assembly machine according to claim 7, **characterized in that** said operating means (80) comprise one single source (81) of mechanical energy.

9. The assembly machine according to any one of the preceding claims, **characterized in that** each said transfer system (15a, 15b) further comprises two rollers (41) rotatable around respective rotation axes (H, I) transverse to said axis (A).

10. The assembly machine according to any one of the claims from 4 to 9, when dependent on claim 3, **characterized in that** it comprises at least one compacting device (17) of said first and/or second diaphragms (51, 52) inside said seats (13);

each said compacting device (17) comprising:

- a main body (71) which is fixed with respect to said frame (10);
- an element (72) which is movable with re-

spect to said main body (71) along a second direction (M) which is radial with respect to said drum (11); and
- further operating means (73) adapted to handle said element (72);

said control unit (70) being operatively connected to said further operating means (73);
said at least one compacting device (17) being positioned at a said compaction station (8).

11. The assembly machine according to any one of the claims from 4 to 10, **characterized in that** said extraction means (16) are operatively connected to said control unit (70) and comprise a compressed air source (65);

each said template (12) comprising a plurality of nozzles (66) operatively connected to said compressed air source (65);
said control unit (70) being programmed to command said extraction means (16) to extract said first and/or second diaphragms (51, 52) from said seat (13) of each said template (12) by virtue of a compressed air flow emitted, in use, from said nozzles (66) of said template (12).

12. The assembly machine according to any one of the claims from 4 to 11, **characterized in that** it further comprises sensing means (67) operatively connected to said control unit (70) and configured to detect the correct assembling of said honeycombed separators (50) inside said seats (13) of each said template (12);
said sensing means (67) being configured to send, to said control unit (70):

- a first signal relative to the incorrect assembling of a said honeycombed separator (50) inside a said seat (13); or
- a second signal related to the correct assembling of a said honeycombed separator (50) inside a said seat (13).

13. The assembly machine according to any one of the claims from 4 to 12, **characterized in that** it further comprises position sensing means (90) configured to detect the angular position of each said template (12) with respect to said axis (A);
said position sensors (90) comprising:

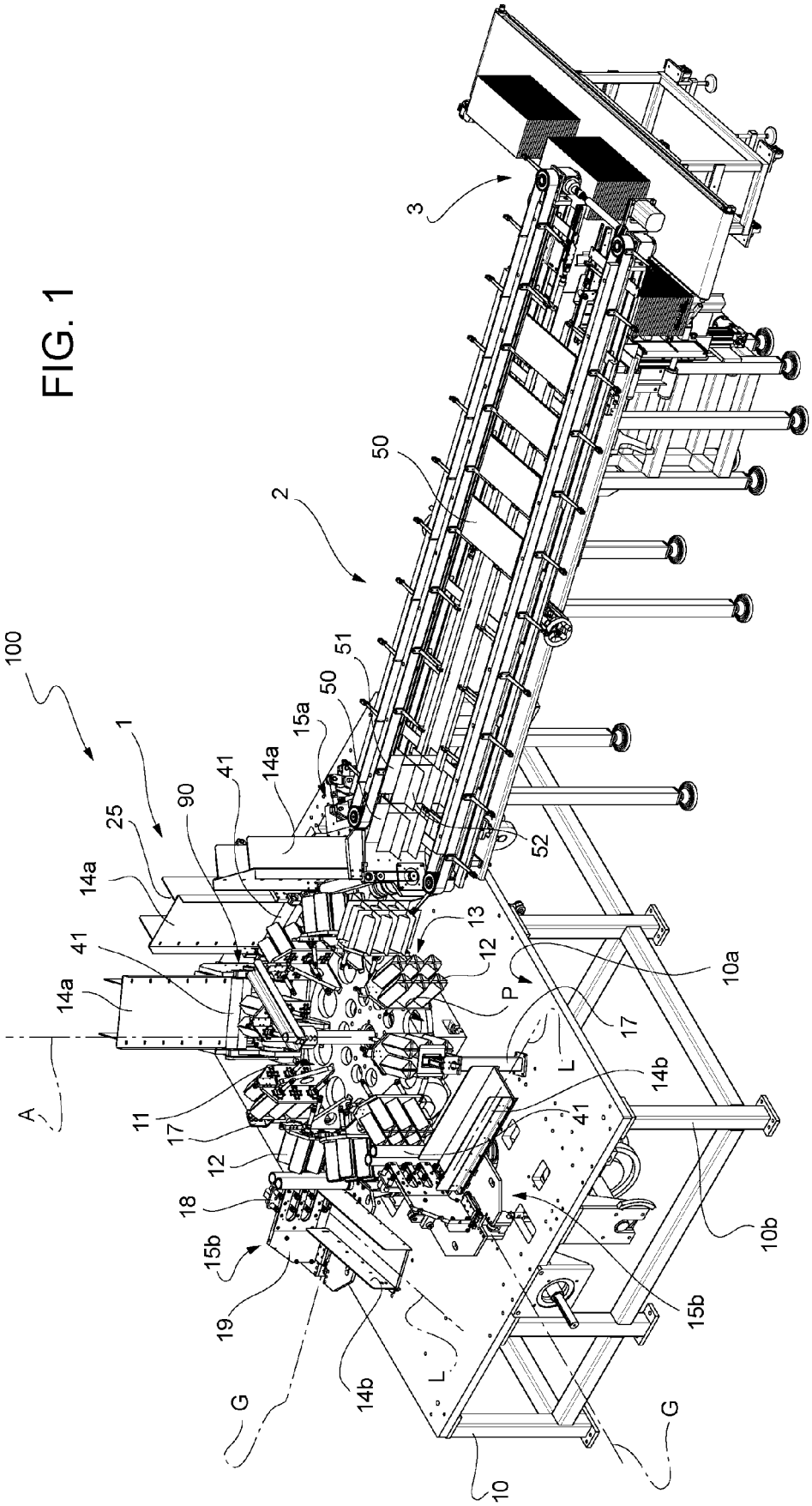
- a first detector (91), which is angularly fixed with respect to said drum (11); and
- a plurality of second detectors (92), each one integral with a respective said template (12);

said position sensing means (90) being operatively connected to said control unit (70) and being configured to send, to said control unit (70), a third signal relative to the position of said templates (12).

14. Manufacturing system of honeycombed separators (50) comprising:

- an assembly machine (1) according to any one of the preceding claims; and
- a folding device (2) of the honeycombed separators (50) assembled by the assembly machine (1); and/or
- a stacking (3) and transport device of said honeycombed separators (50).

FIG. 1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1
2
3
50
51
52
15a
14a
41
90
25
13
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10a
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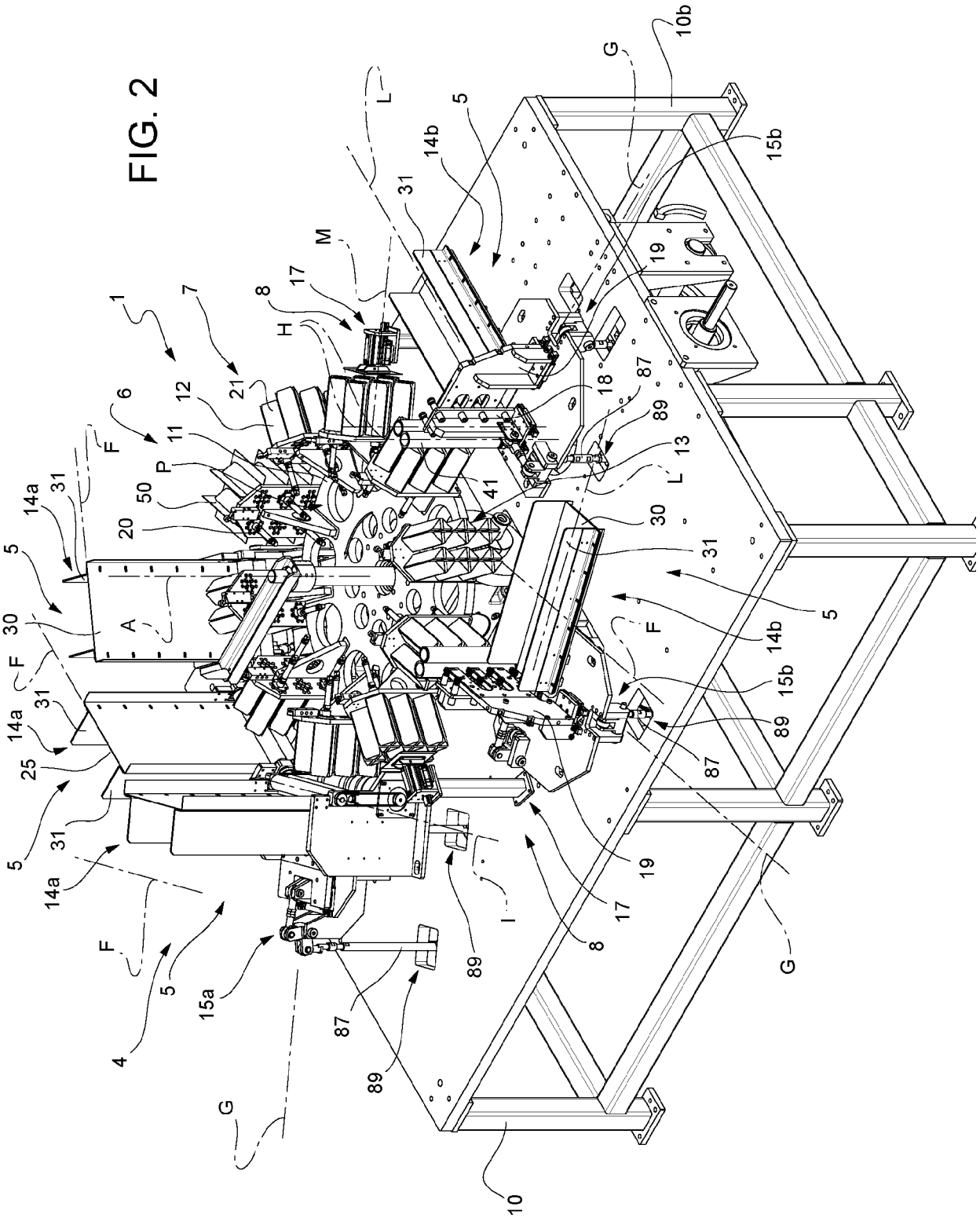
15b
A
11
18
19
G
10

FIG. 2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11
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50
20
41
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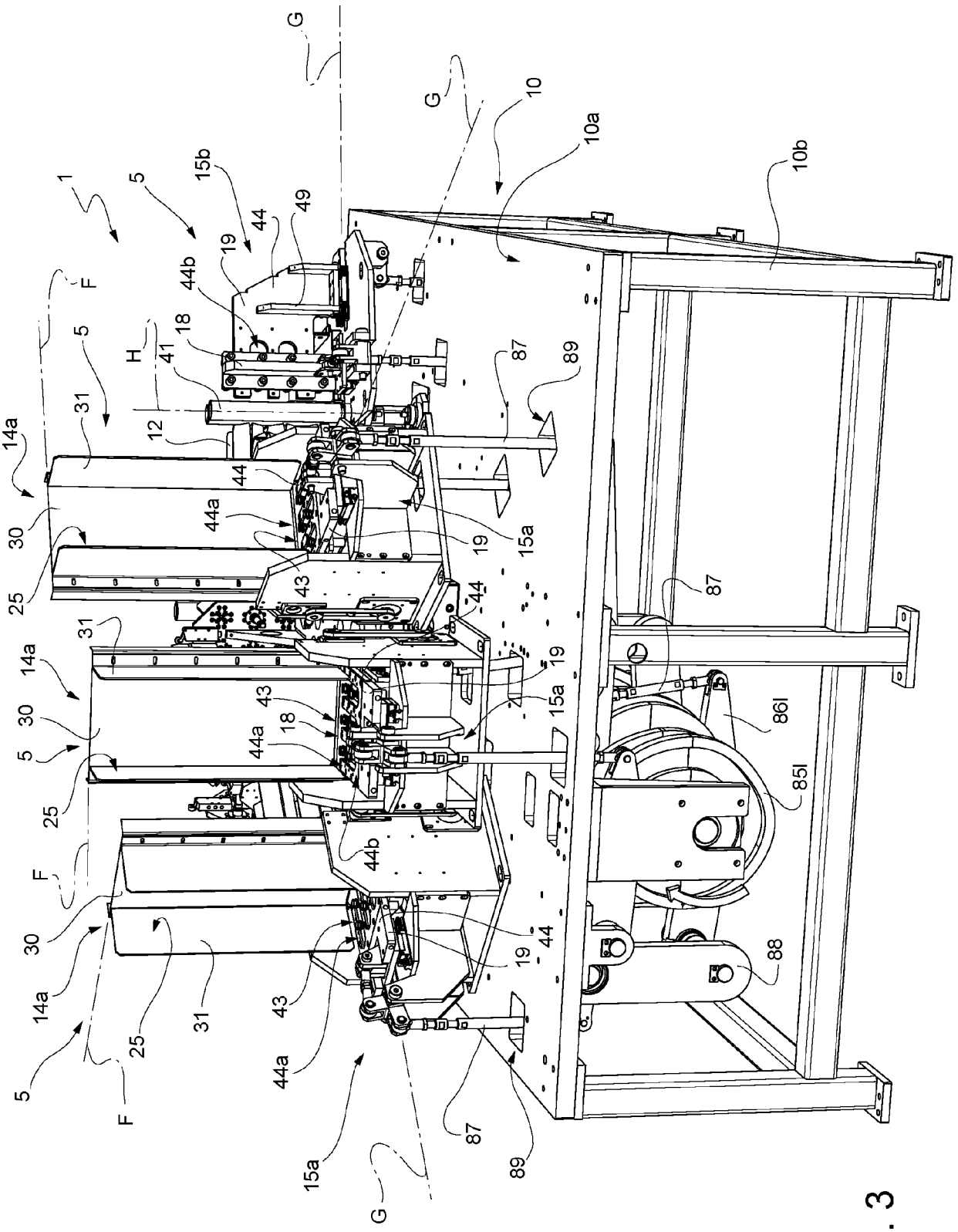
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19
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15a
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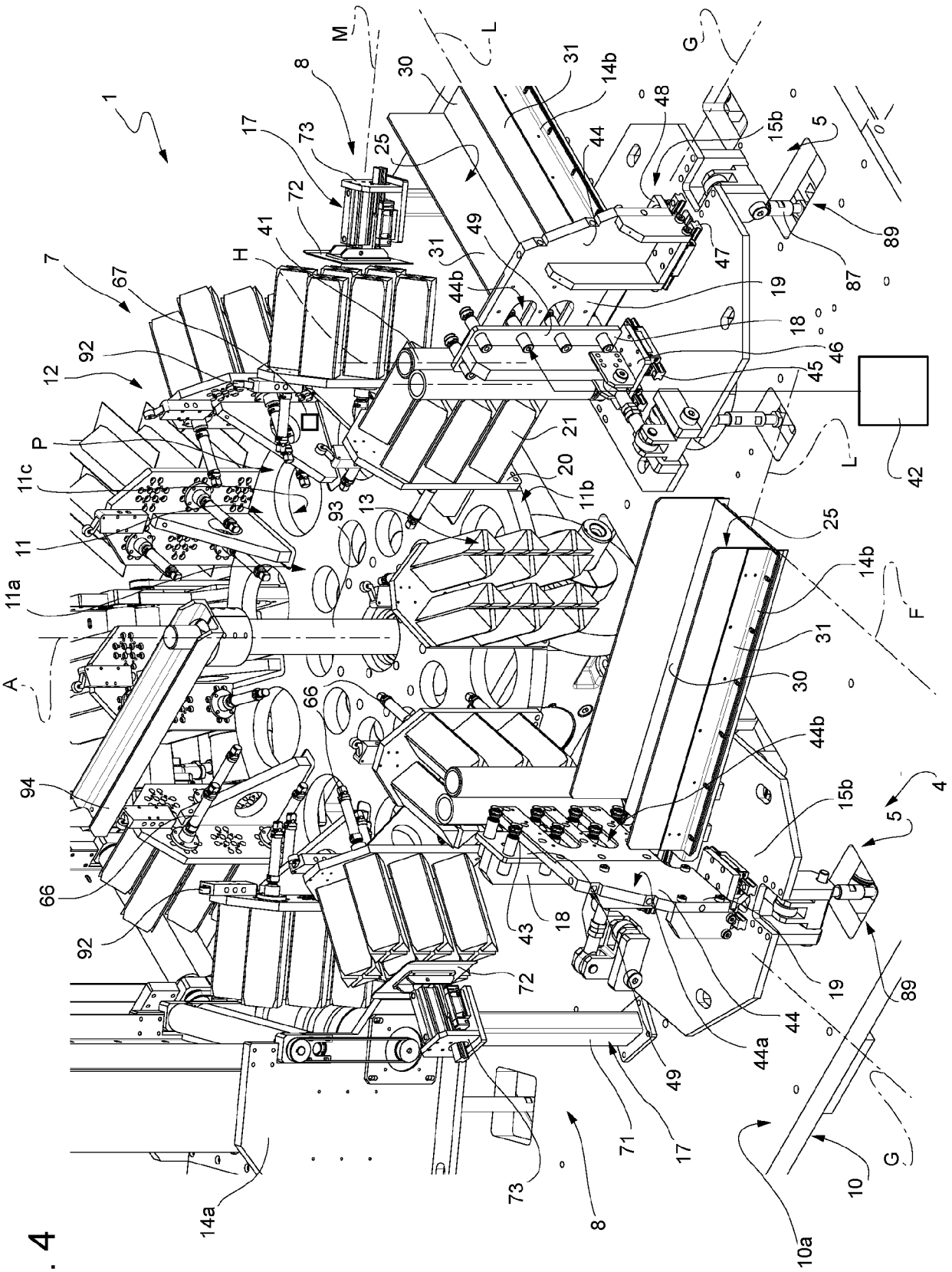
86l
85l
88

FIG. 3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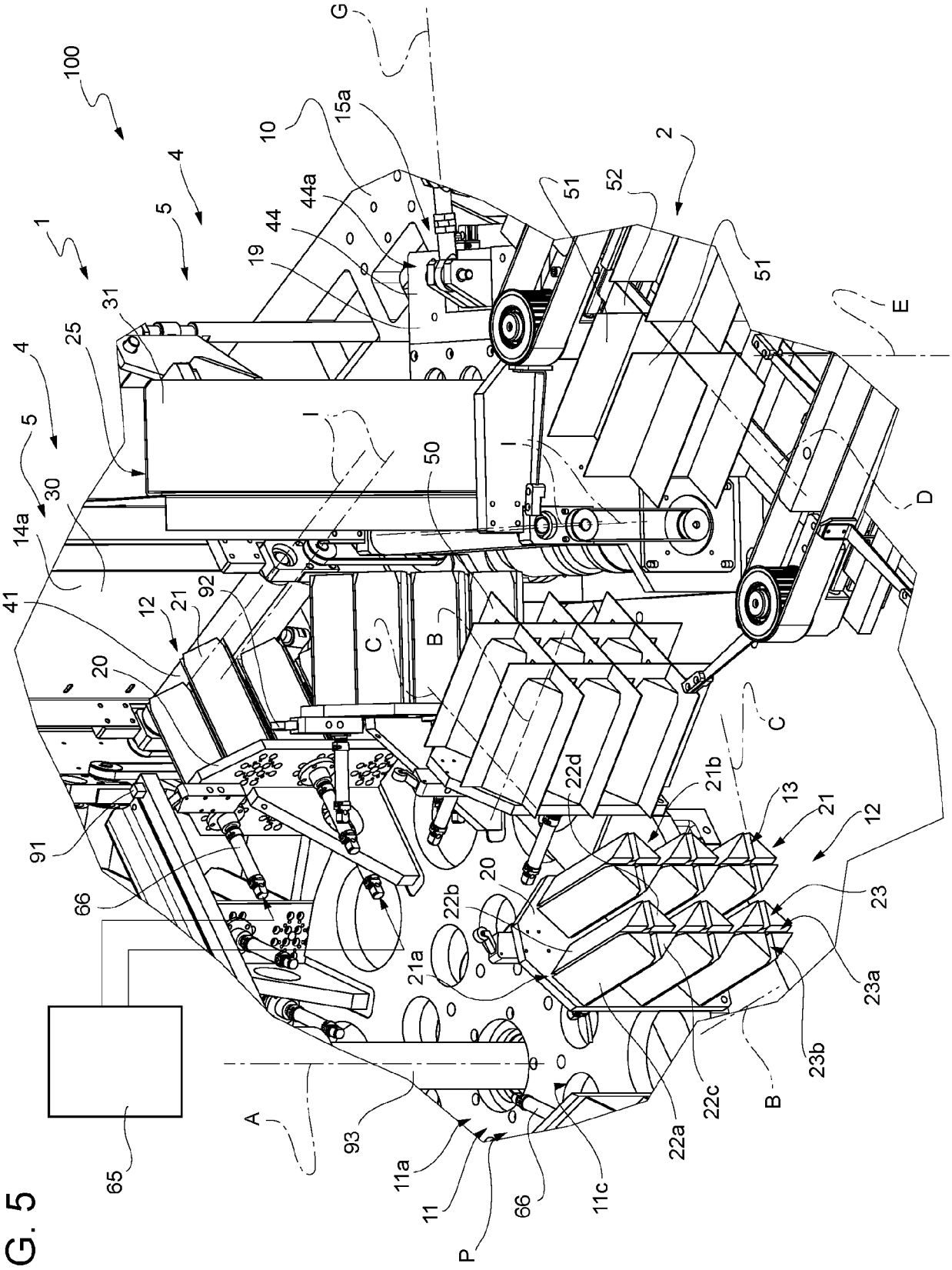
44b
19
18
92
12
46
45
P
21
20
42
11c
11b
93
13
25
11
14b
11a
F
31
A
30
66
44b
94
15b
4
5
66
92
43
18
72
19
89
44
44a
49
71
17
14a
73
8
10
G
10a

FIG. 4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1
4
5
10
15a
G
2
44a
44
19
51
52
31
25
30
14a
41
12
21
92
20
91
66
65
A
93
11a
11
P
66
11c
22a
22c
B
23b
23a
23
13
21b
22d
C
D
E
50
I
B
C

FIG. 5

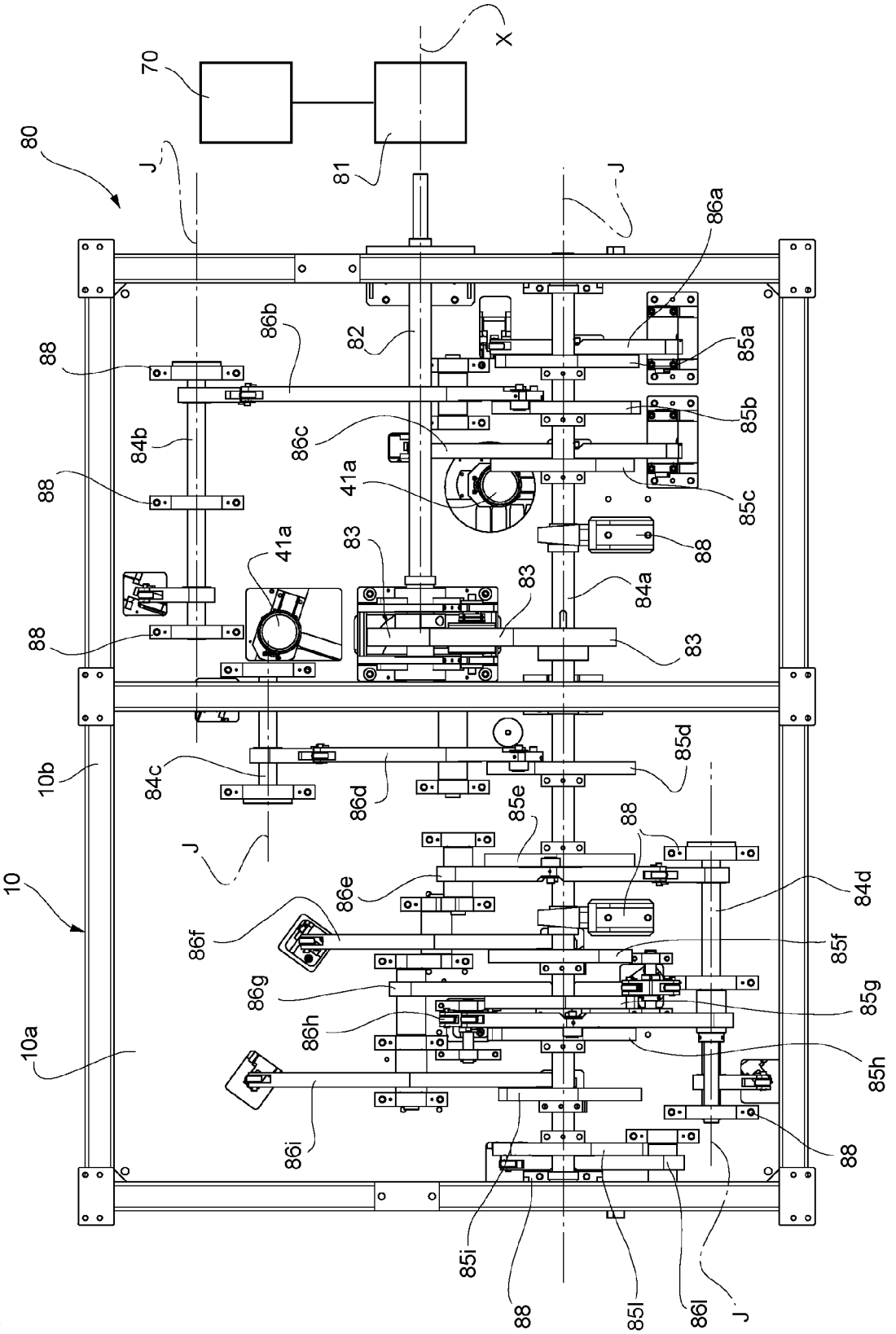
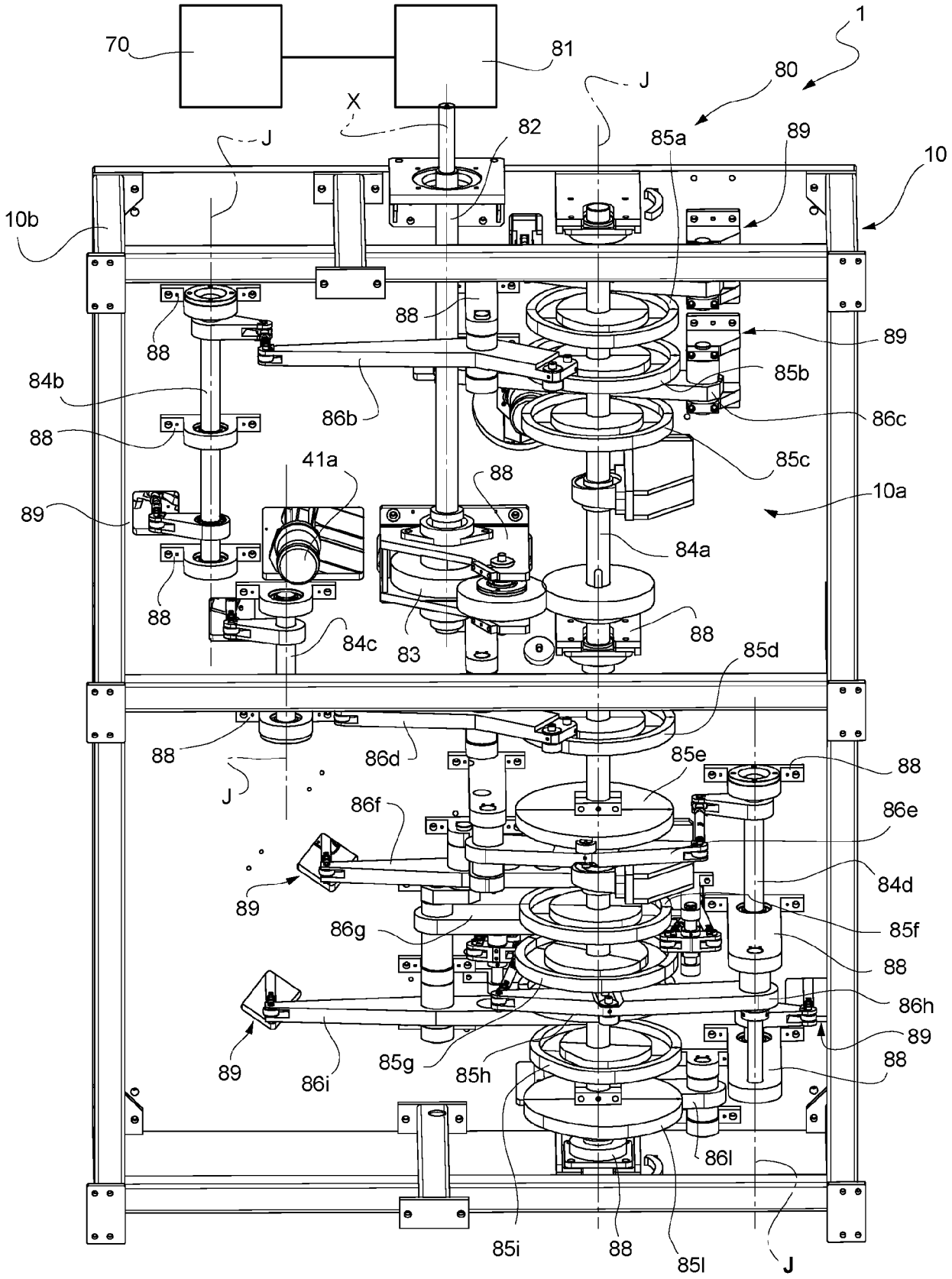

X
70
80
J
81
J
86a
86b
82
85a
88
85b
84b
86c
41a
85c
88
41a
83
88
83
84a
88
83
10b
85d
84c
86d
85e
88
J
10
86e
84d
86f
85f
86g
85g
86h
10a
85h
86i
88
85i
88
85l
86l
J

FIG. 6

FIG. 7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81
1
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J
X
82
85a
89
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J
10b
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84b
88
86b
86c
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85c
41a
88
10a
89
84a
88
84c
83
88
85d
88
J
86d
85e
88
86f
86e
89
84d
86g
85f
88
86h
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88
89
86i
85g
85h
86l
85i
88
85l
J

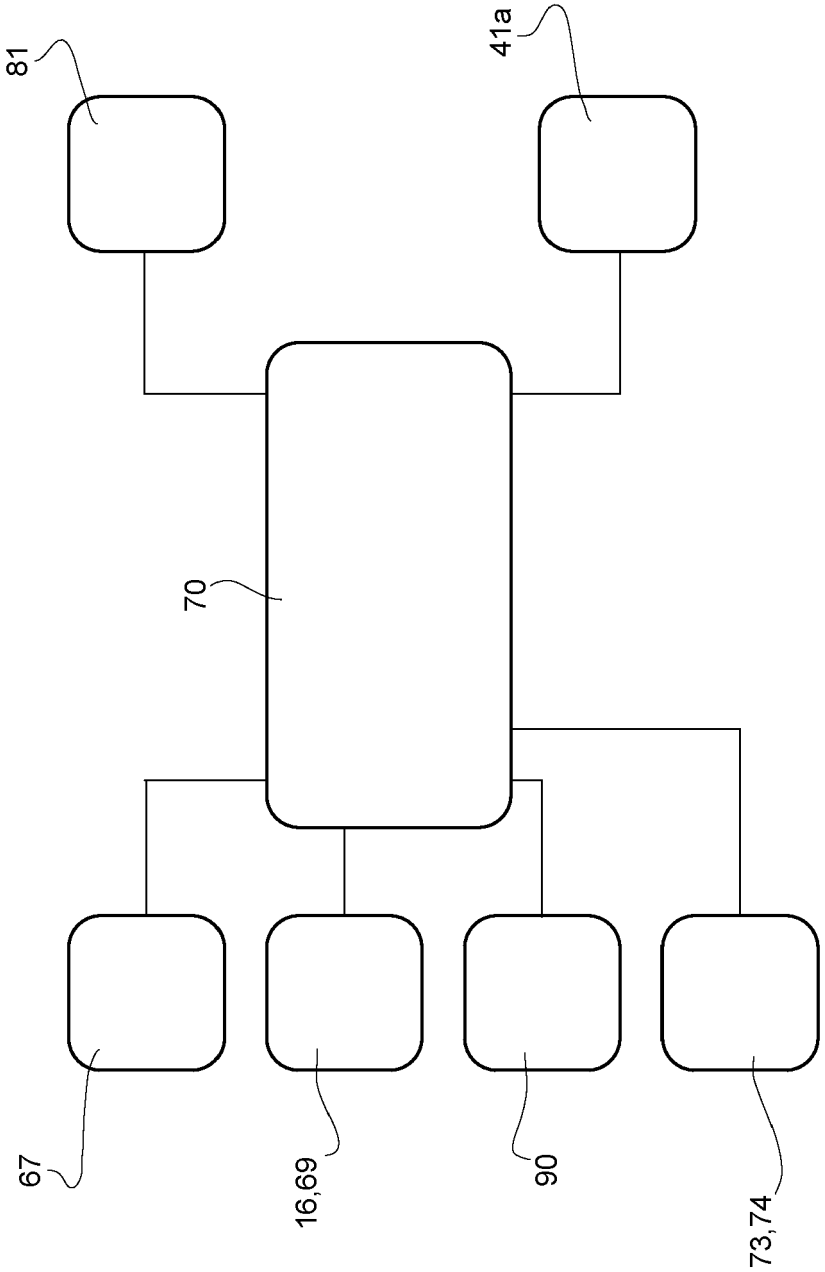

FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 8345

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* column 2, line 21 - page 5, line 45;	4-9,14	
A	figures 1-9 *	3,10	

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Y	* column 3, line 63 - column 6, line 2 *	4,6-9,14	
A	* column 9, line 72 - column 12, line 2 * * column 15, line 35 - column 18, line 46; figures 1-3, 5, 6, 8, 34-38 *	3,10	

X	DE 23 34 146 A1 (FELDMANN HANS) 23 January 1975 (1975-01-23)	1,2	
Y	* the whole document *	14	TECHNICAL FIELDS SEARCHED (IPC)
A		3,10	
	-----		B31D
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A	US 2 643 590 A (HEINZ AHLMEYER ET AL) 30 June 1953 (1953-06-30) * column 4, line 16 - line 26; figures 1b, 2b, 3 *	3,10	

A	KR 2019 0118079 A (MI RAE CO LTD [KR]; INTOPS CO LTD [KR]) 17 October 2019 (2019-10-17) * figures 2, 12 *	3,10	

	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 October 2022	Sundqvist, Stefan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 8345

DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	DE 12 79 436 B (OWENS JLLINOIS INC) 3 October 1968 (1968-10-03) * figure 1 *	14	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 October 2022	Sundqvist, Stefan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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Application Number
EP 22 15 8345

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 22 15 8345

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1, 2(completely); 3(partially)

   Discharge of discarded components in a partition assembly machine (claim 3, first alternative).

   ---

2. claim: 3(partially)

   Compaction of sheets in a partition assembly machine (claim 3, second alternative).

   ---

3. claims: 4-13

   Gripping and handling in a transfer system of a partition assembly machine (claim 4 as dependent on claim 1; claims 5-8 and 10-13 as directly or indirectly dependent on claim 4; claim 9 as dependent on claim 1).

   3.1 claims: 4, 5 (6-10)
   Handling in a direction radial to axis (A) in a transfer system of a partition assembly machine (claim 5 as dependent on claim 4).

   3.2 claim: 11
   Air extraction means in a partition assembly machine (claim 11 as dependent on claim 4).

   3.3 claim: 12
   Assembly sensing means in a partition assembly machine (claim 12 as dependent on claim 4).

   3.4 claim: 13
   Position sensing means in a partition assembly machine (claim 13 as dependent on claim 4).

   ---

4. claim: 14(partially)

   Folding of separators assembled by an assembly machine in a manufacturing system of separators (claim 14, first alternative, as dependent on claim 1).

   ---

5. claim: 14(partially)

   Stacking of separators assembled by an assembly machine in a manufacturing system of separators (claim 14, second alternative).

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 15 8345

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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12-10-2022

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