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

(11) **EP 3 936 244 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.01.2022 Bulletin 2022/02

(21) Application number: **21183069.0**

(22) Date of filing: **01.07.2021**

(51) Int Cl.:
B08B 9/08 *(2006.01)* ***B08B 9/087*** *(2006.01)*
B08B 9/20 *(2006.01)* ***B08B 9/36*** *(2006.01)*
B65G 21/20 *(2006.01)* *B08B 3/04* *(2006.01)*
B08B 5/02 *(2006.01)* *B08B 9/30* *(2006.01)*

(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

(30) Priority: **08.07.2020 CZ 20200399**

(71) Applicant: **Well Pack s.r.o.**
10100 Praha 10 (CZ)

(72) Inventors:
- **Srp, David**
  28912 T ebestovice (CZ)
- **Kalina, Luká**
  66902 Dyjákovi ky (CZ)

(74) Representative: **Sedlák, Jirí**
Okruzni 2824
370 01 Ceské Budejovice (CZ)

(54) BRUSH SECTION OF TUNNEL WASHING LINES FOR REMOVING LABELS FROM CRATES

(57) A brush section (1) of the tunnel washing lines (0) for removing labels from crates (3) is provided with a conveyor (2), a water rinse (4), at least two left side brushes (5) situated on the left side of the wash zone of the brush section (1) and at least two right side brushes (6) situated on the right side of the wash zone of the brush section (1), the left side brushes (5) and the right side brushes (6) being of circular cross-section and the centres of the left side brushes (5) lying on the left side line (a) that is parallel to the right side line (b) on which the centres of the right side brushes (6) lie, the left side line (a) and the right side line (b) being parallel to the conveyor (2) feed axis (h).

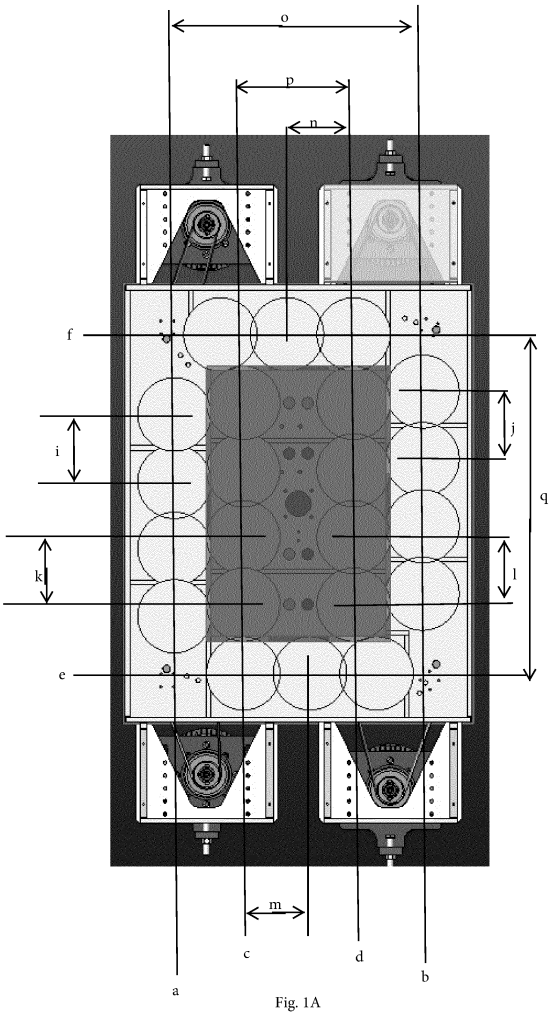

Fig. 1A

EP 3 936 244 A1

Description

Field of the Technology

Washing lines for crates

State of the Art

[0001] Essential parameters for washing lines are the quality of washing and the smoothness of operation. To a great extent, both depend on the washing line settings and are also largely affected by the dimensions and parameters of the line. The shaping of the wash zone of the line is important when washing crates or boxes of various shapes and sizes.

[0002] The standard washing process takes place so that the crate is transported upside down by the input conveyor to the washer. In the washer, the crate is caught by pins of the guide chains or washer conveyor from the inside. Thus, the washer chain pins ensure that the crate does not fold when passing through the washer, even if it is not locked in the locks.

[0003] When passing through the washer, the crate is sprayed with water distributed using pumps and a nozzle system. The frame inside the washer, in which several sets of nozzles are installed in a row, one above the other or next to each other and mostly with added detergent/disinfection, is divided into Pre-wash, Main wash, Disinfect rinse and Clean water rinse sections. These nozzle sections are permanently installed in the washer, wherein the nozzle system acts on the crate or a given place on the crate by pressure from different sides and angles with 3, 6, or up to 20 bar from above, from below and from both sides along the washer guide. Thus the crate can be washed without being lifted, overturned, folded or rotated in the washer. Furthermore, even by the passage of a small crate, the nozzles on one or both sides are more or less distant from the crate, i.e. act on the crate or the given place on the crate with different pressures.

[0004] After washing and rinsing with clean water, the crate is taken out of the washer to the output conveyor.

The length of the standard washer used for this calculation is 18.6 m

[0005] The speed of a standard washer is 0.3 m/s = 1,800 crates/hour; the efficiency of removing labels is around 30 per cent.

[0006] The speed of a washer with a high-pressure module is 0.85 m/s = 2,600 crates/hour; the efficiency of removing labels is around 50 per cent.

[0007] Labels are glued to the shorter side of the crates. It is, therefore, necessary to expose this side to the most efficient and effective washing.

[0008] As standard, large crates with plan dimensions of 600*400 mm and a height of 20 to 300 mm, small crates with plan dimensions of 400*300 mm and a height of 20 to 300 mm are washed. However, smaller crates are no exception, for example for the automotive industry, where small parts are stored in tiny crates. Not only are automotive crates unusually small, but in addition to labels, they are also soiled from oils and lubricants, which increases the demands on their washing.

Flow rates:

Standard washer	Flow rate 95 m^3/h = 25 l/s
Washer with a HP module	Flow rate 15 m^3/h = 4 l/s

Nozzles on the main washing section

Standard washer	Flow rate 95 m^3/h = 6 nozzles on each side
Washer with a HP module	Flow rate 15 m^3/h = 5 nozzles on each side

[0009] With a standard 50% efficiency and a speed of 2,600 crates per hour, the price for one washed crate increases, as every other crate is not washed according to customer requirements. It is necessary to consider the costs of selecting out the poorly washed crate - performed by the washing line operator, and the costs of washing it - either by hand with a high-pressure cleaner or by re-introducing into the washing line. If poorly washed crates are fed back into the line, they reduce the rate of introducing the first-time washed crates into the washing line to 1,733 crates per hour. All these non-standard operations resulting from poor washing efficiency significantly contribute to the price and time of crate washing.

[0010] The following documents summarize the state of the art:

Document JP S54139269 A discloses a washing module for washing crates for glass bottles. This washing module is designed for washing 6-bottle crates. The module is adapted to this and contains ten vertical washing brushes, of which six brushes penetrate the crate into six bottle compartments, and the remaining four brushes wash the crate from the outside. The brushes are mounted on a movable plate, which allows the horizontal circular movement of the brushes after the brushes enter the crate, thus perfectly washing the compartments of the washed crate. Although the module according to this document may contain also other brushes, the document solves a different problem than our invention, and that is the perfect washing of the inner compartments of beverage crates, not the perfect removal of labels and stickers from the outside of the crates.

[0011] Document WO 2005028130 A1 discloses a washing module, also for washing beverage crates, comprising horizontal brushes, vertical brushes and a mechanism for lifting crates, wherein the outer brushes, according to Figures 12, 13 and 14, do not rotate around their axes but are located on a rotating mechanism allowing the brushes to move around crates. The advantage described in this document is that, compared to the prior art, this module washes all four crate sides in one go because it aims to wash the crates perfectly from dirt, not to remove the labels and stickers.

[0012] Document JP 2001232308 A discloses a washing module for crates that are washed with nozzles from all possible sides. The washing module does not have brushes.

[0013] Document CN 208261460 U discloses a washing module for buckets and other round containers. The buckets are fixed on a conveyor; preferably, the buckets rotate around their axes and are washed by passing through the brush section. The brushes are static.

[0014] Document CN 208357415 U discloses a washing module for crates, which is not intended for high-pressure and high-speed washing, as the module must first be opened on one side by lifting the horizontal brush. Then, each crate must drive into the module, the module closes, the crate is washed, the module opens again, and the crate leaves. This batch washing method is highly inefficient, both in time and money. The pressurized water is pumped continuously, leading to massive waste or is switched on and off with opening and closing of the module, which brings pressure shocks to the system, and the system wears out very quickly.

[0015] Document DE 20021637 U1 discloses the washing module for crates when the crate is placed on the conveyor with the bottom backwards or forwards, i.e., placed on its side. In this way, it passes through a carwash-like brush section, i.e. two vertical brushes on both sides of the conveyor and one horizontal brush above the conveyor. Another brush can be placed under the conveyor. Thanks to this, the crate is washed from three or four sides in one go, only from the outside. Again, the goal is to clean the crate from dirt on all sides at one time, not to remove labels and stickers.

[0016] Document US 1883772 A discloses, similarly to document D6, the washing of crates sitting on their side. The washing module for such washing also includes a tilting mechanism. The crate lying with its bottom on the conveyor is rotated by 90 degrees to be placed with its side down on another conveyor. In this position, it is washed by passing through a brush section analogous to that in DE 20021637 U1, i.e., two vertical brushes on the sides of the conveyor, one horizontal brush above the conveyor and another horizontal brush below the conveyor.

Description of the Invention

[0017] Despite the deep-rooted technological prejudices, when the crates are washed only by a non-contact intensive spraying with nozzles with highly pressurized water and despite the constant improvement of the nozzles, their positions and the angle of water spray on the crate, no perfect washing of product presentation labels and stickers, which must be completely removed from the crate before further use, was achieved, the tunnel washer was equipped with brushes. Surprisingly, it has been found that the use of brushes and their particular arrangement results in perfect washing. It is technically possible and effective in this field to use brushes even when paper and plastic labels and stickers are used. A brush section of tunnel washing lines was developed, with washing efficiency of up to 99 per cent at a speed of 1,800 crates per hour, without the need to sort crates. The brush section can be located anywhere in the wash zone of the crate washing line, for example, at pre-wash, main wash and even behind main wash before rinsing.

[0018] The brush section of the tunnel washing lines for removing labels from the crates is equipped with a conveyor for passing the crate through the brush section, a rinsing with water, at least one left side brush situated on the left side of the brush section wash zone and at least one right side brush situated on the right side of the brush section wash zone, wherein both the left side brush and the right side brush are of circular cross-section, and through the centre of the left side brush the left side line *a* passes, which is parallel to the right side line b passing through the centre of the right side brush, the left side line *a* and the right side line *b* being parallel to the *h* axis of the conveyor feed, and the distance *o* between the left side line *a* and the right side line *b* is $ps + \frac{1}{2}r_a, + \frac{1}{2}r_b < o < p_s + r_a + r_b$, where ps is the width of the crate, r_a is the radius of the left side brush, rb is the radius of the right side brush.

[0019] Meeting these conditions ensures that the side brushes wash the outer side plates of the crate located in the wash zone of the brush section, where most of the labels and stickers are placed. The brushes are in contact with the crate either at only one single point - the boundary condition $o < p_s + r_a + r_b$, or they are in overlap with the crate when

projected from above, in a maximum overlap ½r, i.e., the second boundary condition ps + ½r_a, + ½r_b < o. An overlap bigger than ½r causes significant deformation of the brush at the expense of washing efficiency.

[0020] If there are several side brushes placed one behind the other, they must be placed along one axis with the same diameter, or at least the conditions ps + ½r_a + ½r_b < o < p_s + r_a + r_b must be met for each brush, i.e., if the brushes on one side are not of the same diameter, their edges facing the crate must be in one line so that the crate does not zigzag through the wash zone between the side brushes. This would lead to jamming of the crates in the brush section, and thus to frequent failures of the brush section.

[0021] Preferably, the rotational axes of the left side brush and the right side brush are situated perpendicular to the surface of the conveyor, above the surface of the conveyor. Thus, brushes with a circular cross-section are oriented vertically. In another embodiment, the brushes can preferably also be arranged horizontally in the brush section. The rotational axes of the left side brush and the right side brush are located parallel to the conveyor surface, above the conveyor surface and parallel to the axis h of the conveyor feed.

[0022] The brush section is preferably provided with at least two right side brushes and at least two left side brushes, wherein the left side brushes whose centres lie on the left side line *a* have the same diameter and the right side brushes whose centres lie on the right side line *b* have the same diameter. Then the distance *i* between the centres of left side brushes is 2r_a - ½r_a < i ≤ 2r_a, and the distance *j* between the centres of right side brushes is 2r_b - ½r_b < j ≤ 2r_b.

[0023] In such a case, the adjacent brushes either touch at one point - the boundary condition i ≤ 2r_a and j ≤ 2r_b, or the adjacent brushes are overlapped when projected from above, specifically in a maximum overlap ½r, i.e., the second boundary condition 2r_a - ½r_a < i and 2r_b - ½r_b < j. An overlap bigger than ½r causes significant deformation of the brush at the expense of washing efficiency. In another preferred embodiment, the distance *i* between the centres of the left side brushes is 2r_a < i, and the distance *j* between the centres of the right side brushes is 2r_b < j, i.e., the adjacent brushes do not touch at all.

[0024] Preferably, the brush section is provided with a reversible lifting mechanism, especially if the crate is washed bottom down in the brush section. The reversible lifting mechanism serves to lift the crate oriented bottom down towards the ceiling of the wash zone of the washing line. This is particularly advantageous when the ceiling of the wash zone is fitted with brushes. The reversible lifting mechanism is preferably realized by at least two reversible lifting fixators, or at least two lifting fixators and at least two reversible means, or at least one lifting plate and at least two reversible means, wherein the reversible means can be reversible forks or reversible lasts. The reversible lifting fixators serve to grip the crate located in the bottom part of the wash zone, preferably on the conveyor, to pick it up and also to return it to the bottom part of the wash zone. Lifting fixators are only used to grip the crate and lift it. To return the crate to the bottom part of the wash zone, reversible means are then used, which actively push the crate downwards. The reversible forks are located above at least two side plates of the crate placed bottom down on the lifting mechanism in the brush section. The reversible last is located above the bottom of the crate placed bottom down on the lifting mechanism in the brush section.

[0025] The lifting plate is used to lift the crate upwards. Preferably, the lifting plate is actuated by a piston.

[0026] The brush section is preferably provided with at least one horizontal brush situated in the upper or bottom part of the wash zone of the brush section, the horizontal brush having a circular cross-section and the axis of rotation of the horizontal brush lying in the horizontal line *g* parallel to the axis *h* of the conveyor feed, wherein the horizontal brush is located between the left side line *a* and the right side line *b.* Preferably, the horizontal brush is mounted from above the wash zone of the brush section and thus allows it to penetrate the crate oriented bottom down, the crate preferably entering the brush by a reversible lifting mechanism. Equally well, the horizontal brush can wash the bottom of a crate placed on the conveyor upside down without the need to immerse the crate in the brushes, simply by passing the crate through the brush section. Analogously, if the horizontal brush is located in the bottom part of the wash zone of the brush section, the horizontal brush can wash the bottom of the crate placed on the conveyor bottom down without the need to immerse the crate in the brushes, simply by passing the crate through the brush section.

[0027] In another embodiment, the horizontal line g passing through the centre of the upper/bottom brush is perpendicular to the axis *h* of the conveyor feed, and the horizontal brush is located between the left side line *a* and the right side line *b.*

[0028] Preferably, the brush section is provided with a plurality of upper brushes. The brush section is preferably provided with at least one left inner brush located in the upper left part of the brush section wash zone and at least one right inner brush located in the upper right part of the brush section wash zone, the left inner brush and right inner brush being of circular cross-section and through the centre of the left inner brush a left inner line c passes parallel to the right inner line *d* passing through the centre of the right inner brush, the left inner line c and the right inner line *d* being parallel to the conveyor feed axis *h* and located between the left side line *a* and the right side line *b.*

[0029] Preferably, the rotational axes of the left inner brush and the right inner brush are then situated perpendicular to the surface of the conveyor, above the surface of the conveyor.

[0030] Preferably, the distance *p* between the left inner line *c* and the right inner line *d* is ps - r_c - r_d < p < p_s - ½r_c - ½r_d, where r_c is the radius of the left inner brush, r_d is the radius of the right inner brush.

[0031] This ensures that the inner brushes wash the side plates of the crate from the inside of the crate located in the wash zone of the brush section. The brushes are in contact with the crate either at only one point - the boundary condition $p_s - r_c - r_d < p$, or they are in overlap with the crate when projected from above, in a maximum overlap of ½r, i.e., the second boundary condition $p < p_s - ½r_c - ½r_d$. An overlap bigger than ½r causes a large deformation of the brush at the expense of washing efficiency.

[0032] In another embodiment, the distance p between the left inner line c and the right inner line *d* is preferably $p < r_c + r_d - ½r_c$, if r_c is less than r_d, or $p < r_c + r_d - ½r_d$, if r_d is less than r_c, wherein r_c is the radius of the left inner brush and rd is the radius of the right inner brush.

[0033] This ensures that adjacent inner brushes perpendicular to the axis *h* of the conveyor feed are in overlap when projected from above, the overlap of the brushes being at most ½r of the smaller of the brushes.

[0034] The brush section is preferably provided with at least two left inner brushes and at least two left inner brushes, the inner brushes being of circular cross-section; and the inner brushes located in the same line have the same diameter and the centres of the left inner brushes are located on the left inner line c and the centres of the right inner brushes are located on the right inner line *d.*

[0035] Preferably, the distance *k* between the centres of the left inner brushes is $2r_c - ½r_c < k \leq 2r_c$, and the distance *l* between the centres of the right inner brushes is $2r_d - ½r_d < 1 \leq 2r_d$. By meeting these conditions, the brushes placed on one line either touch at one point when $k \leq 2r_c$ and $1 \leq 2r_d$, or overlap when projected from above, by a maximum of ½r, if the condition $2r_c - ½r_c < k$ and $2r_d - ½r_d < 1$ is met.

[0036] In another preferred embodiment, the distance *k* between the centres of the left inner brushes is 2rc <k and the distance *l* between the centres of the right inner brushes is $2r_d < 1$. In this case, the adjacent brushes located on one line do not touch at all.

[0037] Preferably, the brush section is also provided with front and rear brushes which, after the crate enters the brushes, wash the front and rear side plates of the crate from the outside. The brush section is preferably provided with at least one front brush located in the front upper part of the brush section wash zone and at least one rear brush located in the rear upper part of the brush section wash zone, the front brush and rear brush being of circular cross-section and through the centre of the front brush a front line *e* passes parallel to the line *f* passing through the centre of the rear brush, the front line *e* and the rear line *f* being perpendicular to the axis *h* of the conveyor feed and are located between the left side line *a* and the right side line *b.*

[0038] Preferably, the rotational axes of the front brush and the rear brush are situated perpendicular to the surface of the conveyor, above the surface of the conveyor.

[0039] Preferably, the distance *q* between the front line *e* and the rear line *f* is $p_d + ½r_e + ½r_f < q < p_d + r_e + r_f$, where p_d is the length of the crate, r_e is the radius of the front brush and r_f is the radius of the rear brush.

[0040] This ensures that the front and rear brushes wash the side plates of the crate from the outside of the crate located in the wash zone of the brush section. The brushes are in contact with the crate either at only one point - the boundary condition $q < p_d + r_e + r_f$, or they are in overlap with the crate when projected from above, in a maximum overlap ½r, i.e., the second boundary condition $p_d + ½r_e + ½r_f < q$. An overlap bigger than ½r causes a large deformation of the brush at the expense of washing efficiency.

[0041] Preferably, there is a plurality of front and rear brushes in the brush section. Preferably, the brush section is provided with at least two front brushes and at least two rear brushes, the brushes being of circular cross-section and the brushes located on the same line having the same diameter and the centres of the front brushes being located on the front line *e* and the centres of the rear brushes located on the rear line *f*

[0042] Preferably, the rotational axes of the front brush and the rear brush are situated perpendicular to the surface of the conveyor, above the surface of the conveyor.

[0043] Preferably, the distance m between the centres of the front brushes is $2r_e - ½r_e < m \leq 2r_e$, and the distance n between the centres of the rear brushes is $2r_f - ½r_f < n \leq 2r_f$, where r_e is the radius of the front brush and r_f is the radius of the rear brush.

[0044] If a plurality of front and rear brushes are located in the brush section, adjacent brushes located on one line perpendicular to the *h* axis of the crate feed can either touch at one point, i.e., the boundary condition that $m \leq 2r_e$ and $n \leq 2r_f$ is met, or adjacent brushes overlap when projected from above, by a maximum of ½r, i.e., $2r_e - ½r_e < m$ and $2r_f - ½r_f < n$.

[0045] In another preferred embodiment, the distance *m* between the centres of the front brushes is $2r_e < m$, and the distance *n* between the centres of the rear brushes is greater than $2r_f < n$, where r_e is the radius of the front brush and r_f is the radius of the rear brush and adjacent brushes do not touch at all.

[0046] The bristles of the brushes in the brush section are preferably made of uncoloured nylon and have a circular cross-section. In this case, the bristles do not soften during the crate washing due to the water soaking into the bristle material, since the uncoloured silicone has low water absorption and softens at a temperature of 140 °C. The circular cross-section, in turn, ensures lower fragility of bristles compared to bristles with an edge. Preferably, the bristles have a diameter of 0.3 to 5 mm.

[0047] The brushes of the brush section preferably have a diameter of 80 to 250 mm. This brush diameter was chosen for its versatility, when the most frequently washed crates 600*400 mm and 300*400 mm are washed, for example, at one time by 22 brushes with a diameter of 160 mm - of which four are left side brushes, four are right side brushes, four are left inner brushes, four are right inner brushes, three are front brushes and three are rear brushes. The left side brushes have an overlap of 10 mm with adjacent brushes, as well as the right side brushes have an overlap of 10 mm, as well as the left inner brushes have an overlap of 10 mm, as well as the right inner brushes have an overlap of 10 mm, as well as the front brushes have an overlap of 10 mm, as well as the rear brushes have an overlap of 10 mm, whereby the adjacent brushes, provided they are rotatable, are cleaned. Preferably, the adjacent brushes rotate around their axes in the opposite direction, thus enhancing the cleaning effect, where one brush wipes the other, etc. The left side brushes have an overlap of 10 mm with the left inner brushes, just as the right side brushes have an overlap of 10 mm with the right inner brushes, thereby pressing the inserted crate and washing it.

[0048] Preferably, the brushes are non-static, rotatable around their axis and driven by a drive. The brushes are preferably connected to a brush drive and are rotatable in the range of 1 to 3,000 rpm, more preferably 1 to 1,500 rpm and most preferably 400 to 800 rpm. It applies here that what is not washed during five rotations of the brush, is not washed by further rotation.

[0049] Preferably, so that the crate does not have to be lifted too high into the brushes, the length of upper brushes from the ceiling of the working wash zone of the brush section is less than t - u, where t is the height of the working wash zone and u is the height of the location of the side plate of the crate placed on the conveyor.

[0050] This ensures that the crate placed on the conveyor reaches the brush section, passing under the front brushes, the left and right inner brushes and the reversible lifting mechanism picks up the crate bottom down into the brushes. Then the reversible lifting mechanism returns the crate to its initial position, preferably on the conveyor, and the crate continues its passage through the brush section, passing under the rear brushes. As it passes through the brush section, the crate is preferably washed by the side brushes from the outside, if the side brushes have a length from the ceiling of the free wash zone greater than t - u, where t is the height of the free wash zone and u is the height of the location of the side plate of the crate placed on the conveyor.

[0051] At its entrance, the brush section is preferably provided with at least two centring guides with a centring lead directed towards the axis of the conveyor feed, which ensure the centring of the crate with respect to the axis of the conveyor feed. Preferably, the centring guide is triangular in shape and includes driven straps for contact with the crate.

Summary of presented Drawings

[0052]

Fig.1: A: Arrangement of brushes in the brush section of the tunnel washing line for crates B: Brush section for tunnel washing lines, general view from the front

Fig.2: Brush section of the tunnel washing line, detailed view of the wash zone with the washed crate placed on the conveyor, with water rinsing, with side and upper brushes

Fig.3: Brush section of the tunnel washing line, general side view

Fig.4: Brush section of the tunnel washing line, detailed top view, connection of the brushes to the belt drive

Fig.5: Brush section of the tunnel washing line, detailed sectional view, visible side and upper brushes

Fig.6: Brush section of the tunnel washing line, detailed front view from the side, the washed crate placed on the conveyor bottom down is ready to be lifted by a reversible lifting mechanism into the brushes

Fig.7: Brush section of the tunnel washing line, detailed front view from the side, the washed crate placed on the conveyor bottom down is ready to be lifted by a reversible lifting mechanism into the brushes

Fig.8: Brush section of the tunnel washing line, detailed view from below, the washed crate placed on the conveyor bottom down is ready to be lifted by a reversible lifting mechanism into the brushes

Fig.9: Brush section of the tunnel washing line, detailed front view, the washed crate placed on the conveyor bottom down is ready to be lifted by a reversible lifting mechanism into the brushes

Fig.10: Brush section of the tunnel washing line, detailed side view from above, the washed crate is lifted bottom down into the brushes by the lifting mechanism, visible side and front brushes

Fig.11: Brush section of the tunnel washing line, detail of the conveyor belt located in the bottom part of the wash zone of the brush section

Fig. 12: Brush section of the tunnel washing line, detailed view into the wash zone of the brush section, visible four parts of the belt conveyor and the lower guide rails

Fig.13: Detail of a centring guide with rubber bands with a centring lead directed towards the conveyor feed axis

Fig. 14: Detail of the reversible lifting mechanism when gripping the crate

Fig. 15: Detail of the reversible lifting mechanism when releasing the crate

Fig. 16: Detail of the lifting mechanism when gripping the crate, general view with the crate from the front

Fig. 17: Detail of the lifting mechanism when gripping the crate, general view with the crate from the side
Fig. 18: Detail of the lifting mechanism when gripping the crate, general view with the crate from below
Fig. 19: Detail of the reversible mechanism realized by reversible forks
Fig.20: Detail of water rinsing performed by water nozzles
Fig.21: Detail of a brush for the brush section
Fig.22: Brush section of the tunnel washing line, detail of the reversible lifting mechanism when gripping the crate, general view with the crate from the front
Fig.23: Brush section of the tunnel washing line, detail of the connection of the brush to the drive
Fig.24: Brush section of the tunnel washing line, detailed layout of brushes in the brush section according to Example 4, example of the location of a large crate and a small crate
Fig.25: Brush section of the tunnel washing line, detailed layout of brushes in the brush section according to Example 4, location of a large crate
Fig.26: Brush section of the tunnel washing line, the reversible lifting mechanism realized by a piston-driven lifting plate and reversible forks
Fig.27: Brush section of the tunnel washing line, detail of the lifting plate and reversible forks, a large crate
Fig.28: Brush section of the tunnel washing line, detail of the lifting plate and reversible forks, a small crate
Fig.29: Brush section of the tunnel washing line, the reversible lifting mechanism realized by a piston-driven lifting plate and reversible forks, detail of location of a large crate and a small crate
Fig.30: Brush section of the tunnel washing line, the reversible lifting mechanism realized by a piston-driven lifting plate and reversible forks, detail of the lifting plate, view from below
Fig.31: Soiled crate to be washed
Fig.32: Crate washed in a standard, high-pressure industrial tunnel washing line for crates
Fig.33: Crate washed in the brush section
Fig.34: Location of the brushes in the brush section according to Example 1A
Fig.35: Location of the brushes in the brush section according to Example 2
Fig.36: Location of the brushes in the brush section according to Example 3
Fig.37: Double tunnel washing line equipped with a double brush section with horizontal and side brushes, where two lines run side by side in parallel, large crates
Fig.38: Double tunnel washing line equipped with a double brush section with horizontal and side brushes, where two lines run side by side in parallel, small crates

Examples of Invention Execution

Example 1A Two side brushes, static, vertical

[0053] A brush section 1 of a tunnel washing line 0 for crates 3 was built. In the existing washing line 0, two side brushes of circular cross-section with a height equal to the height of the working wash zone, i.e., 320 mm, with a diameter of 160 mm, were installed in the main wash section. The brushes were made with a steel cylindrical heart with a diameter of 25 mm, a nylon coating with an outer diameter of 80 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 1 mm. The brushes were positioned opposite each other, i.e., one left side brush 5 and one right side brush 6, the centres of the two brushes lying in one axis perpendicular to the axis h of the conveyor feed. The distance between the centres of the left and right side brushes was 530 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm and a 10mm overlap with the left and right side brushes. The brushes were without drive. When passing through the washing line, the crate 3 wipes on the left and right side brush, thereby achieving contact washing of the crate 3 and the efficiency of removing the labels on the crates 3 glued to the side plates of the crate 3 from the outside reaches up to 60 per cent. The location of the brushes in the brush section 1 is shown in Figure 34.

Example 1B Four side brushes, static, horizontal

[0054] A brush section 1 of a tunnel washing line 0 for crates 3 was built. In the existing washing line 0, four side, horizontal brushes of circular cross-section with a length of 1,000 mm, with a diameter of 200 mm, were installed in the main wash section. The brushes were made with a steel cylindrical heart with a diameter of 35 mm, a nylon coating with an outer diameter of 100 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 0.5 mm. The brushes were placed opposite each other, i.e., two left side brushes and two right side brushes, the axes of rotation of the left side brushes 5 lying in one plane and the axes of rotation of the right side brushes 6 lying in one plane, and the left and right side planes perpendicular to the plane of conveyor 2 and located above the plane of conveyor 2. The distance between the left and right side plane was 500 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm and a 50 mm overlap with the left and right side brushes. The distance between the centres of the left side

brushes 5 on the left side plane was 190 mm, i.e., the adjacent brushes overlapped by 10 mm. The right side brushes 6 were placed at the same distance. The brushes were connected to the drive and were rotatable in the range of 1 to 800 revolutions per minute. When passing through the washing line, the crate 3 wipes on the left and right horizontal rotating brushes, thereby achieving contact washing of the crate 3 and the efficiency of removing the labels on the crates 3 glued to the side plates of the crate 3 from the outside reaches up to 65 per cent.

Example 2 Eight side rotating brushes

[0055] A brush section 1 of a tunnel washing line 0 for crates 3 was built. In the existing washing line 0, eight side brushes of circular cross-section with a height of half of the working wash zone, i.e., 160 mm, with a diameter of 160 mm, were installed in the main wash section. The brushes were placed in the bottom part of the working wash zone to be able to wash by contact the sides of the passing crates 3, especially in their bottom part, where labels are usually placed. The brushes were made with a steel cylindrical heart with a diameter of 25 mm, a nylon coating with an outer diameter of 80 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 1 mm. Four left side brushes 5 were placed on the left side line a, four right side brushes 6 were placed on the right side line b. The right and left side lines were parallel to the axis h of the conveyor 2 feed. The left side brushes 5 were placed relative to the right side brushes 6 with a displacement along the left side line a of 8 cm, i.e., ½ r. The distance between the left and right side lines was 530 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm and a 10mm overlap with the left and right side brushes. The distance between the centres of the left side brushes 5 on the left side line a was 120 mm, i.e., the adjacent brushes overlapped by ½r. The right side brushes 6 were placed at the same distance. The steel hearts of the brushes were led out through the ceiling of the working wash zone of the brush section 1, where it was connected to the gears and belts connected to the drive. The drive was provided by an electric motor and the brushes were rotatable in the range of 1 to 3,000 revolutions per minute.

[0056] The brush drive is switched on and set to 800 revolutions of brush per minute. When passing through the washing line 0, the crate 3 is wiped with rotating left and right side brushes, thus achieving contact washing of the crate 3 and the efficiency of removing the labels on the crates 3 glued to the side plates of the crate 3 from the outside reaches up to 75 %. The location of brushes in the brush section 1 is shown in Figure 35.

Example 3 *Eight side rotating brushes and eight upper rotating brushes*

[0057] A brush section 1 of a tunnel washing line 0 for crates 3 was built. In the existing washing line 0, twelve side brushes of circular cross-section with a height corresponding to the height of the working wash zone, i.e., 620 mm, with a diameter of 80 mm, were installed in the main wash section. The brushes were placed on the sides of the working wash zone to be able to wash by contact the sides of the passing crates 3, where labels are usually placed. The brushes were made with a steel cylindrical heart with a diameter of 15 mm, a nylon coating with an outer diameter of 35 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 0.3 mm. Four left side brushes 5 were placed on the left side line a, four right side brushes 6 were placed on the right side line b. The right and left side lines were parallel to the axis h of the conveyor 2 feed. The left side brushes 5 were located opposite the right side brushes 6 with a displacement along the left side line a by ½r, i.e. the centre of the first left side brush 5 was located in one axis centred between the first right and second right side brush 6, this axis being perpendicular to the axis h of the conveyor 2 feed. The distance between the left and right side lines was 560 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm without an overlap. The distance between the centres of the left side brushes 5 on the left side line a was 100 mm, i.e. the adjacent brushes did not touch each other. The right side brushes 6 were placed at the same distance. The steel hearts of the brushes were led out through the ceiling of the working wash zone of the brush section, where they were connected to gears and belts connected to the drive. The brushes were rotatable in the range of 1 to 3,000 revolutions per minute.

[0058] Eight upper brushes of circular cross-section with a length corresponding to the height of the working wash zone t minus the height of the location of the side plate of the crate u, i.e., for a 300 mm high crate lying on a conveyor 620 mm - 300 mm = 320 mm, with a diameter of 160 mm, were also installed in the main wash section. The brushes were placed on the ceiling of the working wash zone so as to allow the passage of the washed crate 3 below them and to be able to wash by contact the inner space of the crate 3 lifted up by the reversible lifting mechanism 7. The brushes were made with a steel cylindrical heart with a diameter of 25 mm, a nylon coating with an outer diameter of 80 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 2 mm. Four left inner brushes 13 were placed on the left inner line c, four right inner brushes 14 were placed on the right inner line d. The right and left inner lines c, d were parallel to the axis h of the conveyor 2 feed and were located between the left and right side lines a, b. The distance between the left and right inner lines c, d was 270 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm and a 15mm overlap with the left and right inner brush 13, 14. The distance between the centres of the left inner brushes 13 on the left inner line c was 160 mm, i.e., the adjacent brushes touched only at one point. The right

inner brushes 14 were placed at the same distance. The left inner brushes 13 were located opposite the right inner brushes 14, i.e., the centre of the first left inner brush 13 was located in one axis with the centre of the first right inner brush 14, this axis being perpendicular to the axis of the conveyor feed. The steel hearts of the brushes were led out through the ceiling of the working wash zone of the brush section, where they were connected to the gears and belts connected to the drive. The drive was provided by an electric motor and the brushes were rotatable in the range of 1 to 3,000 revolutions per minute.

[0059] The brush section was fitted with a reversible lifting mechanism 7 comprising a piston-operated lifting plate 11 and one reversible last. The lifting plate 11 was placed on the conveyor 2, in the middle of the brush section 1 and served to lift the crate 3 into the brushes. The reversible last was attached to the ceiling of the working wash zone and pointed downwards. The reversible last was positioned in the place of the bottom of the crate 3 to be washed and was immersed in the upper brushes. The reversible last was mounted on a spring. The reversible last ensured the return of the lifted crate 3 to its initial position on the conveyor 2.

[0060] The drive of the brushes is switched on and set to 1,000 revolutions of brush per minute. When passing through the washing line 0, the crate 3 is wiped with the rotating left and right side brushes 5, 6, whereby a contact washing of the crate 3 is achieved. In the brush section 1, the passing crate 3 is gripped by the lifting fixators 9 and lifted towards the brushes, thereby coming into contact with the reversible last, which travels together with the crate 3 upwards into the upper brushes. After 1s contact with the brushes, the crate 3 is actively pushed downwards by the reversible last and guided by the lifting fixators 9 to its initial position on the conveyor 2, which takes out the crate 3 from the brush section 1. The efficiency of removing the labels on the crates 3 glued to the side plates of the crate 3 from the outside and inside reaches up to 85 per cent. The location of the brushes in the brush section 1 is shown in Figure 36.

Example 4 *Eight side rotating brushes, eight upper rotating brushes, three front rotating brushes and three rear rotating brushes*

[0061] A brush section 1 of a tunnel washing line 0 for crates 3 was built. In the existing washing line 0, eight side brushes of circular cross-section with a height corresponding to the height of the working wash zone, i.e., 620 mm, with a diameter of 160 mm, were installed in the main wash section. The brushes were placed on the sides of the working wash zone to be able to wash by contact the sides of the passing crates 3, where labels are usually placed. The brushes were made with a steel cylindrical heart with a diameter of 25 mm, a nylon coating with an outer diameter of 80 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 2 mm. The four left side brushes 5 were placed on the left side line a, the four right side brushes 6 were placed on the right side line b. The right and left side lines a, b were parallel to the axis h of the conveyor 2 feed. The left side brushes 5 were placed between the right side brushes 6, i.e., the centre of the first left side brush 5 was in one axis with the centre between the first and second right side brush 6, this axis being perpendicular to the axis h of the conveyor 2 feed. The distance between the left and right side lines a, b was 530 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm and a 10 mm overlap with the left and right inner side 5, 6. The distance between the centres of the left side brushes 5 on the left side line a was 150 mm, i.e., the adjacent brushes have a 10 mm overlap. The right side brushes 6 were placed at the same distance. The steel hearts of the brushes were led out through the ceiling of the working wash zone of the brush section 1, where they were connected to the gears and belts connected to the drive. The drive was provided by an electric motor and the brushes were rotatable in the range of 1 to 3,000 revolutions per minute.

[0062] Eight upper brushes of circular cross-section with a height corresponding to half the height of the working wash zone, i.e., 310 mm, with a diameter of 160 mm, were also installed in the main wash section. The brushes were placed on the ceiling of the working wash zone so as to allow the passage of the washed crate 3 below them and to be able to wash by contact the inner space of the crate 3 lifted up by the reversible lifting mechanism 7. The brushes were made with a steel cylindrical heart with a diameter of 25 mm, a nylon coating with an outer diameter of 80 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 2 mm. Four left inner brushes 13 were placed on the left inner line c, four right inner brushes 14 were placed on the right inner line d. The right and left inner lines c, d were parallel to the axis h of the conveyor 2 feed and were located between the left and right side lines a, b. The distance between the left and right inner lines c, d was 260 mm, i.e., the setting for washing crates 3 with a width/length of 400 mm and a 10mm overlap with the left and right inner brush 13, 14. The left inner brushes 13 were placed between the right inner brushes 14, i.e., the centre of the first left inner brush 13 was in one axis with the centre between the first and second right inner brush 14, this axis being perpendicular to the axis h of the conveyor 2 feed. The distance between the centres of the left inner brushes 13 on the left inner line c was 150 mm, i.e., the adjacent brushes have a 10 mm overlap. The right inner brushes 14 were placed at the same distance. The steel hearts of the brushes were led out through the ceiling of the working wash zone of the brush section 1, where they were connected to the gears and belts connected to the drive. The drive was provided by an electric motor and the brushes were rotatable in the range of 1 to 3,000 revolutions per minute.

[0063] Three front brushes 15 and three rear brushes 16 of circular cross-section with a height corresponding to half

the height of the working wash zone, i.e., 310 mm, with a diameter of 160 mm, were also installed in the main wash section. The brushes were placed on the ceiling of the working wash zone so as to allow the passage of the washed crate 3 below them and to be able to wash by contact from the outside the front and rear side plates of the crate 3 lifted up by the reversible lifting mechanism 7. The brushes were made with a steel cylindrical heart with a diameter of 25 mm, a nylon coating with an outer diameter of 80 mm and bristles of uncoloured nylon with a circular cross-section with a diameter of 2 mm. Three front brushes 15 were placed on the front line e, three rear brushes 16 were placed on the rear line f. The front and rear lines e, f were perpendicular to the axis h of the conveyor 2 feed and the front and rear brushes 15, 16 were located between the left and right side lines a, b. The distance between the front and rear lines e, f was 740 mm, i.e. the setting for washing crates 3 with a width/length of 600 mm and a 10mm overlap with front and rear brush 15, 16. The front brushes 15 were placed between the rear brushes 16, i.e., the centre of the first front brush 15 was in one axis with the centre between the first and second rear brush 16, this axis being perpendicular to the axis of the conveyor feed. The distance between the centres of the front brushes 15 on the front line e was 150 mm, i.e., the adjacent brushes have a 10mm overlap. The rear brushes 16 were placed at the same distance. The steel hearts of the brushes were led out through the ceiling of the working wash zone of the brush section 1, where they were connected to the gears and belts connected to the drive. The drive was provided by an electric motor and the brushes were rotatable in the range of 1 to 3,000 revolutions per minute

[0064] The brush section was fitted with a reversible lifting mechanism 7 comprising two lifting fixators 9 and four eversible forks. The lifting fixators 9 were placed on the conveyor, in the middle of the brush section 1 and served to grip the bottom edge of the crate 3 and lift it up into the brushes. Four reversible forks were mounted in the ceiling of the working wash zone and pointed downwards. The reversible forks were positioned in the place of the front and rear side plates of the crate 3 to be washed and were immersed in the upper brushes. The reversible forks were movable up and down, operated by a drive. The reversible forks ensured the return of the lifted-up crate 3 to its initial position on the conveyor 2, and at the same time their shape prevented the folding of the side plates of the crate 3 and thus the deformation of the crate 3.

[0065] The drive of the brushes is switched on and set to 1,200 revolutions of brush per minute. When passing through the washing line 0, the crate 3 is wiped with the rotating left and right side brushes 5, 6, whereby a contact washing of the crate 3 is achieved. In the brush section 1, the passing crate 3 is gripped by the lifting fixators 9 and lifted towards the brushes, thereby coming into contact with the reversible forks, which secure the crate 3 against folding and travel together with the crate 3 up into the upper brushes. After contact with the brushes, the crate 3 is actively pushed downwards by the reversible forks and guided by the lifting fixators 9 to its initial position on the conveyor 2, which takes out the crate 3 from the brush section 1. The efficiency of removing the labels on the crates 3 glued to the side plates of the crate 3 from the outside and inside reaches up to 99 per cent. The position of the brushes in the brush section 1 is shown in Figures 24 and 25.

Example 5

[0066] The crate 3 with a label, see Figure 32, comes from the customer. The customer's requirement is that after washing, only the bottom layer of the sticker can remain on the crate, i.e., essentially only a 2x2 cm glue. This is an acceptable result of washing, in which case after washing, the crate with such 'residue' is further operated as clean. The crate 3 travels to the classic high-pressure industrial tunnel washing line for washing. After washing, a large amount of paper sticker remained on the crate, see Figure 33, more than the acceptable amount of 2x2 cm glue. In such a case, the crate 3 is excluded from the conventional washing process and travels to be 're-washed' to the desired state into the brush section 1, which guarantees the removal of the remnants of the sticker from the crate 3.

[0067] In this case, the soiled crate 3 was taken bottom down by the conveyor to the brush section 1 according to Example 4, where it was gripped by the lifting fixators 9 and lifted into brushes rotating around their axes at a speed of 800 revolutions per minute. When lifting the crate 3, the crate was secured with four reversible forks located in the place of the side plates of the crate, one fork for each side plate. After 1 s in the upper position, i.e., in contact with the brushes, the crate 3 was pushed out of the brushes by the reversible forks, back onto the conveyor 2 and the lifting fixators 9 moved away from the crate. In this particular case, the crate 3 was lifted into the brushes only once; in cases of extreme soiling the crate 3 can be lifted into the brushes several times, or the speed of rotation of the brushes can be increased or direction of their rotation can be changed. At the same time, it is possible to extend the contact of the crate 3 with the brushes or increase the speed of lifting the crate 3 into the brushes and returning the crate 3 onto the conveyor 2. After releasing the lifting fixators, the crate was collected again by the conveyor 2 and taken out of the brush section 1. The time the crate 3 passed through the brush section 1 was 2 s. After passing through the brush section 1, the crate 3 was thoroughly washed, see Figure 35.

List of marks for terms

[0068]

0. Tunnel washing line
1. Brush section of the tunnel washing line 0
2. Conveyor
3. Crate
4. Rinsing with water
5. Left side brush
6. Right side brush
7. Reversible lifting mechanism
8. Reversible lifting fixator
9. Lifting fixator
10. Reversible means
11. Lifting plate
12. Horizontal brush
13. Left inner brush
14. Right inner brush
15. Front brush
16. Rear brush

a. Left side line
b. Right side line
c. Left inner line
d. Right inner line
e. Front line
f. Rear line
g. Horizontal line
h. Axis of the conveyor 2 feed
i. Distance between the centres of the left side brushes (5)
j. Distance between the centres of the right side brushes (6)
k. Distance between the centres of the left inner brushes (13)
l. Distance between the centres of the right inner brushes (14)
m. Distance between the centres of the front brushes (15)
n. Distance between the centres of the rear brushes (16)
o. Distance between the left side line (a) and the right side line (b)
p. Distance between the left inner line (c) and the right inner line (d)
q. Distance between the front line (e) and the rear line (f)
t. Height of the working wash zone of the brush section 1
u. Height of the location of the side plate of the crate (3) placed on the conveyor (2)

Applicability in Industry

[0069] Industrial tunnel washing lines for crates, removal of labels and stickers.

Claims

1. A brush section (1) of tunnel washing lines (0) for removing labels from crates (3) provided with a conveyor (2) for moving the crate (3) bottom down through the brush section (1), a water rinse (4) and brushes, **characterized in that** it is provided with at least two left side brushes (5) situated on a left side of a wash zone of the brush section (1) and at least two right side brushes (6) located on a right side of the wash zone of the brush section (1),

wherein both the left side brushes (5) and the right side brushes (6) are of circular cross-section and centres of the left side brushes (5) lie on a left side line (a) which is parallel to a right side line (b) on which centres of the right side brushes (6) lie,
wherein the left side brushes (5) have the same diameter and the right side brushes (6) have the same diameter,

a distance (i) of the centres of the left side brushes (5) is $2r_a - ½r_a < i < 2r_a$, and a distance (j) of the centres of the right side brushes (6) is $2r_b - ½r_b < j < 2r_b$, where r_a is a radius of the left side brush (5), r_b is a radius of the right side brush (6), and
the left side line (a) and the right side line (b) are parallel to an axis (h) of the conveyor (2) feed and a distance (o) between the left side line (a) and the right side line (b) is $p_s + ½r_a + ½r_b < o < p_s + r_a + r_b$, where p_s is a width of the crate (3),
wherein rotational axes of the left side brush (5) and the right side brush (6) are situated perpendicular to a surface of the conveyor (2), above the surface of the conveyor (2), and
both the left side brushes (5) and the right side brushes (6) are connected to a brush drive and are rotatable in a range of 1 to 3,000 revolutions per minute.

2. The brush section (1) of tunnel washing lines (0) according to claim 1, **characterized in that** it is provided with at least two left inner brushes (13) situated in an upper left part of the wash zone of the brush section (1) and at least two right inner brushes (14) situated in an upper right part of the wash zone of the brush section (1),

wherein both the left inner brushes (13) and the right inner brushes (14) are of circular cross-section and
centres of the left inner brushes (13) lie on a left inner line (c), which is parallel to a right inner line (d), on which centres of the right inner brushes (14) lie,
the brushes placed on the same line have the same diameter,
wherein the left inner line (c) and the right inner line (d) are parallel to the axis (h) of the conveyor (2) feed and are located between the left side line (a) and the right side line (b), and
a distance (p) between the left inner line (c) and the right inner line (d) is $p_s - r_c - r_d < p < p_s - ½r_c - ½r_d$, where r_c is a radius of the left inner brush (13), r_d is a radius of the right inner brush (14),
wherein rotational axes of the left inner brush (13) and the right inner brush (14) are situated perpendicular to the surface of the conveyor (2), above the surface of the conveyor (2).

3. The brush section (1) of tunnel washing lines (0) according to claim 2, **characterized in that** a distance (k) of the centres of the left inner brushes (13) is $2r_c - ½r_c < k \leq 2r_c$, and a distance (l) of the centres of the right inner brushes (14) is $2r_d - ½r_d < l \leq 2r_d$.

4. The brush section (1) of tunnel washing lines (0) according to claim 1 or 2, **characterized in that** it is provided with at least two front brushes (15) situated in an upper front part of the wash zone of the brush section (1) and at least two rear brushes (16) situated in an upper rear part of the wash zone of the brush section (1),

wherein both the front brushes (15) and the rear brushes (16) are of circular cross-section and
centres of the front brushes (15) lie on a front line (e), which is parallel to a rear line (f), on which centres of the rear brushes (16) lie,
the brushes placed on the same line have the same diameter,
wherein the front line (e) and the rear line (f) are perpendicular to the axis (h) of the conveyor (2) feed and are located between the left side line (a) and the right side line (b), and
a distance (q) between the front line (e) and the rear line (f) is $p_d + ½r_e + ½r_f < q < p_d + r_e + r_f$, where p_d is a length of the crate (3), r_e is a radius of the front brush (15) and r_f is a radius of the rear brush (16),
wherein rotational axes of the front brush (15) and the rear brush (16) are situated perpendicular to the surface of the conveyor (2), above the surface of the conveyor (2).

5. The brush section (1) of tunnel washing lines (0) according to claim 4 **characterized in that** a distance (m) between the centres of the upper front brushes (15) is $2r_e - ½r_e < m \leq 2r_e$, and a distance (n) between the centres of the upper rear brushes (16) is $2r_f - ½r_f < n \leq 2r_f$,.

6. The brush section (1) of tunnel washing lines (0) according to claim 1 or 2 or 4 **characterized in that** the brushes have bristles made of uncoloured nylon with a circular cross-section with a diameter of 0.3 to 5 mm.

7. The brush section (1) of tunnel washing lines (0) according to claim 1 or 2 or 4 **characterized in that** the brushes are rotatable in a range of 400 to 800 revolutions per minute.

8. The brush section (1) of tunnel washing lines (0) according to claim 1 or 2 or 4 **characterized in that** adjacent brushes rotate in opposite directions.

9. The brush section (1) of tunnel washing lines (0) according to claim 1 **characterized in that** it is provided with a reversible lifting mechanism (7).

10. The brush section (1) of tunnel washing lines (0) according to claim 9 **characterized in that** the reversible lifting mechanism (7) is performed by at least two reversible lifting fixators (8).

11. The brush section (1) of tunnel washing lines (0) according to claim 9 **characterized in that** the reversible lifting mechanism (7) is performed by at least two lifting fixators (9) and at least two reversible means (10).

12. The brush section (1) of tunnel washing lines (0) according to claim 11 **characterized in that** the reversible means (10) is a reversible fork or a reversible last.

13. The brush section (1) of tunnel washing lines (0) according to claim 12 **characterized in that** the reversible fork is located above a side plate of the crate (3) placed bottom down on the lifting mechanism in the brush section (1).

14. The brush section (1) of tunnel washing lines (0) according to claim 12 **characterized in that** the reversible last is located above a bottom of the crate (3) placed bottom down on the lifting mechanism in the brush section (1).

15. The brush section (1) of tunnel washing lines (0) according to claim 9 **characterized in that** the reversible lifting mechanism (7) is performed by at least one lifting plate (11) and at least two reversible means (10).

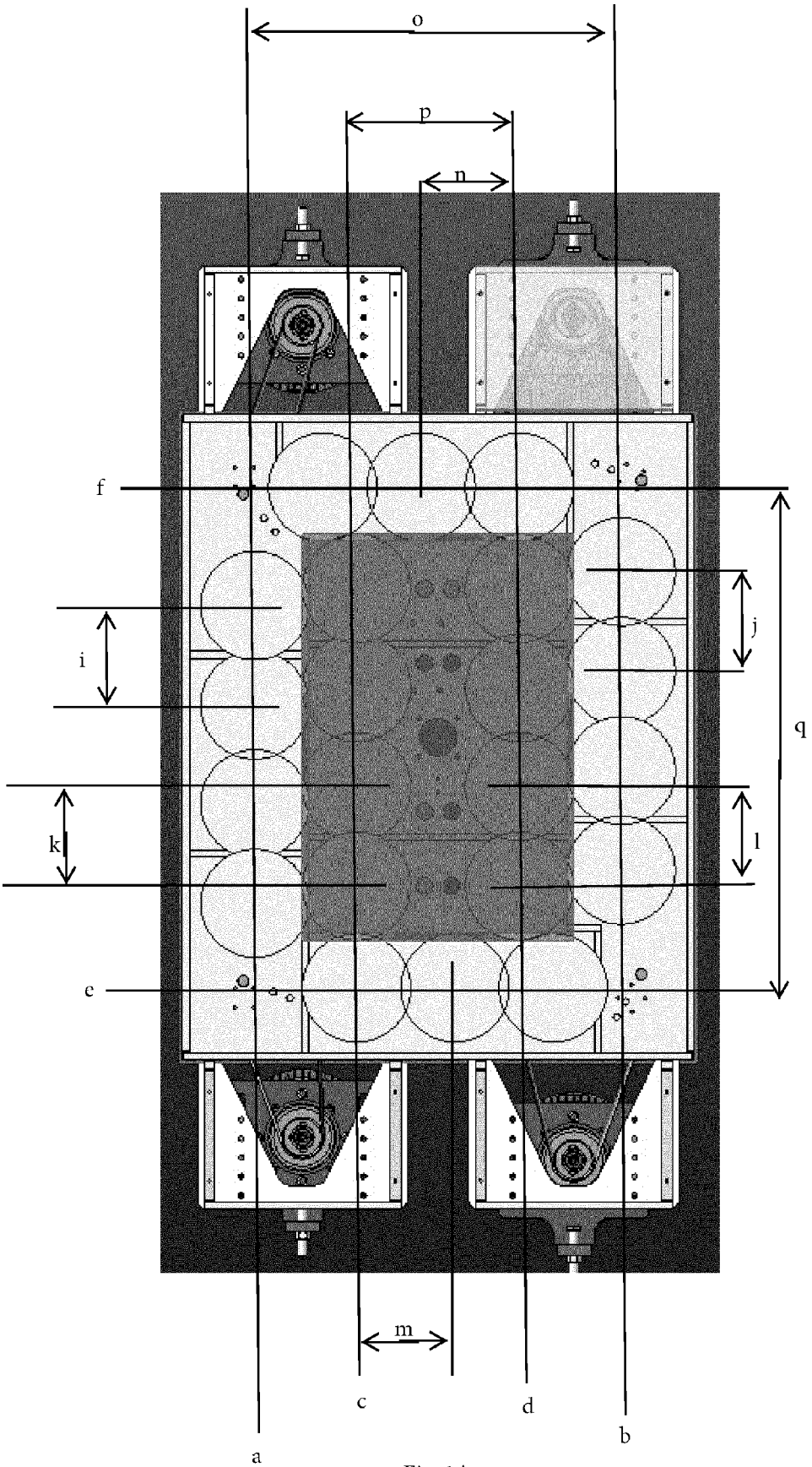

Fig. 1A

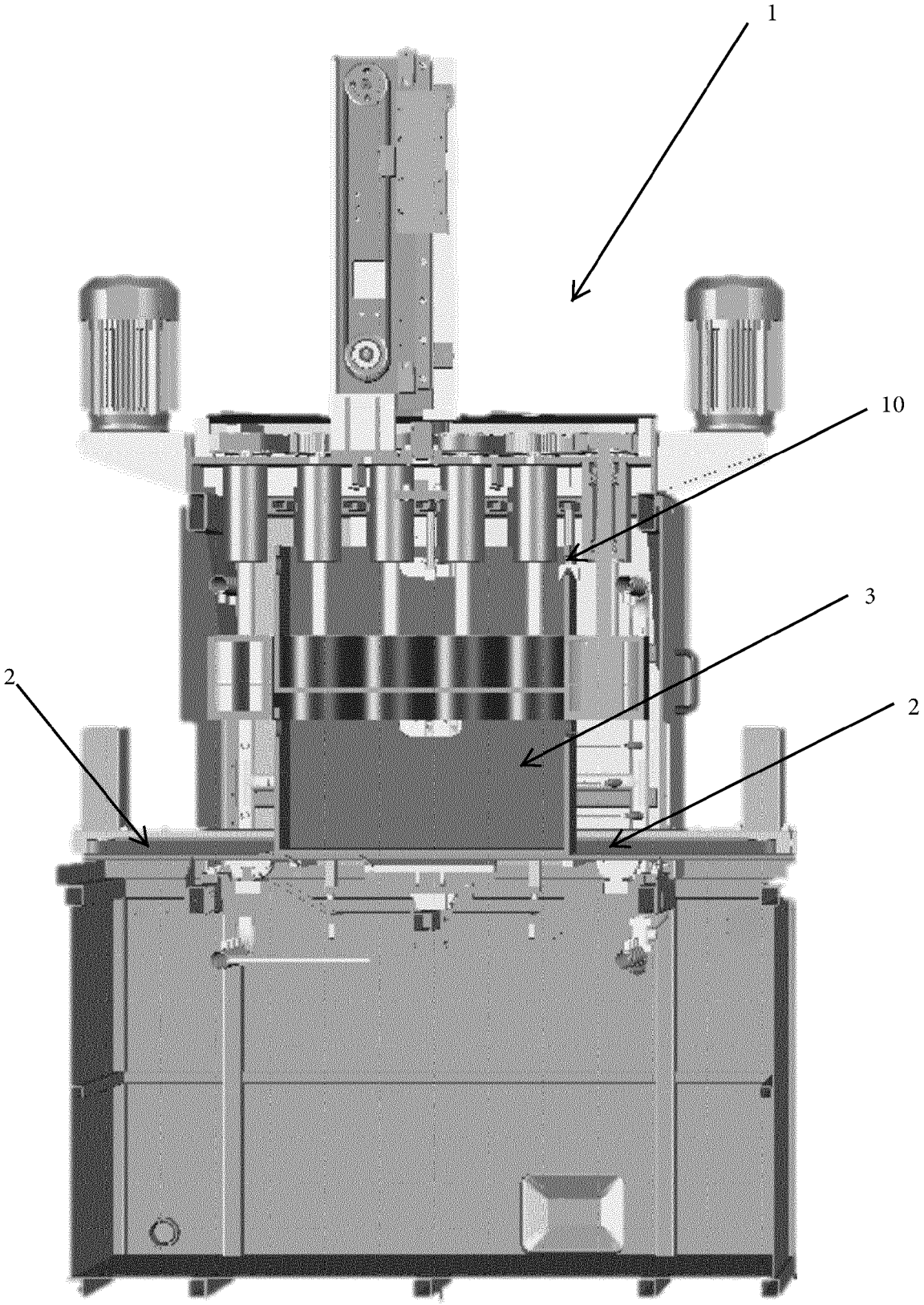

Fig. 1 B

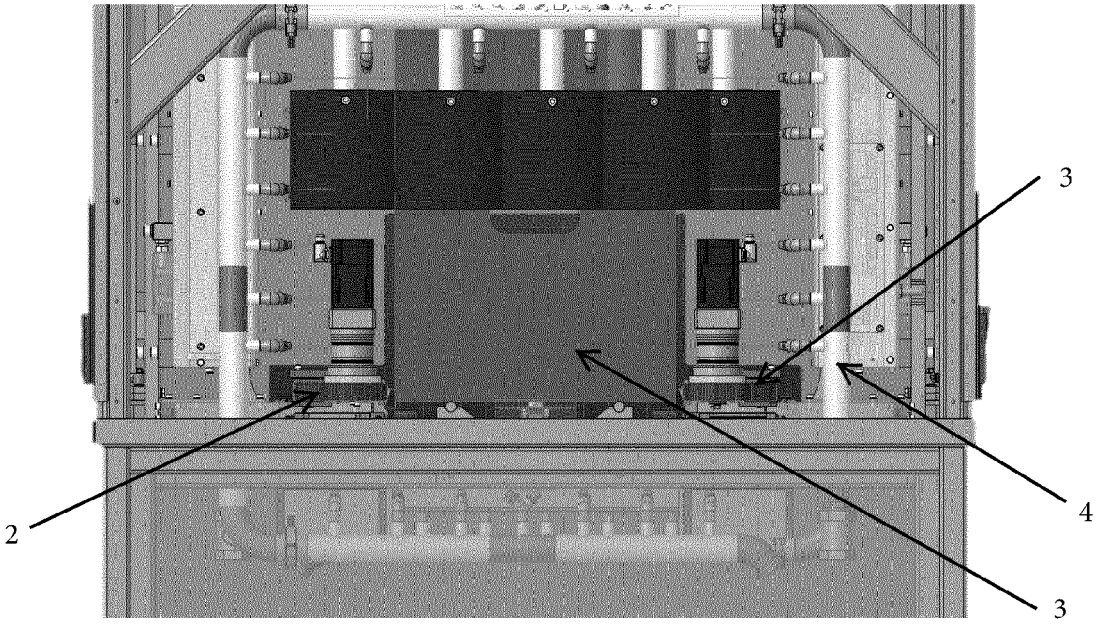

Fig. 2

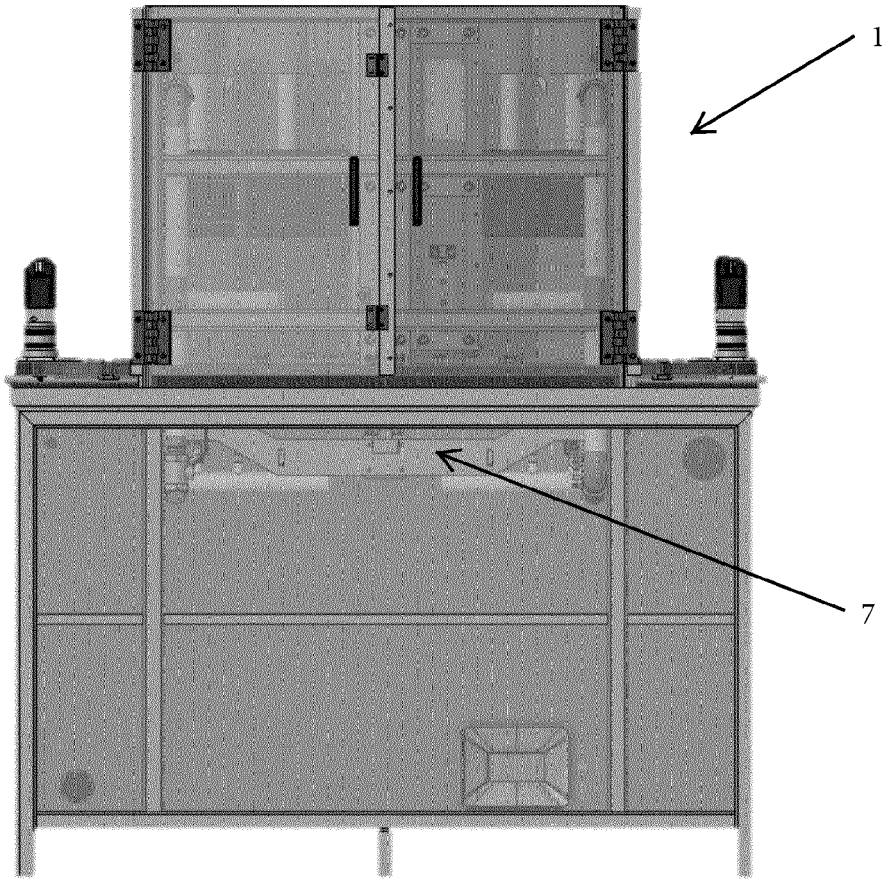

Fig. 3

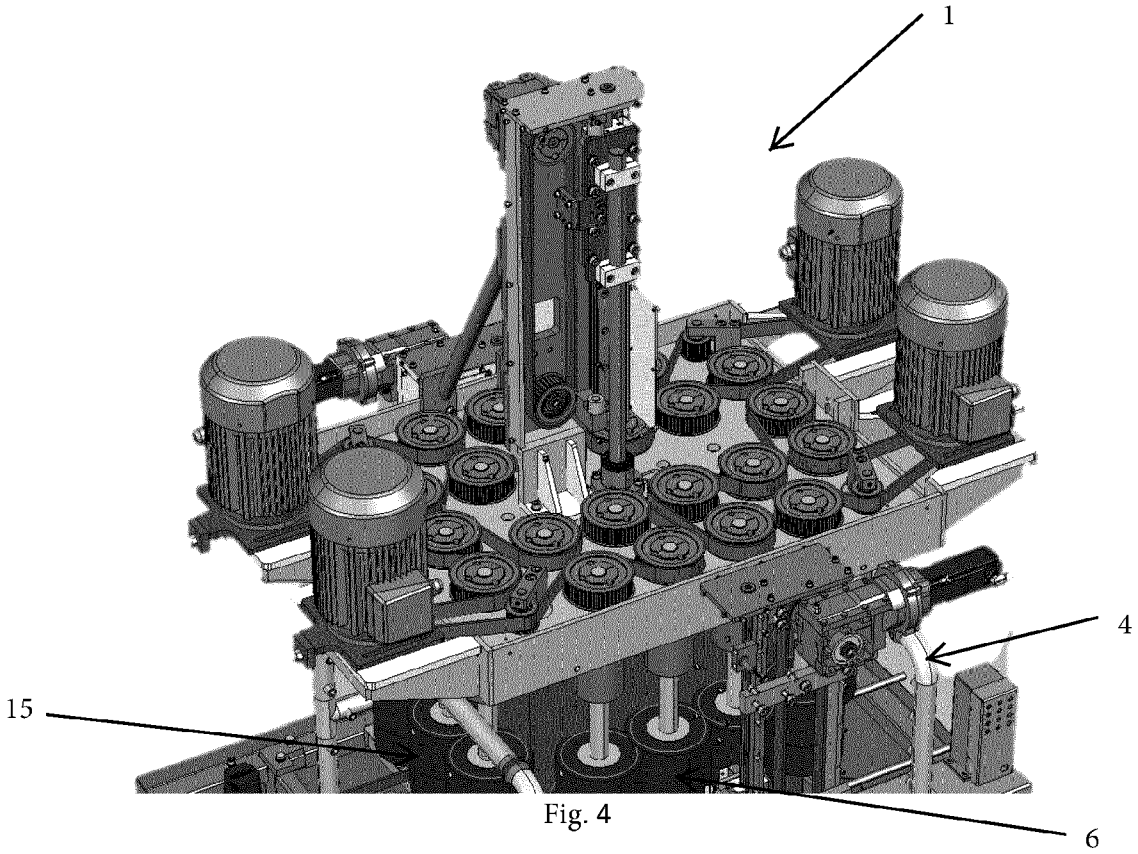

Fig. 4

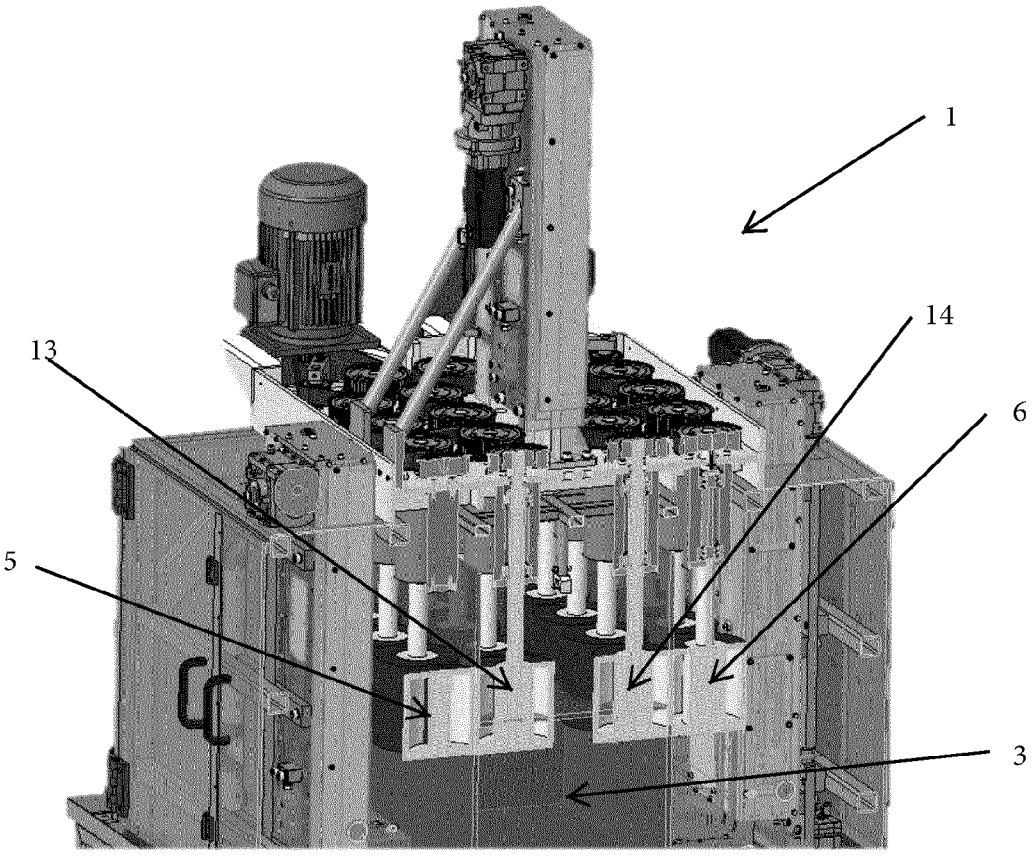

Fig. 5

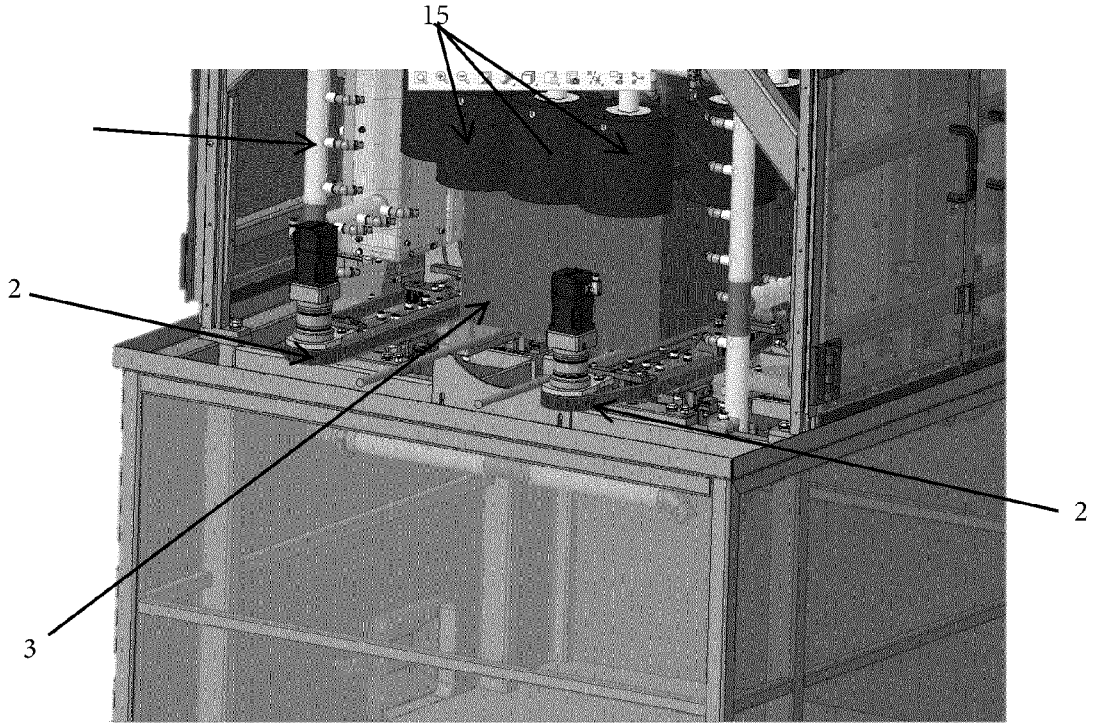

Fig. 6

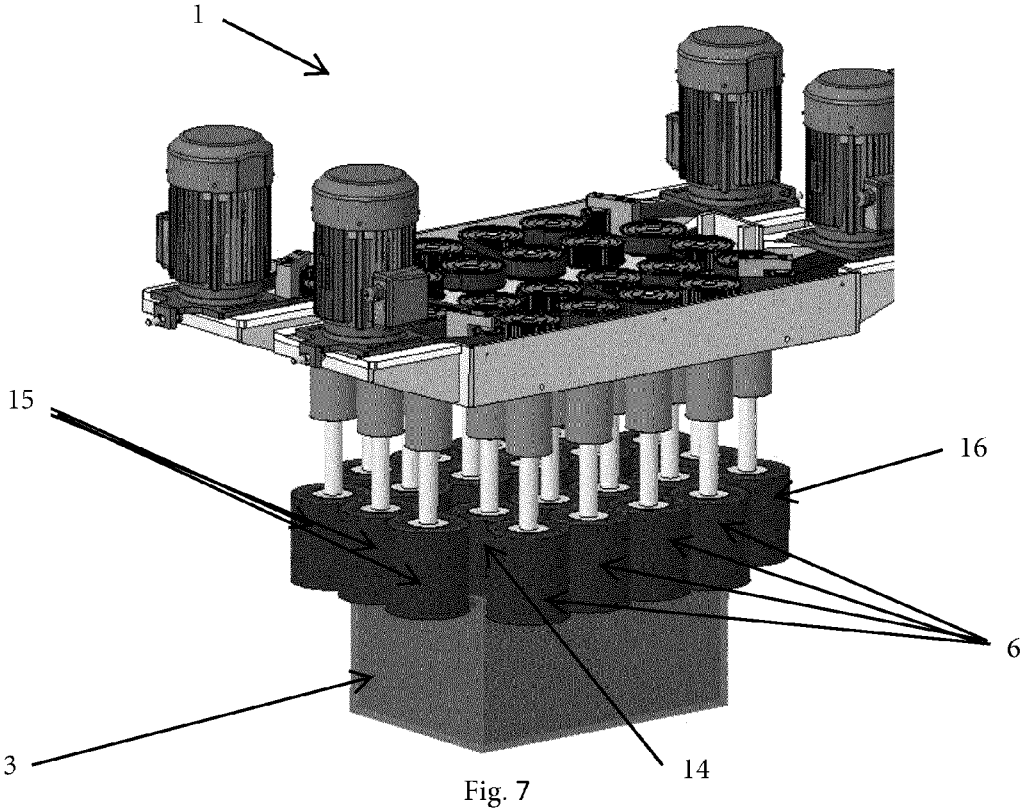

Fig. 7

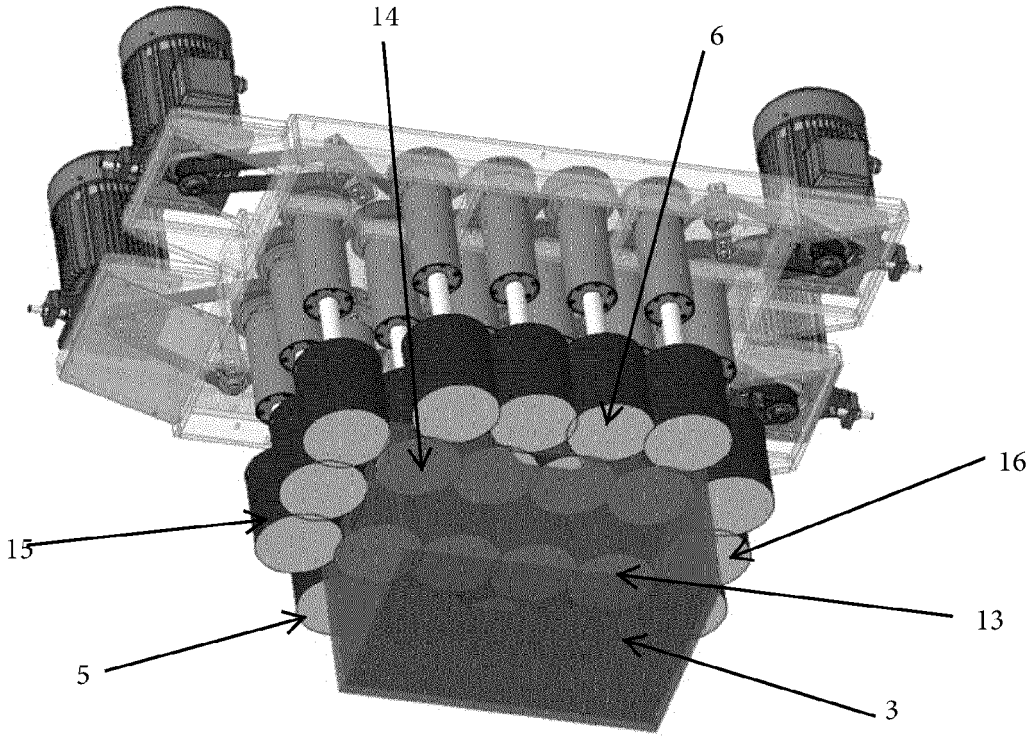

Fig. 8

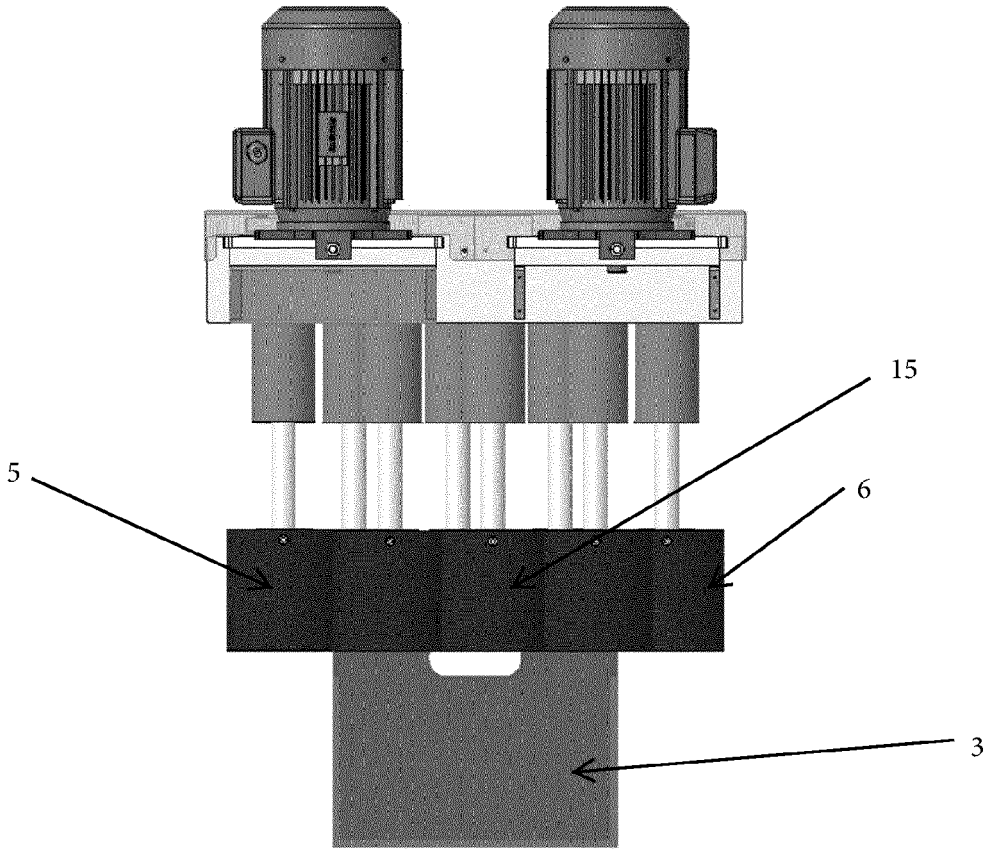

Fig. 9

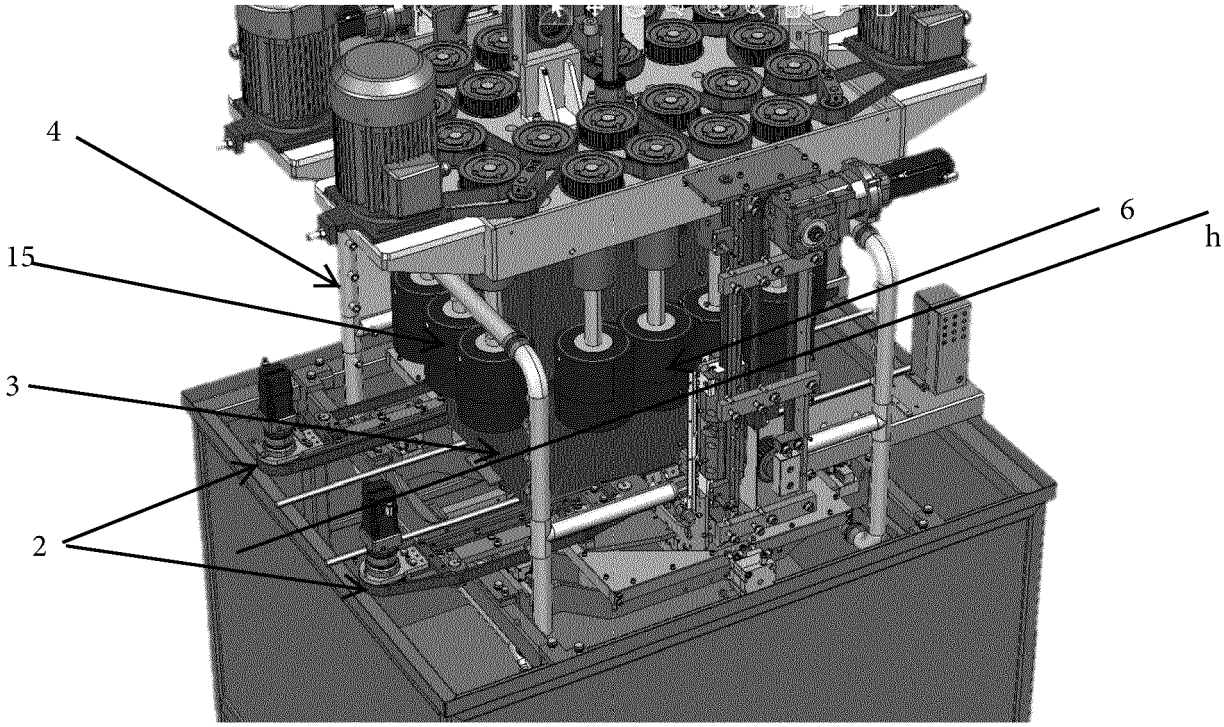

Fig. 10

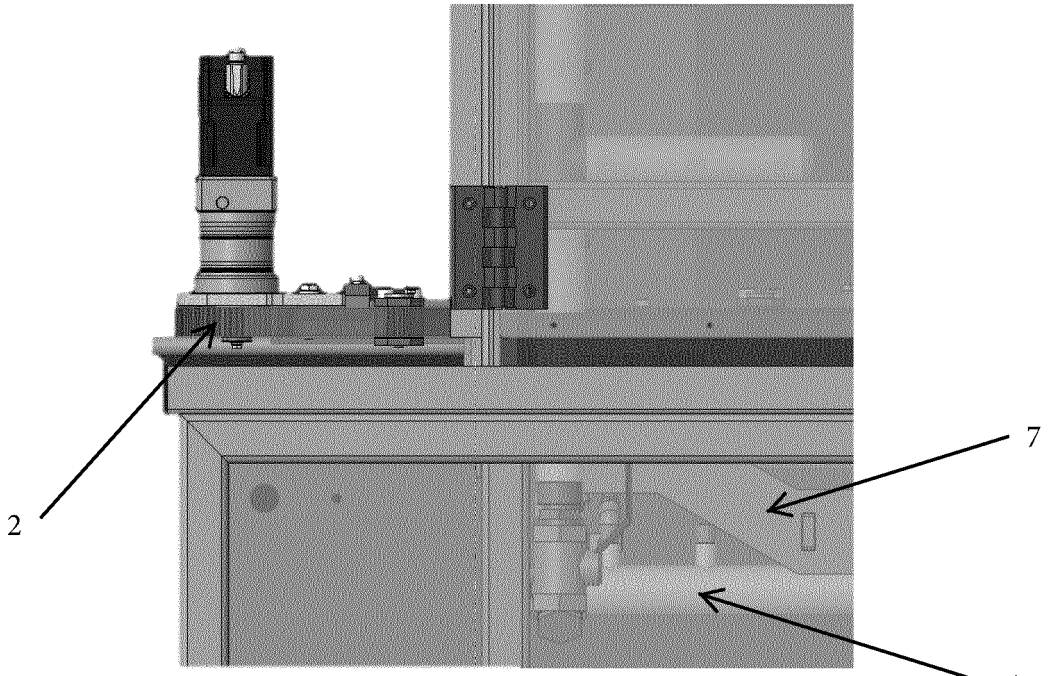

Fig. 11

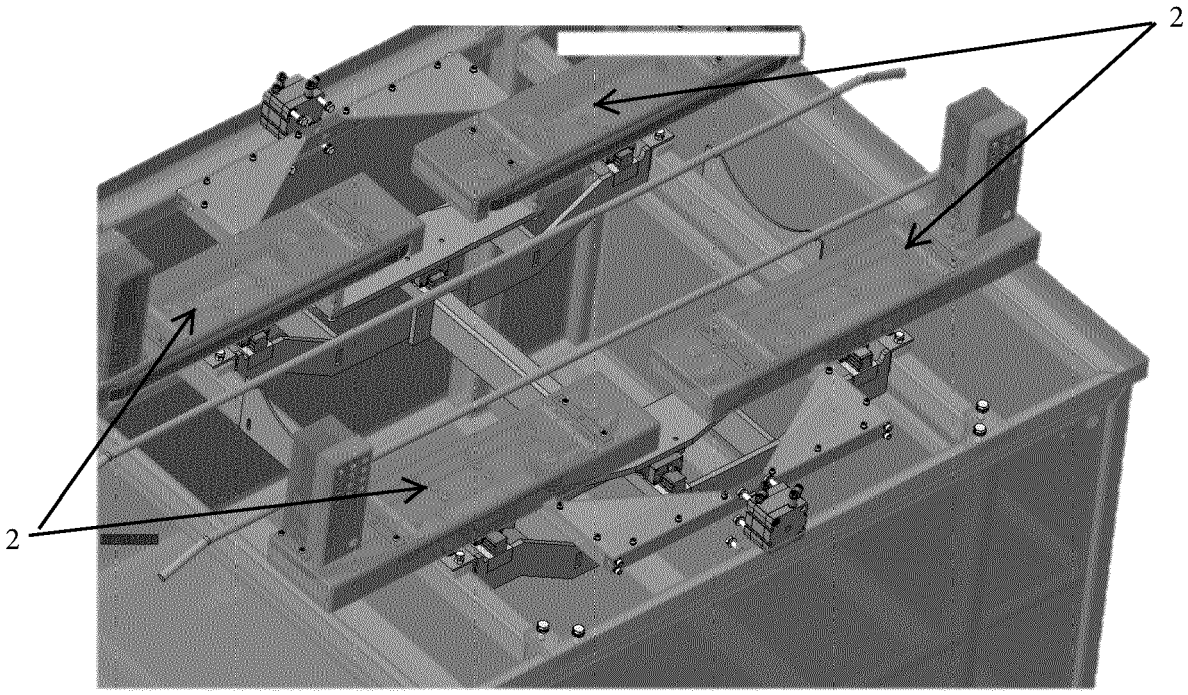

Fig. 12

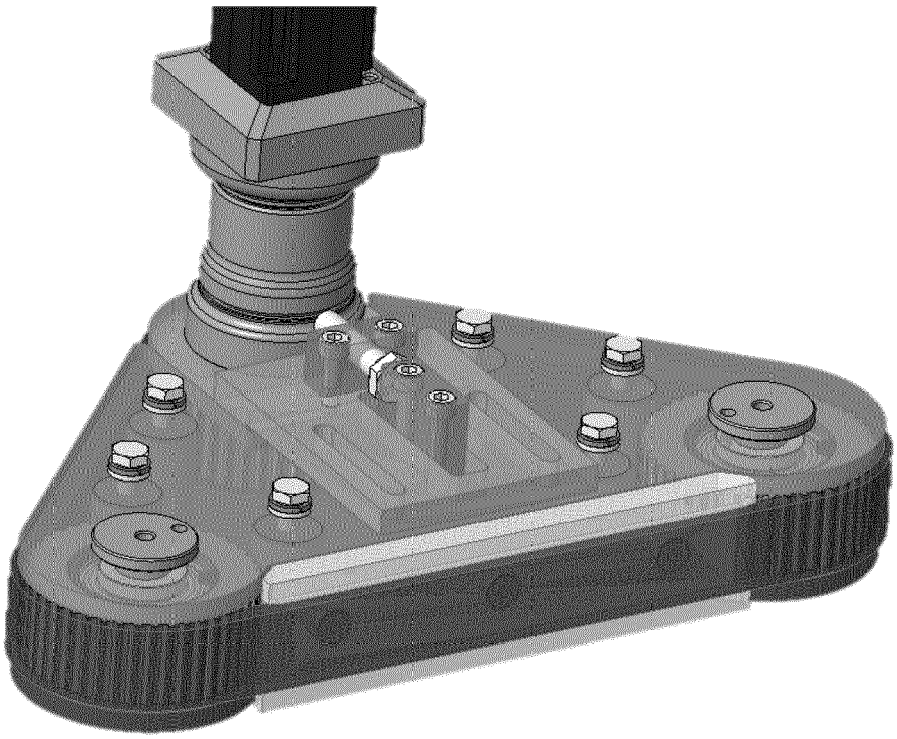

Fig. 13

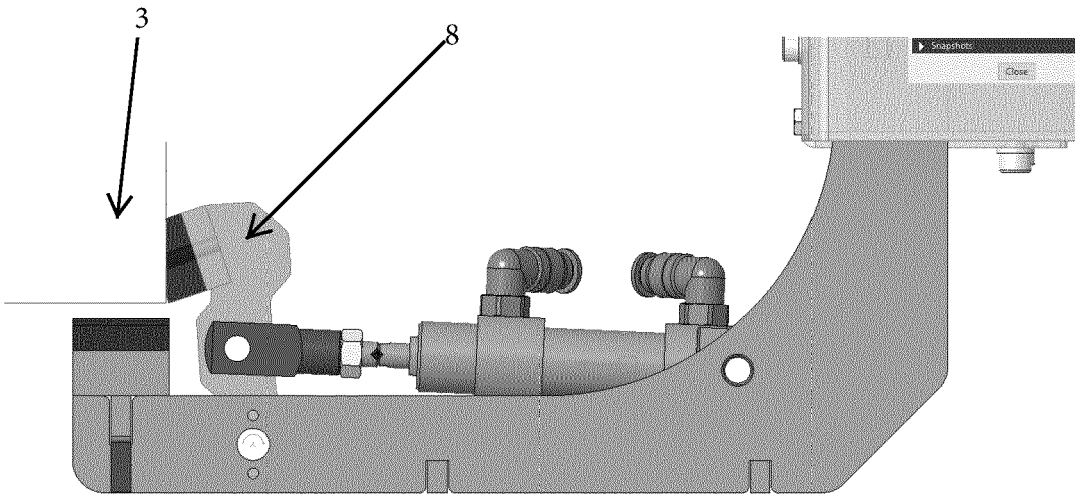

Fig. 14

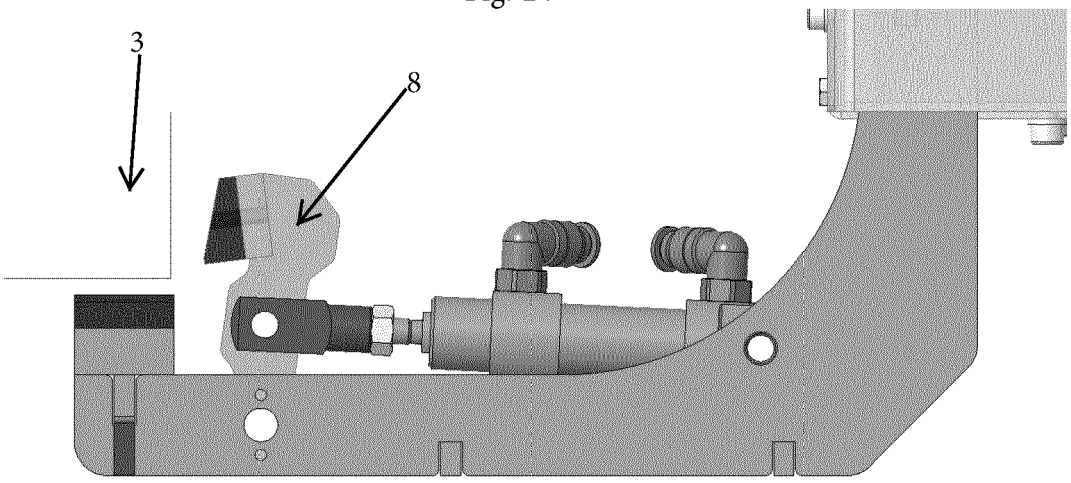

Fig. 15

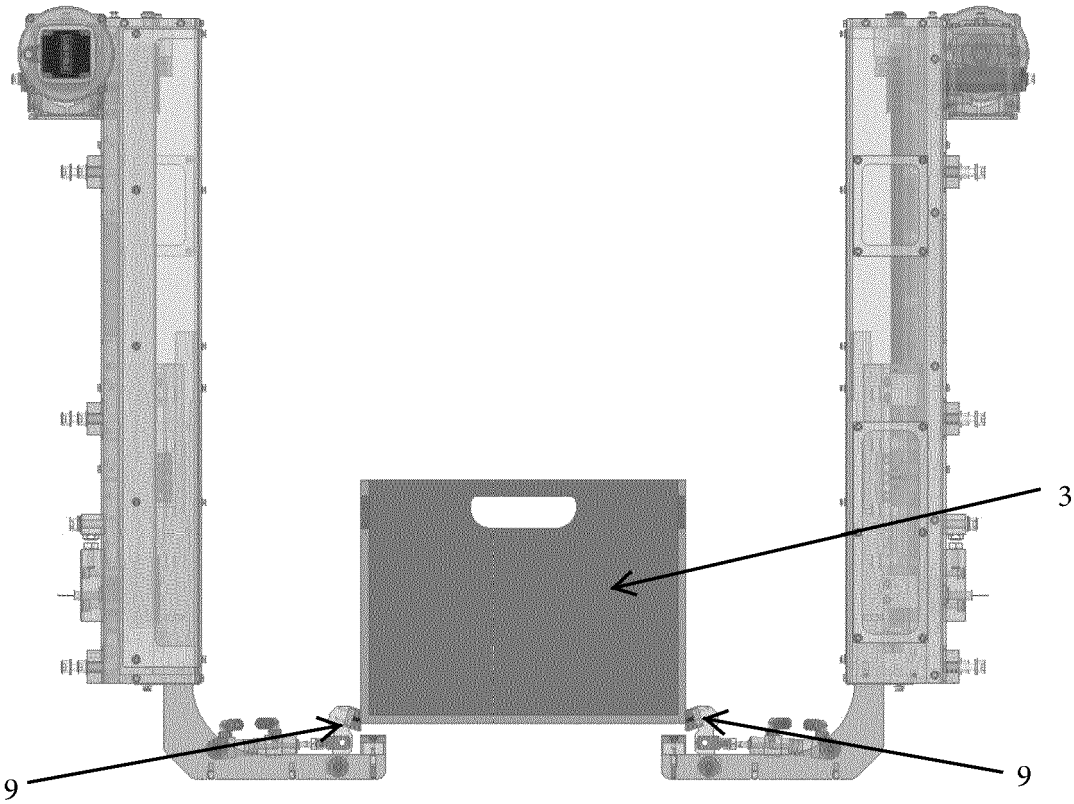

Fig. 16

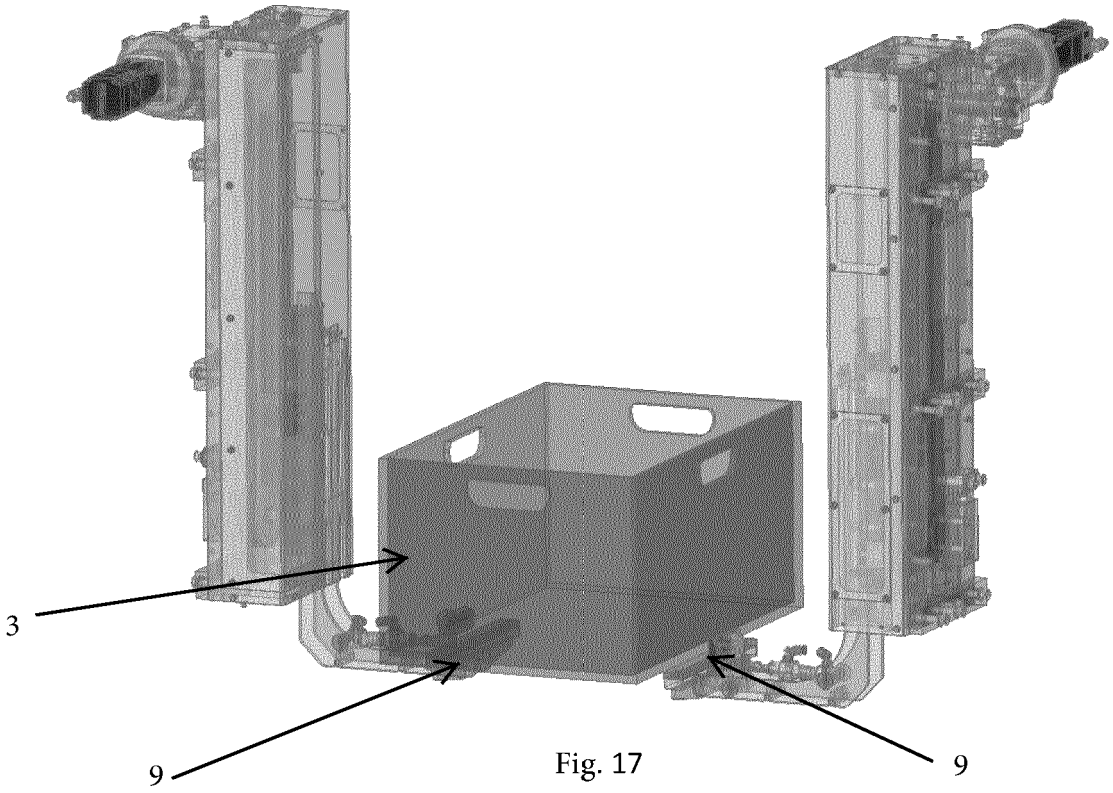

Fig. 17

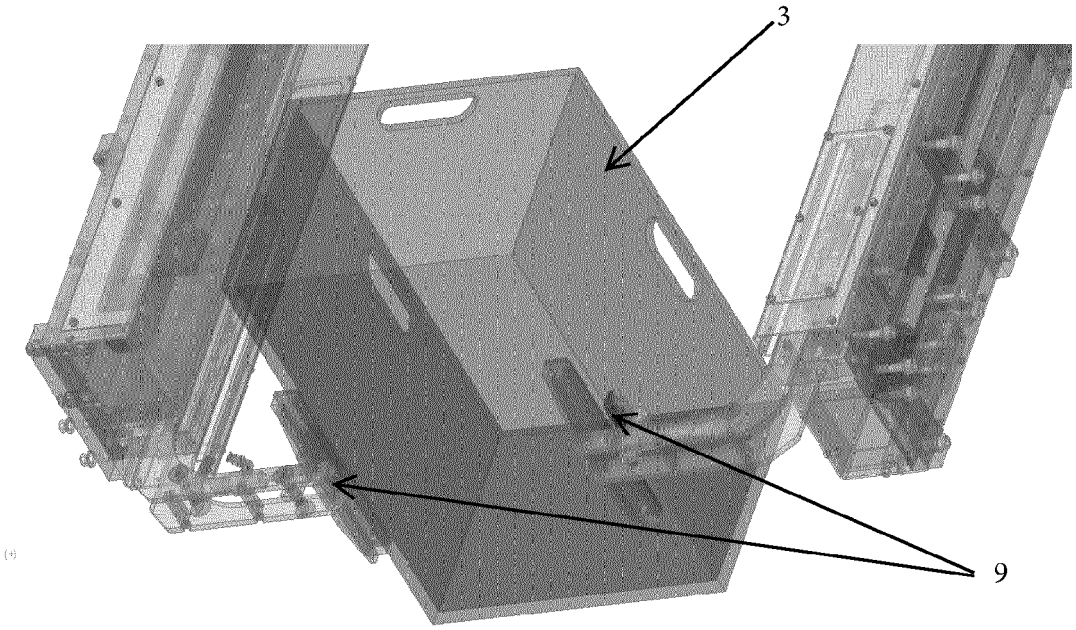

Fig. 18

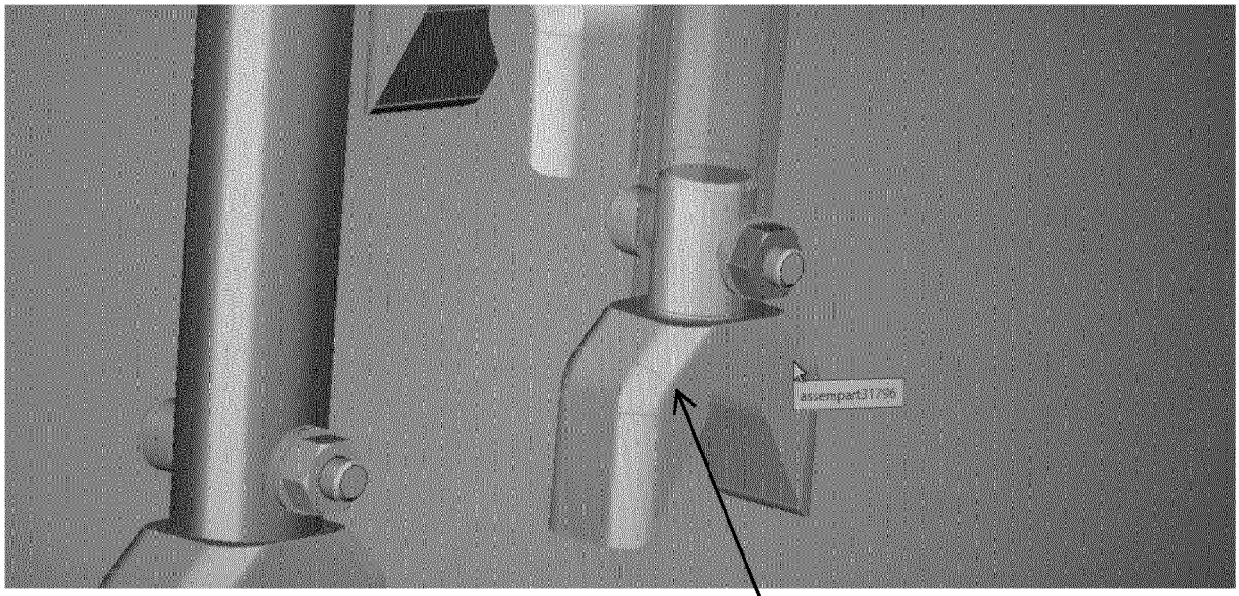

Fig. 19

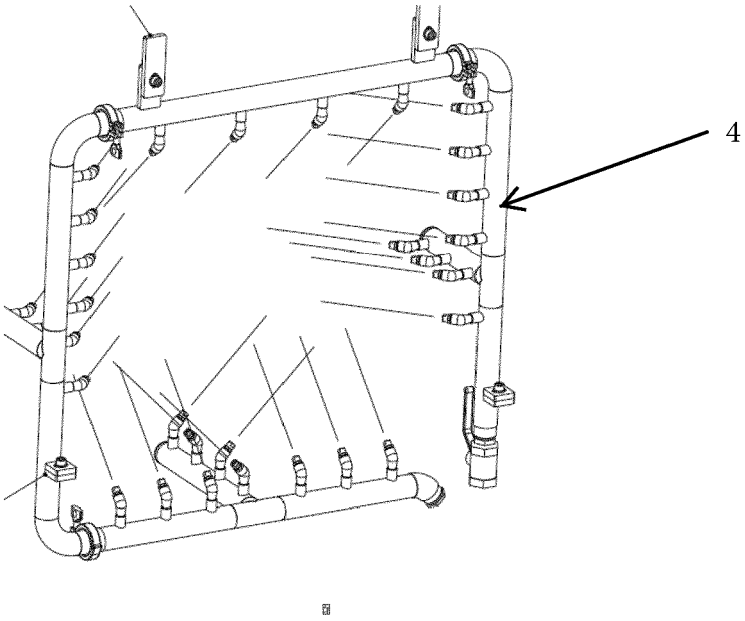

Fig. 20

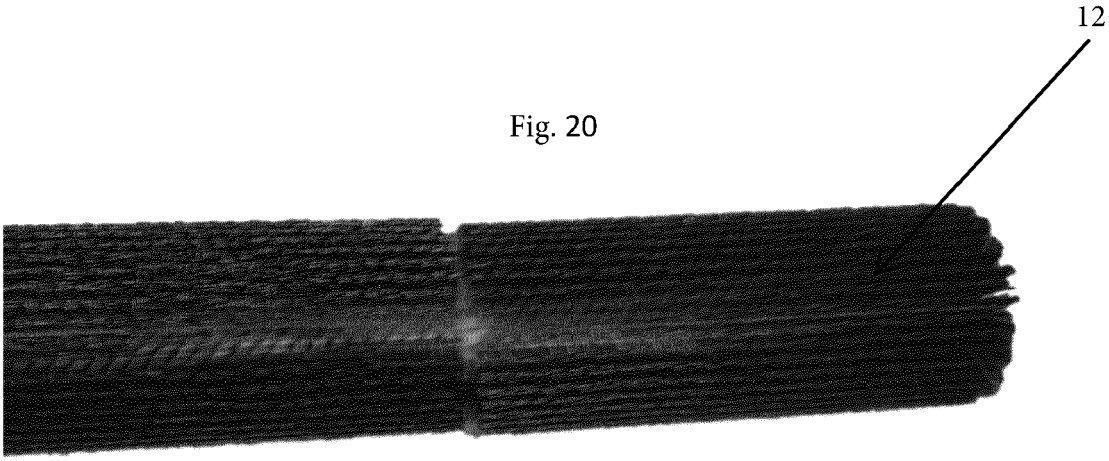

Fig. 21

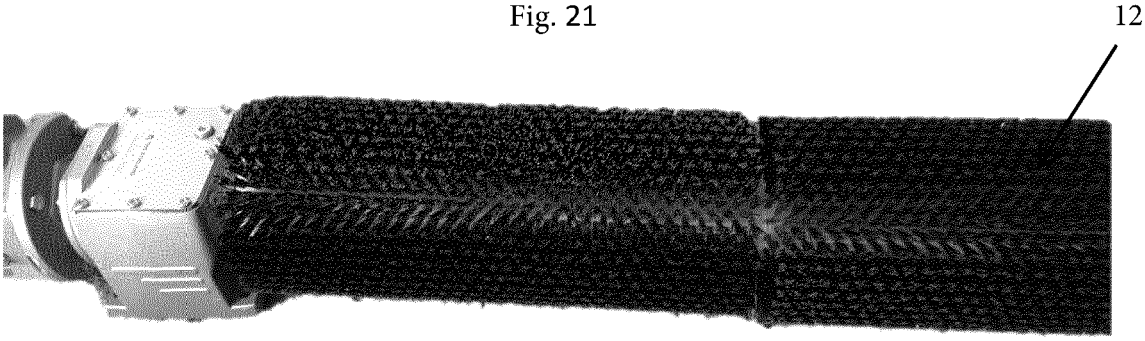

Fig. 22

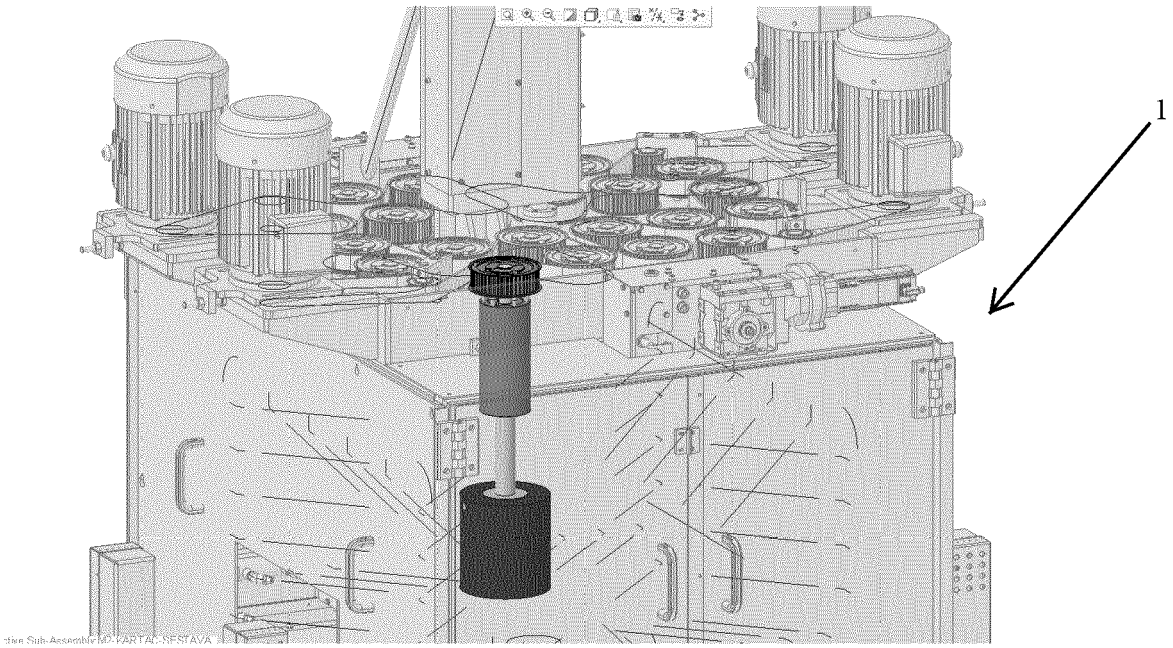

Fig. 23

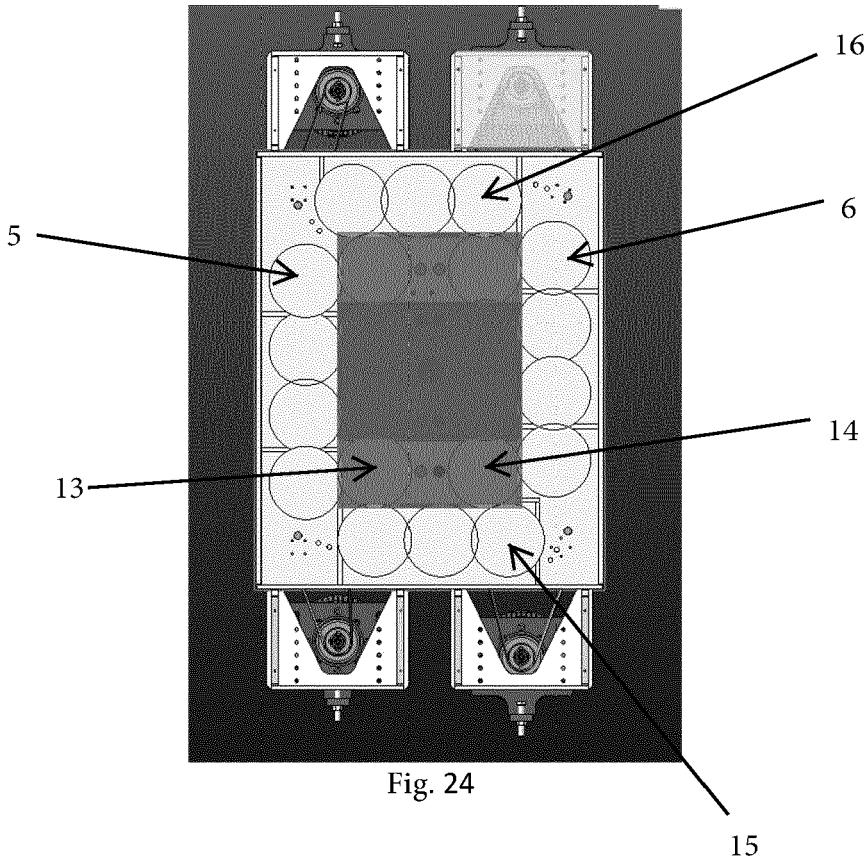

Fig. 24

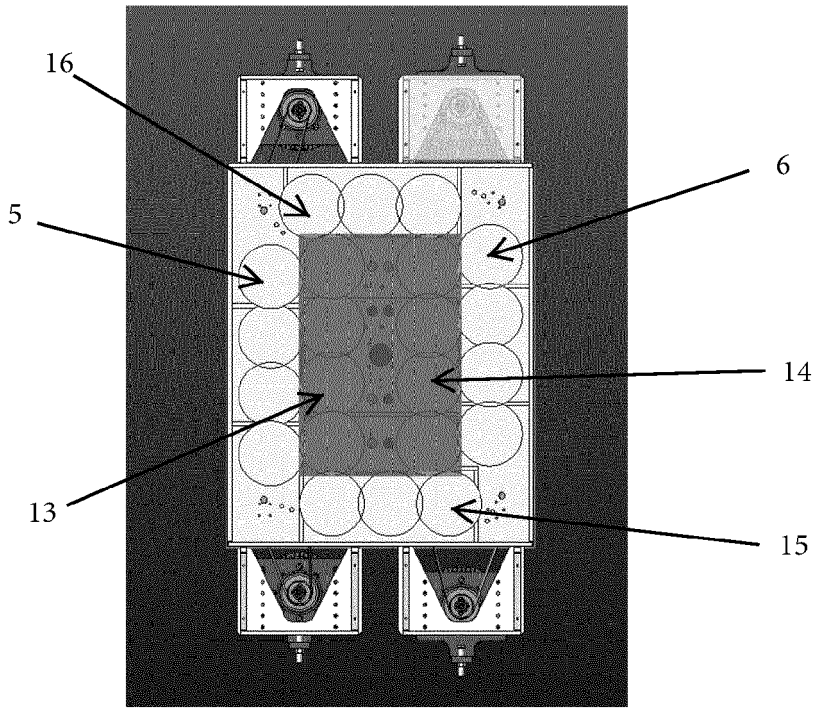

Fig. 25

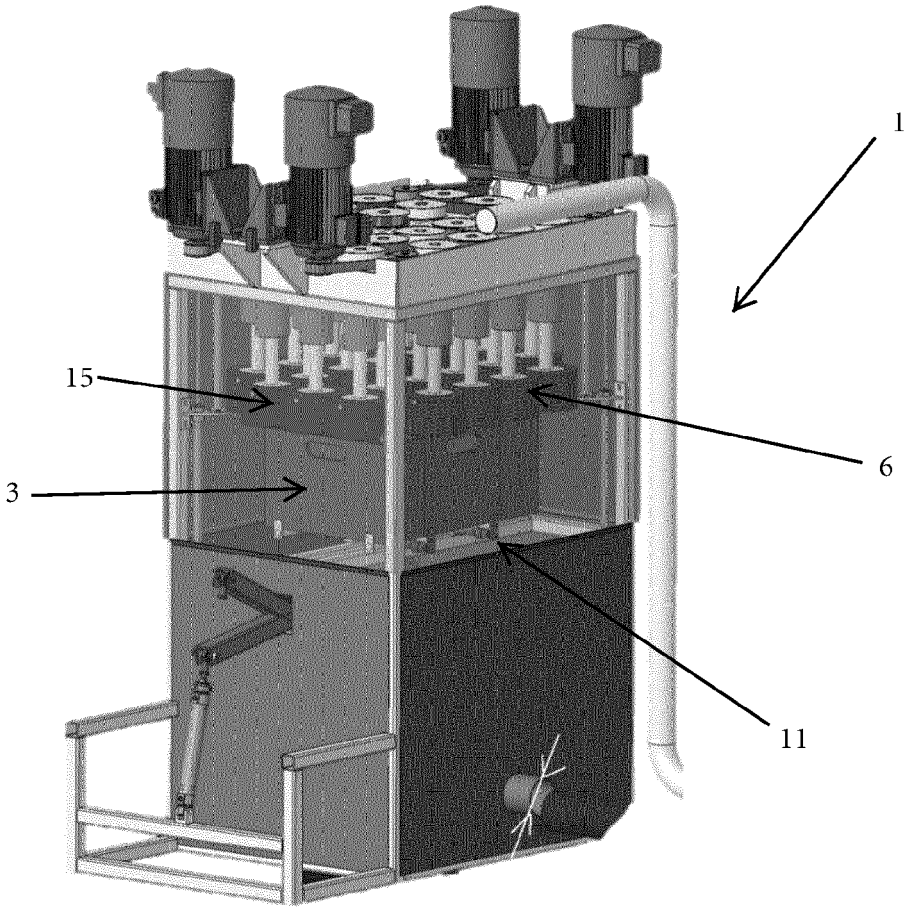

Fig. 26

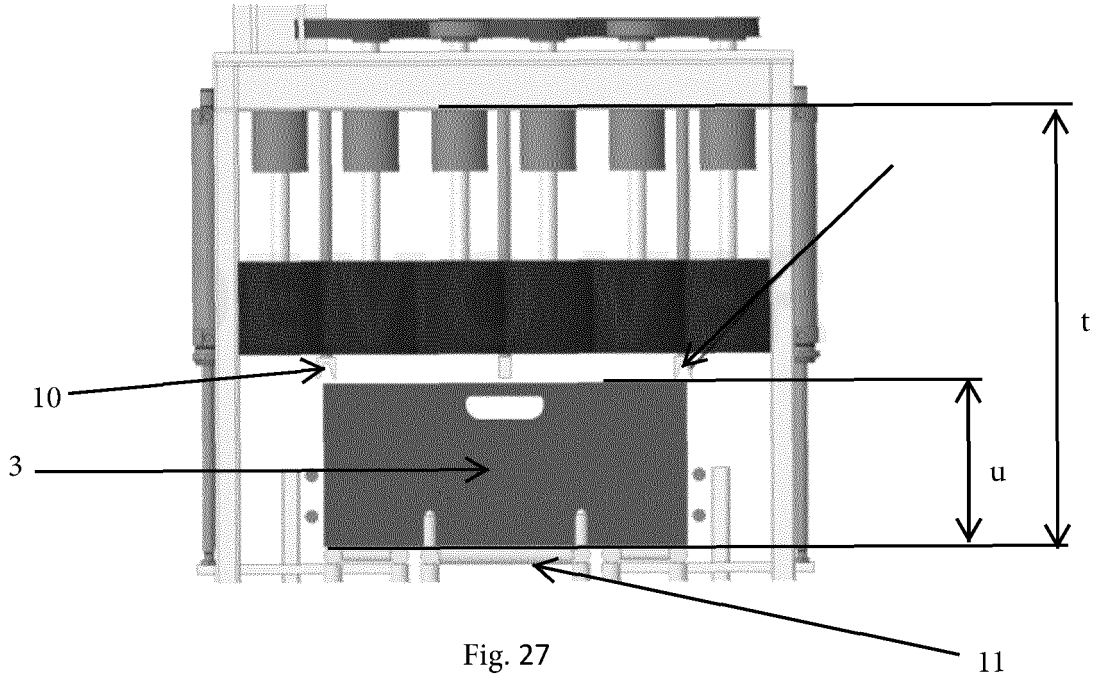

Fig. 27

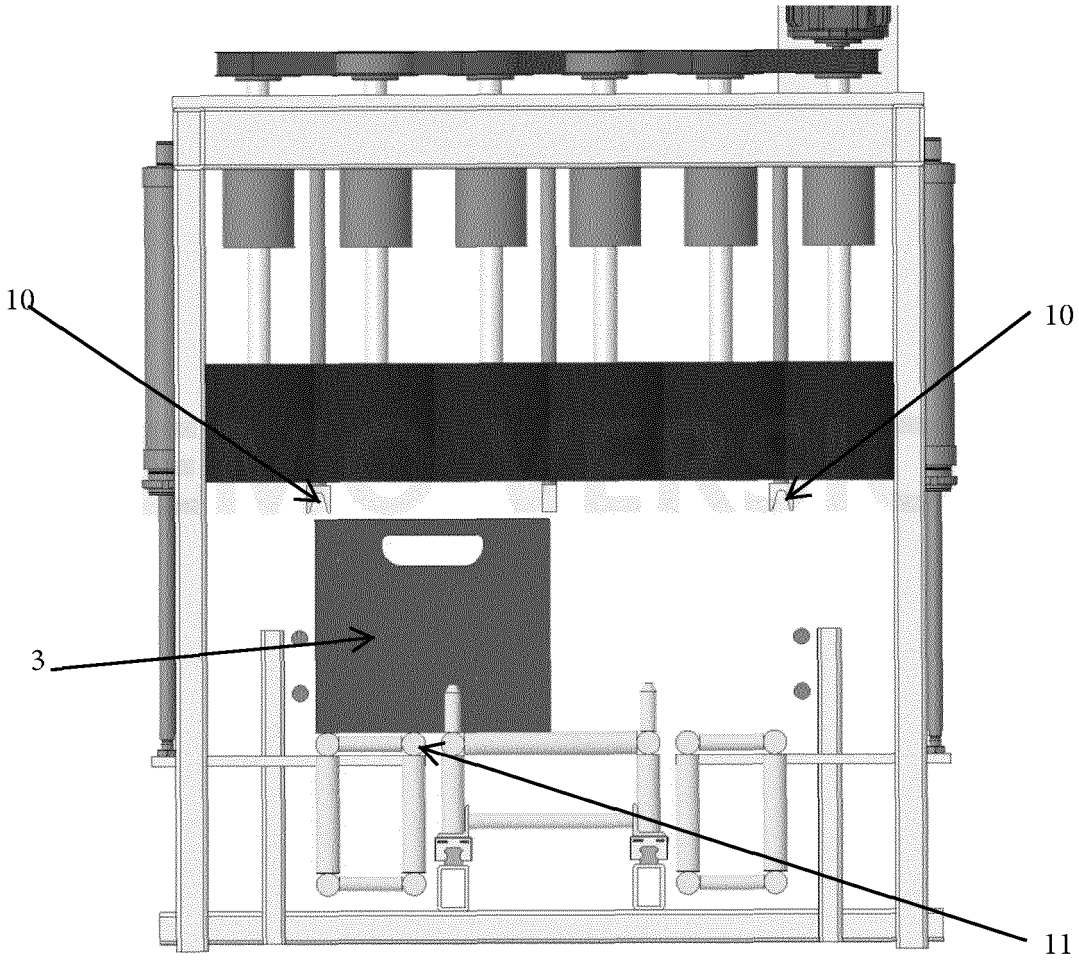

Fig. 28

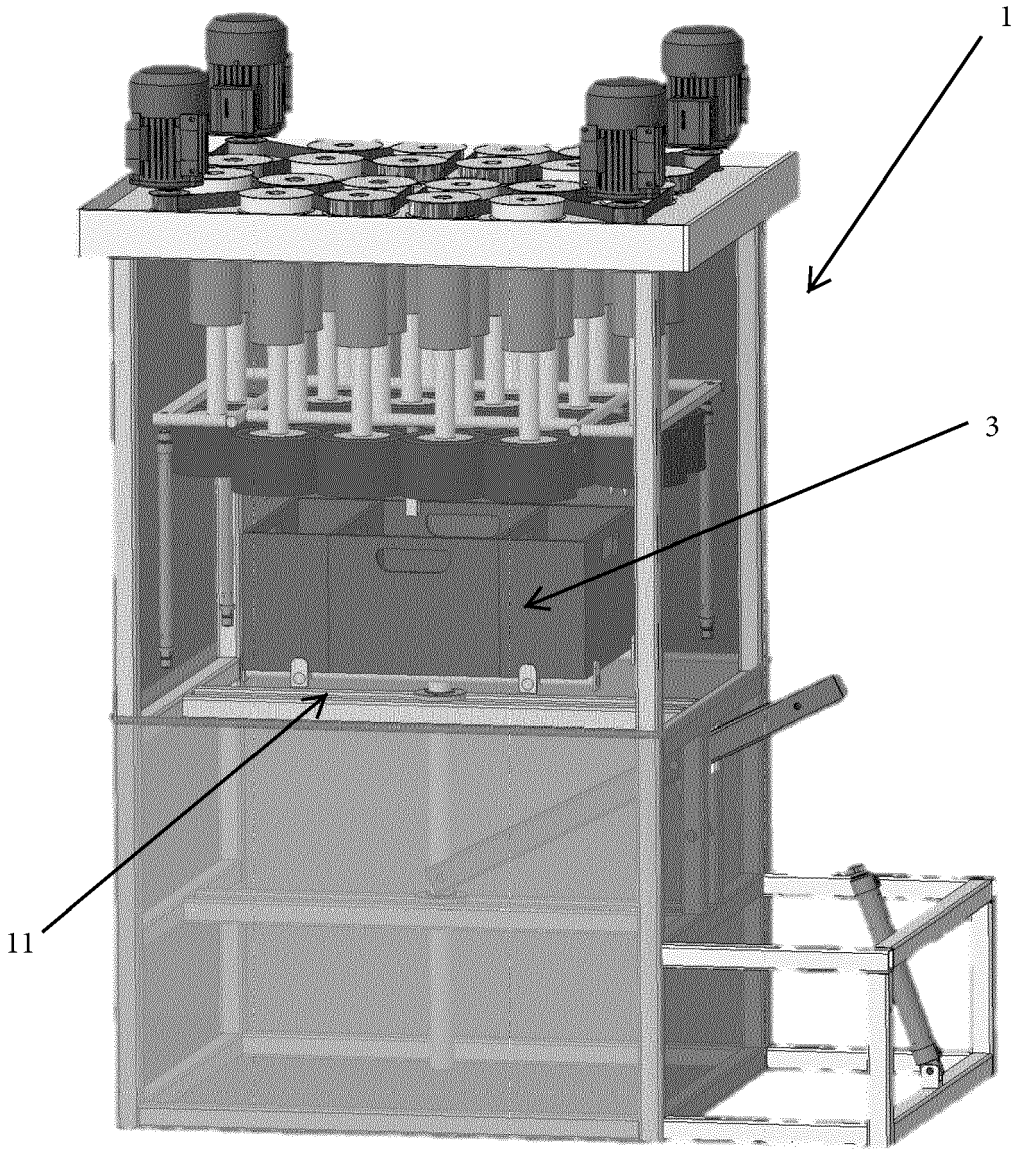

Fig. 29

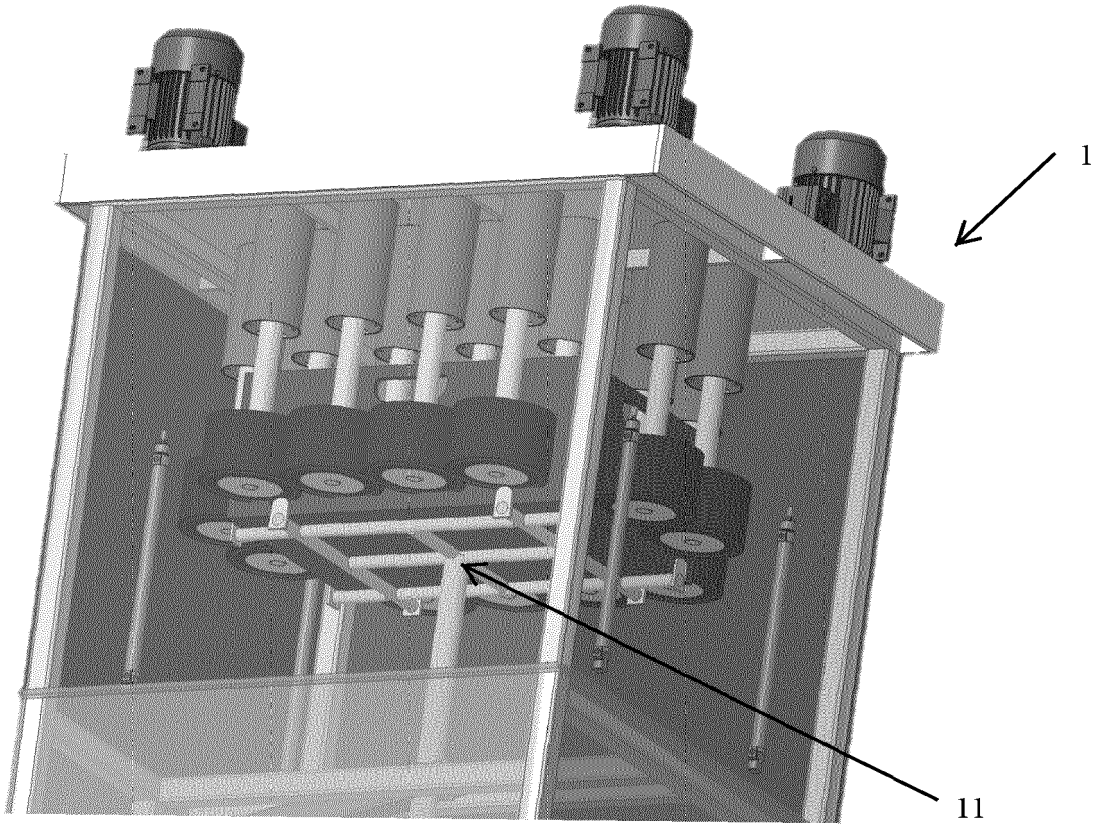

Fig. 30

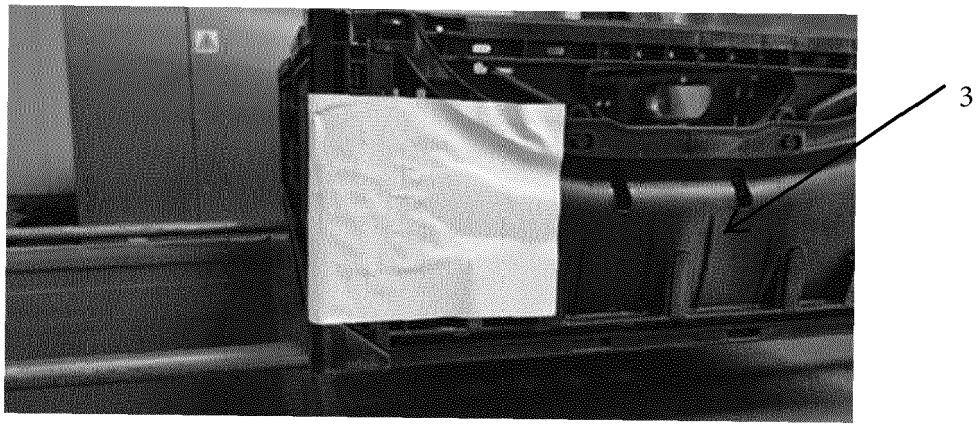

Fig. 31

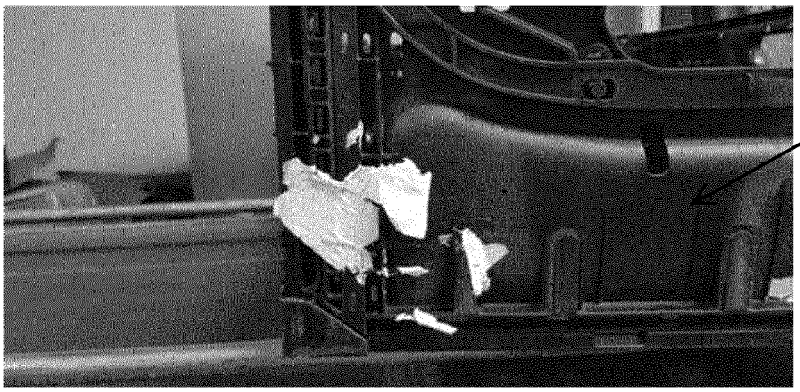

Fig. 32

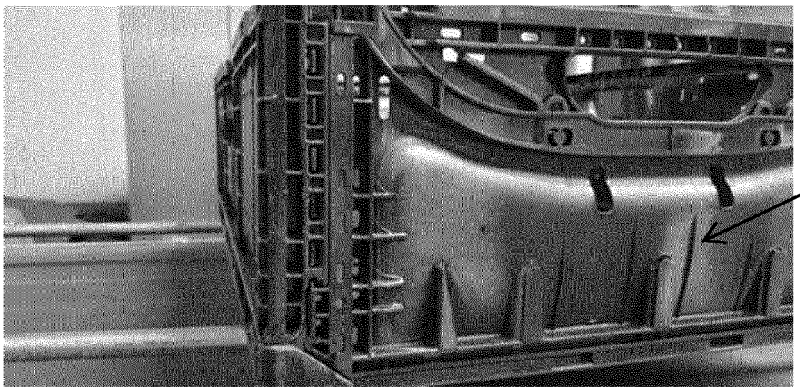

Fig. 33

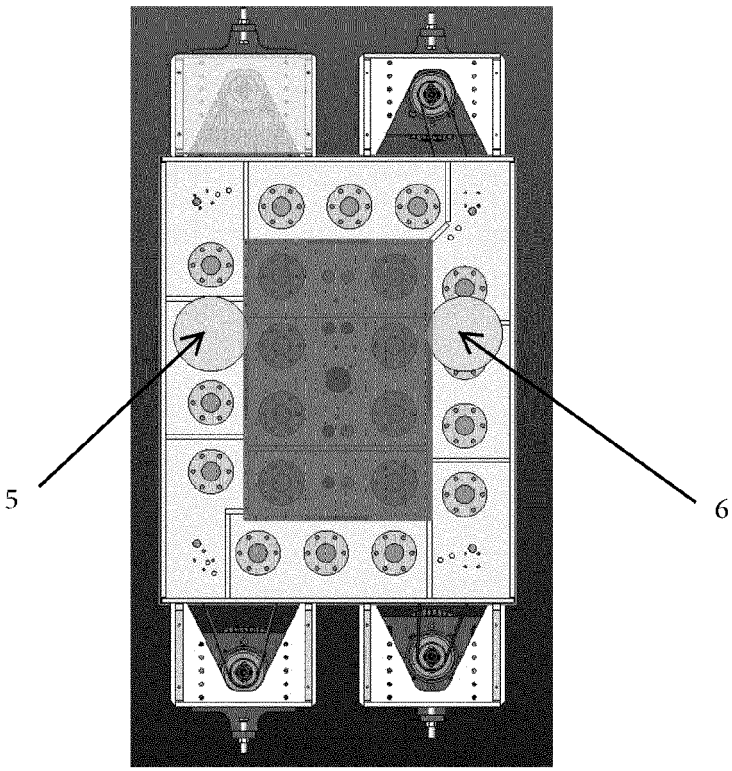

Fig. 34

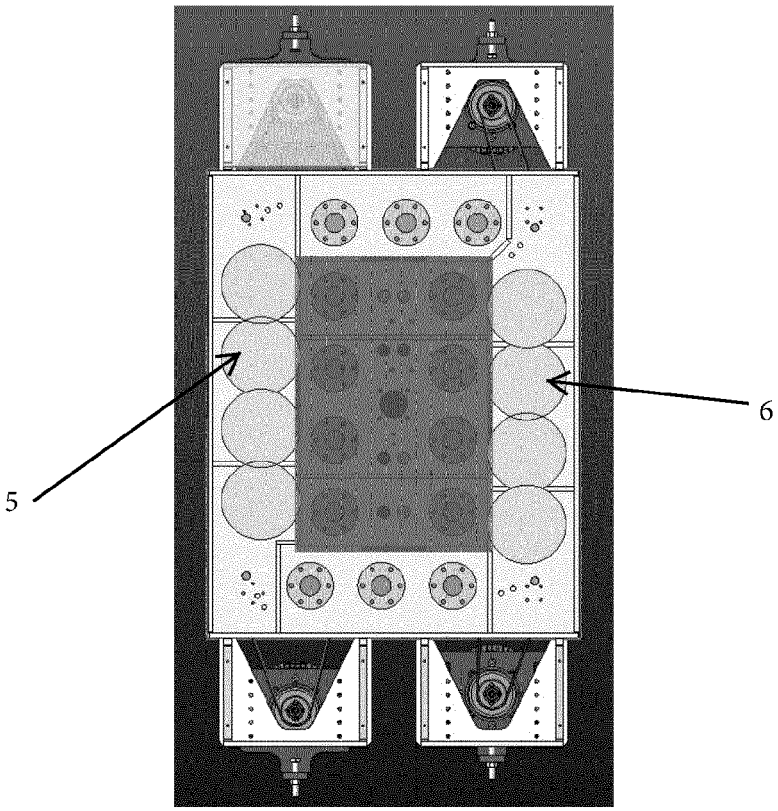

Fig. 35

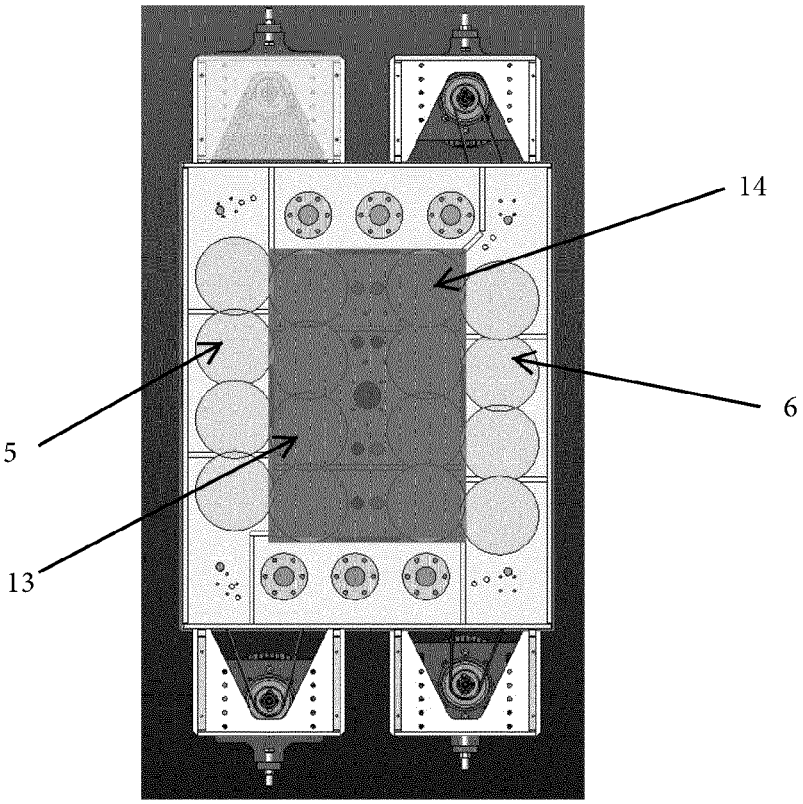

Fig. 36

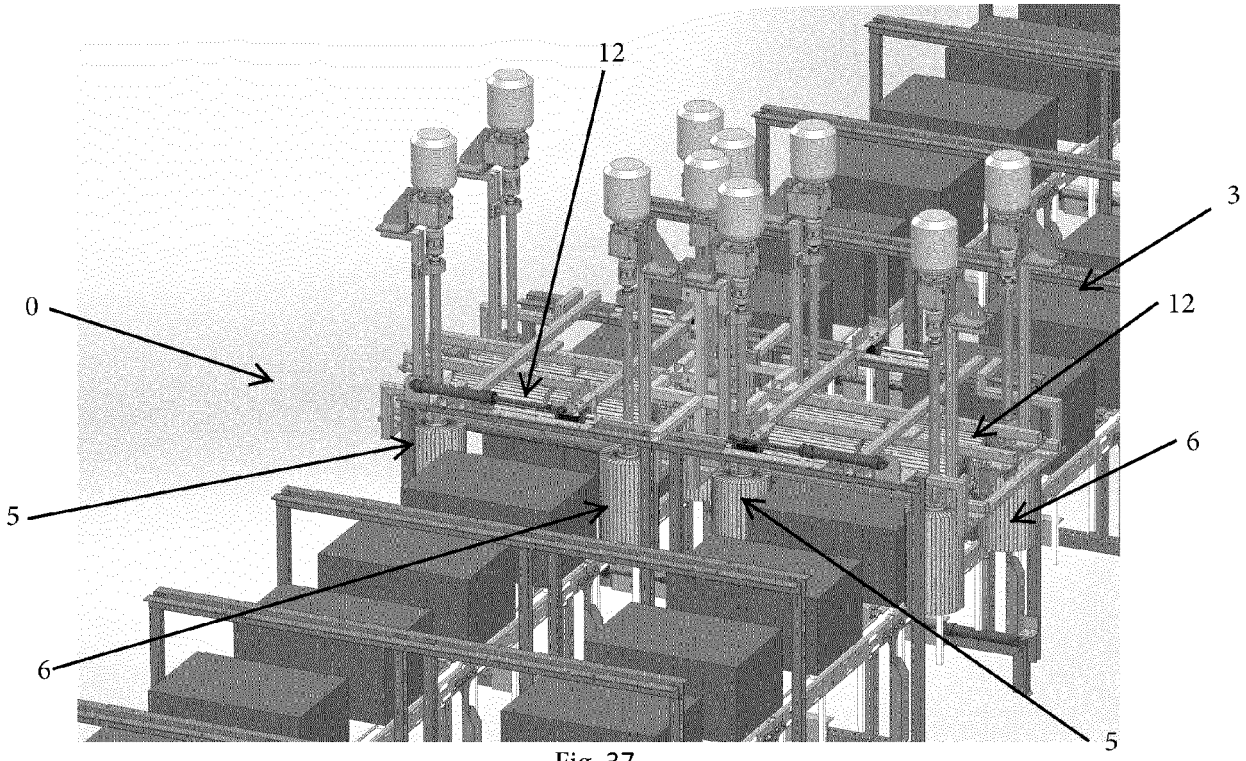

Fig. 37

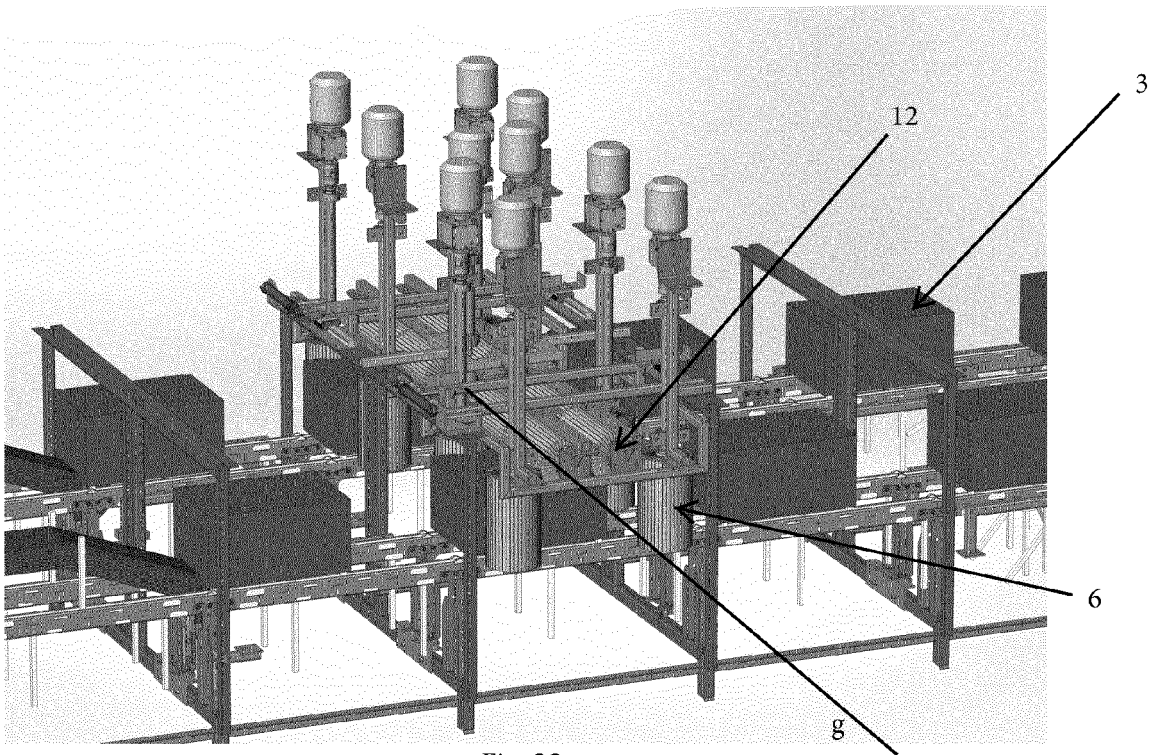

Fig. 38

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 18 3069

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 847 813 A1 (NAAKTGEBOREN BASTIAAN [NL]) 17 June 1998 (1998-06-17) * column 4 - column 6, line 35; figures 1-2 * -----	9	INV. B08B9/08 B08B9/087 B08B9/20 B08B9/36 B65G21/20 ADD. B08B3/04 B08B5/02 B08B9/30

TECHNICAL FIELDS SEARCHED (IPC)

B08B
B65G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 November 2021	Béguin-Adriaenssens

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 18 3069

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-11-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0847813 A1	17-06-1998	DE 69722569 T2	29-04-2004
		EP 0847813 A1	17-06-1998
		NL 1004784 C2	17-06-1998

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP S54139269 A **[0010]**
- WO 2005028130 A1 **[0011]**
- JP 2001232308 A **[0012]**
- CN 208261460 U **[0013]**
- CN 208357415 U **[0014]**
- DE 20021637 U1 **[0015] [0016]**
- US 1883772 A **[0016]**