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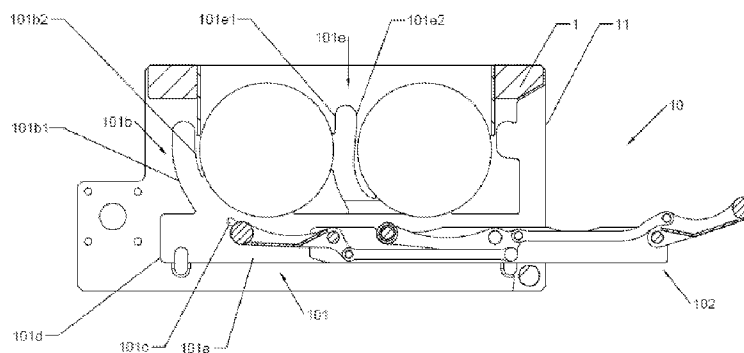


Fig. 2

(57) Abstract: A mesh changing mechanism (10) for a granulator comprises: a hopper (2), a rotary cylinder mounted in the hopper, a mesh configured to cooperate with the rotary cylinder, a guide device (101) arranged at an inner side of the hopper, and a sliding assembly (102) which is slidable into and out of the hopper under the guidance of the guide device while carrying the mesh, through an opening (11) in a side of the hopper in a horizontal direction. The sliding assembly includes: a base (1020); and two end brackets (1021), one end of each of the end brackets being pivotally connected to one end of the base respectively, and a free end of each of the end brackets being provided with a mesh shaft (1024a, 1024b) for holding corresponding end of the mesh. The guide device is configured such that the sliding assembly is able to slide into a predetermined position inside the hopper, at which position the end brackets are positioned in such a manner that the mesh laid between the mesh shafts is tightened and engaged with the rotary cylinder. A granulator having the above mesh changing mechanism and a mesh changing method using the mesh changing mechanism are also disclosed.



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MESH CHANGING MECHANISM, GRANULATOR AND MESH CHANGING METHOD

TECHNICAL FIELD

The present invention relates to the technical field of material granulation technical field, and particularly is adapted for a granulator, e.g. an oscillating granulator, for producing powdered material into granules.

BACKGROUND ART

Wet granulation technology prevails in the industry of food, pharmaceutical, chemical and etc. at present. Oscillating granulators, widely applied in particular, include single-head oscillating granulators (single-rotary-cylinder granulators) and twin-head oscillating granulators (twin-rotary-cylinder granulators), primarily intended for producing wet mass or agglomerated dry material into granules of desired sizes.

The mesh of a granulator on the market currently is fixed at two sides of a rotary cylinder only by means of a pinching device (for example the upper and lower pinching strip assembly in Chinese patent CN204017790U). When the mesh of such a granulator is replaced, it is necessary to detach the hopper housing, to mount and dismount the mesh support shaft as well as the whole mesh mounting assembly, which is a complicated process. Also, the precision of mounting the mesh cannot be ensured.

Currently available mesh changing devices dedicated for changing mesh do not completely solve the problems with the replacement process, such as complicated and time-consuming replacement, high manual cost, imprecise mesh mounting and so on. For instance, Chinese patent CN202459361U discloses a mesh clamping and wrapping device that comprises, on each side of the rotary cylinder, a clamping tube

in which unused mesh is mounted; when the mesh needs to be replaced, part of the mesh is released from the clamping tube by adjusting a hand wheel. This design, however, makes it impossible to control the tightening force of the mesh precisely, in particular when applied to a granulator with multiple rotary cylinders. In addition, the operation is complicated, time-consuming and needs strenuous effort when the mesh type has to be changed.

A problem following replacement of the mesh is regulation of the mesh tightening force that contributes directly to the yield of the granulator and the quality of the products. The existing mesh tightening device only tightens the mesh locally but cannot ensure homogenous tightening of the mesh. A mesh tightening rod disclosed in Chinese patent CN202288859U, for example, regulates the tightening force of the mesh from an end edge of the mesh by means of a ratchet and pawl mechanism, which is difficult to stably control the tightening force desired in the mesh and may damage the mesh easily.

The present invention is intended to overcome the defects and drawbacks in the design of the mesh changing and tightening devices on the market at present, in order to provide a more convenient, more efficient and more reliable mesh changing mechanism and mesh tightening mechanism in wet granulation technology.

SUMMARY OF THE INVENTION

The objective of the present invention is to provide a mesh changing mechanism and a mesh changing method which enable simple and fast replacement of the mesh and save manual cost and resources.

According to one aspect of the invention, a mesh changing mechanism for a granulator is provided, the granulator comprising a hopper, a rotary cylinder mounted in the hopper, and a mesh configured to cooperate with the rotary cylinder, the mesh changing mechanism comprising:

a guide device arranged at an inner side of the hopper;

a sliding assembly which is slidable into and out of the hopper under the guidance of the guide device while carrying the mesh, through an opening in a side of the hopper in a horizontal direction, the sliding assembly including:

a base;

two end brackets, one end of each of the end brackets being pivotally connected to one end of the base respectively, and a free end of each of the end brackets being provided with a mesh shaft for holding corresponding end of the mesh,

wherein the guide device is configured such that the sliding assembly is able to slide into a predetermined position inside the hopper, at which position the end brackets are positioned in such a manner that the mesh laid between the mesh shafts is tightened and engaged with the rotary cylinder.

The sliding assembly of the mesh changing mechanism of the invention is slidable into and out of the hopper, like a drawer. Thus, the replacement is convenient and takes less time.

Preferably, the guide device includes a base guide portion for guiding sliding of the base and a bracket guide portion for guiding movement of the end brackets.

Preferably, the bracket guide portion has a guide surface for guiding movement of a free end of the end brackets and a constraint surface for restricting and positioning the free end of the end brackets.

Preferably, a linkage mechanism is disposed between the end brackets to achieve linkage in pivoting of the end brackets. With joint action of the linkage mechanism and the guide device, the end brackets and the base travel along respective predetermined path smoothly to achieve smooth movement of the sliding assembly and then achieve semi-automatic operation of the mesh changing mechanism.

Preferably, the sliding assembly further includes a mesh support shaft configured

to support the mesh between two adjacent rotary cylinders. For a granulator with multiple rotary cylinders, changing and positioning the mesh can be completed by simply providing corresponding number of mesh support shafts thereon. Therefore, the mesh changing mechanism of the present invention is applicable to a variety of types of granulators.

Preferably, the mesh support shaft is connected to the base by means of a support shaft connecting element.

Preferably, an end of the support shaft connecting element away from the mesh support shaft is pivotally connected to the base.

Preferably, on the base a positioning slot is provided for the mesh support shaft. By virtue of the positioning slot, the mesh support shaft may be placed on the base at a suitable level according to the specific geometrical dimension thereof to ensure that the mesh support shaft moves according to a predetermined moving track during the sliding process of the sliding assembly.

Preferably, the guide device includes a connecting element guide portion for guiding movement of the support shaft connecting element.

Preferably, the connecting element guide portion has a guide surface for guiding movement of the support shaft connecting element and a constraint surface for restricting and positioning the support shaft connecting element.

Preferably, a linkage mechanism is disposed between the support shaft connecting element and at least one end bracket to achieve linkage in pivoting of the support shaft connecting element and the at least one end bracket.

Preferably, the linkage mechanism is a link mechanism.

Preferably, the mesh changing mechanism further includes a fixing and locking mechanism, e.g. a safety switch, for locking the sliding assembly in a predetermined position.

Preferably, the mesh changing mechanism further includes a mounting detection

unit for detecting whether the sliding assembly is mounted in position.

Preferably, the mesh changing mechanism further includes a locking detection unit for detecting whether the fixing and locking mechanism is locked.

Preferably, the guide device further includes a guide block arranged in an end area of the base guide portion for guiding the end brackets to get into cooperation with the bracket guide portion.

Preferably, the guide device includes a stop surface for defining an end of a horizontal travel of the base.

Preferably, the mesh changing mechanism further includes a baffle connected with or integrally formed with the end bracket. The baffle is arranged to preferably guide entry of the material into a mesh working area so as to prevent waste and accumulation of the material.

According to another aspect of the invention, a granulator is provided, comprising the mesh changing mechanism illustrated above.

Preferably, the granulator has one or more rotary cylinders. For a granulator with multiple rotary cylinders, the mesh changing mechanism only needs to be modified by adding a mesh support shaft and a support shaft connecting element, without increasing complexity of the structure thereof.

According to a further aspect of the invention, a mesh changing method using the mesh changing mechanism is provided, comprising the steps of:

- 1) pulling the sliding assembly out of the hopper;
- 2) detaching a used mesh and laying a new mesh of predetermined length between the mesh shafts, with two ends of mesh being fixed to the mesh shafts;
- 3) pushing the sliding assembly carrying the mesh into the hopper to a predetermined position by means of the guide device;
- 4) pivoting an end bracket of the sliding assembly approximate to the opening of the hopper to a predetermined position;

5) locking the sliding assembly to keep the mesh thereabove in a working position (or a ready-for-working position).

Preferably, a detection step of determining whether the sliding assembly is mounted in position is executed after step 4) and before step 5).

Preferably, a detection step of determining whether the sliding assembly is locked is executed after step 5).

The mesh changing mechanism and mesh changing method of the present invention realize semi-automation of the replacement and mounting of the mesh, which greatly simplifies the replacement operation and reduces time required for mesh-changing and prevents operation error caused by manual operation.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the examples of the invention will become apparent with reference to the embodiments and drawings, in which:

FIG. 1 is a general view of an assembly of a mesh changing mechanism and a mesh tightening mechanism according to the present invention;

FIG. 2 shows a hopper when the mesh changing mechanism according to the present invention is in a non-working position, wherein the mesh changing mechanism is not shown;

FIG. 3 is a perspective view of the mesh changing mechanism according to the present invention in a non-working position;

FIG. 4 is a perspective view of the mesh changing mechanism according to the present invention in a working position;

FIG. 5 is a perspective view of the mesh tightening mechanism according to the present invention;

FIG. 6 is a structural view of a tightening force control unit of the mesh tightening mechanism according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The present invention will be described below with reference to the embodiments, which are shown in the drawings. The same reference numbers, if possible, are used throughout the drawings to indicate the same or similar components.

The granulator according to the invention includes a power transmission unit and a granulation unit 1 driven by the power transmission unit. The granulation unit 1 includes a hopper 2, a rotary cylinder mounted in the hopper, a mesh below the rotary cylinder, a mesh changing mechanism 10 for changing the mesh and a mesh tightening mechanism 20 for tightening the mesh. In order to clearly show the mesh changing mechanism 10 and the mesh tightening mechanism 20 of the invention, the upper portion of the hopper, the rotary cylinders in the hopper and the mesh in cooperation with the rotary cylinders are not shown in FIG. 1.

FIG. 2 is a schematic view of the mesh changing mechanism 10 of the invention that is partially inside the hopper 2, wherein the hopper is partially shown and the rotary cylinders are schematically shown by circles.

The mesh changing mechanism 10 includes a guide device 101 provided at an inner side of the hopper and a sliding assembly 102 which carries the mesh, slidable in and out of the hopper 2, guided by the guide device 101, through an opening in a side of the hopper. Preferably, the guide device 101 includes a sliding rail disposed in an inner sidewall of the hopper. The sliding rail may be designed in the form of a groove or protrusion having a cross section shaped to cooperate with a corresponding structure on the sliding assembly.

Referring to FIGS. 3 and 4, the sliding assembly 102 includes a base 1020 which

is in a frame shape as shown in the drawings but may be designed in other shapes, e.g. beam shape. The base 1020 includes two opposed elongate members 1020a, 1020b. End brackets 1021 are pivotally connected at two ends of the base. A pivotal connection between the end brackets and the base is achieved by means of a pivot shaft 1022. Each end bracket 1021 includes two bracket arms 1021a, 1021b opposed to each other, between which, preferably, a baffle 1023 is disposed to guide the granules into the area below the working area of the mesh, thus preventing the granules from falling into a non-working area and being wasted.

A mesh shaft 1024a, 1024b is mounted at a free end of the bracket arm 1021a, 1021b to hold corresponding end of the mesh. In the embodiment of the drawings, the mesh shaft is provided with a plurality of holes 1025 at intervals for passage of fasteners, such as screws. The mesh is fixed by screwing bolts or screws into the holes after being laid in a longitudinal direction of the mesh shaft in predetermined end positions.

Each of the elongate members 1020a, 1020b, in the embodiments illustrated in FIGS. 3 and 4, is pivotally connected with a support shaft connecting element 1026a, 1026b in a predetermined position (for example by means of a pin shaft) along a longitudinal direction thereof. At the free ends of the support shaft connecting element 1026a, 1026b, a mesh support shaft 1027 is mounted which spans across the elongate members of the base 1020 to extend and protrude beyond the outer side of the elongate members and which is engageable in a positioning slot 1028 of the base, when the sliding assembly is in a horizontal position. The weight of the mesh support shaft is supported by the base. The height position of an axis of the mesh support shaft relative to the level of the base is determined depending upon the depth of the slot. The mesh support shaft is configured to support the mesh between adjacent rotary cylinders. The number of the mesh support shafts is entirely dependent on the number of the rotary cylinders. Thus, if the granulator has only one rotary cylinder, it is not

necessary to include a mesh support shaft in the mesh changing mechanism.

In a preferred embodiment, pivotal linkage between opposed end brackets 1021, and between the bracket arms 1021a, 1021b of the end brackets 1021 and the support shaft connecting elements 1026a, 1026b is achieved by a linkage mechanism 1029. The linkage mechanism is configured as a link mechanism in the drawings though, those skilled in the art may envisage a linkage mechanism of other configurations, for instance gear-rack transmission mechanism, traction rope and so on. The linkage mechanism 1029 in the embodiment of the drawings comprises a first link 1029-1 disposed between the bracket arm 1021a, 1021b of one end bracket and the support shaft connecting element 1026a, 1026b, and a second link 1029-2 disposed between the bracket arm 1021a, 1021b of another end bracket and the support shaft connecting element 1026a, 1026b. Thus, pivoting of one end bracket (for example when the end bracket extending into the hopper oscillates upward) drives the first link 1029-1 to move, which leads to forced pivoting of the support shaft connecting element (i.e. the support shaft connecting element oscillates upward accordingly). In the case of pivoting the support shaft connecting element, the second link 1029-2 is caused to move to drive the other end bracket to pivot (i.e. the end bracket approximate to the hopper opening 11 oscillates upward). At last, when the end brackets are moved to certain angular positions, the entire sliding assembly is in a position or state, i.e. working position (ready-for-working position) where the end brackets and the support shaft connecting elements are upstanding, as shown in FIG. 4. The linkage mechanism may also drive or help the end brackets and the support shaft connecting elements to switch from the working position to a replacement position (i.e. where the end brackets and the support shaft connecting elements are in a substantially horizontal position).

The mesh is mounted in such a manner that the rotary cylinder is partially wrapped by the mesh in the working position shown in FIG. 4. One end of the mesh is

fixed to the mesh shaft 1024a and the other end thereof is fixed to another mesh shaft 1024b. Take a mesh that is cooperative with two rotary cylinders as an example, the mesh is substantially W-shaped, wherein recessed portions engage bottoms of circumcircle of the rotary cylinders, and an intermediate bulged portion of the mesh spans across the mesh support shaft 1027 to extend and is supported thereby. Since the mesh has a predetermined length, a tightening degree thereof in the working position is determined by level position of the mesh shafts and the mesh support shaft as well as horizontal interval therebetween.

Turning to FIG. 2, the guide device 101 includes a base guide portion 101a for guiding sliding of the base and a bracket guide portion 101b for guiding movement of the end bracket. The bracket guide portion 101b has a guide surface 101b1 for guiding movement of the free end of the end bracket and a constraint surface 101b2 for restricting and positioning the free end of the end bracket. With the action of the guide surface 101b1 and the constraint surface 101b2, the end bracket has its movement hampered while guided and can be switched easily from the working position to the replacement position or from the replacement position to the working position.

It should be noted that the term “free end” herein refers to an end relative to the end (i.e. hinged end) of the end bracket or the support shaft connecting element connected to the base, but is not truly free and is restricted by other components such as the mesh.

Preferably, the guide device 101 further includes a first guide block 101c arranged in an end area of the base guide portion for guiding the end bracket such that the end bracket gets into cooperation with the bracket guide portion at the appropriate sliding position. The guide device 101 further includes a stop surface 101d for defining the end of the horizontal travel of the base. The end bracket also gets into its destination position when the base slides to a position against the stop surface; namely, the entire sliding assembly gets into the working position.

In the preferred embodiment illustrated in the drawing, the guide device 101 further includes a connecting element guide portion 101e for guiding movement of the support shaft connecting element. Preferably, the connecting element guide portion 101e has a guide surface 101e1 for guiding movement of the support shaft connecting element and a constraint surface 101e2 for restricting and positioning the support shaft connecting element. Preferably, the connecting element guide portion may be designed to include a second guide block for guiding the support shaft connecting element such that the support shaft connecting element gets into cooperation with the connecting element guide portion in a suitable position.

In the embodiments illustrated in the drawings, the sliding assembly may be dispensable with the second guide block because the linkage mechanism is configured to drive, in a suitable sliding position, the support shaft connecting element to pivot, that is to say, pivoting power of the support shaft connecting element partially comes from the linkage mechanism.

In addition, the mesh changing mechanism 10 further includes a fixing and locking mechanism 8, e.g. a safety switch, for locking it in the working position when it is in the working position.

Preferably, the mesh changing mechanism 10 further includes a mounting detection unit for detecting whether the end bracket or the sliding assembly is mounted properly (get into the working position exactly). The mesh changing mechanism 10 further includes a locking detection unit for detecting whether the fixing and locking mechanism 8 is locked.

Preferably, the mesh is woven by a metal wire (which may be made of Type 316L or Type 304 stainless steel, and the mesh range and wire diameter of which are dependent upon granule products, usually comprising 8-20 meshes) or a plastic wire (which may be e.g. nylon and the mesh range and wire diameter of which are dependent upon granule products, usually comprising 8-20 meshes).

Although the hopper herein is provided with two rotary cylinders, those skilled in the art can envisage modifying the mesh changing mechanism so as to be used in a hopper with one or more than two rotary cylinders.

The working principle of the mesh changing mechanism will be illustrated in detail below to show the structure thereof more clearly:

1) At the time of replacing the mesh, the fixing and locking mechanism is released to move from a vertical position (shown in FIG. 1) to a horizontal position. The base is pulled toward the outside of the hopper in a horizontal direction and in the meantime the end bracket approximate to the hopper opening 11 is pivoted downward. During this process, the end bracket at the inner side of the hopper is pivoted downward under the action of the linkage mechanism and slides along the guide surface of the bracket guide portion until it reaches the horizontal position (as shown in FIG. 2). During the process, the support shaft connecting element is pivoted downward under the action of the linkage mechanism and slides along the guide surface of the connecting element guide portion until it reaches the horizontal position and finally the mesh support shaft is positioned in the positioning slot. The sliding assembly now in entirety is slidable through the base guide portion successfully in the horizontal direction; namely, the entire mesh changing mechanism is totally detached from the hopper.

2) The used mesh is removed, and the new mesh is laid above the sliding assembly according to predetermined length and corresponding distribution proportion for each rotary cylinder, two ends of the new mesh being fixed to the mesh shaft of the sliding assembly by bolts.

3) At the time of mounting the meshing, the fixing and locking mechanism 8 is in the horizontal direction, and the sliding assembly carrying the mesh is pushed into the hopper along the base guide portion. The end bracket, when arriving at the position of the guide block 101c, enters into the area of the predetermined bracket guide portion

under the guidance of the guide block to keep sliding forward. Now the guide surface of the bracket guide portion guides the pivoting of the end bracket, and the constraint surface of the bracket guide portion restricts a pivoting angle of the end bracket. At the same time, the linkage mechanism of the sliding assembly operates in cooperation to allow for synchronous pivoting of the end bracket and the support shaft connecting element approximate to the opening. The sliding assembly reaches a predetermined position (or working position of the mesh changing assembly) when the base arrives at the travel destination in the hopper (when the base comes into contact with the stop surface on the leftmost side of the base guide portion). In the predetermined position, the end bracket and the support shaft connecting element are pivoted to certain angular position relative to the base, and the mesh laid on the sliding assembly is suspended in a W-shape below the rotary cylinders with certain tightening degree.

4) Further, the fixing and locking mechanism 8 in the horizontal direction is rotated to a vertical position and locked. The locking is done by the mesh fixing and locking mechanism with a safety switch. The mounting detection unit and the locking detection unit with two sensors (of infrared type or touch type) are used to detect whether the end bracket and the fixing and locking mechanism are mounted properly, which has an advantage of ensuring safe operation.

The granulator now can be started for production. The rotary cylinders begin to oscillate. A powdered material is fed to the hopper and into the rotary cylinder area. A friction between the material and the mesh is generated due to the force applied by scrapers on the peripheral surface of the rotary cylinders, and the powdered material is extruded through mesh orifices of the mesh to produce granule products of desired sizes.

The above steps 1)-4) are repeated when the mesh needs to be replaced.

The mesh has to be replaced every 2 hours in real production. The mesh changing mechanism of the present invention saves 5-6 minutes for each replacement,

and furthermore because of complete automatic operation, the mesh changing is not only simplified but also prevents error caused by manual operation, which improves granulation efficiency, reduces production cost and ensures product quality.

In order to further improve production efficiency, it is necessary to further adjust or optimize the tightening degree of the mesh for the mesh changing mechanism of the present invention. Since the mesh changing mechanism of the present invention can be applied to a granulator with multiple rotary cylinders, a traditional mesh tightener for adjusting the tightening degree of the mesh by rotating the mesh shaft manifests limited usefulness. For this, the inventor of the present application proposes a mesh tightening mechanism which is capable of regulating the tightening degree of the mesh in a more flexible and reliable way than current mesh tighteners. The mesh tightening mechanism according to the present invention is particularly adapted for a granulator with multiple rotary cylinders.

Returning to FIG. 1, the mesh tightening mechanism 20 includes a tightening force control unit 201, a mesh lift unit 202 configured to lift or lower a mesh holder rod (i.e. a mesh shaft and/or mesh support shaft), a force transfer unit 203 configured to transfer output from the tightening force control unit to the mesh lift unit. The tightening force control unit 201 includes a force input device 2011, a force regulator 2012 configured to adjust the force input from the force input device, and a force output device 2013 configured to output the adjusted force.

Referring to FIG. 5, the force input device 2011 is in the form of for example a tightening hand wheel by means of which the tightening force is input and which is operated easily and rapidly to save manual cost and resource. The force output device 2013 is in the form of a rocker arm. The force regulator 2012, as shown in FIG. 6, includes a rotatable member 2012-1 for receiving the force input, a tightening shaft 2012-3 arranged coaxially with the rotatable member and rotatable about the axis, and an elastic assembly 2012-4 disposed between the rotatable member and the tightening

shaft.

Preferably, the rotatable member 2012-1 includes a worm 2012-10 and a worm gear 2012-20 cooperative with the worm, which preferably have self-lock characteristic to ensure stable and constant adjusted tightening force. The tightening force is controlled by worm and worm gear transmission such that stepless adjustment in the tightening force can be achieved, and that the tightening force is controllable within any controllable range. This prevents unstable control of the tightening force by a traditional ratchet mechanism, avoids the damage of the mesh caused due to the unstable tightening force, and also has an advantage of ensuring product quality, increasing lifespan of the mesh and providing stable and controllable mesh tightening force.

Preferably, the elastic assembly 2012-4 includes a rubber elastic assembly which is formed by a square internal metal shell, a square external metal shell disposed around the square internal metal shell and a cylindrical rubber member which is pressed into a space between the internal and the external metal shells that are disposed with a deflection of 45° . A shaft coupling 2012-2 is disposed between the worm gear and the elastic assembly to achieve effective transfer of rotation therebetween. Rotation speed difference between the worm gear and the tightening shaft is created by using elastic deformation and energy-accumulation function of the elastic assembly 2012-4, and also great output of the tightening shaft is prevented because of cushioning or damping function of the elastic assembly.

Preferably, the force input device 2011 is non-rotatably connected to or integrally formed on the worm. Preferably the force output device 2013 is non-rotatably connected to or integrally formed on the tightening shaft 2012-3. In the embodiment of FIG. 6, the force output device is connected to the tightening shaft 2012-3 directly via a cannula joint 2012-5 and a screw to allow synchronous rotation of the tightening shaft 2012-3 and the force output device 2013.

As shown in FIG. 5, the force transfer unit 203 includes a lift rod 203-1, one end of which is hinged with the force output device 2013 in such a manner that they can slide with respect to each other in a horizontal direction and the other end of which is hinged to the hopper wall by a fixed pin 203-1a.

In the embodiment illustrated in the drawing, a connection structure between the lift rod and the force output device includes an elongate hole and a lug extending into the elongate hole. However, as long as the connection structure meets the requirements for pivoting and relative sliding between the lift rod and the force output device, those skilled in the art may envisage other configurations, for example, a hook-loop structure. In the illustrated embodiment, the elongate hole is disposed in the lift rod, and the lug is arranged on the force output device. Those skilled in the art, of course, may envisage providing the lug on the lift rod, and arranging the elongate hole to be matched therewith in the force output device.

The mesh lift unit 202 is configured as a frame-shaped bracket formed by fixedly connecting the opposed lift arms 202-1 and opposed lift shafts 202-2. The lift arms 202-1 are fixedly connected to the lift rod 203-1 by means of a fastener 203-1b such that the lift rod 203 drives the lift arm 202-1 to lift and lower while pivoting about the fixed pin 203-1a.

Returning to FIG. 3, the lift shafts are located below the base and support the base in such a manner that the lift shafts contact with the elongate members 1020a, 1020b of the base. The lifting movement of the lift arms 202-1 and the movement of the lift shafts 202-2 are synchronous, so the lifting movement of the lift shaft 202-2 allows the base of the mesh changing mechanism and the mesh shaft or mesh support shaft supported thereby to lift and lower together, so as to further control lifting and lowering of the mesh, i.e. to adjust the tightening force of the mesh. The mesh tightening mechanism of the present invention controls the tightening force by controlling the lifting and lowering of the entire mesh so that the tightening force

applied is symmetrical. Traditional mesh tightener controls the tightening force by a ratchet mechanism and the tightening is usually done successively at either side of the mesh, which may result in unbalance (consistency) in tightening force and local damage of the mesh.

Preferably, the lifting arm, the force transfer unit and the tightening force control unit are located at the outer side of the hopper, so that the material will not be accumulated on most components of the mesh tightening mechanism. This design facilitates cleaning and meets hygienic requirement of a food machine.

The mesh tightening mechanism 20 further includes a tightening force dial 2014 which is configured to visualize the output (i.e. the mesh tightening force) of the force output device. Traditionally, the tightening force measurement is done by a torque wrench and the measurement value varies from person to person. The mesh tightening mechanism 20 according to present invention thus has an advantage of visualizing adjustment of the tightening force and preventing lagging and inaccuracy of traditional tightening force measurement.

Preferably, the hopper is provided with a particular guide rail therein for guiding the lifting and lowering of the mesh shaft, the mesh support shaft or the mesh changing mechanism in order to ensure accuracy of lifting track of the mesh.

The following is a brief illustration of the working process of the mesh tightening mechanism.

When it is required to regulate the tightening degree of the mesh, the hand wheel 2011 is turned manually to drive the worm to rotate and then to drive the worm gear to rotate. The worm gear applies a rotation torque to the elastic assembly through the shaft coupling 2012-2 such that the elastic assembly is deformed slightly to function for energy accumulation and damping. The torque thus is reduced. In other words, only part of the torque is transferred to the tightening shaft to drive the tightening shaft and the force output device to rotate. Take the tightening process as an example,

the force output device 2013 applies a lifting force to the lift rod 203-1 during the upward pivoting movement, and at the same time an arced displacement takes place at an end of the force output device and the lug provided at this end slides in the elongate hole of the lift rod 203-1. Thus, the end of the lift rod connected to the force output device is lifted upward, and the lift rod 203-1 is pivotable about the fixed pin fixedly arranged on the hopper, whereby lifting the lift arms of the mesh lift unit. The base of the mesh changing mechanism then is furthered lifted by the lift shaft 202-2 to move the mesh shaft and the mesh support shaft upward vertically such that the mesh is lifted to increase the contact between the mesh and the rotary cylinder, i.e. to further tighten the mesh. Besides, to avoid over-tightening of the mesh, the hand wheel can be turned in an opposite direction to lower the level of the mesh shaft and the mesh support shaft.

INDUSTRIAL APPLICABILITY

The mesh changing mechanism and the mesh tightening mechanism of the invention are preferably used in cooperation in practice, and in particular are applied to a granulator with multiple rotary cylinders.

At the time of the replacing the mesh, the lift shaft of the mesh tightening mechanism is located at a lower position by turning the hand wheel, preferably at the bottom of the recess 6 in the hopper wall shown in FIG. 1. In other words, there is no contact between the lift shaft and the base of the mesh changing mechanism, or the lift shaft is at a position not affecting the sliding of the base along the base guide portion. Because of the self-lock characteristic of the worm and worm gear, the position of the mesh tightening mechanism is fixed. Now, the fixing and locking mechanism of the mesh changing mechanism may be released to pull the sliding assembly out of the hopper. The mesh is replaced outside of the hopper, and then the sliding assembly carrying the new mesh is pushed into the hopper to position it in the working position.

After mounting of the mesh is finished, the mesh tightening mechanism is adjusted to control the tightening force of the mesh.

The above is only exemplary embodiments of the granulator. The granulator is not limited to the specific embodiments described herein, but rather, each of the components may be utilized independently and separately from other components herein. The terms “an example”, “another example”, “examples” and so on means that a member/element (e.g. feature, structure and/or feature) related to the example(s) is contained in at least one of the examples herein but may or may not be introduced in other examples. In addition, it should be appreciated that more elements of any examples illustrated can be combined in any manner in multiple different examples, unless specified otherwise.

When introducing elements/components/etc. of the granulator described and/or illustrated herein, the articles “a”, “an”, “the”, and “said” are intended to mean that there are one or more of the element(s)/component(s)/etc. The terms “comprising”, “including”, and “having” are intended to be inclusive and mean that there may be additional element(s)/component(s)/etc. other than the listed element(s)/component(s)/etc.

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

List of reference numbers

1—granulator

11-opening

2—hopper	101—guide device
10—mesh changing mechanism	101a—base guide portion
101b—bracket guide portion	6—recessed portion
101b1—guide surface	8—fixing and locking mechanism
101b2—constraint surface	20—mesh tightening mechanism
101c—first guide block	201—tightening force control unit
101d—stop surface	2011—force input device
101e—connecting element guide portion	2012—force regulator
101e1—guide surface	2012-1—rotatable member
101e2—constraint surface	2012-10—worm
102—sliding assembly	2012-20—worm gear
1020—base	2012-2—shaft coupling
1020a, 1020b—elongate member	2012-3—tightening shaft
1021—end bracket	2012-4—elastic assembly
1021a, 1021b—bracket arm	2012-5—cannula joint
1022—pivot shaft	202—mesh lift unit
1023—baffle	202-1—lift arm
1024a, 1024b—mesh shaft	202-2—lift shaft
1025—hole	203—force transfer unit

1026a, 1026b—support shaft connecting element	203-1—lift rod
1027—mesh support shaft	203-1a—fixed pin
1028—positioning slot	203-1b—fastener
1029—linkage mechanism	2013—force output device
1029-1—first link	2014—tightening force dial
1029-2—second link	

CLAIMS

1. A mesh changing mechanism for a granulator comprising a hopper, a rotary cylinder mounted in the hopper, and a mesh configured to cooperate with the rotary cylinder, comprising:

a guide device arranged at an inner side of the hopper;

a sliding assembly which is slidable into and out of the hopper under the guidance of the guide device while carrying the mesh, through an opening in a side of the hopper in a horizontal direction, the sliding assembly including:

a base;

two end brackets, one end of each of the end brackets being pivotally connected to one end of the base respectively, and a free end of each of the end brackets being provided with a mesh shaft for holding corresponding end of the mesh,

wherein the guide device is configured such that the sliding assembly is able to slide into a predetermined position inside the hopper, at which position the end brackets are positioned in such a manner that the mesh laid between the mesh shafts is tightened and engaged with the rotary cylinder.

2. The mesh changing mechanism according to claim 1, characterized in that the guide device includes a base guide portion for guiding sliding of the base and a bracket guide portion for guiding movement of the end brackets.

3. The mesh changing mechanism according to claim 2, characterized in that the bracket guide portion has a guide surface for guiding movement of a free end of the end brackets and a constraint surface for restricting and positioning the free end of the end brackets.

4. The mesh changing mechanism according to claim 1, characterized in that a linkage mechanism is disposed between the end brackets to achieve linkage in pivoting of the end brackets.

5. The mesh changing mechanism according to claim 1, characterized in that the sliding assembly further includes a mesh support shaft configured to support the mesh between two adjacent rotary cylinders.

6. The mesh changing mechanism according to claim 5, characterized in that the mesh support shaft is connected to the base by means of a support shaft connecting element.

7. The mesh changing mechanism according to claim 6, characterized in that an end of the support shaft connecting element away from the mesh support shaft is pivotally connected to the base.

8. The mesh changing mechanism according to claim 7, characterized in that on the base a positioning slot is provided for the mesh support shaft.

9. The mesh changing mechanism according to any one of claims 5-8, characterized in that the guide device includes a connecting element guide portion for guiding movement of the support shaft connecting element.

10. The mesh changing mechanism according to claim 9, characterized in that the connecting element guide portion has a guide surface for guiding movement of the support shaft connecting element and a constraint surface for restricting and positioning the support shaft connecting element.

11. The mesh changing mechanism according to claim 10, characterized in that a linkage mechanism is disposed between the support shaft connecting element and at least one end bracket to achieve linkage in pivoting of the support shaft connecting element and the at least one end bracket.

12. The mesh changing mechanism according to claim 4 or 11, characterized in that the linkage mechanism is a link mechanism.

13. The mesh changing mechanism according to claim 1, characterized in by further comprising a fixing and locking mechanism for locking the sliding assembly in a predetermined position.

14. The mesh changing mechanism according to claim 1, characterized in by further comprising a mounting detection unit for detecting whether the sliding assembly is mounted in position.

15. The mesh changing mechanism according to claim 13, characterized in by further comprising a locking detection unit for detecting whether the fixing and locking mechanism is locked.

16. The mesh changing mechanism according to claim 1, characterized in that the guide device further includes a guide block arranged in an end area of the base guide portion for guiding the end bracket to get into cooperation with the bracket guide portion.

17. The mesh changing mechanism according to claim 1, characterized in that the guide device further comprises a stop surface for defining an end of a horizontal travel of the base.

18. The mesh changing mechanism according to claim 1, characterized by further comprising a baffle connected with or integrally formed with the end bracket.

19. A granulator comprising the mesh changing mechanism according to any one of the preceding claims.

20. The granulator according to claim 19, characterized in that it has one or more rotary cylinders.

21. A mesh changing method using the mesh changing mechanism according to any one of claims 1-18, comprising the steps of:

- 1) pulling the sliding assembly out of the hopper;
- 2) detaching a used mesh and laying a new mesh of predetermined length between the mesh shafts, with two ends of mesh being fixed to the mesh shafts;
- 3) pushing the sliding assembly carrying the mesh into the hopper to a predetermined position by means of the guide device;
- 4) pivoting an end bracket of the sliding assembly approximate to the opening of the hopper to a predetermined position; and
- 5) locking the sliding assembly to keep the mesh thereabove in a working position.

22. The mesh changing method according to claim 21, characterized in that a detection step of determining whether the sliding assembly is mounted in position is executed after step 4) and before step 5).

23. The mesh changing method according to claim 21, characterized in that a detection step of determining whether the sliding assembly is locked is executed after step 5).

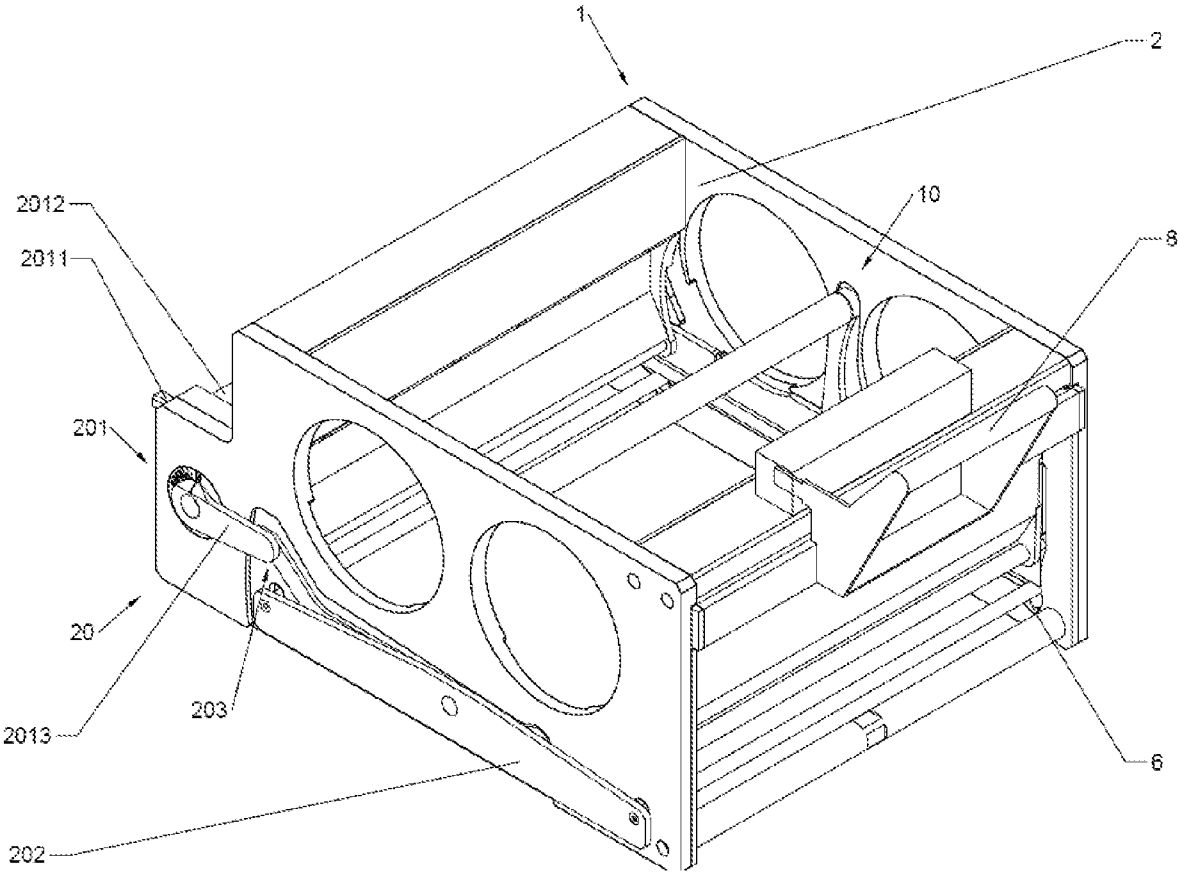


Fig. 1

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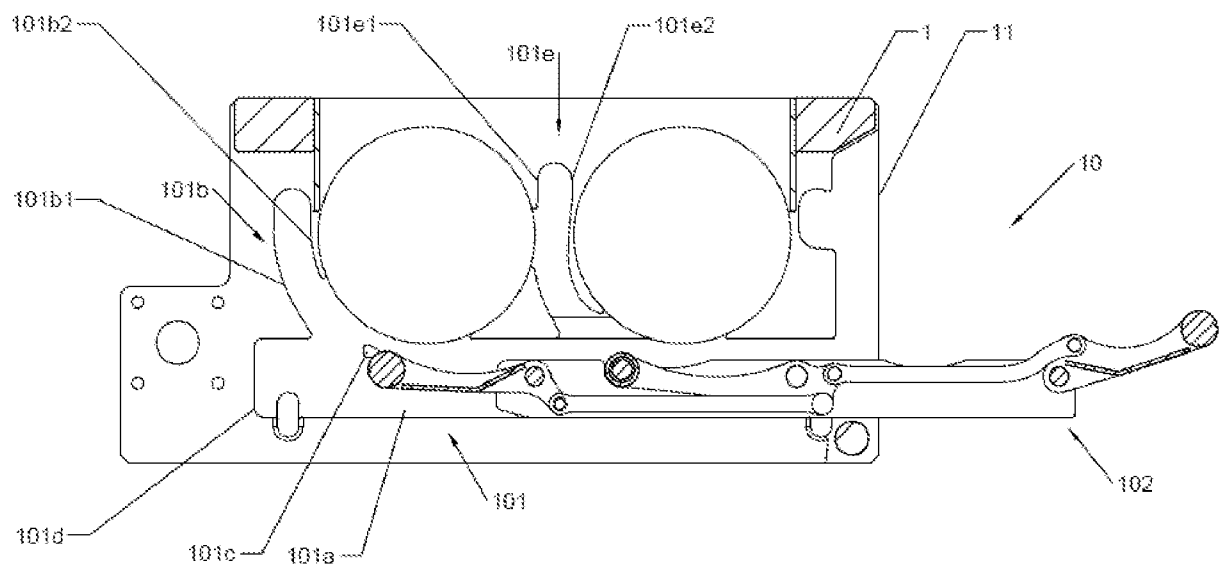


Fig. 2

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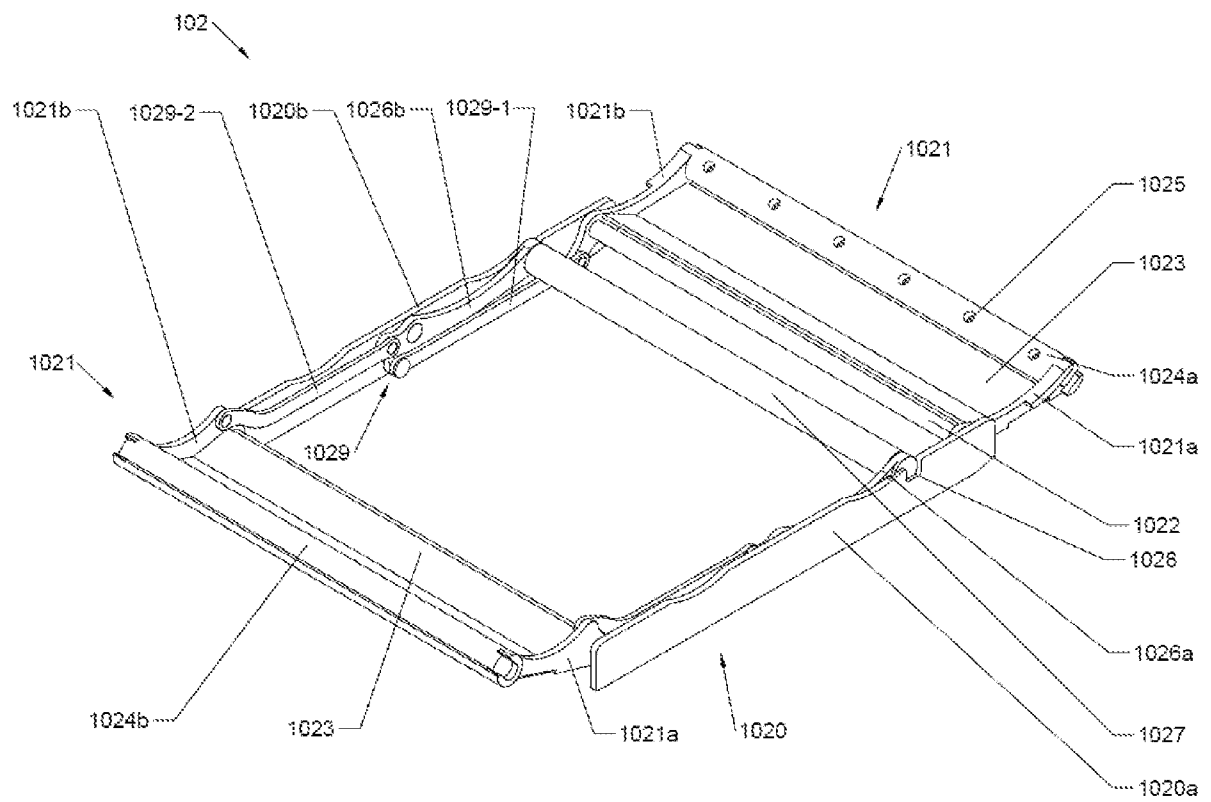


Fig. 3

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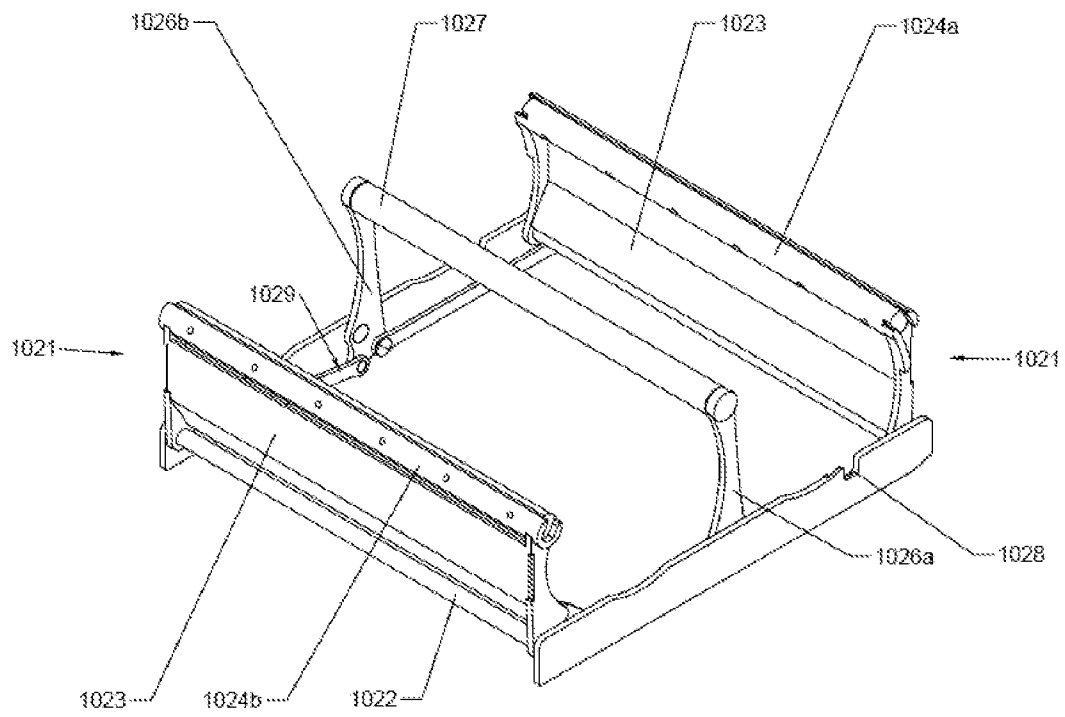


Fig. 4

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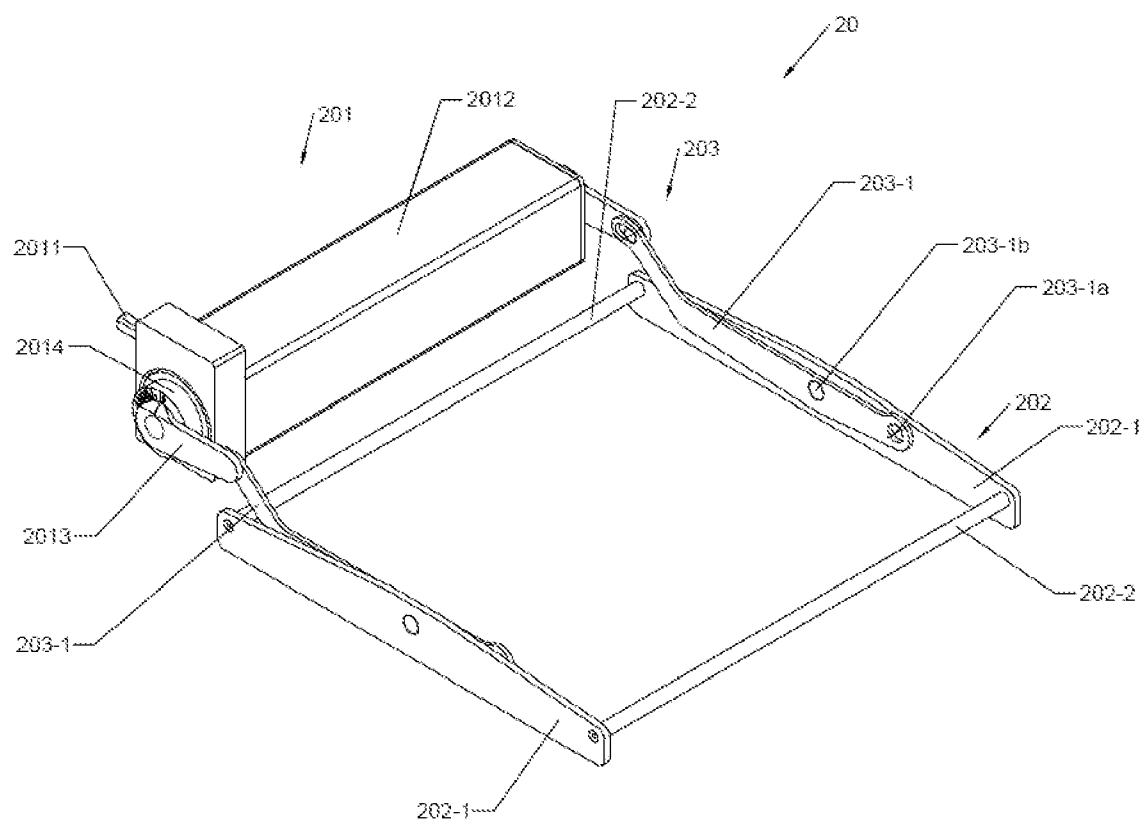


Fig. 5

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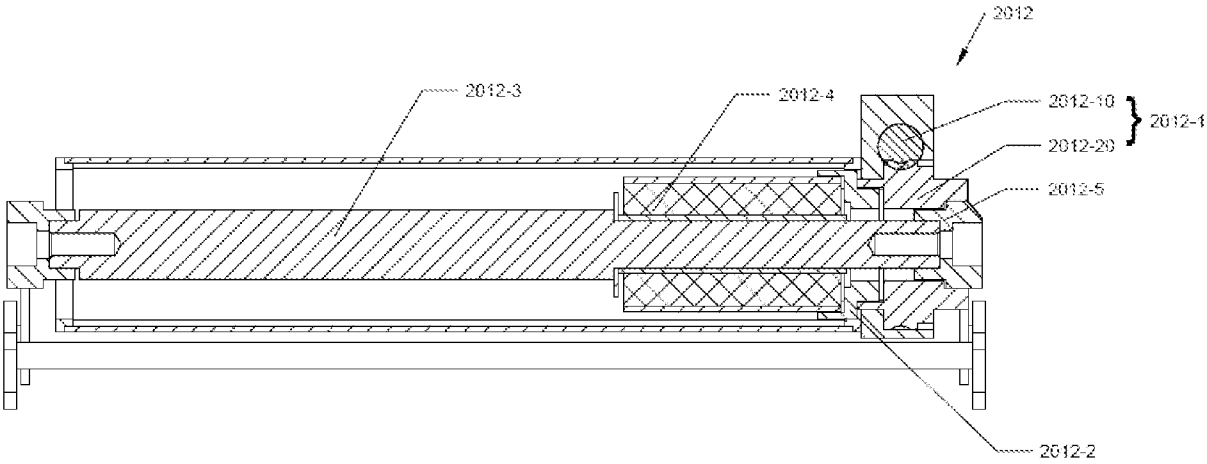


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/075230

A. CLASSIFICATION OF SUBJECT MATTER

B01J 2/20(2006.01)i; B29B 9/00(2006.01)i; A61J 3/00(2006.01)i; B07B 1/46(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01J 2/-, B29B 9/-, A61J 3/-, B07B 1/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, WPI, EPODOC, CNKI: NESTEC, screen, mesh, stencil, granulat+, pellet+, chang+, replac+, detach+, maintain+, mount+, install+, tighten+, link+, slid+, guid+, push+, pull+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 202184939 U (SHENZHEN YIGOR HEALTH FOOD CO., LTD.) 11 April 2012 (2012-04-11) the whole document	1-23
A	CN 202366675 U (JIANGYIN XINDA PHARM&CHEM MACHINERY CO., LTD.) 08 August 2012 (2012-08-08) the whole document	1-23
A	CN 202288859 U (SHANGHAI XINYA PHARMACY HANJIANG CO., LTD.) 04 July 2012 (2012-07-04) the whole document	1-23
A	CN 204017790 U (DALI JINMING ANIMAL PHARMACY CO., LTD.) 17 December 2014 (2014-12-17) the whole document	1-23
A	CN 201823509 U (ZHANGJIAGANG CREAT MECHANICAL MFG CO., LTD.) 11 May 2011 (2011-05-11) the whole document	1-23



Further documents are listed in the continuation of Box C.



See patent family annex.

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“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

24 December 2015

Date of mailing of the international search report

08 January 2016

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/075230**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 203002320 U (ZHEJIANG FUTURE MACHINERY CO., LTD.) 19 June 2013 (2013-06-19) the whole document	1-23
A	DE 3208357 A1 (BASF AG) 23 September 1982 (1982-09-23) the whole document	1-23
A	JP 2014021144 A (CANON KK) 03 February 2014 (2014-02-03) the whole document	1-23
A	JP S63256124 A (SUGIYAMA JUKO KK) 24 October 1988 (1988-10-24) the whole document	1-23

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/075230

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN	202184939	U	11 April 2012	None	
CN	202366675	U	08 August 2012	None	
CN	202288859	U	04 July 2012	None	
CN	204017790	U	17 December 2014	None	
CN	201823509	U	11 May 2011	None	
CN	203002320	U	19 June 2013	None	
DE	3208357	A1	23 September 1982	None	
JP	2014021144	A	03 February 2014	None	
JP	S63256124	A	24 October 1988	None	