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(54) **APPARATUS AND METHOD FOR COUNTING AND FILLING**

(52) **U.S. Cl.**
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USPC *53/475*; *53/244*

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(57) **ABSTRACT**

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(21) Appl. No.: **14/265,956**

The object of the present invention is to provide a method and apparatus for counting and filling, which allows materials to be counted to be supplied smoothly from a hopper to a transport mechanism, and is hardly influenced by the shape of the materials to be counted, and further has a simple configuration. The counting and filling apparatus aligns the materials to be counted through a guide route of a delivery mechanism, delivers the materials to a transport route of a transport mechanism, transports, counts, and fills the materials, and is configured to include the spiral groove rod disposed from the guide route to the transport route, and an adjusting unit which allows the materials supported in spiral grooves of the spiral groove rod to pass from the guide route to the transport route, and prevents passing of the materials overlapped on the spiral groove rod.

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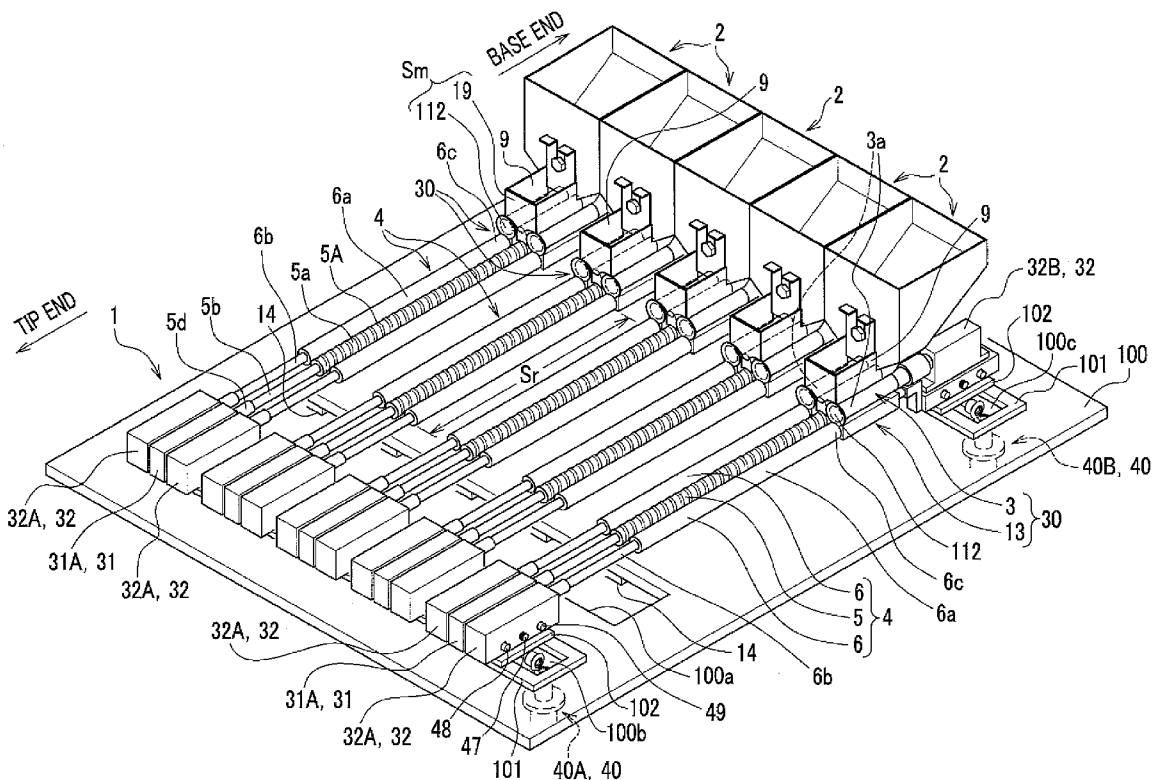


FIG. 1A

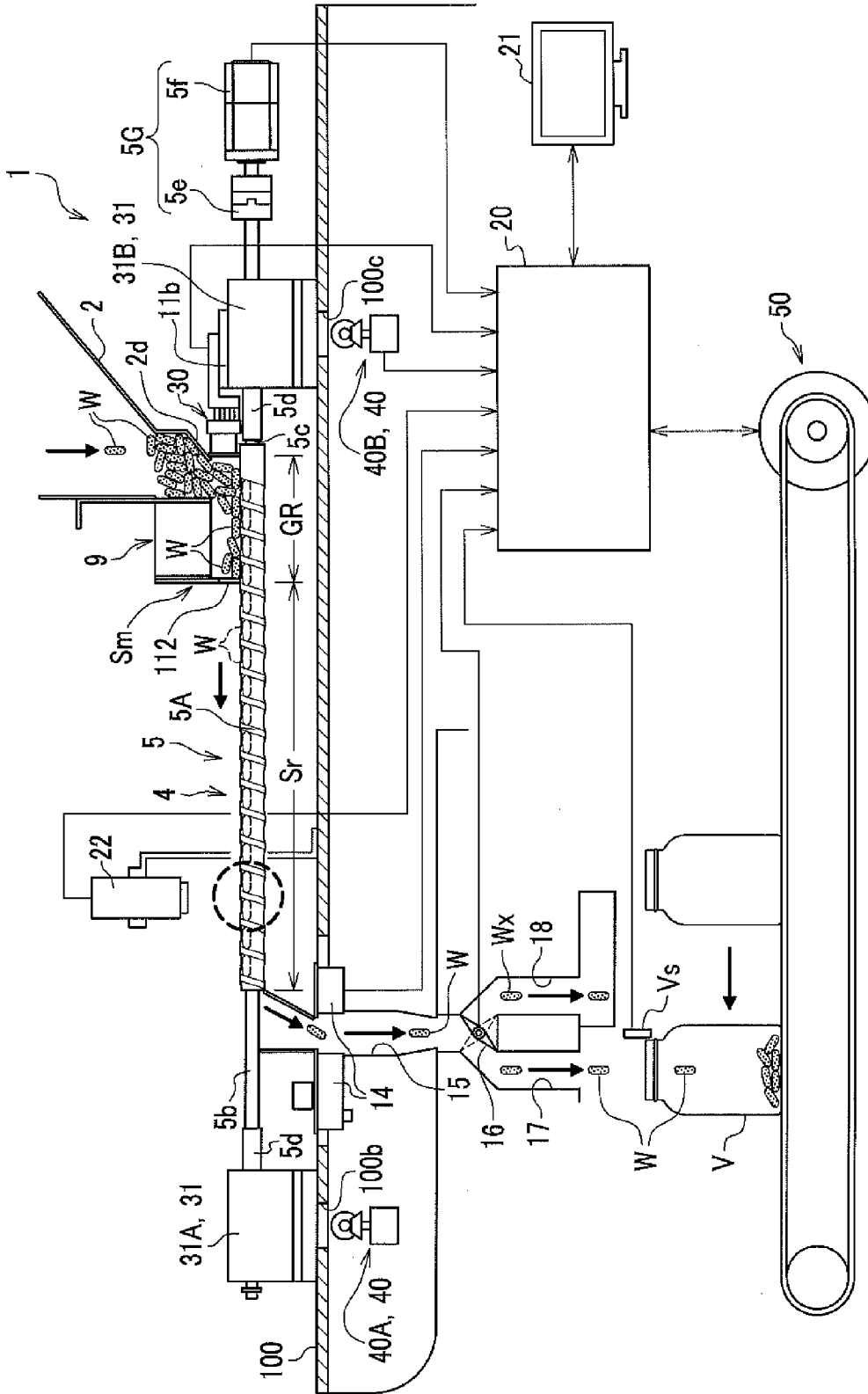


FIG.1B

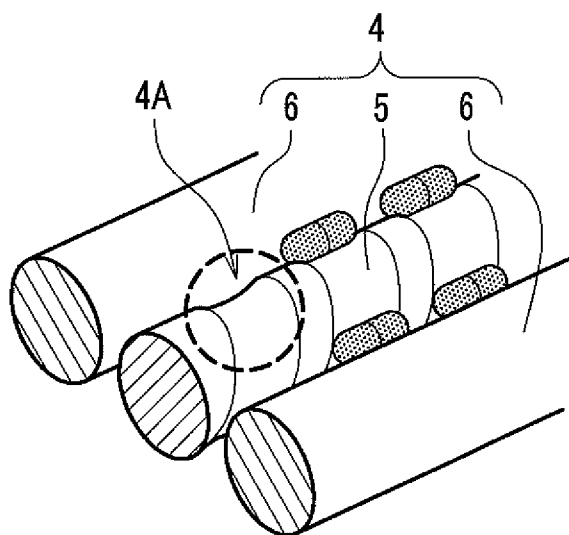
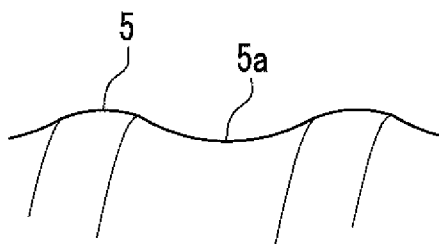


FIG.1C



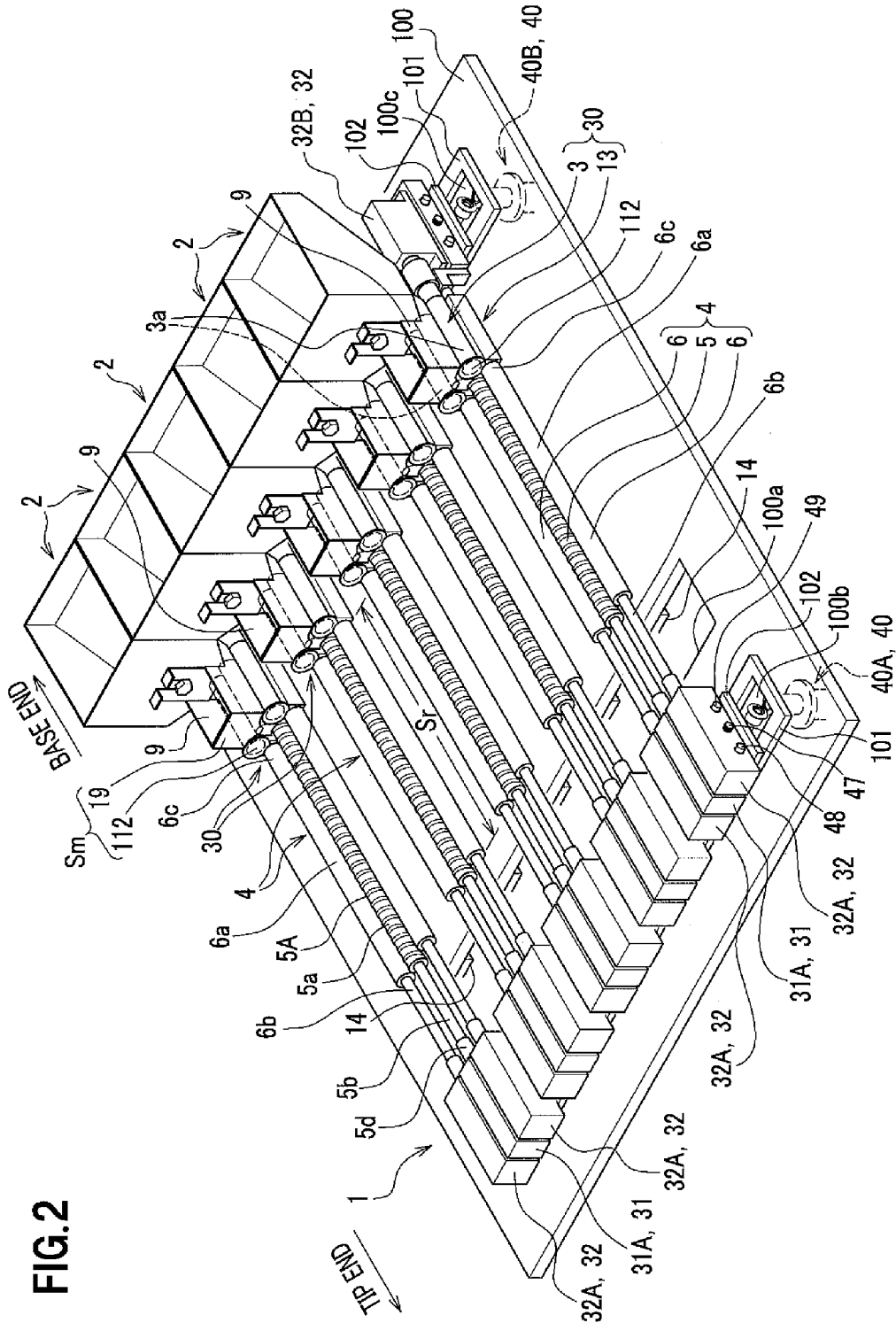


FIG. 2

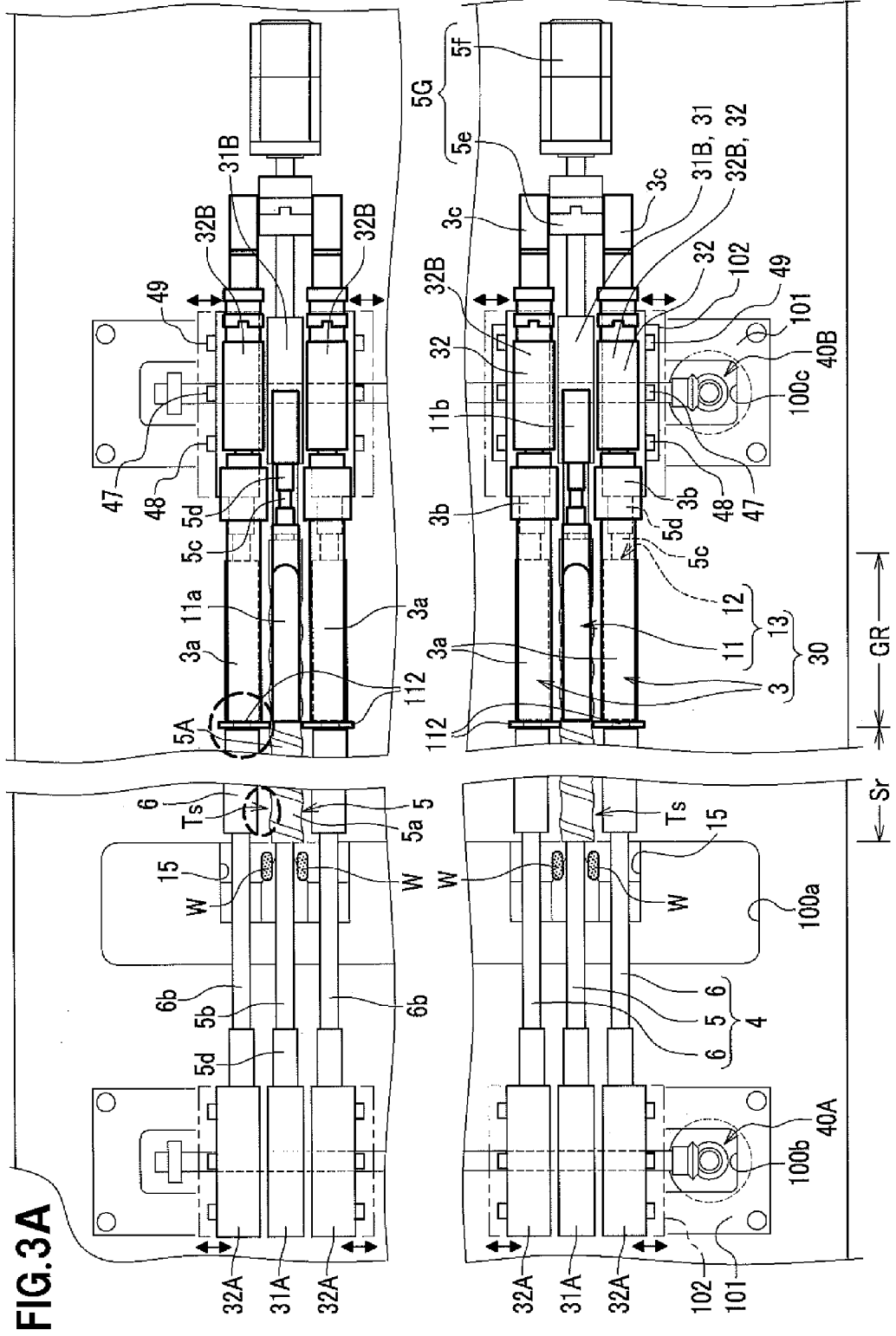


FIG.3B

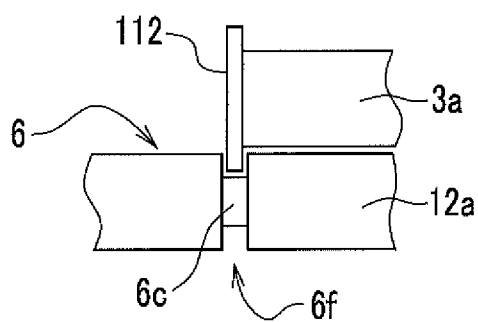


FIG.3C

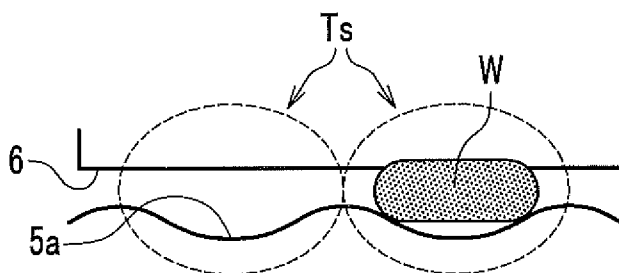


FIG. 4

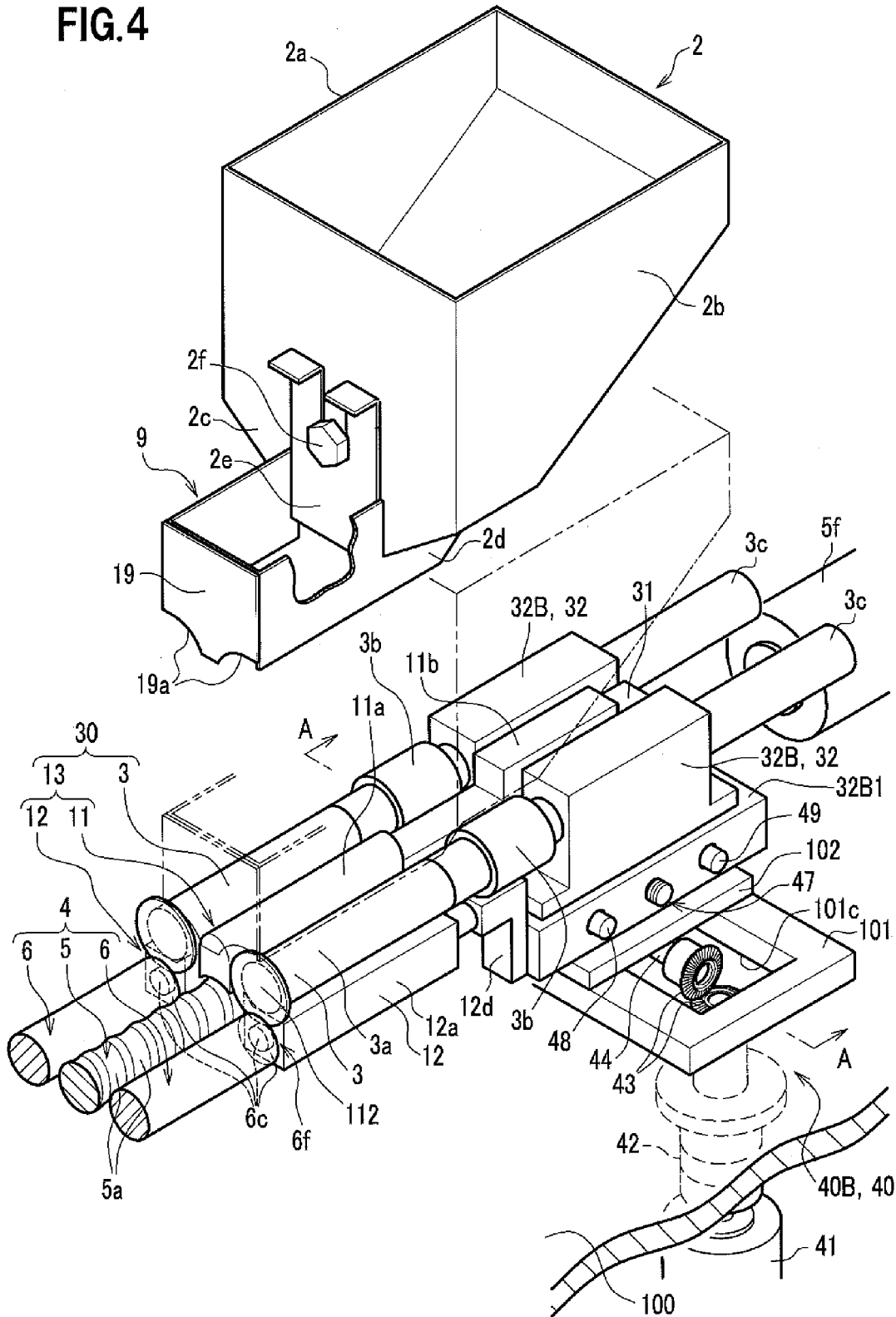


FIG. 5A

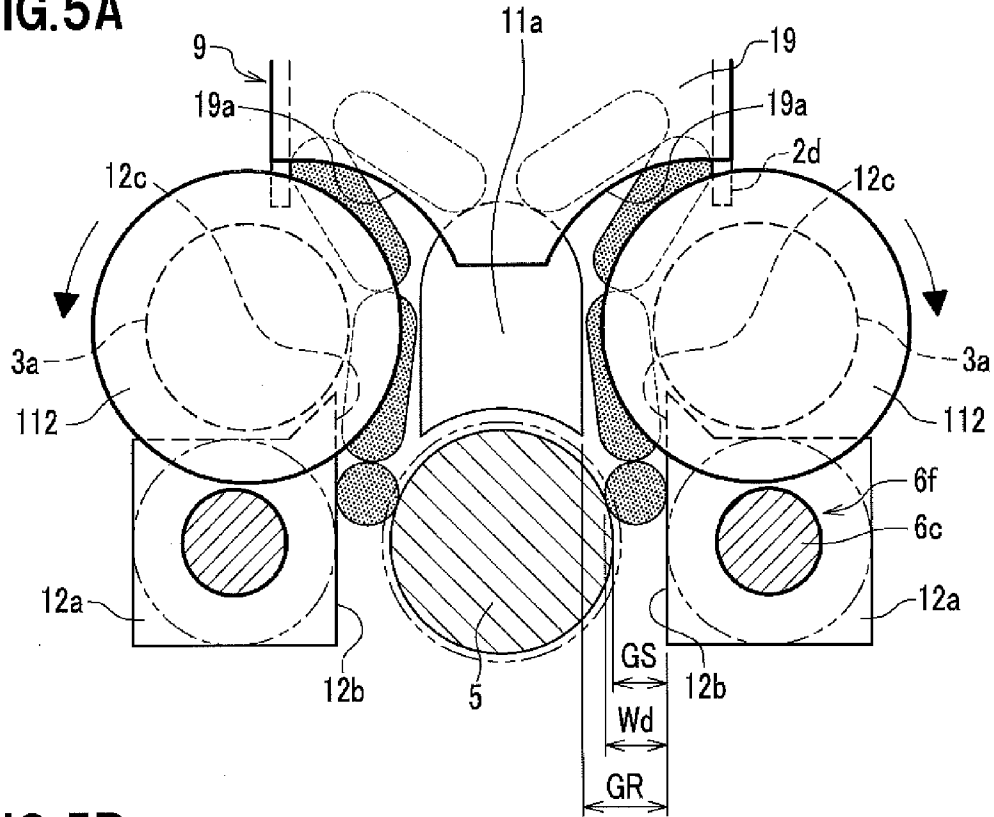


FIG. 5B

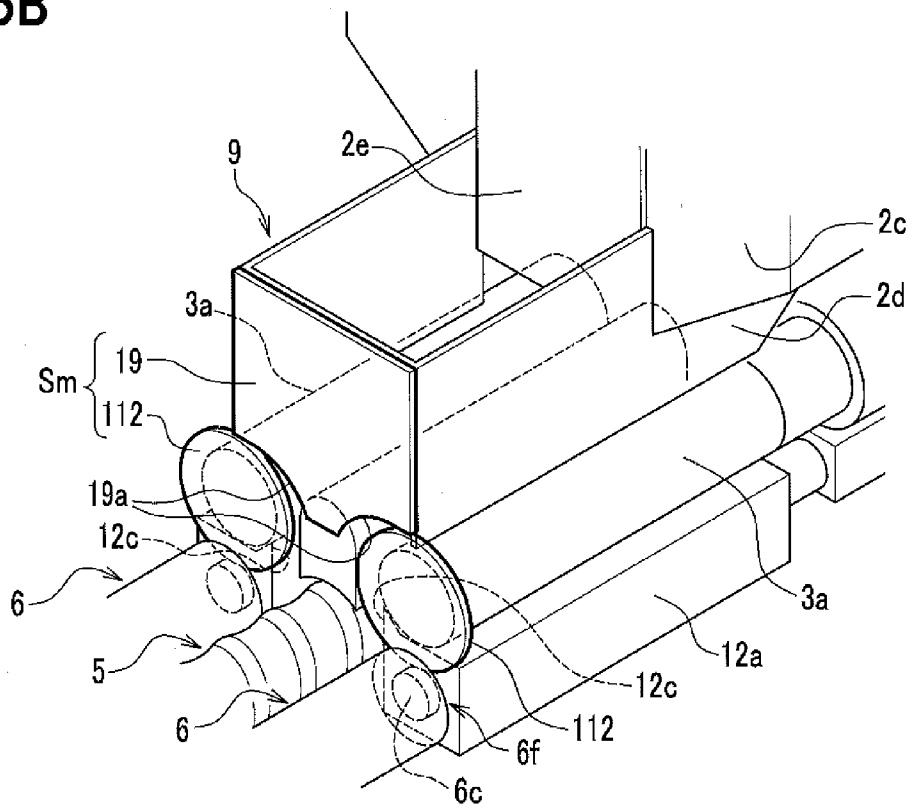
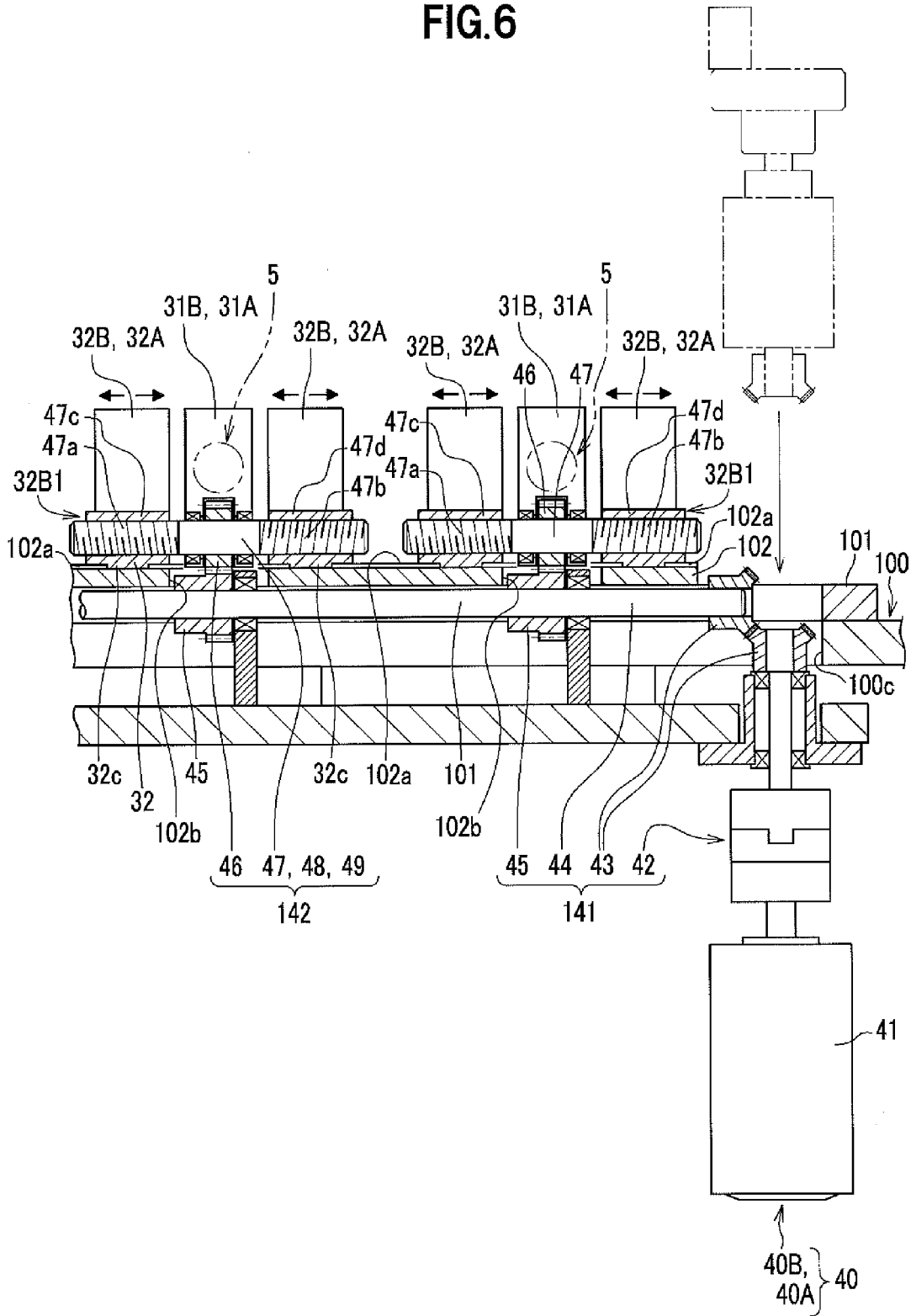


FIG. 6



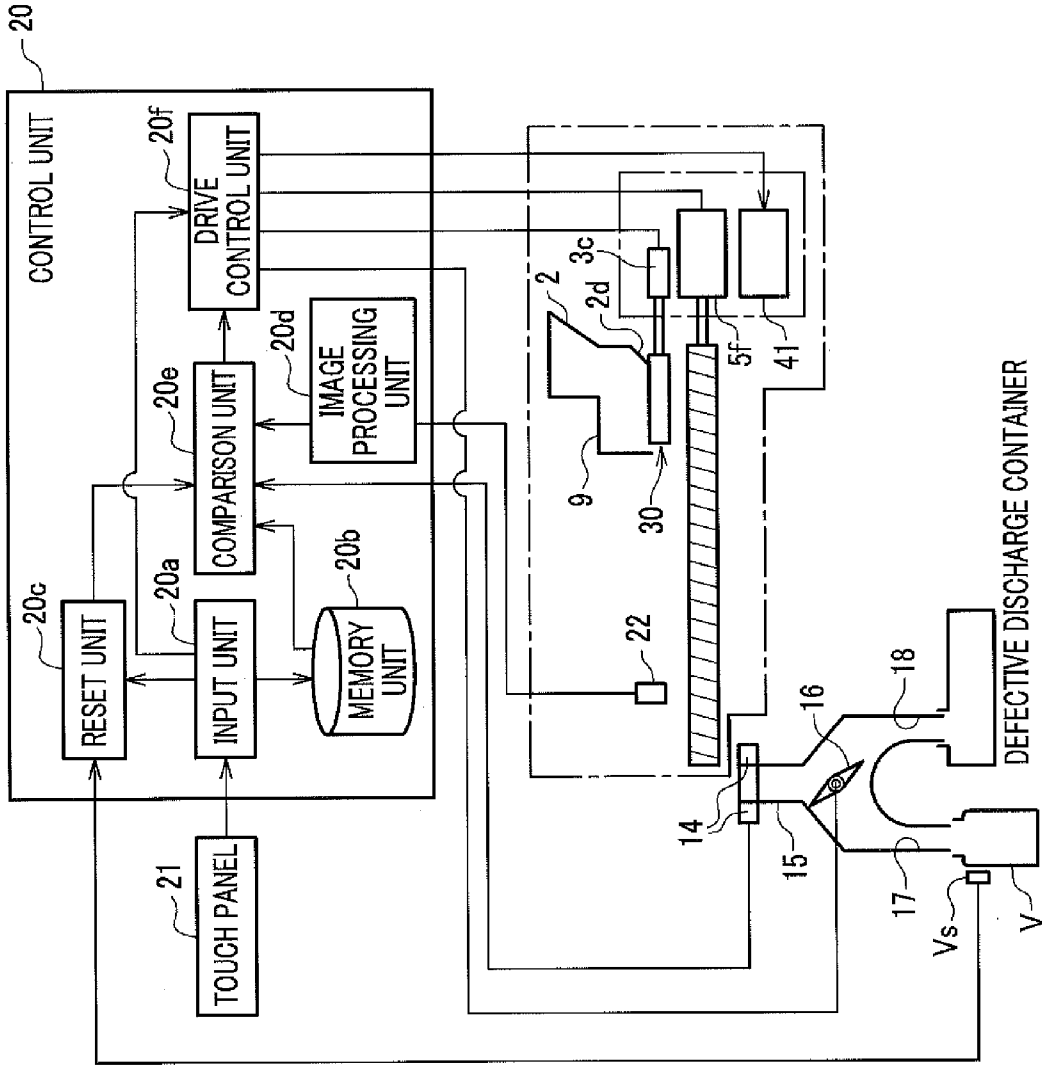


FIG. 7

FIG. 8A

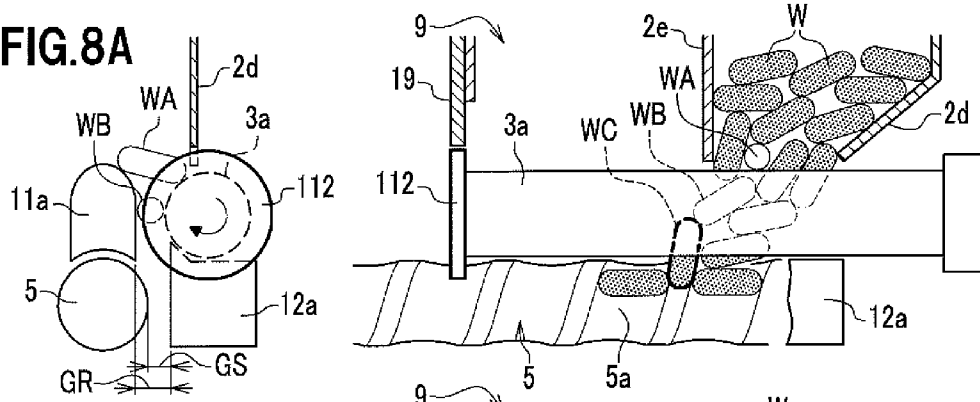


FIG. 8B

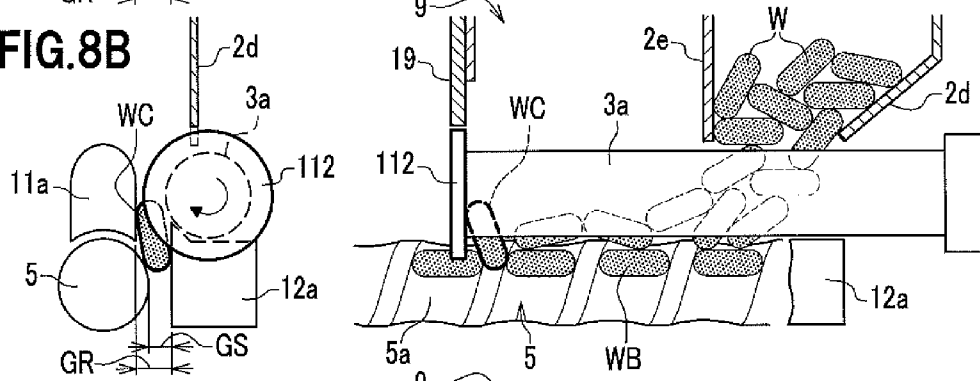


FIG. 8C

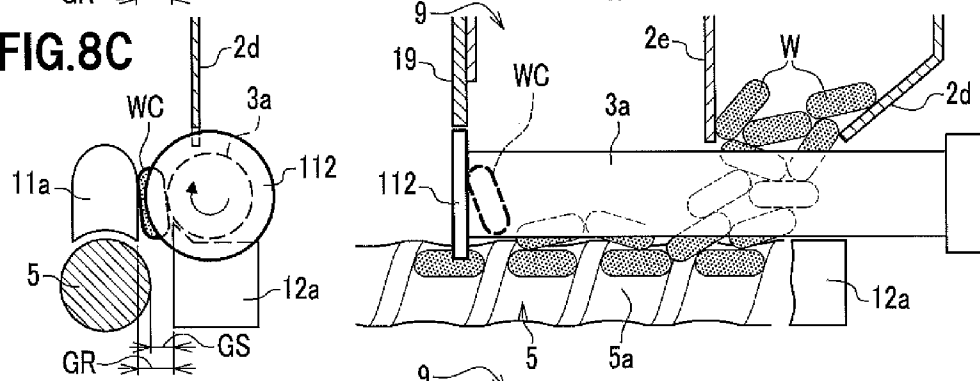


FIG. 8D

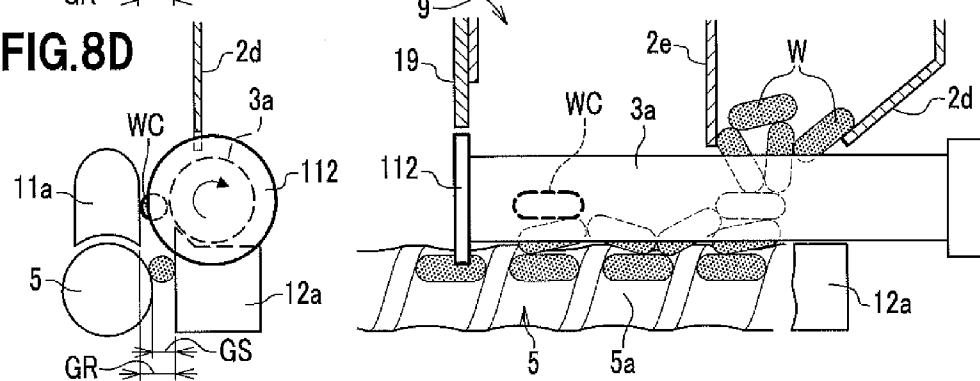


FIG.9A

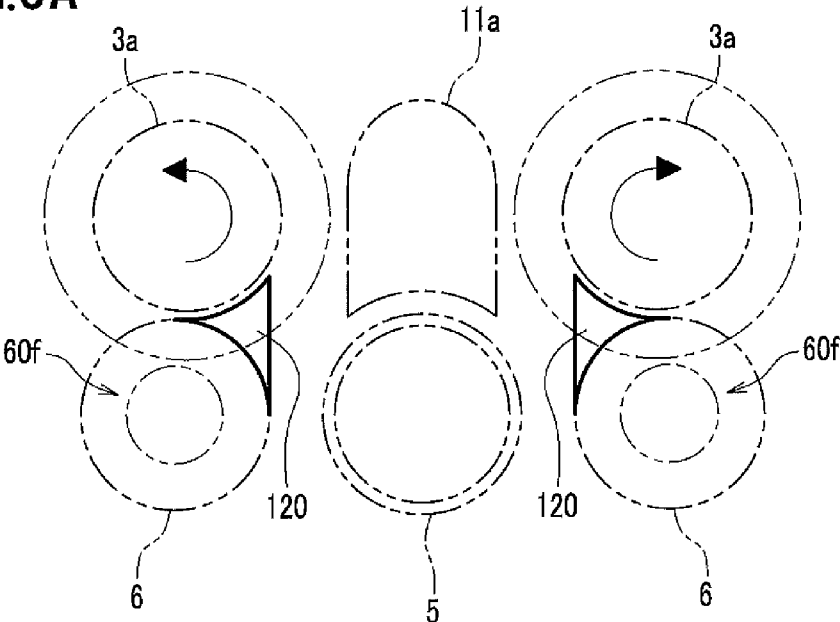


FIG.9B

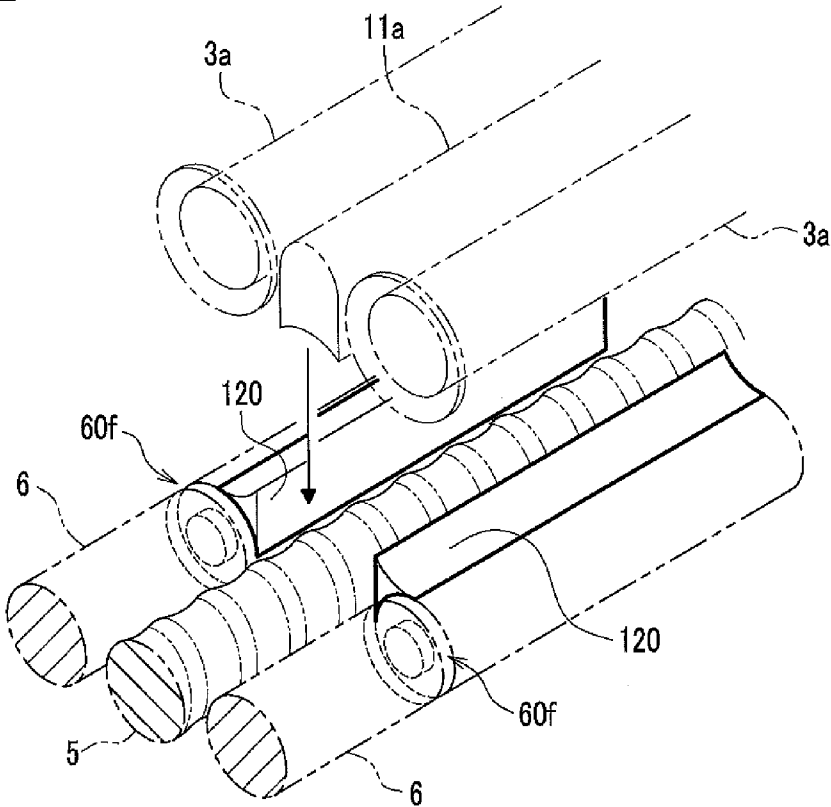


FIG. 11A

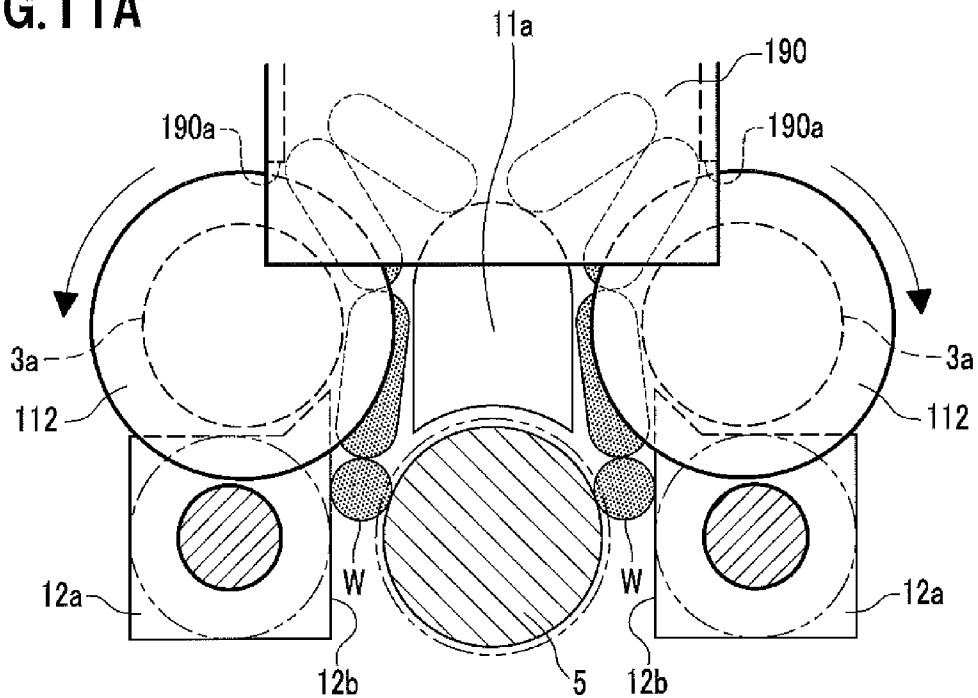


FIG. 11B

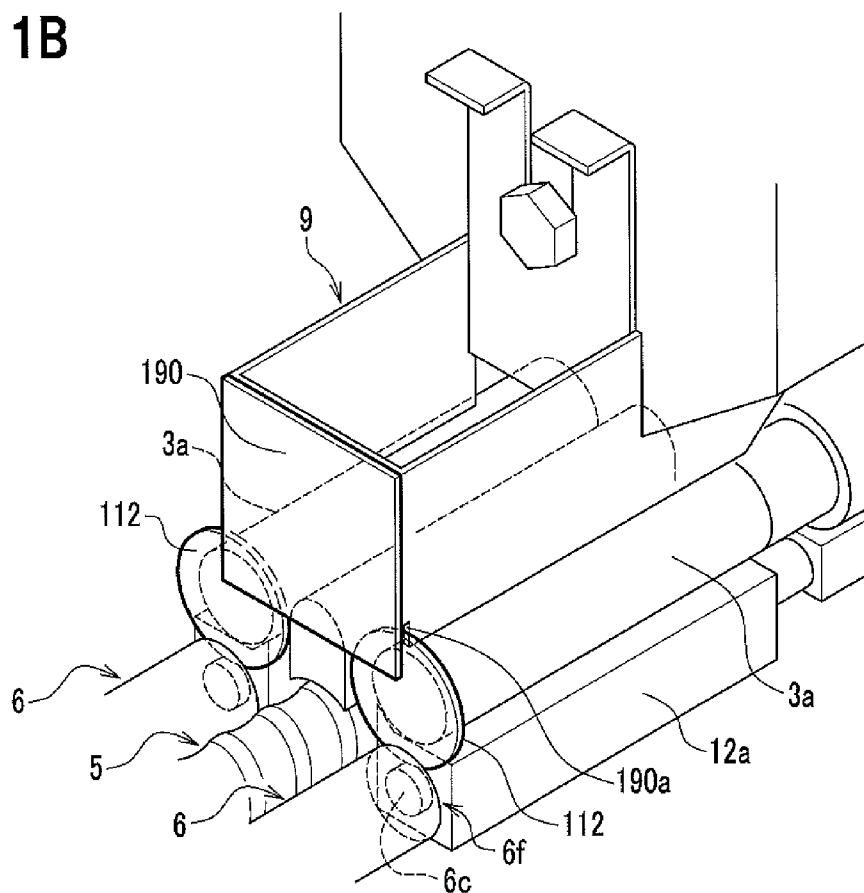


FIG. 12A

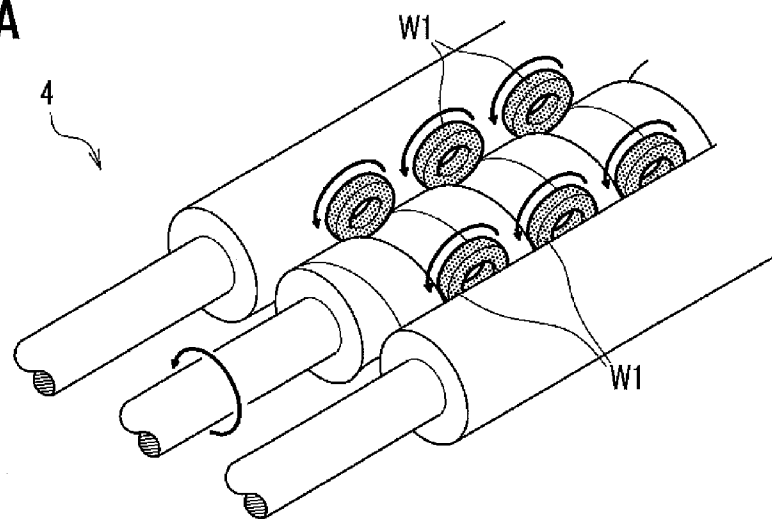


FIG. 12B

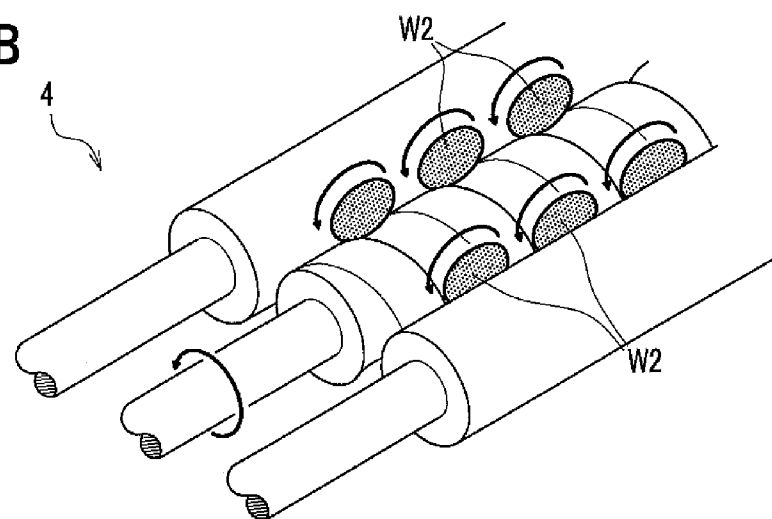


FIG. 12C

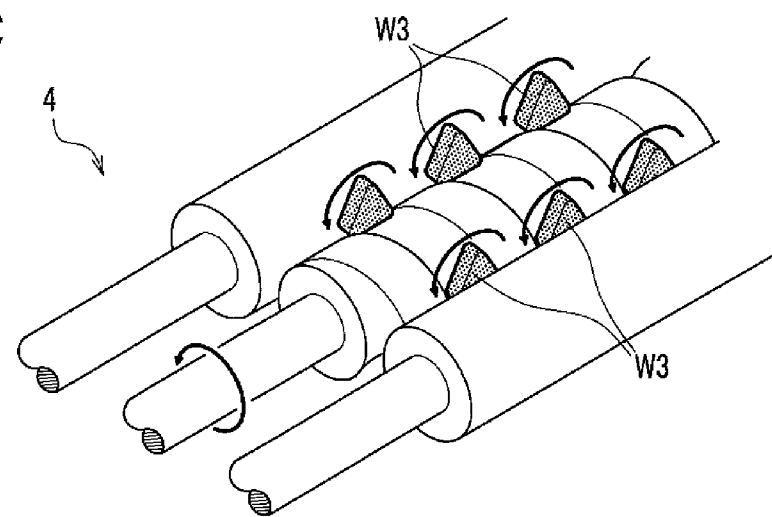


FIG. 13

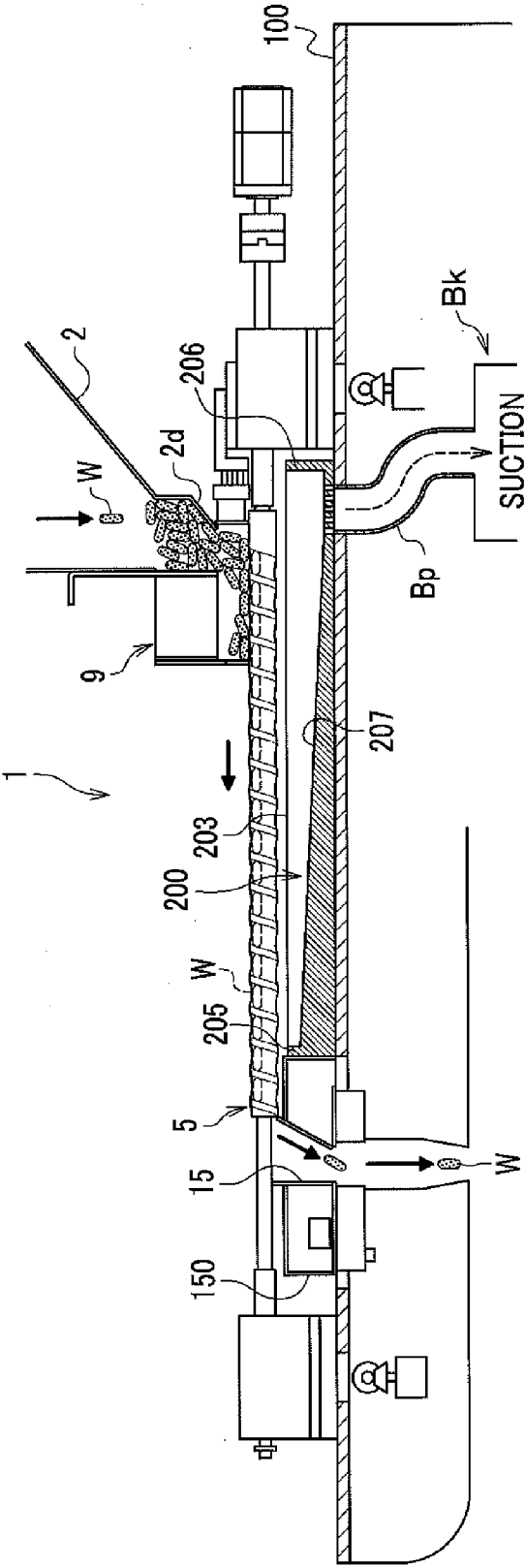


FIG. 14A

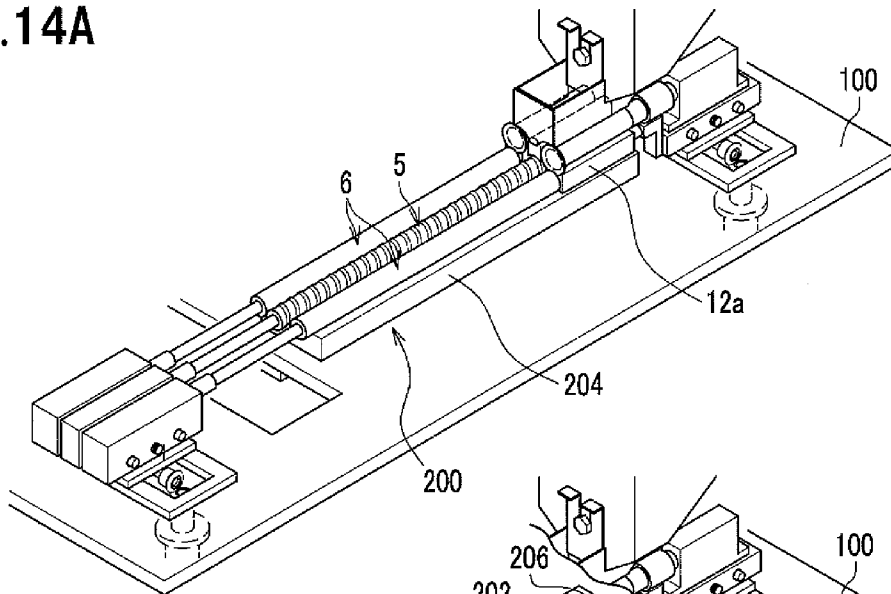


FIG. 14B

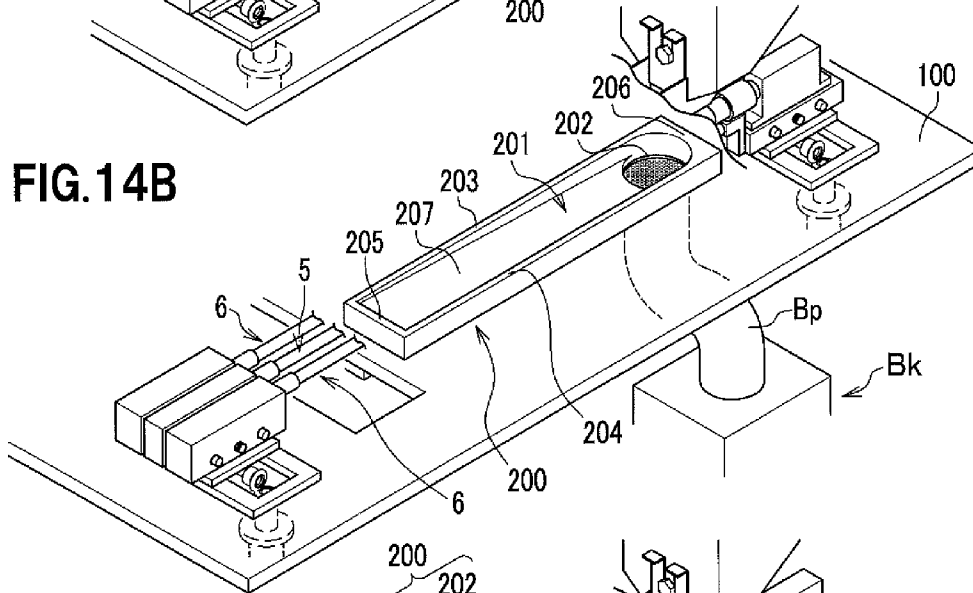
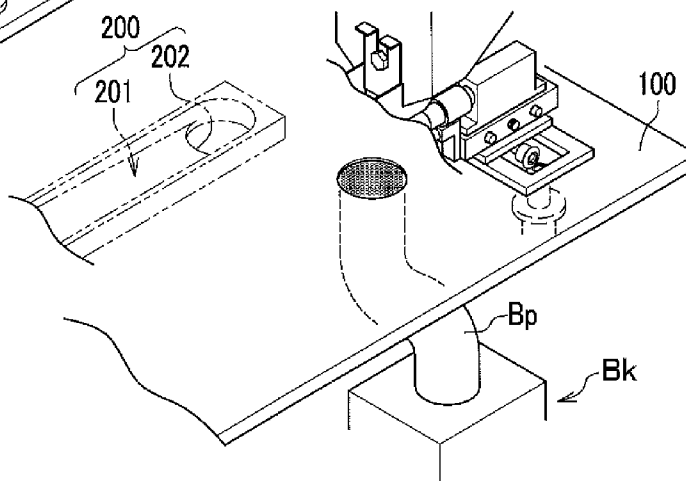


FIG. 14C



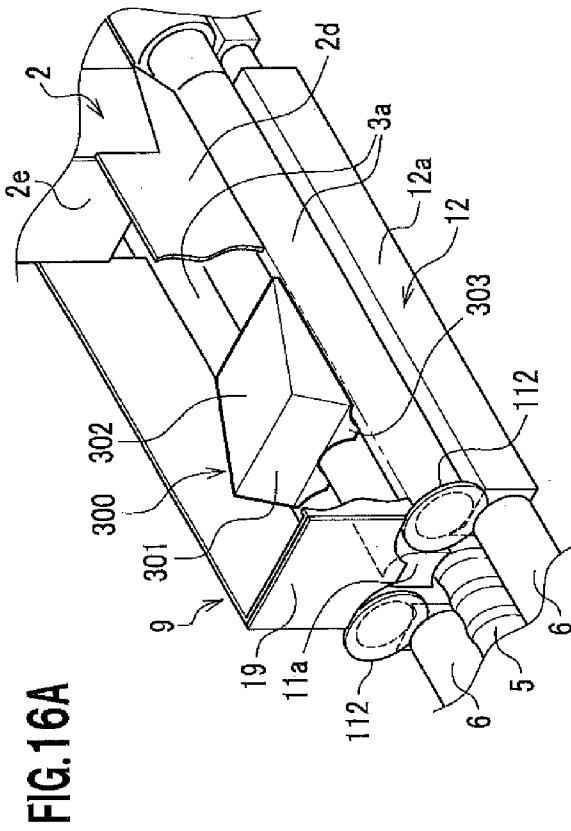


FIG. 16A

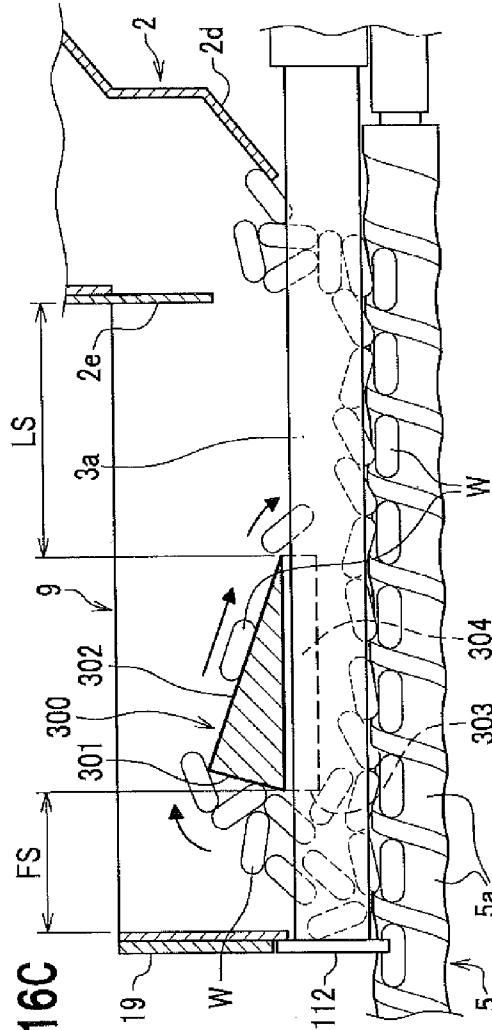


FIG. 16B

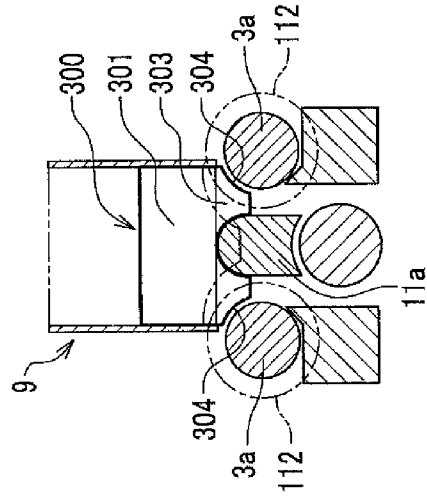


FIG. 16C

APPARATUS AND METHOD FOR COUNTING AND FILLING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the foreign priority benefit under Title 35, United States Code, 119 (a)-(d) of Japanese Patent Application No. 2013-095838 filed on Apr. 30, 2013, and Japanese Patent Application No. 2014-032965 filed on Feb. 24, 2014 in the Japan Patent Office, each disclosure of which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to a method and apparatus for counting and filling, in which materials to be counted such as tablets, capsules, tablet type materials, and capsule type materials, are transported, counted, and filled into a container.

BACKGROUND ART

[0003] As a counting and filling apparatus for counting and filling tablets, the tablet being one of typical materials to be counted, there has been well known a counting and filling apparatus for transporting and counting tablets by using a vibration transport mechanism or a transport mechanism with a spiral groove rod and a vibration transport mechanism (see Patent Document 1 and Non-patent Document 1). However, since the vibration transport mechanism is used in any apparatus, the tablets rub against one another due to vibrations and easily generate powders, and there is a limit to the transport speed because the vibration transport mechanism is used.

[0004] Therefore, there has been conventionally proposed a counting and filling apparatus for transporting the tablets by using a transport mechanism with a spiral groove rod (see Patent Document 2). The transport mechanism of this tablet counting and filling apparatus receives the tablets supplied from a hopper, at a spiral groove position between the spiral groove rod which is rotated by a motor and guide rods which are positioned at the left and right of the spiral groove rod, and transports the tablets in the transport direction by the rotating spiral groove rod. The tablet counting and filling apparatus described above is also proposed to be configured to transport the tablets from the hopper to a filling position by the rotation of the spiral groove rods by including the spiral groove rods of two stages.

CITATION LIST

Patent Literature

- [0005]** Patent Document 1
[0006] Japanese Patent Application Publication No. S53-096176
[0007] Patent Document 2
[0008] Japanese Patent Application Publication No. 2010-208676

Non-Patent Literature

- [0009]** {Non-patent Document 1}
[0010] <http://www.ishida.co.jp/products/280.php> (Ishida Co., Ltd.: Chewable tablet-enabled type tablet counter JZ33-15K type [Feb. 25, 2013])

SUMMARY OF INVENTION

Technical Problem

[0011] However, the conventional counting and filling apparatus leaves room for improvement as described below. Since the counting and filling apparatus receives the tablets directly from the hopper between the spiral groove rod and the guide rod, the tablets overlap near the outlet of the hopper depending on the shape of the tablet, and cannot be supplied smoothly from the hopper in some cases. Further, when the counting and filling apparatus uses the first stage and second stage transport mechanisms, and a plurality of first stage transport mechanisms with the spiral groove rods and the guide rods are arranged in parallel, the configuration becomes complicated and large, because a plurality of spiral groove rods are rotated via a gear box by one servomotor.

[0012] The present invention has been made to solve the problems described above, and an object of the present invention is to provide a method and apparatus for counting and filling, each of which allows the materials to be counted to be supplied more smoothly from the hopper, and is hardly influenced by the shape of the materials to be counted, and further has a simple configuration.

Solution to Problem

[0013] In order to solve the above problems, a counting and filling apparatus according to the present invention aligns materials to be counted in a guide route while changing postures of the materials to be counted by a delivery mechanism provided below a supply port of a hopper, and delivers the materials to a transport route of a transport mechanism which has a guide rod and a spiral groove rod continuing to the guide route, and then transports, counts, and fills the materials into a container, wherein the transport mechanism includes the spiral groove rod which is disposed from the guide route to the transport route, and a lateral guide portion which is provided facing to a base end side of the spiral groove rod and along the axis of the guide rod, and forms the guide route, and wherein the counting and filling apparatus includes, between the supply port and the transport route, an adjusting unit which is provided so as to pass the materials supported via the lateral guide portion in the spiral grooves from the guide route to the transport route, and so as to prevent the materials excessively overlapped on the spiral groove rod or on the other materials from passing to the transport route and allow the materials to wait along the guide route.

[0014] With this configuration, the counting and filling apparatus aligns the materials to be counted through the guide route while changing the postures of the materials falling from the supply port of the hopper by the delivery mechanism, delivers the materials via the lateral guide portion to the spiral grooves which are positioned in the guide route side of the spiral groove rod provided in the transport route and the guide route, and sends the materials to the transport route by the rotation of the spiral groove rod. By the adjusting unit provided between the supply port and the transport route, the counting and filling apparatus passes the materials supported in the spiral grooves, and prevents passing of the other materials overlapped on the spiral groove rod and allows the materials to wait temporarily, and then sends out the materials supported properly in the spiral grooves to the transport route. The counting and filling apparatus is in a state capable of delivering the material to be counted, which are allowed to

wait by the adjusting unit, if there is a vacant spiral groove of the rotating spiral groove rod. Note that, the counting and filling apparatus changes the postures of the materials to be counted, which fall by their own weight and have inappropriate postures, by a posture changing unit of the delivery mechanism, and aligns the materials to be counted, which have appropriate postures, in the guide route by a regulating unit of the delivery mechanism while keeping their postures.

[0015] The counting and filling apparatus may be configured such that the adjusting unit constitutes side walls of a partition frame portion, which is disposed so as to surround the guide route at a position adjacent to the supply port and above the delivery mechanism, by a frame-front side wall which is provided between the guide route and the transport route, a shield-rotating plate which is provided along the frame-front side wall, and frame-left and right side walls which are provided to support the frame-front side wall and are continuous from the supply port of the hopper, wherein the delivery mechanism includes, below the supply port and the partition frame portion, a regulating unit which regulates a guide route width for guiding the materials to be counted to the spiral grooves which are on the base end side of the spiral groove rod, and a posture changing unit which is disposed along the guide route, wherein the regulating unit includes, below the supply port and the partition frame portion, a central guide portion which is disposed just above the spiral groove rod, and the lateral guide portion which is provided to be opposed to a lateral side of the spiral groove rod, and guides the materials to be counted to the spiral groove rod, wherein the posture changing unit includes, above the lateral guide portion, a rotating roller which is provided to be opposed to the central guide portion across the guide route on a lateral side of the central guide portion, and a rotation drive unit which rotates the rotating roller in a direction different from a falling direction of the materials to be counted, wherein a notch portion for rotating the shield-rotating plate is formed on at least one of the frame-front side wall and the frame-left and right side walls, and wherein the shield-rotating plate is provided on a tip end side in the longitudinal direction of the rotating roller, and allows passing of the materials to be counted which are sent while being supported in the spiral grooves, while preventing passing of the materials to be counted which are excessively overlapped on the spiral groove rod or on the other materials to be counted.

[0016] With this configuration, in the counting and filling apparatus, the materials to be counted, which fall by their own weight from the supply port of the hopper, are overlapped in the delivery mechanism and after entering the guide route. The counting and filling apparatus changes the postures of the materials to be counted, which cannot pass through the guide route, while applying a frictional force in a direction different from the falling direction of the materials to be counted by the rotating roller as the posture changing unit provided along the guide route. Note that, if the materials to be counted take postures capable of passing through the guide route, the materials are aligned by falling by their own weight along the guide route without being changed the postures thereof by the rotating roller. In the counting and filling apparatus, the materials to be counted are aligned and supported in the spiral grooves of the spiral groove rod via the lateral guide portion. Further, some of the materials to be counted are sent toward the side of the frame-front side wall of the partition frame portion without being supported in the spiral grooves, however, by coming into contact with the shield-rotating plate, the

materials are lifted temporarily in the rotation direction so that the postures thereof are changed, and are allowed to wait temporarily in the guide route surrounded by the partition frame portion. Then, the materials to be counted, which wait in the guide route in a range surrounded by the partition frame portion while being changed the postures thereof by the rotation of the rotating roller, enter to be supported in the spiral grooves when there is a vacant spiral groove, and are sent toward a transport end without being blocked by the shield-rotating plate and the front wall surface.

[0017] A method for counting and filling for solving the above problems is a method for counting and filling by use of the counting and filling apparatus, wherein materials to be counted inputted into a hopper are aligned in a guide route while the postures of the materials to be counted are changed by a delivery mechanism, delivered to a transport route of a transport mechanism, supported, transported, and sent out by a guide rod and spiral grooves of a spiral groove rod which are the transport mechanism, and the materials to be counted are counted by a counting unit, and filled into a container, wherein the method for counting and filling comprises following steps: an input step of inputting the materials to be counted into the hopper; a delivery step of allowing the inputted materials to be counted to fall by their own weight from the supply port of the hopper, and to be aligned in a guide route formed by use of a regulating unit of the delivery mechanism while changing the postures of the materials to be counted by rotating a rotating roller which is a posture changing unit of the delivery mechanism so as to apply a frictional force in a direction different from the falling direction of the materials to be counted, and delivering the materials to be counted to the spiral grooves of the spiral groove rod via the lateral guide portion of the regulating unit; a transport step of sending the materials to be counted, which are delivered to the spiral grooves of the spiral groove rod by the delivery mechanism, to the transport route of the spiral groove rod from the guide route by the rotation of the spiral groove rod, and transporting the materials to be counted to a transport end in a state of being supported in a support space region between the spiral groove rod and the guide rod; and a filling step of sending out the materials to be counted which are transported to the transport end, counting the materials by the counting unit, and filling the counted materials into the container. In the delivery step, by the adjusting unit provided between the supply port and the transport route, a pre-delivery step is performed together, the pre-delivery step including passing the materials to be counted, which are supported via the lateral guide portion opposed to the spiral grooves, to the transport route from the guide route, preventing passing of the materials to be counted, which are excessively overlapped on the spiral groove rod or on the other materials to be counted, allowing the materials to wait along the guide route, and delivering the material to a vacant spiral groove when there exists the vacant spiral groove of the rotating spiral groove rod.

[0018] By the above procedures, in the method for counting and filling, when the materials to be counted are inputted into the hopper, the materials fall by their own weight from the supply port of the hopper, and become in a state of being overlapped between the supply port and the delivery mechanism and after entering the guide route. Further, in the method for counting and filling, by applying the frictional force for the materials to be counted in the direction different from the falling direction of the materials to be counted by the rotating

roller which is the posture changing unit of the delivery mechanism, the postures of the materials to be counted, which cause a bridge against the guide route, are changed, and become in a state of being aligned by the regulating unit. If the materials to be counted take postures capable of passing through the guide route, the materials are aligned by falling by their own weight along the guide route without being changed the postures thereof by the posture changing unit. Further, in the method for counting and filling, when the materials to be counted, which are supported in the spiral grooves by the rotation of the spiral groove rod, are transported from between the spiral groove rod and the lateral guide portion of the regulating unit to between the spiral groove rod and the guide rod, the materials supported in the spiral grooves are passed, and the materials not supported in the spiral grooves are prevented from passing to the transport route by the adjusting unit and allowed to wait temporarily along the guide route. When a vacant spiral groove of the rotating spiral groove rod comes to a position in the guide route where the materials to be counted wait, the materials to be counted are supported sequentially in the spiral grooves. In the method for counting and filling, the materials to be counted which have passed through the adjusting unit are supported by the support space region between the spiral grooves of the spiral groove rod and the guide rod and transported to the transport end. Further, in the method for counting and filling, the materials to be counted are sent out from the transport end by the rotation of the spiral groove rod, and the falling materials to be counted are counted by the counting unit and filled into the container.

Advantageous Effects of Invention

[0019] A method and apparatus for counting and filling according to the present invention exhibit excellent effects described below. Since the adjusting unit is provided between the supply port and the transport route, the counting and filling apparatus is hardly influenced by the shape of the materials to be counted and can perform quickly and accurately the delivery of the materials to be counted from the guide route to the transport route. In the counting and filling apparatus, since the materials to be counted, which are not supported in the spiral grooves in the guide route, come into contact with the shield-rotating plate on the side of the frame-front side wall of the partition frame portion, the postures of the materials can be changed. Therefore, the materials to be counted, which are excessively overlapped on the spiral groove rod or the like, can be allowed to smoothly wait temporarily in the guide route in the range of the partition frame portion, and then delivered to the spiral grooves when there is a vacant spiral groove, even if the shape of the materials to be counted is an elongated shape such as a rugby ball shape and a capsule shape.

[0020] Further, by providing the shield-rotating plate at the tip end side of the rotating roller, the counting and filling apparatus allows the materials to be counted to wait in the guide route in the range of the partition frame portion while changing the postures of the materials to be counted which have not delivered to the spiral grooves by a delivery mechanism together with the rotating roller. Therefore, the counting and filling apparatus can realize that the materials to be counted are smoothly delivered from the delivery mechanism to the transport mechanism by a simple apparatus configuration compared with a conventional apparatus with a two-stage transport mechanism. Further, the counting and filling appa-

ratus may be configured to have the guide rod in parallel with the spiral groove rod and on one side thereof, or to have a plurality of transport mechanisms disposed in parallel to one another, wherein the guide rods are disposed in parallel to each other on the left and right of the spiral groove rod, and thereby it is possible to accurately fill a number of materials to be counted at a high speed.

[0021] Further, by enclosing the lower side of the guide rod and the spiral groove rod by a region dividing portion and sucking the air in the region dividing portion by a suction mechanism, the counting and filling apparatus can collect dust such as friction particles generated from the materials to be counted, and by urging downward the materials to be counted which are sent by the transport route, the counting and filling apparatus can allow the postures of the materials to be stabilized. Therefore, the counting and filling apparatus can prevent falling of the materials to be counted during transport and perform accurate visual inspection by shooting the materials to be counted in the transport route.

[0022] The method for counting and filling aligns the materials to be counted by the guide route of the regulating unit while changing the postures of the materials to be counted which cannot pass thorough the guide route, by applying the frictional force for the materials which are inputted into the hopper by the posture changing unit, in the direction different from the falling direction of the materials which fall by their own weight from the supply port of the hopper. Further, the method for counting and filling supports the materials to be counted in the spiral grooves of the spiral groove rod in the guide route while allowing the material to wait temporarily in the guide route in the adjusting unit (in the range of the partition frame portion by the shield-rotating plate provided on the tip end side of the rotating roller). Therefore, since the method for counting and filling is hardly influenced by the shape of the materials to be counted and can smoothly deliver the materials to be counted from the delivery mechanism to the support space region between the spiral grooves of the spiral groove rod and the guide rod, thereby quickly transporting, counting, and filling a large amount of materials to be counted.

BRIEF DESCRIPTION OF DRAWINGS

[0023] FIG. 1A is a schematic diagram schematically showing a whole of a counting and filling apparatus according to the present invention;

[0024] FIG. 1B is an enlarged perspective view of a part of a spiral groove rod surrounded by a thick dashed circle in FIG. 1A;

[0025] FIG. 1C is an enlarged view of a part of a spiral groove rod surrounded by a thick dashed circle in FIG. 1B;

[0026] FIG. 2 is a perspective view showing a whole of the counting and filling apparatus according to the present invention by omitting a part thereof;

[0027] FIG. 3A is a plan view showing a whole of the counting and filling apparatus according to the present invention by omitting a part thereof;

[0028] FIG. 3B is an enlarged view of a part surrounded by a thick dashed circle in FIG. 3A, and shows a connecting portion between a guide block and a lateral guide block;

[0029] FIG. 3C is an enlarged view of a part surrounded by a thick dashed ellipse in FIG. 3A, and shows a part of the guide block and the spiral groove rod;

[0030] FIG. 4 is an exploded perspective view showing a configuration of a delivery mechanism by omitting a part of the counting and filling apparatus according to the present invention;

[0031] FIG. 5A is a cross-sectional view schematically showing a configuration of a shield-rotating plate in the delivery mechanism which is a part of the counting and filling apparatus according to the present invention;

[0032] FIG. 5B is a perspective view showing the configuration of the shield-rotating plate in the delivery mechanism by omitting a part of the counting and filling apparatus according to the present invention;

[0033] FIG. 6 is a cross-sectional view from a line A-A direction in FIG. 4 of the counting and filling apparatus according to the present invention, and is a cross-sectional view schematically showing an interval adjusting mechanism for adjusting an interval between second support holders for supporting guide rods;

[0034] FIG. 7 is a block diagram schematically showing a control mechanism of the counting and filling apparatus according to the present invention;

[0035] FIGS. 8A to 8D are schematic diagrams schematically showing states in which materials to be counted are aligned by a regulating unit and a posture changing unit of the delivery mechanism and delivered to a spiral groove rod, and states in which postures of tablets are changed by the shield-rotating plate, in the counting and filling apparatus according to the present invention;

[0036] FIG. 9A is a schematic diagram schematically showing another configuration of lateral guide portions of the counting and filling apparatus according to the present invention;

[0037] FIG. 9B is a perspective view schematically showing another configuration of the lateral guide portions of the counting and filling apparatus according to the present invention;

[0038] FIG. 10 is a schematic diagram schematically showing another configuration of the delivery mechanism of the counting and filling apparatus according to the present invention;

[0039] FIG. 11A is a schematic diagram schematically showing another configuration of a partition frame portion of the counting and filling apparatus according to the present invention;

[0040] FIG. 11B is a perspective view schematically showing another configuration of the partition frame portion of the counting and filling apparatus according to the present invention;

[0041] FIGS. 12A to 12C are schematic diagrams showing another configurations of the materials to be counted which are counted and filled by the counting and filling apparatus according to the present invention;

[0042] FIG. 13 is a cross-sectional view schematically showing a state in which a dust collecting suction mechanism is provided in the counting and filling apparatus according to the present invention by omitting a part thereof;

[0043] FIGS. 14A to 14C are perspective views showing states in which the dust collecting suction mechanism is provided in the counting and filling apparatus according to the present invention by omitting a part thereof;

[0044] FIG. 15 is an exploded perspective view showing another configuration of an adjusting unit of the counting and filling apparatus according to the present invention;

[0045] FIG. 16A is a view showing a state in which an inclined plate is provided in the partition frame portion of the counting and filling apparatus according to the present invention, and is a perspective view showing an inside of the partition frame portion by cutting a part thereof;

[0046] FIG. 16B is a view showing a state in which an inclined plate is provided in the partition frame portion of the counting and filling apparatus according to the present invention, and is a cross-sectional diagram showing the inclined plate from a front side by cutting a part thereof; and

[0047] FIG. 16C is a view showing a state in which an inclined plate is provided in the partition frame portion of the counting and filling apparatus according to the present invention, and is a schematic diagram showing the inclined plate from a lateral side by cutting a part thereof.

DESCRIPTION OF EMBODIMENTS

[0048] Hereinafter, a method and apparatus for counting and filling will be described with reference to drawings. Note that, in each drawing, a configuration in which capsule-type tablets as an example of materials to be counted are counted by a counting and filling apparatus will be described. As an example, the counting and filling apparatus will be described as a configuration in which five transport mechanisms including guide rods provided in parallel to each other on the left and right of a central spiral groove rod are disposed in parallel to one another. Further, a relationship between a size of the tablet to be used and that of each component of the counting and filling apparatus, or positions of the tablets with respect to each component of the counting and filling apparatus are appropriately deformed or schematically shown in the drawings in some cases.

[0049] As shown in FIGS. 1A to 3C, a counting and filling apparatus 1 is for counting a predetermined amount of tablets W and filling them into a container V while transporting the tablets W. The counting and filling apparatus 1 mainly includes a delivery mechanism 30 for delivering the tablets W to a transport mechanism 4 from a hopper 2 in which the tablets W are inputted, the transport mechanism 4 for receiving and transporting the tablets W from the delivery mechanism 30, an adjusting unit Sm provided between a supply port 2d of the hopper 2 and a transport route Sr of the transport mechanism 4, a counting unit 14 for counting the transported tablets W, and a control unit 20 for controlling each mechanism and the like. Note that, the counting and filling apparatus 1 is, in this case, provided with an image capturing unit 22 such as a CCD camera above a predetermined transport route Sr of the transport mechanism 4, and is configured to be able to determine defects such as notch of the tablets W, by data of images taken by the image capturing unit 22 being sent to the control unit 20, and to select the chipped tablets W.

[0050] The counting and filling apparatus 1, in this case, uses a transport conveyor 50 for continuously transporting the containers V in which the tablets W transported by the transport mechanism 4 and counted by the counting unit 14 are filled. Further, the counting and filling apparatus 1 includes a first support holder 31 and a second support holder 32 for holding a spiral groove rod 5, guide rods 6, 6, and the like of the transport mechanism 4, a base 100 for supporting the first support holder 31 and the second support holder 32, and a holder moving mechanism 40 for moving the second support holder 32 close to or away from the first support holder 31 in order to adjust intervals of the guide rods 6, 6 with respect to the spiral groove rod 5. Note that, in the counting and filling

apparatus 1, a guide route GR (see FIG. 1A) is from a space between a central guide block 11a and opposing rotating rollers 3a, 3a (see FIGS. 3A, 3B), to a space between the spiral groove rod 5 and opposing lateral guide blocks 12a, and the transport route Sr (see FIG. 1A) is a space between the spiral groove rod 5 and the opposing guide rods 6, 6. Further, a support space region Ts is a region for supporting the tablets W so that the tablets W can be transported between the guide rod 6 and spiral grooves 5a of the spiral groove rod 5.

[0051] A capsule is a specific example of the material to be counted as the tablet W which is an object to be counted by the counting and filling apparatus 1, however, the tablets to be counted such as a tablet of rugby ball shape, a round tablet, and a tablet of triangular rice ball shape, which have a curved portion in the external shape, are the objects. The material to be counted as the tablet W is, as areas commonly used, not specifically limited to areas such as medicine, supplement, and confectionary. If the tablet W has a curved portion in the external shape, in particular, a disc shape, a lens shape, a rugby ball shape, an annular shape like a troche, or a capsule shape, the tablet W can be rotated when transported, and can be stably transported at a high speed. Further, the tablet W, which is coated on the surface as a sugar-coated tablet or is not coated as a plain tablet, can be handled. The tablet W of capsule is transported in a state of rotating about a long axis as the long axis is in a horizontal direction.

[0052] As shown in FIGS. 1A to 3C, the base 100 of the counting and filling apparatus 1 supports the first support holder 31 and the second support holder 32. The base 100 is formed with through holes 100b, 100c apart from each other on one side and the other side thereof, and formed with a hole 100a which is a counting path 15 for the tablet W at a position of a transport end of the transport mechanism 4 (see FIGS. 2, 3A). Mounting frames 101, 101 are provided on peripheral edges of the through holes 100b, 100c (see FIGS. 2, 3A). The mounting frame 101 is formed in annular and rectangular, and a holder guide plate 102 is provided on the mounting frame 101 (see FIG. 2). The holder guide plate 102 supports the first support holder 31 and the second support holder 32. The holder guide plates 102 are respectively formed with opening holes 102b, through which transmission gears 45 of the holder moving mechanism 40 are connected, in the centers facing a tip end rotation support holder 31A and a base end rotation support holder 31B of the first support holder 31 (see FIG. 6: the transport mechanism 4 composed of the spiral groove rod 5 and the guide rods 6, 6 on the left and right is shown as one unit in FIG. 4, however, two units of the transport mechanism 4 are shown in FIG. 6).

[0053] As shown in FIGS. 2 to 4, the holder moving mechanism 40 of the counting and filling apparatus 1 is for adjusting the intervals between the spiral groove rod 5 and the guide rods 6, 6 by moving the second support holders 32, 32 close to or away from the first support holder 31. The holder moving mechanism 40 includes a tip end holder moving mechanism 40A for moving tip end support holders 32A, 32A close to or away from the tip end rotation support holder 31A, and a base end holder moving mechanism 40B for moving base end support holders 32B, 32B close to or away from the base end rotation support holder 31B. Since the tip end holder moving mechanism 40A and the base end holder moving mechanism 40B have the same configuration, one will be described.

[0054] As shown in FIG. 6, the base end holder moving mechanism 40B includes a holder driving source 41 such as a drive motor, a driving force transmission unit 141 (42, 43, 44,

45) for transmitting a driving force from the holder driving source 41, and a linear moving unit 142 (46, 47, 48, 49 (see FIG. 4)) for linearly moving the base end support holders 32B, 32B by the driving force transmitted by the driving force transmission unit 141. The driving force transmission unit 141 has a coupling portion 42 which transmits the driving force from the holder driving source 41 by being connected to a rotating shaft, a transmission direction changing portion 43 such as bevel gears which changes the transmission direction of the driving force transmitted by the coupling portion 42 and transmits the driving force, a rotating shaft 44 rotated by the driving force which is changed the transmission direction by the transmission direction changing portion 43, and the transmission gears 45 which are attached to the rotating shaft 44 with predetermined intervals intermittently at positions just below the base end rotation support holder 31B and rotate together with the rotating shaft 44.

[0055] The driving force transmission unit 141 transmits the driving force to the linear moving unit 142 by the holder driving source 41 being operated, a rotation speed of the driving force being reduced by the transmission direction changing portion 43, the direction of the driving force being changed to the horizontal direction from the vertical direction by the transmission direction changing portion 43, and the rotating shaft 44 and the plural transmission gears 45 being rotated. The linear moving unit 142 has a driven gear 46 meshing with the transmission gear 45, a rotating shaft 47 to which the driven gear 46 is secured and which is provided in the base end support holder 32B rotatably via a bearing, nut portions 47c, 47d which support and mesh with threaded portions 47a, 47b formed on both ends of the rotating shaft 47, and rotating shaft guides 48, 49 (see FIG. 4) which are provided slidably in the base end support holder 32B in parallel with the rotating shaft 47.

[0056] The linear moving unit 142 can move the base end support holders 32B, 32B along the holder guide plate 102 and the rotating shaft guides 48, 49, because the rotating shaft 47 is rotated together with the driven gear 46 driven by the rotation of the transmission gear 45, and the threaded portions 47a, 47b of the rotating shaft 47 are formed to have threads opposite to each other. Note that, the tip end holder moving mechanism 40A and the base end holder moving mechanism 40B can be operated synchronously or operated separately. The tip end holder moving mechanism 40A and the base end holder moving mechanism 40B can be operated separately in a range of tolerance of a supporting component part.

[0057] As shown in FIGS. 1A, 2, and 4, the hopper 2 is for inputting and storing the tablets W therein, and for supplying the tablets W via the delivery mechanism 30 (see FIG. 4) to a base end side of the transport mechanism 4. The hopper 2 has a hopper main body 2b which is formed narrower in the downward direction from an input port 2a (see FIG. 4) which is open wide in the upward direction, and the supply port 2d formed at the bottom is disposed to face just below the base end side of the delivery mechanism 30. The hoppers 2 may be configured to be provided for each transport mechanism 4 (see FIG. 2), or a plurality of supply ports 2d (not shown) may be configured to be provided in one housing for all of the transport mechanisms 4 provided side by side.

[0058] As shown in FIG. 4, an opening is formed by a notch at a position on a front side wall 2c of the supply port 2d, and a sliding side wall 2e as a partition plate is provided on the opening so as to be stopped at a predetermined position in the vertical direction by a fixing unit (fixing bolt) 2f. The sliding

side wall **2e** is for changing the size of the opening in accordance with the size and shape of the tablets **W** to be inputted. Here, the sliding side wall **2e** is, for an example, set to have an opening height (see FIGS. **5A**, **5B**) such that the tablets **W** supplied from the supply port **2d** are overlapped in about five steps including a tablet taken (supported) in the spiral groove **5a**. As shown in FIG. **5B**, the supply port **2d** is provided so as not to pass the tablets **W** between the lower end of the supply port **2d** and the upper end of the delivery mechanism **30**, by allowing a position of the lower end excluding the front side wall **2c** to be close to the delivery mechanism **30** so that an interval therebetween is smaller than a thickness of the tablet **W**. Here, the frame-left and right side walls of a partition frame portion **9** and the left and right wall surfaces of the supply port **2d** of the hopper **2** are formed integrally. The supply port **2d** is formed of the sliding side wall **2e**, the frame-left and right side walls to the sliding side wall **2e**, and a rear side wall which is a surface opposed to the sliding side wall **2e**.

[0059] As shown in FIGS. **1A**, **2**, and **4**, the partition frame portion **9** is provided in the supply port **2d**, the partition frame portion **9** being provided with shield-rotating plates **112**, **112** and a frame-front side wall **19** as the adjusting unit **Sm** in adjacent manner. As shown in FIG. **4**, the partition frame portion **9** temporarily allows the tablets **W** to wait or stores the tablets **W**, which are supplied and not delivered to the spiral grooves **5a** of the spiral groove rod **5** by the delivery mechanism **30** just below the supply port **2d**, and is for providing a space for delivering via the delivery mechanism **30** the tablets **W** to the vacant spiral grooves **5a** just below the supply port **2d**. The partition frame portion **9** forms a rectangular space which is partitioned by the front side wall **2c** of the hopper **2** and other three side walls. Here, the partition frame portion **9** is formed with a range between the front side wall **2c** (or the sliding side wall **2e**) and the tip end side of the delivery mechanism **30**, and a range including the guide route **GR** (see FIG. **5A**) which is formed of a central guide portion **11** and a posture changing unit **3** of the delivery mechanism **30**.

[0060] Further, the frame-front side wall **19** of the partition frame portion **9** is formed with arc-shaped notch portions **19a**, **19a**, and is configured to cover the notch portions **19a**, **19a** with the shield-rotating plates **112**, **112** to be described later. The shield-rotating plates **112**, **112** to be described later is, for example, formed of a silicone resin and is provided so as not to damage the tablets **W** by momentum of the tablets **W**, which are conveyed in a state of overlapping on the spiral groove rod **5** and come into contact with the shield-rotating plates **112**, **112**. If the tablets **W** are not supported in the spiral grooves **5a**, for example, in a state where the tablets **W** overlap at positions on the spiral groove rod **5** (not in the spiral grooves **5a**), the tablets **W** cannot pass through the shield-rotating plates **112**, **112** and are temporarily held in positions along the guide route **GR** in a range of the partition frame portion **9**. Note that, a state in which the tablets **W**, which could not be delivered to the spiral grooves **5a** of the spiral groove rod **5** via the delivery mechanism **30** from the supply port **2d**, exist in at least one of the guide route **GR** on the lower side of the range of the partition frame portion **9** and a range surrounded by the frame-left and right side walls and the frame-front side wall **19** in the partition frame portion **9**, is in some cases referred to as a storage, a hold, a reserve, or a wait, however, any word is used as a same meaning. Further, the range of the partition frame portion **9** means both or at least one of the guide route **GR** on the lower side of the range

surrounded by the partition frame portion **9** and the range surrounded by the frame-left and right side walls and the frame-front side wall **19** in the partition frame portion **9**.

[0061] As shown in FIGS. **2** to **4**, the delivery mechanism **30** is for aligning the tablets **W** supplied by falling by their own weight from the hopper **2**, and delivering them to the base end side of the transport mechanism **4**. The delivery mechanism **30** is provided just above a position of the base end side of the spiral groove rod **5** and at a position opposed to the partition frame portion **9** and the supply port **2d**. The delivery mechanism **30** includes the posture changing unit **3** and a regulating unit **13**, and forms the guide route **GR** (see FIG. **5A**) with the regulating unit **13**, and is configured to deliver the tablets **W** which are aligned in the guide route **GR** to the spiral grooves **5a** of the spiral groove rod **5**. Here, the delivery mechanism **30** also plays a role of forming the guide route **GR** of the regulating unit **13** with the posture changing unit **3**. The delivery mechanism **30** is set to be able to deliver the tablets **W** to the transport mechanism **4** side, by introducing the tablets **W** to the guide route **GR** of the regulating unit **13** and aligning them while changing their postures by the posture changing unit **3** (rotating rollers **3a**, **3a**) just below the partition frame portion **9** and the supply port **2d**.

[0062] As shown in FIGS. **4**, **5A**, and **5B**, the posture changing unit **3** is for changing the postures of the tablets **W** and guiding the tablets **W** to the guide route **GR**, by applying a frictional force in a direction different from a falling direction of the tablets **W** which fall from the supply port **2d**. The posture changing unit **3** includes the rotating roller **3a** which is a posture changing roller, a connecting portion **3b** which connects the rotating roller **3a** to the base end support holder **32B** of the second support holder **32**, a roller drive motor **3c** which rotates the rotating roller **3a** via the connecting portion **3b** connected to the base end support holder **32B**, and a shield-rotating plate **112** which is provided on the tip end side of the rotating roller **3a**. Note that, "applying a frictional force" means that the rotating rollers **3a**, **3a** directly come into contact with the tablets **W**, or indirectly come into contact with the tablets **W** in need of the posture changes via the other tablets **W**.

[0063] As shown in FIG. **4**, the rotating roller **3a** is a column or a cylindrical body which has substantially the same diameter as the guide rod **6**, and includes a connection structure for being connected with the connecting portion **3b** on the base end side. The rotating rollers **3a**, **3a** are opposed to the central guide block **11a** of the central guide portion **11**, and disposed facing each other just above the lateral guide blocks **12a**, **12a** of lateral guide portions **12**. Here, as shown in FIG. **5A**, the rotating rollers **3a**, **3a** are provided just below the partition frame portion **9** and the supply port **2d** so that lower ends of both side walls of the supply port **2d** of the hopper **2** are in a range of width of the rotating rollers **3a**, **3a**. As shown in FIGS. **5A**, **5B**, lower ends of the partition frame portion **9** and the supply port **2d** are provided in a state close to upper portions of the shield-rotating plates **112**, **112** and the rotating rollers **3a**, **3a** so that a space therebetween is smaller than a thickness **Wd** of the tablet **W**. Note that, the connection structure of the rotating roller **3a** may be a structure such as a general keyway which can be removably attached and connect a rotation driving force from the roller drive motor **3c**, and is not limited thereto. Further, the roller drive motor **3c** is not limited thereto, as long as it is a drive unit such as a common DC motor to rotate a rotating shaft.

[0064] As shown in FIG. 4, the second support holder 32 rotatably supports the rotating rollers 3a, 3a, and supports the lateral guide blocks 12a, 12a. The second support holder 32 includes the tip end support holder 32A (see FIG. 2) and the base end support holder 32B. Further, each of the base end support holders 32B rotatably supports the rotating rollers 3a, 3a, and supports the lateral guide blocks 12a, 12a. Each of the base end support holders 32B (on both sides of the base end rotation support holder 31 B of the first support holder 31) includes a bearing or the like (not shown) which transmits via the connecting portion 3b the rotation driving force from the roller drive motor 3c. Further, each of the base end support holders 32B is configured to be able to move in a direction of being close to or away from the base end rotation support holder 31 B (the spiral groove rod 5 side) as a center. As shown in FIG. 6, each of the base end support holders 32B, 32B includes, in a holder base 32B1 thereof, the nut portions 47c, 47d in which the threaded portions 47a, 47b of the linear moving unit 142 are screwed. Note that the threaded portions 47a, 47b are formed to have threads opposite to each other. Therefore, in accordance with the rotation of the rotating shaft 47, the base end support holders 32B, 32B can move close to or away from the base end rotation support holder 31B, respectively.

[0065] As shown in FIG. 5A, the rotating rollers 3a rotate so as to apply the frictional force to the tablets W in the direction opposite to or different from the falling direction of the tablets W on both sides of the guide route GR (in FIG. 5A, the rotating roller 3a on the right side rotates clockwise, and the rotating roller 3a on the left side rotates anti-clockwise). Therefore, even if a tablet W is in a posture where a large area surface thereof faces the guide route GR, the posture of the tablet W is changed by the rotation of the rotating roller 3a, to be in a posture capable of passing through (entering) the guide route GR. Note that the rotating roller 3a prevents the tablets W from being bridged to each other by applying the frictional force in the direction opposite to the falling direction of the tablets W. A tablet W originally in a posture capable of passing through the guide route GR falls without touching the rotating roller 3a, or the interval to a side surface of the central guide block 11a is small even if the tablet W touches the rotating roller 3a, and thus the tablet W falls along the guide route GR without changing the posture capable of entering the guide route GR by being guided by the central guide block 11a. A rotational speed of the rotating roller 3a is set to be slower than a rotational speed of the spiral groove rod 5. Since the rotational speed of the rotating roller 3a is slower than the rotational speed of the spiral groove rod 5, the posture changing unit 3 can deliver the tablets W more smoothly in a manner where a ratio of the tablets W received in the spiral grooves 5a of the spiral groove rod 5 to the tablets W falling by their own weight is appropriate.

[0066] As shown in FIGS. 4, 5A, and 5B, the shield-rotating plate 112 is formed in a disc shape and disposed on a tip end surface (tip end side) of the rotating roller 3a, and is configured to be rotatable together with the rotation of the rotating roller 3a. The diameter of the shield-rotating plate 112 is formed larger than the diameter of the rotating roller 3a, and the shield-rotating plate 112 includes, on the outside of the rotating roller 3a, a surface thereof capable of coming into contact with the tablets W which are transported by the rotation of the spiral groove rod 5 in a state of not being supported in the spiral grooves 5a. Here, the shield-rotating plate 112 is formed of an elastic member such as a silicone

rubber and a resin (polyacetal, ultrahigh molecular weight polyethylene) which are softer than metal. When the tablet W sent by the rotation of the spiral groove rod 5 comes into contact with the shield-rotating plate 112, the shield-rotating plate 112 can also change the posture of the tablet W by temporarily moving the tablet W in the rotation direction of the shield-rotating plate 112. The tablet W which has been changed the posture thereof is temporarily reserved in the range of the partition frame portion 9. Further, the tablet W which has been changed the posture thereof by the shield-rotating plate 112 waits in a state (posture) to be easily delivered to a vacant spiral groove 5a. Note that, the shield-rotating plates 112, 112 are rotatable even if the diameter thereof is larger than the diameter of the rotating roller 3a, by groove portions 6f of the guide rods 6, 6 to be described later and the arc-shaped notch portions 19a, 19a formed in the frame-front side wall 19 of the partition frame portion 9. As shown in FIG. 5A, a space between the shield-rotating plates 112, 112 and the notch portions 19a, 19a of the frame-front side wall 19 is set so that the shield-rotating plates 112, 112 are rotatable and the tablets W not supported in the spiral grooves 5a cannot be passed.

[0067] Therefore, only the tablets W which are supported in the spiral grooves 5a are delivered by the rotation of the spiral groove rod 5 through the outside of the shield-rotating plate 112, 112, from the guide route GR at the position where the spiral groove rod 5 and the lateral guide blocks 12a, 12a are opposed to each other, to the transport route Sr at the position where the spiral groove rod 5 and the guide rods 6, 6 are opposed to each other. The tablets W, which come into contact with the shield-rotating plates 112, 112 by being transported overlapped in the guide route GR, are changed the postures thereof by being temporarily moved along the rotation direction by the rotation of the shield-rotating plates 112, 112. In particular, when the tablet W has a laterally long shape such as a rugby ball type and a capsule type having a large ratio of horizontal to vertical, a state in which the tablet W enters between the tablets W supported in the spiral grooves 5a can be eliminated. Then, the tablet W is temporarily stored in the range of the partition frame portion 9 while the posture thereof is being changed by the rotating rollers 3a, 3a and the shield-rotating plates 112, 112, and waits for a vacant spiral groove 5a. The tablet W waiting in the range of the partition frame portion 9 is changed the posture thereof by the rotation of the rotating rollers 3a, 3a and the shield-rotating plates 112, 112, and thus the tablet W is in a state of being aligned in the guide route GR, and becomes easy to enter the vacant spiral groove 5a.

[0068] As shown in FIGS. 4, 5A, and 5B, the regulating unit 13 is for regulating a route width from the supply port 2d, forming the guide route GR, aligning the tablets W which fall by their own weight from the supply port 2d of the hopper 2, and guiding the tablets W to the spiral grooves 5a of the spiral groove rod 5. The regulating unit 13 includes the central guide portion 11 which is disposed below the partition frame portion 9 and the supply port 2d and is disposed just above the base end side of the spiral groove rod 5, and the lateral guide portions 12 which are disposed in parallel with and on the left and right of the spiral groove rod 5. Note that the rotating rollers 3a, 3a are disposed facing each other on the left and the right of the central guide block 11a, and thus also play a role of the regulating unit 13. The central guide portion 11 is for distributing the tablets falling by their own weight to the left and the right. The central guide portion 11 includes the central

guide block **11a** and a central block support portion **11b** which supports the central guide block **11a**. The central guide block **11a** is, for example, an elongated block body which has an upper portion thereof formed in a convex curved surface, a lower portion thereof formed in a concave curved surface, and side surfaces formed flat between the upper portion and the lower portion.

[0069] The central guide block **11a** is provided so that the lower portion of a concave curved surface is opposed to the spiral groove rod **5**, and the flat side surfaces are opposed to the rotating rollers **3a, 3a**. Further, the lower portion of the central guide block **11a** is disposed to be in a state of being closer to the spiral groove rod **5** than the thickness of the tablet **W**. The central guide block **11a** is provided such that the base end side in the longitudinal direction thereof is supported by the central block support portion **11b**. The central block support portion **11b** supporting the central guide block **11a** is attached to the outside of the base end rotation support holder **31B**. Since the central guide block **11a** is close to the spiral guide rod **5**, the central guide portion **11** does not allow the tablets **W** to enter between the central guide block **11a** and the spiral guide rod **5** in the guide route **GR**, and prevents the tablets **W** from being bridged to each other.

[0070] As shown in FIGS. **4, 5A, and 5B**, the lateral guide portions **12** are for guiding and delivering the tablets **W**, which are aligned by the guide route **GR** between the central guide block **11a** and the rotating rollers **3a**, to the spiral grooves **5a** of the spiral groove rod **5**. The lateral guide portions **12** includes the lateral guide blocks **12a, 12a**, which are disposed below the partition frame portion **9** and the supply port **2d** and are disposed in parallel with and on the left and right of the spiral groove rod **5**, and lateral guide support portions **12d, 12d**, which respectively support the lateral guide blocks **12a, 12a** individually. Note that the lateral guide blocks **12a, 12a** on the left and the right are disposed symmetrically and are the same structure.

[0071] The lateral guide block **12a** is disposed at a position of being opposed just below the rotating roller (posture changing unit) **3a** and being opposed to the base end side of the spiral groove rod **5**. As shown in FIGS. **5A, 5B**, the lateral guide block **12a** is a block body including a block side surface **12b** which has a flat side opposed to the spiral groove rod **5**, and a space guide protrusion **12c** which is extended to the rotating roller **3a** side from the upper end of the block side surface **12b**. The lateral guide block **12a** is supported by the lateral guide support portion **12d** (see FIG. **4**), and is provided such that the block side surface **12b** is at a position of equivalent to an outermost periphery (outer diameter) of the guide rod **6** (see FIGS. **5A, 5B**). Note that the space guide protrusion **12c** is formed to be in a same plane with the block side surface **12b**. The lateral guide block **12a** is disposed such that an inside surface of the space guide protrusion **12c** is opposed to a rotating surface of the rotating roller **3a**.

[0072] As shown in FIGS. **5A, 5B**, the space guide protrusion **12c** has a flat surface for forming the guide route **GR**, the flat surface being set at the same position as an outermost periphery of the rotating roller **3a** or inside of the outermost periphery (the side away from the spiral guide rod **5** or the central guide block **11a**). As shown in FIG. **4**, tip end surfaces in the longitudinal direction (transport end sides) of the lateral guide blocks **12a, 12a** include a connection structure (not shown) detachably connected to base end sides of the guide rods **6, 6**. As shown in FIG. **5A**, the lateral guide block **12a** is disposed to form the guide route **GR** at a position where the

space guide protrusion **12c** and the central guide block **11a** are opposed to each other, and to form a guide space (guide route) **GS** at a position where the block side surface **12b** and the spiral groove rod **5** are opposed to each other. The lateral guide block **12a** is supported by the lateral guide support portion **12d** attached to the holder base **32B1**.

[0073] As shown in FIG. **5A**, the guide route **GR** (including the guide space **GS**) aligns the tablets **W** and delivers them to the spiral grooves **5a**. Here, the guide route **GR** is formed by a space between the central guide block **11a** and the opposing rotating rollers **3a, 3a**, a space between the central guide block **11a** and the opposing space guide protrusions **12c, 12c**, and a space between the spiral groove rod **5** and the opposing block side surfaces **12b, 12b**. Further, the guide route **GR** is configured to continue to the guide space **GS** from the space between the central guide block **11a** and the rotating rollers **3a, 3a**. Furthermore, the guide route **GR** is set to have a width less than twice the thickness **Wd** of the tablet **W** on the upper side thereof (here, the width is set to be 1.1 to 1.7 times the thickness **Wd**, preferably in a range of 1.2 to 1.4 times the thickness **Wd**), and formed to have an interval that can support the tablet **W** with the block side surface **12b** and the spiral groove **5a** of the spiral groove rod **5** on the lower side thereof.

[0074] Further, the guide space **GS** is set to be narrower than the interval of the guide route **GR**. At the position of the guide space **GS**, the tablets **W** are aligned in a row along the spiral groove rod between the spiral groove rod **5** and the block side surface **12b**. Further, on the tablets **W** aligned in a row in the guide space **GS**, other tablets **W** are overlapped in a state of being aligned along the guide route **GR**. Then, since the spiral groove rod **5** rotates, the tablets **W** are sent to the transport route **Sr** in which the spiral groove rod **5** and the guide rod **6** are opposed to each other, from the position of the guide space **GS** in which the spiral groove rod **5** and the block side surface **12b** are opposed to each other. At this time, the tablets **W** overlapping between the spiral grooves **5a, 5a** of the spiral groove rod **5** are sent by the rotation of the spiral groove rod **5** and enter the vacant spiral grooves **5a** to be supported therein, or are sent as they are, to come into contact with the frame-front side wall **19** or the shield-rotating plates **112, 112**, and forced to temporarily wait in the range of the partition frame portion **9**. On the other hand, the tablets **W** sent to the transport route **Sr** are sent to the transport end while being supported in a support space region **Ts** (see FIG. **3C**) formed of the guide rods **6, 6** and the spiral groove rod **5** as the transport mechanism **5**.

[0075] As shown in FIGS. **1A to 3C**, the transport mechanism **4** is for receiving the tablets **W** via the delivery mechanism **30** from the hopper **2**, and transporting the tablets **W** to the counting unit **14**. The transport mechanism **4** mainly includes the spiral groove rod **5**, the guide rods **6, 6** disposed in parallel with the spiral groove rod **5**, a transport drive unit **5G** for rotating the spiral groove rod **5**, the first support holder **31** for rotatably supporting the spiral groove rod **5**, and the second support holders **32, 32** for supporting the guide rods **6, 6**.

[0076] As shown in FIGS. **1A to 3C**, the spiral groove rod **5** is for transporting the tablets **W** in cooperation with the guide rod **6**. The spiral groove rod **5** is rotatably supported by the tip end rotation support holder **31A** and the base end rotation support holder **31B** as the first support holders **31** which are provided on one end side (tip end side) and the other end side (base end side) on the base **100**. The spiral groove rod **5** includes a groove rod portion **5A** formed with the spiral

grooves **5a** at an interval of aligning the tablets **W** on a circumferential surface thereof, a thin shaft portion **5b** formed continuously to one end side of the groove rod portion **5A**, and a connecting portion **5c** formed continuously to the other end side as the base end side of the groove rod portion **5A**. Both ends of the thin shaft portion **5b** and the connecting portion **5c** of the spiral groove rod **5** are configured so as to be respectively rotatably connected via connection-rotating portions **5d**, **5d** to the tip end rotation support holder **31A** and the base end rotation support holder **31B**. By connecting the connecting portion **5c** as the base end side to the connection-rotating portion **5d**, the spiral groove rod **5** is configured such that a rotational force of a transport drive motor **5f** is transmitted via a shaft connecting portion **5e** connected to the connection-rotating portion **5d**.

[0077] As shown in FIGS. 1A to 3A, the thin shaft portion **5b** is formed to have a small diameter such that the tablets **W** transported on the transport route **Sr** can fall through between the thin shaft portion **5b** and a guide-thin shaft portion **6b** of the guide rod **6** to be described later at a position beyond an end of the spiral groove rod **5**. The connecting portion **5c** includes a protrusion (not shown) which can be detachably connected to the connection-rotating portion **5d** formed with a keyway or the like (not shown). The connecting portion **5c** and the connection-rotating portion **5d** are not limited thereto, as long as they can be detachably connected to each other and integrally rotated. The connection-rotating portion **5d**, **5d** are rotatably supported by a bearing or the like respectively in the tip end rotation support holder **31A** and the base end rotation support holder **31B**.

[0078] Note that, at least one of the connecting portion **5c** and the connection-rotating portion **5d**, or at least one of a tip end of the thin shaft portion **5b** and the connection-rotating portion **5d**, is configured to be detachable by a connection structure such as a keyway, and urged to one side or in the center by an elastic member such as a helical spring. Therefore, by disconnecting the connection structure of the keyway or the like and pressing the spiral groove rod **5** against an urging force of the elastic member, the spiral groove rod **5** can be removed from the connection-rotating portion **5d**.

[0079] The transport drive unit **5G** for rotating the spiral groove rod **5** includes the transport drive motor **5f** such as a servomotor, and the shaft connecting portion **5e** connected to a rotating shaft of the transport drive motor **5f**, and is supported by the base end rotation support holder **31B** of the first support holder **31** via a rotating shaft connected to the shaft connecting portion **5e**. Further, the rotating shaft connected to the shaft connecting portion **5e** is connected to the connection-rotating portion **5d** to transmit a driving force from the transport drive motor **5f**, and rotates the spiral groove rod **5** at a predetermined speed by the transport drive motor **5f**. The transport drive motor **5f** is not limited thereto, as long as it can rotate the spiral groove rod **5** via the shaft connecting portion **5e** and the connection-rotating portion **5d**.

[0080] As shown in FIGS. 1A to 1C, the spiral grooves **5a** are formed with a same groove pitch on a rod peripheral surface of the groove rod portion **5A**, and are formed in a shape, a size, and a depth, of a groove so as to correspond to a shape and a size of the tablet **W**. Note that a groove forming angle with respect to the axial direction of the spiral groove **5a** is formed at an angle corresponding to the type of the tablet **W**. As an example, the spiral groove **5a** is formed such that a groove width thereof is equal to or larger than the diameter (length) of the tablet **W**, and formed to have an interval in

which the tablet **W** does not contact with a tablet **W** located adjacent to each other. Further, the spiral groove **5a** is formed to be in a curved shape (an arc, an ellipse, a parabolic curved surface, or the like) so that it can arrange the tablet **W** in a position in the groove. Here, note that the spiral groove **5a** is formed to be in an arc shape. By forming the spiral groove **5a** in the arc shape, the tablet **W** to be transported is proactively rotated and facilitated to be transported, and thereby the transport speed can be increased. Note that, when the tablet **W** has an elongated shape like a capsule, the tablet **W** is supported by the support space region **Ts** (see FIG. 3C) which is a region between the spiral groove **5a** and the guide rod **6**, such that the axial direction of the tablet **W** is directed to the transport direction, and the tablet **W** is transported while rotating around the axis thereof.

[0081] Further, when the spiral groove **5a** is changed in accordance with the type of the tablet **W** to be handled, the groove pitch, groove shape, and groove depth of the spiral groove **5a** are changed by changing the spiral groove rod **5**. Then, the interval adjustment of a space between the spiral groove **5a** and the guide rod **6** (and the lateral guide block **12a**) is performed by the holder moving mechanism **40**. Note that the spiral grooves **5a** are formed with the same groove pitch, but the groove pitch may be configured to be gradually enlarged.

[0082] As shown in FIGS. 2 to 3C, the guide rod **6** is for guiding the tablet **W** when transporting the tablet **W** in cooperation with the spiral groove rod **5**. The guide rod **6** is formed at the position corresponding to a section of the groove rod portion **5A** of the spiral groove rod **5**, and includes a guide portion **6a** which is formed in a columnar shape and guides the transport of the tablet **W**, the guide-thin shaft portion **6b** which is formed continuously to a tip end as a transport end side of the guide portion **6a**, and a guide-base end portion **6c** which is a base end side connected to the lateral guide block **12a**. Further, the guide rod **6** is in a state of being supported by the second support holder **32**. Specifically, a tip end side of the guide-thin shaft portion **6b** of the guide rod **6** is supported by the tip end support holder **32A** of the second support holder **32**, and the guide-base end portion **6c** as the base end side of the guide rod **6** is supported by the base end support holder **32B** via the lateral guide block **12a** in a state of forming the groove portion **6f**. Note that the guide rod **6** is supported in a state of not rotating. Further, as shown in FIGS. 3B and 5B, the guide rod **6** is configured such that the guide-base end portion **6c** is connected via the groove portion **6f** when it is connected to the lateral guide block **12a**. The groove portion **6f** is formed with a groove depth and groove width in which the shield-rotating plate **112** can rotate.

[0083] A surface of the guide portion **6a** is preferably formed in a state of being polished such that the friction with the tablet **W** to be transported is small. Further, the guide portion **6a** may be formed such that the friction with the tablet **W** is small by covering the surface thereof with a coating film such as fluorine. Although a resin rod is used here as the guide rod **6**, however, a metal rod may be used. The guide-thin shaft portion **6b** is formed at a position corresponding to the thin shaft portion **5b** of the spiral groove rod **5**, and is formed to have a diameter so that the tablet **W** that has been transported can fall through between the thin shaft portion **5b** and the guide-thin shaft portion **6b**.

[0084] Here, the outer diameter of the spiral groove rod **5** and the diameter of the guide rod **6** are formed in the same size, and the diameter of the thin shaft portion **5b** of the spiral

groove rod 5 and the diameter of the guide-thin shaft portion 6b of the guide rod 6 are also formed in the same size. Further, the spiral groove rod 5 and the guide rod 6 are arranged to be in the same position in the height direction, and the interval therebetween is set such that the tablet W located in the spiral groove 5a of the spiral groove rod 5 does not fall through the interval. A space region between the spiral groove rod 5 and the guide rod 6 when the interval therebetween is set as described above is referred to as the support space region Ts. In other words, the support space region Ts is set to the interval in which the tablet W can be supported between the spiral groove 5a of the spiral groove rod 5 and the guide portion 6a of the guide rod 6. Further, the support space region Ts is set to the interval in which it guides the tablet W along the rotating spiral groove 5a of the spiral groove rod 5 and can transport the tablet W along the transport route Sr to the transport end while the tablet W itself is rotating.

[0085] As shown in FIGS. 1A to 3A, the first support holder 31 is provided on the base 100, and rotatably supports the spiral groove rod 5. The first support holder 31 includes the tip end rotation support holder 31A for rotatably supporting an end portion of the thin shaft portion 5b of the spiral groove rod 5, and the base end rotation support holder 31B for rotatably supporting the connection-rotating portion 5d connected to the connecting portion 5c of the spiral groove rod 5. Further, the second support holder 32 is for rotatably supporting the rotating roller 3a of the delivery mechanism 30, and for supporting the guide rod 6 via the lateral guide block 12a. The second support holder 32 includes the tip end support holder 32A for supporting an end portion of the guide-thin shaft portion 6b of the guide rod 6, and the base end support holder 32B for rotatably supporting the rotating roller 3a and supporting the lateral guide block 12a. Note that, the base end support holder 32B of the second support holder 32 are, as already described, configured to also support the rotating roller 3a.

[0086] Further, the first support holder 31 is provided at a position adjacent to the second support holder 32. Then, at the positions adjacent to the left and right of the tip end rotation support holder 31A of the first support holder 31, the tip end support holders 32A, 32A of the second support holder 32 are provided, and at the positions adjacent to the left and right of the base end rotation support holder 31B of the first support holder 31, the base end support holders 32B, 32B of the second support holder 32 are provided. Note that, on the base 100, the first support holder 31 and the second support holder 32 are provided on the holder guide plate 102 mounted on the mounting frame 101.

[0087] As shown in FIGS. 2 and 6, the tip end rotation support holder 31A rotatably supports a shaft portion of the rotating shaft 47 formed with the threaded portions 47a, 47b on the both ends thereof, via a bearing at the lower portion side of the holder. Further, as shown in FIG. 6, the base end rotation support holder 31B rotatably supports the shaft portion of the rotating shaft 47 formed with the threaded portions 47a, 47b on the both ends thereof. The threaded portions 47a, 47b are respectively supported via bearings by the holder bases 32B1, 32B1 (see FIG. 4) which are the lower portion side of the holder. Then, the tip end rotation support holder 31A and the base end rotation support holder 31B respectively include a space in which the driven gear 46 attached to the shaft portion of the rotating shaft 47 is provided.

[0088] Further, the rotating shaft guides 48, 49 (see FIG. 2) in parallel with the rotating shaft 47 are provided through the

tip end rotation support holder 31A and the tip end support holders 32A, 32A, and the tip end support holders 32A, 32A are configured to be slidable. In the same manner, the rotating shaft guides 48, 49 (see FIG. 4) in parallel with the rotating shaft 47 are provided through the base end rotation support holder 31B and the base end support holders 32B, 32B, and the base end support holders 32B, 32B are configured to be slidable. As shown in FIG. 4, the base end support holders 32B, 32B have the holder bases 31B1, 31B1 which are provided with stepped portions from the upper portion thereof for supporting the rotating rollers 3a, 3a and are formed larger than the upper portion thereof. The rotating shaft 47 and the rotating shaft guides 48, 49 are provided through the holder base 32B1, and the holder base 32B1 is formed in a size allowing the lateral guide support portion 12d to be attached to the outside thereof.

[0089] Here, the tip end support holder 32A and the base end support holder 32B of the second support holder 32 are, at the lower ends thereof, respectively provided with engaging portions 32c so as to be movable along a guide groove 102a provided in the holder guide plate 102. Therefore, the tip end support holder 32A and the base end support holder 32B are guided by the guide groove 102 and the rotating shaft guides 48, 49, and slide (move) along the holder guide plate 102. Further, the base end rotation support holder 31B (see FIG. 3A) of the first support holder 31 is configured to support the spiral groove rod 5 and also support the central guide block 11a. Furthermore, the base end support holder 32B (see FIG. 4) of the second support holder 32 is configured to support the lateral guide block 12a and also support the rotating roller 3a.

[0090] Since the transport mechanism 4 includes the configuration as described above, it is possible to input the tablets W from the hopper 2 into where the transport mechanism 4 is ready for transport by rotating the spiral groove rod 5 by the transport drive unit 5G, and deliver the tablet W via the delivery mechanism 30 (from the guide route GR) to the support space region Ts in the transport route Sr, and then transport the tablet W to the transport end. Then, as shown in FIGS. 3A to 5B, the transport mechanism 4 alternately sends out the tablets W aligned on the spiral groove rod 5 and the guide rods 6, 6 from the transport end to the counting path 15, and allows the tablets W to fall to the counting path 15 so as to pass the counting unit 14 (see FIG. 1A). Note that, as shown in FIG. 3A, the transport mechanism 4 is arranged such that a portion of the spiral groove rod 5 formed with the spiral groove 5a is more protruded than a guide surface of the guide rod 6 at the transport end, and is thus set to reliably send out the tablets W to the counting path 15.

[0091] As shown in FIG. 7, the counting unit 14 is for counting the tablets W which are transported and sent out. The counting unit 14 is set for each spiral groove rod 5, and uses an optical sensor capable of counting the tablets W by determining a state in which light is blocked by the tablet W falling. As the optical sensor, a common sensor used for counting the tablets W is used. Note that, in a case of using the optical sensor, in a light emitting unit and a light receiving unit, two or more air chambers are configured to be arranged such that the volume of the air chamber is gradually reduced from a position where the tablet W falls, to a position of the light emitting unit and light receiving unit (for more information, refer to Japanese Patent No. 3041343). Therefore, even in a state where tablet powders generated from the tablets W in accordance with falling of the tablets W are falling, the

tablet powders hardly adhere to a light receiving surface or the like, and accuracy of counting is not reduced.

[0092] Further, when detecting the tablets W, the counting unit 14 sets a first reference for counting the tablet W on the basis of an amount of light blocked in a light path, and counts the tablet W if the amount of light blocked reaches the reference. Here, the counting unit 14 sets two or more comparison values of the amount of light blocked or time of light blocked, so that the comparison value can be reduced stepwise from the above-mentioned reference when the light receiving unit receives the light.

[0093] Therefore, if the amount of light blocked or time of light blocked reaches the first reference, the tablet W passing through the counting unit 14 is counted as a tablet W, and if the amount of light blocked or time of light blocked reaches the second reference, the tablet W passing through the counting unit 14 is not counted as a tablet W. Note that, as shown in FIG. 1A or FIG. 7, the counting and filling apparatus 1 can determine whether or not the tablet W has a defect by processing the image from the image capturing unit 22 provided in the transport route. If the counting and filling apparatus 1 determined that the tablet W has the defect by the image from the image capturing unit 22, it controls the rotational speed of the transport drive motor 5f to be slow, and is set to reliably eliminate only the tablet W with the defect by use of a path switching flap 16.

[0094] As shown in FIGS. 1A, 3A, and 7, the counting path 15 is a path for storing the tablets W in the container V. The counting path 15 is configured to be cylindrical so that the tablet W having passed through the counting unit 14 can be stored in the container V which is disposed at the lower end. Further, the counting path 15 is provided in a tapered shape so that the path is gradually narrower toward the lower from the upper in this case. The path switching flap 16 is for distributing the falling tablets W to a non-defective product path 17 or a defective product discharge path 18 of the counting path 15. The path switching flap 16 is configured to switch the paths under the control of the control unit 20 (see FIGS. 1A, 7).

[0095] The container V is disposed below the counting path 15, and is for storing a predetermined number of tablets W. The shape, size, material, color, and the like of the container V are not particularly limited. Note that, a mounting base on which the container V is mounted may be configured such that an operator replaces the container V manually, or may be, as shown in FIG. 1A, configured such that the transport conveyor 50 is provided, and moved when a predetermined quantity (a filling quantity: a quantity to be stored in the container) is filled into the container. Note that, the transport conveyor 50 may be disposed such that the transport direction thereof is a direction perpendicular to the longitudinal direction (transport direction) of the transport mechanism 4 so as to be across the counting path 15 of each transport mechanism 4, or may be configured to be provided with the same number as the number of the transport mechanism 4, and such that each conveyor 50 is provided along the transport direction of the transport mechanism 4.

[0096] As shown in FIGS. 1A and 7, the control unit 20 is for mainly controlling the transporting mechanism 4, and is realized by a function of a computer with a CPU that performs calculation, comparison, determination, and the like on the basis of information (data) from an input means (a touch panel 21 as a display unit) or the like. The control unit 20

includes an input unit 20a, a memory unit 20b, a reset unit 20c, an image processing unit 20d, a comparison unit 20e, and a drive control unit 20f.

[0097] As shown in FIG. 7, the input unit 20a is an interface for inputting the data or instruction from the touch panel 21 or the like. For example, the input unit 20a inputs, from the touch panel 21, the filling quantity of the tablet W to be filled into the container V, a reference quantity, a reset signal, or an instruction for moving the second support holder 32. Here, the reference quantity is a value less than the filling quantity which is arbitrarily determined in advance by the operator, and is, for example, a quantity of 90 to 95 tablets when the filling quantity is 100 tablets, and it may be a value having a predetermined difference from the filling value so that the counting unit 14 can reliably count the tablets W when the number of tablets W filled into the container V reaches the filling quantity. By the value of the reference quantity, the speed of the tablets W transported by the transport mechanism 4 can be adjusted.

[0098] The filling quantity and reference quantity inputted from the input unit 20a are outputted to the memory unit 20b. Note that, the reset signal to be described later, which is inputted to the input unit 20a, is outputted to the reset unit 20c. Further, the instruction for moving the second support holder 32, which is inputted to the input unit 20a, is outputted to the drive control unit 20f. The memory unit 20b is a common memory unit such as a hard disk, an optical disk, a memory. The memory unit 20b stores the filling quantity, the reference quantity, and the like, which are inputted from the input unit 20a.

[0099] The reset unit 20c receives the reset signal from the input unit 20a or a container sensor Vs, and sends a reset control signal to the comparison unit 20e, then resets the quantity counted by the counting unit 14 in the comparison unit 20e. When the reset unit 20c receives the reset signal indicating that the container V is replaced from the container sensor Vs, or receives the reset signal which is inputted via the input unit 20a by the operator, the reset unit 20c outputs the reset control signal for resetting the comparison unit 20e. In other words, when the reset control signal is outputted to the comparison unit 20e from the reset unit 20c, the comparison unit 20e resets the quantity of the counted tablets from the counting unit 14.

[0100] The image processing unit 20d is for processing the image inputted from the image capturing unit 22, and for example, extracts sampling image data sampled from captured images, or calculates brightness value data from the image, and sends the extracted sampling image data or the calculated brightness value data to the comparison unit 20e. The image processing unit 20d is not limited thereto, as long as it is configured to process the images by a well-known image processing means and compare the images with the reference data or reference values.

[0101] The comparison unit 20e receives the reset control signal from the reset unit 20c, or data from the counting unit 14, data from the image processing unit 20d, and compares the received data with each reference data stored in the memory unit 20b, and then controls the drive control unit 20f and resets numeric values of the counting unit 14. When the comparison unit 20e compares the predetermined filling quantity with the quantity of the tablets W currently counted by the counting unit 14, and they are equal to each other, the comparison unit 20e outputs a first control signal to the drive control unit 20f. Further, when the comparison unit 20e com-

compares the reference quantity stored in the memory unit **20b** with the quantity of the tablets **W** currently counted by the counting unit **14**, and they are equal to each other, the comparison unit **20e** outputs a second control signal to the drive control unit **20f**. Furthermore, the comparison unit **20e** resets quantity values sent from the counting unit **14** by the reset control signal from the reset unit **20c**, and outputs a third control signal to the drive control unit **20f**.

[0102] Further, when the comparison unit **20e** receives the data from the image processing unit **20d**, and compares the data with a reference image or a reference value and determines that the tablet **W** has a defect, the comparison unit **20e** outputs a fourth control signal indicating the defect to the drive control unit **20f**. When the comparison unit **20e** determines that the tablet **W** has the defect, the comparison unit **20e** subtracts one from count data sent from the counting unit **14**, and then compares the subtracted data with the filling quantity or the reference quantity. By subtracting the number of the defective tablets **W**, the comparison unit **20e** accurately calculates the number of the tablets **W** which are currently filled into the container **V**.

[0103] The drive control unit **20f** controls the transport drive motor **5f** of the transport mechanism **4**, the roller drive motor **3c** of the rotating roller **3a**, the path switching flap **16**, and the holder driving source **41** (holder moving mechanism **40**) by the input signal or each control signal sent from the comparison unit **20e**. When the drive control unit **20f** is inputted the second control signal from the comparison unit **20e**, the drive control unit **20f** sends the control signal to the transport drive motor **5f**, and controls the rotational speed of the spiral groove rod **5** to be lower than the predetermined rotational speed. When the predetermined rotational speed is, for example, 1000 rotation/min, the rotational speed is controlled to be 100 to 500 rotation/min.

[0104] Further, when the drive control unit **20f** is inputted the first control signal from the comparison unit **20e**, the drive control unit **20f** sends the control signal to the transport drive motor **5f**, and temporarily stops the rotation of the spiral groove rod **5**. At this time, since the tablets **W** reaches the predetermined quantity, the container **V** is replaced by a new container **V**. Further, when the drive control unit **20f** receives the third control signal from the comparison unit **20e**, it outputs the control signal for controlling the transport drive motor **5f** so that the rotational speed of the spiral groove rod **5** which has been temporarily stopped becomes the predetermined rotational speed. When the drive control unit **20f** receives the fourth control signal from the comparison unit **20e**, it controls the rotational speed for the transport by the transport drive motor **5f** to be smaller than the predetermined rotational speed, and outputs the control signal so as to send the defective tablet **W** to the defective product discharge path **18** by controlling the path switching flap **16** to be switched when the identified tablet **W** falls. Note that, immediately after the defective tablet **W** is discharged, the drive control unit **20f** switches the path switching flap **16** to the non-defective product path **17** of the counting path **15**, and outputs the control signal so that the rotational speed of the transport drive motor **5f** becomes the predetermined rotational speed for the transport. Further, the drive control unit **20f** controls the holder moving mechanism **40** by use of the signal inputted from the touch panel **21** via the input unit **20a**.

[0105] With the above configuration, the control unit **20** effectively performs the filling operation of filling the tablets **W** into the container **V** by controlling the transport mecha-

nism **4**. Here, as shown in FIGS. **1A** and **7**, the touch panel **21** can be used as a monitor for displaying the touch panel as the input unit and a state of the tablet **W** captured by the image capturing unit **22**, simultaneously or by switching. Further, the image capturing unit **22** is, for example, a CCD camera, and captures the rotating tablet **W** in the image capturing range. Here, the image capturing units **22** are arranged with the same number as the transport route **Sr**, and capture the tablets **W** which are transported on the transport route **Sr** formed by the spiral groove rod **5** and the guide rods **6**, **6**.

[0106] Next, the operation of the counting and filling apparatus **1** will be described with reference to FIG. **8** mainly and the other drawings as appropriate. Note that, the drawings shown on the left side in FIGS. **8A** to **8D** schematically show only the structure on the right side of the spiral groove rod **5** by omitting the structure on the left side thereof. In other words, the drawings show only the structure corresponding to the right portion in FIG. **5A**. First, as shown in FIG. **8A**, the counting and filling apparatus **1** is inputted the tablets **W** into the hopper **2** by an input device (not shown) or the operator (input step). The tablets **W** fall by their own weight from the supply port **2d** of the hopper **2**, and are guided to the guide route **GR** formed by the central guide block **11a** and the rotating rollers **3a**, **3a** on the left and right. The tablets **W** take postures in a same direction by entering the guide route **GR**. Further, as shown by a tablet **WA**, some of the inputted tablets **W** take postures not capable of entering the guide route **GR**. However, since the rotating rollers **3a**, **3a** on the left and right rotate so as to apply the frictional force to the tablets **W** in the direction opposite to the falling direction of the tablets **W**, the tablet **WA** is changed the posture directly or indirectly via the other tablet **W**, and becomes a tablet **WB** which has a posture capable of entering the guide route **GR**.

[0107] As shown in FIG. **8B**, the tablets **W** are aligned by the guide route **GR** (see FIG. **8A**) of the delivery mechanism **30** which is formed by the rotating rollers **3a**, **3a**, the central guide block **11a**, and the lateral guide blocks **12a**, **12a** opposed to the spiral groove rod **5**. In particular, the tablets **W** are aligned in a row along the spiral groove rod **5** in the guide space **GS** (see FIG. **5A**), and aligned in a state of overlapping along the guide route **GR** in the upward direction where the tablets **W** are aligned in the row. Then, the tablets **W** are delivered to the spiral groove **5a** by being aligned or by being guided directly, and are supported by the spiral groove **5a** (delivery step). Further, in a state of being supported in the spiral groove **5a**, the tablet **W** is sent out by the rotating spiral groove rod **5** from the position where the spiral groove rod **5** and the lateral guide blocks **12a**, **12a** are opposed to each other, to the transport routes **Sr**, **Sr** (see FIG. **1A**) where the spiral groove rod **5** and the guide rods **6**, **6** are opposed to each other.

[0108] As shown in FIGS. **8B** to **8D**, when the tablets **W** are sent remaining in the overlapped state at the position of the lateral guide blocks **12a**, **12a** by the rotation of the spiral groove rod **5**, the tablets **W** which are not supported in the spiral groove **5a** come into contact with the shield-rotating plates **112**, **112**, and is allowed to temporarily wait in the range of the partition frame portion **9** or along the guide route **GR** in the range thereof. For example, a tablet shown by a tablet **WC** has a vertical posture in a state of being fitted into between the spiral groove rods **5a** when the tablet falls from the supply port **2d** (see FIG. **8A**). And, as shown in FIGS. **8B**, **8C**, the tablet **WC** is sent by the rotation of the spiral groove rod **5** and comes into contact with the shield-rotating plates

112, 112, and thus the tablet WC is temporarily moved in the rotation direction of the shield-rotating plates **112, 112**. Then, as shown in FIG. 9D, the tablet WC can have a proper posture to be supported in the spiral groove **5a** by being changed the posture thereof.

[0109] Therefore, when it is a proper posture that the longitudinal axis of the tablet W is horizontally supported in the spiral groove **5a**, even if a tablet W has a posture where the longitudinal axis thereof is in the vertical direction and is fitted into between the tablets W supported in the spiral grooves **5a**, the tablet W comes into contact with the shield-rotating plates **112, 112**, and thus the tablet W can take a proper posture by changing the posture thereof by the rotation of the shield-rotating plates **112, 112**. As described above, the shield-rotating plates **112, 112** come into contact with the tablet W sent by the rotation of the spiral groove rod **5** without being supported in the spiral groove **5a**, and moves the tablet W in the rotation direction thereof to change the posture of the tablet W, and thus the shield-rotating plates **112, 112** can temporarily store (allow to wait) the tablet W not supported in the spiral groove **5a** in the range of the partition frame portion **9** (in the range to the upper end of the partition frame portion **9** from above the spiral groove rod **5** below the partition frame portion **9**).

[0110] When the spiral groove **5a** is sent in a vacant state because of the rotation of the spiral groove rod **5**, the tablet W waiting in the range of the partition frame portion **9** is fitted and supported in the vacant spiral groove rod **5a**, and sent out to the transport route Sr through under the shield-rotating plates **112, 112** (pre-delivery step). Incidentally, the tablet W stored in the range of the partition frame portion **9** is waiting in the guide route GR at the position adjacent to the supply port **2d**. In other words, the tablet W is waiting in an aligned state or while being changed the posture thereof, in a space between the central guide block **11a** and the shield-rotating plates **112, 112**, the rotating rollers **3a, 3a**, and in a space between the spiral groove **5** and the lateral guide blocks **12a, 12a** opposed to the spiral groove **5**. Therefore, if the spiral groove **5a** is in a vacant state, the tablet W smoothly enters the vacant spiral groove **5a** and is supported in the spiral groove **5a** in the range of the partition frame portion **9**. The tablet W sent out to the transport route Sr (see FIG. 1A) from the guide route GR is transported to the transport end in a state that the tablet W is supported by the support space region Ts which is a region between the spiral groove **5a** of the spiral groove rod **5** and the guide rods **6, 6** (transport step). In the transport mechanism **4**, if the tablet W is a material to be counted having a capsule shape, the longitudinal axis thereof becomes horizontal and the tablet W is transported in the transport direction while rotating around the longitudinal axis.

[0111] Here, as shown in FIGS. 1A and 3A, the tablets W are sent out to the counting path **15** alternately from the transport routes Sr, Sr on the left and the right of the spiral groove rod **5**. In the counting and filling apparatus **1**, a tablet W in one transport route Sr is sent out toward the counting path **15** by the rotation of the spiral groove rod, and when the spiral groove rod **5** is rotated 180 degrees from the state, another tablet W in the other transport route Sr is sent out toward the counting path **15**. Therefore, the tablets W sent out to the counting path **15** by being transported by the transport mechanism **4** can pass through a position of the counting unit **14** in a state where the tablets W are hardly overlapped with each other and easily counted, when they are counted by the counting unit **14** located in a path of the counting path **15**.

[0112] As shown in FIG. 1A, the tablet W sent out to the counting path **15** is counted by the counting unit **14** and filled into the container V (filling step). A signal indicating that the tablet W has passed through the counting unit **14** is sent to the control unit **20** and counted up until the number of the passing tablets W reaches the filling quantity to be filled into the container V. Note that, in the counting and filling apparatus **1**, when the value counted by the counting unit **14**, that is subtracted by the value of the tablets W which are determined to be defective by the image processing unit **20d**, reaches the reference quantity, the second control signal is issued by the control unit **20**, and the rotational speed of the spiral groove rod **5** is allowed to be slower than the set rotational speed. Therefore, it is easy for the counting unit **14** to count the tablets W from the reference quantity to the filling quantity, and it can reliably count the tablets W. When the counted quantity reaches the filling quantity in consideration of the defective tablets W, the counted signal is sent to the control unit **20**. Consequently, in the counting and filling apparatus **1**, the signal (first control signal) for stopping the operation is sent from the control unit **20** to the transport drive motor **5f** of the transport mechanism **4**, and the transport operation of the transport mechanism **4** is temporarily stopped.

[0113] Note that, when the transport operation of the transport mechanism **4** is temporarily stopped, since almost all of the tablets W transported by the transport mechanism **4** are positioned in the spiral grooves **5a**, the tablets W are not sent out due to inertia when the transport operation is stopped. When the container V is replaced with an empty one in the state where the transport of the tablet W is stopped, a signal is sent from the container sensor Vs, and a signal is sent again from the control unit **20** to the transport drive motor **5f**, and then the transport operation of the tablet W is restarted.

[0114] Since the counting and filling apparatus **1** operates as described above, it can accurately count and fill the tablets W into the container V at a high speed. Further, when the container V is replaced, even if the transport operation in the transport mechanism **4** is stopped, the tablet W is in a state of being disposed and supported in the support space region Ts, and thus the tablet W hardly moves due to inertia in the transport direction, even if the rotation of the spiral groove rod **5** is stopped. Therefore, the counting and filling apparatus **1** performs counting of the tablets W in almost perfect condition. Further, even if there is a certain size fragment of the tablet W, since a space between the spiral groove rod **5** and the guide rods **6, 6** is large in the transport route Sr, the counting and filling apparatus **1** can prevent the fragment from falling from the transport route Sr during transport to be filled into the container V, as well as can eliminate the fragment via the path switching flap **16** by the image capturing unit **22**.

[0115] Further, in the counting and filling apparatus **1**, the rotational speed of the spiral groove rod **5** of the transport mechanism **4** is constant, for example, 1000 rotation/min, and thus the count timing of the tablets W sent from each transport route Sr is constant, however, the counting and filling apparatus **1** may be, for example, configured to fill the tablets W into one container V from a plurality of spiral groove rods **5**. As an example, the counting and filling apparatus **1** may vary a rotational speed of a spiral groove rod **5** from those of other four spiral groove rods **5**. The counting and filling apparatus **1** may, in this case, count the tablets W and fill them into one container V through all five spiral groove rods **5**.

[0116] Specifically, if the predetermined quantity is, for example, 1000 tablets, the counting and filling apparatus **1**

operates all five spiral groove rods **5** until the quantity of the tablets **W** reaches 990 tablets, and stops four spiral groove rods **5** which have been rotating at a high speed by a signal from the control unit **20** when the 990 tablets are counted by the counting unit **14**. Then, by performing the filling of 10 tablets remaining until 1000 tablets by a spiral groove rod **5** which is operating at low rotational speed, it is possible to reliably count the tablets **W** and fill them into the container **V** without miscounting the quantity. As described above, by varying the rotational speed of the spiral groove rod **5**, the counting and filling apparatus **1** has an advantage capable of performing the operation in accordance with the quantity to be filled into the container **V**. Note that, as other examples of different configurations, the counting and filling apparatus **1** may be configured to rotate all five spiral groove rods **5** at a high speed and vary all the five to a low speed when the quantity reaches the reference quantity, or may be configured in different ways.

[0117] Further, when the type of the tablet **W** is changed, the counting and filling apparatus **1** adjusts the interval between the spiral groove rod **5** and the guide rods **6, 6**, and the interval between the spiral groove rod **5** and the lateral guide block **12a, 12a**. The counting and filling apparatus **1** adjusts the intervals by the holder moving mechanism **40** via the control unit **20** by the input of the touch panel **21**. The holder moving mechanism **40** drives the holder driving source **41**, and thus rotates the coupling portion **42**, the transmission direction changing portion **43**, and the rotating shaft **44**, and rotates the driven gear **46** by the rotation of the transmission gear **45**. When the rotating shaft **47** rotates by the rotation of the driven gear **46**, in the second support holder **32**, the tip end support holder **32A** and the base end support holder **32B** move along the rotating shaft guides **48, 49** and the holder guide plate **102** (refer to arrows in FIG. 3A). Note that, in accordance with the movement of the second support holders **32, 32**, the shield-rotating plates **112, 112** also move, however, they can move in the range of the space between them and the frame-front side wall **19** (see FIG. 5A). Further, the shield-rotating plates **112, 112** can, by changing the diameter thereof, deal with a large movement of the second support holders **32, 32**.

[0118] The guide rods **6, 6** supported by the second support holder **32** via the lateral guide blocks **12a, 12a** can be adjusted the intervals between the spiral groove rod **5** and themselves by a rotation number transmitted from the holder driving source **41** of the holder moving mechanism **40**. The intervals between the spiral groove rod **5** and the guide rods **6, 6**, or the lateral guide blocks **12a, 12a** are preferably set in advance. In particular, the sizes and shapes of the tablets **W** are listed in a display screen of the touch panel **21**, and by touching a position of an objective in the list, an output rotation number of the holder driving source **41** of the holder moving mechanism **40** is set and outputted, and thus the intervals are adjusted. Note that, as shown by imaginary lines in FIG. 6, the interval adjustment may be performed by a manual means.

[0119] As described above, since the counting and filling apparatus **1** delivers the tablet **W** through the delivery mechanism **30** to the transport mechanism **4** formed of the spiral groove guide **5** and the guide rods **6, 6**, and transports the tablet **W**, the counting and filling apparatus **1** can count a number of tablets **W** at a high speed, and can accurately fill only non-defective tablets into the container. Further, since the counting and filling apparatus **1** uses the spiral groove rod **5** which is different from a transport by a conventional vibra-

tion mechanism, powders of the tablet **W** hardly occur, and a portion contacting the tablet **W** in the transport route is small, and thus cleaning or the like is facilitated. Further, since the counting and filling apparatus **1** has the delivery mechanism **30** as compared to a conventional apparatus including a spiral groove rod, the counting and filling apparatus **1** can smoothly deliver the tablets **W** to the transport mechanism **4**, and thus can perform the steps from the input step until the filling step at higher speed. Furthermore, even if the tablets **W** has an elongated capsule shape or a rugby ball shape, since the rotating rollers **3a, 3a** are provided with the shield-rotating plates **112, 112**, the counting and filling apparatus **1** can change the posture of the tablet **W** and smoothly deliver them to the transport mechanism **4**.

[0120] Note that, the counting and filling apparatus **1** may form the transport route **Sr** by using only one side guide rod **6** in the transport mechanism **4**. Further, the counting and filling apparatus **1** has a capability equivalent to the conventional apparatus by setting the rotational speed of the spiral groove rod **5** to 300 rotation/min, and the capability difference from the conventional apparatus is increased each time adding a transport route **Sr**. Further, since the counting and filling apparatus **1** can set the rotational speed of the spiral groove rod **5** to 500 to 1500 rotation/min and transport the tablets, it has the filling speed more than or equal to several times of the conventional apparatus.

[0121] The counting and filling apparatus **1** has been described as an example that the spiral groove rod **5** is rotated at a speed slower than the predetermined rotation speed when the quantity reaches the reference quantity, and the rotation of the spiral groove rod **5** is stopped when the quantity reaches the filling quantity, however, the counting and filling apparatus **1** may be operated by setting only the filling quantity without setting the reference quantity as a matter of course. Further, although the guide rods **6, 6** have been described in a fixed state, they may be configured to rotate. Note that, since the guide rods **6, 6** serve for guiding the tablet **W**, and they can only guide the tablet **W** in a state of slipping against the tablet **W**, the rotation direction does not matter if they rotate. Further, the materials of the spiral groove rod **5** and the guide rods **6, 6** may be metal, resin, or the like, and not particularly limited thereto.

[0122] As shown in FIGS. 9A, 9B, as the lateral guide portion **12** (see FIG. 4), the guide rods **6, 6** which are extended to the positions of the lateral guide blocks **12a, 12a** may be provided, and the lateral guide portion **12** may be replaced with the configuration in which guide pieces (guide portions) **120** are provided at predetermined positions of the guide rods **6, 6**. The guide pieces **120** are mounted between the posture changing units **3** and the guide rods **6, 6** disposed in parallel with the spiral groove rod **5**. The guide pieces **120** are provided by being attached to the peripheral surfaces of the guide rods **6, 6** which are connected to and supported by the base end support holders **32B, 32B** of the second support holders **32, 32**. The guide pieces **120** are provided such that spaces between themselves and the rotating rollers **3a, 3a** are smaller than the thickness **Wd** of the tablet **W**. Further, the shield-rotating plates **112, 112** are provided rotatably by groove portions **60f** formed in the peripheral surfaces of the guide rods **6, 6**, and the notch portions **19a, 19a** of the frame-front side wall **19** (see FIGS. 5A, 5B). In this case, the groove portion **60f** is formed in a concave groove shape on the circumferential surface of the guide rod **6** at a position which is a tip end of the guide piece **120**.

[0123] Note that, if the spiral groove 5a is formed inclined in an upper right direction to the transport direction (see FIGS. 1A to 3A), the spiral groove rod 5 is rotated clockwise, and if the spiral groove 5a is formed inclined in an upper left direction to the transport direction, the spiral groove rod 5 is rotated anticlockwise. That is, if the spiral groove rod 5 is rotated in a direction such that the tablet W can be transported toward the transport end from the base end side, it may be rotated in either direction in relationship with the spiral groove 5a.

[0124] Further, as shown in FIG. 10, the delivery mechanism 30 may be a delivery mechanism 30B. That is, as shown in FIG. 10, a central rotating roller 111 may be configured to be disposed in place of the central guide block 11a (see FIG. 5A). The central rotating roller 111 is alternately rotated clockwise and anticlockwise (or continuously rotated in either direction), and thus the posture of the tablet W can be changed. Further, between the central rotating roller 111 and the spiral groove rod 5, a spacer SP is provided so that the tablet W does not enter therebetween. With such a configuration, the delivery mechanism 30B has many positions to change the posture of the tablets W, thereby preventing the tablets W from being bridged to each other.

[0125] Further, if the delivery mechanism 30, 30B already described above can align the tablets W from the hopper 2 and deliver them to the base end side of the transport mechanism 4, the delivery mechanism 30, 30B may be configured to include protrusions or concave portions on the circumferential surface of the rotating roller 3a, 3a. Further, the vertical positional relationship between the rotating roller 3a and the lateral guide portion 12 has been described that they are provided to have central axes aligned in the vertical direction, however, their diameter may be changed or their placements may be changed such that the central axes thereof aligned in the vertical direction are shifted to the left or right, as long as the guide route GR can be formed. Further, the shape of the central guide block 11a of the regulating unit 13 is not limited thereto, as long as it can distribute the tablets W to the left and right, and it may be configured to lead the tablets W either to the left or right. Furthermore, in the counting and filling apparatus 1, the rotating rollers 3a, 3a, the central guide block 11a, and the lateral guide blocks 12a, 12a (guide pieces 120, 120) have been described as the same length, however, they need not to be the same length, as long as their portions opposed to each other are just below the partition frame portion 9 and the supply port 2d.

[0126] Further, as shown in FIGS. 11A, 11B, the shield-rotating plates 112, 112 may be configured to be rotatable by being disposed inside a frame-front side wall 190 (in the frame) of the partition frame portion 9. The shield-rotating plates 112, 112 can be provided rotatably by forming the notch portions 190a, 190a in the frame-left and right side walls, and providing groove portion 6f(60f) in the guide rod 6. Note that, the positional relationship between the shield-rotating plates 112, 112 and the other members are as described above. Even with such a configuration shown in FIGS. 11A, 11B, it is possible to achieve the same operation and effect as the shield-rotating plates 112, 112 configured as shown in FIGS. 5A, 5B.

[0127] Note that, even if the type of the material to be counted such as the tablet W which can be handled by the counting and filling apparatus 1 is, for example, an annular tablet W1, a disk-shaped tablet W2, or a tablet W3 of triangular rice ball shape, they can be transported while being

rotated as shown by arrows in FIGS. 12A to 12C. If the tablet W has a disk shape, it is transported by the rotation of the spiral groove rod 5 while being rotated in a posture such that the diameter direction thereof is the upper and lower, and the front and rear directions in the transport route Sr. Still further, the materials to be counted are not particularly limited thereto, as long as they are those need to be counted such as confectionery, supplements, mechanical parts, and semiconductor components in addition to the tablets. Further, the size of the spiral groove 5a may be smaller than, equal to, or larger than that of the tablet W, and the spiral groove 5a may be configured such that a curved portion of the material to be counted comes into contact with an arc shape of the spiral groove 5a, and the tablet W does not come into contact with an adjacent tablet W supported in the spiral groove 5a.

[0128] Further, as shown in FIGS. 13 to 14C, the counting and filling apparatus 1 may be configured to transport the tablet W while sucking, by a dust collecting suction mechanism Bk, an inside of a region partition portion 200 which partitions a space below the lateral guide blocks 12a, 12a, guide rods 6, 6, and the spiral groove rod 5. Note that, the region partition portion 200 is provided so as to surround almost all of a region below the guide route GR and the transport route Sr. As shown in FIGS. 13 and 14, the region partition portion 200 partitions a region to be sucked having an upper opening, and is configured by a suction partition housing 201 which is formed with a suction connection opening 202 at the bottom surface thereof and has the upper opening. The suction partition housing 201 is for housing abrasion powders, damaged pieces, or the like of the tablet W to be transported, and sending them to the suction connection opening 202. The suction partition housing 201 includes route-parallel wall surfaces 203, 204 which are in contact with or close to the guide rods 6, 6 and the lateral guide blocks 12a, 12a, route-cross wall surfaces 205, 206 which are formed continuously in a direction perpendicular to both end portions of the route-parallel wall surfaces 203, 204, and a route-bottom surface 207 which is a housing bottom surface formed with the suction connection opening 202.

[0129] The route-parallel wall surfaces 203, 204 are disposed in parallel to each other below the guide rods 6, 6 and the lateral guide blocks 12a, 12a, and the upper end thereof is provided so as to be close to the guide rod 6 and the lateral guide block 12a. The route-parallel wall surfaces 203, 204 are formed in a predetermined thickness in this case, and each of them is formed so as to face each other just below the guide rod 6 and the lateral guide block 12a. The route-cross wall surface 205 is disposed below the spiral groove rod 5 or below the spiral groove rod 5 and the guide rods 6, 6, and the upper end surface thereof is provided so as to be close to the spiral groove rod 5 or the spiral groove rod 5 and the guide rods 6, 6. The route-cross wall surface 205 is formed so as to be in a predetermined constant thickness in this case, and is formed integrally and continuously to one end portions of the route-parallel wall surfaces 203, 204.

[0130] The route-cross wall surface 206 is disposed below the spiral groove rod 5 or below the spiral groove rod 5 and the lateral guide blocks 12a, 12a, and the upper end surface thereof is provided so as to be close to the spiral groove rod 5 or the spiral groove rod 5 and the lateral guide blocks 12a, 12a. The inner peripheral side of the route-cross wall surface 206 is formed along an arc shape of the suction connection opening 202 in this case, and the route-cross wall surface 206 is formed integrally and continuously to the other end por-

tions of the route-parallel wall surfaces **203**, **204**. The route-bottom surface **207** is for sending the abrasion powders, damaged pieces, or the like of the tablet W to be transported, to the suction connection opening **202**. The route-bottom surface **207** is formed so as to be inclined toward the suction connection opening **202** in this case. Further, on the route-cross wall surface **206** side of the route-bottom surface **207**, the suction connection opening **202** is formed therethrough in a circular shape.

[0131] The dust collecting suction mechanism Bk is for sucking, collecting, and removing the abrasion powders or the like generated from the tablet W. The dust collecting suction mechanism Bk is not limited thereto, as long as it includes a dust collecting mechanism and a suction pump used when the tablet W is transported. The dust collecting suction mechanism Bk is allowed to face the suction connection opening **202** of the suction partition housing **201** by connecting a tip end of a suction hose Bp to a connecting portion formed in the base **100**.

[0132] When performing suction operation via the region partition portion **200** by the dust collecting suction mechanism Bk, the atmosphere in the region partition portion **200** is sucked, and if the abrasion powders are generated from the tablet W in accordance with the transport, the abrasion powders are received by the route-bottom surface **207** of the suction partition housing **201** of the region partition portion **200**, and moved by suction along the route-bottom surface **207**, and then collected from the suction connection opening **202** via the suction hose Bp by the dust collecting suction mechanism Bk (or collected directly from the suction connection opening **202** via the suction hose Bp) (suction step). Further, when the dust collecting suction mechanism Bk performs the suction operation, the tablet W being transported is always urged downward (to the suction direction). Therefore, in the counting and filling apparatus **1**, the tablet W is sent in a state of close contact with the spiral groove **5a** of the spiral groove rod **5** in the transport route Sr or the guide route GR, and thus the transport posture of the tablet W is stabilized. Since the transport posture of the tablet W is stabilized, if the visual inspection is performed in the transport route, the counting and filling apparatus **1** can improve the accuracy of the inspection.

[0133] The counting and filling apparatus **1** described above is not limited to the configuration described above, as long as the regulating unit **13** and the posture changing unit **3** of the delivery mechanism **30** can align the materials to be counted (tablets W) by changing the posture thereof, and deliver them to the transport mechanism **4**. Further, the configuration of the guide route GR formed by the regulating unit **13** is not limited thereto, as long as the guide route GR can align the materials to be counted and lead or guide them to the spiral groove **5a**. Furthermore, the falling of the tablets W means that the materials to be counted fall, or proceed, or move by their own weight toward the delivery mechanism **30** from the supply port **2d**, and when the materials to be counted fall, they may be either in a single state or an overlapped state. Further, the second holder **32** may be configured without providing the guide groove **102a** and the engaging portion **32c** shown in FIG. **6**. Further, the upper surface side of the partition frame portion **9** has been described as a configuration of being formed with opening in this case, it is more preferably configured to be provided with a transparent lid body (not shown). Furthermore, the base end rotation support holder **31B** of the first support holder **31** has been described to

be configured to support the spiral groove rod **5** and also support the central guide block **11a** in this case, however, separate holder portions may be provided to support them. Further, the base end support holder **32B** of the second support holder **32** has been described to be configured to support the lateral guide block **12a** and also support the rotating roller **3a**, however, separate holder portions may be provided to support them.

[0134] The guide route GR has been described to be configured to have a constant interval between a lateral plane of the central guide block **11a** and a lateral plane formed by the rotating roller **3a** and the space guide protrusion **12c**, however, the lateral plane of the central guide block **11a** may be configured to be inclined toward the outer peripheral surface of the spiral groove rod **5** (refer to the spacer SP in FIG. **10**). Further, the region partition portion **200** has been described to be formed by the suction partition housing **201** as an example, however, the route-bottom surface **207** may be the surface of the base **100**, and the route-parallel wall surfaces **203**, **204** and the route-cross wall surfaces **205**, **206** may be integral with an engaging portion (not shown) formed in the surface of the base **100** or may be detachably engaged with the engaging portion as separate bodies. Further, as shown in FIG. **13**, the structure formed with the counting path **15** may be integrally formed with the frame housing **150**, and one lateral wall surface of the frame housing **150** may be in place of the route-cross wall surface **205**. Further, since the region partition portion **200** is sucked by the dust collecting suction mechanism Bk, and thus the tablet W is urged to the direction of being supported in the spiral groove **5a**, even if the region partition portion **200** is provided so as to surround a position corresponding to a part of, or a half of, or all of the transport route Sr continued from the guide route GR, it is possible to obtain the same effect as described above compared with a state without suction.

[0135] Further, the counting and filling apparatus **1** has been described to be configured to form the shield-rotating plates **112**, **112** as the adjusting unit Sm along the frame-front side wall **19**, however, it may be configured as shown in FIG. **15**. That is, as shown in FIG. **15**, the partition frame portion **9A** forms a rectangular space which is partitioned by the front side wall **2c** of the supply port **2d** and the other three side walls. A frame-front side wall **9a** of the partition frame portion **9A** is configured to be formed with a notch **9b** on the side wall thereof, and to cover the notch **9b** with a silicone resin plate **9c** by a fixing unit (fixing bolt). In other words, the partition frame portion **9A** is configured to be provided with the silicone resin plate **9c** on the frame-front side wall **9a**, in place of the shield-rotating plates **112**, **112**. The silicone resin plate **9c** is provided at a position where the tablet W cannot pass through the silicone resin plate **9c**, if the tablet W is not supported in the spiral groove **5a**. The tablet W, which is prevented from passing through by the silicone resin plate **9c**, is temporarily held in the partition frame portion **9**. Further, the silicone resin plate **9c** also serves not to damage the tablets W by momentum of the tablets W, which are conveyed in the state of overlapping too much on the spiral groove rod **5** and come into contact with the silicone resin plate **9c**. Further, the silicone resin plate **9c** is set to be capable of adjusting the installation position thereof by the fixing bolt in accordance with the type of the tablet W. The partition frame portion **9A** including such a silicone resin plate **9c** may be the adjusting unit Sm. Note that, the frame-front side wall **9a** may be configured to be formed integrally with the frame-left and

right side walls by using the same material with the frame-left and right side walls. In other words, as long as the frame-front side wall 9a can allow the tablet W supported in the spiral groove 5a to pass therethrough, and prevent the tablet W excessively overlapped from passing therethrough, the configuration such as a size, a shape, and a material of the frame-front side wall 9a is not limited thereto.

[0136] Further, the counting and filling apparatus 1 may be configured to be provided with an inclined plate 300 shown in FIGS. 16A to 16C, in the partition frame portions 9, 9A shown in FIGS. 4, 11B, 15. Here, as an example, a configuration in which the inclined plate 300 is provided in the partition frame portions 9 in above-described FIG. 4 will be described, however, the configuration of the inclined plate 300 and the moving state of the tablets W in FIGS. 11B, 15 are the same as in FIG. 4. Further, the same components as those already described are denoted by the same reference numerals, and the descriptions thereof will be omitted. As shown in FIGS. 16A, 16B, 16C, the inclined plate 300 is provided in the partition frame portion 9 by being supported by the central guide block 11a (or the inner wall surface of the partition frame 9). The inclined plate 300 is for forcibly moving the tablets W toward the supply port 2d side. The inclined plate 300 includes a rising surface 301 which is provided at a position opposed to the frame-front side wall 9a, an inclined surface 302 which is inclined toward the supply port 2d from the rising surface 301, and an engaging mounting portion 303 which is formed at a position opposed to the central guide block 11a. The inclined plate 300 is configured as a block-shaped member as an example, and is formed so that side surfaces of the inclined plate 300 come into contact with the frame-left and right side walls of the partition frame portion 9, as shown in FIG. 16B.

[0137] As shown in FIG. 16C, the rising surface 301 is disposed at a position spaced apart from the frame-front side wall 9a by a distance which is a predetermined interval FS. Here, the rising surface 301 is disposed at a position spaced apart from the frame-front side wall 9a by more than two tablets W in the longitudinal direction (or diameter direction) thereof. The rising surface 301 is formed at a height where the tablets W, which are between the rising surface 301 and the frame-front side wall 9a, can move by their own weight via the inclined surface 302. Further, the rising surface 301 is preferably formed in a range between 30 degrees and 90 degrees (orthogonal) with respect to the horizontal line at the top of the central guide block 11a in this case.

[0138] As shown in FIGS. 16A, 16C, the inclined surface 302 is formed at an inclined angle where the tablets W, which get over the rising surface 301, are allowed to move by their own weight to the supply port 2d side of the hopper 2. The inclined surface 302 has one end which is formed continuously from the rising surface 301, and has the other end which is formed in a range between a position of the sliding side wall 2e or the front side wall 2c of the hopper 2 and a position spaced apart from the sliding side wall 2e or the front side wall 2c by a predetermined distance LS. The inclined surface 302 is, for example, preferably formed at an inclined angle between 15 degrees and 60 degrees. If the inclined angle is in a range of between 15 degrees and 30 degrees, the inclined surface 302 is suitable for the tablet W having a curved surface shape such as a disk shape, a spherical shape, a rugby ball shape as a part or all of a contour thereof. Further, if the inclined angle is in a range beyond 30 degrees up to 60 degrees, the inclined surface 302 is suitable for the tablet W of

a triangular shape having curved corners or of a shape having flat side surfaces. As a position of the other end of the inclined surface 302 is closer to the sliding side wall 2e or the front side wall 2c of the hopper 2, a moving distance of the tablet W to be returned is increased, and thus the possibility that the tablet W is housed in the spiral groove 5a is increased. The inclined surface 302 has a slope length in which the tablet W can be moved by a distance corresponding to at least three times of the tablet W in the longitudinal direction or the diameter direction thereof, and the inclined surface 302 preferably has the slope length corresponding to 4 to 10 tablets W in this case.

[0139] The engaging mounting portion 303 is for mounting the inclined plate 300 detachably in the partition frame portion 9. Here, the engaging mounting portion 303 is formed such that the bottom surface of the inclined plate 300 is spaced apart from the rotating rollers 3a, 3a, and mounted in engagement with the central guide block 11a. As an example, the engaging mounting portion 303 is formed with an engaging concave portion engaged with a circular portion of the central guide block 11a, and is formed such that facing portions 304, 304 facing the rotating rollers 3a, 3a are spaced apart from the rotating rollers 3a, 3a. As an example, since the inclined plate 300 is formed in a size such that the side surfaces thereof come into contact with the frame-left and right side walls of the partition frame portion 9, the inclined plate 300 can be stably placed by mounting the engaging mounting portion 303 so as to be engaged with the central guide block 11a.

[0140] The above-described inclined plate 300 has the following functions. That is, when the tablets W are allowed to wait in the partition frame portion 9 by the frame-front side wall 19 or the shield-rotating plates 112, 112, the inclined plate 300 accumulates the tablets W between the rising plate 301 and the frame-front side wall 19 by the rising plate 301. When the accumulated tablets W ride on the inclined surface 302 beyond the height of the rising plate 301, the tablets W move by their own weight on the inclined surface 302, and thus the inclined plate 300 move the tablets W to the supply port 2d side. By moving the tablet W to a position close to the supply port 2d by the inclined plate 300, the tablet W can be easily housed in a vacant spiral groove 5a of the guide route GR.

[0141] As described above, since the inclined plate 300 can sequentially move the tablets W, which wait at the side of the frame-front side wall 19 of the partition frame portion 9, toward the supply port 2d side by use of the inclined surface 302, by providing the inclined plate 300 in the partition frame portion 9 as an intra-frame moving mechanism of the tablet W, the possibility of reducing the waiting time of the tablet W waiting in the partition frame portion 9 is increased. Note that, the inclined plate 300 can be secured to the central guide block 11a by engaging the engaging mounting portion 303 located in the center of the lower surface thereof with the central guide block 11a, and thus the inclined plate 300 can be also placed in a state of non-contact with the frame-left and right side walls. Further, when the inclined plate 300 is in the state of non-contact with the frame-left and right side walls, the inclined plate 300 may be in a state where the tablet W cannot enter the space therebetween.

[0142] Further, by preparing the inclined plates 300 having different angles in advance and using them switchably in accordance with the shape, size, or the like of the tablet W, the inclined plates 300 can move the tablet W in the partition

frame portion 9 in accordance with the outer shape of the tablet W. Further, the inclined plate 300 has been described to be configured such that the tablets W move by their own weight, however, an unillustrated belt conveyor may be provided as the intra-frame moving mechanism in the partition frame portion 9 in the same positional relationship as the inclined plate 300, and a drive motor for the belt conveyor may be configured to be provided through either of the frame-left and right side walls of the partition frame portion 9.

REFERENCE SIGNS LIST

- | | | | |
|--------|--------------------------------------|--------|---|
| [0143] | 1: counting and filling apparatus | [0196] | 22: image capturing unit |
| [0144] | 2: hopper | [0197] | 30: delivery mechanism |
| [0145] | 2a: input port | [0198] | 31: first support holder |
| [0146] | 2b: hopper main body | [0199] | 31A: tip end rotation support holder |
| [0147] | 2c: front side wall | [0200] | 31B: base end rotation support holder |
| [0148] | 2d: supply port | [0201] | 32: second support holder |
| [0149] | 2e: sliding side wall | [0202] | 32A: tip end support holder |
| [0150] | 3: posture changing unit | [0203] | 32B: base end support holder |
| [0151] | 3a: rotating roller | [0204] | 32c: engaging portion |
| [0152] | 3b: connecting portion | [0205] | 40: holder moving mechanism |
| [0153] | 3c: roller drive motor (drive motor) | [0206] | 40A: tip end holder moving mechanism |
| [0154] | 4: transport mechanism | [0207] | 40B: base end holder moving mechanism |
| [0155] | 5: spiral groove rod | [0208] | 41: holder driving source |
| [0156] | 5A: groove rod portion | [0209] | 42: coupling portion |
| [0157] | 5G: transport drive unit | [0210] | 43: transmission direction changing portion |
| [0158] | 5a: spiral groove | [0211] | 44: rotating shaft |
| [0159] | 5b: thin shaft portion | [0212] | 45: transmission gear |
| [0160] | 5c: connecting portion | [0213] | 46: driven gear |
| [0161] | 5d: connection-rotating portion | [0214] | 47: rotating shaft |
| [0162] | 5e: shaft connecting portion | [0215] | 47a: threaded portion |
| [0163] | 5f: transport drive motor | [0216] | 47c: nut portion |
| [0164] | 6: guide rod | [0217] | 48: rotating shaft guide |
| [0165] | 6a: guide portion | [0218] | 50: transport conveyor |
| [0166] | 6b: guide-thin shaft portion | [0219] | 100: base |
| [0167] | 6c: guide-base end portion | [0220] | 100b: through hole |
| [0168] | 9: partition frame portion | [0221] | 101: mounting frame |
| [0169] | 9a: frame-front side wall | [0222] | 102: holder guide plate |
| [0170] | 9b: notch | [0223] | 102a: guide groove |
| [0171] | 9c: silicone resin plate | [0224] | 112: shield-rotating plate |
| [0172] | 11: central guide portion | [0225] | 120: guide piece (guide portion) |
| [0173] | 11a: central guide block | [0226] | 141: driving force transmission unit |
| [0174] | 11b: central block support portion | [0227] | 142: linear moving unit |
| [0175] | 12: lateral guide portion | [0228] | 300: inclined plate |
| [0176] | 12a: lateral guide block | [0229] | Sm: adjusting unit |
| [0177] | 12b: block side surface | [0230] | GR: guide route |
| [0178] | 12c: space guide protrusion | [0231] | GS: guide space |
| [0179] | 12d: lateral guide support portion | [0232] | Sr: transport route |
| [0180] | 13: regulating unit | [0233] | Ts: support space region |
| [0181] | 14: counting unit | [0234] | V: container |
| [0182] | 15: counting path | [0235] | Vs: container sensor |
| [0183] | 16: path switching flap | [0236] | W: tablet |
| [0184] | 17: non-defective product path | [0237] | W1: tablet |
| [0185] | 18: defective product discharge path | [0238] | W2: tablet |
| [0186] | 19: frame-front side wall | [0239] | W3: tablet |
| [0187] | 19a: notch portion | | |
| [0188] | 20: control unit | | |
| [0189] | 20a: input unit | | |
| [0190] | 20b: memory unit | | |
| [0191] | 20c: reset unit | | |
| [0192] | 20d: image processing unit | | |
| [0193] | 20e: comparison unit | | |
| [0194] | 20f: drive control unit | | |
| [0195] | 21: touch panel | | |

1. A counting and filling apparatus, which aligns materials to be counted in a guide route while changing postures of the materials to be counted by a delivery mechanism provided below a supply port of a hopper, and delivers the materials to a transport route of a transport mechanism which has a guide rod and a spiral groove rod continuing to the guide route, and then transports, counts, and fills the materials into a container, wherein the transport mechanism includes the spiral groove rod which is disposed from the guide route to the transport route, and a lateral guide portion which is provided facing to a base end side of the spiral groove rod and along the axis of the guide rod, and forms the guide route, and

wherein the counting and filling apparatus includes, between the supply port and the transport route, an adjusting unit which is provided so as to pass the materials supported via the lateral guide portion in the spiral grooves from the guide route to the transport route, and so as to prevent the materials excessively overlapped on

- the spiral groove rod or on the other materials from passing to the transport route and allow the materials to wait along the guide route.
- 2.** The counting and filling apparatus according to claim 1, wherein the delivery mechanism includes a rotating roller, which is provided above the lateral guide portion, the rotation axis of the rotating roller being in parallel to the longitudinal direction of the lateral guide portion, and is capable of changing the postures of the materials to be counted, and a central guide portion which is provided above the base end side of the spiral groove rod, and faces the rotating rotor so as to make a space which is the guide route to align the materials to be counted, and wherein the rotating rotor is provided to rotate via a drive motor in a direction opposite to a falling direction of the materials to be counted which fall by their own weight along the guide route.
- 3.** The counting and filling apparatus according to claim 1, wherein the adjusting unit includes a frame-front side wall which is provided on a tip end side of the rotating roller, and frame-left and right side walls which support the left and the right of the frame-front side wall and are continuous from the supply port, wherein the frame-front side wall and the frame-left and right side walls constitute a partition frame portion which is disposed so as to surround the guide route which is a space between the rotating roller and a central guide portion, wherein the materials to be counted, which are not delivered to the spiral grooves from the supply port of the hopper via the delivery mechanism, are allowed to wait in a region including the guide route in a range surrounded by the partition frame portion, and wherein the frame-front side wall is disposed at a position that allows passing of the materials to be counted which are sent while being supported in the spiral grooves, and prevents passing of the materials which are excessively overlapped on the spiral groove rod or on the other materials to be counted.
- 4.** The counting and filling apparatus according to claim 1, wherein the adjusting unit includes a shield-rotating plate which is provided to be larger than the diameter of the rotating roller at the tip end of the rotating roller, a frame-front side wall which is provided along the shield-rotating plate, and frame-left and right side walls which support the left and the right of the frame-front side wall and are continuous from the supply port, wherein the frame-front side wall, the shield-rotating plate, and the frame-left and right side walls constitute a partition frame portion which is disposed so as to surround the guide route which is a space between the rotating roller and a central guide portion, wherein the materials to be counted, which are not delivered to the spiral grooves from the supply port of the hopper via the delivery mechanism, are allowed to wait in a region including the guide route in a range surrounded by the partition frame portion, and wherein the shield-rotating plate is disposed at a position that allows passing of the materials to be counted which are sent while being supported in the spiral grooves, and prevents passing of the materials which are excessively overlapped on the spiral groove rod or on the other materials to be counted.
- 5.** The counting and filling apparatus according to claim 1, wherein the adjusting unit constitutes side walls of a partition frame portion, which is disposed so as to surround the guide route at a position adjacent to the supply port and above the delivery mechanism, by a frame-front side wall which is provided between the guide route and the transport route, a shield-rotating plate which is provided along the frame-front side wall, and frame-left and right side walls which are provided to support the frame-front side wall and are continuous from the supply port of the hopper, wherein the delivery mechanism includes, below the supply port and the partition frame portion, a regulating unit which regulates a guide route width for guiding the materials to be counted to the spiral grooves which are on the base end side of the spiral groove rod, and a posture changing unit which is disposed along the guide route, wherein the regulating unit includes, below the supply port and the partition frame portion, a central guide portion which is disposed just above the spiral groove rod, and the lateral guide portion which is provided to be opposed to a lateral side of the spiral groove rod, and guides the materials to be counted to the spiral groove rod, wherein the posture changing unit includes, above the lateral guide portion, a rotating roller which is provided to be opposed to the central guide portion across the guide route on a lateral side of the central guide portion, and a rotation drive unit which rotates the rotating roller in a direction different from a falling direction of the materials to be counted, wherein a notch portion for rotating the shield-rotating plate is formed on at least one of the frame-front side wall and the frame-left and right side walls, and wherein the shield-rotating plate is provided on a tip end side in the longitudinal direction of the rotating roller, and allows passing of the materials to be counted which are sent while being supported in the spiral grooves, while preventing passing of the materials to be counted which are excessively overlapped on the spiral groove rod or on the other materials to be counted.
- 6.** The counting and filling apparatus according to claim 1, wherein the lateral guide portion is a lateral guide block, which is disposed to face the rotating roller, and is disposed to face the base end side of the spiral groove rod, for guiding the materials to be counted to the spiral grooves of the spiral groove rod, and wherein the guide rod forms a groove portion which does not come into contact with an outer peripheral edge of the shield-rotating plate at an end portion in the longitudinal direction of the lateral guide block, and is connected to the end portion of the lateral guide block.
- 7.** The counting and filling apparatus according to claim 1, wherein the lateral guide portion is a guide portion which is provided on a circumferential surface of the guide rod, and a surface thereof facing the spiral groove rod is formed in a plane, and wherein the guide rod forms a groove portion which does not come into contact with an outer peripheral edge of the shield-rotating plate at a position corresponding to a tip end portion in the longitudinal direction of the guide portion.
- 8.** The counting and filling apparatus according to claim 6, comprising:

- a first support holder which includes, on a base, a first tip end support holder for rotatably and detachably supporting a tip end of the spiral groove rod, and a first base end support holder for rotatably and detachably supporting a base end of the spiral groove rod; and
- a second support holder which includes, at a position adjacent to the first support holder on the base, a second tip end support holder for detachably supporting the tip end of the guide rod, and a second base end support holder for rotatably supporting a base end in the longitudinal direction of the rotating roller as well as detachably supporting a base end of the lateral guide block connected to a base end of the guide rod,
- wherein the second support holder is connected to a holder moving mechanism which moves the second support holder close to or away from the first support holder along a surface of the base, and
- wherein the holder moving mechanism includes a linear moving unit for linearly moving the second support holder with respect to the first support holder along the base, a driving force transmission unit for transmitting a driving force to the linear moving unit, and a holder driving source for driving the driving force transmission unit.
- 9.** The counting and filling apparatus according to claim 7, comprising:
- a first support holder which is provided on a base so as to rotatably and detachably support both ends of the spiral groove rod; and
- a second support holder which rotatably supports a base end in the longitudinal direction of the rotating roller as well as detachably supports both ends of the guide rod, and is provided on the base at a position adjacent to the first support holder,
- wherein the second support holder is connected to a holder moving mechanism which moves the second support holder close to or away from the first support holder along a surface of the base, and
- wherein the holder moving mechanism includes a linear moving unit for linearly moving the second support holder with respect to the first support holder along the base, a driving force transmission unit for transmitting a driving force to the linear moving unit, and a holder driving source for driving the driving force transmission unit.
- 10.** The counting and filling apparatus according to claim 1, wherein an inclined plate is provided to be spaced apart from the rotating roller, above the rotating roller and the central guide portion, and to be spaced apart from the frame-front side wall at a predetermined interval,
- wherein the inclined plate includes a rising surface which is formed at a position opposed to the frame-front side wall, and an inclined surface which is inclined continuously from the rising surface, and
- wherein the inclined surface is formed in an inclination angle that allows the materials to be counted to move by their own weight toward the supply port side of the hopper.
- 11.** The counting and filling apparatus according to claim 1, comprising:
- a region dividing portion which encloses a region opposed to all or at least a part of the transport route continuing from the guide route, below the spiral groove rod, the guide rod, and the lateral guide portion; and
- a dust collecting suction mechanism which collects dust by sucking air in a range enclosed by the region dividing portion,
- wherein the region dividing portion includes route-cross wall surfaces on both end portions which are formed so as to cross a space between the spiral groove rod and the guide rod and a space between the spiral groove rod and the lateral guide portion, route-parallel wall surfaces on the left and the right which are formed along the longitudinal direction of the guide rod, and a route-bottom wall surface which is provided at a position on a bottom surface side opposed to the guide route and the transport route,
- wherein upper ends of the route-cross wall surfaces are respectively provided to a position in proximity to the guide rod and the spiral groove rod, and to a position in proximity to the spiral groove rod and the lateral guide portion,
- wherein upper ends of the route-parallel wall surfaces are provided to positions in proximity to or contact with the guide rods, and
- wherein a suction opening of the dust collecting suction mechanism is provided on the route-bottom wall surface side.
- 12.** A method for counting and filling by use of the counting and filling apparatus according to claim 1, wherein materials to be counted inputted into a hopper are aligned in a guide route while the postures of the materials to be counted are changed by a delivery mechanism, delivered to a transport route of a transport mechanism, supported, transported, and sent out by a guide rod and spiral grooves of a spiral groove rod which are the transport mechanism, and the materials to be counted are counted by a counting unit, and filled into a container,
- wherein the method for counting and filling comprises following steps:
- an input step of inputting the materials to be counted into the hopper;
- a delivery step of allowing the inputted materials to be counted to fall by their own weight from the supply port of the hopper, and to be aligned in a guide route formed by use of a regulating unit of the delivery mechanism while changing the postures of the materials to be counted by rotating a rotating roller which is a posture changing unit of the delivery mechanism so as to apply a frictional force in a direction different from the falling direction of the materials to be counted, and delivering the materials to be counted to the spiral grooves of the spiral groove rod via the lateral guide portion of the regulating unit;
- a transport step of sending the materials to be counted, which are delivered to the spiral grooves of the spiral groove rod by the delivery mechanism, to the transport route of the spiral groove rod from the guide route by the rotation of the spiral groove rod, and transporting the materials to be counted to a transport end in a state of being supported in a support space region between the spiral groove rod and the guide rod; and
- a filling step of sending out the materials to be counted which are transported to the transport end, counting the materials by the counting unit, and filling the counted materials into the container, and
- wherein in the delivery step, by the adjusting unit provided between the supply port and the transport route, a pre-

delivery step is performed together, the pre-delivery step including passing the materials to be counted, which are supported via the lateral guide portion opposed to the spiral grooves, to the transport route from the guide route, preventing passing of the materials to be counted, which are excessively overlapped on the spiral groove rod or on the other materials to be counted, allowing the materials to wait along the guide route, and delivering the material to a vacant spiral groove when there exists the vacant spiral groove of the rotating spiral groove rod.

13. The method for counting and filling according to claim **12**,

wherein in the delivery step and the transport step, a suction step of performing a suction operation by a dust collecting suction mechanism from a suction opening provided below the guide route and the transport route, is performed together.

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