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(54) **MEDICINE FEEDER**

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(57) **ABSTRACT**

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Medicine containers **4** received in a vertical row in a cassette **1** are successively fed from below. A holding means **6** for holding at least the medicine container **4** positioned in the bottom of the cassette **1** is provided. A transfer means **20** disposed below the cassette **1** and adapted to be vertically movable to downwardly transfer the bottom medicine container **4** held by the holding means **6** is provided. A driving means **20** for upwardly moving the transfer means **20**, lifting the bottom medicine container **4** held by the holding means **6**, canceling a held state established by the holding means **6**, holding a second medicine container **4** from the bottom while downwardly moving the transfer means **20** by a predetermined distance and stopping the same, and downwardly moving the transfer means **20** after the holding means **6** has held the second medicine container **4** from the bottom. This reliably prevents the medicine containers **4** from being damaged during feeding or an error in the feeding number being creeping in.

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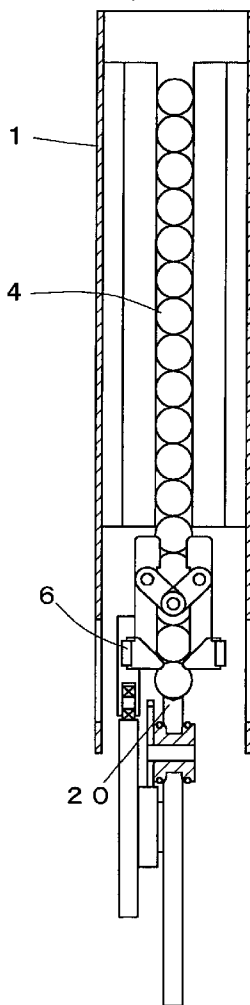


Fig. 1

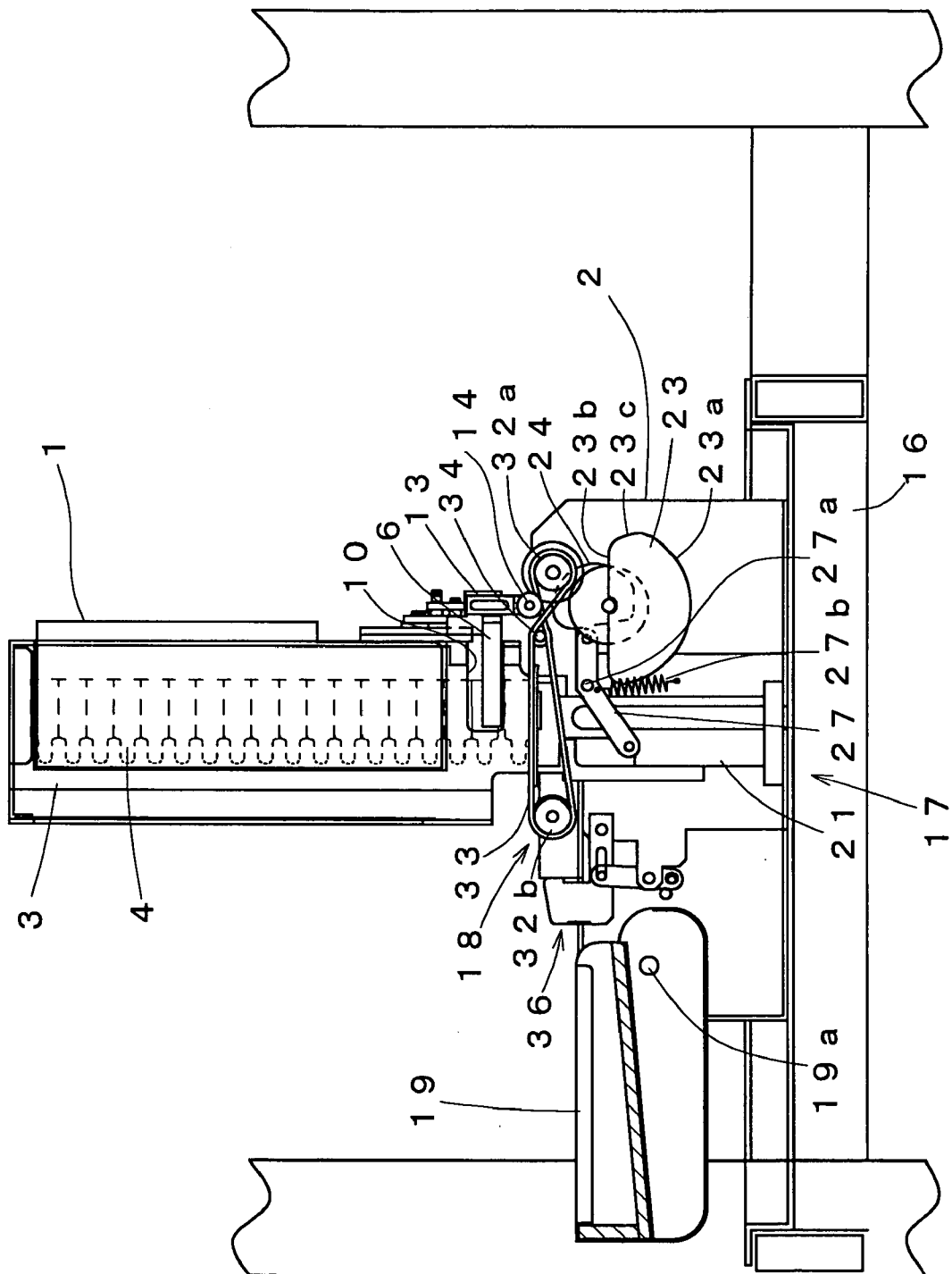


Fig. 2

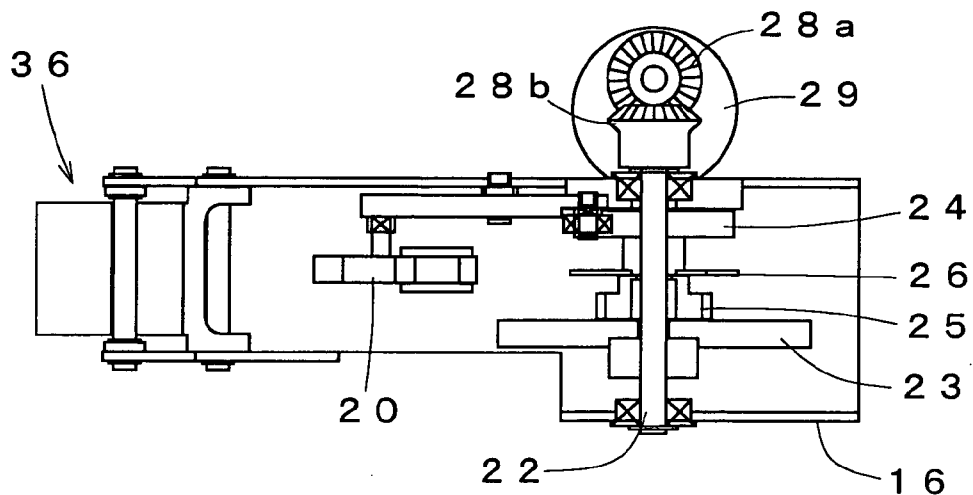


Fig. 3

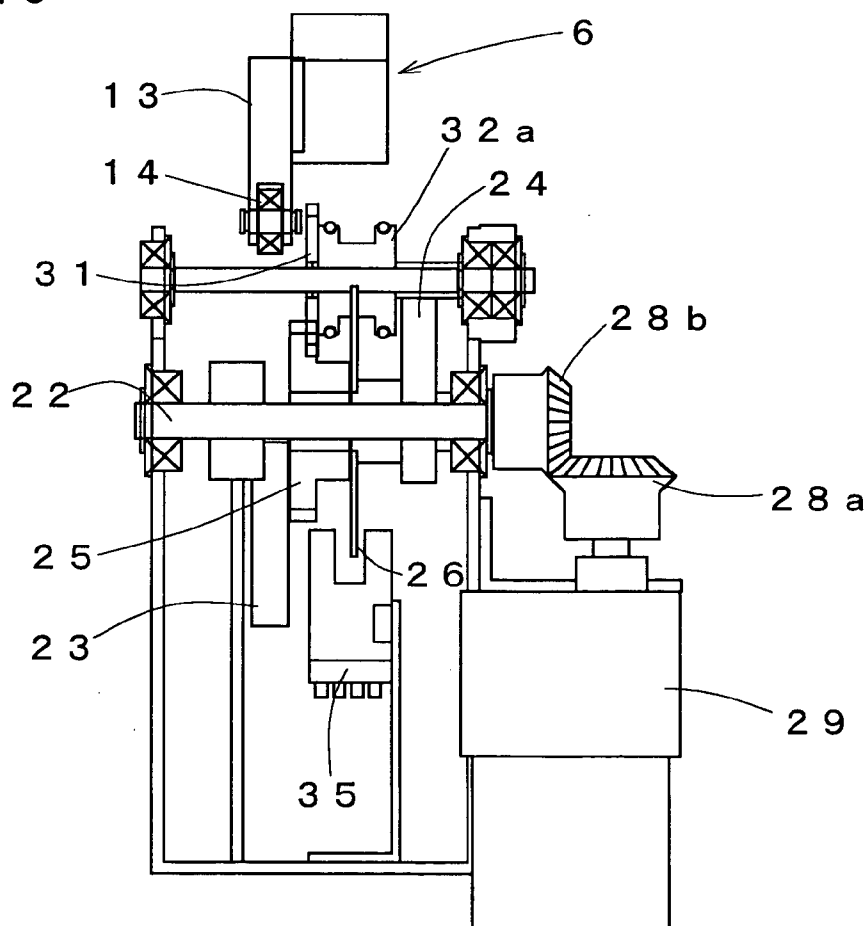


Fig. 4

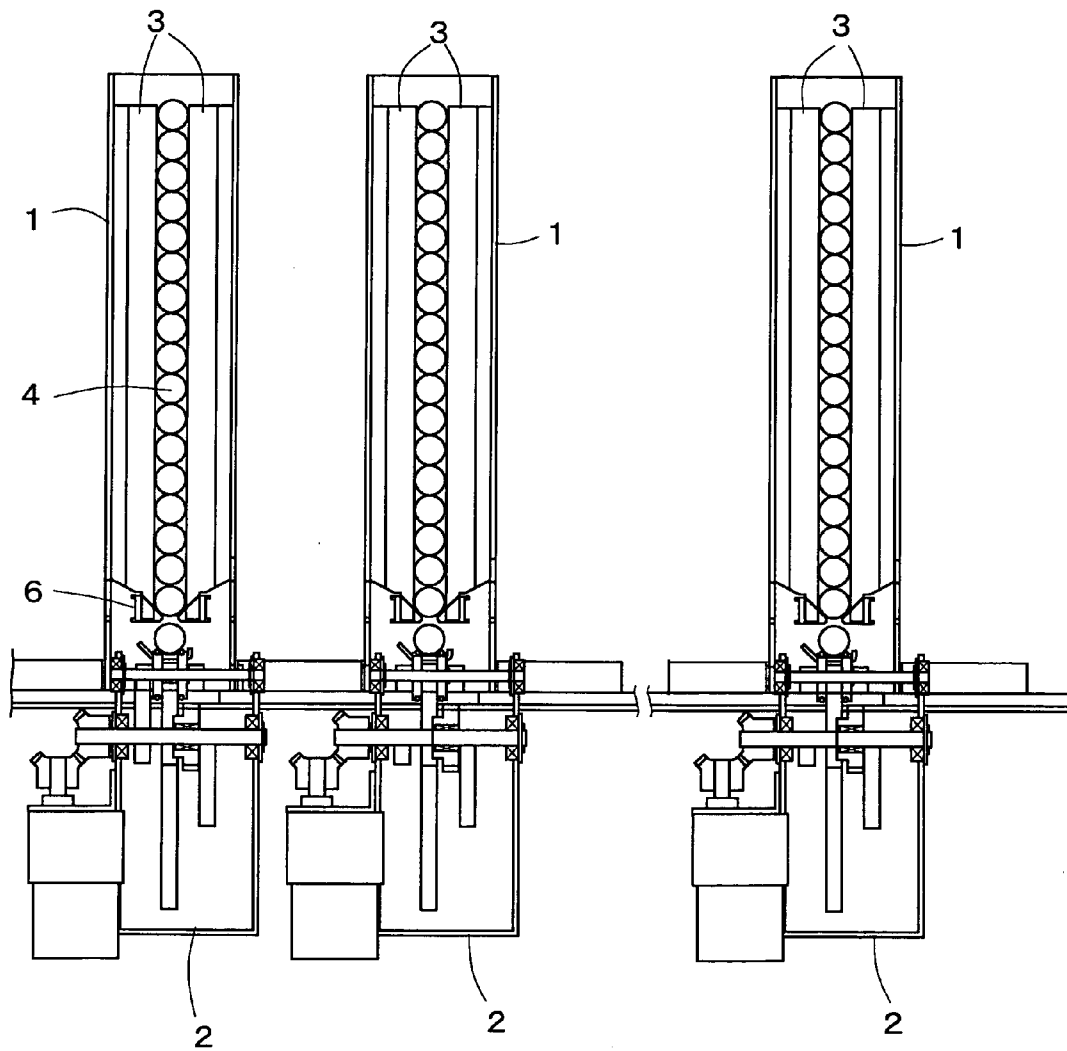


Fig. 5

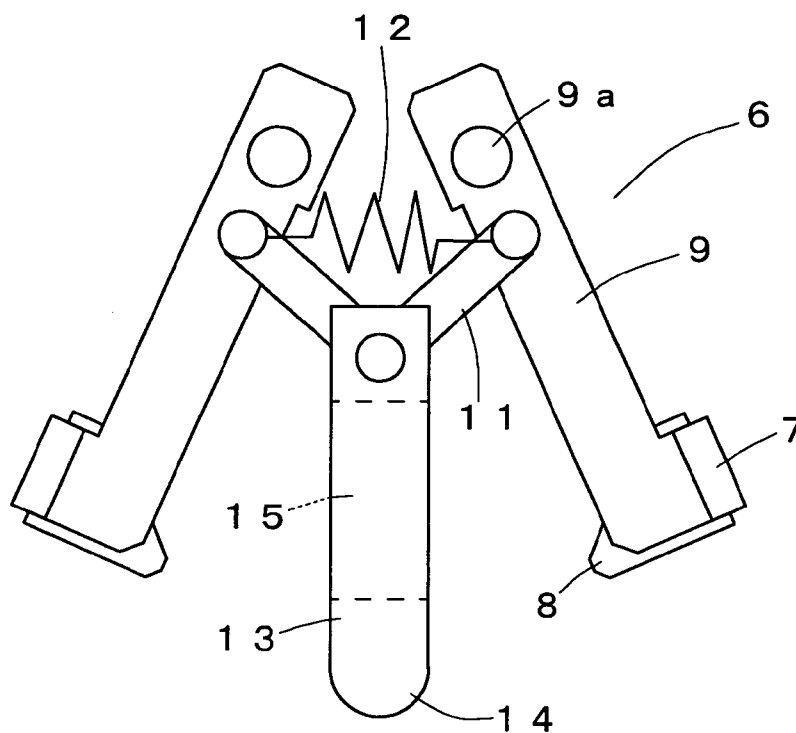


Fig. 6

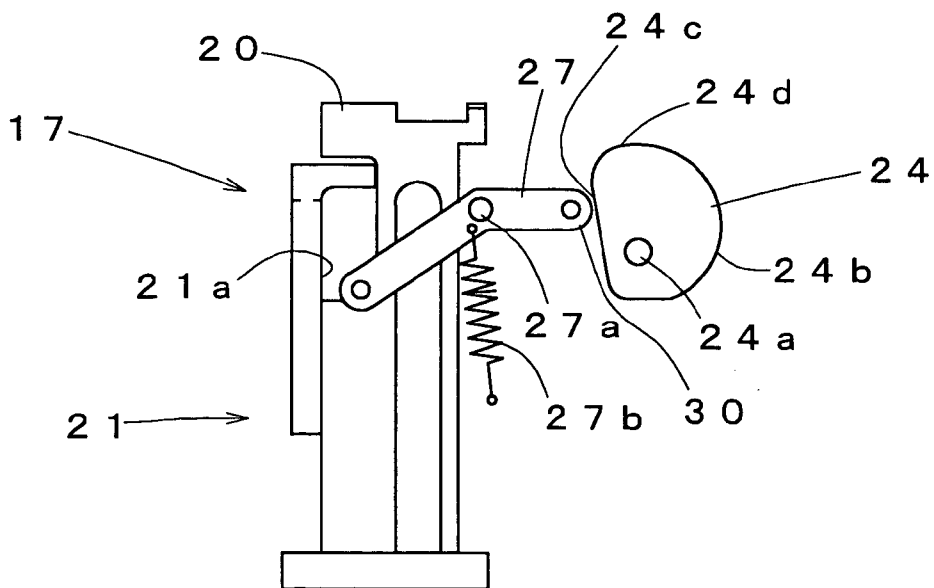


Fig. 7A

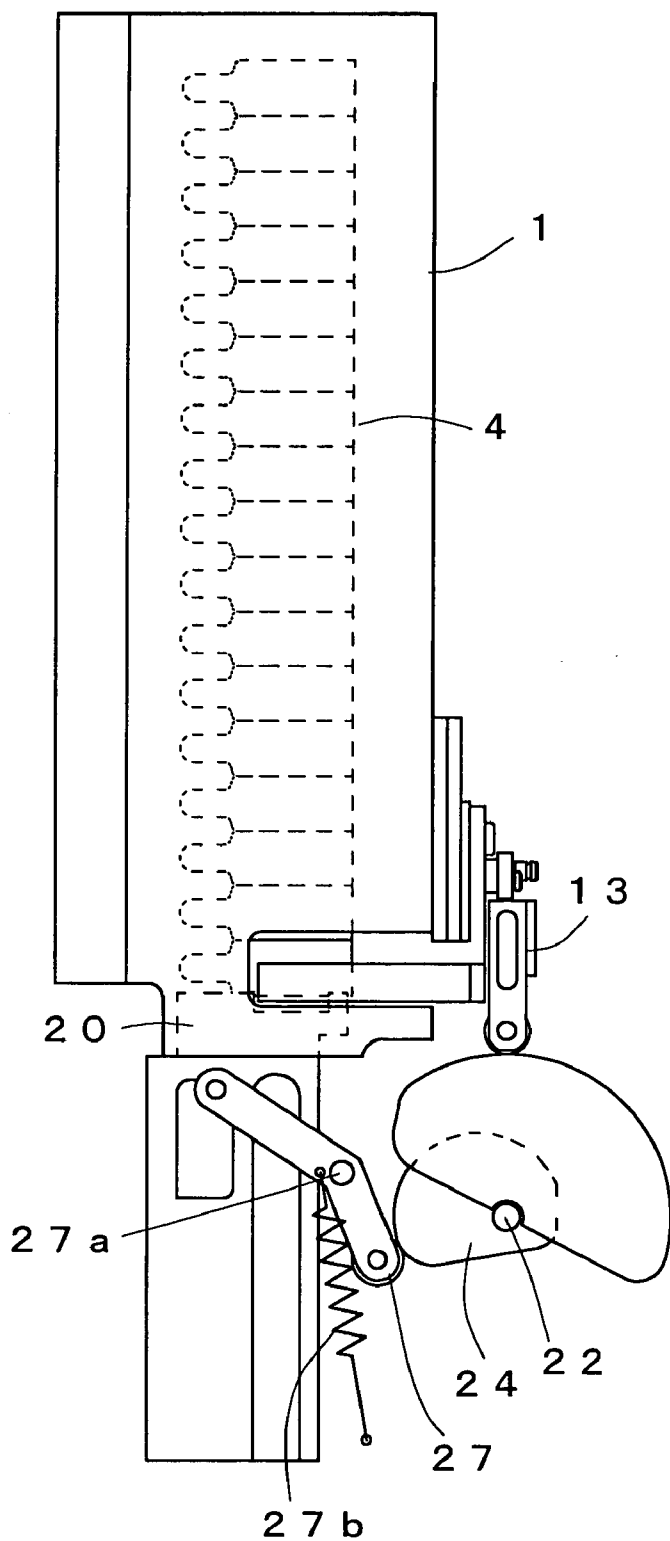


Fig. 7B

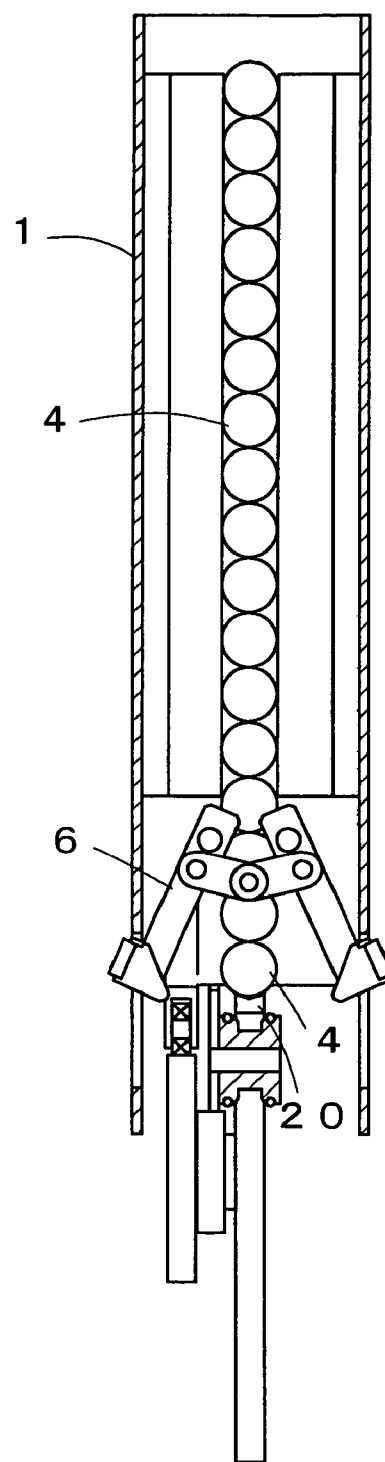


Fig. 8A

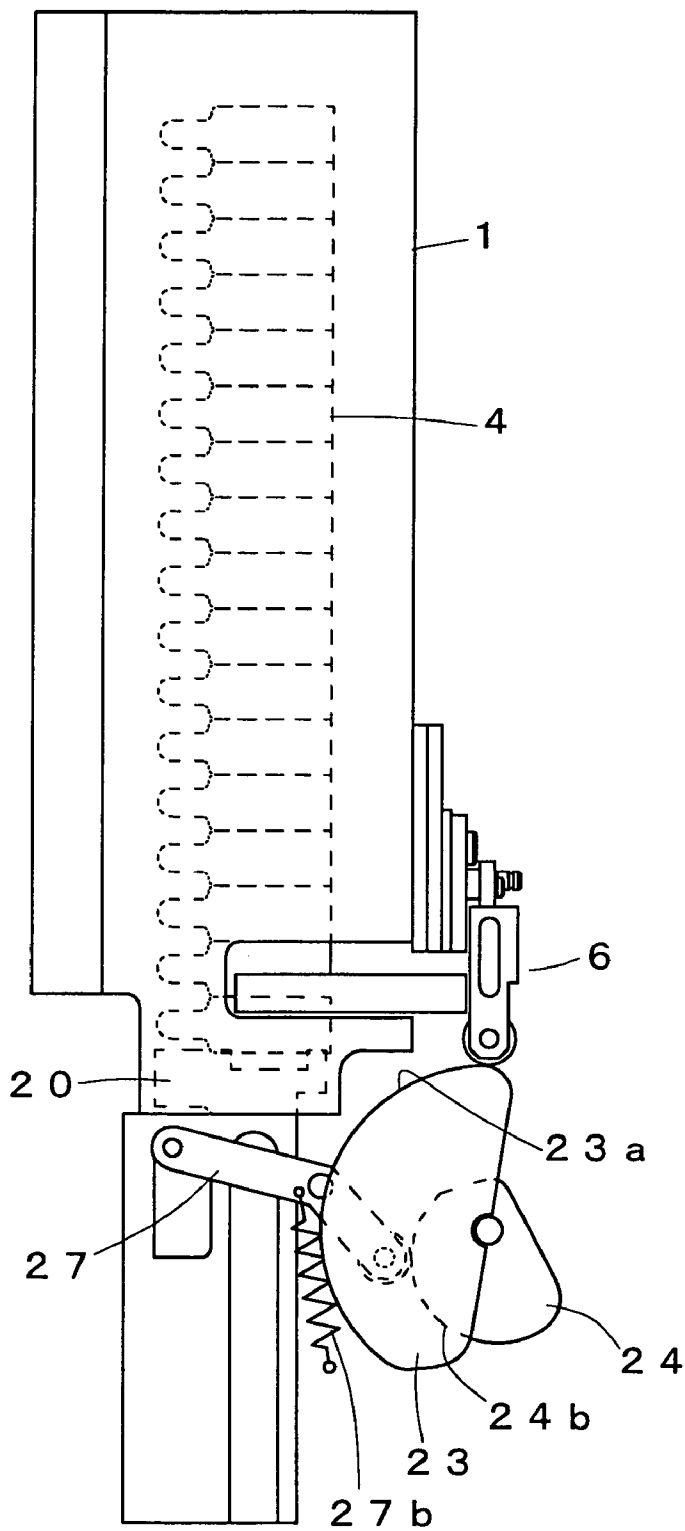


Fig. 8B

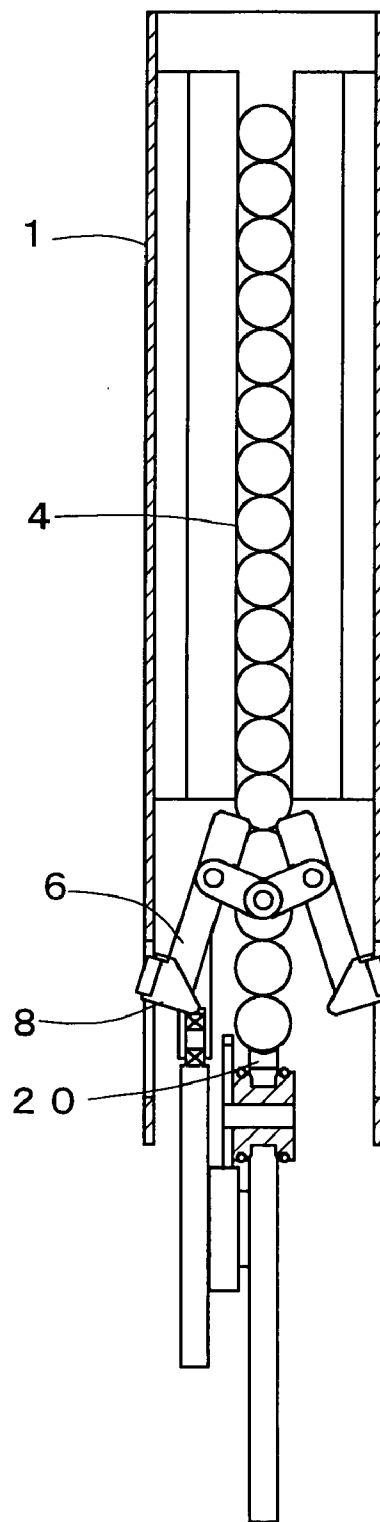


Fig. 9A

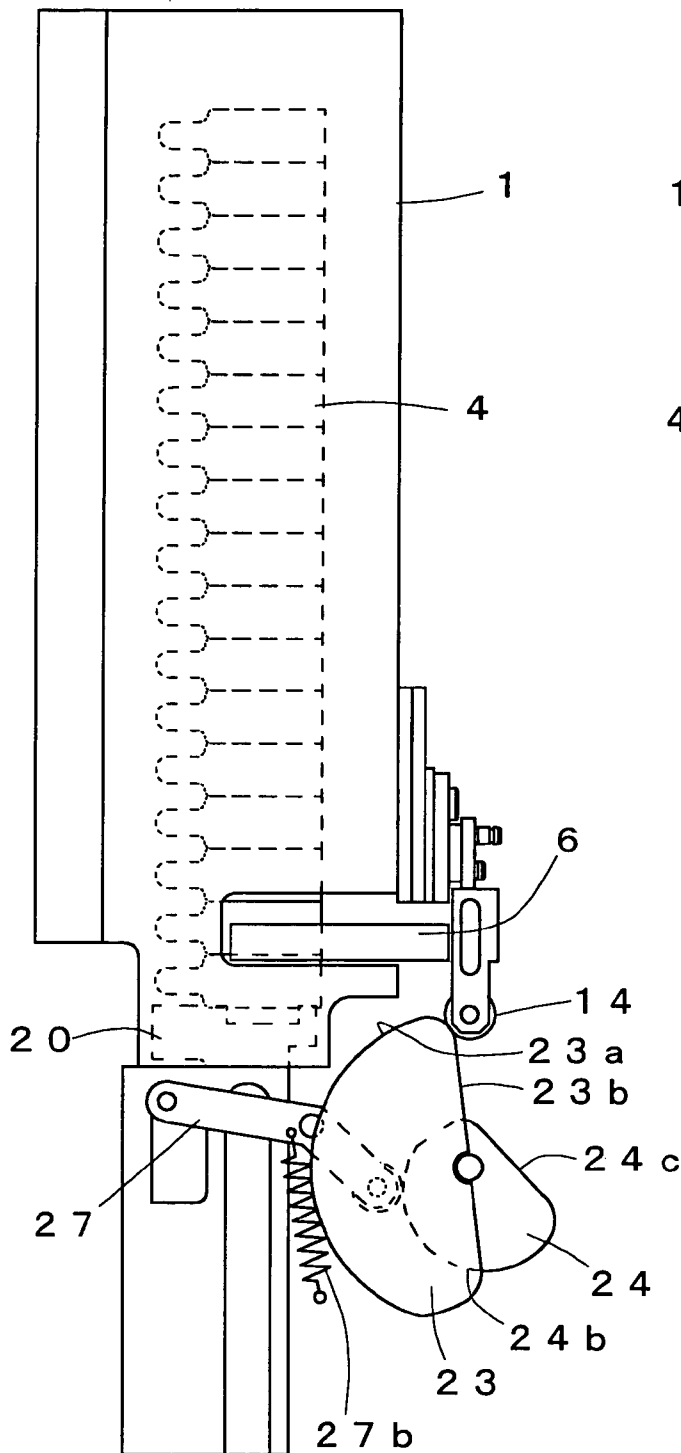


Fig. 9B

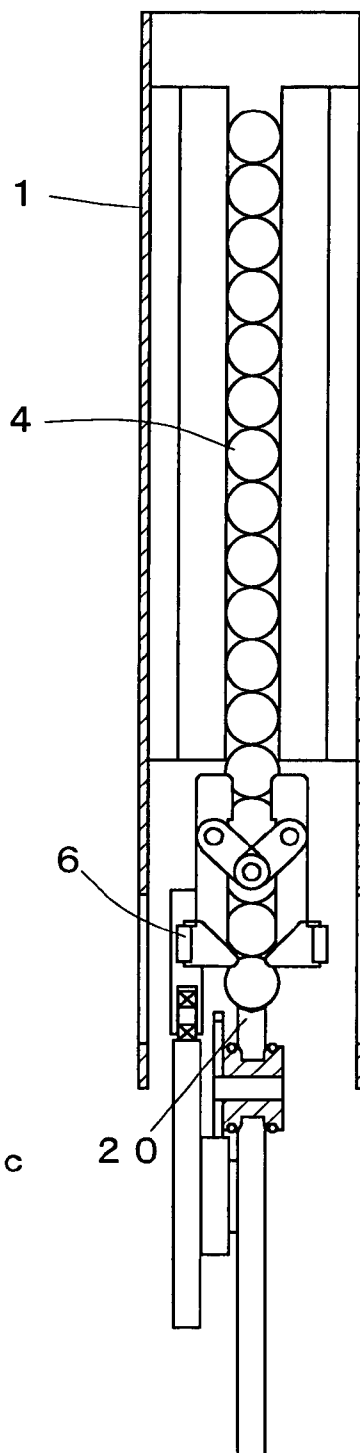




Fig. 10A

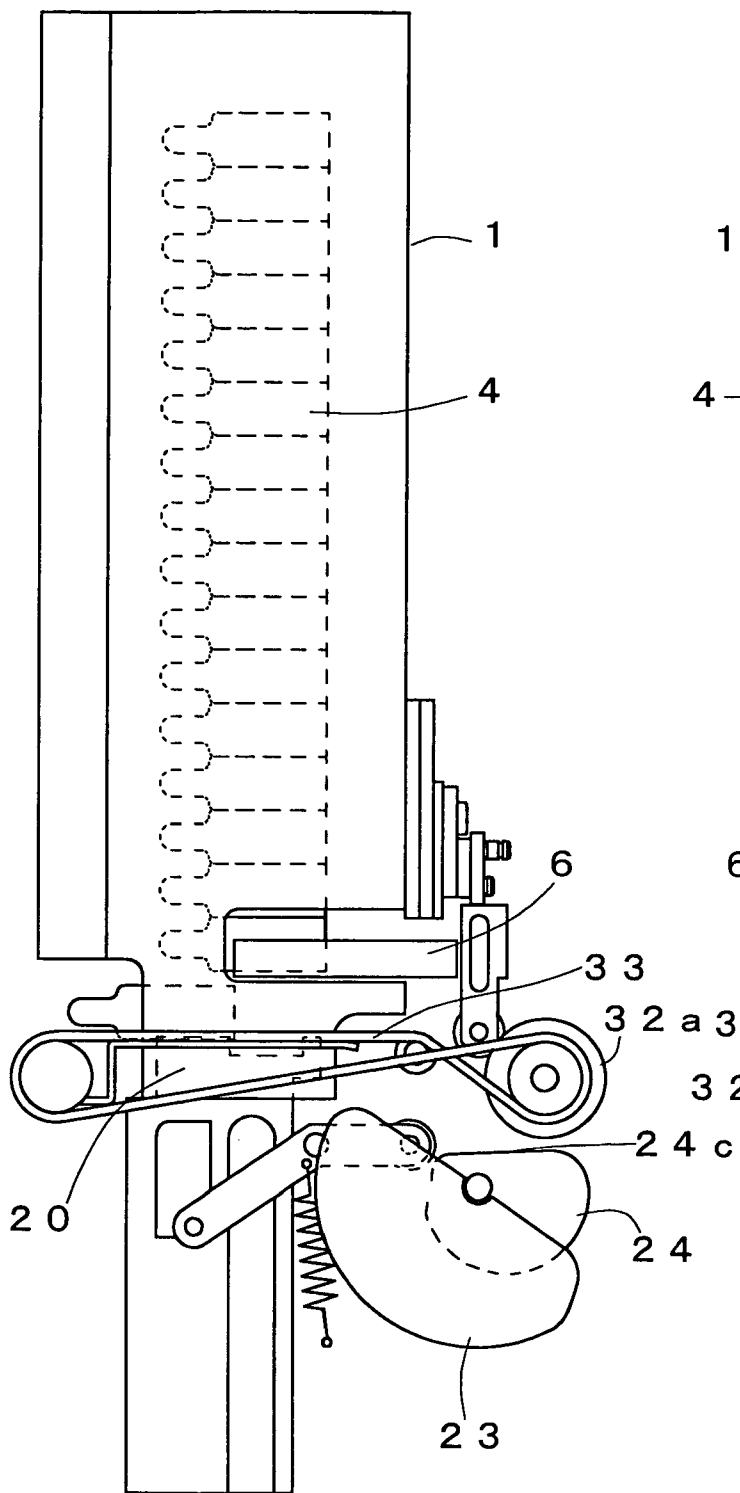


Fig. 10B

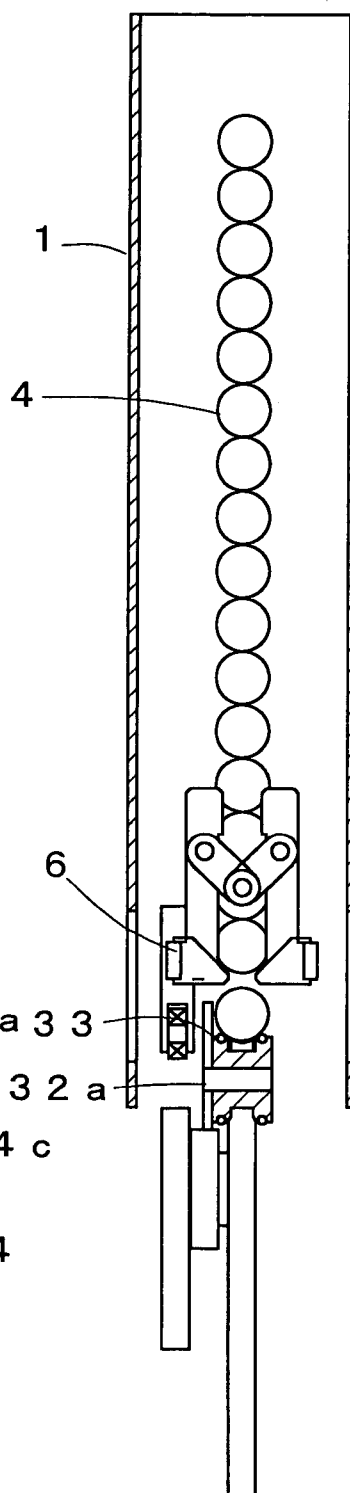


Fig. 11

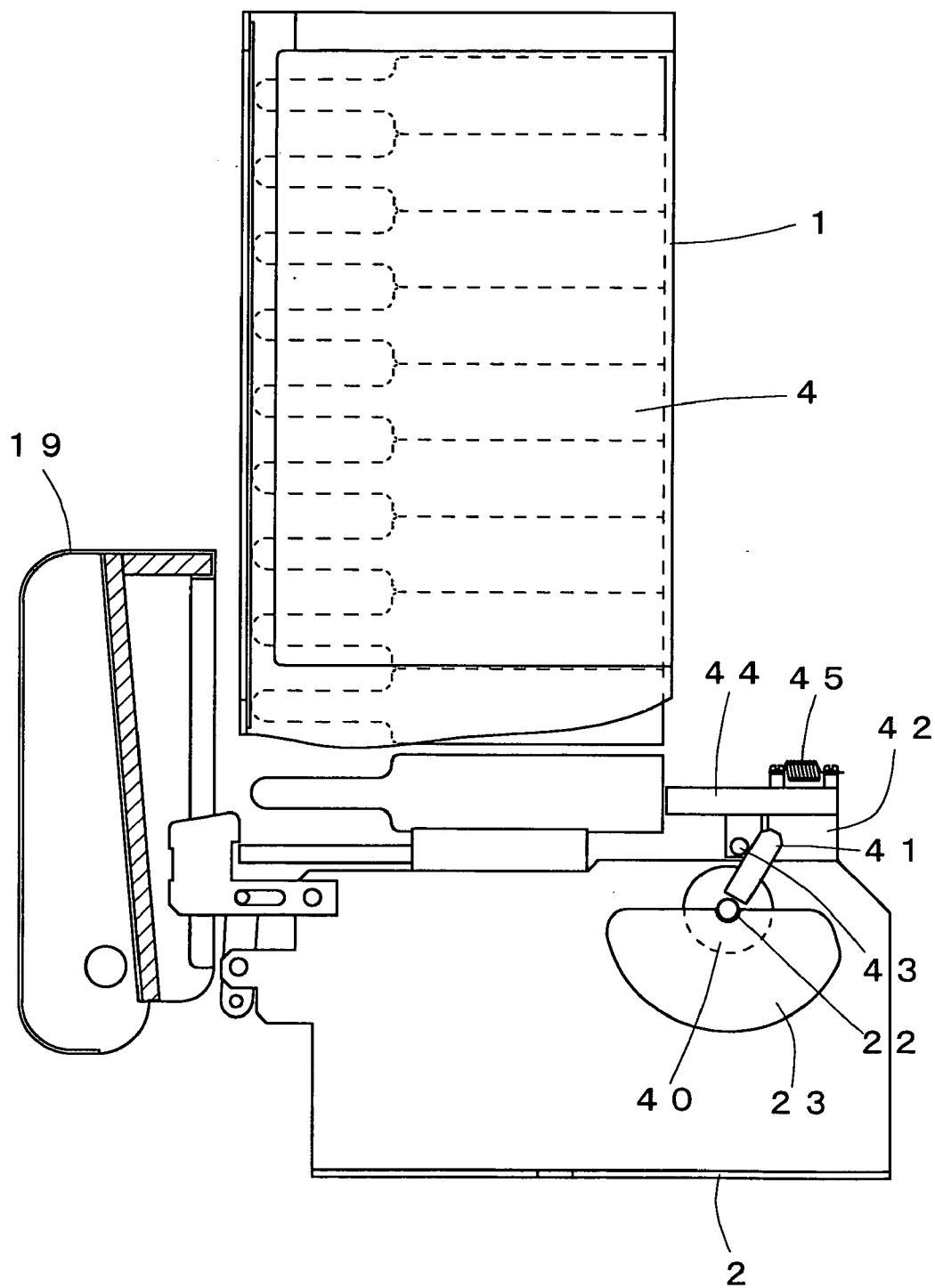
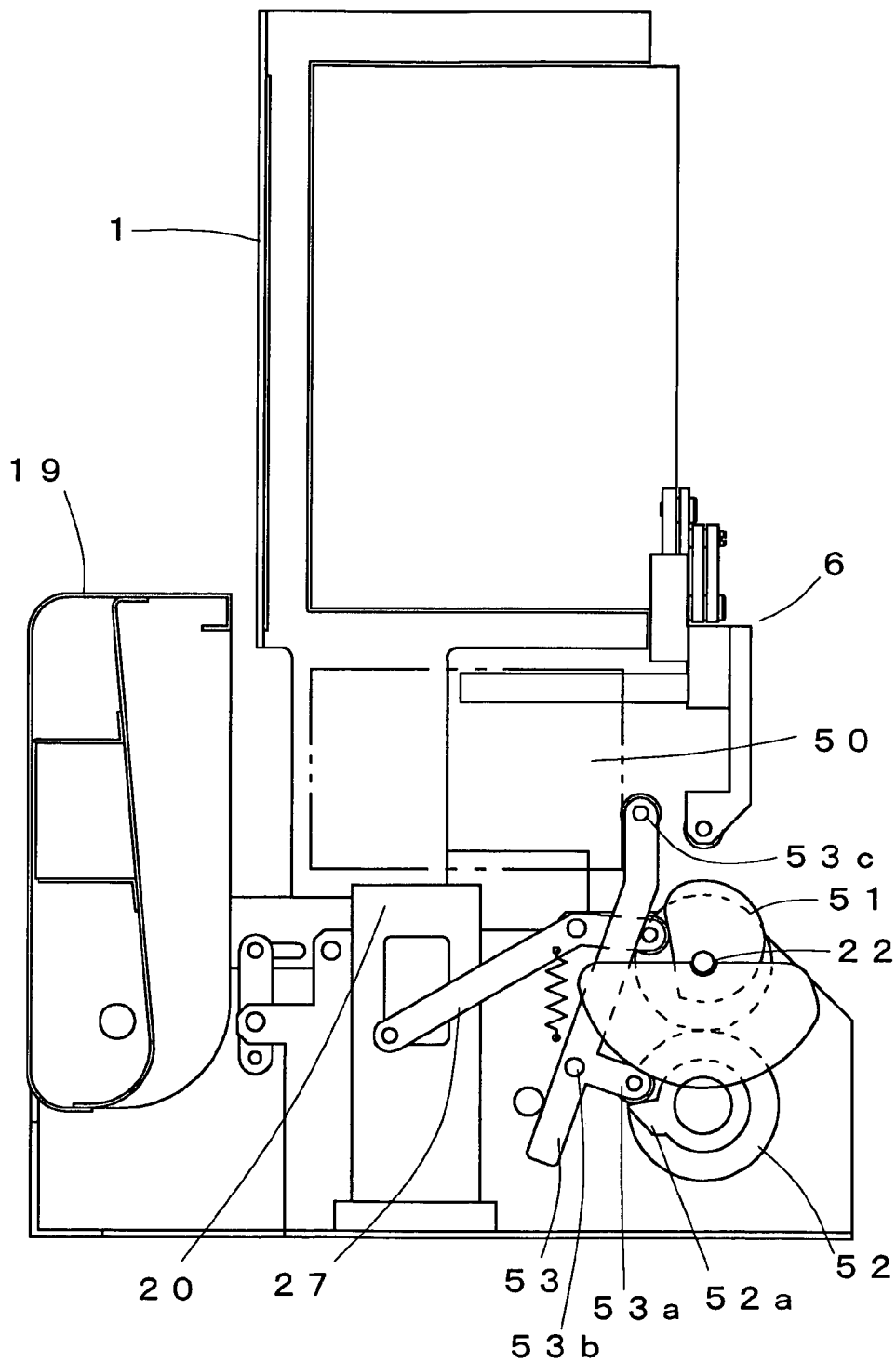


Fig. 12



## MEDICINE FEEDER

### TECHNICAL FIELD

[0001] The present invention relates to a medicine feeding device, more particularly to a medicine feeding device suitable for feeding specific medicines such anticancer drugs.

### BACKGROUND ART

[0002] Generally, specific medicines such as anticancer drugs having toxicity are housed in medicine containers such as ampoules. The medicine containers housing such specific medicines are required to reliably prevent damages during feeding or an error in the feed number from occurring. Therefore, feeding of such specific medicines have conventionally been carried out manually.

[0003] However, automatic feeding is disparately expected by large hospitals and the like where the feeding number of medicines is high. In such case, the problems of damage on the medicines during feeding and an error in the feeding number must be prevented from being occurred on any account. However, the conventional medicine feeding devices do not have such construction.

[0004] Accordingly, it is a primary object of the present invention to provide a medicine feeding device implementing reliable prevention of the medicine containers from being damaged during feeding or an error in the feed number from creeping in.

### DISCLOSURE OF THE INVENTION

[0005] In this invention, there is provided a medicine feeding device in which medicine containers received in a vertical row in a cassette are successively fed from below, comprising:

[0006] a holding means for holding a medicine container positioned in a bottom of the cassette;

[0007] a transfer means disposed below the cassette and adapted to be vertically movable to downwardly transfer the bottom medicine container held by the holding means; and

[0008] a driving means for upwardly moving the transfer means, lifting the bottom medicine container held by the holding means, canceling the held state established by the holding means, holding a second medicine container from the bottom while downwardly moving the transfer means by a predetermined distance, and then downwardly moving the transfer means.

[0009] With this construction, during feeding operation of the medicine containers, the holding means is always in the state of being held by the transfer means. Therefore, the medicine containers can be smoothly fed without an impulse force imposed thereon. Further, since only one medicine container is feedable by the transfer means at any given time, it becomes possible to accurately keep track of the feed number.

[0010] It is preferable that the holding means is composed of a pair of open/close arms having a lower horizontal portion provided in detachable and rotatable manner, and the

horizontal portion has a resinous support portion provided with an inclined plane for supporting the medicine container, which enables medicines to be reliably fed one by one if they are damageable medicines such as those in ampoules.

[0011] It is preferable that a discharge means for discharging the medicine container moved downward by the transfer means in a horizontal direction is provided, and

[0012] the transfer means is vertically movable between a position above a support position provided by a support portion of the open/close arm and a position below a discharge position provided by the discharge means, which enables medicines to be smoothly fed without damage being inflicted thereon.

[0013] It is preferable that the driving means is composed of a single motor, and a driving force of the motor is transmitted to the transfer means and the holding means via a driving shaft and a cam integrated with the driving shaft, so that stable operation can be achieved with simplified construction.

[0014] It is preferable that an operation status detection means for detecting whether or not retrieval of the medicine container is in operation is provided, and if it is determined that the retrieval is not in operation based on a detection signal provided by the operation status detection means, then feeding of medicines is stopped, which makes it possible to prevent handling of medicines by a third party other than a qualified person in charge.

[0015] It is preferable that the cassette is provided with a medicine detection means allowing detection of each medicine housed in a vertical stack, which makes it possible to keep track of stockout or clogging of medicines in the cassette with reliability.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a front view showing a medicine feeding device according to the present embodiment;

[0017] FIG. 2 is a plane view showing a medicine feeding portion in FIG. 1;

[0018] FIG. 3 is a front view of FIG. 2;

[0019] FIG. 4 is a side view of FIG. 1;

[0020] FIG. 5 is a front view showing open/close arms in FIG. 1;

[0021] FIG. 6 is a front view showing a transfer portion in FIG. 1;

[0022] FIG. 7A is a front view showing the operation state of FIG. 1;

[0023] FIG. 7B is a side view showing the operation state of FIG. 1;

[0024] FIG. 8A is a front view showing the operation state of FIG. 1

[0025] FIG. 8B is a side view showing the operation state of FIG. 1

[0026] FIG. 9A is a front view showing the operation state of FIG. 1;

[0027] FIG. 9B is a side view showing the operation state of FIG. 1

[0028] FIG. 10A is a front view showing the operation state of FIG. 1;

[0029] FIG. 10B is a side view showing the operation state of FIG. 1;

[0030] FIG. 11 is a front view showing a medicine feeding device according to another embodiment; and

[0031] FIG. 12 is a front view showing a medicine feeding device according to still another embodiment.

#### BEST MODE FOR CARRYING OUT THE INVENTION

[0032] Embodiments of the invention will now be described with reference to the accompanying drawings.

[0033] FIG. 1 shows a cassette 1 and a medicine feeding portion 2 in the medicine feeding device according to the present embodiment. In the medicine feeding device, a plurality of medicine feeding portions 2 are disposed in parallel in a main unit, and the cassette 1 is detachably mounted on each medicine feeding portion 2 (see FIG. 4).

[0034] The cassette 1 receives ampoules 4 exemplifying medicine containers in the present invention in a vertical row along a built-in guide portion 3. The ampoules 4 contain specific medicines such as anticancer drugs. Each ampoule 4 is detected by an ampoule detection sensor (unshown) exemplifying the medicine detection means that is disposed at a specified pitch (a distance between the centers of the stacked ampoules 4) in a vertical direction along the lateral side of the cassette 1. This makes it possible to reliably detect stockout or clogging of the ampoules 4, and to prevent a feeding error of the ampoules 4 from occurring. On the lower end portion of the cassette 1, there is disposed a pair of open/close arms 6 exemplifying the holding means according to the present embodiment. The open/close arms 6 are almost L-shaped, and a lower-side horizontal portion 7 has a resinous support portion 8 provided with an inclined plane as shown in FIG. 5. The open/close arms 6 are constructed such that an upper-side vertical portion 9 is disposed on the front face of the cassette 1 rotatably around a spindle 9a, and the support portion 8 is inserted into the cassette 1 through a notch portion 10 provided on the lower lateral face of the cassette 1 so as to be able to support a ampoule 4 positioned in the bottom. Each vertical portion 9 of the open/close arms 6 is rotatably linked to one end portion of a link 11 on the lower side of the spindle 9a, and the links 11 are biased inwardly (in a direction approaching each other) by a spring 12. The other end portions of the links 11 are rotatably linked to each other, and a transmission portion 13 extending vertically downward is fixed thereto. At the lower end portion of the transmission portion 13, there is provided a pressure receiving portion 14 that is protruded toward the horizontal direction for pressing upward. Further, a resinous stopper portion 15 is provided on the back side of the transmission portion 13, and the vertical portions 9 of the open/close arms 6 closed by a biasing force of the spring 12 come into contact with the stopper portion 15 so as to position the support portions 8 at specified positions.

[0035] As shown in FIG. 1, the medicine feeding portion 2 is constructed such that a transfer portion 17 exemplifying the transfer means according to the present invention, an operation portion 18 and a closure plate 19 are disposed on a base 16.

[0036] As shown in FIG. 6, the transfer portion 17 is constructed such that a transfer base 20 is vertically moved by an auxiliary arm 27 that is provided on the base 16 rotatably around a spindle 27a. The auxiliary arm 27 is biased counter clockwise around the spindle 27a of FIG. 6 by a spring 27b. The transfer base 20 is curved so that its upper face fits along the perimeter face of the ampoule 4, and has a leg portion 21 having a long hole 21a guided by an unshown guide portion provided on the base 16. The transfer base 20 is vertically moved between the position slightly above the support position of the open/close arms 6 by the support portion 8 and the position slightly below the conveyance line by a later-described belt 33.

[0037] In the operation portion 18, a first cam 23, a second cam 24, a driving gear 25 and a detection target disk 26 are integrated with a rotating shaft 22 for directly operating the open/close arms 6 and indirectly operating the transfer portion 17 via the auxiliary arm 27 (see FIG. 1) as shown in FIG. 2 and FIG. 3.

[0038] Power from a single motor 29 exemplifying the driving means according to the present invention is transmitted to the rotating shaft 22 via bevel gears 28a, 28b provided in one end portion.

[0039] The first cam 23 has an almost semicircle shape as shown in FIG. 11, and its perimeter portion engages with the pressure receiving portion 14 formed on the transmission portion 13 of the open/close arms 6 so as to part the support portions 8, which cancels the supported state of the ampoule 4 positioned in the bottom of the cassette 1. In an interface portion between a circular arc portion 23a and a linear portion 23b of the first cam 23, an inclined plane 23c is formed on the side of a counter clockwise direction (rotation direction side) for implementing smooth pressing operation of the pressure receiving portion 14.

[0040] The second cam 24, as shown in FIG. 6, is formed such that an outer edge of a circular arc portion 24b is gradually coming closer to the rotating shaft 22 from the counter clockwise direction side (rotation direction side) to the clockwise direction. In a region extending from a linear portion 24c to the circular arc portion 24b, there is formed a circular arc portion 24d smaller in radius of curvature from the circular arc portion 24b.

[0041] The auxiliary arm 27 is provided on the base 16 rotatably around the spindle 27a in a middle bending portion, and is biased by a bias force by the spring 27b to a counter clockwise direction in FIG. 6. One end portion of the auxiliary arm 27 comes into contact with an outer circumferential edge of the second cam 24 so that the auxiliary arm 27 reciprocally rotates according to the rotation of the second cam 24. A pressing portion 30 is formed on the other end portion of the auxiliary arm 27. The pressing portion 30 is positioned at a rectangular hole 21a formed in the leg portion 21 of the transfer portion 17 for vertically moving the transfer base 20.

[0042] The positional relation between the first cam 23 and the second cam 24 is such that at the time when the transfer base 20 is upwardly moved by the second cam 24 and the ampoule 4 positioned in the bottom of the cassette 1 is lifted, the support portions 8 of the open/close arms 6 are parted by the first cam 23. The both cams are fixed to the same rotating shaft 22, and therefore properly setting their

positional relationship in a rotation direction makes it possible to get appropriate timing of the operation of the transfer base 20 and the open/close arms 6 with reliability. Consequently, less impact force acts on the ampoule 4, thereby eliminating the possibility of damage thereon.

[0043] A driven gear 31 is geared with a driving gear 25. The driven gear 31 is fixed to an axis of a pulley 32a. In a position away from the pulley 32a by a specified distance from the pulley 32a, another pulley 32b is disposed as shown in FIG. 1, and a belt 33 exemplifying the discharge means according to the present invention is hung on the both pulleys 32a, 32b. The belt 33 is made of a material having flexibility such as rubber, and is hung on the both pulleys 32a, 32b so as to form two lines crossed in a middle section. The belt 33 is pushed down by a guide rod 34 in the middle section of the both pulleys 32a, 32b so that its contact area with the pulley 32a on the driving side is increased and slip of the belt 33 is suppressed.

[0044] The detection target disk 26 is, as shown in FIG. 3, provided with a detection target portion composed of such member as a permanent magnet, a notch and a through hole at a specified position, and an initial position of the detection target disk 26 is detected by a rotation position detection sensor 35 composed of a light emitting device and a light receiving device. Every time the initial position is detected, it means that the rotating shaft 22 is rotated once.

[0045] The closure plate 19, which is disposed rotatably around a spindle 19a as shown in FIG. 1, rotates in a horizontal direction when a registered fingerprint is detected by an unshown fingerprint identification device, allowing driving of the medicine feeding device and takeout of a medicine fed from the medicine feeding portion 2. Further, it is detected whether or not the apparatus is in operation by a floor mat (unshown) exemplifying the operation status detection means according to the present invention. When the floor mat does not detect the operation status over a specified time, the closure plate 19 automatically rotates in vertical direction to close an outlet port so as to prevent the risk of arbitrary administration. It is to be noted that the operation status may be detected by area sensors and the like in addition to the floor mat.

[0046] It is to be noted that the outlet port is provided with a locking member 36 that is locked and unlocked to/from the cassette 1 mounted and dismounted on/from the medicine feeding portion 2.

[0047] Next, the operation of the medicine feeding device is described.

[0048] Upon identification of a fingerprint by the fingerprint identification device, the closure plate 19 is rotated to allow feeding operation of medicines by the medicine feeding device. When the type and number of medicines are input from an unshown operation portion, the motor 29 of a medicine feeding portion 2 on which a cassette 1 housing corresponding medicines is mounted is driven. Consequently, the rotating shaft 22 is rotated, and from the initial state shown in FIG. 1, first, one end portion of the auxiliary arm 27 is pressed by the circular arc portion 24b of the second cam 24. The auxiliary arm 27 is rotated, as shown in FIG. 7, clockwise around the spindle 27a to upwardly move the transfer base 20. The transfer base 20 lifts the ampoule 4 positioned in the bottom of the cassette 1 supported by the support portion 8 of the open/close arms 6.

[0049] As shown in FIG. 8, the transfer base 20 is gradually moved downward as one end portion of the auxiliary arm 27 moves the circular arc portion 24b of the second cam 24. During this movement, the first cam 23 also rotates, and the circular arc portion 23a upwardly pushes the pressure receiving portion 14. Then, the vertical portion 9 is rotated through the transmission portion 13, which parts the support portions 8. The parted state is maintained while the pressure receiving portion 14 moves the circular arc portion 23a of the first cam 23, i.e., while the transfer base 20 moves downward.

[0050] At the time when only the ampoule 4 positioned in the bottom moves lower than the support portion 8, the pressure receiving portion 14 of the open/close arms 6 moves from the circular arc portion 23a of the first cam 23 from the linear portion 23b as shown in FIG. 9. This enables the support portion 8 of the open/close arms 6 to support the second ampoule 4 from the bottom smoothly.

[0051] The transfer base 20 keeps on moving downward, and as shown in FIG. 10, the ampoule 4 is placed on the belt 33. The belt 33 moves the ampoule 4 placed thereon in horizontal direction by power of the motor 29 transmitted to one pulley 32a.

[0052] Thus, one ampoule 4 can be fed by every one rotation of the rotating shaft 22, and therefore a specified number of ampoules 4 can be fed by driving of the motor 29 maintained till the number of the ampoules 4 detected in the detection target portion of the detection target disk 26 by the rotation position detection sensor 35 reaches an inputted feeding number of medicines.

[0053] According to the above-constructed medicine feeding device, the driving means is implemented by a single motor 29, which makes it possible to simplify the construction and decrease production costs. Further, since the first cam 23 for rotating the open/close arms 6, the second cam 24 for vertically moving the transfer base 20 and the like are all fixed to the same rotating shaft 22, the positional relation of each member may be set simply and accurately. Furthermore, since the ampoule 4 is transferred by the transfer base 20 without an impact force being inflicted thereon, problems such as leakage of drug solution due to breakage of the ampoule 4 are not occurred.

[0054] It is to be noted that although in the above-described embodiment, the construction for feeding the ampoules 4 as medicine containers is described, boxes containing medicines can still be fed in the same construction.

[0055] Further, although in the above-described embodiment, the ampoules 4 are fed to the outlet port by the pulley 32 and the belt 33, they can be fed by horizontal movement of a rod as shown in FIG. 11. In FIG. 11, a third cam 40 is integrated with the rotating shaft 22. Above the third cam 40, there is provided a base portion 42, on which a rod 44 is disposed slidably in horizontal direction in the figure. As an extension portion 41 provided on the third cam 40 is pressed by a pin 43 formed on the rod 44, the rod 44 slides in horizontal direction in the figure against a bias force of a spring 45 to press the ampoule 4 positioned in the bottom.

[0056] Further, as shown in FIG. 12, boxes 50 containing medicines may be fed by a rotating arm member 53. In FIG. 12, a first gear 51 is integrated with the rotating shaft 22, and

a protrusion **52a** provided on a second gear **52** that is geared with the first gear **51** presses a pressure receiving portion **53a** of the arm member **53**. Consequently, the arm member **53** rotates counter clockwise around a spindle **53b**, and by a pressing portion **53c**, the box **50** is fed to the left-hand direction in the figure.

[0057] It is naturally understood that the both constitutions shown in **FIG. 11** and **FIG. 12** are applicable to feeding of various medicine containers such as ampoules and boxes housing medicines.

**1-6.** (Cancelled)

**7.** A medicine feeder in which medicine containers received in a vertical row in a cassette are successively fed from below, comprising:

holding means for holding a medicine container positioned in a bottom of the cassette;

transfer means disposed below the cassette and adapted to be vertically movable to downwardly transfer the bottom medicine container held by the holding means;

driving means for upwardly moving the transfer means, lifting the bottom medicine container held by the holding means, canceling a held state established by the holding means, holding a second medicine container from the bottom while downwardly moving the transfer means by a predetermined distance, and then downwardly moving the transfer means; and

medicine detection means for detecting various medicine containers housed in the cassette,

wherein if it is determined that stockout or clogging of the medicine containers are generated based on a detection

signal provided by the medicine detection means, then feeding of the medicine containers are stopped.

**8.** The medicine feeding device as defined in claim 7, wherein the holding means is composed of a pair of open/close arms having a lower horizontal portion provided in detachable and rotatable manner, and the horizontal portion has a resinous support portion provided with an inclined plane for supporting the medicine container.

**9.** The medicine feeding device as defined in claim 8, further comprising discharge means for discharging the medicine container moved downward by the transfer means in a horizontal direction, wherein

the transfer means is vertically movable between a position above a support position provided by a support portion of the open/close arm and a position below a discharge position provided by the discharge means.

**10.** The medicine feeding device as defined in claim 7, wherein the driving means is composed of a single motor, and a driving force of the motor is transmitted to the transfer means and the holding means via a driving shaft and a cam integrated with the driving shaft.

**11.** The medicine feeding device as defined in claim 7, further comprising operation status detection means for detecting whether or not retrieval of the medicine container is in operation, wherein if it is determined that the retrieval is not in operation based on a detection signal provided by the operation status detection means, then feeding of medicines is stopped.

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