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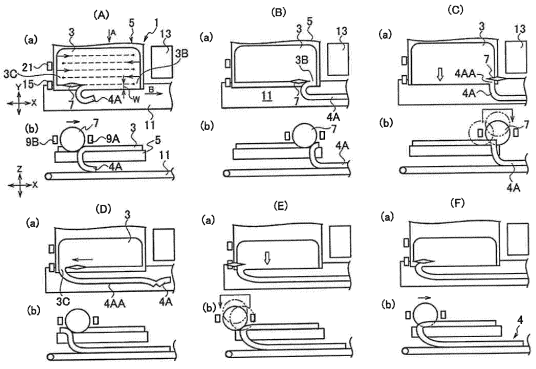
(54) FOOD-DOUGH CUTTING METHOD AND DEVICE

(57) The present inventions provide a method and an apparatus for cutting flattened food dough into long-shaped food dough, without adding stress to the food dough.

The method for cutting flattened food dough 3 into a long and continuous shape, comprising:
(a) a process for cutting the flattened food dough 3 by moving a cutter 7 relative to the food dough 3 from one lateral end to the other lateral end of the food dough 3, and a process for discontinuing the cutting process by lifting up the cutter 7 from the food dough 3 so that an uncut part is left near the other lateral end;
(b) a process for cutting the flattened food dough 3 from the other lateral end to the one lateral end of the food dough 3 after moving the cutter 7 relative to the food dough 3 along the direction perpendicular to the direction to cut the food dough 3, and a process for discontinuing the cutting process by lifting up the cutter 7 from the food dough 3 so that an uncut part is left near the one lateral end;
(c) a process for moving the cutter 7 relative to the food dough 3 along the direction perpendicular to the direction to cut the food dough 3; and
(d) processes for repeating the processes (a) to (c).

Fig. 1



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Description

Technical Field

[0001] The inventions relate to a method and an apparatus for cutting flattened food dough into an elongated shape (a long shape), such as a continuous and string-like, belt-like, or rod-like shape. Particularly, they relate to a method and an apparatus for cutting the flattened food dough into a continuous and elongated shape, for example by cutting the flattened food dough in a zig-zag manner in a lateral direction.

Background of the Inventions

[0002] Conventionally, when a small piece of food dough having a desired weight is produced from a big lump of food dough, such as bread dough, for example, the lump of the food dough is formed into a belt-like shape, then, the belt-like shaped food dough is cut into pieces having a desired weight (see Patent Documents 1 and 2).

[0003]

Patent Document 1: Japanese Patent Laid-open Publication No. 2001-95468
Patent Document 2: International Publication No. WO02/080683 A2

Summary of the Inventions

[0004] The invention disclosed in Patent Document 1 has a configuration that has a hopper to load a big lump of bread dough, etc., and a cutting apparatus disposed at a rectangular and elongated opening positioned at the bottom of the hopper. In this configuration, elongated pieces of food dough having a predetermined length and an approximately constant size cut by the cutting apparatus fall on a transfer conveyer movable with respect to a longitudinal direction of the opening. Then, by laying a distal end of an elongated piece of the food dough that is being cut on a proximal end of the preceding one that is being conveyed on the transfer conveyer, long and continuous food dough is formed.

[0005] The cutting apparatus in the configuration explained in the above paragraph is so-called "a star-shaped cutter." It has a pair of rotating shafts that have a plurality of plate-like cutting blades and rotate in the opposite direction against one another. Thus, it can continuously cut the big lump of the food dough into the elongated pieces of the food dough, each of which having a constant length and a desired weight.

[0006] The invention disclosed in Patent Document 2 has a configuration that has a star-shaped cutter, which is positioned at an opening of a hopper and cuts food dough descending from within the hopper. The star-shaped cutter includes a first blade, which has a cutout part at one lateral end, and a second blade, which has a cutout part at the other lateral end, and wherein the first and the second blade are alternately positioned. Thus, when the food dough is cut by rotating the star-shaped cutter, a first condition, in which one end of the food dough remains connected to the food dough in the hopper are connected together, and a second condition, in which the other end of the food dough remains connected to the food dough in the hopper, appear alternately. Namely, the food dough, which gradually descends from within the hopper, is cut and formed into an elongated and continuous shape.

[0007] Namely, in the conventional invention for forming food dough having an elongated and continuous shape by cutting the food dough by means of the star-shaped cutter, when the food dough is cut by the star-shaped cutter, the food dough is stressed not only in the process that it reaches at the star-shaped cutter, but also at the moment when it is cut by the star-shaped cutter.

[0008] The present inventions address the aforementioned problems. The purpose of the present inventions is to provide a method and an apparatus for forming food dough having a continuous and elongated shape by cutting the flattened food dough, without compressing the whole of the food dough and without adding stress to the food dough.

[0009] To solve the aforementioned problems, the present inventions have the following technical features:

a method for cutting flattened food dough into a long and continuous shape, comprising:

(a) a process for cutting the flattened food dough by moving a cutter relative to the food dough from one lateral end to the other lateral end of the food dough, and a process for discontinuing the cutting process by lifting up the cutter from the food dough so that an uncut part is left near the other lateral end;
(b) a process for cutting the flattened food dough from the other lateral end to the one lateral end of the food dough after moving the cutter relative to the food dough along the direction perpendicular to the direction to cut the food dough, and a process for discontinuing the cutting process by lifting up the cutter from the food dough so that an uncut part is left near the one lateral end;
(c) a process for moving the cutter relative to the food dough along the direction perpendicular to the direction to cut the food dough; and
(d) processes for repeating the processes (a) to (c).

[0010] Further, the present inventions have the following technical features:

a method for cutting flattened food dough into a long and continuous shape, comprising:

(a) a process for placing the flattened food dough on a conveyer belt, wherein the conveyer belt conveys the food dough in one direction;
(b) a process for cutting the food dough from one lateral end to the other lateral end of the food dough on the conveyer belt and near the end of it, by moving a cutter in a forward direction perpendicular to the direction of the movement of the conveyer belt, and a process for discontinuing the cutting process in the forward direction by lifting up the cutter from the food dough so that an uncut part is left near the other lateral end;
(c) a process for conveying the food dough for a predetermined distance by driving the conveyer belt;
(d) a process for cutting the food dough from the other lateral end to the one lateral end of the food dough by moving a cutter in a backward direction opposite to the forward direction, and a process for discontinuing the cutting process in the backward direction by lifting up the cutter from the food dough so that an uncut part is left near the one lateral end;
(e) the same process as (c); and
(f) processes for repeating the processes (b) to (e).

[0011] Further, the present inventions have the following technical features:

the method for cutting the flattened food dough explained in the above paragraph, further comprising:

a process for transferring long food dough in the forward direction by a transfer conveyer positioned below the end of the conveyer belt, wherein the long food dough is cut from the flattened food dough and is fallen onto the transfer conveyer due to its weight,
wherein the speed of the cutter in the backward direction is faster than that in the forward direction.

[0012] Further, the present inventions have the following a technical feature:

the method for cutting the flattened food dough explained in the above paragraph, wherein the speed of the cutter in the forward direction corresponds to the speed of the transfer conveyer.

[0013] Further, the present inventions have the following a technical feature:

the method for cutting the flattened food dough explained in the above paragraphs, wherein the final process for cutting the food dough is the process wherein the cutter is moving in the forward direction.

[0014] Further, the present inventions have the following a technical feature:

the method for cutting the flattened food dough explained in the above paragraphs, wherein the flattened food dough is fermented on a tray.

[0015] Further, the present inventions have the following technical features:

an apparatus for cutting flattened food dough into a long and continuous shape, comprising:

a cutter being able to reciprocate horizontally between one lateral end and the other lateral end of the food dough and up and down vertically, relative to the food dough; and
a means for carrying the food dough in a direction perpendicular to the direction of the reciprocating motion of the cutter, in an intermittent manner and relative to the food dough.

[0016] Further, the present inventions have the following technical features:

an apparatus for cutting flattened food dough into a long and continuous shape, comprising:

a conveyer belt for conveying the flattened food dough in one direction;
a cutter being able to reciprocate in a direction perpendicular to the direction of the motion of the conveyer belt, and up and down, near the end of the conveyer belt; and
a control device for controlling the motions of the conveyer belt and the cutter.

[0017] Further, the present inventions have the following technical features:

the apparatus for cutting the food dough explained in the above paragraph, wherein the cutter is disposed at a slider, which can reciprocate in a direction perpendicular to the direction of the motion of the conveyer belt, so as to be able to up and down; and the apparatus, further comprising:

a means for detecting a lateral end of the food dough before the cutter reaches the lateral end.

[0018] Further, the present inventions have the following technical features: the apparatus for cutting the food dough explained in the above paragraphs, further comprising:

a transfer conveyer for transferring long-shaped food

dough in a direction perpendicular to the direction of the movement of the conveyer belt, wherein the long-shaped food dough is cut from the food dough near the end of the conveyer belt and is fallen onto the transfer conveyer due to its weight.

[0019] Further, the present inventions have the following technical features:

the apparatus for cutting the food dough explained in the above paragraph, wherein the speed of the cutter in the forward direction corresponds to the speed of the transfer conveyer, and wherein the speed of the cutter in the backward direction is faster than that in the forward direction.

[0020] Further, the present inventions have the following technical features: the apparatus for cutting the food dough explained in the above paragraphs, further comprising:

a means for detecting a proximal end of the food dough being conveyed by the conveyer belt, wherein the control device includes a calculating means for adjusting a width of the food dough being cut by the cutter by determining a number of cuttings of the food dough based on the data detected by the means for detecting the proximal end so that the final process for cutting the food dough is completed by moving the cutter in the forward direction.

[0021] Further, the present inventions have the following technical features:

the apparatus for cutting the food dough explained in the above paragraphs, further comprising:

a means for detecting a turned edge of the long-shaped food dough, which is cut by the cutter.

[0022] Further, the present inventions have the following technical features:

a method for cutting flattened food dough into a long and continuous shape, comprising:

(a) a process for placing the food dough on a conveyer belt, wherein the conveyer belt conveys the food dough in one direction; and
(b) a process for cutting the food dough by rotating a reel-type cutter so that the reel-type cutter is pressed toward the conveyer belt while conveying the food dough by the conveyer belt,

wherein the reel-type cutter has a plurality of blades, which are disposed on an outer periphery of a cylindrical structure so that the blades are protruded in a spiral manner from the outer periphery of the cylindrical structure, each of the blades has a cutout part at one lateral end for not cutting the food dough, and the blades having the cutout parts at the right lateral ends and the blades having the cutout parts at the left lateral ends are alternately positioned side by side.

[0023] Further, the present inventions have the following technical features:

an apparatus for cutting flattened food dough into a long and continuous shape, comprising:

(a) a conveyer belt for conveying the food dough in one direction; and
(b) a reel-type cutter rolling in synchronization with a speed of the conveyer belt so that the reel-type cutter is pressed toward the conveyer belt,

wherein the reel-type cutter has a plurality of blades, which are disposed on an outer periphery of a cylindrical structure so that the blades are protruded in a spiral manner from the outer periphery of the cylindrical structure, each of the blades has a cutout part at one lateral end for not cutting the food dough, and the blades having the cutout parts at the right lateral ends and the blades having the cutout parts at the left lateral ends are alternately positioned side by side.

[0024] Further, the present inventions have the following technical features: the apparatus for cutting the food dough explained in the above paragraph, further comprising:

a transfer conveyer for transferring the long-shaped food dough, which is cut from the food dough near the end of the conveyer belt and is fallen onto the transfer conveyer due to its weight.

Effects of the Inventions

[0025] According to the present inventions, when the flattened food dough is cut into a continuous and long shape, it can be cut without compressing the whole of the food dough and without adding stress to the food dough.

Brief Description of the Drawings

[0026]

Fig.1 is an explanatory drawing to conceptually and schematically explain a method for cutting food dough by an apparatus for cutting the food dough, which is an embodiment of the present inventions.
Fig. 2 is a functional block diagram of a control de-

vice.

Fig. 3 is an explanatory drawing to explain each of cutting processes terminates by moving a cutter to one lateral end of food dough.

Fig. 4 is an explanatory side view of the apparatus for cutting the food dough to conceptually and schematically show a whole constitution of the apparatus.

Fig. 5 is an explanatory elevational view of the apparatus for cutting the food dough to conceptually and schematically show the whole constitution of the apparatus.

Fig. 6 is an explanatory plan view to conceptually and schematically show a constitution of another embodiment of the apparatus for cutting the food dough in which a moving direction of a transfer conveyer is changed.

Fig. 7 shows variations of cross-sectional shapes of blades for a rotary cutter.

Fig. 8 shows a plan view of an apparatus for cutting food dough of a second embodiment of the present inventions.

Fig. 9 shows an elevational view of an apparatus for cutting food dough of a third embodiment of the present inventions.

Fig. 10 shows a plan and an elevational view, of an apparatus for cutting food dough of another variation of the third embodiment.

Preferred Embodiments of the Inventions

[0027] Below, based on the drawings, a constitution of an apparatus for cutting food dough of a first embodiment of the present inventions is explained. To facilitate understanding of these inventions, first, functions of main components and a method for cutting food dough are explained.

[0028] Fig.1 is a set of explanatory drawings to conceptually and schematically explain processes for cutting food dough by an apparatus for cutting the food dough, which is a first embodiment of the present inventions. In each of drawings [A]~[F] of Fig. 1, (a) is an explanatory plan view to conceptually and schematically shows a state of the apparatus during a cutting process, and (b) is an explanatory elevational view to conceptually and schematically shows a state of the apparatus during a cutting process.

[0029] As conceptually and schematically shown in Fig. 1, the apparatus 1 for cutting the food dough of the first embodiment of the present inventions has a conveyer belt 5 for conveying the food dough 3 in the front-back direction (the direction indicated by an arrow "A" along a Y axis). The food dough 3 has a flattened shape, and is directly and horizontally disposed on the conveyer belt 5.

[0030] At the near end of the conveyer belt 5, a cutter 7, which is used to cut the food dough 3 in the lateral direction (the direction along an X axis), is disposed so as to freely reciprocate in the lateral direction and freely move up and down in the vertical direction (the direction along a Z axis). The apparatus 1 further has photo sensors 9A and 9B, as means for detecting a lateral end of the food dough before the cutter reaches the lateral end, to detect both lateral ends of the food dough 3 when the cutter 7 cut the food dough 3 by moving in the lateral direction. In case of the means for detecting the lateral end that is configured so as to revolve the photo sensor in the horizontal plane, only one sensor may be positioned anteriorly in the direction of movement of the cutter 7.

[0031] A transfer belt 11 is disposed under the distal end of the conveyer belt 5. The transfer belt 11 carries the food dough 4 that is cut by the cutter 7 and has a long shape (long-shaped food dough), such as a continuous and string-like, belt-like, or rod-like shape, toward the next step to process weighing and cutting it. In this embodiment, the transfer belt 11 extends in the direction along the lateral direction of the conveyer belt 5, which is perpendicular to the direction of the movement of the conveyer belt 5 (indicated by the arrow "A"). The transfer belt 11 carries the long-shaped food dough 3Ain the direction indicated by an arrow "B."

[0032] Movements for carrying the food dough by the conveyer belt 5 and the transfer belt 11 are driven by a servomotor (not shown in Fig. 1), for example. Thus, the movements of the conveyer belt 5 and the transfer belt 11 can be freely controlled by a control device 13, such as a computer. The cutter 7 moves in the lateral direction by a driving mechanism (not shown in Fig. 1), such as an endless belt that can rotate forward and backward, a ball-screw mechanism, and a fluid pressure actuated cylinder. Further, the cutter 7 moves vertically by an actuator (not shown in Fig. 1), such as a fluid pressure actuated cylinder. The movements of the cutter 7 in the vertical and lateral direction are controlled by the control device 13.

[0033] In the apparatus having the constitution explained in the above paragraphs, the food dough 3 is disposed on the conveyer belt 5, and the conveyer belt 5 is driven under the control of the control device 13. Then, when the food dough 3 is carried forward in the direction along the Y axis (indicated by the arrow "A"), a means (a photo sensor) 15 for detecting the distal end of the food dough 3, which is disposed at the predetermined position that is located at slightly upstream side of the distal end of the conveyer belt 5, detects the distal end of the food dough 3. When the photo sensor 15 detects the distal end of the food dough 3, the food dough 3 is further carried forward for a predetermined distance corresponding to a cut width W of the food dough to be cut, and then the conveyer belt 5 is stopped.

[0034] Namely, as explained in the above paragraph, when the photo sensor 15 detects the distal end of the food dough 3, the distance to be carried forward is calculated by a calculating means 17 (see Fig. 2) included in the control device 13, based on the relationship between the position of the cutter 7 and the position of the photo sensor 15 in the direction of the movement of the

food dough 3, and the predetermined cut width W of the food dough to be cut.

Then, based on the results of the calculation by the calculating means 17, a rotation of a Y-axis motor 19, which drives the conveyer belt 5, is controlled. When the distal end of the food dough 3 is carried forward for the distance corresponding to the cut width W from the position for cutting the food dough, the Y-axis motor 19 is stopped.

[0035] As explained in the above paragraph, when the distal end of the food dough 3 is carried forward for the distance corresponding to the cut width W from the position for cutting the food dough, the cutter 7, which is positioned at the predetermined location in the lateral direction, is lowered to the position for cutting, and then the distal end of the food dough 3 is cut by moving the cutter 7 in the lateral direction. Since the position for cutting the food dough 3 is located near the distal end of the conveyer belt 5, the long-shaped food dough 4A that is continuously cut from the food dough 3 in the lateral direction falls onto the transfer belt 11 due to its weight. The transfer belt 11 carries the long-shaped food dough 4A in the lateral direction (indicated by the arrow "B") perpendicular to the direction of the movement of the conveyer belt 5.

[0036] As shown in Fig. 1(A), when the direction of cutting the food dough 3 by the cutter 7 corresponds to the direction of the movement of the transfer belt 11, which is defined as "cutting in a forward direction," a velocity of the movement of the cutter 7 (a velocity of cutting) is appropriate level corresponding to the velocity of the movement of the transfer belt 11, such as at about half of the velocity of the movement of the transfer belt 11. Thus, when the long-shaped food dough 4A is fallen onto the transfer belt 11 due to its weight, it does not loop back on itself.

[0037] As explained in the above paragraphs, when the food dough 3 is cut by moving the cutter 7 in the direction indicated by the arrow "B" (cutting in the forward direction), when the photo sensor 9A, which is positioned anteriorly in the direction of the movement of the cutter 7, detects the right lateral end of the food dough 3, the cutter 7 is lifted up at the predetermined position apart from the right lateral end of the food dough under the control of the control device 13. Then the cutter 7 is moved to the position located outside the right lateral end of the food dough 3 so that an uncut part is left near the right lateral end. Namely, the food dough 3 and the long-shaped food dough 4A remain connected each other at the uncut part 3B near the right lateral end of the food dough 3.

[0038] As explained in the above paragraph, when the cutter 7 is moved to the position located outside the right lateral end of the food dough 3, the conveyer belt 5 is driven again, and stopped after the food dough 3 is carried forward for the distance corresponding to the cut width W. Then, the cutter 7 is lowered, and the following long-shaped food dough 4AA is cut off from the food dough, wherein the following long-shaped food dough 49A remains connected with the preceding long-shaped food dough 4A at the uncut part (namely, they are not completely separated from each other) by moving the cutter 7 to the left direction, i.e., in the reverse direction indicated by the arrow "B" ("in the backward direction"). In this process, the moving direction of the cutter 7 and that of the transfer belt 11 are opposite to each other. Thus, when the long-shaped food dough 4AA, which is cut and partly separated from the food dough 3, is fallen onto the transfer belt 11 due to its weight, it does not loop back on itself. Thus, when the direction of the movement of the cutter 7 for cutting the food dough 3 is opposite to the direction of the movement of the transfer belt 11 ("cutting in the backward direction"), the transfer belt 11 is driven under the control of the control device 13 so that the velocity of the movement of the transfer belt 11 is faster than that of the cutter 7.

[0039] When the cutter 7 comes close to the left lateral end of the food dough 3, and when the photo sensor 9A, which is positioned anteriorly in the direction of the movement of the cutter 7, detects the right lateral end of the food dough 3, the cutter 7 is lifted up so as to leave an uncut part 3C, as the same way in cutting in the forward direction. Then, after the cutter 7 is moved to the position located outside the left lateral end of the food dough 3, and the food dough 3 is carried forward for the distance corresponding to the cut width W, the food dough 3 is again cut by moving the cutter 7 in the right direction.

[0040] From the explanations in the above paragraphs, it can be understood that:

> By repeating that the flattened food dough 3 disposed on the conveyer belt 5 is carried forward for the distance corresponding to the cut width W, and by cutting the food dough 3 alternately in the left and right directions by the cutter 7 with the uncut parts being remained at the near left and right lateral ends of the food dough 3, the continuous and long-shaped food dough 4 can be cut out from the flattened food dough 3.

[0041] In the apparatus 1 for cutting the flattened food dough of the first embodiment of the present inventions, since the long-shaped food dough 4 cut out from the food dough 3 is fallen onto the transfer belt 11 from the distal end of the conveyer belt 5 due to its weight, and since the transfer belt 11 moves only in one direction (indicated by the arrow "B"), the movements of the conveyer belt 5 and the cutter 7 are controlled so that a final cut point of the food dough 3 is positioned at the right lateral end of the food dough 3, namely, so that the final cut point is positioned at the downstream side in the direction of the movement of the transfer belt 11.

[0042] A means (a photo sensor) 21 for detecting a proximal end of the food dough 3 is disposed at the side of the conveyer belt 5 and at a predetermined position that is located at the back (the upstream of the conveyer belt 5) of the means 15 for detecting the distal end of the

food dough 3. The photo sensor 21 detects the food dough 3 that is carried by the conveyer belt 5. As explained in the above paragraphs, the food dough 3 is cut into the continuous and long-shaped food dough 4 by the cutter 7, and is carried by the conveyer belt 5, while the cutting operations are repeated. Then, when the photo sensor 21 detects the proximal end of the food dough 3, the calculating means 17 calculates a number of cutting by the cutter 7 and a new cut width WA, for the remaining food dough 3.

[0043] Fig. 3 shows the condition that the food dough 3 is temporarily stopped at the position where the food dough 3 is carried forward for the distance corresponding to the cut width W from the position where the food dough 3 was previously cut, after detecting the proximal end of the food dough 3 by the photo sensor 21.

[0044] The length between the position 7C for cutting the food dough 3 and the proximal end of it is defined as (L-L1), wherein the distance between the position 7C for cutting by the cutter 7 and the photo sensor 21 is L, and wherein the distance between the photo sensor 21 and the proximal end of the food dough 3 is L1. The calculating means 17 calculates the distance L1, wherein L1 is the distance that the food dough 3 is further carried from the position when the photo sensor 21 detects the proximal end of the food dough 3, based on the information of the distance that the food dough 3 is conveyed from the time when the food dough 3 was previously cut to when the photo sensor 21 detects the proximal end of the food dough 3.

[0045] The length (L-L1) between the position 7C for cutting the food dough 3 and the proximal end of it, that is a remaining length, is calculated by a calculating means 23 to calculate the remaining length based on the length L and L1. The length L1 may be determined by measuring a distance that the food dough 3 is carried from the position when the photo sensor 21 detects the proximal end of the food dough 3 to the position when the movement of the food dough 3 is stopped.

[0046] However, productivity is improved by calculating the length L1 when the photo sensor 21 detects the proximal end of the food dough 3.

[0047] Then, a calculating means 25 calculates (L-L1)/W, based on the length (L-L1) and the cut width W, and then the number N (integer number) of cutting the rest of the food dough 3 is determined. Then, based on the results of the above calculation and information relating to the present position of the cutter 7, it is calculated at which lateral end of the food dough 3 the cutter 7 is to complete the cutting process, when the final cutting process to cut the food dough 3 is terminated. Further, the final cut width R of the food dough 3 that includes the proximal end is calculated.

[0048] Below, the method for calculating the new cut width WA is explained, in the case where it is calculated that the final cutting process to cut the food dough 3 is terminated when the cutter 7 completes the cutting process near the right lateral end of the food dough 3 after the cutter 7 cuts the food dough 3 in the direction indicated by the arrow "B" (in the forward direction). Since the final cut width R of the food dough 3 is narrower than the cut width W, the final cut width R may become extremely narrow as compared to the cut width W. In this case, pieces having predetermined weight cut from the long-shaped food dough 4 have a narrow shape, and this is not preferable in the following process, such as a process for rounding the pieces of the food dough.

[0049] Thus, to prevent the final cut width R from being extremely narrower than the predetermined cut width W, the calculating means 17 determines the new cut width WA as follows:

> If the final cut width R becomes wider than one-half of the cut width W, it is determined that the new cut width WA is equal to the cut width W, and if the final cut width R becomes narrower than one-half of the cut width W, the calculating means 17 calculates the new cut width WA based on the equation, WA=(L-L1)/(N+1), wherein the (L-L1) is the remaining length of the food dough 3. The threshold value, one-half of the cut width W, is just an example. The threshold value, a ratio of (the final cut width R)/(the cut width W), may be set as 70%, for example.

[0050] If the final cutting process to cut the food dough 3 is terminated when the cutter 7 completes the cutting process near the left lateral end of the food dough 3 after the cutter 7 cuts the food dough 3 in the reverse direction indicated by the arrow "B" (in the backward direction), a new cut width WA is calculated as follows: First, the setting of the number of cutting is changed so that one (1) is added to or subtracted from, the number N of cutting the rest of the food dough 3, and next, the new cut width WA is calculated based on the newly-set number of cutting the food dough 3.

[0051] At this time, for example, if the final cut width R of the food dough 3 becomes wider than one-half of the cut width W, one (1) is added to the number N of cutting the rest of the food dough 3, and the calculating means 17 calculates the new cut width WA based on the equation, WA=(L-L1)/(N+2), wherein the (L-L1) is the remaining length of the food dough 3 and the (N+1) is the newly-set number of cutting the food dough 3.

[0052] Further, if the final cut width R of the food dough becomes narrower than one-half of the cut width W, one (1) is subtracted from the number N of cutting the rest of the food dough 3, and the calculating means 17 calculates the new cut width WAbased on the equation, WA=(L-L1)/(N), wherein the (L-L1) is the remaining length of the food dough 3 and the (N-1) is the newly-set number of cutting the food dough 3.

[0053] In this way, the food dough 3 having the remaining length (L-L1) is cut into the long-shaped food dough 4 having the new cut width WA. Then, the apparatus 1 may be controlled so that the final cutting process to cut the food dough 3 is terminated when the cutter 7 cuts it

in the direction indicated by the arrow "B" (in the forward direction), and completes the cutting process near the right lateral end of the food dough 3.

[0054] Thus, at the end of the processes for cutting the food dough 3, when the thin and long-shaped part of the food dough 3 that is placed on the distal end of the conveyer belt 5 is fallen onto the transfer belt 11, it does not loop back on the preceding long-shaped food dough 4 on the transfer belt 11.

[0055] Next, the whole constitution of the apparatus 1 for cutting the food dough of the first embodiment of the present inventions is explained.

[0056] As it is conceptually and schematically shown in Fig. 4, the apparatus 1 for cutting the food dough of the first embodiment of these inventions has a frame 29 like a box having casters 27. A conveyer frame 31 being attached to an axis 33 is disposed at the back side (the left side in Fig. 4) of the frame 29, and can rotate about the axis 33. In particular, right and left conveyer brackets 35L and 35R (see Fig. 5) are disposed apart from each other in the lateral direction (indicated by the X axis) and at the nearly central part of the frame 25 in the vertical direction.

[0057] Further, the conveyer frame 31 is disposed at the back side (the left side in Fig. 4) of the conveyer brackets 35L and 35R, and is rotatable about the axis 33. The left end and the right end of the driving roller 37 extending in the lateral direction are rotatably supported at the conveyer brackets 35L and 35R, respectively. Then, the conveyer belt 5 having an endless loop is wound around a driven roller 39 disposed at the back end of the conveyer frame 31 (the left side in Fig. 4) and the driving roller 37.

[0058] A motor 41, such as a servomotor, is disposed at the frame 29 to drive the driving roller 37. A driving chain 47 having an endless loop is wound around a driving sprocket 43 rotated by the motor 41 and one relay sprocket 45A rotatably supported by the conveyer brackets 35L and 35R. Then, the driven chain 51 is wound around the other relay sprocket 45B connected in parallel to the relay sprocket 45A and a driven sprocket 49 connected to the driving roller 37. Further, the photo sensor 21 is disposed at one side of the conveyer frame 31 in the lateral direction, and the photo sensor 15 is disposed at either of the conveyer bracket 35L or 35R.

[0059] In the apparatus 1 having the configuration explained in the above paragraphs, the food dough 3 placed on the conveyer belt 5 can be carried forward (the right direction in Fig. 4). Further, the photo sensor 15 can detect the forward end (the distal end) of the food dough 3, and the photo sensor 21 can detect the proximal end of the food dough 3.

[0060] To cut the food dough 3 in the lateral direction near the distal end of the conveyer belt 5, upper and lower guide members 55 are disposed above the distal end of the conveyer belt 5, wherein the left and right ends of the upper and lower guide members 55 are supported by left and right side frames 53L and 53R of the frame 29. Further, a slider 57 is supported by the guide members 55 and is movable in the lateral direction. A actuator 59 driven vertically, such a fluid pressure actuated cylinder, is disposed at the slider 57. A supporting axis 63 horizontally extending in a front-back direction is disposed at the lower part of an up-and-down moving member 61, such as a piston rod, which is connected to the actuator 59 driven vertically and is vertically movable. The cutter 7 is rotatably attached to the supporting axis 63.

[0061] To move the slider 57 in the lateral direction, a motor bracket 65 is disposed above the space between the side frame 53L and the side frame 53R of the frame 29, and a motor 69 having a driving sprocket 67 is attached to the right part of the motor bracket 65. Further, a supporting bracket 72, to which a driven sprocket 71 is rotatably attached, is disposed at the left part of the motor bracket 65. A chain 70 having an endless loop is wound around the driving sprocket 67 and the driven sprocket 71, and the chain 70 and a part of the slider 57 are integrally connected to each other by means of a connecting plate 76.

[0062] Thus, the slider 57 can be moved in the lateral direction by rotating the motor 69 in clockwise and counter-clockwise direction. Further, the cutter 7 can be moved up and down by driving the actuator 59 driven vertically. Thus, as explained in the above paragraphs, the food dough 3 being carried forward by the conveyer belt 5 can be cut into the long-shaped food dough 4.

[0063] A transfer conveyer 73, which has the conveyer belt 11 for carrying the long-shaped food dough 4 cut from the food dough 3, to the right side in the lateral direction, is disposed below the distal end of the conveyer belt 5.

[0064] Further, a carrying conveyer 75, which carries the long-shaped food dough 4 moved downward from the distal end of the transfer conveyer 73, in the reverse direction, is disposed under the transfer conveyer 73.

[0065] A cutting device 77, such as a guillotine cutter, for cutting the long-shaped food dough 4 into pieces 4C having a predetermined weight is disposed at the downstream of the carrying conveyer 75. A weighing conveyer 79, which weighs the long-shaped food dough 4 to be cut when it is cut into the pieces 4C by the cutting device 77, is also disposed at the downstream side of the carrying conveyer 75. Further, a second weighing conveyer 81, which weighs the pieces 4C cut from the long-shaped food dough 4, is disposed at the downstream of the weighing conveyer 79.

[0066] Since the carrying conveyer 75, the cutting device 77, and the weighing conveyer 79 and 81 are already well-known, the explanation of the constitutions of these devices is omitted.

[0067] The cutter 7 of the first embodiment is not limited to a disk-like rotary cutter shown in Fig. 1, 5, and 6. An ultrasonic cutter (not shown), which cuts while vibrating a knife-like blade with about tens of microns of small amplitude and with tens of KHz of high frequency, may be used for the cutter 7.

[0068] Further, in case of using the disk-like rotary cutter, the rotary cutter having shapes of the blades as shown in Fig. 7 may be used for the cutter 7. Namely, the rotary cutters that have a blade having a sharp edge at its periphery (see Fig. 7(a)), a blade having a blunt and rounded edge at its periphery (see Fig. 7(b)), a blade having a sharp edged part at a blunt and rounded edge at its periphery (see Fig. 7(c)), and a blade having a step-like part, where the thickness of the blade is different from the other part, near the edge at its periphery (see Fig. 7(d)), may be used for the cutter 7.

[0069] The flattened food dough 3 in the present inventions contains not only a plate-like food dough formed by a well-known apparatus for extending food dough, but also a flattened food dough fermented in a tray.

[0070] From the explanation in the above paragraphs, it can be understood that:

> According to the first embodiment, in the apparatus 1, the food dough 3 is directly placed on the conveyer belt 5 and intermittently carried forward, and the food dough 3 is cut in a zig-zag manner by alternately moving the cutter 7 in the lateral direction. Thus, the food dough 3 can be cut into the long-shaped food dough 4 under a nearly stress-free condition.

[0071] In particularly, for the flattened food dough 3 fermented in a tray, since the food dough 3 is not stressed at all before the cutting process by using the method and apparatus of the present inventions, the long-shaped food dough, such as a continuous and string-like, belt-like, or rod-like shape, can be easily manufactured under the nearly stress-free condition.

[0072] In the first embodiment explained in the above paragraphs, it is possible to appropriately modify the configuration of the first embodiment.

[0073] Namely, it is possible to preliminarily set the position to move up and down the cutter 7 according to a width of the food dough 3 placed on the conveyer belt 5 in the lateral direction. In this configuration, the photo sensors 9A and 9B disposed at the right and left sides of the cutter 7 may be omitted. Further, a contact-type sensor contacting the food dough 3 may be used instead of using the photo sensors 9A and 9B.

[0074] Also, as shown in Fig. 6, it is possible that the apparatus 1 may include a transfer conveyer 11A, disposed under the conveyer belt 5, carrying the long-shaped food dough 4 in the same direction as that of the conveyer belt 5. If the width of the transfer conveyer 11A is narrower than that of the conveyer belt 5, the food dough 3 is cut in a zig-zag manner, while reciprocating the conveyer belt 5 in the lateral direction as shown in Fig. 6, so that the long-shaped food dough 4 cut from the food dough 3 is always placed on the transfer conveyer 11A. The guillotine cutter 77A is disposed near the downstream end of the transfer conveyer 11A. Further, the first and the second weighing conveyers 79A and 81A are disposed at the downstream side of the transfer conveyer 11A, and weigh the pieces 4C cut from the long-shaped food dough 4.

[0075] In the above explanation, the apparatus 1 has the transfer conveyer 11A having the width narrower than that of the conveyer belt 5, and has the transfer belt 5 reciprocating in the lateral direction. However, it is possible that the apparatus 1 has the transfer conveyer 11A having the width equal to that of the conveyer belt 5, and places the long-shaped food dough 4 on the transfer conveyer 11A in a zig-zag manner.

[0076] Below, a second embodiment of the present inventions is explained. In the explanation of the second embodiment, to avoid duplication, the explanation of the constitution having the same configuration as that of the first embodiment is omitted. Thus, below, only the different points are explained.

[0077] The difference between an apparatus 101 for cutting food dough of the second embodiment and the apparatus 1 of the first embodiment is a cutter.

[0078] In the first embodiment, the apparatus 1 for cutting the food dough has the cutter 7 that is the disk-like rotary cutter or the ultrasonic cutter. But, in the second embodiment, the apparatus 101 uses a reel-type cutter 107.

[0079] As shown in Fig. 8, the reel-type cutter 107 has a plurality of blades, which are spirally protruded from an outer periphery of a cylindrical structure. Each blade of the reel-type cutter 107 has an uncut part, wherein a part of the one end of the blade is trimmed away. The uncut parts of the neighboring spiral blades are alternately disposed side by side, at the right and the left ends of the blades (the right and the left sides in Fig. 8).

[0080] Namely, in the first spiral blade, the uncut part is disposed at the right end of the blade, and in the second spiral blade, the uncut part is disposed at the left side of the blade. In the following spiral blades, the uncut parts are alternately disposed in the same manner.

[0081] In the apparatus 101 for cutting the food dough having the configuration explained in the above paragraphs, the food dough 103 carried by the conveyer belt 105 has a width slightly narrower than that of the spiral blade (the length of the cylindrical structure in its longitudinal direction) disposed at the outer periphery of the cylindrical structure.

[0082] As shown in Fig. 8, the flattened food dough 103 carried by the conveyer belt 105 is cut in a zig-zag manner, by rotating the reel-type cutter 107 in synchronization with the velocity of the conveyer belt 105, by means of a servomotor (not shown), so as to push the reel-type cutter 107 toward the conveyer belt 105.

[0083] Namely, as explained in the above paragraph, since the uncut parts, i.e., a part of the blade trimmed away, are alternately disposed at the right and the left ends of the neighboring spiral blades, uncut parts are alternately formed at the right and the left ends of the flattened food dough 103.

[0084] Since the reel-type cutter 107 has the spiral-shaped blades, the whole spiral blade does not cut the

food dough 103 at one moment, but one point of the spiral blade contacts with the conveyer belt 105, and then the spiral blade sequentially cuts the food dough 103. Thus, the food dough 103 can be cut without receiving heavy stress.

[0085] As shown in Fig. 8, the food dough 103 cut on the conveyer belt 105 is fallen onto a transfer belt 111 disposed at the downstream side of and below, the conveyer belt 105 due to a weight of the cut food dough. By setting the velocity of the transfer belt 111 faster than the velocity of the conveyer belt 105, a continuous and string-like, belt-like, or rod-like shaped food dough can be formed.

[0086] Below, a third embodiment of the present inventions is explained based on Fig. 9. In the explanation of the third embodiment, to avoid duplication, the explanation of the constitution having the same configuration as that of the first and second embodiments is omitted. Thus, below, only the different points are explained.

[0087] The difference between an apparatus 201 for cutting food dough of the third embodiment and the apparatus 1 of the first embodiment is that the apparatus 201 has a photo sensor 203 for detecting a turned edge 4E of the long-shaped food dough 4A, which is cut by the cutter 7. The photo sensor 203 is disposed in front of the cutter 7 (at the near side from a viewer of Fig. 9), namely, above the distal end of the conveyer belt 5, and between the photo sensors 9A and 9B (see Fig. 9). The photo sensor 203 is disposed so as to move together with the cutter 7. A first weighing conveyer 79B, a second weighing conveyer 81B, and a carrying-out conveyer 205 are sequentially disposed at the downstream side of the transfer belt 11. The guillotine cutter 77B is disposed near and above the downstream end of the transfer conveyer 11.

[0088] The food dough 3 has a different physical property per food dough. In case where the food dough 3 is relatively soft and is fermented food dough with a high-viscosity, sometimes the long-shaped food dough 4 adheres to the conveyer belt 5 and is not fallen downwardly right away. In this case, if, as the same as in the first embodiment, the cutter 7 starts to cut the food dough 3 in the reverse direction under the control of the control device 13, before the long-shaped food dough 4 cut in first does not fall downward from the conveyer belt 5, the following long-shaped food dough 4 is cut. Thus, the previous food dough 4 and the following food dough 4 overlap and fall onto the transfer belt 11.

[0089] The overlapped long-shaped food dough 4 causes a trouble, namely it causes the first weighing conveyer 79 to reduce its precision.

[0090] Next, an operation of the cutter 7 of the apparatus 201 for cutting the food dough of the third embodiment is explained. When the food dough 3 is cut by moving the cutter 7 in the direction indicated by the arrow "B" (in the right direction in Fig. 9) (a cutting operation in the forward direction), after the photo sensor 9A positioned anteriorly at the cutter 7 detects the right lateral end of the food dough 3, the photo sensor 203 detects the turned edge 4E of the long-shaped food dough 4A, which is cut by the cutter 7, and the cutter 7 is lifted up at the predetermined position apart from the lateral end of the food dough 3, under the control of the control device 13.

[0091] By controlling the motion of the cutter 7 in this manner, when the cutter 7 changes its movement for cutting the food dough 3 from one direction to the other direction, the long-shaped food dough 4A is prevented from overlapping.

[0092] Further, another modified example of the apparatus 201 for cutting the food dough of the third embodiment is explained based on Fig. 10.

In this modified example, bar-like food dough 6 having a longitudinal cut width WA is cut from rectangular-shaped food dough 3 having a longitudinal length LA and a lateral length LB, and then pieces 6C having a lateral cut width WB are cut from the bar-like food dough 6.

[0093] The calculating means calculates the longitudinal cut width WA and the lateral cut width WB based on the longitudinal length LA and the lateral length LB of the food dough 3, by inputting an arbitrary dividing number for each cut width by means of an input device (not shown), such as a touch panel.

[0094] In the apparatus 201 for cutting the food dough of the modified example, the cutter 7 is designed so as to reciprocate for a predetermined interval. Further, a photo sensor 207 for detecting a downstream end of the bar-like food dough 6 is disposed at a side of and near, the distal end of a transfer belt 11. Further, a first weighing conveyer 79B and a second weighing conveyer 81B are used as carrying conveyers continuously driven at the same velocity as that of the transfer belt 11.

[0095] In the apparatus having the constitution explained in the above paragraphs, the food dough 3 is placed on the conveyer belt 5, and the conveyer belt 5 is driven under the control of the control device 13. When the food dough 3 is carried forward in the Y axis direction, the distal end of the food dough 3 is detected by the photo sensor 15. Next, the distal end of the food dough 3 is carried forward for the distance corresponding to the longitudinal cut width WA from the position for cutting the food dough 3 by the cutter 7, and then, the conveyer belt 5 is stopped.

[0096] Then, the cutter 7, which is positioned at the predetermined location at the left side in the lateral direction, is lowered onto the conveyer belt 5, and next, the distal end of the food dough 3 is cut by moving the cutter 7 toward the right side in the lateral direction at a high velocity. The bar-like food dough cut by the cutter 7 is fallen onto the stopped transfer belt 11. When the bar-like food dough 6 is carried in the direction indicated by the arrow "B" by the transfer belt 11, the photo sensor 207 detects the distal end of the bar-like food dough 6. When the bar-like food dough 6 is carried forward for the distance corresponding to the lateral cut width WB, based on signals from the photo sensor 207, the bar-like food dough 6 is cut into pieces 6C by driving a guillotine cutter

77B. For the last piece 6C, the guillotine cutter 77B is not driven. Namely, if the bar-like food dough 6 is cut into six equal pieces, the guillotine cutter 77B is driven at five times.

[0097] The cutter 7 is moved to the predetermined position at the right side while cutting food dough 3 into the bar-like food dough 6, and then lifted up. When the bar-like food dough 6 placed on the transfer belt 11 is carried from the area under the distal end of the conveyer belt 5 to the outside of the area, the conveyer belt 5 is driven again, carries the food dough 3 forward for the distance corresponding to the longitudinal cut width WA, and then is stopped.

[0098] Next, the following bar-like food dough 6 is cut from the food dough 3 by lowering the cutter 7 and then moving it at a high velocity toward the left end in the lateral direction, and the bar-like food dough 6 is fallen onto the transfer belt 11. Then, as the same as explained in the above paragraphs, the pieces 6C are cut from the bar-like food dough.

[0099] From the explanation in the above paragraphs, it can be understood that:

> The rectangular-shaped food dough 3 placed on the conveyer belt 5 is cut into the bar-like food dough 6 having the longitudinal cut width WA, which is equally divided the food dough 3 having a longitudinal length LA, by a predetermined number based on the longitudinal length LA. Further, the bar-like food dough 6 is cut into the pieces 6C having the lateral cut width WB, which is equally divided the food dough 3 having a lateral length LB, by a predetermined number based on the lateral length LB. In this way, the rectangular-shaped food dough 3 can be cut into a predetermined number of pieces 6C.

[0100] Also, in this embodiment, the fine-shaped pieces 6C can be cut from the food dough under the nearly stress-free condition.

Explanations of Denotations

[0101]

1	an apparatus for cutting food dough
3	food dough
3B, 3C	an uncut part
4	long-shaped food dough
4E	a turned edge
5	a conveyer belt
6	bar-like food dough
6C	a piece
7	a cutter
7C	a position for cutting food dough
9A, 9B	a photo sensor (a means for detecting a lateral end of food dough)
11	a transfer belt
13	a control device
15	a photo sensor (a means for detecting a distal end of food dough)
17	a calculating means
21	a photo sensor (a means for detecting a proximal end of food dough)
23	a calculating means to calculate a remaining length
25	a calculating means to calculate a number for cutting a rest of food dough
101	an apparatus for cutting food dough of a second embodiment
103	food dough
105	a conveyer belt
107	a reel-type cutter
111	a transfer belt
201	an apparatus for cutting food dough of a third embodiment
203	a photo sensor
205	a carrying-out conveyer
207	a photo sensor
LA	a longitudinal length of food dough
LB	a lateral length of food dough
WA	a longitudinal cut width
WB	a lateral cut width

Claims

1. A method for cutting flattened food dough into a long and continuous shape, comprising:

> (a) a process for cutting the flattened food dough by moving a cutter relative to the food dough from one lateral end to the other lateral end of the food dough, and a process for discontinuing the cutting process by lifting up the cutter from the food dough so that an uncut part is left near the other lateral end;
> (b) a process for cutting the flattened food dough from the other lateral end to the one lateral end of the food dough after moving the cutter relative to the food dough along the direction perpendicular to the direction to cut the food dough, and a process for discontinuing the cutting process by lifting up the cutter from the food dough so that an uncut part is left near the one lateral end;
> (c) a process for moving the cutter relative to the food dough along the direction perpendicular to the direction to cut the food dough; and
> (d) processes for repeating the processes (a) to (c).

2. A method for cutting flattened food dough into a long and continuous shape, comprising:

> (a) a process for placing the flattened food dough on a conveyer belt, wherein the conveyer belt conveys the food dough in one direction;

(b) a process for cutting the food dough from one lateral end to the other lateral end of the food dough on the conveyer belt and near the end of it, by moving a cutter in a forward direction perpendicular to the direction of the movement of the conveyer belt, and a process for discontinuing the cutting process in the forward direction by lifting up the cutter from the food dough so that an uncut part is left near the other lateral end;
(c) a process for conveying the food dough for a predetermined distance by driving the conveyer belt;
(d) a process for cutting the food dough from the other lateral end to the one lateral end of the food dough by moving a cutter in a backward direction opposite to the forward direction, and a process for discontinuing the cutting process in the backward direction by lifting up the cutter from the food dough so that an uncut part is left near the one lateral end;
(e) the same process as (c); and
(f) processes for repeating the processes (b) to (e).

3. The method for cutting the flattened food dough according to claim 2, further comprising:

a process for transferring long food dough in the forward direction by a transfer conveyer positioned below the end of the conveyer belt, wherein the long food dough is cut from the flattened food dough and is fallen onto the transfer conveyer due to its weight,
wherein the speed of the cutter in the backward direction is faster than that in the forward direction.

4. The method for cutting the flattened food dough according to claim 3, wherein the speed of the cutter in the forward direction corresponds to the speed of the transfer conveyer.

5. The method for cutting the flattened food dough according to claim 3 or 4, wherein the final process for cutting the food dough is the process wherein the cutter is moving in the forward direction.

6. The method for cutting the flattened food dough according to any of claims 1-5, wherein the flattened food dough is fermented on a tray.

7. An apparatus for cutting flattened food dough into a long and continuous shape, comprising:

a cutter being able to reciprocate horizontally between one lateral end and the other lateral end of the food dough and up and down vertically, relative to the food dough; and
a means for carrying the food dough in a direction perpendicular to the direction of the reciprocating motion of the cutter, in an intermittent manner and relative to the food dough.

8. An apparatus for cutting flattened food dough into a long and continuous shape, comprising:

a conveyer belt for conveying the flattened food dough in one direction;
a cutter being able to reciprocate in a direction perpendicular to the direction of the motion of the conveyer belt, and up and down, near the end of the conveyer belt; and
a control device for controlling the motions of the conveyer belt and the cutter.

9. The apparatus for cutting the food dough according to claim 8,
wherein the cutter is disposed at a slider, which can reciprocate in a direction perpendicular to the direction of the motion of the conveyer belt, so as to be able to up and down; and
the apparatus, further comprising:

a means for detecting a lateral end of the food dough before the cutter reaches the lateral end.

10. The apparatus for cutting the food dough according to claim 8 or 9, further comprising:

a transfer conveyer for transferring long-shaped food dough in a direction perpendicular to the direction of the movement of the conveyer belt, wherein the long-shaped food dough is cut from the food dough near the end of the conveyer belt and is fallen onto the transfer conveyer due to its weight.

11. The apparatus for cutting the food dough according to claim 10,
wherein the speed of the cutter in the forward direction corresponds to the speed of the transfer conveyer, and wherein the speed of the cutter in the backward direction is faster than that in the forward direction.

12. The apparatus for cutting the food dough according to any of claims 8-11, further comprising:

a means for detecting a proximal end of the food dough being conveyed by the conveyer belt, wherein the control device includes a calculating means for adjusting a width of the food dough being cut by the cutter by determining a number of cuttings of the food dough based on the data detected by the means for detecting the proximal

end so that the final process for cutting the food dough is completed by moving the cutter in the forward direction.

13. The apparatus for cutting the food dough according to any of claims 8-12, further comprising:

a means for detecting a turned edge of the long-shaped food dough, which is cut by the cutter.

14. A method for cutting flattened food dough into a long and continuous shape, comprising:

(a) a process for placing the food dough on a conveyer belt, wherein the conveyer belt conveys the food dough in one direction; and
(b) a process for cutting the food dough by rotating a reel-type cutter so that the reel-type cutter is pressed toward the conveyer belt while conveying the food dough by the conveyer belt,

wherein the reel-type cutter has a plurality of blades, which are disposed on an outer periphery of a cylindrical structure so that the blades are protruded in a spiral manner from the outer periphery of the cylindrical structure, each of the blades has a cutout part at one lateral end for not cutting the food dough, and the blades having the cutout parts at the right lateral ends and the blades having the cutout parts at the left lateral ends are alternately positioned side by side.

15. An apparatus for cutting flattened food dough into a long and continuous shape, comprising:

(a) a conveyer belt for conveying the food dough in one direction; and
(b) a reel-type cutter rolling in synchronization with a speed of the conveyer belt so that the reel-type cutter is pressed toward the conveyer belt,

wherein the reel-type cutter has a plurality of blades, which are disposed on an outer periphery of a cylindrical structure so that the blades are protruded in a spiral manner from the outer periphery of the cylindrical structure, each of the blades has a cutout part at one lateral end for not cutting the food dough, and the blades having the cutout parts at the right lateral ends and the blades having the cutout parts at the left lateral ends are alternately positioned side by side.

16. The apparatus for cutting the food dough according to claim 15, further comprising:

a transfer conveyer for transferring the long-shaped food dough, which is cut from the food dough near the end of the conveyer belt and is fallen onto the transfer conveyer due to its weight.

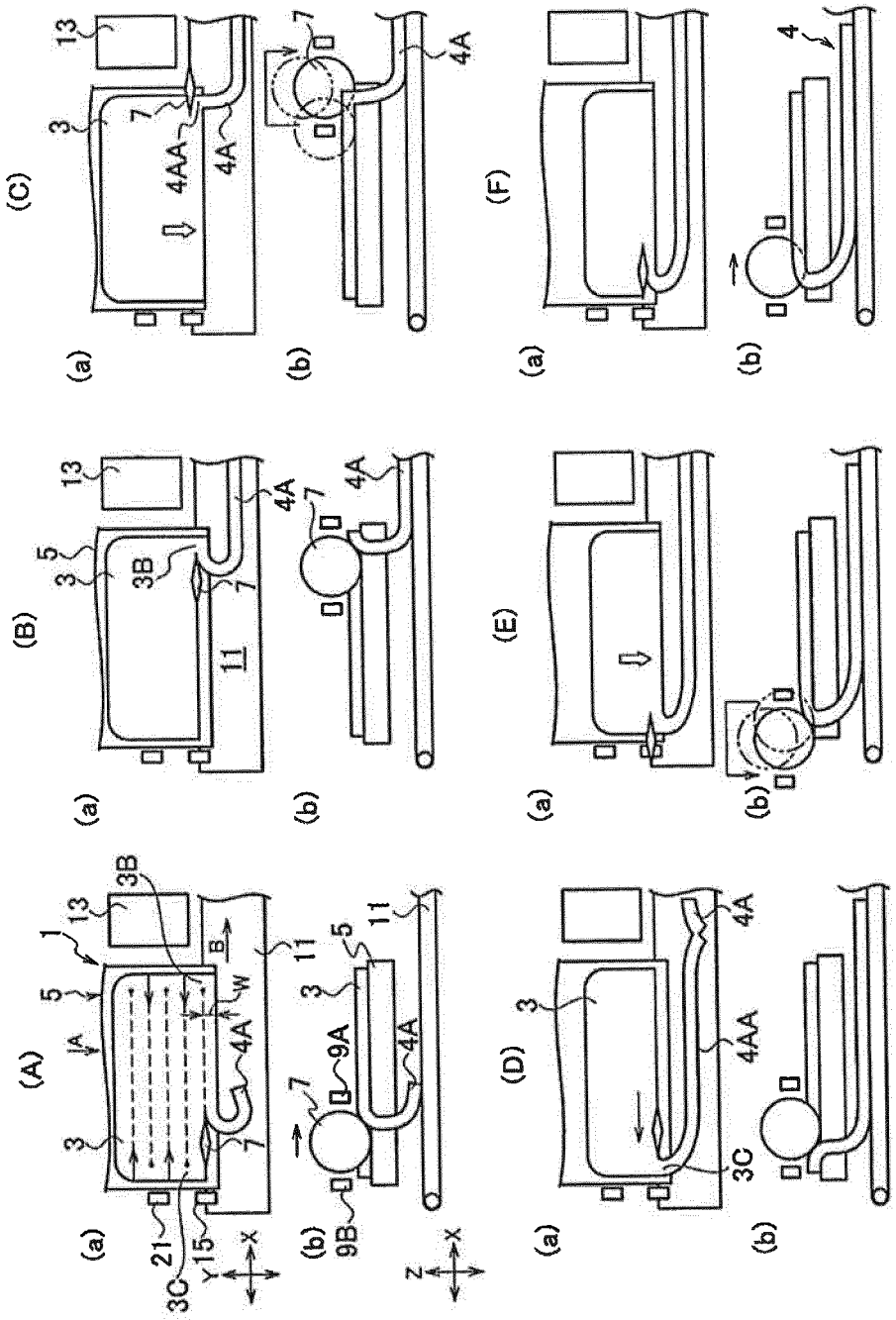


Fig. 1

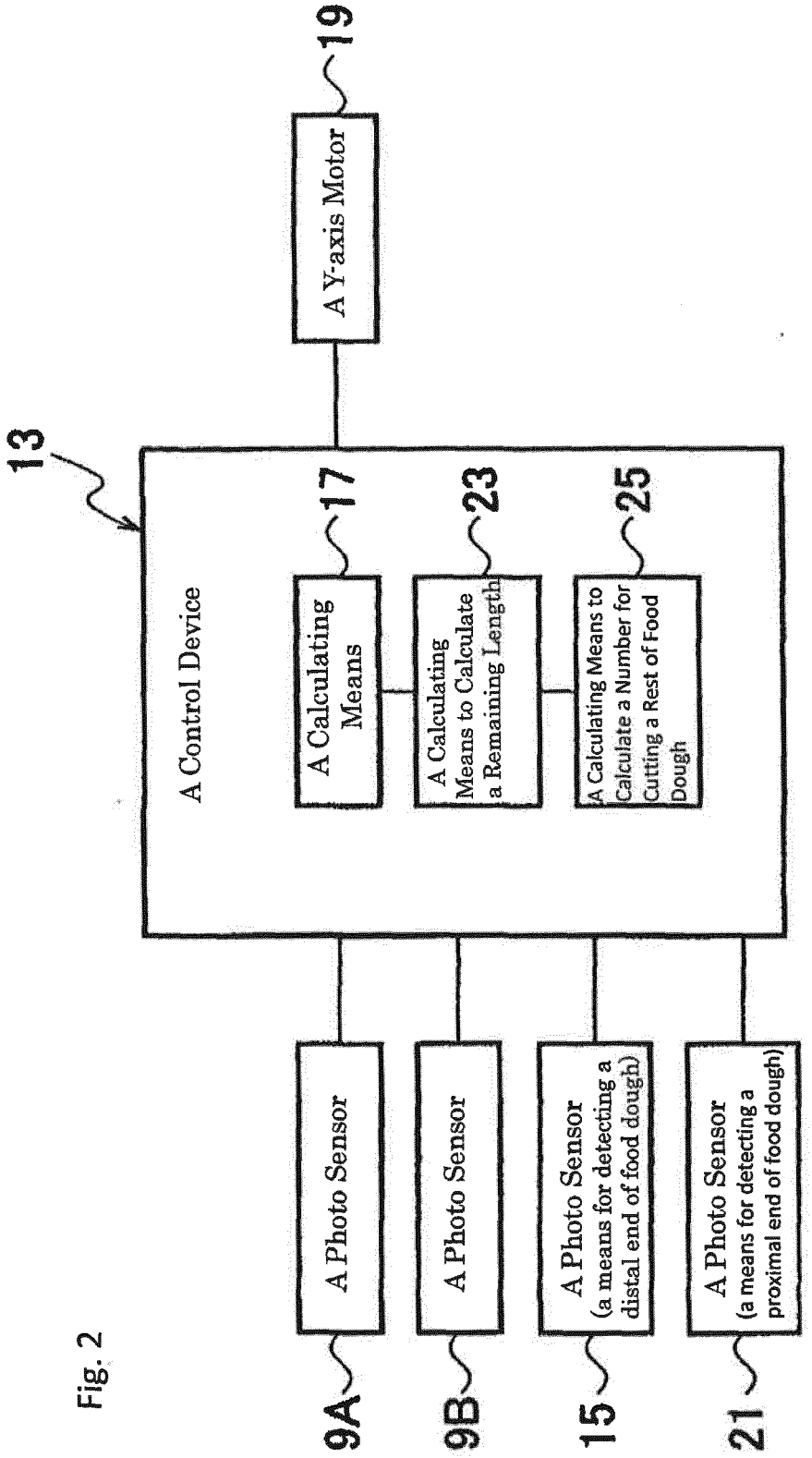

19
A Y-axis Motor
13
A Control Device
17
A Calculating Means
23
A Calculating Means to Calculate a Remaining Length
25
A Calculating Means to Calculate a Number for Cutting a Rest of Food Dough
A Photo Sensor
A Photo Sensor
A Photo Sensor (a means for detecting a distal end of food dough)
A Photo Sensor (a means for detecting a proximal end of food dough)
9A
9B
15
21

Fig. 2

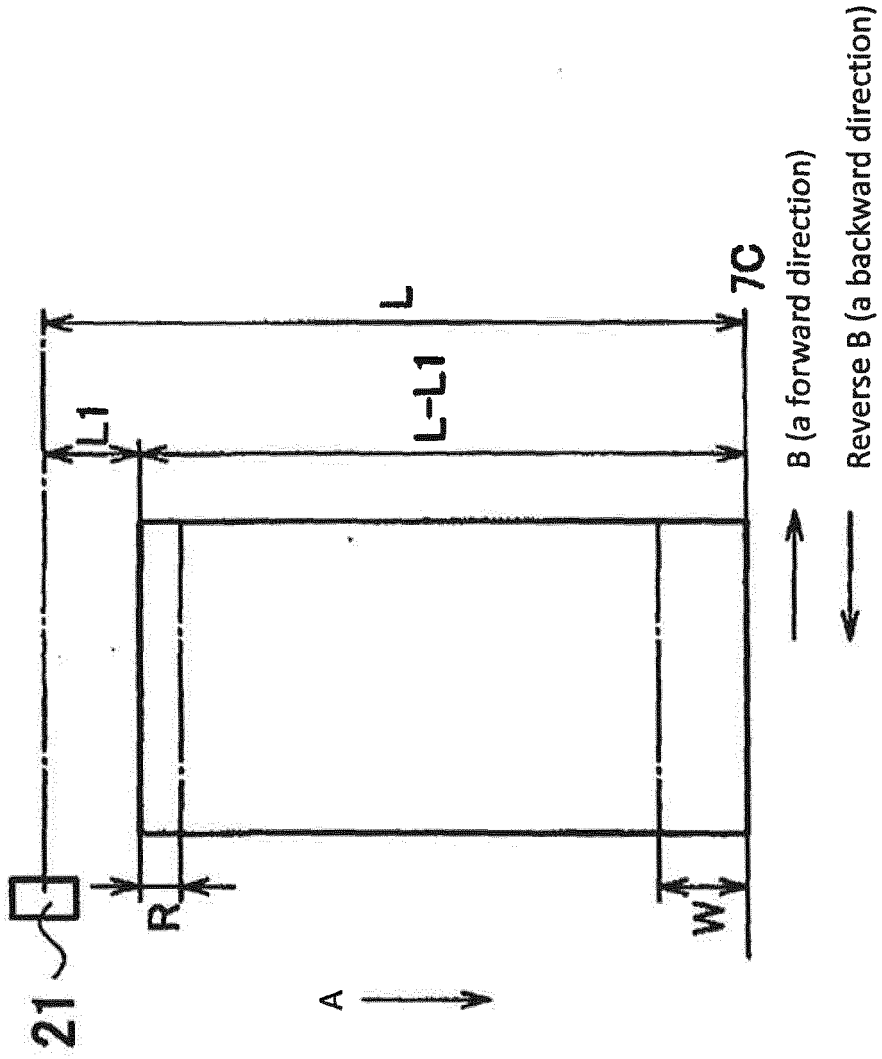

L
7C
L1
L-L1
B (a forward direction)
Reverse B (a backward direction)
21
R
W
A

Fig. 3

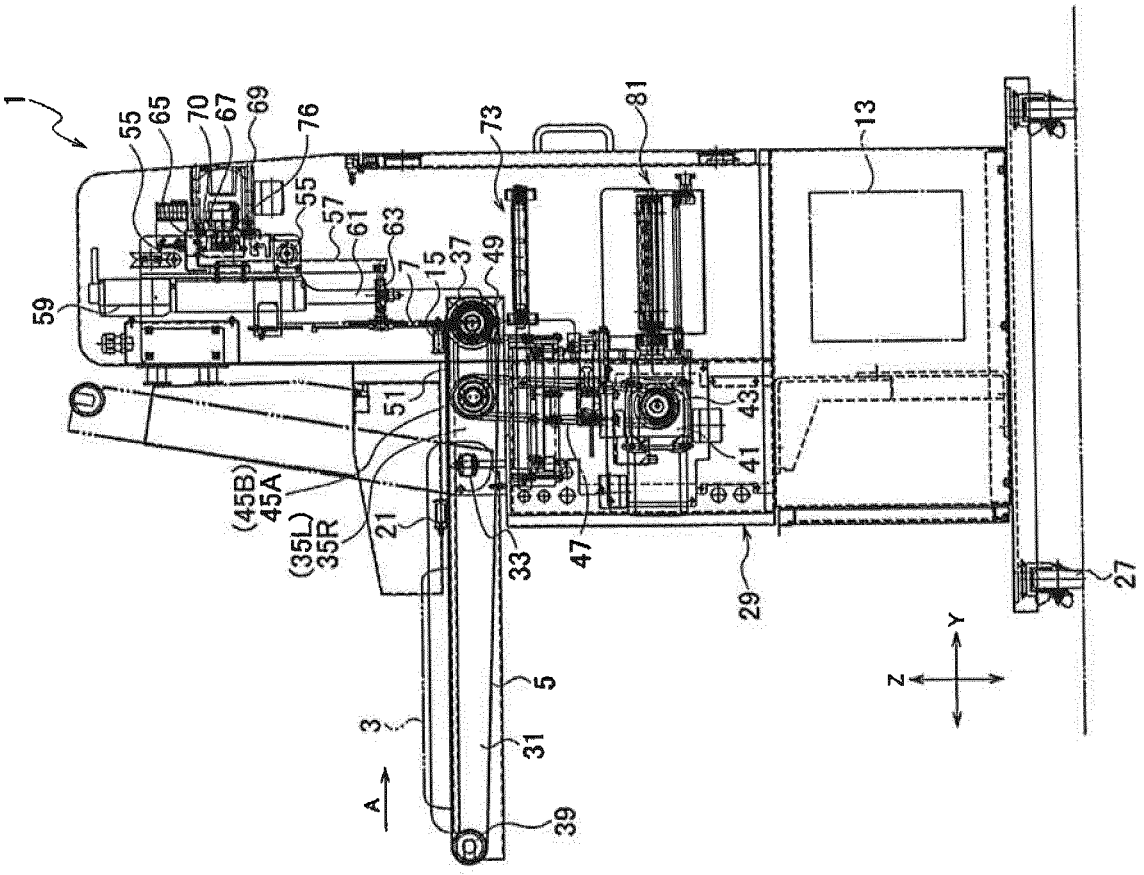

1
55
65
70
67
69
76
55
57
61
63
7
15
37
49
73
81
13
59
51
43
41
(45B)
45A
(35L)
35R
21
33
47
29
27
Y
Z
3
5
31
39
A

Fig. 4

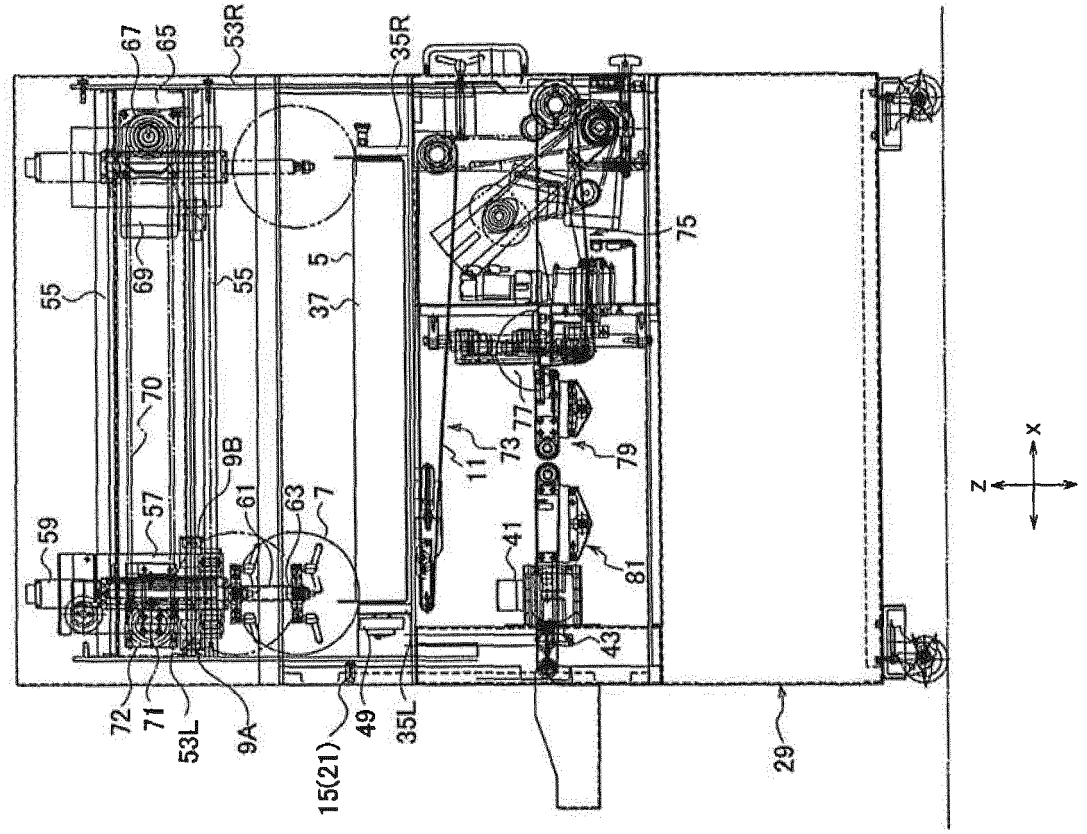

67
65
53R
35R
75
55
69
55
5
37
70
77
73
11
79
9B
61
63
7
57
59
41
81
43
72
71
53L
9A
15(21)
49
35L
29
X
Z

Fig. 5

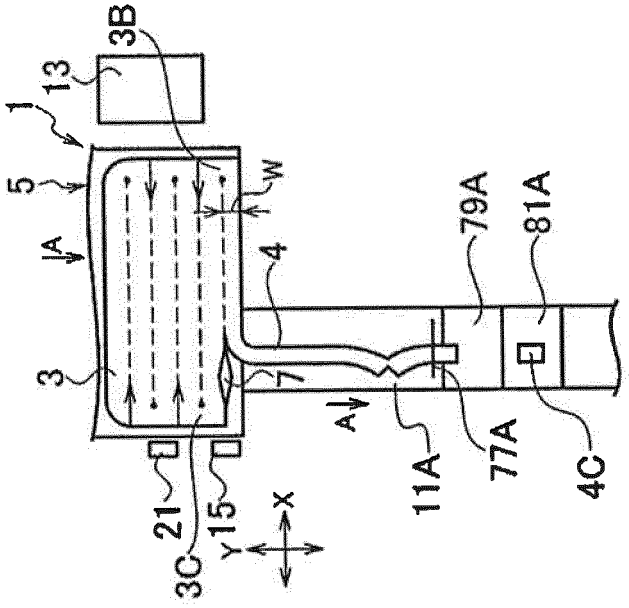


Fig. 6

Fig. 7

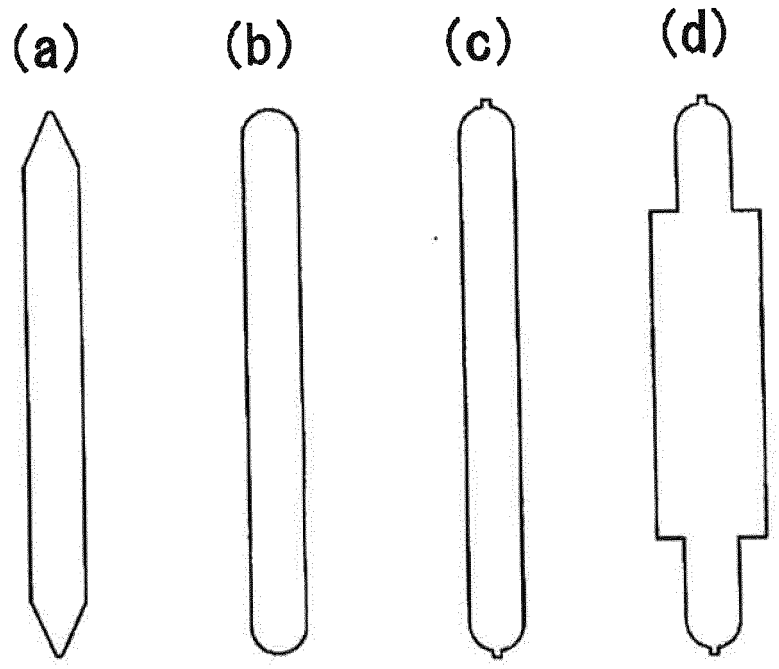


Fig. 8

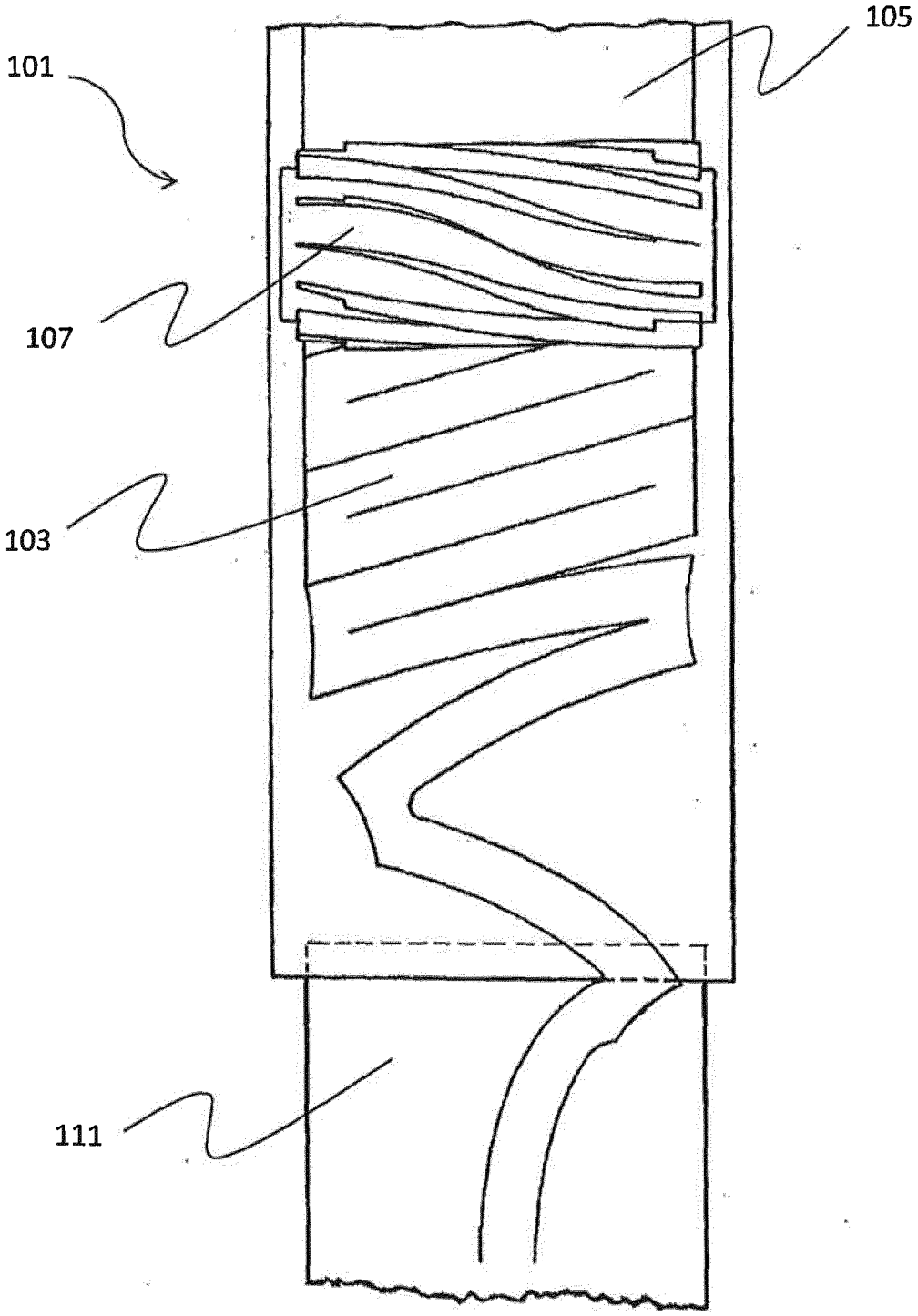


Fig. 9

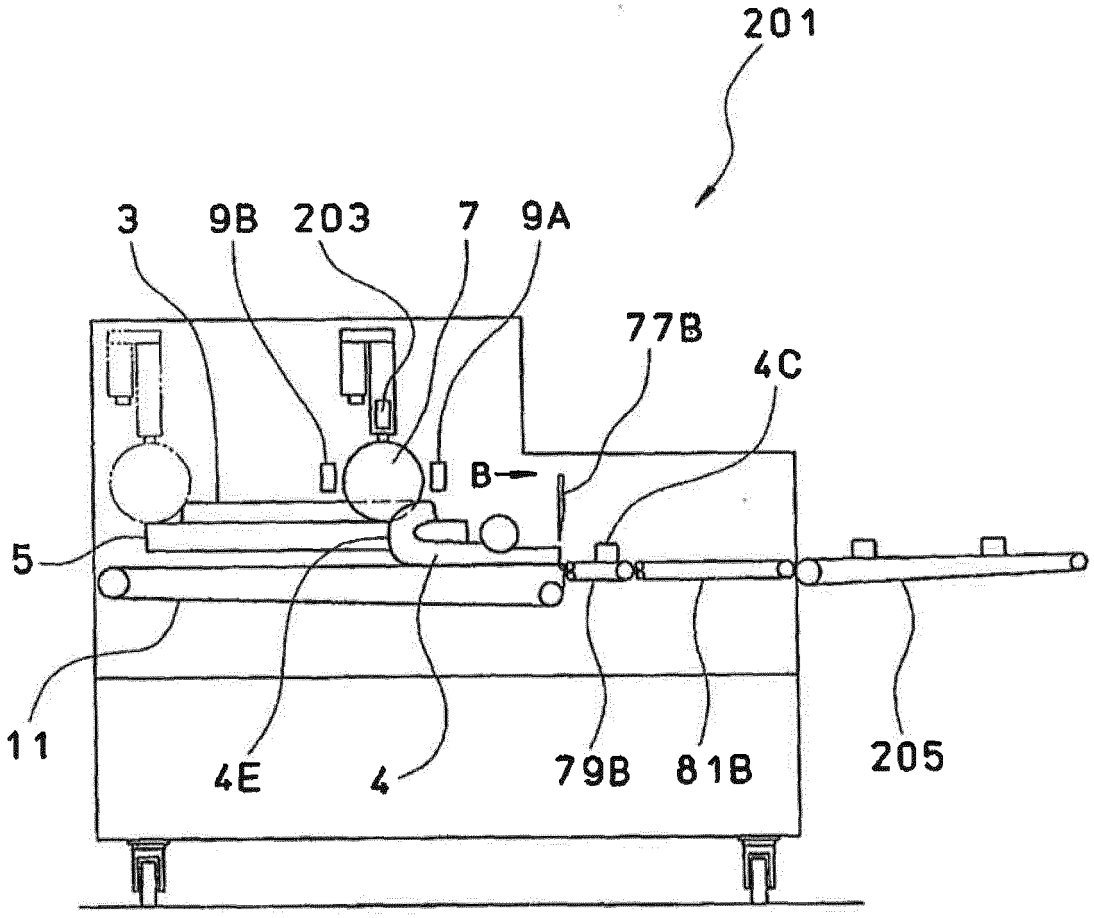
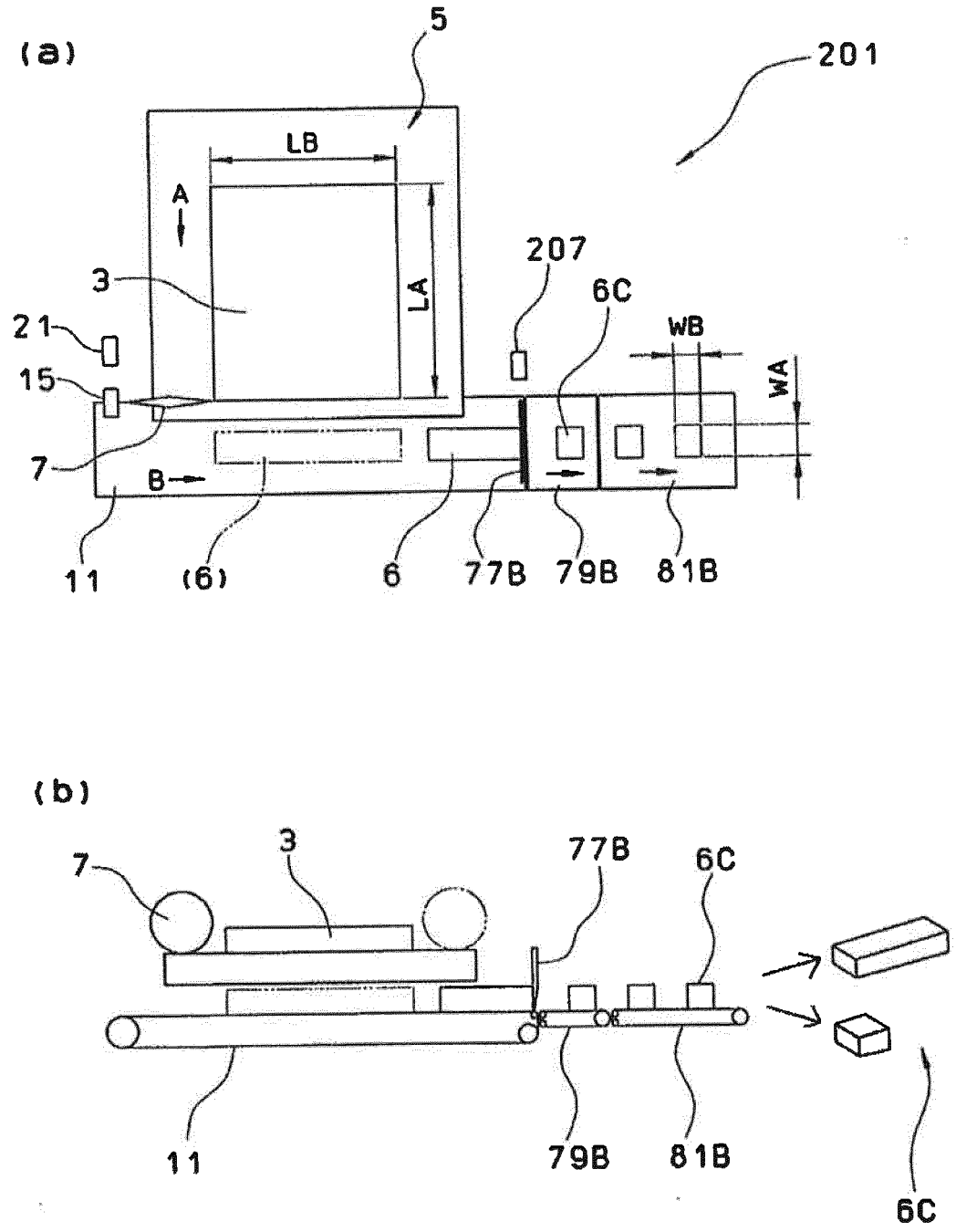


Fig. 10


(a)
5
201
LB
A
LA
207
6C
3
21
WB
15
WA
7
B
11
(6)
6
77B
79B
81B
(b)
7
3
77B
6C
11
79B
81B
6C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/065110

A. CLASSIFICATION OF SUBJECT MATTER
A21C11/10(2006.01)i, *B26D1/36*(2006.01)i, *B26D3/10*(2006.01)i, *B26D3/24*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A21C11/10, B26D1/36, B26D3/10, B26D3/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2007-189955 A (Anzen Foods Kabushiki Kaisha), 02 August 2007 (02.08.2007), paragraphs [0023] to [0041]; all drawings (Family: none)	7-8 10 1-6,9,11-13
Y A	JP 2912836 B2 (Firma Emil Lihotzky Maschinenfabrik), 28 June 1999 (28.06.1999), paragraphs [0044] to [0045]; fig. 5 to 6 & JP 7-284365 A & DE 4338232 A1 & KR 10-0139715 B & CN 1111935 A	10,16 11-13
Y	JP 11-9178 A (Yamazaki Baking Co., Ltd.), 19 January 1999 (19.01.1999), paragraph [0039]; fig. 8 (Family: none)	14-16

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 August, 2014 (15.08.14)	26 August, 2014 (26.08.14)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/065110

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2007-166942 A (Rheon Automatic Machinery Co., Ltd.), 05 July 2007 (05.07.2007), paragraph [0010]; fig. 4 (Family: none)	14-16
Y	US 2003/0175393 A1 (BARROCHE HEINRICH, Wilfried), 18 September 2003 (18.09.2003), fig. 3 & WO 2002/080683 A2 & CA 2418487 A	14-16
A	JP 2003-304799 A (Rheon Automatic Machinery Co., Ltd.), 28 October 2003 (28.10.2003), (Family: none)	1-16

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/065110

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See extra sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/065110

Continuation of Box No.III of continuation of first sheet(2)

The inventions of claim 1, claim 7, and claim 8 have a common technical feature, i.e., "food dough cutting for cutting flat food dough into a series of elongated food dough by a cutter, the cutter being capable of reciprocating relatively in a direction from one side edge to the other side edge of the horizontal flat food dough and capable of moving up and down."

However, the above-said technical feature cannot be considered to be a special technical feature, since the technical feature does not make a contribution over the prior art in the light of the contents disclosed in the document 1 (JP 2007-189955 A (Anzen Foods Kabushiki Kaisha), 02 August 2007 (02.08.2007), paragraphs [0023] to [0041], all drawings).

Further, there is no other same or corresponding special technical feature among these inventions.

Furthermore, the inventions of claim 1, claim 14, and claim 15 have a common technical feature, i.e., "food dough cutting for cutting flat food dough into a series of elongated food dough, the food dough being cut by a cutter."

However, the above-said technical feature cannot be considered to be a special technical feature, since the technical feature does not make a contribution over the prior art in the light of the contents disclosed in the document 1.

Further, there is no other same or corresponding special technical feature among these inventions.

Accordingly, claims are classified into three inventions each of which has a special technical feature indicated below.

(Invention 1) claims 1-6

"A method for cutting food dough, the method including: (a) a step of cutting flat food dough by moving a cutter relatively in a direction from one side edge to the other side edge of the food dough and stopping the cutting motion by removing the cutter from the food dough in an upward direction while leaving a not-yet-cut portion at a position close to the other side edge; (b) a step of moving the cutter to the food dough relatively in a direction orthogonal to the cutting direction, then cutting the food dough in a direction from the other side edge to the one side edge, and stopping the cutting motion by removing the cutter in an upward direction while leaving a not-yet-cut portion at a position close to the one side edge; (c) a step of moving the cutter to the food dough relatively in a direction orthogonal to the cutting direction; and (d) a step of repeating the steps (a) to (c) above a number of times as appropriate."

(Invention 2) claims 7-13

"A device for cutting food dough, the device including a transport means which is capable of intermittently transporting the food dough to a cutter relatively in a horizontal direction orthogonal to a reciprocating direction of the cutter."

Claims 7-13 are not relevant to inventions which involve all of the matters to define the invention in claim 1 and which have a same category.

(Continued to next extra sheet)

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INTERNATIONAL SEARCH REPORT

International application No.
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Further, as a result of the search which has been carried out with respect to claims classified into Invention 1, claims 7-13 are not relevant to inventions on which it is substantially possible to carry out a search without an additional prior-art search and judgment, and there is no other reason for that it can be considered that it is efficient to carry out a search on claims 7-13 together with claims 1-6, and consequently, it is impossible to classify claims 7-13 into Invention 1.

(Invention 3) claims 14-16

"A method for cutting food dough, the method including: (a) a step of placing flat food dough onto a transport belt for transporting the food dough in one direction; and (b) a step of cutting the food dough by rotating a reel-shaped cutter so as to push the cutter against the transport belt while transporting the food dough on the transport belt, wherein the reel-shaped cutter has a plurality of helically projected cutting edges disposed on the outer circumferential surface of a cylindrical structure, and each of the helical-shaped cutting edges includes a non-cutting part with one end portion cut away, the non-cutting part being disposed alternately on the right end portion and on the left end portion of the adjacent helical-shaped cutting edges."

Claims 14-16 are not relevant to inventions which involve all of the matters to define the inventions in claim 1 or 7 and 8, and which have a same category.

Further, as a result of the search which has been carried out with respect to claims classified into Invention 1, claims 14-16 are not relevant to inventions on which it is substantially possible to carry out a search without an additional prior-art search and judgment, and there is no other reason for that it can be considered that it is efficient to carry out a search on claims 14-16 together with claims 1-6 or claims 7-13, and consequently, it is impossible to classify claims 14-16 into Invention 1 or 2.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001095468 A **[0003]**
- WO 02080683 A2 **[0003]**