

APPARATUS AND METHOD FOR CONTINUOUSLY AND UNIFORMLY SUPPLYING DOUGH

Background of Invention1. Field of Invention

REPLACED SHEETS	SG
☐ Description : paged to paged	
☒ Claim(s) : paged <u>15</u> to paged <u>17</u>	
☐ Drawing(s) : paged to paged	
☒ Abstract : paged <u>18</u> to paged <u>19</u>	
DATE OF RECEIPT	

This invention relates to a method and an apparatus for continuously and uniformly supplying highly viscous and elastic dough through a narrow space at the bottom of a hopper during a bread-making step.

2. Prior Art

Dough is a fluid material with a high viscosity and elasticity due to its gel structure. This has prevented dough from being uniformly and continuously fed through a narrow space between oppositely rotating rolls located below a hopper into which dough is supplied.

In a conventional apparatus, to uniformly and continuously discharge dough from the bottom of a hopper into which dough is supplied, a piston and a cylinder are provided at the bottom of the hopper. A predetermined amount of dough is sucked by means of the piston into the cylinder and then it is cut from the remainder and is extruded by the piston from the cylinder. These steps are repeated. Also, they are complex. These steps repeatedly cause a shearing stress in the dough, so that it loses its elasticity. Thus, a chemical additive such as potassium bromide is used to recover the elasticity before bread is made.

An arrangement of rolls that are horizontally and oppositely positioned is taught by Japanese Patent Publication Nos. 5-3253 and 6-37. Dough is continuously fed between the rolls, so that a web of dough is formed that has a constant thickness and width. This arrangement is similar to that of the rolls of this invention. However, this conventional apparatus cannot make a thin web of dough. Also, it does not completely eliminate the disadvantage of losing the elasticity of dough.

Summary of Invention

This invention is to overcome the disadvantages in the prior art where a complex and large apparatus and a step to recover the elasticity of dough are required for a dough-supplying step. This invention also avoids the disadvantages caused by the conventional apparatus when a web of dough is to be continuously and uniformly discharged.

An object of this invention is to provide an apparatus that includes oppositely positioned rolls located at the bottom of a hopper that is used to feed dough. Unlike the conventional apparatus, the gap between the rolls is periodically changed to avoid any concentrated stress in the dough. The dough is constantly and stably fed through the gap. As a result, the successive steps for making bread are simplified.

Another objet of this invention is to provide a method that comprises a step for continuously supplying dough from a hopper, and comprises a step for providing a pair of opposite rolls at the bottom of a dough-feeding hopper. The rolls are driven in opposite directions and linearly moving and/or swinging to repeatedly carry out pressing motions.

Further object of this invention is to provide a method that comprises a step for providing a plurality of pairs of rolls below the bottom opening of the hopper. The pairs of rolls are arranged vertically. Each pair of rolls rotates in opposite directions and repeats the pressing motion. The method also comprises a step for locating the pairs of rolls such that the distances between the pairs of rolls gradually decrease from the uppermost pair downwards to the lowermost pair.

The pair or the plurality of pairs of oppositely and horizontally positioned rolls may be provided as a pressing means at the bottom of a dough-feeding hopper. The rolls reciprocally and linearly move or reciprocally swing. By these motions the distances between the opposite rolls are repeatedly increased or decreased to press and remove the pressure from the dough, so that the inner stress of the dough is prevented from increasing, and so that a web of dough having a predetermined thickness can be continuously discharged from an opening at the bottom of the hopper.

Brief Description of the Drawings

Fig. 1 is a view of the first embodiment of this invention, to explain its function.

Figs. 2 and 3 are sectional views of the first embodiment, to explain its function.

Figs. 4-7 are sectional views of alternatives to the first embodiment, to explain their functions.

Fig. 8 is a sectional view of the second embodiment of this invention, to explain its function.

Fig. 9 is a sectional view of the third embodiment of this invention, to explain its function.

Fig. 10 is a sectional view of the fourth embodiment of this invention, to explain its function.

Figs. 11-14 are sectional views of the fifth embodiment of this invention, to explain its function.

Fig. 15 is a sectional view of the sixth embodiment of this invention.

Fig. 16 is a sectional view of the seventh embodiment of this invention.

Description of the Preferred Embodiment

Fig. 1 illustrates a conventional apparatus. It includes a hopper 1, which stores dough 3. Rolls 2 and 2' are provided at the bottom of the hopper. They are opposite each other and have a gap c between them to press the dough 3. This apparatus cannot allow the dough 3 to be fed from a hopper 1 because of the following reasons.

A study revealed that, as in Fig. 1, when the rolls 2 and 2' were rotated in the direction of arrows a, the dough 3 in the hopper 1 flowed in the directions of arrows b1 and b2. It was difficult for the dough to flow toward the gap c between the rolls 2 and 2'.

This phenomenon is caused by the two flows of the dough caused by the two rolls when they rotate in the directions of arrows a. That is, the two flows collide with each other, and then flow together in the directions of arrows b1 and b2. The directions b1 and b2 are the reverse of the direction toward the gap c between the rolls 2 and 2'. The reason is that the stress in the dough 3 at the gap is higher than that at the upper portion of the dough 3. Thus, this invention is to reverse these stresses, i.e., to make the stress in the dough at the gap be lower than that at the upper position of the dough, so that the dough 3 can be fed out through the gap stably.

Figs. 2 and 3 show a first embodiment of this invention. It includes the rolls 2 and 2'. However, they are moved by a suitable means (not shown) to recede from or approach each other. The reversal of

the stresses is carried out by periodically widening the gap c between the opposite rolls by moving them. The arrows d in Fig. 2 show the directions of the rolls when they move outwardly. When the gap is widened to equal the gap c_2 , as in Fig. 2, the stress at the position b_1 in the dough decreases. As a result, the dough 3 flows into the gap c_2 . When the gap c is widened to equal the gap c_2 to decrease the stress at that gap, the surfaces of the rolls can lead the dough 3 in the directions of the arrows a by the friction between the surface of each roll and the dough. Therefore, when the stress at the position b_1 decreases, the dough 3 is led by the surfaces of the rolls 2 and 2', so that the dough 3 can flow in the directions of the arrows a , and flow through the gap c , as in Fig. 3.

Then, the rolls move to return to their original positions to form the narrow gap c_1 . As they move, the dough 3 is pressed by them, so that the friction between the surfaces of the rolls and the dough increases. As shown by the mark b in Fig. 3, the dough 3 is discharged through the gap. That is, when the wide gap c_2 is narrowed to equal the narrow gap c_1 , friction between the surfaces of the rolls and the dough 3 can be generated, so that the dough can be continuously discharged through the gap. By repeating the movement of the rolls a stable and continuous discharge of the dough can be achieved.

A study on the discharge of the dough found that the discharge rate of the dough in Fig. 3 was substantially the same as the

circumferential speed of the rolls. The widening and narrowing of the gap did not cause any change in the size of the material when it was discharged through the gap.

In the first embodiment of this invention, the rolls 2,2', which are arranged opposite each other to press the dough 3, linearly reciprocate when the gap c is widened and narrowed. Alternatively, as in Figs. 4 and 5, the roll 2 may be fixed at a predetermined position, while the roll 2' may reciprocate. The cross-sectional shapes of these rolls are not limited to be circular. For example, rolls can be polygonal (see rolls 2A and 2A' in Fig. 6), polygonal with rounded corners (not shown), or with concave or convex portions (see rolls 2B and 2B' in Fig. 7).

As stated above, in the first embodiment a pair of the rolls 2,2' linearly reciprocates. However, a pair of rolls can be made to swing to widen or narrow a gap c through which dough is discharged (not shown). These rolls can generate effects similar to those of the rolls 2,2'.

Next, a second embodiment of this invention is now explained by reference to Fig. 8. It has additional advantages over the first embodiment. Elements similar to those of the first embodiment are denoted by the same reference numbers.

A group of pressing rolls 21, 22, 23, and 24 are arranged opposite to a group of pressing rolls 21', 22', 23', and 24'. These rolls are

rotated by a driving means (not shown). The circumferential speeds of the lower rolls of the groups are higher than those of the upper rolls of the groups, so that the dough 3 is effectively moved downwards and formed as a web of dough. It is then fed by a conveyor 26 to the successive steps.

The rolls 21, 22, 23, and 24 are pivotably positioned on a swinging arm 10' to form a group 20. The arm 10' is swung around a shaft 10. Similarly, the rolls 21', 22', 23', and 24' are pivotably positioned on a swinging arm 11' to form a group 20'. The arm 11' is swung around a shaft 11. The swinging movement of the rolls of the group 20 is caused by means of a motor 12 through a swinging bar 14 and a crank 15. The group 20' is also swung by means of a motor 13 through a swinging bar and a crank (not shown).

The arms 10' and 11' are arranged to form a "V," and positioned at the lower position of a hopper 40, as in Fig. 8. The position of the arms is at the opening between the lower ends of opposite walls 25, 25'. A gap C is formed between the bottom ends of these arms. The dough 3 is to be discharged through the gap. The size of the gap C is changed when the rolls 21, 22, 23, and 24 and the rolls 21', 22', 23', and 24' are swung by the motors 12, 13 to recede from or approach each other. The range and rate of the swinging movement are controlled by the motors 12 and 13.

In short, the groups 20, 20' of the rolls are arranged like a V. They are positioned at the lower opening of the hopper 40. The

rotating speed of the rolls nearer the bottom outlet between the groups of rolls is higher than that of the rolls nearer the lower end of the hopper. The distances between the opposite rolls nearer the bottom outlet are smaller than those between the opposite rolls nearer the lower end of the hopper. The dough in the hopper 40 is supplied to the space between the groups of the rolls, which groups are arranged like a V. The stress in the dough is prevented from being increased by repeatedly increasing and decreasing the distances between the opposite rolls by the arms 10', 11', so that the dough can be stably discharged through the gap C.

The arrangement of a plurality of pairs of rolls allows the compression ratio to be greater than where one pair of rolls is used.

Thus, the arrangement allows the discharging ability of the dough to be increased. When the dough is discharged through the gap, its discharge speed is the same as the circumferential speed of the lowest pair of rolls.

Fig. 9 shows a third embodiment of this invention. Elements of this embodiment that are similar to those of the second embodiment are denoted by the same reference numbers.

In the second embodiment the groups 20, 20' of rolls are arranged like a V and are positioned at the lower outlet of the hopper 40. The distances between the opposite rolls are repeatedly widened and narrowed by the arms 10', 11'. However, this invention is not limited to that arrangement. For example, like the third embodiment,

as in Fig. 9, only one group of rolls can be swung to widen and narrow the distances. That is, a pair of groups of rolls 30, 30' is arranged like a V and is positioned below the hopper 40 '. The group of rolls 30 is fixed at a predetermined position, while the group of rolls 30' can be swung around a shaft 34 by a swinging arm. To repeatedly increase and decrease the distances between the opposite rolls it is unnecessary to swing both the groups 30, 30'. The rotating speed of each roll in the group 30 can be controlled. The cross-sectional shape of each roll is hexagonal, but its corners are rounded. A pair of groups of rolls 30, 30 ' comprises a group of three rolls 31, 32, and 33 and a group of three rolls 31', 32', and 33', respectively. By this arrangement the dough 3 is moved by the rotation of the rolls, while the group of rolls 30' is swung to repeatedly widen and narrow their gaps, so that a web of dough that has a predetermined thickness is discharged from the outlet.

In the third embodiment the rolls that are hexagonal and have rounded corners allow the friction between them and the dough 3 to be increased, so that the dough is forced to be discharged by the friction.

The force to lead the dough by the friction can be changed by changing the shape of the rolls, the rotating speed of each roll, or the ratio of the rotating speed of the upper roll to that of the lower roll. They are appropriately selected according to parameters such as the characteristics of the dough 3, the amount of discharged dough, etc.

Fig. 10 shows a fourth embodiment of this invention. Elements of this embodiment that are similar to those of the third embodiment are denoted by the same reference numbers.

As stated above, in the second and third embodiments the rolls are put on the swinging arms. That is, the rolls in each group are linearly positioned on the arm. Thus, the rolls in one group are jointly swung to recede from or approach the corresponding rolls in the other. In the fourth embodiment, as in Fig. 10, group of rolls 21-24 and 21'-24' are not put on any swinging arm, and each of the rolls is independent of each other. Thus, each pair of opposite rolls are made to recede from or approach each other independently of the other pairs, so that adjacent pairs of rolls can be moved in reverse directions. This arrangement allows the distances between the opposite rolls to be increased and decreased, so that the adjacent pairs of rolls alternately move in two directions, i.e., when a pair of rolls move toward each other an adjacent pair of rolls moves away from each other. As a result, pressure is applied to or removed from the dough at different levels while the rolls rotate in directions to urge the dough downwards, so that the dough can be discharged more effectively.

Figs. 11-14 show a fifth embodiment of this invention. By this embodiment a group of the rolls jointly pull down and press the dough 3, so that the dough can be smoothly fed down. That is, first the pair of rolls 21 and 21' are moved to approach each other, as in Fig.

12. Then, the pair of rolls 21 and 21' are moved to recede from each other, while the pair of rolls 22 and 22' are moved to approach each other, as in Fig. 13. Similarly, then the pair of rolls 22 and 22' are moved to recede from each other, while the pair of rolls 23 and 23' are moved to approach each other, as in Fig. 14. As a result, the pairs of rolls are moved such that the pressing movement of a pair of rolls is transmitted from an upper pair to the next lower pair. By this arrangement the pressed portion in the dough moves from an upper pair to next lower pair, so that the dough feeding is effectively speeded. Additionally, the force caused by the surfaces of the rolls to lead the dough is continuously applied, so that the dough is effectively led by the force and then discharged.

Fig. 15 shows a sixth embodiment of this invention. While a group 50' of rolls are fixed, another group 50 of rolls are swung by a motor, to widen and narrow the distances between the groups of the rolls. The rolls are arranged such that a roll in one group corresponds to a roll in another group forming a pair of rolls arranged on the same level in terms of height. A dough-supplying apparatus 60 is located above the rolls. It comprises a hopper 61 and a pair of cutters 65. The cutters 65 are oppositely positioned at the bottom opening of the hopper 61, and are rotatable. A knife portion comprising one or more knives is provided at the end of each cutter 65. When the cutters are rotated, pieces of the dough in the hopper 61 are cut and then fall onto the dough that has previously been supplied between a pair of groups of rolls 50, 50'. The dough is then discharged through the gap between the lowest pair of rolls

to form a web of dough. It is conveyed by the conveyor 26 to subsequent stations.

Fig. 16 shows a seventh embodiment of this invention. In this embodiment no hopper is located above the pair of groups of rolls 50, 50'. A conveyor 17 feeds a mass of the dough 3 and supplies it to the position between the pair of groups of rolls.

In the embodiments above, a pair of rolls or pairs of rolls are used to discharge the dough therebetween. However, a pair of conveyor or pairs of conveyors may be used instead of the pair of rolls or pairs of rolls. For example, each of the groups of rolls 20, 20' in Fig. 8 may be replaced by a plurality of conveyors, e.g., two or three conveyors.

As stated above, a pair of groups of rolls comprises the rolls positioned vertically. In the explanation of the embodiments above, it is explained that the rotating speeds of the rolls gradually increase in the direction from the upper to the lower rolls. However, this invention is not limited to this arrangement. The difference between the rotating speeds of the rolls can be determined based on conditions such as the dough material. In the embodiments the rolls are shown to be always rotated. However, the rolls can be intermittently rotated in response to the widening and narrowing of the distances between the pairs of rolls.

As stated above, this invention provides a method for providing a pair of rolls that are rotatable in opposite directions and that are

positioned at the bottom opening of a hopper, and pressing dough between the opposite rolls, characterized by the step of repeatedly increasing and decreasing the distance between the rolls, whereby the stress in the dough is prevented from being increased.

Alternatively, horizontally positioned pairs of opposite rolls are vertically arranged. The distance between the respective opposite pair of rolls is periodically changed. By this arrangement the dough can be discharged more stably.

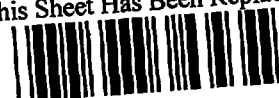
A roll whose cross section is polygonal can be used instead of one whose cross section is circular, so that the ability to discharge the dough increases. In the pairs of the rolls the distance between a horizontal pair of opposite rolls can be increased and decreased alternately while an adjacent pair of opposite rolls are moved in reverse directions. The distance between the opposite rolls can be changed such that the narrow gap between the opposite rolls is moved from the upper pair of rolls to the lower pair of rolls. As a result, the stress in the dough can be prevented, so that the dough can be discharged through the gaps stably.



Claims:

1. A method for continuously and uniformly supplying dough comprising the steps of providing at least one horizontally positioned pair of means that are rotatable in opposite directions and discharging the dough, characterized by repeatedly increasing and decreasing the distance between said pair of means, thereby preventing the stress from being increased in the dough at the position between the pair of means, and constantly discharging the dough through the gap between the pair of means.
2. A method of claim 1 wherein said at least one horizontally positioned pair of means that are rotatable in opposite directions are at least one horizontally positioned pair of rolls.
3. A method of claim 1 wherein said at least one horizontally positioned pair of means that are rotatable in opposite directions are at least one horizontally positioned pair of conveyors.
4. A method of claim 1 wherein the steps for providing the horizontally positioned pair of means includes a step for providing the means at the bottom opening of a hopper.
5. A method of claim 1 wherein production of the web of dough is controlled by changing the circumferential speeds of the pair of means that are oppositely positioned.

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6. A method of claim 1 wherein production of the web of dough is controlled by changing the speeds of the increase and decrease of the distance between the pair of means that are oppositely positioned.
7. An apparatus for continuously and uniformly supplying dough comprising at least one horizontally and oppositely positioned pair of means, the pair of means being rotatable so as to guide the dough downwardly therebetween, the distances between the pair of means being periodically changed, whereby the dough is stably and continuously discharged by the opposite means to form a web of dough.
8. An apparatus of claim 7 wherein said at least one horizontally positioned pair of means that are rotatable in opposite directions are at least one horizontally positioned pair of rolls.
9. An apparatus of claim 7 wherein said at least one horizontally positioned pair of means that are rotatable in opposite directions are at least one horizontally positioned pair of conveyors.
10. An apparatus of claim 7 wherein said at least one horizontally and oppositely positioned pair of means comprises at least two pairs of rolls provided in a plurality of tiers.
11. An apparatus of claim 7 wherein the pair of means are located at the opening of a hopper.

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-17-

12. An apparatus of claim 7 wherein the distances between the opposite means are changed by a swinging means.

13. An apparatus of claim 7 wherein the distances are changed by moving said means so that the pressing movements are sequentially generated between the opposite means from above downwards.

14. An apparatus of claim 7 wherein the distances between the pair of means are alternately changed in the vertical direction such that the pressing movements between the opposite means are alternately effected in the vertical direction.

15. An apparatus of claim 8 wherein the cross-sectional shape of the rolls is circular or polygonal.

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