

DESCRIPTION

Device for Distributing Dough in an Extruder

5 Technical Field

The present invention relates to a device for extruding an expandable dough for confectionery from plural openings of the device to prepare expanded confectionery (sticks), and more particularly the device for distributing the expandable dough formed at terminal end of a rotor in an extruder to said plural
10 openings.

Background Arts

As extruders for preparing expanded confectioneries, in general, a single or twin screw type one has been employed and each of the them comprises a
15 screw(s) which shall be referred to in this Description as "rotor(s)", a barrel and a device for distributing an expandable dough, which has openings for expanding the dough. A starch raw material fed into the extruder from a raw material feeding port at beginning end of the rotor is heated, pressurized and subjected to shear force by the rotor in the barrel to gelatinize the same and make it into the expandable dough
20 which is fed to the openings of said dough distributing device arranged at terminal end of the rotor and to cause expansion thereof, whereby the expanded confectionery is prepared.

In such conventional apparatuses for preparing expanded confectioneries, a portion of each dough distributing device has a structure as shown in Figs. 6 or 7.

25 The dough distributing device shown in Fig. 6 comprises a flat plate or disc B arranged at terminal end of a rotor A and having through hole B₁ at central portion thereof, a diverging member C to distribute an expandable dough together with the flat plate, and an opening forming plate D fixed to terminal end of the diverging member and having plural openings D₁. However, the expandable
30 dough dwells on inner wall C₁ of the diverging member C, which is opposingly arranged to the through hole B₁ and the portion vicinity thereto to cause thermal scorching phenomenon, whereby an amount of the dough flowing into each of the plural openings D₁ changes. This means that each of the expanded confectioneries obtained by the expanded confectionery preparing apparatus provided with such a

dough distributing device is not uniform in quality thereof.

While, the dough distributing device shown in Fig.7 is structurally different from that shown in Fig.6 in that a cavity B_2 is formed in rotor-side surface of a flat plate or disc B arranged at terminal end of a rotor A and having a through hole B_1 ,
5 that structure of a diverging member is simplified, and that plural openings C_2 are formed in the diverging member *per se*. In this dough distributing device, an expandable dough for confectionery passed the through hole B_1 is uniformly and spreadingly fed to the plural openings C_2 , by an actions of outer wall of the flat plate B and inner wall of the diverging member C, and distributed to the openings, but
10 such a phenomenon generates similar to the dough distributing device shown in Fig.6 that the expandable dough for confectionery dwells on the inner wall C_1 of the diverging member C and portion vicinity thereof, each of the expanded confectioneries formed through plural openings is not so uniform in quality.

In Japanese Patent 62-259538(A) as one of patent literatures, there is
15 disclosed a screw extruder for extrudingly preparing various foods by supplying thereto raw material dough, wherein an extruding passage is diverged into plural diverging passages, each having same shape and same length, and a food extruding die is fixed to each tip end of the diverging passage. When the extruder is applied for preparing an expanded confectionery, uniformity in quality as whole of
20 the products shall be improved, but ununiformity in quality of each expanded confectionery formed though each extruding holes in the die can not be still dissolved.

In Japanese Patent 61-19445(A), further, an "apparatus for preparing expanded snack confectionery" has been disclosed. A dough distributing device for
25 the apparatus is shown in Fig.8. The dough distributing device has such a structure that a flat plate F is arranged between a rotor A of a single screw extruder and a die portion E and with a slight gap from tip end of the rotor, wherein the flat plate has a through hole F_1 at central portion thereof and a dough guiding cavity F_2 at die side surface to communicate the through hole to die openings E_1 . When the apparatus
30 for preparing expanded snack confectionery and provided with the dough distributing device is employed, uniformity in quality as whole of the products can be improved, but if depth T of the dough guiding cavity is different from diameter W in each of the die openings, ununiformity in quality still presents between the expanded confectioneries formed through plural die openings.

Therefore, an object of the invention is to provide a device for distributing an expandable dough for confectioneries, which drastically reduces ununiformity in quality of each of expanded confectioneries extrudingly and concurrently formed through each of plural openings at terminal end of an extruder.

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Disclosure of Invention

Fundamentals of the invention lies in immediately diverging flow of an expandable dough passed through rotor portion of a single or twin rotor extruder, and feeding each of the expandable dough flows to relative opening to cause expansion of the dough for preparing desired expanded confectionery.

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Therefore, a device for distributing dough in an extruder according to the invention is characterized by comprising

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a first member arranged near terminal end of a rotor in the extruder, and having a through hole for the expandable dough at central portion thereof and plural of radial channels which communicate to the through hole, and

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a second member connected to said first member, having bores in same number with the radial channels in said first member and arranged so as to form a concentric circle, and having on central portion of an inner wall a multi-faced pyramid-like projection, which inner wall has radial channels extending from each basement of the face at the projection, and each free end of the radial channels being communicated to each end of the bores.

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According to the dough distributing device of the invention, each of the radial channels formed in the first and second members is oppositely arranged in alignment manner to form each of diverging flow passages for the expandable dough and each end of the diverging flow passages communicates to each end of the bores formed in the second member, whereby there is no portion for causing dwelling of the expandable dough passed the through hole formed in the first member. Therefore, an amount of the expandable dough extruded from each free end of the bores becomes substantially same, so that quality of expanded confectioneries obtained through each of the bores shall become uniform.

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If somewhat thick end plate formed with through holes somewhat large in diameter is attached to outer wall of the second member, state of the expanded confectionery becomes more preferable.

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Brief Description of Drawings

Fig.1 is a diagrammatic vertical section of a dough distributing device for preparing expanded confectioneries, according to the invention;

Fig.2 is a front view of a first member in the expandable dough distributing device shown in Fig.1;

Fig.3 is an enlarged partial section showing one of the radial channels shown in Fig.2;

Fig.4 is an enlarged partial section showing diverging passages of the expandable dough;

Fig.5 is a rear view of a second member in the expandable dough distributing device shown in Fig.1;

Fig.6 is a diagrammatic vertical section of one of conventional expandable dough distributing devices;

Fig.7 is a diagrammatic vertical section of another conventional expandable dough distributing device; and

Fig.8 is a diagrammatic vertical section of an expandable dough distributing device shown in Japanese Patent 61-19445(A).

Best Mode for Carrying Out the Invention

Now, in the first place, the invention will be explained in more detail with reference to Figs.1-5, and then with Examples for preparing expanded confectioneries and Test Examples on the resulting expanded confectioneries.

Fig.1 shows a dough distributing device 10 for expanded confectioneries, according to the invention. The dough distributing device is attached near terminal end of a rotor 3. The application of compressive and shearing forces to a starch raw material fed into a barrel 1 at the position of beginning end of the rotor 3 results in generating of temperature in the dough, so that the raw material can be made into gelatinized expandable dough. To a second member 30 of said dough distributing device, plural through bores 32 are formed on a concentric circle. If necessary, somewhat thick end plate 5 with through holes 5A is connected to the second member 30, which through holes communicate with the bores 32 in the second member 30 and have a diameter somewhat larger than that of the bores, to give change in visual appearance of expanded confectionery to be prepared.

The dough distributing device 10 is constructed with a first member 20

arranged at the rotor-side and having a through hole 22 for the expandable dough at central portion thereof, and the second member 30 having plural bores 32 which are arranged, so as to form an concentric circle, and a multi-faced pyramid-like projection 34 at central portion of its inner surface.

5 In outer wall of the first member 20, as shown in Fig.2, plural channels 24 are formed, each of which communicates with the through hole 22 and radially extends about the through hole 22. In Fig. 2, 6 radial channels are shown, but number thereof shall not be limited thereto and should be construed as same with number of bores 32 formed in the second member 30. One of exemplar sectional
10 shape of the radial channels 24 formed in the first member is shown in Fig.3.

Fig.4 shows positional relations of the through hole 22 and the radial channels 24 communicating with the through hole, both of which are formed in the first member 20, and the multi-faced pyramid-like projection 34 presenting at central portion of inner wall of the second member 30 and channels 36 radially extending
15 from basement of each surface at the pyramid-like projection. As shown in Fig.5, each of the channels 36 radially extends from the basement of each surface in the pyramid-like projection 34 and free end of each channel communicates with each of the bores 32 arranged so as to form a concentric circle in the second member 30. In Fig. 5, 6 radial channels 36 are shown in response to the number of radial
20 channels 24 formed in the first member 20 and shown in Fig.2, and each of the channels group is opposingly arranged in an alignment manner (see Fig.4). -

When the expandable dough distributing device with said construction is attached to front end of the extruder, namely terminal end of the rotor, for preparing expanded confectionery, the expandable dough extrudingly fed by an action of the
25 rotor 3 into the through hole 22 in the first member 20 is guided by the multi-faced pyramid-like projection 34 in the second member 30 to reach in each of the bores 32 through each diverging flow passage formed by the radial channels (24, 36 in Fig.4) presenting in the first and second members (20, 30 in Fig.1) and opposingly arranged in alignment manner, and then extrudingly discharged from the opening of
30 each bore to cause expansion for preparing the products. If diameter of each diverging flow passage is same with that of each bore, the expandable dough flows without causing any dwelling, so that quality of each expanded confectionery prepared through each bore becomes substantially same with one another.

If necessary, the end plate 5 (see Fig.1) is attached to the expandable

dough distributing device and if diameter of the through holes 5A arranged so as to form a concentric circle therein is larger than that of the bores 32 formed in the second member 20, configuration of the expanded products becomes better. In this case, it is preferable to set ratio of the diameters in the through hole and bore to about 2 : 1.

The invention is further explained with reference to Examples for preparing expanded confectionery, which were carried out by attaching to an extruder a dough distributing device substantially same with that described above, Test Examples carried out with use of the expanded confectioneries, Comparative Examples for preparing expanded confectionery, which were carried out with use of conventional dough distributing devices, and Test Examples carried out with use of the expanded confectioneries which were obtained by the Comparative Examples.

Manufacturing Example 1

The expandable dough distributing device shown in Figs. 1 - 5 was attached to terminal end of a rotor in a single rotor extruder (Model MS-25, manufactured by Aoi Seiki Kabushiki Kaisha, Japan), but which dough distributing device had 4 dough diverging flow passages and 4 bores in the second member as well as 4 holes in the third member or end plate. Sizes of various portions in the dough distributing device were as follows. Diameter of the through hole in the first member: 20mm, opening width of each radial channel: 4mm, depth thereof: 2mm, height of multi-faced pyramid-like projection (tetrahedral projection): 4mm, opening width of the basement at the projection and each of the radial channels in the second member: 4mm, depth of the radial channels: 2mm, diameter of each bore: 4mm, and diameter of each hole in the third member or in the end plate: 4mm.

Then, a starch material prepared by adding 8 parts by weight of water into 100 parts by weight of corn grits and homogeneously mixing the same was fed into a raw material feeding port at beginning end of the rotor of the extruder for gelatinizing the raw material by setting conditions to 200rpm (rotational velocity of the rotor), 140°C (temperature) and 4MPa (pressure) to prepare an expandable dough for confectionery at terminal end of the rotor in the extruder. The expandable dough was fed through the through hole in the first member, diverged into uniform 4 dough flows by an action of the multi-faced pyramid-like projection, and forcedly fed into each of the diverging flow passages formed by opposing and alignment

arrangement of the radial channels to make it into each dough rope having diameter of 4mm, each of which was passed the bore having diameter of 4mm to reach the through hole having diameter of 4mm in the end plate to cause rapid expansion which makes the dough rope into expanded confectionery. Thereafter, the dough distributing device was exploded to visually observe inside thereof to find out no scorched residue of the expandable dough, so that it has been ascertained that no dwelling phenomenon of the expandable dough has occurred during the passing inside of the dough distributing device.

Then, the long rod-like expanded confectioneries were cut into those having length of 10cm to measure weight of each sample for checking difference in weight thereof. Results are shown in Table 1 given later.

Comparative manufacturing Example 1

A conventional expandable dough distributing device as shown in Fig. 6 was attached to terminal end of a rotor in the single rotor extruder (Model MS-25, manufactured by Aoi Seiki Kabushiki Kaisha, Japan). Sizes of through hole, bores and hole in the dough distributing device are same with those as given in Manufacturing Example 1 to prepare expanded confectioneries. Thereafter, the dough distributing device was exploded to observe inside thereof. As a result, scorched residue of the expandable dough has been recognized on inner wall C₁ of the diverging member, so that it has been ascertained that dwelling of the expandable dough has occurred during the passing thereof in the dough distributing device.

Then, the expanded confectionery obtained by passing through each of the bores was cut as in Manufacturing Example 1 to check difference in weight. Results are shown in following Table 1.

Table 1

	Bore number	1	2	3	4	Mean
Example 1	Mean weight (g)	1.12	1.10	1.09	1.10	1.1025
	Standard deviation	0.02	0.01	0.01	0.01	0.0125
Comparative Example 1	Mean weight (g)	1.05	1.13	0.96	1.21	1.075
	Standard deviation	0.04	0.05	0.03	0.07	0.045

As shown in above Table 1, it has been ascertained that differences in mean weight and standard deviation of each expanded confectionery manufactured through each bore become small by using the dough distributing device according to the invention as shown in Fig. 1, in comparison with the case using the conventional dough distributing device as shown in Fig.6.

Comparative Manufacturing Example 2

Expanded confectionery was prepared by using the conventional dough distributing device shown in Fig.8 under conditions of composition of the starch raw material and operations for the extruder same with those in Manufacturing Example 1. In this dough distributing device, diameter of through hole was 20mm and each diameter of 4 bores was 4mm.

The resulting expanded confectionery was cut as in Manufacturing Example 1 to measure weight for checking differences thereof. Results are shown in following Table 2.

According to the results, the value on standard deviation showing difference in weight of the expanded confectionery is lower than that of the expanded confectionery obtained by Comparative Manufacturing Example 1, but apparently

large than that of the expanded confectionery obtained by Manufacturing Example 1.

Table 2

5	Bore number	1	2	3	4	Mean
	Mean weight (g)	1.22	1.18	1.27	1.26	1.233
10	Standard deviation	0.0281	0.0313	0.0356	0.0328	0.03195

Manufacturing Example 2

The expandable dough distributing device as shown in Figs. 1 - 5 was attached to terminal end of rotors for twin rotor extruder (Model BC45, manufactured by CLEXTRAL corporation). Moreover, each of rotors with reverse spiral flight generating back pressure was attached at a portion from terminal end of the twin rotor to a position of 1/10 in full length of the twin rotor.

A composed mixture of wheat flour (75 parts by weight), potato starch (25 parts by weight), table salt (0.5 parts by weight), sugar (2.0 parts by weight) and vegetable oil (2.5 parts by weight) was fed into raw material feeding port at beginning end of the twin rotor and water was concurrently supplied by using a pump arranged near the twin rotor extruder to obtain a mixed dough with water content of 20 parts by weight.

The mixed dough was gelatinized by setting operation conditions of the extruder to 250rpm (rotational velocity of the twin rotor), 180°C (temperature) and 10 MPa (pressure) to prepare expandable dough which was extruded out from bores in the dough distributing device to obtain expanded confectionery by rapid expansion of the expandable dough.

The resulting expanded confectionery was cut as in Manufacturing Example 1 to measure for checking differences in weight of samples. Results are shown in Table 3 given later.

Comparative Manufacturing Example 3

Expanded confectionery was obtained by carrying out operations similar to

those as described in Manufacturing Example 3, excepting that the conventional dough distributing device as shown in Fig.6 was used.

The resulting expanded confectionery was cut as in Manufacturing Example 1 to measure for checking differences in weight of the samples. Results are shown in following Table 3.

Table 3

	Bore number	1	2	3	4	Mean
10	Example 2	Mean weight (g)	1.18	1.20	1.22	1.20
15		Standard deviation	0.0	0.0	0.0	0.0126
20	Comparative Example 3	Mean weight (g)	1.30	1.24	1.20	1.25
		Standard deviation	0.0	0.0	0.0	0.0631

As shown in above Table 3, it has been ascertained that differences in mean weight and standard deviation of each expanded confectionery manufactured through each bore become small by using the dough distributing device according to the invention as shown in Fig.1, in comparison with the case using the conventional dough distributing device as shown in Fig.6, in also the case using the twin rotor extruder.

Manufacturing Example 3

The expandable dough distributing device shown in Figs.1-5 was attached to terminal end of a rotor in a single rotor extruder (Model MS-25, manufactured by Aoi Seiki Kabushiki Kaisha, Japan), but which dough distributing device has 4 dough diverging flow passages and 4 bores in the second member as well as 4

holes in the third member or end plate. Sizes of various portions in the dough distributing device are as follows. Diameter of the through hole in the first member : 20mm, opening width of each radial channel : 4mm, depth thereof : 2mm, height of multi-faced pyramid-like projection (tetrahedronal projection) in the second member : 4mm, opening width of the basement at the projection and each of the radial channels : 4mm, depth of each radial channel : 2mm, diameter of each bore : 4mm, and diameter of each through hole in the end plate : 8mm.

Then, a starch material prepared by adding 8 parts by weight of water into 100 parts by weight of corn grits and homogeneously mixing the same was fed into a raw material feeding port at beginning end of the rotor in the extruder for gelatinizing the raw material by setting operational conditions as 200rpm (rotational velocity of the rotor), 140°C (temperature) and 4MPa (pressure) to prepare an expandable dough for confectionery at terminal end of the rotor in the extruder. The expandable dough was fed through the through hole in the first member, diverged into uniform 4 dough flows by an action of the multi-faced pyramid-like projection, and forced into each of the diverging flow passages formed by opposing and alignment arrangement of the radial channels to make it into each dough rope having diameter of 4mm, each of which was passed through the bore to reach the through hole having diameter of 8mm in the end plate and caused rapid expansion, and as a result, expanded confectionery was obtained. Thereafter, the dough distributing device was exploded to visually observe inside thereof to find out no scorched residue of the expandable dough, so that it has been ascertained that no dwelling phenomenon of the expandable dough has occurred during the passing thereof in the dough distributing device.

Then, the long rod-like expanded confectioneries were cut into those having length of 10cm to measure weight of each sample for checking difference in weight. Results thereof were substantially same with those as described in Manufacturing Example 1.

The expanded confectionery obtained by this Example showed clear wave-like configuration on its surface.

Industrial Applicability

As referred to above, the weight in unit length of expanded confectionery products discharged from each opening of plural bores presenting at terminal end

of the dough distributing device can be made substantially constant, when the expandable dough is treated by attaching the dough distributing device of the invention to front end of the extruder. This is provided by the fact that no scorching of the expandable dough due to dwelling thereof in inside of the expandable dough distributing device occurs, and it makes production of the expanded confectionery smooth.

CLAIMS



1. A device for distributing dough in an extruder characterized by comprising
a first member (20) arranged near terminal end of a rotor in said extruder,
5 and having a through hole (22) for the expandable dough at central portion thereof
and plural of radial channels (24) which communicates to the through hole, and
a second member (30) connected to said first member, having bores (32) in
same number with the radial channels in said first member and arranged so as to
form a concentric circle, and having on central portion of an inner wall a multi-faced
10 pyramid-like projection (34), which inner wall has radial channels (36) extending
from each basement of the face at the projection, and each free end of the radial
channels being communicated to each end of the bores.
2. A dough distributing device according to Claim 1, characterized in that the
15 radial channels (24) in said first member and the radial channels (36) in said
second member are opposingly arranged in alignment manner to form each of
diverging flow passages for the expandable dough, and that sectional size of the
diverging flow passage is same with that of the bore (32) formed in said second
member.