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- (57) Claim

1. A pretreatment process in a flour milling method in which raw wheat grains are first polished, and the grains thus polished are ground and milled for producing end flour, said pretreatment process comprising:

a first polishing step in which a pericarp of each wheat grain is removed;

a second polishing step in which a seed coat of each raw wheat grain is removed;

a third polishing step in which a part of cell walls of aleuron layer cells that was in contact with the removed seed coat of each raw wheat grain is removed such that a cell membrane of each aleuron layer cell is caused to be ruptured and that a substance in each aleuron layer cell is caused to be in a state which permits said substance to flow out; and

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a step of adding water in which, by adding the water to each raw wheat grain, the substance in said aleuron layer cells is caused to flow out from the aleuron layer cells, resulting in producing a polished grain in a state in which the substance in said aleuron layer cells has been separated from each raw wheat grain.

ABSTRACT

PRETREATMENT PROCESS IN FLOUR MILLING METHOD

1 A pretreatment process in a flour milling method in which
raw wheat grains are first polished and the polished grains
are ground and milled for producing end flour, includes a
first, a second, a third polishing step, and a step of
5 adding water. In the first polishing step a pericarp (516)
of each wheat grain is removed, in the second polishing
step a seed coat (518) of each raw wheat grain is removed,
and in the third polishing step a part of cell walls (530)
of aleuron layer cells (519) that was in contact with the
10 removed seed coat is removed so that a cell membrane (522)
of the aleuron layer cell is caused to be ruptured and that
a substance (521) in the aleuron layer cell is caused to be
in a state which permits the substance to flow out. In
step of adding water, by adding the water to each raw wheat
15 grain, the substance (521) in the aleuron layer cells (519)
is caused to flow out from the aleuron layer cells, result-
ing in producing a polished grain in a state in which the
substance (521) in the aleuron layer cell (519) has been
separated from each raw wheat grain. It is possible to
20 increase the yield of the end flour collected by the subse-
quent grinding operation.

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PRETREATMENT PROCESS IN FLOUR MILLING METHOD

The following statement is a full description of this invention, including the best method of performing it known to us:

1

BACKGROUND OF THE INVENTION

(1) Field of the Invention

5 The present invention relates to a flour milling method for such grains as wheat grains, and more particularly to a pretreatment process in the flour milling method in which polishing operations are carried as a pretreatment process in the flour milling method.

10 (2) Description of the Related Art

In each wheat grain milled for producing flour, as shown in Fig. 6, an endosperm 511 which becomes an end flour product is covered by a husk portion. Sequentially from the outside of the wheat grain, the husk portion has a pericarp 516 formed of an outer epidermis 512, a middle layer 513, cross cells 514, and tube cells 515, the pericarp 516 being comparatively easy to remove; a seed coat 518 formed of nucellar tissue 517, the seed coat being comparatively difficult to remove; and an aleuron layer 520 formed of aleuron layer cells 519. The husk portion has a high ash content so that, when it is mixed into the end flour obtained by the grinding, the quality of the end flour is degraded. Thus, the efforts are being made so as to enhance the yield of the end flour by collecting the endosperm 511 in a powder form in such a way that the

mixing of the husk portion therein is avoided.

5 The conventional methods include a method in which, in order to avoid the mixing of the husk portion into the end flour, the pericarp 516, the seed coat 518 and the aleuron layer 520 (the aleuron layer being a part of the endosperm but, in an ordinary flour milling, this is removed as the husk portion) are first removed for the grains to become polished grains, and then these polished grains are
10 subjected to the grinding to produce the end flour.

However, with the above method, since it is difficult to make a complete removal and separation of only the husk portion from the endosperm 511, a part of the endosperm is removed together with the husk portion thus enabling the removal of the husk portion from the endosperm. In this way, the ash content which is a
15 cause for the degradation of the quality of the end flour can be reduced but, at the same time, the yield of the end flour is also lowered, which is a problem in this conventional method.

There is another conventional method in which it is attempted to separate and remove only the pericarp 516 and the seed coat 518 with the aleuron layer 520
20 left in place so as not to lower the yield of the flour. However, a problem in this method is that, since the aleuron layer 520 has an ash content to the highest extent (the ash content in the substance 521 in the aleuron layer cells 519 is



1 especially high), the end flour suffers from the degradation
because of the high ash content.

SUMMARY OF THE INVENTION

5 An object of the present invention, therefore, is to
overcome the problems existing in the prior art, and to
provide a pretreatment process in a flour milling method,
whereby the end flour of high quality is produced without
the yield being lowered.

10 According to an aspect of the invention, there is
provided a pretreatment process in a flour milling method
in which raw wheat grains are first polished, and the
grains thus polished are ground and milled for producing
end flour, the pretreatment process comprising:

15 a first polishing step in which a pericarp of each
wheat grain is removed;

a second polishing step in which a seed coat of each
raw wheat grain is removed;

20 a third polishing step in which a part of cell walls
of aleuron layer cells that was in contact with the removed
seed coat of each raw wheat grain is removed such that a
cell membrane of each aleuron layer cell is caused to be
ruptured and that a substance in each aleuron layer cell is
caused to be in a state which permits the substance to flow
25 out; and

1 a step of adding water in which, by adding the water
to each raw wheat grain, the substance in the aleuron layer
cells is caused to flow out from the aleuron layer cells,
resulting in producing a polished grain in a state in which
5 the substance in the aleuron layer cells has been separated
from each raw wheat grain.

According to the invention, the removal of the peri-
carp and the seed coat of the raw wheat grains is made by
the polishing operations. During the polishing, a part of
10 the cell membranes of the aleuron layer cells is ruptured
and the substance in the aleuron layer cells becomes ready
to flow out. The grains in this state are subjected to
water so that the substance in the aleuron layer cells flow
out together with the water with the grains resulting in
15 polished grains in which the substance in the aleuron layer
cells has been removed.

BRIEF DESCRIPTION OF THE DRAWINGS

20 The above and other objects, features and advantages
of the present invention will be apparent from the follow-
ing description of preferred embodiments of the invention
explained with reference to the accompanying drawings, in
which:

25 Fig. 1 is a front view showing a general arrangement

1 of a flour milling apparatus used for explaining a method
according to the invention;

Fig. 2 is an enlarged rear view, partially in section,
showing a general arrangement of a polishing means in the
5 apparatus shown in Fig. 1;

Fig. 3 is a vertical sectional view showing a second
water adding unit in the apparatus shown in Fig. 1;

Fig. 4 is an enlarged sectional view showing a clean-
ing section in the second water adding unit;

10 Fig. 5 is a front view showing the second water adding
unit shown in Fig. 1;

Fig. 6 is a side sectional view showing an internal
state of an ordinary wheat grain;

15 Fig. 7 is a side sectional view showing a state of a
wheat grain after the pericarp has been removed by the
friction polishing unit from the grain in the state shown
in Fig. 6;

20 Fig. 8 is a side sectional view showing a state of a
wheat grain after the seed coat and a part of the aleuron
layer have been removed by the abrasion polishing unit from
the grain in the state shown in Fig. 7; and

25 Fig. 9 is a side sectional view showing a state of a
wheat grain after the substance in the cell forming the
aleurion layer has been removed by the second water adding
unit from the grain in the state shown in Fig. 8.

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PREFERRED EMBODIMENT OF THE INVENTION

Now, a preferred embodiment of the invention is explained with reference to Fig. 1. As means for carrying out treatments before the processing by the polishing means 6, there are sequentially provided a separator unit 1, a first water adding unit 2, a tempering tank 4 serving as a first conditioning unit 3, and a water adding tank 5. Means for carrying out treatments after the processing by the polishing means 6 include a second water adding unit 7 and a tempering tank 9 as a second conditioning unit 8, and means for carrying out treatments after the tempering tank 9 include a break roll machine 11 serving as a grinding unit 10.

The first means among the overall flour milling means 15 is the separator unit 1 which includes a coarse separator 12 whose function is to remove comparatively light impurities such as straws, plants, wastes and dust, and a stone remover 13 whose function is to remove comparatively heavy impurities such as metal and stone pieces from the raw 20 wheat grains that are taken out from, for example, a silo (not shown) to store the raw wheat grains.

Next to the separator unit 1 is provided the first water adding unit 2 with a passage way W1 being interposed. In the first water adding unit 2, there is provided a 25 cylindrical trough 16 which has an inlet 14 for the grains

1 at one end, an outlet 15 at the other end and a screw conveyor 17 inside thereof. Above the cylindrical trough 16, there is provided a shower nozzle 18 which is connected to a water tank 21 through a heater 19 and an electromagnetic
5 valve 20.

The outlet 15 of the first water adding unit 2 is connected to a feeding port 22 of the tempering tank 4 as the first conditioning unit 3. The feeding port 22 has a scattering vane means 23 which hangs and rotates therein,
10 and the bottom of the tempering tank 4 has a pair of rotary valves 24 which horizontally extend therein. Underneath the rotary valves 24, there is provided a receiving trough 25 which has a discharging screw conveyor 26 therein. One
15 end of the discharging screw conveyor 26 is connected to an inlet opening of the water adding tank 5 equipped with a water adding nozzle 27. A discharge opening of the water adding tank 5 is connected to the polishing means 6.

Next, the polishing means 6 is explained with reference to Fig. 2. The polishing means 6 in this embodiment
20 include a friction polishing unit 28 which performs friction polishing operation and an abrasion polishing unit 29 which performs abrasion polishing operation. These two units are connected with each other in series.

In the friction polishing unit 28, as shown in Fig. 2,
25 a hollow shaft 31 extends horizontally through the inside

1 of a bran removing polishing cylinder 30 and is rotatable
therein. The hollow shaft 31 opens at its one end and is
connected to an air supplying means (not shown), and the
hollow shaft 31 rotatably carries a friction polishing
5 rotor 34 which is provided with stirring projections 32 and
air jet slits 33. The friction polishing rotor 34 is
hollow and, on a peripheral surface of the hollow shaft 31
within the friction polishing rotor 34, there are provided
a plurality of air holes 35. The gap defined between the
10 friction polishing rotor 34 and the bran removing polishing
cylinder 30 constitutes a polishing chamber 36. One end of
the polishing chamber 36 communicates with a feeding inlet
37 and the other end thereof communicates with an outlet
38. A feeding hopper 39 is provided at the feeding inlet
15 37, and a resisting lid 41 being urged by a weight 40 is
provided at the outlet 38. Further, at a position near the
feeding inlet 37, a grain conveying rotor 42 having screw
vanes is rotatably provided on the hollow shaft 31, and a
bran collecting chamber 43 is formed around the bran remov-
20 ing polishing cylinder 30. The bottom part of the bran
collecting chamber 43 communicates with a bran collecting
duct 45 and a bran collecting fan 46 through the bran
collecting hopper 44. The outlet 38 of the friction pol-
ishing unit 28 is connected to an abrasion polishing unit
25 29 of the next stage through an elevator 47.

1 In the abrasion polishing unit 29, there is provided a
main shaft 49 which extends through within the bran remov-
ing polishing cylinder 48 which is formed by a perforated
wall. This main shaft 49 rotatably carries abrasion pol-
5 ishing rotors 50 formed by powder emery, and the gap be-
tween the abrasion polishing rotors 50 and the bran remov-
ing polishing cylinder 48 constitutes a polishing chamber
51. One end of the polishing chamber 51 communicates with
a feeding inlet 52 and the other end thereof communicates
10 with an outlet 53. A feeding hopper 54 is provided at the
feeding inlet 52, and a resisting lid 56 being urged by a
weight 55 is provided at the outlet 53. Further, at a
position near the feeding inlet 52, a grain conveying rotor
57 having screw vanes is rotatably provided on the main
15 shaft 49. Also, a bran collecting chamber 58 is formed
around the bran removing polishing cylinder 48. The bottom
part of the bran collecting chamber 58 communicates with a
bran collecting duct 60 through the bran collecting hopper
59. The outlet 53 of the abrasion polishing unit 29 is
20 connected to the second water addition unit 7 through a
passage way W2.

Now, the second water adding unit 7 is explained
hereunder with reference to Figs. 3 to 5. The second water
adding unit 7 is constituted by a cleaning section 61 and a
25 transporting section 62 and, in the cleaning section 61,

1 there is provided a screw rotor 64 which is rotated by a
motor 65 for transporting the grains downwardly from a
feeding trough 63. The screw rotor 64 is provided at its
lower portion with a water supply port 67 (shown in Fig.
5 4), which is connected to a water supply duct 66. Fixed to
the lower end of the screw rotor 64 is a plate-like rotary
cylinder 68 which is bent upwardly and surrounds the pe-
riphery of the screw rotor 64. Between the screw rotor 64
and the rotary cylinder 68, there is provided, as shown in
10 Fig. 4, a fixed cylinder 71 which defines a flow passage 69
directed downwardly to the side of the screw rotor 64 and a
flow passage 70 directed upwardly to the side of the rotary
cylinder 68 and which surrounds the screw rotor 64 from the
above. At the side of the rotary cylinder 68, there is
15 provided a transporting passage way 72 which supplies to
the transporting section 62 the grains flowing down over
the upper end of the rotary cylinder 68 from the flow
passage 70. Also, a part of the rotary cylinder 68 is
formed as a perforated wall 73, and the space between the
20 rotary cylinder 68 and the transporting passage way 72
constitutes a collecting chamber 74 for collecting the
matters passed through the perforated wall 73 and, to the
collecting chamber 74, a discharging duct 75 for discharg-
ing the matters to the outside of the machine is connected.
25 The transporting section 62 is arranged such that,

1 within a circular machine frame 78 which has at one end an
inlet 76 connected to the transporting passage way 72 and
at the other end an outlet 77 for the grains, there is
provided a stirring unit 92 which has a main shaft 82
5 having thereon a plurality of stirring vanes 81 and which
laterally and centrally extends through the machine frame
78 on a pair of bearings 80 fixed to a supporting frame 79.
On one end of the main shaft 82, there is a pulley 83 which
is coupled to a pulley 85 of a motor 84 by a V-belt, and
10 the main shaft 82 is caused to rotate at an appropriate
speed. The outlet 77 is provided with a resisting lid 87
which is urged by a weight 86 towards the outlet 77, and an
outlet trough 88 for discharging the grains to the outside
of the machine is connected to the outlet 77. As shown in
15 Fig. 5, the machine frame 78 is supported on the supporting
frame 79, with the machine frame being positioned horizon-
tally or with the outlet 77 side thereof being slightly
lower, by a supporting member 89 projecting from the ma-
chine frame 78 and a plurality of joining members 90. The
20 machine frame 78 carries thereunder a vibrating motor 91
which generates vibrations.

Now, referring to Fig. 1 again, the outlet trough 88
of the second water adding unit 7 is connected to a supply
port 93 of the tempering tank 9 of the second tempering
25 unit 8. In the supply port 93, there is vertically provid-

1 ed a plurality of rotatable scattering vanes 94 and, at the
bottom of the tank, there is laterally provided a pair of
rotary valves 95. Also, under the rotary valves 95, there
is a receiving trough 96 in which a discharging screw
5 conveyor 97 is provided. The conveying end portion of the
screw conveyor 97 is connected to the break roll machine 11
of the grinding unit 10 which is a first stage unit in the
flour milling steps. As means for flour milling after the
break roll machine 11, there are provided appropriate means
10 which include a plurality of rolls, a sifter, and a purifi-
er (not illustrated).

Now, the function of the apparatus as described above
is explained.

The raw wheat grains taken out from, for example, a
15 tank, undergo a process of removing impurities by the
coarse separator 12 and also a further process of removing
stone and metal pieces by the stone remover 13. The raw
wheat grains from which foreign objects have been removed
by the removal processes are first introduced into the
20 first water adding unit 2 where the water is added to the
grains by the shower nozzle 18. The amount of water is
adjusted by the electromagnetic valve 20 such that the
water content of the raw wheat grains becomes 12 - 14%
(normal water content of raw wheat grains being about 11%).
25 Where the temperature of water is low as in a winter sea-

1 son, the raising of water temperature by the heater 19
facilitates the water penetration. The raw wheat grains to
which the water has been added are stirred and transported
by the screw conveyor 17 and, during this period of time,
5 the water added evenly penetrates into the inside of all
the grains. Then, the raw wheat grains having been trans-
ported by an elevator to the feeding port 22 of the temper-
ing tank 4 are filled in the tempering tank 4 while being
scattered by the scattering vane means 23. The wheat
10 grains in the tempering tank 4 are left alone as they are
for 16 - 36 hours so that almost all of the water added
penetrates into the endosperm of the wheat grains.

The wheat grains for which the tempering has been
completed in the tempering tank 4 flow into the receiving
15 trough 25 by the rotation of the rotary valves 24, 24 and
are transported to the water adding tank 5 from the dis-
charging screw conveyor 26. To the grains having been
transported to the water adding tank 5, the atomized water
is again added by the water adding nozzle 27. The amount
20 of water added may be to the extent that the water pene-
trates the epidermis of the grains and be 0.5 - 2% by
weight with respect to the grains. After the water has
been added, the grains are held in the water adding tank 5
for 3 - 5 minutes for the water to penetrate into the
25 epidermis of the grains. Thereafter, the grains are sup-

1 plied to the polishing means 6.

In the polishing means 6, the grains are first fed into a feeding hopper 39 of the friction polishing unit 28 and conveyed by the grain conveying rotor 42 to the polishing chamber 36 where the grains are subjected to the polishing operation by the friction polishing rotor 34. The friction resistance in the grain surfaces is caused to increase by the water addition at the water addition tank 5 and, by the stirring action of the friction polishing rotor 34 rotating within the polishing chamber 36 of the friction polishing unit 28 and the stirring projections 32 thereof, the grains undergo grain-to-grain friction and the bran layer portions except a crease are removed. The bran that has thus been frictionally removed is caused to pass through the perforated wall of the bran removing polishing chamber 30 by the air jetted into the polishing chamber 36 through a hollow portion of the hollow-shaft 31, air holes 35 therein and jet air slits 33, and the bran is discharged to the outside of the machine by the bran collecting fan 46. The grains (polished grains) that gush out against the force of the resisting lid 41 from the outlet 38 of the friction polishing unit 28 are elevated by the grain elevator 47, fed into the feeding hopper 54 of the abrasion polishing unit 29 and conveyed to the polishing chamber 51 by the grain conveying rotor 57.

1 The function of the friction polishing unit 28 is to
separate and remove, out of the bran layer portions of the
grains, those portions that can easily be removed, hence
down to the pericarp. This is explained with reference to
5 Figs. 6 and 7. From the state of the grains shown in Fig.
6, the removal of the outer epidermis 512, middle layer
513, cross cells 514 and tube cells 515 takes place as a
result of the grain-to-grain friction caused by the fric-
tion polishing rotor 34 and, as shown in Fig. 7, the grains
10 that have the seed coat 518, aleuron layer 520 and endo-
sperm 511 are produced and supplied to the abrasion polish-
ing unit 29. It can be appreciated that, by the operation
of the friction polishing unit 28, the pericarp which is
softer as compared with the seed coat is first removed.

15 At the abrasion polishing unit 29, the bran layer
portions with the exception of the crease of the grains are
removed while being pulverized by the powder emery carried
around each of the abrasion polishing rotors 50 which
rotates within the polishing chamber 51. The powdery bran
20 portions removed pass through perforations of the bran
removing polishing cylinder 48 and are discharged to the
outside of the machine through the bran collecting hopper
59 and the bran collecting duct 60. The grains polished
are forced out through the outlet 53 against the resisting
25 lid 56 and fed to the feeding trough 63 of the second water

1 adding unit 7 through the conveying passage way W2.

Measuring means are provided before and after the abrasion polishing unit 29 whereby the amount of the grains before the abrasion polishing and that after the abrasion
5 polishing are compared to calculate the respective yields. If the lowering rate of the yield is within a range from 1.0 to 2.0% by weight (weight percent against the raw wheat grains), it indicates that the removal of the seed coat and a part of the aleuron layer (that was in contact with the
10 seed coat) has been made without the endosperm of the grains being removed so that the substance within the aleuron layer cells is in a state which allows it to flow out from the aleuron layer cells. If the lowering rate in the yield is not within the range from 1.0 to 2.0% by
15 weight, the weight 55 of the polishing unit 29 is adjusted either automatically or manually so as to maintain the values within the range.

The function of the abrasion polishing unit 29 is to separate the seed coat 518 and a part of the aleuron layer
20 520 and also to cause the rupture of the cell membranes 522 of the aleuron layer cells 519. This is explained with reference to Figs. 7 and 8. From the state of the grains having the seed coat 518, aleuron layer 520 and endosperm 511 as shown in Fig. 7, the seed coat 518 is first removed
25 at the abrasion polishing unit 29 by the abrasive force of

the powder emery of the abrasion polishing rotors 50. Then, of the cell walls of the aleuron layer cells 519, the portions that were in contact with the seed coat are removed as shown in Fig. 8, and the cell membranes 522 of the aleuron layer cells 519 are broken and ruptured by the powder emery of the abrasion polishing rotors 50. Thus, the substance 520 within the aleuron layer cells 519 turns to a state which allows the substance to be washed out of the cells and, thereafter, the grains are fed into the second water adding unit 7.

10 The grains supplied from the second water adding unit 7 into the cleaning section 61 flow along the inner wall of the fixed cylinder 71 and reach the flow passage 69 between the fixed cylinder 71 and the screw rotor 64. At the flow passage 69, the grains are allowed to move down circularly due to the rotation of the screw rotor 64 and, during this time, the water is supplied radially to the grains from the water supply port 67 provided to the screw rotor 64. Although the grains to which the water is added are once stagnated at a lower portion of the flow passage 69, they are subjected to an appropriate pressure by the grains that flow down through the flow passage 69 due to the rotation of the screw rotor 64 so that they are subjected to the stirring and grain-to-grain friction actions which cause the grains to be forced up to the flow passage 70 between the fixed cylinder 71 and the rotary cylinder 68. During this time, the bran attached to the grains and the husk portion attached to the grains are removed into the water added and, at the same time, the substance in the cells of the aleuron layer is washed by the added water so as to cause the substance to flow out from the cells together with the added water.

25 At the flow path 70, the supplied water together with the bran, the husk portion and the substance in the cells are blown off from the perforated wall 73 by the centrifugal force of the rotary cylinder 68, are collected at the collecting chamber 74 and are discharged to the outside of the machine through the discharging duct 75. Also, the grains from which the bran, the husk portion and the substance in the cells have been removed, flow into the transporting passage way 72 from the upper periphery of the rotary cylinder 68 and are supplied to the conveying section 62 through the transporting passage way 72.

30 The polished grains supplied to the conveying section 62 are conveyed to the side of the outlet 77 from the side of the feeding port 76 while being subjected to the stirring action of the stirring vanes 81 so as not to stick

1 together and being subjected to the vibrating action of the
vibration motor 91 so as not to be stagnant within the
machine frame 78. During this period, the water adhered to
grain surfaces penetrates into the inside of the grains.
5 The grains having reached the outlet 77 shows that the
water has penetrated into the inside of the grains from
their surfaces so that the grains are not caused to stick
together, and the grains are discharged to the discharging
trough 88 from the outlet 77 against the resisting force of
10 the resisting lid 87.

The function of the second water adding unit 7 is to
cause the substance in the aleuron layer cells to flow out
and to be separated from the grains. This is explained
with reference to Figs. 8 and 9. The grains to be fed to
15 the second water adding unit 7 is in a state in which, at
least that portion of the cell walls of the aleuron layer
cells 519 which was in contact with the seed coat has been
removed as shown in Fig. 8, and the substance 520 in the
aleuron layer cells 519 is ready to flow out. In this
20 state, the water added to the grains causes the substance
520 in the cells to be washed out and, as shown in Fig. 9,
the grains (polished grains) remain only with a part of the
cell walls 530 of the aleuron layer cells whose ash content
is comparatively small and the entire endosperm 511.

25 In the conveying section 62, in order to cause the

5 water on the grain surfaces to penetrate into the grains in such a way that the grains do not stick together, the stirring and vibration action may be subjected to the grains for at least 3 minutes and, in this connection, appropriate adjustments may be made for the amount of the grains fed to the second water adding unit 7 and for the resisting force of the resisting lid 87 by the weight 86 and the vibration number and width of the vibration motor 91, which depend on the amount of the water added to the grains.

10 For the grains discharged from the second water adding unit 7 to be in a condition suited for the subsequent grinding process, and also for the water content of the end flour obtained by the grinding process to have such water content as suited for a subsequent use of the end flour, the water content of the grains may adjusted to 15 - 17% by the second water adding unit 7.

15 The grains discharged from the discharging trough 88 of the second water adding unit 7 are conveyed to the tempering tank 9 of the second tempering unit 8 where they are filled in the tempering tank while being scattered by the scattering vanes 94 of the tempering tank 9. The tempering time 20 in the tempering tank 9 may be as short as 0.5 - 2 hours since the water content of the epidermis of the grains has already fairly satisfactorily adjusted by



1 the first water adding unit 2 and the first tempering unit
3.

The grains whose tempering has been completed by the
tempering tank 9 flow into the receiving troughs 96 in each
5 of which the rotary valve 95 rotates, and are discharged to
the outside of the machine by the discharging screw convey-
or 97. Thereafter, the grains are fed into the break rolls
11 of the grinding unit 10 for the grinding process.

Detailed explanation of the operations that take place
10 subsequent to the grinding unit 10 is omitted here but, in
such operations, the endosperm is taken out in the form of
coarse particles by the step-by-step grinding of the pol-
ished grains using various break roll machines, is classi-
fied by various sifters, and further selected and purified
15 by purifiers, followed by the grinding by use of roll means
(smooth rolls) to produce the end flour.

In the above explained embodiment of the invention,
the polishing means 6 is constituted by the friction pol-
ishing unit 28 of a lateral shaft type and the abrasion
20 polishing unit 29 of a lateral shaft type. However, the
means may well be in a vertical shaft type with the fric-
tion polishing rotor and the abrasion polishing rotors
being arranged on a single vertical shaft.

Also, in the explained embodiment of the invention,
25 the polishing of the raw wheat grains is conducted by the

1 friction polishing unit 28 and the abrasion polishing unit
29, but this polishing may well be carried out all by the
abrasion polishing unit 29. In such a case, by making the
adjustment of, for example, the resisting force of the
5 resisting lid 56, only the abrasion polishing operation
enables the removal of the pericarp, seed coat and aleuron
layer and the rupturing of the aleuron layer cell membrane.
However, since the pericarp is softer as compared with the
seed coat and can be easily removed by the friction opera-
10 tion, a more efficient method is the method explained as
the embodiment of the invention wherein the pericarp is
first removed by the friction polishing operation followed
by the abrasion polishing operation which removes the seed
coat and the aleuron layer.

15 According to the method of the invention in which the
raw wheat grains are first polished, and the polished
grains are ground for producing the end flour, the pericarp
and the seed coat of the raw wheat grains are peeled and
removed, and the polished grains in the form in which the
20 aleuron layer cell membranes have been destructed are
subjected to the water addition so that the substance in
the aleuron layer cells flows out and is separated from the
polished grains. In this way, the polished grains fed to
the grinding unit are in a state in which the endosperm is
25 the same size as that in the raw wheat grain without being

1 removed at all and in which most of the cell walls of the
aleuron layer cells remains. Moreover, since the pericarp,
the seed coat and the substance in the aleuron layer cells
in which the ash content is high have been removed, it is
5 possible to increase the yield of the end flour collected
by the grinding operation and to obtain the end flour of
high quality and low ash content.

For removing the aleuron layer cells, the abrasion
polishing is effective in breaking and rupturing the cell
10 membranes of the aleuron layer cells.

While the invention has been described in its pre-
ferred embodiments, it is to be understood that the words
which have been used are words of description rather than
limitation and that changes within the purview of the
15 appended claims may be made without departing from the true
scope of the invention as defined by the claims.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A pretreatment process in a flour milling method in which raw wheat grains are polished, and the grains thus polished are ground and milled for producing end flour, said pretreatment process comprising:
- 5 a first polishing step in which a pericarp of each raw wheat grain is removed;
- a second polishing step in which a seed coat of each raw wheat grain is removed;
- 10 a third polishing step in which cell wall portions of aleuron layer cells in contact with the removed seed coat are removed, wherein the third polishing step causes a cell membrane of each aleuron layer cell to rupture and expose a cell internal substance having a high ash content percentage; and
- 15 a fourth step of adding water to cause the exposed cell internal substance in said aleuron layer cells to flow out of the aleuron layer cells, thereby resulting in a polished grain with a substantial part of the cell, walls remaining thereon and in which the cell internal substance in said aleuron layer cells has been separated from each raw wheat grain.
- 20 2. The pretreatment process of claim 1, in which a reduction rate in yield after said second and third polishing steps of the raw wheat grain is about 1.0-2.0% by weight when the weight percent of the raw grains is 100.

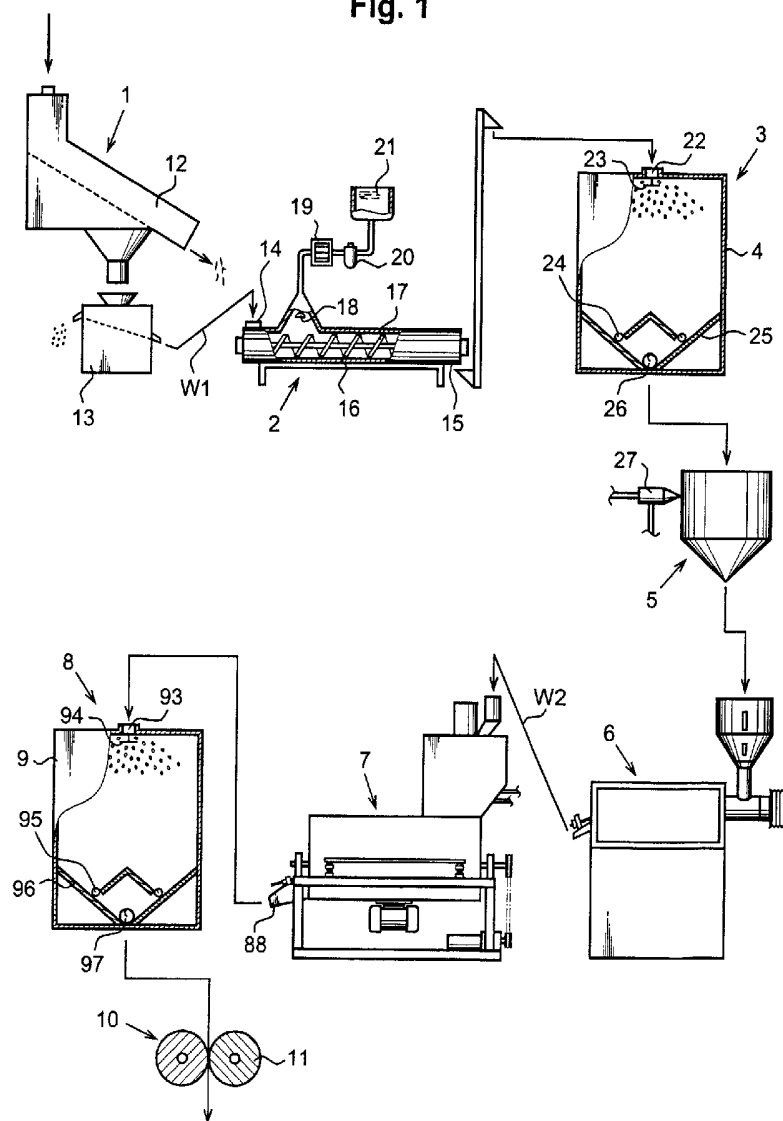
Dated this 8th day of February 1999

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SATAKE CORPORATION
By their Patent Attorneys
COLLISON & CO.



Fig. 1



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Fig. 2

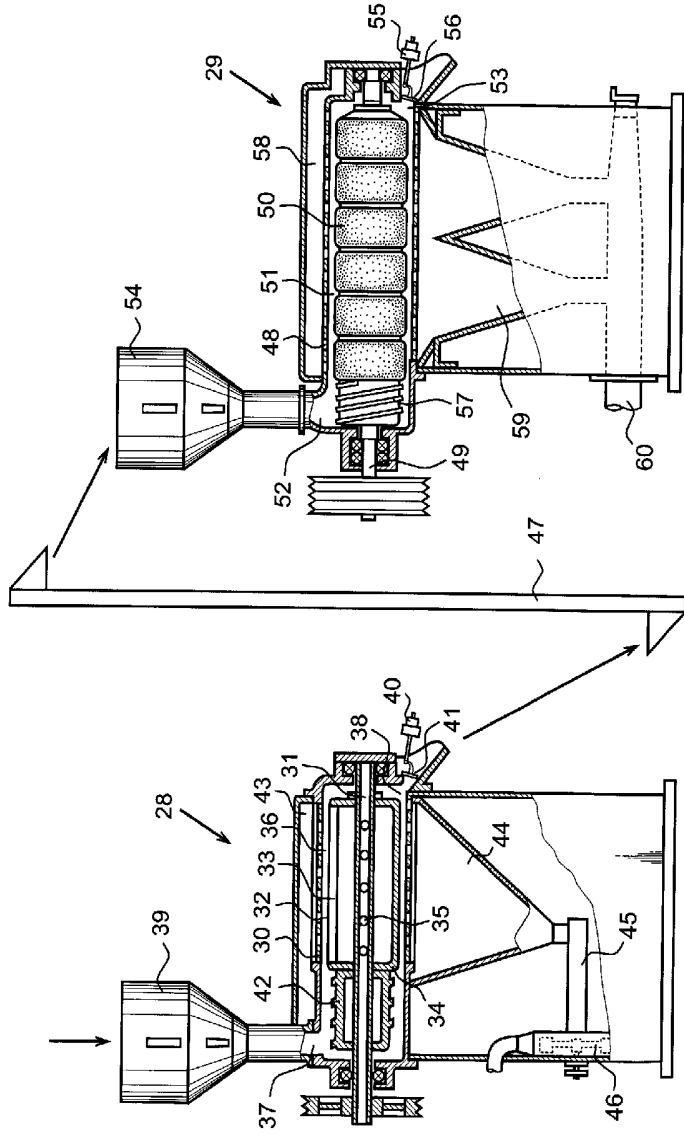


Fig. 3

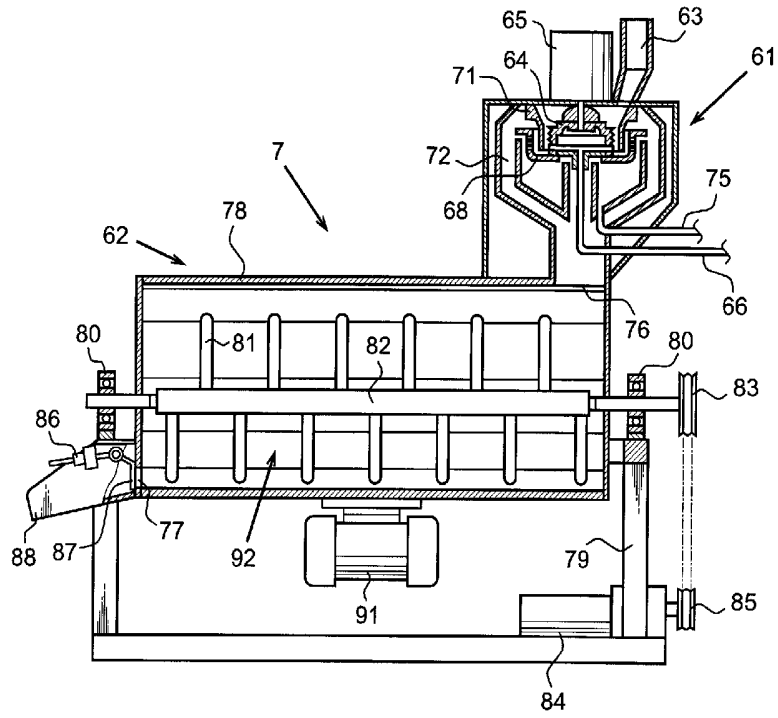


Fig. 4

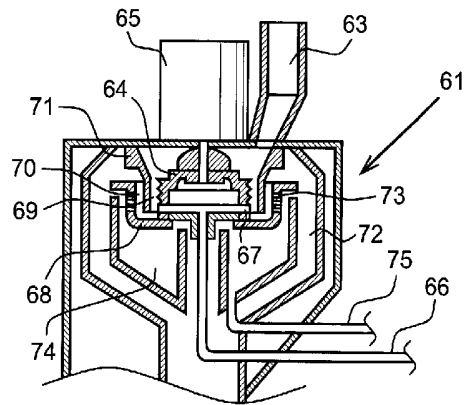
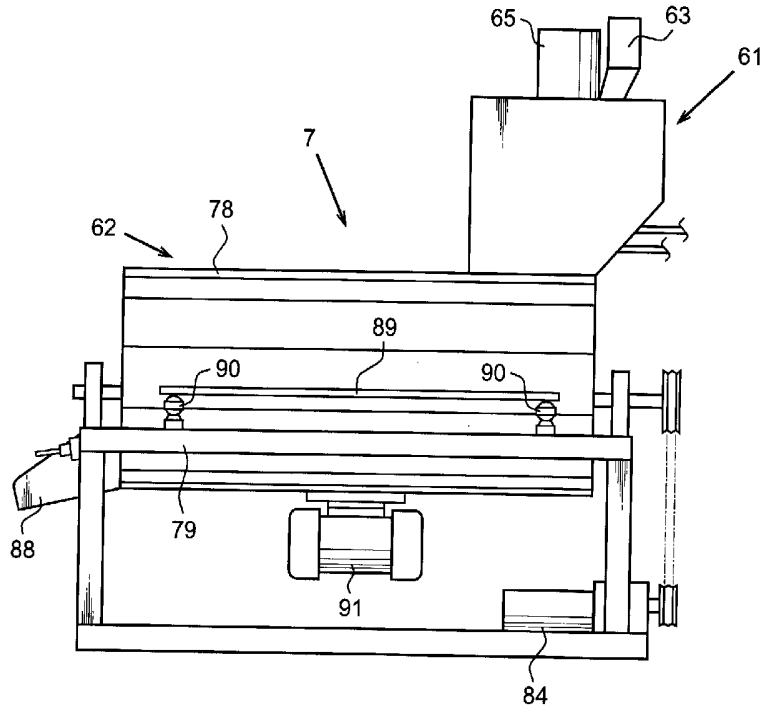


Fig. 5



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Fig. 6

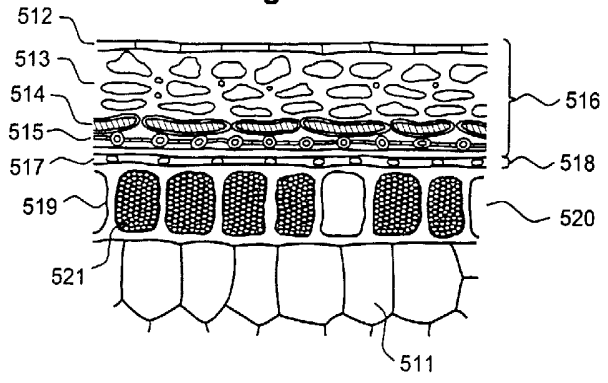


Fig. 7

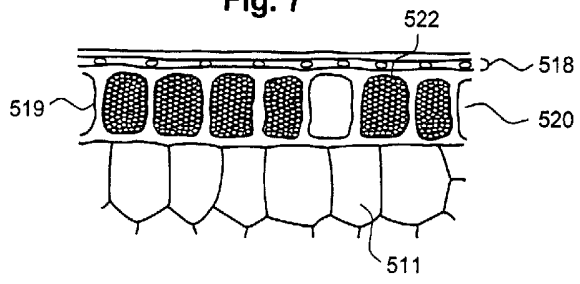


Fig. 8

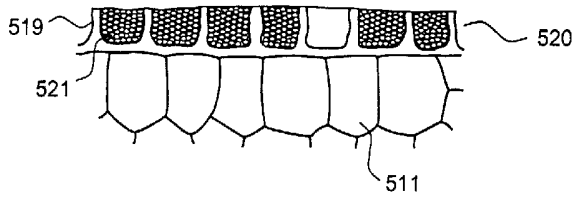


Fig. 9

