United States Patent

Peebles

[15] **3,669,363**

[45] **June 13, 1972**

[54] **APPARATUS FOR HEATING GRAIN**

[72] Inventor: **Joseph M. Peebles**, Wayzata, Minn.

[73] Assignee: **The Pillsbury Company**, Minneapolis, Minn.

[22] Filed: **Dec. 15, 1969**

[21] Appl. No.: **884,925**

[52] **U.S. Cl.** 241/8

[51] **Int. Cl.** B02b 1/08

[58] **Field of Search** 241/8, 18, 62, 65; 34/134, 34/138

[56] **References Cited**

UNITED STATES PATENTS

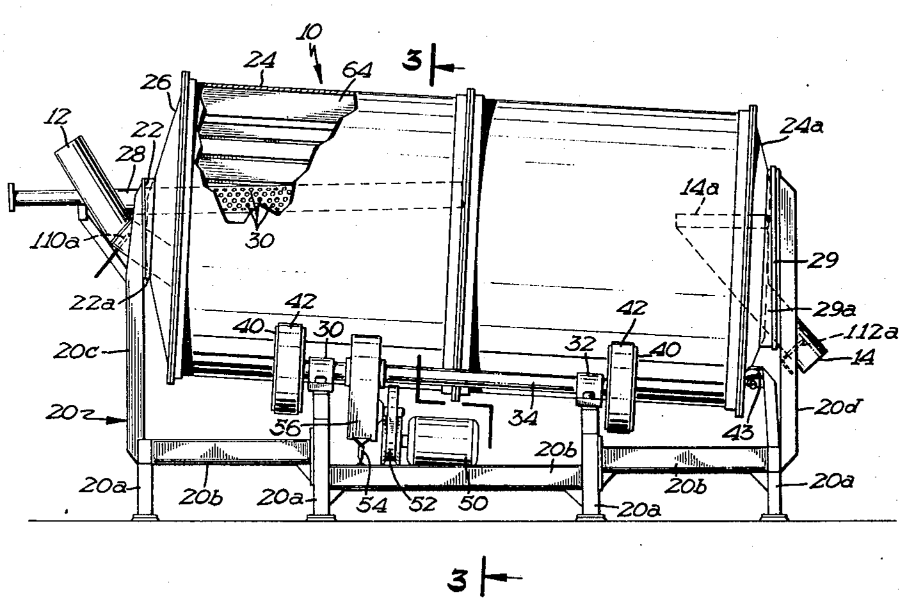
2,709,306	5/1955	Magnusson et al.	34/138 X
601,777	4/1898	Oesterreich	241/18
131,379	9/1872	Wells	241/8
125,170	4/1872	Chicester	241/8
1,079,153	11/1913	Topf	34/138
1,426,385	8/1922	Huhn	34/134 X

Primary Examiner—Granville Y. Custer, Jr.
Attorney—Ronald E. Lund, James V. Harmon and M. Paul Hendrickson

[57] **ABSTRACT**

Grain such as wheat is heated to improve the yield of high-grade flour by elevating the wheat and allowing it to fall repeatedly through a steam-filled vessel thereby providing intimate contact between the steam and the individual grains for a period of about 30 to 40 seconds. The temperature of the wheat is raised to about 85° F. and maintained at this temperature for about 2 to 4 hours before milling.

3 Claims, 4 Drawing Figures



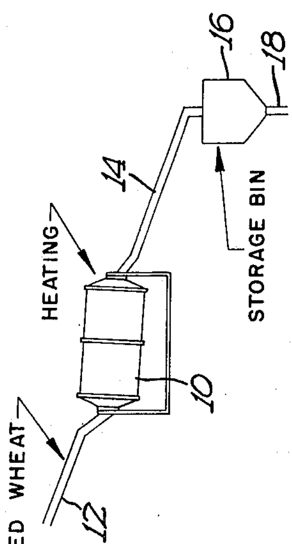


FIG 1

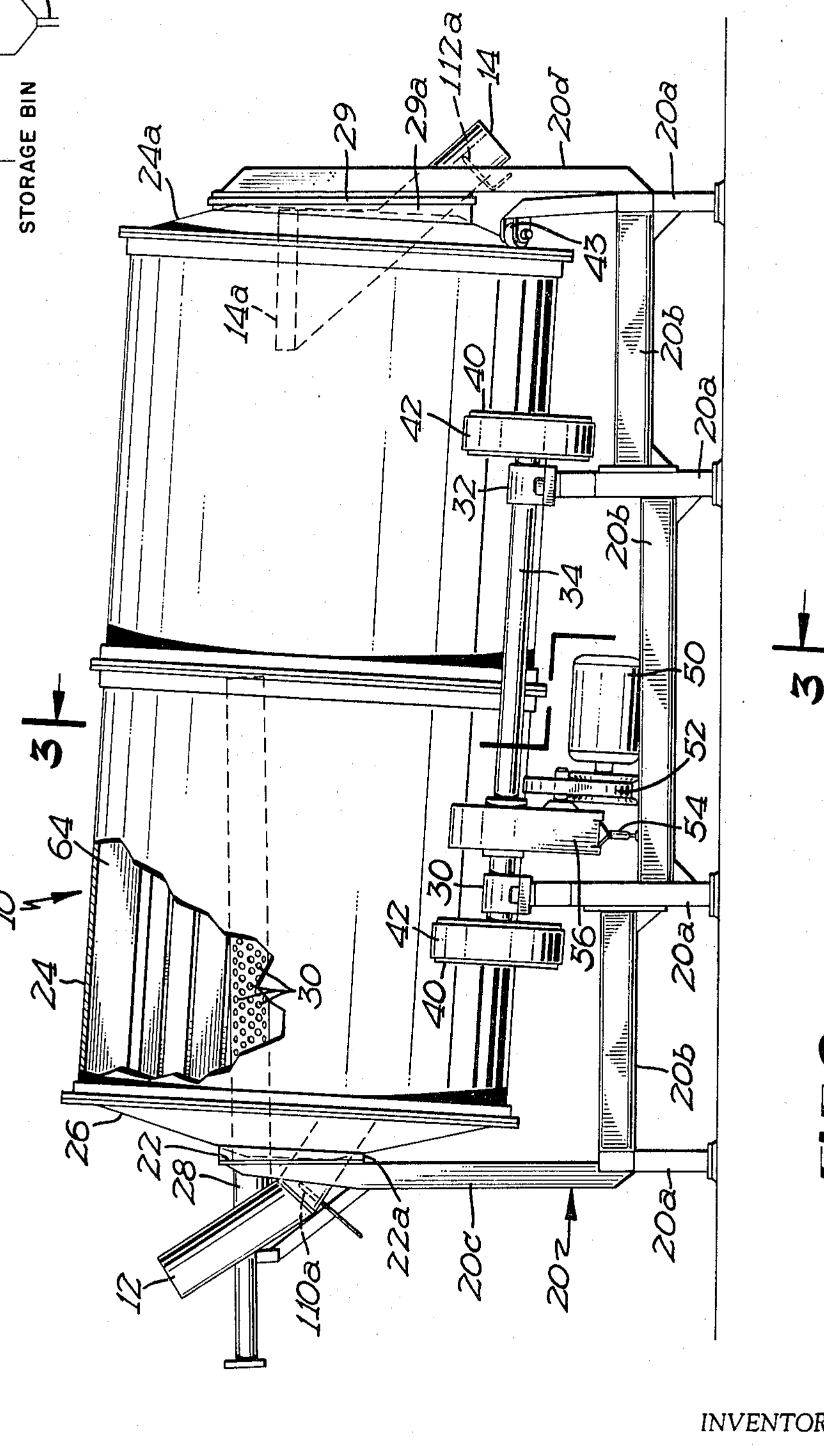


FIG 2

INVENTOR.

JOSEPH M. PEEBLES

BY James V. Harmon

ATTORNEY

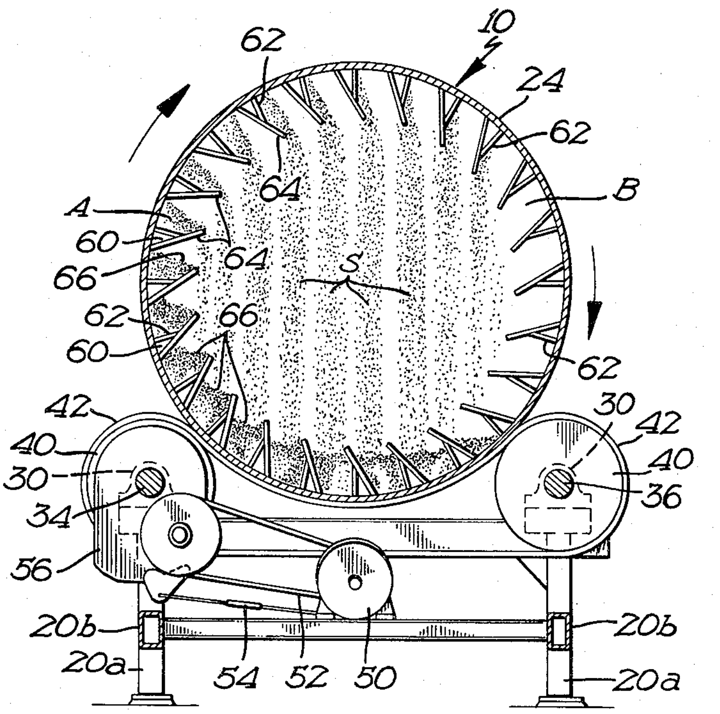


FIG 3

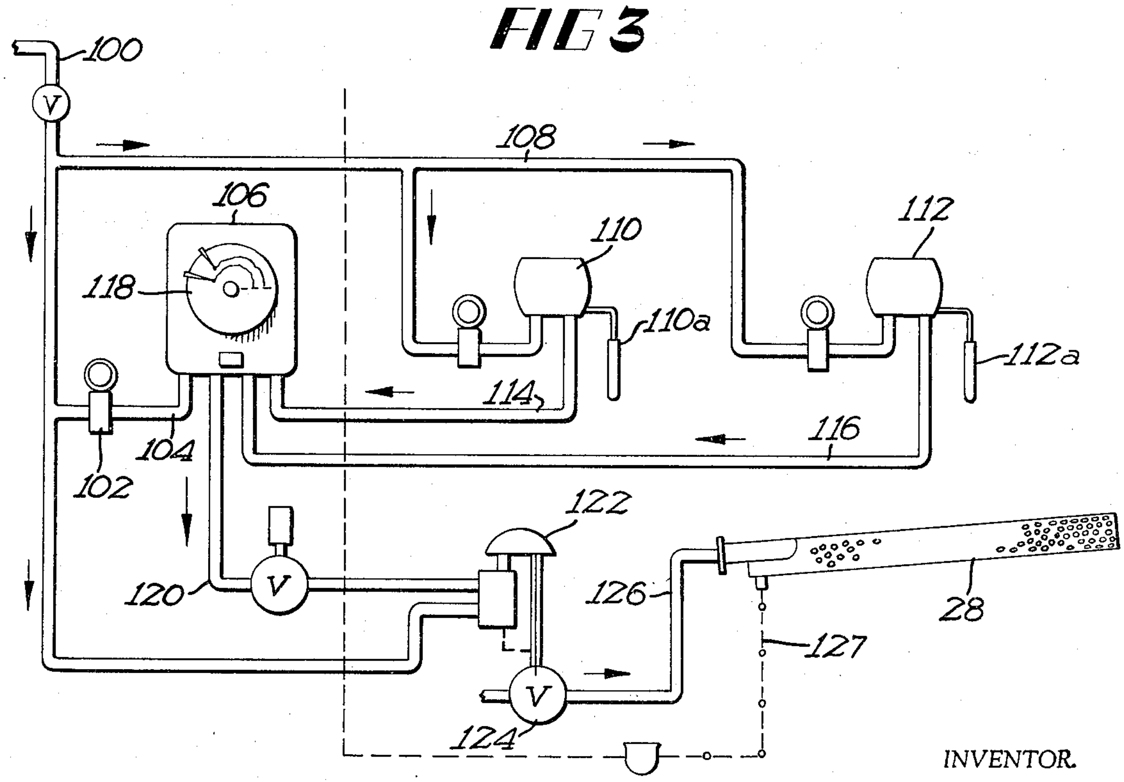


FIG 4

INVENTOR.
JOSEPH M. PEEBLES
BY
James V. Horwood
ATTORNEY

APPARATUS FOR HEATING GRAIN

It has been known for some time that the temperature of wheat at the time it is milled affects the milling process. During winter months grain is often received at a temperature below 40° F. In the course of the work conducted in developing the present invention, it was discovered that the yield of high-grade flour from hard wheat could be substantially improved if milling was conducted with the wheat at constant and relatively warm temperature, e.g., about 85° F. It has been previously proposed to heat grain as it is transferred from one location to another by means of the screw conveyor but the relatively low heating capacity of such equipment has been a problem in the past. Another problem has been a lack of uniformity in the exposure of individual grains to the heating element or heating medium. The result has been low throughput rates and temperature variations in the finished product. Moreover, some prior processes reduce the moisture content of the grain. In some equipment used for heating grain, heat is transmitted to the grain by conduction and must be carried from one grain to another by contact. This process is relatively slow and tends to result in nonuniform heating.

In view of these and other defects of the prior art, it is an object of the invention to provide a process and apparatus for heating grain having the following characteristics and advantages: (a) the capacity to heat as much as a ton of grain per minute from a temperature of about 40° F. to about 85° F.; (b) to accomplish heating with a maximum of efficiency and with a minimum of moisture loss; (c) the ability to minimize heat loss; (d) a provision for direct and intimate exposure of a heating medium with the individual grains while the grains are in a highly turbulent condition; (e) equipment that will assure uniformity in the time period during which each of the grains is exposed to the heating medium; (f) a provision for heating grain with steam and for eliminating the requirement for a steam exhaust; (g) the provision of a chamber for exposing the grain to a heated atmosphere such as steam and a further provision for filling substantially the entire chamber with the grain under a turbulent condition; (h) the provision of a grain heater with self-cleaning internal flighting; (k) a provision for preventing damage to the grain due to overheating in the event the flow of wheat out of the heater is interrupted.

These and other more detailed and specific objects of the invention will be apparent in view of the following specification and drawings wherein:

FIG. 1 is a flow diagram showing the transfer of grain through the heating apparatus to a storage bin.

FIG. 2 is a side elevational view partly broken away of one heating apparatus embodying the invention.

FIG. 3 is a vertical transverse sectional view taken on line 3—3 of FIG. 2, and

FIG. 4 is a schematic view of the circuit used for controlling the temperature.

In the accomplishment of the above objectives, the invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

Briefly, the invention processes grain such as wheat to improve the yield of high-grade flours by elevating the wheat and allowing it to fall freely through a steam-filled vessel thereby providing intimate contact between the steam and the individual grains for a period of at least 10 seconds to elevate the temperature of the wheat to above 60° F. and maintain the wheat at this temperature for a period of time before being milled.

For best operation, it was discovered that the grain should be heated to from about 60° F. to about 90° F. and preferably between 80° F. and 87° F. and that it should be held at this temperature for a time, e.g., at least 1 hour and preferably between 2 to 4 hours before being milled. The steam can be admitted at atmospheric pressure or slightly above. Good results were obtained when the steam was admitted at a pressure of about 2 to 4 psig (220° F.).

It was found that sufficient exposure of grain to the steam atmosphere was accomplished at this temperature in a period of only about 30 to 40 seconds and that this could be done without any steam being exhausted from the outlet of the apparatus. Because no exhaust is necessary, the entire quantity of steam injected is utilized and incorporated into the grain.

Refer now to the drawings and particularly to FIG. 1. As seen in the figure, wheat which has been tempered is introduced to the heater **10** through an inlet duct **12**. The grain is tempered conventionally by spraying it with water and storing it for a period of about 6 to 12 hours. After being heated to the requisite temperature within the heater, the grain is withdrawn through a duct **14** and stored for about 2 to 4 hours in a bin **16**. It is then transferred to the milling equipment through duct **18**.

The heater **10** will now be described with particular reference to FIGS. 2 and 3. A supporting framework **20** is composed of uprights **20*a*** to which are welded longitudinally extending beams **20*b***. At the ends of the framework **20** are provided uprights **20*c*** and **20*d***. The upright **20*c*** includes a circular collar **22** at its upward end which is closed at its left end by a circular plate **22*a***. Terminating within the collar **22** is the conical end wall **26** of cylinder **24**, both of which are formed from sheet metal. The collar **22** serves as a closure and seal for the inlet end (left end) of the heater **10**. The duct **12** passes through the plate **22*a*** as seen in FIG. 2 as does a sparger tube **28** that is used to introduce steam into the cylinder **24**. The sparger tube **28** is provided with a plurality of outlet openings **30** as shown in FIG. 2.

The right end of the cylinder **24** as seen in FIG. 2 acts as an outlet. The outlet is covered by a vertically disposed closure plate **29** which is supported upon the upper end of the upright **20*d***. Welded to plate **29** is a collar **29*a***. An end wall **24*a*** of conical configuration welded to the right end of the cylinder **24** fits in the collar **29*a*** with just sufficient clearance to rotate freely therein to substantially seal the right end of the cylinder **24**. The duct **14** extends into the cylinder through a suitable opening in plate **29** and is provided at its inward end with a funnel **14*a*** to catch the falling grain when it reaches the right end of the cylinder. In this manner the grain that has reached the requisite temperature is withdrawn from the heater.

Mounted for rotation within journals **30** and **32** are laterally aligned longitudinally extending inclined shafts **34** and **36**. Upon the ends of shafts **34** and **36** are mounted rubber wheels **40** over which are entrained belts **42** that serve to support the drum **24** at an angle inclined at about 3° to the horizontal for advancing the grain toward the outlet end of the cylinder **24**. Suitably mounted on the framework **20** is one or more wheels **43** to resist the downward thrust of the cylinder **24**.

The shaft **34** and the belts **42** are driven during operation by a motor **50** operating through a variable speed drive **52** which is controlled by tightening or loosening a turnbuckle **54**. This variable speed drive **52** in turn drives a speed reducer **56** which is coupled to the shaft **34**.

Within the cylinder **24** are provided a plurality of longitudinally extending axially aligned flights **60** each composed of two pieces **62** and **64** of steel sheet welded to the cylinder **24** along their outward edges and to each other at their inward edges. The sheet **62** is preferably welded to the surface of sheet **64** at its approximate center. Each flight **60** in this way defines a longitudinally extending scoop **66** which is filled with grain at the bottom of the cylinder. In the embodiment of the invention illustrated, 24 shaped flights spaced 15° apart are welded to the inside surface of the cylinder. Each of the flights **60** runs the full length of the cylinder.

During the operation, the speed of the drive **52** is controlled so that the scoops **66** begin dumping grain in streams S at approximately the position designated A in FIG. 3 and continues to dump the grain throughout an arc of 90° or more until position B is reached thereby filling almost the entire enclosed space within the cylinder **24** with the falling streams of grain S. In this manner, the grain is dumped repeatedly and uniformly mixed with the incoming steam while in a turbulent condition. It was discovered that the uniform and turbulent mixing of the incoming steam and the falling grain was highly effective in promoting rapid heat transfer from the steam to the grain. Because the streams S fill substantially the entire cylinder **24**, the entire volume of the cylinder is utilized as a contact zone for heat transfer.

The controller employed for regulating the operation of the apparatus will now be described with particular reference to FIG. **4**. Compressed air supplied by line **100** passes through pressure regulator **102** in line **104** to a temperature recording controller **106** of a suitable known construction and through line **108** to temperature sensing transmitters **110** and **112**. Transmitter **110** includes a sensing probe **110***a* located in duct **12** for sensing the temperature of the incoming grain. The temperature transmitter **112** includes a similar sensing probe **112** located in the duct **14** for sensing the temperature of the outgoing grain. The transmitters **110** and **112** thus provide air at a pressure between about 3 and 15 psi (depending upon the sensed temperature) through lines **114** and **116** respectively to the controller **106** which displays both temperatures on chart **118** and which utilizes the pressure sensed at the outlet (sensor **112***a*) to change the pressure in a control line **120** which controls a diaphragm regulator **122** that in turn opens or closes steam valve **124** in line **126**. The valve **124** feeds steam to the sparger tube **28**. Condensed steam is withdrawn as seen in FIG. **4** through a line **127**. The signal of sensor **110** is recorded on the chart recorder only and performs to control function.

In operation, if the temperature sensed by the sensor **112***a* is too high, the controller **118** will reduce the pressure within line **120** thereby closing somewhat the valve **124**. When the temperature drops below a predetermined value, more steam will be admitted through valve **124**.

The invention will be better understood by reference to the following examples:

EXAMPLE I

Winter wheat was heated from a temperature of about 50° F. to 85° F. using the apparatus illustrated in the figures. The cylinder **24** was 6 feet in diameter and was 12 feet long. It was rotated at a speed of 16 rpm. Saturated steam was admitted through the sparger **28** at a pressure of about 2 to 4 psig (220° F.) at the rate of about 1,650 pounds per hour while the grain was admitted through line **12** at the rate of about 2,000 pounds per minute. It was found that all of the steam was absorbed within the heated product and that no exhaust was required. The turbulent grain substantially filled the entire cylinder **24**. The exposure time was about 30 seconds.

After reaching a temperature of about 85° F. the wheat was transferred through the line **14** to a storage bin and held there for 2 hours. It was then milled conventionally. The resulting wheat was milled and produced a high yield of grade A flour.

I claim:

1. A process for heating chilled grain to temperatures above room temperature to facilitate milling, said process comprising providing a sealed enclosure having a cylindrical side wall with end walls extending transversely across each end thereof, continuously feeding steam and grain into the enclosure, continuously elevating the grain from the bottom of the enclosure to the top thereof and allowing the grain to fall when it approaches the top of the enclosure whereby the grain falls under the influence of gravity from the upper portion of the enclosure across substantially the entire width of the enclosure to thereby provide streams of falling grain which substantially fill the entire volume of the enclosure, the whole volume of the enclosure being thereby utilized as a contact zone for heat transfer while preventing the escape of steam from the enclosure whereby substantially all of the steam that is introduced is condensed upon and absorbed by the grain to thereby prevent heat from being carried away with escaping steam and continuously withdrawing the grain from the outlet end of the enclosure whereby the grain is elevated in temperature from a chilled condition to a temperature about 35° F. higher than its original temperature in a period of about 30 seconds or less when 825 pounds of steam is used for each 1,000 pounds of grain.

2. The process of claim **1** wherein the steam is admitted at a pressure of about 2 to 4 psig and the temperature of the grain is elevated to between 85° F. and 87° F.

3. The process according to claim **1** wherein the grain is wheat and, after being heated, the grain is stored for a period of at least 1 hour before being milled.

* * * * *