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Patented Aug. 12, 1902.

B. BERG.
PNEUMATIC MALTING KILN.

(Application filed Dec. 30, 1901.)

(No Model.)

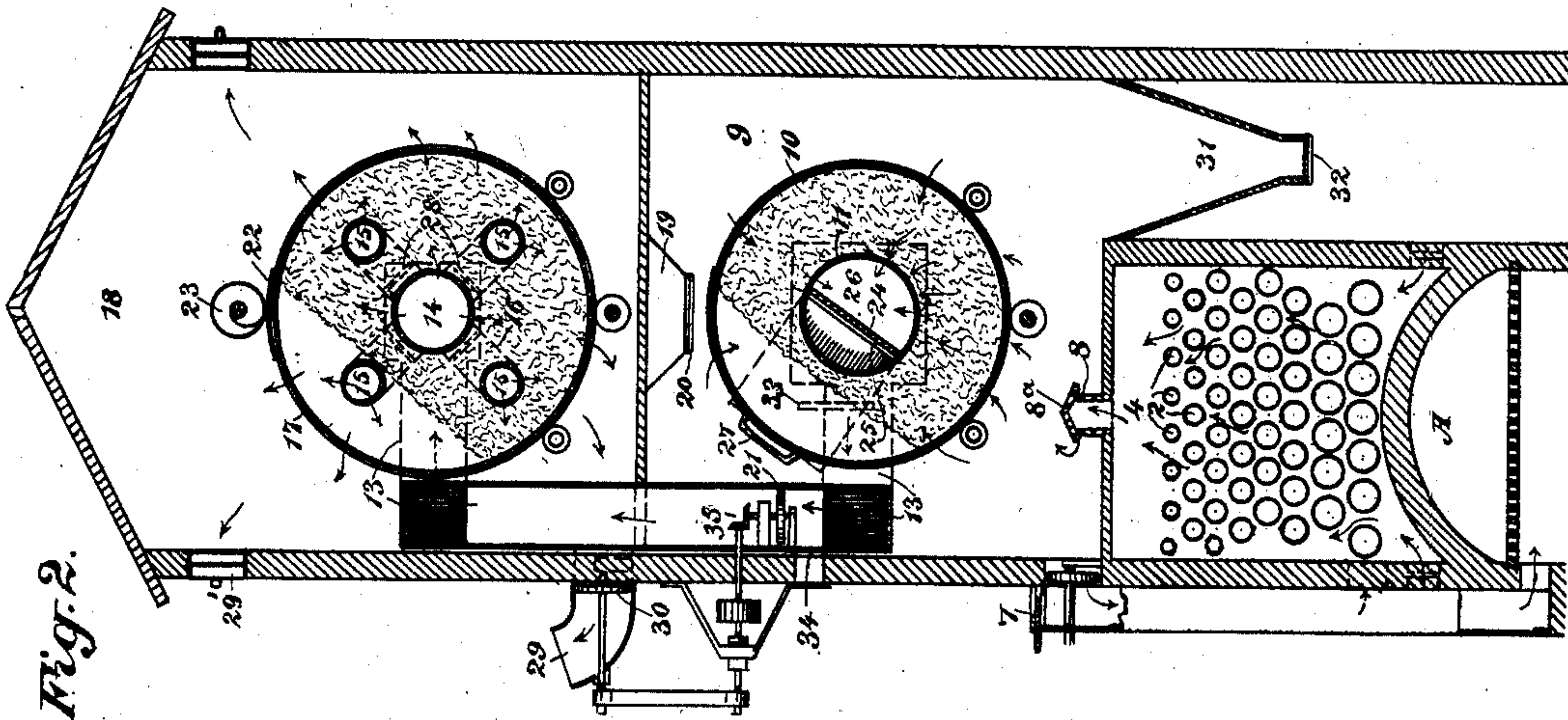


Fig. 2.

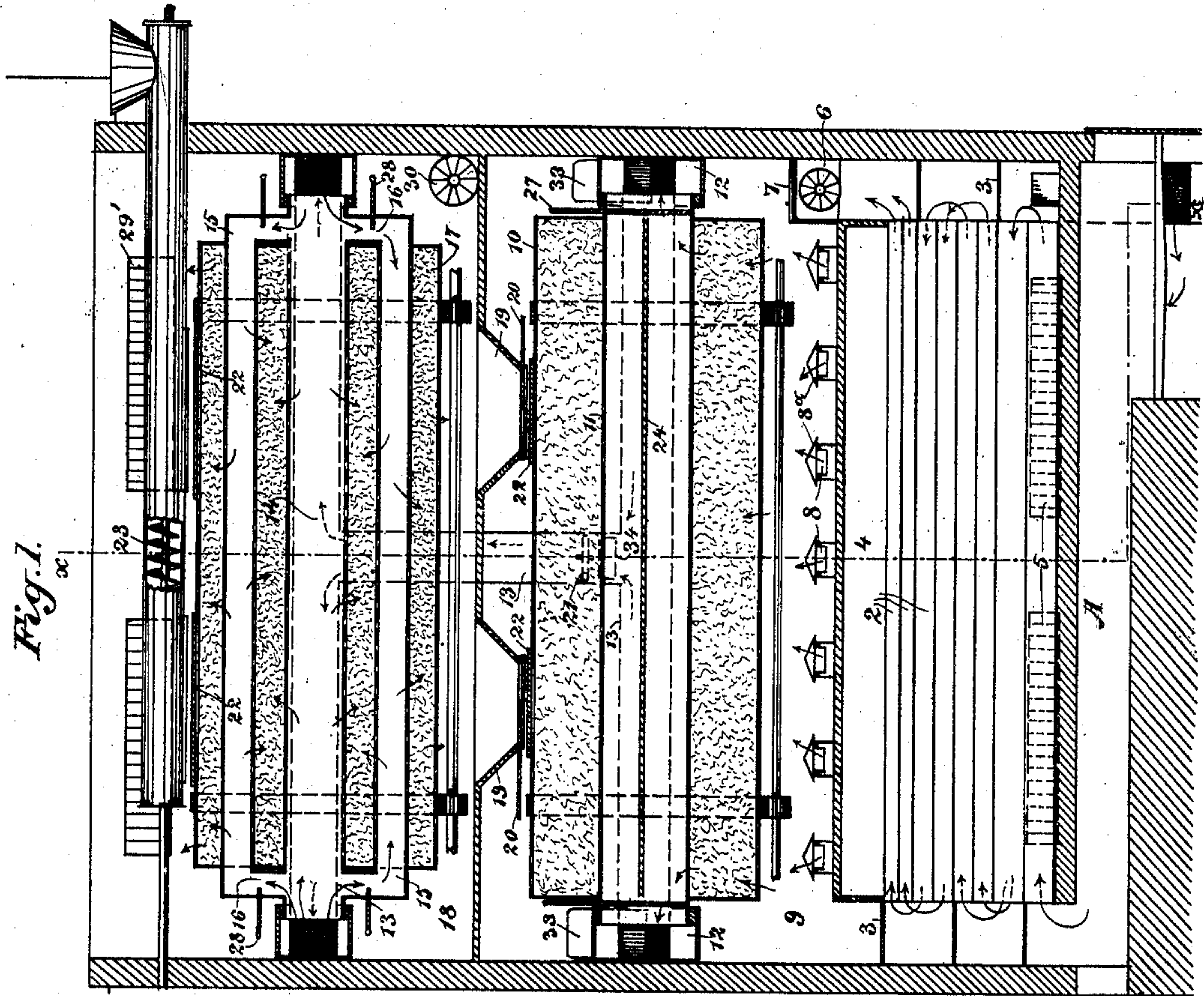


Fig. 1.

Witnesses,
St. James
H. S. Aschbeck

Inventor,
By Bernard Berg
Dewey Strong & Co.
attys.

UNITED STATES PATENT OFFICE.

BERNARD BERG, OF SAN FRANCISCO, CALIFORNIA.

PNEUMATIC MALTING-KILN.

SPECIFICATION forming part of Letters Patent No. 706,716, dated August 12, 1902.

Application filed December 30, 1901. Serial No. 87,746. (No model.)

To all whom it may concern:

Be it known that I, BERNARD BERG, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented an Improvement in Pneumatic Malting-Kilns; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to an improved apparatus for preparing malt. Its objects are to furnish a device in which the air shall first be thoroughly heated and sterilized and in which the air so heated shall be distributed more equably through the mass of material than is possible by ordinary means.

It consists of a heater or furnace having the flues carrying the products of combustion separate from the air-passages, said flues arranged serially, decreasing in diameter and increasing in number in succeeding series, whereby the heating area of the flues is augmented, heating-chambers, drums revoluble therein, cylinders in said drums, longitudinal partitions in certain of said cylinders, means for admitting the material from the drum of one chamber to a drum in a succeeding chamber, means for inducing air-currents through said chambers and drums, and means for controlling said currents.

It also comprises details which will be more fully set forth hereinafter, having reference to the accompanying drawings, in which—

Figure 1 a longitudinal central vertical section through the kiln. Fig. 2 is a vertical section on line *xx* of Fig. 1 and showing the upper portion of the passage 6 broken away.

A represents a heater or furnace having the flues 2 arranged in series, as shown, said flues decreasing in size and increasing in number in the succeeding series. By means of suitable partitions 3, disposed alternately between the ends of the flues, the heat, smoke, and other products of combustion pass in circuitous course through the chamber 4, into which air is received through shutters 5. The flues finally discharge into a passage 6, whence they may be reconducted to the furnace or discharged into the outer air through a gate 7. The flues 2 being so disposed offer a very large heating area to be exposed within the chamber 4. From the latter chamber the

heated and sterilized air is delivered through suitable openings 8 into the first kiln-chamber 9. Distribution of the heated air in the latter is assisted by means of the hoods 8^a, disposed over the ends of the passages 8. A perforated drum 10 is revolubly mounted in this chamber, and a perforated cylinder 11 is disposed within and concentric with the drum 10. The cylinder 11 extends through the heads of the drum, and its ends terminate in the air-boxes 12 in the air-trunks 13, which lead to a chamber above and communicate with a second cylinder 14. The latter has its ends suitably supported and packed in the sides of the trunks 13, so as to form practically air-tight joints and at the same time allow the cylinder to turn. A series of supplemental parallel cylinders 15 are supported radially of the cylinder 14, and the ends of the former communicate through short sections 16 with the interior of the cylinder 14. All these cylinders are perforated, so that air from the passages 13 may pass freely through all of said cylinders and into and through a perforated revoluble drum 17, in which the cylinders are contained. The drum 17 is inclosed in a superposed chamber 18, which communicates with chamber 9 through hoppers 19. These hoppers may be closed by gates 20, as it is intended that ordinarily chamber 9 shall be practically closed except for the openings 8. A current of air is induced through the chambers and drums by means of the fans or aspirators 21, disposed in the passages 13 and operating in a manner shortly to be explained. Access is had to the interior of the drums for purposes of inspection, charging, emptying, &c., through openings provided with suitable closures 22.

This apparatus is devised particularly for purposes of drying the already-germinated grain. The material to be treated is delivered in a moist condition by means of a conveyer 23 in the top of the chamber 18 into the drum 17 in such quantity as to cover the cylinders within but not entirely fill the drum. When the grain has been sufficiently dried in the drum 17, it is discharged through the hoppers 19 into drum 10, where the process of drying is completed.

Heretofore it has been customary to use a

single drum and central air-cylinder and force the heated air into the latter and out through the surrounding grain. The difficulty has always been to distribute the air throughout the mass so that the grain will be acted upon uniformly. Various devices have been employed to prevent the air from the inner cylinder seeking the shortest route through the surrounding material by attempting to force it by one means or another to penetrate through the deeper portions of the body of grain.

In any form of malt-drying apparatus it is essential that the grain be subjected as little as possible to any bruising effects, and so it is that the containing-drum and air-distributing cylinder are preferably of cylindrical form, as then they offer no sharp edges for the grain to fall against or over, but allow of a gentle movement of one particle upon the other as it is brought gradually to the surface.

In effecting the desired result of an equable distribution I have employed certain means of controlling such distribution in the cylinders 11, 14, and 15. In the cylinder 11 is a diaphragm 24, extending the entire length of the cylinder and dividing the latter into two entirely separate though not necessarily equal compartments 25 and 26. Both compartments, however, are in open communication with the air-trunks 12 and may be closed more or less by means of the slide-gates 27, situated exterior to the drum. While in the present instance I have shown but one partition, as that is ordinarily sufficient, I do not wish to limit myself to the use of a single partition. Though not shown, a similar longitudinal partition may be placed in the cylinder 14. The air-supply, however, to the various cylinders 15 is regulated by means of slide-gates 28 in the sections 16. The effect of the aspirators 21 is to create a suction in the trunks 12 and cylinder 11 and a forced draft through the pipe 13 and cylinders 14 and 15, or, in other words, the heated air is drawn from the chamber 9 inwardly through the drum and grain, while in the chamber 18 the action of the air is from the center of the drum outwardly through the grain. By disposing a number of cylinders 15 as shown the body of the grain in chamber 18 is affected in every part in a manner impossible with a single central air-distributing cylinder. Having been partially dried in drum 17, the material is discharged, as before described, into drum 10, where it is subjected to the drier and hotter air of the furnace and the last traces of moisture removed. Thus, in effect, the material in drum 10 serves as an attenuating means, cooling and moistening the air just sufficiently so that it will be in the proper condition when brought into contact with the moist material of drum 17, for if very dry and very hot air were brought into immediate contact with the moister material

the kernels would become when dry as hard and irrefrangible as glass. The moisture-laden air issuing from the drum 17 into chamber 18 is discharged thence through apertures 29, and the discharge may be facilitated, if desired, by means of an aspirator 30.

The discharge-aperture 29, containing the aspirator 30, is used when the kiln is first started and when the air from the drum is so heavily laden with moisture that it would not pass out readily through the shutters 29' above, and condensation would accordingly take place in the bottom of the chamber. The aspirator is driven by the gearing 35, which also drives the fan 21. During the operation of the fan the shutters 29' are closed, and as the air becomes drier the shutters may be opened.

When the drums are first charged with malt, the gates or valves 27 and 28 are opened to their fullest extent and the cylinders are allowed to revolve freely with the drums. The apparatus is then stopped for a period of four or six hours longer. It is now that the function of the gates and of the partition 24 becomes apparent. The apparatus is stopped, so that the diaphragm 24 will be inclined in substantial conformity to the angle of resistance of the grain in the drum 10 and with compartments 25, whose air-supply is controlled by the gates 27 adjacent to the shallow portion of the material. By closing the gates 27 the full blast of air may be drawn through the compartment 26 downward and through the center of the body of grain and the latter be acted upon even in its deepest portions. However, it is intended that a certain proportion of the air-supply should be admitted to compartment 25 and pass thence through the shallower portions of grain. This air-supply is accordingly regulated by opening the gates more or less, according to the requirements of a particular case. In the drum 17 the gates 28, controlling the air-supply to those cylinders lying nearest the surface of the grain, are partially closed, so as to force the greater quantity of air through the deeper mass of material. When the process of drying has been finally completed in drum 10, the finished product is discharged through a hopper 31, located in the floor of the chamber 9. This hopper is ordinarily closed by a gate 32 in such manner that no air may enter the chamber except through passages 8 during the operation of the aspirator 21.

By means of gates 33 in the trunks 12 the air may be drawn more or less from one end or the other of cylinder 11, as may be advisable under some circumstances.

In case it is desired to further attenuate the air entering drum 17, a gate 34, communicating with the outer air, may be opened more or less to admit a cold draft into the trunks 13.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination in a malting apparatus of a heater, a plurality of chambers, revoluble perforated drums in said chambers, cylinders in said drums, said cylinders adapted to have their ends extend through the heads of said drums, connections between the ends of said cylinders whereby air is delivered from one to the other, air-passages between the heater and the first chamber, hoods or spreaders in said chamber by which the air from said passages is distributed, and means for inducing an air-current through said chambers, drums and cylinders.

2. The combination in a malting apparatus of a heater, a plurality of chambers superposed in relation to each other, revoluble perforated drums therein, perforated cylinders in said drums, means for admitting material into said drums, openings in the floor of the uppermost chambers through which the material in the uppermost drum may be delivered into the drum in the chamber beneath, closures for said openings, passages through which air from the heater is admitted to said lower chamber, connections between the ends of said cylinders, and means in said connections by which the air is drawn into the first cylinder through the surrounding material whereby it is attemperated and is thence delivered to the second cylinder and forced outwardly through the material surrounding the latter.

3. In a malting apparatus, the combination of a heating-furnace, a chamber within which said furnace is located, a malting-chamber, one or more mains connecting said chambers, a stationary horizontally-disposed cylinder in the malting-chamber, said cylinder divided longitudinally into compartments, mains in which the ends of said compartments terminate and valves controlling the flow of air through said compartments, and means for forcing air through the apparatus.

4. In a malting apparatus, the combination of a furnace, an air-chamber within which said furnace is located, mains leading from said chamber, a horizontal, perforated cylinder longitudinally divided into a plurality of separate compartments, a revoluble perforated drum inclosing said cylinder, mains in which the ends of the cylinder terminate, valves adjacent to the ends of said cylinder whereby the flow of air through said longitudinal compartments may be regulated, and means for forcing a current of air through the apparatus.

5. In a malting apparatus, the combination of a horizontal, perforated, hollow structure, means for forcing a current of air there-through, longitudinal partitions therein whereby the air-current is divided, and valves at the ends of the cylinder controlling the compartments thereof and regulating the admission of air thereto, and a drum inclosing said structure and revoluble thereto.

6. In a malting apparatus the combination

of a stationary horizontal cylinder, means for forcing a current of air therethrough, longitudinal partitions in said cylinder whereby the air is divided, valves at the ends of the cylinder for controlling the flow of air through certain of the compartments formed by said partitions, and a revoluble drum inclosing said cylinder.

7. In a malting apparatus the combination of a stationary horizontal perforated cylinder, partitions in said cylinder whereby the latter is interiorly divided into a plurality of separated longitudinal compartments, means by which heated air may be forced through said compartments, slide-valves at each end of the cylinder by which the supply of air to any one of said compartments may be controlled, and a drum or germinating-chamber within which said cylinder is contained.

8. In a malting apparatus the combination of a horizontal perforated stationary cylinder, air-conducting mains with which the ends of said cylinder communicate, longitudinal partitions in and extending the length of said cylinder, gates slidable across the ends of the cylinder and regulating the admission of air to the compartments thereof, and a revoluble drum inclosing said cylinder.

9. In a malting apparatus, the combination of a horizontal perforated cylinder, air-conducting mains with which the ends of said cylinder communicate, partitions within said cylinder whereby the cylinder is longitudinally divided into a plurality of air-conduits communicating with said air-mains, gates or valves slidable across the ends of the cylinder whereby the admission of air to said conduits may be controlled, and a drum inclosing said cylinder.

10. In a malting apparatus, a revoluble perforated drum, a centrally and horizontally disposed, perforated cylinder in said drum, the ends of said cylinder extending beyond the ends of the drum, mains connected therewith, a plurality of perforated cylinders within the drum parallel with the first and having their ends extending beyond the ends of the drum, and short sections connecting the ends of said last-named cylinders with the central cylinder.

11. In a malting apparatus, a perforated drum, a plurality of perforated cylinders in said drum disposed parallel with the axis of the drum, said cylinders having their ends extending through the heads of the drum, means by which a current of air is forced through said cylinders and means in said cylinders exterior to the drum by which the air supplied to said cylinders is regulated.

12. The combination in a malting-kiln of a furnace, a chamber in which said furnace is situated, air inlets and outlets in said chamber, a plurality of drying-chambers, the first of said chambers adapted to receive the air from said heating-chamber, perforated drums in said drying-chambers, a horizontal perfo-

rated cylinder in the first of said drums, a longitudinal partition in said cylinder, a plurality of horizontal cylinders in the second drum, air-trunks uniting the ends of the cylinders in both drums, a suction apparatus in said trunks whereby a current of air is induced through the chambers, drums and cylinders, and valves in each of said cylinders

whereby the flow of air therethrough may be regulated. 10

In witness whereof I have hereunto set my hand.

BERNARD BERG.

Witnesses:

S. H. NOURSE,

CHAS. E. TOWNSEND.