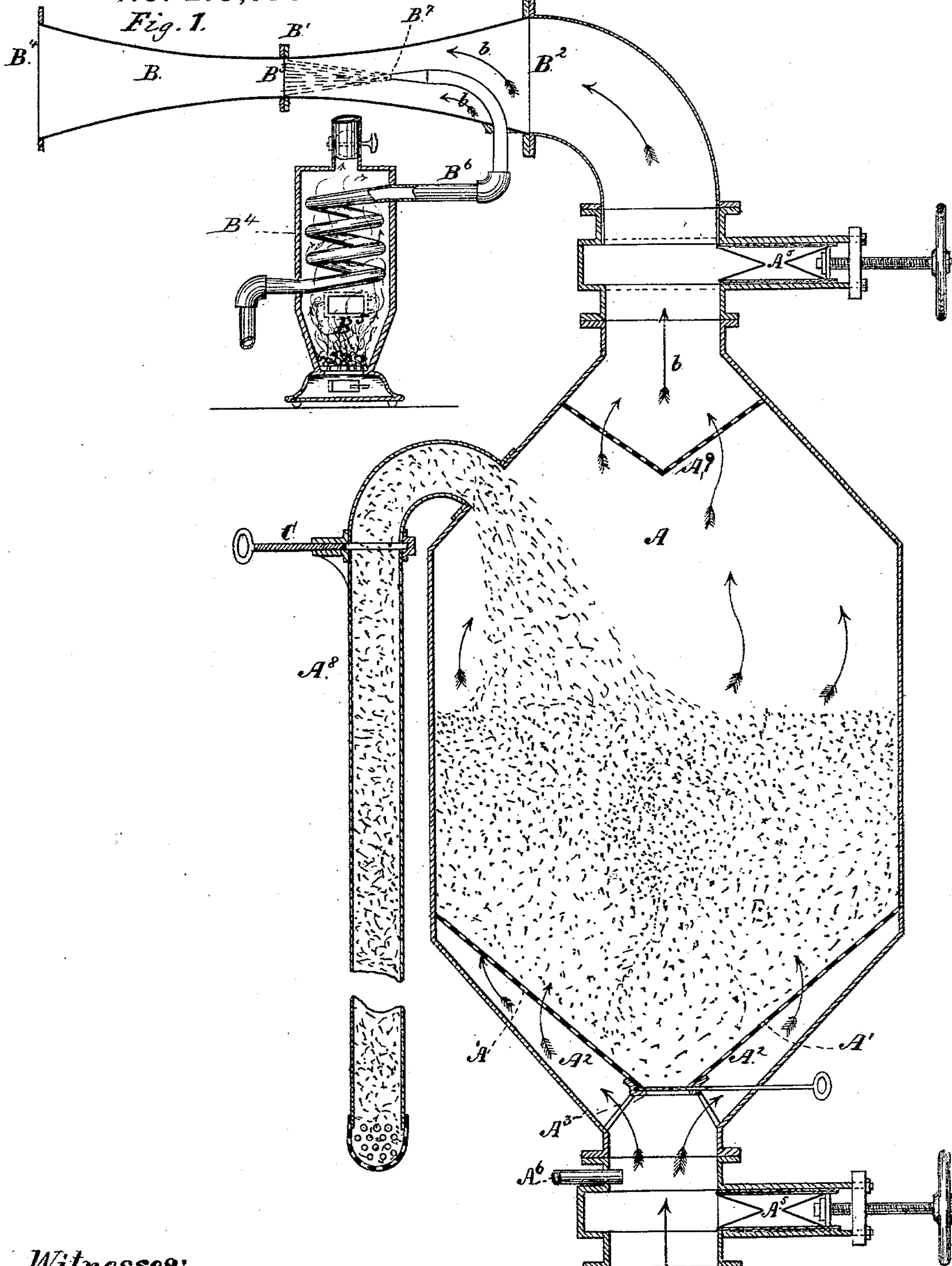


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Apparatus and Process for Drying Cereals.

No. 210,793.

Patented Dec. 10, 1878.



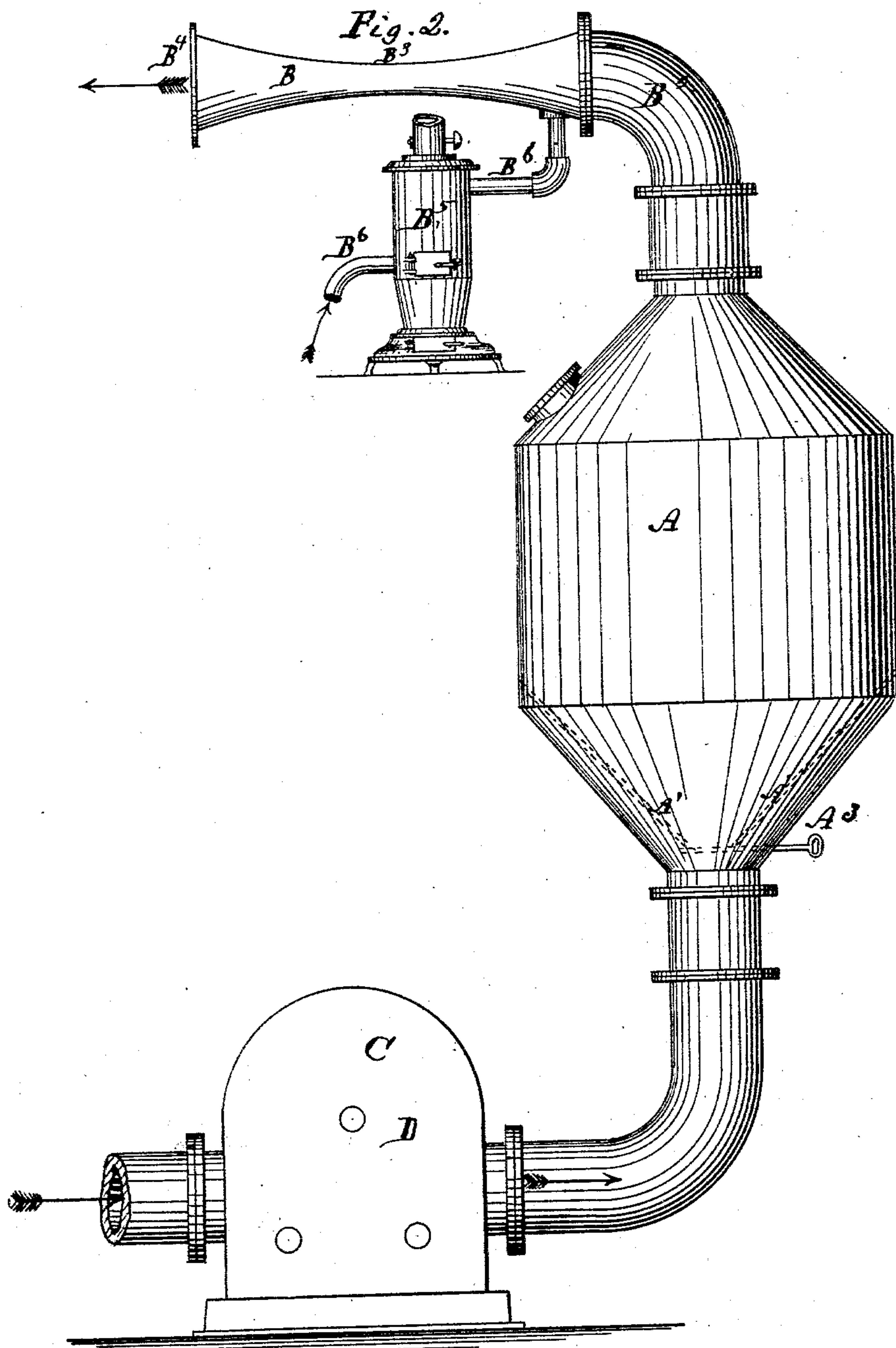
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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN APPARATUS AND PROCESSES FOR DRYING CEREALS.

Specification forming part of Letters Patent No. **210,793**, dated December 10, 1878; application filed August 5, 1878.

*To all whom it may concern:*

Be it known that I, FREDERIC A. LUCKENBACH, of the city, county, and State of New York, have invented an Improved Apparatus and Process for Drying Indian Corn and other Cereals; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, making part of this specification—

Figure 1 being a central vertical section of the improved apparatus; Fig. 2, a side elevation of the same.

The object of my invention is to provide an improved apparatus for, and effect an improved method or process of, drying Indian corn and other cereals in a mass or body.

My improved apparatus consists, essentially, of a strong chamber or vessel, constructed to contain the mass of grain, and adapted to be made air and steam tight by means of a valve or valves, substantially as hereinafter described, so as to exclude the surrounding atmosphere and allow a high degree of pressure inward or outward, the said vessel being provided with a steam-jet nozzle and narrow escape-pipe, by which an exhaustion of many pounds to the inch, approaching complete exhaustion, can be produced in the vessel; also, with a steam-superheating device, and with a device for introducing either cold or heated air and steam under various degrees of pressure, substantially as hereinafter specified.

The improved process consists in subjecting the grain in the vessel to the powerful exhaustive action of a powerful steam-jet with superheated or other steam, both to exhaust the air and moisture from the vessel and to draw heated or cold air at different times rapidly through the grain, and, in connection therewith, the forcing into the vessel and through the grain, hot or cold air or steam under pressure at the same time that the powerful exhaustive action of the steam-jet is going on, all substantially as hereinafter set forth.

By this means not only is a powerful and rapid drying, heating, and cooling action produced, rendering the process very rapid, but a powerful agitation is produced among the grain, overcoming the resistance due to the compactness and quantity of the mass, thus rendering the process very uniform, complete, and effective.

Although the apparatus may have various forms, even quite different from that represented in the accompanying drawings, yet I prefer substantially this construction, as follows:

The main vessel or bin A, in which the grain is introduced for drying, is represented as of cylindrical form, with two conical ends or heads, one at the top and the other at the bottom. The upper extremity of the upper conical head opens into a curved discharge-pipe, B<sup>2</sup>, of suitable dimensions to convey away the air or steam from the vessel as fast as may be desired. This terminates, for convenience of position, horizontally, and joins with a horizontal outlet tube or extension, which is comparatively wide where it joins with the tube B<sup>2</sup> and at its discharge end B<sup>4</sup>, but is narrowed in the middle to a much smaller diameter at B<sup>3</sup>, as small as practicable for the discharge of the air or steam from the grain-vessel and the steam of the jet commingling therewith.

The nozzle B<sup>7</sup> of the steam-jet is situated centrally in the inner part of this double conical discharge-tube, a little back of the narrowest part, B<sup>3</sup>, through which it blows with great force, being properly of taper form. The steam-pipe B<sup>6</sup>, which supplies this jet, passes through a superheating furnace or device, B<sup>5</sup>, in the form of a coil, as shown, or otherwise.

At the top of the grain-vessel is a valve, A<sup>5</sup>, for cutting off the discharge-outlet of the air or steam when desired.

At the bottom of the vessel or chamber A the grain does not rest on the outer head or end, but upon an interior bottom or partition plate, A<sup>1</sup>, preferably of conical or concave form, and constructed of perforated sheet metal or strong wire-gauze of the proper mesh to sustain the grain, but to admit air or steam from below up into the grain. Between this inner plate or bottom and the outer lower head of the grain-vessel is a space, A<sup>2</sup>, sufficient to allow a sufficient circulation of air or steam for supplying the mass of grain through the perforated partition, which is to be properly supported or stayed to sustain the mass of grain above. At the lower extremity of this inner bottom is an outlet through which to discharge the dried grain, to be opened and closed by a valve, A<sup>3</sup>, which also may be preferably made of perforated metal, to admit the



upward passage of air and steam. The discharge-opening continues through the lower end of the outer lower head by a conveying pipe or passage, and this is provided with a steam and air tight gate-valve, A<sup>5</sup>, similar to the one similarly marked at the upper end of the vessel. Into this grain-discharge passage, or into the space A<sup>2</sup>, is introduced a steam-pipe, A<sup>6</sup>, reaching to a steam generator or boiler, for supplying steam, under the desired pressure, to the lower part of the vessel, for forcing through the mass of grain. Also, through the lower large pipe or otherwise, into the space A<sup>2</sup> air is admitted, to be drawn or forced through the grain. A suitable forcing-pump or blower, D, Fig. 2, is connected with this air-inlet, to force the air, hot or cold, under the desired pressure, into the grain-vessel and through the grain. When the air is to be hot or warm it is heated by any suitable means before it is drawn or driven into the grain-vessel.

I propose to introduce the grain into the vessel A through a pipe, A<sup>3</sup>, at or near the top of the vessel by the exhaustive power of the steam-jet, the outer end of the said pipe being fed with grain and inflowing air commingled, or, in other words, to pump the grain into the vessel by the medium of inflowing air. This pipe, when the vessel is filled with grain, is closed by an air-tight valve, C.

A suitable perforated plate or wire-gauze partition, A<sup>9</sup>, is located in the upper part of the grain-vessel, to prevent any grain being drawn out by the exhaustive power of the steam-jet.

The object in employing a steam-jet for exhausting air from the grain-vessel is to obtain an exhaustive pressure greatly beyond that which can be produced by a revolving fan, or practically by a pump, since I employ a much greater power of exhaustion and rapidity of circulation through the grain than has been heretofore attempted, whereby not only do I obtain a much more rapid drier, but thoroughly uniform and effectual. The steam is superheated to increase the exhaustive power of the jet. An equivalent practicable device might be used instead; but I know of none equally effectual and simple.

The successive steps and action of the improved process are substantially as follows: The grain having been introduced into the vessel A, air heated to a uniform temperature of 180° Fahrenheit, more or less, is admitted into the lower part of the vessel, and the steam-jet is put in action, by the powerful exhaustive action of which, in connection with the inward forcing of the air by the fan-blower at the bottom, the hot air is rapidly and thoroughly driven through every part of the mass of the grain a few minutes, or until the grain is thoroughly heated to the temperature of the air, and the moisture of absorption in the grain well expelled. Then the admission of air at the bottom is cut off, and the steam-jet con-

tinued a minute or two, thereby exhausting the greater part of the air from the vessel, producing a partial vacuum. Then, while the exhaust-steam jet continues in full action, steam is admitted through the pipe A<sup>6</sup>, at the bottom of the vessel, from a boiler containing steam preferably under a pressure as high as sixty or eighty pounds. This is continued from five to ten minutes, forcing immense volumes of steam through the entire mass of grain, thereby subjecting the grain to the combined action of moisture and heat, removing all mustiness from the grain, if any is there, and killing the germs thereof. It also completely vaporizes and expels every particle of moisture from the interior of the grains. Then the steam from the boiler is cut off, and hot air forced into the mass of grain while the exhaust-jet continues, thus rapidly drawing through the mass the dry air, and rapidly carrying off the moisture left by the steam, and thoroughly drying it. This is continued a few minutes, or until the grain is thoroughly dried, the time varying with the quantity of grain, heat of the air, and rapidity of its motion through the grain. A little experience with a particular apparatus soon determines the time. Then cold air is forced and drawn through the grain in the same way, to cool it expeditiously. This requires only a few minutes.

A single mass of grain, if there is no haste, may be left to cool slowly in the vessel; but ordinarily the forcing process will be required.

The part of the above-described process which consists in first heating the mass of grain by hot air before admitting steam into the grain may be dispensed with, since the grain may be heated by the steam, though, perhaps, not quite so economically. In such case, the first step in the process is to exhaust the air from the vessel as far as possible by the exhaust-jet. Then the steam is introduced, while the jet continues in action, thus excluding outside air continuously.

By my process, employing both powerful exhaustive and powerful in-forcing pressure, I dry grain with great rapidity, and with a comparatively small apparatus. This, together with the thoroughness and uniformity of the results, renders the process valuable and desirable.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an apparatus for drying Indian corn and other cereals, a grain vessel or chamber having a valve or valves, substantially as set forth, for making it air-tight, and provided with a steam-jet device for partially exhausting air therefrom and for rapidly drawing air and steam through the same, substantially as and for the purpose herein specified.

2. In an apparatus for drying Indian corn and other cereals, a grain vessel or chamber having a valve or valves, substantially as set forth, for making it air-tight, and provided with



a steam-exhaust-jet device and a steam-superheating device, substantially as and for the purpose herein specified.

3. In an apparatus for drying Indian corn and other cereals, the combination of a grain vessel or chamber having a valve or valves, substantially as set forth, for making it airtight, a steam-exhaust-jet device for drawing air and steam therefrom, and a blower for forcing air, hot or cold, into the same, substantially as and for the purpose herein specified.

4. A process of drying Indian corn and other cereals, consisting in first partially exhausting the air from the vessel or chamber containing the grain, then admitting steam under pressure into the same, and rapidly forcing it through the mass of grain by the combined action of its pressure and the exhaustive action of a steam-jet or its equivalent, and finally

forcing and drawing heated and cool air through the mass of grain, substantially as and for the purpose herein specified.

5. In a process of drying Indian corn and other cereals, forcing steam into the mass of grain under pressure, and at the same time employing a steam-exhaust jet to draw the steam more rapidly through and from the same, substantially as herein specified.

6. In a process of drying Indian corn and other cereals, charging the containing vessel or chamber with grain by the inward flow of air through a pipe or tube, through which the grain is caused to pass commingled therewith, substantially as herein specified.

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