(No Model.) 2 Sheets—Sheet 1.

J. E. TURNEY.

GRAIN DRIER.

No. 565,055. Patented Aug. 4, 1896.

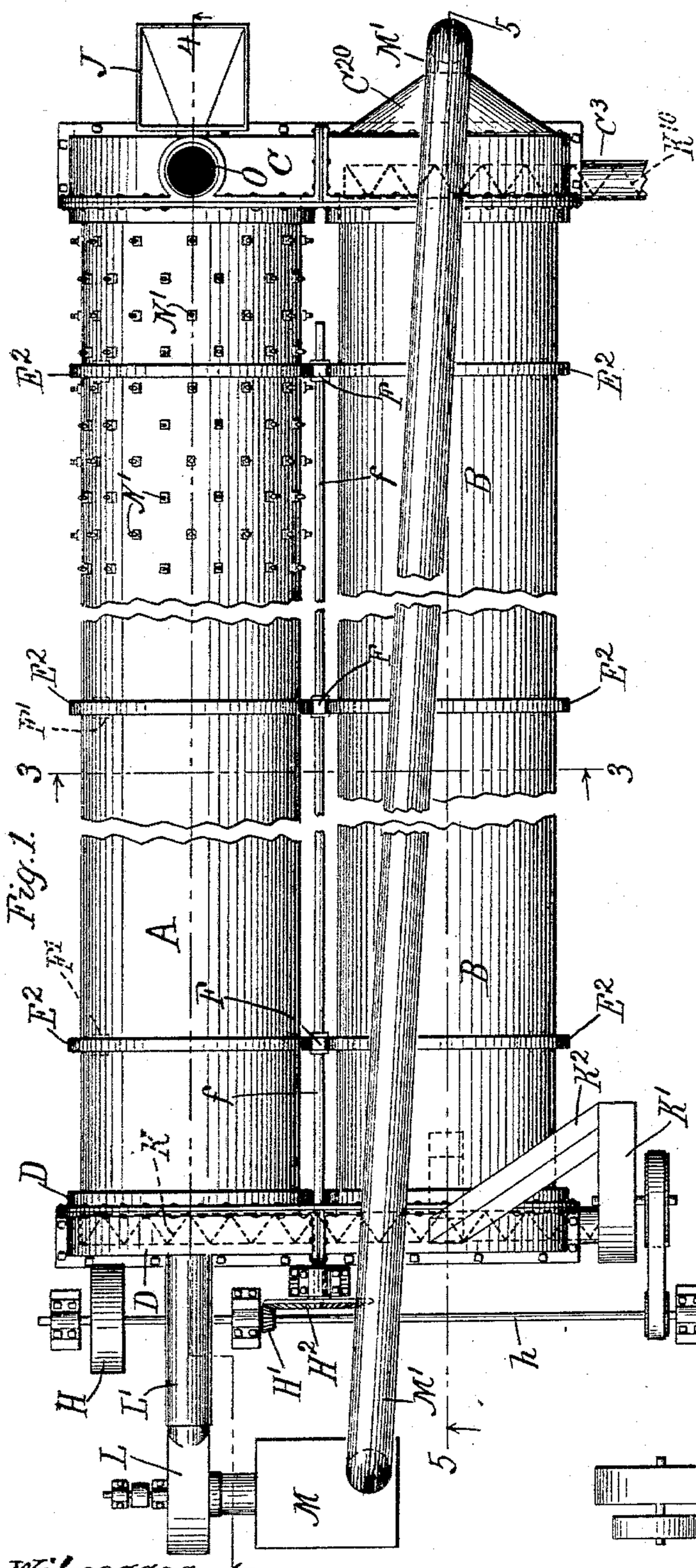

Fig. 1.

Fig. 3.

Fig. 2.

Witnesses.
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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

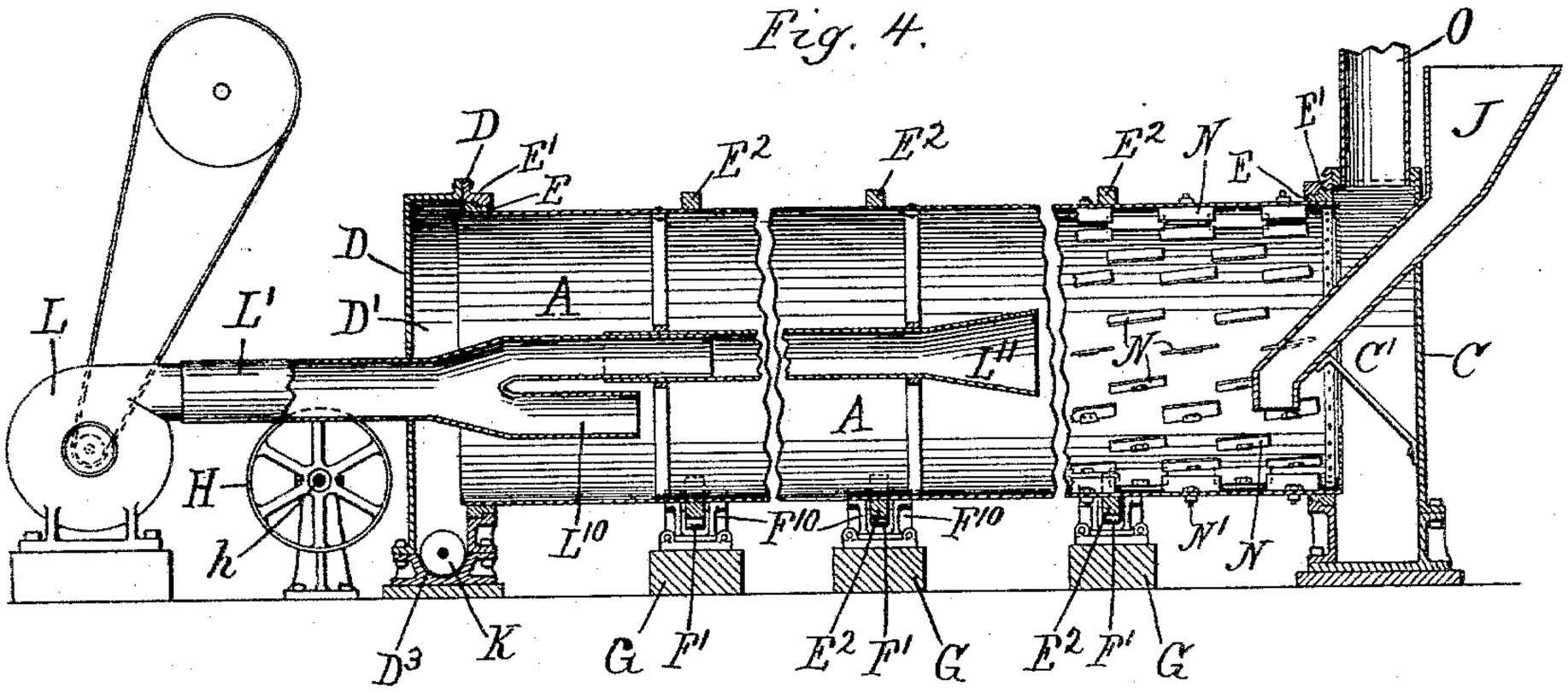


Fig. 5.

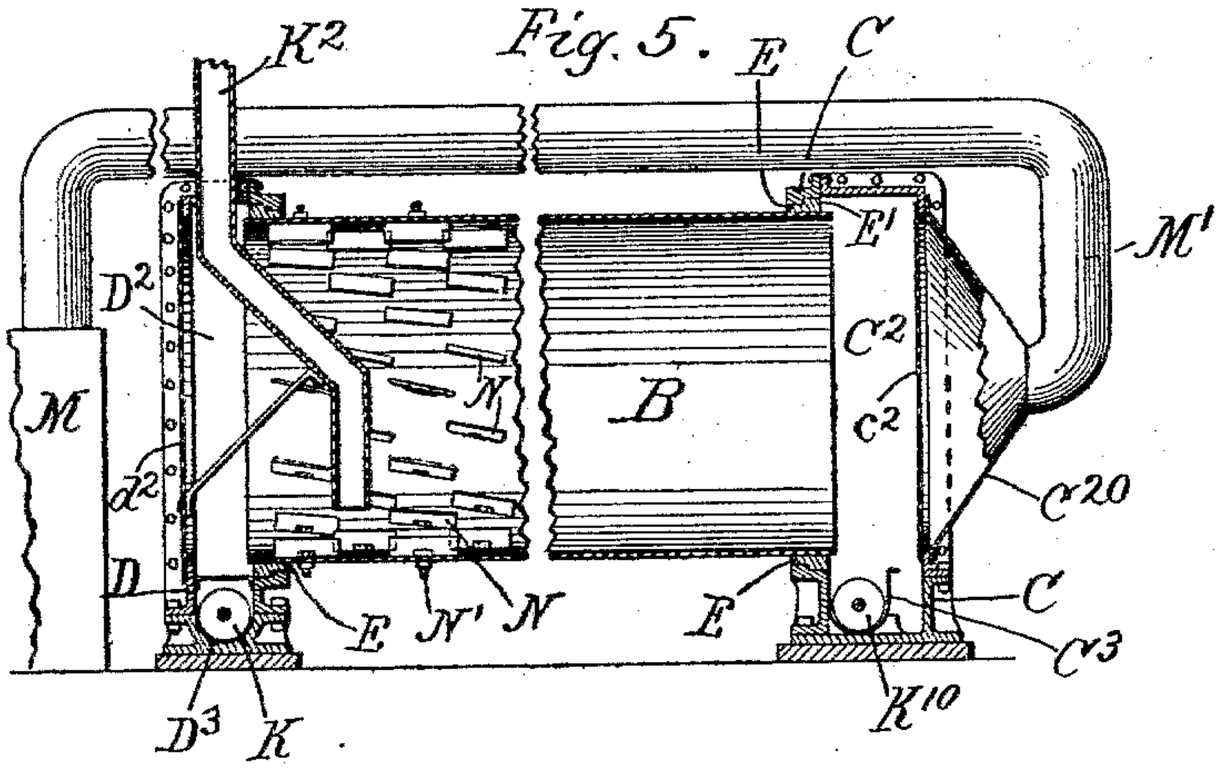
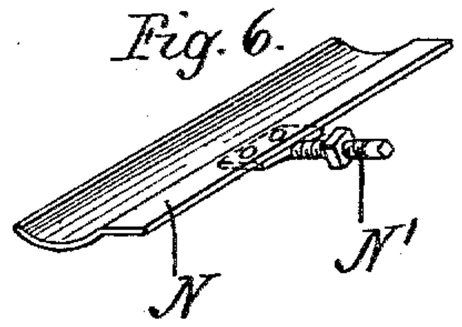


Fig. 6.



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UNITED STATES PATENT OFFICE.

JOHN E. TURNEY, OF OAK PARK, ILLINOIS, ASSIGNOR TO THE UNITED STATES GRAIN DRYING COMPANY, OF CHICAGO, ILLINOIS.

GRAIN-DRIER.

SPECIFICATION forming part of Letters Patent No. 565,055, dated August 4, 1896.

Application filed November 20, 1893. Serial No. 491,426. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. TURNEY, a subject of the Queen of Great Britain, residing at Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Grain-Driers, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to mechanism for drying and cooling wet grains, and it is particularly intended for use in operating upon the residual grains or meal commonly known as "brewers' grains," and also distillers' slops and like refuse material which has been malted or otherwise treated for brewers' or distillers' purposes, but which, still retaining a very large percentage of the nutritive matter, is valuable for feeding, but must be dried in order to be kept any length of time in condition for feeding or for shipment. In a former application, Serial No. 471,399, filed April 22, 1893, now pending in the Patent Office, I have shown a mechanism for drying and cooling such material, the general features of which are retained in my present invention.

The present application relates to details in which the structure is modified as compared with that former application.

In the drawings, Figure 1 is a plan of my improved drier and cooler, certain deflecting devices by which the material is fed longitudinally through the drying and cooling cylinders being shown only over a portion of one of the cylinders, the remainder being omitted to avoid confusion in the general representation. Fig. 2 is an elevation at the end at which the grain is supplied. Fig. 3 is a vertical transverse section at the line 3 3 on Fig. 1. Fig. 4 is a vertical section through the drying-cylinder at the line 4 4 on Fig. 1, non-distinctive portions being broken out to condense the figure and the deflecting devices above mentioned being shown only over a short portion of its length. Fig. 5 is a vertical section, at the line 5 5 on Fig. 1, through the cooling-cylinder, condensed lengthwise in the same manner as Fig. 4 and showing the deflecting devices only over a little portion of one end, the air-conduit back to the heater and the heater, partly broken away, being shown in elevation in connection with the cylinder. Fig. 6 is a detail perspective of one of the deflecting devices.

A is the drying-cylinder, and B the cooling-cylinder. These are mounted side by side in the heads C and D at opposite ends, respectively, opening freely into the chambers of the heads, as hereinafter more particularly described, and obtaining bearings also in said heads at openings through which the cylinders protrude thereinto, fitting comparatively closely such openings, but having expansion-joint connections at the same, so that as the cylinders expand and contract lengthwise by change of temperature they may have suitable play at their entrances to the heads. These cylinders may be made of comparatively light metal, their weight being carried by collars, several of which are provided at intervals throughout the length, the collars E E, at the ends, affording the seat for the cylinders in the heads, and being provided with the stop-flanges E′ E′ to prevent end-wise displacement of the cylinders beyond the extent which expansion and contraction of the latter may make necessary, and the other collars, E^2 E^2 E^2, intermediate the ends, being quite heavy and constituting the bearings of the cylinders upon the driving-rollers F F, &c., and the outer supporting-rollers F′ F′.

The driving-rollers F F are mounted on a driving-shaft *f*, journaled in suitable brackets *f′ f′* between the cylinders, so that the two cylinders rest upon the roller at opposite sides of a vertical plane through the axis of the shaft. The outer supporting-rollers F′ F′ may be each independently journaled in brackets F^{10} F^{10}, said brackets and the brackets *f′* being mounted upon suitable supporting masonry G and being tied together by tie-rods G′ G′ to keep them from spreading under the weight of cylinders resting upon the rollers, as seen best in Fig. 5.

h is a shaft to which power is communicated by proper belt over the pulley H. On this shaft there is mounted the beveled pinion H′, which meshes with the beveled gear H^2 on the shaft *f*, and by this means the power necessary to rotate the cylinder is com-

municated thereto. The grain to be dried is supplied to the drying-cylinder through a hopper and chute J at one end, the chute extending through the chamber C′ of the head C and into the open end of the drying-cylinder A, where its open mouth overhangs without coming into contact with the deflecting devices with which that cylinder is provided, as hereinafter more particularly explained. From the opposite open end of the cylinder A the grain falls through the chamber D′ of the head D into the horizontal trough D^3 at the bottom of the head D, in which the screw conveyer K operates to convey the grain across toward the drying-cylinder and into the lower end of the elevator K′, by which it is taken in a customary manner and carried up to a point above the drying-cylinder, and thence delivered downward through the chute K^2, which, protruding through the chamber D^2, terminates within the open end of the cooling-cylinder B, as seen in Fig. 5, in the same manner as the chute terminates within the open receiving end of the drying-cylinder A. At the opposite end of the cooling-cylinder it discharges into the chamber C^2 of the head C, at the bottom of which, in a trough C^3, is located another endless screw conveying device K^{10}, by which the dried and cooled grain is carried out, and by any suitable passage-way may be delivered to a bagging-machine or other receptacle.

L is a fan by which the air-currents for drying and cooling are produced and drawn or forced through the cylinders, respectively.

M is a heater by which the air is raised to the proper temperature for performing the function of drying. The head D is open at the outer side of the chamber D^2, into which the end of the cooling-cylinder protrudes, the opening being preferably covered by a wire screen or perforated sheet d^2. At this end, therefore, the air may freely enter the cooling-cylinder from the exterior. The head C is similarly opened at the opposite end of the cooling-cylinder, and the opening preferably occupied by a woven wire or perforated sheet c^2, and a funnel-shaped cap C^{20} is attached at the outer side of the head C, covering said opening, and from the smaller end of said cap the pipe M′ leads to the air-intake of the heater M. The air-outlet of the heater is connected directly to the air-intake of the fan, and the fan discharges through the pipe L′ into the drying-cylinder A, the discharge-pipe being bifurcated after it enters the cylinder, so that the air is discharged through two mouths—L^{10}, which is near the receiving end, and L^{11}, which is preferably beyond the middle toward the discharge end. This construction of the drying-cylinder is not a part of the present invention and is not herein claimed.

The cylinders, as will be noticed, are placed substantially horizontal on their supports, and the material is fed through them from end to end by the deflecting-shelves N N, &c., with which the inner surfaces of both cylinders are provided, said shelves being each from ten to fifteen inches long and from two to four inches in width, and in cylinders of the size represented in the drawings, which are designed to be forty feet long and about six feet in diameter, there will be from ten to fifteen of these shelves in the circumference and from thirty to forty in the length of each cylinder. Their order of arrangement longitudinally with respect to the cylinders is such that from the receiving end toward the delivery end of each cylinder each shelf slightly overhangs the next following shelf, as seen in the portions of the cylinders in which these shelves are represented in the drawings. Preferably the form of each shelf is as seen in Fig. 6, being curved or dished concave forward in the direction of rotation, so that the grain which is delivered into the cylinder from the chutes at the receiving end is carried up by the shelves and held by their concavity until they pass well up toward or past the top in the rotation of the cylinder. The shelves are designed to be set at more or less of an angle inclined downward from the receiving toward the delivery end, and by this expedient the grain delivered into them is caused to slide more or less toward the delivery end and to be delivered, therefore, onto the next succeeding shelf, or, if the sliding takes place after the rotation of the cylinder has carried the shelf in question so far up that the grain falling off from it is out of range of the next shelf, it will fall obliquely toward the delivery end, lodging again upon the bottom of the cylinder and being picked up by another shelf farther advanced from the delivery end than the one to which it fell. The grain is thus fed steadily from the receiving toward the delivery end at a rate dependent upon its condition of moisture and dryness and consequent adhesiveness and upon the inclination or pitch of the shelves and rate of rotation of the cylinders. The rate at which it advances through the cylinder therefore, or, in other words, the length of time in which it may be detained in the cylinder, may be regulated by setting the shelves N N at a less or greater angle to the horizontal. The shelves N have each a stem N′, which protrudes through the cylinder-wall, being threaded and provided with a binding-nut upon the outside and squared at the end to receive an operating key or wrench, so that the shelf may be adjusted from the outside and secured by the nut. These shelves and their stems are shown only over a small portion of the length of the cylinders in the drawings, but it will be understood that the cylinders are provided with them throughout their entire length.

It will be noticed that the exterior air, entering through the end of the cooling-cylinder, passes through in the same direction with the grain which is delivered into that cylinder at the same end, and that having become heated

in performing its function of cooling the grain it passes to the heater, where it is further heated, the heat which it has abstracted from the grain being utilized and diminishing the work required of the heater. From thence the air is drawn by the fan and forced into the drying-cylinder in a direction opposite that in which the grain is advanced through that cylinder, and emerges, laden with moisture, at the end of the cylinder at which the grain enters, passing out through the flue O. The necessity or, at least, the decided advantage of causing the drying-current to move against the movement of the grain is that otherwise the air, coming from the heater hot and dry, would become quickly heavily charged with moisture upon meeting the fresh wet grain, and would lose its capacity to take further moisture from the grain as it is advanced with it along the cylinder, and the grain would therefore emerge only partly dried, whereas, moving against the grain, the driest air meets the driest grain and advances, becoming more and more moist to meet grain which is more and more moist, until the point of saturation is reached, which should occur, if all the conditions are properly adjusted, just when the air reaches the discharge-flue O.

A disadvantage of making the cooling-current move against the dried grain is that the latter is light and contains a large quantity of fine dust, which the opposing air-current would blow back and cause to accumulate at the receiving end and eventually clog the passages, only the larger and heavier grain being properly carried through the drier, the air passing off carrying a large proportion of the fine dust through the heater and fan and into the drying-cylinder again, tending to clog both the heater and fan and load the drier with a substance which would become paste therein, to the great detriment of the operation. It is for this reason that I prefer to make the cooling-current move with the hot grain rather than against it. To effect the cooling in this mode of operation, probably little more air is necessary to be drawn by the fan from the exterior through the cooler and forced into the drier, but the work done by the heater being properly proportioned to the amount of air there is no loss economically due to this circumstance.

I claim—

In a grain drier, or cooler, in combination with a cylinder, the shelves N concaved or dished as set forth, and having the stems N′, protruding through the cylinder-wall and provided with binding-nuts upon the outside of the cylinder substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 16th day of November, 1893.

JOHN E. TURNEY.

Witnesses:
CHAS. S. BURTON,
JEAN ELLIOTT.