

No. 620,432.

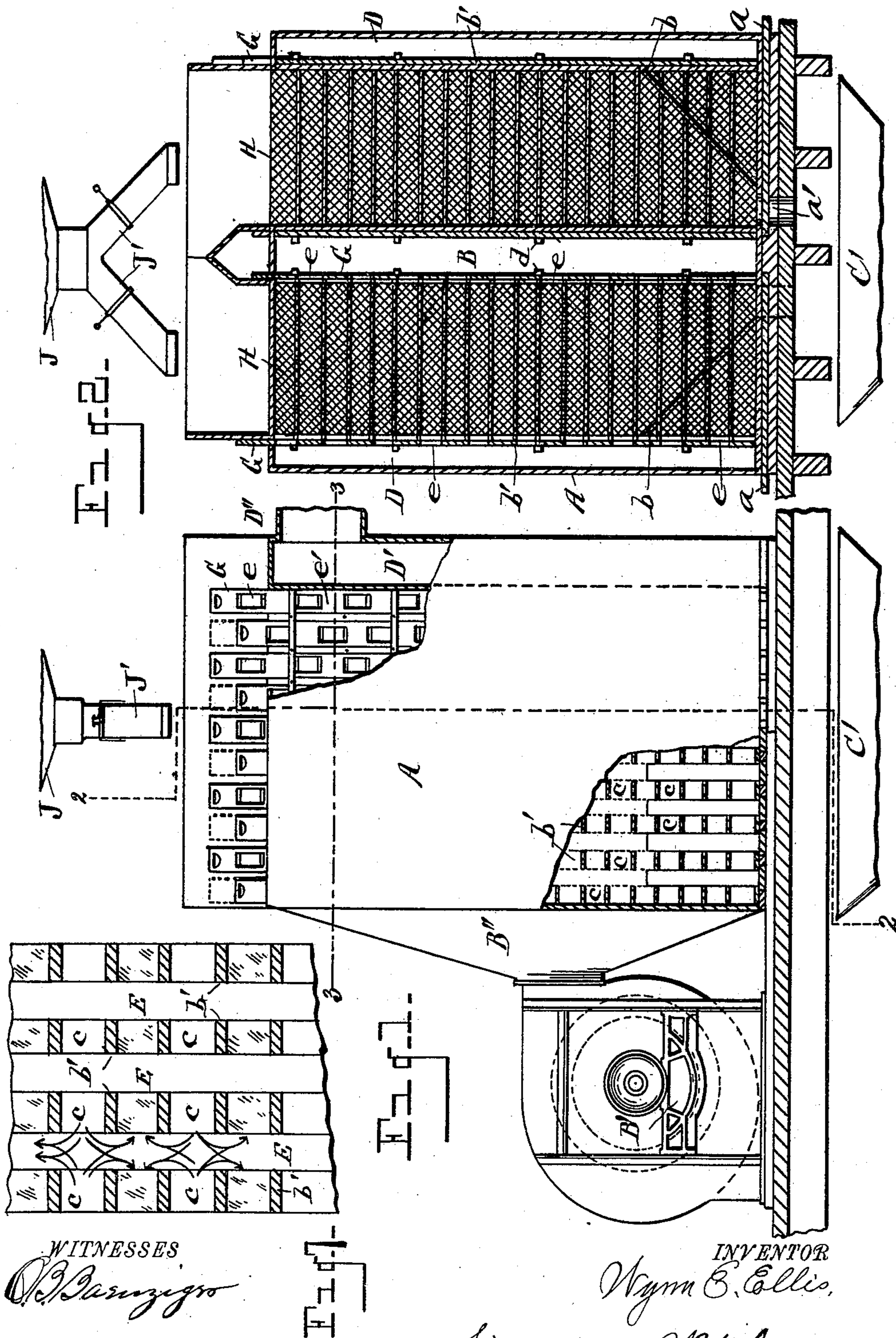
Patented Feb. 28, 1899.

W. E. ELLIS.  
GRAIN DRIER.

(Application filed Nov. 5, 1897.)

(No Model.)

2 Sheets—Sheet 1.



WITNESSES  
*O. J. Samzgro*  
*M. A. Martini*

INVENTOR  
*Wynn E. Ellis*

By his Attorneys *B. B. Wheeler & Co.*

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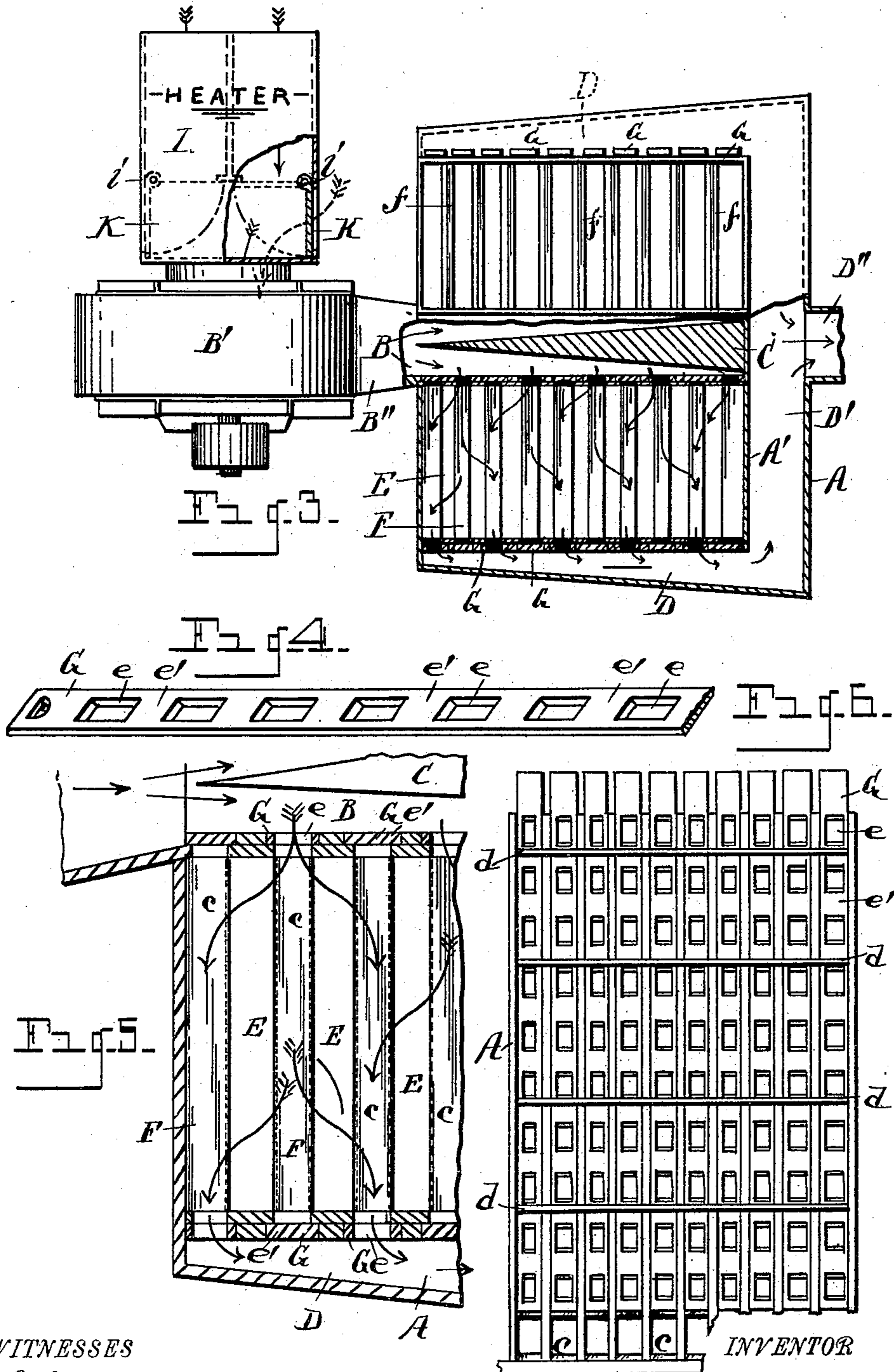
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WITNESSES

*O. B. Sarnego.*

*M. A. Martin.*

By his Attorneys,

*Wynn E. Ellis,*

*B. B. Wheeler & Co.*

# UNITED STATES PATENT OFFICE.

WYNN E. ELLIS, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE PAINE-ELLIS GRAIN DRIER COMPANY, OF SAME PLACE.

## GRAIN-DRIER.

SPECIFICATION forming part of Letters Patent No. 620,432, dated February 28, 1899.

Application filed November 5, 1897. Serial No. 657,524. (No model.)

*To all whom it may concern:*

Be it known that I, WYNN E. ELLIS, a citizen of Great Britain, residing at Milwaukee, in the county of Milwaukee, State of Wisconsin, have invented certain new and useful Improvements in Grain-Driers; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improved apparatus for drying wet grain and other substances; and it consists in the construction and arrangement of parts hereinafter fully set forth, and pointed out particularly in the claims.

The objects of the invention are to provide simple and effective means for passing the hot-air blast in opposite directions through a body of wet grain or into said grain from opposite sides in such manner as to facilitate the operation of drying; to effect a uniform and even drying of all parts of said grain exposed to said air-blast, so as to render a re-handling of the grain unnecessary when it shall have passed once through the device, and to provide, by a change of the air-blast, for removing all accumulated dust from the drier, obviating the choking or filling up of the air-spaces thereof. These objects are attained by the construction illustrated in the accompanying drawings, in which—

Figure 1 is an end elevation of my improved drier, parts being broken away. Fig. 2 is a vertical section as on line 2 2 of Fig. 1. Fig. 3 is a partial horizontal section as on line 3 3 of Fig. 1, the heater, exhaust-fan, and one side of the drier appearing in plan and a portion of the heater-casing being broken away. Fig. 4 is an isometrical view of one of the vertically-movable slides for controlling the air-currents. Fig. 5 is an enlarged detail in section, showing the passage of the air-currents through the device. Fig. 6 is an elevation of one end of the drier, the outer casing being removed and the series of slides being raised in position for cleaning the air-pas-

sages of the drier. Fig. 7 is an enlarged view, partly in section, showing the parts so arranged as to cause the pressure-ducts to stand horizontally opposite each other and the two air-currents passing therefrom to meet in the interposed grain-space and discharge into the exhaust-ducts above and below said pressure-ducts.

Referring to the letters of reference, A designates the exterior or inclosing case, which is preferably quadrilateral in form and may be of any suitable height. Within the exterior case is the drier proper, A', consisting of a closed rectangular framework which is divided at its center transversely by means of an air-blast or pressure chamber B, communicating with the exhaust-fan B' through the connecting-spout B". This chamber B, as shown in Fig. 3, is divided centrally by a longitudinal V-shaped partition C, which separates the pressure-chamber into two tapering divisions whose area decreases as said chamber recedes from the point of entrance of the air-blast.

On opposite sides of the casing A are the tapering exhaust-chambers D, which communicate at their rear ends with the open space D', crossing the rear of said casing and communicating with the discharge pipe or stack D".

As will be seen on referring to Fig. 3, the central pressure-chamber B divides the drier into two opposed independent sections, which sections are supplied with an air-blast from the respective divisions of the pressure-chamber. Crossing transversely the interior of the divisions of said drier, between the divided pressure-chamber and the exhaust-chambers D, are the alternate grain and air spaces E and F, respectively. The grain-spaces E are closed at their ends, but are open at the top and provided at the bottom with a slide *a*, which is adapted to close the opening *a'* through the bottom of the grain-spaces, through which the dried grain is discharged, said opening being at the lower end of the inclined strip *b*, located in the bottom of the grain-spaces to facilitate the passage of the grain therefrom. Located below the openings in the grain-spaces is a suitable hopper C' of such capacity as to hold the contents of the drier. The air-spaces F are not

continuous in that they do not extend in an unbroken space from the top to the bottom, but instead are divided horizontally by a series of horizontally-extending dividing strips or floors *b'*, which divide the air-spaces *F* into a series of independent horizontal air flues or ducts *c*, which communicate at opposite ends with the air-blast chamber *B* and the exhaust-chamber *D*.

*G* designates a series of vertically-movable slides, which are located at the opposite ends of said air-ducts and are adapted to travel in suitable ways, being confined in place by the transverse retaining - strips *d*. These slides are provided with a series of apertures *e*, which are so spaced as to register with each alternate air-duct, while the blank or solid space *e'* between said apertures is adapted to close the end of each of said alternate air-ducts. These slides are so arranged, as shown in Fig. 1, as to normally close the opposite ends of each alternate duct, so that one half of said ducts communicate at one end with the pressure-chamber and the other half communicate at the opposite end with the exhaust-chamber, the ducts communicating with the pressure-chamber being closed at their opposite ends, while the ducts communicating with the exhaust-chamber are closed at their ends adjacent the pressure-chamber. These air-flues are arranged in horizontal tiers and alternate in vertical order, so that each of the air-spaces *F* is divided into a series of alternating air-flues having alternately opened and closed ends.

The partitions dividing the grain-spaces *E* from the air-spaces *F* are of wire screen *H* or other suitable form of foraminous wall adapted to admit of the passage of air there-through, but capable of confining the grain and other material to be dried within the grain-spaces *E*.

By means of the arrangement of the air-ducts as above described it will be seen that the air-spaces are divided vertically into a series of horizontal air-flues whose open ends alternately communicate with the pressure-chamber and with the exhaust-chamber and that the arrangement is such as to form horizontal tiers of these air-ducts which alternate horizontally and between which are the interposed grain-spaces *E*, whereby the blast of air is caused to pass alternately from opposite sides through the grain-space from top to bottom, as shown by the arrows in Figs. 3 and 5. The air-ducts whose open ends communicate with the pressure-chamber receive the air-blast which passes across the interposed grain-spaces on opposite sides and discharges into the opposed air-ducts whose open ends communicate with the exhaust-chambers, into which the air, laden with the moisture from the wet grain through which it has passed, is discharged and escapes through the stack or flue *D''*.

In the practice of drying wet grain by confining it in thin vertical layers or divisions

and passing a blast of hot air therethrough from one side to the other it has been found that the grain upon the side adjacent to the air-blast becomes unduly dried, while the grain upon the exhaust or opposite side is still too wet for commercial purposes, owing to the fact that the moisture driven out of the grain first encountered by the air-current condenses upon the cooler grain on the opposite side as the air is driven therethrough, whereby the grain upon the discharge side of the thin division thereof is still laden with moisture when the grain upon the opposite side shall have been sufficiently dried, resulting in an uneven drying of the grain and often necessitating a rehandling thereof to again pass it through the drier, that a more uniform drying may be attained. In the construction herein shown the necessity of rehandling is obviated, and at the same time a perfect and uniform drying of the grain is effected by reason of the alternation of the hot-air blast, which passes through the grain-spaces from side to side in vertical reciprocal succession. When the grain to be dried is first placed in the grain-spaces, it is swollen with the moisture contained thereby, and therefore occupies more space than when partially or completely dried. This being the fact, the grain in the process of drying gradually settles in the grain-spaces, so that a portion thereof, through which the hot air is passed in one direction, will, upon settling to the line of a lower tier of flues, receive an air-blast there-through from the opposite direction, and so on as it settles or is gradually moved downward through the grain-space said grain is subject to alternating blasts of hot air, which pass therethrough from opposite sides in reciprocal succession, whereby a most perfect and uniform drying of the grain is effected, rendering all parts thereof equally dry and obviating the overdrying of any portion, so that when once the grain is passed through the drier it is ready for commercial use without rehandling.

When the grain in the process of drying shall have been so reduced in bulk that a point is reached where it will no longer settle, the alternation of the air-blast through any portion of the grain from opposite sides may still be effected through the medium of the apertured slides *G*, which may be adjusted to open the ends of the air-ducts previously closed and close the ends of those ducts previously opened and cause a reversal of the air-currents through the air-ducts and grain-spaces, as will be well understood, or said slides may be so arranged as to cause the air-blast ducts to stand horizontally opposite, as shown in Fig. 6, so that the air-blasts will enter the grain-space from opposite sides on the same horizontal plane and, meeting in the center of said grain-space, discharge into the air-exhaust ducts above and below, as clearly shown by the arrows in Fig. 7. Thus it will be seen that the air may be

caused to act simultaneously upon the same body of grain from opposite sides, driving the moisture therefrom between the opposed air-blasts and drying both sides of the grain with equal facility. By means of these apertured slides G the air-ducts may also be opened at both ends, so that an air-blast may be passed directly through said ducts to remove all accumulated dust.

The walls of the drier rise above the grain and air spaces, forming a receptacle to receive the wet grain, from which it is fed into the open upper ends of the grain-spaces, the upper ends of the air-spaces being closed by beveled caps f, which prevent the accumulation of the grain thereon. The wet grain is retained in a suitable charging-bin J above the drier, from which it is directed into the grain-spaces by means of suitable spouts J'.

The air is heated by being drawn through a heating device I, which may be of any suitable construction and through which the air is drawn by the fan B', which fan forces the heated air into the pressure-chamber B.

It will be observed that the area of the pressure-chamber is greatest at the point adjacent the fan, while the area of the exhaust-chamber is greatest at the point remote from the fan, the purpose of which is to equalize as nearly as possible the air-pressure in all the air-spaces of the drier. The reduced area of the pressure-chamber remote from the fan tends to keep up the air-pressure at said remote point, which condition the large area of the exhaust-chamber opposite assists in maintaining by obviating any back pressure, while the reduced area of the exhaust-chamber offers some resistance to the passage of the air through the drier from the pressure-chamber at a point adjacent the fan.

Grain which has been dried preparatory to grinding must be cooled for the reason that in its heated state it is unfit to be passed to the rolls. To effect the cooling of the grain while in the drier, the case I, inclosing the heater, is provided on opposite sides near the fan with two doors K, which are hinged at i to swing inward, as shown by dotted lines in Fig. 3, so as to entirely cut off the heater from the fan and at the same time provide an opening through the casing I for the entrance of cold air, so that when said doors are swung inward, as described, cold air only is admitted to the fan, which in turn is forced by the fan into the pressure-chamber and through the grain, enabling the grain to be cooled while in the drier to normal temperature, from which it may then be conveyed to the rolls for grinding or to the storage-bins for shipping.

By placing the pressure-chamber in the center of the drier and locating the alternating grain and air spaces on opposite sides thereof the air-spaces are all brought adjacent to the fan, enabling a more uniform pressure to be attained at all points in the drier, at the same time forming a compact and convenient de-

vice which occupies but a comparatively small area in proportion to its capacity: It is evident, however, instead of placing the pressure-chamber in the center between the opposite divisions containing the grain and air spaces, forming a double drier, I may construct what I would term a "single" drier, in which all of the grain and air spaces will stand in a single row, with the pressure-chamber at one end and the exhaust-chamber at the other, without departing from the spirit of my invention.

Having thus fully set forth my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a grain-drier, the combination with the inclosing case, the drier located within said case consisting of two opposed independent divisions, a central pressure-chamber between said divisions, the exhaust-chamber on opposite sides of said divisions, a series of alternating grain and air spaces crossing said divisions of the drier transversely and separated by a perforated wall, the grain-spaces being closed at their ends and open at the top and having a discharge-opening at the bottom, said air-spaces communicating at one end with said pressure-chamber and at the opposite end with said exhaust-chambers, and means for supplying a blast of air to said central pressure-chamber, substantially as set forth.

2. In a grain-drier, the combination with the inclosing case, the pressure-chamber on one side of said case and the exhaust-chamber on the opposite side thereof, a series of alternating grain and air spaces crossing said case transversely and separated by a perforated wall, said grain-spaces being closed at their ends and provided with a discharge-opening at the bottom, said air-spaces being closed at the top and bottom and communicating at their opposite ends with said pressure-chamber and said exhaust-chamber, said pressure-chamber being tapering in shape and of smaller area remote from the entrance of the air-blast, said exhaust-chamber being also tapering in shape and of larger area at the discharge end thereof, and a fan or other means for forcing an air-blast into said pressure-chamber.

3. In a grain-drier, the combination with the air induct and educt chambers, a series of parallel grain and air spaces arranged alternately and having screens or perforated walls between them, the grain-spaces being closed at their ends and open at the top and having a discharge-opening at the bottom, the air-spaces consisting of a series of horizontal ducts communicating at opposite ends with the air-induct and air-educt, said air flues or ducts communicating with the grain-spaces through said screens or perforated partitions, a series of vertically-movable slides located at the ends of said air-ducts having apertures therein which register with each alternate air duct or flue to afford communication between the

opposite ends of each alternate air-duct and the air induct and educt, respectively, whereby an air-blast is caused to cross the grain-spaces from side to side in reciprocal succession.

4. In a grain-drier, the combination with a pressure-chamber and exhaust-chamber, a series of alternating grain and air spaces extending between said chambers, said grain-spaces being closed at their ends and provided with a discharge-opening at the bottom, screens or perforated walls separating said grain and air spaces, a series of horizontal strips dividing said air-spaces into a series of horizontal air flues or ducts communicating at opposite ends with the pressure-chamber and with the exhaust-chamber, a series of vertical movable slides closing the end of each vertical series of said air-ducts, said slides having apertures which register with each alternate air-duct, as and for the purpose set forth.

5. In a grain-drier, the combination of an inclosing case, of a series of alternating grain and air spaces crossing said case transversely and separated by perforated partitions, a pressure-chamber and an exhaust-chamber on opposite sides of said case, said air-spaces being divided into a series of horizontal air-flues, half of which flues are pressure-flues

and communicate with the pressure-chamber, the other half being exhaust-flues which communicate with the exhaust-chamber, said pressure-flues being arranged horizontally on each side of the grain-spaces so that the blasts entering from said pressure-flues meet in the center of the grain-spaces and exhaust into the exhaust-flues immediately above and below said pressure-flues.

6. In a grain-drier, the combination of a grain-space, a series of horizontal air-flues arranged on opposite sides of said grain-space and communicating therewith, said air-flues consisting of pressure-flues and exhaust-flues which alternate vertically, said pressure-flues and said exhaust-flues on opposite sides of said grain-space being arranged in the same horizontal plane, a pressure-chamber and an exhaust-chamber communicating with the opposite ends of said pressure-flues and said exhaust-flues, respectively, to cause the air-blasts to meet in the center of said grain-space from opposite sides and escape into said exhaust-flues above and below.

In testimony whereof I affix my signature in presence of two witnesses.

WYNN E. ELLIS.

Witnesses:

CASSIUS M. PAINE,  
JOHN H. PAINE.