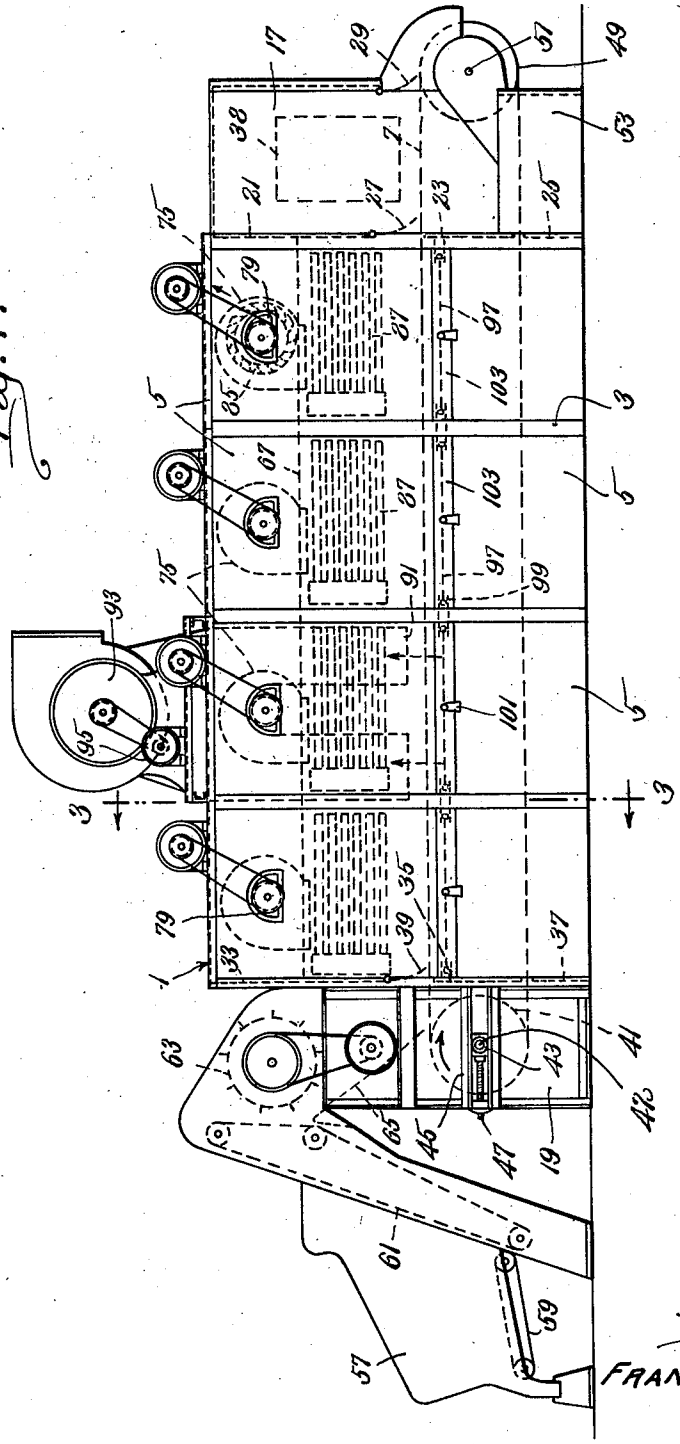
April 11, 1944. F. B. MORRILL 2,346,138

APRON DRIER

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Fig. 1.



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APRON DRIER

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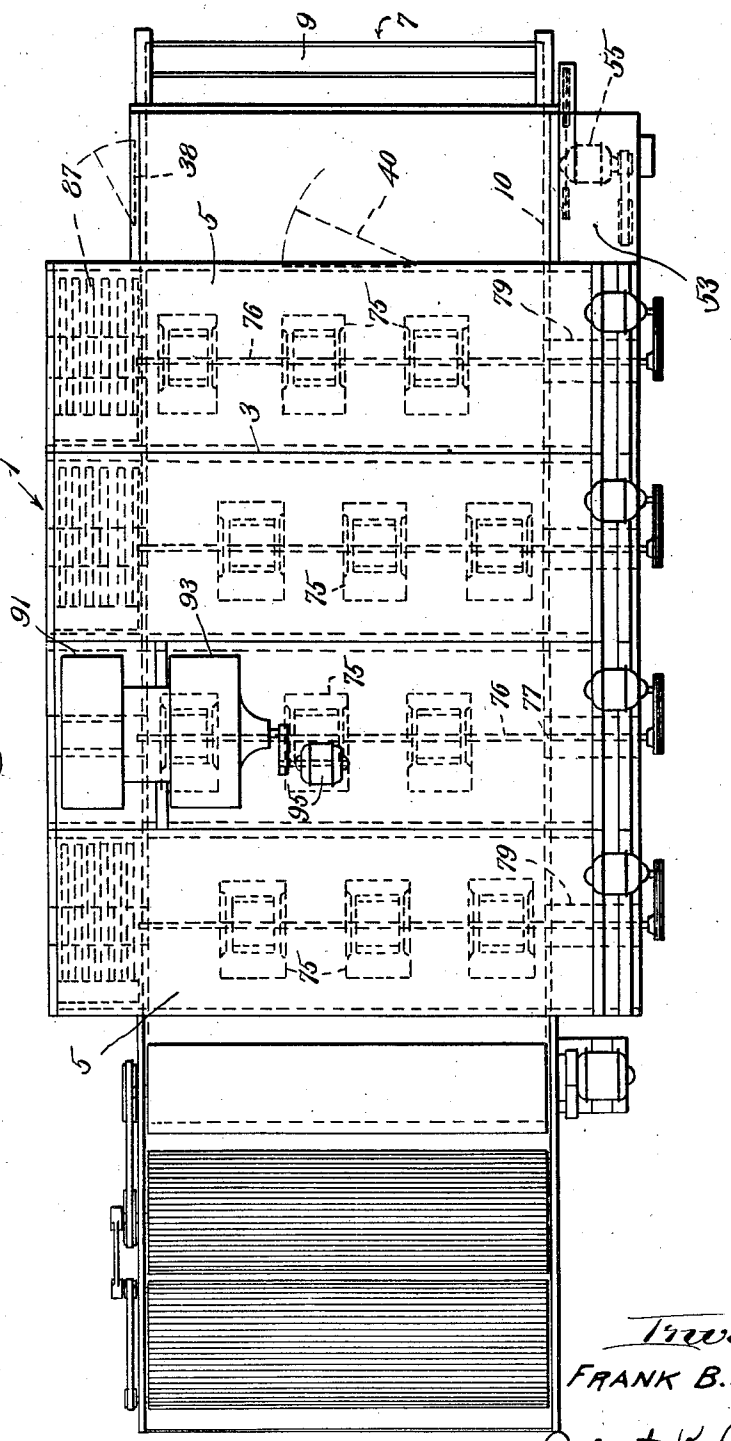


Fig. 2.

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APRON DRIER

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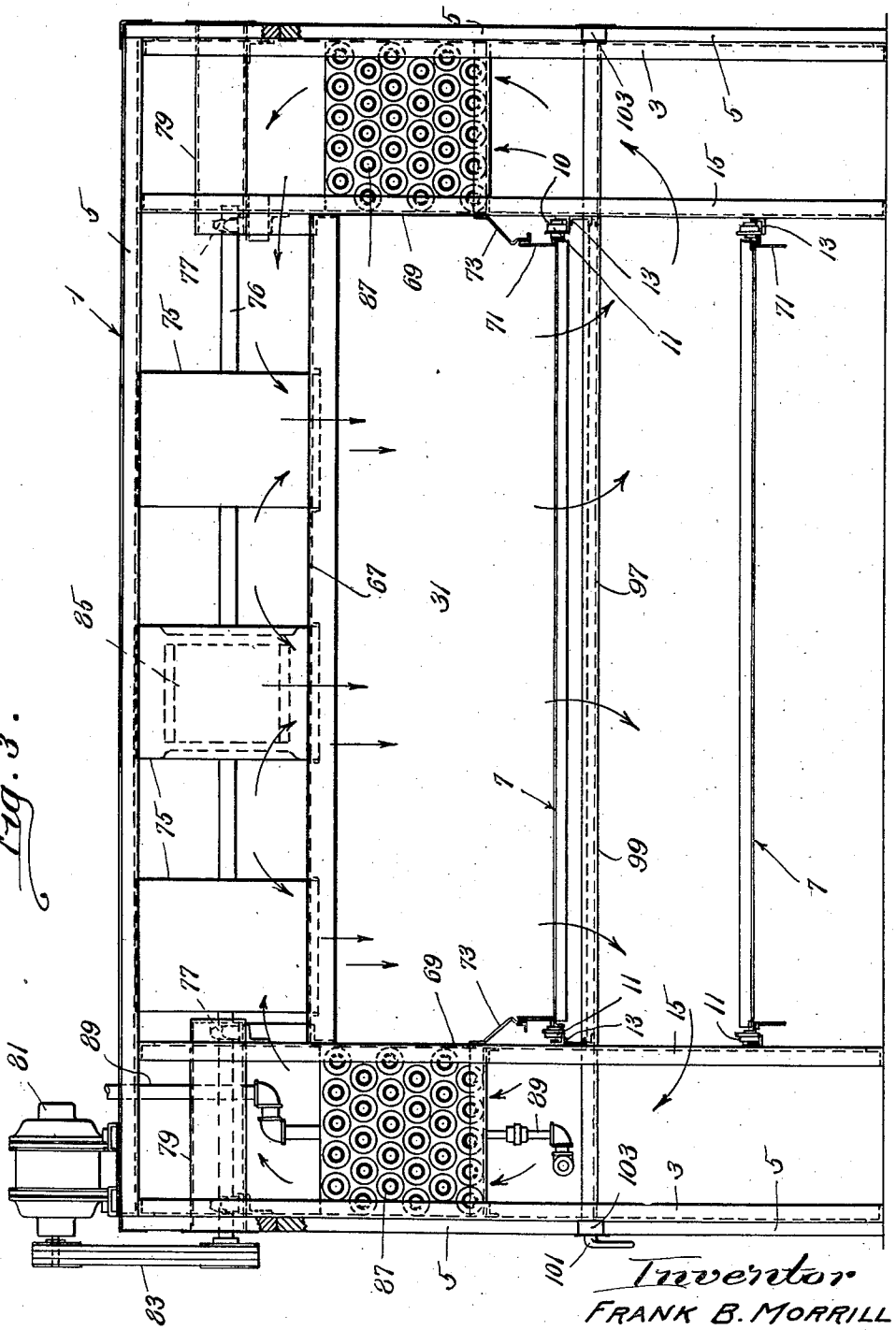


Fig. 3.

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2,346,138

APRON DRIER

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3 Claims. (Cl. 34—223)

This invention relates to loose stock driers of the type in which woolen, rayon, and other fibers are deposited, after dyeing or other processing, in a layer upon an air-pervious apron which travels through a housing while currents of heated air are directed against and through the apron and the stock carried thereby, to dry the stock.

Since the fibers are wet and cling together in clumps or wads as delivered onto the apron by the hopper-feeder conventionally used to spread the material out over the apron, the drying air when caused to flow through the apron and the layer of stock thereon by a difference in atmospheric pressure at the two surfaces of the apron tends naturally to take the paths of least resistance and pass between the wads of stock so far as possible, rather than going through the wads, thus drying the fibers at the interior of the wads more slowly than those outside, resulting in uneven moisture content of the dried stock when it reaches subsequent stages in processing.

To remedy this, it is common to resort to the use of a relatively thick layer of stock on the apron, so that the upper clumps will close the apertures between the under ones, thus forcing more of the air to pass through the clumps. However, this practice cuts down the rate of production of the drier because the thick sheet dries more slowly, or else requires the expenditure of considerably more power in the blowers in order to build up an air pressure sufficient to penetrate and flow through the stock copiously, in either event tending to dry the top portion beyond the optimum desired moisture content. Also, when it is employed this resort to higher pressure introduces accompanying drawbacks, through blowing the stock off laterally from the apron to jam in the chains carrying the apron and in its guards and to clog the heaters, and through blowing it off endwise also; the unavoidable air-leaks in the housing waste more heat as the amount of escaping hot air increases with the pressure.

Recognizing that air traveling at high velocity can be made to penetrate more deeply into wadded fibers by reason of its momentum than air merely flowing over the surface thereof and free to turn aside to follow an easier path, some effort has been made to profit therefrom by directing high-speed jets of air against a thin layer of wet stock laid out on the pervious traveling apron. But so far as I am aware this has always been done heretofore by the method of creating a static pressure by blowers and then converting a part of this into kinetic pressure by the use of nozzles or baffles creating a constricted path for the air-blast in order to raise the velocity of the air so that its momentum would cause the desired penetration of the fibers.

Not only does the cost of the nozzles and the small area of the apron served by each nozzle add to the cost of the drier and slow down its production, but the kinetic energy imparted to the air by the blowers is thrown away in converting the total energy into static pressure and then reconverting part of it into kinetic energy at the nozzles by constricting the path of flow.

Hence, a main object of my invention is to attain more uniform drying and a greater rate of production by drying a thin layer of loose stock under the impact of streams of air having both static pressure and kinetic energy and penetrating the stock at relatively high velocity, without the expenditure of the excessive amounts of power heretofore needed to drive the blowers when producing the requisite high-speed jets by the roundabout method described, or when merely creating a high static pressure. In accordance with the invention, this is accomplished by mounting centrifugal blowers directly over the apron to discharge their blasts straight at the layer of stock at short range and at right angles thereto, preferably locating a plurality of centrifugal blowers side by side across the width of the apron at successive points in the length thereof and with the blowers of one such transverse row staggered with respect to the blowers of the adjacent row to assure complete coverage of the entire width of the layer by blasts of practically equal intensity.

Since the kinetic energy of the blowers' blasts is not lost through use of distributing devices such as nozzles or baffles deflecting the blasts, forwardly-curved blades are used in the centrifugal blowers, producing a larger volume of discharged air from the same sizes of blowers with less power consumption than where static pressure alone is useful and wanted. In prior types of apron driers, where the kinetic energy of the air is wasted, the blowers utilize radial or backwardly-curved blades to throw the air off radially against the blower-housing interior and thus build up preponderantly static pressure, because the tangential blast of the forwardly-sloped blades such as I employ represent largely kinetic energy serving no real useful purpose in prior driers and therefore needlessly consuming power in its creation. The forwardly-curved blades employed in my drier

impart a relatively larger proportion of kinetic energy to the air, while producing the necessary static pressure to get the air completely through the stock, the apron, the screens, the heaters, and the connecting passages as well. Since the layer of wet stock on the apron is thin, there is relatively less back-pressure against which the blowers must work, and also the fibers at and near the upper surface of the layer, into which the air penetrates by reason of its momentum and which are thus quickly dried, comprise a much higher percentage of the total quantity of stock on the apron.

In furtherance of economy and efficiency of operation, the heated air used for drying is as hitherto recirculated repeatedly through the stock, but in such manner that the only positive pressure existing within the drier proper is in the drying chamber above the top run of the apron on which rests the stock. All the rest of the circuit of the air is effected under negative pressure, suction. This is of considerable practical value, because thus the unavoidable leaks in the walls of the housing result in inflow of air at room temperature to act as part of the make-up air supply, rather than in escape of hot air with resultant loss of heat representing waste of fuel. Also, at all points of its contact with the outside walls of the housing the recirculating air is thus sucked past such walls, thus avoiding the substantial transfer of its heat to such walls which results from impact thereagainst of a blast under positive pressure. With average quality of insulation the outside of the improved drier stays comparatively cool all over, although the temperatures employed within are well above those used heretofore in similar driers. In practice, driers embodying the features of the invention commonly attain a rate of production 50% to 75% greater than comparable prior apron driers of the same size.

By way of further improving the uniformity of drying of the mass of loose stock, the air is returned to the blowers for recirculation by means of passages located at both lateral edges of the apron, so that the air passing through the apron and the stock thereon is handled identically at both sides of the machine, instead of being withdrawn wholly at one edge of the apron and thus tending to pass mainly through the stock adjacent thereto as in certain prior stock driers. In this way a much closer approach to uniformity of drying across the width of the apron is attained, because the pressure differential created by the blowers' suction and cooperating with the kinetic energy of the discharged air to get the air through the stock remains more nearly constant across the width of the apron at the underside of the top run, than in the prior one-sided arrangement.

Other objects of the invention, and the manner of their attainment, are as set forth hereinafter.

An illustrative embodiment of the invention in a preferred form is shown in the accompanying drawings, in which—

Fig. 1 is a side elevation of the improved drier, showing also a hopper feeder for feeding the loose stock onto the apron.

Fig. 2 is a plan view of the same.

Fig. 3 is a vertical section on line 3—3 of Fig. 1.

The housing 1 of the drier is of usual construction, comprising a framework of structural steel members 3 of various cross-sections, to the outside of which are applied the usual metal-covered panels 5 of heat-insulating material to form with the floor of the building a more or less air-tight enclosure. Through this housing travels a horizontally disposed apron 7 made up of perforated plates 9 carried by a chain 10 having rollers 11 traveling on tracks 13 mounted on uprights 15 set in some distance from the side walls of the housing 1. At the discharge end of the housing 1 is provided a smaller compartment or chamber 17, closed at top, rear, and both sides, and at the bottom by the floor of the room, which serves in conjunction with fixed baffles 21, 23, 25, and flexible baffle 27, together with its own flexible baffle 29, to create a dead-air space forming an air lock through which apron 7 and the stock borne on the top run thereof may emerge from the drying chamber 31 without the loss of a great amount of the heated air contained in such chamber under positive pressure, and without being blown out of the drier. A similar air-lock 19 at the feed end of the machine performs a like service, in conjunction with fixed baffles 33, 35, 37, and flexible baffle 39 in the front end of housing 1, the top of compartment 19 being open to admit the stock fed thereinto by the hopper feeder. Doors 38, 40 give the operator access to the drier interior. Sprockets 41 for the feed end of apron 7 are carried on shaft 42 mounted in air-lock 19 by means of bearings 43 receiving its journals, these bearings being adjustable lengthwise of the housing between their supporting guides 45 by means of a screw 47, to keep the apron tight. Suitable bearings for the shaft 51 carrying sprockets 49 around which the delivery end of the apron reverses its direction of travel are provided in connection with the side walls of air-lock 17. The apron is driven through a sprocket applied to the shaft 51, such sprocket being driven through a variable speed unit 53 of standard construction propelled by motor 55.

The hopper feeder is of customary construction, comprising a hopper 57, a slatted apron 59 forming its bottom, a spiked apron 61 to elevate the stock, and a cleated cylinder or doffer 63 dumping the stock lifted by the spiked apron into the throat defined by inclined baffle 65 and the two side walls of compartment 19, there to be deposited on the top run of apron 7.

The drying chamber is defined by a horizontal baffle 67 extending for the full length of housing 1 and widthwise between uprights 15, as well as by two vertical baffles 69 applied to the uprights and of equal length with baffle 67. To prevent escape of the stock from the lateral margins of the apron 7, the usual guards 71 are provided on the ends of each plate 9, for engagement with packing material applied along the bottom edges of resilient baffles 73 fixed to the lower edges of baffles 69 and coextensive therewith. Baffles 21 and 33, with their flexible baffles 27 and 39 depending respectively therefrom, close the ends of this chamber, so that when air is blown into the chamber its only way out is through the apron and the stock lying thereon, with the exception of small unavoidable leakage elsewhere.

Multivane centrifugal blowers 75 which blow air into the drying chamber are located in the top of the housing immediately above the baffle 67 and with their discharge ports extending through apertures made therefor in such baffle and pointed squarely at the apron below. The blowers are mounted three or more to a shaft 76 across the housing. As they must be spaced apart along the

shaft in order to admit air to the axial intake ports in the sides of their involute housings, the blowers of the successive shafts disposed at intervals along the length of the apron are staggered with respect to the blowers of the preceding shaft, so as to cover the zones of stock which lay out of the path of the blasts of the immediately preceding blowers; thus the entire surface of the apron is uniformly covered by the blasts in the course of its travel. To avoid subjecting the bearings 77 of these blower shafts to the heat within the housing, they are located in air-wells 79 opening to the air outside the housing. Spaces are left in the housing around these shafts, through which air is sucked in, cooling the bearings and also supplying fresh air to the interior.

The shaft 76 of each row of blowers is driven by its individual motor 81 by V-belts 83 and pulleys.

As indicated in the right-hand blower of Fig. 1, the blades of the rotor 85 are slanted or curved sharply forward to impart kinetic energy to the blast, as well as building up static pressure.

The air passing through the apron 7 and the stock thereon returns to the blowers by passing transversely of the apron through the space between its upper and lower runs, around both lateral margins of the upper run, and up through the space between these margins and the sidewalls of the housing, all as indicated by the arrows in Fig. 3. Across this latter space at each edge of the apron are located extended-surface heaters 87, fed by pipes 89 from a suitable source of steam, so that all recirculated air entering the blowers is forced to pass through such heaters and to be raised to the desired temperature.

The major part of the resistance to the recirculation of the air is met with in passing through the stock 8 on the apron. Thus, the air forced into the drying chamber 31 is raised above atmospheric pressure and driven through the stock by its combined momentum and static pressure, but as soon as it has passed through it is subjected to the exhausting action, suction, of the blower intakes and is reduced to a sub-atmospheric or negative pressure. Hence the air is at no place forced against any outer wall of the drier under positive pressure, but wherever it contacts such wall it is under a negative pressure, or induced draft; under these circumstances it imparts much less of its heat to the outer walls. Also, all leaks through the outer walls are inward.

This favorable situation is enhanced by the location of the intake of an exhaust duct 91 in the space between one edge of the top run of apron 7 and the adjacent outer wall of the housing, (Fig. 1). This duct, split to straddle one of the air-wells 79 for the blower-shaft bearings, is connected at its top end with the intake of an exhaust blower 93 driven by its motor 95, and serves as usual to carry off moist air. Make-up air is provided through leaks, by air wells 79, and underneath the apron at the flapper baffles 27, 29, 39. The heater 87 of this section is omitted to make room for the duct.

Horizontally disposed screens 97, coextensive with the apron in width, are slidably mounted in guides 99 beneath the top run of the apron, to stop lint which passes through the apron from entering and collecting in the heaters. They are withdrawn by first removing panels 103 equipped with handles 101, and come out horizontally without spilling their burden of lint.

With the blowers located in the top of the housing, free access is afforded to the entire space within the drier below the top run of the apron, for cleaning, and for adjustment and repair of the apron. Removal of the lower and middle side-panels 5 is easily effected for this purpose, and the heaters 87 are then easily accessible for cleaning, and the floor below the apron can be swept clean.

What I claim as my invention is:

1. A drier having in combination a housing, means transporting the material to be dried through the housing in a horizontal sheet, a plurality of shafts extending across and supported above said transporting means at spaced intervals in the length thereof, a plurality of blowers in spaced relation on each shaft, and staggered with relation to the blowers on an adjacent shaft, blowing against the surface of the sheet and uniformly covering the entire width thereof with their blasts, means rotating the shafts, and means leading air passing through the sheet around both lateral edges of the sheet back to the blower intakes.

2. A drier having in combination a traveling apron, a housing through the end-walls of which the apron travels to traverse the interior of the housing, means creating an air-pressure greater than atmospheric within the housing over the surface of the apron, means guiding the air thus driven through the apron around the edges thereof back to the pressure-creating means for recirculation, entrance and exit ports in the housing for the apron to pass through, an antechamber enclosing all of the feed end of the apron outside of the housing and closed on all sides save at the top where it is open for the introduction of the material to be dried, and a chamber adjacent the end-wall of the housing enclosing all of the discharge end of the apron outside the housing except the reverse bend thereof and closed on all sides to create a dead-air chamber, these two chambers serving as air-locks to prevent the material from being blown out of the drier.

3. A drier having in combination a housing, means transporting the material to be dried through the housing in a horizontal sheet, a plurality of shafts extending across and supported above said transporting means at spaced intervals in the length thereof, a plurality of blowers in spaced relation on each shaft, and staggered with relation to the blowers on an adjacent shaft, blowing straight down against the surface of the sheet and uniformly covering the entire width thereof with blasts penetrating the material to be dried by reason of the momentum of such blasts, means rotating the shafts, and means leading air passing through the sheet around both lateral edges of the sheet back to the blower intakes.

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