

Nov. 23, 1943.

E. R. ZADEMACH

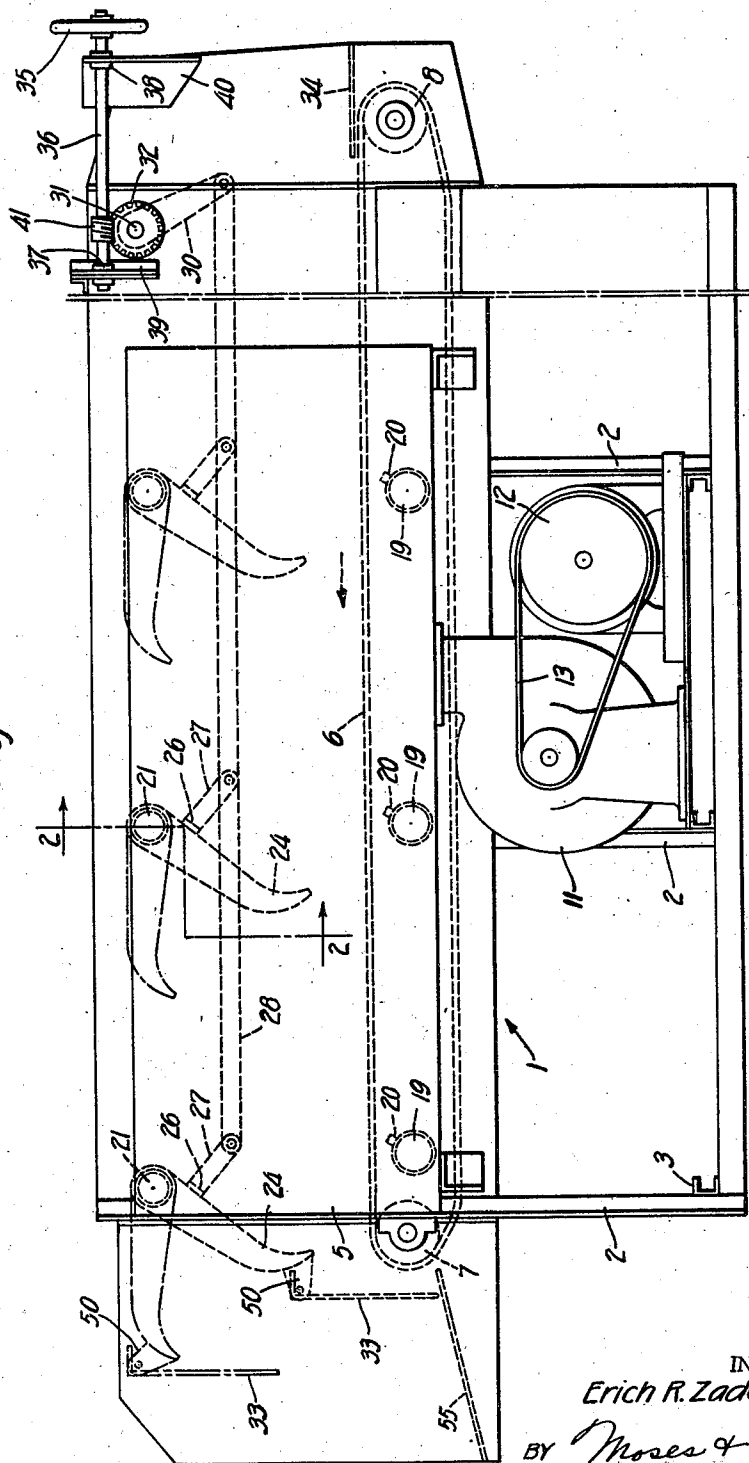
2,334,854

DRIER

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6 Sheets-Sheet 1

Fig. 1.



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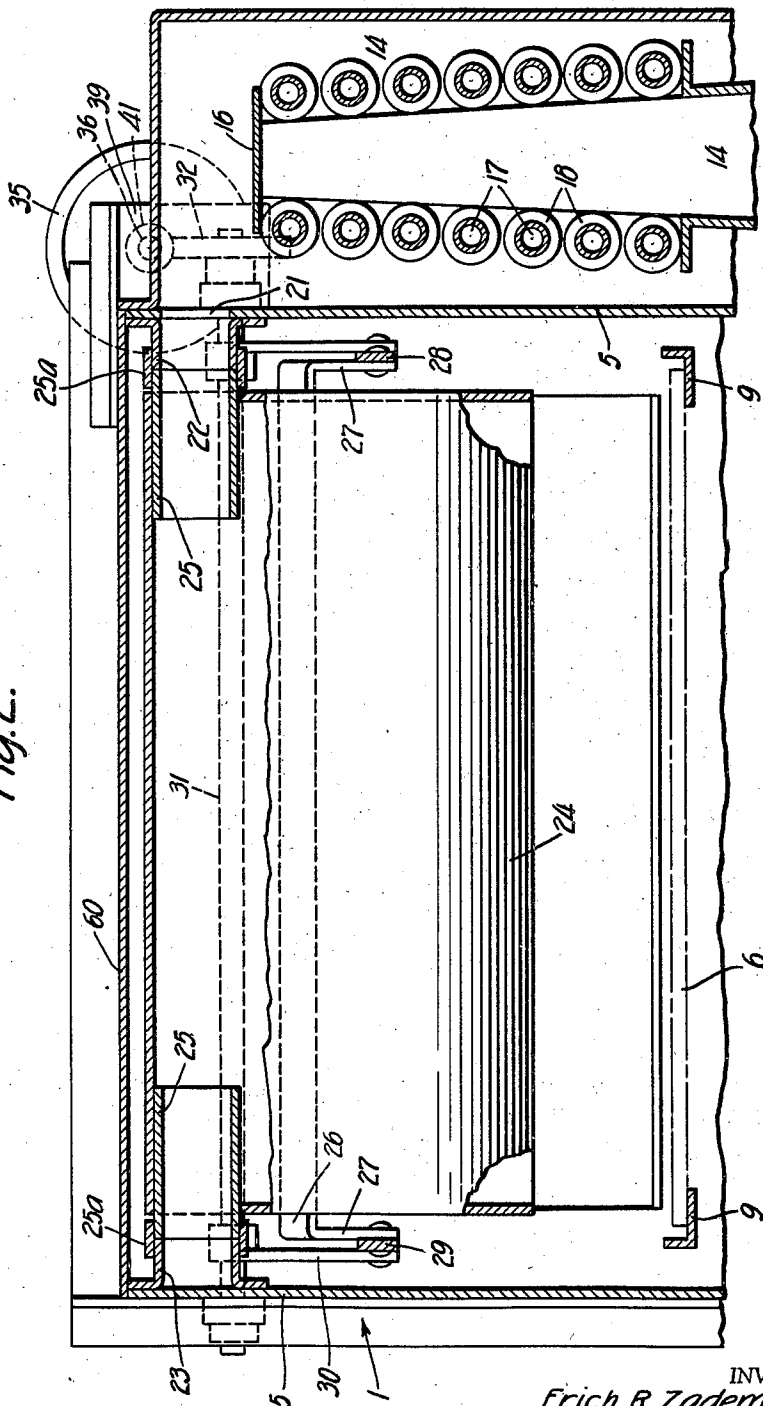
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Fig. 2.



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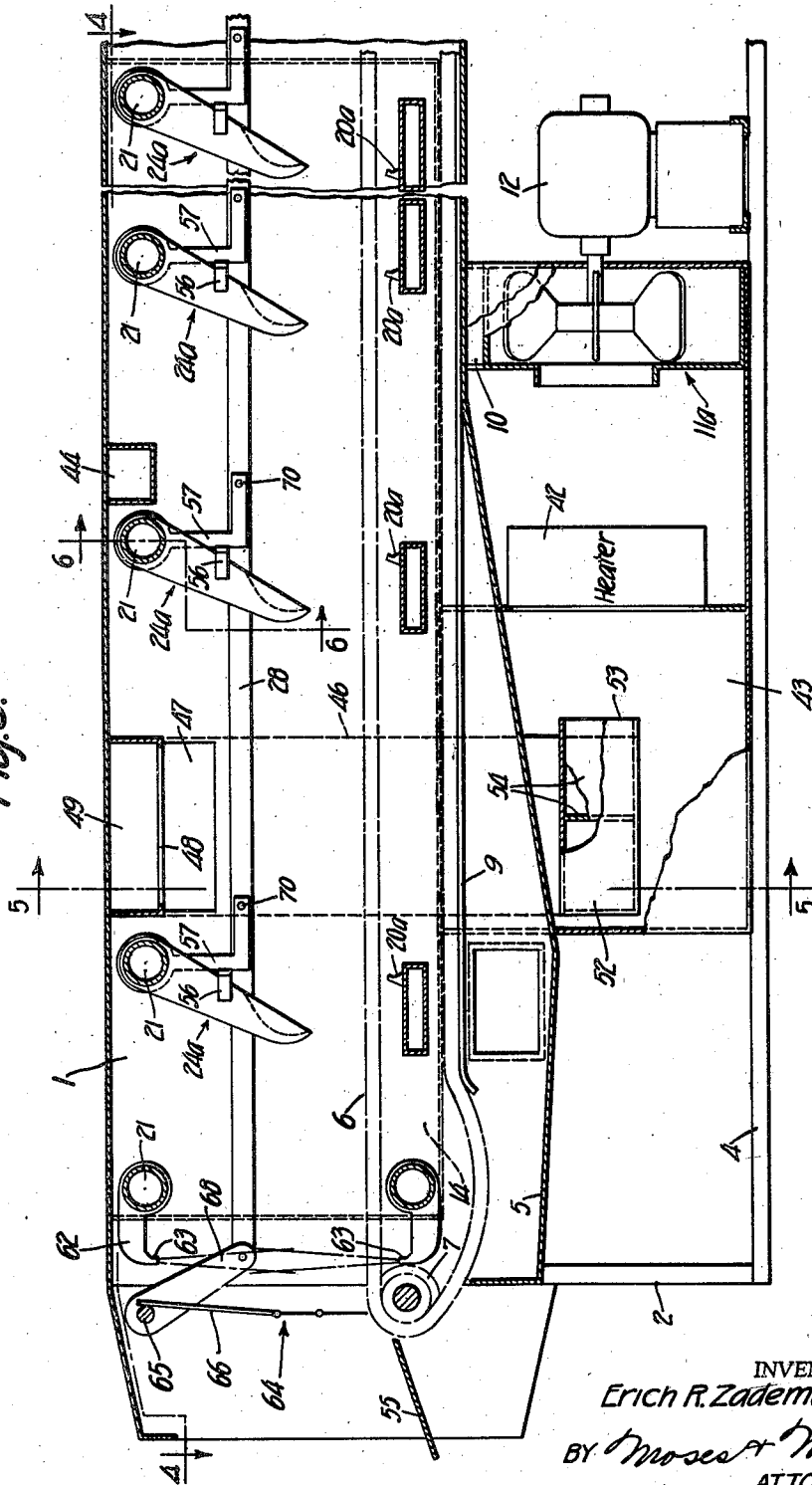
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Fig. 3.



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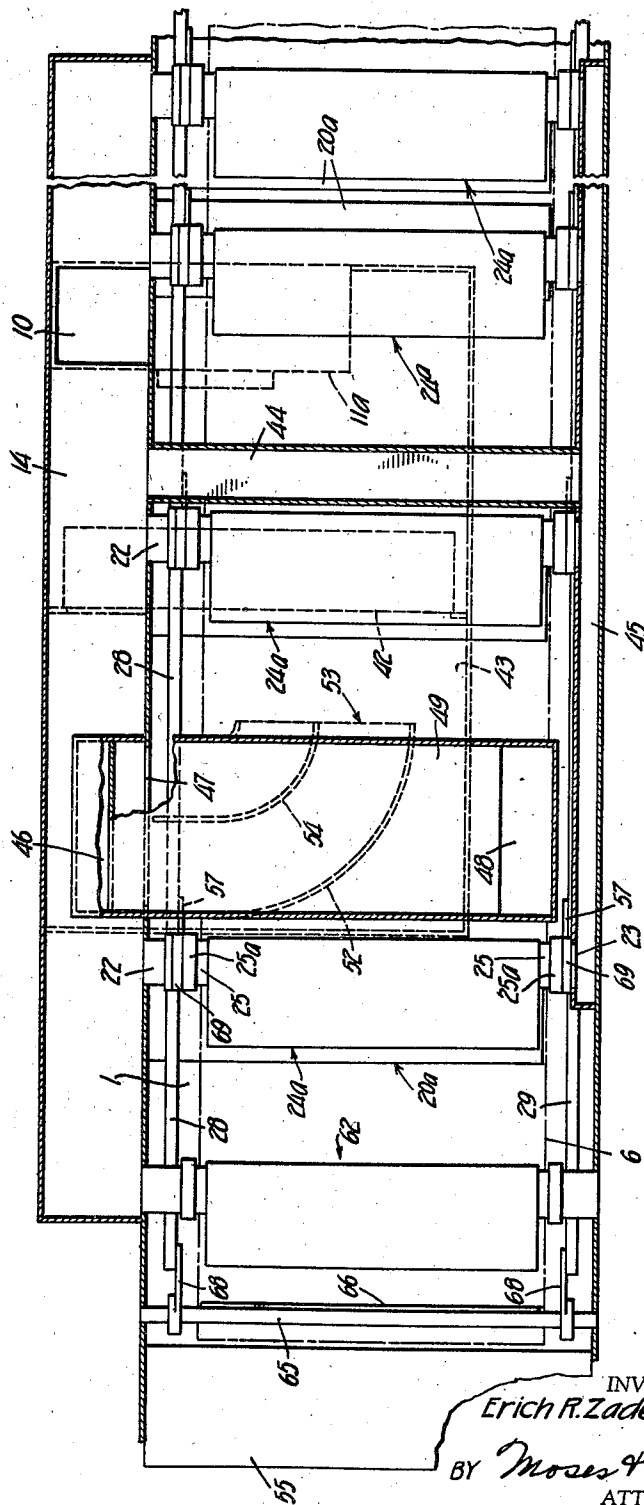
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Fig. 4.



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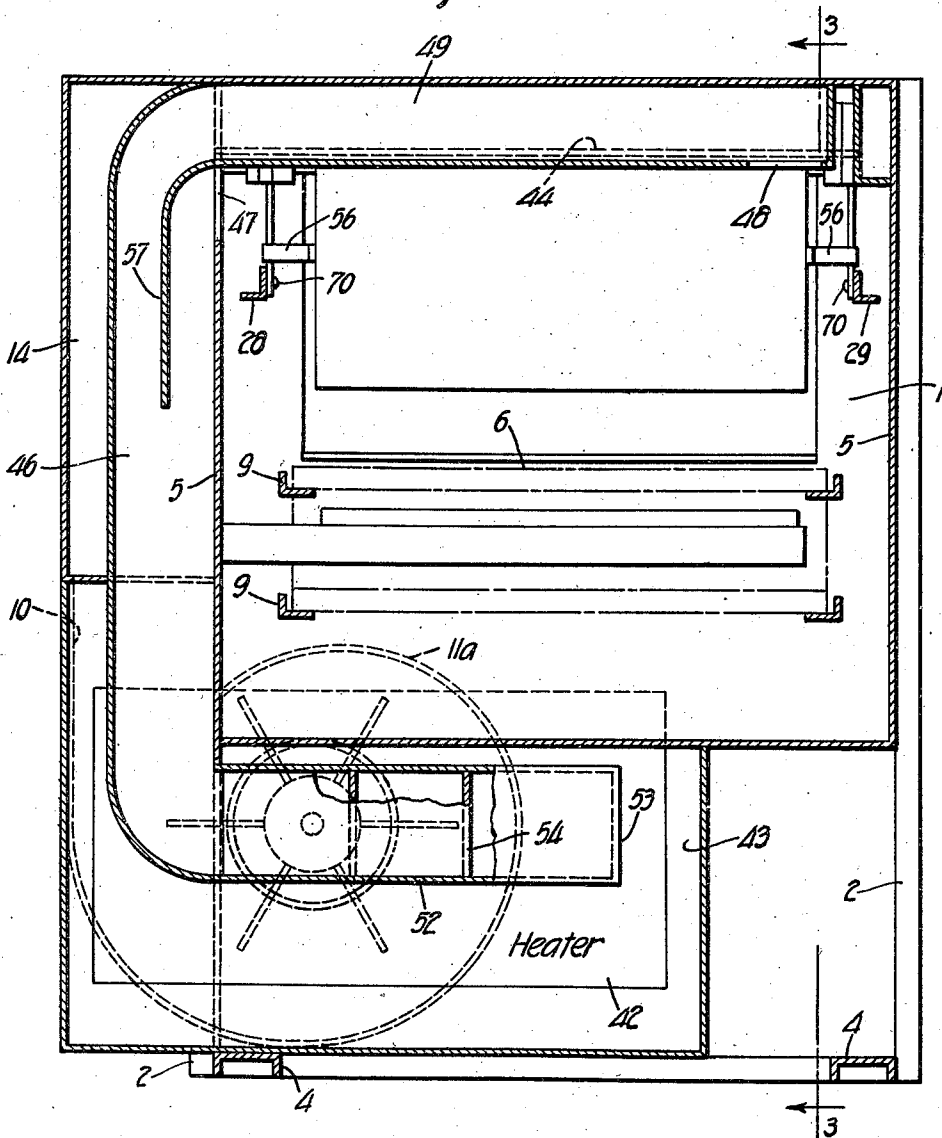
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Fig. 5.



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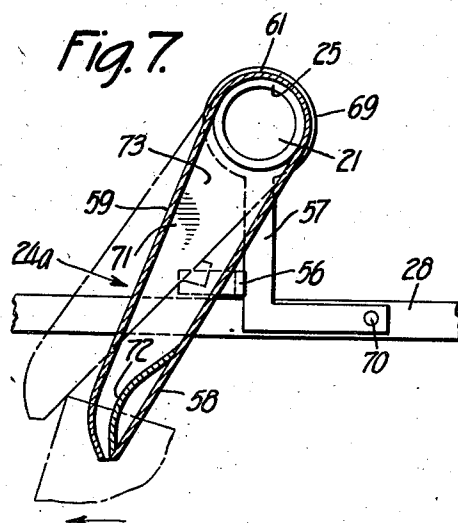
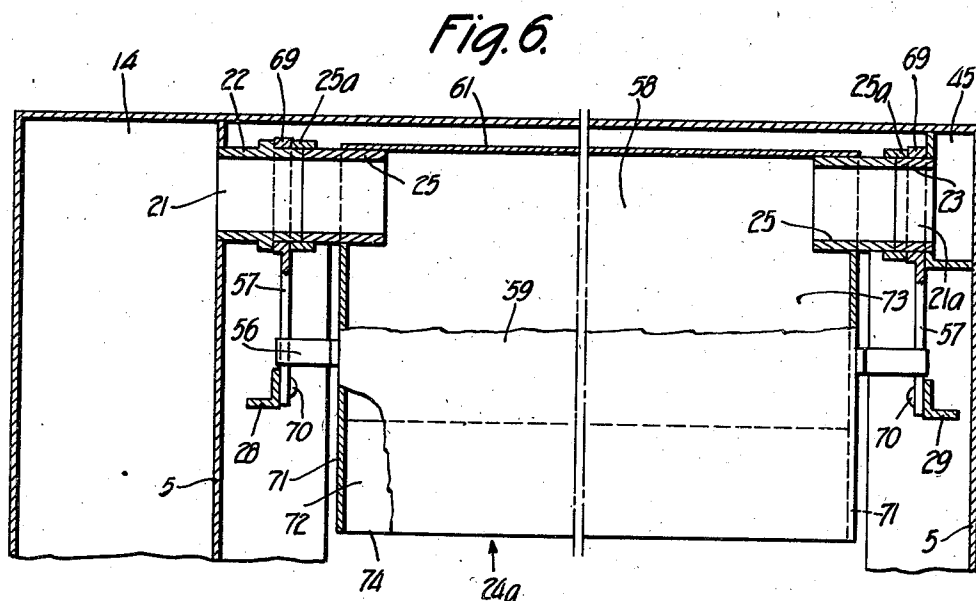
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DRIER

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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,334,854

DRIER

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Application March 25, 1940, Serial No. 325,845

12 Claims. (Cl. 34—87)

This invention relates to driers which act to blow air upon wet articles carried through a drying chamber by means of a conveyer.

Driers of the kind are generally used at different times for drying articles of different sizes, although the articles put through at a single run are generally all of the same size. It is desirable that the blowing nozzles be located as close to the articles on the conveyer as is practicable because the blast from a nozzle is strongest right at the nozzle tip.

It is an object of the present invention to provide a series of nozzles which may be adjusted so as to locate the nozzle tips at different distances above the conveyer. Thus for small articles the nozzle tips will be located at a low level to be near the articles, while for relatively large articles the tips will be adjusted to a higher level which is sufficiently high to clear the articles comfortably.

It is a further object of the invention to provide a common adjusting means for adjusting all of the nozzles in unison.

It is a further object to provide an exit gate or guard at the exit end of the machine which is also adjustable in unison with the nozzles.

A further object of the invention is to dispose the nozzles in such a manner that the entire length of the drier is effectively utilized for drying purposes.

The invention also includes improvements in the circulation of the drying air, providing greater uniformity of application of the air to the articles, a more thorough utilization of the drying capacity of the air, and improved efficiency in the recirculation system. These features are embodied in an improved form of the invention shown in Figs. 3-7. They include introduction of air through opposed inlets into a large chamber formed within the nozzle, so that the flow of air from all parts of the nozzle outlet is uniform. Another feature is the provision of a simple and convenient duct arrangement for withdrawing air from the drying chamber at opposite sides adjacent the top. This arrangement, particularly in conjunction with the indicated duplex air supply to the nozzles, provides improved uniformity of circulation and utilization of the drying capacity of the air, and is designed to provide balanced air withdrawal from the drier. An arrangement has also been provided in which the various ducts and manifolds are located at one side of the drier, which in general is more convenient and economical.

Another improvement is the combination of the

nozzle adjusting means with a nozzle support which permits a nozzle to yield upwardly upon engagement with an article on the conveyer without affecting the functioning of the adjusting means. This is advantageously accomplished by supporting the nozzle by gravity on the adjusting structure. An improved nozzle-engaging arrangement has been developed.

An improved nozzle construction is disclosed arranged to facilitate the theoretically correct curvature of the outlet passage without forming a convex external face or pocket on the feed side of the nozzle which might engage or retain articles on the conveyer.

A further feature is the provision of effective means for preventing the influx of cold air through the discharge end of the drier while permitting free emergence of dried articles. This is in general accomplished by providing a curtain or sheet of hot air propelled across the outlet and the path of the articles through said outlet. The effectiveness of this arrangement is enhanced by providing a movable curtain at the discharge side of such air current, which advantageously extends across the entire width of the drier.

Other objects and advantages will hereinafter appear.

In the drawings forming part of this specification and illustrating a preferred embodiment of the invention,

Figure 1 is a fragmentary view in side elevation illustrating a drier unit;

Fig. 2 is a transverse, vertical sectional view, taken on the line 2-2 of Figure 1, and looking in the direction of the arrows;

Fig. 3 is a view similar to Fig. 1 taken on line 3-3 of Fig. 5, showing a modified construction with parts broken away and omitting the nozzle adjusting mechanism;

Fig. 4 is a horizontal sectional view on line 4-4 of Fig. 3;

Fig. 5 is a vertical transverse sectional view on line 5-5 of Fig. 3 looking toward the feed end;

Fig. 6 is a transverse vertical sectional view similar to Fig. 2 taken on line 6-6 of Fig. 3; and

Fig. 7 is a detail vertical sectional view through a nozzle.

In the embodiment shown in Figs. 1 and 2 the drying chamber 1 is supported at a distance above the floor upon legs 2 in the form of angle bars. The legs are secured at their lower ends to cross beams 3, which in turn are secured to longitudinally extending channel bars 4. The drying chamber is desirably composed of a three-

sided sheet metal plate 5 which forms the sides and bottom of the chamber, and a flat plate 60 which forms the top of the chamber. An endless conveyer belt 6 runs through the chamber, being arranged to travel around end sprockets 7 and 8 and to be supported between the sprockets on rails 9. The articles are conducted through the chamber upon the upper or active stretch of the belt 6.

A blower 11 mounted alongside the chamber 1 and below it, is driven from a motor 12 through a belt 13. The blower delivers air into a heating chamber 14 which is located above the blower and along one side of the drying chamber. The air passes first into a space which is bounded at its top by imperforate plate 16 and which is bounded along its sides by steam coils 17 which have radiating fins 18 formed or mounted upon them at frequent intervals. All the air delivered by the blower must pass out through one bank or the other of the heating pipes forming the steam coils. A portion of the air escapes from the heating chamber 14 through lower openings 19 to lower jets 20 which are located in the drying chamber between the upper and lower stretches of the conveyer.

The principal feature of the present invention has to do with upper nozzles which the air from the heating chamber 14 enters through openings 21. A flanged bearing tube 22 is secured within the chamber 1 in line with each opening 21. A similar bearing tube 23 is secured to the opposite wall of the drying chamber. A nozzle 24 is provided with bearing tubes 25 of the same size as the bearing tubes 22 and 23. Bearing rings 25a are provided which may be initially mounted upon the bearing tubes 22 and 23 and which may be slid inward to overlap the bearing tubes 25 when the latter have been put in place. Each nozzle has fixed to its lower side a yoke shaped plate 26, each plate 26 including end arms 27 outside the lateral bounds of the nozzle which arms extend downward. The end arms 27 at one side of the chamber are all pivotally connected to a longitudinally extending bar 28 and the end arms at the other side of the chamber are all pivotally connected to a longitudinal bar 29. The bars 28 and 29 extend to a point adjacent the introductory end of the apparatus and are there connected to crank arms 30 which are fast upon a shaft 31. The shaft 31 also has fast upon it a gear 32. In the illustrative embodiment a loading platform 34 is provided at the entrance end of the drying unit which stands a little above the level of the conveyer 6.

In the present form of the invention the nozzle 24 which is disposed near the exit end of the apparatus, is provided on its back and near its mouth with a pair of brackets 50 which support the swinging exit gate 33.

The nozzles 24 are each so shaped that the hot air is directed in a direction opposed to the travel of the articles being treated.

Adjustment of the nozzles and the exit gate in unison is effected by operation of a hand wheel 35 located at the introductory end of the apparatus. The hand wheel 35 is fast upon a shaft 36. The shaft 36 is journaled in bearings 37 and 38 carried, respectively, by brackets 39 and 40. The shaft 36 also has fast upon it a worm 41 which meshes with gear 32 and drives the gear to effect the desired adjustments.

The two dotted line positions of the nozzles indicate the two extreme positions of such nozzles, the gate and other associated devices. Such

adjustment is made to permit of the passage of articles of different size and still to permit of the impingement of the hot air flowing out of the nozzles on the articles as near the mouths of the nozzles as possible.

The gate depends considerably below the mouth of the nozzle and is swung outwardly by the articles as they tumble off the belt 6 onto the delivery platform 55.

In the present arrangement the gate serves to minimize the amount of cold air that will enter the drying machine, and the arrangement is such that such cold air becomes well intermingled with the hot air so that the articles become uniformly treated.

It will be seen that in the present arrangement the first nozzle directs its hot air in the direction of the entrance to the drying machine and the mouth of the nozzle at the exit end is disposed either at or ahead of the end of the belt 6. The result is that the articles are subjected to the drying action throughout the length of travel of the articles through the machine. When the exit nozzle is in its highest position or at some intermediate position, the hot air issuing from the mouth of the nozzle forms a curtain of hot air through which all the cold air entering the chamber must pass and become intermingled therewith. In this position the gate 33 serves as a deflector and causes the hot air to be deflected downwardly and inwardly.

The preceding description embodies the disclosure of the invention set forth in my prior application No. 198,344, relating to Swinging nozzles, filed March 28, 1938, of which this application is a continuation in part, and includes a substantial part of the disclosure of my Patent No. 2,137,104, also relating to Swinging nozzles, issued November 15, 1938, to which reference is made of a more detailed description of certain features, including particularly the recirculation of air to the blowers.

In the embodiment shown in Figs. 3-7 the drying chamber, the conveyer structure, the nozzle arrangement and the supporting and adjusting structure and mechanism are substantially the same as in the form heretofore described. In the second embodiment however the heating means is located beneath the drying chamber. Instead of in chamber 14. It comprises a suitable open heater 42, which may consist of steam coils or the like through which the air may pass freely, located in an air heating chamber 43 communicating with the inlet to blower 11a. The heated air discharged from said blower is conducted to inlets at opposite ends of each upper nozzle 24a (Fig. 6), the air entering a large chamber 73 in the nozzle in opposed streams, arranged to provide improved uniformity of distribution and pressure of the drying air in the nozzle and correspondingly improved uniformity in the discharge of the air through all parts of the elongated nozzle outlet. In the illustrated embodiment this is accomplished by connecting the discharge duct 10 of blower 11a to the heating chamber or manifold 14 extending along one side of chamber 1, from which manifold the air passes through openings 21 into upper nozzles 24a this part of construction being the same as that of Figs. 1 and 2. Chamber 14 is connected by means of a transverse duct 44, extending across the top of drying chamber 1, to an auxiliary duct or manifold 45 extending along the opposite side of chamber 1 and carrying bearing tubes 23 in register with openings 21a in the inner wall of duct 45

through which heated air is fed to the other end of upper nozzles 24.

The air in the drying chamber is advantageously recirculated by withdrawing it from the upper part of the chamber and returning it to the heater 42 and blower 11a. For this purpose air is withdrawn from the upper part of chamber 1 through recirculation duct 46 extending downwardly along the side of drying chamber 1 and passing through manifold 14, duct 46 having an inlet 47 in the upper part of a side wall of chamber 1 and an inlet 48, adjacent the upper part of the opposite side wall of chamber 1, in the lower wall of extension 49 of duct 46 located in the upper part of chamber 1. It has been found advantageous to separate the flow from inlets 47 and 48, as by providing a partition 57 extending downwardly for a substantial distance in duct 46 from the bottom of the connecting end of extension 49, as shown in Fig. 5, for the purpose of equalizing the flow of air through said inlets.

The lower end of duct 46 discharges into the air heating chamber 43 beneath drying chamber 1, the arrangement illustrated including a curved horizontal outlet section 52 projecting into chamber 43 beneath the bottom of drying chamber 1 and curved to provide an outlet 53 arranged to direct the air against heater 42. Uniform distribution of air discharged through outlet 53 may be improved by the use of suitable partition means such as curved vertical partition 54.

While the lower nozzles or jets 20a are rectangular in cross section in this embodiment, their general arrangement and function is substantially the same as that set forth in connection with lower nozzles 20 in Figs. 1 and 2.

In the arrangement shown in Figs. 3-7 an improved nozzle supporting and adjusting construction is disclosed. The arrangement illustrated in the above-mentioned patent and in Figs. 1 and 2 includes rigid adjusting connections to the nozzles which prevent yielding of a nozzle when coming in contact with articles or the conveyor 6. A construction has been provided which permits the nozzles to yield under pressure from articles on said conveyor without affecting the elevation-adjusting system or changing the normal elevation of such yielding nozzle.

In this arrangement each upper nozzle 24a is provided with a supporting lug 56 mounted on each end 71 of the nozzle and arranged to bear against an adjusting arm 57 fixed at its upper end to a support ring 69 which is rotatably fitted around tubes 22 and 23. In this arrangement each tube 25 projects from the end 71 of nozzle 24a a sufficient distance to permit the necessary endwise movement of the bearing ring 25a in mounting or dismounting the nozzle, ring 25a being normally held in place as by set-screws (not shown).

Each arm 57 is arranged with its upper portion, which engages lug 56, in substantially vertical position when the associated nozzle is in its lowermost position, the lower portion of arm 57 extending at right angles toward the feed end and having a pivotal connection 70 to bar 28 or 29. This arrangement permits the desired angular adjustment of upper nozzles 24a by longitudinal movement of bars 28 and 29 with a minimum of vertical movement of said bars. In this construction the longitudinal adjustment of bars 28 and 29 by manipulation of hand wheel 35 will vary the elevation of the outlets of upper nozzles 24 between the lower position shown in Fig. 3 and an

upper position corresponding to that shown in dotted lines in Fig. 1; but if any one of said nozzles should come in contact with an article on conveyor 6 the nozzle will be free to rise and clear the article, as shown in dotted lines in Fig. 7 thereafter dropping back into the proper vertically adjusted position.

In order to provide increased drying efficiency it is desirable that the upper nozzles 24a be arranged to deflect the air jet so that in their uppermost position the jet will be directed downwardly and in lower positions will be impelled toward the feed end of the drier. For this purpose the discharge passage in each nozzle should be tapered downwardly and curved in vertical section according to established engineering design. Where the nozzle is constructed of sheet metal this passage contour produces a concavity at the feed side of the nozzle which tends to catch and hold articles traveling along conveyor 6.

A simple nozzle construction employing sheet metal and eliminating this feature is shown in Figs. 6 and 7. It comprises a flat front wall 58 at the feed side, a rear wall 59 having its lower portion curved toward wall 58, and a curved top wall 61 connecting the upper ends of walls 58 and 59. The three walls 58, 59 and 61 may advantageously be formed from a single sheet of metal. The end margins of the wall are connected by sheet metal end plates 71 which abut bearing tubes 25. This construction of upper nozzle 24a provides a relatively large internal chamber 73 which facilitates the equalization of air flow and pressure before the air reaches the bottom outlet 74.

A filler 72, which is advantageously made of similar sheet metal, is mounted on the walls of nozzle 24a, within the nozzle and adjacent the lower margins thereof. Filler 72 is shaped to provide a convex inner surface having its upper and lower edges in contact with the inner face of the front wall 58, the lower margin of filler 72 being located adjacent the lower margin of rear wall 59 and forming therewith outlet 74 from the nozzle.

An improved arrangement for obstructing the influx of air to the drying chamber 1 through the discharge opening is disclosed. It includes means for directing a curtain or sheet of air across the outlet to the drier, and in the illustrated embodiment comprises upper and lower discharge nozzles 62 each extending across chamber 1 and fixed at its ends to the side walls of the chamber, with one end communicating through an opening in a chamber wall with manifold 14. Each nozzle 62 is provided with an outlet 63 extending substantially across drying chamber 1 and directed across the discharge opening in the end of said chamber, the arrangement being such that the currents of air from outlets 63 meet and form a sheet or blanket of warm air extending substantially across the entire area of said opening, presenting an effective obstruction to the entrance of cold air from without. The lower discharge nozzle 62 is advantageously mounted between the runs of conveyor 6 in a manner similar to that employed for lower nozzles 20, so that the air from said lower discharge nozzle 62 must pass through the conveyor 6; but as said conveyor is normally formed of relatively coarse wire mesh it will permit an adequate flow of air for the purpose indicated.

The operation of the air curtain from nozzles 62 is advantageously assisted and supplemented by employing an auxiliary curtain 64 which is

movable to permit discharge of articles, and in the preferred form is vertically adjustable in conformity with the adjustment of nozzles 24a. An arrangement of this type is shown in which transverse shaft 65 journaled at its ends on the sides of drying chamber 1 carries a metal sheet or curtain section 66 fixed thereto and extending substantially across the width of the chamber 1. A yieldable skirt 67, which may consist of hinged metal or fabric sections, is attached to and extends downwardly from the lower edge of curtain section 66 to any desired elevation above conveyor 6 with relation to the corresponding elevation of the lower ends of nozzles 24a. The longitudinal adjusting bars 28 and 29 are pivotally connected to adjusting arms 68 fixed to shaft 65, the arrangement being such that the adjustment of nozzles 24a by shifting bars 28 and 29 will correspondingly rotate shaft 65 and swing the curtain section 66 upwardly, raising to a corresponding extent the skirt 67 and providing at all times an accurate register between the vertical position of the lower margin of curtain 64 and that of the lower margins of nozzles 24a.

A feature of the invention is the provision of an arrangement whereby the nozzles may be set at various heights, this feature being referred to in certain of the claims as a locking construction; but attention is directed to the fact that such locking does not preclude the nozzles from yielding upwardly when engaged by an article on the conveyor, and thereafter dropping back to locked position.

I have described what I believe to be the best embodiments of my invention. I do not wish, however, to be confined to the embodiments shown, but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. In a drier, the combination with a drying chamber and a conveyor running therein, of a series of nozzles disposed over the conveyor, each of said nozzles being pivotally mounted and capable of assuming any position between two extreme positions for varying the distance between the mouth of the nozzle and the conveyor, the mouth of each nozzle being directed downwardly and towards the entrance end of the chamber when in the lowest position, the nozzle nearest the exit carrying near its mouth a pair of brackets and an exit guard pivotally mounted on said brackets whereby the exit nozzle and the guard serve as a closure for the exit end of the chamber.

2. In a drier, the combination with a drying chamber and a conveyor running therein, of a series of nozzles disposed over the conveyor, each of said nozzles being pivotally mounted and capable of assuming any position between two extreme positions for varying the distance between the mouth of the nozzle and the conveyor, the nozzle nearest the exit carrying near its mouth a pair of brackets and an exit guard pivotally mounted on said brackets whereby the exit nozzle and the guard serve as a closure for the exit end of the chamber.

3. In a drier, the combination with a drying chamber and a conveyor running therein, of a series of nozzles disposed over the conveyor, each of said nozzles being pivotally mounted and capable of assuming any position between two extreme positions for varying the distance between the mouth of the nozzle and the conveyor, the mouth of each nozzle being directed downwardly and towards the entrance end of the chamber when in its lowest position, means for moving the

nozzles in unison from the lowest to the highest position while the mouth of each nozzle is directed towards the conveyor, the nozzle nearest the exit carrying near its mouth a pair of brackets and an exit guard pivotally mounted on said brackets whereby the exit nozzle and the guard serve as a substantial closure for the exit end of the chamber.

4. In a drier, the combination of a drying chamber having entrance and outlet openings, a conveyor passing through the chamber and said openings, and means for directing a current of warm air onto said conveyor including a nozzle adapted to be oscillated in the outlet opening and an exit gate swingably carried by said nozzle and adapted to be engaged by an article leaving the conveyor.

5. The combination as set forth in claim 4, in which the exit gate is arranged to deflect the current of air discharged by said nozzle towards the end portion of the conveyor upon the adjustment of the nozzle towards its topmost position.

6. In a drier, the combination with a drying chamber and a conveyor running therein, of a nozzle disposed over the conveyor, said nozzle being pivotally mounted and capable of assuming any position between two extreme positions for varying the distance between the mouth of the nozzle and the conveyor, the mouth of the nozzle being directed downwardly towards the conveyor and towards the entrance end of the chamber when in the lowest position, and being directed downwardly towards the conveyor and towards the exit end of the drier when the nozzle is in the highest position, and means for moving the nozzle from the lowest to the highest position while the mouth of the nozzle is directed towards the conveyor.

7. In a drier, the combination of a drying chamber, a conveyor passing through the chamber, a nozzle for directing a current of air onto said conveyor, means for pivotally supporting said nozzle for oscillating movement when contacted by articles supported on the conveyor means for locking the nozzle in predetermined position against downward pivotal movement while permitting said oscillating movement, and means for vertically adjusting said position.

8. In a drier, the combination as set forth in claim 7, in which the nozzle locking means includes a member upon which the nozzle is freely supported by gravity.

9. In a drier, the combination of a drying chamber, a conveyor passing through the chamber, a nozzle for directing a current of air onto said conveyor, means for yieldably supporting said nozzle for oscillating movement when contacted by articles supported on the conveyor and means for vertically adjusting the position of the nozzle above the path of material on the conveyor, the nozzle being gravitationally seated in engagement with the adjusting means to permit said oscillating movement.

10. In a drier, the combination of a drying chamber, a conveyor passing through the chamber, and means for directing a current of warm air onto the conveyor, including a nozzle extending transversely across the conveyor, air heating and propelling means located beneath the drying chamber, means including a flat duct forming part of the side wall of the chamber extending from the heating and propelling means and connected to the nozzle through inlets at opposite sides of the chamber, and means including a flat duct forming a part of the side wall of the drying

chamber having inlet connections with the upper part of the drying chamber and a discharge outlet communicating with the heating and propelling means.

11. In a drier, the combination of a drying chamber having a discharge opening, a conveyor in said chamber and arranged to propel material through the opening, means for directing a current of drying air onto the conveyor, means for withdrawing air from the chamber, and means for obstructing the entrance of air into the chamber through said opening comprising means for propelling a current of drying air across said opening in a sheet substantially normal to the path of the conveyor, and a movable curtain extending across said opening at the drier discharge side of said obstructing current of air.

12. In a drier, the combination of a drying chamber having a discharge opening, a conveyor in said chamber and arranged to propel material through the opening, a nozzle system for directing a current of drying air onto the conveyor, means for vertically adjusting said nozzle system, means for withdrawing air from the chamber, and means for obstructing the entrance of air into the chamber through said opening comprising means for propelling a current of drying air across said opening in a sheet substantially normal to the path of the conveyor, a curtain at the drier discharge side of said obstructing current of air, said curtain being vertically adjustable by said adjusting means.

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