

June 27, 1933.

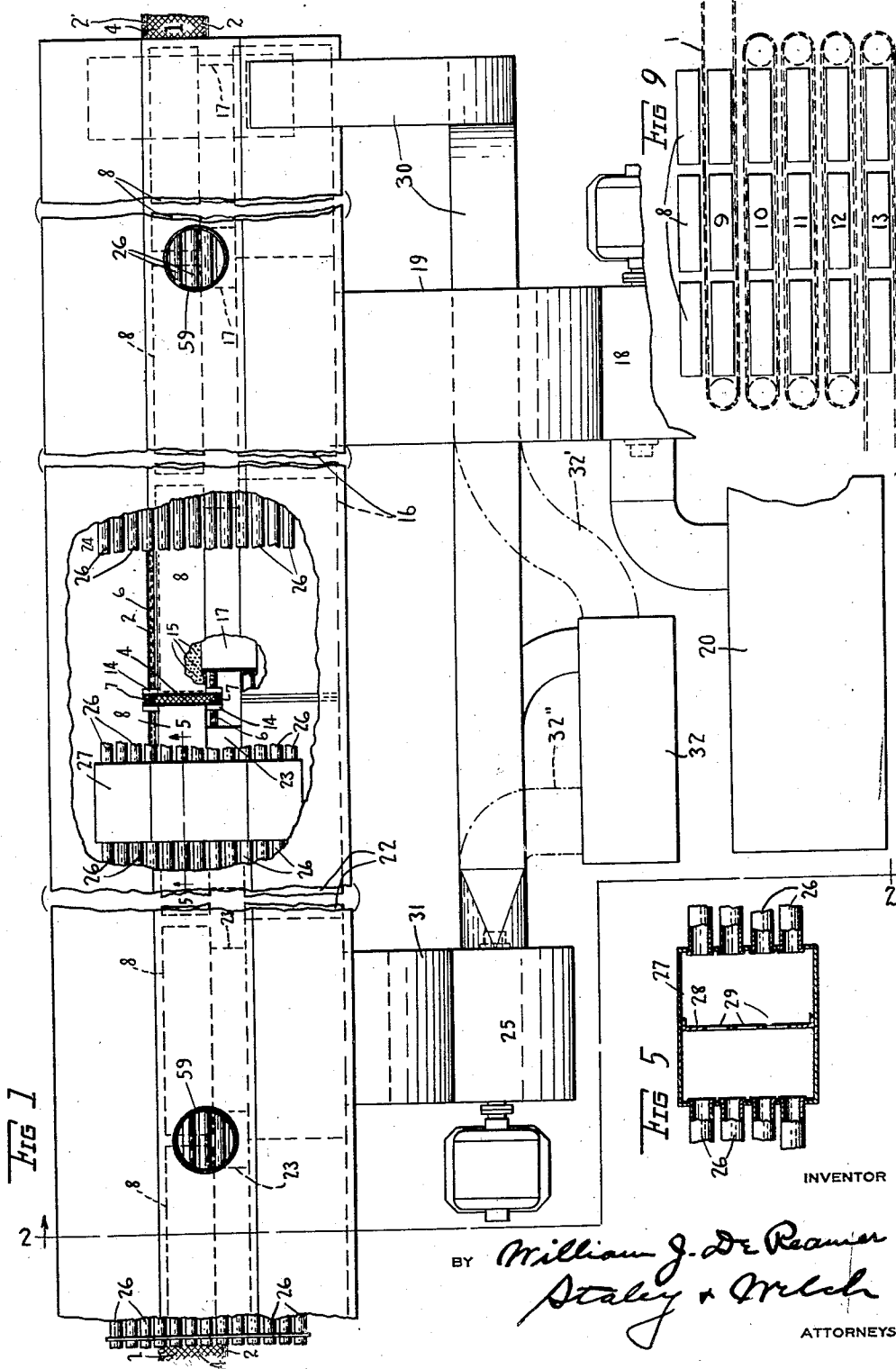
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DRYING APPARATUS

Filed July 7, 1931

3 Sheets-Sheet 1



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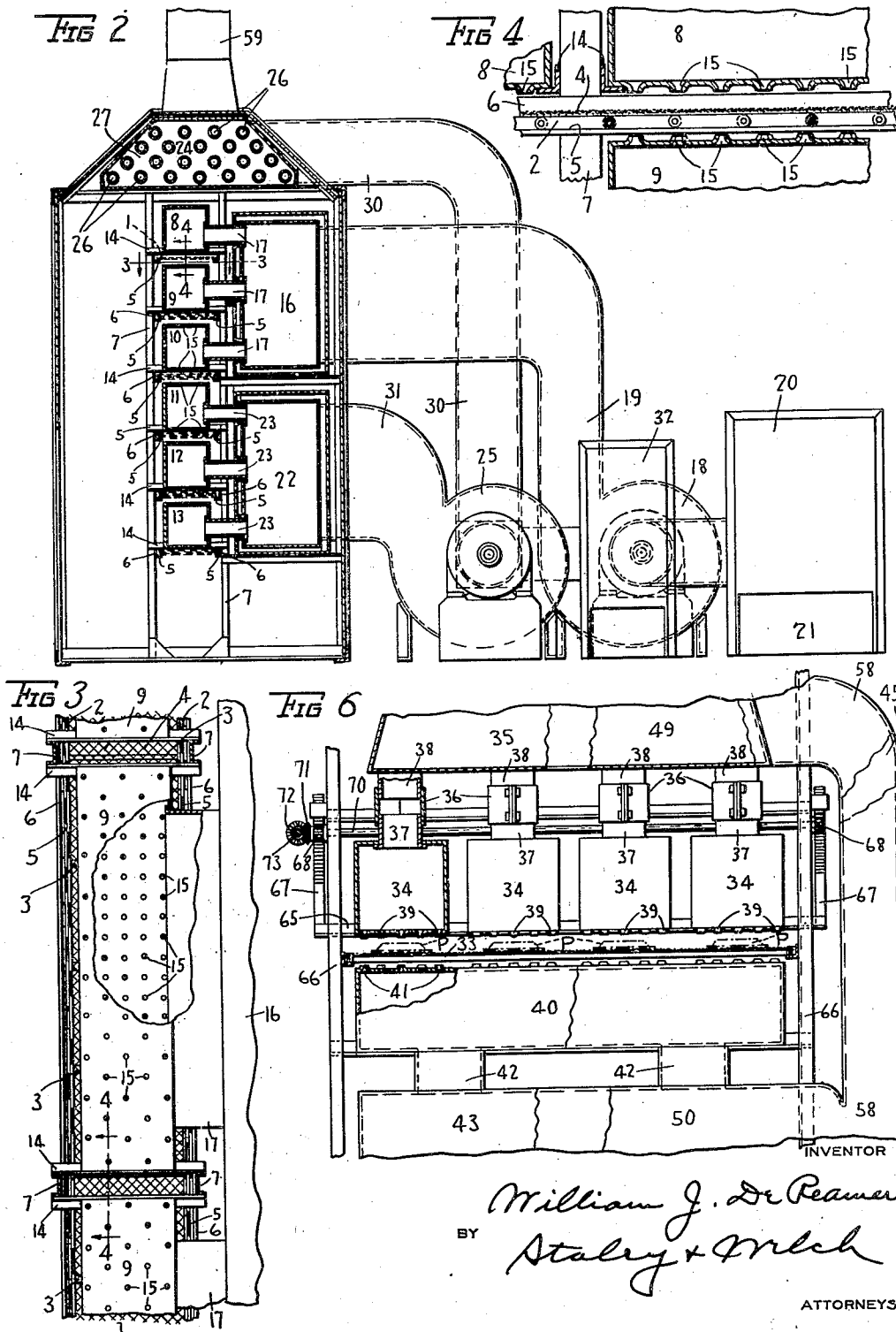
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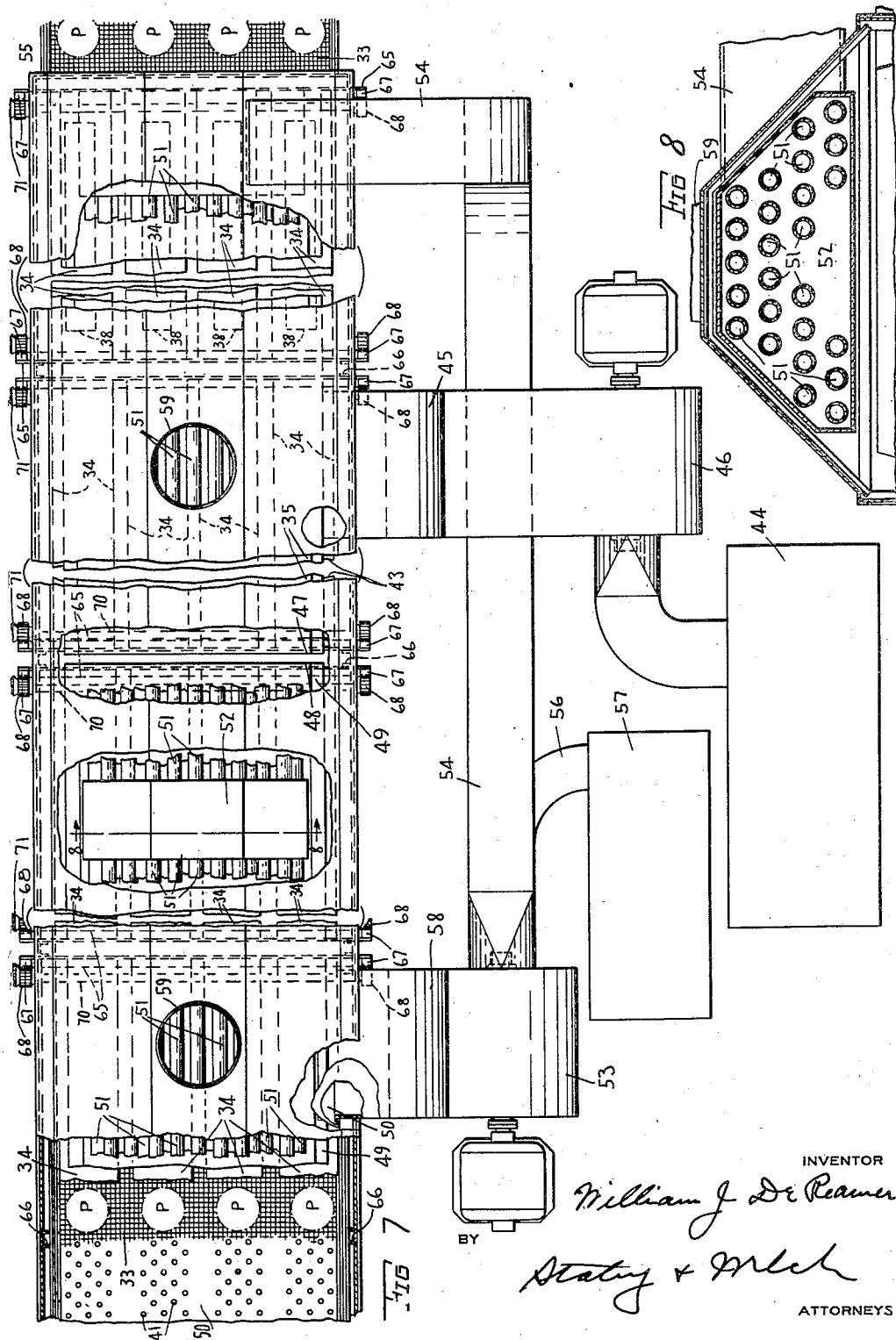
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UNITED STATES PATENT OFFICE

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DRYING APPARATUS

Application filed July 7, 1931. Serial No. 549,187.

This invention relates to improvements in machines designed to dry moulded articles of paper or pulp stock or the like, the stock for which is prepared by admixture with large quantities of water, it more particularly relating to improvements in that class of driers in which the articles are carried throughout the drier on endless conveyors and exposed to the influence of a drying agent such as heated air, the articles being subjected to either a single passage or to a plurality of travels past the drying agent.

The moisture content present in articles on delivery to the driers is reduced to a minimum through the employment of improved moulding machines, but varies somewhat on account of the character of the product used and to a certain extent from changes in the weather. Therefore, the improved drier is so designed that the air is supplied through means whereby greater efficiency in operation is secured and in amounts and at temperatures which may be varied readily to suit conditions. Furthermore, the moisture-laden air is permitted to escape only through a heat reclaiming device whereby an economy in fuel consumption is obtained.

One of the objects of the invention is to provide improved means whereby the efficiency of the machine as a drier is increased, one of the results of which is the possibility of reducing the length of travel of the articles while being dried, as a consequence of which the cost of the drier unit may be lowered, with an accompanying reduction in total floor space required, and the drier made more applicable to a system in which it is interposed between the moulding apparatus and a counting and packing machine.

Another object is to secure the economy in fuel consumption previously mentioned.

In the accompanying drawings:

Fig. 1 is a fragmentary, top plan view showing conventionally a drying machine in which the principles of the invention are embodied.

Fig. 2 is a transverse vertical section on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged fragmentary horizontal section on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged fragmentary longitudinal section on the line 4—4 of Figs. 2 and 3.

Fig. 5 is an enlarged fragmentary longitudinal section on the line 5—5 of Fig. 1.

Fig. 6 is an end view, partly in transverse vertical section, of a drying machine of a modified form, the view also being conventionally shown.

Fig. 7 is a fragmentary top plan view on a slightly enlarged scale of the modified form of the invention.

Fig. 8 is a fragmentary enlarged transverse section on the line 8—8 of Fig. 7.

Fig. 9 is an elevation in diagrammatic form on a reduced scale, showing the relative arrangement of the conveyors and air boxes of the preferred form.

Referring to the drawings, the improved drier comprises a frame-work in which is supported conveyor mechanisms such as endless belts, chains or the like, blast boxes arranged to discharge heated air on the articles, a duct supplying highly heated air to certain of the blast boxes, a series of ducts constituting a heat reclaiming device located in the path of the escaping heated air, a secondary duct receiving a major portion of its air from the heat reclaimer, and blast boxes connected with the secondary duct. The greater portion of the frame-work is enclosed by side-walls and a roof, while such appurtenances as conveyor driving mechanism, bearings, and the like are located at either end of the frame-work, where it is preferably not enclosed. Other accessories such as fans or heaters are also located outside the frame structure at suitable points.

A portion of a conveyor is indicated at 1 at the intake end of the drier, Fig. 1, and in a more detailed manner in Figs. 4 and 9. The conveyor may travel throughout the drier in a single run, or may deliver the articles deposited thereon to a second lower conveyor, and the second to a third, several such transfers being made until the delivery end of the drier is reached. The latter variation in construction is treated as the preferred form of the invention, as the floor space requirements are much less than that

necessary when using the single pass machine, the time element, or the length of travel being substantially equal in either case.

Each conveyor is identical in the respect that the preferable construction provides a foraminated surface on which the articles rest, thereby permitting free passage of air through this surface. Briefly, each conveyor comprises a pair of spaced apart endless chains 2 connected by cross rods 3 to which is secured a strip 4 of woven-wire cloth. The conveyor is supported on the horizontal legs 5 of angle-section members, the chains 2 making direct bearing contact therewith. The angle members are properly spaced apart and positioned so as to utilize the vertical legs 6 as guides and also as points of attachment to vertical stanchions 7.

The adjacent runs of the endless conveyors are placed close together, as shown best in Fig. 9, and suitable turning mechanism (not shown) is provided for transferring the articles from one conveyor to another, the turning mechanism employed being that illustrated in Patent No. 1,664,663, dated April 3rd, 1928.

Upon entrance into the enclosed portion of the drier upon the upper run of the upper conveyor, the articles are at once subjected to the simultaneous action of jets of heated air applied upwardly and downwardly. The jets of air issue from blast-boxes arranged above and below and in parallel alignment with the conveyors, the boxes being spaced apart vertically a sufficient distance to provide ample clearance for the passage of the conveyor and articles carried thereon, and also to allow a ready escape for the air, since after the air impinges upon the moist articles, it rapidly becomes heavily moisture-laden, and, with the exception of the residual heat, is unfit for further use.

Series of sheet-metal blast boxes are indicated at 8, 9, 10, 11, 12 and 13, Fig. 2, in cross-sectional form. The boxes are preferably comparatively short, as seen in Fig. 1, and are supported at each end by angle members 14 secured to the stanchions 7. Each box is rectangular in form, and in the bottom of each of those in the series 8 is a plurality of jet orifices 15, while in the series 13, the top, and in all others both tops and bottoms are perforated with the orifices 15 in like manner. The jet orifices are conically shaped, the cone portion projecting outwardly, in order to lessen the friction developed in the flow of the air, and also to provide a more important advantage in insuring that the air reaches the article in ample quantities. The top series of boxes 8 are positioned above the upper run of the upper conveyor, while the other series of boxes are each positioned between the runs of a conveyor.

Each box of the series 8, 9, and 10 is con-

nected to a large duct or chamber 16 by short rectangular ducts 17 whose flow capacity is sufficiently great that the air pressures in the boxes and ducts do not materially differ, but preferably the arrangement is such that a somewhat greater blast of air will be placed on the upper sides of the articles to hold them to the conveyor and this may be accomplished by having a greater number of nozzles in the bottom of each blast box than in the top thereof. The pressure is created by a fan 18 connected to conduit 19, while the suction side of the fan is in communication with a primary heater 20 whose air inlet is shown at 21. This arrangement provides that a large quantity of air is supplied to the boxes of the series 8, 9 and 10, which air is heated to the maximum temperature allowable at any point in the drier, and being in the present instance approximately 600 degrees Fahrenheit. In those runs of the conveyor served by the boxes of this series, the moisture content rapidly diminishes from the maximum to an approximately medium content, but as the content is not evenly distributed throughout the article, thin sections or edges and corners are likely to dry out before other portions, and the ensuing temperatures should be reduced. Therefore on traversing the remaining runs, the articles are acted upon by air at a materially lowered temperature.

This lower temperature air is supplied to the blast boxes of the series 11, 12 and 13 by a duct or chamber 22 through short ducts 23 similar to the above-mentioned ducts 17. The duct 22 receives heated air from a heat-reclaiming device indicated in general at 24 through the medium of an interposed fan 25, thereby providing a means for securing an economy in operation as the exchanging surfaces of the reclaimer are heated by the discharged air previously mentioned.

The reclaimer may be of any suitable form. In the simple and effective arrangement employed, use is made of a plurality of thin-walled tubes 26 and mixer boxes 27 in which are placed centrally-located baffle plates 28 having openings 29, the whole uniting to form a conduit approximately equal in length to the enclosed portion of the drier proper. The suction side of the fan 25 is connected to one end of the reclaimer, preferably near the intake end of the drier, by the duct 30, while the dust 31 leads from the discharge side of the fan 25 to the duct 22. The opposite end of the reclaimer is more preferably at some point outside the frame structure where vapor arising from the drying articles is not drawn in by the suction.

Under normal conditions, the air supplied to the duct 22 is sufficiently heated by having passed through the reclaimer, but in the event additional heat is required, use is made of a secondary heater 32. This heater may

be employed as shown in full lines, Fig. 1, wherein the suction of the fan 25 draws air through this heater, in addition to that air flowing through the duct 30 from the reclaimer or, as shown by the dot-dash lines, where the ducts 32' and 32'' lead to and from the heater 32. In the latter case, it is obvious that all air received from the reclaimer passes through the heater, and any necessary additional heat is supplied by operating this heater.

The drier as shown and described as being the preferred form is suitable for such articles as can be conveniently transferred at the termination of horizontal runs to other conveyors. One advantage of this construction has been stated previously, that is, in the saving of floor space; one other may be added in that to avoid loss of heat, a compact arrangement is found advisable. However, other forms of articles may not be successfully turned or inverted at the end of a run, necessitating for the drying of such articles a single-pass drier. An end view of a simple single-pass is shown in Figs. 6 and 7 in which it will be seen that the output of the machine may be increased by providing a conveyor 33 sufficiently wide to accommodate several rows of articles, which in the figure are represented as pie-plates P in an inverted position.

Over each row of the plates P is a plurality aligned series of blast-boxes 34 similar to those described in the preceding description. In this instance, however, the boxes are supported on an adjustably secured frame comprising angle members 65 slidably attached to vertical stanchions 66. Attached to the outer ends of the supporting members 65 are vertically disposed rack members 67, in mesh with which are pinions 68 on transversely arranged shafts 70, and at one end of each of these shafts 70 is secured a miter gear 71 meshing with a miter gear 72 on a longitudinal shaft 73, whereby on rotation of the shaft 73 the blast-boxes 34 may be elevated or lowered simultaneously to provide the proper clearance for the articles which are to be carried on the conveyor 33.

The boxes 34 are individually connected to a large duct 35 by a telescoping arrangement consisting of an adjustably secured sleeve 36 encompassing both the short, rectangular ducts 37 projecting upwardly from each box and the respective ducts 38 projecting downwardly from the duct 35. The lower sheets or bottoms of the boxes 34 are perforated by conically formed orifices 39 similar to the orifices 15 above mentioned. The boxes 34 are spaced apart as shown to provide air ducts therebetween to permit escape of the moisture-laden air.

Located below the conveyor at a suitable distance is a series of aligned boxes 40 preferably sufficiently wide to provide that in the upper side of each box there may be a plu-

rality of rows of perforations 41, located in the upper surface of the boxes 40 in vertical alignment with the orifices 39. This provides that there is a similar simultaneous application of heated air to either side of the articles resting on the conveyor, it being understood that the articles are deposited thereon in properly spaced rows.

The boxes 40 are supplied with air through short vertical ducts 42 from a longitudinal duct 43, which, in common with the duct 35, extends throughout the initial portion of the drier length (approximately one-half). Each receives air from a heater 44 through the branched duct 45 connected with the discharge side of a fan 46, whereby the articles P are acted upon by the simultaneously flowing jets of more highly heated air flowing downwardly and upwardly from the orifices 39 and 41, respectively.

As the articles are carried by and through these jets, moisture is expelled in the lighter sections, as described heretofore. It then becomes necessary to complete the drying operation with air at lower temperatures. This is accomplished by providing a series of similar boxes and ducts arranged in the same horizontal alignment in such manner as will provide a single, straight run for the conveyor 33. Referring to Fig. 7, the numeral 47 represents the furthest extended portion of the ducts 35 and 43, while 48 indicates the beginning of the similar ducts, one of which is seen at 49, the lower one corresponding to the duct 43 indicated at 50, at the left of Fig. 7. It will then be clear that while the articles P are passing under the duct 35, the drying process is carried on by the more highly heated air, and when passing under the duct 49, the air is supplied at much lower temperatures.

In this modification, heat reclamation is obtained in a similar manner as described previously, there being the plurality of tubes 51 and mixer boxes 52 forming a conduit extending preferably over the entire space in which air is discharged from the orifices 39 and 41.

At 53 is shown a fan whose suction side is connected to a duct 54 leading from that end of the heat reclaimer adjacent the intake end of the drier. The duct 54 also receives air through a duct 56 from a secondary heater 57, by means of which added heat may be supplied to the air drawn from the reclaimer. The vertical duct 58 is a branched duct similar to the duct 45 and connects the discharge side of the fan 53 with the ducts 49 and 50.

A feature common to both the preferred and modified forms of the invention is that the fans are connected to the supply ducts such as those described as at 16, 22, 35, 43, 49 and 50 at their approximately central points to provide for a comparatively uniform distribution of pressure. Further, after the

moisture-laden air passes through the reclaiming devices, it is discharged to outside atmosphere through stacks 59.

Having thus described my invention, I claim:

1. In a drying apparatus of the character described, a plurality of movable endless open conveyors for the articles to be dried located one above another, one conveyor adapted to transfer articles to another adjacent conveyor, means located upon the upper run of the uppermost conveyor for projecting blasts of heated air downwardly upon the articles carried by said conveyor, and blast boxes located between the runs of at least one other conveyor each having air discharge means upon both the upper and lower sides for projecting blasts of air both upwardly and downwardly, the air discharge means on the upper side of each box being less in capacity than the air discharge means on its lower side and also less in capacity than the air discharge means for the uppermost conveyor.

2. In a drying apparatus of the character described, a plurality of movable endless con-

veyors for the articles to be dried located one above another, one conveyor adapted to transfer articles to another adjacent conveyor, a plurality of blast boxes above the upper run of the upper conveyor, each of the boxes having a plurality of air discharge nozzles on its under side, a plurality of air blast boxes located between runs of an intermediate conveyor each having a plurality of nozzles on both its upper and lower sides, a plurality of air blast boxes located between the runs of the lower conveyor each having a plurality of air discharge nozzles upon its upper side only, the air discharge nozzles on the upper side of the intermediate blast boxes being less in capacity than the nozzles of the blast boxes above the upper run of the upper conveyor and the air discharge nozzles on the lower side of the intermediate boxes being greater in capacity than the nozzles of the blast boxes located between the runs of the lower conveyor.

In testimony whereof, I have hereunto set my hand this 22nd day of June, 1931.

WILLIAM J. DE REAMER.

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