

A. C. RICE.
DRIER FOR PAPER.
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Patented June 20, 1911.

2 SHEETS—SHEET 1.

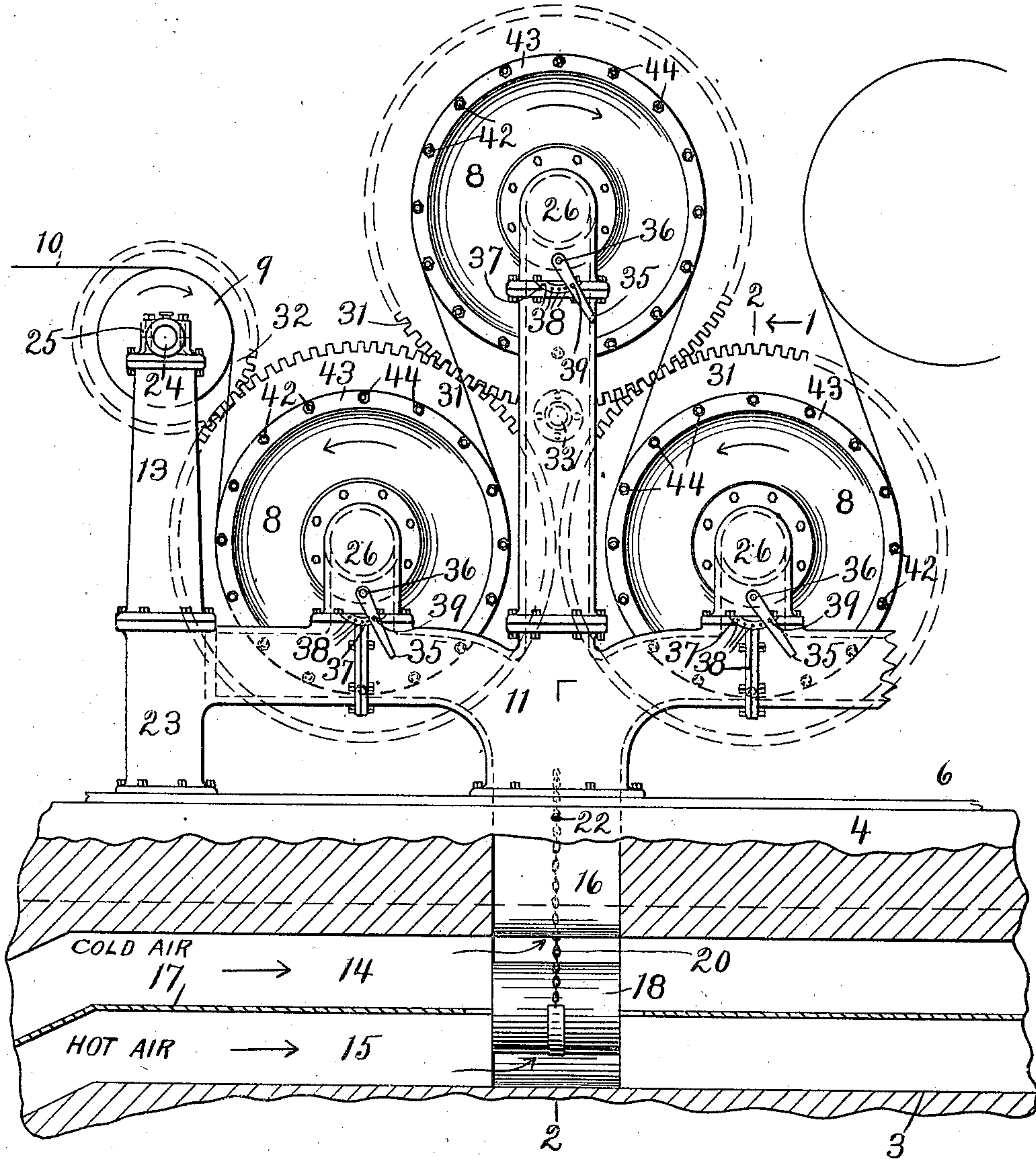


FIG. 1.

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2 SHEETS--SHEET 2.

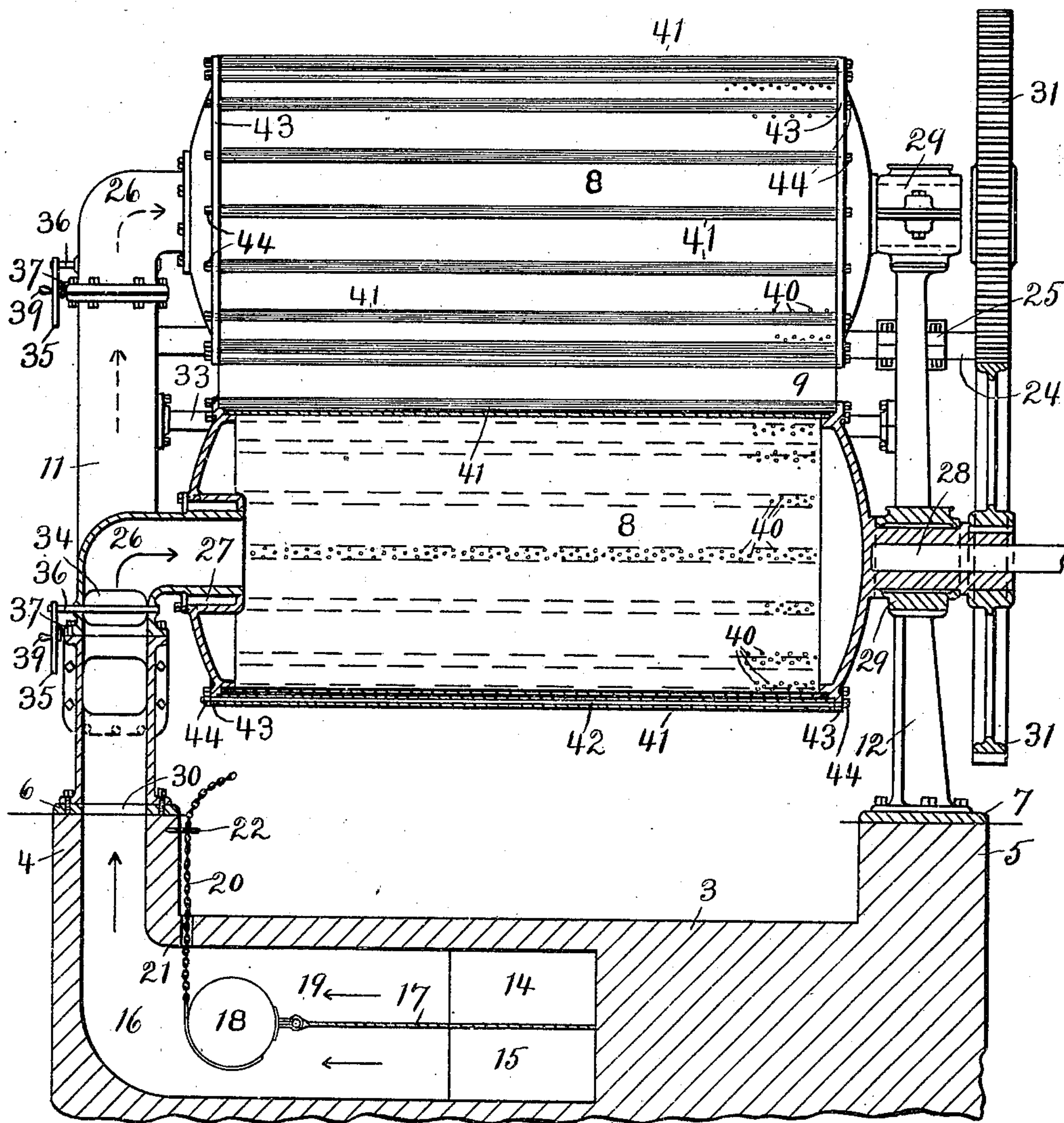


FIG. 2.

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DRIER FOR PAPER.

995,721.

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To all whom it may concern:

Be it known that I, ALVA C. RICE, a citizen of the United States of America, and a resident of Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Drier for Paper, of which the following is a specification.

My invention relates to improvements in devices for drying paper by means of a forced draft, in which I employ certain peculiar, hollow drying cylinders or drums for the paper, together with a novel arrangement of air conduits and suitable means of control for both the temperature and the volume and consequently the pressure of the air admitted to said drums, all as hereinafter set forth.

In the manufacture and treatment of various kinds of paper, it is customary to dry the same in lofts, but this method has several disadvantages, among which may be mentioned the large amount of space required, and the fact that paper so dried is apt to be wrinkled or uneven because the air at the top of the loft is hotter or warmer than at the bottom so that its action on the paper is not uniform. Forced-draft driers for special purposes and with a view to overcome the defects found in loft-dried paper have been produced before, but I am not aware of any device, apparatus, appliance, or mechanism which so applies the air to the paper and which so regulates such application as to dry the paper in a thorough and perfect manner and without injury to the same. With my drier I am able to handle satisfactorily all kinds of paper, whether it be paper direct from a paper-making machine or paper treated for any purpose after its manufacture, and to properly dry the same regardless of the amount of moisture which the paper may contain when delivered to said drier, and to this end and with this object in view I have produced the drier herein described.

Another object of my invention is to provide a drier of the class specified which is capable of being made of any length by simply increasing the number of drums and their air-duct connections which can be done very readily.

Strength, durability, and simplicity, also ease of control, are all characteristics of my drier and greatly enhance the value thereof.

These and other objects and advantages which will appear in the course of the following description I attain by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of the front end portion of a drier embodying a practical form of my invention, the foundation in which the main air-ducts are located being in partial section, and, Fig. 2, a transverse vertical section on lines 2—2, looking in the direction of the arrow 1, in Fig. 1.

Similar reference figures designate similar parts in the two views.

I illustrate a group of three drums which ordinarily will be the least number used, but by providing additional conduits leading from the main air-ducts more drums can be added and the drier made of any length desired. In the event that the single group of three drums, with the associated parts and members, is to constitute the drier, then the main air-ducts must be closed immediately back of the transverse passage or branch leading therefrom, and the horizontal branch of the conduit which supports one end of and supplies the rearmost drum must be closed behind the point where it opens to supply said rearmost drum. Usually, however, the drier will be of some considerable length and equipped with quite a large number of drums.

Air is forced through the main ducts by any suitable means, as by a fan (not shown) located at the entrance to such ducts, or at the entrance to a large duct connected with the ducts first referred to and which will be described presently in detail. These ducts, two in number and preferably one above the other, are for hot and cold air, respectively. The air in the hot-air duct is heated in any suitable manner, as by means of a heater (not shown) situated in said duct at a point where it will be most effective.

Referring to the embodiment of the invention as illustrated in the drawings, it will be observed that I have there shown a foundation 3, preferably of concrete with

a longitudinally-depressed center which leaves raised portions 4 and 5 along the front and back sides, respectively; bed-plates 6 and 7 secured in place on said raised portions 4 and 5, respectively; three hollow cylinders or drums 8 arranged in the form of a trefoil; a guide roller 9 for the paper, the latter being represented at 10; a combination bearing support and air distributor 11 for said drums, such member 11 being mounted on and bolted to the bed-plate 6; a bearing support 12 mounted on and bolted to the bed-plate 7, this latter support being for the drums at one end while said member 11 carries them at the other end; and two bearing supports or uprights for opposite ends of the roller 9, one of such uprights appearing at 13 in Fig. 1 and the other being hidden thereby in this view and by the support 12 in Fig. 2.

Extending longitudinally through the center of the foundation 3 are two main air-ducts 14 and 15, the former which is for cold air being above the latter which is for hot air. Leading downward from an opening 30 in the bed-plate 6 and opening there-through into the base of the combination bearing support and air distributor 11, hereinafter termed "distributor", is an angular branch duct or mixing-chamber 16 which turns inward in line with the ducts 14 and 15 and opens into the same. The horizontal septum 17 which divides the cold-air duct 14 and the hot-air duct 15 one from the other is extended a short distance into the horizontal portion of the mixing-chamber 16, and a valve 18 is pivotally attached at 19 to the end of this extension from said septum which is in said chamber. The valve 18 is in the form of a cylinder the length of which is about equal to the space between the vertical walls of that part of the mixing-chamber 16 in which said valve operates. A chain 20, for supporting and operating the valve 18, has its inner end fastened to said valve, and extends upward through an opening 21, in the roof of the aforesaid chamber, to be attached to a pin 22 projecting from the inner face of the raised portion 4 of the foundation 3. Upon releasing the chain 20 from the pin 22, the valve 18 by means of said chain can be raised or lowered to cut off wholly or partially to any degree desired the cold air from the duct 14 or the hot air from the duct 15 to the branch duct or mixing-chamber 16. After adjusting the valve 18 at the desired point, the chain 20 is again attached to the pin 22 to support said valve, unless the latter be lowered clear to the floor of the mixing-chamber 16 when such attachment is not necessary except for the purpose of holding up the chain. In changing the position of the valve to decrease the

volume of air from either main duct, it necessarily follows, owing to the peculiar construction and arrangement of the valve, that the volume of air from the other main duct will be correspondingly increased, so that given a certain volume under a certain pressure in each main duct and the volume of air which is admitted to the vertical part of the branch duct or mixing-chamber is always the same, only its temperature varying. To state it differently, the volume of air admitted to the mixing-chamber by the valve 18 is constant at all times, excepting when the degree of pressure which drives or forces the air into the main ducts is increased or decreased.

As hereinbefore suggested, or intimated at least, there may be any reasonable number of mixing-chambers and distributors, and the main air-ducts will be of any length required to supply the same.

The distributor 11 herein shown is a hollow member comprising a base, into which the mixing-chamber 16 opens, and a vertical piece, for the support of the adjacent end of the upper drum 8, and two horizontal arms, for the support of the adjacent ends of the two lower drums 8, springing from said base, together with an extension 23 at the front end of the forward arm, which like the base is bolted to the bed-plate 6. By preference, the distributor 11 has a generally rectangular shape in cross-section, with rounded corners. The upright 13 is supported on the extension 23. The shaft 24 of the guide roller 9 is journaled at each end in an ordinary box-bearing 25 on the supporting upright beneath. There are three elbows 26 mounted in triangular relation to each other on the distributor 11. The axes of the horizontal portions of the elbows 26 are equidistant from one another, and the arrangement is such that the two lower axes are on the same horizontal plane. The front end of each of the drums 8 is mounted to revolve on the horizontal portion of one of the elbows 26, with anti-friction rollers 27 between. The opposite end of each drum 8 is provided with a trunnion 28 which is journaled in ordinary box-bearings 29 on the support 12. Tight on the trunnions 28, behind the bearings 29, are intermeshing gears 31, and tight on the corresponding end of the shaft 24 is a gear 32 which meshes with the first gear 31. The gear 32 is required to be smaller than either of the gears 31, which latter are all of the same size, in order to allow for the difference in diameter between the roller 9 and any one of the drums 8; thus all of the paper-actuating, rotary members have the same surface speed. The gears 31, intermeshing as they do, insure a uniform motion on the part of the drums, lessen the lia-

bility of backlash, and so cause the paper 10, which passes under and over said drums, to have a regular and even motion.

The arrows on the drums and the guide roller denote the directions of rotation of such members, and the arrows in and on the air conduits indicate the various courses of the air currents.

Any suitable driving means from any suitable source of power may be employed to actuate the revolving members of my drier.

33 is a brace rod between the distributor 11 and the bearing support 12.

For the purpose of governing the volume of air which enters each drum 8, I place a horizontal damper or valve 34 in each elbow 26 and operate the same by means of a handle or operating arm 35 fastened at its upper end to the protruding end of the valve rod 36 which is journaled in the front and back sides of the elbow. Affixed by means of rearwardly-extending ears and bolts at the ends to the coupling flange of each elbow 26, behind each arm 35, is a depending, segmental, index plate 37 having a plurality of holes or indentations 38 therein, and said arm is provided with a pin 39 which is adapted to be brought into registry with any one of said indentations as the arm is moved in front of said plate. Through the medium of the aforesaid plates 37 and pins 39 it is possible to open or close the valves 36 to any desired degree with certainty, since said pins click by the indentations 38 as the arms 35 are swung from right to left or vice versa, and so register the amount of such movement and the consequent amount of movement of said valves which are fast on the rods 36 and they in turn rigidly connected with the operating arms. In manipulating either of the arms 35, when the pin 39 in such arm arrives at the indentation 38 that corresponds to the degree at which it is desired to have the associated valve 34 stand, said arm is released and left with said pin in said indentation, and the engagement between the pin and the plate 37 behind is sufficiently forceful to retain the arm and valve in the positions in which they are left. Thus the indented plates and the pin-provided arms serve the double purpose of an index or indicator and retaining or holding means for the outlet valves of the distributor.

The novel feature of the drums 8, the annular sides of which are perforated, resides in a series of air-breaks, with which said drums are furnished, upon which the air impinges when it escapes through the perforations in the drums and is thus prevented from striking the paper in jets, but is diffused by such air-breaks evenly over the entire surface of said paper. By this means and in this manner the paper is gently

bathed, as it were, in air, with the result that a most complete and effectual drying of said paper is brought about without injury to the most delicate texture and without any unevenness in the paper thus treated.

In the present case, the annular side of each drum 8 is perforated at 40, such perforations being arranged in groups which extend longitudinally of said drum and are spaced apart, there being three rows of perforations in a group; and the air-breaks consist of imperforate tubes 41 mounted on rods 42 supported outside of said groups of perforations or holes by flanges 43—43 at the ends, exteriorly, of said drum. The flanges 43 locate the tubes or air-breaks proper, 41, a little distance away from the groups of holes 40, so as to leave space enough for the air to pass out of said holes. When the air escapes through the holes 40 it encounters the air-breaks 41 and is thereby broken up as it passes around said air-breaks, so that the air finally reaches the paper 10, which latter is carried directly by the air-breaks, in a highly diffused condition.

The operation of the drier will be generally understood from the foregoing, but it may be briefly recapitulated as follows: The paper 10, which may be either old or new, is passed over the roller 9, led down under the first or left-hand drum 8, up over the second or top drum 8, down again under the third or right-hand drum 8, and then to another drum, roller, or suitable guide or carrier, a fourth drum being indicated, in Fig. 1, as the receiving member for said paper after it leaves said third drum. As noted above, the paper 10 travels on and with the air-breaks 41. The valve 18 is set to admit the proper proportions of hot and cold air from the main ducts 15 and 14 into the mixing-chamber 16, so as to have air of the right temperature delivered by way of the distributor 11 to the drums 8 and by them discharged on both surfaces of the paper. And the valves 34 are set to admit to the drums the desired or required quantities or volumes of air. It is now clear that, as the drums 8 revolve, the paper 10 is literally bathed on both sides in the air which is forced through said drums and broken up by the air-breaks 41 over or outside of the holes 40. Both sides of the paper are exposed to the air owing to the arrangement of drums, as is clear from the first view. The paper is run through the drier in a continuous strip, of course, and comes out at the back end of said drier completely dry and ready to be wound into a roll, cut into sheets, or otherwise disposed of.

Although I have illustrated a drier having two tiers of drums, it is obvious that there might be more or less than that number of tiers. Where economy in floor space is a desideratum, and such is generally the case, a

three-tier drier will usually be employed, but since this invention does not particularly concern the arrangement of the drums in tiers, it has not been deemed necessary or
 5 desirable to encumber the application with further illustration and description of this particular feature.

More or less change in details of construction may be made in my drier without departing from the nature of my invention.
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What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, in a drier for paper, with a mixing-chamber, hot and cold air-
 15 ducts opening into such chamber, and means to regulate the currents of air which may enter said chamber from said ducts, to obtain different temperatures of the air in the chamber, of means consisting in part of per-
 20 forated revoluble drums to convey the air from said mixing-chamber and discharge it on the paper.

2. The combination, in a drier for paper, with a mixing-chamber, hot and cold air-
 25 ducts opening into such chamber, and means to regulate the currents of air which may enter said chamber from said ducts, to obtain different temperatures of the air in the chamber, of means, consisting in part of
 30 perforated revoluble drums arranged on opposite sides of the course of the paper to convey the air from said mixing-chamber and discharge it on both sides of the paper.

3. The combination, in a drier for paper, with a mixing-chamber, hot and cold air-
 35 ducts opening into such chamber, and a valve capable of regulating the currents of air which may enter such chamber from said ducts, without changing the volume of air
 40 in the chamber, regardless of the position of said valve to obtain different temperatures of the air in the chamber, of means, consisting in part of perforated revoluble drums to convey the air from said mixing-chamber
 45 and discharge it on the paper.

4. The combination, in a drier for paper, with air-supply conduits, of a series of per-
 50 forated revoluble drums, a hollow air distributor opening into said conduits and serving as a support for said drums at one end, a bearing support for said drums at the other end, rotatable valves arranged in said distributor to control the air in its passage from the distributor to the drums, said
 55 valves being provided with exterior operating arms, index members affixed to the outside of said distributor, and means to fasten said arms to said members at different points.

5. In a drier for paper, a perforated drum provided with exterior air-breaks arranged to revolve with said drum.

6. In a drier for paper, a drum having longitudinally-arranged rows of holes there-

in and provided with external air-breaks 65 adjacent to such rows of holes.

7. In a drier for paper, a drum having longitudinally-arranged groups of holes therein and provided with external air-
 70 breaks adjacent to such groups of holes.

8. The combination, in a drier for paper, with a perforated revoluble drum having a plurality of air-breaks arranged around the outside of said drum parallel with the axis of the same, of an air conduit opening into
 75 said drum and supporting it at one end, a bearing support for said drum at the other end, and means to supply air to said conduit.

9. The combination, in a drier for paper, of a mixing-chamber, hot and cold air-ducts
 80 opening into such chamber, means to regulate the passage of air from said ducts into such chamber to determine the temperature of the air in the chamber, a hollow air distributor opening into said chamber, a bear-
 85 ing support, and a plurality of paper-carrying perforated drums mounted to rotate between said distributor and said bearing support and adapted to receive air from the distributor.
 90

10. The combination, in a drier for paper, of a mixing-chamber, hot and cold air-ducts opening into such chamber, means to regulate the passage of air from said ducts into such chamber to determine the temperature
 95 of the air in the chamber, a hollow air distributor opening into said chamber, a bearing support, a plurality of paper-carrying perforated drums mounted to rotate between said distributor and said bearing sup-
 100 port and adapted to receive air from the distributor, and valves in the latter to govern the passage of air therefrom into said drums.

11. The combination, in a drier for paper, of a mixing-chamber, hot and cold air-ducts
 105 opening into such chamber, means to regulate the passage of air from said ducts into such chamber to determine the temperature of the air in the chamber, a hollow air distributor opening into said chamber, a bear-
 110 ing support, a plurality of paper-carrying perforated drums mounted to rotate between said distributor and said bearing support and adapted to receive air from the distributor, and air-breaks arranged around
 115 said drums adjacent to the perforations therein.

12. The combination, in a drier for paper, of a mixing-chamber, hot and cold air-ducts opening into such chamber, means to regulate
 120 the passage of air from said ducts into such chamber to determine the temperature of the air in the chamber, a hollow air distributor opening into said chamber, a bearing support, a plurality of paper-carrying
 125 perforated drums mounted to rotate between said distributor and said bearing-support and adapted to receive air from the distribu-

ter, air-breaks arranged around said drums adjacent to the perforations therein, and valves in the distributor to govern the passage of air therefrom into the drums.

5 13. The combination, in a drier for paper, with a suitable air-supply conduit, of a hollow air distributor connected with such air-supply conduit, a bearing support, a plurality of paper-carrying perforated drums
10 mounted to rotate between said distributor

and said bearing support and adapted to receive air from the distributor, air-breaks arranged around said drums adjacent to the perforations therein, and valves in the distributor to govern the passage of air there- 15 from into the drums.

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Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."
