No. 703,044. Patented June 24, 1902.

C. H. CROWELL.

DRIER FOR PAPER, CLOTH, &c.

(Application filed Oct. 2, 1901.)

(No Model.) 3 Sheets—Sheet 1.

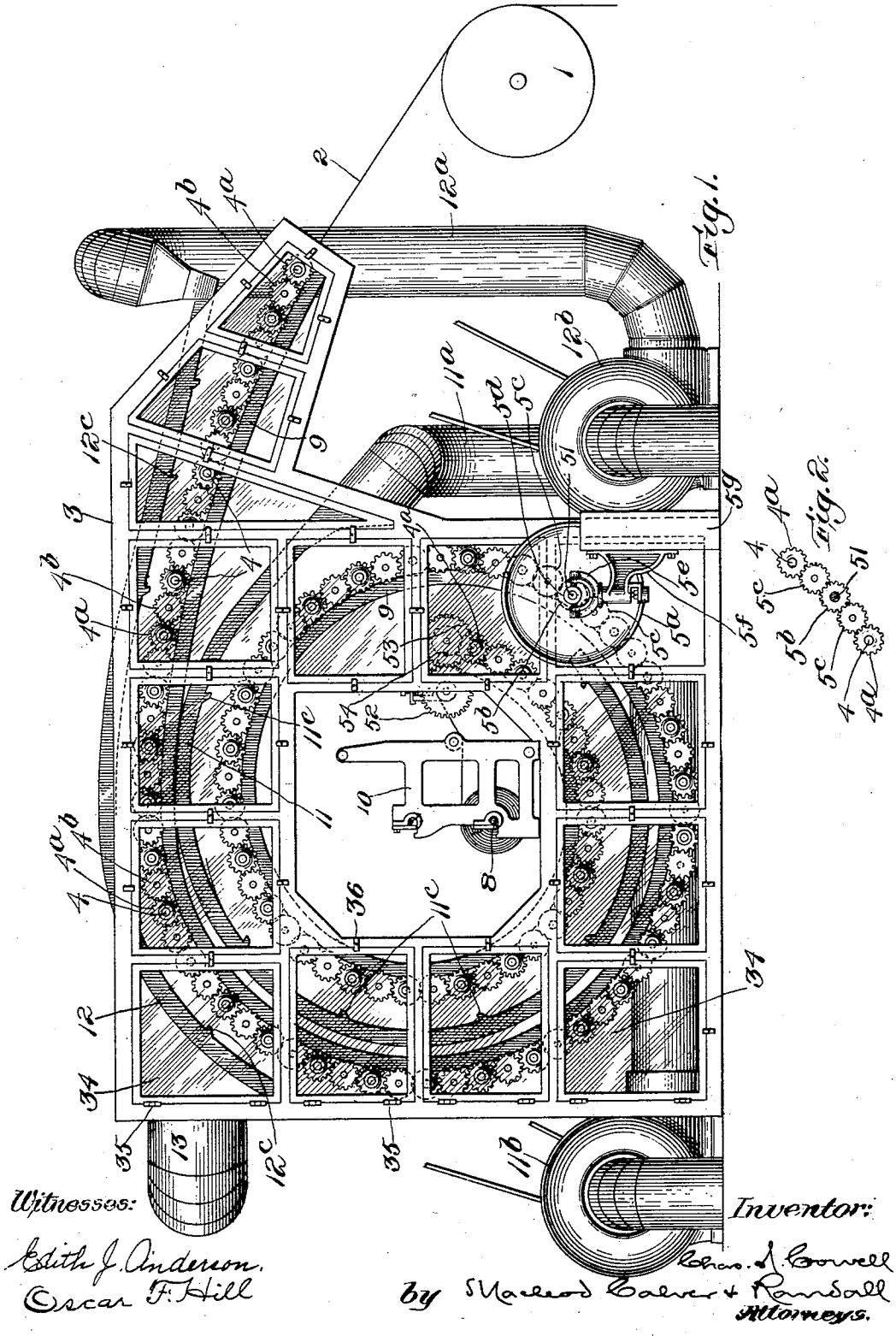


Fig. 1.

Fig. 2.

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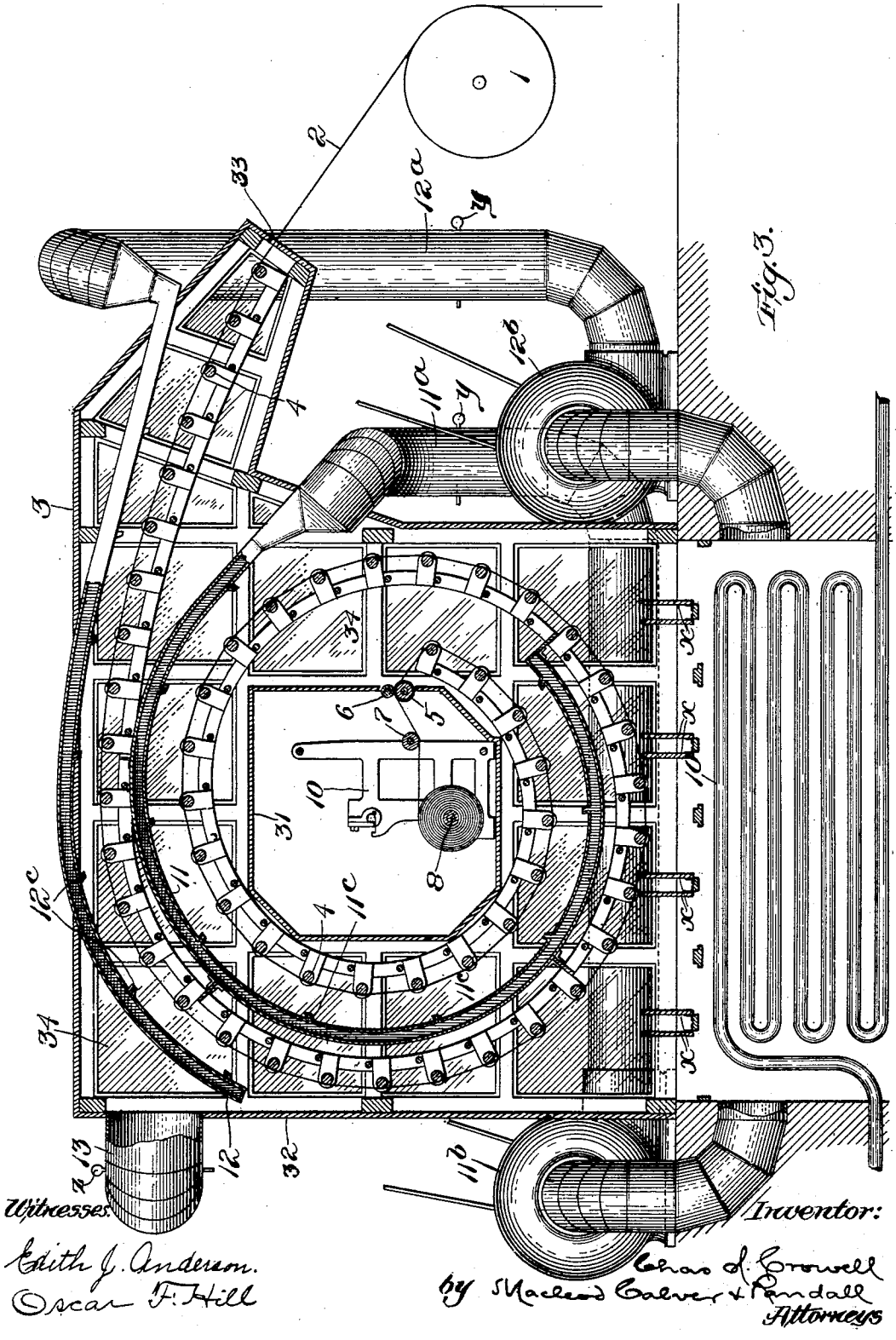
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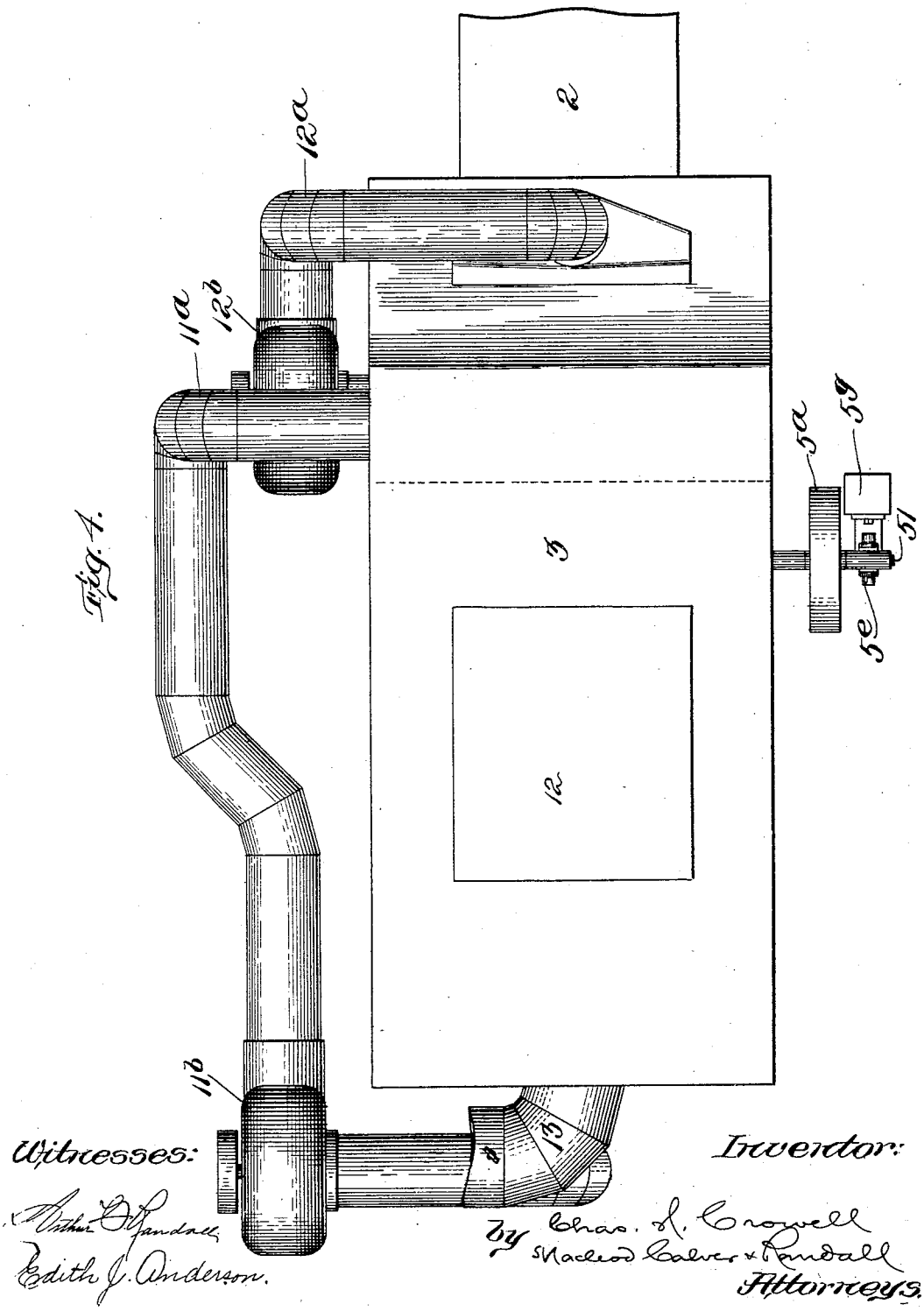
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(No Model.) 3 Sheets—Sheet 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES H. CROWELL, OF LYNN, MASSACHUSETTS.

DRIER FOR PAPER, CLOTH, &c.

SPECIFICATION forming part of Letters Patent No. 703,044, dated June 24, 1902.

Application filed October 2, 1901. Serial No. 77,263. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. CROWELL, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented a certain new and useful Improvement in Driers for Paper, Cloth, &c., of which the following is a specification, reference being had therein to the accompanying drawings.

The invention consists, generally speaking, in an improved drier which has been devised for use in handling continuous webs or lengths of paper, cloth, and the like after having been colored, gummed, sized, or subjected to other preparatory or finishing operations.

One principal object of the invention is to reduce the size of the apparatus or machine, and more especially the extent of the floor-space which is required to be occupied thereby. Another is to maintain continuous and complete control over the material under treatment until it is wound after having been dried, keeping it under tension and spread out in flat and smooth condition, whereby the paper or other material is prevented from curling transversely upon itself or wrinkling as it dries. Another is to greatly expedite the drying process.

In the drawings, Figure 1 shows my improved drier in side elevation. Fig. 2 is a detail view showing certain gearing. Fig. 3 is a longitudinal vertical section of the drier. Fig. 4 is a view showing my improved drier in plan.

Having reference to the drawings, at 1 is a conventional representation of a preparatory or finishing machine by which the material under treatment is operated upon before being subjected to the drying process. 2 designates a continuous length of material which is subjected to the action of the said machine and conducted therefrom to the drier. 3 designates the casing in general of the drier. Within the said casing the continuous length of material coming from the machine 1 travels along a consecutive series of rolls 4 4, &c., the said rolls being arranged proximately to one another in order to support the said material at intervals close together. In practice I have arranged the said rolls at a distance of about twelve inches apart, although the said distance may be departed from more or less, if deemed desirable. On leaving the said series of rolls the material passes between a delivery-roll 5 and presser-roll 6, it issuing from the casing as it leaves the said rolls 5 6 and going thence to the winding mechanisms. The said material is shown as passing part way around a guide-roll 7 after leaving the rolls 5 6 and being received next upon the winding mandrel or roll 8. The said mandrel or roll is in practice furnished with suitable means for rotating the same, not necessary to be shown or described, inasmuch as the same may be of any usual and well-known character.

One important characteristic of my invention is the fact that the series of rolls 4 4, &c., is disposed in a curve. Another is the fact that the curved series of rolls forms an involute spiral—that is to say, the curve thereof has a gradually-decreasing radius of curvature. A third is the fact that the respective rolls of the series are rotated by means of gearing or other operating mechanism in connection therewith.

The spirally-curved arrangement of the series of rolls is shown clearly in Figs. 1 and 3 of the drawings. In the illustrated embodiment of the invention the series makes substantially two full turns, although the extent of the spiral may be greater or less without involving a departure from the principles of the invention. The said extent will vary somewhat in practice according to the character and quality of the material under treatment, the nature of the treatment to which the said material is subjected before being passed into the drier, and other considerations which will be obvious to those skilled in the art in which my invention is fitted to be utilized.

Having reference more especially to Fig. 1, the respective rolls 4 4, &c., are shown provided with driving-gears 4^a 4^a, &c., which mesh with intermediate or carrier gears 4^b 4^b, &c. For the purpose of rotating the rolls a driving-shaft 51 is provided, it having a suitable band-pulley 5^a for the reception of driving power and a pinion 5^b. The said pinion 5^b is interposed between and meshes with carrier-gears 5^c 5^c, the latter meshing with the gears 4^a 4^a on two adjacent rolls 4 4, as shown in

Figs. 1 and 2. The gearing described rotates the rolls of the series in unison. I have shown the driving connections as arranged to rotate every roll 4 positively. If desired, in some cases certain of the rolls may be unprovided with driving connections, and when this is the fact the driven rolls will alternate with the others. The bearings for the rolls are applied to spiral supports 9, on which latter are mounted also the intermediate or carrier gears 4^b. The driving-shaft 51 is or may be mounted in a bearing 5^d, carried by a hanger 5^e, supported by a bracket 5^f, attached to a suitable standard 5^g. The manner and means of supporting the rolls and carrier or intermediate gears, the particular arrangement of the gearing, and the precise manner and means of communicating driving power to the rolls are not important and may be varied in response to the exigencies of practice and the views of builders and users of driers embodying the invention. As a convenient means of driving the delivery-roll 5 it is shown provided with a gear 52, meshing with a like gear 53, fast with a gear 54, meshing with the gear 4^a on the adjacent roll 4, herein the last roll of the series.

The advantage of the curvature of the series of rolls 4 4, &c., lies in the fact that the paper or other material traversing the said series is drawn by its own tension into close and firm contact with the surface of every roll upon the outer or convex side of the curve. Thereby it is caused to lie flat against every roll and to make good frictional contact therewith. The rolls when arranged in the said curved series act in consequence of the fact just stated to support the paper or other material from edge to edge thereof, and they prevent the said paper or other material from curling, which it does when exposed to the drying operation in a relaxed state, as when it is not positively supported throughout its entire width.

The advantage of arranging the series of rolls in an involute spiral is that while maintaining the important advantage gained by the curvature of the series it enables a series of rolls of length adequate to secure perfect and complete drying and which if extended in a straight line would be of exceedingly great, inconvenient, and impracticable length to be inclosed in a casing occupying a relatively small amount of floor-space. Moreover, not only are compactness, economy of floor-space, and reduced cost of construction secured by the spiral arrangement, but the material being dried is exposed more advantageously to the currents of heated air which are employed in order to effect the drying, so that the drying is performed with enhanced efficiency and greater economy than otherwise would be possible.

The employment of rolls located at a short distance apart from one another and positively driven—*i. e.*, driven by the mechanism of the drier and not by the frictional contact of the material being passed through the drier—distributes the feeding action throughout the whole length of the material within the drier. In so doing it obviates injury from longitudinal strains and relieves the paper or other material under treatment from all tendency to draw into wrinkles in consequence of the said strains. The use of the series of rotating rolls located, as aforesaid, at a short distance apart also causes the paper or other material to follow a perfectly straight course through the drier and to wind truly upon the receiving mandrel or roll at 8. Usually in practice a continuous web of paper or the like when being drawn off a roll and through a machine has an almost irresistible tendency to sway from side to side as it passes through such machine. In my improved drier although in practice the paper or other material goes a distance of sixty feet it passes through straight and winds truly, as aforesaid. The short distance intervening between two adjacent rolls obviates the tendency to deviation of the paper or other material.

My improved drier has been designed more especially for use in the drying of material which is gummed, coated, colored, or otherwise finished or treated upon one side only thereof. Such material enters the drier gummed, coated, or colored side outermost, the other side alone making contact with the rolls 4 4, &c., throughout the traverse of the entire series of rolls by the said material.

An inner shell 31, forming part of the casing 3, extends transversely through the space which is inclosed by the spiral series of rolls 4 4, &c., and within the central opening is placed the winding mechanism, comprising the frame 10, the receiving mandrel or roll 8, and the guide-roll 7. Thereby the said winding mechanism is rendered accessible from the exterior. The delivery-roll 5 and presser-roll 6 are located in a transverse slot that is formed in the said inner shell 31.

The delivery-roll 5 has a soft or yielding covering of felt and is given a surface speed slightly in excess of that of the rolls 4 4. This maintains the material in a proper state of tension within the drier. It is necessary that the material, especially paper, should be formed into a firm and hard roll upon the receiving or winding mandrel or roll 8, and consequently in practice it is usual to cause a considerable draft to be communicated to the material between the said mandrel or roll 8 and the delivery-roll 5 and its presser-roll 6 by suitably speeding up the winding-shaft. The rolls 5 and 6 prevent the strain which is communicated to the material by the winding mechanism from extending back past such rolls 5 and 6. In case of breakage of the paper adjacent the receiving or winding mandrel or roll the rolls 5 and 6 maintain the feed of the paper through the machine. In the absence of such rolls the travel of the paper would become discontinued in case of such

breakage and the paper would accumulate between the gumming or other preparing or finishing machine and the drier. The winding device through slipping of the operating-belt or for other reasons is apt to communicate a varying degree of tension to the material which is being wound. The rolls 5 and 6, which may be designated "feed-rolls," in consequence of being driven at uniform speed maintain a constant and uniform degree of tension of the material in its travel through the drier.

The main portion of the spiral series of rolls 4 4, &c., is contained between the two shells 31 and 32 of the casing 3. The outer portion of the series of rolls is carried outward in the form of an extension toward the preparatory or finishing machine 1, as shown in Figs. 1 and 3, the casing having a corresponding extension projecting outward from the main body thereof. The continuous web of material 2 enters the said extension through the transverse slot 33 at the outer end thereof and travels first over the rolls pertaining to the said extension of the series. Beneath the main body of the drier is located the steam-coil 10. The heated air from the said steam-coil rises against the material traveling upon the spiral series of rolls 4 4.

Parallel with the outer and inner portions of the spiral series of rolls and closely adjacent thereto I arrange ducts 11 12. These ducts are flattened and correspond approximately in width with the web of material 2. They are connected, respectively, with flues or pipes 11^a 12^a, leading from the casings of blowers or fans 11^b 12^b, which latter draw heated air from the space surrounding the steam-coil 10. The heated air which is forced by the said blowers or fans into the ducts 11 12 is discharged therefrom onto the adjacent surface of the web 2 of material passing around the series of rolls 4 4 through the openings of nozzles 11^c 12^c, with which said ducts are furnished. Preferably the said nozzles are inclined, as shown, so as to direct the issuing streams of air in the direction which is the reverse of that in which the web 2 is moving. Preferably, also, they are arranged in such position as to cause the streams of air issuing therefrom to impinge upon the web 2 at those places where the said web is supported by the rolls 4 4. With the upper portion of casing 3 a discharge flue or pipe 13 communicates. This flue or pipe 13 is connected with a suitable exhaust-fan. (Not shown.) The capacity of the exhaust-fan should be considerably greater than that of the blowers which discharge heated air into the interior of the casing through the ducts and their nozzles, preferably twice as great, in order to insure that all of such air shall be drawn off through the exhaust arrangement and that in addition an ample volume of air shall be drawn in past the heating-coil at the bottom.

With the object in view of enabling the condition of the web 2 in its course within the drier to be closely observed and of facilitating the paying of any required attention to the said web at any necessary point in its length the opposite sides of the casing are made with movable sections 34 34 in the shape of glass windows, as represented. Through these windows the interior of the drier may be inspected, and any one or more of them may be opened to permit of access to any required portion of the interior. The said windows are shown hinged at 35 35 and provided with turn-buttons 36 36, by which to fasten them in closed position.

The arrangement of the outer portion of the spiral series of rolls 4 4 is designed to cause the paper or other material upon first entering the drier at the slot 33 to be subjected to a less degree of heat than that which it afterward experiences. The object is to dry the material somewhat gently at first, so as to give the substance with which it has been treated an opportunity to become set—that is to say, to penetrate and take hold of the fibers. Afterward as the paper or other material proceeds around the main body of the spiral, and especially as it reaches the lower portion thereof, it is subjected to the full effect of the currents of heated air within the drier and the drying is expeditiously completed.

My improved drier has greater efficiency than usual in consequence of the fact that the web 2 of material is subjected therein under the most favorable conditions to moving and constantly-replenished currents of heated air, which are continuously withdrawn from the interior with the load of moisture which they have abstracted from the said web.

I have hereinbefore referred to the value of the drier for use in connection with material gummed, coated, colored, or the like upon one side only thereof. The drier is of equal value in treating cloth or other material which is saturated or charged upon both sides thereof before entering the drier and is required to have a right side or face and a wrong side or back when finished. Only the back of such material is required to come in contact with the surface of the rolls 4 4 in its transit through the machine, thereby enabling a more perfect finish to be given to the face than would be possible if such face contacted with guide-rolls or the like in its travel within the drier.

The use of the glass windows or doors in the casing is of the greatest importance in practice in dealing with paper, inasmuch as the latter material is liable to become broken or torn. The said glass windows or doors enable the place of the break or other injury of the paper to be ascertained at a glance and obviate the loss of time, of heated air, and of material which would be experienced if the sides of the drier were not transparent and if the sections thereof had to be removed one after another in endeavoring the find the place of the break.

Some classes of material will be dried sufficiently by means of the streams of air issuing from the nozzles of the ducts. In such cases in order to avoid waste of heated air and obviate injury to the material under treatment the passage between the steam-coil and the body of the drier will be more or less completely closed by means of dampers. In the present instance I have illustrated a series of dampers x x, located between the steam-coil and the spiral series of rolls.

For the purpose of regulating the volume of air issuing through the nozzles of the ducts 11^c 12^c I have provided the pipes 11^a 12^a with dampers y y, and in order that the outflow of moisture-laden air may be regulated as desired I have provided the discharge-pipe 13 with a damper z.

I claim as my invention—

1. A drier for drying continuous-web material coming from gumming or similar devices, said drier having means for supporting and guiding said web while exposed to the drying agency entirely without contact with the moist face thereof, the said means comprising, essentially, a multiplicity of rods or rollers arranged proximately to one another in a curved line or series and upon the peripheries of which at the convexity of said line or series the said web travels, and means of feeding the said web along the said series of rods or rollers through the drier, substantially as described.

2. A drier for drying continuous-web material coming from gumming or similar devices, said drier having means for supporting and guiding said web while exposed to the drying agency entirely without contact with the moist face thereof, the said means comprising, essentially, a multiplicity of rolls arranged proximately to one another in a curved line or series and upon the peripheries of which at the convexity of said line or series the said web travels, means for rotating the respective rods or rollers in the direction of the feed, and means of feeding the said web along the said series of rods or rollers through the drier, substantially as described.

3. A drier for drying continuous-web material coming from gumming or similar devices, said drier having means for supporting and guiding said web while exposed to the drying agency entirely without contact with the moist face thereof, the said means comprising, essentially, a multiplicity of rods or rollers arranged proximately to one another in an involute spiral and upon the peripheries of which at the convexity of said line or series the said web travels, and means of feeding the said web along the said series of rods or rollers through the drier, substantially as described.

4. A drier for drying continuous-web material coming from gumming or similar devices, said drier having means for supporting and guiding said web while exposed to the drying agency entirely without contact with the moist face thereof, the said means comprising, essentially, a multiplicity of rods or rollers arranged proximately to one another in an involute spiral and upon the peripheries of which at the convexity of said line or series the said web travels, means for rotating the respective rods or rollers in the direction of the feed, and means of feeding the said web along the said series of rods or rollers through the drier, substantially as described.

5. A drier for material in the form of a continuous web comprising, essentially, a multiplicity of rolls arranged proximately to one another in a curved line or series and upon the peripheries of which at the convexity of the said line or series the said web travels, means for rotating the respective rolls in the direction of the feed, means of feeding the said web through the drier, and means of producing moving currents of heated air to act on said web while in transit along the said series of rolls, substantially as described.

6. A drier for material in the form of a continuous web comprising, essentially, a multiplicity of rolls arranged proximately to one another in a curved line or series and upon the peripheries of which at the convexity of the said line or series the said web travels, means of feeding the web through the drier, and a duct adjacent the said series of rolls discharging air in streams upon the said web, substantially as described.

7. A drier for material in the form of a continuous web comprising, essentially, a multiplicity of rolls arranged proximately to one another in a curved line or series and upon the peripheries of which at the convexity of the said line or series the said web travels, means of feeding the web through the drier, a duct adjacent the said series of rolls discharging air in streams upon such web, and means of forcing heated air through said duct, substantially as described.

8. A drier for material in the form of a continuous web comprising, essentially, the series of rolls arranged in an involute spiral and upon the convexity of which the web travels, means of feeding the web along said series, and means of producing moving currents of heated air to act on said web while in transit along the series of rolls, substanially as described.

9. A drier for material in the form of a continuous web comprising, essentially, the series of rolls arranged in an involute spiral and upon the convexity of which the web travels, feed-rolls at the inner end of said spiral, and means of producing moving currents of heated air to act on said web while traveling along the series of rolls, substantially as described.

10. A drier for material in the form of a continuous web comprising, essentially, the series of rolls arranged in an involute spiral and upon the convexity of which the web travels, means for rotating the respective rolls in the direction of the travel of the web, feed-rolls

at the inner end of said spiral, and means of producing moving currents of heated air to act on said web while traveling along the series of rolls, substantially as described.

11. A drier for material in the form of a continuous web comprising, essentially, the series of rolls arranged in an involute spiral, feed-rolls at the inner end of said spiral, and the ducts adjacent the spiral series of rolls discharging streams of heated air upon the material in transit along the series of rolls, substantially as described.

12. A drier for material in the form of a continuous web comprising, essentially, the series of rolls arranged in an involute spiral, the feed-rolls at the inner end of said series, means for furnishing heated air beneath said spiral, and the ducts adjacent the spiral series of rolls discharging streams of heated air upon the material in transit along the series of rolls, substantially as described.

13. A drier for material in the form of a continuous web comprising, essentially, the spiral series of rolls having the outer end thereof extended outwardly, the feed-rolls at the inner end of said series, means for furnishing heated air at the lower part of said spiral, the ducts adjacent the spiral series of rolls discharging streams of heated air upon the material in transit along the said series, and the casing having the extension inclosing the said outer end of the series of rolls, substantially as described.

14. A drier for material in the form of a continuous web comprising, essentially, the series of rolls arranged in an involute spiral and upon the convexity of which the web travels, means for rotating the respective rolls in the direction of the travel of the web, and means of producing moving currents of air to act on said web while traveling the said series of rolls, substantially as described.

15. A drier for material in the form of a continuous web comprising, essentially, a curved series of rolls upon the convexity of which the said web travels, means of feeding the web through the drier, a duct adjacent the said series of rolls discharging air in streams upon said web, means of supplying a current of air moving upwardly past the material on the rolls, and dampers to regulate the flow of said current, substantially as described.

16. A drier for material in the form of a continuous web comprising, essentially, the multiplicity of rolls arranged proximately to one another in a spiral series and upon the convexity of which series the web travels, the duct adjacent the said series of rolls discharging streams of air upon the material in transit along the series of rolls, the steam-coil, and means of regulating the flow of air from the said steam-coil past the material while passing along the said series of rolls, substantially as described.

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

CHARLES H. CROWELL.

Witnesses:

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