

March 14, 1939.

C. S. JENNINGS ET AL

2,150,445

ART OF DRYING MATERIALS

Filed Feb. 4, 1936

3 Sheets-Sheet 1

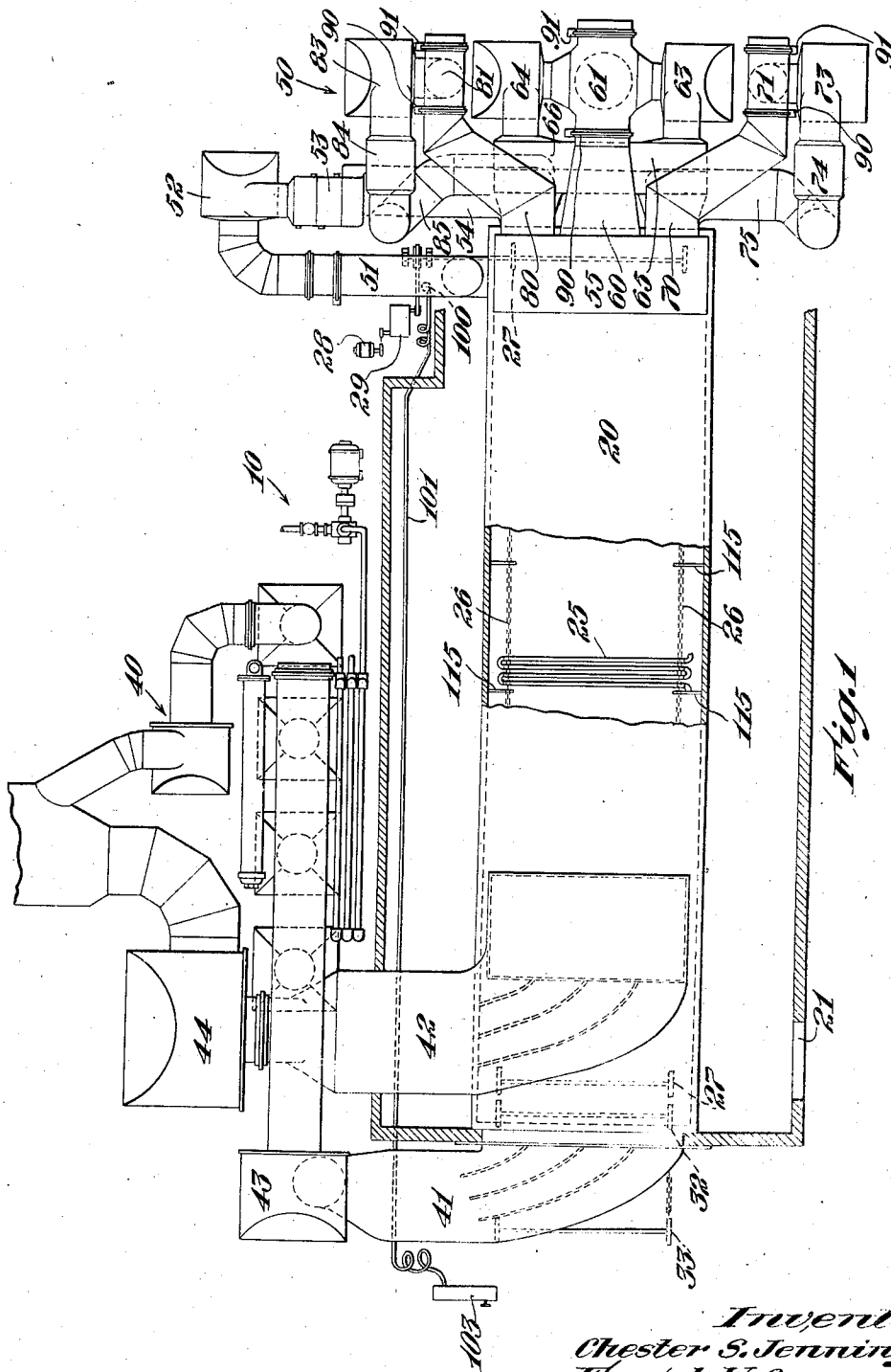


Fig. 1

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3 Sheets-Sheet 2

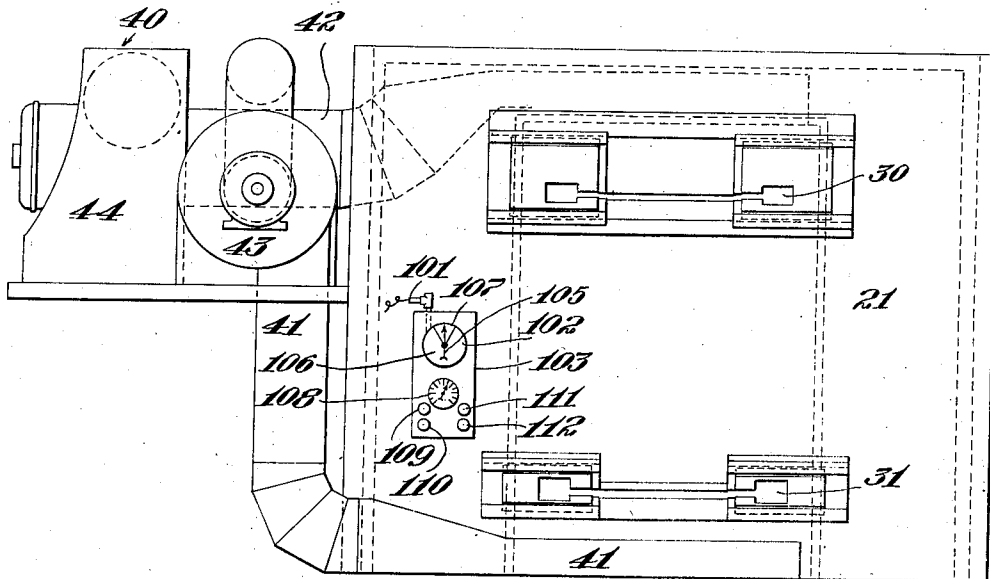


Fig. 2

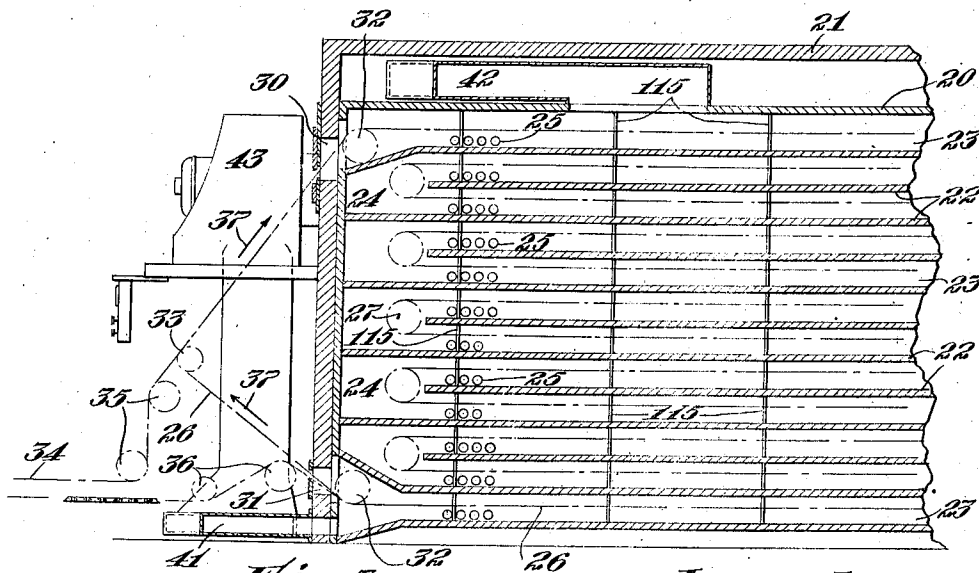


Fig. 3

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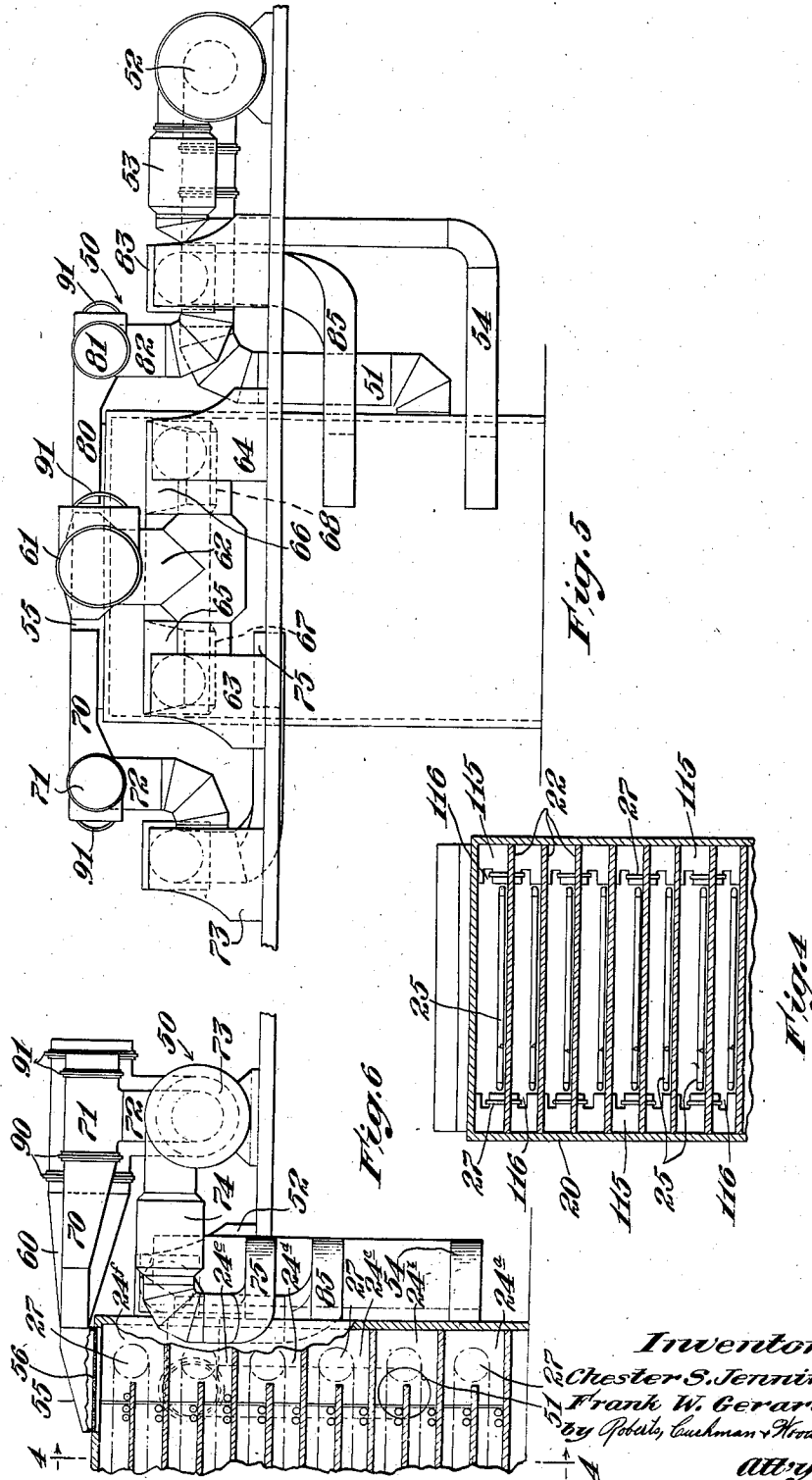
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,150,445

ART OF DRYING MATERIALS

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Application February 4, 1936, Serial No. 62,286

7 Claims. (Cl. 34—48)

This invention relates to an improvement in the art of drying materials, more particularly to drying methods and apparatus wherein the material to be dried is conveyed through a dryer comprising a chamber divided into a plurality of compartments to which drying air is supplied, and is a further development of the invention disclosed in our copending application Serial No. 744,332, filed September 17, 1934, now matured into Patent No. 2,101,335 of Dec. 7, 1937.

The primary objects of the present invention reside in the provision of means for setting up an intercirculation of the drying air between the compartments thereby attaining greater efficiency, of means for determining the condition of the material at an intermediate stage in its travel through the drying chamber and of means for retaining the drying air in contact with the material being treated.

These and other objects will appear from an examination of the following description and of the accompanying drawings which form a part thereof and in which

Fig. 1 is a plan view of the drying apparatus, the housing and a portion of the drying chamber being shown in section;

Fig. 2 is a front view of the dryer;

Fig. 3 is a sectional side view of the forward end of the drying chamber.

Fig. 4 is a cross sectional view of such chamber;

Fig. 5 is a rear end view showing the mechanism by which the air is drawn from compartments of the drying chamber, heated and returned to the drying chamber; and

Fig. 6 is a side view of such mechanism and a sectional side view of the rear end of the chamber.

The drying apparatus shown in the drawings and generally indicated as 10 comprises briefly, a drying chamber 20 through which the material to be dried is passed, mechanism 40 by which the drying air is prepared, supplied to the chamber 20 and removed therefrom and mechanism 50 by which the air in the chamber is recirculated.

The drying chamber 20 is enclosed within a housing 21 and is divided by horizontally arranged partitions 22 into a plurality of compartments 23. The partitions 22 alternately terminate short of the ends of the chamber 20 as shown in Figs. 3 and 6 to form passages 24 each of which connects two adjacent compartments. The passages at the rear end of the chamber are designated 24^a—24^f, respectively, for convenience in description (see Fig. 6). Extending across the chamber in each compartment directly over the partitions 22 and the floor of the chamber, are a plurality

of pipes 25 through which steam or other heating medium is circulated by any well known means. (Not shown because no part of the present invention.)

The material to be dried is transported through the compartments of the chamber by endless conveying means, for example a pair of tenter chains 26, as illustrated in the drawings, which pass over sprockets 27 mounted in the passages 24. Suitable driving means for the chains are provided such as that illustrated in the drawings wherein one pair of sprockets 27 at the rear end of the machine is positively driven by a motor 28 through gearing including a variable speed drive 29. The chains 26 enter and leave the chamber 20 through openings 30 and 31 formed in the front wall of the housing near the top and bottom thereof passing over sprockets 32 mounted in enlargements of the top and bottom compartments 23 and sprockets 33 suitably mounted outside the housing. The chamber 20 abuts the front wall of the housing and has suitable openings therein which register with the openings 30 and 31 in the housing.

The material to be dried is here shown as a web of cloth 34 fed to the chains 26 over rollers 35 and withdrawn therefrom over rollers 36. The chains are driven in the direction indicated by the arrows 37 in Fig. 3 so that the cloth enters the chamber at the upper compartment through the opening 30 and leaves the chamber from the lowest compartment through the opening 31. The openings 30 and 31 are suitably formed so as to reduce to a minimum the entry of outside air and the escape of the drying air from the chamber. (See for example our copending application mentioned above.)

The drying air, brought by the mechanism 40 to a desired temperature and moisture content, is fed to the lowest compartment of the chamber through an inlet pipe 41 and withdrawn from the upper compartment of the chamber through an outlet pipe 42. Suitable means, such as the blowers 43 and 44, set up and maintain the air flow. It will be noted that the treated air flows through the compartments in a direction opposite to that in which the cloth travels, that its temperature is raised by reason of the heat supplied from the pipes 25 and that its moisture content is increased because of the moisture which escapes into the chamber from the cloth being dried therein. Consequently the cloth as it travels through the lowest compartment to the opening 31 is subjected to treated air in its optimum condition for removing the moisture.

The apparatus described thus far is substantially equivalent to that set forth in our copending application previously mentioned. It has been determined however that while this apparatus operates satisfactorily its effectiveness may be increased by recirculating a portion of the drying air, by regulating the speed of travel of the conveyor and by restricting the path of travel of the air so that it remains in contact with the cloth during a greater part of its travel through the chamber.

The recirculation of the air carried on by the mechanism 50 consists in withdrawing air from points in the chamber, heating such air and returning it to the chamber at points below those at which it was withdrawn. Referring to the drawings it will be seen that in the illustrated apparatus the withdrawing and returning operations occur at the rear end of the chamber.

A portion of the air adjacent the passage 24^b is withdrawn through a pipe 51 leading from the side of the casing by a blower 52, passed through a heating element 53 and returned through a pipe 54 entering the passage 24^a at the rear wall of the casing near one side thereof. The air at the passage 24^b has only traveled a small part of its way through the chamber and while its temperature has been somewhat increased by the heat from the pipes 25 it has taken up a very small amount of moisture only because the cloth with which it has come into contact has already, before reaching this point, given up most of the moisture it originally carried.

Mounted on the top of the drying chamber 20 is a hood 55 connected with the interior of the chamber through a screened outlet 56. Air rises into the hood from the passage 24^c and is withdrawn therefrom by a plurality of blowers through pipes 60, 70 and 80. The pipe 60 terminates in a chamber 61 from which a T-shaped pipe 62 leads to blowers 63, 64. The blowers 63, 64, return the withdrawn air to the drying chamber through heaters 65, 66 and pipes 67, 68 respectively, both pipes supplying air to the passage 24^c. The pipe 70 terminates in a chamber 71 connected by a pipe 72 to a blower 73 by which the withdrawn air is returned through a heater 74 and pipe 75 to the passage 24^c. Similarly air is withdrawn through pipe 80, chamber 81 and pipe 82 by blower 83 and returned through heater 84 and pipe 85 to passage 24^c. It will be noted that each of the pipes 54, 65, 66, 75 and 85 enters the drying chamber in the upper part of the various passages so that the air thus introduced travels in the same direction as the main stream of air through the chamber and blends into that stream without undue disturbance.

The treatment of various forms of material varies and conditions often arise which necessitate the introduction into the chamber of air other than the conditioned air supplied by the mechanism 40. This air taken from outside the chamber usually has a lower temperature and a lower dewpoint than the conditioned air. Thus it will increase the effectiveness of the air stream, a particular advantage when the material being dried is heavy and contains a large amount of moisture. This regulation of the air stream is attained by the provision of gates 90 and 91 at the ends of each chamber 61, 71 and 81 respectively.

The gates 90 control the amount of air withdrawn from the drying chamber. The outer end of each of the chambers 61, 71 and 81 is normally open and the gates 91 determine the

amount of air admitted from outside the chamber. By a proper manipulation of these gates the proportion of conditioned and unconditioned air in the air stream can be varied as desired and drying of the material controlled.

Means are provided for the purpose of readily determining the condition in which the material will be discharged from the drying chamber. It has been discovered that the temperature of the air stream adjacent the passage 24^b reflects this condition. Thus if that temperature were below a certain level the material would be discharged in a damp condition and if that temperature were above that level the material when discharged would be dry and have a satisfactory feel. If the temperature were found to be materially above that level the speed of the apparatus would be increased and the output would still be dry and have the proper feel. Similarly if the temperature were below that level the speed of the apparatus would be decreased so that the time of drying would be increased and the output be in the best condition. One convenient way of determining the temperature of the air stream is to mount within the pipe 51 which leads from the passage 24^b a bulb 100 connected through a lead 101 with an indicator 102 mounted upon a control board 103 at the front end of the apparatus. The needle 105, which responds to the bulb, moves over the dial 106 and so long as its tip remains within the sector 107 the drying is proceeding satisfactory. If, however, the movement of the tip of the needle beyond the left (Fig. 2) of the sector indicates that the drying is proceeding too slowly and that the material will be too damp and the speed of the conveyor should be reduced, and its movement beyond the right of the sector indicates that the drying is proceeding too rapidly and the material will be too dry and the speed of the conveyor should be increased. The dial 108 indicates the output in yards per minute and the buttons 109, 110, 111 and 112 permit the starting, stopping, speeding up or retarding, respectively, of the apparatus conveyor. The connections of the dial 108 and the buttons may be of any well known type and have not been set forth on the drawings.

The sprockets 27 are mounted inwardly of the side walls (see Fig. 4) and hence each side of the material in each compartment is spaced from such walls. The air traveling in such spaces will obviously not come into contact with the material and hence having any drying function will be wasted. In order to break up this condition and guide the air into contact with the material a plurality of vertical barriers 115 are mounted at the sides of each compartment. These barriers 115 are each provided with slots 116 through which the chains 26 will travel freely. The areas defined by the barriers 115 permit portions of the air stream to flow around the edges of the material from contact with one face into contact with the other face.

While one embodiment only of this invention has been shown and described it will be understood that we are not limited thereto and that other embodiments may be made without departing from the spirit and scope of this invention as set forth in the following claims.

We claim:

1. In a drying chamber divided by horizontal partitions into a plurality of compartments connected by passages at the ends thereof and including conveying means by which the material to be dried is transported successively through

5 said compartments, means for setting up a stream of air which flows through the compartments successively in a direction opposite to that in which the material flows, and vertical barriers extending transversely of the chamber in the compartments between which the material passes and by which the stream of air is guided into contact with the material.

10 2. In a drying chamber divided by horizontal partitions into a plurality of compartments connected by passages at the ends thereof and including conveying means by which the material to be dried is transported successively through said compartments, means for setting up a stream of air which flows through the compartments successively in a direction opposite to that in which the material flows, and vertical barriers extending transversely of the chamber in the compartments between which the material passes, said barriers defining areas through which the air may flow around the edges of the material from contact with one face thereof into contact with the other face.

25 3. The art of drying material in a chamber divided by horizontal partitions into a plurality of compartments connected by passages at the ends thereof and including conveying means by which the material to be dried is transported successively through said compartments, which comprises setting up a stream of conditioned air which flows substantially undiminished through the compartments successively in a direction opposite to that in which the material travels, withdrawing a portion of the air stream from the chamber, mixing fresh air therewith, heating said mixture, and returning said mixed and heated air to the chamber where it blends with the air stream.

40 4. The art of drying material in a chamber divided by horizontal partitions into a plurality of compartments connected by passages at the ends thereof and including conveying means by which the material to be dried is transported successively through said compartments, which comprises setting up a stream of conditioned air which flows substantially undiminished through the compartments successively in a direction opposite to that in which the material travels, withdrawing a portion of the air stream from the chamber, mixing fresh air therewith, heating said mixture, and returning said mixed and heated air to the chamber where it blends with the air stream at a point in the chamber through which the air stream had flowed before the portion had been withdrawn.

5 5. The art of drying material in a chamber divided by horizontal partitions into a plurality of compartments connected by passages at the ends thereof and including conveying means by which the material to be dried is transported successively through said compartments, which comprises setting up a stream of conditioned air which flows substantially undiminished through the compartments successively in a direction opposite to that in which the material travels, withdrawing a portion of the air stream from the chamber as it flows through one of the passages in the chamber, mixing fresh air therewith, heating said mixture and returning said mixed and heated air to the chamber where it blends with the air stream, the returned air entering a passage in the chamber through which the air stream had flowed before the portion had been withdrawn.

10 6. The art of drying material in a chamber divided by partitions into a plurality of compartments connected by passages at the ends thereof and provided with conveying means by which the material to be dried is transported successively through said compartments, which comprises setting up a stream of unsaturated conditioned air which flows substantially undiminished through the compartment successively in a direction opposite to that in which the material travels, ascertaining the temperature of the air forming such air stream as it flows through the chamber to determine the condition with respect to humidity which the material then in progress will possess when discharged and regulating the rate of travel of such material accordingly.

15 7. The art of drying material in a chamber divided by partitions into a plurality of compartments connected by passages at the ends thereof and provided with conveying means by which the material to be dried is transported successively through said compartments, which comprises setting up a stream of unsaturated conditioned air which flows substantially undiminished through the compartment successively in a direction opposite to that in which the material travels, withdrawing a portion of such air stream from the chamber, ascertaining the temperature of the withdrawn portion to determine the condition with respect to humidity which the material then in progress will possess when discharged and regulating the rate of travel of such material accordingly.

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