Dec. 5, 1950 R. A. HAYWARD 2,532,910

APPARATUS FOR DRYING PAPER, PAPERBOARD, PULP, AND THE LIKE

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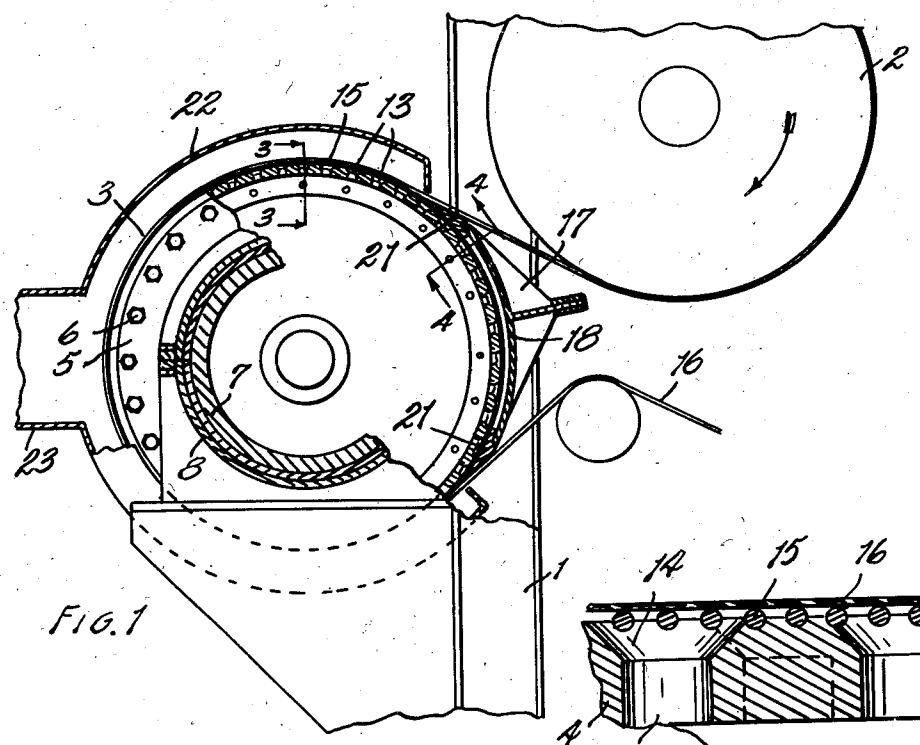

FIG. 1

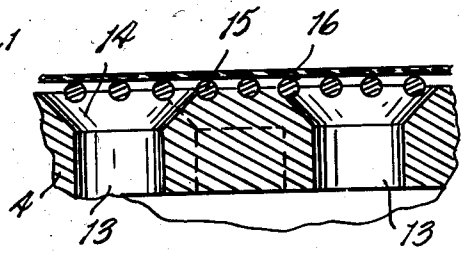

FIG. 3

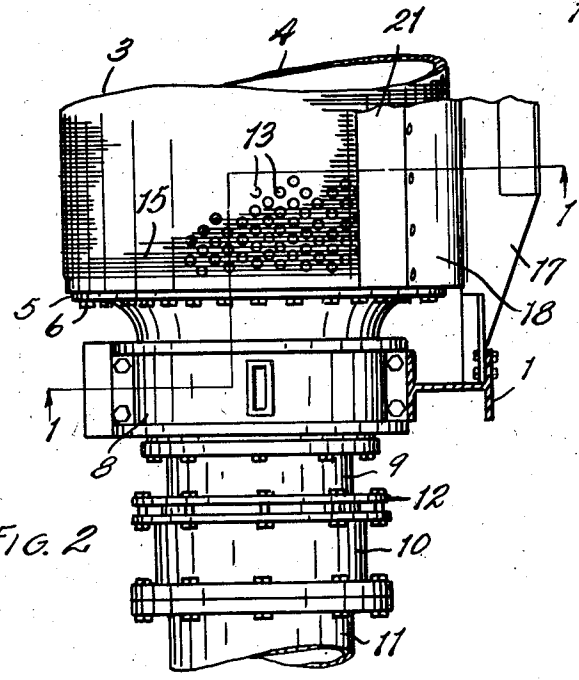

FIG. 2

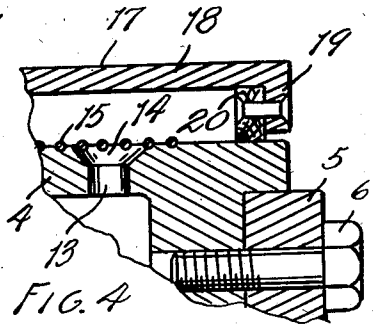

FIG. 4

INVENTOR.
Ralph A. Hayward
BY
Otto A. Earl
Attorney

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APPARATUS FOR DRYING PAPER, PAPERBOARD, PULP, AND THE LIKE

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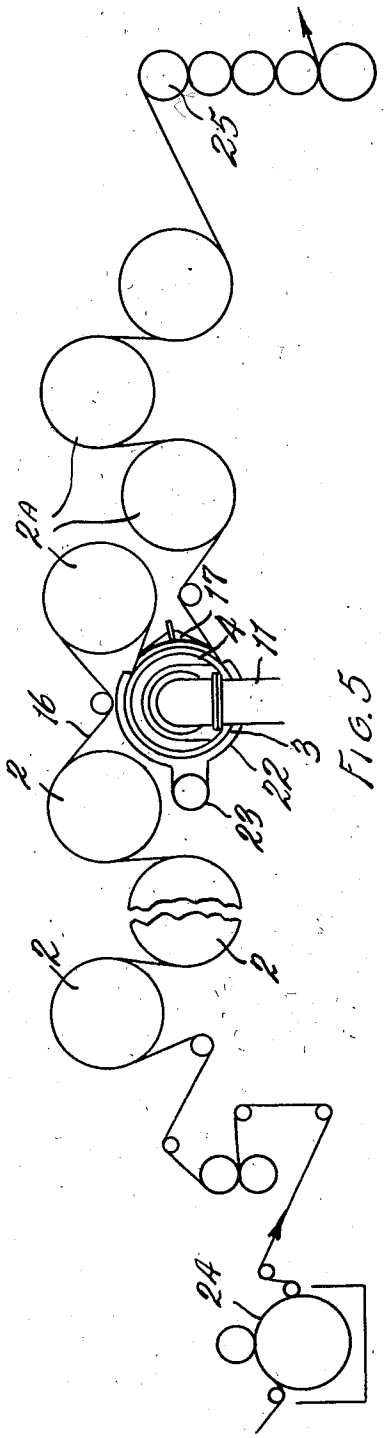

FIG. 5

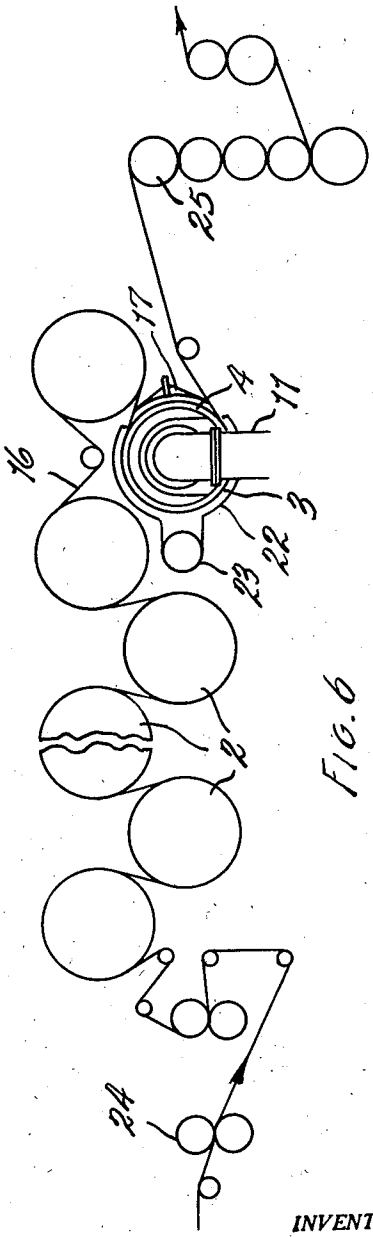

FIG. 6

INVENTOR.
Ralph A. Hayward
BY
Otto A. Earl
Attorney.

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APPARATUS FOR DRYING PAPER, PAPERBOARD, PULP, AND THE LIKE

Ralph A. Hayward, Parchment, Mich., assignor to Kalamazoo Vegetable Parchment Company, Parchment, Mich.

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5 Claims. (Cl. 34—68)

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This invention relates to improvements in apparatus for drying paper, paperboard, pulp and the like.

The principal objects of this invention are:

First, to provide apparatus for drying paper pulp, paperboard or other paper stock which will effectively dry a web of the material and which apparatus will be less expensive to manufacture and operate than existing paper drying apparatus.

Second, to provide apparatus for drying paper pulp and the like which greatly reduces the amount of space required and also the equipment necessary to complete the drying operation.

Third, to provide a novel drying roll for a paper drying machine which may be installed in existing paper making machinery to materially increase the speed of operation and output of the machinery.

Fourth, to provide a method of drying paper pulp, paperboard or other paper stock which is faster than presently used methods of drying similar materials.

Fifth, to provide a method for drying paper stock of various types which materially increases the drying area of the paper while at the same time materially reduces the amount of mechanical apparatus for handling the stock.

Other objects and advantages pertaining to the details and economies of my invention will be apparent from a consideration of the following description and claims.

The drawings, of which there are two sheets, illustrate a preferred form of my drying apparatus and two examples of the application of my apparatus and method to a paper drying machine.

Fig. 1 is a fragmetary end elevational view, partially broken away in cross section along the line 1—1 in Fig. 2, of my paper drying apparatus as installed on a conventional paper drying machine.

Fig. 2 is a fragmentary plan view of one end of the apparatus shown in Fig. 1, portions of the supporting framework being broken away in horizontal cross section.

Fig. 3 is a fragmentary cross sectional view along the line 3—3 in Fig. 1 and illustrating the web of paper in operative position on my drying apparatus.

Fig. 4 is a fragmentary cross sectional view along the line 4—4 in Fig. 1 and illustrating certain details of the construction of the baffle structure employed therein.

Fig. 5 illustrates conventionally the application of my drying apparatus and method to a machine for drying paperboard and the like.

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Fig. 6 illustrates conventionally the method of employing my apparatus and method in a machine for drying pulp stock.

At the present time it is the practice in the manufacture of paper stock of various weights and quality, ranging from pulp stock to paperboard and thin finished paper, to form a web of the stock by well-known manufacturing processes which web is extremely wet and weak due to its moisture content. The web is then passed over a series of a large number of heated rolls for driving off the moisture in the web to strengthen and fix the stock. The drying operation is effected by evaporation from the surfaces of the web, the rolls acting merely to heat, flex and support the web during the evaporation process. As a result, paper drying machines have been provided with a large number of rolls and operated at relatively slow speeds to allow time for the necessary evaporation.

It is my invention to materially reduce the number of drying rolls necessary to effectively dry the paper stock and to increase the speed at which the web and rolls may be operated. I do this by first passing the newly formed web of stock in its wet condition over a series of heated rolls in the same manner as has previously been done but to raise the temperature of the moisture in the web to 212° F. or above, as soon as possible. I then pass the web over a device for applying a vacuum to one side of the web to draw a quantity of air through the web to displace the moisture therein. While previous machines have encouraged the circulation of air around the drying rolls, I can eliminate this feature in my initial rolls as the principal object of the initial rolls is to raise the temperature of the web as rapidly as possible and vaporize the moisture in the web. I also prefer to provide a source of heated air to be drawn through the web so that there is no condensation of the moisture in the web as the air is drawn therethrough by the vacuum.

Different types and grades of paper stock will of course require slightly different methods of treatment depending upon the properties desired in the finished product. Thus, in drying paper pulp where the main object is to remove as much moisture as possible for shipment of the pulp, the web of pulp stock may be collected immediately upon leaving my vacuum drying apparatus. In manufacturing paperboard or finished sheet stock where certain moisture contents are desired

in the stock, it may be desirable to pass the web over a few equalizing and conditioning rolls after leaving my vacuum drying apparatus before collecting the web in its finished form. In any use of my drying method and apparatus, the effect of the apparatus is to increase the effective drying area of the stock millions of times, since the hot air in being drawn through the web of stock passes over each of the individual fibres within the stock as distinguished from passing merely over the surface of the web.

While various methods of applying a vacuum to the paper may be devised, I prefer to employ a roll which may be installed in an existing paper drying machine in place of any one of the existing rolls in that machine. In Figs. 1 to 4 I have illustrated portions of a paper drying machine having a framework 1 and a conventional drying roll 2. My drying roll which replaces one of the conventional rolls is illustrated generally at 3 and consists of a hollow cylindrical roll 4 having hollow end members 5 secured thereto as by the bolts 6. The roll end member 5 is shaped into a hollow journal portion 7 arranged to be supported in a bearing 8 mounted on the framework 1 in the usual fashion. The journal portion is provided with a rotating gland member or inner ring 9 which rotates with the roll and roll end member 5 and fits within an outer ring 10 secured to the fixed vacuum pipe 11. A suitable packing gland and ring is provided at 12. The opposite end member of the roll (not shown) may be provided with a similar vacuum connection or may be closed so that all of the air is drawn through one end of the roll 4. The pipe 11 is connected to any suitable vacuum pump or fan (not shown).

The body of the roll 4 defines a series of radially extending holes 13 preferably countersunk as at 14 at their outer ends and the surface of the roll is spirally grooved to receive one-half the thickness of a spirally wound wire wrapper 15. The adjacent turns of the wrapper wire 15 are spaced close enough together to effectively support the web of paper stock indicated at 16, but at the same time provide passages opening to the holes 13. Note that the under surface of the web is thus spaced from the surface of the roll between the holes 13 to provide a substantially continuous surface open to the action of the vacuum in the roll.

In order to seal off the holes 13 between the entering and leaving positions of the web 16, I provide a baffle, generally indicated at 17, consisting of a curved baffle plate 18 which is spaced radially from the surface of the roll and provided with inwardly turned flanges 19 along each end thereof (see Fig. 4). The flanges 19 support curved, wood sealing blocks 20 which slidingly engage the ends of the roll 4 to seal the ends of the baffle to the roll. The leading and trailing edges of the baffle plate 18 are sealed to the surface of the roll by tapered doctor blades 21 which also serve to guide the web 16 onto and away from the vacuum roll.

In order to provide the supply of heated air to the outer surface of the web as it passes around the vacuum roll, I provide a hood 22 extending substantially around the vacuum roll between the doctor blades 21 and completely along the length of the vacuum roll. The hood 22 is spaced radially from the web to provide an air chamber and a conduit 23 is connected to the hood through which hot air may be supplied from any suitable source.

In Fig. 5 I have illustrated an installation of of my vacuum roll in a conventional drying machine for drying paper and paperboard in which the moisture content of the finished product is to be accurately controlled. The conventional heating rolls are indicated at 2 and my vacuum roll is indicated at 3. The pipe for applying a vacuum to the roll is shown at 11 and the conduit for supplying hot air to the roll is shown at 23. In this arrangement of my vacuum roll the web 16 is passed from the paper making machine 24 over a sufficient number of initial heating rolls 2 to raise the temperature of the web and the moisture therein to 212° F. or above, and the web is then passed around my vacuum roll as previously described. From my vacuum roll the web is passed around a heating roll 2A to equalize the remaining moisture content of the web and is then passed through a set of calendering or pressing rolls 25 where calendering is desired.

Fig. 6 illustrates an application of my vacuum roll 3 to a paper drying machine for producing pulp stock. In this arrangement the web 16 is passed around a suitable number of initial heating rolls 2 as in Fig. 5 and then around the vacuum roll 3. After leaving the vacuum roll 3 the pulp stock may be passed through pressure rolls if desired.

It should be understood that my method and apparatus has varying applications depending upon the weight and grade of the paper stock or paper pulp being produced and the desired final properties of the product produced. The examples I have illustrated are intended to illustrate the principles of operation of my method and apparatus and are not intended to define the limits of their application.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A drying roll adapted to be mounted in a paper drying machine comprising a hollow cylindrical roll member defining a plurality of radially extending apertures opening to the outer surface thereof, and counter-sunk at their outer ends, the outer surface of said roll member being spirally grooved, a wrapper wire wound in said spiral groove and projecting thereabove by one-half the thickness of said wire, the pitch of said spiral groove and wire being slightly greater than the diameter of the wire whereby several successive turns of the wire bridge each of the countersunk ends of said apertures in transversely spaced relationship, a hollow roll end member secured to one end of said roll member and forming a hollow journal adapted to be supported in said machine, a rotating gland member secured to the end of said juornal, and a vacuum pipe communicating with said hollow journal and having a fixed gland cooperating with said rotating gland member.

2. A drying roll adapted to be mounted in a paper drying machine comprising a hollow cylindrical roll member defining a plurality of radially extending apertures opening to the outer surface thereof, the outer surface of said roll member being spirally grooved, and a wrapper wire wound in said spiral groove and projecting thereabove, the pitch of said spiral groove and wire being slightly greater than the diameter of the wire whereby several successive turns of the wire bridge the ends of each of said apertures in transversely spaced relationship.

3. A machine for drying paper stock compris-

ing, means for translating a web of the stock, a preliminary heating element positioned to have said web passed in heat transfer relationship therewith and adapted to raise the temperature of said web and the moisture therein to the boiling temperature of the moisture, walls forming a vacuum chamber, one of said walls being perforated and positioned to have said web translated thereacross while at said boiling temperature, a series of supporting elements disposed in closely and transversely spaced relation along said perforated wall and projecting slightly therefrom and bridging the perforations therein to have line contact with and support said web in closely spaced relation to said perforated wall, means for maintaining a vacuum in said chamber, a hood forming an air chamber and located on the opposite side of said web from said perforated wall, means for supplying heated air to said air chamber, and a second heating element positioned to have said web passed in heat transfer relationship therewith after passing said vacuum chamber.

4. In a web drying apparatus the combination of means for translating a web to be dried, heating means for raising the temperature of the moisture content of the web to the vaporization point while the web is in motion, a rotatable suction head positioned at the rear of said heating means, said head being provided with a plurality of suction orifices having enlargements at the peripheral surface of the head, the head being provided with peripheral encircling web supporting ribs certain of which extend across the orifices and constitute means for supporting the web to provide circulation passages between the ribs opening to the orifices, and means for supporting and guiding the web around a substantial peripheral segment of said head.

5. In a web drying apparatus the combination of means for translating a web to be dried, means for raising the temperature of the moisture content of the web to the vaporization point while the web is being translated and a suction head positioned at the rear of said heating means, said head being provided with a plurality of orifices having enlargements at the surface of the head, the head being further provided with web supporting ribs certain of which extend across the orifices and constituting means for supporting the web to provide circulation passages between the ribs opening to the orifices.

RALPH A. HAYWARD.

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