

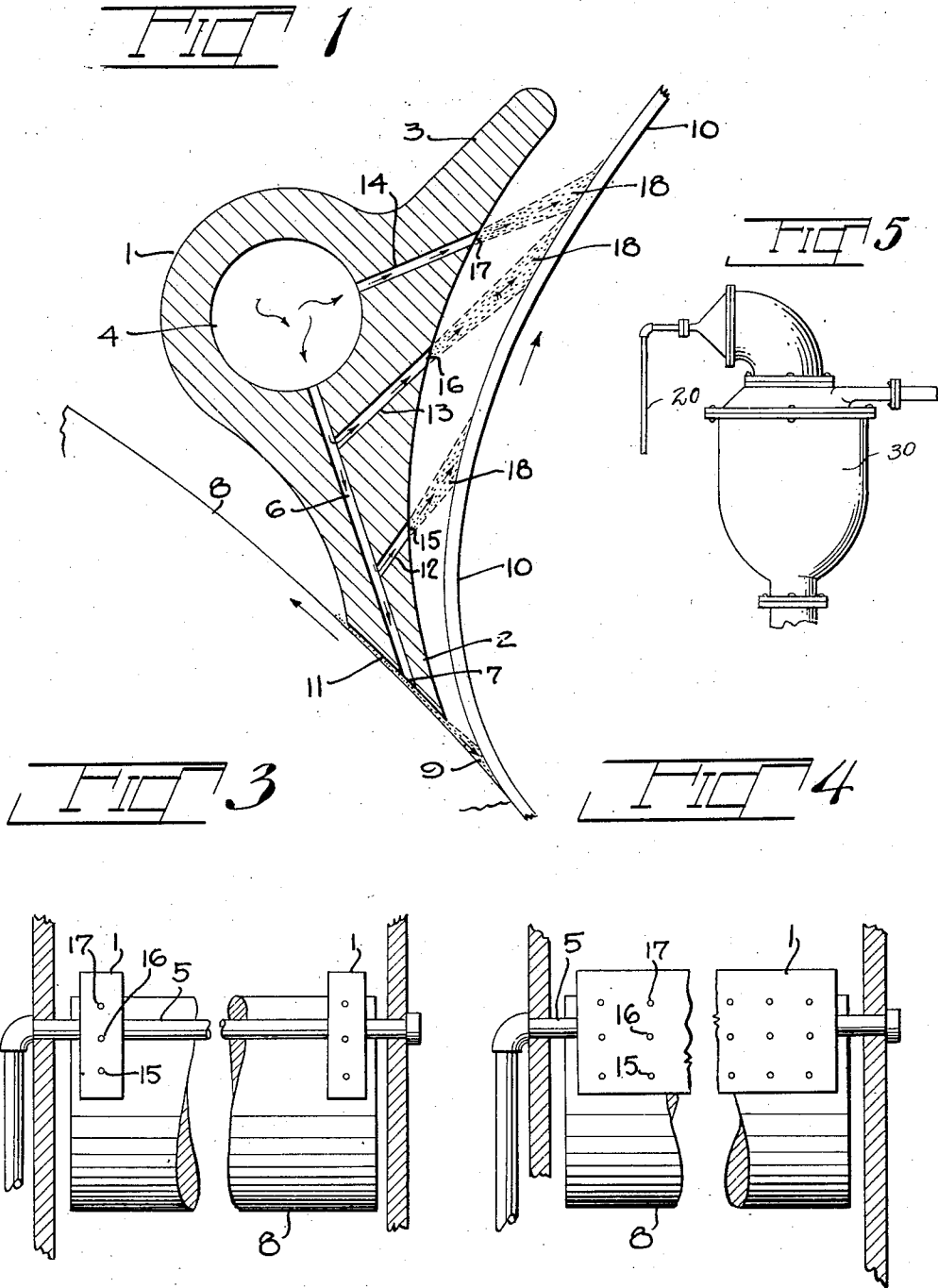
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METHOD OF STRIPPING AND FEEDING PAPER AND APPARATUS

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METHOD OF STRIPPING AND FEEDING PAPER AND APPARATUS.

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My invention relates to a method of removing or stripping sheet material from a rotating surface. Also to the method of feeding said material into the path of another rotating surface over which the material is to travel. My invention further relates to the apparatus to carry out this method.

My invention more particularly relates to removing or stripping a wet web of paper, or similar material, from a drying drum or cylinder by means of fluid pressure. Also to directing the end of the web, which has been stripped, into the path of the next dryer without the web coming in contact with any fixed surface.

My invention further relates to a fluid doctor which is provided with means to direct a fluid under pressure in the form of a jet, to remove the web from the rotating drying drum or cylinder, without the web coming in contact with the doctor, or the doctor in contact with the drying drum or cylinder.

My invention further relates to the combination of such a fluid doctor and a vacuum apparatus in which the doctor and the heated drying drums or cylinders are mounted. In such a combination an easily condensable fluid, as steam, is used to form the jet for stripping the web from the drying drum or cylinder, and also from one or more endless felts if desired.

My invention further relates to the fluid doctor as a new article of manufacture, which is preferably, though not necessarily, used with a vacuum apparatus. When used with exposed drying drums or cylinders, another fluid will be used such as heated air, as steam with exposed dryers would render the atmosphere in the drying room unbearable.

My invention further relates to certain steps, and combinations of steps, also to certain elements and combinations of elements, whereby the method or processes herein described may be carried out, as well as to certain details of construction, all of which will be more fully hereinafter described in the specification and pointed out in the claims.

I have shown in the drawings, different forms of apparatus which may be used to carry out my improved method, but it is to be distinctly understood that my invention

is not to be confined to the particular form of apparatus, shown by way of illustration.

In the accompanying drawings the same reference numerals refer to similar parts in the several figures.

Fig. 1 is a vertical section on an enlarged scale of my improved doctor shown in connection with a rotating drying drum or cylinder and web;

Fig. 2 is a vertical section through a vacuum apparatus showing three heated drying drums or cylinders, a web and an endless felt with which my doctor is adapted to co-operate;

Fig. 3 is a fragmentary detail showing one form of my doctor which does not extend entirely across the drums or cylinders;

Fig. 4 is a view similar to Fig. 3, but showing the doctor extending substantially entirely across the drying drum or cylinder.

Fig. 5 is a diagrammatic view, on a smaller scale, of a barometric condenser to condense the steam coming from the vacuum chamber.

I will describe my invention as applied to drying a wet web of paper as it comes from the wet end of a paper machine. It is to be understood, however, that my invention is adapted to drying webs of woven fabrics or other material coming from bleaching or dyeing vats or otherwise treated by a liquid of some description.

In the commercial practice of drying a web of paper coming from the wet end of a paper machine, usually at high speed, the web is passed around a great number of steam heated drying drums or cylinders mounted in a drying room and opened to the atmosphere. Frequently these drying drums or cylinders will be as many as forty (40) to one hundred (100). To insure the web passing from one drying drum or cylinder to the next one of the series, so as to be progressively dried in the atmosphere, it is customary to have scrapers which rest upon the drums or dryers and which scrape off the web from the drying drums or cylinders by contacting with them. These scrapers are known in the art as "doctors". Resting upon the drying drum or cylinder they rapidly wear out and need replacement; besides they wear more or less the surface of the drying drum or cylinder and have a tendency to form an uneven surface on the cylinders. In addition to these seri-

ous objections the doctors cause the material, as for example, paper, to wrinkle or crinkle which is also a serious matter in the manufacture of paper. These doctors direct the web of paper by the web contacting with them, so that the web will be brought into the bite of the next drying drum or cylinder. I am aware that it has been proposed to use with an ordinary form of scraping doctor resting upon the drum or cylinder, a jet of air, or in some cases two jets of air, to direct the web to the next succeeding drying drum or cylinder after it has been scraped from the drum or cylinder by the scraping doctor.

By my invention my doctor 1, Fig. 1, has a toe 2 and a heel 3. The center portion of the doctor is hollow at 4 to fit the pipe 5. From the hollow portion 4 to the toe 2 I provide a passage 6 which ends in a port 7 near the very end of the toe. In operation the drying drum or cylinder 8 is rotated under the toe 2 in the direction of the arrow, Fig. 1. Fluid under pressure is fed through the pipe 5 and into the passage 6. This fluid will escape at the port 7 in the form of a jet 9, which will strip the web 10 from the drying drum or cylinder 8 and cause it to move in the direction of the arrow and into the path of the next succeeding drying drum or cylinder. A portion of the fluid under pressure will back up and form a cushion 11 between the toe 2 and the drying drum or cylinder 8; so that in operation the doctor 1 will not contact with the drying drum or cylinder, but will be separated from it by a thin film or cushion of fluid.

Preferably, though not necessarily, I provide my doctor with one or more other passages 12, 13 and 14, ending in ports 15, 16 and 17, so that each one of these ports will form jets 18, 18, which will impinge upon the web 10, keep it from contacting with the doctor 1 and direct it generally in the direction of the next succeeding drying drum or cylinder.

My doctor may extend substantially across the width of the drying drum or cylinder 8 as shown in Fig. 4, or it may be made of less width than the cylinder 8, in which case I preferably use two such doctors as shown in Fig. 3. In this latter form the doctor will feed through a ribbon in threading, or rethreading the dryers, whereas in the preferred form shown in Fig. 4, the entire width of the web may be threaded through the machine at once without first threading a ribbon as is the common practice.

So far as I am aware no doctors or scrapers have ever been used to successfully strip a web of paper from endless felts. A doctor which rested upon the felt would not only wear out the felt but the moment that the toe of the doctor came into en-

gagement with the joint connecting the two ends of the felt, the doctor would cut and ruin the felt. These felts are comparatively expensive and under the most favorable conditions their life is comparatively short.

By my invention I can use my doctor with an endless felt and strip the web of paper from the felt by means of the jet of fluid issuing from the toe of my doctor, the doctor not contacting with the felt.

My invention, so far described, is adapted for universal application on any drying drums or cylinders and with any endless felts, including such drying drums and felts as are now in use on dryers open to the atmosphere. On such open dryers I would use air, or preferably heated air, as the operating fluid to pass through my doctor to form the jets 9 and 18. It will not be feasible for example to use steam as the escaping steam from these jets would render the atmosphere of the drying room unbearable. When heated air is used, the air serves also to assist in drying the web 10.

My invention is also adapted for drying a web of paper, or similar material, in a vacuum drying apparatus.

I have shown such a structure in Fig. 2 in which 19 is a portion of the vacuum chamber. The pipe 20 is connected to any suitable form of vacuum apparatus.

Within the vacuum chamber 19 are mounted the drying drums or cylinders 21, 22 and 23 over which the web 10 is fed. To assist the web passing through the vacuum chamber I preferably employ two endless felts 24 and 25, respectively. The lower felt 25 passes, with the web 10, around the drying drum or cylinder 21, thence over the guide roller 26 and over the drum or drying cylinder 23. The upper felt 25 passes over the guide roller 27, then over the drying drum or cylinder 22 and around the guide roller 28.

To insure the web 1 taking its proper course through the vacuum chamber and over the drying drum or cylinders, I use my doctors 1 to strip the web from the drying drums and also, though not necessarily, from the endless felts.

When my doctors are used in a vacuum apparatus where I preferably employ them, the fluid to form the jets 9 and 18 must be of some medium which will not injuriously affect the vacuum in the chamber 19. One such medium, which I preferably employ is steam. Whatever fluid is used it must be one which is easily condensable. The steam serves to heat up the vacuum chamber 19 and is readily condensed after passing out through the pipe 20 by any suitable condenser 30. By using steam in my doctors mounted in the vacuum chamber 19, the steam assists in drying the web. Should the web break in the machine, this steam

will cause the end of the broken web to instantly dry and become firm so that it can be threaded through the machine. This firm dry end can be more easily threaded through the machine than can a limp wet end of the web.

The first doctor 1 will strip the web 10 from the endless felt 24. The second doctor will strip the web 10 from the drying drum or cylinder 22 and the third doctor will strip the web from the felt 25.

The ordinary steam pressure in exposed drying drums or cylinders is 5.3 lbs. gage pressure, and has a temperature of about 228° F. Preferably I maintain a 28 inch vacuum in the vacuum chamber 19. At this temperature the water in the web 10 will boil at 100° F. It will therefore be seen that there is a temperature difference of 128° F. which will immediately dry the end of the paper and make it strong and easy to thread through the machine.

When the steam of about 5.3 lbs. gage pressure is fed through the doctor 1 into a vacuum of about 28 inches in the vacuum chamber 19, the steam will have the force of the steam pressure in the pipe 5, namely 5.3 lbs., plus the pressure due to the vacuum of 28 inches, or about 14 lbs. additional, making roughly a total pressure of approximately 19.3 lbs. It will therefore be seen that not only will the jets 9 and 18 issuing from the steam doctor have a difference of 128° F. over the boiling point of the water in the web 10, but these jets will also have approximately 19.3 lbs. pressure.

My steam doctor, therefore not only strips the web 10 from the drying cylinder, but also dries it so as to make it easier to thread through the machine.

My doctor can be used to strip the web from one or both of the felts 24, 25 for the doctor never touches the felt and consequently will not engage with the joint in the felt where the two ends are connected together.

The steam for the doctors may be turned on only when the machine is originally threaded, or when it is desired to rethread it after it breaks or "broke", or I may leave the steam turned on slightly all the time, so that in case the web does break from any unforeseen reason, as it will do at times, my steam doctors will automatically feed the web through the machine without any delay, or the machine becoming foul.

It will be noted that the escape of steam from my steam doctors does not heat up the temperature of the drying room, but on the contrary passes off through the pipe 20 and is condensed by a barometric, or eductor type or other condenser 30 with practically no expense, as such condensers operate through an abundance of cold water which is always to be found adjacent to a paper

mill for such mills are usually mounted on the banks of a stream.

My method as applied to drying a web in a vacuum chamber possesses many advantages not present in processes heretofore used for many years in the drying of paper.

The evaporation process, which is characteristic of the so-called loft drying of paper, has many fully recognized disadvantages; and yet it is used today and has been in use for many years. In this method the wet paper is taken from the paper machine, cut into sheets, hung on poles, carried to the drying room where it is subjected to hot air at about 130° F. for about 48 hours, and when dry, each sheet is separately calendered. Although possessing the advantage of drying at a comparatively low temperature, whereby the moisture is slowly evaporated, loft drying is obviously very inefficient and costly, because it requires many separate manipulations, is extremely slow, uses extensive floor space and wastes heat.

The process which is employed in the ordinary paper machine in common use, is likewise subject to many disadvantages. In such machine, the wet paper as it comes from the paper machine, is passed over many revolving cylinders, heated internally by steam to sufficiently high degree of heat, to raise the temperature of the water in the paper to 212° F., the atmospheric boiling point of water. It is customary to supply the drying cylinders with steam at approximately 5.3 pounds gauge pressure, at which the steam has a temperature of 228° F., giving a difference of temperature (228°—212°) of only 16° F. With this slight difference of temperature the transfer of heat is extremely slow, and hence it is necessary to employ many drying cylinders, in board machines often one hundred, and in news print machines, forty or more.

Also due to convection and conduction losses, as well as those incident to leaks in the piping system and other inefficiencies, the heat actually required for atmospheric drying of a ton of wet paper, is very much in excess of the theoretical requirement. The thermal efficiency of atmospheric drying by steam heated cylinders is therefore very low. Furthermore, the steam produced from boiling the water out of the paper, is driven off into the operating room, and although fans and exhausters are employed, at large expense for power and maintenance, the room atmosphere is so constantly saturated with moisture as to rust and ultimately destroy all iron and steel materials, and produces an exceedingly disagreeable and unhealthy atmosphere in which to work. It is well known that the minimum temperature 212°, the atmospheric boiling point of water, is positively injurious to, and results in oxidizing, the fibres of the paper,

the strength of which is vastly improved when the paper is dried at lower temperatures, as in loft drying. This atmospheric drying process requires large initial cost for cylinders, felts, and other necessary equipment, and extensive floor space, and results in the consumption of large amounts of power, and great cost for operation, maintenance and repairs.

In my improved vacuum drying method I contemplate maintaining within the chamber a vacuum of about 28" of mercury, in which water boils at 100° F., and supplying the drying cylinders with steam at 5.3 pounds gauge pressure, producing a temperature of 228° F. The temperature difference between the temperature of the steam in the cylinders and that of the paper, is therefore, 128° F. in my vacuum method, or 8 times greater ($16^{\circ} \text{ F.} \times 8 = 128^{\circ} \text{ F.}$) than the temperature difference in atmospheric drying. In my improved method the paper dries approximately 8 times faster than in atmospheric drying, and I require only about one-eighth the number of drying cylinders to dry paper at the same rate of speed. I am able to dry paper with 5 cylinders in the same time required of 40 cylinders drying at atmospheric pressure, resulting in great economies in cost of the machine, floor space and of necessary piping, felts, auxiliary equipment, and particularly in power and maintenance charges.

The thermal efficiency of my vacuum method is very much greater than that of the atmospheric cylinder drying heretofore in universal use for drying paper. Theoretically, it requires about 5287 pounds of steam to dry one ton of paper at atmospheric pressure, but to compensate for convection and conduction losses, and those due to leaks in the piping system, and other inefficiencies, it has been shown in practice that about 10,600 pounds are required.

In my method using a vacuum of about 28", the convection, conduction and piping losses are exceedingly small and the total steam required to dry a ton of paper by my method is approximately 5200 pounds.

It is an established fact that paper dried at low temperatures is much stronger than when it is dried at the high temperatures used in paper machine atmospheric drying. Paper dried in a vacuum of 28", or at a temperature of about 100° F., as in my method, is very much stronger than paper dried at atmospheric pressure, when the steam in the driers is at 228° F. When paper is dried by my method, therefore, a cheaper furnish or stock can be used and still produce a paper equal in strength to atmospheric dried paper, in which a higher grade furnish or stock is used. In making newsprint paper, I am able to dispense with a considerable portion of the more expen-

sive sulphite pulp, as this can be replaced with the cheaper ground wood pulp. By my method I also reduce the number of breaks in the web as it passes over the cylinder.

Some of the modern open air dryers are equipped with a blower system by which air, either heated or not, is blown through the dryer section, which will lower the temperature at which the water is evaporated from the paper much below 212° F. and may, in some cases, reduce the temperature of evaporation as low as 180° F. or lower.

Furthermore, in my method there is a great saving of heat or steam because the process is carried on in a vacuum chamber which acts on the principle of a thermos bottle, and the steam and vapors driven out of the wet paper are caught in the closed vacuum chamber, and conducted away to the condenser. The operating room is free from steam, humidity and heat, and fans, and exhausters are dispensed with. In the use of my method the apparatus is at all times operating under definite humidity, the control of the drying can be closely standardized, and the moisture content in the paper carefully regulated.

The vacuum apparatus, and the method of feeding a web into and out of the vacuum chamber 19 is more particularly described and claimed in my companion application, case J, filed herewith, Ser. No. 384,212 filed May 25, 1920.

Having thus described this invention in connection with illustrative embodiments thereof, to the details of which I do not desire to be limited, what is claimed as new and what is desired to secure by Letters Patent is set forth in the appended claims.

What I claim is:—

1. The method of drying a web of paper or similar material in a vacuum consisting in passing the web over drying drums or cylinders and in stripping the web from the drying drum or cylinder by means of a readily condensable fluid and condensing said fluid.

2. The method of drying a web of paper or similar material in a vacuum consisting in passing the web over drying drums or cylinders and in stripping the web from the endless felts by means of a readily condensable fluid and condensing said fluid.

3. The method of stripping a web of paper or similar material from drying drums or cylinders mounted in a vacuum chamber consisting of introducing a jet of a heated and readily condensable fluid between the web and the drum or cylinder.

4. The method of drying a web of paper or similar material in a vacuum consisting in passing the web over drying drums or cylinders and in stripping the web from the drying drum or cylinder by means of a steam jet and condensing said fluid.

5. The method of drying a web of paper or similar material in a vacuum consisting in passing the web over drying drums or cylinders in contact with endless felts and in stripping the web from the endless felts by means of a steam jet and condensing said fluid.

6. A new article of manufacture comprising a doctor for paper or similar dryers, said doctor having a toe and a passage in the doctor to the toe to permit fluid under pressure escaping from the toe in the form of a jet to strip the web from the dryers or felts without the doctor touching the said dryers or felts.

7. A new article of manufacture comprising a doctor for paper or similar dryers, said doctor having a toe and a passage in the doctor to the toe to permit fluid under pressure escaping from the toe in the form of a jet to strip the web from the dryers or felts without the doctor touching the said dryers or felts, said doctor being provided with one or more other ports to permit fluid under pressure to direct the web after it has been stripped from the dryer or felt.

8. A new article of manufacture comprising a doctor having a toe and a heel portion both the toe and heel portions being pro-

vided with ports for the passage of fluid under pressure.

9. The combination in a vacuum drying apparatus of a vacuum chamber provided with one or more drying drums or cylinders, one or more doctors mounted in said vacuum chamber adjacent to the drums or cylinders but not touching the same, said doctors being provided with ports for the passage of a condensable fluid under pressure.

10. The combination in a vacuum drying apparatus of a vacuum chamber provided with one or more drying drums or cylinders and endless felts, one or more doctors mounted in said vacuum chamber adjacent to the drums or cylinders and endless felts, but not touching the same, said doctors being provided with ports for the passage of a condensable fluid under pressure.

11. The method of stripping and drying material from drying drums, cylinders or felts consisting in introducing a jet of a heated and condensable fluid between the material and the drums, cylinders or felts, to strip the material from the drums, cylinders or felts, and at the same time causing other jets of heated and condensable fluid to impinge upon the material to direct its travel.

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