

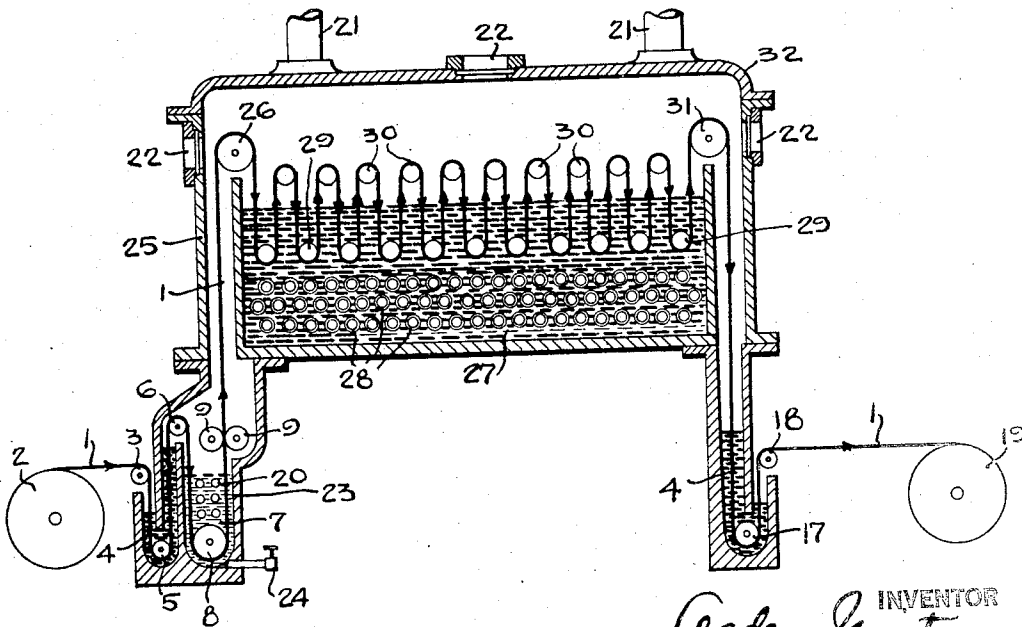
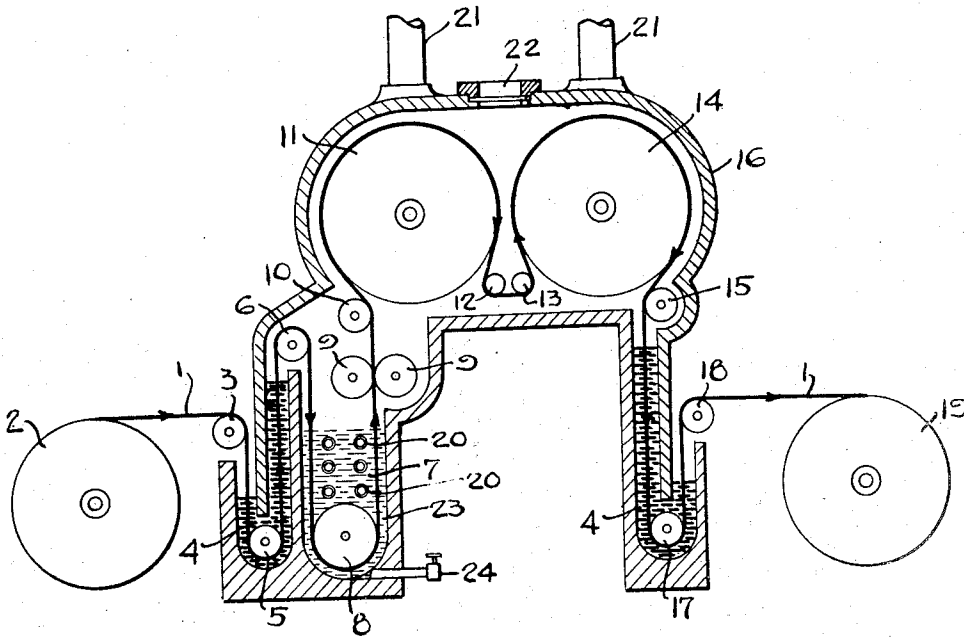
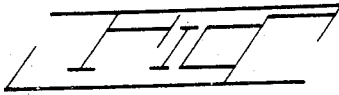
Aug. 10, 1926.

1,595,236

O. MINTON

METHOD OF TREATING MATERIAL IN A VACUUM AND APPARATUS

Original Filed March 4, 1920 3 Sheets-Sheet 1



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METHOD OF TREATING MATERIAL IN A VACUUM AND APPARATUS

Original Filed March 4, 1920 3 Sheets-Sheet 2

FIG 3

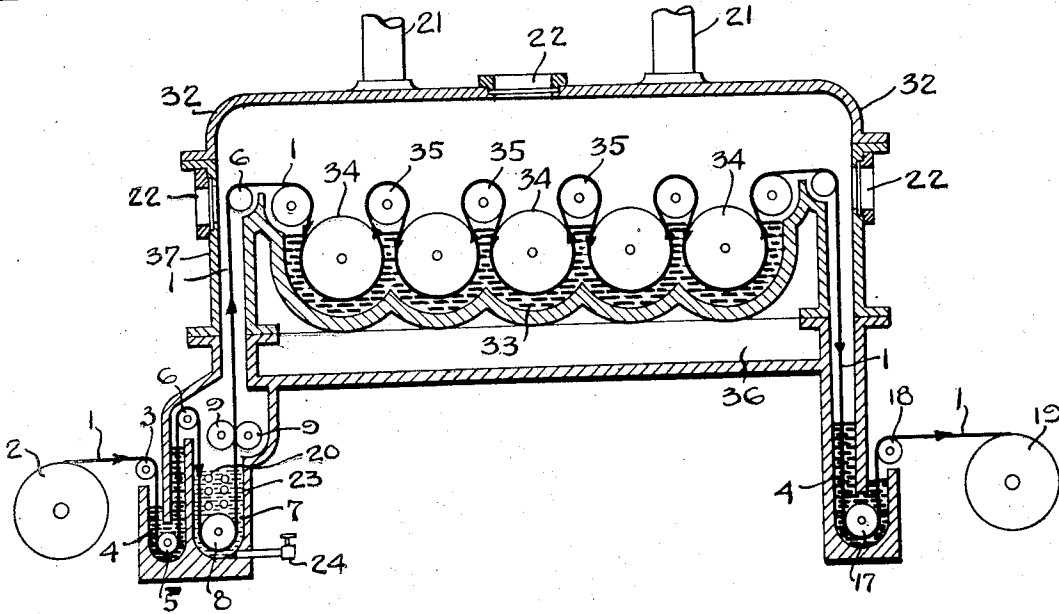
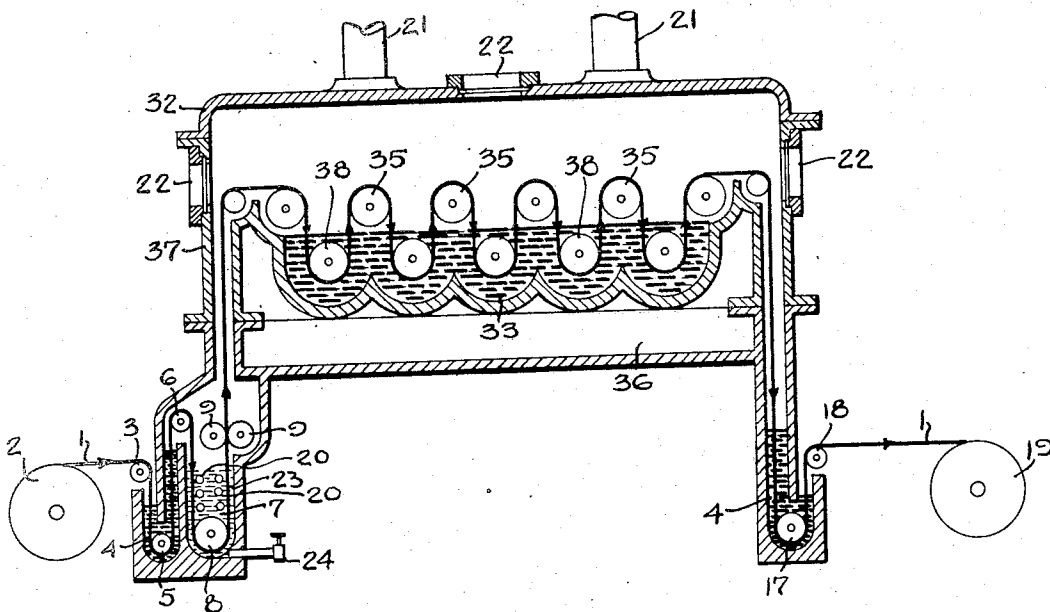


FIG 4



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FIG 5

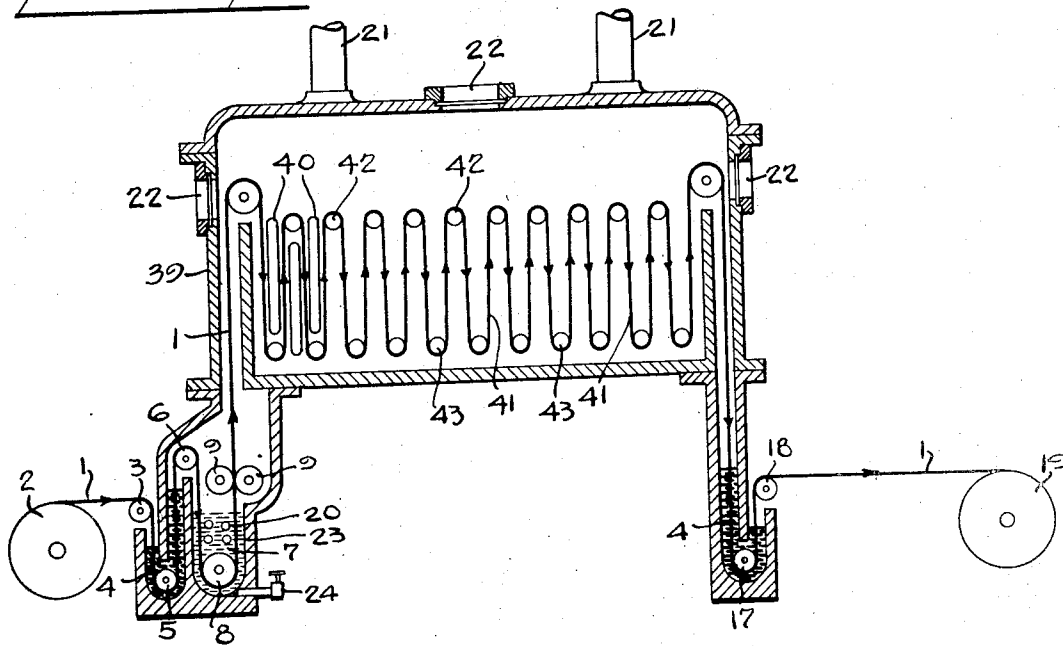
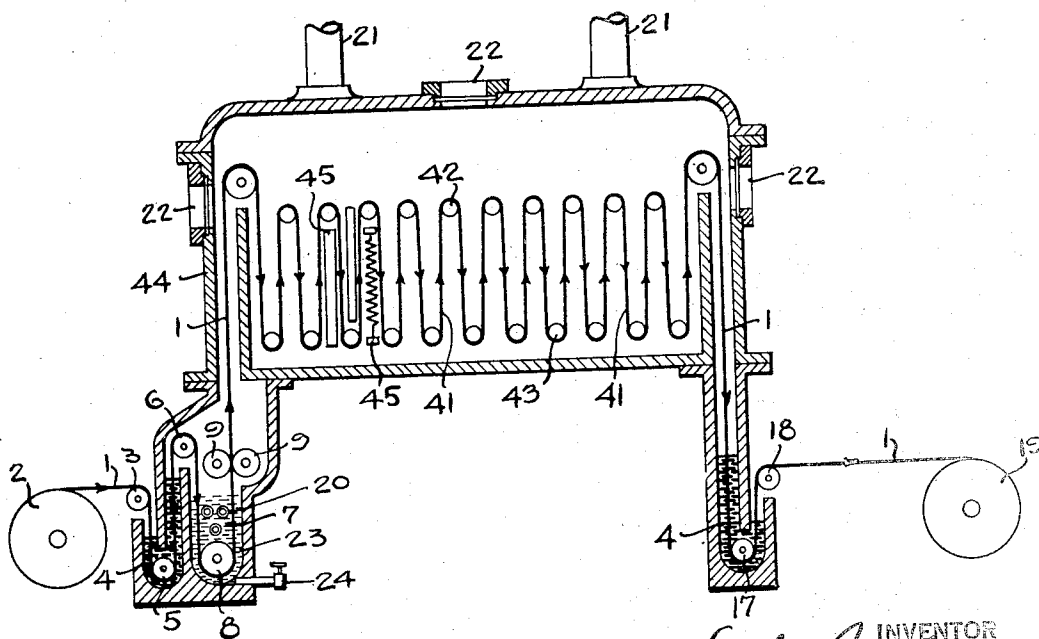


FIG 6



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UNITED STATES PATENT OFFICE.

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METHOD OF TREATING MATERIAL IN A VACUUM AND APPARATUS.

Application filed March 4, 1920, Serial No. 363,349. Renewed February 17, 1926.

The present invention relates to an apparatus and method for coating or coloring, or impregnating paper or other sheet material, in a vacuum chamber, and drying said sheet material in the vacuum chamber before it is again subjected to the atmosphere.

My improved method consists in passing the sheet material which is to be coated, colored, sized or impregnated into a vacuum chamber through a liquid sealing medium which has no affinity for the material, then coating, coloring, sizing or impregnating the paper or other sheet material while in the vacuum chamber, then drying the coated, colored, sized, or impregnated sheet material while still in the vacuum chamber, and then passing the dried material out of the vacuum chamber through a seal.

My invention further relates to the article treated, as a new article of manufacture.

This method may be practiced by the use of various forms of apparatus, some of which are herein disclosed. In any form, however, it is essential that the apparatus be provided with a closed chamber in which a partial vacuum may be maintained. In order that the material to be treated may be continuously passed through the vacuum chamber, the latter is provided with openings closed to the admission of air by a liquid sealing medium which has no affinity for the material. The liquid seal effectively closes the entrance and exit passages against the admission of air to the chamber, but permits the passage of the material into and out of the chamber. The heating elements within the vacuum chamber, for drying the material, the shape, form, dimensions and location of the liquid seal containers, and the means for passing the sheet material through the chamber, may all vary. I have shown herein a number of varieties which I contemplate using.

My invention further relates to obtaining better and more uniform product than any now known on the market. My invention further relates to the method of coating or impregnating sheet material which insures that there will be no blemishes, uneven surfaces, blisters or minute raised portions due to the air which may be held or occluded within the sheet material which, in the present practice of coating as for example with a water-proof compound, leads to rejections or discards due to these imperfections with the consequent waste of material and labor.

My invention further relates to the treatment of paper and coating or impregnating it in a vacuum chamber, without breaking the vacuum, and drying it within said vacuum chamber.

My invention further relates to manufacturing paper wherein the fibers are not weakened and the size in the paper is not injured or damaged due to drying at high temperatures.

My invention further relates to manufacturing colored paper and drying it without substantially impairing the coloring matter and mordants used in the paper. Among other advantages this insures that the paper will have bright colors, which will be substantially uniform in different runs of paper, permitting matching of colored paper without any appreciable difference in color.

My invention further relates to rapidly and expeditiously coating or impregnating sheet material in a continuous web or sheet.

My invention further relates to sizing paper in a vacuum chamber and drying the sized paper in said vacuum chamber at such low temperatures as not to injure the fibers of the paper or the size. My invention further relates to withdrawing the occluded air from the paper and immediately filling the interstices normally filled with the occluded air with the size, and then drying the thoroughly sized paper in the vacuum chamber before it is subjected to atmospheric conditions. My invention further relates to carrying out this method continuously with a continuous web of paper which passes into and out of the vacuum chamber without breaking the vacuum. 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.

The accompanying drawings, which are partly diagrammatic, illustrate several, but not the only, forms of my apparatus, by the use of which my improved method may be practiced.

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

Fig. 1 is a vertical diagrammatic section

through one form of apparatus which may be used to carry out my improved process;

Fig. 2 is a diagrammatic vertical section of a modified form in which the web of sheet material is passed through a heated bath to dry the same;

Fig. 3 is a vertical diagrammatic section of a modified form of apparatus in which a combination of heated drums and a heated bath are used to dry and finish the sheet material;

Fig. 4 is a vertical diagrammatic section of another modification in which different sized drums are used with a heated liquid bath to vary the finish given to the sheet material;

Fig. 5 is a vertical diagrammatic section of still another modification in which the web of sheet material is passed in folds or loops through the vacuum chamber adjacent to but not in contact with fixed heating surfaces; and

Fig. 6 is a vertical diagrammatic section of still another modification in which the web of sheet material is fed through the vacuum chamber, and in its passage through said chamber subjected to convected heat, preferably a glowing member of an electric heater.

In describing my invention I will describe it as applied to sheet material in the form of paper though it is to be distinctly understood that textile fabrics may also be treated by my process and that my claims cover all forms of sheet materials.

In the ordinary drying of a web of paper such high heat is used as to injuriously affect the fibers of the paper; and in case the paper is colored it will materially affect the coloring matter and mordants used. Drying paper in the high temperatures used in ordinary practice often affects the size so that the resulting paper varies in quality, is not uniform and is not a perfect product.

In coating or impregnating fabrics it is found in practice that the coated fabric will frequently have blemishes due to large or small blisters and blow holes, these often being about the size of a pin-head or a pin-point. This is caused by the air which is held or occluded being collected, more or less, in small pockets under the coating or impregnating material, or in some cases causing minute blow holes. In water proof fabrics this results in large quantities of the material being rejected with the consequent loss to the manufacturer.

By my invention I insure that substantially all the occluded air is withdrawn from the sheet material which will permit the coating or impregnating material, whatever it may be, to thoroughly fill these minute interstices or pockets normally occupied by occluded air, forming thereby a better and more uniform product and one devoid of

blisters, blow holes or such blemishes. By my invention I immediately dry such coated or impregnated sheet material while still in the vacuum chamber so that when the sheet material emerges from the vacuum chamber the coating or impregnating material is dry and set without any danger of atmospheric pressure or atmospheric conditions spoiling or marring the finished product.

As previously stated I will describe my invention with relation to coating, coloring, or impregnating paper, though it is to be understood that textile fabrics may be treated in the same manner.

The web 1 of paper is fed from the reel or roll 2 over the guide roll 3 into a liquid seal 4. The liquid of this seal may be of any suitable material which has no affinity for, or deleterious action upon, either the web 1 as it is first fed into the machine or after it has been coated or impregnated. I preferably employ mercury as the sealing medium 4, but it is to be distinctly understood that any amalgam, alloy, or any other suitable liquid sealing medium may be employed which has the characteristics above specified.

The web 1 is fed beneath the roller 5 in the liquid seal 4, up over the guide roller 6 and down through the coating, coloring, or impregnating bath 7 under the submerging roller 8, between the squeeze rollers 9, 10 which remove the surplus coating or impregnating material, thence in contact with the guide roller 10, over the rotating heating drum 11, guide rolls 12 and 13, over the second rotating heating drum 14, guide roller 15, and out of the vacuum chamber 16 through the second liquid seal 4 under the roller 17 and over the guide roller 18, when the web 1 is preferably wound into the finished, dry coated or impregnated reel or roll 19.

While I have shown two drying heating rollers 11 and 14, it is to be understood that either one or a greater number than two such rollers may be used as may be found convenient or expedient.

The coating or coloring or impregnating bath 7 may be of any suitable material with which it may be desired to coat or color or impregnate the web 1. For example it may be size, wax, tar or in fact any coating, or water-proofing, or impregnating or coloring material. Preferably, though not necessarily, I mount steam pipes 20, 20 in the bath 7 so that it may be heated if desirable.

As the web 1 emerges from the liquid seal 4 into the vacuum chamber 16 it is immediately subjected to the action of, preferably, a high vacuum which withdraws substantially all of its occluded air. It then immediately, while still in the vacuum chamber, passes into the impregnating or coat-

ing bath 7 where its interstices, normally filled with such occluded air, will be filled with portions of the bath 7 whatever that bath may be. The web then passing up through the squeeze rollers 9, 9 will have the surplus coating or impregnating materials removed, and then immediately, while still in the vacuum chamber 16, will be dried by passing over and in contact with the drums 11 and 14, so that the coating or impregnating material will be thoroughly set and dried in the vacuum chamber before the web 1 emerges from the second liquid seal 4.

The drying drums or cylinders 11 and 14 may be heated by exhaust steam or hot water, or otherwise. Their temperature may be varied within quite wide limits but they must not be heated to such a temperature as to injuriously affect the material treated, or the size, or coloring matter or mordants, if such be used.

If the coating or impregnating material 7 is a compound including highly volatile liquids, these volatile liquids will of course boil or be given off at a lower temperature than that given above.

The vacuum chamber 16 is provided with pipes 21, 21 which are connected to any suitable form of vacuum machine or condenser to maintain the particular degree of vacuum within the chamber desired, withdrawing the steam, moisture, and air given off by the web of paper as it dries. If the coating or impregnating material includes volatile liquids, which it may be desired to recover and use over again, this may be done in any well-known manner. The vacuum chamber is provided with windows, such for example, 22 and also with suitable man-holes and means to replenish the supply of the bath 7 in any well known manner (not shown). The liquid of the bath 7 may be withdrawn from the chamber 23 by operating the cock 24 preparatory to changing the baths or cleaning out said chamber.

The vacuum of the chamber 16 not only removes the occluded air from the web 1 of paper, woven fabric or other suitable material, but it also removes the occluded air from the bath 7, so that a smoother and finer product is obtained without any blemishes, blisters or defects due to small portions of air being held under any of the coating; or seeking to escape therefrom, causing pin-holes to appear in the surface. In passing the web over the revolving drying cylinders 11 and 14 it is given a flat and smooth surface.

In some cases it may be desirable to give a different effect to the finished web than that which is obtained from passing it over and in contact with the revolving heating drums 11 and 14.

I have shown for example a modification

of my invention in Fig. 2, in which the web 1, after passing through the liquid seal 4 over the guide roller 6 and through the coating or impregnating bath 7 passes into a vacuum chamber 25, Fig. 2, over a guide roller 26 and is fed through a heated liquid bath 27. This bath may be of any suitable material which has no affinity for or deleterious action upon the web 1. Preferably it is heated mercury, but it is to be distinctly understood that it may be an amalgam, alloy, or any other suitable medium which has the characteristics above specified. Preferably this heating bath 27 is heated by the steam pipes 28, 28. Preferably, though not necessarily the web 1, after being coated or impregnated, is fed through the heating bath 27 by passing under one or more submerging rollers 29, 29 and guide rollers 30, 30. The web then passes over the guide roller 31 and out through the second liquid seal 4, under the submerging roller 17 and over the guide roller 18 where it is preferably immediately wound into the finished roll or reel 19.

In some cases it may be desirable to give the coated or impregnated web 1 a finish and smoothness different from what it is given in the apparatus shown in Figs. 1 and 2. I may for example pass the web 1, Fig. 3, into a vacuum chamber 32 through a liquid heating bath 33 of any suitable medium which has no affinity for deleterious action upon the web 1, as, for example, mercury, amalgam, an alloy or any other suitable liquid having the characteristics above specified. In passing the web 1 through this heating bath 33 I employ drums 34, 34 which may be heated or not and which are partially submerged in the bath 33. These drums may be rotated in any suitable manner.

The web 1 passes in contact with these drums 34, and also with the guide rollers 35, 35 until it reaches the end of the vacuum chamber 32 at which point it is thoroughly dried and the coating or impregnating material thoroughly set. The web is then wound into the roll 19, after passing out of the second seal 4.

The liquid bath 33 may be heated in any suitable manner such as by passing steam, or products of combustion through the chamber 36.

The finish of the web may be still further varied by changing the size of the rollers 34, 34. These changes may be in wide limits. Simply for purposes of illustration I have shown another variation in which the vacuum chamber 37, Fig. 4, is provided with the same liquid bath 33 and guide roller 35, 35, but with smaller drums 38, 38. In this modification the web will not have a finish quite so flat and smooth as given by the apparatus in Fig. 3 or in Fig. 1, but will give

a flatter and smoother finish than the apparatus of Fig. 2. While these different forms are shown it is of course to be understood that they are simply illustrative and that my invention is not to be confined to them.

The forms shown in Figs. 2 to 4 are the subject of my divisional application Ser. No. 545,214.

It is desirable in finishing some webs of sheet material, particularly paper, to pass them adjacent to, but not in contact with, the heating element. I have shown in Fig. 5 a vacuum chamber 39 provided with fixed heating elements 40, 40. These elements preferably are heated with steam or hot water. The web 1 of coated or impregnated material is fed through the vacuum chamber 39 in folds or loops 41, 41, over the guide rollers 42, 42 and under the guide rollers 43, 43. Between one or more of these folds or loops, preferably between each one of them, is mounted one of the fixed radiators 40, 40, so that as the web is fed through the vacuum chamber 39 in these folds or loops they are heated by the radiators 40, 40.

In some cases I may use a vacuum chamber 44 in which the web 1 is fed through in folds or loops and in its passage is subjected to radiant heat, preferably the glowing member of an electric heater 45, of Fig. 6. These electric heaters are preferably placed between one or more of the folds or loops so that the sheet material, after being coated or impregnated, is dried in the vacuum chamber in this manner before it passes out of the second liquid seal 4 to the atmosphere to be wound in the finished roll 19.

The forms shown in Figs. 5 and 6 are the subject of my divisional application Ser. No. 545,215.

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.

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

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 can be used and still produce a coated or sized paper equal in strength to atmospheric dried paper, in which a higher grade furnish is used. In making newsprint paper, I am able to dispense with a considerable portion of the more expensive 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.

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.

By my process and apparatus the web of sheet material, whether it be paper or textile material, is rapidly coated or impregnated and immediately dried within the vacuum chamber so that when it emerges the coating or impregnating material is dried and set permitting it to be immediately wound into a roll or reel for transportation. The low temperature used and the great difference in temperature which I employ from that necessary under atmospheric conditions insure that the sheet material will not be injured in any particular and that the process may be speeded up, thereby reducing the cost of manufacture. The sheet material is never subjected to high temperatures, which high temperatures invariably injure its fibers or threads. I am enabled also to use a comparatively small machine, which takes up comparatively small floor space thereby reducing overhead expenses.

Having pointed out the many advantages of my method and apparatus over those heretofore used, it will be apparent that the use of my invention results in great economy in the initial cost of apparatus and in large savings in cost of operation, maintenance and repairs.

Having thus described this invention in connection with an illustrative embodiment 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 treating a web of paper consisting in feeding it into and out of a vacuum chamber without breaking the vacuum and without injury or deleteriously affecting the web, coating or impregnating the web in the vacuum chamber and then immediately while in the said vacuum chamber drying said web under slight tension sufficient to cause its constituent fibres to slightly rearrange themselves in the direction of travel of the web thereby giving a smooth and flat surface to the web of paper, and then passing said smooth, coated or impregnated web of paper out of the vacuum chamber without breaking the vacuum.

2. The method of continuously treating a web of paper consisting in continuously feeding it into and out of a vacuum chamber without breaking the vacuum and without injuring or deleteriously affecting the web, continuously coating or impregnating the web in the vacuum chamber and then immediately while in the said vacuum chamber continuously drying said web under slight tension sufficient to cause its constituent fibres to slightly rearrange themselves in the direction of travel of the web, thereby giving

ing a smooth and flat surface to the web of paper, and then continuously passing said smooth, coated or impregnated web of paper out of the vacuum chamber without breaking the vacuum.

3. An apparatus for treating material including a vacuum chamber, means to permit the material to pass into and out of said vacuum chamber without breaking the vacuum, coating or impregnating means mounted in the vacuum chamber, and drying means to put the constituent elements of the material under sufficient tension to cause them to slightly rearrange themselves to form a smooth and flat product, and means to permit the dry coated or impregnated material to pass from the vacuum chamber without breaking the vacuum.

4. An apparatus for treating material including a vacuum chamber, means to permit the material to pass into and out of said vacuum chamber without breaking the vacuum, coating or impregnating means mounted in the vacuum chamber, and drying drums or cylinders to put the constituent elements of the material under sufficient tension to cause them to slightly rearrange themselves to form a smooth and flat product, and means to permit the dry coated or impregnated material to pass from the vacuum chamber without breaking the vacuum.

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