

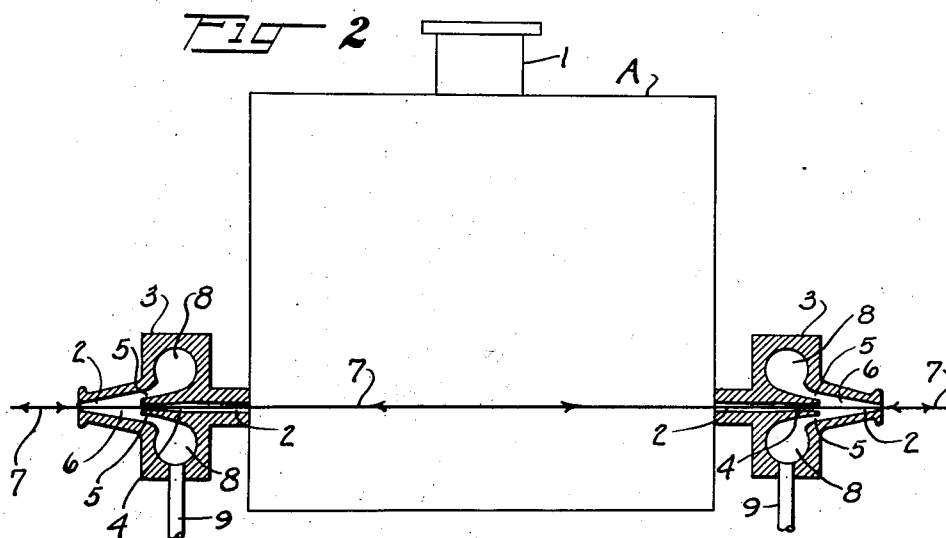
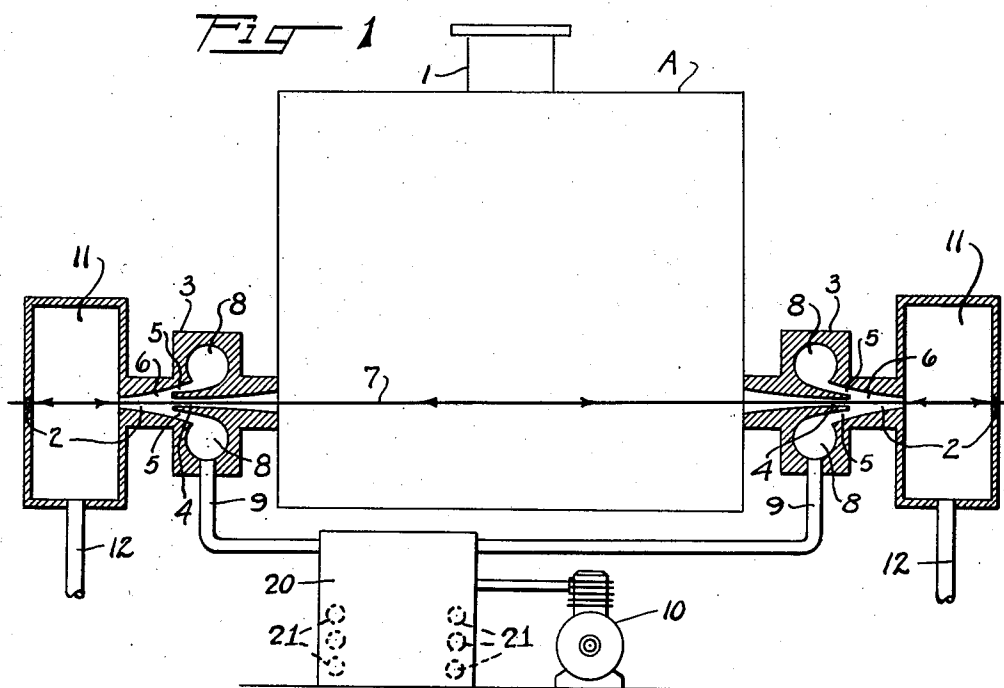
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VELOCITY AIR VACUUM SEAL, METHOD AND APPARATUS

Original Filed Feb. 8, 1922 2 Sheets-Sheet 1



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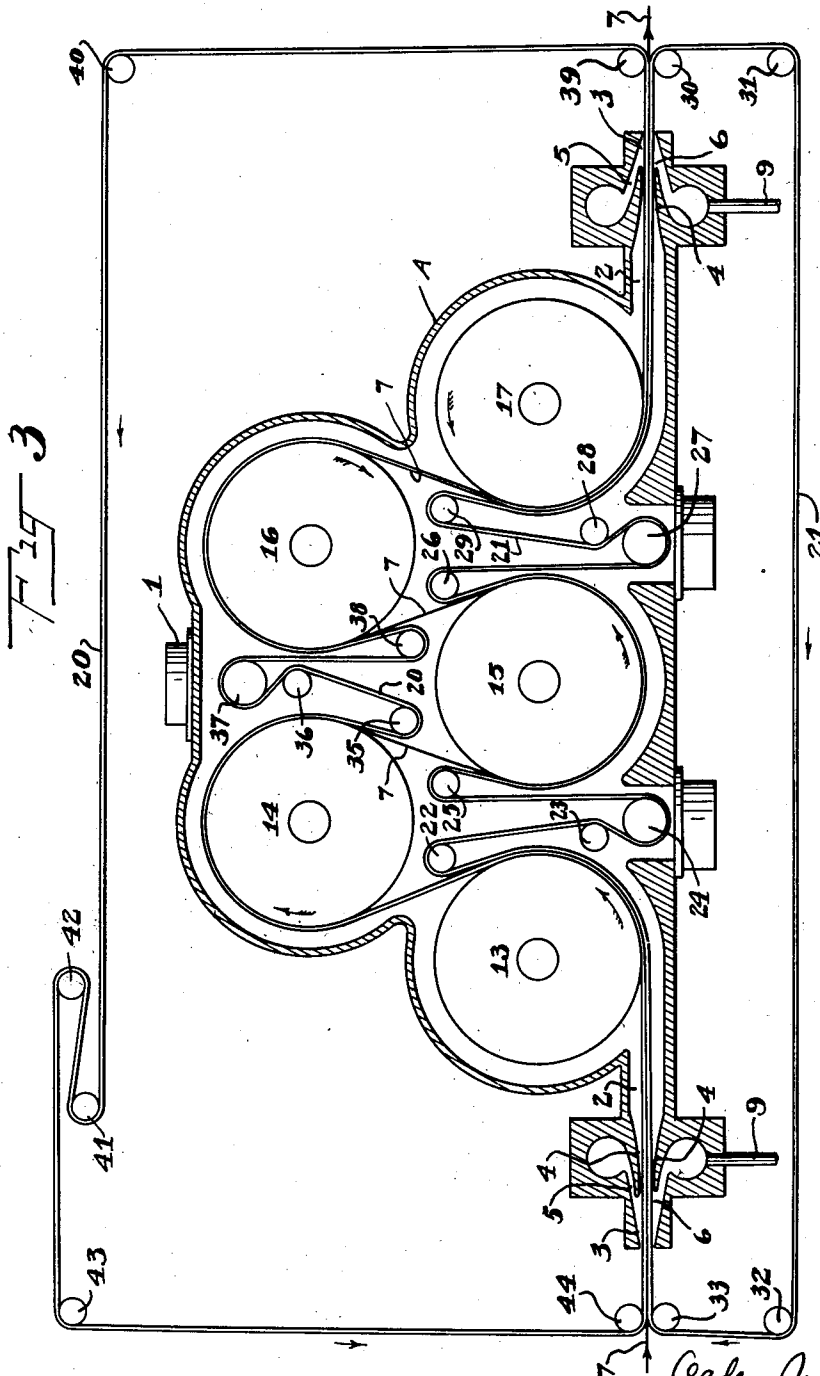
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VELOCITY AIR VACUUM SEAL, METHOD AND APPARATUS

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UNITED STATES PATENT OFFICE.

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VELOCITY AIR VACUUM SEAL, METHOD AND APPARATUS.

Application filed February 8, 1922, Serial No. 535,006. Renewed February 17, 1926.

This application is a continuation in part of my copending application Ser. No. 427,436 filed November 30, 1920, Case L.

My invention relates to the method of treating materials in a vacuum, and more particularly to the method of protecting the opening or openings into the vacuum chamber, through which opening or openings the material to be treated is introduced and withdrawn from the chamber.

My invention relates more particularly to a vacuum seal maintained by the application of velocity head, i. e. the difference in pressure between the atmosphere and vacuum being balanced by the velocity head of the sealing medium. Through this seal the material to be treated in the vacuum chamber is passed in any suitable manner.

My invention further relates more particularly to the method of drying sheet material, as a continuous web of paper either coming from the wet end of a paper machine, or from a sizing vat, or from a coloring apparatus, coating machine or printing machine or directly from a roll of wet paper.

My invention further relates to a vacuum apparatus including a vacuum chamber having passages extending from the said vacuum chamber and open to the atmosphere. These passages are protected by velocity fluid seals which prevent the admission of air into said vacuum chamber as the material to be treated is introduced and withdrawn through said seals.

My present invention relates to employing velocity air seals to protect the openings in the vacuum chamber.

This air, in some cases, is heated to give a preliminary drying to the wet web.

My invention further relates to employing passages having restricted areas merging into progressively larger areas between the atmosphere and the interior of the vacuum chamber, forming in effect Venturi nozzles, through which the fluid of the velocity fluid seals flow.

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 diagrammatic view of one form of my invention;

Fig. 2 is a diagrammatic view of the simplest form of my invention;

Fig. 3 is a diagrammatic view, similar to Fig. 2, showing the web of paper or similar sheet material passing over rotating drying drums or cylinders mounted in the vacuum chamber.

The vacuum chamber A has a vacuum maintained therein in any suitable manner by connecting the pipe 1 with any suitable exhausting apparatus. This vacuum chamber has two passages 2, 2 open to the atmosphere. Through these passages the material to be treated in the vacuum chamber A is introduced and withdrawn. Of course if the passages were left unguarded the vacuum in the vacuum chamber A would be broken.

My invention broadly consists in guarding the passages to the atmosphere by velocity air vacuum seals, the velocity of the air being sufficiently high to prevent any air working past the velocity seal into the vacuum chamber.

In my invention suitable material may be introduced into and withdrawn from the vacuum chamber A through my velocity air seals 3, 3. It may be treated in any suitable manner within the vacuum chamber. It may be fed through the vacuum chamber continuously or not. I have shown by way of example the material in the form of a continuous web which passes continuously through the vacuum chamber A and the velocity air vacuum seals 3, 3. This web may be dried in the vacuum chamber, or coated, impregnated or treated in any other suitable manner, and may be fed into and out of the vacuum chamber in either direction as indicated by the arrows in Fig. 1.

These passages 2, 2 have restricted areas 4, 4. Connected with these restricted areas are nozzles 5, 5. The area of the passages 2, 2 increases at 6, 6 adjacent the restricted areas 4, 4.

Air which has no affinity for or deleterious effect upon the web 7, or other material

treated is forced into the chambers 8, 8 through the pipes 9, 9 by any suitable means as the pump 10. This air is then permitted to flow through the nozzles 5, 5 at sufficient velocity to equal or preferably exceed the atmospheric pressure, which will prevent any of the air of the velocity seals, or air of the outside atmosphere working into the vacuum chamber A. The velocity required will depend on the vacuum maintained in the vacuum chamber. Preferably I employ as near a perfect vacuum as I can maintain, usually about 28 inches of mercury.

The air passes through the nozzles 5 with comparatively high velocity. As the air reaches the portion 6 of comparatively large area its velocity is reduced. The passage 2 with its restricted area 4, nozzles 5 and portions of greater area 6 is in effect a Venturi type nozzle. The passage 2 is of course wide enough to permit the free passage of the widest web or other material to be passed into and out of the vacuum chamber.

The air may be collected in the chambers 11, 11 and withdrawn therefrom in any suitable manner by the pipes 12, 12. Preferably, however, I omit the chambers 11, 11 as shown in Fig. 2, and permit the air of the velocity seals to exhaust directly into the atmosphere.

My invention is particularly adapted to be used in connection with drying sheet material in the form of paper, though it is to be distinctly understood that it is equally applicable to and covers drying any material, and any sheet material, as for example, sheet material in the form of textile fabrics. Such sheet material may be dried after it has been washed or bleached or dyed, or otherwise treated by a liquid of some description.

The wet web of paper 7 coming directly from the wet end of a paper machine, or from a coloring apparatus, coating machine, printing machine, or directly from a roll of wet paper is fed to the vacuum chamber A through the velocity air seal 3 at the left of Fig. 1, then heated and dried in the vacuum chamber A and then out through the second velocity air seal 3 at the right of Fig. 1.

When a wet web of paper 7 coming from any source, such as that above described, is to be dried, I preferably pass it through the velocity air seal at the left of Fig. 3 and into the vacuum chamber A. The web 7 cooperates with the heated drying drums or cylinders 13, 14, 15, 16 and 17 and is dried by them. It then passes out of the chamber through the velocity air seal at the exit end of the vacuum chamber A.

In this form of my invention the material to be dried is completely protected by the upper guard belt or felt 20, and the lower guard belt or felt 21 as it passes into and

out of the vacuum chamber A. The lower guard felt or belt 21 in its passage through the vacuum chamber cooperates with the drying drums or cylinders 13, 15 and 17 and in contact with the guide rollers 22, 23, 24, 25, 26, 27, 28 and 29, and then out through the velocity seal at the exit end of the vacuum chamber, and around the guide rollers 30, 31, 32 and 33 where it again meets the upper felt or belt 20, and thence again passes through the vacuum chamber.

The upper felt or belt 20, with the lower belt 21, protects the web of material 17 as it passes through the velocity seal at the entrance to the chamber. It cooperates with the drying drums or cylinders 13, 14, 16 and 17. On the periphery of the drying drum or cylinder 17 it again meets the lower felt or belt 21, so that the web 7, when cooperating with this drying drum or cylinder 17, is again protected by both the upper and lower guard felts or belts 20 and 21, which continue to protect it until the web, now dry, passes through the exit velocity air seal, on the right of Fig. 3. The upper belt or felt 20, after passing around the drying drum or cylinder 14 cooperates with the guide rollers 35, 36, 37 and 38 within the vacuum chamber. It also cooperates with the guide rollers 39, 40, 41, 42, 43 and 44 on the exterior of the vacuum chamber.

These drying drums or cylinders are driven at the same speed that the web 7 is traveling.

Preferably, though not necessarily, I may heat the air of my velocity air seals so that said seals not only protect the openings into the vacuum chamber A, but they also serve to assist in drying the wet web of sheet material. When this web is paper the first velocity air seal will give the web a preliminary drying which will give the web body, or make it firmer, so that it can be more readily fed through the vacuum chamber and over the drying drums or cylinders.

The air may be heated in any suitable manner, as for example, by heating it while in the air reservoir 20, by means of steam pipes 21, 21.

My method 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.

5 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
10 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
15 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
20 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.

25 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
30 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
35 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
40 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
45 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
50 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.

55 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
60 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
65 greater (16° F. $\times$ 8 = 128° F.) than the tem-

perature 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
70 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
75 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
80 the atmospheric cylinder drying heretofore in universal use for drying paper. Theoretically, it requires about 4287 pounds of steam to dry one ton of paper at atmospheric pressure, but to compensate for convection and conduction losses, and those due
85 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
90 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
95 at low temperature 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
100 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
105 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 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.

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.

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 different 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 sealing against the admission of air into a vacuum chamber having openings for the passage of material to be treated in said chamber, consisting in preventing the admission of air through said openings by causing a gas under pressure to flow through said openings against the pressure of the atmosphere.

2. The method of continuously drying sheet material consisting in continuously feeding the sheet material into and out of openings in the vacuum chamber, drying the sheet material in the vacuum chamber, and preventing the admission of air through said openings by causing a gas under pressure to flow through said openings against the pressure of the atmosphere.

3. In a vacuum apparatus the combination of a vacuum chamber provided with one or more openings for the admission and withdrawal of material into and from said vacuum chamber to be treated, and one or more velocity air seals protecting said openings and preventing admission of air into said vacuum chamber.

4. In a vacuum apparatus the combination of a vacuum chamber provided with one or more restricted passages similar to a Venturi nozzle connected with the vacuum chamber and through said restricted passage or passages the material to be treated in the vacuum chamber is adapted to pass, and means to supply gas through said restricted passage or passages at sufficient velocity to prevent the admission of air into the vacuum chamber.

OGDEN MINTON.