June 1, 1937. P. J. MASSEY ET AL 2,081,945

MEANS AND METHOD OF DRYING COATED FLEXIBLE WEBS

Filed Nov. 27, 1935 2 Sheets-Sheet 1

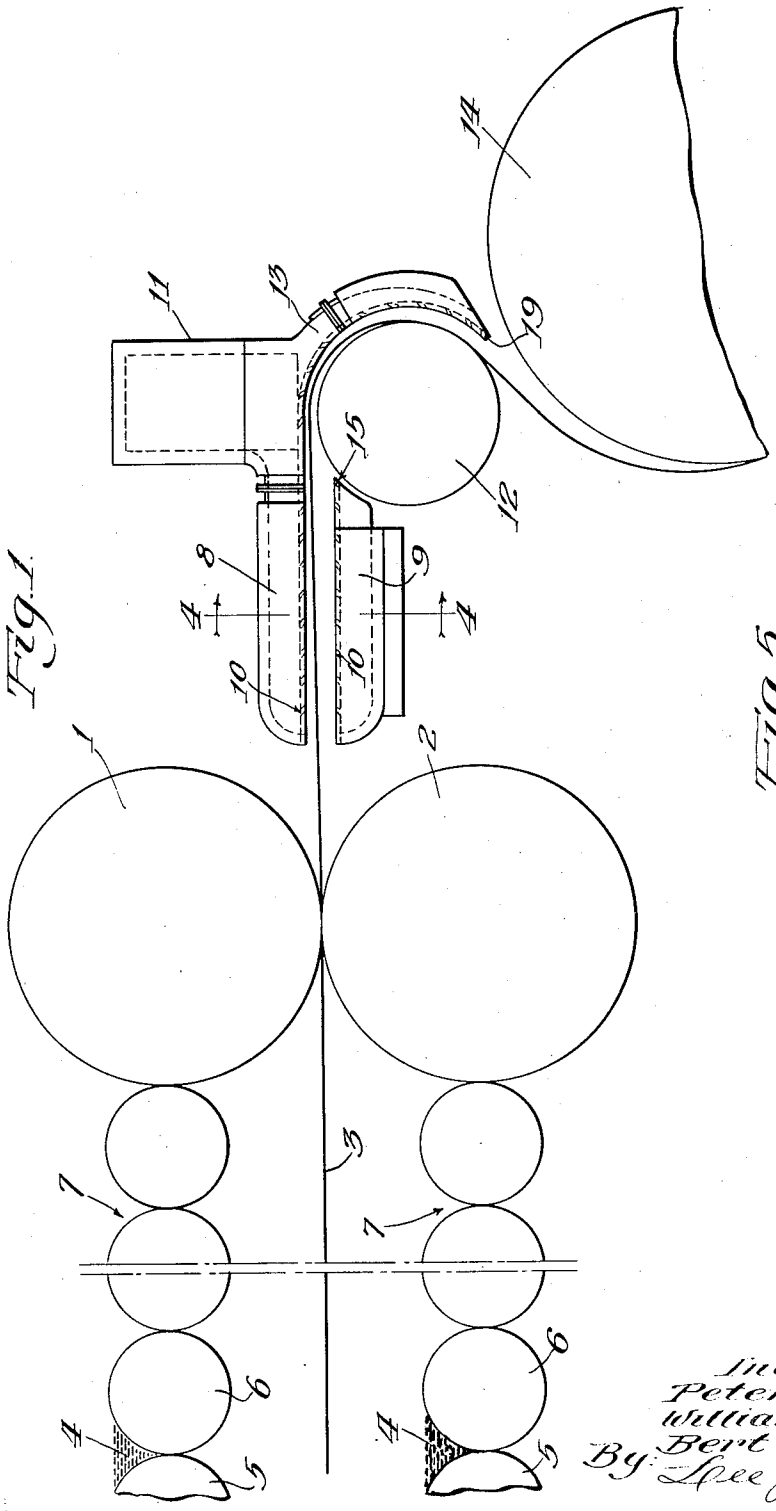

Fig. 1.

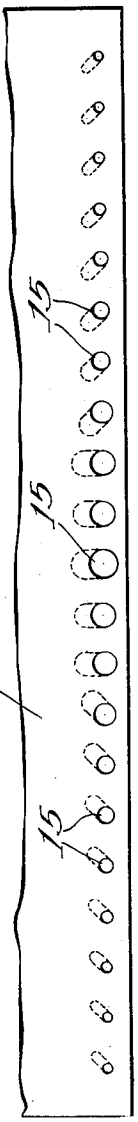

Fig. 5.

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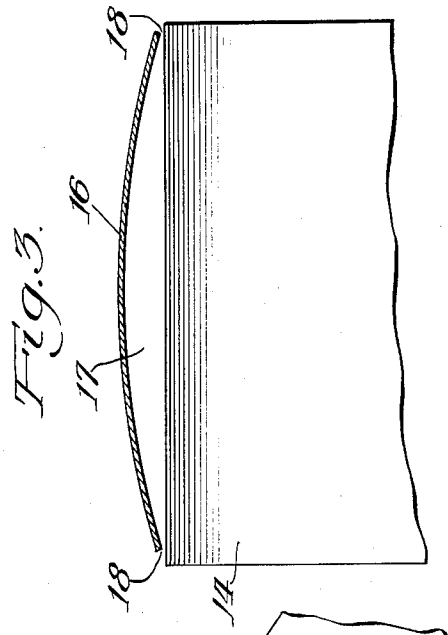

Fig. 3.

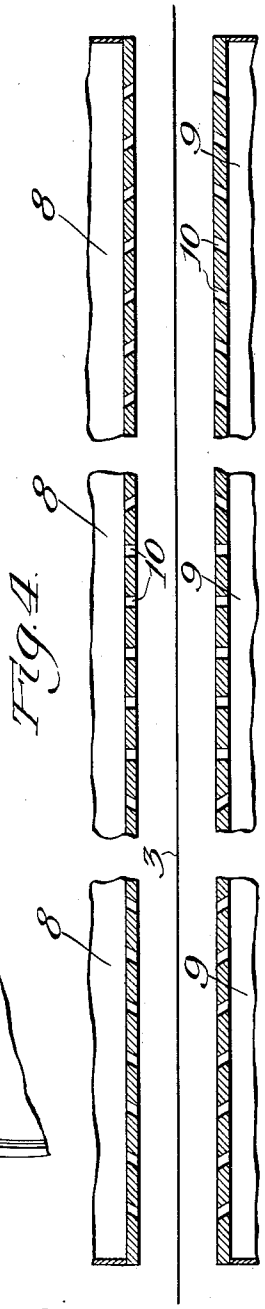

Fig. 4.

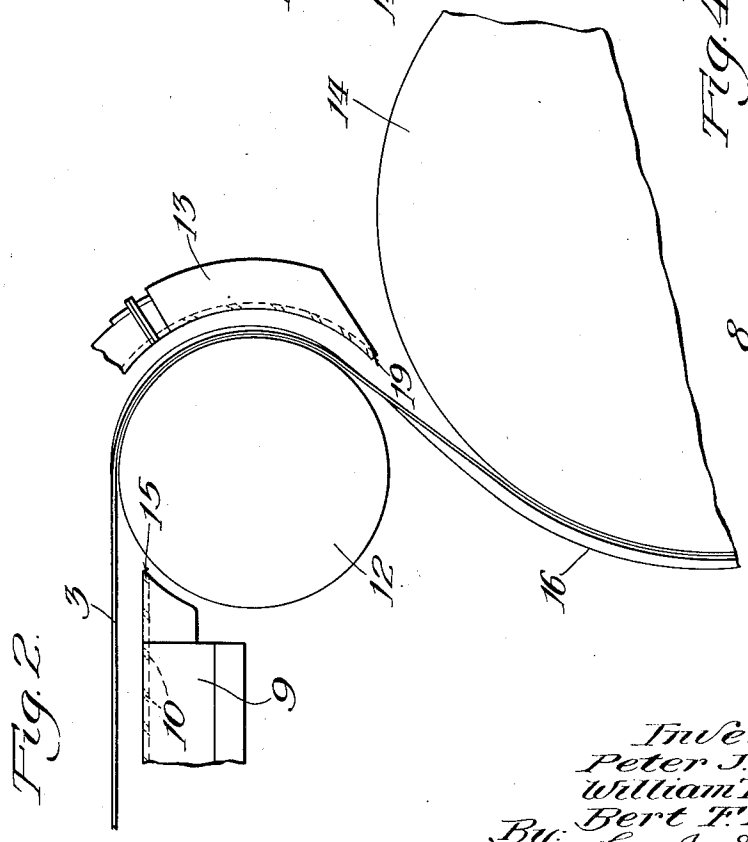

Fig. 2.

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UNITED STATES PATENT OFFICE

2,081,945

MEANS AND METHOD OF DRYING COATED FLEXIBLE WEBS

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Application November 27, 1935, Serial No. 51,740

3 Claims. (Cl. 34—24)

This invention relates to improvements in a method and means for drying wet webs, and refers specifically to a method and means for drying a freshly coated flexible web by passing the same over a series of heated drying drums, the freshly coated surface being subjected to blasts of heated air or other fluid so directed as to provide an insulating air film or cushion between the coated surface and the surfaces of the drums so that the coated surface will not be disrupted or marred.

In the coating of flexible paper and fabric webs, difficulty has heretofore been encountered in economically drying the same without disfiguring or marring the coating. This difficulty is most pronounced in handling or conveying the web immediately after its exit from the coating device, since the coating, at this period, is most moist and susceptible to disfigurement.

Various expedients have heretofore been proposed, the most widely used being to festoon the coated web after its exit from the coating machine. This method of drying has serious drawbacks among which may be mentioned; that the festooning apparatus requires extensive plant space; the drying is inefficient and slow; and the drying section of the machine cannot be run in step with the coating device.

Drum driers have heretofore been deemed impractical or at best unsatisfactory since the contact between the drum surface and freshly coated web surface resulted in disfigurement and marring of the coated surface. Consequently, for the drying of coated webs where the smoothness and fineness of the coating is of importance, such as the coating on paper webs used for printing purposes, drum driers with their other many advantageous features have been out of the question.

Our present invention contemplates a method and means whereby a freshly coated web may be passed over drum driers immediately after the coating operation without injuring the freshly applied coating. This phenomenon is accomplished by first subjecting the coated web to blasts of heated air under pressure to preliminarily set the coating and then passing the web over the initial rolls or drums of the drier while simultaneously directing air blasts between the web and the drum surface, entrapping the air therebetween so as to form an insulating air film or cushion between the coated surface and the drum surface. In this manner actual physical contact between the drum surface and the coating is substantially prevented or at least harmful contact is eliminated.

Another difficulty inherent in the use of drum driers is the tendency of the freshly coated web, particularly thin webs, to "rope" in passing from the coater to the first drying drum, or from drum to drum. "Roping" is the longitudinal wrinkling of the web due to its tension in being drawn over the drums and also due to the tendency for the web to creep transversely upon the drum surfaces. Both of these tendencies are intensified when the wet coating on the web moistens the body of the web thereby diminishing its normal rigidity or stiffness.

As a feature of our invention the air blasts, above referred to, are so directed with respect to the web that a transverse component of force is exerted upon the web in opposite directions thereby tending to place the web under slight transverse tension sufficient to eliminate the undesirable roping effect.

Other objects and advantages of our invention will be apparent from the accompanying drawings and following detailed description.

In the drawings, Fig. 1 is a diagrammatic side elevational view of suitable means for carrying out our invention.

Fig. 2 is an enlarged fragmentary side elevation illustrating the "bellying" of the web during its passage over the drier drums.

Fig. 3 is a fragmentary transverse sectional view illustrating the bulging of the web, during its passage over the drum due to the entrapped air.

Fig. 4 is a transverse sectional view taken on line 4—4 of Fig. 1.

Fig. 5 is a top plan view of one end of the air discharging chests.

Referring in detail to the drawings, 1 and 2 indicate oppositely disposed co-acting coating rolls which are adapted to transfer a mobile coating material from their respective surfaces to the opposite faces of a continuously passing flexible web 3.

For purposes of example, our invention will be described in conjunction with a coating device utilized for coating both surfaces of a web of paper, the paper to be used for printing purposes. It is to be understood, of course, that our invention is not to be limited to this precise application, since it is equally applicable to the drying of substantially any type of flexible web carrying a surface coating, on one or both surfaces, which coating is susceptible of being dried or set by heat.

The coating device shown diagrammatically in Fig. 1 is intended to illustrate a coating machine similar to that described in our co-pending application, Serial No. 40,150 filed Sept. 11, 1935. In this type of coating device a mobile coating material 4 is carried between two juxtaposed gate rolls 5 and 6. By controlling the relative speeds of rotation of rolls 5 and 6 a controlled quantity of the coating material 4 may be carried upon the exterior surface of the rolls 6 and may be transferred to a series of osculating distributing rolls 7. The last roll of the series in both the upper and lower tiers is adapted to contact the coating rolls 1 and 2 and transfer to the surface thereof a smooth, uniformly distributed film of coating material. As has been hereinbefore described, this film is subsequently transferred from the surfaces of the rolls 1 and 2 to the opposite faces of a continuously passing paper web 3. In many coating operations, particularly when coating paper which is to be used for printing or similar purposes, it is imperative that the finished coating be smooth and uniformly distributed over the surface of the paper. As described in our hereinbefore mentioned co-pending application such a surface may be deposited upon the web 3. Therefore, it is essential that after the web 3 passes from between the rolls 1 and 2, extreme care be taken that the coating be undisturbed particularly while said coating is yet wet and unset. Of course, after leaving rolls 1 and 2 the coating on web 3 still contains a considerable quantity of moisture and although immobile in the sense that it will not flow, the coating is still sufficiently pliable or mobile as to be susceptible to scratches and disfigurement by contact with solid bodies.

In order, therefore, to dry and set the coating upon the opposite faces of the web 3 after its exit from between rolls 1 and 2, we contemplate passing the coated web between chests 8 and 9, respectively, disposed above and below the passing web. The chests 8 and 9 preferably extend transversely across the entire width of the web 3 and the respective opposed surfaces of said chests are spaced from the web. Said opposed surfaces of the chests may be provided with a series of apertures 10 which open into the interior of the chests. The chests 8 and 9 may form portions of a larger supply or equalizing chest 11 which may be connected to a source of heated air or fluid under pressure. It is obvious that, after web 3 passes between chests 8 and 9 the heated fluid within said chests will be discharged through the apertures 10 and said heated air will contact the coated surface of the web 3 thereby tending to preliminarily set the coating material. In view of the fact that the coating material at this stage is in a more or less pliable state, it is essential that the velocity of the fluid striking the coating material be so controlled as not to displace or disturb the coating.

In view of the fact that the web 3 is adapted to travel in a continuous manner, said web must be maintained under longitudinal tension. Moreover, in order to thoroughly dry the coating material said web is to be passed over a series of drum driers. When the coating material is applied to the web a quantity of the moisture carried by the coating material permeates the web thereby rendering said web less rigid or stiff. Due to the fact that the web is under tension and is passing over a roll surface, the web when traveling between the chests 8 and 9 would tend to "rope", that is, wrinkle longitudinally. This roping is due primarily to the longitudinal tension of the web and also the fact that in passing over the roll 12 the web tends to creep transversely. Consequently, in order to prevent this roping effect the apertures are so arranged that the air blasts which strike the web surfaces adjacent the sides of the web tend to set up transverse components of force which are exerted in opposite directions transversely of the web. This force places the web under a slight transverse tension and effectively prevents longitudinal wrinkling of the web. As clearly illustrated in Fig. 4 of the drawings the apertures 10 adjacent the longitudinal edges of the web are so inclined as to discharge the air at an angle to the web surface. The apertures 10 adjacent the opposite longitudinal edge of the web discharge the air at angles to the web which are oppositely inclined to those upon the other end. The apertures 10 at the center of the chests 8 and 9 discharge air blasts at right angles to the surfaces of the web and therefore exert no component in either direction.

The apertures 10 in addition to being inclined in a transverse direction with respect to the web are all, including the central apertures, inclined in a longitudinal direction so as to exert a component of force which acts in the direction of motion of the web. Therefore, the web 3 after leaving rolls 1 and 2 and while the same is between the chests 8 and 9, is in both transverse and longitudinal tension thereby maintaining the web surface flat and preventing distortion of the coating films due to wrinkling.

A conduit 13 may also be connected to the chest 11, said conduit being arcuate in shape and following the contour of roll 12. That face of conduit 13 which is adjacent roll 12 is also provided with apertures 10 which are inclined in the same manner as those provided in the chests 8 and 9. When the web 3 passes from between the chests 8 and 9, said web is trained around roll 12 and is thereafter passed over the surface of drying drum 14 which may comprise the first drum of a series of driers, the remaining drums not being shown.

It will be noted that the portion of the chest 9 adjacent roll 12 terminates in a more or less pointed edge. The extreme edge of the chest substantially at said point is provided with a transverse row of apertures 15 which direct blasts of air into the nip between the lower surface of the web and the surface of roll 12. That end of the chest 9 hereinabove described is illustrated in detail in Fig. 5 which clearly shows the apertures 15. It will be noted that in general the angular inclination of the apertures 15 follow that of the apertures 10, that is, the apertures adjacent the sides are inclined transversely outwardly and the apertures adjacent the center are inclined, with respect to their transverse inclination, at right angles to the web surface and that all of the apertures are inclined longitudinally, in the direction of motion of the web.

In passing over the roll 12 it is our intention that a film or cushion or air or other fluid be interposed between the surface of the web and the surface of the roll 12 so that injurious contact between the coated surface of the web and said roll will be prevented. In discharging the air or other fluid from the apertures 15, said fluid is directed between these opposed surfaces. The web is therefore slightly raised from the surface of the roll 12 during its passage therearound, being carried upon the air discharged from the apertures 15. In order to prevent the rapid escape of this cushioning air, the apertures 15 are

so arranged as to size that a greater quantity of air is delivered at the central portion of the web than is discharged by said apertures adjacent the longitudinal edges of the web. This construction is clearly shown in Fig. 5 and results in the bulging or "bellying" of the web as shown at 16 in Fig. 3. It can readily be seen that inasmuch as a greater quantity of air is discharged from the central apertures 15, the longitudinal central portion of the web will be blown as in a convex manner and the edges of the web will be disposed closer to the roll surface.

In this manner a quantity of fluid will be entrapped in the space 17, the only exits for the escape of said fluid being the relatively small clearance spaces 18 adjacent the edges of the web. By so entrapping the fluid the web 3 may be caused to travel around roll 12 without injuriously contacting the surface of said roll.

The end of the conduit 13 is so constructed as to direct air or fluid from the endmost row of apertures 19 between the web and the surface of the first drier 14. The apertures 19 extend transversely across the conduit 13 and are constructed with respect to size and angular inclination similar to apertures 15. The air or fluid discharged from apertures 19 tends to belly web 3 in the manner shown in Fig. 3 thereby providing a trapped body of fluid between the web and drum 14 which serve as a cushion or insulating medium for said web during its passage around drum 14.

It is to be understood, of course, that the air or other fluid discharged through apertures 10, 15 and 19 may be heated or said air may be at normal temperature. Moreover, if desired, the air may be impregnated with a desired agent which may produce a chemical or physical effect upon the coating. In the drying of some coating materials it may be desirable to provide the insulating cushions of fluid described in conjunction with the passage of the web over rolls 12 and 14 throughout the entire drier. With coating materials which set more quickly it may be necessary only to provide said fluid cushions during the passage of the web over the initial roll or rolls of the drier. Our invention, of course, contemplates either operation.

I claim as my invention:

1. A method of drying a coated flexible web which comprises, continuously passing a freshly coated web forwardly over a drum and discharging fluid under pressure between the web and drum surface so as to provide a fluid cushion between the web and drum surface, a greater quantity of fluid being discharged adjacent the longitudinal center of the web than that discharged adjacent its edges so as to belly the web away from the drum and entrap the fluid between the web and the drum surface.

2. A method of drying a coated flexible web which comprises, continuously passing a freshly coated web forwardly over a heated drum and discharging fluid under pressure between the web and drum surface so as to provide a fluid cushion between the web and drum surface, a greater quantity of fluid being discharged adjacent the longitudinal center of the web than that discharged adjacent its edges so as to belly the web away from the drum and entrap the fluid between the web and the drum surface.

3. A method of drying the coated area of a flexible web comprising, continuously passing a web forwardly having a wet mobile substance upon its surface, discharging heated fluid under pressure into contact with the wet areas of said surface to dry said substance, said fluid contacting the web in such a manner as to place the web under transverse tension, passing said web over a drum and discharging heated fluid under pressure between the web and drum surface so as to provide a fluid cushion between the web and drum surface, a greater quantity of fluid being discharged adjacent the longitudinal center of the web than that discharged adjacent its edges so as to belly the web away from the drum and entrap the fluid between the web and the drum surface.

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