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DRYING EQUIPMENT

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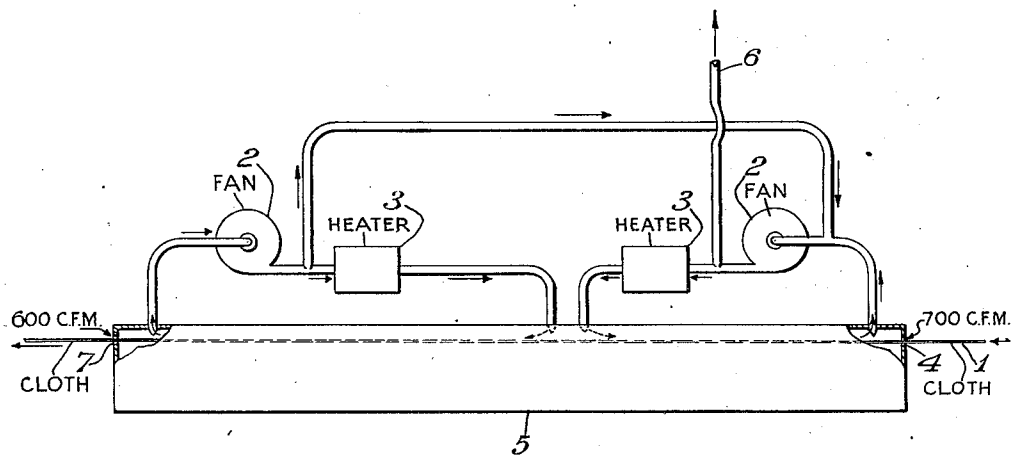

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DRYING EQUIPMENT

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3 Claims. (Cl. 34—48)

This invention relates to a method and apparatus for drying coated sheet material at a high speed.

The coating of sheet material with cellulose derivatives as conventionally practiced is effected while the sheet unwinds from a supply roll and moves in a horizontal direction. In such a method, the cloth or other sheet material passes over two transverse rollers which are in a horizontal plane and the doctor blade bears against the material to form a trough between the two transverse rollers. The coating composition is continuously poured into the trough on the forward side of the doctor blade. As the fabric passes under the blade, a thin film of the composition being applied is deposited on the sheet and thereafter it is passed into a drying chamber. The conventional drying chamber consists of a tunnel which is heated by means of steam coils or other suitable means located within the tunnel either above or below the cloth. The volatile components of the coating composition are driven off and drawn by suction fans through suitable ducts and discharged into the atmosphere or delivered to a solvent recovery apparatus. Such a drier evaporates the solvent from the fabric coating slowly; and the speed at which the sheet material is passed through the apparatus is therefore limited. There are also limits which determine the maximum temperature practical to use preventing increase in drying rates by this means compared to conventional rates. If on the other hand it is desired to pass the fabric through the drying chamber at a comparatively high rate, it is necessary to increase the length of the drying apparatus which increases the cost of the apparatus.

This invention has as an object the provision of a method and apparatus for drying coated sheet material rapidly which allows the coating to be carried out at higher speeds than heretofore.

Another object of this invention is the provision of a method of drying fabrics coated with cellulose derivative compositions in which the danger of explosion is reduced to a minimum.

Another object is the provision of a method which results in a more effective heat transfer in drying the coated fabric. Other objects will appear hereinafter. These objects are accomplished according to the present invention by an arrangement of the parts of a drying tunnel in which air is circulated at high velocity partly in a countercurrent flow to the coated fabric and partly in a direct flow with the fabric.

In the drawing, the figure represents a diagrammatic sketch of the relation of the parts of the apparatus. The fabric or other sheet material which has been coated is represented as 1, the fans which circulate air are designated as 2 and the heating means are shown as 3. An adjustable orifice through which the cloth passes and through which air is drawn into the system is designated as 4. The tunnel in which the vapors are volatilized is shown as 5. An exit pipe leading to the atmosphere or solvent recovery apparatus is shown as 6. The exit orifice corresponding and similar to the intake orifice 4 is shown as 7.

In the operation of the apparatus, the coated fabric enters the apparatus at 4 and a current of air is drawn in at the mouth of the tunnel 5 where the cloth enters also at 4. The fan circulates the air from this point through the heater 3 back into the tunnel at a point about ⅓ between its entrance and exit. At the same time the other fan 2 draws air into the orifice 7 and circulates it through the heater back into the tunnel 5 at a point approximately ⅔ from the exit to the entrance of the tunnel. This air is lean in solvent vapors and the amount of the air drawn into the orifice 7 is sufficient to dilute the vapors well below the point at which there is any danger of explosion. Part of the lean mixture is led to the fan which circulates air at the entrance end of the tunnel. This mixture and the mixture drawn from the entrance of the tunnel is injected into the tunnel at a point about ⅓ of the distance between the entrance and the exit of the tunnel 5. Part of this mixture is withdrawn in pipe 6 as mentioned above. The air is circulated at a relatively high speed, as indicated in the drawing about 700 cu. ft. per minute is drawn in at 4 and about 600 cu. ft. per minute is drawn in at 7. The high velocity of the air in the tunnel is accompanied by such turbulence that it is brought into very intimate contact with the wet film of composition on the coated sheet material.

As illustrated in the drawing, the air is returned to the tunnel at a point approximately ⅓ of the distance from the entrance to the exit. This division is made at a point at which evaporation has ceased to be the controlling factor in drying and diffusion has become the controlling factor. It has been determined that approximately 70 to 80% of the total solvent removed from a conventional nitrocellulose composition is drawn off in the first third of the drying chamber as illustrated in the drawing. Removal of the remain-

ing solvents requires approximately twice the period as required for the first 70 to 80%. It will be obvious that this division is somewhat dependent upon the volatility and vapor pressure of the solvents contained in the cellulose derivative coating composition and upon other factors governing respective rates of drying in the two sections of the machine.

It has also been found desirable to circulate air at a higher temperature in the first section than in the second section since the evaporation of the solvent absorbs a considerable amount of heat. A temperature of 200° F. in the first section and 180° F. in the latter ⅔ of the tunnel has been found to be satisfactory. The film of coating composition on the fabric after it passes through the machine becomes hardened to some extent on the surface and subsequent removal of the solvent depends upon its diffusion through the film to the surface. By circulating air at a temperature of approximately 20° F. lower in the latter portion of the tunnel it has been found possible to eliminate undesirable exuding of the softener in the coating composition to the surface film. It has also been found desirable to circulate the warm air in a countercurrent direction during the first third of the travel of the cloth through the tunnel and in the same direction as the travel of the cloth through the latter ⅔ of the travel of the cloth through the tunnel.

In the operation of the machine optimum drying conditions are maintained when approximately 8500 cu. ft. of air per minute are circulated by each fan. A circulation of this order produces a maximum of turbulence with a minimum of resistance to the flow of air in the tunnel. These conditions render the process extremely efficient in carrying out the drying operation. In fact, under optimum conditions cloth can be dried at a rate as high as 120 yds. per minute.

The fans, heaters, and solvent recovery apparatus may be of any type and do not constitute in themselves a part of this invention. The coating head may likewise be of any conventional type. However, particularly good results are obtained when the fabric is coated by means of the apparatus disclosed in the copending application of W. T. Anderson, filed Nov. 24, 1934, Serial No. 754,595.

The equipment disclosed herein is adapted for drying coated sheet materials such as woven or felted fabrics of various types including cloth, paper, etc., particularly where it is desired to remove the volatile constituents of the coating composition rapidly. The apparatus is particularly useful in removing explosive or otherwise dangerous solvents at a rapid rate and without any escape of the solvents into the atmosphere.

The advantages of this machine over the conventional types of coating machines are that it can be safely operated at a high speed thus increasing the efficiency of the coating operation and reducing the cost per unit of coated material. Another advantage is that when used in conjunction with the coating head of Anderson mentioned above, there is less tension on the warp threads while passing through the dryer. This reduced tension causes little or no pull down in width of the cloth thereby making it possible to use cloth of a narrower width than required by machines in which the tension through the drier is greater. This reduction in tension also makes it possible to reduce the so-called "rib" effect which is an imprint of the goods showing through the coating and is particularly objectionable in sateens.

A further advantage is that the drying chamber is divided into two sections. This makes it possible to maintain a different temperature in the sections of the drying tunnel than has heretofore been possible in a one section drier. A still further advantage is that approximately half of the total air taken into the apparatus through the back section is delivered while lean in solvents to the front section. This assures proper dilution of solvent regardless of whether the larger portion of the evaporation takes place in the front or rear section of the drying chamber.

As many apparently widely different embodiments of the invention may be made without departing from its spirit and scope, it is to be understood that the invention is not limited to the specific embodiments hereinbefore set out, except as defined in the appended claims.

We claim:

1. An apparatus for drying coated fabrics which comprises a long tunnel, means for passing the coated fabric through the said tunnel, means for heating air and means for circulating the hot air through the first portion of the tunnel in a direction countercurrent to the travel of the coated fabric, and means for passing hot air in a direction concurrent with the travel of the cloth in the latter section of the tunnel and means for passing a portion of the air circulating in the latter portion of the tunnel to the air circulating in the first portion of the tunnel.

2. An apparatus for drying coated fabrics which comprises a long tunnel, means for passing the coated fabric through the said tunnel, means for heating air and means for circulating the hot air through the first portion of the tunnel in a direction countercurrent to the travel of the coated fabric, and means for passing hot air in a direction concurrent with the travel of the cloth in the latter section of the tunnel and means for passing a portion of the air circulating in the latter portion of the tunnel to the air circulating in the first portion of the tunnel, and means for withdrawing a portion of the air circulating in the first part of the tunnel, and means for supplying fresh air to the system located at the entrance and exit of the tunnel.

3. Process of removing volatile organic solvents from fabrics coated with a cellulose derivative composition containing the said solvents which comprises passing the said fabric through a long chamber, passing heated air at a high rate of speed over and about the said fabric in a direction countercurrent to the travel of the said fabric for about ⅓ of its passage through the said chamber and passing a similar current of air over the said fabric in a direction the same as the travel of the fabric through the latter portion of the chamber, removing a portion of the air from the latter current, and supplying it to the first current, and withdrawing air from the said first current.

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