SYSTEM FOR DISPERSING FIBERS IN SUSPENSION INCLUDING AIR LAYING WEB, CONDITIONING FIBERS IN WEB, DISPERSING WEB IN LIQUID

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Filed July 20, 1972, Ser. No. 273,628
Claims priority, application France, Aug. 4, 1971, 219,475
Int. Cl. D06c 1/00; D21c 9/06
U.S. Cl. 8—151
19 Claims

ABSTRACT OF THE DISCLOSURE

A method and apparatus for improved dispersion of fibres or particles into a liquid suspension comprises the steps of first finely dispersing the fibres or particles in a gas or vapour current depositing the dispersed fibres or particles on a moving foraminous support and submerging the support with deposited fibres or particles in a liquid bath. The dispersing step may include mechanical dispersion followed by entrainment of the dispersed fibres or particles in the gaseous stream. The moving support may be a single foraminous screen, double foraminous screens, or a perforated cylinder.

The present invention relates to improvements in a process and apparatus for the dispersion of fibres or particles.

The main, but not exclusive, field of application of the present invention is the manufacture by a wet process of non-woven webs and in particular of non-woven textiles, papers or of similar articles, in which it is desired to obtain a continuous sheet by filtration or drainage of a liquid bath containing natural or synthetic fibres, or other solid particles, or a mixture of these materials. In the text which follows, the terms "fibres" or "particles" will be used indifferently, but it is to be understood that this term refers to fibres, particles or a mixture of fibres and particles.

In this type of manufacture it is generally very useful, in order to obtain a homogeneous web, to ensure at the outset as regular as possible a dispersion of the particles or fibres in the liquid, to ensure good regularity of the web to avoid the inclusion in the web of heterogeneous masses, to permit a regular distribution of the various constituents, and/or to facilitate the action of various chemical or physical agents in the manufacturing steps.

One of the difficulties which is often encountered, when attempting to ensure a good dispersion of fibres for use in the manufacture of non-woven webs by a wet process, is that the raw material exists, in the dry state, in the form of masses or "flocks," which are more or less coherent and which result from the method of manufacture of the fibres or particles, and/or from the methods of handling or of storage.

It is found to be difficult to disperse homogeneously masses of dry material in a liquid. On one hand, air trapped between the solid particles tends to bring them to the surface of the liquid bath, and on the other hand the bubbles of air retained by capillarity oppose wetting. In addition, the state of flocks, are often difficult to disperse subsequently, because of the molecular attraction forces or the mechanical forces of entanglement, reinforced by the movements of the liquid, or again, owing to the effect of the surface tension forces developed by the poor elimination of air.

To obtain a good dispersion, and above all if a homogeneous mixing of several constituents is to be ensured, a very considerable ratio of liquid to solid is thus often used, and this can make more difficult or onerous certain operations such as the fixation of dyestuffs, coating agents, or other chemical agents. It is often found necessary, in the case of a direct wetting of the flocks, to provide a very considerable agitation energy to disintegrate the masses of fibres or particles. This can be very deleterious in the case of long fibres because of possible entanglements, and equally deleterious to achieving the stability and good fixation of certain adjuvants.

In contrast, it is known to be often easier to disperse fibrous masses by mechanical and/or aerodynamic action in the dry state, in air or in any gaseous medium.

However, many reactions are not suited to a diluted medium, others are effected more easily or even exclusively in a non-aqueous medium, and finally certain reactions can only be considered in a gaseous medium. But in all cases the reactions are better effected, the greater the extent to which the material is divided and thus offers a greater surface of contact with the reagent.

In addition, some adjuvants have to be introduced in the solid form, others in the liquid or gaseous form. It is always of concern to mix the major part of these adjuvants intimately with the various other constituents, and this addition is more easily performed on a fibre or particle suspension either in a gas or in a liquid.

In order best to resolve the sum total of these difficulties and best to satisfy all the required conditions, the present invention provides a process according to which the particles or fibres are, during a first period of time, finely dispersed in a gas or in a vapour, and are brought in this state onto a movable support which enters a liquid bath, during a second period of time, for the wetting, pre-treatment or dilution of the fibres of particles, the said particles being laid by suitable means on the movable support when the latter enters the bath.

The particles may be dispersed mechanically and deposited on the movable support directly or, by means of an air stream, in the form of a suspension.

When the fibres, dispersed in the dry state, are deposited on the support after travelling in a gaseous fluid, the path of travel may also be used for carrying out treatments continuously, or for suitably metered additions.

A chamber for the dispersion, mixing and/or pre-treatment of the particles in a gaseous medium may be interposed in the path of the gaseous stream, and additives may be added to the particles in this chamber.

The movable support may be cylindrical or be constituted by an endless cloth.

The extent of the movable support preceding its immersion in the wetting bath may be used to subject the deposited fibres to any type of useful treatment. For example, the deposited fibres may be impregnated locally or uniformly, by spraying, by printing rollers or, in the case of a support constituted by an endless cloth, by initial passage into an auxiliary liquid bath.

After wetting, the fibres may be maintained on the support up to the point of leaving the bath and then detached from the support in the form of a suspension at high concentration, which may be stored for later dilution for the manufacture of a non-woven article.

They may likewise be detached from the support within the bath and extracted by a stream of liquid, for the later manufacture of a non-woven article.

The features and advantages of the present invention will become apparent from the following description of embodiments thereof, given by way of example only, with reference to the accompanying drawings in which:

FIG. 1 is a detail view of the feed hoppers of an embodiment of apparatus according to the invention;
FIG. 2 is a detail view of a modification of the apparatus of FIG. 1; FIG. 3 is a detail view of a liquid bath with a moving cloth to be used with the apparatus of FIG. 1 or 2; FIG. 4 is a detail view of another liquid bath with two moving cloths; FIG. 5 is a detail view of another liquid bath with a hollow perforated cylinder; FIG. 6 is a view of another embodiment of apparatus according to the invention without gaseous transport of the fibres; FIG. 7 is a view of a further embodiment of apparatus according to the invention without gaseous transport; and FIG. 8 is a view of yet another embodiment of apparatus according to the invention without gaseous transport.

In FIG. 1 can be seen an example of an embodiment of the feed for three fibrous constituents, which comprises three hoppers 2, 3 and 4, each for a type of fibre, with metering devices 5, 6, 7 having perforated drums actuated by electric motors 5', 6', 7' whose speed of rotation is controlled by regulators 5", 6", 7" under the control of a proportioner 21 which is itself controlled by a photoelectric cell 22 which detects the flow of material passing through a main conduit 11.

Each hopper 2, 3 and 4 is provided with rotary dispersers 23, 24, both the metering devices, for the purpose of deflocculating the fibres.

The fibres from each hopper enter conduit 11, where they are taken up by an air stream produced by fan 29 and also by the complementary fluid which may be supplied by conduit 25.

FIG. 2 shows a modification of the feed system, in which a vertical chamber 18 for dispersion, mixing, or pretreatment of fibres in the gaseous stream is interposed in conduit 11, treatment additives being introduced into this chamber 18, via conduit 30, by means of fan 31 and conduit 32, this admission being controlled by valve 33 which is controlled by a regulator 34 controlled by the proportioner 21.

In the embodiment of FIG. 2, the photoelectric cell 22 for the detection of flow, which controls the proportioner 21, is placed downstream of chamber 18.

FIGS. 3, 4 and 5 show embodiments of liquid baths for wetting and, if necessary, pretreatment and dilution of the fibres; the baths are fed by conduit 11, which may include a dispersion chamber.

In FIG. 3, the fibres in the gaseous stream leaving conduit 11 are deposited on a moving cloth or endless screen and maintained on this cloth by suction boxes 36, 37, the cloth being wrapped around a portion of a revolving hollow perforated cylinder 38 immersed in a liquid wetting bath 39, the fibres leaving in the wet state on the portion 40 of the cloth being emptied into a storage bin 41.

The fibres next made thus imprisoned between the moving cloth and the perforated drum during the whole of the phase of wetting by immersion in the liquid bath 39.

The tank 42 containing the cylinder 38 can be fed with liquid, as shown, by a conduit 43 controlled by a valve 44, while an overflow 45 provided within the cylinder 38 evacuates the excess liquid.

The liquid could alternatively be fed in via the interior of the drum, the important feature being that the speed of passage of the liquid through the fibrous mat should be sufficient to entrain the pockets of gas which surround the fibres, so that the wetting is as complete as possible.

In the embodiment of FIG. 4, it can be seen that the fibres supplied by the gaseous stream from conduit 11 are deposited between two moving cloths or screens 46 and 47 by means, respectively, of suction boxes 48 and 49.

The fibres maintained between the two cloths 46 and 47 pass successively into wetting and treatment liquid baths 50 and 51 contained in tanks 52 and 53, which are provided with feed conduits 54 and 55 and with overflows 56 and 57, the suspension thus obtained between the two moving cloths 46 and 47 being emptied into a tower 58 for high-density storage. The cloths 46 and 47 are provided with rinsing sprays 59.

At the base 60 of the tower 58 the suspension is fed to a manufacturing machine via a conduit 61, by the action of a pump 62, additives being added to the suspension in this portion 60 of the chamber via conduits 63 and 64 and mixed by means of an agitator 65. The additive introduced via conduit 63 is, in general, water or another suspension liquid, whose flow is controlled, as a function of the concentration of solid materials in conduit 61, by means of a regulating system 66.

The embodiment of FIG. 5 shows a wetting and dispersion chamber 78 in which the fibres from conduit 11 are deposited on a rotary hollow perforated cylinder 67 and held thereon by the effect of interior suction produced at the upper portion 68 of the latter via a suction duct 69.

These fibres then pass into a liquid bath 70 fed by a conduit 71 controlled by a valve 72, and leave the chamber as a wet suspension to be fed directly to a manufacturing machine via a conduit 74. The control of the level of the bath 70 is effected by a regulating system 73 for the flow in duct 74 by means of a valve 75.

Cylinder 67 is provided with wetting sprays 76, while sprinklers 77 are provided above the bath 70 to ensure good immersion of the fibres at this point.

In the apparatus of FIG. 6 the dry fibres are taken at the exit of a hopper 1 by a rotary disperser 79 and are deposited directly onto a revolving perforated cylinder 67, within which a reduced pressure is produced by a suction duct 69.

The revolving cylinder 67 is located within a wetting chamber 78, which comprises a liquid inlet 71 outside the cylinder, equipped with a distributor 94 in order to supply the liquid uniformly onto the whole length of the cylinder.

In a first portion 95 of its travel, the liquid traverses the cylinder from outside to inside, and wets the layer, keeping it against the cylinder. With this arrangement, particles in suspension such as cellulose fibres can be carried along with the liquid and are then retained by the layer in the course of filtration.

In a second portion 96 of its travel, limited by a throttle 97 of chamber 98, the liquid exists from the inside to the outside of cylinder 67', entraining the fibres and other particles in the form of a liquid suspension, evacuated by a conduit 98 towards a manufacturing machine.

FIG. 7 shows an embodiment in which fibres coming from hopper 1 pass into a rotary mixer-disperser 80 and are deposited on a moving cloth 81 and held thereon by means of suction in box 82. This cloth brings the fibres directly into treatment chambers for wetting and dispersion as previously described with reference to FIGS. 3 and 4.

The embodiment of FIG. 8 shows a system comprising two hoppers 2 and 3, provided with rotary dispersers 83 and 84, and which deposit, in succession, the contents of the two hoppers 2 and 3 in two layers onto a moving cloth 85 on which they are held by means of suction in boxes 91 and 92.

The two layers of fibres thus placed on the cloth 85 are introduced into a wet treatment chamber of the same type as that described with reference to FIG. 4, compris-
ing an upper cloth 86, the fibres contained between the two cloths 85 and 86 passing into a liquid bath 87 in a tank 88 and leaving in the form of a suspension, which is fed by means of a blower box 89 into a storage chamber 90.

What is claimed is:

1. Process for conditioning fibers and particles prior to suspension in a liquid bath for the manufacture of continuous nonwoven sheets and papers including the steps of successively dispersing fibers in a gaseous fluid, depositing the dispersed fibers on a moving support as a web, moving the support with the formed web thereon into a wetting bath for the fibers, maintaining the formed web as a web in the wetting bath, removing the web after wetting from the support and then forming a suspension of the wetted fibers in a liquid bath prior to fabrication of a sheet.

2. A process as described in claim 1 wherein said dispersing of the fibers in the gaseous fluid is done mechanically.

3. Process as described in claim 1 including the step of first mechanically dispersing the fibers in a gaseous fluid current and then depositing the fibers on the moving support by the current of gas.

4. Process as described in claim 1 including the step of wetting the fibers by forcing a liquid through the web during movement of the support while the web is in the wetting bath.

5. Process as described in claim 1 including the further steps of storing the fibers after removal from the support in a highly concentrated suspension and then diluting the suspension prior to fabrication of the sheet.

6. Process as described in claim 1 including the step of removing the fibers from the moving support by a current of liquid passing through the support from the interior thereof toward the exterior, the current of liquid and the fibers forming said suspension prior to fabrication of the sheet.

7. Process as described in claim 6, the fibers remaining on the support during a first part of the movement thereof in the bath, removing the fibers from the support during a further movement thereof in the bath and then removing the fibers by a current of liquid from the bath prior to fabrication of the sheet.

8. Process as described in claim 1, the wetting bath containing fibers in suspension to be added to the web on the moving support during movement of the support in the wetting bath.

9. An apparatus for conditioning fibers to be placed in suspension in a feed liquid for the making of a continuous nonwoven web and paper by filtration of the suspension of fibers comprising at least one feed hopper containing the fibers, a discharge orifice for said hopper, means for deflecting and dispersing the dry fibers at said discharge orifice in a gaseous fluid, a movable support including at least one endless permeable band, means for depositing on said support as a web the dispersed fibers at said discharge orifice, at least one tank containing a bath of wetting liquid for the fibers, said moving support entering said bath during a part of its movement after deposit of the web for wetting the fibers in the web in the bath, and means for detaching the web from said support after wetting of the fibers and for dispersing the wetted fibers into a feed and suspension conduit for apparatus for forming a continuous nonwoven sheet.

10. Apparatus as described in claim 9 including a connecting conduit between said discharge orifice and said moving support and means for creating a gaseous current in said conduit for transportation of the fibers from said discharge orifice to said moving support.

11. Apparatus as described in claim 10, said connecting conduit including a dispersion chamber for mixing and pretreating the fibers in a gaseous medium.

12. Apparatus as described in claim 9, said moving support passing under said discharge orifice and said hopper including adjacent said discharge orifice means for mechanically dispersing and projecting the fibers onto said moving support.

13. Apparatus as described in claim 9, said moving support being a perforated cylinder.

14. Apparatus as described in claim 9, said moving support being an endless screen and a perforated cylinder in said tank, said screen passing around said cylinder.

15. Apparatus as described is claim 14, including means for removing the wetting liquid through said perforated cylinder and for maintaining the liquid at a lower level within said cylinder than exterior of said cylinder.

16. Apparatus as described in claim 9, said moving support being two continuous screens moving at the same speed and in engagement over a part of their paths in said wetting bath, the fibers being deposited upstream of said part on at least one of said screens and maintained as a web between said screens during movement in said wetting bath.

17. Apparatus as described in claim 9, said means for depositing the fibers on said support including at least one aspirating header beneath said support, the fibers being plated on said support as a web by aspiration of the gaseous fluid into said header.

18. Apparatus as described in claim 9, said means for detaching the web from said moving support including means for creating a current of liquid jetted through said support from the interior toward the exterior thereof, the current of liquid entraining the fibers and forming a feed suspension for a nonwoven sheet forming machine.

19. Apparatus as described in claim 9 wherein said moving support divides said tank into two parts, an upstream one of said parts forming said wetting bath, a downstream one of said parts discharging into the suspension feed conduit, the wetting liquid and the suspension liquid passing through said support successively from said wetting bath toward the interior of said support and from the interior of said support toward the feed suspension conduit.

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U.S. Cl. X.R.

8—156; 19—66 R; 68—44, 62, 158, Digest 5; 162—380; 264—121